MIINISTRY OF HEALTHCARE OF UKRAINE
O.O. Bogomolets National Medical University

Prosthetic Dentistry

Part I

Fixed Prosthodontics

Edited by Professor V.P. Nespriadko, Ass. Prof. Z.Y. Zhegulovych

Textbook for students of higher medical education institutions of the 4th level of accreditation

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The textbook includes the main basic approaches in diagnostics, planning of dental prosthetic treatment of the patients with teeth damage. The textbook include contemporary methods of the patients examination. Dental occlusion condition basic principles and tools for inspection are shown. Teeth anaesthesia methods and armamentarium as important part of clinical procedures and emergency conditions are included. The textbook deal with the different types of fixed dentures - crowns, post and cores, bridges, which are fabricated in general dental practice. A separate part is devoted to the historical review of the dental department scientific and methodical work. The text information is accompanied with 181 illustrations, which will help the students to read and understand the information in a better way.

This textbook is recommended for students of the Higher Medical Educational Institutions of the 3-4th level of accreditation.

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CHAPTER 1.

History of the Prosthetic Dentistry Department Bohomolets National Medical University

Fig. 1-1. *L.N. Dudkin (1920-1948)*

History of Prosthetic Dentistry Department is closely connected with the history of Dental Faculty of O.O. of Bogomolets National Medical University where the department is one of the leading.

The Department of Prosthetic Dentistry was founded in August 1920, a year of reorganization of the Odontology Institute in Odontology Faculty of Kiev Medical Institute. L.N. Dudkin was appointed as its first Head. He was heading the department staff for 28 years (1920-1948).

Dudkin Lev Naumovych is a founder and organizer of Prosthetic Dentistry Department, well-known specialist in prosthetic dentistry (Fig. 1-1). He was born in 1873 in Radomyshl (Zhytomir region) in the family of a clerk. In 1892 he entered James Levy Dental School in Warsaw. After its finishing in 1893 he was left there to teach prosthetic technique.

In 1898-1901 he was studying in the clinic of Professor K. Bayer (Munich), where he improved his skills in complex prosthesis and maxillofacial orthopedics. In 1901 he passed the exam and gained the title of dentist at Medical Faculty of Yuriyevsky University (now University of Tartu, Estonia). In 1902 he worked as an assistant in the First Dental Hospital in St. Petersburg, and in 1903 – as assistant of doctor Kamayev in Tiflis, in 1904 he worked as assistant of doctor Bohdanovsky in Poltava.

In 1905 he joined the First Kiev Dental School as a senior lecturer at the Department of Prosthetic Dentistry. The next year he was approved by the Medical Department as a teacher of prosthetic dentistry and took management of clinical and laboratory departments of the discipline, where he had been

working until 1919. At the same time in 1907 he lectured at postgraduate training courses for dentists.

Since 1908 L.N. Dudkin had been working at the Faculty Surgery Department of Medical Faculty of St. Volodymyr University in Kiev (during the heading of Professor Malinovsky), developing questions of jaw orthopedics and prosthetics in complex surgery and other jaw injuries.

In 1910 L.N. Dudkin was elected as a member of the Kiev Scientific Odontology Union.

In 1914, at the beginning of the World War I, he was appointed as a Head and instructor of prosthetic devices and sophisticated prostheses for maxillofacial injuries and defects treatment at maxillofacial Surgery Department of Red Cross Hospital in Kiev.

In 1919 L.N. Dudkin worked in the dental education committee at People's Commissariat of Health in Kiev and was appointed as a Head of Prosthetic Dentistry Department of newly created Odontology Institute, which was connected to the Kiev Medical Institute as a separate department in 1920. At the same time, since 1927, he had been serving as the Head of Educational Deparment and teaching at the dental courses.

During this period, higher dental education experienced significant difficulties due to imperfect educational process, the lack of distinct plans of study and programs, qualified teaching staff, as well as clinical bases were unprepared for teaching students. Due to unfavorable conditions in which the department was working and low qualification of teachers, research at the department was being held at low level for a long time.

Since 1930 the Department of Prosthetic Dentistry began teaching orthodontics, because after the death of professor K.P. Tarasov, the Department of Orthodontics, which was headed by him, was eliminated.

In 1932 the reorganization of Dental Faculty into Dental Institute was conducted, where the Department was transferred as well.

The Department staff provided a great job of training and improving the quality of prosthetic care in Ukraine, the development of prosthetic dentistry as a science. Thus, L.N. Dudkin proposed two articulators for the functional arrangement of artificial teeth. Assistant V.D. Petrov invented a way of making impression mass, A.M. Kysilenko designed a simple and accurate instrument for determining the parallelism between contact surfaces of teeth that have to be prepared while developing prosthetic methods for convergenced teeth, I.N.

Vaisblat published a paper on the indications for the use of anatomical articulators.

In 1940 the first candidate's thesis "Fixation of the denture at the lower jaw" was published by M.M. Matesis at the department, but officially the thesis wasn't defended because of the Great Patriotic War beginning.

At the beginning of the World War II the department hadn't any candidates of medical sciences, and department staff had published only three scientific papers. Meanwhile, the Department of Prosthetic Dentistry produced a significant group of qualified professionals who occupied senior positions in hospitals of the Soviet Army.

***Fig. 1-2**. Prosthetic Dentistry Department (1940s years)*

In June, 1941 the Prosthetic Dentistry department, like all other dental departments, was evacuated to the Frunze city. In the same year, L.N. Dudkin had passed the candidate's minimum but because of the beginning of the World war II didn't defend his work. Throughout the time of evacuation in Frunze L.N. Dudkin headed Prosthetic Dentistry Department in Kyrgyz State Medical Institute.

At that time, L.N. Dudkin was involved not only in teaching and research work but also provided practical assistance to health authorities. He organized

Jaw Department for wounded, where he worked as a consultant till reevacuation. Faculty teachers also acted as consultants in maxillofacial hospitals.

It was a difficult period in the life of the Department, which was associated with the war and forced evacuation. After returning to Kiev in October 1944, according to the call of People's Commissariat of Health, L.N. Dudkin again headed Prosthetic Dentistry Department at Kiev State Medical Institute. In November, 1945 Kiev Dental Institute was restored.

After the war L.N. Dudkin was awarded with the Medal for Valiant Labor during the Great Patriotic War.

The development of maxillofacial orthopedics during the Great Patriotic War, orthodontics as preventive discipline and dental prosthetics allowed prosthetic dentistry to occupy an important place in health care system.

In 1948 L.N. Dudkin was excused from his duties as Head of the Department on his own will and moved to the position of assistent of the Department. And in July 1950 by the order № 105 of O.K Gorchakov – Director of the Kiev Dental Institute (1950-1955) – and by the decision of certifying committee he was forced to retire.

L.N. Dudkin – one of the oldest workers of the Soviet prosthetic dentistry – a serious professional, with his 50-year teaching job brought up several generations of dentists. Under his leadership three department staff members wrote candidate's thesises: Aisenberg, A.M. Kysilenko, M.M. Matesis.

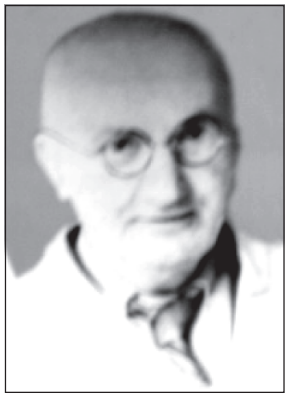


***Fig. 1-3**. Assistant Professor I.L. Zlotnik (1948-1949)*

In 1948-1949 Assistant Professor **I.L. Zlotnik** was serving as Head of Prosthetic Dentistry Department (Fig. 1-3).

Zlotnik Isaac L'vovich – an outstanding organizer and scientist. He was born in 1889. In 1937 he graduated from Kharkov Dental Institute, where he worked as an assistent at the Prosthetic Dentistry Department before the World War II.

27.05.1944 I.L. Zlotnik, who was an assistent of Prosthetic Dentistry Department in Kyrgyz Medical Institute in Frunze, got the scientific degree of Candidate of Medical Sciences.

From 13.08.1946 he became an Assistant Professor of Prosthetic Dentistry Department of Kiev Dental Institute.

He was awarded with state award – the "Medal for Valiant Labor."

Isaac L'vovych is the author of 30 publications, including monographs "Orthodontics," which at that time was the main textbook in orthodontics. The book included the functional anatomy of the masticatory apparatus, therapy and prevention of maxillomandibular deformities. The textbook included many pictures of orthodontic equipment, radiographs and photographs of models of different types of dentition deformities from the collection of the author.

***Fig.1- 4.** Professor A. I. Betelman (1949-1968)*

In 1949-1968 the Prosthetic Dentistry Department of Kiev Medical Institute was headed by Professor **A.I. Betelman** (Fig.1– 4).

Abram Isaakovich Betelman (1889-1980) worked as prosthetic dentist in dental clinics of Tulchin and Moscow until 1932, and then in the Central Institute of Traumatology and Orthopedics. In 1936 he was invited to the position of assistent of 2nd Dental Department of Central Institute for Doctors' Advanced Training of (Moscow).

After having defended his doctor's thesis A.I. Betelman was heading the Department of Prosthetic Dentistry at Perm Dental Institute (1941-1945). During these years he also was working as a consultant at maxillo-facial department of evacuation hospital in Perm. For his work at the hospital he was awarded by People's Commissariat of Health of USSR and the medal "For conscientious work during the Great Patriotic War." In 1945 A.I. Betelman returned to Moscow and worked as Assistant Professor of prosthetic dentistry at Moscow Medical Dental Institute until 1949. In the same year Abram Isaakovich was transferred to Kiev and appointed as a Head of Prosthetic Dentistry Department of Kiev Dental Institute, which became Dental Faculty of Kiev Medical Institute in 1954.

In 1947 A.I. Betelman defended doctor's thesis "Clinic of plate dental prosthetics"and got the scientific degree of Doctor of Medical Sciences. Since 1949 A.I. Betelman became a permanent member of the Presidium of Kiev Union of Dentists, a member of the All-Union Association of Dentists, member of the Problem Committee of the Council of the Ministry of Health of the USSR, member of the Editorial Board of "Dentistry" journal.

The textbook "Prosthetic dentistry" which received great recognition and became popular in our country and abroad was published in 1947. It was written by A.I. Betelman, co-authored by B.M. Bynin. The second edition was translated into Polish, Romanian, Bulgarian and Chinese.

After the war, except for teaching and educational process the department also carried out extensive scientific work. The main scientific direction of the Department of Prosthetic Dentistry is to study and improve methods of prosthetic, orthodontic treatment of tooth-jaw deformities and maxillofacial defects.

Trough all written works of A.I. Betelman permeates the idea of interdependence of the oral cavity and the body as a whole, the relationship between form and function. Scientist proposed a number of clinical classifications, new methods of diagnosis and treatment of defects and deformities of dental rows and theoretically grounded manual manipulation used in the fabrication of orthopedic devices.

Fig. 1-5. *Prosthetic Dentistry Department in the year of the 125th anniversary of Kiev Medical Institute (1966)*

In 1969 the Department was headed by a disciple of A.I. Betelman – **S.I. Kryshtab** – well-known scientist, teacher, who led it until 1984 (Fig.1-6).

Fig.1-6. *Professor S.I. Kryshtab (1969-1984)*

Kryshtab Sergei Iosifovich (1924-1984) was born in Kiev in a family of a clerk. In 1949 he graduated with honor from the Dental Faculty of Kiev Medical Institute named after A.A. Bogomolets.

After graduating from the Institute he went to Small Divytsa village at Chernihiv region to work at the position of dentist and otolaryngologist after specialization courses. In 1951 he was enrolled to clinical residency at the Prosthetic Dentistry Department of Kiev Medical Dental Institute. In 1953 he was transferred to the position of assistent, then Assistant Professor and in 1969 – Head of the Department.

In 1957 under the direction of Professor A.I. Betelman he defended his cadidate's thesis on "To the issue of impact of Act on chewing on gastric secretion" which set out the experimental study of the dynamics of secretory function of the stomach with a different nature and intensity of the chewing act. In 1968 he defended his doctoral thesis "Materials on the pathogenesis and diagnosis of deformities of the lower jaw", which widely covered issues of patterns of jaw growth and diagnosis of bite deformities. In 1971 he got the title of Professor.

The significant contribution of Professor S.I. Kryshtab to the development of domestic dentistry is to resolve important theoretical and practical issues of teaching methodology prosthetic dentistry propaedeutic course and orthodontics, functional diagnostics, the use of metal-ceramics, implantology. Professor S.I. Kryshtab and his disciples introduced such new research directions, as implants for fixing dental prostheses, prosthetics with cast bridges, studied the mechanisms of adaptation to orthopedic appliances and developed ways to correct the bite height.

Rich experience of scientist and teacher is implemented in 106 scientific papers and textbook "Prosthetic dentistry" (1986), which shows the chewing apparatus pathology, anatomy of teeth and jaws in children of different ages and adults as well as the prosthesis in case of partial and complete absence of teeth . He described prosthetics and splinting of teeth in case of paradontosis,

significant injuries of jaws and other parts of the face, the known issues of dental materials and construction apparatus for their use in orthopedic purposes. Under the leadership of S.Y. Kryshtab two doctoral and twelve candidate's theses were defended.

During this period the cabinet of functional diagnostics, implant dental office, metal-ceramics dental laboratory were opened at the Department. More profound and extensive study of functional diagnostics, the use of ceramic in prosthetic dentistry, the introduction of implants as artificial supports for dentures fixation became possible.

Professor S.I. Kryshtab repeatedly represented the Soviet dentistry at international congresses of dentists, participated in the All-Union, republican congresses and conferences of dentists. Under his leadership cast dentures and metal ceramic dentures, were developed and implemented at the Prosthetic Dentistry Department, intraosseous dental implantation was introduced, research on tissue reactions to dental materials was carried out. Research on adaptation of patients to dentures, functional pathology, complex methods of treatment of some dental diseases was widely developed.

Fig1-7. *Professor S.I. Kryshtab with colleagues from Prosthetic Dentistry Department*

In 1982 the department was divided into the Prosthetic Dentistry Department and the Prosthetic Dentistry Propedeutics and Orthodontics Department, headed by Professor Z.S. Vasilenko.

Since 1985 Prosthetic Dentistry Department is headed by Professor **V. P. Nespryadko** – well-known scientist in Ukraine and abroad, author of a number of papers and fundamental researches in experimental and clinical prosthetic dentistry (Fig.1-8). He made a significant contribution to medical science, training of dental personnel and improvement of dental care in Ukraine.

Fig.1- 8. *Professor V.P. Nespryadko (1985-present time)*

Nespryadko Valeriy Petrovych was born in 1940. In 1967 he graduated from Kyiv Medical Institute with honour. In 1969 he finished residency, and in 1971 – postgraduate studies at Prosthetic Dentistry Department. Since 1975 he worked as assistent, since 1984 – Assistant Professor of Prosthetic Dentistry Propedeutics and Orthodontics Department of KMI.

In 1985 he defended his doctoral thesis "Pathogenesis, clinic and treatment of impacted teeth" and was moved to the position of Assistant Professor of Prosthetic Dentistry Department and appointed acting head of the Department. In 1986 he was officially elected as head of Prosthetic Dentistry Department of KMI, which he heads at present time.

From 1988 to 1998 Professor V.P. Nespryadko served as Chief Dentist of Ministry of Public Health of Ukraine.

In 1999 V.P. Nespryadko was awarded with the title "Honored Worker of Science and Technics of Ukraine."

In 1993, V.P. Nespryadko was appointed as a Dean of the Dental Faculty.

Nowadays Professor V.P. Nespryadko is Member of the Board of Dental Association of Ukraine, a member of several editorial boards of journals of Ministry of Public Health of Ukraine.

Professor V.P. Nespryadko has significant achievements in the field of dental materials science and the development of new types of equipment for dental laboratory. Under his leadership the series of works on creation of dental metal alloys, artificial teeth made of increased hardness resin-based and ceramic masses, samples of equipment for dental laboratories, foundries and complex equipment for sterilization in dentistry were carried out.

V.P. Nespryadko is an author of more than 400 scientific works, among which there are 3 books, 1 monograph and 4 textbooks: "Prosthetic dentistry" (Rozhko M.M., Nespryadko V.P., 2003), "Dental Prosthetic Appliances" (Rozhko M.M., Nespryadko V.P., 2006), "Dental implantology. Basic theory and practice "(Nespryadko V.P., Kuts P.V.), 10 guidelines. He is the author of 34 inventions and patents, among which are fundamentally new methods of diagnostics and treatment of dental pathology. Professor V.P. Nespryadko prepared 8 Doctors and 23 Candidates of Medical Sciences.

Professor V.P. Nespryadko serves as a Head of the Specialized Council of NMU in the specialty 14.01.22 – "Dentistry" for defending of doctoral and candidate's theses.

Fig.1-9. *Prosthetic Dentistry Department Staff (2000)*

Fig. 1-10. *Prosthetic Dentistry Department Staff (2000)*

CHAPTER 2.

Functional interaction of the masticatory apparatus components. Gnathophysiology

The understanding of the main principles of the gnathophysiology of the stomathognatic system is important in all branches of dentistry. For successful dental care all components of the system must be normalized and for the improvement a dental occlusion it is important to understand that the stomathognatic system is a morphofunctional complex of the tissues and organs interrelation. The oral cavity and face cranium function in unit with skeletal muscles of the body and all mandibular movements occur as a result of coordinated interaction of muscles of mastication, teeth, temporomandibular joints (TMJ) under control of central nervous system (CNS) and provide chewing, swallowing, speech and emotions (Fig.2-1).

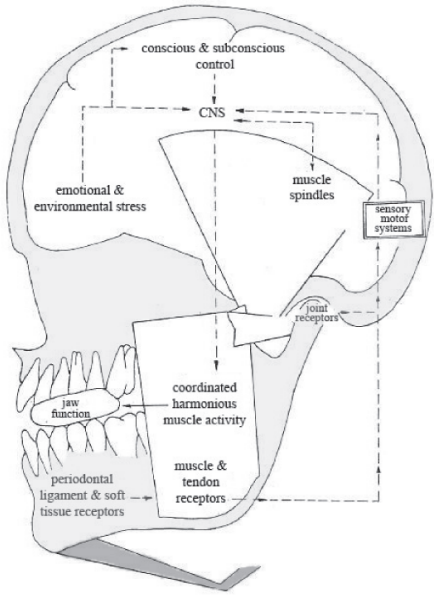


Fig. 2-1. *Functional interaction of the masticatory system components. (by Gross M.D., Mathews J.D., 1985).*

The occlusion and jaw movements peculiarities, the structure and function of the TMJ, chewing muscles characteristics and CNS coordinated components must be analysed for diagnosis making and treatment planning.

TMJ. Temporomandibular joint structure and function.

TMJ are a bilateral diarthroidal synovial hinge joints which consist of two articulations connected by the mandible. They are known as coupled–

because both joints act together to produce synchronized jaw movements. The temporomandibular joints are formed by articular fossa (fossa mandibularis) of the temporal bone and condyles of the mandible and these articular surfaces are covered with avascular fibrous tissues. A synovial membranes and an articular cavities are present between them.

In a newborn the elements of articulation are poorly developed and not marked by any defined functional orientation. They form distinctly after the age of six to seven years.

Each of two articulations has an intraarticular cartilage disk, an articular capsule, and ligaments. Intraarticular disk separates joint space to upper and lower levels. Thanks to intracapsular disk it is possible to exhibit two types of movements in joints: rotation and translation. The upper compartment of the joint produces translation and the lower – rotation. During translation the condyle with disk moves against the glenoid fossae and the rotation of the mandible is the result of the condyle movement against the articular disk and glenoid fossa (Fig.2-2).

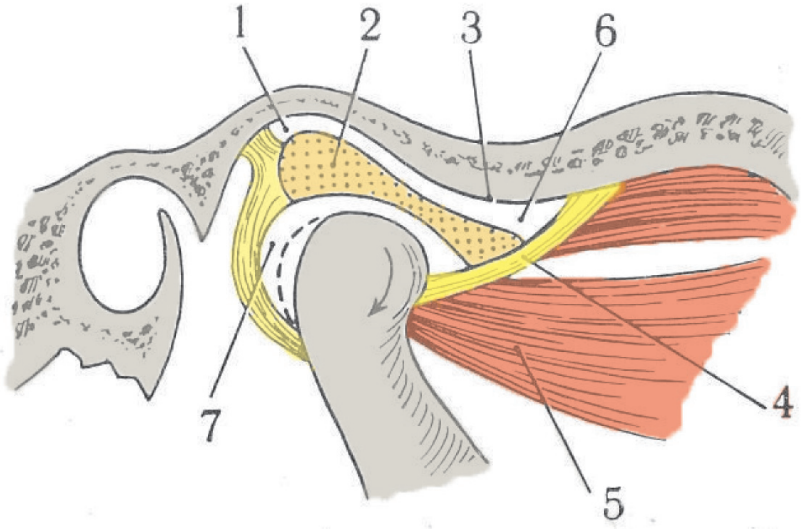


Fig. 2-2. *Diagram of temporomandibular joint.*
1 – articular fossa; 2, – intraarticular disc; 3 – articular eminence; 4 -articular capsule; 5 – fibres of the lateral pterygoid muscle; 6 – superior articular space (upper joint compartment); 7 – inferior articular space (lower joint compartment).

The disk consists of the dence connective tissues attached in posterior part to vascularized and innervated connective tissues "bilaminare zone", which are known as the retrodiscal tissues or posterior attachment. Distally this part is placed to the posterior wall of the articular capsule. Medially and laterally the disk is attached to the poles of the condyle firmly. Anteriorly it fuses to the capsule and superior band of lateral pterygoid muscle. The extreme periphery of the disk is slightly innervated. The disk is avascular and without nerves in articulation part.

In the saggittal plane it can be divided in thickness into three parts: anterior and posterior parts are thick and intermediate part is thin and named as intermediate zone. In normal joint the articular surface of the condyle is located in the intermediate zone.

From the anterior view the disk is generally thicker medially than laterally. The shape of the disk is determined by the morphology of the condyle, which is very variable in individuals. During mandible movements the disk can adapt to the functional demands of the articular surfaces. Because of firm attachment to condyle process the disk follows all condyle movements and weak attachment of the posterior connective tissues support this.

The articular disk is connected to the capsular ligaments and after this superior and inferior spaces appear which are bordered peripherally by synovial membrane and capsule and contain synovial fluid. Synovial fluid lubricates the articular surfaces means of two mechanisms. The first is boundary lubrication during joint movements. The second is weeping lubrication due to of the ability of the articular surfaces to absorb a small amount of synovial fluid.

The TMJ is supplied by superficial temporal artery from the posterior and the middle meningeal artery and from the anterior and the internal maxillary artery. Also the deep auricular, anterior tympanic and ascending pharyngeal arteries are involved.

The TMJ is innervated by the trigeminal nerve which provide motor and sensor innervations of the condyle-related muscles. Branches of the mandibular nerve (auriculotemporal nerve), deep temporal and masseter nerves also provide innervations.

The ligaments of the joint consist of collagenous connective tissues and do not work actively during joint function rather they act to limit and restrict border movements. Three functional ligaments support the TMJ: the collateral ligaments, the capsular ligaments, the temporomandibular joint ligaments.

The mandible is attached to the base of the scull by three paired ligaments; temporomandibular, sphenomandibular, stylomandibular. Due to the limit of stretches they are bordering jaw movements and protecting the structures of the joint from injuries (Fig.2-3).

All skeletal components of the body are held together and move by skeletal muscles. Muscles consist of numerous fibres ranging between 10 and 80 μm in diameter. Muscles fibers can be characterized by types according to the amount of the myoglobin. Fibers with high level of myoglobin concentration are deeper red and capable to slow and sustained contraction (1st type – slow muscles fibers), fibers with lower concentration of myoglobin are whiter and capable to quick contraction (2nd type of fibers – fast muscles fibers). All skeletal muscles contain a mixture of fast and slow fibers in different proportions that reflects the function of that muscles.

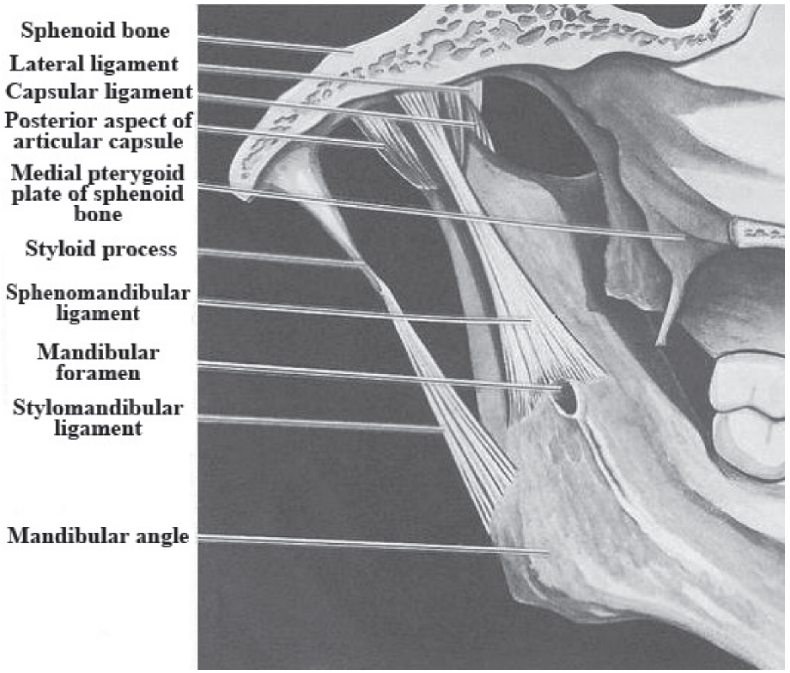


Fig. 2-3. Ligaments of TMJ.
Masticatory muscles.

The functional groups of muscles of mastication consist of the jaw elevating muscles (m. temporalis, m. masseter, m.medial pterygoid), jaw opening muscles (m. geniohyoid, m. mylohyoid, m.digastric pars anterior) and protractors (lateral pterygoid muscles). The lateral pterygoid muscles contain two bellies which are function horizontally during opening and closing (Fig.2-4). The inferior belly is active during protrusion, depression and lateral movement, the superior belly is active during closure. Each muscle of mastication provides a few actions (Tab.2-1). Functionalneuro anatomy and physiology of the masticatory system.

A highly developed neurological system regulates and coordinates the activities of the masticatory system. The basic component of the neuromuscular system is the motor unit. It consists of a number of muscles fibres which are innervated by one motor neuron, joined to the muscle. When the neuron is activated, a small amount of the acetylcholin is released to initiate

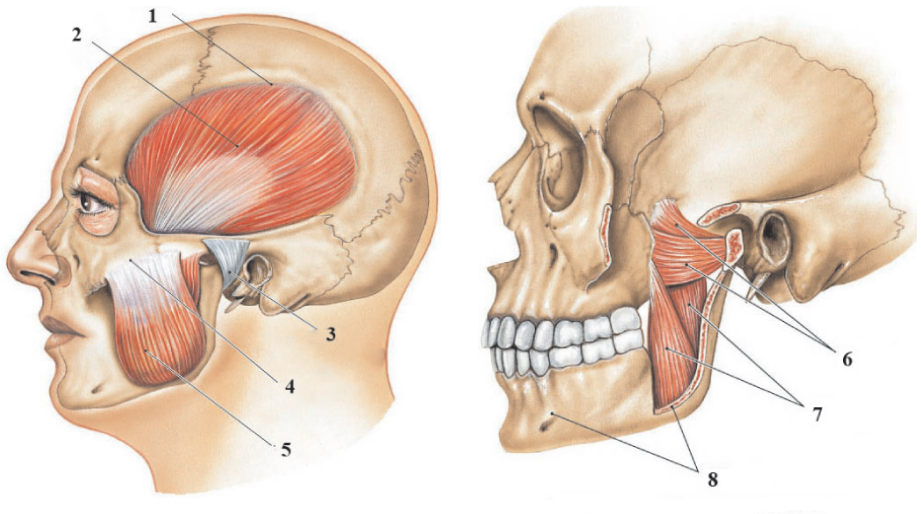


Fig. 2-4. Muscles of mastication (from http://droualb.faculty.mjc.edu/Lecture%20Notes/Unit%203/muscles%20with%20figures.htm): 1 – superior temporal line, 2 – m. temporalis, 3 – capsule of temporomandibular joint, 4 – zygomatic arch, 5 – m. masseter, 6 – m. pterygoideus lateralis, 7 – m. pterygoideus medialis, 8 – mandible.

Table 2-1.

Muscles of mastication/

Name of the muscle	Origin	Insertion	Innervation	Supply	Vascular Function
Temporal	Lateral surface of the skull	Coronoid process and anterior border of the ramus	Temporal nerve (branch of mandibular)	Middle and deep temporal arteries (branches of superficial temporal and maxillary)	Elevates and retracts the jaw, assists in rotation, clenching
Masseter	Zygomatic arch	Angle of mandible	Masseteric nerve (division of trigeminal)	Masseteric artery (branch of maxillary)	Elevates and protracts the jaw, assists in lateral movement, clenching
Medial pterygoid	Pterygoid fossa and medial surface of lateral pterygoid plate	Medial surface of the angle of mandible	Medial pterygoid nerve (division of trigeminal)	Branch of maxillary artery	Elevates jaw, causes lateral movement and protrusion
Superior lateral pterygoid	Infratemporal surface of greater wing of sphenoid	Articular capsule and disc, neck of condyle	Branch of masseteric or buccal nerve	Branch of maxillary artery	Positions disc during closing
Inferior lateral pterygoid	Lateral surface of lateral pterygoid plate	Neck of condyle	Branch of masseteric or buccal nerve	Branch of maxillary artery	Protrudes and depresses jaw, causes lateral movement
Mylohyoid	Inner surface of mandible	Hyoid and mylohyoid raphe	Branches of mylohyoid nerve (division of trigeminal)	Submental artery	Elevates and stabilizes hyoid

Geniohyoid	Genial tubercle of mandible	Hyoid	First cervical via hypoglossal nerve	Branch of lingual artery	Elevates and moves hyoid forward
Anterior belly of digastric	Tendon linked to hyoid by fascia	Digastric fossa (lower border of mandible)	Branch of mylohyoid nerve (division of trigeminal)	Branch of facial artery	Elevates hyoid, depresses jaw

depolymerization of the muscle fibre. This step influences muscles fibres to contract. The number of muscles fibres are innervated by one motor nevron, which can vary according to the function of the motor unit. Thousands of motor units along with blood vessels and nerves are bundled together by connective tissues and fascias to make up a muscle.

There are three types of potential functions of muscles:

1. The type of muscle shortening under the constant load is called isotonic contraction.

2. The type of contraction without shortening is called isometric contraction.

3. The type of muscles function – controlled relaxation.

The basic structural unit of the nervous system is the neuron. It is composed of the nerve cell body, dendrites and axon. The nerve cell bodies are located in the spinal cords. Cell bodies found outside are grouped together in ganglias. The axon forms the essential conducting part. Many neurons are grouped together to form the nerve fiber.

Depending on the location and function neurons are divided to a few types: efferent neurons, interneurons, sensory neurons.

Neuron impulses are transmitted from one to another in synaptic junction (synaps) (Fig.2-5). Multiple interneurons transfer the impulse to the thalamus and cortex and higher for interpretation and evaluation. The interneurons ascend by means of several tracts passing through the area of the brainsteam – reticular formation. When impulses arise to thalamus it makes assessment and directs the impulses to the higher centers for interpretation.

The hypothalamus is the center for controlling the internal body function. The limbic structures function is to control emotional and behavioral activity.

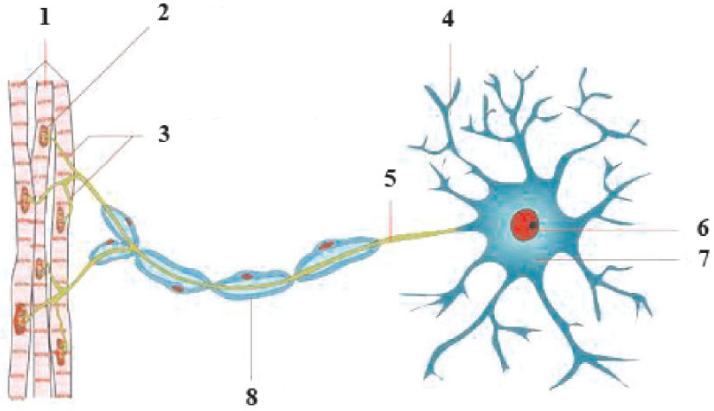


Fig. 2-5. *Neuron structure (from http://www.infovisual.info): 1 – muscle fibre, 2 – motor end plate, 3 – terminal arborisation, 4 – dendrite, 5 – axon, 6 – nucleus, 7 – cytoplasme, 8 – myelin sheath.*

Impulses from the lymbic system leading into the hypothalamus can influence the changes in internal body functions, controlled by hypothalamus. Impulses which are given to cortex under memory association can influence adequate answer.

Sensory receptors are the neurologycal structures which are located in all organs of the human body. They provide the transmission of the information to CNS. Some receptors are specific for discomfort and pain, known as nociceptors. Other receptors transfer information about position and movement, known as proprioceptors. Receptors that carry information about the internal organs condition are named as interoceptors. Impulses received from receptors allow the cortex and brainstem to coordinate muscles to create appropriate response of the body.

The dynamic balance of the head and neck muscles is possible through feedback of the various sensory receptors. Two general reflex actions are important in the masticatory system: myostatic reflex and nociceptive reflex. Myostatic reflex protects the masticatory system from sudden stretching of the muscle. The nociceptive reflex protects the teeth and supported structures from sudden and heavy nonfunctional forces. The neurologic control for antagonistic groups of muscles is known as reciprocal innervations. As a result of such

control the smooth and exact mandibular movements are achieved. Muscles tonus play an important role in mandibular rest position and in resistance to any displacement of the lower jaw (Fig.2-6).

Main functions of the masticatory system

The three main functions of the masticatory system are postulated: mastication, swallowing, speech. Secondary functions are the aid in respiration and expression.

Sensory information from the masticatory system structures (teeth, periodontal ligaments, jaws bon, cheeks, tongue) are integrated in CNS and coordinate muscles activity for functional movements.

Mastication is the initial stage of digestion, when the food is prepared for swallowing. It is the complex function with using of teeth, periodontal structures, muscles of cheek, lips, tongue, palate and salivary glands. This functional activity is automatic but sometimes can stay under the voluntary control. The mandible movement in this function is known as the chewing stroke.

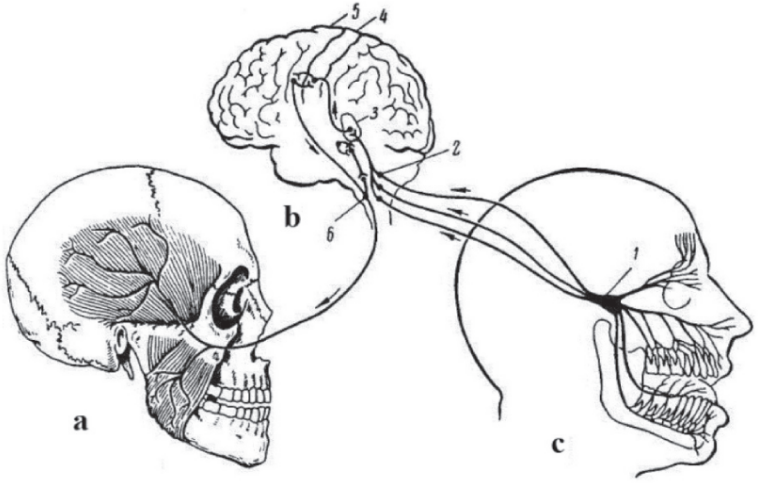


Fig. 2-6. *General reflex action (by I.S. Rubinov):*
a – the mobile part of the masticatory organ, b – cortex and other parts of the brain, c – sensory receptors; 1 – Hasser's ganglion of the trigeminal nerve, 2 – sensitive nucleus of medulla oblongata 2 – motor neuron, 3– tuber opticus (3-motoneuron), 4 – posterior central gyrus (sensory cortex – 4 neuron), 5 – posterior central gyrus (motor cortex), 6 – motor cortex of medulla oblongata.

Chewing stroke consists of the four phases: In the opening the mandible moves down to 16-18 mm, than lateral to 5-6 mm from the midline. During closure movement the muscles of the tongue and cheeks move food between the teeth. After that the mandible elevate to the first contact of the tooth with less lateral displacement compare to opening– 3 mm. This is the start of the grinding phase of the mandible closing movement. During this phase the mandible is guided by the occlusal surfaces of the teeth back to the intercuspal position and food is trapped between the teeth. Mastication can occure bilaterally but 78% of observed persons showed the prefered side of chewing. (Okeson J., 2006). Studies of the jaw movement during mastication with masticatiography and condilography showed these stages.

Also the teeth contacts during the mastication were investigated according to position and number. When food was initially introduced to the mouth the number of contacts were minimal. After the bolus was broken down the frequency of tooth contacts was increased. In the final stage of mastication before swallowing contacts occur during every stroke. Two types of contacts were identificated: gliding contact during grinding stage of mastication and contacts in maximum intercuspal position (MIP).

The CNS controls chewing influence the forces, time and trajectory of chewing stroke according to food consistency, cusp and fossae occlusal contacts relation, TMJ and chewing muscules condition. It is evident that worn of flattened teeth encourage a broader chewing stroke. In patiens with TMJ pain the chewing strokes are shorter and slower with irregular pathway.

The maximal mastication forces which can be applied to the teeth may vary in individuals. Generally the forces of mastication are bigger in males compare to females. The study has reported that a female's biting load ranges from 35,8 to 44,9 kg compare to male's biting load 53,6 to 64,4 kg. The greatest maximum biting forces were 443 kg. (Okeson J., 2008).

The lower jaw is moved from the position of maximum opening to the position of complete teeth contact by elevate muscles contraction. At this time the condyles follow a reverse track with rotation and translation movements. Coming in contact, the teeth crush food on the occlusal surfaces of the teeth.

The jaw can be moved forward by bilateral contraction of the lateral pterygoid and masseter muscles and medial pterygoid muscles during mastication. The jaw is moved back by contraction of the temporal muscle (posterior part) and the digastrics, mylohioideus, and geniohyoideus muscles.

When the jaw moves back the incisal edges of the lower incisors slide upward along the palatine surfaces of the upper incisors and effect the final tearing and biting of the food (Fig.2-7).

Mastication is a complex activity accomplished by a unique arrangement of the muscles of the head and neck and the maxillomandibular relationship. All parts of the system operate in a synchronized way to function efficiently and effectively. Depending on the direction of displacement of the mandible, a muscle will be active one moment and inactive the next. Groups of muscles have concurrent (protagonist or synergistic) actions during a given functional movement to promote efficient chewing. Therefore, muscles on one side of the mouth compensate the muscular activity on the other side. (Jose dos Santos, 2009)

Studies of the structure of the mandibular and maxillary set of masticating teeth have related the following: (a) the lateral surfaces of the lower masticating teeth are not parallel; the crowns are wider on the vestibular side than on the lingual. The crowns are inclined toward the tongue and the buccal and lingual cups lie at different levels; (b) on the upper jaw the palatine cups lie lower than the buccal. The different levels of the cusps of the masticating teeth lateral curves of occlusion are formed, which pass through the buccal and lingual cups of the masticating teeth on both sides (Wilson curve). The occlusal relation of the cusps of antagonistic teeth is specific: on the side of the contracting muscles analogues cusps meet, and on the opposite side different cusps come in contact.

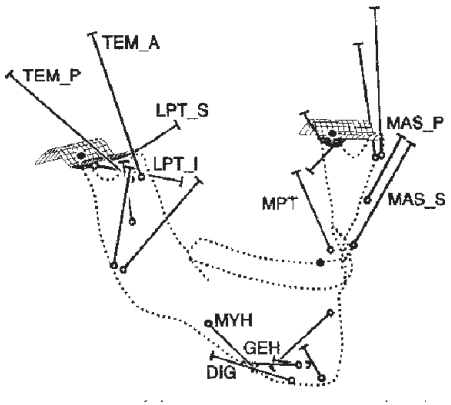


Fig. 2-7. *Masticatory system muscles lines of action, ventro-lateral view (J.H. Koolstra, 2002). (Cross-bar: muscle origin. Circle: muscle insertion. MAS_S– superficial masseter; MAS_P– deep masseter; MPT– medial pterygoid; TEM A– anterior temporalis; TEM P– posterior temporalis; LPT_S– superior lateral pterygoid; LPT_I – inferior lateral pterygoid; DIG– digastric; GEN– geniohyoid; MYH– mylohyoid).*

When the food is chewed the jaw describes something like a circle. Gyzi schematically divides the masticatory movements into four phases. At the starting point of the movement the

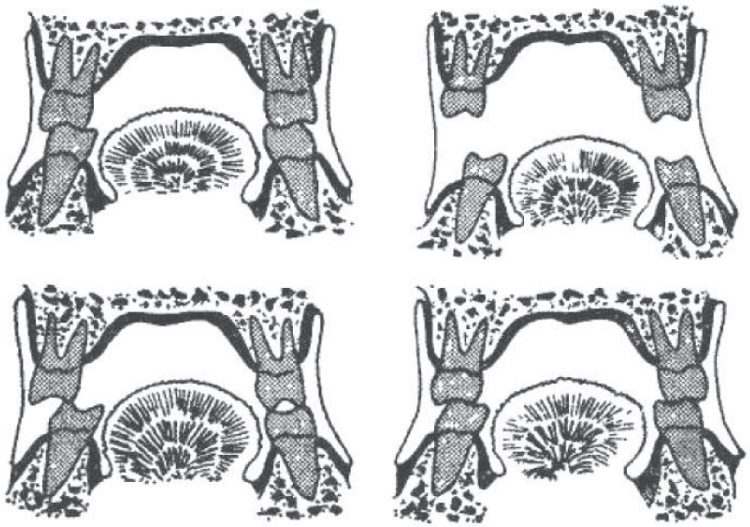


Fig. 2-8. *Molars cusps position during mastication. (Gyzi chewing cycle).*

position of the jaws is in the central occlusion or habitual position. In the first phase the jaw is lowered and pushed forward. In the second phase the mandible offset to the side (transversal movement). In the third phase the teeth are closed on the working side with dental cusps of the same name, and on balancing side the oppositely charged cusps. In the fourth phase the teeth returned to the position of the central occlusion and chewing cycle is repeated. After finishing of the chewing the mandible is set to relative physiological rest position (Fig.2-8. Fig.2-9).

Mastication could not be performed without soft tissues. Lips, tongue and cheeks moves, support and control food amount and position during all stages of mastication.

Swallowing is the sequence of the coordinated muscles activity that moves the bolus of the food from the oral cavity to esophagus and stomach. It consists of voluntary, involuntary and reflex muscles contraction. In normal swallow (somatic swallow) teeth are used for mandibular stability. The lack of teeth support as the result of poor teeth condition or mandible to maxilla relationship causes the infantile swallow. Swallowing consists of three stages and stays under control of the CNS and provide by pharyngeal muscles. The swallowing cycles can occur 590 times per 24 hour period. (Okeson J., 2006)

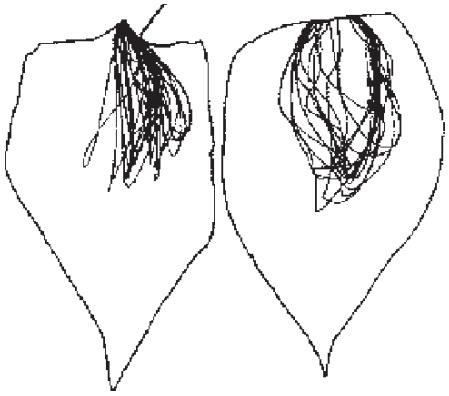


Fig. 2-9. *Chewing strokes in different occlusion condition (by I. Klineberg, frontal view: A– steep canine, B-worn canine)*

Speech is the third main function of the masticatory system. The speech is created by the air going out from the lungs through the larynx and oral cavity. Articulation of sounds is created by specific position of the tongue, teeth and lips. Different relationship of the lips and tongue to the palate and teeth can produce a variety of sounds.

Bite and Dentition

The alveolar process of the jaw bones starts to grow with the eruption of the teeth. A fully developed alveolar process is consists of compact bony plates (inner and outer) and is divided into sockets (alveoli) separated one from another by interalveolar septies. Each alveolus contains the root of the tooth, which is of the same shape and size as the socket. There are several holes at the bottom of the alveoli for vessels and nerves.

The alveolar processes are curved and narrowed at the top and become wider in the direction of the body of the jaws. The inner parts of the jaws are spongy. In an adult the alveolar process of the maxilla is terminated distally to the third molar. The alveolar process of the mandible is continues with the ascending ramus and mucosae eminences founded distally to the third molar, called the tuberculum mandibulare and is accepted in the clinic as its point of end.

The periodontium consists of the gingiva, the periodontal ligaments, the root cementum, the alveolar bone. The periodontium is also called "the attachment apparatus" or the "supporting tissues of the teeth". The alveolar processes play the main role in retention of the teeth; they receive the masticatory pressure and distribute it in different directions through the bone.

The union between the root of the tooth and the alveolus appears as a thin space on X-ray (periodontal membrane). The space grows larger from the neck of the tooth to the apex of the root, its average width is ranging between 0,2

and 0,25 mm for the maxillary teeth and 0,15 and 0,22 mm for the mandible in an adult (Fig.2-10).

The periodontal membrane (attachment apparatus) bears the following functions:

– nutrition;

– metabolic processes;

– supporting and fixation of the tooth in the socket;

– absorbtion the pressure produced on mastication;

– tissue regeneration;

– sensory, due to the presence of nerves.

The periodontium undergoes the changes with age and subjected to morphological changes related to functional load and alterated under the overload and oral environment.

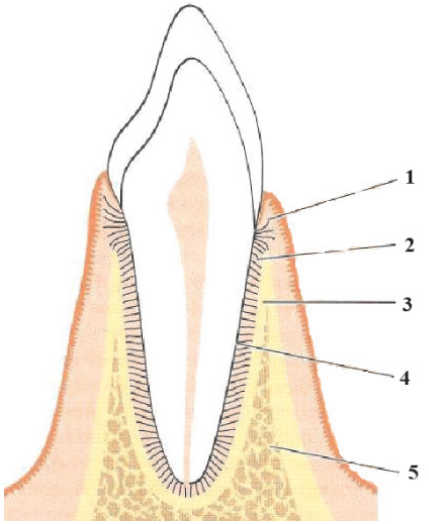


Fig. 2-10. *Attachment apparatus consists of the next tissues: the gingiva (1) the periodontal ligament (2), the root cementum (4), the alveolar bone which consists of two components, the alveolar bone proper (3) and the alveolar process (5). (Lindle J., 2003)*

Histologically the periodontal membrane is a fibrous connective tissue composed of nonelastic fibres arranged irregularly at different levels of the alveolus. Connecting fibres of the type of Sharpey's fibres penetrate the bone with one end and root cementum with another. A great number of cells (fibroblasts, osteoblasts, cementoblast) are found between the fibres of the periodontal membrane.

The dental rows (the teeth in position in the dental arches) are adapted to load bearing, a special adaptation being made to masticatory load in the vertical and horizontal directions. On the upper jaw masticatory load is distributed and released by buttresses (counterfort) – frontonasal, zygomatic, pterygopalatine, palatine. The first frontonasal buttress corresponds to the lateral wall of the nasal cavity. Heading up it goes into the nasal process and strengthens the area of the upper jaw in this field, balancing the pressure forces developed by canines and thrust upward. Second the zygomatic buttress leans on the top of the zygoma

bone and in addition it is supported by zygoma arch from the back. It receives the load coming from chewing teeth and distributes this up, back and inside. Third pterygopalatine buttress is generated by tuber maxilla and is supported by pterygoid process of sphenoid bone. It perceives the pressure from molars and transforms up and forward. Forth palatine buttress is formed by palatine process of the maxilla. Palatine processes fasten together the left and right sides of the dental arch in transversal direction. Palatine buttress receives and transforms the load in transversal direction (Fig.2-11).

The bone structure peculiarities release the masticatory load on the mandible (Fig.2-12).

The upper dental arch of an adult is ellipsoid in shape, while the lower dental arch is paraboloid. The teeth are set close one to each other, the shapes of the crowns form contact points with their convex parts. The contact points protect the gingival margin at the approximal aspects of the teeth from being injured by the food. An interproximal space is formed between two adjacent teeth; it is shaped triangle and filled with mucosae papillae. The teeth of both jaws are slightly tilted to the forward and outward.

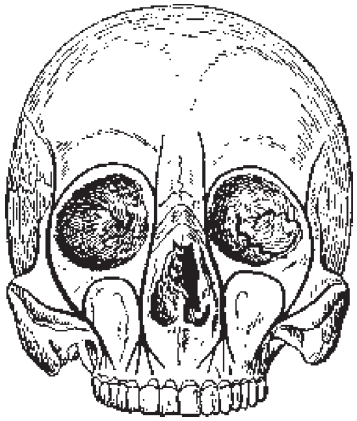


Fig. 2-11. Counterforts on the upper jaw (by F. Walkhoff, 1967).

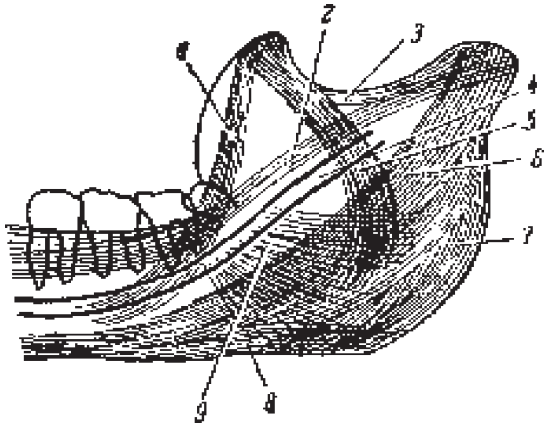


Fig. 2-12. Lower jaw trajectories of the masticatory pressure releasing: 1 – tr. praeceps, 2 – tr.centrale, 3 – tr.copulans, 4 – canalis alveolaris inferior, 5 – tr. transversum, 6 – tr.basilare, 7 – tr.posticum, 8 – tr.marginale, 9 – tr.radiatum (by F.Walkhoff, 1967).

There is a definite relation between the dental arches and between the antagonistic teeth when the jaws stay in contact. The signs of a normal relation of the dental arches are as follows: – when the dental arches are brought together each tooth on the upper jaw comes in contact with its antagonist on the lower jaw; – the midsagittal plane passes between the upper and lower central incisors; – each tooth of the upper and lower jaws comes in contact with two antagonists except the lower medial incisors and the upper third molars.

Angle had published the classification of occlusion in 1890. It was the first step in definition of normal occlusion and malocclusion. Angle postulated that the upper first molars were the keys of occlusion and that the upper and lower molars should be related in a manner: the mesial cusp of the upper molar places in the mesio-occlusal groove of the lower molar. If this molars relationship exists and the teeth are arranged on a smoothly curving line of occlusion, the normal occlusion is present. Angle described three classes of malocclusion, based on the occlusal relationship of the first molars.

The human bite consists of 28-32 permanent teeth (14-16 to each jaw). The teeth arranged in a definite manner and adjusted in occlusal contacts are completed by the age of 14-16, except of the third molars. The incisal ages of anterior teeth and the occlusal surfaces of the molars lie in the same plane known as an occlusal plane or plane of occlusion.

These signs are encountered with a few main types of bite: physiological, pathological and transitional (TrezubowV.N., 1994)

Orthognathous (normal) bite is decided to be physiological. The main signs for this bite is: the incisal edges of the upper teeth overlapping the incisal edges of the lower antagonists (overbite). The maxillary anterior teeth and the alveolar process slightly slope forward from the body of the jaw. The first molars interrelation is the Angle Class I. It provides a full function of mastication, speech, swallowing, and aesthetic values (Fig.2-13).

Transitional bite can't support the function completely. There are a few types of human bite in this division: orthognathous bite with deep overlap, with protrusive and retrusive inclination of the frontal teeth, frontal teeth edge-to– edge bite. Edge-to-edge bite (straigth) – orthognathic bite with the incisors as forcept-like. The relation of the incisors is visualized without overlap and with edge-to-edge contact. With this type of bite the teeth and alveolar processes are strictly vertical to the body of the jaws.

Abnormal bites are:

1. Progenia– mean the condition of the mandible projection to maxilla that show teeth interrelation changing The lower anterior teeth and the alveolar process slightly slope forward from the body of the jaw (Fig.2-15).

2. Prognathous bite – the condition of the maxilla projecting to mandible with incisors and alveolar processes of the upper jaw overlapping the lower jaw with overjet (Fig.2-14).

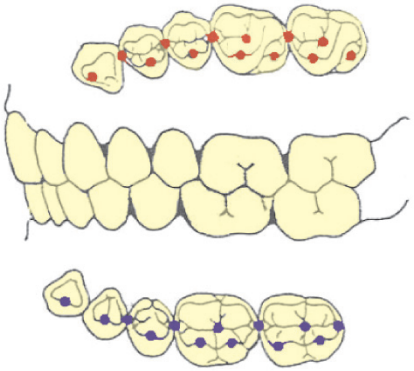


Fig. 2-13. *Class 1 occlusion teeth contacts (Orthognatic bite) (Gross M.D., Mathews J.D., 1982)*

3. Deep bite– the Angle II class malocclusion, second division. The condition, that show big amount of the overbite and can be related with any anteroposterior or transverse malocclusion.

4. Crossbite – is the form of the malocclusion when teeth (tooth)are placed more buccal (lingual) with the interrelation changing. .

5. Open bite– is the form of malocclusion, when frontal teeth do not touch each other even when the mouth is clothed.

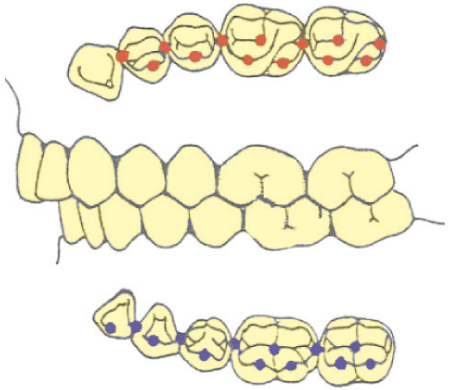


Fig. 2-14. *Class 2 occlusion teeth contacts (Prognatic bite) (Gross M.D., Mathews J.D., 1982)*

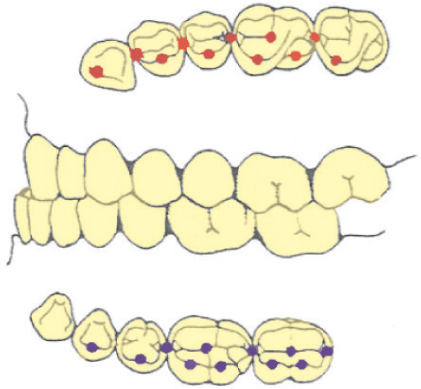


Fig. 2-15. *Class 3 occlusion teeth contacts (Progenic bite) (Gross M.D., Mathews J.D., 1982)*

Maxillomandibular relation

The activity of the masticatory system is schematically demonstrated in the following phases: opening and closing of the mouth and forward, backwards, lateral, and combined movements of the lower jaw. Two main conditions for the prosthetic purposes are distinguished from the mandible biomechanics: articulation and occlusion.

Katz included all contact relationship of the teeth of the dental rows in the various phases of the mandible movements under the term "articulation". The term "occlusion" designates any possible contact relationship of the lower and upper teeth. Occlusion is a particular case of articulation. The distinction of occlusal conditions in the biomechanics of the masticatory system is of great theoretical and practical importance.

Occlusion in modern concepts mean the dynamic biological relationships of determinants of the stomatognatic system that control teeth contacts during function and disfunction. It is essentially for the integrated action of the jaw, muscles, temporomandibular joints and teeth. The main characteristics of the system are genetically determined– jaw muscles characteristics, jaws shape and size, teeth eruption sequence and relationship. The influence of muscles parafunctions, teeth surface lost, teeth tilting and drifting, teeth lost may ongoing remodelling of the jaws bone and muscles allowing adaptation and disfunction of the masticatory system. (Klinenberg I., Jagger R., 2004)

The determination of the occluding action between opposite dental arches during mandible movements is possible with special terminology and set standards.

Next principal types of occlusion are distinguished.

Centric occlusion (CO) is provided when the jaws are closed with the teeth are brought into the occlusal contacts. The bite signs can be investigated in closed centric occlusion position with the key of occlusion at the first molar and different types of anterior teeth overlaps. Occlusal adjustment procedure approaches, orthodontic treatment and restorative treatment use CO as the basis for developing the occlusal scheme.

Maximum intercuspation (MIC) – also known as habitual occlusion, (intercuspal position) represents the intercuspation of the occlusal surfaces of the antagonizing teeth which are changed from CO, but the patient is adapted to this condition. This position can be affected by head posture, muscles and temporomandibular joint pathology, teeth surface lost. This occlusion condition

under the unsatisfied function of the masticatory system components have to be indicate to improve.

Centric relation (CR) is the position when the hinge movement of the mandible (known as the terminal hinge axis) can take place. When comprehensive occlusal rehabilitation is planned for a patient who has lost the great amount of the occlusal surface substance, this reproducibility is important because dental casts are mounted in articulator in accordance with the hinge axis. In edentulous patients and in patients with occlusal relationship changed (malocclusion, habitual occlusion) the CR is used for prosthetic reconstruction, because it is considered to be a reliable and reproducible reference position (Fig.2-16).

Rest position (RP) – is the postural position of the mandible which can encompass the equilibrium of the elevator and depressor masticatory muscles as well as their viscoelastic qualities. (Jose dos Santos, 2007) These condition keep the mandible at the 1-3 mm distance from the maxilla (Fig.2-17).

For prosthetic purposes the lower part of the face should be investigated for the height of relative rest and the occlusal height. The height of relative rest is encountered with the dental arches not completely drawn together and a space left between them, and with the face muscles in a state of physiological tonus. The occlusal height (vertical distance of occlusion– VDO) is characterized by tight closure of the dental arches in centric occlusion, with the muscles contracted.

Fig. 2-16. *Manipulating of the mandible for muscles deprograming and CR reaching. (Gross M.D., Mathews J.D, 1982)*

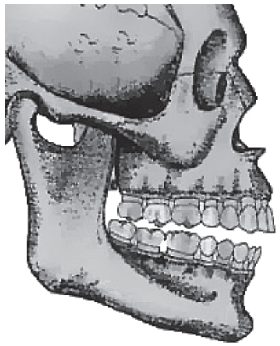


Fig. 2-17. *Rest position teeth interrelation. (Hvatova V.A.,1999)*

Both heights are measured when prostheses are constructed (Fig.2-18). The difference between the two heights should be from two to three millimeters.

In addition we can use a few orientation points on the face, which determine the spatial position of the teeth in relation to other bones of the facial skeleton for ptosthetic reconstructive procedures, especially those applied in patients with entire loss of teeth. The main orientation point is the occlusal plane esthetic level, which virtually placed between lips embrasure (Fig.2-19< Fig.2-20).

Mandibular movements

All movements of the lower jaw are inspected and measured in TMJ components and on frontal teeth interrelation.

Condyle guidance is determined as mandibular guidance generated by the condyle and articular disk that reflect the contour of the glenoid fossa. Condyle-disk assembly moves along the distal incline of the tuberculum articulare. The slope of the articular eminencia is shaped in different levels of inclination. The condyle movement track called as condylar guidance and is measured in degrees.

Anterior guidance is defined as "The influence of the contacting

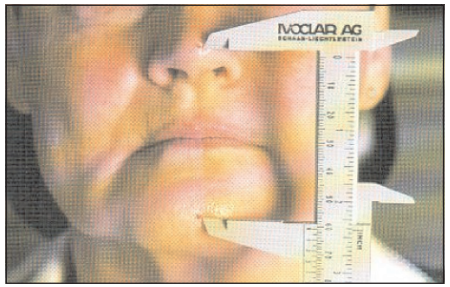


Fig. 2-18. *Measurements of the VDO. (Ivoclar, Germany)*

Fig. 2-19. *Lips and teeth harmony.*

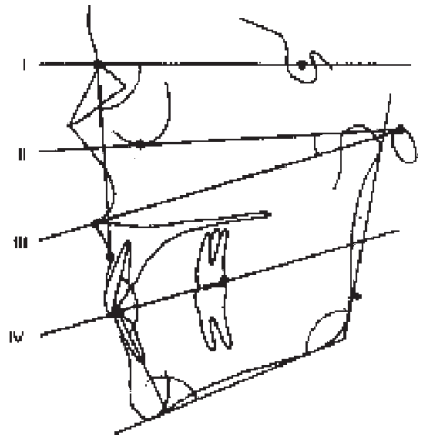


Fig. 2-20. *Cranium planes map: I– base plane, II– Francfurt plane, III– Camper plane, IV– occlusal plane, V– mandibular plane.*

surfaces of the mandibular and maxillary anterior teeth during mandibular movements "-(GPT-8). When the mandible moves forward, the lower frontal teeth incisal edges slide along the palatal surfaces of the upper frontal teeth in edge-to-plane contacts. The palatal surfaces of the upper incisals function as the guide occlusal surfaces (plane) where the tips of the lower incisals (edge) contact and move.

Basically mandibular movements are divided into rotation and translation of condyles. The mandible can be displaced in protrusion, retrusion direction and laterally. Lateral displacement divided into left and right lateral rotation with small displacement on the working side (Bennett movement), lateral translation (Bennett angle) on the non-working side and immediate side shift (ISS).

All movements of the mandible can be registered in three dimentions and better evaluated when they are projected and viewed in orthogonal spatial plans. These projections and traces document the mandible border movements. All movements are examined in sagittal, frontal and horizontal planes. Sagittal plane bisects the scull into two symmetric mirror images anteroposteriorly. Frontal (coronal) plane is positioned toward the face perpendicular to the horizontal plane and intersects head in different points. Horizontal plane is parallel to the floor (Fig.2-21).

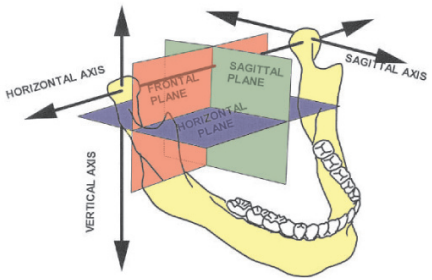


Fig. 2-21. *Spatial planes (from S.F. Rosenstiel, 2006).*

Sagittal plane mandible movements

Condyle rotation and translation are parts of the border movements they can be easily viewed in sagittal plane. All TMJ movements are reflected in incisal point mandible movements.

When the mandible is rotated in centric relation (CR), antagonizing teeth show first contact– retruded contact position (RCP). CR mandibular movement can be reflected with the arch of 16-25 mm between opposing incisors. After the first tooth contact is reached in closing of the mandible the slide toward in the intercuspal position is realized under the tightening of the masticatory muscles. The record of the terminal hinge axis and first tooth contact are visible in posterior

portion of the Posselt diagram. On opening the mouth the lower teeth describe a curve that is a part of a circumference the centre of which lies in the centre of the condyle (Fig.2-22).

Next after this the slide of the antagonizing teeth move the mandible to complete contacts (CO or MIP) as it is marked on the diagram (CR-CO). After intercuspal position of the teeth (MIC) condyle can move forward in translation. This movement is known as protrusion of the low jaw with contacts of the teeth during main part of translation. After edge-to-edge contacts in protrusion the mandible moves forward (F– point). Next part of trace from F to E shows the mandible move down to the maximum opening. An increase of opening around the terminal hinge axis produces the translation movement of the condyle against the articular eminence, that is terminated in maximum opening of the mandible and lower incisors move from point B to the point E on diagram. From CO teeth interrelation the opening of the mouth is also possible and this is trace from point CO to E on the diagram (Fir.2-22).

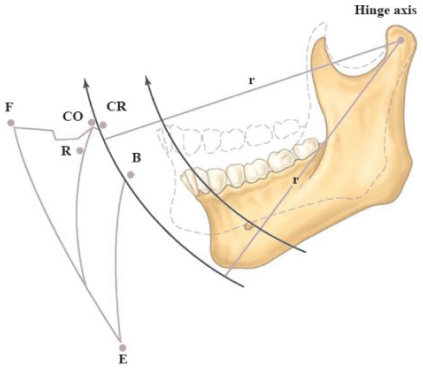


Fig. 2-22*. The mandible movements in the sagittal view with Posselt diagram (from http://what-when-how.com/dental-anatomy-physiology-and-occlusion/the-temporomandibular-joints-teeth-and-muscles-and-their-functions-dental-anatomy-physiology-and-occlusion-part-2/).*

In protrusion movement the condyles are displaced forward and lie at the top of the articular eminence. It is known as the sagittal condylar path. The angle (or inclination) of this part varies with the individual and ranges between 20 and 40 degrees. (mean 30-33 degrees) (Fig.2-23).

The mandible opening movement after protrusion (F-E) provides the rotation of the condyles after translation on the top of the tuberculum articulare. The level of the mandible opening is the diagnostic test for masticatory muscles and TMJ condition. (mean 40-60 mm) (Fig.2-22).

Anterior occlusion is formed with protrusion of the mandible. From intercuspal position the mandible can moves forward only when the mandibular incisors come out from the overlapping of the maxillary teeth. Their incisal

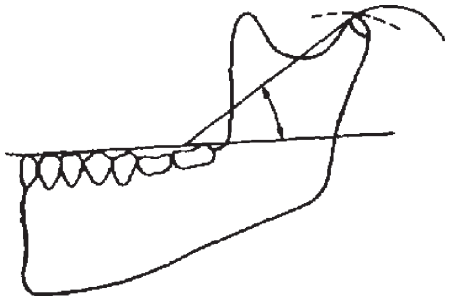


Fig. 2-23. *Sagittal condylar path angle.*

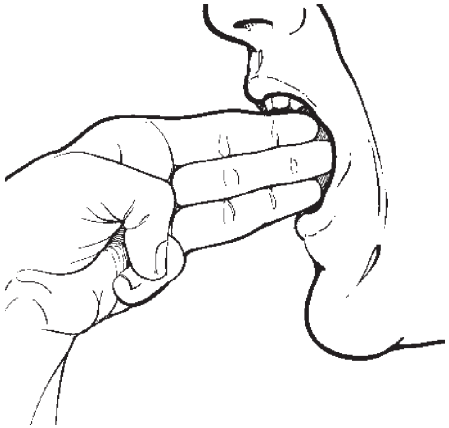


Fig. 2-24. *Mouth opening measurement.*

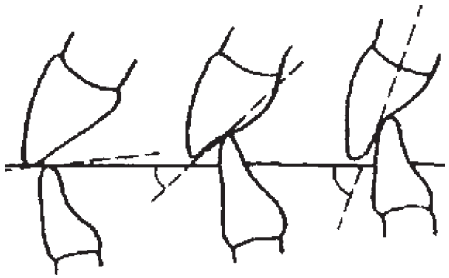


Fig. 2-25. *Anterior teeth interrelation.*

edges slide down on the palatal surfaces of the maxillary incisors till they come in edge to edge contacts. The way followed by the mandibular incisors when the lower jaw moves forward is known as the sagittal incisal path. The angle of incisal gliding is also determined in relation to the occlusal plane and can be traced by a special recording instrument. According to Gyzi the angle of the sagittal incisal path differs with the individual and ranges between 40 and 50 degrees (Fig.2-25).

Frontal plane movements.

While observing the lateral movement in a frontal plane, different right and left condyles displacement can be viewed.

Open movement of the mandible on the incisal point in frontal view can be observed from centric occlusion to maximum opening with vertical line. Deviation and deflection from this line mark the signs of the TMJ pathology. The lower jaw is moved down by the force of gravity and by the bilateral contraction of the muscles. Three phases are distinguished in the process: slight, considerable, and maximum lowering. The lowering of the mandible and, respectively, the distance covered by the condyles is also strictly individual depending on the shape and height of the articular eminences slope.

Lateral movements of the teeth in frontal view.

Eccentric movements of the mandible in frontal plane show different characteristics in right and left joints, depending on the side to which the mandible moves. If the mandible is moved to open from a lateral position, the result is a curved path ending at maximum opening. At the joints, to achieve maximum opening of the jaw, the non-working condyle must also translate forward at the same time. As the maximum limit of mandibular opening is reached, there can be no lateral movement (Fig.2-26). Asymmetry in left and right opening tracks must be analyzed for TMJ condition.

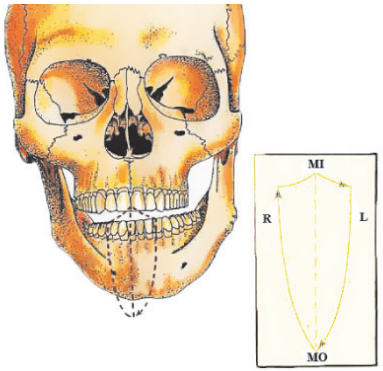


Fig. 2-26. *Frontal teeth movements in frontal view (by Jose dos Santos, 2009)*

Lateral movement of the lower jaw is effected by contraction of the lateral pterygoid muscle and the anterior horizontal bundle of fibres of the temporal muscle on the opposite side.

Mandibular movements in horizontal plane

Mandibular range of motions projected on the horizontal plane also can be analyzed at both the incisors and temporomandibular joints. The condyle tracks represent distinct marks for each position or registration (protrusion, retrusion, laterotrusion, mediotrusion, ISS).

Lateral occlusion – left or right, is formed when the lower jaw is moved to the left or right side. If the mandible moves to the left, the left condyle remains inside the articular fossa with a rotational movement with slight displacement. This condyle is called the rotating condyle or working condyle. The opposite side right condyle in left movement translates forward, inward, and downward along the articular eminence. This right condyle is identified as the non-working, translating condyle or balancing condyle. The movement of this condyle is measured in degrees. (mean 15-17 degrees) and is known as the angle of the lateral condylar path. When the mandible slides to the right side, the condition is reversed.

The condyles do not have a perfectly spherical configuration, and similarly the articular fossae and eminences are not perfectly concave. Therefore, during

lateral movements there is no pure rotation and translation of condyles in joints, but the tendency for a shift of the jaw toward the side to which the mandible is moving appears. This lateral displacement of the mandible, known as the Bennett movement or the Bennett shift (mean 0-2 mm)

Along with the condyles the anterior teeth are also displaced sideways when the jaw moves to the side. The lateral displacement of the anterior portion of the mandible can be demonstrated by the different positions of two triangles which base is formed by a line, joining the two condyles and the upper incisal point (the point lying at the junction of the medial incisal surfaces). These three points are connected between formed the equal side triangle– Bonwill triangle. The trace traversed by the incisal point from CR to the side is known as the lateral incisal path. The amount of such displacements stay under influence of the non-working condyle ways (Bennett angle).

The diagramm of tracing received on teeth, show CR point, CO point, retrusion, protrusion and left-right side laterotrusion. The posterior corners of diagram, corresponding to centric relation position, represent the important clinical landmarks for reconstruction of occlusion, articulator adjusting, complete denture construction. Tracings originating from centric relation are commonly called Gothic arch tracings. (mean 100-110 degrees) (Fig.2-27).

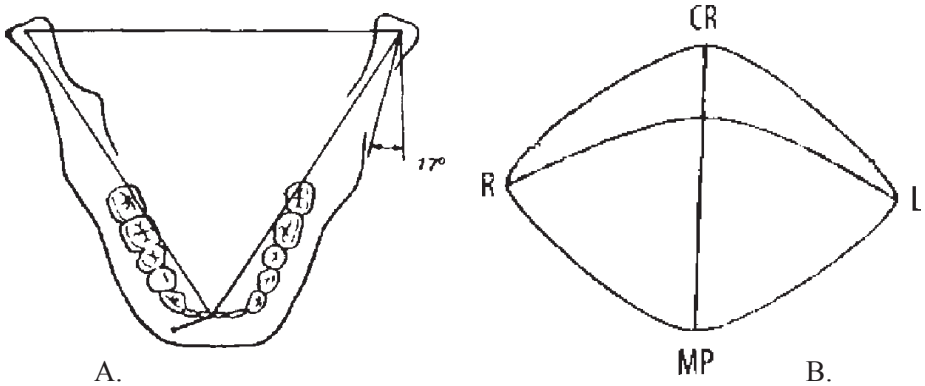


Fig. 2-27. *Bennett angle (A) and incisal point displacements in horizontal view. Frontal teeth point (B) movements in horisontal view (by Jose dos Santos). R – right, L – left, Cr – centric relation, MI – maximum intercuspation, MP – maximum protrusion) Horizontal view of teeth diagram near first molars is received during intraoral registration for CR determination and teeth arrangements for complete denture fabrication.*

Occlusion and its characteristics

Factors and forces which determine tooth position.

When the teeth erupt, they are directed in position where the opposing forces are equilibrium. Lips, cheeks and tongue muscles forces supported teeth when it is equal. Proximal contacts between teeth help to maintain teeth in normal alignment. Occlusal contacts prevent the overeruption of teeth.

The incisal edges of frontal teeth and the occlusal surfaces of the premolars and molars form the occlusal surface of the dental rows. Teeth of the lower jaw in sagittal view is downward curvature is shaped which becomes pronounced by the age of 11 to 13 years and named the curve of Spee. The curve is measured as the radius. (mean 95-110 mm) (Fig.2-28). From the transversal view left and right side molars on upper jaw the occlusal downward curve is shaped at the same manner – the curve of Wilson. Curve of Wilson can be negative, straight and positive. Both of them are known as compensating curves (Fig.2-29).

The occlusal surface of the teeth is appeared with the numerous of the cusps, grooves and sulci. The area between the buccal and lingual cusp tips of the posterior teeth is called the occlusal table. The occlusal table is presented with approximately 50-60% of the total buccolingual dymention in the posterior tooth and is positioned over the long axis of the tooth (Fig.2-30).

Each cusp represents the inner and outer inclines that extend from the cusp tip. Tooth inclines are also identificated to mesial and distal direction and show mesial and distal portion.

All cusps are divided according to function: supporting cusps and guiding cusps. Supporting cusps maintain the vertical dimension of occlusion. The main role of the guiding cusps is to minimize soft tissues impingement and to maintain the bolus of food on the occlusal table for crushing. Also the guiding cusps contact during mandible lateral movement from the MIC as a guide (Fig. 2-31).

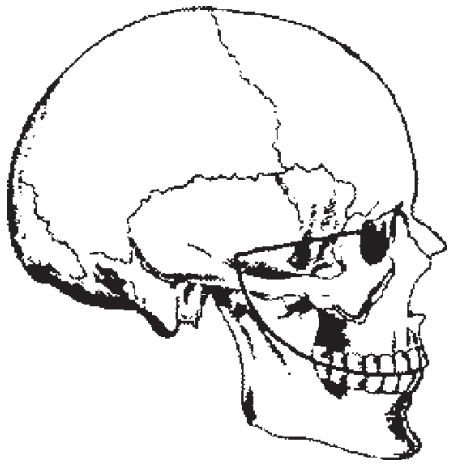


Fig. 2-28. *Curve of Spee.*

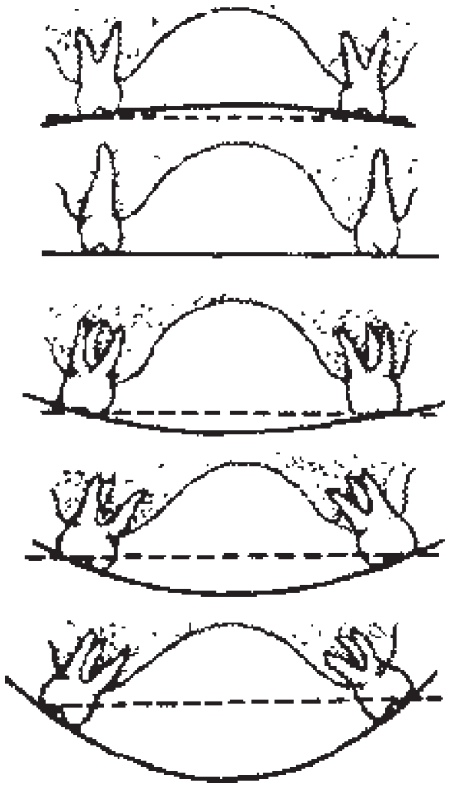


Fig. 2-29. *Curves of Willson shapes.*

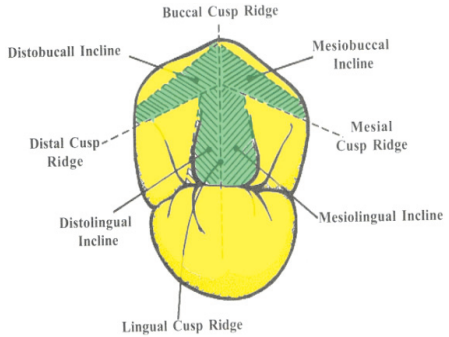


Fig. 2-30. *Occlusal surface of the tooth*

The normal occlusal contacts on anterior teeth are lighter then on posterior teeth. The functional mean of anterior teeth is to guide the mandible to the anterior movements. The anterior guidance is examined through the horizontal overlap– overjet and vertical overlap-overbite (Fig. 2-32). Traditionally it is described as an arbitrary of 2 mm for horizontal and 3 mm for vertical overlap is being ideal. Nevertheless for most patients greater vertical overlap is important for prevention undesirable posterior teeth contacts during mastication. (Rosentiel S.E., 2001) The main functions of the anterior teeth are speech and food cutting.

Canines are the best suited to accept heavy forces during eccentric movements. They have the longest roots, and can provide adequate laterotrusive guidance. In the other cases group function (canines and premolars) suitable to provide laterotrusion and disclose distal teeth on working and non-working sides (Fig.2-33 (A,B).

Balansing occlusion means the presence of occlusal contacts on molars in protrusion and laterotrusion on mediotrusive side. Such occlusal contact is considered to be nonphysiological in a natural bite because of unfavorable forces applied to posterior teeth. But in complete

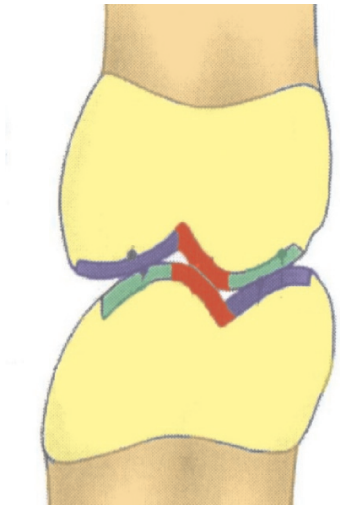


Fig. 2-31. *Transversal view of the tooth*

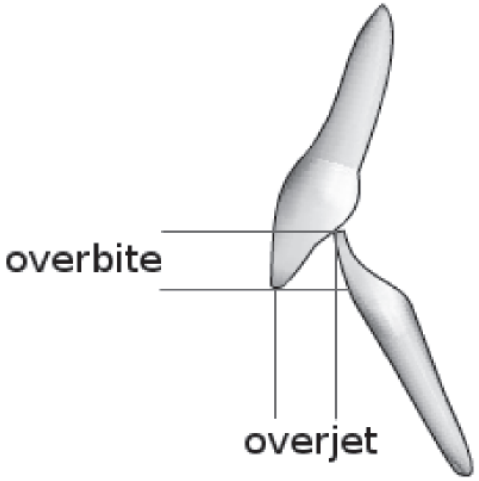
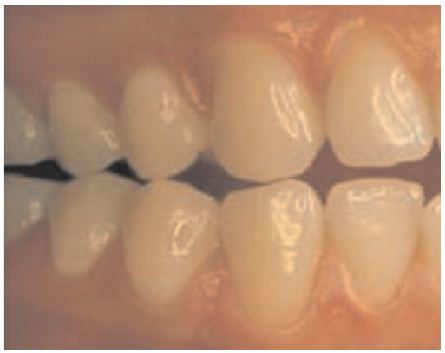


Fig. 2-32. *Overbite and overjet.*

A.



B.

Fig. 2-33*. Canine guidance (A) and group function (B).*

Fig. 2-34. *Balansing occlusion in complete dentures.*

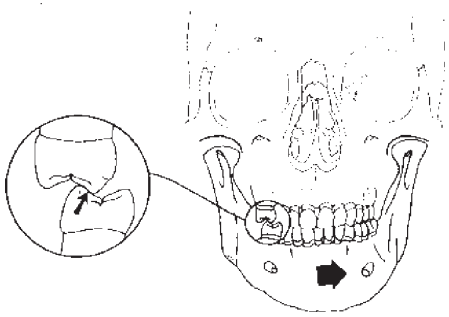


Fig. 2-35*. A non-working side contact – balancing contact between buccal incline of the upper palatal cusp and lingual incline of the buccal cusp. (Shillinburg H.T., Hobo S., ets., 1997)*

dentures such occlusal contacts are arranged to prevent denture displacements during functioning (Fig.2-34, 2-35)).

Optimal functional occlusion (Okeson J., 2008)

1. When the teeth close the condyles are in their most superoanterior position, resting on the posterior slopes of the articular eminences with the disks properly interposed. All teeth are in contacts but the anterior teeth contacts are slightly.

2. All teeth contacts provide axial loading of occlusal forces.

3. In laterotrusion the adequate teeth-guided contacts on the laterotrusive (working) side are present to disocclude the mediotrusive (non-working) side immediately. The most desirable guidance is provided by the canines (canine guidance).

4. When the mandible moves into protrusion the adequate tooth-guided contacts on anterior teeth are present to disocclude all posterior teeth immediately.

Determinants of occlusal morphology.

The health of occlusal surfaces of the teeth is influenced by the interaction of all determinants of the masticatory system. During mandible movements the posterior controlling factors – TMJ and anterior controlling factors -anterior teeth are interrelate. The posterior teeth are positioned between these two controlling factors and can be affected by both.

Condyle movements parameters are the result of the steepness of the artucular eminence. The angles at which the condyle moves away from the started point are sagittal condyle inclination and transversal condyle inclination.

As the mandible protrudes or moves laterally the incisal edges of the mandibular teeth occlude with the lingual surfaces of the upper jaw anterior teeth. The steepness of the slope of the tuberculum articulare and frontal teeth overlap level can vary and influences the height of posterior teeth cusps. It is mean that the parameters of the sagital condyle inclination and Bennett angle stay in direct relation with the height of the cusps of the teeth.

Occlusal plane position affect the height of cusps. Occlusal plane is an imaginary plane touching the incisal edges of the maxillary anterior teeth and the cusps of the maxillary posterior teeth. The relation of the occlusal plane and the size of eminence of the tuberculum articulare are influenced by the steepness of the buccal teeth cusps. Curves of Spee and Wilson also are formed by the distal teeth cusps height (Fig.2-36).

Lateral movements amount and direction influence the level and coincidence of guided cusps and affect the ridge and groove direction (Fig.2-37).

Numerous interocclusal gliding motions are produced during excursive movements. The associated trajectories are developed by teeth cusps interrelation with their respective fossae during balancing, working, and protrusive border

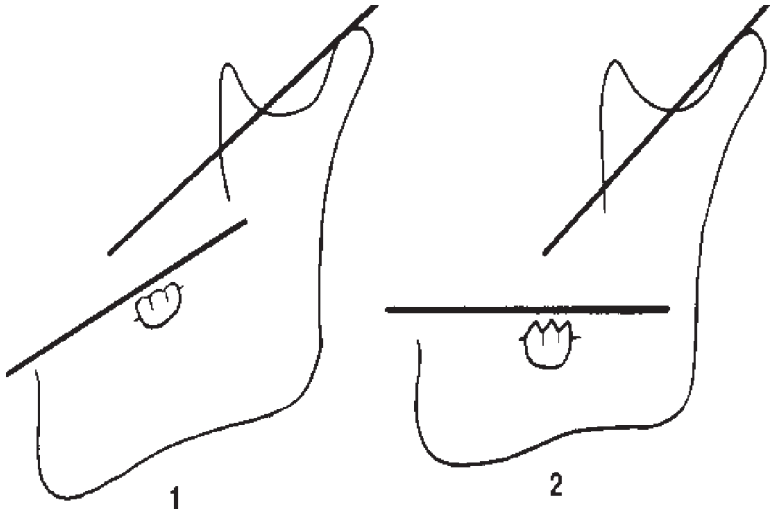


Fig. 2-36. *Cusps height are influenced by occlusal plane positioning (by U. Lozmann).*

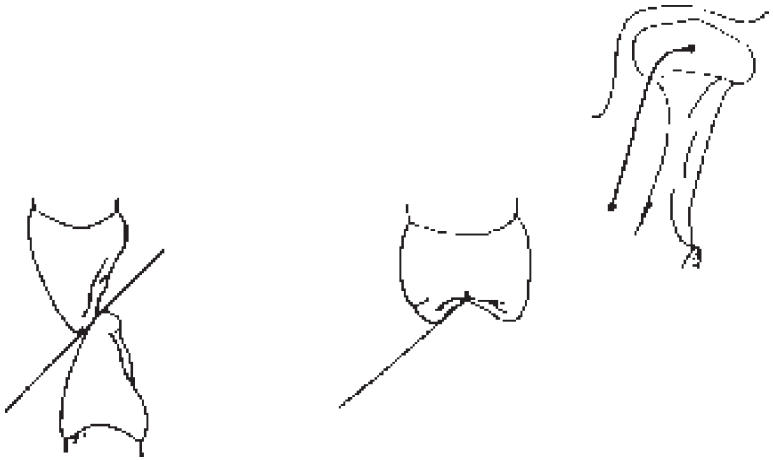


Fig. 2-37. *Interrelation between Bennett angle, molar cusp incline and incisal overlap. (Shillinburg H.T., Hobo S., et al., 1997)*

movements of the mandible. These trajectories are comparable to a "dove's footprint" entering the mouth in the mandibular arch and leaving in the maxillary arch. The same traces on the occlusal surface are investigated by Polz M.H., Schulz D., 1980 and named as "occlusal compass". These data are important for analyzing and balancing of occlusion in everyday dental practice (Fig.2-38).

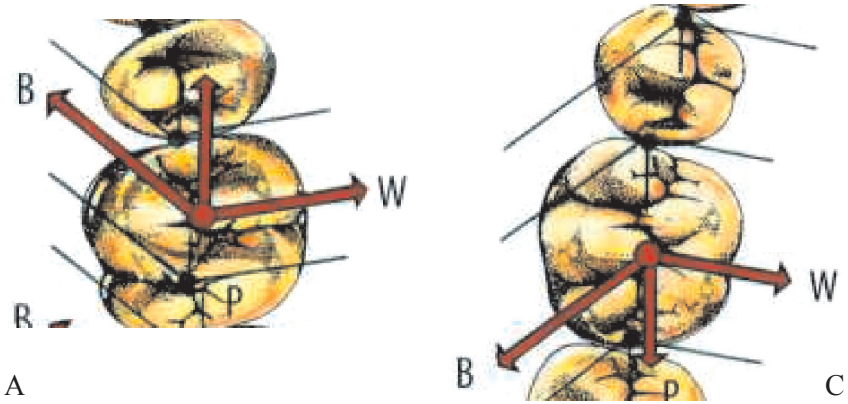


Fig. 2-38. *Direction of movements in protrusion (P), balancing (B), and working (W). A-on the upper jaw, C– on the lower jaw.*

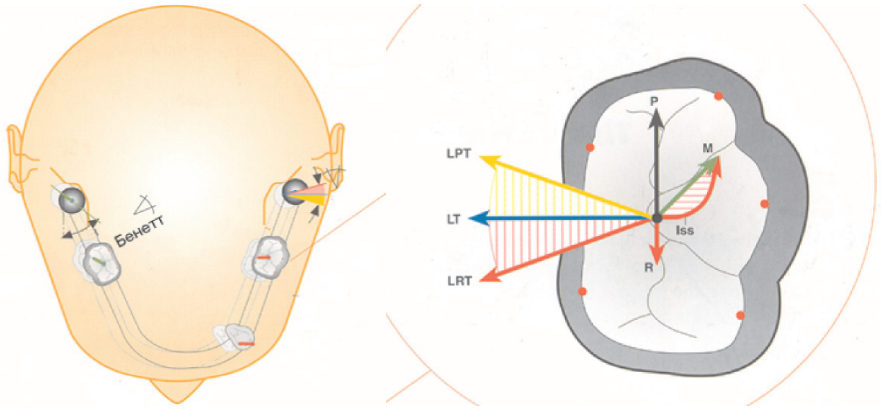


Fig. 2-39. *Condyle movements on the working and non-working sides– A, and molar occlusal table with "occlusal compass" trajectories (LPT– lateroprotrusion, LT – laterotrusion, LRT – lateroretrusion, P – protrusion, R – retrusion, M – mediotrusion, ISS – immediate side shift) (From Protar (KAVO) manual)*

Modern concepts of occlusion (Presswood R.G., Toy A., 2008)

1. Cuspid (canine) protection: the simultaneous contact of the anterior and posterior teeth on mandibular closing, with immediate disocclusion of the posterior teeth in excursive movements. Introduced by D'Amigo (1958) the canine and anterior teeth protect the posterior teeth from occlusal overload by inhibiting the masticatory muscles

2. Group function: the simultaneous working side contact of multiple teeth in gliding movements of the mandible. Presented by von Spee (1890) and commonly used by dentists until the 1960 when it was replaced by cuspid (canine) protection.

3. Balansed occlusion with distal molar contacts in protrusion and laterotrusion. Very popular concept for artificial teeth arrangement. Presented by Gyzi , Bonwill (1924).

4. Neuro-muscular /physiological/ esthetic uses electromiographic (EMG) measurements to determine the "ideal" muscles length and jaw position for the individual. It uses a technical system (EMG) originally presented by Jankelson (1969).

5. Physiological (behavioural) habitual: proposes that physical function of the teeth have little effect on the general health and function of other aspects

of the stomatognatic system. The concept as presented by Dworkin and Burgess (1968) suggests that the system is adaptable to almost all physical change and that clinical issues of discomfort and pain are more psychosocial than physical.

Artuculators in dental practice

Articulators are the devices which can reproduce jaws position and range of motions. The movements of the mandible are managed by the bones and ligaments of the TMJs which include hard and soft tissues function. The articulator movements with hard mechanics can be only relatively constant and reproducible. Most of the articulators are adjustable to simulate these movements. As a result, they can be used for diagnostics and treatment of a jaws and TMJ dysfunctional condition and teeth restoration. All articulators have different functional and mechanical restrictions and occlusal theories influence the design, construction and indication for using.

There are two main types of such devices: arcon and non-arcon. They differ in condyle mechanism construction. Arcon articulator condyle part consists of condylar housing attached to the upper frame and the condylar balls connected to each side of the vertical bearing of the lower frame. Non-arcon articulator condyle constructed with condylar balls attached to the upper frame and the condylar housing are attached to the vertical stands of the lower frame. Non-arcon articulators do not precisely reproduce the anatomic features of the human skull, that's why arcon articulator is the most commonly used in dental practice (Fig. 2-43; 2-44).

Both types of articulators are divided to fully adjustable, semi-adjustable and average value. GPT-8 prescribes to differentiate the articulators into four classes. Class I articulator: a simple holding instrument capable of accepting a single static registration; vertical motion is possible. Class II articulator – an instrument that permits horizontal as well as vertical motion but does not orient the motion to the TMJ. Class III articulator: an instrument that simulates condylar pathways by using average or mechanical equivalents for all or part of the motion; these instruments allow orientation of the casts to be relative to the joints and can be arcon or nonarcon instruments. Class IV articulator: an instrument that will accept three dimensional dynamic registrations; these instruments allow orientation of the casts to be relative to the TMJ and simulation of mandibular movements.

Many restorations are made on small non-adjustable articulators. Their use often leads to occlusal discrepancies in restorations, because these

instruments do not have the capacity to reproduce the individual range of mandibular movement. Some discrepancies can be corrected intraorally.

The differences between the hinge closure of a small articulator and the patient are of practical significance. The distance between the hinge and the tooth to be restored is significantly less on this device than in the patient. Such articulator range of motion results in premature contacts, because cusp position is affected. This is important to note before treatment planning.

For routine fixed prostheses fabrication the semiadjustable articulator is a practical approach to provide the necessary coincidence and to minimize clinical correction. This articulator can represent the anatomic structures properties and movements.

The fully adjustable articulator includes a wide range of position and can be set to follow a patient's border movements. This articulator needs exact jaw movements measurements for the condyle house and incisal table for precise adjustments (Fig.2-40).

For transferring the casts to articulator start point is used– arbitrary hinge axis, which is located as virtual horizontal transverse axis of rotation of condyles and represents the fixed axis of the mandibular rotation. This point is located with facebow. Each type of articulators has the own face-bow. Two main types of face-bow are manufactured– arbitrary face-bow and hinge axis face-bow (Fig.2-41; 2-42).

The arbitrary face-bow is positioned by orientation to reference points: two earpieces to external meatus (or styli to hinge axis position) and nose or face support (anterior point of reference). A face-bow consists of metal frame with ear of face extentions, face reference point, and transfer assembly (bite fork with fixating device).

To mount the casts to articulator the mounting clutch is connected to the upper and lower frames in the articulator. Before starting the placing casts to articulator condylar elements

Fig. 2-40. *Fully adjustable articulator with mounted casts.*

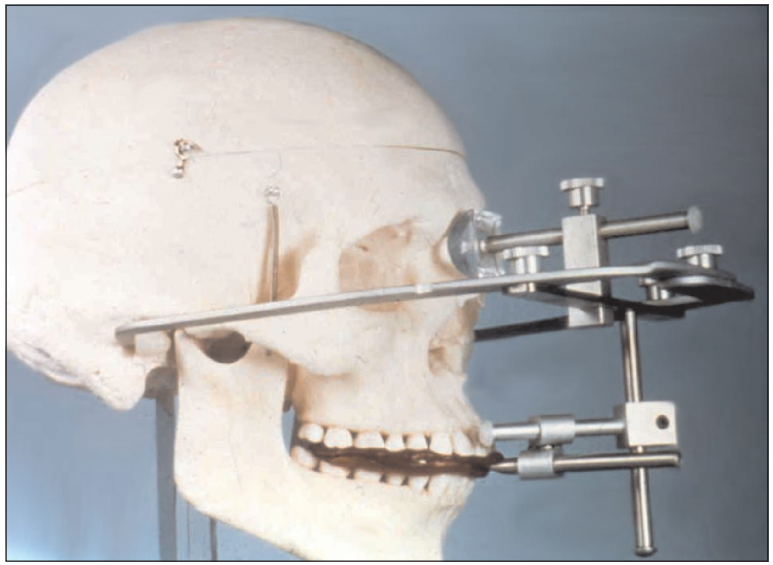


Fig. 2-41. *Facebow position on cranium (Whip-Mix, USA)*

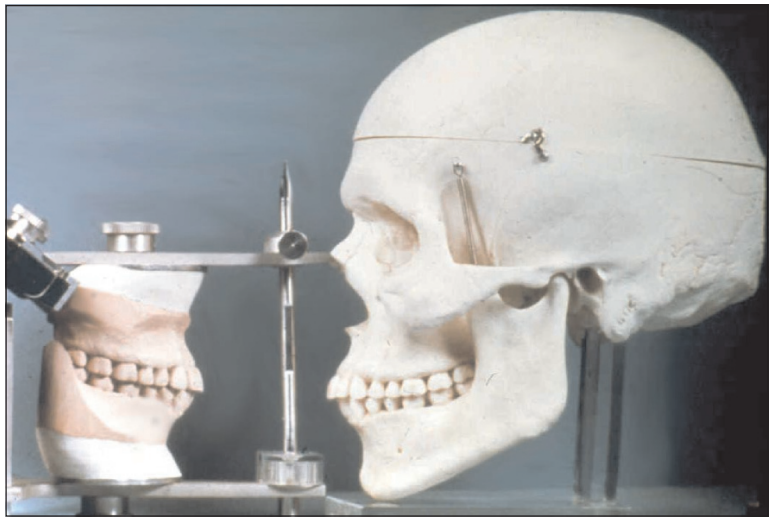


Fig. 2-42. *Interrelation between teeth cranium position and teeth-articulator position after face-bow upper cast transferring to articulator. (Whip-Mix, USA)*

must be secured and the facebow transfer part should be connected to the instrument. The bite fork supported device should be placed to the lower frame at the mounting plate to support the facebow assembly (bite fork and fixating device). The maxillary cast should be placed to bite fork, than the small amount of mounting plaster is applied to the top of the cast and upper frame mounting plate. The upper frame of the articulator should be closed under the control of the mounting clutch or incisal pin on the frontal part of the articulator. Once the plaster is set completely, the mounting clutch should be detached and zero pointed incisal pin is attached (Fig.2-45).

Fig. 2-43. *Artex TS semiadjustable articulator non-arcon. (Girrbach, Germany)*

The next step is to attach the lower jaw cast. This procedure is provided with bite record of the CR, CO, MIC. Bite registration record depends on the

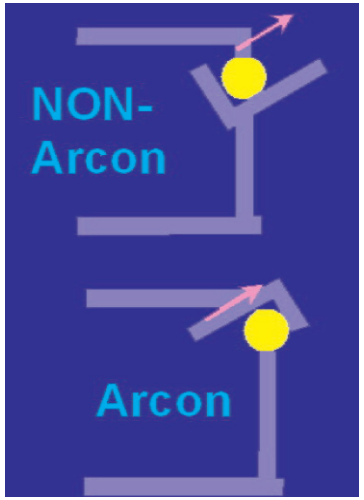


Fig. 2-44. *A – Artex AR – fully adjustable articulator, arcon (Girrbach, Germany). B– The diagram of arcon and non-arcon condylar boxes differences.*

Fig. 2-45. *Mounting the upper jaw cast in articulator with face-bow assembly (bite fork and fixating device). (Whip-Mix USA)*

Fig. 2-46. *Mounting the lower jaw cast in articulator.*

number of antagonizing pairs of teeth and mandible dislocation in vertical (VDO) direction.

Four main approaches to jaws interrelation are distinguished in patients with normal and decreased VDO.

The first type approach we use for dentate patients who show no less than three pairs of antagonizing teeth which are placed in left-right molar region and in front part of the jaws. To fix this bite condition the patient is asked to swallow and close the teeth on bite silicone material which is input to the lower jaw dental row left-right side (Fig.2-47).

The second type approach is applied to patients with normal VDO and no less than one pair of antagonizing teeth are positioned on one or two parts of the jaws. We apply the same approach as in first type occlusion. In patients with VDO decreasing the wax occlusal rims on acrylic base plate must be used for VDO reaching and fixing.

The third type of dental occlusal condition is dental rows without antagonizing teeth. For such patients the VDO can be adjusted on occlusal wax rims and occlusion must be fixed with swallowing test on occlusal rims in CR position (Fig.2-48).

The fourth type of occlusion condition is the edentulous patients.

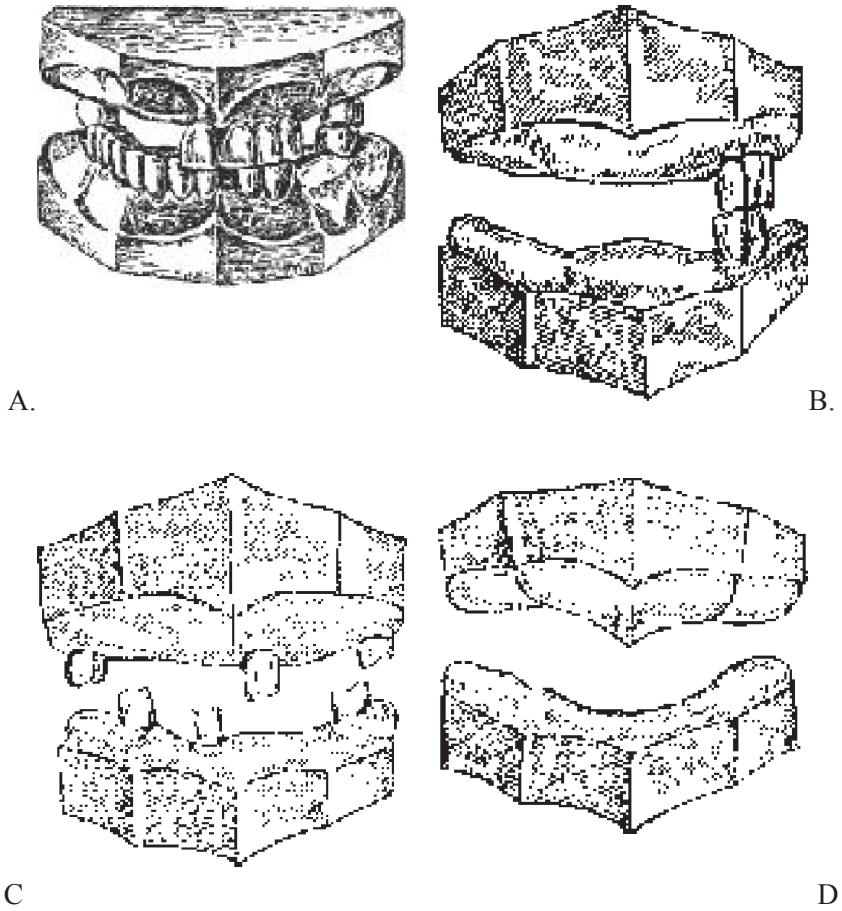
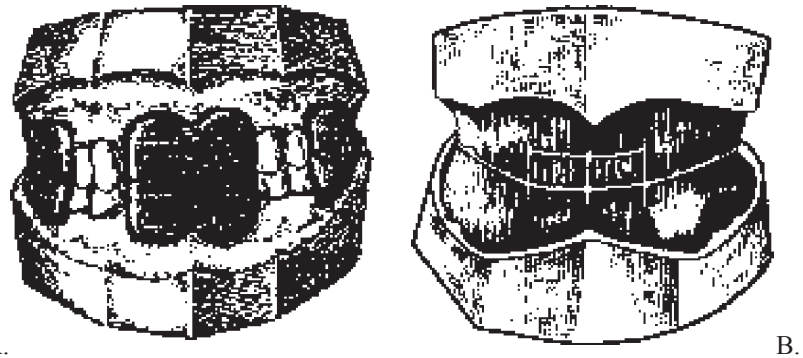


Fig. 2-47. *A – first type, B – second type, C – third type, D – forth type of jaws interrelation.*

The VDO, sagittal, transversal interrelation of the mandible to maxillae are gone. Esthetic face points and functional rules are used to point the main characteristics of occlusion on wax occlusal rims. The CR position of the jaws is fixed on wax rims.

CR records also can be prepared from the dentate patient for diagnostic and treatment reason in reorganization of occlusion. Precisely recorded, the



A. B.

Fig. 2-48. *Wax occlusal rims for CR determining and fixing in patients with partially (A) and comlete (B) teeth lost.*

centric relation of interocclusal retio should be a reproducible skeletal anatomic position between the maxilla and mandible. The occlusal analysis, occlusal adjustment and other complex rehabilitation procedures involve the use of centric relation as an initial reference position for the clinical assessment of the dental occlusion and mandibular position (Fig.2-49; 2-50; 2-51).

Placing the mandible into centric relation is not an easy procedure. Patients with certain conditions may not allow their masticatory muscles to relax, and muscles activity will occur, producing displacement of the mandible. Disorders of the masticatory system, a psychological reaction of the patient, poor patient cooperation and other problems will make centric relation registration very difficult. A good clinical method to increase the patient's level of relaxation is to ask the patient to occlude on cotton rolls on each side in the molar areas for 20 minutes before registration. This approach influences "deprogramming" of the proprioceptive sensation of the mandible (Fig.2-49; 2-50; 2-51).

Fig. 2-49. *Sliding Guide (Girrbach, Germany) for CR determining.*

The CR registration starts with a relaxed seating position for the patient in the dental chair with well adapted headrest. The clinician may use one or two-handed technique for mandibular manipulation for securing a restful position for directing the condyles into a consistent and reproducible transverse hinge axis, without the risk of deviation of the jaw to either side. After this the records of the CR must be prepared with wax, silicone of acrylic. After being trimmed, the registration must be rechecked in the mouth.

Articulator must be replaced on top at the table. The silicon or wax base plate bite record should be placed precisely to the upper cast teeth after that the teeth of the lower jaw cast must be positioned to the top of the record. Mounting plaster is applied to the cast and lower frame base plate. The articulator is closed and the incisal pin contact on the incisal table must be checked (Fig.2-46).

For proper use of the full adjustable or semi-adjustable articulator it is necessary to adjust it. The intraoral bite record of protrusion and left and right laterotrusion must be prepared with silicone or wax base plate. The settings of condylar inclination are adjusted with this records. The condylar housing can be adjusted to a positive inclination of 60 degrees and a negative inclination of 0-5 degrees Also the data from

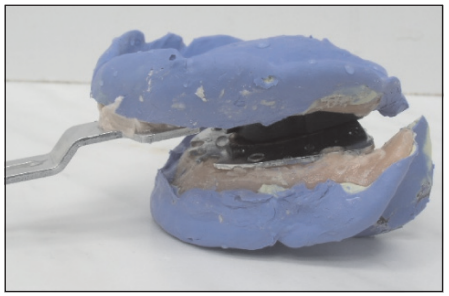


Fig. 2-50. *Centro Fix (Girrbach, Germany) for CR determining and fixing in edentulous patients.*

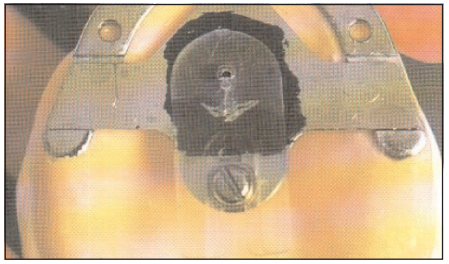


Fig. 2-51. *Gothic Arch intraoral record (Ivoclar, Germany)*

Fig. 2-52. *Articulator adjustment procedure with protrusion registration on wax plate.*

Fig. 2-53. *Acrylic individualized incisal table.*

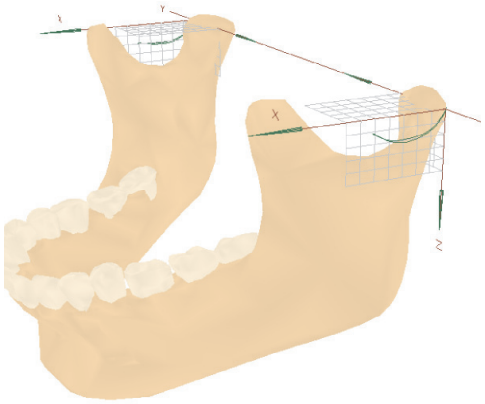


Fig. 2-54. *Electronical condilography (Cadiax Diagnostic, Gamma, Austria)*

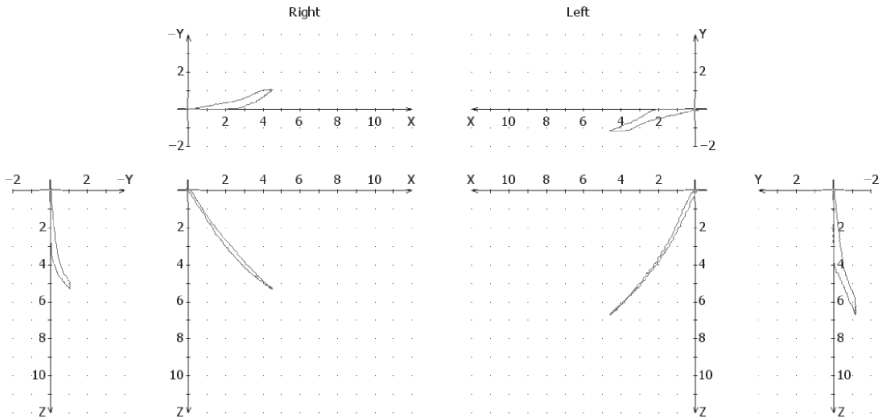
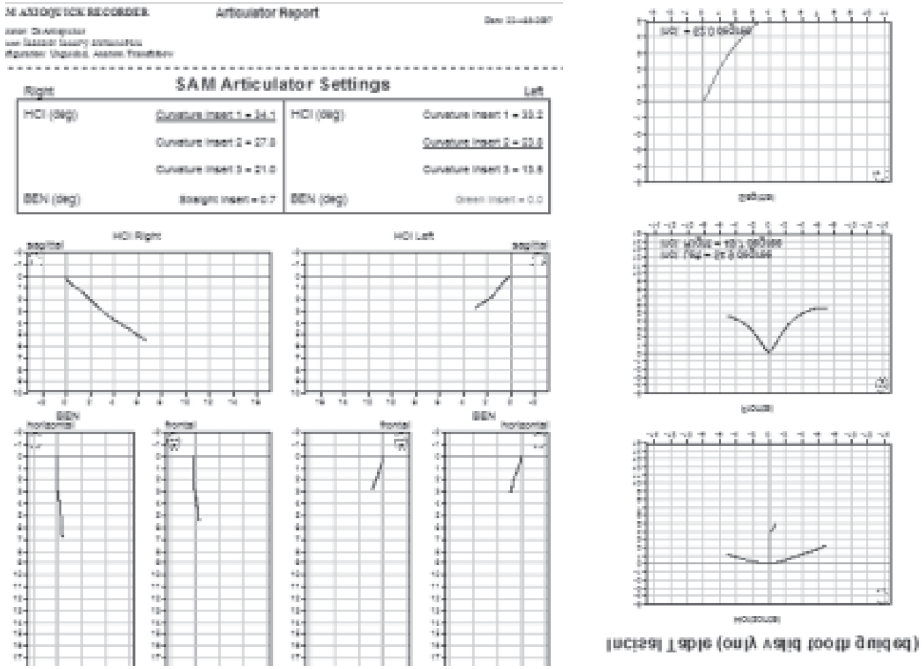


Figure 2-55. *Mandible traces in Gamma Dental Software.*



A B.

Fig. 2-56. *A – data for articulator after condilography, B – incisal point data after condilography (axiography) (Axioquick Recorder, SAM, Germany)*

condilography (mechanical, electronic) and intraoral gothic arch tracings can be used for this purpose (Fig.2-52; 2-54; 2-55;2-56).

The adjustable incisal table of articulators can be inclined and adjusted to guide of the incisal pin. In general, the incisal table can be adjusted to a positive inclination of 60 degrees and a negative inclination of 20 degrees. This adjustment is set when the casts are moved into protrusive and lateral positions. Also the small amount of acrylic or silicone can be added to the flat table and during protrusion and laterotrusion imitation of the cast displacements the incisal pin the individual occlusal table can be prepared. After material is set the groves on the surface can be used as individual anterior guidance. The incisal guidance is set to simulate tooth guidance when tooth structures are not present or to prevent wear of the casts during manipulation of the articulator (Fig.2-53).

Cast analysis in articulator

Requirements for casts.

Casts must be the precise reproductions of the maxillary and mandibulary arches, made from distortion-free alginate impressions. They should be fabricated with 4 class stone. The casts must be without bubbles and positive nodules, especially on the occlusal surfaces.

Articulated diagnostic casts can provide a great deal of information in occlusion condition and dental arches interrelation in static and dynamic occlusion in well-adjusted articulator. Occlusal plane position and inclination, antagonizing teeth contacts and overlap, edentulous space length, anomalies and deformities, teeth supereruption and other pathology signs can be investigated. Diagnostic casts grinding, set up of the teeth for orthodontic treatment planning and wax-up teeth shape reorganizing procedures can help to project the results of future treatment.

Disordered occlusion, its clinical manifestations, methods of diagnostics. Occlusogram.

Occlusional disorders can be the result of teeth surface lost, teeth tilting and drifting, teeth lost, wisdom tooth eruption and deformities of the dental rows near the edentulous spaces. Under these reasons the occlusal derangements appear. Static and dynamic occlusion are changed as a result of dental surfaces lost. Anterior guidance and posterior teeth damaged position can influence the displacement of the mandible. Parafunctional movements of the mandible can occur as a result of non-physiolodical occlusal determinants. Stress also can cause parafunctional mandible movements under muscles tendeness and splinting. As a result teeth contacts in static and dynamic can represent the occlusal interferences (prematurities).

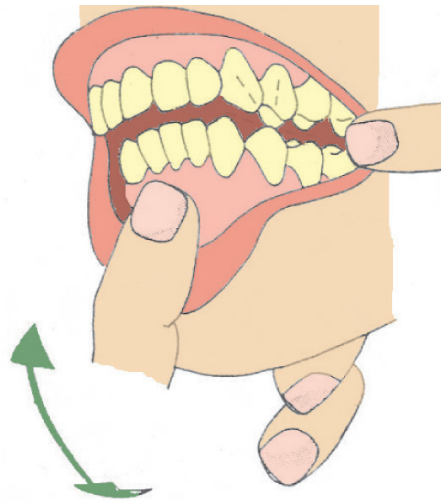


Fig. 2-57. *Manipulating technique is important to check the occlusal interferences.*

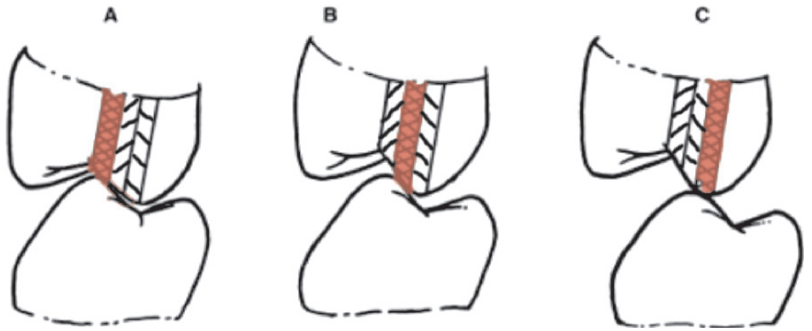


Fig. 2-58. *Rules of third (Inner inclines of the posterior teeth supporting cusps are divided into thirds. A – bottom part of the cusp incline, B-middle part, C – top part of the incline (Okeson J., 2008).*

Parafunctional movements of the mandible can be described as sustained activities that occurred beyond the normal function of mastication, swallowing and speech. There are many forms of such activities: bruxism, clenching, neil biting, pen chewing and so on. Long time manifestation of parafunction increases muscles contraction and hyperactivity. After this the excessive occlusal pressure and non-typical occlusal contacts influence excessive teeth wear, mobility, migration or cracks of teeth. Muscles disfunction such as myospasm, myalgia can appear.

The two main forms of parafunctional activities are bruxism and clenching may lead to occlusal trauma. The etiology of bruxism is unclear. Some theories relate bruxism to malocclusion, neuromuscular disturbances, responces to emotional stress or combination of these factors.

Clenching is determined as the pressing and clamping of the jaws and teeth together associated with acute nervous tension or physical effort. The etiology can be associated with stress, intense concentration and occlusal disorders. In contrast to bruxism, clenching will not result in damage of teeth because the direction of teeth pressure placed to long axes of posterior teeth. Typically the elevator muscles seem overdeveloped. The increased load may result in damage of periodontium and TMJ and muscles disorders. Clenching and bruxing condition are difficult to diagnose. The long-time supervision is important and prosthetic treatment can be not successful. Occlusion balancing can improve teeth and muscles condition and prevent teeth damage.

Static and dynamic occlusion derangement can be inspected with occlusogram (wax plates). A slightly heated wax base plate, shaped for dental rows size with scissors is placed on teeth for bite, it can show heavy contacts in MIC, protrusion and laterotrusion. After marking of these contacts the grinding procedure can be applied for occlusion improving. The map of normal occlusion contacts and occlusal concept requirements are golden rules for occlusion improving.

Occlusal adjustment means the equilibration of the natural dentition through various approaches. There are many techniques for occlusal adjustment. All are equally effective when performed in accordance with the occlusal concepts on which they are based (Fig.2-59)..

Occlusal adjustment is differed from occlusal equilibration and selective grinding with indication and aims. Occlusal adjustment is the procedure whereby the selected areas of teeth surface are modified with reduction and restoring. In such way the teeth and jaws stability and the load of antagonizing teeth can be improved.

Occlusal equilibration is carried out to produce a specific occlusal scheme in deranged dentition, required the extensive restorative treatment. It is usually designed to achieve: – the coincidence between the CR contacts and ICP contacts; – precise cusp to fossa contacts; -anterior guidance resulting in disocclusion of posterior teeth. In cases of the extensive teeth modification to develop the prescribed occlusal scheme fixed restorative procedures can be carried out.

Selective grinding is the method of reshaping of some teeth to alter the undesirable teeth contacts or inclinations. It is carried out to reduce plunger cusps, overerupted teeth, wedging or locking effects of restorations and so on. Selective grinding is indicated in periodontics, orthodontics, restorative dentistry.

Before staring the buccolingual relationship, frontal teeth overlap of the maxillary and mandibulary teeth are examined and VDO is checked. The distance between the centric cusps and opposing fissure is examined in transversal direction and rule of third is applied. Compare to this rule the inner inclines of the posterior centric cusps are divided into thirds. When the condyles are in the CR position, and the opposing centric cusp tip contacts with the third closest to the centric fossa part – selective grinding is the most appropriate occlusal treatment. When the opposing centric cusp tip contacts with the middle

third of the inner slope of the gliding cusp – the crowns or other fixed proshetics are generally indicated. When the opposing centric cusp tip contacts with the third closest to the top of the gliding cusp surface– the orthodontics is the most appropriate occlusal treatment (Fig. 2-58).. Prematurities of the supporting cusps have to be investigated thoroughly before start to grind because of VDO supporting function.

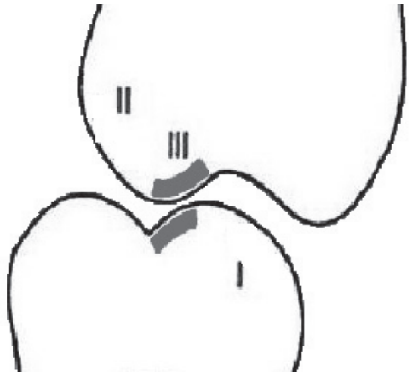


Fig. 2-59. *Jenkelson's map of the occlusal interferences.*

For selective grinding procedures the next tools are important; set of diamond burs, occlusal papers with fixator, polishing heads. Round, football, pear, flame and needle diamond cutting and polishing burs are prefferable. Using the "occlusal compass" functional occlusal direction to place instruments and to cut is important.

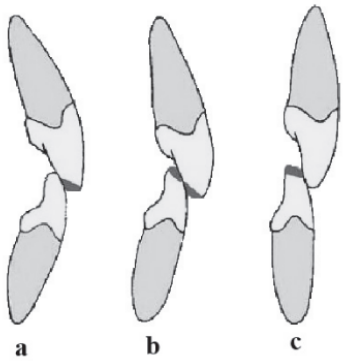


Fig. 2-60*. Frontal teeth prematurities: direction of grinding (a – horizontal, b – vertical, c – top of incisal edge or cusp) (Rosentiel S.E., Lang F.M., 2001).*

The need for adjustment because of occlusal trauma must be based on the precise diagnosis of the problem, rather than on the presence of occlusal interferences. Interferences sometimes are undesirable because such occlusal contacts may produce mandibular deviation during closure to MIC or in guided movements of the mandible (Fig.2-57).

There are four types of occlusal interferences: centric; working; nonworking; protrusive.

The centric interference is a premature contact that occurs when the mandible closes with the condyles in their optimum position in glenoid fossae. It will cause deflection of the mandible in a posterior, anterior, or lateral

direction. The working interferences may occur between jaws during lateral movements. The non-working interferences contacts opposite the side of the mandible movement can occur. These contacts can damage teeth because of forces placed outside the tooth long axes and disrupt muscles function. The protrusive interference is a premature contact between the mesial aspects of mandibular posterior teeth and the distal aspects of maxillary posterior teeth. Heavy contacts and vector of the forces make this interference potentially dangerous for posterior and anterior teeth (Fig.2-60).

Occlusal adjustment should be used as the treatment of occlusal trauma. Prior to any kind of extensive restorative procedure, occlusal adjustment may be provided, as a starting point for restorations, but in all cases the patient must be free of dysfunctional signs and/or symptoms in the masticatory system. The effect of occlusal adjustment on periodontal therapy was evaluated in many studies. The results demonstrated that patients who received occlusal adjustment had a significantly greater gain of clinical periodontal attachment. (Jose dos Santos, 2007, Klinenberg I., Jagger R., 2004.)

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Tests for self-assesment

1. A 47-year-old is patient consulted a dentist about dental cervix exposure (recession) on both jaws. Objectively: the dentitions are intact, the dental cervixes are exposed. Prematurity teeth contacts are present. It is planned to perform selective grinding. What controlling method should be chosen?

A. Occlusiography
B. Masticatiography
C. Chewing test
D. Roentgenography
E. Gnathodynamometry

2. A 35-year-old patient has teeth mobility of I degree, the teeth have apparent dental cusps. The dentist recommends to perform occluding teeth grinding. What method is the most objective for determining the grinding topography?

A. Occlusiography
B. Masticatiography
C. Roentgenography
D. Gnathodynamometry
E. Rubinov's masticatory test

3. Examination of a 25-years-old male patient revealed maximal number of occlusional contacts of opposing teeth during teeth joining (occluding). X-ray picture shows that the condyles of the mandible is near the base of the slope of articular tubercle. What type of occlusion is present?

A. Central occlusion
B. Anterior occlusion
C. Right lateral occlusion
D. Left lateral occlusion
E. Posterior occlusion

4. One of the methods to analyze dental occlusion is to construct a plane that will go through cutting edges of central incisors and distobuccal tubercles of last molars. What plane should be constructed?

A. Occlusal plane
B. Sagittal plane
C. Vertical plane
D. Transversal plane
E. Frankfort plane

5. A 34-year-old patient consulted a prosthodontist about pain and clicking in the final stage of mouth opening. The patient has a history of a joint disk dislocation. Amplitude of maximal mouth opening is 58 mm. Mouth opening should be limited down to the following amplitude:

A. Up to 40-50 mm
B. Up to 25-30 mm
C. Up to 50-60 mm
D. Up to 10-15 mm
D. Up to 90-100 mm

6. A 53-year-old patient with generalized periodontitis visited a prosthodontics clinic for fabrication of fixed splints for his both jaws to stabilize the dentitions along the entire dental arch. Which of the upper jaw buttresses (counterfort) will be functionally significant for the distribution of masticatory pressure and stress release?

A. Frontonasal, zygomatic, pterygopalatine, palatine couterfort
B. Frontonasal, zygomatic, pterygopalatinecouterfort
C. Zygomatic, pterygopalatine, palatine couterfort
D. Frontonasal, pterygopalatine, palatine couterfort
E. Frontonasal, zygomatic, palatinecouterfort

7. Teeth shape restoration with crowns are prepared in small articulator have to adjust in occlusal relations with different movements of the lower jaw. Transversal movements of the lower jaw are initiated by the following muscles:

A. External (lateral) pterygoid muscles
B. Internal (medial) pterygoid muscles

C. Temporal muscles
D. Masticatory muscles
E. Digastric muscles

8. To improve teeth occlusal surfaces dental casts are mounted to semiadjustable articulator in CR position. Centric relation is the maxillomandibular relationship in which the condyles are in their most:

A. Posterior position with the disc interposed at its thickest avascular location
B. Posterior position with the disc interposed at its thinnest locale
C. Superior position with the disc in its most anterior position
D. Superior-anterior position with the disc interposed at its thinnest position

9. During muscles condition examination the patient is asked to close the jaws. Which of the following muscles assists in the elevation of the mandible?

A. Lateral pterygoid muscles.
B. Medial pterygoid muscles.
C. Digastric.
D. Genohyoid.
E. Mylohyoid.

10. The rest-position is important to rich the vertical dimention of occlusion (VDO). While recording the rest position of the mandible, the patient s head position must be:

A. Head should be upright and unsupported
B. Head should be supported by the head rest
C. Patient should be lying in repose position
D. The neck should be extended
E. Head can be in any position

11. Axiography results show different directions of the mandible tracks. How many planes the mandible movements can exposure?

A. One
B. Two
C. Three
D. Four

12. Muscles condition examination results must be explained according to their function. Which mandibular movements are the results of the bilateral contraction of the posterior fibers of the temporalis muscles?

A. Retrusion
B. Protrusion
C. Opening
D. Closing

13. In addition to chewing muscles the expression muscles present in maxillo-facial region. Which muscles play a subsidiary role in mastication?

A. Masseter muscles
B. Lateral pterygoid muscles
C. Buccinator muscles
D. Medial pterygoid muscles
E. Temporalis muscles

14. Depression of the mandible stay under the work of the muscle group near the hyoid. All of the following are suprahyoid muscles, except the:

A. Geniohyoid muscle
B. Mylohyoid muscle
C. Omohyoid muscle
D. Digastric muscle

15. The posterior teeth play the main role in mastication with their special anatomic location.

The chewing surface of posterior teeth is referred to as the:

A. Clinical crown
B. Incisal edge
C. Occlusal surface
D. Anatomic crown

16.The anteroposterior curvature (in the saggittal plane) and the mediolateral curvature (in the frontal plane) are used in the alignment of the occluding surfaces and incisal edges of artificial teeth to develop balanced occlusion is called:

A. Curve of Spee
B. Compensating Curves
C. Curve of Wilson
D.Curve of Pleasure

17.To treat of the pathogenic occlusion the centric relation position is important. Centric relation is an example of a:

A. Tooth-to-tooth relation
B. An occlusal relation
C. Joint interrelation
D. Balanced relation

18.During the dental treatment of the patient with periodontities the selective teeth grinding is planned. To remove the prematurities on the balancing side the marking of the interferences is important. Generally the non-working side prematurities occur on the inner aspects of the:

A. Inner incline of the buccal cusps of the mandibular molars
B. Outer incline of the buccal cusps of the maxillary premolars

C. Outer incline of the lingual cusps of the mandibular molars
D. Outer incline of the facial cusps of the maxillary molars

19.Where do dynamic occlusion contacts normally occur during a protrusive movement while dental occlusion examination realized ?

A. On the maxillary molars mesial inclines and mandibular molars distal inclines
B. On the maxillary molars mesial inclines and mandibular molars mesial inclines
C. On the upper incisors palatal surfaces and lower incisors tops
D. On the maxillary premolars distal inclines and mandibular premolars distal inclines

20. To place face-bow to the reference points a few planes can be used.

Which of the following true describes Camper's line (plane)?

A. It is a line (plane) which is determined by the occlusal surfaces of the teeth
B. It is a line (plane) which extends from the outer canthus of the eye to the superior border of the tragus of the ear
C. It is the line (plane) running from the inferior border of the wing of the nose to the inferior border of the tragus of the ear
D. None of the above

21. To analyze the dental rows interrelation in ortognatic bite the first molar position is used. Where do the mesiobuccal cusp of a permanent maxillary first molar occludes in the intercuspal position,?

A. The fissurae between medial and distal buccal cuspsof the first molar
B. Central fossa of the mandibular first molar
C. The interproximal marginal ridge areas between mandibular first and second molars
D. The interproximal marginal ridge areas between mandibular second and third molars

22. During checking the normal non-working side excursive movements, the permanent maxillary first molar's mesiolingual cusp gets away through:

A. The lingual groove of the mandibular first molar
B. The mesiobuccal groove of the mandibular first molar
C. The buccal groove of the mandibular second molar
D. The distobuccal groove of the mandibular first molar

23. At typical empty mouth swallowing, the mandible is braced in jaw position to allow for proper stabilization. What is this position?

A. Intercuspal position (ICP)
B. Retruded contact position (RCP)
C. Protruded contact position (PCP)
D. Centric relation (CR)

24. When the mandible is in its physiologic rest or postural position, the contacts of teeth are in:

A. ICP
B. Not present
C. Protrusion
D. Centric relation

25.The lingual cusps of the maxillary posterior teeth are:

A. Non-supporting and working
B. Supporting and balancing
C. Supporting and working
D. Non-supporting and balancing

26.All of the following concepts related to occlusion are true except:

A. Occlusion requires minimum adaptation by the patient
B. Bilateral balanced occlusion dictates that a minimum number of teeth should contact during mandibular excursive movements
C. Unilateral balanced occlusion or "group function" is called for all teeth on the working side to be in contact during a lateral excursion
D. Mutually protected occlusion, also called "canine guided" or "organic" occlusion is the one in which anterior teeth protect posterior teeth in all mandibular excursions

27. In an ideal intercuspal position, the mesiobuccal cusp of the permanent maxillary second molar opposes:

A. The distobuccal groove of the mandibular first molar
B. The buccal groove of the mandibular second molar
C. The mesiobuccal groove of the mandibular second molar
D. The developmental groove between the distobuccal and the distal cusps of the mandibular first molar

28. In the early stages of lateral movements, the condyle appears to rotate with a slight lateral shift in the direction of the movement. This movement is called the Bennett movement. This Bennett movement refers to the:

A. Non-working side condyle only
B. Working side condyle only
C. Both the non-working and working side condyles
D. Neither of the condyles

29. In an ideal intercuspal position, the facial cusp tips of permanent maxillary premolars oppose:

A. The facial embrasure between their class counterpart and the tooth mesial to it
B. The facial embrasure between their class counterpart and the tooth distal to it

C. The opposing central fossae
D. The opposing mesial marginal ridge

30. While establishing a canine guidance, the lingual cusps of maxillary posterior teeth

on the balancing side should not contact:

A. The central fossae of mandibular posterior teeth
B. The lingual inclines of facial cusps of mandibular posterior teeth
C. The lingual inclines of lingual cusps of mandibular posterior teeth
D. The facial inclines of lingual cusps of mandibular posterior teeth

Answers to tests for self-assessment

1	A
2	A
3	A
4	A
5	A
6	A
7	A
8	D
9	B
10	A
11	C
12	A
13	C
14	C
15	C
16	B
17	C
18	A
19	C
20	C
21	A
22	D
23	A
24	B
25	B
26	B
27	B
28	B
29	B
30	B

Questions for self-assessment

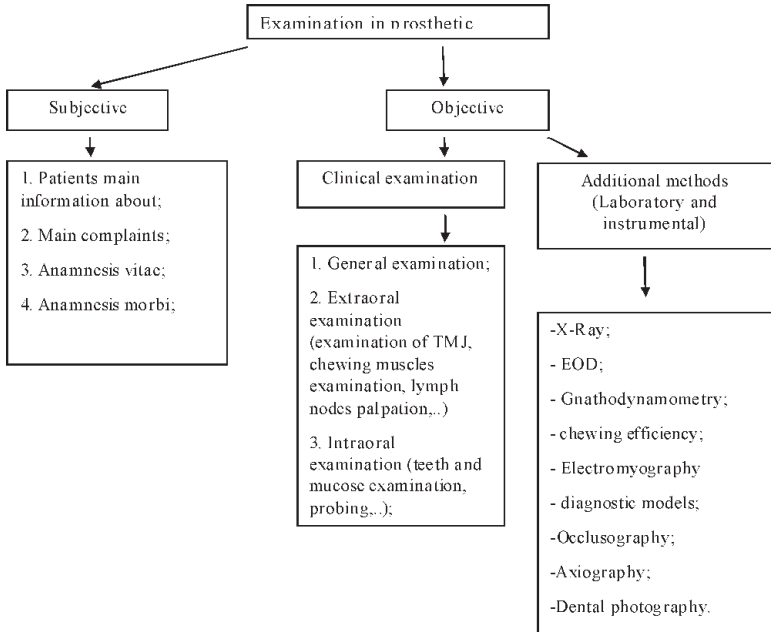
1. Which peculiarity of the TMJ structure is compared to another joints in human body?
2. What are the main directions of the condyle movements?
3. What movements of the condyles are determined in mouth opening phase?
4. What movements of the condyles are determined in laterotrusion?
5. What is the functional meaning of the teeth occlusal surfaces?
6. What are the shapes of the upper and lower jaws dental rows.
7. What is the mechanics of the teeth stabilization in dental row?
8. What do you know about "occlusal compass"?
9. What do you know about the "rules of third"?
10. What diagram shows the incisal point movements?
11. What planes do we use for condyle and incisal point movements examination?
12. What cranium points do we use for sagittal condyle inclination angle measurement?
13. What plane do we use for transversal condyle movements measurements?
14. What does "Gothic arch" mean?
15. What muscles provide closing function?
16. What does it mean; the phenomenon of reciprocal antagonism, synergism in masticatory muscles activity?
17. Define the terms "articulation", "occlusion"/
18. What types of the mandibular movements reproducing devices do you know? Name differences between them.
19. What do the curve of Spee and curve of Wilson mean? What is their importance in dental rows function?
20. What modern concepts of occlusion do you know?
21. What are the requirements to physiological occlusion?
22. Can you explain the differences between teeth equilibration and dental rows balancing approaches?
23. What types of the stomatognatic system reflexes do you know?
24. What does the term "parafunction of the muscles" mean?
25. What does the term "bruxism" means?
26. What are the main concepts of bruxism origin?
27. Which signs of the bruxism can you find in the oral cavity?
28. Which devices can we use for dental occlusal contacts analyse?
29. What are the signs of the TMJ and muscles disorders?
30. What are the functional characteristics of the human TMJ?
31. What signs of the norm of bite do you know?
32. What normal and pathological bites do you know?
33. What does the "key of occlusion" mean?
34. What are the interrelation between movements in TMJ and incisal point traces?
35. What is the coincidence between the type of bite and TMJ structure?
36. What frontal teeth interrelation do you know? What is their coincidence with TMJ structure?

CHAPTER 3.

Examination of the patient in Prosthetic Dentistry Department

For highly skilled and effective dental help doctor must follow the main general principles of patient's examination. Organs of maxillofacial system are deeply connected with all human organism and our interventions have big influence on it. So, first of all doctor should be very attentive during patient's information collection before treatment to get best final results. Nowadays prosthodontics doctors have big choice of modern stuff for examination, but some basic principles are invariable.

In the scheme below examination methods in prosthetic dentistry are presented.



Subjective part of examination in prosthetic dentistry department

Examination always starts from subjective part, because this information gives direction to future actions. To fill medical documents we need personal patient's information such as age, sex, address, place of work, social status. In different age people have different problems and needs. Place of living and work can show us cause of some pathology.

Main complaints should be recorded from patient's words accurately. We can divide it on categories:

1. Esthetic (Discoloration, bad shaped teeth, fractures and damages of restorations and other is usually best motivation for prosthetic treatment);

2. Function (Impossibility of normal chewing and speaking, changes of taste);

3. Sensation (Pain, teeth sensitivity, gingival bleeding, decreasing of chewing efficiency etc.);

4. Social (Bad smell, visible edentulous space);

Anamnesis vitae – is information about patient's general problems, illness, operative treatment during all his/her life. Especially clinicians must draw acute attention to diseases and conditions with manifestation in oral cavity as diabetes, cardiovascular diseases, pregnancy, menopause, anticonvulsant drugs, allergic reactions, gastrointestinal diseases, hematological diseases, neurological diseases, endocrine diseases. Except this, dentist and dental staff always must remember about personal risk from patients who are suspected or confirmed carriers of hepatitis B, acquired immunodeficiency syndrome, tuberculosis or syphilis. To prevent infection transmitting full infection control must be taken for every patient (because not all patients know their health problems, some of them don't want to inform about it).

Anamnesis morbi – is history of illness (when patient has felt first signs, how it happened, complaints, previous treatment etc.).

Information collected from the patient is very important for clinician. You must understand patient's problems and expectations. During communication doctor defines patient's psychological type, made of confidence fences for better final result of treatment.

Objective part of examination in prosthetic dentistry department

The Extraoral examination.

Objective clinical examination starts from first look on the patient's appearance, gait, posture, weight, skin condition and color. Vital signs, such as

respiration, pulse, temperature, and blood pressure, must be measured and recorded to medical history. Prosthodontic treatment is often indicated in middle-aged or older patients, who can be at higher risk for cardiovascular disease. That's why patients with vital signs outside normal ranges should be referred for a comprehensive medical evaluation before definitive treatment is initiated. Special attention is given to facial symmetry, intensity of nasolabial folds. Clinician must compare right and left face parts. Expressed asymmetry can be caused by inflammatory processes in maxillofacial region, oncological status, after nerves conduction disturbance of mimic and chewing muscles, after trauma.

Craniometry.

Craniometrical methods of examination are based on the regular type of the structure of the facial and cerebral cranium, proportional relationship between the individual parts of the head, and a definite relation of these parts to the different planes.

For face harmony analyzing it is important to divide the face into three parts, equal in height (Fig.3-1). Upper part of the face stays between hair-covering border and line which is connected with the eyebrows. Middle part is placed between eyebrows and the base of the nose. Lower part stays from the base of the nose to the bottom of the chin. This division is a virtual because of

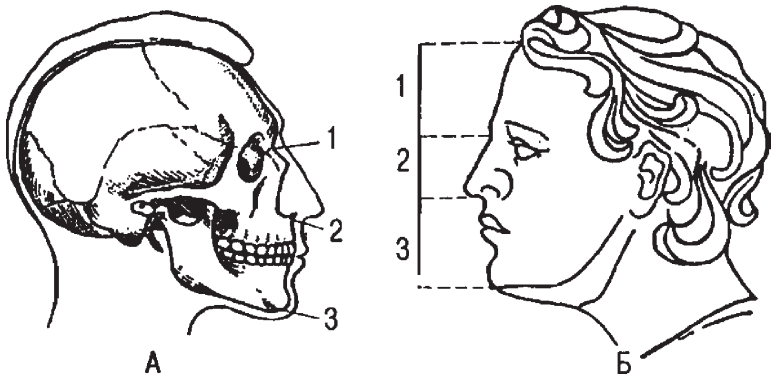


Fig. 3-1. *Face division to upper, middle and lower equal parts A: 1-nasion, 2-nasospinale, 3-gnathion. B: 1-upper part, 2-middle part, 3-lower part, 2+3 - facial part of cranium.*

not precise measurements. During the life these points are being changed (Fig.3-2). The shape and size of teeth stay in harmony with face type and this information is received for artificial teeth shape choice for prostheses all the time. Equal distance between all parts of the face is a pointer for vertical distance of occlusion detection and correction.

Anthropometric and special stomatological methods of examination are used to determine the relationship between the masticatory apparatus or its individual parts, other bones of the facial, cerebral skeleton and to reveal any abnormalities.

The spatial localization of the maxillodental apparatus in relation to the cranium and any deviations are determined by Simon's method employing special instruments (gnathostat, symmetrography, gnathostatic models, an orbital measuring bar). Anthropometric studies are done on the upper jaw because it is securely joined with the other bones of the skull.

For more detail diagnosis of facial asymmetry dentists use dental photography.

Normal human craniofacial morphology develops as a result of the genetic and environmental interactions. In contrast, craniofacial abnormalities may occur as a result of early embryonic tissue formation problems or later biomechanical or disruptive fetal tissue differentiality. Craniofacial abnormalities are the result of pathological influences during life as well.

The development of the cerebral skull, respiratory apparatus, bones, and musculature form the shape of the face, so that four types are known: cerebral, respiratory, digestive, and muscular.

Bauer defined 4 general face types (Fig. 3-3):

1. Cerebral – shows the cerebral part of the face and cranium prevalence (high and wide forehead, face looks like pyramid with base on top);

2. Respiratory – the middle part of the face prevalence (good developed maxillary sinuses, Zygomatic arches, face looks like rhombus);

3. Digestive – dominance of lower one-third of face (big jaws, low and narrow forehead, face looks like trapezium);

4. Muscular – show equal size of the parts with strait line of the hair covering border (all parts of face similar developed and have a shape like square).

Photography and smile analysis.

Patients have different tooth visibility during smile. Clinician should analyze normal and exaggerated smiling (during laughing) and fix it on photo

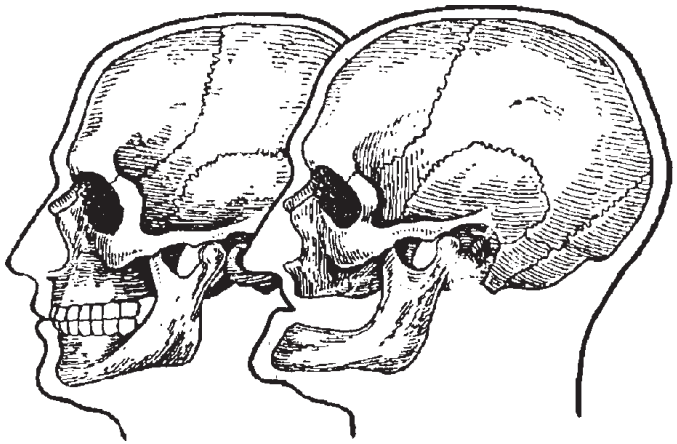


Fig. 3-2*. Dentate and edentulous patients profile.*

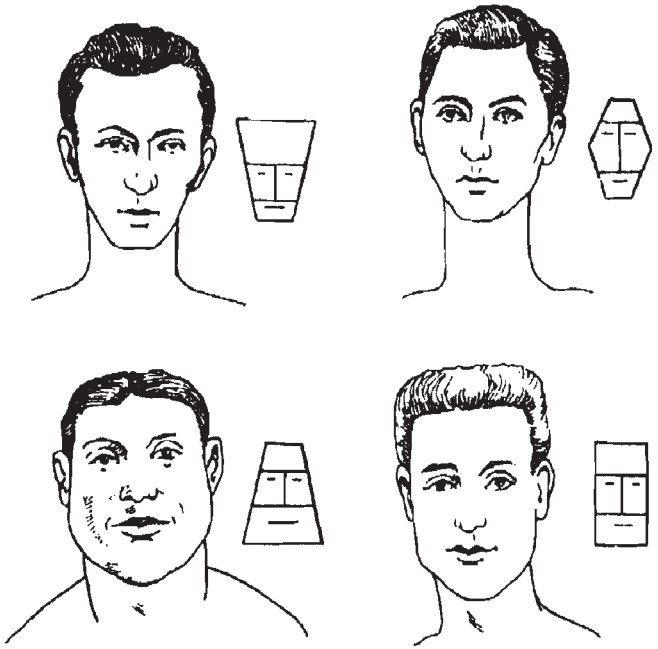


Fig. 3-3. *Face types by Bauer. 1-cerebral; 2– respiratory; 3– digestive; 4– muscular.*

or scheme. Most of people show only their maxillary teeth during smile. Elder people are more often shows their lower frontal teeth. This can be critical in prosthodontic treatment planning, especially for margin placement of crowns. Some patients have a "gingival smile" – they are shows considerable part of gingiva during smile. The extent of the smile will depend on the length and mobility of the upper lip and the length of the alveolar process. During laughing the mouth opens a little and clinician can see a black space between lower and upper teeth and distal teeth and cheeks, it's named "negative space". Absence of teeth, diastemas, tremas, fractured or poorly restored teeth, old restorations, bite peculiarities and dental rows anatomy will disrupt the harmony of the "negative space", and esthetic rehabilitation can be important.

Examination of the temporomandibular joints.

To examine TMJ clinician can use auscultation, lateral and auricular (distal) palpation techniques. For lateral palpation clinician locates his fingers on the TMJs bilaterally just anterior to the external acoustic meatus while asking

Fig. 3-4. *Intraoral dental photography.*

Fig. 3-5. *Extraoral dental photography.*

the patient open and close the mouth (Fig. 3-6). For auricular (distal) technique examiner put his fingers bilaterally inside of external acoustic meatus with light pressure, it helps to identify signs of pathology in the posterior attachment of the disk. Clinician pays attention to:

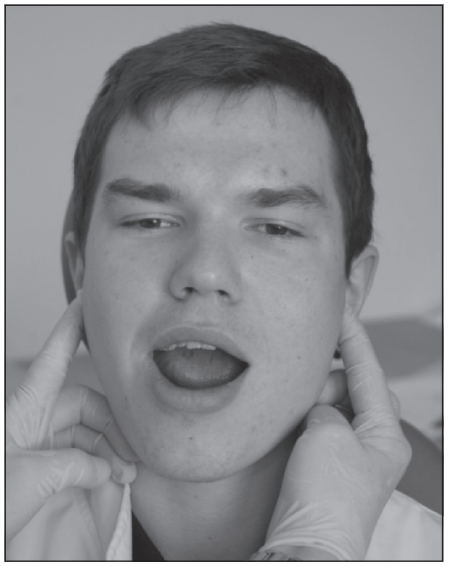


Fig. 3-6. *TMJ's palpation.*

-range of the jaw lateral movements

-range of the jaw vertical movements during opening

-opening asymmetry (may indicate an anterior disk displacement that blocks one of the condyles from making a normal translatory movement)

-lower jaw movements during opening (deviation, deflexion)

-sounds (clicking, popping, chopping can be in the start, in middle or end of the opening, and during closing))

-pain during jaw movement indicates of inflammatory changes in the retrodiscal tissues.

Examination of masticatory muscles.

With palpation method clinician can examine superficial (extraoral palpation), some deep masticatory muscles (intraoral palpation). Posture muscles must be examined also, because they may have influence on a lower jaw positioning.

Masseter muscle can be palpated extraorally by placing fingers over the lateral surfaces of the ramus of the mandible (Fig. 3-7). In the same manner temporalis can be examined as well as sternocleidomastoideus, trapezius muscles and the floor of the mouth. To palpate the medial pterygoid muscle clinician must place his finger on the inner ridge of mandible laterally to the last molar (Fig.3-8). Lateral pterygoid muscle is palpated intraorally also. Clinician slides his finger high up under the inner surface of coronal process of mandible to palpate it (Fig. 3-9). If any difference during palpation is reported

Fig. 3-7. *Palpation of m. masseter.*

Fig. 3-8.*Palpation of the medial pterygoid muscle.*

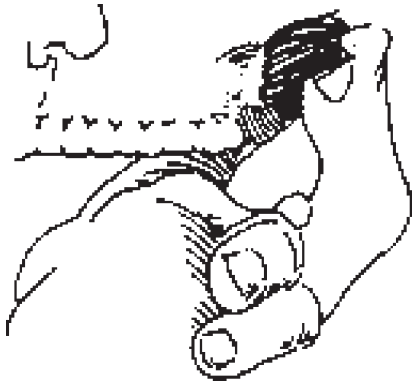


Fig. 3-9. *Palpation of lateral pterygoid muscle.*

between the left and right sides, the patient is asked to classify the discomfort or pain as mild, moderate, or severe.

Cervical, submandibular, submental, preauricular, retroauricular lymph nodes must be also palpated, because of their meaning in inflammatory and oncological processes in maxillofacial region (Fig. 3-11).

The Intraoral examination

Examination of oral cavity begins from mouth opening investigation (Fig.3-12). Clinician can register this data with metal ruler. Measurement is performed between lower and upper interincisal points (take attention on overbite level). Average normal distance is 40-60 mm for mouth opening. Although women in general have more mobile joints, men are able to open their jaws wider by 3-5 mm.

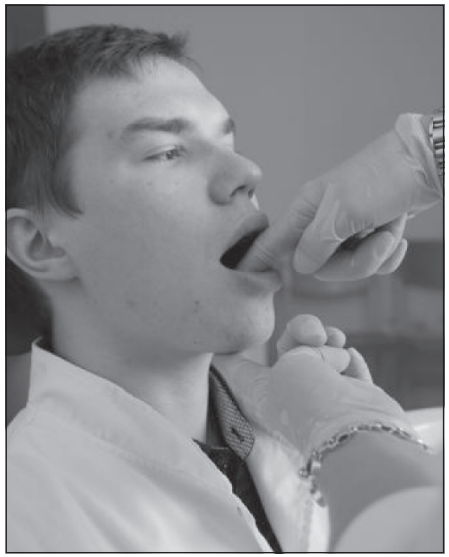


Fig. 3-10. *Mouth floor muscles palpation.*

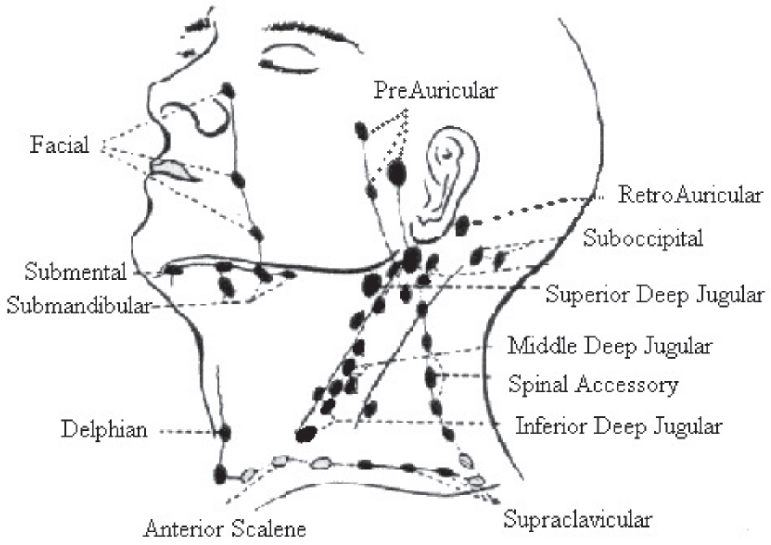


Fig. 3-11. *Lymph nodes of head and neck.*

Fig. 3-12. *Mouth opening investigation.*

According to widespread opinion jaw opening is directly related to body size. Limited mouth opening indicate of the muscle spasm (trizmus) or intracapsular changes in the TMJs.

Deviation – process when the opening pathway is altered but returns to a midline position at the maximum opening (Fig. 3-13).

Deflection – process when opening pathway is altered and does not return to midline (Fig. 3-14).

During intraoral examination clinician can reveal considerable information concerning the condition of the soft tissues, mucous, dental rows, teeth, and supporting structures. The tongue, floor of the mouth, vestibule space, cheeks, frenulums and hard and soft palates are examined. Standard instrument kit for intraoral examination in prosthetic dentistry includes: dental mirror, probe, and forceps (Fig. 3-15).

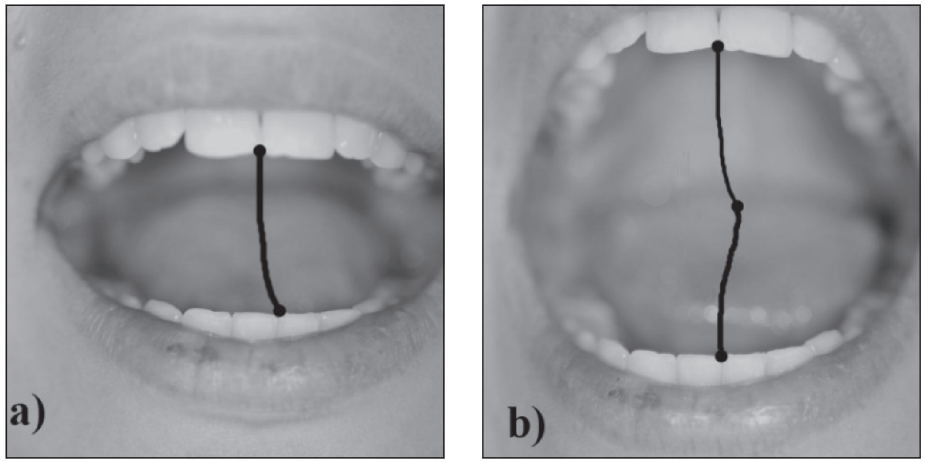


Fig. 3-13. *Deviation (a – beginning of mouth opening, b – maximum mouth opening).*

Examination of the tongue consider checking of: volume of the tongue, integrity of the papillae, cracks or fissures, swelling or ulcers, mobility, color, incrustation presence.

The *color* of attached and marginal gingival is normally described as light pink. In gingivitis, the color changes to reddish blue (Fig. 3-16). Pigmentation is present in all normal individuals and depends of race property. *Contour* of gingival varies differently according to shape of teeth and alignment in arch. Normal contour is termed as scalloped. Consistency of normal gingival is firm and resilient, except at the free gingival margin. In inflammation, it becomes soft and edematous. *Surface texture* of the normal gingival gives an orange peel appearance and is called as *stippled*. It occurs in attached gingiva. Stippling is a form of adaptive specialization or reinforcement for function. Position is refer to the level at which the gingival margin is attached to the tooth. One of the methods

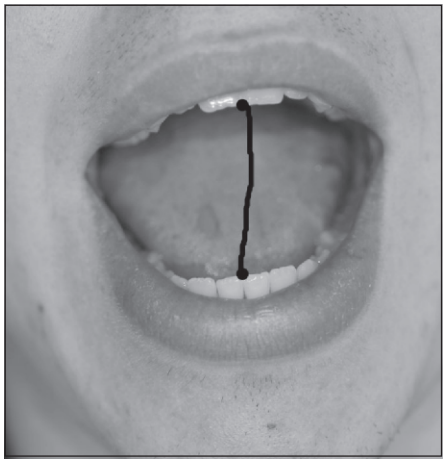


Fig. 3-14. *Deflection.*

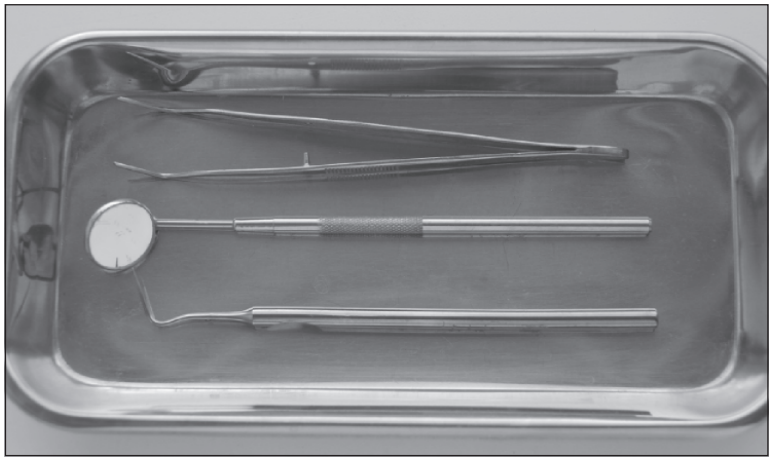


Fig. 3-15. *Standard set of dental examination instruments*

of inflammation detection is probing. The insertion of a probe to the gingival pocket elicits bleeding if the gingiva is inflamed and the pocket epithelium is atrophic or ulcerated. The probe is carefully introduced into the bottom of the pocket and gently moved laterally along the pocket wall. After inserting the examiner should wait for 30-60 seconds.

Periodontal pockets are defined as a pathological deep of gingival sulcus. The examination includes assessing the surface of the tooth, the pocket depth and the type of the pocket. A periodontal probe is used for the assessment in a "walking" technique.

Palpation. The gingiva must be carefully palpated to express any exudate or pus that may be present in the sulcular area.

Palpation test of oral cavity tissues is very demonstrative for practitioner to, especially for removal dentures planning. Palpation of alveolar processes can discover acute bone ridges (exostosis), mucous strength and compliance in different anatomical areas, shape of bone, a presence or absence of palatal torus.

This information notes and can be properly evaluated during treatment planning only if objective indices, rather than vague assessments, are used.

Dental rows examination.

Examination of dental rows of upper and lower jaws is taken apart from each other. Clinician discovers their shape, peculiarities and type of bite. Dental rows of upper and lower jaws have different anatomical shape. Upper jaw looks as half of ellipse, lower as parabola (Fig. 3-17).

Continuity of dental rows ensure teeth contacts. Interdental contacts of frontal teeth are placed near incisal edge, of distal teeth – closely to occlusal surface. Interdental contacts transmit masticatory forces, except roots,

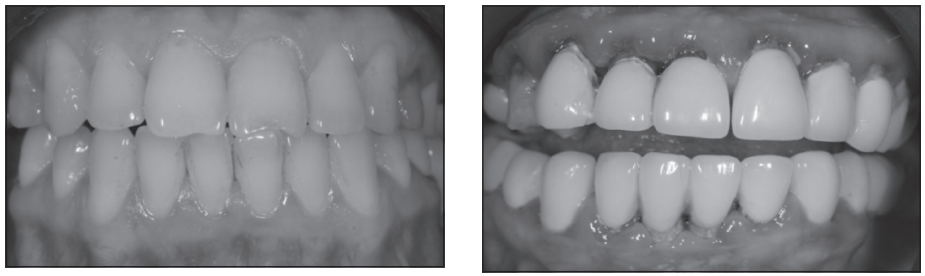


Fig. 3-16. *Gingiva: a – normal, b – inflamed.*

periodontium and bone, on all teeth in dental row. In young people teeth contact with each is over in points, later enamel here is given to abrasion and points transforms to planes (Fig. 3-18). Because of it dental rows will be shorter in elder patients. In case of single or partial teeth missing, dental rows are divided to functional groups.

Except dental rows in prosthetic dentistry are of great importance alveolar and basal (apical) rows of upper and lower jaws (Fig. 3-19).

Alveolar row is imaginary line drawn on the middle of alveolar ridge.

Basal (apical) row is conceptual curve drawn along teeth root apexes.

Upper alveolar dental row is wider than alveolar and basal, because upper teeth roots incline inside. Lower dental crowns incline inside and dental roots outside, so basal row is the widest here. That's why after complete teeth missing patients bite looks like progenic (Fig. 3-2).

Dental rows can be narrowed or extended. Patient of different age quite often may have dental deformities after teeth loss, especially if teeth were extracted in young age (Popov – Godon's phenomena). Phenomena of Popov-Godon means that after teeth extraction during some time, if the defects are not restored, antagonists occur which move in vertical direction, narrow teeth move in direction of defect free space.

Fig. 3-17. *Anatomical shape of upper and lower dental rows.*

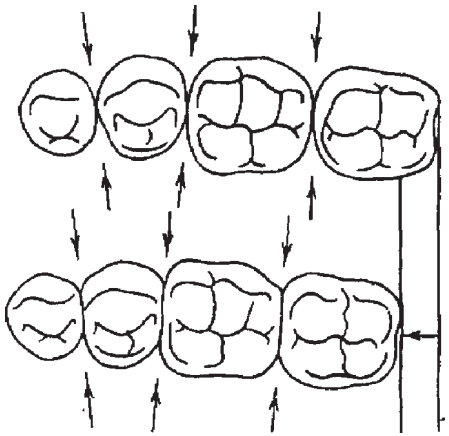


Fig. 3-18.Interdental contacts: a – in young patients; b – in older patients.

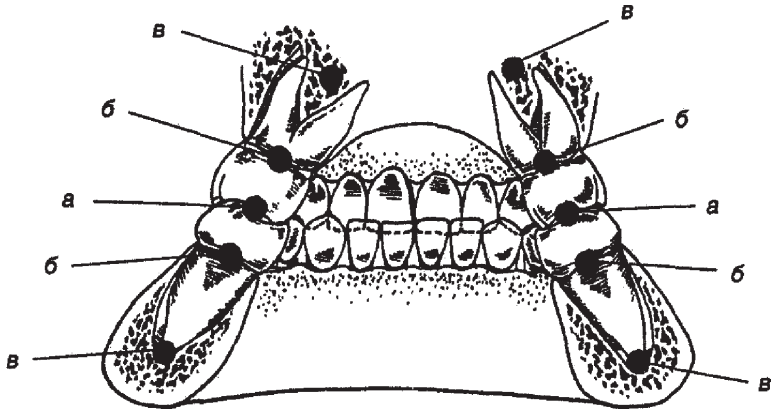


Fig. 3-19. *A – Dental rows, b – Alveolar rows, c – Basal (apical) rows.*

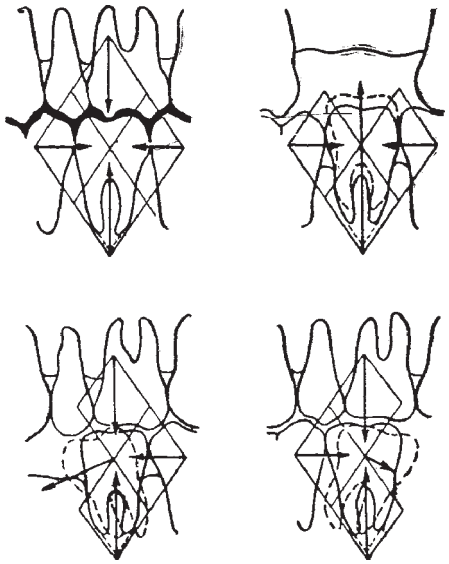


Fig. 3-20. *The scheme of forces which moves the teeth bordered to dental row defect (by Godon).*

By the length dental row defects are divided into (by Gavrilov V.I., 1984): *small* – not more than 3 teeth are absent, *middle* – from 4 to 6 teeth are absent, *large* – more than 6 teeth are absent. In addition to this the dental row defects can be located in *frontal* and *distal*. Depend on location, and depend on remaining teeth position the can be divided to: *included* between presence natural teeth and *unlimited*.

To classify dental rows defects, clinician can use classifications by Kennedy or Betelman.

Classification by Kennedy (1925) is positional or anatomical picture of certain teeth and their relationship, but it gives insufficient information about the teeth presence and their positional relationship (Fig. 3-21).

Class I – The bilateral edentulous areas located posterior to remaining teeth.

Class II – A unilateral edentulous areas located posterior to the remaining teeth.

Class III – A unilateral edentulous area with teeth remaining both anterior and posterior to it.

Class IV – A single edentulous area located in frontal area.

Applegate's Rules for Applying the Kennedy Classification

Rule 1: Classification should follow rather than precede extraction.

Rule 2: If the 3rd molar is missing and not replaced, it is not considered in the classification.

Rule 3: If the 3rd molar is present and to be used as an abutment, it is considered in the classification.

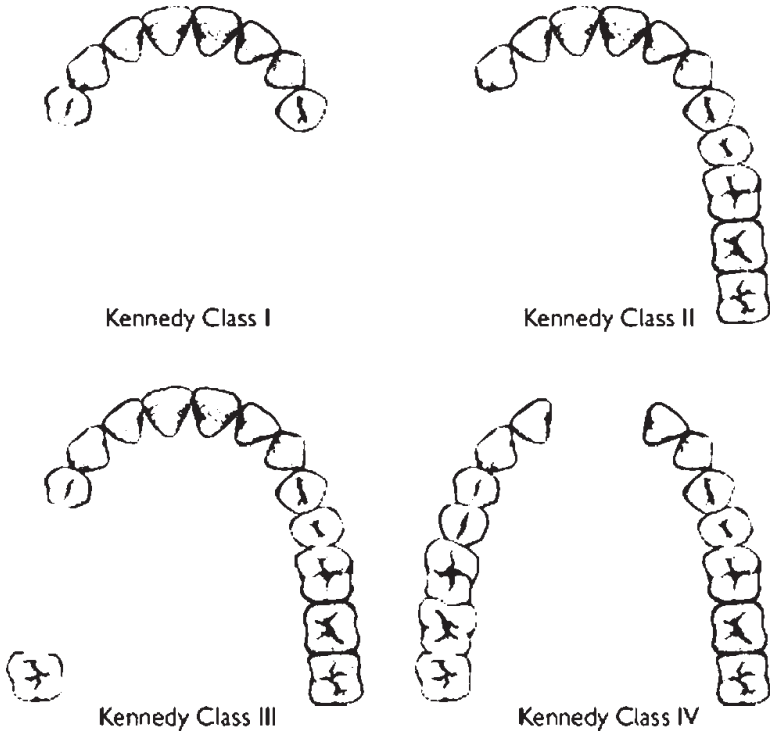


Fig. 3-21. *Kennedy's classification.*

Rule 4: If the second molar is missing and not replaced, it is not considered in the classification.

Rule 5: The most posterior edentulous area determines the classification.

Rule 6: Edentulous areas different from those determining classification are called modification spaces.

Rule 7: The extent of the modification is not considered, only the number.

Rule 8: There is no modification space in Class IV.

Classification of dental row defects by Betelman

Class I – Includes edentulous areas located posterior to the remaining natural teeth. There are two subclasses in this class:

- 1st subclass: includes unilateral edentulous area located posterior to the remaining natural teeth i.e., there is a single edentulous space located in the posterior region without any teeth posterior to it.
- 2nd subclass: includes bilateral edentulous areas. There are two edentulous spaces located in the posterior region without any teeth posterior to it.

Class II – Includes one or few edentulous areas with natural teeth anterior and posterior to it.

- 1st subclass: Includes edentulous areas not longer than three removing teeth.
- 2nd subclass: Includes edentulous areas longer than three removing teeth.

Teeth examination.

Examination of teeth is taken in particular order. Teeth are divided into four segments and every teeth have own number. Clinician must remember that his frontal look on patient means that right side of patient it is left side in examination table of medical history. Examination begins from left upper segment to right upper, next – right upper to left lower (Fig. 3-22).

During examination of every tooth clinician pays attention to:

- ✓ location in dental row
- ✓ shape
- ✓ color
- ✓ hard tissues condition
- ✓ mobility
- ✓ presence of restorations and their condition
- ✓ correlation of extra alveolar and intra alveolar part of tooth
- ✓ gingival sulcus condition (or gingival pocket)
- ✓ plaque and calculus presence and intensity

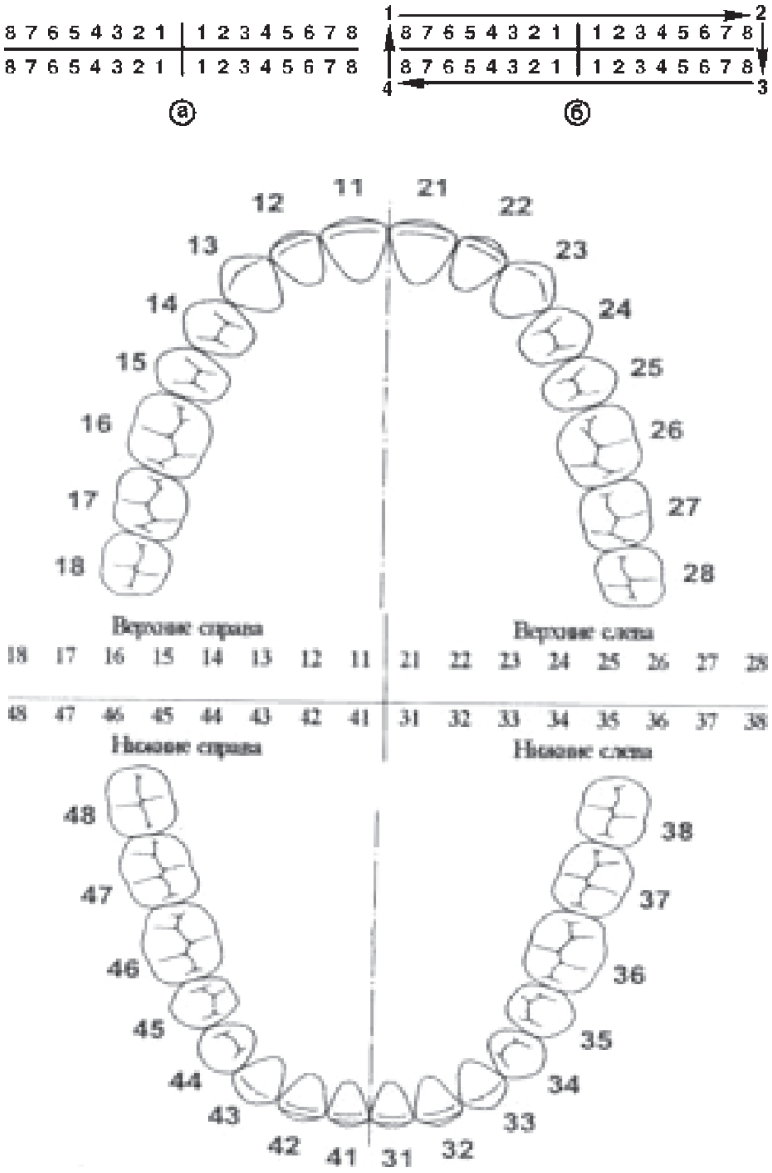


Fig. 3-22. *Dental formula.*

Damages of teeth have different etiology (trauma, caries, teeth wearing etc). To note of it clinician should use different classifications. Black's classification is indicate defect localization, but does not show the defect occurrence.

Black's classification (Fig. 3-23):

I class – Pits and fissures on the occlusal surfaces of molars and premolars, facial (buccal) or lingual pits of molars, lingual pits of maxillary incisors.

II class – Proximal (mesial or distal) surfaces of the premolars and molars.

III class – Proximal (mesial or distal) surfaces of incisors and canines.

IV class – Proximal (mesial or distal) surfaces of incisors and canines and also involving the incisal edge.

V class – Cervical cavity location of the vestibular tooth surfaces.

VI class – Atypical cavity location.

For prosthetic reason Milikevych's classification (Fig. 3-24) is used, because it shows tooth defect occurrence in relation to restoration approach, depending on index value. ITOSD (Index of Teeth Occlusal Surface Damage) – 0,2-0,6 – composite restoration is recommended, metal or ceramic inlay; 0,6-0,8 – artificial crown; 0,8 and more – post and core with artificial crown.

Kurilenko's classification is used to determine the treatment approach for vital and endodontically treated teeth.

I -hard tissue lesions of the crown part of a devitalized tooth

II – hard tissue lesions of the crown part of a vital tooth:

1. Hard tissue lesions of the crown part of chewing teeth on approximal, occlusal-approximal and mesio-distal surfaces.

2. Hard tissue lesions of the crown part of frontal teeth on approximal and incisal edge surfaces.

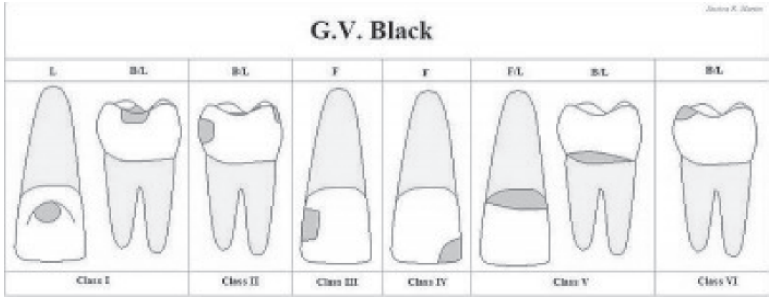


Fig. 3-23. *Black's classification of tooth defects.*

3. Hard tissue lesions of the crown part of teeth on all surfaces except the approximal, occlusal-approximal and incisal edge.

Tooth mobility. All teeth have a slight amount of physiologic mobility. The destruction of periodentium makes the tooth loose in the socket. Clinician can investigate it with dental forceps. Tooth mobility is graded as: 1st level – slight mobility, up to 0,5 mm in one direction (mesio-distal or oro-vestibular); 2nd level – moderate mobility, more than 0,5 mm but less than 1 mm in one or two directions; 3rd – extreme mobility, tooth is movable both mesio-distally, oro-vestibulary and in vertical direction, may be depressible in the socket.

Percussion method is realized with help of handle of probe, or another dental instrument usually. Under test tooth is tapped lightly in all directions so that the patient will be unable to expect the percussion of the suspect tooth. The percussion indicate the inflammation in the periapical region, specifically, inflammation of the apical part of the periodontal ligament. Positive (painful) horizontal percussion indicates inflammatory process in marginal periodontal tissues. Positive vertical percussion is typical to inflammatory processes in apical periodentium tissues (chronic and acute periodontitis).

Tooth vitality testing. Pulp health must be assessed, usually by measuring the response to thermal stimulation. A diagnosis of vitality can be confirmed by preparing a test cavity without the administration of local anesthetic.

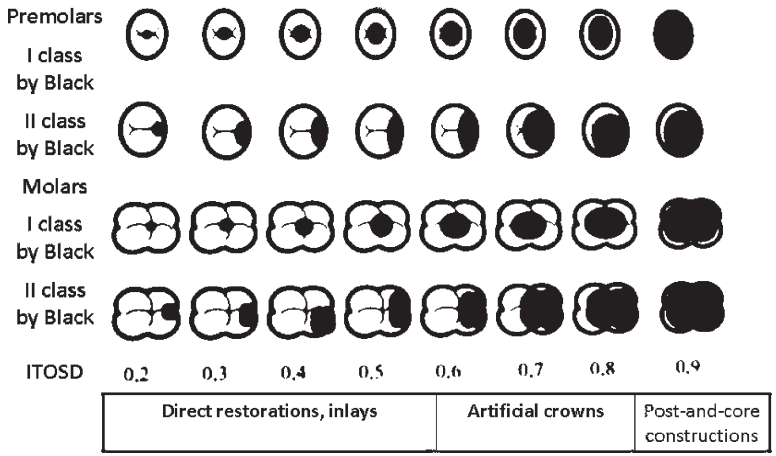


Fig. 3-24. *Milikevych's classification of tooth defects.*

For thermal stimulation clinician can use cold (cold water, sticks of ice, ethyl chloride) and heat (hot water, warmed-over gutta percha, and heated compound material) tests. To get detailed information about tooth vitality condition clinician should use electrical stimulation – electroodontodiagnosis (EOD).

Examination and analysis of the occlusion

Occlusion is one of the most controversial subjects for prosthetic dentistry. Different dental schools are uses different approaches to occlusal concepts. But for examination most of them use the same methods.

Usually it is enough to examine the occlusion clinically (in oral cavity directly), but in more extensive occlusal reconstructions or where there specific complaints of patient are present, diagnostic casts in articulator the detailed information.

Clinical examination of the occlusion

Clinically occlusion can be examined with articulating paper or foil, thin wax plate, registration silicones, plastic strips.

Clinician should examine occlusion more attentive if patient complaints on temporomandibular joint pain, muscle spasm or unexplained chronic dental or head pain, progressive teeth wear, teeth mobility, have difficulty of jaw excursions or fills occlusal interferences (for example after restoration).

Articulating paper and foil

Flexible articulating paper or plastic foil of different colors and thickness may be used to mark occlusal contacts in different excursions (Fig. 3-25). For example, the intercuspation position (ICP) may be recorded in one color (blue) and the retruded contact position (RCP) in another color (red).

Articulating paper is rather difficult to use, having a tendency to mark the tips of cusps whether or not they are in occlusion, and often it does not register

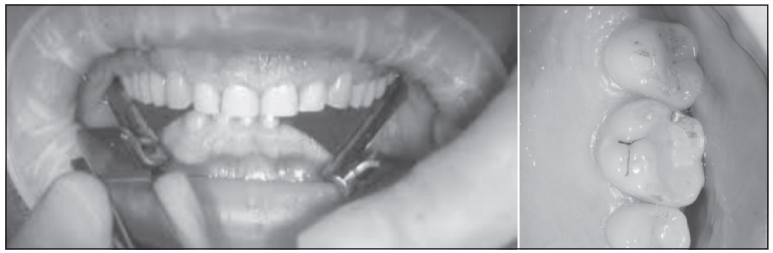


Fig. 3-25*. On the left – articulating paper in patient's mouth; on the right – marked occlusal contacts on upper molars.*

contacts on polished metal and glazed porcelain restorations. The thickness of the paper will have an influence on the degree of marking that occurs and ideally it should be as thin as possible. Occlusal paper produced now, have the thickness from 200 μ till 40 μ. The thinnest product for occlusal contacts marking is an occlusal foil (8 μ, 12 μ, 16 μ). The teeth are very sensitive to the thickness of material between them and can easily detect the differences between the materials.

Wax occlusography.

Thin, soft wax with an adhesive on one side is marked as a material for registering occlusal contacts. This is useful but rather expensive. A better alternative is to use 0.5 mm thick, dark colored sheet wax. Occlusal registrations in this material are shown in Fig.3-26. It has the advantage that it can be removed from the teeth and placed over the study casts for the occlusal contacts to be studied more closely. It can also be used in full arch-sized pieces. Areas of contact in the mouth may be marked through the perforations with a chinagraph pencil.

Occlusal registration with bite-silicone.

Fast setting A-silicone rubber materials can be syringed between teeth and the occlusal contacts are recorded. These materials are soft initially so offer no resistance to the closure of the mandible, which can be a problem with more viscous materials such as wax if it is not softened properly. The resistance felt on biting into a more viscous material and can guide the mandible into a different position. Once set the silicone material is flexible but sufficiently rigid to be used as an accurate interocclusal record to articulate casts. It can be placed on the model to show, by means of the perforations, which parts of the

Fig. 3-26. *Occlusal contacts on wax plates.*

occlusal surface are making contact. Because it can be replaced onto the model or the patient's teeth without damage it is a better material than wax.

Plastic strips

Plastic strips may be used to test whether teeth are making contact in various excursions. The thinnest of these materials (shimstock) is opaque and silver-colored and is only 8 micrometers thick. The strip is placed between opposing teeth and pulled aside once occlusal contact has been made. Often two pieces are used on opposite sides of the jaw to test the symmetry of the occlusion, or between the restored tooth and its antagonist to find premature contacts. Less accurate (40 micrometers thick) but more manageable mylar matrix strips, used for composite restorations, are sometimes an acceptable alternative.

Additional methods of examination (Laboratory and Instrumental)

Radiographic (or X-ray) examination

Radiographic examination can provide useful information to clinician about patient's compact tissues. Method is widely used because of relative safety, simplicity, not a high cost and demonstrative. Only this kind of investigation provides full hidden cavities, bone loss, tissue changes control (choice of supporting teeth, type of bone lesion). Radiographic examination gives negative image of hard tissues. It means that dental caries, bone lesions, the periodontal ligament, anatomical cavities look darker because X-rays readily penetrate these less dense structures. Dental restorations (fillings, crowns) may look lighter or darker, depending on the density of the material.

Radiographic methods of examination are divided into **general (intraoral and extraoral) and additional (tomography, computed tomography, telerentgenography or cephalometry, digital radiography).**

Intraoral X-Ray examination (apical, bite, occlusal x-ray views).

The periapical radiograph shows the most accurate image of crowns, roots, and supporting structures of a particular area of the oral cavity. Supporting tissues examined in a periapical radiograph include the alveolar bone, lamina dura, periodontal ligament, periodontal membrane space, and 2-3 mm of supporting tissue beyond the apex of the tooth (Fig. 3-27). Periapicals are used to examine the anatomy and pathology of a particular area

The bitewing (interproximal) radiograph shows both the maxillary and mandibular teeth in occlusion (Fig.3-28). Bitewings can either be taken horizontally or vertically. The main purpose of a bitewing is to examine the

Fig. 3-27. *Periapical radiographs.*

interproximal surfaces, mesial and distal, and the height of the crestal bone level. Other purposes include detection of overhanging restorations, pathology of the pulp, and detection of location of calculus.

With occlusal films clinician can examine the complete arch of teeth, maxillary or mandibular, all in one view. The occlusal film is much larger than a bitewing or periapical film. This film is used to locate objects present in the oral cavity, along with locating supernumerary teeth (extra teeth), impacted teeth, root tips of extracted teeth that were left behind, tumors, and cysts. Other uses the occlusal film including the examination of the maxillary sinuses, large sections of the jaw to determine the presence of any jaw fractures or pathologies such as cysts and malignancies (Fig. 3-29). There are two main techniques for exposing an occlusal film topographical and cross-sectional.

Radiovisiography is a digital intraoral radiography (Fig. 3-30).

Advantages:

✓ Speed: pictures can be obtained on the monitor in 2-3 seconds. This provides efficiency during the treatment process.

✓ Radiation dose: is 10 times less than in the case of a usual x-ray picture – safety for the patient.

✓ Diagnosis: the computer program allows getting more information on each individual picture – due to special functions, such as: zoom in, contrast, length measurement.

✓ Sociability: colored and relief images are clear to the patient.

It must be remembered that the radiograph is a two-dimensional picture of a three-dimensional entity and is dependent on mineral densities for its image. The depth of a carious lesion can be underestimated by as much as a third on a

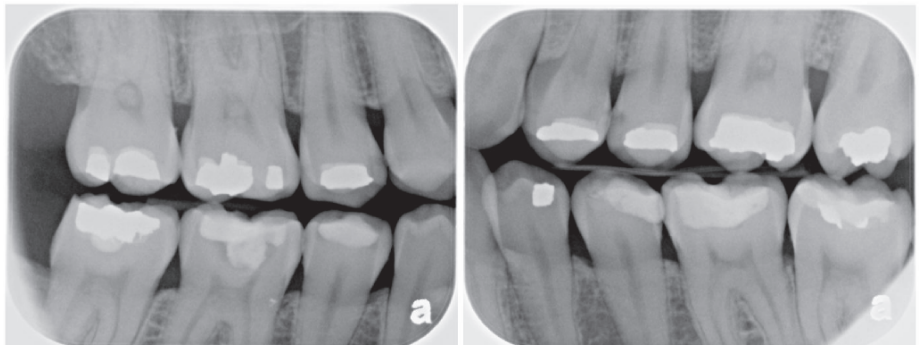


Fig. 3-28. *The bitewing views.*

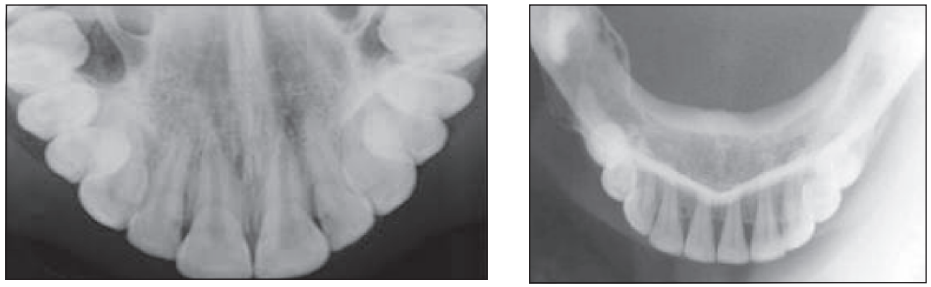


Fig. 3-29. *Occlusal films of upper and lower jaw.*

bitewing, and pulp horns can be superimposed on the caries, whereas they are actually in a different plane.

General extraoral X-Ray examination (Panoramic, lateral jaw, cephalometric, TMJs views, maxillary sinus views, submentoventrics views).

Dental panoramic radiography (orthopantomogram or orthopantomograph) is a panoramic scanning dental X-ray negative side of the upper and lower jaw which shows a two-dimensional view of a half-circle from ear to ear (can be digital or film). A complete survey can be made of the teeth and related structures, some tumors and cysts can be examined and evaluated, the location and position of impacted teeth may be determined, fractures of the lower face may be located, and growth patterns of the jaws can be studied and evaluated (Fig. 3-31).

Indications for this investigation is a treatment planning, pathology of lower jaw bone, fractures, TMJ pathology, periodontal pathology, orthodontic treatment, positioning of impacted teeth.

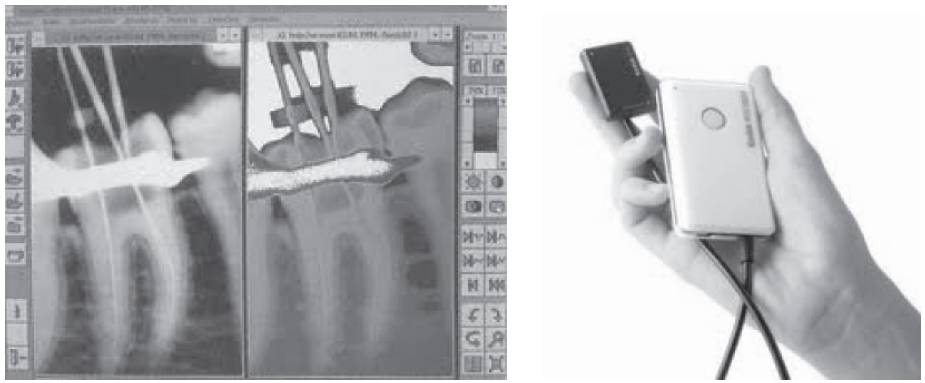


Fig. 3-30. *Radiovisiography view and sensor.*

Advantages: large anatomical area covered, relatively low dose, easy to operate, improved patient cooperation. Disadvantages: relatively high cost, decreased sharpness, may not see objects outside focal trough, small caries, periodical disease along with other diseases, and abnormalities that would show up on intraoral x-rays would not be identified on a panoramic view. Other problems would include magnification, distortion, and natural overlapping of some of the teeth.

This investigation can be processed in two ways: The film and X-ray tube is moves around the patient's head or the X-ray tube rotates around the patient's head in one direction while the film moves in the opposite direction.

Tomography is a radiographic technique that allows the imaging of one layer or section of the body while blurring images from structures in other planes (Fig. 3-32).

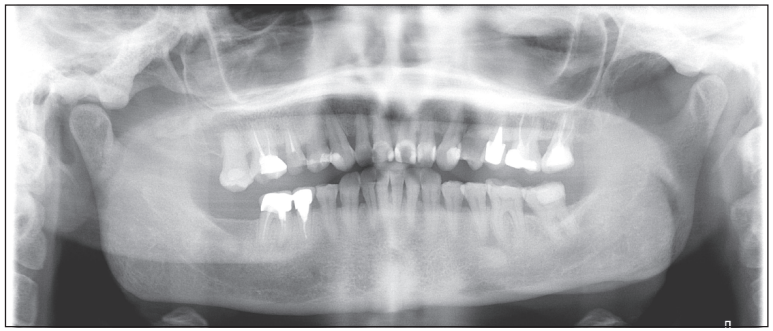


Fig. 3-31. *Orthopantomogram*

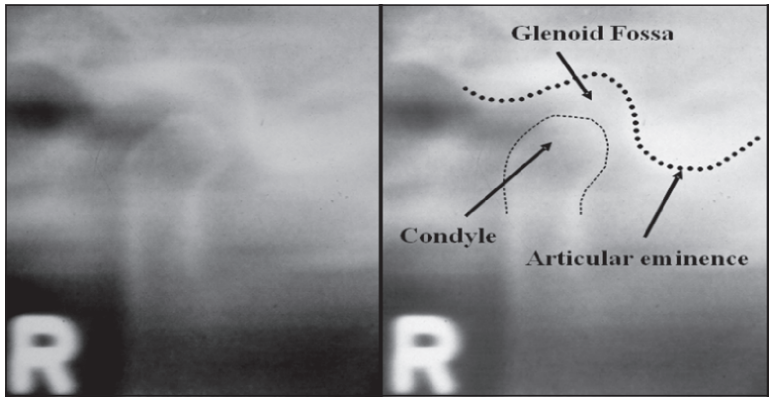


Fig. 3-32. *Tomogram of TMJ*

Computed tomography (CT, computed axial tomography or computer assisted tomography) is the procedure that uses computer-processed X-rays to produce tomography images (slices) of all areas of the body. These cross-sectional images are used for diagnostic in all medical disciplines. For dentistry it is especially used in surgery and dental implantation. Digital geometry processing is generates a three-dimensional image of the inside of an object from a large series of two-dimensional X-ray images taken around a single axis of rotation. With the help of specialized software three-dimensional reconstruction can be done. It helps to visualize bone structure, loss of hard tissues, root canals topography, anatomical structures topography (mandibular canal, maxilla sinus, etc.) for greater prosthetic treatment planning and prognosis (Fig. 3-33).

Magnetic resonance imaging (MRI), nuclear magnetic resonance imaging (NMRI), or magnetic resonance tomography (MRT) is a medical imaging technique that is used in radiology to visualize internal structures of the body in details (Fig. 3-34). MRI makes use of the property of nuclear magnetic resonance (NMR) to image nuclei of atoms inside the body. MRI can create more detailed images of the human body than are possible with X-rays.

An MRI scanner is a device in which the patient lies within a large, powerful magnet where the magnetic field is used to align the magnetization of some atomic nuclei in the body, and radio frequency magnetic fields are applied to systematically alter the alignment of this magnetization. This causes the nuclei to produce a rotating magnetic field detectable by the scanner-and this information is recorded to construct an image of the scanned area of the

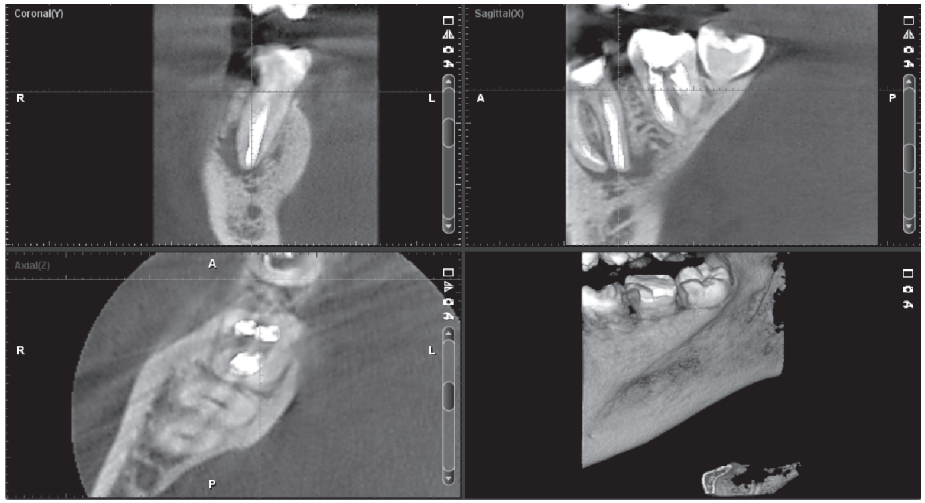


Fig. 3-33.*The left lower molars region 3D CT and three-dimensional reconstruction.*

body. Magnetic field gradients cause nuclei at different locations to process at different speeds, which allows spatial information to be recovered using Fourier analysis of the measured signal. By using gradients in different directions, 2D images or 3D volumes can be obtained in any arbitrary orientation.

MRI provides detailed images of the body in any plane, good contrast between the different soft tissues of the body, which makes it especially useful in imaging the brain, musculoskeletal, the cardiovascular, and cancers compared with other medical imaging techniques such as computed tomography (CT) or X-rays. Unlike CT scans or traditional X-rays, MRI does not use ionizing radiation. It works on another principle – a powerful magnetic field to align the nuclear magnetization of (usually) hydrogen atoms in water in the body. Radiofrequency fields are used to systematic alter the alignment of this magnetization, causing the hydrogen nuclei to produce a rotating magnetic field detectable by the scanner. This signal can be manipulated by additional magnetic fields to build up enough information to reconstruct an image of the body.

With MRI investigation temporomandibular joints can be examined simultaneous bilateral. A routine MRI evaluation of TMJ consists of a series of acquisitions. Images are obtained in the axial plane to define the location of the joints and provide a global view of the surrounding anatomy (Fig.3-

Fig. 3-34. *MRI procedure.*

35). Coronal images are routinely obtained because they provide information about mediolateral relationships at the TMJ. The sagittal images are assigned from the axial in an oblique plane corresponding to the axis of the condyle and body of the mandible. These oblique sagittal images provide the greatest diagnostic detail for anatomical diagnosis. The TMJ can be examined with all clinically available magnet strengths. As opposed to CT, MRI visualized hard and soft tissues (the structures such as TMG disk, muscles, glands, etc.).

Electrical tooth vitality testing (EOD – electroodontodiagnostic) is determination of tooth pulp reaction on low electric impact. This method is provided with special device (Fig.3-36) which measures tooth electroexcitability (microampere). EOD is informative, non-invasive and safe method of tooth vitality testing.

Electric pulp testing passes a low current at high potential through the tooth. The current must have a square wave form because it must pass through enamel and dentine, which are relatively poor conductors, and reach the other

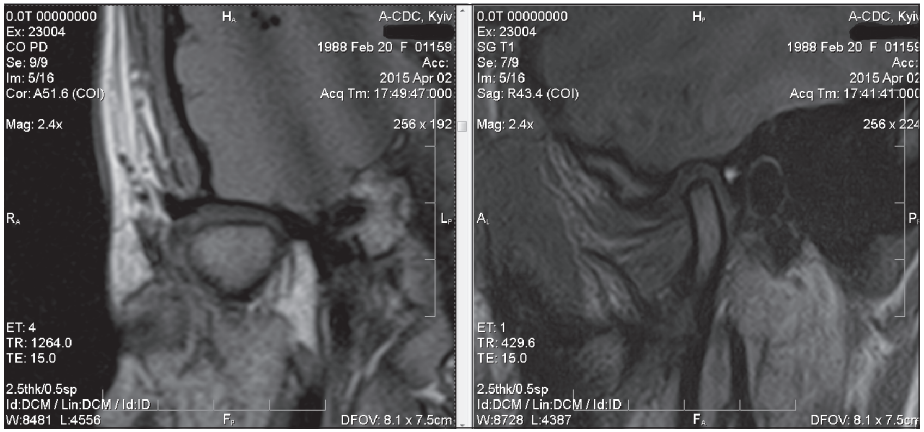


Fig. 3-35. *MRI of TMJ. Frontal (left side) and – sagittal (right side) views.*

side at sufficient potential to stimulate the nerves of the pulp. Unfortunately, numbers are ascribed to the patient's response, and this gives the test more apparent scientific validity than it actually possesses. It really is subjective with a "yes" or a "no" as the response. The patient's expectation of the test influences the result, particularly if the sensation from the first, control tooth is very painful. A pre-emptive response is very likely in the subsequent tests. Vital tooth responds to 2-6 mkA current, from 6 to 50 mkA – pulp necrosis, more than 50 mkA – periodontitis. If increasing of tooth electric respond was detected, it needs an additional examination of the structure on X-ray. The method not indicated to the patients with heart pacemaker.

Electromyography.

Electromyography (EMG) is an experimental technique concerned with the development, recording and analysis of muscles electric signals. These signals are formed by physiological variations in the state of muscle fibers membranes. There are three general types of EMG investigation: surface, Intramuscular and nerve conduction study.

Intramuscular or fine wire EMG is used for small, deep muscles not accessible by surface electrodes, to isolate specific muscles from a muscle group or adjacent muscles investigation. Needle electrodes are used to collect the data in this way.

Fore Nerve conduction studies the shock electrodes are placed directly over the nerve projection on skin, and a recording electrode is placed over the muscles controlled by this nerve. Several quick electrical pulses are given to the nerve, and the time which takes muscle to contract in response to the

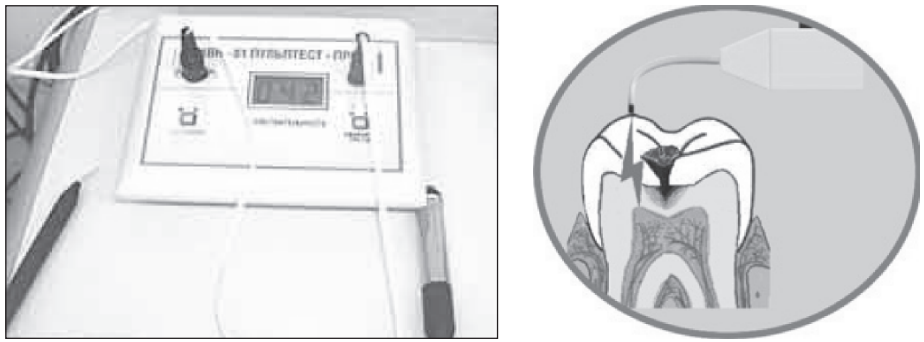


Fig. 3-36.*Pulp vitality test.*

electrical pulse is recorded. The speed of the response is called the nerve conduction velocity.

SEMG is a standard method for evaluating and recording the sum electrical activity produced by skeletal muscles from the skin surface. EMG is performed using an instrument called an electromyograph, to produce a record called an electromyogram (Fig. 3-37). An electromyography detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical abnormalities, activation level, symmetry, synergy, recruitment order or to analyze the biomechanics of movement.

The EMG signal directly reflects the recruitment and firing characteristics of the detected motor units within the measured depolarization zone. Raw SEMG can range between +/– 5000 microvolt and typically the frequency contents ranges between 6 and 500 Hz, showing most frequency power between 20 and 150 Hz. For the recording individual surface electrodes are pastes on the most protruded part of the functioning muscle.

For dentistry most informative superficial muscles are: m.temporalis, m.masseter, m.sternocleidomastoideus, anterior belly of m.digastricus. Internal chewing muscles can be investigated only with needle electrodes. The needle method is invasive, hard and painful, that is why not popular in dental clinical practice.

SEMG gains information concerning both the resting and the functional activity (clenching, chewing, swallowing. speech) of the musculature. For more diagnostic information, tests can be taken in different positions of the patient: in the standing position, in the sitting position, in the lying position.

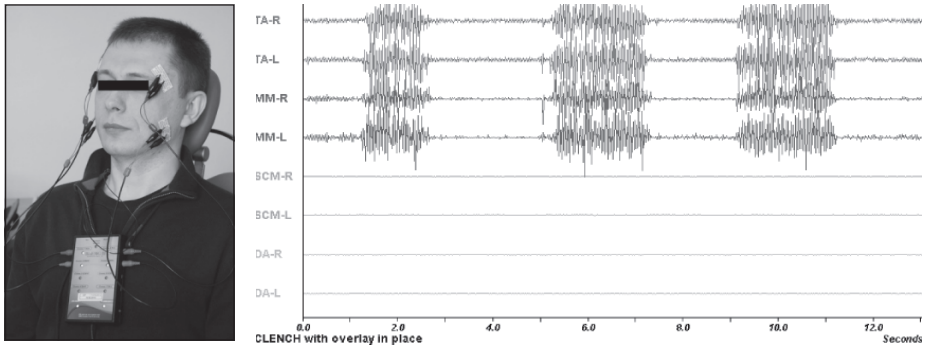


Fig. 3-37. *BioEMG III Electromyoraphy.*

Indications: TMD, force orthodontic treatment, complete prosthetic rehabilitation, bruxizm, pathological wearing of teeth, chronic pain in maxillo-facial region.

This method is a not invasive and very informative. SEMG information is invaluable to the clinician who hopes to create beautiful dentistry that works with the patient's physiology for better results.

Joint Vibration Analysis (JVA).

Joint Vibration Analysis (Fig. 3-38) – the electronic recording and computer-enchanced examination and interpretation of solid-borne joint vibration (tissue pressure waves).

JVA work principle is based on motion and friction. Normal functioning joints have smooth gliding surfaces, enough of synovial fluid and are usually quiet. Injured joint surfaces and disk produce specific wave's form that can be analyzed in special computer software (Fig.3-39).

For the record sensors are placed directly over TMJ. Recording process is a fast (3-5 min), not invasive, not painful and safe. Data analysis of numeric values performs with help of standard chart (Fig.3-40). Preliminary diagnosis determined according to Piper's classification of TMD:

- ✓ Stage I (Normal TMJ)
- ✓ Stage II (laxity of the lateral collateral ligament)
- ✓ Stage IIIa (chronic displacement of the disc from the lateral pole with Reduction)

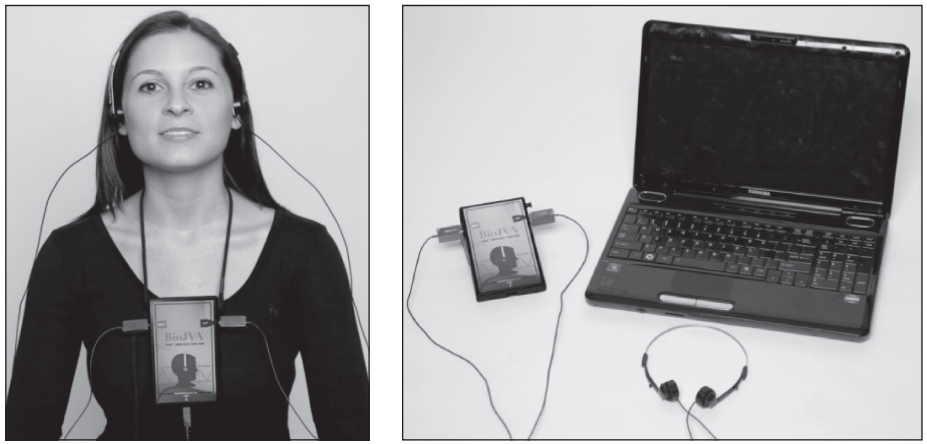


Fig. 3-38. *BioJVA device.*

✓ Stage IIIb (chronic displacement of the disc from the lateral pole without Reduction)

✓ Stage IVa (displacement of the disc from the medial pole of the condylar head with Reduction)

✓ Stage IVb (displacement of the disc from the medial pole of the condylar head without Reduction)

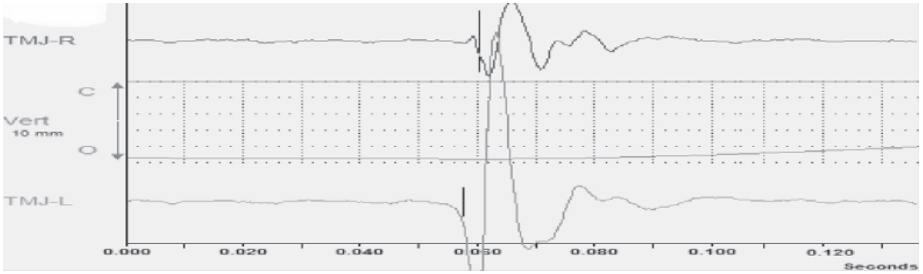


Fig. 3-39. *Zoomed view of joint vibration.*

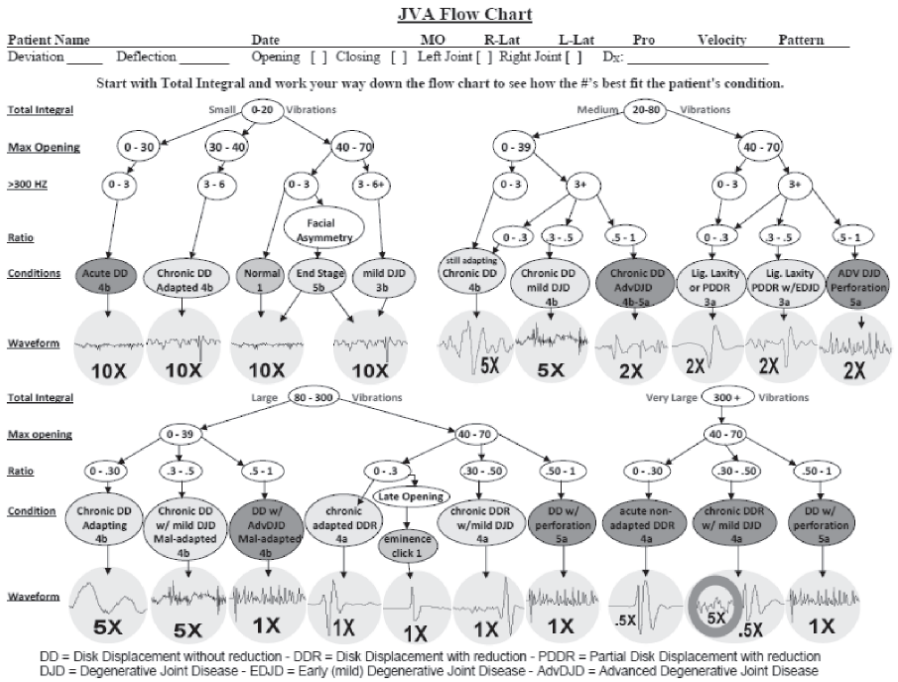


Fig. 3-40. *Standard diagnostic chart of joint vibration analysis data.*

✓ Stage Va (disk perforation with acute degenerative joint disease)

✓ Stage Vb (disk perforation with chronic degenerative joint disease)

Examination with JVA is a very useful for fast TMJ pathology finding. But it is only screening test and for full final diagnosis another methods are needed.

Ultrasound examination.

At diagnostic process ultrasound (US) high frequency sound waves are transmitted in to the body by a transducer and echoes from tissue interface being detected and displayed on a screen (Fig. 3-41). The transducers are designed to produce longitudinal waves hence only those waves can pass through tissues and get reflected, Audiofrequency of a sound wave is 20 KHz (20,000 hertz). Anything below this is called infrasonic and above is Ultrasound. Medical Ultrasound uses the frequency of 1-15 MHz (2.5, 3.5, 7.5 and 10 MHz). The receiver has a special property called piezoelectric effect i.e. they can convert sound waves in to electrical waves and vice versa.

Fig. 3-41. *Ultrasound system.*

Sonography.

Medical sonography (ultrasonography) is an ultrasound-based diagnostic medical imaging technique used to visualize muscles, tendons, and many internal organs, to capture their size, structure and any pathological lesions with real time tomographic images. The technology is relatively inexpensive and portable, especially when compared with other techniques, such as magnetic resonance imaging and computed tomography.

Ultrasound in dentistry is used for detection of fractures of the Maxillo-facial region i.e. Nasal bone fractures, Orbital rim fractures, Maxillary fractures, 3 Mandibular fractures, and Zygomatic arch fractures and for locating the position of Mandibular condyles. And post operative view can be done instantly.

Ultrasound can be used to detect parotid lesions, where solid and cystic lesions are reliably differentiated and diffuse enlargement of the parotid gland (or) focal disease is readily shown by Ultrasound. Sonographically, benign lesions usually look well defined, homogeneous and hypoechoic, while Malignant lesions tend to be poorly defined and hypoechoic with heterogeneous internal architecture and enlarged cervical lymph node may be visible and reactive intra parotid lymph nodes may also be readily assessed.

The value of Ultrasonography is well recognized in inflammatory soft tissue conditions of the head and neck region and superficial tissue disorders of the maxillofacial region.

Ultrasound with aid of high resolution transducer, can demonstrate the internal Muscle structures more clearly than CT. hyper echoic bands, which correspond to the internal fascia are usually observed on US Image of normal Muscles and are sometimes referred to as septa. These bands diminish or disappear with inflammation; hence this is an important structural Index of Masseteric Infection. Ultrasound is also an accurate Modality for measuring the thickness of Muscles, data regarding thickness may provide information useful in diagnosis and treatment especially in follow up examination.

Investigation of functional Reserve periodontal forces.

Periodontal tolerance to functional load is determined by vessels and connective tissues condition. The adaptation ability of periodontal tissues to functional load changing is a "Reserve periodontal force". The size of root area surface is characterizing the ability of this tooth to resist the loading. The greatest size of root area the first upper molars have, minimal – lower central incisors (Table 1). Reserve periodontal forcers can be increased by training (hard food).

Table 1.

Periodontal Resistance to Load under Normal Conditions (by the gnathodynamometery results, V. Kurlyandsky).

Teeth	Upper first incisors (11, 21)	Upper second incisors and lower incisors (12,22,32, 31,41,42)	Canines	Premolars	Molars	Wisdom teeth
Coefficient	1.25	1.0	1.5	1.75	3.0	2.0

Under physiological conditions the intact supporting apparatus of each tooth use only half of its force in resistance to the masticatory pressure. The other half is mobilized during strong unusual stimulation which thus does not cause the development of pathological conditions.

The degree of atrophy of a tooth alveolus is determined by clinical and X-ray (panoramic, 3-D CT). The combination of both examinations is necessary because two-dimensional X-rays cannot show the true condition of the atrophic process. Usual X-ray film gives an image of one plane, whereas atrophic processes usually develop irregularly around a tooth. The degree of the process is determined from the area of maximum atrophy; clinically it is established with the help of a safe graduated periodontal probe.

By V. Kurlyandsky four degrees of alveolar atrophy are distinguished: I degree – root length; III degree – exposure of three-quarter root length; IV degree – full exposure of root.

The resistance of the teeth supporting apparatus to pressure decreases with a higher degree of alveolar atrophy. The atrophic processes are usually attended with considerable changes in the periodontal receptor apparatus, which together with the tooth loosening are developing due to the atrophy makes measurement of the actual periodontal resistance to pressure impossible. That is why the periodontal resistance to load in atrophy is expressed by means of conventional coefficients based on the proportional ratios of the resistance of a healthy periodontium of different teeth to the load, determined with a gnathodynamometer.

The coefficient of periodontal resistance to the load decreases correspondingly with different degrees of alveolar atrophy in different teeth (Table 2).

In IV degree atrophy the periodontium has no resistance to load (and the tooth should be extracted). It is accepted in practice that the periodontium of a tooth can resist a load double that experienced during food breakdown (Fig. 3-42).

For therapeutic purposes it is recommended to utilize the reserve forces of the periodontium (of a single tooth, group of teeth, or the whole row) in pathological conditions for the supporting tissues of a single tooth or a group of teeth.

A unit of teeth joined as a functionally orientated antagonists group, the maxillary and mandibular anterior teeth or the masticating teeth on the right or

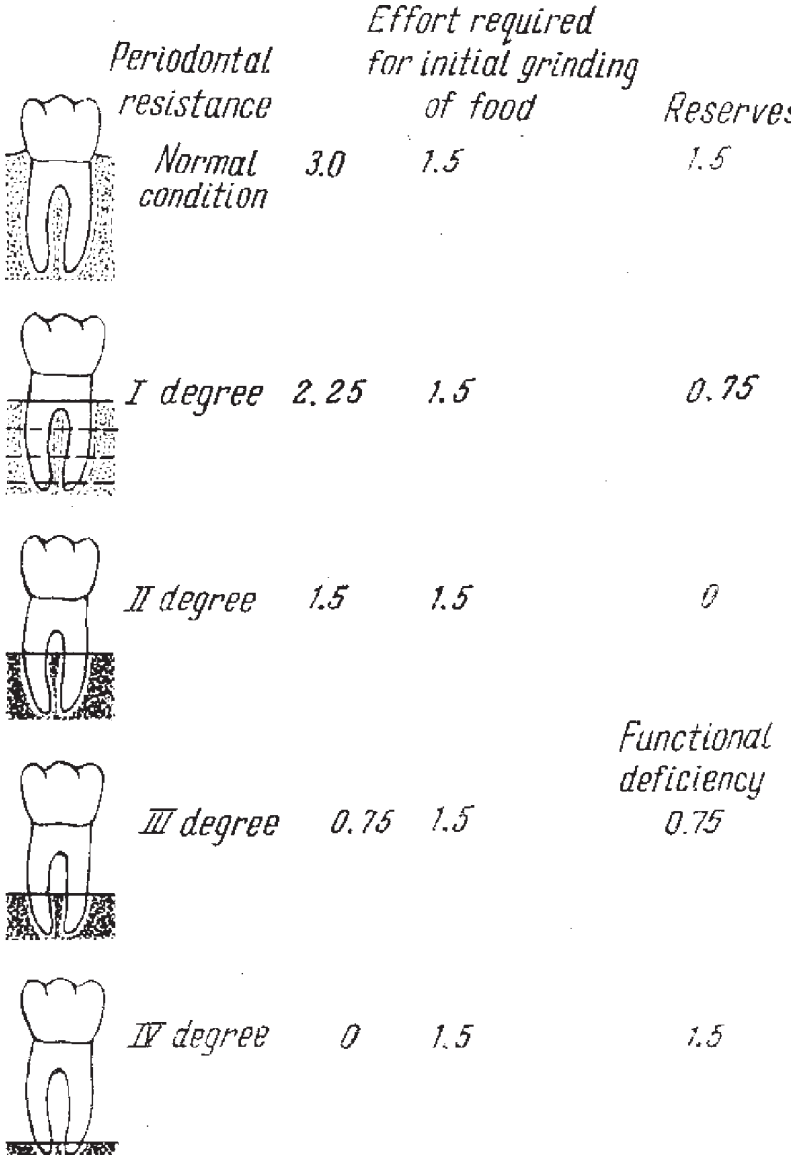


Fig. 3-42. *Representation of changes in the reserve forces of the periodontium with different degrees of atrophy and development of functional deficiency schematically (V. Kurlyandsky, 1977).*

Table 2.

Changes in Periodontal Resistance in Different Degrees of Alveolar Atrophy

Teeth Degree of atrophy	Upper first incisors (11, 21)	Upper second incisors and lower incisors (12, 22, 32, 31, 41, 42)	Canines	Premolars	Molars	Wisdom teeth
Normal (initial) values	1.25	1.0	1.5	1.75	3.0	2.0
I (1/4)	0.9	0.75	1.1	1.3	5.25	1.5
II (1/2)	0.6	0.5	0.75	0.9	1.51	1.0
III (3/4)	0.3	0.25	0.4	0.45	0.75	0.5

left side of the jaw shown on the Fig.3-43. Joining the teeth in a single unit greatly increased the periodontal resistance to pressure: the individual under test could strain his muscles to the most extreme value without feeling, pain and outcome in the periodontium.

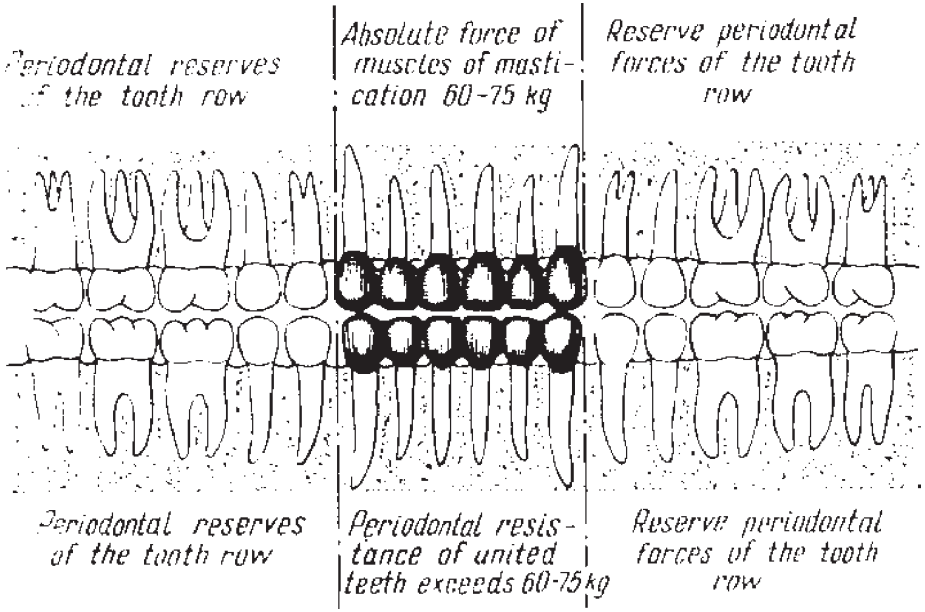


Fig. 3-43. *Reserve periodontal forces of the tooth row with the anterior teeth joined in a single unit (V. Kurlyandsky, 1977).*

Odontoparodontogram by Kurlyandsky.

An odontoparodontogram (Fig.3-44) is a chart for periodontal resistant force analyzing by the level of alveolar bone atrophy. It gives a clear picture of the functional state of the teeth supporting apparatus, and the course of the treatment process (compare to dynamic records). Each tooth is shown on the diagram according to the dental formula.

Information about the tooth supporting apparatus condition is recorded in the chart encoded in symbols:

N-no pathological changes;
0-absent tooth;
1/4-I degree atrophy;
1/2-II degree atrophy;
Ca-caries;
P-pulpitis;
Pr-periodontitis;
3/4-III degree atrophy;
over 3/4-IV degree atrophy;
-the tooth or root must be extracted.

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Prosthetic Dentistry Department

Date "_____" _____ 20__ year
The name of the patient _____
Age of the patient _____
Diagnosis _____

ODONTOPARODONTOGRAM

			11,5					7,5						11,5				
The degree of atrophy	More than ¾	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	TOTAL
	¾ - 75%																	
	½ - 50%																	
	¼ - 25%																	
	N	2,0	3,0	3,0	1,75	1,75	1,5	1,0	1,25	1,25	1,0	1,5	1,75	1,75	3,0	3,0	2,0	
		8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
The degree of atrophy	N	2,0	3,0	3,0	1,75	1,75	1,5	1,0	1,25	1,25	1,0	1,5	1,75	1,75	3,0	3,0	2,0	TOTAL
	¼ - 25%																	
	½ - 50%																	
	¾ - 75%																	
	More than ¾	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			11,5					7,5						11,5				

Fig. 3-44. *Not filled odontoparodontogram map by V.Kurlyandsky.*

Collecting and recording information about the condition of the teeth supporting apparatus by results of the clinical and X-ray examination data are quite simple. But analysis and synthesis of this information for treatment planning are extremely important.

Static methods of mastication efficiency definition

Some authors suppose that the functional importance of each tooth could be indicated by coefficient. The score of coefficients shows the total functional ability of the masticatory system. With loss of some teeth the degree of impairment of the masticatory system could be determined by subtracting the sum of their coefficients.

Different authors propose different evaluation systems. The tests usually founded on: the size of the occlusal surface, the depth and length of roots, number of roots, number of cusps, and distance from the tooth to the site of attachment of the main muscles of mastication.

In 1927 N.I. Agapov suggested that the functional capacity should be taken as 100 per cent on the basis of the anatomo-physiological properties of the dental system (relation of the tooth and jaw, number and strength of the roots of individual teeth, size of the incisal edge and occlusal surface of the teeth, and position of the tooth in the set) so that each tooth would have an appropriate coefficient expressed as a percentage (Tab.3)

Tooth	1	2	3	4	5	6	7	Total
Coefficient	2	1	3	4	4	6	5	25

Table 3. Static method by N.I. Agapov – sum efficiency is 100 % except 18 28 38 48 have numeral coefficient.

The coefficient of wisdom teeth with antagonists was taken as equal to the area of their masticatory surface (molar-molar, premolar-premolar). In that case the dental system amounts more than 100 per cent. The degree of impairment is estimated by subtracting the sum of coefficients of the missing teeth and their antagonists from total.

For example, the following teeth are missing: 16, 25, 26, 27, 35, 44, 45, 47.

The sum of their coefficients adds up to 38 per cent. The sum of the coefficients of the antagonist teeth, 38 percent, is added to it. The total impairment will constitute 76 per cent.

If in a dental system 14 teeth remain but there is not one pair of antagonists, the masticatory value is zero.

I.M. Oxman proposed (1955) the same method of masticatory efficiency fixing but he includes the wisdom teeth number coefficient.

Jaw	Tooth								In all
	1	2	3	4	5	6	7	8	
upper	9	1	9	3	3	6	5	3	25
lower	1	1	2	3	4	6	5	4	25

Table 4. Static method by I.M. Oxman use the same scheme of calculation, but with wisdom teeth.

Functional methods of mastication efficiency definition

The static method is a relative, because it does not show us ability of a human masticatory organ to adaptation being to mastication following the loss of teeth. The first who try to give an objective evaluation of the functional state of the masticatory apparatus was Carl Christiansen. He proposed a test of the masticating ability by giving to the subject some food with determinate weight and consistency, and then inspecting how well it was chewed. For the testing he used a wild nut and after it was chewed he determined the degree of its grinding and in this manner determined the mastication efficiency.

I.S. Rubinov modified the Christiansen's test. He suggested that foodstuffs differing in physical properties should be used (nuts, crusts, fresh bread, etc.) and their treatment in the mouth is combined with reflexes arising in the oral cavity, which was determined by means of masticatiography. I.S. Rubinov discovered from studies that with a more impaired dental system the time needed for chewing hard food (nut) before it was swallowed is increased, but nonetheless food particles swallowed were relatively large. For instance, an adult with a normal masticatory apparatus took about 14 seconds to chew a single nut before swallowing it, and no residue was left on the sieve. In the absence of two or three teeth the chewing lasted 23 seconds, part of the kernel being inadequately grinded. The time needed for chewing soft food with intact dentition differed but little from that needed with an impaired dental system, which stresses the importance of external adaptations of the human being (choice of soft food, abundant moistening in liquids) to the loss of teeth. In his test I.S. Rubinov used a single nut kernel instead of 5 grammes of almond, which allowed

evaluation of the functional state of individual tooth groups (the data obtained from chewing the kernel were treated by Gelman's technique). The tests suggested by Gelman and Rubinov are used not only to determine the functional condition of the maxillodental system and to apply dental prostheses for facilitating gastrointestinal activity, but also to estimate the efficiency of orthopedic treatment and prosthetic management.

Gnathodynamometery.

Gnathodynamometry uses gnathodynamometer is an instrument for objective measuring of the muscles force on the mouth closing (Fig. 3-45). Also this instrument detects power of masticatory muscles. There are mechanical and electronic gnathodinamometers.

One of the first gnathodinamometers was proposed by Black. According to his studies the possible pressure (determined by the reflex sensitivity of the periodontium) in the region of the masticating teeth was 47.2 kg. According to other authors, the pressure produced in females in frontal teeth is from 20 to 30 kg, and in the molars area up to 40 kg; the respective values for males were from 20 to 40 kg and from 60 to 80 kg. We proved experimentally the absolute force of the masticatory muscles by increasing the resistance of the periodontium of a set of teeth to the pressure exerted by them. The experiments showed that the absolute force of the masticatory muscles that raised the lower jaw was 90 to 150 kg (with the gnathodynamometer applied in the molars area) and 60 to 75 kg (with the instrument applied in the frontal teeth area). The variations of

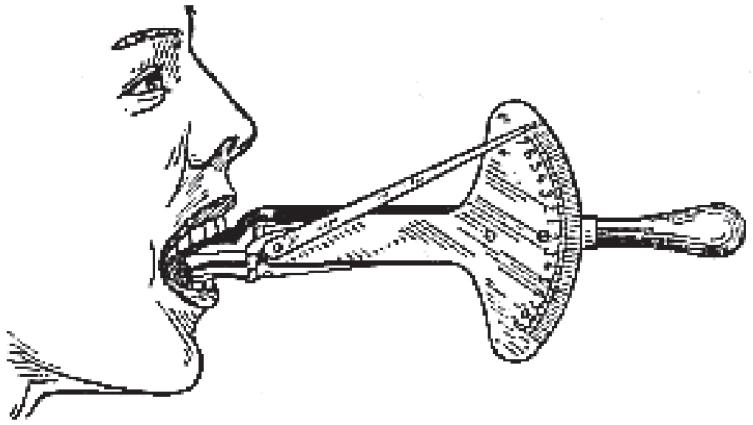

Fig. 3-45. *Gnathodynamometery (by V. Kurlyandsky, 1977).*

the measures (from 90 to 150 kg and from 60 to 75 kg) can be attributed to the individual and depend of development of the masticatory muscles.

Gnathodinamometry data is not define all muscles force, it only shows limit of periodontium endurance. Because then it became painful, muscle contraction stops by periodontal receptors. The data can be very variable for individuals, that is why better to use this method in dynamic during treatment.

Average readings of teeth supporting tissues functional resistance, N (I.U.Lebedenko, 2003)

Gender	Tooth number								All
	1	2	3	4	5	6	7	8	
Male									
Upper jaw	110	60	135	170	175	325	315	170	1460
Lower jaw	60	60	135	170	175	325	315	170	1410
Female									
Upper jaw	75	45	110	135	140	265	240	135	1145
Lower jaw	45	45	110	135	140	265	240	140	1120

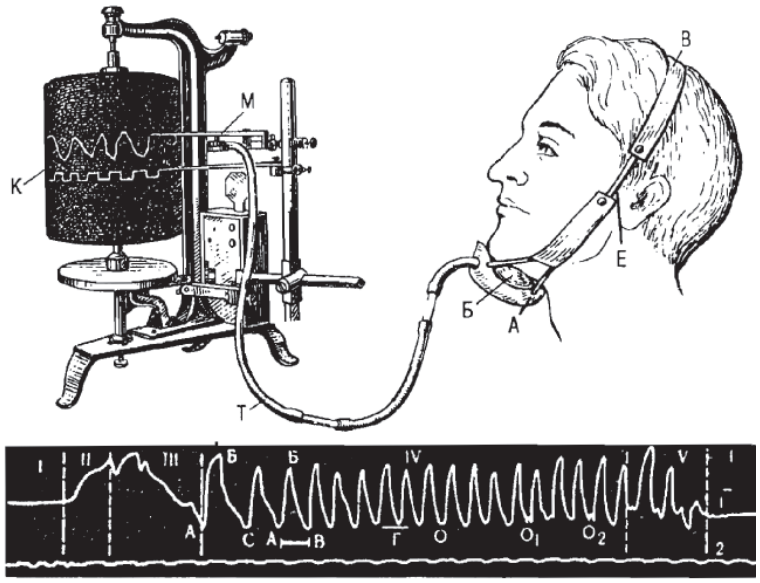

Fig. 3-46. Masticatiography by S.I.Rubinov.

Mastication test.

Mastication test (masticatiography) is a graphical method for detection of reflex lower jaw motion activity during chewing (Fig. 3-46). The apparatus for mastication test is mastikaciograph (S.I. Rubinov, 1954).

Mastication test is an analysis of lower jaw movements. Diagram of examination includes 6 parts (phases):

1st phase is physiological rest;

2nd phase is an introduction of food (as usual used hazelnut);

3rd phase is a start of mastication;

4th phase is a main (basic) mastication;

5th phase is a bolus shaping;

6th phase is a swallowing.

Galvanometry.

Galvanometry is a method for difference of electric potentials between metallic inclusions measure. This method uses extensively for galvanosis ("burning mouth" symptoms) diagnostic.

At Prosthetic dentistry department of the National O.O.Bohomolets Medical University was developed measure method of electric activity in oral cavity with "CompaDent" device (Fig.3-47). This device and special software make possible to determine next parameters:

- To identify causal metal inclusion (by the way of electric current between metal inclusions in oral cavity)
- To measure instantaneous voltage and own internal resistance of metal restoration in oral cavity
- To measure Individual electrical susceptibility threshold of mucous
- Computer modeling of removing of present metal restoration (without real removing of metal-included fixed restorations) in special software

Rheography.

Rheography is a method of blood vessels fluctuations investigation (graphic changes of tissues electrical resistance). This method is based on the fact that when an alternating current of sonic or ultrasonic frequency passes through a body, the organic

Fig.3-47. *The "Compadent" system.*

fluids act as conductors. It makes possible to determine the condition of the blood circulation in tissues (Fig.3-48).

A rheogram is recorded by a rheograph, which consist of a power unit, a high-frequency current oscillator, an amplifier, a recording device, and electrodes.

Rheography is used for functional condition of periodontium and mucosa, prosthetic and orthodontic treatment efficiency rating, tooth pulp condition.

Condylography.

Condylograph (Axiograph) is electronic or mechanical device (Fig. 3-49) for recording of mandibular movements. This method is not invasive, safe and greatly informative (especially electronic).

Mechanical axiography is a simple, made possible of recording the sagittal condylar track (Fig. 3-50) and Bennett movement. Tracks are views on graph paper.

The sagittal condylar track is reproduced easily and generally very well with all of the methods, which is not the case for the transversal condylar track. The evident reason is that the sagittal track is determined by the structure, while the transversal track is determined by function and ligaments (R. Slavicek "Masticatory organ"). Computerized systems are having the greater possibility to diagrams and traces analyzing in special advanced software (Fig. 3-50).

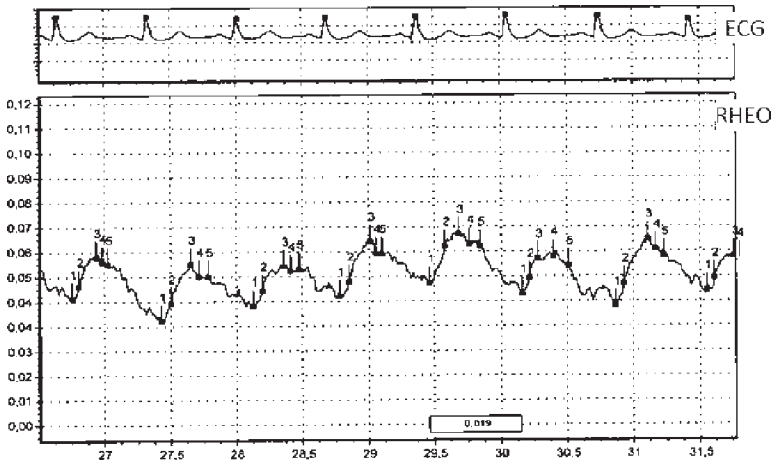

Fig.3-48. *The rheogram view.*

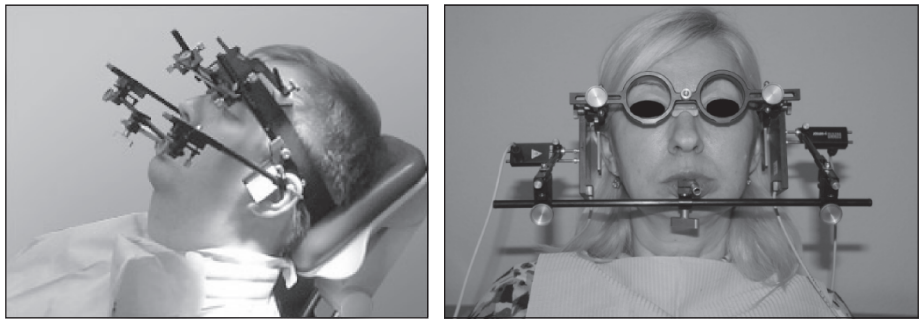

Fig. 3-49. *Condylography: a) with mechanical device; b) with electronic device.*

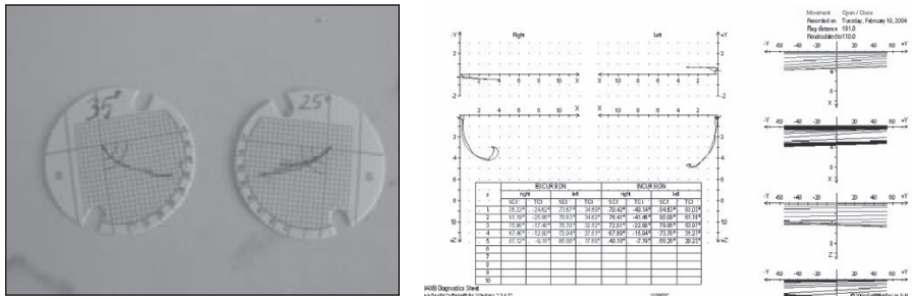

Fig. 3-50. *Tracks after mechanical (left) and digital (right) axiography.*

This means that insignificant track changes can be observed more precisely (for example initial disk displacements) than with the mechanical device.

For data recording occlusal and para-occlusal clutch can be used. For occlusal record method use the clutch that cover occlusal surfaces of teeth and it except their influence on trace (only joint structures forms trace view). Para-occlusal clutch fixed on the lower teeth vestibular surfaces and not inhibits habitual movements determined by individual's occlusion.

These measurement systems are commonly used by prosthodontics to reveal the maxillomandibular relationship for improved diagnosis, treatment planning, individual parameters for fully-adjustable articulator determining. The method depend a lot of the clinician's personal preference.

Diagnostic casts investigation.

For more detailed studies of the dental rows and jaws clinician can make the diagnostic models. Anatomical impression with stock tray must be taken

from the lower and upper jaw as usual. With prepared impressions plaster models must be made in dental laboratory. Diagnostic models must be accurate, without defects on occlusal surface.

Symmetroscopy is used for diagnostic models analysis. This method performs with scaled transparent plastic plate. The plate should be applied to the diagnostic model, focusing midline on the median palatine suture (Fig.3-51). Location of the teeth can be learned in relation to the horizontal and vertical scale lines.

Diagnostic casts transferring to the articulator (semi-adjustable or fully-adjustable) are basic in a planning of prosthetic treatment (Fig.3-52). This permits static and dynamic relationships of the teeth without interference from protective neuromuscular reflexes, and unencumbered views from all directions reveal aspects of the occlusion not always easily detectable intraorally (for example the relationship of the lingual cusps in the occluded position). If the maxillary cast has been transferred with a facebow, a centric relation (CR) interocclusal record has been used for articulation of the mandibular cast, and the condylar elements have been appropriately set (such as with protrusive and excursive lateral records), reproducing the patient's movements with reasonable accuracy is possible. If the casts have been articulated in CR, assessing both the CR and the MI position is possible, because any slide can then be reproduced. Another critical information is not immediately apparent during the clinical examination includes the occlusocervical dimension of edentulous spaces. On an articulator, these are readily assessed in the occluded position and throughout the entire range of mandibular movement.

Relative alignment and angulations of proposed abutment teeth are easier to evaluate on casts than intraorally, as there are many other subtle changes in

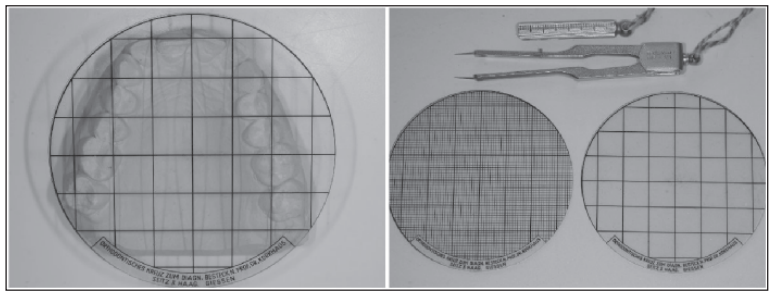

Fig. 3-51. *Symmetroscopy on the diagnostic model.*

individual tooth position. Articulated diagnostic casts can be performed for a better diagnosis and treatment plan; tooth preparations can be simulate on the casts, and diagnostic wax-up procedures allow evaluation of the desired effect of planned treatment (Fig. 3-53).

Fig. 3-52. *Diagnostic casts mounted in SAM articulator.*

Occlusal contacts analysis with T-Scan.

In 1987, Tekscan, Inc. (South Boston, MA) developed the T-Scan Occlusal Analysis System, a grid-based sensor technology for reliable measurements of occlusal biting forces and contacts placement. This system consists of a hand-held device with a flat, U-shaped pressure-measuring sensor, which is placed into the patient's mouth between dental rows and produces measurement at a consistent rate of 100Hz which are analyzed with software (Fig. 3-54, Fig. 3-55). This unit produces a frame-by-frame (equal to 0.01 seconds) T-Scan movie, which appears on PC screen. The screen displays the percentage of forces per tooth and a two-dimensional arch view that can be divided into quadrants. Also a three-dimensional force diagram on dental arch model and chart of forces appear in time (Fig. 3-56).

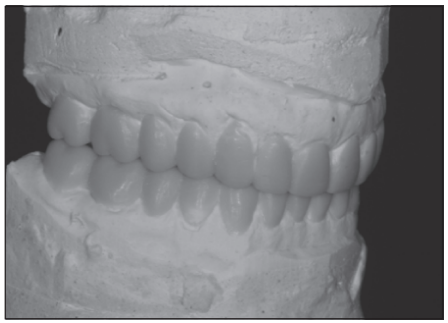

Fig. 3-53. *Diagnostic models with wax up.*

If the patient has the mouth closed the first contact will expose to the movie-window with real time chart. Sequentially all contacts will be shown as time grows. As soon as record is completed the real time window becomes a movie window. It is possible to review and analyze the recorded occlusal forces data refer to time and teeth row sides. Movie displays occlusion in 2-D and 3-D windows with center of forces exposure. For each closure occlusion start

time and occlusion time end are labeled on the Graphs and calculated to norm. Each heavy force point can be marked, grinded and checked after grinding with this device. The T-scan system is capable to record intercuspal position, centric relation, protrusion, left-right laterotrusion contacts and maximal intercuspal clench.

The T-Scan III has many applications in dentistry, including the occlusion balancing on implant supported dentures, fixed prosthetics occlusion equilibration, periodontics and orthodontic treatment occlusal trauma checking and removing.

Digital analysis of occlusion with T-Scan has advantages before occlusal paper: where is no influence of saliva, possibility to analyze first contacts, premature contacts, contacts power, occlusion and disocclusion timing.

Fig. 3-54. *T-scan in working condition*

Fig. 3-55. *T-scan with sensor and fixator.*

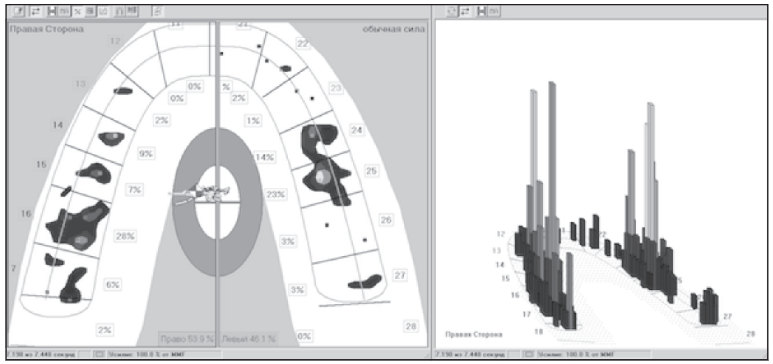

Fig. 3-56. *2D and 3D forces charts.*

Disadvantage of the method is influence of sensor thickness and approximately contacts orientation on the screen. So it needs to use diagnostic models and thin occlusal paper with T-Scan together.

Medical History in prosthetic department

Medical history (case history) is an official and required by doctor document which was approved by Ministry of Public Health of Ukraine order №302 from 27.12.1999. Statistic form №043/0.

Structure of dental medical history:

I. Main information.

II. Anamnesis.

A. Chief complaints.

B. Anamnesis morbi:

- ✓ type of nutrition;
- ✓ cause of teeth losing;
- ✓ using of dentures in past (type of construction, term of sing);
- ✓ oral cavity pathology in past and their possible therapy;
- ✓ bad habits in childhood.

C. Anamnesis vitae:

- ✓ social history (general information about patients work, working and live conditions);
- ✓ genetic predisposition;
- ✓ general diseases in history (especially hepatitis, tuberculosis, HIV, AIDS, oncological processes, allergic status);
- ✓ intoxication habits (smocking, alcohol, drugs);
- ✓ sleeping, rest, appetite, anxiety.

III. Objective examination:

- ✓ face configuration (type, symmetry, skin color and condition);
- ✓ chewing muscles condition;
- ✓ TMJ condition;
- ✓ mucous status;
- ✓ dental formula;
- ✓ teeth characteristics (vitality, mobility, shape, color, wearing, placing, structure, dental calculus, presence of restorations);
- ✓ oral hygiene;
- ✓ type of dental row defects (using of Kennedy or Betelman classifications of dental rows defects);

- ✓ type of bite (using of Engle classification);
- ✓ masticatory efficiency (using one of static methods);
- ✓ radiograph investigation;
- ✓ morphological characteristics of jaw bones;
- ✓ condition of oral cavity tissues before prosthetic treatment.

IV. Diagnosis:

a) topography of defect;

b) percent of masticatory efficiency (by Agapov or Oxman);

c) esthetic disturbance;

d) speech disturbance.

V. Treatment plan.

VI. Doctors diary.

VII. Epicrisis.

Information about the patient's general health is essential for the planning of his dental care planning. Some medical conditions will influence the component items of a treatment plan or change its whole direction, while others will influence the way in which "normally" planned care is delivered.

THE DIAGNOSIS.

After accurate and full examination clinician forms a diagnosis. Diagnosis is based on patient's complaints, clinical and instrumental examination results. It must demonstrate morphological and functional disturbances of maxilla-facial area. Morphological disturbances include teeth defects (caries, erosion, pathological wearing, etc.), dental row defects, pathological bites, periodontal pathology, temporo-mandibular disorders, dentoalveolar deformities, masticatory muscles and tongue pathology, mucosa pathology. Functional disturbances include decreasing or loss of masticatory efficiency, swallowing dysfunctions, speech, respiration, esthetics, and chewing problems.

During diagnosis formulation clinician must specify and sign general cause of disease or etiology, pathogenesis (history of disease development), localization of the pathological process, stage and character of disorder.

Basically Diagnosis is divided into three parts: 1) General disorder; 2) Their complications; 3) Concomitant conditions (dental and general, pathogenetically associated with general disorder). Most of clinicians recommend considering as general disorder the one which causes the most negative effect on people's life and health. General disorder must be treated in prosthetic dentistry department, contaminant in other departments (therapeutic, orthodontic, surgical, and neurological).

Prosthetic Diagnosis is divided into three parts:

1) Etiological (cause of teeth defects or loss);

2) Anatomical (based on classifications of dental row defects by Kennedy or Betelman, hard tooth tissues defects by Milikevych or Black, etc.);

3) Functional (loss of functional efficiency calculation by Agapov or Oxman chart).

True diagnosis in prosthetic dentistry is possible only if clinician has precise information about etiology, pathogenesis, pathological anatomy and clinical signs. Every dentist must improve his skills during all clinician practice.

Thus, diagnostics is the main part of clinical practice on the whole and prosthetic dentistry in particular.

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Questions for self-assessment

1. How can you explain the diagnostic process significance for selecting treatment plan?
2. What methods of intraoral examination do you know?
3. What methods of extraoral examination do you know?
4. What muscles are included in dentistry palpation procedure?
5. How can you examine temporo-mandibular joints?
6. Discuss the various types of radiograph available for diagnostic purposes. What are the advantages and disadvantages of different techniques?
7. What are masticatory force, masticatory pressure, and masticatory efficiency?
8. What methods of masticatory efficiency assessment do you know?
9. What classifications does doctor use for prosthetic diagnosis?
10. How many parts does the prosthetic diagnosis consist of?

Tests for self-assessment

1. Patient 55 years, applied to the clinic with complaints about difficulty in chewing and aesthetic defects. It is known from anamnesis, that teeth are taken after caries complications, during a year. Before to the doctor did not apply. Objective status: 18, 17, 16, 15, 14, 13, 12, 11, 21, 22, 23, 26, 27, 28, 37, 36, 35, 33, 32, 31, 41, 42, 43, 44, 46, 47, 48 are present. Mucous membrane is without visible pathological changes, even atrophy of alveolar rim. The 46 has the 1st degree of mobility. To find a complete diagnosis, choose the construction of prosthetic bridge. What additional method of examinations must be used?

A. Electromyography
B. Electrocardiography
C. Orthopantomography
D. X-rays of abutment teeth

2. Which devices simulate the lower jaw movements?

A. Occludators.
B. Occludators, articulators.
C. Articulators.
D. Gnatomat Junior, Biocop, Gizi, Simplex.

3. A 56-year-old patient complains of missing lateral teeth on both sides of mandible. Objectively: the 48, 47, 46, 45, 35, 36, 37, 38 teeth are missed. Make a diagnosis:

A. Kennedy I dentition defect
B. Kennedy IV dentition defect
C. Kennedy II dentition defect
D. Kennedy III dentition defect

4. A 28-year-old patient complains of a cosmetic defect in the frontal part of his upper jaw. Objectively: the crown part of the 11 tooth is decayed below the gum level. The root is stable, percussion is painless. It is planned to restore the tooth with a post-and-core and metal-ceramic crown. What additional method of diagnostics should be applied in this clinical situation?

A. X-ray diagnostics
B. Electromyography
C. Masticatiography
D. Gnathodynamometry

5 A 38-year-old patient complaints of metal taste, dry mouth and tongue burning. Objectively: defects of the lower dental arch were replaced with soldered stainless steel bridges. What examination method would be the most appropriate in this case?

A. Galvanometry
B. Masticatiography
C. Occlusiography
D. Electroodontometry

6. Tooth replacement with complete removable dentures involves adjustment of occlusal relations by different movements of the lower jaw. Transversal movements of the lower jaw are initiated by the following muscle:

A. External (lateral) pterygoid muscle
B. Internal (medial) pterygoid muscle
C. Mastication muscle
D. Digastric muscle

7. Patient K., male, 22 years old complaints of pain in 11 tooth that happens from time to time. Objectively 11 tooth has old big restoration and changed it color. In future doctor will plan to cover it with all-ceramic crown. What additional examination method does doctor need in this case?

A. EMG
B. JVA
C. Galvanometry
D. Electroodontometry

8. Patient V., female, 34 years old complaints of weared teeth. Objectively all teeth have wear facets in occlusal and incisal surfaces, lower incisors clinical crowns are weared on half of height. What additional examination method does doctor need in this case?

A. Galvanometry
B. Odontoparodontogramm
C. JVA
D. EMG

9. The patient's dental formula is 17, 14, 13, 12, 11, 21, 22, 23, 24, 27, 37, 33, 32, 31, 41, 42, 43, 44, 47. What percent of masticatory efficiency does he have by Agapov?

A. 100
B. 52
C. 34
D. 20

10. Subjective investigation is composed of the next parts:
A. Conversation with a patient and visual patient`s examination
B. Collection of facts about patient`s life and development
C. Patient`s face and mouth cavity examination
D. Passport details, patient`s complaints, anamnesis morbi, anamnesis vitae.

11. Masticatory effectiveness is studied according to the method of:
A. Suple, Lund
B. Shreder, Keller
C. Agapov, Oksman
D. Black

12. Defects of teeth hard tissues are classified according to:
A. Betelman
B. Kennedy
C. Supple
D. Black, Milikevych

Test #	Key
1.	C
2.	B
3.	A
4.	A
5.	A
6.	A
7.	D
8.	D
9.	B
10.	D
11.	C
12.	D

CHAPTER 4.

Anesthesia in a prosthetic dental clinic

Indications for anesthesia in prosthetic dental patients.

According to the literature from 42.4% to 84% of patients are in a state of nervous tension before the teeth preparation, due to the possible feeling of pain. Teeth preparation for stamped crowns is accompanied by pain in 47.1% of cases, preparation for acrylic crown in 68.3% of cases and under PFM crowns 96.5% of cases.

The incidence of pain depends on the depth of preparation of solid tissue.

In depth preparation distinguished:

1) Surface preparation - in the enamel (to dentin-enamel boundary) for example stamped or metal cast crowns.

2) The average depth of the preparation (in the range of surface dentin) for example plastic, ceramic, composite crowns.

3) Deep dissection (within vasodentin) for example PFM or combined crowns.

Changes in pulp after preparation

While preparing a tooth for all coverage (crown or bridge), it is necessary to place a temporary restoration. Because tooth preparation can case numbers of factors that can lead to inflammatory changes in the pulp.

Even at careful and sparing treatment of tooth under anesthesia and with cooling of his fabrics inflammation of pulp is possible, most often it is met in patients older than 35 years. The decline of functional properties of pulp creates terms for speed-up development of its inflammation in connection with the total action of local factors (high temperature, vibration of tooth, partial or complete absence of enamel coverage and other).

However, except for the vessels reaction, damaged odontoblasts, there is retraction of the nuclei in the dentinal tubules. Alterative changes begin at submicroscopic level and manifest disorders of energy metabolism in the pulp: inhibition of enzyme activity is observed by respiratory terminal oxidation and ATPase, disturbed exchange of nucleic acids is the depolymerization of

glycosaminoglycans, thus accumulated lactic acid and other oxidized metabolites. In the process of oxidative phosphorylation, ATP synthesis is enhanced, resulting in both a qualitative and quantitative changes in the oxidation-reduction processes in the pulp and development of oxygen deficiency. Following hypoxia is joined by other mechanisms, contributing to a violation of the trophic pulp and determine its humoral regulation. There are biologically active substances - histamine, serotonin, acetylcholine, which are exempted from degranulated tissue basophils, increased vascular permeability, thereby increasing the osmotic pressure of the tissues.

According to that the blood circulation in the pulp is in a constant volume of the cavity of the tooth, the expansion of blood vessels, leading to increased pressure in the pulp tissue, is a violation of its existence. In the initial stages of the inflammatory response poor circulation is compensated by the acceleration of venous flow under the influence of pulse fluctuations of the arteries and an abundance of capillary network. However, the increase in vascular permeability leads to the exit from the vascular bed into the surrounding tissue of the liquid part of blood and blood corpuscles.

In inflammatory conditions there is a decrease of pH, which promotes the formation of vasoactive polypeptides, contributing to the inflammatory response. This, in turn, results in damage to the subcellular structures - lysosom and mitochondria pulp. With increased lysosomal membrane permeability, or if they are breaking the release of hydrolytic enzymes that cause the denaturation of the protein substrates. In the process of alteration nerve receptors, cells, intercellular substance, and the vessels of the pulp are involved. Inflammatory response in the pulp increases in exudation and migration of cellular elements. Exudate in the beginning, is serous in nature, as it is seropurulent and purulent at the end. Polymorphonuclear leukocytes, which accumulate in the inflammatory exudate, can also damage the pulp due to excessive release of vasoactive proteases. It passes, directly or through the formation of kinins causing destructive changes in the pulp. Important role in the vascular changes while inflammation belongs to granulocytes collagenase enzyme, cleaving the collagen fibers into separate fragments. In the process of exudation increased swelling of pulp tissue, exacerbated by tissue hypoxia, anaerobic glycolysis and acidosis is observed. Violation of the outflow due to stasis in the vessels and their compression exudate, clogging clots causing further accumulation of organic acids that increase local acidosis also present. Tissue damage

accompanied by destruction of a significant number of cells, resulting in freed they contain potassium. Potassium concentration also increases due to enlarged permeability of the membrane of intact cells, caused by inflammation. Increase of the potassium amount in the pulp leads to disruption of the normal state electrolytes. Change by the pulp nervous system tone is increased by congestion. Large quantities of biologically active substances, stimulating the nerve receptors of the pulp through exudation and increase the pressure in the tooth cavity contribute to the emergence of pain characteristic of pulpitis, are produced. Condition is reversible if eliminate the source of inflammation before it will reachs the power that can cause alteration of the tissue. If the action of damaging factors continues, stepping accumulation of leukocytes, it will lead to the formation of pus in the pulp microfoci, abscess and phlegmon.

Theories of pain appearance.

1. Theory nervous (Avery and Rapp). Pain sensitivity due to the presence of nerve endings directly in dentine. Existing theory without morphological evidence, but to date, some authors provide evidence of the nerve fibers in the dentine of type A-delta.

2. Theory of vascular receptors (theory by Fomin). The cause of pain is biologically active substances which are released during the destruction of odontoblasts and act on receptors located in the vessel walls of the pulp.

3. Theory of odontoblastic transformation. Pain occurs when exposed part react to a stimulus while the odontoblast process and subsequently transfers to the nerve fiber. Synaptic contacts were found between of the odontoblasts and nerve fibers.

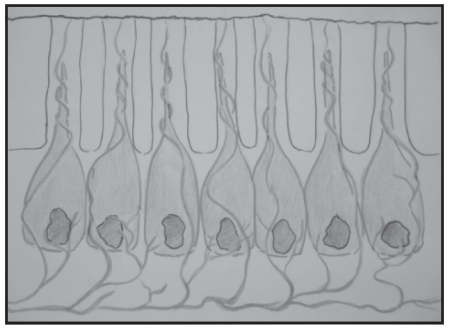

Fig. 4-1. *Theory of nerve fibers.*

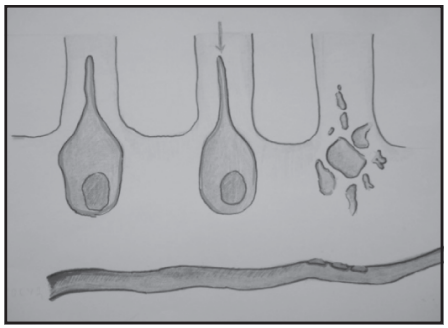

Fig. 4-2. *Theory of vascular receptors.*

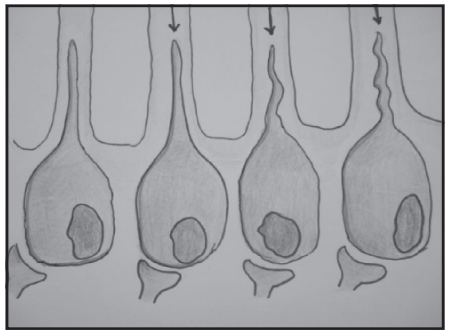

Fig. 4-3. *Theory odontoblastic transformation.*

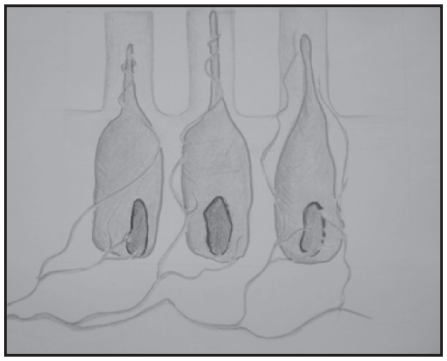

Fig. 4-4. *Hydrodynamic theory.*

4. Hydrodynamic theory (theory by Br?mstr?m). Pain occurs when the dentinal tubules fluid chang flow under the influence of the stimulus, that leads to deformation of subodontoblastic plexus nerve fibers.

The arousal of the two components of pain (the first rapid or sharp pain and the second dull pain) are considered to be related to activation of A delta- and C-type nociceptive primary afferents. The same dichotomy of pain sensations may also exist in teeth, although due to the short distance between the site of stimulation and the brain the two sensations might not be as clearly separated as in stimulation of, for example, the extremities. The sensations are evoked by stimulation of human teeth vary according to the type of the stimuli applied. Low-intensity electrical stimulation is able to induce non-painful (prepain) sensations. At high current intensities pain is evoked. Drilling, probing and air-drying of exposed dentin induce only pain. Most studies also indicate that thermal stimulation only induces painful sensations. The quality of dental pain can vary. Typically, dentinal stimulation of teeth with healthy pulps induces sharp pain. On the other hand intense heat stimulation can result in dull pain which radiates to a wider area of the face and jaws. This component of the stimulus-induced pain seems to share some characteristics of toothache associated with painful pulpitis. Single fibre recordings of intradental nerve activity in experimental animals have shown that in addition to A-fibres a considerable number of C-type primary afferents innervate the dental pulp. This is in accordance to the results of neuroanatomical studies, which indicate that 70-80% of pulpal axons in human, monkey, dog, and cat teeth are

unmyelinated. Intradental A- and C-fibre groups seem to be functionally different and can be activated separately by certain external stimuli. Comparison of the response characteristics of the pulp nerve fibres and the sensations induced from human teeth indicate that:

1) A-fibres are responsible for the sensitivity of dentine and thus for the mediation of the sharp pain induced by dentinal stimulation,

2) prepain sensations induced by electrical stimulation result from activation of the lowest threshold A-fibres some of which can be classified as A beta-fibres according to their conduction velocities. Comparison of the responses of the A beta- and A delta-fibres indicate that they belong to the same functional group,

3) intradental C-fibres are activated only if the external stimuli reach the pulp proper. Their activation may contribute to the dull pain induced by intense thermal stimulation of the tooth and to that associated with pulpal inflammation.

Classification of anesthesia hard tissue of teeth in prosthetic dentistry

1) Psychotherapeutic method. These methods include the suggestion, hypnosis, and other similar techniques

2) Pharmacologic pain relief (most used group of methods in prosthodontics, therefore, this group of methods will be discussed in great detail):

a). Topical anesthesia
b). Injection anesthesia
c). Tranquilizers
g). Narcosis

3) Physical methods (this group include methods such as electro analgesia)

4) Combined methods

Indication for topical anesthesia:

1. Preparation of cavities for inlays
2. Slight tooth preparation(when removing a layer of enamel)
3. Removing the gag reflex increased before taking impressions
4. Anesthesia injection site.

Indications for injection anesthesia

1) Preparation of teeth for combined crowns
2) Preparation of teeth with hard tissue hyperesthesia
3) Preparation of teeth with the expressed Popov-Godon phenomena

4) Preparation cavities under the inlays

5) Preparation of teeth with a distinct equator

6) Psychological stress patients before preparation

Indication for general anesthesia

1. Allergy to local anesthetics

2. Functional disorders of the nervous system (neuralgia, hysteria)

3. Individuals with unstable nervous system, prone to such complications: syncope, tachycardia, nausea, vomiting, tremors etc.

4. Contraindications for injection type of anesthesia.

1. Patients intolerant of local anesthetics (absolute contraindication)

2. Cardiovascular failure

3. Expression of functional impairment in liver and kidney

4. Functional disorders of the nervous system (neuralgia, hysteria)

5. Hemophilia

Injections anesthesia is the most commonly used form of anesthesia.

In prosthetic dentistry to dental anesthesia at preparing the particular use of the following techniques is given:

Tab. 4.1.

Indications for different types of injection anesthesia in prosthetic dentistry

Kind of local anesthesia	Indication
Nerve block	Preparation group of teeth on the lower jaw, lower jaw molars
Infiltration	Preparation of upper teeth, preparation of anterior teeth and premolars of the lower jaw with the use of anesthetics of the fourth generation with high level of vasoconstrictor
Intraligamentary anaesthesia	Preparation of teeth of the upper and lower jaw, additional anesthesia during non effective nerve block anesthesia in the mandible
Intraseptal anaesthesia	Preparation of teeth of the upper and lower jaw, additional anesthesia during non effective nerve block anesthesia in the mandible

Choice of the anesthesia

Tab. 4.2.

Choice of the anesthesia for lower jaw

	Factors causing the choice				
The method of anesthetic anesthesia	**The teeth of the lower jaw**	**Hemophilia**	**Diseases of the CAS**	**Duration of intervention**	**Kind of local**
Infiltration	35, 34, 33, 32, 31, 41, 42, 43, 44, 45 – the use of 4th generation anesthetics, 33, 32, 31, 41, 42, 43 – the use of anesthetics for 3 generations	-	±	Last no longer than 40-50 minutes (when using anesthetics 4th generation), 30-40 min (using a 3-generation anesthetics)	Anesthetics 3-4 generations (Special or Forte)
Nerve block (mandibular)	38, 37, 36, 35, 34, 33, 43, 44, 45, 46, 47, 48	– (absolutely contraindicated)	-	1,5 - 2 hours	3-4 generations
Intraligamen-tal and intraseptal	All teeth	+	+	30-50 min	4th generation (with an increased concentration of adrenaline)
Nerve block + Intraligamental or intraseptal	38, 37, 36, 35, 34, 33, 43, 44, 45, 46, 47, 48	-	±	~2 hours	Anesthetics of 3-4 generations may use different anesthetics for different anesthesia

Examination of a patient before anesthesia.

Patients don't intentionally lie about their medical history. The problem is that when they get a question they don't quite understand, it is much easier for them to say "no." The goal is to make the patient answer all questions, those which were answered positively should make doctor focus on those aspects of the medical history that might increase our index of suspicion. This helps the patient to recall any pertinent information and also helps him/her rectify any answers incorrectly indicated. A verbal review in question form of the major organ systems is following:

- Cardiovascular system-"Have you ever had high blood pressure, a heart murmur, heart failure, heart disease, angina, rheumatic fever, mitral valve prolapse, or any heart defects? Did you ever have a heart attack, shortness of breath, easily fatigued, chest pains, heart surgery, insertion of a pacemaker or defibrillator, swollen ankles, or palpitations? Is your fatigue, shortness of breath, or chest pain getting worse? Have you ever been told to take antibiotics before dental or medical treatments?"
- Respiratory system-"Have you ever had difficulty breathing, sinus problems, or emphysema, asthma, or TB exposure? Do you need more than one pillow to sleep on at night or do you wake up choking or gasping for air?"
- Allergies-"Are you allergic to any medicines, codeine, aspirins, local anesthetics in the dental office, or antibiotics? Have you ever had any past reactions while in the dental office like fainting, palpitations, or rashes, etc.?"
- G.I and G.U.-"Have you ever been told about liver problems, bleeding problems, kidney disease? Have you ever received dialysis or hepatitis (A, B, C, etc.) or were you jaundiced?"
- Endocrine and blood systems-"Have you ever had any history of thyroid problems, diabetes (type 1 or type 2), hemophilia, blood transfusions, bleeding problems, or complications after a previous dental extraction?"
- Medications-"Have you taken insulin, aspirin, non-prescription over-the-counter drugs, digitalis, antibiotics, blood thinners, antihistamines, high blood pressure or any other heart medicines, birth control pills, or steroids within last few years?"
- Treatments-"Have you ever received radiation treatments to the head, neck, or any region, cancer chemotherapy, operations, or insertion of something artificial into your heart, arms, legs, or hips? Have you ever been treated for fainting spells, blurred vision, stroke, temporomandibular joint (TMJ) problems,

endocarditis or an infection of your heart, arthritis, painful swollen joints, high or low blood pressure, or seizures? Are you pregnant, breast feeding, had a large weight loss or weight gain recently?"

- Do you have any conditions that were not mentioned on the health history or that we didn't discuss?

Any positive responses could lead to a discussion and an undisclosed illness. It may also help the patient recall an incident from his/her past medical history that he/she may have forgotten. By mentioning symptoms, the patient might reveal a condition requiring a medical evaluation prior to treatment that could pose a possible problem if we initiated treatment.

Tools and armamentarium for local anesthesia.

Syringe

The syringe is one of the three essential components of the local anesthetic armamentarium (others being the needle and the cartridge). It is the vehicle wherein the contents of the anesthetic cartridge are delivered through the needle to the patient.

TYPES

There are seven types of syringe for local anesthetic administration in use in dentistry today. They represent a considerable improvement over the local anesthetic syringes formerly used.

1. Nondisposable

a breech-loading, metallic, cartridge-type, aspirating

b breech loading, plastic, cartridge-type, aspirating

c breech loading, metallic, cart ridge-type, self-aspirating

d. pressure injector

2. Disposable

3. "Safety" syringes

To increase the case of aspiration, several self aspirating syringe systems have been developed.

These syringes use the elasticity of the rubber diaphragm in the anesthetic cartridge to obtain the required negative pressure for

Fig. 4-5. *Dental syringe.*

aspiration. The diaphragm rests on a metal protection inside the syringe that directs the needle into the cartridge. Pressure ailing directly on the cartridge through the thumb disk indirectly through the plunger shaft distorts (stretches) the rubber diaphragm, producing a positive pressure within the anesthetic cartridge. When that pressure is released, sufficient negative pressure develops within the cartridge to permit aspiration. The use of a selfaspirating dental syringe permits multiple aspirations to be performed easily throughout the period of local anesthetic deposition.

Pressure Syringes

Being introduced in the late 19th century pressure syringes brought about a renewed interest in the periodontal ligament injection. Though usable for any tooth, it has made it possible to achieve consistently reliable pulpal anesthesia to isolated tooth in the mandibular arch, whereas in the past nerve block anesthesia, with its attendant potential problem for prolonged soft tissue (e.g.. lingual) anesthesia, was necessary. Second-generation syringe for a PDL injection causes rapid injection of the anesthetic solution aming to patient discomfort both during the injection and later. However when it is used as recommended (slowly) by the manufacturers, these pressure syringes are of some benefit in the administration of this valuable technique of anesthesia.

Safety Syringes

In recent years there has been a move toward the development and introduction of "safety" syringes in both medicine and dentistry. Use of a safety syringe will minimize the risk of accidental needle-stick injury occurring to a denial health provider with a contaminated needle after the administration of a local anesthetic.

Metal and plastic reusable syringes are designed to provide long term service if properly maintained, following a summary of manufacturers recommendations concerning care of these syringes:

1) After each use thoroughly wash and rinse the syringe free of any local anesthetic solution, salts or other foreign matter. Autoclave the syringe in the same manner as other surgical instruments.

2) After every five autoclaving, dismayed the syringe and lightly lubricate all threaded joints and where the piston contacts the thumb ring and guide bearing.

3) Clean the harpoon with a brush after each use

4) Although the harpoon is designed for long term wear prolonged use will result in decreased sharpness and failure to remain embedded within the stopper of the cartridge. Replacement pistons and harpoons are readily available at low cost.

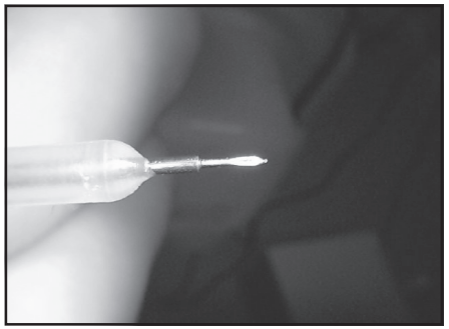

Fig. 4-6. *Needle for intraosseos injection.*

Needles

The needle permits the local anesthetic solution to travel from the dental cartridge into the tissues surrounding the needle tip. Most needles used in dentistry are stainless steel and disposable. Other needles are constructed of platinum or an iridium-platinum or ruthenium-platinum alloy. The stainless steel needle is highly recommended. Needles currently available for dental practices are presterilized and disposable.

Reusable needles should not be used for injections.

All needles have several components in common. These include the bevel, the shank, the hub and the syringe-penetrating end.

When needles are selected for use in various injection techniques, there are two important factors that must be considered: the gauge and the length, Gauge refers to the diameter of the lumen of the needle: the smaller the number, the greater the diameter of the lumen. A 35-gauge needle has a smaller internal diameter than a 25-gauge needle. Long needles are preferred for all injection techniques requiting penetration of significant thicknesses of soft tissue (e.g., the inferior alveolar, Gow-Gates). Short needles may be used for injections that do not require the penetration of significant depths of soft tissue.

Recommendations

1.Sterile disposable needles should be used.

2. If multiple injections are to be administered, needles should he changed after three or four insertions in a single patient

3. Needles must never be used on more than one patient.

4. Needles should not be inserted into tissue to their hub unless it is absolutely necessary for success of the injection.

5. Do not change a needle's direction when it is still in tissue

6. Never force a needle against resistance.

7. Needles should remain capped until used and made safe immediate on withdrawal.

8. Needles should be discarded and destroyed after use to prevent injury or reuse by unauthorized.

9. The following injection techniques are listed with their recommended needles (for the average-size adult);

a. Inferior alveolar nerve block-25-gauge long (25 mm)

b. Gow Gates mandibular nerve block-25-gauge long (25 mm)

C. Supra periosteal (local infiltration)- 27-gauge short (12 mm)

D. Periodontal ligament injection-27-gauge short (8-12 mm)

E. Intraseptal injection-27-gauge short (8mm)

Cartridge

The dental cartridge is a glass cylinder containing, among other ingredients, the local anesthetic drug. In recent years local anesthetic manufacturers in same countries have introduced a local anesthetic cartridge composed of plastic.

The prefilled 1.8 ml dental cartridge consists of four parts:

l Cylindrical glass tube

2. Stopper

6. Aluminum tap

7. Diaphragm

The ***stopper*** (plunger) is located at the end of the cartridge that receives the harpoon of the aspirating syringe. An ***aluminum tap*** is located at the opposite end of the cartridge from the rubber plunger. It fits snugly around the neck of the glass cartridge, holding the thin diaphragm in position. It is silver colored on all cartridges. The ***diaphragm*** is a semipermeable membrane, usually latex rubbers through which the cartridge end of the needle penetrates.

Cartridge contents

The solution contained within The dental cartridge has several components:

Local anaesthetic agent .

Vasoconstrictor :

Reducing Agent: Sodium Metabisulphite

Preservative: Methylparaben

Isotonic Solution: Sodium Chloride

Fungicide: Thymol

Vehicle: Ringer's Solution

Diluting Agent: Distilled water

To adjust pH: Sodium Hydroxide

Nitrogen Bubble: 1-2mm in diameter.

Action of each component

The ***local anesthetic drug*** is the raison d'elre for the entire dental cartridge. It interrupts the propagated nerve impulse, preventing it from reaching the brain.The drug or drugs contained within the cartridge are listed by their percent concentration. The local anesthetic drug is quite stable, capable of being autoclaved, healed, or boiled without breaking down. However, other components of the cartridge are more labile (i.e.. vasopressor drug and cartridge seals).

Mode and site of action of local anesthetics

It is possible for local anesthetic agents to interfere with the excitation process in a nerve membrane in one or more of the following ways:

1. Altering the basic resting potential of the nerve membrane

2. Altering the threshold potential (firing level)

3. Decreasing the rate of depolarization

4. Prolonging the rate of repolarization

It has been established that the primary effects of local anesthetics occur during the depolarization phase of the action potential.

These effects include a decrease in the rate of depolarization particular in the phase of slow depolarization. Because of this, cellular depolarization is not sufficient to reduce the membrane potential of a nerve fiber to its firing level, and a propagated action potential does not develop. There is way accompanying change in the rate of repolarization.

Vasoconstrictor function: Decrease blood flow to the site of injection leads to absorption of local anesthetic into the cardiovascular system,decreases the risk of local toxicity, higher volume of local anesthetic agent remains in and around the nerve for longer period, thereby increasing the duration of action, vasoconstrictor decreases bleeding at the site of their administration.

Mechanism of action of local anesthetics.

There are many methods of inducting local anesthesia:

- Mechanical trauma
- Low temperature
- Anoxia
- Chemical irritants

8. Neurolytic agents such as alcohol and phenol

The dilution of vasoconstrictors is commonly referred to as a ratio (eg, 1:100000, 1:200000)

The genesis of vasoconstrictor dilutions in local anesthetics began with the discovery of adrenalin in 1897 by Abel. In 1903 Braun suggested using adrenalin as a "chemical tourniquet" to prolong the duration of local anesthetics. He recommended use adrenalin in dilution 1:10,000 to 1:100,000 in nasal surgery. It appears, currently that a dilution of 1:200,000 provides comparable results, with fewer systemic side effects of epinephrine. The 1: 200,000 dilution, which contains 5 Mg/ml has become widely used in nub medicine and dentistry and is currently found in articaine, prilocaine, lidocaine, etidocaine and bupivacaine.

Though the most used vasoconstrictor in both medicine and dentistry epinephrine is not an ideal drug. This benches to be gained from adding a vasoconstrictor to a local anesthetic solution must be weighed against any risks that might be present, epinephrine is absorbed from the site of injection, just as is the local anesthetic. Measurable epinephrine blood levels are obtained, which influence the heart and blood vessels. Resting plasma epinephrine levels (39 pg/ml) are doubled following the administration of one cartridge of lidocaine with 1:100,000 epinephrine. The elevation of epinephrine plasma levels is linearly dose-dependent and persists from several minutes to half an hour. Contrary to a previously held position that the intraoral administration of usual volumes of epinephrine produced no cardiovascular response and that patients were more at risk from endogenously released epinephrine than they were from exogenously administered epinephrine. Most recent evidence demonstrates that epinephrine plasma levels equivalent to those achieved during moderate to heavy exercise may occur following intraoral injection. These are associated with moderate increases in cardiac output and stroke volume. Blood pressure and heart rate are minimally affected by all these dosages, in patients with preexisting cardiovascular or thyroid disease, the side effects of absorbed epinephrine must be weighed against those of elevated local anesthetic blood levels. It is currently thought that the cardiovascular effects of conventional epinephrine doses are of little practical concern, even in patients with heart disease. However, even following usual precautions (aspiration, slow injection), sufficient epinephrine can be absorbed to cause sympathomimetic reactions such as apprehension, tachycardia, sweating, and pounding in the chest, the so-called "epinephrine reaction".

Intravascular administration of vasoconstrictors as well as their administration to "sensitive" individuals (hyperresponders) or the occurrence of unanticipated drug-drug interactions can however, produce significant clinical manifestations. Intravenous administration of 0,015 mg of epinephrine with lidocaine results in increases in the heart rate ranging from 25 to 70 beats per minute, with elevations in the systolic blood from 20 to 70 mm Hg. Occasional rhythm disturbances may also be observed, premature ventricular contractions (PVCs) are being the most often noted.

Many other vasoconstrictors used in medicine and dentistry include norepinephrine, phenylephrine, levonordefrin, and octapressin.

Norepinephrine, lacking significant b2 actions, produces intense peripheral vasoconstriction with possible dramatic elevation of blood pressure, and is associated with a side effect ratio nine times higher than that of epinephrine. Although currently available in many countries in local anesthetic solutions, norepinephrine's use as a vasopressor in dentistry is not recommended. The use of a mixture of epinephrine and norepinephrine is to be absolutely avoided.

Phenylephrine, a pure a-adrenergic agonist, theoretically possesses advantages over other vasoconstrictors. However, in clinical trials peak blood levels of lidocaine were actually higher with phenylephrine 1:20.000 (2.4 mg/ml) than with epinephrine 1:200,000 (1.4 mg/ml).

Levonordefrin have cardiovascular effects most closely resemble to those of norepinephrine.

Octapressin was shown to be about as effective as epinephrine in reducing cutaneous blood flow.

Tab 4..3.

Concentration of epinephrine used with a variety of anesthetics.

Dilution with epinephrine	Local anesthetic
1:50,000	Lidocaine
1:80,000	Lidocaine
1:100,000	Articaine, lidocaine
1:200,000	Articaine, mepivacaine
1:300,000	Mepivacaine, articaine

Preservative: Stability of modern local anesthetic solution is maintained by adding caprylhydro-cuprienotoxin which includes xylotox and methylparaben.

Reducing agent: This acts as preservatives for vasoconstrictor agents. Vasoconstrictors are unstable in solution and may oxidize, especially on a prolonged exposure to sunlight. Sodium metabisulphite which competes for the available oxygen is added in the concentration between 0.05% and 0.1% most frequently used is sodium bisulfite. It prevents the destroying of the vasopressor by oxygen, which might he present in the cartridge during manufacture or which can diffuse through the semipermeable diaphragm after filling. Sodium bisulfite reacts with oxygen before the oxygen can destroy the vasopressor. The sodium bisulfite is oxidized to sodium bisulfite, a chemical with an even lower pH the clinical relevance of this lies in the label that increased burning (discomfort) is experienced by the patient on injection of an "older" cartridge of anesthetic with vasopressor than with a fresher cartridge. Allergy to bisulfite must be considered in the medical evaluation of all patients prior to local anesthetic administration.

Vehicle: All the above solutions and local anesthetic agent are dissolved in a modified ringer solution. This isotonic vehicle minimizes discomfort during injection.

Methods of anesthesia (application, conductive, infiltrative)

A topical anesthetic may be used to prepare the tissues at the site of injection prior to the initial needle penetration. Its function is to produce a transient decrease in the bacterial population at the injection site, thereby minimizing any risk of postinjection infection.

The application of a topical antiseptic is considered to be an optional step in tissue preparation prior to intraoral injection. Topical anesthetic preparations are discussed. Their use prior to initial needle penetration of the mucous membrane is strongly recommended. It is recommended that a minimal quantity of topical anesthetic is to be applied to the end of the applicator stick and placed directly at the site of penetration for approximately 1 minute. Any patient receiving local anesthetic injections should be in a physiologically sound position prior to and during the injection.

Aspiration must always be carried out prior to deposing a volume of local anesthetic at any site.

With the needle in position al the target and aspirations completed negative begin pressing gently on the plunger to start administering the predetermined (for the technique) volume of anesthetic.

During deposition of the local anesthetic it is important to communicate with the patient.

After completion of the injection the doctor or assistant should remain with the patient while the anesthetic begins to take effect.

The supraperiosteal injection, is the most frequently used local anesthetic technique for obtaining pulpal anesthesia in maxillary teeth, especially in prosthodontics. The supraperiosteal injection is indicated whenever dental procedures are confined to a relatively circumscribed area in either the maxilla or the mandible. The entire region innervated by the large terminal branches of this plexus: pulp and root area of the tooth, buccal periosteum.

Indications

a. Anesthesia of the maxillary teeth

b. Anesthesia mandibular incisors, canine and premolars (when used anesthetics 4th generation).

c. Soft tissue anesthesia when indicated gingival retraction.

Contraindications

1. Infection or acute inflammation in the area of injection

2. Dense bone covering the apices of teeth for example maxillary first molar, central incisor apex may also be located beneath denser bone (i.e., of the nose), thereby increasing the failure rate.

Advantages

1.High successful rate (> 95%)

2.Technically easy injection

3.Usually entirely atraumatic

Disadvantages. Not recommended for large areas, because of the need for multiple needle insertions and the necessity to administer larger amount of anesthetic solution.

The success rate of the inferior alveolar nerve block is lower than for most other (maxillary) nerve blocks. Because of anatomical considerations in the mandible (primarily the density of bone) the administrator must accurately deposit local anesthetic solution to within 1 mm of the target nerve. The inferior alveolar nerve block has a significantly lower success rate because of two factors-1) anatomical variation in the height of the mandibular foramen on the lingual side of the ramus and 2) the greater depth of soft tissue penetration required-that consistently lead to greater inaccuracy.

The inferior alveolar nerve block, is the most frequently used and quite possibly the most important injection technique in dentistry, unfortunately it also proves to be the most trust rating, the one with the highest percentage of

clinical failures (approximately 15% to 20%) even when properly administered. Supraperiosteal injection (infiltration) may be needed in the lower incisor region to correct partial anesthesia caused by the overlap of sensory fibers from the contralateral side. A periodontal ligament (PDL) injection might be required when isolated portions of mandibular teeth (usually a first mandibular molar) remain sensitive following an otherwise successful inferior alveolar nerve block. The administration of bilateral inferior alveolar nerves blocks is considerable discomfiture, primarily from the lingual soft tissue anesthesia which usually persists for several hours after injection (the duration, of course, being dependent upon the particular anesthetic used).

Partial anesthesia possible where a divided inferior alveolar nerve and divided mandibular canals are present.

The Gow-Gates Technique

Successful anesthesia of the mandibular teeth and soft tissues is more difficult to achieve than anesthesia of maxillary structures. Failure rates of up to 20% are not uncommon with the inferior alveolar nerve block technique previously described. Primary factors for this failure arc the greater anatomical variation in the mandible and the need for deeper soft tissue penetration. In 1973 George Gow-Gates, a general practitioner of dentistry in Australia, described a new approach to mandibular anesthesia. He had been used this technique in his practice for approximately 30 years, with an astonishingly high success rate approximately 99% .

The Gow-Gates technique is a true mandibular nerve block since it provides sensory anesthesia to virtually the entire distribution of inferior alveolar, lingual,

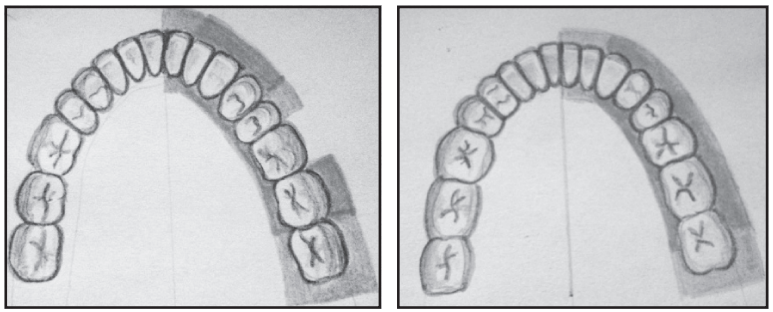

Fig. 4-7. *Different areas of anesthesia on mandible after IANB (Red - complete, Yellow - partial), depends on the availability of additional sources of innervation.*

mylohyoid, mental, incisive, auriculotemporal and all nerves are blocked in the Gow-Gates injection.

Significant advantages of the Gow-Gates technique over the inferior alveolar nerve block include its higher success rate, its lower incidence of positive aspiration (approximately 2% versus 10 to 15% with the inferior alveolar nerve block), and the absence of problems with accessory sensory innervation to the mandibular teeth.

Intraosseous anesthesia involves the deposition of local anesthetic solution into the bone that supports the teeth. Though not new-intraosseous anesthesia dates back to early 1900 - a resurgence of interest to this technique in dentistry has taken place over the past 15 years.

Intraligament anesthesia (Periodontal Ligament Injection)

On rare occasions supraperiosteal injection in the apical region of a mandibular lateral incisor will provide effective pulpal anesthesia. However, in other regions of the mandible a regional nerve block must be administered to teeth anesthesia in recent years an old technique hits become repopularized. The technique, known is either the periodontal ligament (PDL) injection or the iniraligamentary injection (ILI) was originally described as the peridental injection in local anesthesia textbooks dating from 1912 to 1925.

The peridental injection was not well received in those earlv years, because it was claimed that the risk of producing blood born infection and septicemia was too great to warrant its use in patients the technique never became popular but was used clinically by many doctors, though it was not referred to as the peridental technique. In clinical situations in which an inferior alveolar nerve block failed to provide adequate anesthesia to the first molar (usually its mesial root), the doctor would insert a needle along the long axis of the mesial root as far apically as possible and deposit, under pressure, a small volume of local anesthetic solution. This invariably provided effective pain control.

Fig. 4-8. *Anesthetic spread during intraligamentary anesthesia (radiopaque research). (by A.Zh.Petrykas, 1989)*

Fig. 4-9. *Orapix dispenser*

Fig. 4-10*. Wand system.*

It was not popular until the early 1980s that the intraligamentary or PDL- Injection gained the popularity it still maintains today. Credit for its increased interest must go to the manufactors of syringe devices designed to make the injection easier to administer. These original devices, the Peripress and Ligmaject. Provide a mechanical advantage that allows the administrator to deposit the anesthetic more easily.

The PDL injection may also be used quite successfully in the maxillary arch; however, with the ready availability of other highly effective and atraumatic techniques. Such as the supraperiosteal (infiltration) injection to provide single pulpal anesthesia, there has been little compelling reason for use of the PDL in the upper jaw (although their is absolutely no other reason not to recommend it in this area).

Slow administration of the anesthetic makes the PDL injection atraumatic. Improper use (read: fast injection) of the PDL syringe produces both immediate and postinjection pain.

The extreme pressure applied to the glass may shatter the cartridge. The PDI syringes provide a metal or plastic covering for the glass cartridge, thereby protecting the patient from shards of glass should the be conducted during injection.

The Wand system

Many manufacturers of PDL syringes recommend use of 30-gauge short or 30-gauge ultrashort needles in this technique.

Indications

1. Anesthesia of one or two teeth in a quadrant
2. Treatment of isolated teeth in two mandibular quadrants (to avoid bilateral inferior alveolar nerve block)
3. Patients to whom residual soft tissue anesthesia is undesirable
4. Situations in which regional block anesthesia is contraindicated
5. As a possible aid in diagnosis of pulpal discomfort
6. As an adjunctive technique following nerve block anesthesia if partial anesthesia is present.

Contraindications

1. Infection or inflammation at the site of injection
2. Patient who requires a numb sensation for psychological comfort

Intraseptal Injection

The intraseptal injection is similar in technique and design to the PDL injection. Saadoun has shown that the path in diffusion of the anesthetic solution is through the medullary bone, as in the PDL injection.

Advantages

1. Lack of lip and tongue anesthesia (appreciated by most patients)
2. Minimum volumes of anesthetic solution required
3. Minimized bleeding during the surgical procedure
4. Atraumatic
5. Immediate (up to 30 seconds) onset of action
6. Very few postoperative complications
7. Useful on periodontally involved teeth (avoids infected pockets)

Disadvantages

1. Multiple tissue punctures may be required
2. Comparatively short duration of pulpal anesthesia;

Fig. 4-11. *Intraligamentary injection.*

Fig. 4-12. *Intraseptal anesthesia.*

3. Clinical experience necessary for success

Duration of expected anesthesia

The duration of anesthesia is 27-35 min

Intraosseous Injection

Deposition of local anesthetic solution into the interproximal bone between two teeth has been practiced in dentistry since the start of the twentieth century. Originally intraosseous anesthesia required the use of a half-round bur to provide entry into intraseptal bone that had been surgically exposed. Once the hole had bean made, a needle would be inserted into this hole and anesthetic solution deposited.

The periodontal ligament and intraseptal injections, previously described, are modifications of intraosseous anesthesia. In the PDL injection the anesthetic solution enters the interproximal bone through the periodontal tissues surrounding a tooth, while in the intraseptal technique the needle is gently embedded into the interproximal bone without the use of a bur.

In recent years the intraosseous technique has been modified with the introduction of a new device that simplifies the procedure. This system consists of two parts: a perforator, a solid needle that perforates the cortical plate of bone with a conventional slow-speed contraangle handpiece, and an 8 mm long 27-gauge needle that is inserted into this predrilled hole for anesthetic administration.

Experience with the intraosseous technique has shown that the perforation of the interproximal bone is usually entirely atraumatic.

Intraosseous injection technique can provide anesthesia of a single tooth or of multiple teeth in a quadrant. To a significant degree the area of anesthesia will be independent upon both the site of injection and the volume of anesthetic solution deposited, it is recommended that 0.45 to 0.6 ml of anesthetic should be administered when treatment is to be confined to not more than one or two teeth. Greater volumes, up to 1,8 ml may be administered when treatment of multiple teeth in one quadrant is contemplated. The intraosseous injection may be used when managing six or eight mandibular anterior teeth (first premolar to first premolar bilaterally, for example).

As the injection site is relatively vascular it is suggested that the volume of local anesthetic delivered should be kept to recommended minimum to avoid possible overdose.

Pulpal anesthesia till between 15 and 30 minutes can be expected.

Mistakes and complications of anesthesia.

Tab. 4.5.

Recommendation for the use of local anesthetics in medically compromised patients

		Local anaesthetic	Vasoconstrictor	Other aspects
Alcoholism		Reduce maximum dose		
Allergy towards				
	Anaesthetic	Other type of (documented) anaesthetic (depending on allergy testing results)		Alternative: general anaesthesia
	Antioxidant (bisulphite)		Only adrenaline without bisulphite added	Bisulphite contraindicated. Alternative: felypressin containing anaesthetic
	Latex			Glass cartridges with rubber diaphragm contraindicated Alternative: fill plastic syringe with anaesthetic
Anaemia	Reduce maximum dose of prilocaine			
Angina pectoris	Unstable	Contraindicated		
	Other		Reduce adrenaline	

Anorexia nervosa		Reduce maximum dose		
Asthma				Preservatives discouraged
Behavioural disorders - using medication			Reduce adrenaline	
Bradycardia		Reduce maximum dose	Reduce adrenaline	
Bronchitis chronic			Reduce adrenaline	Bilateral regional block anaesthesia discouraged
Cardiac rhythm abnormalities			Reduce adrenaline	
Cocaine < 24 h ago			Adrenaline contraindicated	
Celiac disease		Reduce maximum dose		
COPD			Reduce adrenaline	Bilateral regional block anaesthesia discouraged
CVA	-<1 year ago			Consult patients physician
	->1 year ago		Reduce adrenaline	
Diabetes mellitus poorly			Reduce adrenaline	
Eczema constitutional				Preservatives discouraged
Extreme fear (of needles, syringe, anesthetics)				Alternatives: the Wand, general anaesthesia, premedication
G6PD-deficiency		Prilocaine discouraged		
Gastro-oesophageal reflux disease		Reduce maximum dose		

Glaucoma			Reduce adrenaline	
Haemophilia factor level <50%				Regional block anaesthesia discouraged
Hemorrhagic diathesis				Avoid regional blocks, if possible
Heart failure		Reduce maximum dose	Reduce adrenaline	
Heart valve defects (including valve replacements)				Intraliga-mentary injection discouraged
Hepatitis		Reduce maximum dose		If necessary, use ester type anaesthetic
Huntington's disease - using medication			Reduce adrenaline	
Hypertension			Reduce adrenaline	
Hyperthy-roidism - uncontrolled			Adrenaline contraindicated	Postpone treatment
Hypoprotein-aemia		Reduce maximum dose		
Hypothyroidism		Reduce maximum dose		
Ischaemic heart disease		Reduce maximum dose	Reduce adrenaline	
Kidney insufficiency		Reduce maximum dose		
Leukaemia - with increased bleeding tendency				Regional block anaesthesia discouraged
Liver cirrhosis		Reduce maximum dose		If necessary, use ester type anaesthetic
Lung emphysema			Reduce adrenaline	Bilateral regional block anaesthesia discouraged

Malunion		Reduce maximum dose		
Marijuana - recent use				Adrenaline discouraged
Myasthenia gravis			Reduce adrenaline	
Myocardial infarction	-<6 weeks ago treatment	Contraindicated		Postpone
	->6 weeks ago	Reduce maximum dose	Reduce adrenaline	
Old age		Reduce maximum dose	Reduce adrenaline	
Osteopetrosis			Reduce adrenaline	
Parkinson's disease - using medication			Reduce adrenaline	
Peptic ulcer - using cimetidine or proton pump inhibitor		Reduce maximum dose		
Pheochromo-cytoma			Adrenaline contraindicated	
Porphyria		Lidocaine and mepivacaine discouraged		
Pregnancy		Bupivacaine discouraged; another anaesthetic with high degree of protein bilding first choice; reduce maximum dose	Felypressin discouraged; reduce adrenaline	If possible postpone treatment
Psychiatric disorders - using medication			Reduce adrenaline	
Radiotherapy - of head and neck area			Reduce vasoconst-rictors	

Short bowel syndrome		Reduce maximum dose		
Sickle cell anaemia		Reduce maximum dose of prilocaine	Reduce adrenaline	
Spasticity				Injection needles in mouth discouraged. Alternative: inflation sedation or general anaesthesia
Systemic lupus erythematosus - advanced disease		Reduce maximum dose		
Thrombocy-topenia - platelets< 50,000/mm3			Avoid regional blocks, if possible	
Von Willebrand's disease			Avoid regional blocks, if possible	

Complication of anesthesia

Local complications include: pain on place of insertion, needle breakage, pain on injection, burning on injection, persistent anesthesia or paresthesia, trismus, hematoma, infection, edema, sloughing of tissues, sterile abscess, soft tissue injury, facial nerve paralysis, postanesthetic intraoral lesions, pain on withdrawal.

Problems of injection

Leakage During Injection

When reloading a syringe with a second local anesthetic cartridge and a needle already in place, one should he sure that the needle penetrates the center of the rubber diaphragm. An out center perforation will produce an ovoid puncture of the diaphragm that permits leakage of the anesthetic solution around the outside of the metal needle and into the patient's mouth.

Broken Cartridge

A hardly worn syringe may damage the cartridge, leading to breakage. This can also result from a bent harpoon. A needle that is not sharp at its proximal end may not perforate the diaphragm on the cartridge. Positive pressure of the thumb ring increases intracartrige pressure, which can cause the cartridge to break.

Bent Harpoon

The harpoon must be sharp and straight. A bent harpoon produces an off-center puncture of the rubber plunger, causing the plunger to rotate as it moves down the glass cartridge This may occasionally result in cartridge breakage.

Disengagement of the Harpoon from the Plunger during Aspiration.

Disengagement occurs if the harpoon is dull or if the administrator applies too much pressure to the thumb ring during aspiration. If this occurs the harpoon should be cleaned and sharpened or replaced with a new sharp harpoon. A very gentle backward motion of the plunger is all that is required for successful aspiration.

Surface Deposits

An accumulation of debris, saliva, and disinfectant solution interferes with syringe function and appearance Deposits,which can resemble rust, may be removed with a thorough scrubbing. Ultrasonic cleaning will not harm syringes.

General complications

CLASSIFICATION OF ADVERSE DRUG REACTIONS

Overdose reactions, allergy, and idiosyncrasy are very important topics in relation to local anesthetics and pain control in dentistry.

Overdose reactions are those clinical signs and symptoms that manifest as a result of an absolute or relative overall administration of a drug, which produces elevated levels in the blood. Clinical manifestations of overdose are related to a direct extension of the normal pharmacological effects of the agent in the various tissues and organs of the body. Local anesthetics are drugs that act to depress excitable membranes (i.e., the central nervous system (CNS) and heart). When administered properly and in therapeutic dosages, they cause little or no clinical evidence of CNS or CVS depression. However with increased levels in the cerebral circulation or myocardium signs and symptoms of selective CNS and CVS depression are observed.

Allergy is a hypersensitive state acquired through exposure to a particular allergen (a substance capable of inducing altered bodily reactivity), reexposure to which brings about a heightened capacity to react.

In contrast to the overdose reaction, in which clinical manifestations are related directly to the pharmacological properties of the causative agent, in allergy the clinically observed reaction is always produced by an exaggerated response of the immune system. Allergic responses to a local anesthetic, antibiotic, latex, or to bee sung,or strawberries are produced by the same mechanism and may appeal clinically similar. All require the same basic management. Overdose reactions to these substances are clinically quite different, necessitating entirely different modes of management.

Another point of contrast between overdose and allergic responses relates to the amount the drug required to produce or provoke a reaction. For an overdose reaction to develop,a large enough amount of the drug must have been administered so that will be excessive in organ or tissues. Overdose reactions are dose evaluated. In addition, the degree of intensity (severity) of the clinical signs and symptoms relates to the blood level of the administered drug. The greater the dose administered, the higher will be the blood level and the more the reaction.

In contrast, allergic reaction cause by little amount of local anesthetics.

Toxicity caused by direct extension of the usual pharmacological effects of the drug:

1. Side effects
2. Overdose reactions
3. Local toxic effects

Toxicity caused by alteration in the recipient of the drug:

1. A disease process (hepatic dysfunction, congestive heart failure, renal dysfunction)
2. Emotional disturbances
3. Genetic aberrations (atypical plasma cholinesterase, malignant hyperthermia)

1. Idiosyncrasy

Toxicity caused by allergic responses to the drug are not dose related. A large dose of a medication administered to a nonallergic patient will not provoke an allergic response, whereas a minuscule amount of a drug to which the patient is allergic can provoke life-threatening anaphylaxis.

Idiosyncrasies the third category of the true adverse drug reactions, are the response that cannot be explained by any know pharmacological or biochemical mechanism. A second definition considers an idiosyncratic reaction to be any adverse response that is neither an overdose nor an allergic reaction.

It is thought that virtually all instances of idiosyncratic reaction have an underlying genetic mechanism.

Specific management of idiosyncratic reactions is difficult to discuss because of the unpredictable nature of the response.Treatment is necessarily in symptomatic positioning.

OVERDOSE

A drug overdose reaction has previously been defined as those clinical signs and symptoms that result high blood level of a drug in various target organs and tissues. Overdose reactions are the most common of all true adverse drug reactions accounting for up to 99% in some estimates.

For an overdose reaction to incur the drug must first gain access to the circulatory system in quantities sufficient to produce adverse effects on various tissues of the body. Normally there is both a constant absorption of the drug from its source of administration into the circulatory system and a steady removal of the drug from the blood as it undergoes redistribution (e.g., to skeletal muscle and fat) and biotransformation in other pans of the bod) (e.g.. liver). In this situation overly high drug levels in the blood and target organs rarely develop.

There are, however, a number of ways in which this "steady state" can be altered, leading to either a rapid or a more gradual elevation of the drugs blood level, in another case a drug overdose reaction is caused by a sufficiently high level of a drug in the blood adequate to produce adverse effects in various organs and tissues of the body. The reaction continues only as long as the blood level of the agent remains above the threshold for overdose in those tissues.

Predisposing Factors

Overdose reaction to local anesthetics is related to the blood level of the agent occurring in certain tissues after the agent is administered. Many factors have a profound effect of the rate at which this level is elevated and the length of time it remains elevated The presence of one or more of these factors predispose the patient to the development of overdose. The first group of factors concerns the patient, the second group concerns the agent and the area to which it is administered.

Patient factors

Age. Although adverse drug reactions,including over dose, can occur in persons of any age. Individuals at either end of the age spectrum experience a higher incidence of this reaction, the functions of absorption, metabolism, and

excretion may be imperfectly developed in young persons and may be diminished in old persons, thereby increasing the half-life of the drug, elevating circulating blood levels, and increasing the risk of overdose.

Weight. The greater the body weight of a patient (within certain limits), the larger will be the dose of a drug that can be tolerated before overdose reactions occur Most drugs are distributed evenly throughout the body. Maximum recommended doses (MRD) of local anesthetics are normally calculated on the basis of milligram of drug per kilogram of weight. Determination of maximum doses according to milligram per kilogram of body weight is based on the responses of the "normal-responding" patient, which are calculated from the responses of thousands of patients. Individual patient response to drug administration, however, may demonstrate significant variation. However, patients with hyporesponding may not demonstrate seizure until a significancy higher brain-blood level is reached, whereas others (hyperresponders) may have seizures at a brain blood level considerably below.

Other medications. Administrates of concomitant medications may influence local anesthetic drug levels. Patients taking meperidine and desipramine (tricyclic antidepressant) leave increased free local anesthetic blood levels and thus may case toxic effects at lower administered doses because of protein binding competition.

Sex. In humans the only instance of sexual difference affecting a drug response is pregnancy. During pregnancy, renal function may be disturbed, leading to impaired excretion of certain drugs. their accumulation in the blood and increased risk of overdose.

Diseases. Presence of diseases may affect the ability of the body to transform a drug into an inactive product. Hepatic and renal dysfunction impair the body's ability to break down and excrete local anesthetic leading to an increased anesthetic level in the blood.

Genetic. Genetic deficiencies may be after a patients response to certain drugs. A genetic deficiency in the enzyme serum pseudoholinesterase (serum cholinesterase), plasma pseudocholinesterase, plasma cholinesterase) ban important example. This enzyme, produced in the liver, circulates in the blood and is responsible for the biotransformation of the ester local anesthetics. A deficiency in this enzyme either quantitatively or qualitatively can prolong the half-life of an ester local anesthetic as well as increase its blood level. Approximately in 2 of 20 persons or 6% to 7% of patients in most populations possess atypical serum pseudocholinesterase.

Drug Factors

Vasoactivity. Local anesthetics currently used in dental practice have vasodilating properties. Injection of these drugs into soft tissues increases the vascularity of the area, leading to an increased rate of absorption from the site of injection into the cardiovascular system. This causes two undesirable effects: a shorter duration of clinical anesthesia and an increased blood level of the local anesthetic.

Concentration. The greater the concentration (% solution injected) of the local anesthetic administered, the greater the number of milligrams per milliliter of solution and the greater the circulating blood volume of the drug in the patient. The lowest concentration of a given drug that is clinically effective should be selected for use. For the commonly used local anesthetics in dentistry these ideal concentrations have been determined and are represented in this commercially available forms of these agents.

Dose. Then larger the dose of a local anesthetic agent used, the greater number of milligrams injected and the higher the circulating blood level, the smallest dose of a giving drug that is clinically effect should readministered for each of the injection techniques.

Intravascular injection. An important factor in local anesthetic overdose in dentistry is inadvertent intravascular injection. Extremely high drug levels can be reached in minimal time, leading to serious overdose reactions.

Many local anesthetic overdose reactions occur as a result of the combination of inadvertent intravascular injection and too rapid rate of injection, both of which are virtually 100% preventable.

Rate of injection. The rate at which a drug is injected is a very important factor in the causation or prevention of overdose reaction. Rapid intravenous administration (15 seconds) of 36 mg of lidocaine produces greatly elevated levels and virtually ensures an overdose reaction.

Vascularity of the injection site. The greater the vascularity of an injection site the more rapid the absorption till the drug will be from that area into the blood circulation. Unfortunately (in this regard) for dentistry; the oral cavity is one of the most highly vascularized areas of the entire body. However there are some areas within the oral cavity that are less well perfused, and these are usually mere highly recommended than other heller-perfused, sites (i.e., those for the inferior alveolar or posterior superior alveolar nerve block).

Presence of vasoconstrictors. The addition of vasoconstrictor to a local anesthetic produces a decrease in the perfusion of an area and a decreased rate

of systemic absorption of the drug, it greatly reduces the clinical toxicity of the local anesthetic.

Inadequate levels of local anesthetics may result from one or more of the following:

1. Biotransformation of the drug is unusually slow
2. The drug is too slowly eliminated from the blood through the kidneys
3. Too large a total dose is administered.
4. Absorption from the injection site is unusually rapid
5. Intravascular administration.

Minimum effective volumes of anesthetic should be used. Average, even low-average, doses may be capable of producing an overdose if liver function is compromised to a critical enough degree; however this situation is unlikely to be seen in an ambulatory patient. Renal dysfunction can also delay elimination of active local anesthetic from the blood.

Excessive Total Dose

In excess all drugs are capable to produce signs and symptoms of overdose. Precise milligram dosages or the blood levels at which clinical effects are noted are impossible to predict. Biological variability has a great influence on the manner in which persons rescind to drugs.

The maximum recommended dose (MRD) of parenterally administered (injected) drugs is commonly calculated after consideration of a number of factors, including:

4. Patients age at both ends of the age spectrum may be unable to tolerate normal doses, which should be decreased accordingly.

5. Patient's physical status. For medically compromised individuals the calculated MRD should be decreased.

6. Patient's weight the larger the person (within limits), the greater the distribution of the drug will be. With a normal dose the blood level of the drug is lower in the larger patient, and a larger milligram dose can be administered safely. Although it is a rule which is generally valid, but there are always exceptions; care must be exercised when any drug is administered.

Rapid absorption into the circulation

Rapid absorption of topical anesthetics may also occur following their application to oral mucous membranes. Absorption of some topically applied local anesthetics into the circulation is quite rapid, exceeded in rate only by direct intravascular Injection.

Both intravenous (IV) and intraarterial (IA) injections are capable to produce overdose reactions. With care and knowledge of the anatomical area to be anesthetized, and proper technique of aspiration prior to infecting the anesthetic solution, overdose as a result of inadvertent intravascular injection is minimized.

To prevent intravascular injection, use an aspirating syringe.

The clinical manifestations of local anesthetic overdose will continue until anesthetic blood levels in the affected organs (brain, heart) fall below the minimum value or until clinical signs and symptoms are terminal and through the use of appropriate drug therapy.

Epinephrine Overdose

A number of vasoconstrictors arc currently used in dental practice with epinephrine the most effective and most widely used. Overdose reactions, though possible, are uncommon with vasoconstrictors other than epinephrine.

ALLERGY

Allergy is a hypersensitive state, acquired through exposure to a particular allergen, reexposure to which produces a heightened capacity to react.

Predisposing Factors

Allergy to local anesthetics does occur, but its incidence has decreased dramatically since the introduction amide anesthetics.

Allergic responses to local anesthetics include dermatitis, bronhospasm (asthmatic attack) and systemic anaphylaxis. The most frequently encountered are localized dermatological reactions. Life-threatening allergic responses related to local anesthetics are indeed rare.

Allergic reaction.

Persons allergic to bisulfate (most often asthmatics) may induce a severe response (bronchospasm). A history of allergy to bisulfates should alert the dentist to the possibility of this same type of response if sodium bisulfite or metabisulfite is included in the local anesthetic solution. Sodium bisulfite or metabisulfite is found in all dental local anesthetic cartridges that contain a vasoconstrictor, but is not found in plain local anesthetic solutions.

Topical anesthetics possess a potential which may induce allergy. Most of the commonly used topic anesthetics in dentistry are esters, such as benzocaine and tetracaine. The incidence of allergy to this classification of local anesthetics far exceeds that of the amide local anesthetics. Many also contain preservatives such as methylparaben, ethylparaben or propylparaben.

Prevention

If the patient relates a history of alleged local anesthetic allergy, it is imperative that the dentist insider the following factors:

1. Assume that the patient is truly allergic to the drug in question and take whatever steps are necessary to determine whether the alleged "allergy" is indeed an allergy.

2. Any drug or closely related agent to which a patient claims to be allergic to must not used until the alleged allergy can be absolutely disproved.

Consultation and Allergy Testing

Consultation should be considered if any doubt remains as the cause of the reaction following the dialogue history referral to a doctor who will test for allergy to local anesthetics is recommended. Informed consent is obtained prior to allergy testing, the consent includes, among other possible complications, acute allergy (anaphylaxis), cardiac arrest and death. To determine the sensitivity to anesthetics the following tests are used in most cases:

- sublingual
- intradermal

Management of the patient with confirmed allergy

Management of the dental patient with a confirmed allergy to local anesthetics will vary according to the nature of the allergy. O.ften patients are mislabeled "allergic to local anesthetics". Such patients ultimately must have dental treatment carried out in a hospital setting, usually under general anesthesia, when a proper evaluation might have saved the patient time and money and decreased the risk of dental care.

Allergic skin reactions, if the sole manifestation of an allergic response, are normally not life threatening; however those occurring rapidly following drug administration may be the first indication of a more generalized reaction which can follow.

Clinical signs and symptoms of allergy may be solely related to the respiratory tract, or respiratory tract involvement may occur along with other systemic responses.

Bronchospasm is the classic respiratory allergic response. Its signs and symptoms: respiratory distress dyspnea, wheezing, flushing, cyanosis, perspiration, tachycardia, increased anxiety, use of accessory muscles of respiration.

Laryngeal edema is a life-threatening emergency.

Generalized Anaphylaxis

The most dramatic and acutely life-threatening allergic reaction is generalized anaphylaxis. Clinical death can occur within a few minutes, generalized anaphylaxis can develop after the administration of an antigen by any route but is more common following parenteral administration (injection).

Time of response is variable, but the reaction typically develops rapidly, reaching maximum intensity within 5 to 10) minutes. It is unlikely that this reaction will ever be noted following the administration of amide local anesthetics.

Signs and symptoms of generalized anaphylaxis, listed according to their typical progression, follow:

1. Skin reactions

2. Smooth muscle spasm of the gastrointestinal and genitourinary tracts and respiratory smooth muscle (bronchospasm)

3. Respiratory distress

IV. Cardiovascular collapse

In fatal anaphylaxis, respiratory and cardiovascular disturbances predominate and are evident early in the reaction.

The typical reaction progression follows

1. Early phase; skin reactions

a. Patient complains of feeling sick

b Intense itching (pruritus)

c. Flushing (erythema)

d. Giant hives (urticaria) over the face and upper cheat

e. Nausea and possibly vomiting

f Conjunctivitis

g. Vasomotor rhinitis (inflammation of the membranes in the nose, marked by increased mucus secretion)

h. Pilomotorgereition (feeling of hair standing on end)

2. Associated with skin responses are various gastrointestinal and/or genitourinary disturbances related to smooth muscle spasm

1. Seven abdominal cramps

2. Nausea and vomiting

c. Diarrhea

d. Fecal and urinary incontinence

3. Respiratory symptoms usually develop next

a. Substernal tightness or pain in chest

b. Cough may develop

c. Wheezing (bronchospasm)

d. Dyspnea

e. If the condition i severe cyanosis of the mucous membranes and nail bents

f. Possible laryngeal edema

4. The cardiovascular system is next to be involved

a. Pallor

b. Palpitations

c. tachycardia

d. Hypotension

e. Cardiac dysrhythmias

f. Inconscioumiess

g. Cardiac arrest

In rapidly developing reactions all signs and symptoms may occur within a very short time. In particularly severe reactions respiratory and cardiovascular signs and symptoms may be the only ones present The reaction or any part of it can last from minutes to a day or more.

With prompt and appropriate treatment the entire reaction may be terminated rapidly. However hypotension and laryngeal edema may persist for hours to days despite intensive therapy death, which may occur . If any time during the reaction is usually secondary to upper airway obstruction produced by laryngeal edema.

Management is predicated on the rate at which the reaction appears following antigenic challenge.

Delayed skin reactions.

Step 1. Oral histamine blockers for 5 to 1 days should be given to the patient.

Step 2. Obtain medical consultation to determine the cause of the reaction. A complete list of all drugs and chemicals administered to or taken by the patient should be compiled for use by the allergy consultant.

Immediate skin reactions

Signs and symptoms of allergy developing within 5 minutes require more vigorous management examples are conjunctivitis, rhinitis, urticaria, pruritus, and erythema.

Step I. Administer 0,3 mg epinephrine IM or subcutaneously.

Step 2. Administer IM histamine blocker.

Step 3. Obtain medical consultation with a physician, allergist, or hospital emergency before discharge from the dental office, if epinephrine has been administered. It may be necessary to transfer the patient to the physician or hospital for observation before discharge. This should be done via emergency medical services.

Step 4. Observe the patient a minimum of 20 minutes for evidence of recurrence.

Step 5. Prescribe an oral histamine blocker for 3 days .

Step 6. Fully evaluate the patient's reaction for further dental care.

Respiratory Reactions

Bronchospasm

Step I. Terminate dental therapy

Step 2. Place the patient in a comfortable (semi-erect) position

Step 3. Administer oxygen via full face mask, nasal hood, or nasal cannula.

Step 4. Administer epinephrine or other appropriate bronchodilator via aerosol inhaler.

Step 5. Observe the patient for 20 minutes before considering discharge. If relapse occurs, readminister 0.3 mg epinephrine via IM injection or aerosol. Common out side medical assistance, if there is no response to treatment.

Step 6. Administer a histamine blocker to minimize relapse possibility.

Step 7. After medical consultation and observation the patient may be discharged or transferred to a hospital via ambulance with paramedical personnel.

Step 8 Prescribe an oral histamine blocker and complete a thorough allergy evaluation before subsequent dental therapy.

Generalized Anaphylaxis

Signs of allergy present

When signs and symptoms of allergy present (eg. urticaria, erythema, pruritus, and wheezing), they should signal an immediate diagnosis of allergy. The patient will usually be unconscious. No signs of allergy present if a patient receiving a local anesthetic injection loses consciousness and no signs of allergy are present, the differential diagnosis includes psychogenic reaction (vasodepressor syncope), overdose reaction, and allergic reaction involving only cardiovascular system, among other possibilities.

Step 1. Terminate dental treatment

Step 2. Position of the patient. Management of this situation, which might prove to result from any of a number of causes, will require Immediately placing the patient in the supine position in with the legs slightly elevated.

Step 3. basic life support, as indicated. Victims of vasodepressor syncope or postural hypotension rapidly recover consciousness once they are proper positioned with an ensured airway Patients who do not recover at this point should continue to have the elements of basic life support applied (breathing, circulation).

Step 4. Common medical assistance. If consciousness does not return rapidly following the institution of the steps of basic life support, emergency medical assistance should be sought immediately.

Step 5. Administer oxygen.

Step 6. Monitor vital signs. Blood pressure, heart rate and rhythm, and respirations should be monitored at least every 5 minutes, with the elements of basic life support started at any time they are required.

Step 7. Definitive management. On arrival, the emergency medical personnel will seek to make a diagnosis of the cause of the loss of consciousness. If this is possible appropriate drug therapy will be instituted, when the patient is stabilized and he can be transferred to a Local hospital emergency department.

SUMMARY

Systemic complications of Local anesthetic drug administration and techniques are frequently preventable.

Here is a summary of those procedures recommended to minimize their occurrence:

I. Preliminary medical evaluation should be completed prior to anesthetics administration.

2. Anxiety, fear and apprehension should be recognized and managed before administration of a local anesthetic

3. All dental injections should be administered with the patient supine or semisupine. Patients should not receive local anesthetic injections in the upright position unless special conditions dictate (e.g.. severe cardiorespiratory disease).

4. Topical anesthetic should be applied before all injections for a minimum of 1 minute

1. The weakest effective concentration of local anesthetic solution should be injected in the minimum volume compatible with successful anesthesia.

a. The selected anesthetic solution should be appropriate for the dental treatment contemplated (duration of action).

5. Vasoconstrictors should he included in all local anesthetics unless specially contraindicated by the desired duration of effect or the patients physical status.

6. Needles should be disposable, sharp, rigid, capable of reliable aspiration, and of adequate length for the contemplated injection techniques.

9. Aspirating syringes must always be used for all infections.

10. Aspiration should be carried in at least two planes prior to injection.

11. Injection should be made slowly a minimum of 60 seconds for deposition of 1.8 ml of anesthetic 12. observe the patient both during and after the administration for signs of undesirable reaction.

Questions for self assessment

7. What are the indications for topical anesthesia?

8. What are the contraindication for injection anesthesia?

9. What are the indications for injection anesthesia?

10. What are the advantages for injection anesthesia?

11. What are the features anesthesia in prosthetic?

12. What types of methods of injection anesthesia preferred in prosthetic for lower molars?

13. What types of methods of injection anesthesia used in prosthetic for maxillary teeth?

14. What are the local complications for injection anesthesia?

15. What are the general complications for injection anesthesia?

16. What is the prevention of toxic complications of local anesthesia?

17. What types of local anesthetics are used for topical anesthesia in prosthetic?

18. What types of local anesthetic are used for injection anesthesia in prosthetic?

19. What is the benefit from using vasoconstrictors in solution of local anesthetics?

Tests for self assessment

1. Afferent or sensory nerves conduct impulses to the
A. CNS.
B. Periphery of the body.
C. Motor nerves of muscles.
D. Pin stimulus.

2. Efferent or motor neurons conduct messages from
A. The periphery of the body to the CNS.
B. The pain stimulus to the periphery.
C. The CNS to the periphery.
D. The cell body to the CNS.

3. The most widely held theory on nerve transmission attributes conduction of the nerve impulse to changes in the
A. Axoplasm.
B. Axolemma.
C. Cell body.
D. CNS.

4. The local anesthetic to be clinically useful,
A. It should be compatible with the tissues (not irritating)
B. It's action should be temporary.
C. It's action should be completely reversible.
D. All of the above.

5. Amide anesthetics include:
A. Lidocaine
B. Cocaine
C. Novocaine
D. Procaine

6. Ester anesthetics include:
A. Mepivacaine (or carbocaine)
B. Prilocaine (or citanest)
C. Procaine
D. Bupivacaine (or marcaine)

7. Local anesthetics interfere with how the impulses travel down the length of the nerve.
A. True
B. False

8. Anesthetics are not effective when infection is present because the pH of the tissues allows the anesthetic to penetrate the nerve sufficiently.

A. Too high
B. Too low

9. A local anesthetic that is absorbed by the bloodstream is carried to
A. All the tissues of the body
B. Some of the fat tissues of the body
C. The urinary tract only
D. The brain only

10. Organs like the brain, liver, lungs, and kidneys will have higher blood levels of anesthetic following injection than other less_____areas.
A. Innervated
B. Toxic
C. Vascular
D. Complex

11. Vasoconstrictors are added to local anesthetics to prolong the anesthetic effect.
A. Decrease
B. Increase
C. Stop
D. Facilitate

12. Epinephrine is contraindicated in patients with:
A. Daily episodes of angina pectoris or unstable angina
B. All of the above factor that influences the action of local anesthetics areas.
C. Blood pressure over 200 systolic or 115 diastolic,
D. Uncontrolled hyperthyroidism,
E. Severe cardiovascular disease including less than 6 months after a myocardial infarction.

13. Lidocaine 2% with epinephrine 1:100,000 will provide pulpal anesthesia for approximately
A. 3 hours
B. 60 minutes
C. 10 minutes
D. 2 hours

14. Topical anesthetic is effective only about 2-3 mm of depth into the tissues on which it is applied.
A. True
B. False
15. When administering lidocaine 2% to a 80 kg. patient, the maximum amount recommended is:
A. 300 mg
B. 500 mg
C. 700 mg
D. 100 mg

16. The most likely place for a needle to break is
A. At the bevel
B. At the tip
C. In the middle
D. At the hub

17. Dental cartridges should be:
A. Submerged in alcohol.
B. Submerged in cold sterile solution.
C. Left overnight in a cartridge warmer.
D. Kept dry.

18. If a patient's blood pressure is 205/110, consult with their physician before administering local anesthetic.
A. True
B. False

19. The patient's baseline vital signs including should be taken and recorded in the patient's chart before the injection of local anesthetic.
A. Blood pressure
B. Heart rate
C. Respiration rate
D. All of the above

20. Pain on injection can be caused by
A. An injection technique that is too rough.
B. A dull needle.
C. Rapid deposition of solution.
D. A barb on the needle.
E. Any of the above.

21. Hematomas most often occur during a
A. Posterior superior alveolar nerve block.
B. Palatal injection.
C. Maxillary nerve block.
D. Periodontal ligament injection.
22. Facial nerve paralysis may result from anesthetic being injected
A. To a vessel.
B. To a nerve.
C. To the parotid gland.
D. To the pulp of a tooth.

23. The most common cause of needle breakage is
A. Sudden movement by the patient.
B. Bowing of the needle during injection.
C. Autoclaving the needle.
D. Incorrect recapping technique.

24. Who performed the first ever peripheral nerve block?
A. Dr. William Salk
B. Dr. Nils Lofgren
C. Dr. William Halsted
D. Dr. Alfred Einhorn

25. All local anesthetics currently use of are _____.
A. Naturally occurring
B. Synthetic
C. Derivatives from the coca bush
D. Short-acting

26. Topical anesthetics are used to _____.
A. Numb the surface of the gingiva before an injection
B. Calm the patient
C. Numb the facial nerves of the oral cavity
D. All of the above.
E. To prevent the patient's gag reflex while taking impression

27. Local anesthetics are classified according to linkages, _____ and _____.
A. NHCO and COO
B. Amide and ester
C. Both A and B
D. Neither A nor B

28. Most injectable anesthetics are _____.
A. Esters
B. Amides
C. Both A and B
D. Neither A nor B

29. All anesthetics have:
A. A pKa from 9.5 to 11.5
B. An amino terminus
C. Poor solubility
D. Weak bases

30. Which of the following affects absorption of the anesthetic's pharmacologic agent?
A. The pH level of the tissue
B. Drug solubility
C. Vascularity of the tissue at the injection site
D. All of the above.

31. Most anesthetics are ____, which leads to rapid diffusion away from the site.
A. Vasoconstrictors
B. Concentrated
C. Esters
D. Vasodilators

Correct answers

1	A
2	C
3	B
4	D
5	A
6	C
7	A
8	B
9	A
10	C
11	D
12	C
13	B
14	A
15	A
16	D
17	D
18	A
19	A
20	E
21	A
22	C
23	A
24	C
25	B
26	A
27	C
28	B
29	D
30	D
31	D

CHAPTER 5.

Prosthetic treatment of hard dental tissues defects with inlays, artificial crowns and pin constructions

Inlays: indications and contraindications, clinical and laboratory stages of fabrication

Inlays are the microprostheses which restore the anatomical shape of the crown that was damaged by caries, attrition, wedge-shaped defects.

The restoration of the defects of teeth crowns by inlays should be carried out in cases of medium degree of destruction of the crown when there are good conditions for retention of the microdenture. The size and topography of hard tissues defect leads to a wide range of indications for such prosthetics.

Thus, when planning prosthetic treatment, it is important to understand the indications, contraindications and clinical stages of microprosthetics fabrication.

Microprostheses is an artificial restoration of hard dental tissues defect formed as a result of extensive decay, hypoplasia of dental tissues, tooth injury or other pathologies.

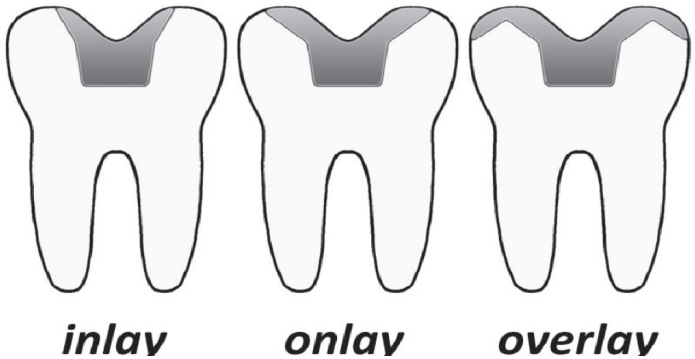

Fig. 5-1. *Differences between inlay, onlay and overlay microprosteses.*

Classification of the microprostetics by their position in the tooth Fig. 5-1:

a) Inlay – box-shaped microprothesis that is positioned inside the tooth and reproduces its anatomical shape and occlusal surface;

b) Onlay – the box-shaped microprothesis with the part of the occlusal surface restoration;

c) Overlay is replaced the whole occlusal surface;

g) Pinlay – the microprosthesis with additional cavities or pins for retention.

Inlays are classified in accordance with the recommendation of the CEREC 3D system developers:

Inlay O – occlusal inlay in case of intact cusps;

Inlay OD, Inlay OM – occlusal-distal or occlusal-medial inlays;

Inlay MOD – medial-occlusal-distal inlays;

Onlay – extensive inlay with partial cusp overlap;

Overlay – extensive inlay with full cusp overlap.

According to the material of fabrication inlays can be divided to:

a) Metal (gold, cobalt-chrome alloy, silver-palladium alloy);

b) Plastic;

c) Ceramic (IPS Empress System, Cerec);

d) Combined (metal-plastic, metal-ceramic);

According to the method of fabrication inlays can be divided to:

a) Direct method of fabrication;

b) Indirect method of fabrication.

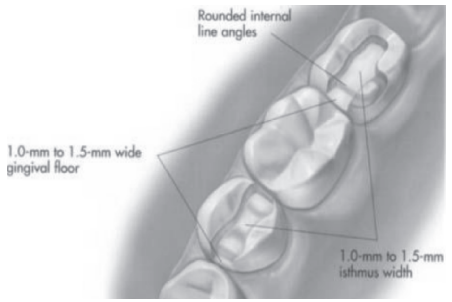

Fig. 5-2. *Teeth preparation requirements for MOD inlay and onlay fabrication.*

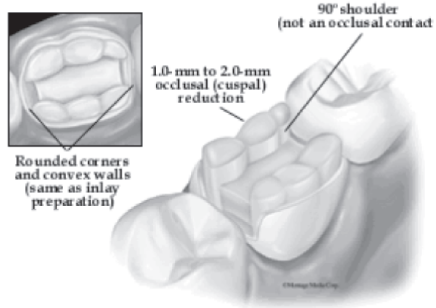

Fig. 5-3. *Tooth preparation for overlay fabrication.*

The comparative characteristic of inlays and light-cured composite fillings

Generally defects of dental hard tissues of the teeth are restored with light-cured composites. Before filling of the carious cavity, the doctor removes the damaged tissues, and shapes the cavity. Then the prepared cavity walls are treated with acid, adhesive and the portions of light-curing material are put. The strength of connection between the composite and tooth walls is great. During light curing composite is subjected to shrinkage, i.e. the fillings shrinks to 0.8-1.8%. When the size of the filling is significant the composite attached to the walls of the tooth can pull the tooth walls to the centre of shrinkage with a very big force.

Thus: 1. Polymerisation shrinkage leads to internal stresses in the filling. As a result, when there are thin walls and a high volume of restoration, there are cracks in the teeth. 2. During shrinkage the filling comes off from the walls of the tooth which causes secondary caries.

Inlays are free from such negative properties, because they are already fabricated in the laboratory and passed the stages of polymerization.

All filling materials are characterized by wear resistance. Filling materials have durability, close to the tissues of the teeth, but in the oral cavity during polymerization the filling usually is not fully cured, but only 60-70%. This dramatically influences the strength of the restoration.

Inlays are polymerized in special devices with high level of cure, which increases the wear resistance substantially.

It's difficult to make a composite restoration with all occlusal peculiarities directly in the mouth. Therefore, the advantage of making the restoration by laboratory method is that a dental technician, working with models in articulator, can take into account all peculiarities of the patient's occlusion.

In the result the inlay will fit the individual characteristics of the patient's occlusion. In case of filling the doctor sees the situation only in the oral cavity and is not able to assess and take into account all the anatomical features of the tooth and occlusion from the outside.

Indications for inlays fabrication:

– defects of tooth crowns of different origin, which cannot be replaced by a filling;

– pathological teeth wearing (inlays on antagonizing distal teeth prevent the increased abrasion);

– defects of dental rows (in small included defects of dental row inlays can play the role of abutments for dental bridge;

– periodontal disease (splinting of teeth with inlay-supported splints).

Contraindications for inlays fabrication:

– very deep and poorly accessible cavity located under the gum;

– defects in tooth with low clinical crown.

Clinical and laboratory stages of the metal inlays fabrication:

1. Clinical stage:
   a) cavity preparation and fabrication of wax pattern (direct method);
   b) cavity preparation and impression taking (indirect or reverse method);
   c) cavity preparation and pattern fabrication by combined method.
2. Laboratory stage:
   a) replacement of wax composition with metal alloy;
   b) modelling of wax pattern and replacement it with metal alloy.
3. Clinical stage:
   a) try-in and adjustment of the inlay.
4. Laboratory stage:
   a) finishing and polishing of the inlay.
5. Clinical stage:
   a) fixing of the inlay with glassionomer or polymeric cements.

For aesthetic inlay fabrication during the patient first visit after diagnosis delivering the cavities preparation and impression taking the colour selection is important to perform. At the next clinical stage the colour of inlay checking is important to do. The aesthetic inlays are fixed only with polymeric cements.

General requirements for cavities for inlay, onlay, overlay.

1. The cavity must be the most suitable shape, such that the inlay could easy be inputted and take out.

2. When shaping a cavity it is important to prevent caries recurrence.

3. The bottom and walls of the cavity must be resistant to masticatory pressure.

4. When complex cavity is shaped, grinding the multiple surfaces of the tooth create additional retention points.

5 .The cavity should be of sufficient depth with slightly inclined walls (3-5 degrees) for resistance of the inlay. In such way it cannot move under the influence of masticatory pressure.

6. The cavity must be asymmetrical to prevent rotation of the inlay.

7. To prevent cracks of the thin edges of enamel it is important to create a bevel on the edge of the cavity or cover the chewing surfaces with onlay or overlay. Fig. 5-2, 5-3

Peculiarity of the 1-St class cavities preparation

In the preparation of 1-St class, you need to be careful with the tubercles and the jumpers connecting. Grinding of jumpers dramatically weakens the tooth and may lead to splits and tubercle brakes and damage of the wall or the crown. You should also avoid creating sharp corners between the walls and the floor. The bottom of the cavity formed perpendicular to the walls of the cavity.

Peculiarity of the II-nd class cavities preparation

The tooth preparation have to be start with mesial wall or with separation of the distal surface of the tooth with flame diamond bur. This separation must be parallel to the long axis of the tooth. Then cylindrical bur can be used to shape cavity on the contact and occlusal surfaces of the teeth. The cavity walls are shaped to be parallel with slightly incline (3-5 degrees) and the bottom must be perpendicular. Gingival wall should be placed at the level of the gum edge or a little above in order to prevent the development of secondary caries.

For prevention of the displacement of the inlay in the direction of the missing wall on chewing surfaces it is impossible to form a more complex shape cavity (cross, swallow's tail).

To ensure the durability of the tooth width jumper connecting primary and secondary cavity should not be less than 1/3 the width of the chewing surface. Wider wall cavities can weaken the jumper and contribute to their cracks. In cases of caries lesions of the two contact surfaces it is necessary to connect and form a u-shaped cavity. Fig. 5-5

Peculiarity of the III-d class cavities preparation.

If only the contact surface is damaged and the nearby tooth is absent it is possible to create a cavity in the form of a triangle with the bottom facing the cement-enamel border, and the top-to the cutting edge. The bottom of the cavity must be convex, parallel to the contact surface of the tooth. When the nearby tooth in contact, the cavity is prepared on the oral surface of the tooth with cube shape. To prevent inlay displacement the additional cavity on the palatal surface is important in a swallow tail shape.

Peculiarity of the IV-th class cavities preparation.

On the teeth with thin cutting edge enamel the additional cavities and fixing sites are only on the palatal surfaces. Two proximal cavities should be connected

on the tubercle with the isthmus. Pins for additional retention should be used.

Peculiriety of the V-th class cavities preparation.

Such cavities have to be shaped in ellipse or oval, trying to avoid symmetry. The bottom of the cavity walls must be convex and walls have to be parallel. The finishing of the cavity preparation should be completed with smoothing of the edges and sides.

Fig. 5-4. *Temporary inlay making with fluidable resin after impression and teeth grinding.*

Fabricating the temporary inlays.

At the time that it takes for manufacturing of the inlays in the laboratory it is important to cover the cavities with temporary fillings or inlays. For this purposes the special materials can be used. Easy way to do this is to take an impression with silicone before preparation of the tooth. After preparation the impression with special liquid plastic filled to imprints of the grinded teeth is placed on the jaw for a few minutes to harden Fig. 5-4. After final curing plastics, the impression is removed from the teeth, the layer of plastic is aligned, ground, after this time the temporary inlays is ready, and can be fixed with temporary material on teeth.

Setting the inlays.

Before fixing the inlays into the cavity, estimate how tight it is adjacent to the tooth, check the shape and colour. Be sure to check the bite.

To ensure the absolute isolation of the operative field of saliva and protecting the patient against aspiration using a rubber dam is strictly optional.

CERAMIC INLAY fitting and fixing.

Applied the hydrophilic acid 10% within 1,5 sec to inner surface of the inlay.

The inlay rinsed with water/air, drying with air to clean the internal surface of the restoration from hydrofluoric acid.

The enamel is etched the enamel for 30 sec. and dentin for 15 sec with phosphoric acid. Acid is washed with plenty of water and dried.

A thin layer of silane is applied to the inner surface of the inlay, 1 min. and dried with air. It is desirable to repeat the procedure 2-3 times.

The bond is puted by dual polymerization adhesives to the internal surface of the restoration and the tooth cavity. The dual polymerization cement is mixed and puted to the cavity and to the inner side of the restoration. The restoration is adapted in the cavity and removed excess cement. The marginal fit of inlay is checked out of inlay around the perimeter. Then we are polymerizing with light and waiting for chemical phase. The restoration is finishing and polishing. The teeth is coating with fluoride treatment.

Inlay direct method of fabrication.

After the cavities preparation inlay patterns have to made with special shape wax directly in the mouth. This method should be the best, but it requires a doctor's ability to model the shape of the tooth.

Operation: prepared tooth should be cleaned with cotton from saliva. Warmed wax stick is pressed into the cavity with such force than the excess wax came out. For the second class cavity, the regular metal matrix is important to use. For the second, third and fourth class, it is better to prepare a copper ring, which is removed after the wax pressing and shaping.

The patient is asked to bite down the soft wax to obtain the imprint of antagonists and modelling the contours of the inlay. Next the piece of wire or pin have to be connected in a thickness of about 1 mm after heated the end of it over the flame and quickly pushed it into a wax pattern. The wire melts the wax and stuck to it. The wax is cooled with air -syringe or with wet cotton. After that the inlay pattern should be carefully extracted from the cavity using stucked wire. If the cavity is double, it is important to use two pieces of wire. Wax pattern must be removed from the cavity without difficulty, so it should not have deformity. Otherwise, in this way the checking the parallelism of a wall also is provided. This inlay pattern is sent to the laboratory and poured to investment material for changing to alloy and the wire can be used as the part of the sprue.

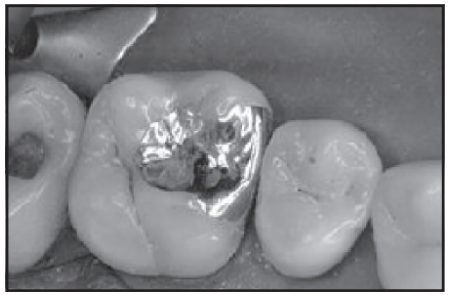

Fig. 5-5. *Gold inlay for II-nd class.*

The combined method of the inlay fabrication.

Prepared tooth cavity is filled with wax and the wax imprint of teeth-antagonists is got. Then a piece of wire with one bended end and with the second end warm up is putted to wax

pattern. Impression of the teeth and auxillary impression is taken. Wax stamp goes to the stone model. In the articulator on the stone models the external surface of the inlay is reshaped and then removed from model and moulds of metal as usual. Fitting of the inlay after fusing procedures is made on the model at first and only after finishing and polishing is sent to clinic.

In the fabrication of high-strength plastic inlays (Akrodent "STOMA") a special technologies are used step by step.

1. Formation of the cavity;
2. Impression taking;
3. Getting a master model with stone and additional model and mounting these to articulator;
4. Application of the separation layer of varnish on the surface of the cavity in the tooth on model;
5. On the separation varnish layer a special liquid (catalyst) is putted;
6. The cavity on the stone model is filled step by step with composite and polymerized each layer while the shape of the inlay is reached;
7. The last layer is completed with glaze;
8. The laboratory phase is ended with temperature and pressure polymerization. (10 minutes at a temperature of 120° C and a pressure of 6 Bar).

Artificial Crowns

Restoration of the dental crown defects with artificial crowns.

The most widespread prostheses used for restoration of the destroyed dental crown are the complete artificial crowns. As they have different construction peculiarities and used with various aims, they are classified by certain points.

I. According to the construction, or the tooth size and the way they hold the tooth:

1) Complete, i.e. those which cover the whole dental surface;
2) Equator, i.e. those which cover the tooth surface till its middle;
3) Crowns with post
4) Telescopic crowns;
5) Fenster crowns;
6) Semicrowns;
7) Three-quarter crowns.

II. According to the fabrication method:

1) Stamped;
2) Cast;
3) Stitched – aren't used nowadays.

III. According to the material:

1) Metal (alloys of the gold, stainless steel, cobalt and chromium, silver and palladium, titanium);

2) Non-metal (plastic, porcelain);

3) combined those which are covered by the plastic, porcelain or other ceramics (metal-plastic or metal-ceramic).

IV. According to the functions:

1) Restorative;

2) Supporting (in bridge denture or other prostheses);

3) Fixing (to hold the medications, orthodontic or other facial-mandibular appliances);

4) Splinting;

5) Temporary and permanent.

Indications and contraindications for the artificial crowns' use.

The procedure of restoring the broken tooth anatomical structure using the artificial crowns is widely used in orthopedic practice, with the following indications for the use:

1) an urgent indication for the artificial crown use is the considerable tooth destruction, resulting from caries and caries complications, wedge defects, in which it seems impossible to restore the anatomical structure of the tooth by the filling or inlay;

2) In cases when the metal crowns serve a support for the clasp;

3) They are used as the supporting crowns for the treatment with the bridge prostheses;

4) In case of dental anomalies presence (microdentia, merging teeth);

5) In case of pathological wear, to prevent the further enamel and dentine wear, sometimes– simultaneously for increasing the intra-alveolar height;

6) Fixing various orthodontic and dental-mandibular apparatuses;

7) For splinting in case of the periodontal tissues complex treatment;

8) Under the considerable dental crown preparation necessity, when the tooth has protruded or angulated towards the dental row defect side;

9) To hold the medications in it;

10) Esthetic indications (porcelain, plastic, metal-plastic, metal-ceramic crowns).

The contraindications for the artificial crowns use are as follows: covering the intact teeth, if it's not caused by the construction peculiarities of the dental

prostheses. It is contraindicated to fix the crowns onto the teeth with existing chronic inflammation foci in the marginal or periapical parodontium area, onto the teeth with pathological mobility of the 2nd degree as well as in case of general bad health condition.

Treatment tactics and operative techniques of preparing the teeth for the artificial crowns.

Hard dental tissues preparation is a necessary part of the clinical-laboratory sequence of the stamped or cast crowns fabrication. The peculiarities of the tooth preparation depend on the crown kind, crown material and the condition of the crown to be prepared. The process of the hard dental tissues preparation is extremely important for the patient as it may produce psychological, thermal and mechanical traumas. This is why preparation procedures should be "sparing" performed corresponding **to the following rules**:

1) The preparation instruments must be well centered;

2) Hard dental tissues preparation should be performed with time breaks;

3) The patient must frequently gargle the oral cavity with the potassium permanganate solution, to cool and remove the smallest particles, if the machine doesn't have a device for continuous water irrigation;

4) If possible, the hard dental tissues must be economically prepared.

Another view on the dental preparation was expressed by Staegman (Staegman, 1977). The author suggests a sequence to perform hard dental tissues preparation as follows on Fig. 5-6, 5-7.

An thin layer of the hard tissues, 0.3mm in width, is to be removed from the chewing surface, if it is the steel stamped crown. It is controlled using the warm wax strip or a copy paper strip, folded in 4-6 layers.

In case of preparing the chewing surface of the molars and premolars in fissure areas it is convenient to use the moulded (shaped) heads with diamond cover.

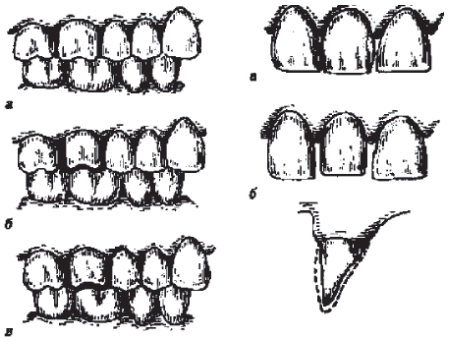

Fig. 5-6. *Sequence to perform hard dental tissues preparation (by V.Kurlandsky 1985 y.):*
1) Chewing surface (cutting edge);
2) Buccal and lingual surface;
3) Separation and processing the contact surfaces;
4) Edge smoothing.

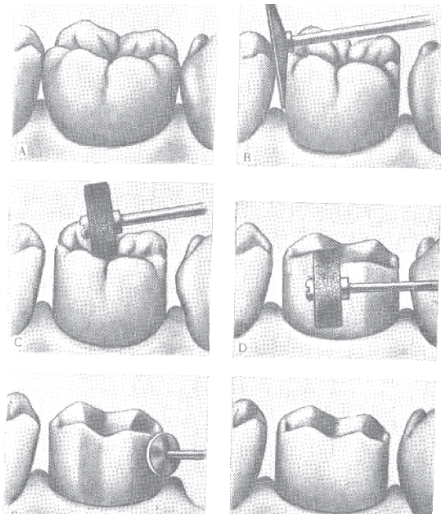

Fig. 5-7. *The main stages of preparation (by V.Kurlandsky 1985 y.)*

It is better not to change the anatomical tooth shape, which is prepared. The buccal and oral surface preparation starts with most protruding areas. The width of the layer to be removed depends on the tooth shape and its neck diameter. To prevent traumas of the gingiva, the preparation must be done using the moulded head which is a reversely truncated cone. Fig.5-8

After preparation the tooth diameter must not exceed its cervical diameter. To create smooth transition of one surface into another one, the sharp edges must be smoother by moulded heads. The preparation is complete when the probe smoothly glides over the dental surface without obstructions.

Quite often complications arise during preparation. The most characteristic ones are:

1) When a patient refuses preparation because of pain possibility;

2) Effective anesthesia requires for the strict control of preparation regimen, as there is a possibility of pulp overheating;

3) Traumas of the cheek and tongue soft tissues;

4) During the separation procedure there may occur a mistake called a "step" on tooth crown.

5) Insufficient removal of the hard tissues from the chewing surface;

6) Insufficient removal of the hard tissues from the vestibular, lingual and contact dental surfaces;

7) Unconsciousness, collapse.

General and local human body reactions into the teeth preparation

Preparation of enamel and dentine should be attributed to the trauma, which causes the general and local reactions of the body.

Dental hard tissue during the preparation process experiences many physical and other factors: vibration, temperature increase, mechanical pressure. During the preparation we observe an increase in temperature of the enamel and dentine.

Local reactions due to exposure to the temperature (+60 ° C) in the experiment appeared in the degradation of crystalline formation of enamel. The heating of the tooth (+60 ° C) causes changes in the dental pulp at the sub cellular, cellular and tissue levels.

Fig.5-8*. Central incisor prepared for cast combine artificial crown.*

Microscopic examination of histological specimen of the teeth of dogs after preparation for various types of crowns (porcelain, combined, full stamped) showed that response to acute surgical trauma of hard tissue in the pulp causes acute vascular disorders: expanding the blood capillaries, hyperemia and hemorrhage. Vascular disorders are clearly manifested an hour after beginning of the operation. Hemorrhages like hematoma and hemorrhagic infiltrates were determined mainly in the coronal pulp and its peripheral subodontoblastic layers. Fig. 5-9.

Fig. 5-9. *Histological sections of dental pulp (by V.Kurlandsky 1985 y.).*

In the later periods in addition to the vascular reaction in the pulp we found deposits of the replacing dentine. This phenomenon should be seen as a protective reaction of the pulp.

The preparation of the tooth causes aseptic inflammation in the periodontium, which is related to local vibration. Inflammatory reaction of the periodontium is mostly expressed 6-12 hours after preparation. In the periodontium we observe disturbed hemodynamic, there is pronounced venous congestion.

Basic rules of the teeth preparation:

1. To reduce the overall response of the human body – preparation should be carried out only under anesthesia and in patients with cardiovascular diseases – with medical assistance.

2. We must remove only the required layer of enamel and dentine.

3. We should monitor the tooth preparation regimen, preventing high temperature, which can cause burns of the peripheral layers of the pulp.

4. We should use high-speed machines, centered with a large tool cutting ability (Diamond tools and Tungsten carbide drills).

Plastic crowns

A general indication for use plastic crown:

1. The aesthetic requirements,
2. The pulp protection after preparation of teeth,
3. As temporary during fabrication of the permanent prosthesis.

General contraindications

1. The overload of the teeth.
2. Pathological abrasion of the teeth.
3. Allergies to composite.
4. Deep bite.
5. The absence of posterior teeth.

The tooth preparation for plastic crown.

The preparation is to be performed with the cutting or chewing surface, removing the hard tissue layer for 1,5mm. The subpalatal surface of the frontal teeth must be carefully prepared because pulp may of open.

The distance between the antagonist teeth must be 1-1,5mm. The lateral walls must be additionally prepared to get the slightly expressed cone, with not more than 3-5 degrees incidence.

In the end of preparation procedure the sharp angles are smoothed and the prepared tooth is checked for the antagonizing teeth both in central occlusion position and during the side movements. Fig. 5-10 The impressions are taken using the silicone mass, double impressions are obtained in this way. The color of plastic is detected, this finish the first stage.

Fig. 5-10. *General view of tooth prepared for full artificial crown.*

In dental technical laboratory a model from plaster is made using the obtained impressions. The gingival edge is shaped on the model until its deepest imprint on the gingival sulcus.

After preparation of the cervical area, which must prevent of penetration of the plastic crown into the gingival sulcus (not more than 0.5mm), anatomical tooth shape modeling is performed. The wax reproduction of the future artificial crown is modeled.

The supporting tooth model with a wax reproduction of the artificial crown is cut together with the positioned teeth, as a block. The plaster teeth are cut cone-shaped, it refers to those teeth which contact with the wax model, and the whole plaster block is plastered in a special stomatological flask using one of the methods on Fig. 5-11.

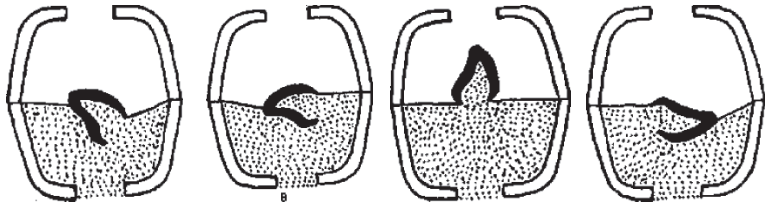

Fig. 5-11.*Different positions of teeth in plastic packaging(by V.Kurlandsky 1985 y.)*

The surface of the hardened plaster is moistened with Izokol, the upper part of the flask is put and plaster is poured into it. After the plaster crystallization the flask is put into the boiling water for 10-15 min and then it is opened. The rests of the melted wax are completely removed by washing them off with warm water and the flask is cooled.

A doctor examines the ready crown to detect its quality. After disinfection the crown is placed to the supporting tooth.

Then the occlusion contacts are checked. Extra plastic which disturbed the occlusal relationship must be polished with burs. It's particularly important to restore the interdental contacts. The checking of the crown in the oral cavity is finished with appreciation of its anatomical shape and if necessary, it must be corrected, after which the surface is restored by polishing. It is then fixed with the cement which is chosen according to the crown color. Fig.5-12, 5-13.

Temporary acrylic crown fabrication:

Special temporization materials are indicated for using for temporary crowns to cover permanent teeth after preparation. Also such materials can be used to design pre-existing tooth structure and anatomy for use in digital imaging applications and for future crown shape and colour checking.

Fig. 5-12. *Ready plastic crowns*

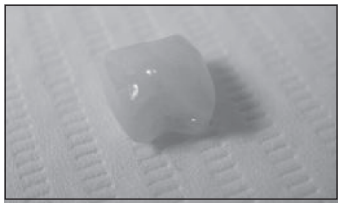

Fig. 5-13. *Complete plastic crown.*

It is necessary to take an impression with silicone before the tooth preparation. After we prepared the tooth for crown size and thickness, the portion of material should be squeezed on the glass. Then, using a spatula, material must be carefully stirred to evenly and filled the impression. The tray should be placed to the dental arch in the mouth for 5-7 minutes until cured. Then the impression must be removed from the mouth. Using tweezers a temporary crown should be took out from the impression, cut and polished.

The next step is the temporary crown fixing with special temporary materials for fixation: RelyX TMTemp E or RelyX TMTemp NE (ESPE), Tempobond (Kerr) Fig. 5-14

Fig. 5-14. *Temporary materials for fixation*

ARTIFICIAL METAL CROWNS

Stamped metal crowns.

After examination of the patient, preparation of the supporting teeth and impression taking the first clinical stage of stamped metal crowns' fabrication is over.

The working and auxiliary models are made in the dental technical laboratory using the obtained impressions, they are matched in the central occlusion position, and then plastered in an occludator or an articulator. This is how a laboratory stage of metal stamped crowns fabrication begins.

After examination of the plaster models the dental necks engraving with the ocular scalpel is performed. During the process the gingival sulcus shouldn't be deepened, it's necessary only to mark its contours. If necessary the interdental space must be separated with a special saw (scroll saw). The dental clinical neck is marked with a chemical pencil.

The obtained line will serve an orientation point to detect the length and width of the crown edge as well as the degree of its penetration into the gingival sulcus.

A dental technician performs the restoration of the prepared tooth' anatomical shape, using the special modeling wax and modeling spatula.

The first layer which will cover the dental stump is a melted wax, put from the neck till the cutting edge, to exclude the wax from the gingival surface this may cause future crown shape changes. After putting the layer of a wax, anatomical dental shape modeling starts. The modeled tooth is miniaturized onto the metal width, i.e. 0,25-0,3mm.

After restoring the tooth anatomical shape with wax, gypsum and metal – stamps are made. The wax-modeled tooth is cut from the gypsum model. The crown tooth part towards the longitudinal axis must be extended for at least two crowns' length. The width of the gypsum stamp root part must match the transverse profile cut in the dental neck area. Widening or narrowing of this stamp part will cause the mistakes in future crown size, especially near the gingival part.

The gypsum stamp marking may be done using various methods.

According to one of them, we go back onto 1 mm from the clinical dental neck line, marked with a chemical pencil, and a groove 0,5mm in depth is made parallel to it, and this one will serve an orientation point for detecting the metal crown edge length.

According to the other method, at first we mark with a chemical pencil the

second line on the distance of 1mm from the first one, after it the groove is engraved, going back another 1mm from the second line. The advantage of this method is that we previously provide for the extra crown length which decreases the danger of short crown fabrication, so, the highest accuracy will be achieved.

Then using the scalpel the gypsum rests are removed from the cervical part, on which marking was made, and so it gets the same transverse cut profile as the neck contour.

Using the obtained gypsum stamps, the metal stamps are made. To obtain the accurate metal copy of the gypsum stamp it must be first put into water for some time. The liquid gypsum is poured into the rubber ring (bottle), 3-4 cm in diameter and 4-5cm in height. The moist gypsum stamp, which was previously covered with a thin gypsum layer, is taken out and then completely put into the liquid gypsum so that the stamp is positioned vertically, by the rubber ring center. After hardening the gypsum block is pushed out of the rubber ring. On two opposite sides we make wedge-like longitudinal sulci 3-4mm in depth, leaving the layer to the gypsum stamp not less than 3-5mm. The longitudinal sulci must look only at the longitudinal axis of the gypsum stamp. To break the gypsum form it must be put into the palm of the left hand and the knife blade is inserted into the longitudinal sulcus. The block is split and the gypsum stamp is released. After the gypsum stamp release all parts of the gypsum form are put together, in the rubber ring, where the melted metal is poured melted in a special spoon under 65-95 Celsius degrees (usually Melot alloy is used). Fig. 5-15.

For each tooth two stamps are produced, the first one will be used for the final stamping, and the second one-for the prior. The metal stamps' surface is processed with the file, with a great attention paid to the dental neck area, chewing surface, if necessary, they are processed with burs. The prepared metal stamps are ready for the crown stamping.

A dental technician must choose the metal workpiece in the bushing shape, from which the crown will be stamped. The stomatological industry produces standard bushing of various diameter and width(0,20-0,28 mm).

When the crowns are fabricated from the gold alloy we can use the disks 23-20 mm in diameter, 0.25-0.28 mm in width. The process of the bushing preparation for stamping includes the choice of the bushing the diameter of which will match the dental crown so that it fits the metal stamp, if we press with strength on it. If there are no bushings of appropriate diameter, then the Samson apparatus is used for its miniaturization. Fig. 5-15

To obtain the bushing of the appropriate diameter the standard disk is inserted opposite the certain matrix opening and it is pulled, the bushing moving from one opening to another, and in this way we can obtain the required diameter.

The multiple pulling of the bushing through the openings make metal change its structure, the so-called steel deposit. To remove it it's necessary to process the bushing with temperature a few times. The steel bushing is heated to 1100 Celsius degrees temperature until it becomes straw yellow, then it is quickly cooled in water. This provides for the fixation of its most strong structure.

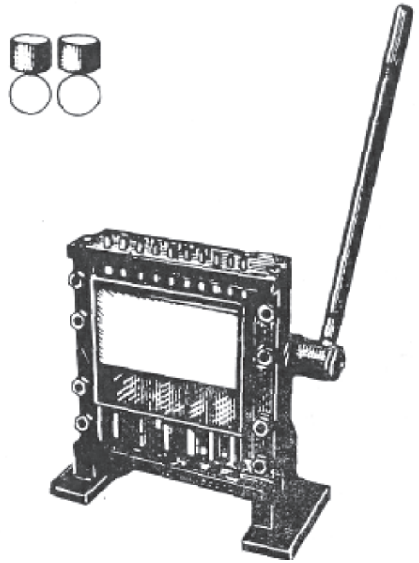

Fig. 5-15. *Apparatus of Samson from (by V.Kurlandsky 1985 y.)*

After the whole complex of the preparation works, a dental technician starts the prior crown stamping. For this the anvil uses, the lead base and hammers -the brazen one for the steel, corneous one – for the gold alloy. The future crown obtains the possible shape on the anvil at first. Then, putting the shell onto the metal stamp №2, it is processed with a hammer, and its shape becomes similar with the stamp shape, the hammer must work on the most convex bushing areas, then moving towards the dental neck side, folds appear on metal. It is possible to use the lead squimed beam, in which the bed is created, and the prior stamping of the cutting or chewing surface is performed.

The strikes of the hammer onto the bushing provide for the approximately same shape of the future crown, with the close fitting to the whole metal stamp surface as the aim. Here the prior crown stamping finishes and it is performed only on the second metal stamp. Before the final stamping the previously prepared crown is taken off the metal stamp by melting the last one, and the crown is thermally processed.

The final stamping may be internal, external and combined. The most widespread method, though not most accurate one was the external stamping, performed in a Parker's apparatus.

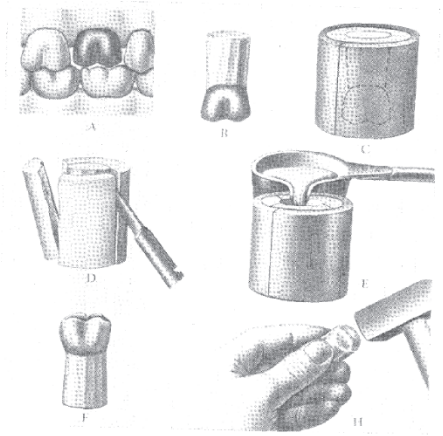

***Fig. 5-16**. Stages of fabrication stamped stainless crown (by V.Kurlandsky 1985 y.)*

External stamping.

The Parker apparatus contains two parts– the hollow cylinder base and a cylinder which comes into it.

The external end of the cylinder is that with vast smooth surface. The cavity of the base is filled with molding (mix of white clay and glycerin) or vulcanite rubber. The base is attached in the lower part of the press and the other cylinder is attached to the upper part of the press.

The metal stamp of the tooth with the previously stamped crown, being pulled onto it, is wrapped by the cloth or tight paper (to prevent molding from the space between the crown and the stamp tooth), and after it is positioned directly with the center of the chewing surface, then it is moved down, by the hammer tap or pressing in a special press, and pushed into the mass.

The press is rotated by the handle cylinder, coming into the base, connect to the stamped part, and molding or rubber serve the contrastamp, which equally distribute the pressure in all directions and provide for the tight fitting of the crown to the metal stamp surface.

After stamping, if the folds on the crown surface are present, they are broken with a hammer, the crown is taken off the stamp by its melting, the crown to be held with tweezers. If the necessity of repeated stamping is present, a new stamp is produced; the crown is thermally processed and stamped again. This represents the end of the first laboratory stage.

Before being delivered to a clinic, the single dental crowns are whitened, boiled and wiped, and if the crown is required for the anchor attachment of the bridge prosthesis, it is whitened after the final production of the last.

Having performed all the mentioned procedures, after confirming that the crown corresponds to all the mentioned requirements, the technician gives it to the next laboratory stage– whitening, grinding and polishing.

The crown is whitened to remove the oxide layer formed after the numerous thermal processing.

The whitening substances are water solutions of various acids: the hydrochloric, sulphuric, nitric acid, and their mixtures.

To whiten the crowns made from the stainless steel we use a mixture of 6 parts of the nitric acid, 47 parts of the hydrochloric acid and 47 parts of water. The crowns will be boiled in such mixture for 1-2min. The whitening substances interact not only with the protective layer on the metal surface, they partially dissolve the metal itself, this is why it is particularly important to keep to all rules of whitening.

After whitening the crown is grinded with an elastic circle, then on the hard brush, fixed on grinding engine, the polishing paste is put (depending on the material a crown is made of), and the polishing finishes with a soft woolen brush called " a fluff".

Before trying the crown in the oral cavity it must be carefully rinsed in the hydrogen peroxide and disinfected in alcohol. The crown is put onto the supporting tooth, to check how it corresponds to all requirements, mentioned above. Before fixation the crown is cleaning, decreased and dried with hot air. After this it must be processed with hydrogen peroxide, the mouth is to be rinsed with water. The cotton rolls are put around the supporting tooth, which is processed with alcohol and dried with warm air. Fig. 5-17.

It is especially important to clear the crown from the cement. To prevent the gingival trauma all the movements of the instruments must be directed from the gums to the incisal margin or the chewing surface.

After removing the cement excess we should be inform to avoid load on teeth for 1-2 hours until the complete hardening of the fixing material.

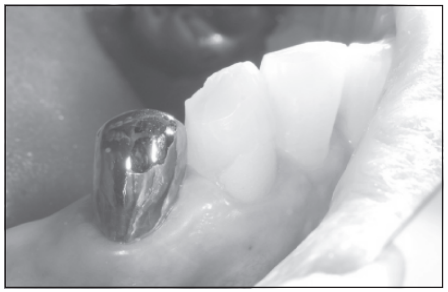

***Fig. 5-17.** Stamped stainless steel crowns*

Equator and telescope crowns

An equator crown is a kind of the metal crown which covers the tooth only till its equator. The equator crowns can be stamped and cast. It is used as a supporting and fixing element in bridge prostheses, in case of the chewing teeth convergence and divergence, when it's necessary to prepare the hard tissues with previous pulp removal, which is undesirable in old people and those patients with somatic pathologies. The equator crowns are used for splinting of the chewing teeth if periodontal disease is present. They don't obstacle surgical and therapeutic procedures.

The teeth preparation is performed like in case of complete stamped crown, but until the equator, on the level of which circular projection is made. All the clinical and laboratory stages are the same. The equator crown must rest against the projection, providing for the gradual transition to the gingival part. It's better not to create the retention points where the food debris will accumulate.

The telescopic crowns represent a system of double crowns – the external and internal. The internal crown has a cylinder shape and fits the contours of the prepared tooth. The external represents the anatomical tooth shape and it is always joined with the removable plastic prosthesis. They are used for fixation of the bridge or removable plastic prostheses.

The indications for the telescopic crowns use provide for their fixing properties and the necessity of removing much bulk of hard tissues of the supporting tooth at the double crowns width. According to this, the supporting teeth must have high and large clinical crowns, if such are present; a large layer of hard tissues can be removed without any danger of pulp opening.

There are two types of the telescope crowns used in clinics. These are the stamped and cast crowns.

The first ones are easier for the production technology; the second ones are precisely accurate. The possibility of the coating use makes the cast telescope crowns advantageous esthetically. Fig. 5-18

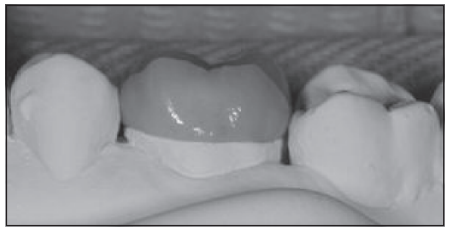

Fig. 5-18. *Equator crowns*

Combined crowns

The crown fabrication according to Belkin includes the following stages.

The first clinical and laboratory stage includes all the procedures which correspond to the making of the complete metal stamped crown.

The second clinical stage includes adjusting the stamped crown by the

generally accepted method. Then the crown is taken off the supporting tooth and the perforation of the vestibular side of the crown using the bur is performed. The supporting tooth is additionally grinding from the vestibular side, and just slightly polished from the approximal sides to release the space for plastic.

The crown is filled with a melted wax and repeatedly it is put onto the supporting tooth stump, in this case the wax rests will come out through the opening on the vestibular surface. The rests of the wax are removed and the impression with the crown is obtained, then the color of plastic must be detected, and the crown is sent to the dental technician laboratory with the task.

On the second laboratory stage the dental technician casts the model according to the obtained impression. The crown is heated over the gas burner, then it is taken away and the rests of the wax are melted. The crown is grinded and polished, after this on the vestibular surface a "window" is cut using the separation disc, and a narrow strip in the neck area is left 0,5 mm. near the cutting edge. To improve contact of metal with plastic the cuts in the "swallow tail" shape are done through the perimeter using the wheel-like bur Fig. 5-19.

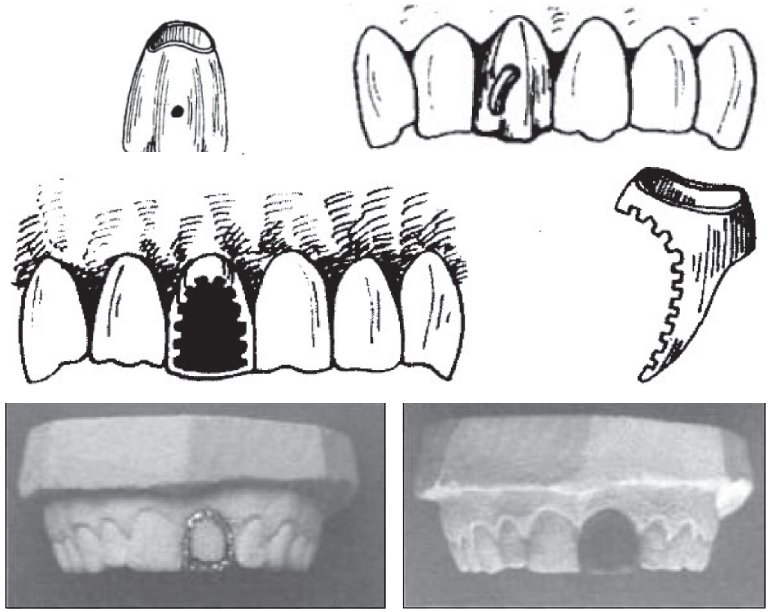

Fig. 5-19. *Stages of fabrication of a plastic-coated crown (Belkin's method). (by V.Kurlandsky 1985 y.)*

Then the frame of the stamped crown is put onto the working model and check if it fits. The crown is taken off the model, it is degreased and the perigingival strip is isolated with a varnish. After drying the varnish the crown is again set onto the model and vestibular surface is modeling with wax. We should cut a plaster block from the model, and it includes a tooth with an artificial crown and the neighbor teeth from each side, the block is plastered into the flask with vestibular surface looking upside, it is put into water for some time period and a contrastamp is removed. The stomatological flask is put under the press to remove the plaster rests and for plaster crystallization. The flask is opened using hot water, the wax is melted, then it is cooled and the plastic of appropriate color is packed. This method is characterized by the simplicity of production, but it has many great disadvantages which restrict its usage. First of all it's a weak mechanical connection of plastic with metal. This results in present gaps into which food debris may get, the metal is translucent, there are defects of plastic covering, not tight contact of the crown in cervical region and others.

CAST COMBINED CROWNS

The advantages of the cast crowns over the stamped and combined ones are evident. First of all, the cast frame because of higher tightness in comparison with the stamped crowns is less susceptible to deformations, and this provides for more reliable attachment of the covering material. As the cast itself, cast-shaped crown tightly and accurately fits and covers the dental stump, harmful influence of the plastic onto the dental tissues isn't present here, and more reliable prosthesis fixation is provided in this way. This provides for the maximum reduction of the plastic's influence onto the marginal periodontium, as the plastic margins end on the projection, it doesn't penetrate into the gingival sulcus and doesn't deform the dental-gingival attachment. Production of the cap with projection provides for the increased plastic layer in the cervical area, which improves the esthetic properties of the plastic. Fig.5-20 The devices used for the attachment of the plastic covers used at fabrication of the whole piece cast crowns are more reliable than those in stamped. The cast combined crowns are better to be used in case of the teeth defects restoration when the destroyed tooth part is restored with a cast overlay or covering material on the cast cap. Here the stamped crowns are less steady to chewing pressure. The cast combined crowns are the most convenient constructions for the support of the whole piece cast bridge denture. Fig. 5-24.

The main problem of the combined cast crowns' construction is creation of the reliable attachment for the plastic cover.

A abutment teeth is covered with a cast cap, on which an attachment for the plastic is constructed. To attach acrylic material on the metal crown base tightly, such attachment elements may be used: loop hooks, retention beads, frames and sulci on the metal frame base.

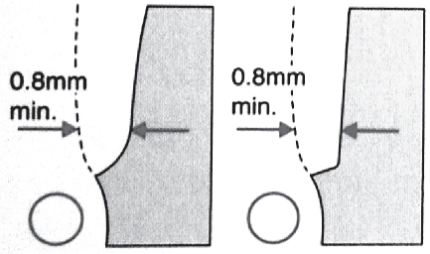

Fig.5-20. *Shoulder level and shapes*

There are two ways of the plastic cover use. The traditional method is represented with the previous modeling of the covering part with wax and after its melting the hot polymerization plastic forms in the flask. In other case, quickly hardening plastic of hot polymerization is used. The polymerization of such plastic occurs in special apparatuses under 3-4 atm pressure. In such conditions the quickly hardening plastic by its chemical and physical properties is a more advantageous material than hot hardening plastic, e.g. its tightness increases, it glistens and it is slightly transparent.

Impression for cast combined crowns.

The double layer silicon impressions are obtained using Zetaflow (Zhermack, Italy), Silagum (DMG, Germany) or other masses (Fig.5-21), the sectional model is fabricated and the crown frame is designed. The method of the cap production is described in page 204.

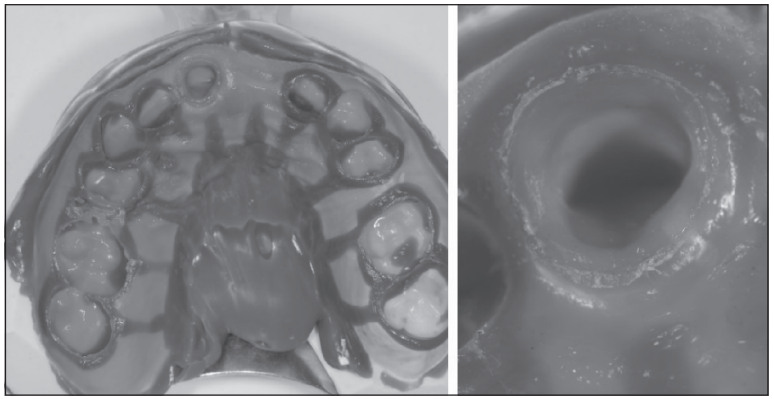

Fig.5-21. *The double layer silicon silicon impression of prepared incisor*

Firstly after the disinfection of the final impression, the dental technician fabricates working casts and dies using Class IV stone. Working cast is a cast that is used to represent the patient's prepared tooth and dies are positive reproductions of the prepared portion of a tooth. After the plaster sets, the models are then needed to be trimmed to acceptable measurements. Before trimming the models, you must wet the models and make sure the maxillary and mandibular base surfaces are parallel to each other. We were trimmed models according to these measurements; maxillary cast should were about 10 mm above the bottom base to the gingival margin of the tooth, the mandibular cast should were about 15 mm above the base to the gingival margin of the tooth. After the model is dried, we were used the router to trim the side of the models.

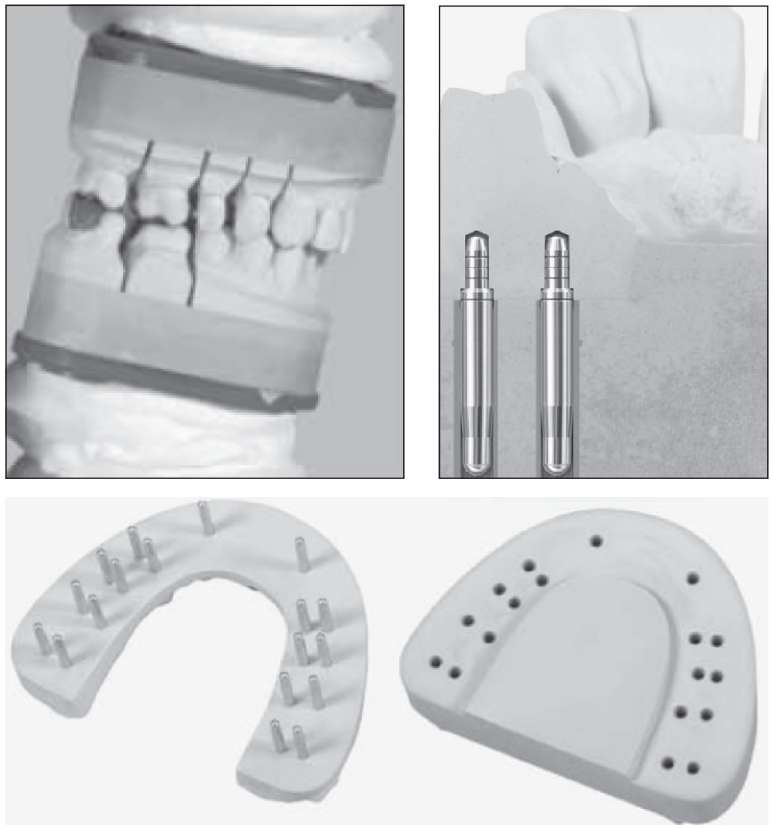

Fig. 5-22. *Master-pin cast system (by Bredent).*

Pindexing is done after the models are trimmed properly; the purpose is to drill holes where pins will be inserted. Models should be completely dry before this process. We are using a red/blue pencil to mark the center of the occlusal surface of the tooth that needs to be restored on the maxillary model, align the pindex machine light with the marked surface and drill a hole. Then we are checking each hole with the pin to see if it fits all the way into the rim. As with the mandibular cast, just drill three holes, one near the centrals and one on each side towards the molars. Pindexing can be done with two types of pins, dual pins or dowel pins. After the holes are drilled, pinning is done. Pinning is the placement of pins into the drilled holes and making sure that all the pins are parallel to each other for easy removal. Glue is applied to the end of the pins and place them inside the holes. Once the glue dries, sleeves are placed and rubber ends over the pins. Fig. 5-23

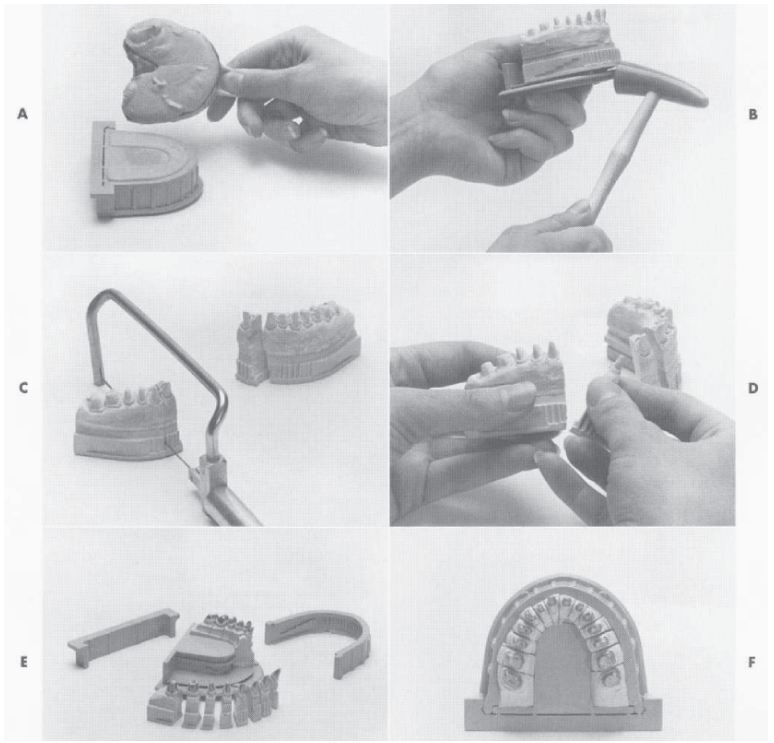

Fig. 5-23. *Stages of the master cast fabrication (Fixed Prosthodontics Stephen, F. Rosenstiel, Martin F. Land, Junhei Fujimoto 2001 y.)*

Base mold construction is to create a base for the prepared casts. The separating agent is applying to the surface of the base of the models before pouring the stone into a mold, let the separator dry completely. We are preparing a mix of dental stone III class that will be used for the base construction. Then we are placing the cast into the mold and fill it with stone on the vibrator. While the stone is setting center the midline of the model with the midline in the mold and we are letting the stone set for 45 to 60 min. After the models set, it is time to separate the models from the base.

Models are then separated from the base and ready for die sectioning. Only separate the maxillary model since the mandibular model will not be worked on during this step. Die sectioning is the process of cutting the dies as parallel as possible to each other. This process can be done by hand, bur or electric saw. When die sectioning, we are making sure not to cut the surfaces of the teeth or the pins inside the dies. Only we are making cuts on the maxillary model, cuts are not necessary for the mandibular model. After this is done check bite registration and then articulate. Fig. 5-24

Articulation establishes contact relationships between the occlusal surfaces of the teeth during function. In this process, the models are to be mounted onto an articulator, for crown and inlay restoration we used a simple plastic hinge nonadjustable articulator.

Die preparation involves exposing the margins on the die that requires restoration. The die preparation process is composed of trimming and ditching. Trimming is the removal of any excess stone from the axial surface of the root portion of a die; for easy taking for pieces of the model. Ditching is a process of exposing the margins on a die for easy margin identification. Prior to trimming

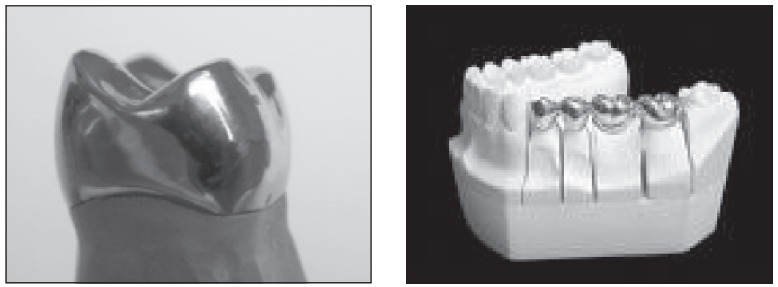

Fig. 5-22. *Ready cast metal crown*

and ditching, we are obtaining a red/blue color pencil to highlight the margins. Then the die may be trimmed and then ditched. We are using a carbide bur to trim the dies and a round carbide bur to ditch the die.

After the dies are trimmed and ditched, it is necessary to apply die hardener to cover the entire preparation. The die hardener hardens the die and helps create resistance to breaking. Then we are applying two layers of die spacer onto the prepared crown, this is not necessary for the inlay restoration. After that we apply two coats of either silver or gold and then we're ready for the inlay and full crown waxing process.

Before waxing it is necessary to remember to identify the margins and we apply die separator onto the preparation to prevent wax patterns from sticking to the die. After these steps, you are ready to wax the inlay and the full crown that was requested by the dentist. There are two types of waxing techniques, negative and positive waxing. Positive waxing is done by adding small increments of wax and negative waxing is a buildup/ carving technique. Fig. 5-25

The two prepared caps are positioned on the plaster tooth model and the crown frame is modeled with the Modewax wax (Kharkiv Ukraine). The glue is put onto the vestibular crown surface and the retention beads are positioned. The beads, according to their size and number, are positioned with a certain interval and the distance 0,5mm between them, evenly on the whole surface, to prevent their contact between themselves. Fig. 5-26

Some authors, like V.Kopeikin recommend applying the beads without any order.

After modeling the funnel system is made, using Voskolit-2, with the channels for air diversion.

To prepare the crown stainless steel and gold alloys are used, for the bridge prostheses– cobalt-chromium alloys. To improve the attachment of the covering to metal bed the air-abrasive processing is done. The beads are polished until obtaining the half-sphere shape, for their better fixation of the covers and degreasing their sizes. The frame is covered with a varnish to isolate the metal from plastic covering.

If Sinma-74 acrylic is used as a covering mass, it should be applied onto the metal bed without time breaks, this provides for tight filling of the subequatorial space, between the beads on the crown edges. To create the effect of the natural multicolored tooth after pressing the flask is opened, plastic is removed in the cervical area and the dark plastic is packed onto the free space.

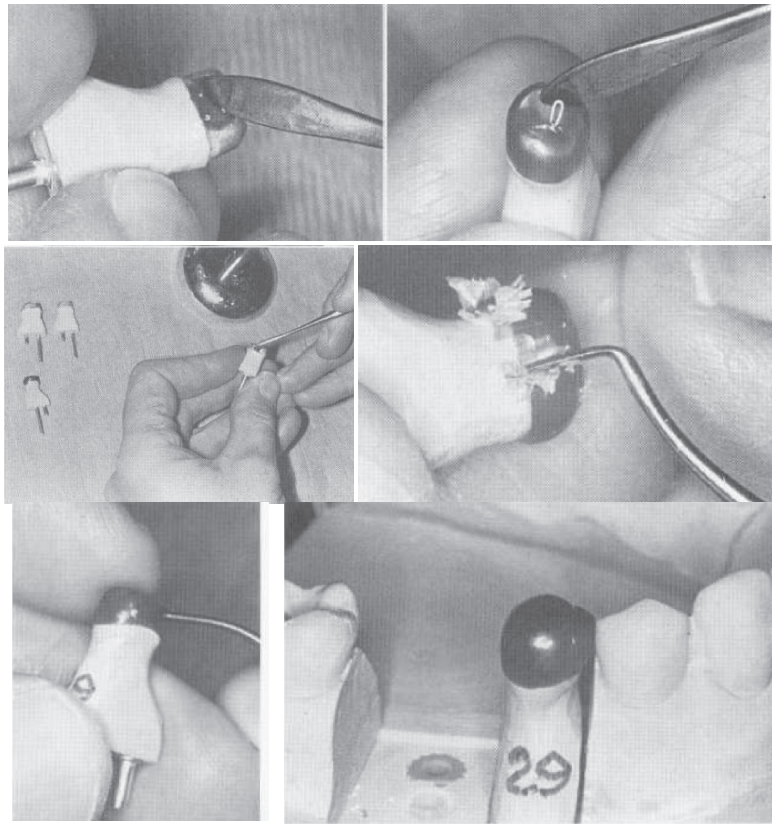

Fig. 5-23. *Stages of applying wax reproductions of the future crown (Fixed Prosthodontics Stephen, F. Rosenstiel, Martin F. Land, Junhei Fujimoto 2001 y.)*

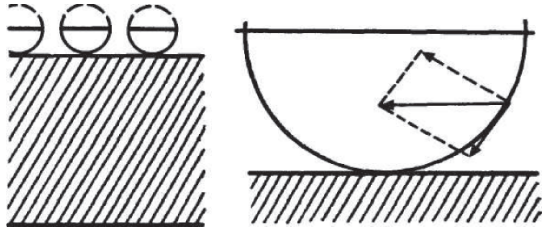

Fig. 5-26.*Adhesive pearls for fixing plastic lining (by V.Kurlandsky 1985 y.)*

The technique of casting process

The steps following the inlay and crown waxing is spruing and investing. Spruing is done by attaching a prefabricated plastic or wax tube to the wax pattern that will aid the transfer and flow of the melting alloy during the casting process. There are two methods, indirect and direct; indirect is done by using a runner bar to sprue multiple wax patterns and direct is done by using a single reservoir sprue for single or multiple wax patterns. We should obtain a casting ring and placing some wax onto the ring base and seal it. In this case, the direct spruing method is used, sprue should be placed on a 45degree angle to the long axis of the tooth and at the thickest part of the waxed restorations. Then we must place the wax patterns into the casting ring and making sure the wax pattern is in the cold zone and outside of the thermal zone. After spruing, investing is done. The process of investing is performed to create a mold for the casting process. After that mixing investment according to the manufacturing instruction. Before pouring the investment into the ring, spray the wax patterns with debubblizer to reduce surface tensions. Then we should pouring the investment into the ring using a vibrator and fill up the ring, then place the invested ring into the pressure unit for 15-20 minutes to eliminate air bubbles.

After the invested ring is removed from the pressure pot, gently trimming the top surface of the ring. Now the process of burning is ready to be carried out. The burning process aims to eliminate wax from the wax ups along with the sprues that was in the investment ring to provide space for metal to enter.

The rubber sprue former is removed from the invested ring after the investment has hardened. The ring, which now contains the wax pattern and attached sprue completely surrounded by investment material, is then placed into an oven at 250C with the sprue end down, thus allowing the melted wax to flow out. After 30 min. the wax will have been removed completely. At this point, metal tongs are used to transfer the ring to an oven set at approximately 650 C. The ring is placed with the sprue hole down so that the investment material will not crack from excessive thermal shock, a problem for brittle materials. After 45 minutes at this elevated temperature, the ring is ready to be cast.

This high-temperature heating has two purposes, besides the removal of the wax. As the investment material is heated to 650 C, it undergoes a thermal expansion of 1.25%. Thus, the total expansion of the investment material in the high-heat technique is approximately 1.95%. This creates a larger cavity for the metal to fill in the next step. For the hydroscopic technique, the mold is also

heated, but to a lower temperature. This produces less thermal expansion, but the total expansion 2.05% is slightly greater than that for the high-heat technique. The other important aspect of the heating is that it raises the temperature of the investment to a level closer to the temperature of the molten metal than that which will be cast into it. If the thermal shock produced by a very hot liquid metal hitting a very cold ceramic mold is too great, the mold may crack and cause a defective casting. Heating the investment to such a high temperature reduces the likelihood that this will happen.

Then the process is to melt and then cast or thrust the metal by centrifugal force through the sprue hole into the cavity within the investment. The machine used to accomplish this is called a centrifugal casting machine. It consists of a stage attached to an arm that has a counterweight at the other end and is supported in the middle by a rotating spindle. The spindle is spring loaded and can be wound by hand. When the arm is released, it spins and throws the molten metal outward into the investment.

We should placing the investment rings into the oven and apply heat according to manufacturing instruction. Following the burnout step, casting is done next; in which metal will be shot into the casting ring. Removing the ring from the casting machine and let it cool. Divesting is done after the ring cools. The purpose of divesting is to remove the restoration from the investment. After this is done, you finish and polish, disinfect and the restoration is ready to be sent back to the dentist. .

Casting Machines:

All casting machines pour the molten metal into the mold either by centrifugal force or air pressure.

The selection of the casting and melting techniques is heavily influenced by the type of alloy and restoration to be cast.

Centrifugal machines: A variety of centrifugal casting machines are available. Some spin the mold in the plane parallel to the table top which the machine is mounted on, whereas others rotate in a plane vertical to the table top. Some are spring driven and others are operated by electric power. An electric heating unit is attached to some machines to melt the alloy before spinning the mold to throw in the metal. Others have a refractory crucible in which the alloy is melted by torch before the casting operation is competed. Each of these machines depends on the centrifugal force applied to the molten metal to make it completely fill the mold with properly melted metal. Fig. 5-27

Advantages

Simplicity of design and operation, the opportunity to cast both large and small castings on the same machine.

Casting machine is spring wound 2 to 5 turns depending on particular machine and the speed of casting rotation desired. The alloy melted is melted by a torch flame in a glazed ceramic crucible attached to the broken arm of the casting machine. The broken arm features accelerate the initial rotational speed of the crucible and casting ring thus increasing the linear speed of the liquid casting alloy as it moves into and through the mold. Once the metal has reached the casting temperature and the heated ring is in position, the machine is released and spring triggers the rotational motion. As the metal fills the mold, a hydrostatic pressure gradient develops along the length of the casting.

Induction Melting Machine:

Alloy is melted by an induction field that develops within a crucible surrounded by water cooled metal tubing. The electric induction furnace is a transformer in which an alternating current flows through the primary winding coil and generates magnetic field in the location of the alloy to be melted in a crucible. Once the alloy reaches the casting temperature in air or in vacuum, it is forced into the mold by centrifugal force, by pressure or by vacuum. Fig. 5-28

Fig. 5-27. *Centrifugal casting machines (Bego catalogue of dental technology 2015)*

Fig. 5-28. *Induction melting machine (Bego catalogue of dental technology 2015)*

More commonly used ones for melting are base metal alloys. Melt alloy is got much faster than those heated by torch, if the procedure is not watched closely– alloy can easily be overheated. An electric monitor is useful for indicating temperature.

Direct Current Arc melting machine: The direct arc is produced between two electrodes, the alloy and water cooled tungsten electrodes. The temperature within the arc exceeds 4000 ^{o}C and the alloy melts very quickly. This method has a high risk of overheating the alloy and damage may result after only a few seconds of prolonged heating.

Casting crucibles: Generally four types of casting crucibles are available: clay, carbon, quartz and aluminium zirconium. Clay crucibles are appropriate for many of the crown and bridge alloys such as high noble and noble types. Carbon crucibles can be used not only for high noble crown and bridge alloys but also for the higher fusing, gold based metal-ceramic alloys. Crucibles made from alumina quartz, or silica are recommended for high fusing alloys of any type. They are especially suited for alloys that have a high melting temperature or those that are sensitive to carbon contamination. Crown and bridge alloy with a high palladium content such as Pd-Ag alloys for metal ceramic coping, and any of the nickel based or cobalt based alloys are included in this category.

Torch Melting: Most common method of heating dental alloys for full car metal restorations is by using a gas-air torch. A properly adjusted torch develops and adequate temperature for melting dental alloy ranges between 870?C to 1000?C. Completing the melting operation promptly also depends on the proper adjustment of the torch flame. Poorly adjusted flames can waste time during melting and considerably damage the alloy through excessive oxidation or gas inclusion. Small and irregularly shaped flames should not be used to melt moderate or large quantities of alloy for casting purposes. A well defined torch flame is the hottest and most effective for such melting operations. The properly adjusted flame contains well defined components. Parts described as inner and outer cones or portions having different color intensities.

Classification of casting defects:

1. **Distortion is usually due to the distortion of wax pattern.**

To avoid this:

– Use manipulation of the wax at its softening temperature.

– Invest the pattern at the earliest stage.

– If storage is necessary– store it in a refrigerator.

2. **Surface roughness may be due to:**

– Air bubbles on the wax pattern.

– Cracks due to rapid heating of the investment.

– High W/P ratio.

– Prolonged heating of the mold cavity.

– Overheating of the gold alloy.

– Too high or too low casting pressure.

– Composition of the investment.

– Foreign body inclusion.

3. Porosity may be internal or external. External porosity causes discolouration.

Internal porosity weakens the restoration.

Classification of porosity.

I .Those caused by solidification shrinkage:

a) Localised shrinkage porosity.

b) Suck back porosity.

c) Microporosity.

They are usually irregular in shape.

II) Those caused by gas:

a) Pin hole porosity.

b) Gas inclusions.

c) Subsurface porosity.

Usually they are spherical in shape.

III) Those caused by air trapped in the mold:

a) Back pressure porosity.

b) Localised shrinkage porosity.

c) Large irregular voids found near sprue casting junction.

Occurs when cooling sequence is incorrect .

If the sprue solidifies before the finishing of the casting process, no more molten metal is supplied from the sprue which can cause voids or pits (shrink pot porosity)

This can be avoided by -

– using asprue of correct thickness .

– Attach the sprue to the thickest portion of the pattern.

– Flaring of the sprue at the point of atttachment.

– Placing a reservoir close to the pattern.

Suck back porosity

It is an external void seen in the inside of a crown opposite the sprue .

Hot spot is created which freezes last.

It is avoided by:

Reducing the temperature difference between the mold & molten alloy

4. Incomplete casting.

5. Oxidation.

6. Sulfur contamination.

Metal-ceramic crowns

The orthopedic treatment using the metal-ceramic crowns contains a sequence of the clinical-laboratory stages: patient's examination, planning the treatment, preparing the supporting teeth, impression taking, fabrication of the provisional (protecting) crowns, obtaining the demountable combined models, modeling and casting the metal frame, its adjustment in the oral cavity, covering the frame with ceramics, adjusting and fixation of the ready prosthesis.

On the examination stage it is necessary to know and apply the criteria for the metal-plastic crown fabrication according to the clinical conditions. So, the indications for the use of such prostheses application may be:

1) Hard dental tissues defects, with impairments of color, shape, both acquired and inborn;

2) Increased hard dental tissues' abrasion;

3) Metal fixed dentures which don't correspond to the requirements;

4) Allergy to plastic;

But for the indications for metal-ceramic crowns' fabrication there exist absolute and relative contraindications.

Absolute contraindications for the metal-ceramic crowns are:

– teeth with vital pulp in children and teenagers;

The absolute contraindications are:

– occlusal abnormalities with deep overlap;

– the mandibular incisors with vital pulp and low clinical crowns;

– chewing muscles parafunctioning;

– increased abrasiveness of the hard dental tissues;

The preparation of the supporting teeth for the metal-ceramic crowns doesn't differ from the same preparation for the porcelain, metal-plastic and plastic crowns.

After finishing the preparation we must produce and temporarily fix provisional crowns onto the supporting teeth. The impression taking must be

performed on the next day after preparation finishing, to prevent mistakes on the next stage of the metal-ceramic crowns fabrication.

The dental technician after the obtained impressions produces cast model as removable die system and starts the crown frame modeling. To compensate the metal shrinking, the gypsum dental stump is covered with special compensating varnish.

The wax composition may be obtained in such way. After application onto the stump of two layers of the compensating varnish it is pour into the melted modeling wax in a special heating device. The wax is melted in temperature for required width is obtained. Then extra modeling of the wax composition of the crown design is performed. A dental technician during the final modeling must pay attention to the thickness of the metal frame no less than 0.3 mm. The width and thickness of the "garland" is detected in every certain case individually.

The sprueing system is formed on the wax reproduction of the frame; in the casting laboratory wax is changed with metal. Now more than 100 alloys types for the frame production are used:

– base alloys with nickel-chromium alloys – Wiron-77, Wiron-88, Wiron-99;

– base alloys with cobalt-chromium alloys – Witallium, celesit, etc.

After obtaining the cast frame a dental technician processes with the abrasive heads all its surfaces, checking smoothness of the transitions and wall width, which shouldn't be less than 0,3mm.

The metal frame must be thoroughly adjusted on the gypsum model. The orientation point is usually the place of positioning of the frame edge in cervical area. The distance from the metal frame and occlusal surface of the antagonizing teeth must be 1,5-2mm. The quality of the fabricated metal frame is checked in clinic.

In a clinic the orthopedic dentist must thoroughly examine the produced frame quality. If any defect is present, it must be corrected. The frame which corresponds to all the requirements must be disinfected and tried on the supporting tooth in the oral cavity.

The color of the teeth is detected in natural light in oral cavity, the color shade is informed to the technical laboratory. Then the frame is sent to the dental technical laboratory for the next laboratory stage.

In a dental technical laboratory the metal frame surface inaccurately polished with hard-alloy dental heads and processed in the sandblaster apparatus, as a

result, the metal surface becomes more rough which increases contact area for the covering material. The crown frame is processed during 1 min under the pressure of 5-6 atm., the corundum particles' size is 200-300 nm. Fig. 5-29 After this the frame is cleared from the sand by boiling in water during 3-5 min, degreased with ethyl acetate. After this the frame isn't to be taken by hands but only with clamps. The dried frame undergoes the thermal processing to create the oxide film necessary for the tight contact of the metal with ceramic mass. The processing procedure occurs in the ceramic preparation oven under 980-1000 Celsius degrees temperature during 10-15min. Resulting from such processing the frame is covered with even layer of dark-green or dark protective film. Each alloy type and ceramics type has its own thermal processing regimen.

To obtain the opaque layer the powder of the ground layer is mixed with the distilled water and it will be done to the sour-cream consistency on the special ceramic plate with grooves.

The prepared material(ceramic) is applied onto the frame surface in even layer with a brush, being condensed with a grooved spatula. The width of the applied layer must be minimum. A frame with an opaque layer is put on the ceramic support (trigger) and it is previously heated near the sintering machine initial part under 980+– 1000 Celsius degrees temperature during 4-5min. Fig. 5-30

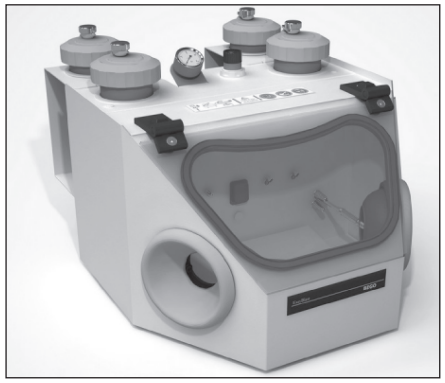

Fig. 5-29. *The sandblaster apparatus (Bego catalogue of dental technology 2015)*

After this we perform modeling and burning the dentine ceramic layer, applying it in small portions, condensing with grooved instruments and removing the moist with the filtering paper. The dentine layer is applied until the anatomical tooth shape is restored. The next stage is cutting the dentine layer from the cutting edge to the dental neck, so that the transparent enamel mass will smoothly integrate into the dentine layer. In all case we should create the color of the natural teeth, detected according to the table.

The vacuum burning is

performed under the temperature manual for each ceramic material. Here the laboratory stage of metal-ceramic crown fabrication finishes.

The crown with the plaster model is transferred to the clinics and it must be tried in the oral cavity. A dentist must examine the crown thoroughly: whether it corresponds to the tooth anatomical shape, presence of interdentally contacts and the occlusal interrelation character, a character of fitting the gingival part of the tooth. If necessary, the dried crown is colored with special dyes. After this the crown goes to the last laboratory stage – application of the glazing.

The glazing is aimed to give the ceramic layer a shine which is characteristic for the natural teeth enamel. So the enamel surface is polished and washed under running water with a brush. After the processing of the crown it is put onto the abutment tooth. Fig.5-31

The ready crown is disinfected and checked, putting it onto the abutment tooth. If everything is correct, the crown is again thoroughly disinfected and dried by the air under pressure. The supporting tooth is isolated from the saliva with cotton swabs, disinfected, degreased and dried with warm air under pressure. According to the luting cement is mixed, the crown filled with mix cement. The crown is applied into the tooth and the patient is asked to close the teeth accurately in the central occlusion position. The excess cement is carefully removed in 3-5 minutes, to prevent the marginal periodontium tissues' damage. A patient is advised to look after the crown correctly, it is not recommended to eat anything during the first 2-3hours.

Fig. 5-30. *Sintering machine (From catalogue of Ivoclar Vivadent 2015)*

Fig. 5-31. *Ready metal-ceramic crown*

Mistakes and complications of the fabrication and using metal cast and metal-ceramic crowns

Mistake on the clinical stage of the fabrication.

The mistakes and complications may usually occur at any clinical-laboratory stage of the metal cast and metal-ceramic crowns' fabrication. It is related to various difficulties of the clinical-laboratory stages of such crowns' fabrication.

The clinical experience shows that the most responsible stage of the esthetic constructions fabrication is the preparation of dental hard tissues, this is why the amount of complications of this stage is the greatest. The preparation of a great thickness of hard tissues of the teeth with vital pulp requires for efficient anesthesia combined with psychological preparation of the patient. If we don't keep to this requirement, a traumatic pulpitis may occur. This complication results from the traumatic preparation with a blunt instrument, centerless bur, movable handpiece, continuous preparation without cooling with water. The pulp may be injures if we can't correctly estimate the pulp chamber topography.

It is also very important for preventing the complications to keep during the tooth preparation to the accuracy of the teeth size and the shape of their stumps. Shortening of the supporting tooth (more than it is stipulated with the treatment plan) will lead to loosening of the retention and deplastment of the artificial crowns. Keeping to the cone shape provides for reliable fixation of the crowns. As the majority of authors think, the optimum cone inclination is 3-8 degrees. The cone inclination between the vestibular and subpalatal walls, especially a great inclination of the subpalatal walls of frontal teeth may lead to dislocation of occlusal interrelations. The absence of the vestibular protrusion on the supporting teeth may in future lead to splinter of the ceramic covering in the precervical area and esthetic discomfort in the cervical region of the supporting tooth. In the lateral teeth area there may be observed a traumatization of the marginal periodontal tissues by the material of the crown edge.

The percentage of complications has decreased with implementation into the orthopedic clinical process of the modern impression materials. The mistakes may be related to the material use, the expiry dates of which are much shorter. The mistakes may be related to the use of the materials, the expiry date of which is already over, with incorrect technology of the composite impression material mixing.

The impression taking must be performed on the next day after preparation. If we don't keep to the rule, the shape of the cervical gingival area will be spoilt.

Mistakes on the laboratory stage of the fabrication.

The incorrect shape of the prepared teeth and mucosa on the models may results in mistakes of gypsum models' making.

The mistakes of modeling and frame casting in metal-ceramic crowns are manifested in such issues as wide or narrow crowns. We can often observe such mistake as insufficient casting on the crowns, related to thin frame modeling. The minimum width of the cap walls must be 0,3-0,4mm (0,5mm-extra mm for the mechanical processing).

The next mistakes group is related to incorrect detection of the ceramic cover color. The most widespread causes of such mistake are a very thin layer of the ceramic cover which is related to insufficient preparation of hard dental tissues. The fluorescence of the metal frame leads to changes in the covering color.

The opaque layer must be applied twice but in small thickness. Dirty powder of the ceramic mass in dental technical laboratory, if we don't keep to the rules of managing ceramic mass, causes the color change.

If the metal surface wasn't prepared correctly, there may appear defects of the ceramic cover in "bubble" shape, from the metal surface coming through all layers of the cover.

It's necessary to keep to all the rules of air-abrasive frame processing. The silicate carbide sand can't be used, as it makes metal surface bad, as it penetrates its surface. The necessary point is the control of sand dispersion in the air-abrasive apparatus to create the sufficient toughness of the metal surface.

When prosthetic metal crowns may cause rejection to metal dentures. The reason for this might be defective metal used for casting, individual aversion to metals, the presence of electrolytic processes that lead to corrosion processes in metal components of artificial crowns. To prevent these manifestations should be carefully collect history, keep up the quality and use of casting alloys one kind.

Fabrication of crowns for dental implants

At this time of significant development of implantation, a dentist must have equipment to fabricate crowns for implants. In prosthodontics clinic a patient comes with a fixed shaper gums.

Construction of dentures on implants is significantly different from the traditional methods of making dentures. The method of prosthetics depends on the design features of implant.

Prosthetic appliances are divided into two large groups.

1. Overdenture prosthesis:

a) Overdenture is fixed with different type of attachments;

b) Overdenture is fixed on bar

2. Fixed dentures which fixing with cement or screw:

a)crown

b) bridges

There are three ways of taking the impression for implant: ordinary impression, impression with closed tray, impression with open tray.

All the impressions require transfers which help to copy into the plaster model the oral pattern exactly as it is. There are two types of transfers for taking impression according their attachment with an implant or abutment:

– transfer which joins like a twisting screw

– closing transfer which joins like a locked mechanism

The impression obtained with a tray provides for the more accurate "transfer" from the oral cavity onto the model of the implant position.

This method includes some stages:

– the gingival shaper is screwed out, and the transfer is joined to the implant;

– the impression is taking in a "sandwich" method (two-layer silicon material). Both layers of the impression (the internal -with low viscosity and external– with high viscosity)– are simultaneously introduced into the oral cavity. After setting time the impression is taken out of the oral cavity.

– The transfer is removes from the implant or abutment;

– a laboratory analogue is joined to the transfer (this is a device which imitates the interbone part of the implant or abutment);

– The impression with tray is sent to the dental laboratory;

– the dental technician creates the gingival margin with laboratory mask in the implant area, then pour the impression with plaster of 4th class;

– the dental technician separates the transfer from the laboratory analogue (which is situated in the stone), as a result, the analogue representing the implant in the model, with the gum imitation. Fig. 5-32

The open tray impression is taken with individual tray, and it includes the following stages:

– the gum shaper is screwed and the transfer is screwed into the implant;

– we take the impression using the "sandwich' method;

– we take the impression out of the oral cavity, with a transfer inside the impression;

– the impression is sent to the dental technician;

All next steps are the same as in prosthetics by closed tray.

In any method the impression of the opposite jaw is also taken, it is necessary to detect the jaw ratio, like in ordinary prosthetics. Fig. 5-33

The next stage is to select implant superstructures. These are usually called prosthetic implant abutments. These abutments can be made from a variety of materials, such as titanium, cobalt-chrome alloys. More modern abutments are now also made from zirconia, which is a whiteceramic, to better complement the aesthetics of a dental implant restoration. The ceramic abutment can enhance a ceramic crown by giving it a more lifelike appearance. Ceramic abutments have to be used with care, however, since their compressive strength is nowhere near that of titanium, gold or other noble metals. Most clinicians feel more comfortable

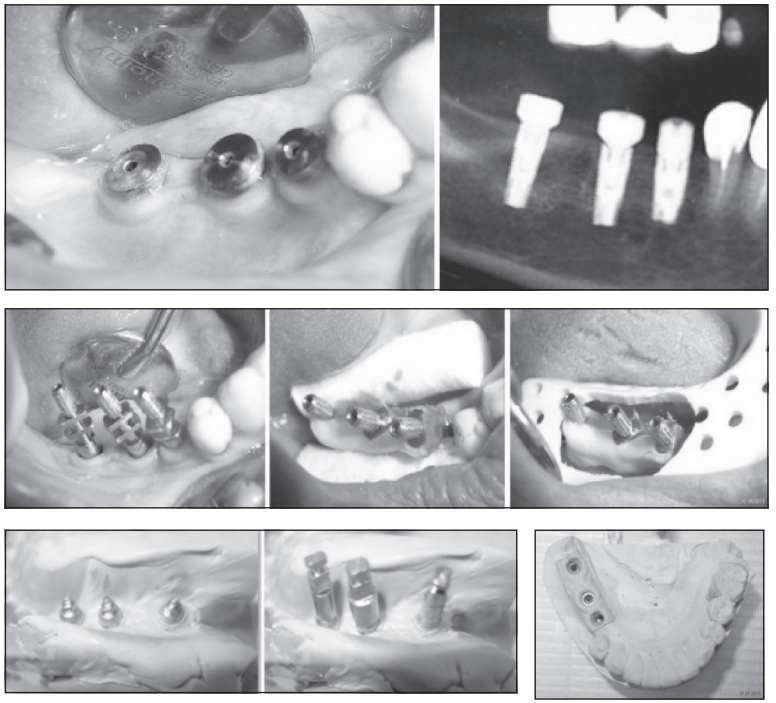

Fig. 5-32. *The main stages of taking impression by open tray(Publication of the journal "Green Implant System Tec" 2011 y.)*

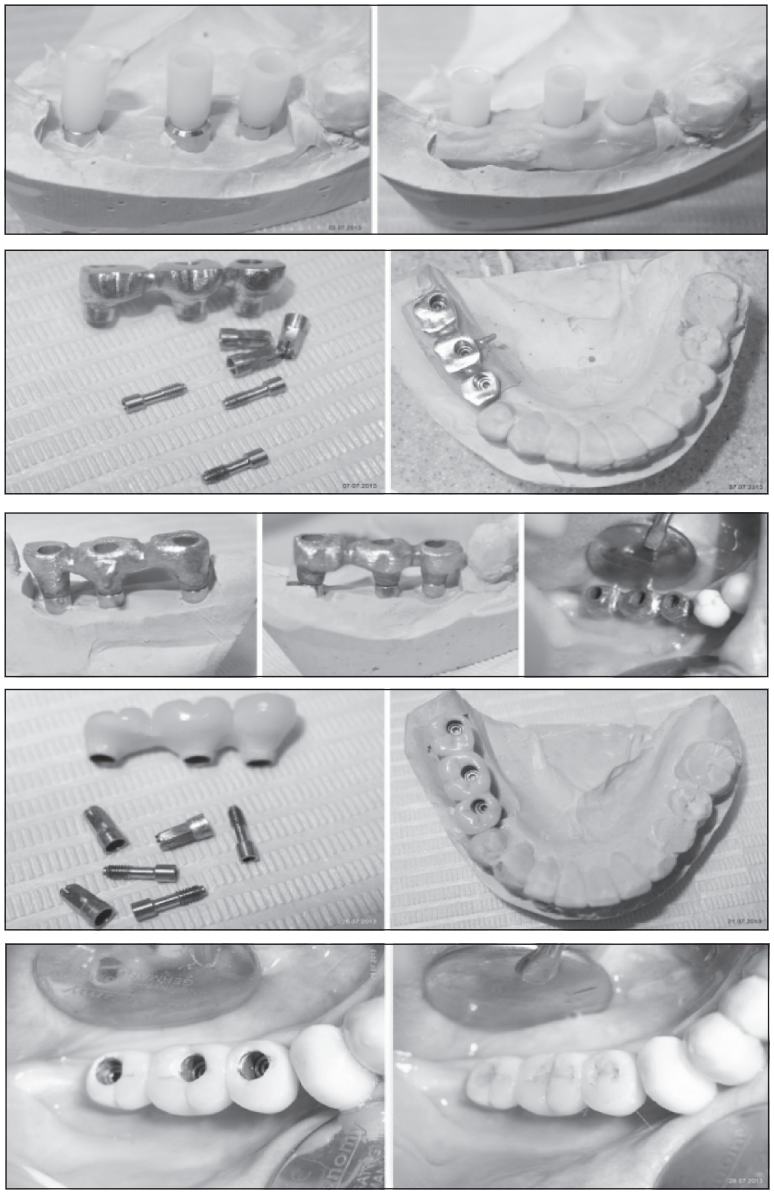

***Fig. 5-33**. The main stages of crowns on implants fabricating (Publication of the journal "Green Implant System Tec" 2011 y.).*

using a metal prosthetic abutment in the posterior molar areas, due to the increased masticatory forces present in these areas. An abutment is not necessarily parallel to the long axis of the implant. It is utilized when the implant is at a different inclination in relation to the proposed prosthesis. Most crowns and fixed partial dentures have a cemented or screw-retained fixation on the abutment.

In a three piece implant the abutment is fixed on the implant with a screw butt joint. This screw needs to be tightened to a predetermined torque with a dental torque wrench, in order to avoid screw loosening during chewing, which can often create a counter-clockwise torque on the implant-abutment interface, encouraging the abutment screw to come loose. This can largely be prevented with proper screw design and torquing of the abutment. In a two piece implant the abutment is morse tapered or cold welded on the implant. Microbial leakage and colonization between the implant and the abutments can result in inflammatory reactions and crestal bone loss. Morse taper conical abutments showed a cumulative implant survival rate of 98.23% in terms of seal performance, microgap formation, torque maintenance, and abutment stability. A one piece implant (OPI) incorporates the trans-mucosal abutment as an integral part of the implant. This type of implant is often used with a flapless procedure and immediate loading (the crown is placed in a short time after placing the implant).

Also abutments are standard or individual. There may be straight or angled. Depending on the clinical cases you choose the appropriate. Fig.5-34

After fixing abutment in the implant, it is fixed artificial crown with cement or screw.

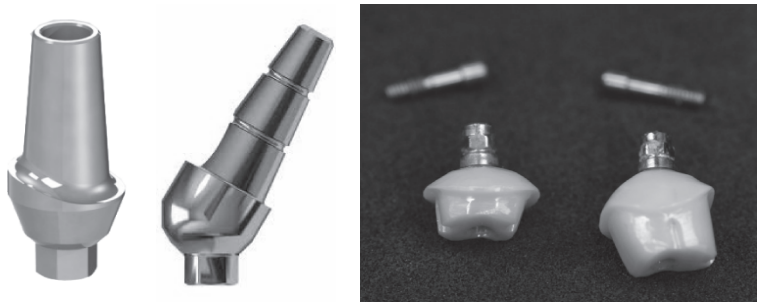

***Fig. 5-34**. Different types of abutment.*

Restoring of the endodontically treated teeth

An endodontically treated tooth should have a good prognosis. It can resume full function and serve satisfactorily as an abutment for a fixed or removable partial denture. However, special techniques are needed to restore such a tooth. Usually a considerable amount of tooth structure has been lost because of caries, endodontic treatment, and the placement of previous restorations. The loss of tooth structure makes retention of subsequent restorations more problematic and increases the dangerous of fracture during functional loading. Two factors influence the choice of technique: the type of tooth (whether it is an incisor, canine, premolar, or molar) and the amount of remaining coronal tooth structure. The latter is probably the most important indicator when determining the prognosis.

Different clinical techniques have been proposed to solve these problems, and opinions vary about the most appropriate one. Recent experimental data have improved our understanding of the difficulties inherent in restoring an endodontically treated tooth. This chapter offers a rational and practical approach to the challenge.

There are following requirements for using core and post to restore crown of the tooth:

- The teeth roots must be filled to the apex, the filling material in the canal must lie homogenously;
- There couldn't be any sight of periodontal inflammation;
- The root we use for restoration must be without cracks;
- The root length always must be larger than the future artificial crown;

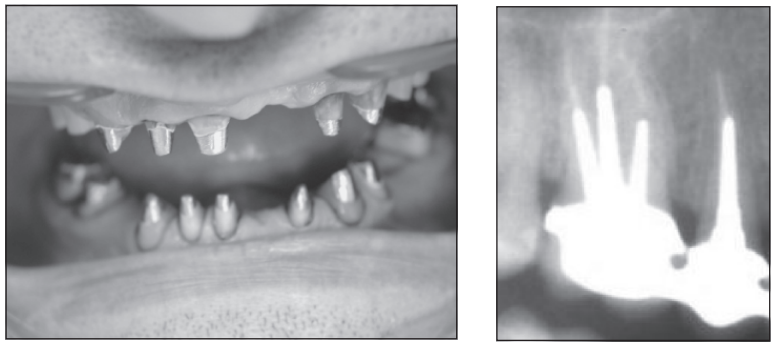

Fig. 5-35. *Cemented metal pins.*

- The tooth root must be stable, its margins must be placed higher or at the same level as the gingival margin;
- While probing the tooth tissues must be solid.

The crown part of the tooth can be restored in single or multirooted teeth, using the construction with one or several posts. The root canal of single root teeth is prepared on 2/3 of its length. In multiroot teeth it is possible to prepare two roots on 1/2 of their length, if they are parallel. If the root canals are not parallel, one root is preparation on 2/3 of its length, while the other is prepared on 2-3 mm., that provides resistance and improves the construction retention. Fig. 5-35, Fig. 5-36

The root is prepared as follows:

The thin walls are removed on its surface, while leaving 1.5-2 mm. of the tooth high above the gingival surface. If the roots surface is situated of the same level or below a gingival, preliminary surgical and orthodontic treatment is important for forming of the ferrule of supragingival localization root. Then infected and softened tissues surfaces are removed, forming necessary biomechanical elements of design. The width of the prepared root canal must be no less than 2 mm at the tooth canal orifice.(and for lower incisors – no less than 1.5 mm) The width of the root canal in the area of the probable post apex must be no less than 1.0 mm. While preparing a root canal you should avoid forming the circular section, preferring oval. Fig. 5-36

Six features of successful design is identified:

1. Adequate apical seal;
2. Minimum canal enlargement (no undercuts remaining);
3. Adequate post length;
4. Positive horizontal stop (to minimize wedging);
5. Vertical wall to prevent rotation (similar to a box);
6. Extension of the final restoration margin onto sound tooth structure.

Endodontically treated teeth often have lost much coronal tooth structure as a result of caries, of previously placed restorations, or in preparation of the endodontically accessed cavity. However, if a cast core is to be used, further reduction is needed to accommodate a complete crown and to remove undercuts from the chamber and internal walls. This may leave very little coronal dentin. Every effort should be made to save as much of the coronal tooth structure as possible, because this helps reduce stress concentrations at the gingival margin. Fig. 5-37 The amount of remaining tooth structure is probably the only most

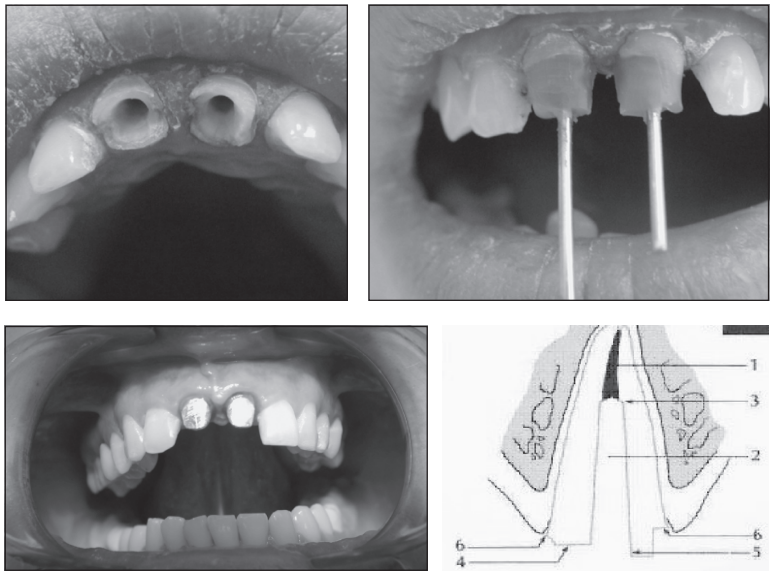

Fig. 5-36. *Faciolingual cross section through a maxillary central incisor prepared for a post-and-core. Six features of successful design are identified: 1, Adequate apical seal; 2, minimum canal enlargement (no undercuts remaining); 3, adequate post length; 4, positive horizontal stop (to minimize wedging); 5, vertical wall to prevent rotation (similar to a box); 6, extension of the final restoration margin onto sound tooth structure. (Fixed Prosthodontics Stephen, F. Rosenstiel 2001 y.)*

important predictor of clinical success. If more than 2 mm of coronal tooth structure remains, the post design probably has a limited role in the fracture resistance of the restored tooth. The once common clinical practice of routine coronal reduction to the gingival level before post-and-core fabrication is outmoded and should be avoided. Extension of the axial wall of the crown apical to the missing tooth structure provides what is known as a ferrule and is thought to help bind the remaining tooth structure together, preventing root fracture during function. Fig. 5-38 Although there is evidence that preserving as much coronal tooth structure as possible will enhance prognosis, it is less clear whether the prognosis will improve by creating a ferrule in an extensively damaged tooth by surgical crown-lengthening. In this latter circumstance, although the crown-lengthening allows a ferrule, it also leads to a much less favourable crown-to-root ratio and therefore increased leverage on the root during function. One recent

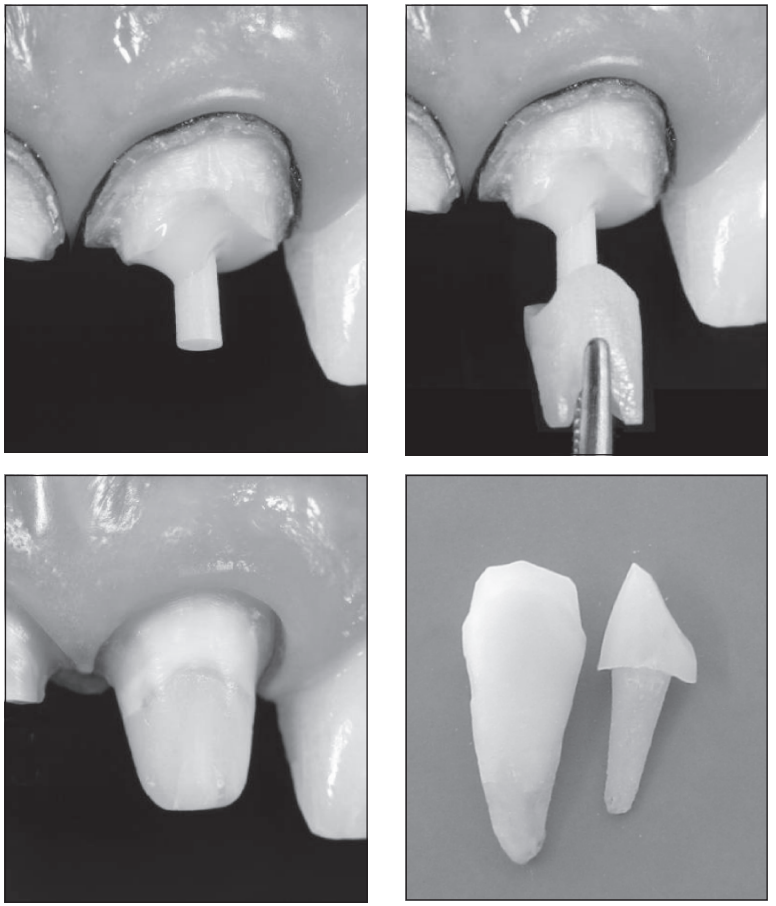

Fig. 5-37. *The main stages of fiberglass pins fabrication.*

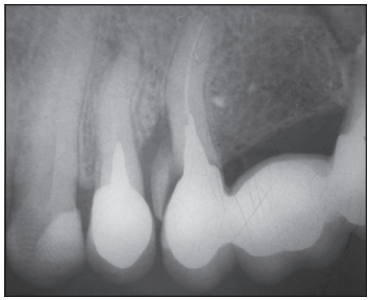

Fig. 5-38. *Fracture of the root as a result of uncorrected metal post shape and length.*

laboratory study showed that creating a ferrule through crown lengthening resulted in a weaker, rather than a stronger, restored tooth. Creating a ferrule with orthodontic extrusion may be preferred as, although the root is effectively shortened, the crown is not lengthened.

CEMENTATION

As with the cementation of any indirect restoration, the purpose of the cement is to secure the retention inherent in the design and to ensure a seal against micro-leakage. Cements are best introduced into the canal with a lentulo-spiral and the post also coated with cement.

Current resin-modified glass ionomer luting cements provide adequate properties and are widely used for cementation. Fig.5-39

Zinc phosphate cement cannot be discounted as it provides high modulus, ease of use, and has withstood the test of time. For post situations with less than optimal retention, resin cements can provide a significant increase in retentive strength.

The concept of adhesive fixation of a post and core in order to stabilize the tooth is an emerging concept. Several studies suggest adhesive cementation of posts can both increase post retention and reinforce the tooth. Effective bonding of the post can also reduce dentine stresses. The used cements are dual-cured, provide the stabilization of the post and immediate core build-up with composite resin. The success of any type of post is highly dependent on the presence of an adequate ferrule for the overlying crown. All post parameters such as length, width, design and cement are far less important than vertical tooth structure between the crown and core margins. Where there is minimal vertical tooth structure, all other parameters become far more critical and the long-term prognosis is worse.

Fig. 5-39. *The glass ionomer cement*

Questions

1. What are the indications for fabrication the inlay?
2. Which additional retentive shapes we add in II-nd class of inlays?
3. What are the causes of secondary caries after inlay fixing?
4. What are the peculiarities of the IV class inlay cavity preparation?
5. Requirements to artificial crowns. Mistakes and complications during fabrication. Indications for covering of a tooth with the crown. Classifications of the crowns. Materials which are used for fabrication of the artificial crowns?
6. Clinical and laboratory stages of a stamped crown fabrication. Kinds of punching?
7. Clinical and laboratory stages of a plastic crown fabrication. Materials which are used for this purpose?
8. Rules for teeth preparation under the combined crown. Methods of fabrication. Selection of dental materials?
9. Materials technology. General and additional materials for the cast metal and combine crowns and bridges?
10. Materials technology. Metal alloys in prosthetic dentistry – classifications, chemical and physical features?
11. Mistakes and complications which appear during acrylic crowns fabrication. Causes and prevention?
12. Mistakes and complications which appear during metal cast crowns. Causes and prevention?
13. What main rule for preparation of the oral cavity for the dental prosthetics?
14. What are the indications and contraindications for plastic crowns? What are the main clinical and laboratory stages of their fabrication?
15. What clinical indications for combined crown? What methods of fabrication? What are the facing materials we use?
16. What are the comparative characteristics of modern cladding materials for the fabrication of dental prostheses? (Plastics, ceramics, composites).
17. What are the indications and contraindications for porcelain crowns. Clinical and laboratory stages of their fabrication?
18. Describe please clinical and laboratory stages of fabrication metal-ceramic dentures, factors that provide a connection between ceramics and metal frame?
19. What are the main peculiarities for impressions by open tray?

Tests

1. The crown for the 47-th tooth has been fabricated according to Parker's method. What kind of stamping does this method belong to?

A. External stamping
B. Internal stamping
C. Combined

2. During the process of fabrication of stamped crown the bushings are thermally worked at t– 1050?C (yellow color). What is the aim of this processing?

A. To bring rigidity and flexibility to the metal
B. To increase the solidity
C. To increase the antirust properties
D. To increase oxidation resistance
E. To increase mechanic properties

3. After the final stamping and fitting in a clinic, the crown is cleaned and polished. What is the crown thick?

A. 0,25 – 0,28 mm;
B. 0,3 – 0,35 mm;
C. 0,4 – 0,5 mm;
D. 0,5 – 0,7 mm;
E. 0,8 – 1,0 mm.

4. Gingival shoulder of the tooth should be placed:

A. At the edge of the gums;
B. Below the gum 0.2-0.5 mm;
C. On the top edge of 0.5-1 mm gums.

5. What kind of bur you can use for make gingival shoulder:

A. Separating disk;
B. Carborundum stone;
C. Cones diamond bur:
D. Cylinder diamond bur.

6. Protection of the prepared teeth is conducted in the following ways except:

A. Coating with BF-b;
B. Lacquer "Tsiadent";
C. Rinsing the mouth with a solution of soda;
D. Production of provisional crowns

7. What is the purpose of the gingival retraction:

A. To closing the gingival sulcus for getting the monolayer impression
B. To single-layer impression for disclosure gingival sulcus
C. To disclosure gingival sulcus for getting the double-layer impression
D. To protected the gingival margin for receiving the three-layered impression :

8. What materials are most commonly used for taking impression on the metal dentures fabrication?

A. Gypsum, thermoplastic
B. Thermoplastic and elastic;
C. Resilient, gypsum;
D. Silicone.

9. Which mechanism of the joining ceramic material to the framework?

A. Chemical connection
B. Mechanical connection
C. Polar connection
D. Biophysical connection

10. Sandblast processing of the dental bridges frameworks are made for:

A. Prepare the surface for the material
B. Increase usable space for lining
C. Cleaning the surface from dirt;
D. All above-mentioned

11. The patient B. at the age of 34, is complained by discoloration of 23 tooth and aesthetic discomfort. In history: the treatment of the caries complications, allergic to plastic. Objectively, 23 tooth is dark blue. On radiographs of the root canal is sealed to the apex. Which artificial crowns is the better for the patients?

A. Plastic
B. Stamped
C. Plastic
D. Porcelain

12. For the patient M., 35 years old, a doctor is fabricated a porcelain crown on the 11 tooth. In which level of the neck the shoulder is formed?

A. At the level of the gingival margin of the tooth
B. Above the gingival margin by 1 mm
C. Above the gingival margin by 2 mm
D. Below the gingival margin by 2 mm

13. For the patient B. – 40 years old, the doctor is fabricated a porcelain crown on the 11 tooth. Which wide of the shoulder is formed around the perimeter of the neck?

A. 0,5-1,0 mm
B. 0,25-0,3 mm
C. 0,35-0,4 mm
D. 0,5-2 mm
E. 2,5-3 mm 4

14. The porcelain crown is fabricating on the 11 tooth. The plan is to leave the tooth vital. What events are applying for prevention pulp of the tooth by inflammation?

A. Fabrication of provisional crowns
B. Purpose of fluorinated drugs
C. Purpose calcium preparations
D. Vitamin therapy

15. For the patient C are fabricated the porcelain crowns. Before taking working impression the dentist is conducting gingival retraction. For what purpose is making this manipulation?

A. For accurately reflect the cervical area
B. For prevent injury, the gingival margin
C. For prevent injury periodontal connection
D. For easily removing the stamp from the prosthetic bed

16. For the patient 35 years old, is fabricated the porcelain crowns. Which material we use for taking the impression?

A. Express
B. Alligat
C. Stomafleks
D. Stens

17. The female 25 years old is complaining of discoloration of the tooth 12, an aesthetic defect. In history: the treatment of dental caries and its complications, the allergic to plastic. Objectively, 12 tooth has a dark gray colour, which restored by the filling material. On radiographs: root canal is sealed to the apex. Which artificial crowns are indicated for this patient?

A. Porcelain
B. Plastic
C. Metal
D. Cast

18. For the patient is fabricated a porcelain crown on 21. When you spend gingival retraction?

A. Before Impression
B. Before adjustments of the frame
C. After the Impression
D. After adjustments of the frame

19. The patient 30 years old, has a partial defect in the coronal part of the tooth which is restored for 11 porcelain crowns. The prosthesis is made in occluder. In what plane recreated the movement of the lower jaw?

A. Vertical
B. Transversal
C. Vertical, sagittal
D. Vertical, sagittal, transversal

Correct answers

1	A
2	A
3	A
4	A
5	C
6	D
7	C
8	D
9	A
10	D
11	D
12	B
13	C
14	A
15	A
16	A
17	A
18	A
19	A

CHAPTER 6.

Dental bridges (fixed partial dentures)

Consequences of a tooth loss.

When even a single tooth is lost, the structural integrity of the dental arch becomes violated (Fig. 6-1). Teeth adjacent or opposing to the edentulous space often move into it. Neighboring teeth, especially distally located to the edentulous space, may drift bodily, although a tilting movement is a far more common. If an opposing tooth intrudes severely into the edentulous space, it is not enough just to replace the missing tooth. To restore the complete function of masticatory system, which is free of interferences, it is often necessary to restore the tooth opposing to the edentulous space. In severe cases this may necessitate the devitalization of the overerupted antagonizing tooth to permit enough teeth grinding for correction of the occlusal plane.

Selection of prosthesis kind and design in a case of dental row defect.

Missing teeth in a case of partial defect of dental row can be replaced by one of three prosthesis types: a *removable partial denture (RPD), a tooth-supported fixed partial denture (FPD or dental bridge), or an implant-supported fixed partial denture*. Several factors must be taken into account when choosing the type of prosthesis to be used in each situation. Biomechanical, periodontal, esthetic, and financial factors, as well as the patient's wishes, can significantly influence the choice.

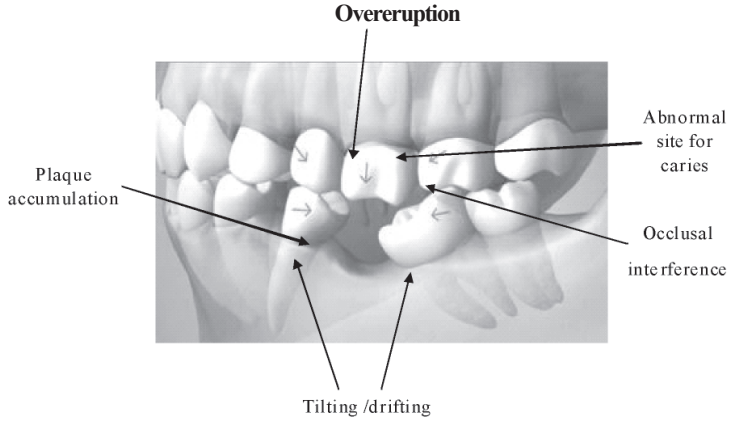

Fig. 6-1. *Consequences of tooth loss*

Fig. 6-2*. Removable partial plate denture*

A removable partial denture (RPD) is generally indicated for distally non-limited defects of dental rows or edentulous spaces larger than three posterior teeth or four anterior teeth (Fig. 6-2).

A **bridge denture** is a fixed dental restoration used to replace missing teeth by joining artificial teeth permanently to retainers fixed on adjacent teeth or dental implants.

Dental bridges can be classified according to various criteria: the material (metal, plastic, porcelain, composite and combined), technique of fabrication (stamped and brazed or cast), design of retainers and pontics.

Conventional dental bridge (Fig. 6-3) consists of two or more retainers fixed on the prepared abutment teeth and pontic (an intermediate part or body

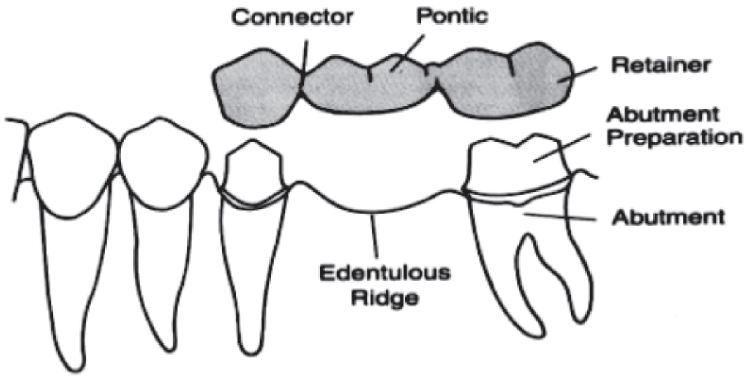

Fig. 6-3. *Parts of the conventional dental bridge (by Herbert T. Shillingburg, Jr.)*

of prosthesis). Full stamped or cast crowns or metal crowns coated with plastic or porcelain, half-crowns, pin crowns, inlays can be used as retainers in dental bridges. The choice of retainers design depends on the specific clinical conditions.

A bridge denture is often indicated when the patient has 1-3 missing teeth. Such teeth can be replaced by the pontic which is designed to fulfill all the functional and often esthetic requirements. Pontic is connected to the retainers which are the restorations fixed on the prepared abutment teeth.

Bridges are indicated in small and medium-sized included defects (extending up to 4 teeth in the anterior region and up to 3 teeth in the distal area).

The abutment teeth should meet such requirements:

1) they should be stable without large and with satisfying periodontal condition,

2) they should have rather high clinical crowns and the same functional orientation.

When a missing tooth must be replaced, the majority of patients prefers a fixed partial denture. Usual configuration for a fixed partial denture utilizes an abutment tooth on each end of the edentulous space to support the prosthesis. If the abutment teeth are periodontally healthy and straight, the edentulous span is short and the retainers are well-designed and well-fabricated, the fixed partial denture can be expected to provide a long term function for the patient. Several factors influence the decision whether or not to fabricate a fixed partial denture, what teeth to use as abutments and what kind of retainers design to fabricate.

Implant-supported fixed partial denture is ideally suited for use in case when there is insufficient number of abutment teeth or inadequate strength of abutments to support a conventional fixed partial denture and when patient's attitude and/or a combination of intraoral factors make a removable partial denture a poor choice.

Implant-supported fixed partial denture or dental bridge (Fig. 6-4) as commonly known can be either screw retained or cemented. Screw-retained prosthesis allows removal of the bridge if needed. Cemented bridge cannot be removed as it is fixed permanently.

Types of bridges may vary depending on method of fabrication or way of retention. Conventionally bridges are made by the indirect method of fabrication.

However, bridges can be fabricated directly in the mouth using such materials as composite resin reinforced by fiberglass cords or stripes.

Fig. 6-4. *Implant-supported dental bridge*

An edentulous space with no distal abutment usually requires fabrication of a removable partial denture. There are exceptions in which a cantilever fixed partial denture can be used, but this solution should be approached cautiously. Cantilever prosthesis is a kind of dental bridges with unilateral abutment. Their fabrication can be indicated in a case of a tooth in the frontal area absence. Anyway, cantilever construction is not the best choice.

Adhesive (Meryland) bridges use wings as retainers. They are fixed on the abutment teeth with composite cements. These prostheses do not require significant tooth preparation (only within the enamel). The indications for their use are small included dental defects in young patients (absence of one tooth) with small overbite and high clinical crowns. Abutment teeth in this case must be intact and have a healthy periodontium.

Indications and contraindications for dental bridges fabrication

In case of partial defects of dental rows the dental prosthesis should be used for both prophylactic and therapeutic purposes.

Indications for dental bridges:

– restoration of small or middle-sized (1-4 teeth in frontal area and up to 3 teeth in distal areas) distally limited defects of dental rows;

– sufficient height of clinical crowns of abutment teeth;

– elimination of esthetic defects;

– teeth splinting to improve the ability of periodontium of abutment teeth to withstand the load of a denture.

Contraindications for dental bridges:

– possibility to use implant-supported dentures in order to avoid grinding intact teeth limiting the defect;

– insufficient physiological reserves of abutment teeth for resistance to occlusal load;

– too large or distally not limited defects;

– the slope of the long axis of abutment tooth is more than 15 degrees, short clinical crown of the abutment tooth etc.

- moderate defects if abutment teeth belong to the different functional groups;

- pathological mobility of the teeth limiting the defect in posterior part of the dental row;

- abutment teeth with periapical chronic inflammatory processes which can not be treated;

- untreated abutment teeth.

In spite of its obviously favorable effect when it is used as a prophylactic or therapeutic measure, a fixed denture has certain shortcomings.

The application of a fixed bridge prosthesis for treatment and reconstruction in a case of maxillodental system lesions has following disadvantages:

1. The necessity of teeth preparation which is often extremely painful and harmful to the hard dental tissues, pulp and periapical tissues, contamination of dental canals, damage and burn of the pulp, development of chronic periapical processes etc.

2. The gingival edge of the crown can cause the development of chronic gingivitis by injuring the gingival margin. It is especially marked with an anadequately made crown, which is too long or too wide at the neck of the tooth.

3. Gaps where food debris and dental calculus with large amount of bacteria accumulate can appear between the pontic of the bridge and gingiva. Inappropriate embrasures can make oral hygiene difficult and frequently even impossible.

With wrong chosen design of the prosthesis and less number of abutment teeth the destructive and inflammatory process can occur in the supporting apparatus of the abutment teeth and antagonists, resulting in death of the periodontium and teeth loss.

This conditions are diagnosed as:

a) direct traumatic knot due to overloading of the segment of dental row by fixed prosthesis or choice of insufficient number of abutment teeth resulting in their loothening,

b) referred traumatic knot due to adjustment of a fixed prosthesis so that it stands below the line of occlusion in distal area or above the occlusal line in anterior region,

c) force dissociation caused by reinforcement of one of the dental rows by the prosthesis,

d) traumatic occlusion due to irrational application of a prosrhesis.

Infliction of a trauma by a dental appliance can be prevented by increasing the number of abutment teeth in case of an abnormal load caused by main supportring components or by joining the antagonists into a single unit if they experience an excess load exerted on them by the bridge prosthesis.

Dental bridges biomechanical considerations.
Requirements to abutment teeth

Every dental restoration has to be able to withstand the occlusal forces to which it is subjected. This is very important while designing and fabricating a dental bridge, because the forces that would normally be absorbed by the missing tooth are transmitted through the pontic, connectors and retainers to the abutment teeth. Abutment teeth should withstand the forces normally directed to the missing teeth, in addition to those usually applied to the abutments.

The design of a fixed partial denture is determined by the physical factors affecting the prosthesis. The major biomechanical factors which influence the design of a bridge are:

- Length of the edentulous span
- Height and design of the pontic.
- Arch curvature.
- The direction of forces acting on the bridge.

The masticatory load placed on the abutment tooth or pontic by antagonizing teeth is a variable factor. It depends on the size of the piece of food and on its site on the prosthesis, which determines the number of antagonists taking part in the chewing of the food.

With a few antagonists or in a case of their periodontal involvement the load sustained by the unit decreases, while the load sustained by the antagonists increases. In this case some pathological conditions can arise in their periodontium.

The curvature of the arch increases the pressure developed within a bridge. If the pontic lies outside the interabutment axis, then it will behave like an arm

of a lever. In such cases forces acting on the pontic will produce torquing forces around the abutment. To prevent trauma of abutment tooth, additional abutment should be chosen.

In a case of long span the bridge transfers excessive load to the abutment teeth and also tends to flex to a greater extent. The longer is the span, the bigger is the range of the bridge's flexion (Fig. 6-5). In addition to the increased load placed on the periodontal ligament by a long-span bridge, longer spans are less rigid. Bending or deflection vary directly with the cube of the length and inversely with the cube of the occlusogingival thickness of the pontic. Compared with a bridge having a single-tooth pontic, a two-tooth pontic will bend 8 times more. A three-tooth pontic will bend 27 times more than single pontic. A pontic with a given occlusogingival dimension will bend eight times as much if the pontic thickness is halved.

A long-span bridge on short mandibular teeth could have disappointing results. Longer pontic spans also have the potential for producing more torquing forces on the bridge, especially on the weaker abutment. To minimize the flexing caused by long and/or thin spans, pontic designs with a greater occlusogingival dimension should be chosen. The prosthesis may also be fabricated of an alloy with a higher yield strength.

It has been theorized that the forces are transmitted to the terminal retainers as a result of the middle abutment acting as a fulcrum, causing failure of the weaker retainer. However, stress analysis and displacement measurement

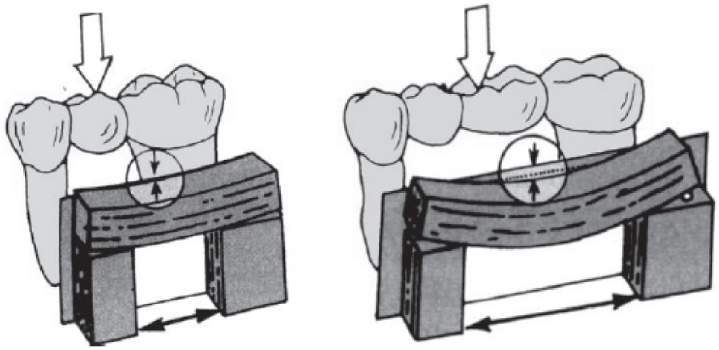

Fig. 6-5. *Biomechanics of the bridge – dependence between the length of the span and flexion of the bridge (by Rosenstiel S.F.).*

indicate that the prosthesis more bends rather than rocks. Intrusion of the abutments under the loading could lead to failure between any retainer and its respective abutment.

Dental bridges should be avoided in cases of long edentulous spans because they produce excessive force on the abutment teeth.

The expediency of constructing a bridge prosthesis depends on the condition of the periodontium of the abutment teeth, the length of the defect and the condition of the antagonizing teeth.

It can be established, for example, that two abutment teeth can support the body of a prosthesis made of three or four teeth if the antagonists are weak (if there are only few of them or if their periodontium is compromised. On the contrary, two abutment teeth with a weak periodontium can not carry the body of a prosthesis formed of two teeth. In this way these data determine the decision on the number of abutment teeth needed for a bridge denture and on the manipulations which have to be done with the antagonists if they are few in number or if their supporting apparatus is damaged.

Agapov's and Oksman's masticatory efficiency coefficients can be used for dental bridges design planning. The sum of coefficients of the missing teeth should be less then the sum of coefficients of abutment teeth.

Ante's law (Fig. 6-6) determines if a fixed prosthesis can be used or not. It states that the root surface area of the abutment teeth had to be equal or to exceed that of the teeth bieng replaced with pontics.

According to the Ante's law, the combined pericemental surface area at 3 and 5 should be equal or greater than that of 4. If both 3 and 4 are missing, the combined pericemental surface area of 2 and 5 should be equal to the combined pericemental surface area of 3 and 4. For such cases the Ante's law can be fulfilled by taking additional support for 1 so that 1+2+5=3+4.

Double abutments sometimes can be used as a means of overcoming problems created by unfavorable crown-root ratios and long spans. There are several criteria that must be met if a secondary (remote from the edentulous space) abutment has to strengthen the bridge and not to become a problem itself. A secondary abutment must have at least as much root surface area as the primary (adjacent to the edentulous space) abutment it is intended to bolster and same favorable crown-root ratio.

As an example, a canine can be used as a secondary abutment to a first premolar primary abutment, but it would be unwise to use a lateral incisor as a secondary abutment to a canine primary abutment. The retainers on secondary

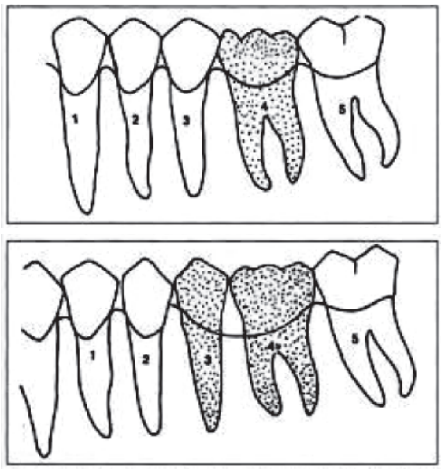

Fig. 6-6. Application of Ante's law (see the explanations in text)

abutments must be at least as retentive as the retainers on the primary abutments. When the pontic flexes, tensile forces will be applied to the retainers on the secondary abutments. There also must be sufficient crown length and space between adjacent abutments to prevent impingement on the gingiva under the connector. Because of the distance through which movement occurs, the independent direction and magnitude of movements of the abutment teeth, and the tendency of the prosthesis to flex, stress can be concentrated around the abutment teeth as well as between retainers and abutment preparations.

Different designs of dental bridges

The pontic can be joined by connectors to different kinds of retainers that are cemented to the abutment teeth. Bridges may be classified according to the kind of retainers and connectors or design of the pontic.

The retainers may be either wings (resin retained or adhesive bridgework) or inlays and crowns (conventional bridgework). The pontic may be fixed to the retainer by a rigid connector or it may have a movable joint (non-rigid connector). In addition the pontic may have only one connector and be free at the other end – in case of cantilever bridge.

Conventional bridges (Fig. 6-7, 6-8).

The design of conventional bridgework depends upon:

-Biological factors

-Mechanical factors

-Aesthetic factors.

All fixed partial dentures, long or short, flex to some extent. Because of the forces being applied through the pontics to the abutment teeth, the forces on castings serving as retainers for fixed partial dentures are different in magnitude and direction from those applied to single restorations. The dislodging forces on a fixed partial denture retainer tend to act in a mesiodistal

direction, as opposed to the more common buccolingual direction of forces on a single restoration. Tooth preparation should be modified in order to produce greater resistance and structural durability. Multiple grooves, including some on the buccal and lingual surfaces, are commonly used for this purpose.

Fig. 6-7. *Conventional dental bridge*

Pontic design

A pontic is the suspended artificial replacement for a missing natural tooth. It is connected to abutment retainers which are fitted to prepared natural teeth. The connection of pontics and retainers can be accomplished by means of rigid cast or soldered connectors, or by nonrigid key and keyway attachments. Ideally, a pontic must restore the function of the tooth it replaces and meet the demands of esthetics and patient comfort. Pontics must be made of materials that are compatible with contacting oral soft tissues, and their design features must facilitate daily cleansing by the patient.

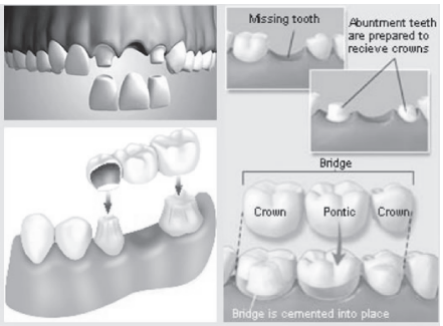

Fig. 6-8. *Components of conventional bridges*

Pontic-tissue contact should be kept to a minimum. Inflammation (swelling and redness) of contacting tissue is a reaction to local irritations. The intensity of the inflammatory reaction will vary with the amount of debris trapped between the pontic and the tissue.

Over the years, clinical observations have revealed that design is the most important single factor in preventing inflammation in the vicinity of pontics. Nonetheless, conversion of the full ridge lap configuration to a modified ridge lap with minimal tissue contact will not prevent the occurrence of an inflammatory response unless the corrected surface is finished with a proper

polish or glaze. In other words, modification of outline form without due attention to surface smoothness does not prevent the occurrence of pontic-induced inflammation.

Requirements to the pontic:

1. The pontic must be hygienic so the patient can easily maintain good oral hygiene. The pontic must not cause any irritation to the underlying soft tissue by pressure or by food accumulation. Therefore, the contact of the pontic tissue surface with the underlying soft tissue should be convex to prevent entrapment of food under the pontic.

2. The contact area should guard the interproximal area and the embrasure should be opened well to allow massage of the gingival tissue. If it is too small there will be an increased interproximal space and possible food accumulation. The connecting region would be weak and prone to fracture. If we have too wide contact area there will be impingement of the pontic on the interproximal gingival tissue.

3. The contour of the labial and lingual surfaces of the pontic must be proper and lie with the same line of contour of the adjacent teeth so it will allow protection of the underlying tissues.

4. The pontic must restore the masticatory function of the tooth it replaces efficiently. It is advisable to narrow the occlusal surface of pontic to reduce the stress that is going to be transmitted to the abutment tooth by occlusal forces.

5. The pontic must be strong enough to withstand the force to which it is subjected so mostly we use full metal in posterior region to withstand the heavy occlusal stress.

6. The pontic must provide good esthetics to improve the appearance of the patient.

A properly constructed posterior pontic exhibits the following characteristics:

1) all surfaces are convex, smooth and polished or glazed;

2) contact with soft tissues is minimal and pressure-free;

3) buccal contours conform to those of the adjacent teeth;

4) overall length of the buccal surface is equal to the surface of adjacent abutments.

A properly constructed anterior pontic exhibits the following features:

1) all surfaces are convex, smooth and polished or glazed;

2) lingual contours are in harmony with those of the adjacent teeth or pontics;

3) contact with labial mucosa is minimal and pressure-free. If the residual ridge is resorbed excessively, a longer area of tissue contact may be required to avoid the unaesthetic display of a "black space".

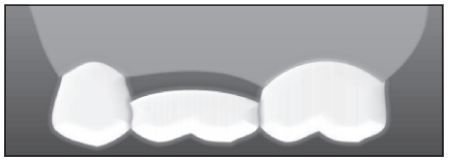

Fig. 6-9. *Hygienic pontic*

The configuration of the **sanitary (hygienic) pontic** (Fig. 6-9) allows the best access to abutment teeth for the maintenance of good oral hygiene because it does not come in contact with the underlying soft tissue and provides easy access for oral hygiene aids to clean the abutment teeth. Use of this pontic design should be considered in the construction of the fixed prosthesis when esthetics is not a major concern.

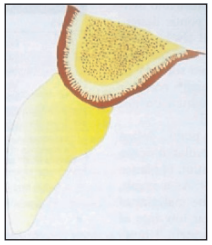

Fig. 6-10*. Saddle pontic (by D. Edelhoff)*

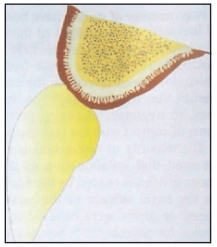

Fig. 6-11. *Ridge lap pontic (by D. Edelhoff)*

Saddle pontic (Fig. 6-10) has a concave fitting surface that overlaps the residual ridge buccolingually, simulating the contour and the emergence profile of the missing tooth on both sides of the residual ridge. This design gives the illusion of a non extracted tooth which is accepted by the patient. However, saddle or ridge lap designs should be avoided because the concave gingival surface of the pontic is not accessible to cleaning with dental floss, which may lead to plaque accumulation. This has been shown to result in tissue inflammation.

A reduction of the surface area in ridge lap pontic (Fig. 6-11) does not significantly improve hygiene underneath the pontic, because the basal contour remains concave, unsuitable to provide a tight contact to the dental floss.

The **modified ridge lap pontic** (Fig. 6-12) is the most popular type of pontic. The convex basal surface, which rests on a small area of the alveolar ridge, fulfills the recommendations given in the dental literature with regard to hygiene procedures and prevention of irritation of the underlying soft tissue. However, the contour of the alveolar ridge requires that a compromise should be made in the design to prevent the impairment of esthetics, function, or phonetics. In particular, the vertical loss of dimension of the ridge, occurring

Fig. 6-12. *Modified ridge lap pontic (by D. Edelhoff)*

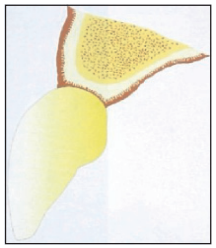

Fig. 6-13. *Ovate pontic (by D. Edelhoff)*

in the majority of the patients, can cause difficulties in this aspect.

In contrast to the classic requirements for pontics, which suggest the importance of pressure-free contact over a small area, the ovate pontic (Fig. 6-13) comes in contact with a larger area of the underlying soft tissues and applies light pressure. This design has been found to produce highly esthetic results following suitable pretreatment of the alveolar ridge.

The pontic may be fabricated from casting metal or combination of metal and porcelain or acrylic facing. Usually the full metal pontic is used for the posterior region while the combination of metal and facing (porcelain or acrylic) is used in anterior region for esthetic reason.

The glazed porcelain is more preferable than acrylic in pontic fabrication because acrylic is porous and difficult in obtaining highly polished surface which leads to plaque accumulation and cause gingival inflammation.

Resin retained (adhesive) bridges (Fig. 6-14).

The concept of the resin retained bridge (RRB) is that metal "wings" are retained to enamel surface. The "wings" are part of a metal subframe that also supports a resin or ceramic tooth. Metalwork covered the whole of the lingual enamel surface and retention to the cementing composite resin was achieved through small holes in the metal (Rochette, 1973). Other workers developed the alternative ways of obtaining macromechanical retention to the metal.

In the late 1970s, Livaditis and Thompson at the University of Meryland developed an electroetching procedure for non-precision ceramic bonding alloys to produce a microporous surface that provided a micromechanical interlock with the cement. This gave rise to the "Maryland bridge" that had the advantages of thinner wings and no perforations compared the Rochette type. Electro-etching, however, was a demanding technique and two other techniques, acid etching and sand blasting, were developed. Grit blasting was the most simple and reliable and the other two have been largely superseded. This has not stopped incorrect use of the term "Meryland bridge" for all RRBs.

Further longevity improvements have been obtained by the development of specific affinity cements and by metal primer systems that increase the bonding of the cement to the metal.

Indications for RRB fabrication:

– caries-free abutment teeth;
– maxillary and mandibular incisors replacements;
– periodontal splints;
– single posterior tooth replacements.

Contraindications for RRB fabrication:

– extensive caries;
– allergic reactions;
– deep overbite.

Advantages of RRB:

– reduced cost;
– no anesthetic needed;
– supragingival margin;
– minimal tooth preparation;
– rebonding possible.

Disadvantages of RRB:

– uncertain longevity;
– no space correction;
– no aligment correction;

Cantilever bridges (Fig. 6-15).

Cantilever bridge is a bridge having an artificial tooth attached beyond the point of anchorage of the bridge.

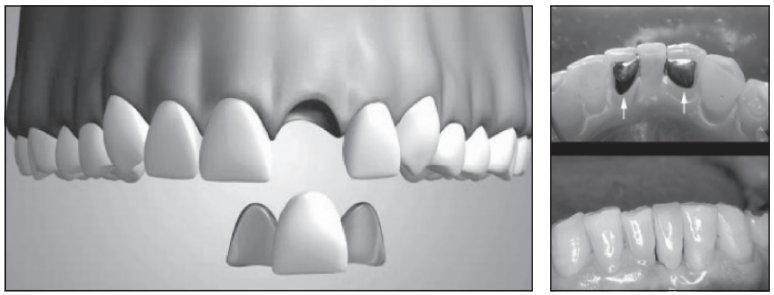

Fig. 6-14. *Adhesive (resin-retained) bridges*

A cantilever fixed partial denture is one that has an abutment at one end only, with the other end of the pontic remaining unattached. This is a potentially destructive design with the lever arm created by the pontic, and it is frequently misused.

In the conventional three-unit dental bridge force that is applied to the pontic is distributed equally to the abutment teeth. If there is only one pontic and it is near the interabutment axis line, less leverage will be applied to the abutment teeth or to the retainers than with a cantilever. When a cantilever pontic is employed to replace a missing tooth, forces applied to the pontic have an entirely different effect on the abutment tooth. The pontic acts as a lever that tends to be depressed under forces with a strong occlusal vector. In case of firmly standing natural antagonizing teeth presence the abutment tooth of the console prosthesis will be overloaded in distal direction and, with a vertical load, in a buccolingual or linguobuccal direction.

A cantilever bridge can be used for replacing a maxillary lateral incisor. There should be no occlusal contact on the pontic in either centric or lateral excursions. The canine must be used as an abutment, and it can serve in the role of solo abutment only if it has a long root and good bone support.

A *proximal half crown* sometimes can be used as a retainer on the distal abutment. This preparation design is simply a three-quarter crown that has been rotated 90 degrees so that the distal surface is uncovered. This retainer can be used only if the distal surface is untouched itself by caries or decalcification and if there is a very low incidence of proximal caries throughout the mouth. The patient must also demonstrate an ability to keep the area exceptionally clean. If there is a severe marginal ridge height discrepancy

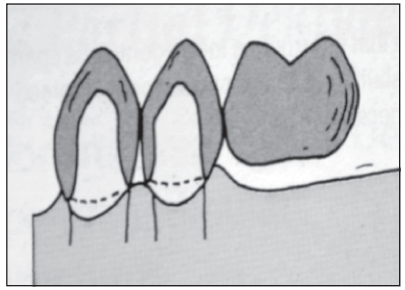

Fig. 6-15. *Cantilever fixed partial denture*

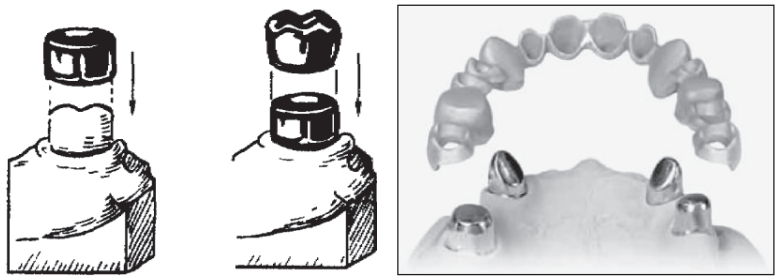

Fig. 6-16. *Double (telescope) crowns as retainers for a dental bridge*

between the distal of the second molar and the mesial of the third molar as a result of tipping, the proximal half crown is contraindicated.

Telescope or double crowns (Fig. 6-16) can also be used as a retainer on the distal abutment. A full crown preparation with heavy reduction is made to follow the long axis of the tilted molar. An inner coping is made to fit the tooth preparation and the proximal half crown that will serve as a retainer for the bridge denture is fit over the coping. This restoration allows total coverage of the clinical crown while compensating for the discrepancy between the paths of insertion of the abutments. The marginal adaptation for this restoration is provided by the coping, the path of insertion is parallel with the long axis of that tilted tooth. A box form is placed in the distal surface of the premolar to accommodate a keyway in the distal of the premolar crown. It is tempting to place the connector on the medial aspect of the tipped molar, but this could lead to even greater tipping of the tooth.

Post-and-core crowns. In cases of severe damage of the crown parts of abutment teeth or if they have been endodontically treated, different post-and-core crowns and other pin designs can be indicated for better retention and strength (Fig. 6-17).

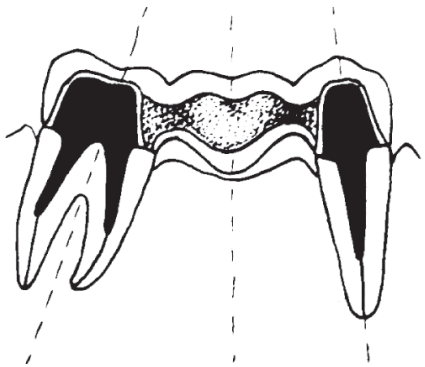

Fig.6- 17. *Post-and-core as abutment for a dental bridge*

Crown contour.

Contours of the cast restoration are important not only for esthetics, but also for appropriate function and preservation of soft tissues healthy condition. Thus, a triangular space

(embrasure) for protection of the interdental tissues must be created by contact of the convex proximal surfaces of adjacent teeth. During mastication, labial, buccal and lingual convexities must divert the flow of food to insure protection of the investing tissues. Both under-contoured and over-contoured restorations create unhygienic conditions which may lead to the onset of periodontal disease.

Each abutment tooth has to be examined before proceeding with tooth preparation. Radiographs should be made and pulp health must be assessed by evaluating the response to thermal and electrical stimulation. Teeth in which pulpal health is doubtful should be endodontically treated before the initiation of bridge fabrication. If the tooth is properly treated endodontically, it can serve well as an abutment with a post and core foundation for retention and strength. Failure occurs, however, particularly on teeth with short roots or little remaining coronal tooth structure. Core is needed to obtain maximum retention for the post and core. Sometimes it is better to recommend removal of a badly damaged tooth rather than to attempt endodontic treatment.

The unrestored, caries-free tooth is an ideal abutment. It can be prepared conservatively for a strong retentive restoration with the best esthetics. The margin of retainer can be placed without modifications to accommodate existing restorations. In adult patient the unrestored tooth can be safely prepared without pulp removal if the design and technique of tooth preparation are wisely chosen.

Loss of a permanent mandibular first molar because of dental caries early in life is still relatively common. If the prosthesis use suggestion is ignored, the second molar will tilt mesially especially with eruption of the third molar. Than it can become difficult or impossible to make a satisfactory fixed partial denture, because the teeth relationship does not allow the parallel path of insertion without interference from the adjacent teeth. In such circumstances sometimes the bridge can be made with modified teeth preparation design or with a non-rigid connector.

Clinical and laboratory procedures for stamped-soldering, stamped-fused and cast bridges fabrication. Peculiarities of tooth preparation

Clinical and laboratory stages of dental bridges differ according to the peculiarities of their constructions. In general, the construction of a bridge prosthesis consists of such clinical and laboratory procedures:

1) diagnostics and treatment planning;

2) preliminary treatment of the teeth and soft tissue management;

3) anesthesia and preparation of abutment teeth;

4) impressions taking;

5) determination and fixation of centric occlusion or centric relation;

6) casts fabrication, their mounting in occludator or articulator;

7) construction of the retainers of the prosthesis (crowns, half-crowns, inlays, pin-teeth, etc.) for stamped-soldered and stamped-fused bridges or fabrication of wax pattern and casting of metal bridge framework for cast bridges;

7) try-in and adjustment of the abutments or metal framework and determination of coating shade in case of combined bridge fabrication;

8) taking impression from the jaw with abutments on the teeth for stamped-soldered and stamped-fused bridges;

9) fabrication of pontic, soldering or fusing it with abutments for stamped-soldered and stamped-fused bridges;

10) construction of wax pattern of the coating and changing it with acrylic for metal-plastic bridges or fabrication of ceramic or composite coating;

11) try-in of the bridge in the mouth and its adjustment.

12) finishing and polishing of the bridge;

13) fixation of the bridge on abutment teeth with cementum.

Teeth preparation.

Teeth preparation for dental bridges is identical to single units but with some additional considerations. The parallelism of abutment teeth preparation is a common for all dental bridges: all abutment teeth should have the same path of insertion (Fig. 6-18).

The preparation of abutment teeth should be carried out according to the common principles discussed earlier. The walls of the prepared abutment teeth should be parallel to each other, for which more hard dental tissues have to be often ground off that in preparation for a single crown. Otherwise a bridge prosthesis cannot be applied. It is obvious that with more abutment teeth included in a single system of a bridge prosthesis the formation of parallel walls is more difficult. Specific technical difficulties arise with the use of inlays, half-crowns, pin-teeth, or internal attachments as the supporting parts of the prosthesis. In such cases care should be taken that not only the walls of the abutment crowns are made parallel, but also the walls of the inlay cavities, of the root canals if the pin teeth are employed, of the approximal grooves if half-crowns are used, and of the elements of the internal attachments.

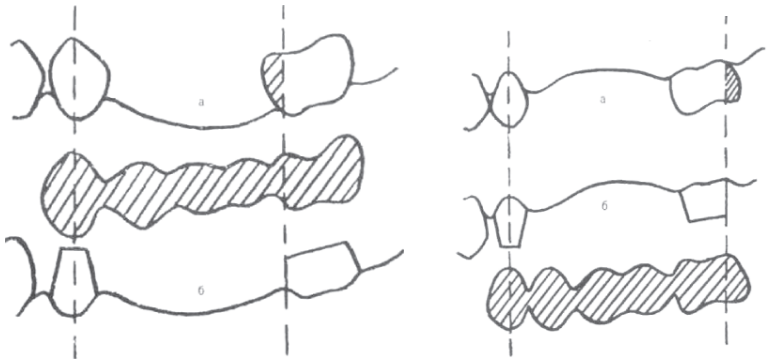

Fig. 6-18. *Parralelism of the teeth preparation in cases of convergention and divergention*

Preparation of abutment teeth for a crown is begun with separation of the approximal walls, taking care that they are parallel.

After the teeth are separated, preparation is continued with differently shaped diamond burs. Each prepared tooth crown should have aprropriate shape with a diameter equal to or smaller than that a tooth neck. The prepared tooth crowns should be parallel to each other.

Impressions taking.

After preparation of the abutment teeth working (taken from the teeth of the jaw for which the prosthesis is constructed) and auxiliary (taken from the antagonizing teeth) impressions are taken from upper and lower jaws.

Working impression should accurately reproduce the teeth and their necks and the alveolar process in the region of the defect, while the auxilliary impression should reproduce the dental row or edentulous alveolar ridge and the cutting edges and occlusal surfaces of the teeth. If the antagonists of the abutment teeth and future artificial teeth are missing the crowns and artificial teeth are made according to the anatomical shape and size of the respective natural teeth. For stamped-soldered and stamped-fused bridges fabrication alginate and plaster can be used for impression taking. For cast bridges fabrication silicon impression material should be used for impression taking and gum retraction is required.

Determination and fixation of centric occlusion.

Recording of centric occlusion varies depending on the presence of antagonizing pairs of teeth and their location. Three main variants are

distinguished: the first is marked by the presence of antagonizing pairs of teeth on the left and right side of the jaws and on the anterior portion; in the second there are one or two segments with antagonizing pairs of teeth; the third variant is characterized by the absence of antagonizing pairs of teeth.

With the first variant centric occlusion can be easily represented on the casts by dental technician. Adjustment of the models in centric occlusion is guided by the antagonizing pairs of teeth.

If the number of antagonizing pairs of the teeth is not sufficient (second variant) or if there are no antagonizing pairs (third variant) the teeth are set in centric occlusion by means of plaster or silicone bite blocks (if vertical dimension of occlusion is normal) and wax occlusal rims made on casts in the laboratory. For their fabrication the impressions taken from the jaws should provide an accurate reproduction of the palate and alveolar processes as well as dental rows.

Two blocks four to five centimeters long and one centimeter thick should be formed from mixed putty silicone and activator and placed between the dental rows in both sides of the jaws; then the patient is asked to bring his teeth together in centric occlusion. Impressions of the antagonizing teeth will be left on the silicone. Such silicone blocks are called bite blocks. They should be taken out from the mouth and fitted to one of the casts; the other cast will be adjusted in place. An accurate relation of the dental rows is obtained in this way. Then the casts together with the bite blocks should be mounted in occludator.

Determination and fixation of centric occlusion with wax occlusal rims (Fig. 6-19). The base is fitted to the jaw and the patient is asked to get the jaws together (in centric relationship). An appropriate occlusal contact between the natural teeth and between the teeth and wax rims is established by trimming away the wax at the sites of premature contacts. For better imprints it is necessary to heat a small layer of the wax. Then the base

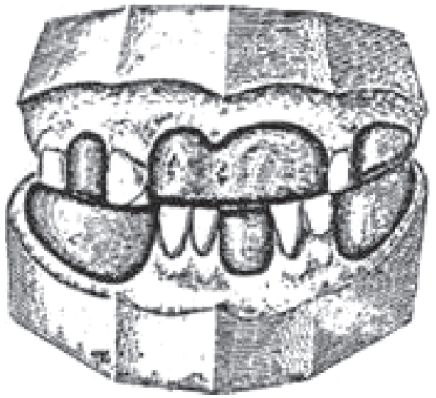

Fig. 6-19. *Determination and fixation of centric occlusion with wax occlusal rims*

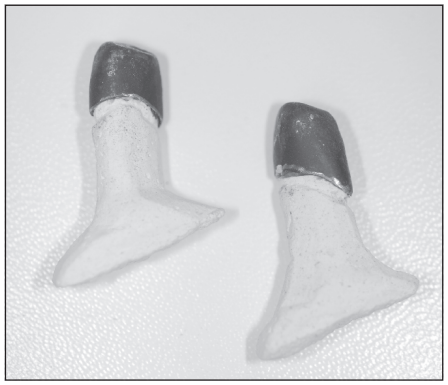

Fig.6-20. *Stamped crowns on the plaster stamps.*

Fig. 6-21. *Secondary impression with the crowns*

is removed from the mouth and seated on the model: both models are joined together with wax and mounted in occludator.

Fabrication, try-in of stamped crowns and secondary impression taking.

After mounting of the casts in occludator dental technician fabricates stamped crowns (Fig. 6-20) as described in previous chapter.

Try-in of the crowns follows the rules described earlier, main care is being taken that the cervical edge of the crown fit closely around the neck of the tooth and inserted no more than 0,5 mm deep into the cervical sulcus. The occlusal surface or cutting edge must correspond to the anatomical shape of the covered tooth. It is important to reconstruct the contact points. The adjusted crowns should not disturb occlusion and at the same time they should come in close contact with the antagonists.

After checking the crowns secondary impression is taken (Fig. 6-21). The crowns removed from the teeth are inserted into the impression so that they will not be displaced during casting. Apart from this, the inner walls of each crown should be covered with melted wax so that it can be easily removed from the model, which is important for further manipulations during construction of a bridge prosthesis.

Pontic fabrication. The casts are joined in centric occlusion and mounted in occludator. After this construction of the pontic begins (Fig. 6-22, 6-23).

The space between the crowns on the model is filled with a block shaped from a plate of wax. The block should be slightly higher and wider than the

crowns. After it is fitted in place the models are brought together and an impression of the antagonists is obtained on it. Teeth are moulded from the block with a spatula, first removing the excess of wax till the block is the same width as the adjacent teeth. Marks are made on the block according to the number of missing teeth and then moulding of each tooth begins, giving the appropriate anatomical shape to the vestibular and occlusal aspects of the premolars and molars and to the vestibular, incisal and oral aspects of the anterior teeth. To avoid injury to the tongue mucosa the transition from one tooth to the next on the oral aspects is only gently demarcated. After shaping the sides of the teeth the wax is removed from the model and all excess bits on the surface facing the gingival mucosa are trimmed away.

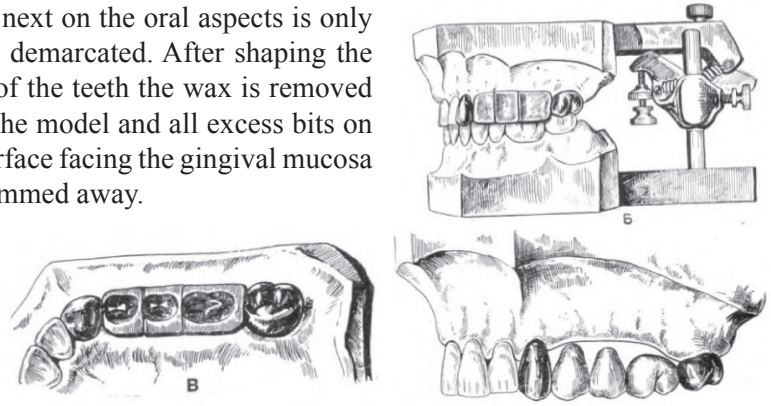

Fig. 6-22. *Stages of metal pontic's wax pattern fabrication*

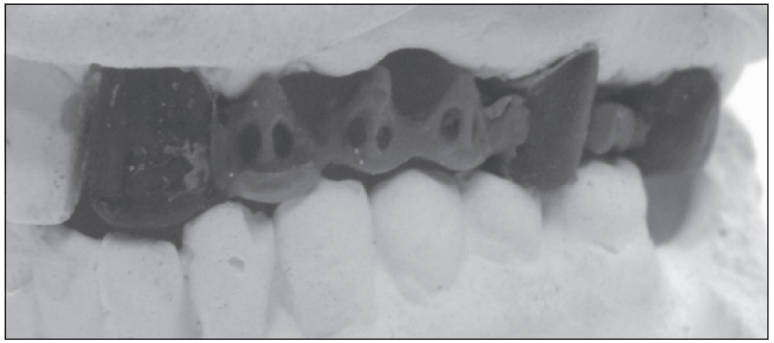

Fig. 6-23. *Wax pattern of combined metal-acrylic pontic for stamped-soldered bridge*

The next procedure comprises replacement of the wax with metal – sprueing, investing and casting (Fig. 6-24). The sprues of 2-3 millimeters in diameter and 3-4 centimeters long are fastened to the waxed teeth, joined with wax, and fastened on a cone. Then the waxed teeth are immersed in a casting mould filled with investment materials of thick-cream consistency.

When the investment mass hardens, which takes 10 to 20 minutes, the cone is removed, and the mould is placed in a muffle, to melt out the wax. After the mould is slightly heated the pins are taken out of the investment material so that the melted wax can flow out. The sprues left by the pins are used for filling the mould with molten metal. After the pins are removed heating of the mould is continued till all wax melts away and no moisture remains in the investment materials. For final heating of the mould the temperature in the muffle is raised to 800 ^{o}C.

As soon as all wax is removed the metal alloy is put into the mould, molted and cast. The cast pontic should be treated with sandblaster and different shaped diamond stones and carbide tools (excess metal is removed and the tooth surfaces are smoothed), seated between the natural crowns and their position in relation to the antagonists is checked. After this all the components of the prosthesis are made ready for fusion. The crowns are removed from the model (which is easily done by heating them over a frame, because they are covered with wax inside), cleaned of wax, and the sides of approximation with the cast teeth are carefully freshened with a carbide tools.

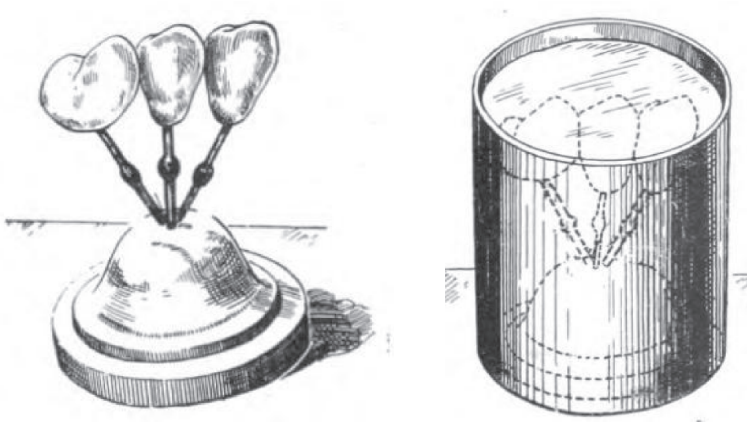

Fig. 6-24. *Sprueing and investing*

Soldering (brazing).

Soldering is the process of joining two or more metallic objects with an alloy (solder) that melts at a relatively low temperature. Upon melting, the solder flows by capillary action between and around the adjacent, heated but unmelted objects to be joined.

Quality of the soldered connection depends on the cleanliness, joint design and properties of the solder. The properties of the solder must be compatible with those of the parent material(s). It should melt over a range of temperatures which will not distort or melt the objects being soldered. It should flow readily over the unoxidized surface of the parent alloy. Its color should match to the castings to be joined.

During soldering a glass-like covering formed by the flux limits the ability of oxygen to react with the hot metal. When melted, the flux forms a protective film which prevents oxidation of the solder and the alloy being joined. This function is important because solder will neither wet nor flow on the oxidized surfaces of the castings. Also, oxides formed during melting are dissolved by the flux. In addition to borax, a glass former, the most useful fluxes also contain carbon. The flux should be applied as soon as alloy begins to turn red. The manner in which the torch flame is used influences the outcome of the soldering operation. A brush type flame should be used for the initial heating. The flame should be directed toward the investment until the flux melts and forms a protective film over the surfaces to be soldered. Once the flame is applied to the joint area it must not be withdrawn until the procedure is completed. A protective blanket can be maintained around the joint area by using the reducing portion of the flame to heat the castings. Some operators prefer a well-defined, pointed and relatively small flame for the final heating of a localized area. It is important that the castings must be heated to a temperature slightly higher than the upper limit (liquidus) of the melting range of the solder. Contact of the solder with the hot castings will cause the former material to melt and flow. Thus, the focus of the flame should not be shifted from the castings to the solder. As soon as the flow of molten solder through the joint space is completed, the flame is withdrawn. Overheating can result in pitting and weakening of the connection and perforation of thin sections of the retainers.

Ready crowns and cast pontic are mounted on the model and after checking the accuracy of their position in relation to the antagonists they are joined at the sites of approximation with sticky wax. After all components are joined

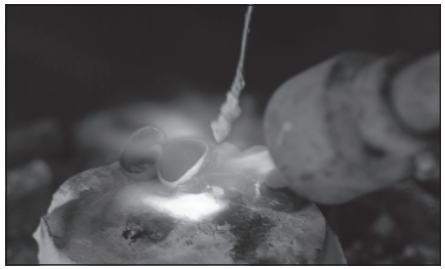

Fig. 6-25. *Soldering process*

together the whole prosthesis is removed from the model and invested in plaster for brazing. Investment comprises the following: the crowns are filled with plaster, then some plaster is poured on the table and the prosthesis is immersed in it and all parts with the exception of the points of fusion are covered with it. When the plaster hardens excess amount is cleaned off so that the sites of fusion are left free owing to which the flame reaches them easily and removes the solder. The sticky wax is washed off with a jet of hot water and the sites of fusion are painted with a solution of borax with water (borax absorbs oxygen from the surface of the metal and in this way promotes diffusion of the solder into the thick of it).

The prosthesis prepared by the method described is heated evenly on the frame of a soldering apparatus till all borax precipitates (at first the flame causes distention of the borax). Then pieces of solder are placed on the sites of fusion and heating of the plaster and prosthesis is continued till the solder melts and flows into the spaces between the surfaces fused (Fig. 6-25).

Finishing, polishing, trying-in and fixation of the bridge.

After all its components are joined together the prosthesis is cleaned from plaster and oxides, finishing and polishing is performed.

In case of combined metal-plastic stamped-soldered bridge fabrication ready metal framework after soldering is put on the cast and wax pattern of the coating for pontic is made. Then the wax is changed into acrylic according to the common procedure, the coating is finished and polished.

Ready bridge prosthesis is washed in alcohol and inserted into the mouth. After checking the accuracy of its fit, the bridge is fixed on the teeth with cementum.

Fabrication of stamped-fused bridge.

This construction differs from the stamped-fusion denture only in laboratory procedures.

The stamped crowns and wax pattern of the pontic are connected on the models with additional portion of the wax The crown surfaces must be grinded with the bur before connecting.

For replacement the wax by metal all construction is filled with the investment material for casting procedure. Molten metal is connected with the crown. Denture is treated with sand blaster and different diamond stone. Excess metal is removed and the bridge surfaces are smoothed.

After this the denture is mounted on the model and after checking the accuracy of their position and relation to antagonists should be sent to the clinic for try-in procedure.

Next stages are similar to construction of stamped-soldered bridge.

Fabrication of cast bridges.

Cast bridges are modern constructions with the wide range of indications.

The preoperative model is used as a template with the shape of the pontics and retainers being provided either from the diagnostic waxing or from the addition of denture teeth to the model. Model is used for study and plan the construction.

The preparation design (Fig. 6-26) for any given tooth, under any given clinical situation, must comply with the following requirements.

1. It must provide angles and surfaces being suited to resist fracture off the tooth.

2. It must allow the establishment of well defined margins.

3. It must not subject the tooth and, or its supporting structures to injury during function.

4. It must provide the access required in the making of in impression.

5. It must offer retentive support and resistance to dislongement of the cast restoration.

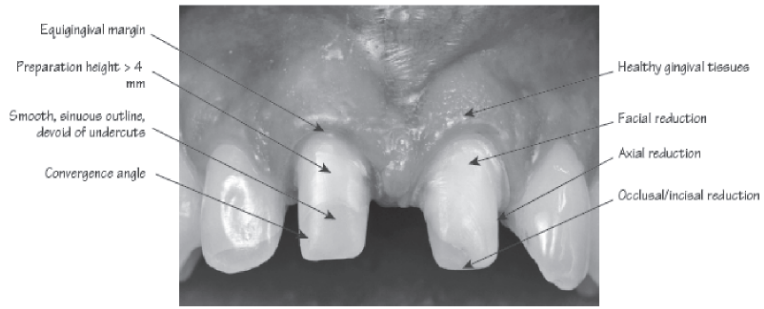

Fig. 6-26. *Teeth preparation futures (by Irfan Ahmad)*

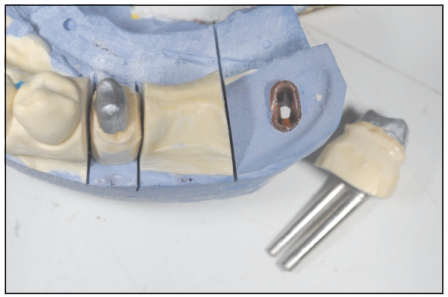

Fig. 6-27*. Cast with removable dies covered with spacer*

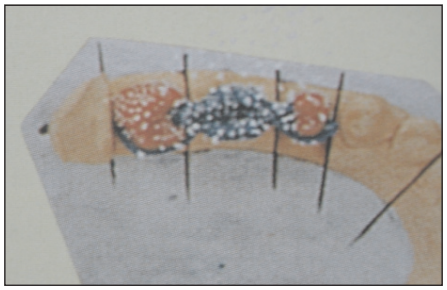

Fig. 6-28. *Retentive balls on the surface of wax pattern of the bridge*

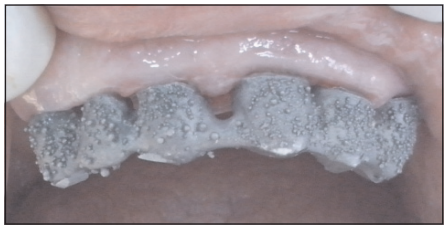

Fig. 6-29. *Try-in of metal framework of future combine metal-plastic bridge.*

6. It must provide enough space for coverage by an adequate thickness of alloys.

The fabrication of dental casts and dies requires the existence of suitable impressions of the dental arch. An impression is made from silicone. Gingival retraction cord is placed in the gingival sulcus for marginal tissues retraction before impression taking.

The use of Dovel Pins makes possible the construction of a denture on the model with a removable dies (Fig. 6-27).

Before attempting to create wax patterns required for the construction of cast restoration, the operator must gain complete mastery of the anatomical features of the 32 human teeth. A wax pontic is designed and positioned between the complete retainer patterns. Wax loops or balls (pearls) are placed to the wax pattern to provide retention for the acrylic coating (Fig. 6-28).

After casting the try-in of the metal framework in the clinic has important advantages: accuracy of the casting can be checked and refabrication of the coating prevented (Fig. 6-29). If there are errors, then the time and cost of adding coating to a deficient base is avoided.

It is important to use temporary bridge (Fig. 6-30) to protect abutment teeth, prevent their tilting and drifting or change of vertical dimension of occlusion during the fabrication of final cast bridge.

The steps of veneering are similar to these in case of combined cast crowns fabrication.

The final bridge should be examined carefully. The following must be checked:

– marginal adaptation of retainers;

– retention and stability;

– integrity of contact areas with adjacent uncut teeth;

– adaptation of the pontics to the soft tissues;

– occlusal relationship in centric occlusion, centric relation and excursions;

– esthetics – colour, shape and tooth position;

– speech.

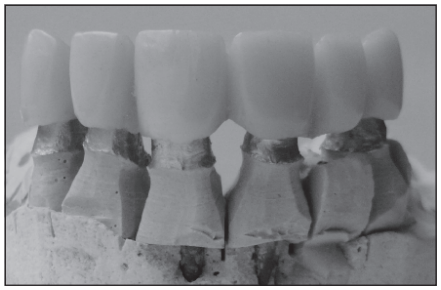

Fig. 6-30. *Temporary acrylic bridge on the model (a) and immediately after cementation (b).*

Only when everything is satisfying the bridge can be cemented permanently. After the cement has set, the marginal adaptation should be checked again and excess cement should be cleaned from the embrasures and from the space under the pontic. After that occlusal relationship should be checked again.

It's important to teach the patient appropriate oral hygiene procedures.

Glossary

Abutment – a supporting structure to sustain lateral or horizontal pressure, as the anchorage tooth for a fixed or removable partial denture. (Dorland's Medical Dictionary for Health Consumers. © 2007 by Saunders, an imprint of Elsevier, Inc.)

Abutment – a tooth, root, or implant that supports and provides retention for a fixed or removable dental prosthesis. (Mosby's Medical Dictionary, 8th edition. © 2009, Elsevier.)

Pontic – the portion of a dental bridge that substitutes for an absent tooth. (Dorland's Medical Dictionary for Health Consumers. © 2007 by Saunders, an imprint of Elsevier, Inc.)

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Questions for self-assessment

1. Name the indications for bridge denture fabrication. What are the kinds of bridge constructions?
2. What are the indications for usage of different kinds of retainers in bridge dentures? Name their advantages and disadvantages.
3. Point out the requirements to abutment teeth.
4. What are the indications for bridges fabrication?
5. Name the classifications of dental bridges.
6. Describe the biomechanics of the bridges.
7. What kinds of pontics do you know?
8. What are the designs of bridge prosthetic that are utilized for treatment of dental rows defects?
9. What are the indications for treatment of dental rows defects by bridge prosthesis?
10. What are the contraindications for treatment of dental rows defects by bridge prosthesis?
11. Name the comparative characteristics of soldering and casting in bridge dentures.
12. What are the clinical and laboratory stages of stamped-soldered bridge denture fabrication? Name the coating materials.
13. What are the clinical stages of stainless steel stamped-soldered bridge fabrication?
14. What are the laboratory stages of stainless steel stamped-soldered bridge fabrication?
15. What are the clinical and laboratory stages of cast metal bridge fabrication?
16. What are the clinical stages of cast combined bridge fabrication?
17. What are the laboratory stages of cast combined bridge fabrication?
18. Name the indications and contraindications for use of different kinds of coating materials.
19. Name the mistakes and complications which appear during cast metal bridges fabrication. State the causes and prevention.
20. What are the factors which provide bridges fixation? What are permanent and temporary cements for the fixed dentures?

Tests for self-assessment

1. For patient K., 55 years old, the stamped crown is planned to be fabricated. Which of stamping methods is the most popular?
A. External stamping
B. Internal stamping
C. Combined stamping
D. Cast stamping

2. For patient V., 60 years old, dentist has made a cast bridge denture. Which impression material is it necessary to use to take an impression for fabrication of cast bridge denture with plastic coating?
A. Plaster
B. Alginate
C. Silicone
D. Termoplastic

3. A patient has a defect on the upper jaw limited by 16 and 13 teeth. It has been planned to fabricate a cast bridge denture with ceramic coating. What kind of pontic design should be selected?
A. Hygienic
B. Tangential
C. Saddle
D. Ovate

4. A patient has defect of dental row on the lower jaw. The defect is limited by 33 and 37 teeth. What design of the bridge denture can be preferable?
A. Stamped-soldered bridge denture with plastic coating and hygienic pontic;
B. Removable bridge denture
C. Cast metal-ceramic bridge denture with saddle pontic
D. All these designs

5. A 45-year-old patient was referred to the dental clinic with complaints about missing teeth, esthetic defect and speech disturbances. Objectively teeth formula is:

$$\frac{-6\,5\,4\,3--/--3\,4\,5\,6\,7}{7\,6\,5\,4\,3--/1\,2\,3\,4\,5\,6\,7}$$

What prosthesis construction would be preferable?
A. Partial removable denture
B. Brazed bridge denture
C. Metal cast bridge denture
D. Combined cast bridge denture

6. A patient A, 40 years old, was referred to the dentist with complaints about missing teeth, difficulties with food chewing.

The objective teeth formula is:

– 7 – – 4 3 2 1 / 1 2 3 4 – – 7-

8 – – 5 4 3 2 1 / 1 2 3 4 5 – 7-.

Which design of dental prosthesis should be used in this case?

A. Cantilever bridge dentures

B. Brazed bridge dentures

C. Partial removable denture

D. Cast bridge denture

7. You have received a framework of the fixed bridge prosthesis which has deep air bubbles at the vestibular surface of the metal frame. What are your further actions?

A. To proceed to the next stages, the air bubbles aren't important;

B. To polish the pores;

C. To solder the pores;

D. To repeat the frame fabrication on this stage.

8. After the basic (opaque) layer has been applied on the frame of metal-ceramic bridge denture prosthesis and the first burning was done. Defects of opaque layer were detected during examination of the surface of the framework. What is the next step in this work?

A. To cover it with the dentin and proceed with the second burning;

B. To cover it with opaque dentin and proceed with the second burning;

C. C. To remove the coating, repeat oxidation of the framework, cover it with opaque layer and continue with the first burning;

D. To cover it with dentine and enamel and make the third burning.

9. What are the indications for dental bridge?

A. Defect of the crown of the tooth;

B. Complete absence of the tooth crown while the root is stored;

C. The absence of 1-4 teeth in the anterior region of the dental row or 1-3 teeth in the posterior region of the dental row.

D. Edentulous jaw.

10. What appliances can be used as retainers in a bridge denture?

A. Crowns, half-crowns, pins

B. Pins, half-crowns, retentive clasps with occlusal rest

C. Retaining clasp, pin tumbler teeth, telescopic crowns

D. Telescopic crowns, retentive clasps with occlusal rest, attachment.

11. For the patient K., 40 years old, a bridge will be fabricated. For which kind of the retainer the most deep preparation of hard dental tissues must be carried out?

A. Cast combined

B. Cast metal

C. Stamped metal

D. Stamped combined

12. Fixed bridge denture consists of:

A. Pontic

B. Retainers and pontic

C. Retainers, pontic, artificial teeth and basis

D. Telescopic crowns and body.

13. Which methods of tissue retraction are used in prosthetic dentistry clinic during the fabrication of cast bridge dentures covered with plastic?

A. The destruction of periodontal marginal edge with solution of alcohol

B. Mechanical, chemical, combined

C. Electrosurgical, medical

D. Surgical with premedication

14. Patient B., 55 years applied to the dental clinic with complaints about difficulty of chewing and aesthetic defects. Objective status:

18 17 16 15 14 13 12 11 21 22 23 26 27 28

48 47 46 4544 43 42 41 31 32 33 34 35 36 37 38

Doctor plans to fabricate cast bridge denture with retention on 23, 26 teeth. What kind of impressions is it necessary to take in this case?

A. Two-layer silicone impression from the upper jaw, anatomical alginate impression from the mandible

B. Anatomical alginate impressions from the upper and lower jaws

C. Anatomical silicone impressions from the upper and lower jaws.

D. Alginate impression from the upper jaw, two-layer silicone impression from the mandible

15. What is negative in case of cantilever bridge with retention on a single tooth fabrication?

A. It is necessary to devitalize the abutment tooth

B. Preparation of many abutment teeth

C. Unsatisfactory aesthetic qualities

D. The presence of angular momentum in the area of the abutment

16. Dentist prepares the teeth for fabrication of cast combined bridge denture. What is the optimal convergence of the side surfaces of the abutment tooth ?

A. 0 ° – 3 °.
B. 4 ° – 6 °.
C. 10 ° – 12 °.
D. More than 13 °

17. In patient V., 54 years old, it is planned to fabricate a cast bridge denture to restore the defect in distal part of the dental row. The advantages of cast bridges in comparison to brazed bridges are:

A. Durability
B. High aesthetics
C. The lack of solder
D. All answers are correct

18. In Patient A, 61 years old, it is planned to fabricate cast bridge denture coated with plastic on the lower jaw. What possible complications can arise during the usage of cast bridge denture coated with plastic?

A. Wearing of plastic pontic;
B. Inflammation of gums which have contact with the plastic;
C. Specific odour in the mouth;
D. Functional overload of the abutment teeth;

19. For permanent fixation of bridges can be used:

A. Zincoxid-silicate cement
B. Calcium
C. Zincoxideeugenol cement
D. Glassionomer cement

20. What possible complications can arise if dentist doesn't balance occlusial contacts?

A. Periodontal trauma;
B. Eesthetic defect;
C. The weakening of fixation of bridge prosthesis;
D. Dissolving of the metal.

21. The reasons of poor fixation of abutment crowns of stamped-soldered bridge can be:

A. Excessive tapering of tooth;
B. Excessive shortening of the tooth;
C. Occlusal disturbance;
D. All answers are correct.

22. What must the dentist take into account when he chooses the design of bridge denture:

A. Topography of the dental row;
B. In absolute force of masticatory muscles;
C. The condition of periodontal tissue of antagonist-teeth;
D. The condition of mucosa.

23. For patient C. cast bridge denture with 25 and 28 abutment teeth will be fabricated. What is the first laboratory stage:

A. Fabrication of the casts and mounting them to occludator;
B. designing of the bridge framework;
C. Changing wax into the plastic;
D. Polishing of bridge framework.

24. Patient of 55 years applied to the clinic with complaints about difficulty of chewing and esthetic defects. It is known from anamnesis that teeth were lost because of complicated caries a year ago. Objective status:

18 17 16 15 14 13 12 11 21 22 23 - - - 26 27 28
48 47 46 44 43 42 41 31 32 33 34 35 36 37 38

What treatment plan can you propose in this clinical situation?

A. Cast bridge denture coating with plastic
B. Cantilever bridge dentures
C. Brazed bridge dentures
D. Partial removable denture

25. Patient of 55 years applied to the clinic with complaints about difficulty of chewing and esthetic defects. It is known from anamnesis, that teeth were lost because of complicated caries during a year ago. Objective status:

18 17 16 15 14 13 12 11 21 22 23 - - - 26 27 28
48 47 46 44 43 42 41 31 32 33 34 35 36 37 38

What additional method of examination must be used first of all?

A. Ortopantomography
B. Electroodontodiagnostics
C. Computer tomography
D. Percussion

Correct answers

1	C
2	C
3	C
4	C
5	D
6	E
7	D
8	C
9	C
10	A
11	A
12	B
13	B
14	A
15	D
16	C
17	D
18	B
19	D
20	A
21	D
22	A
23	A
24	A
25	A

List of abbreviations

TMJ – temporomandibular joint
CNS – central nervous system
MIP – maximum intercuspal position
ICP – intercuspal position
MIC – maximum intercuspation
CO – centric occlusion
CR – centric relation
RP – rest position
VDO – vertical distance of occlusion
ISS – immediate side shift
LPT – lateroprotrusion
LT – laterotrusion
LRT – lateroretrusion
RCP – retruded contact position (CR contact)
EOD – electroodontodiagnostic
CT – computed tomography
MRI – magnetic resonance imaging
EMG – electromyography
SEMG – surface electromyography
JVA – Joint Vibration Analysis
US – ultrasound examination
KMI – Kiev Medical Institute
AIDS – acquired immunodeficiency syndrome
CVS – cardiovascular system
CNS – cerebronervous system
CVA – cardiovascular attack
COPD – chronic obstructive pulmonary disease
ILA – intraligamentar anesthesia
ILI – intraligamentar injection
IM – intramuscular
IV – intravenous
MRD – maximum recommended dose
PDL – periodontal ligament
PFM – porcelain fused to metal

Contents