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IDENTIFICATION OF SPECIFIC CEPHALOMETRIC MARKS IN PATIENTS WITH LATERAL CONDYLAR POSITION TEMPOROMANDIBULAR JOINT

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ABSTRACT

Relevance. Temporomandibular joint dysfunction is one of the most widely spread and common disease nowadays. It includes disorders on different levels of whole body and multi symptom as clinical manifestation. There is still less of evidence in ethiopathology of Temporomandibular dysfunction (TMD).
Objective. The research aimed to find new etiological factors impacting the formation of TMJ, recorded growth and developmental disorders of the facial skull in the experimental group.
Materials and methods. The sample group consisted of 59 patients. The experimental group included 38 patients with lateral joint displacement; the control group included 21 patients. Subjects were examined with functional probes, occlusion diagnosis with articulation paper Baush 200,100,8 microns, cephalometryc analysis by Grummons, computed tomography of temporomandibular joint, licensed software application Planmeca Romexis Viewer, statistical analyses with program IBM SPSS Statistic Base v.22.
Results. 91.6% of patients with dentofacial deformities of the maxilla (ddm) also have TMJ with lateral displacement of the articular heads of the mandible. Patients without maxillary dentofacial deformities experience lateral displacement of the articular heads with a frequency of 8.7% and probable risk of 10.5 (95% CI 2.79-39.8). Patients in 1group (63,16%) experiences asymmetric inclination of the angles of the right and left upper jaw and occlusal plane around tooth number 6 and 7, 79.94% of patients in the experimental group recorded a displacement of the mandible <89° dental deformity. There is a specifically, ramifications of the pathological factors via rotational, simultaneous, one-sided, and three-level move with a delay in the horizontal growth of the dental apparatus.

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Introduction. Nearly 60% - 70% of the population is diagnosed with temporomandibular joint dysfunction (TMJ), one in four seeks help from a specialist. (1) Dysfunction impairs chewing, swallowing, pronunciation, and increases facial asymmetry (2). The etiology of TMJ is multifaceted, with the pathology covering biomechanical, neuromuscular, bio-sociological and anatomical factors (3).

While examining the mechanisms of occlusal trauma-myofascial pain syndrome, experimental models in animals established a relationship between occlusal instability and central pathological sensitization, and mechanical hyperalgesia of the masticatory muscles. (4) Multifactorial disorder not only complicates the diagnosis but hinders identification of the underlying etiological factor which eliminates or reduces the disorder’s impact.

According to Angle (5, 6, 7), considerable attention is paid to the nature of the interactions of craniofacial anomalies. Thus, a contributing factor that leads to disorders in the biomechanics of the masticatory organ is a certain skeletal development of the facial skull. There is a possibility that certain anatomical and topographic features of the dental-maxillary apparatus affect the symmetry of the distribution of masticatory weight on the bone structures of the skull.

As a result, traditional solutions often have a temporary effect while rehabilitation remains incomplete. Well known studies also confirm this, establishing the need for development, implementation, and rationale behind various unique individualized methodical approaches, the purpose of which is the long-term validity of results. The impact of the facial skeleton development and the correlation with TMJ has been insufficiently covered in the scientific community. We rely on numerous observations of other researchers and the results obtained by us to substantiate a comprehensive approach to the treatment of patients with musculoskeletal and craniofacial anomalies.

Materials and Methods The sample group consisted of 59 patients, ages 18 to 35. A case control study design was used. The experimental group included 38 patients; the control group included 21 patients. The inclusion and exclusion criteria are outlined in Table 1.

Table 1. Inclusion and exclusion criteria

Inclusion Criteria	**Exclusion criteria**
Male and female adults	Patients after surgical procedures
Aged 18 - 35 years	Patients with neurological dysfunction or fibromyalgia
Patients with condylar lateral displacement	History of brain and spinal cord injuries
Patients with or without the displacement of the articular disk	Presence of rheumatoid arthritis
Written informed consent signed by the individual	Substance use, abuse, and dependence. Substances included pain relievers, antidepressant medications, oral contraceptives, muscle relaxers, alcohol, and drugs
	Mental disorders
	Presence of at least one tooth number 8
	Presence of dental restorations
	Presence of orthopedic structures
	Patients with supra-contacts
	Posterior condylar displacement
	History of treatment with dental braces
	History of treatment with orthodontic plates
	Dental Filling of 2 or more lateral teeth in one quadrant
	Tooth anomalies

IBM SPSS Statistic Base v.22, a licensed software, was used to evaluate biostatics where median, standard error of the median, prevalence, incidence, and risk probability were measured to evaluate correlations between dental deformities and TMJ. Planmeca Romexis Viewer, a licensed software application, was used to process the TRG in direct projection and to process cone-beam computed tomography (CT). The following examination methods were used: medical histories, clinical examination according to RDC/TMD protocol, palpation of associated musculature (muscles of mastication), identification of supra-contacts via the use of occlusogram, Bausch 200- and 100-microns paper, and 8 micron articulating foil.

Results and Discussion 91.6% of patients with dentofacial deformities of the maxilla (ddm) also have TMJ with lateral displacement of the articular heads of the mandible. Patients without maxillary dentofacial deformities experience lateral displacement of the articular heads with a frequency of 8.7% and probable risk of 10.5 (95% CI 2.79-39.8). The following Table 2 represents the two sample groups.

Table 2. Combination of dental deformities with lateral displacement of the articular heads of the TMJ

	With dentofacial deformities of the maxilla	Without dentofacial deformities of the maxilla	Total
With lateral displacement of the mandible	33(91.6%)	2(8.7%)	35
Without lateral displacement of the mandible	3(8.4%)	21(91.3%)	24
Total	36	23	59

To assess the deformation of the upper jaw on the Cephalometric in direct projection, the following lines were drawn (reference Figure 1 by Grummons):

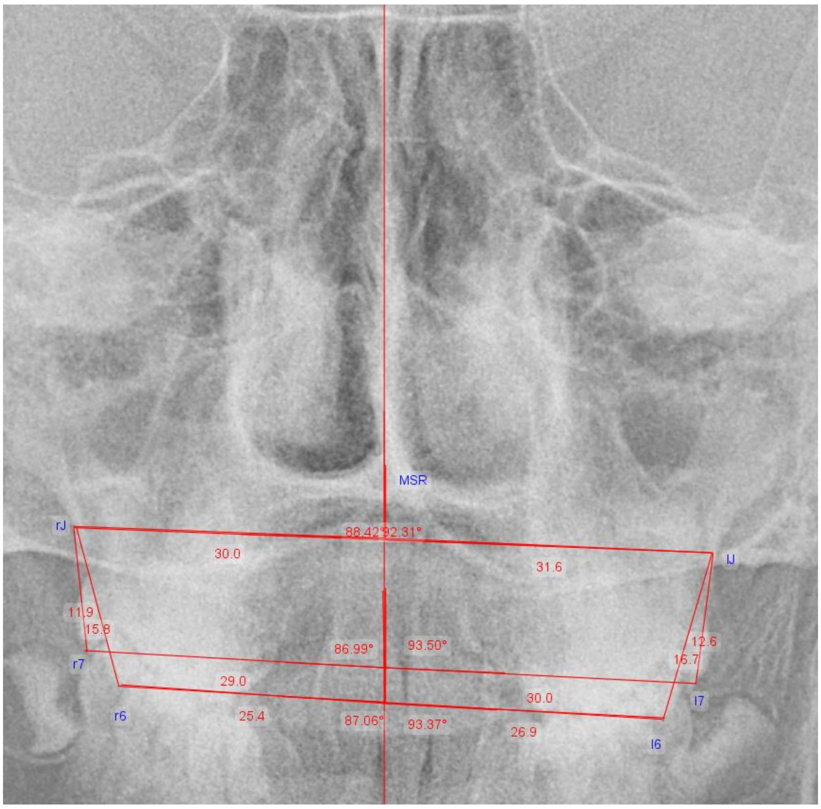

Fig. 1.

MSR - midsagittal reference line
rJ –maxillary tuberosity crossing zygomatical buttress right side
lJ- maxillary tuberosity crossing zygomatical buttress left side
r7-buccal cusp of tooth number 17
r6- buccal cusp of tooth number 16
l7- buccal cusp of tooth number 27
l6- buccal cusp of tooth number 26

Corresponding angles and lengths from each point to the midsagittal reference line:
(rJ-MSR)°, (lJ-MSR)°, (r7-MSR)°, (r6-MSR)°, (l7-MSR)°, (l6-MSR)°
L(rJ-MSR), L(lJ-MSR), L(r7-MSR), L(r6-MSR), L(l7-MSR), L(l6-MSR)
Lengths between two points:
L(r7-rJ), L(r6-rJ), L(l7-lJ), L(l6-lJ)

The experimental group was divided into subgroups based on the angles rJ-MSR, lJ-MSR, r7-MSR, r6-MSR, l7-MSR, l6-MSR and lateral displacement of the TMJ joint heads (reference Table 3). The variance of angles ± 1 ° is accepted as norm.

Table 3. Comparison of Cephalometric indicators with displacement of articular heads

Subgroup	Indicators	Abs	%	Lateral displacement of the articular heads
1	rJ-MSR, r7-MSR, r6-MSR <89°+ lJ-MSR, l7-MSR, l6-MSR>91°	21	55.26	Offset <89°
		3	7.9	Offset >91°
2	rJ-MSR, r7-MSR, r6-MSR 89°-90°+ lJ-MSR, l7-MSR, l6-MSR MSR 89°-90°	2	5.26	Dextral
3	rJ-MSR, lJ-MSR 89°-90°+ r7-MSR, r6-MSR <89°/>91°+ l7-MSR, l6-MSR <89°/>91°	5	13.16	Offset <89°
4	rJ-MSR, lJ-MSR <89°/>91°+ r7-MSR, r6-MSR >91°/<89+ l7-MSR, l6-MSR >91°/<89	4	10.52	Offset <89°
5	rJ-MSR, r7-MSR, r6-MSR 89°-90°+ lJ-MSR, l7-MSR, l6-MSR MSR 89°-90°	3	7.9	Absent
	Grand Total	38		

Out of 30 subjects, 78.94% recorded a displacement of the mandible <89° maxillofacial deformation relative to the MSR line, with 9 individuals recorded 23.68% displacement of the occlusal angular inclinations r7 / l7-MSR, r6/ l6-MSR.

The first (1) subgroup consisted of 24 subjects, representing 63.16% of the total number of patients. In this group the direction of inclination of the upper jaw rJ/ lJ -MSR coincides with the direction of inclination of the occlusal planes r7/ l7-MSR, r6/ l6-MSR. The second (2) subgroup consisted of 2 people, representing 5.26% of the total number of patients. This group had angles at 89°-90°, but with a visible displacement of the articular heads. The third (3) subgroup consisting of 5 people, or 13.16% of the total number of patients, had angles of inclination of the upper jaw at 89°-90°, but occlusive angles at <89°/>91°. The fourth (4) subgroup, consisting of 4 people, or 10.52% of the total number of patients, experienced an inclination of the upper jaw and occlusal planes in opposite directions. Finally, the fifth (5) subgroup, consisting of 3 patients, or 7.9% of the total number of patients, had corresponding angles at 89°-90°, but experienced myofascial pain.

The following was recorded while processing statistical data of the control and experimental groups:

1. (rJ-MSR)° – (lJ-MSR)°; (r7-MSR)°– (l7-MSR)°; (r6-MSR)°– (l6-MSR)°; L(r7-rJ) – L(l7-lJ) revealed statistical difference of $p<0.01$ using Dunnett's test
2. L(rJ-MSR) – L(lJ-MSR); L(r6-MSR) – L(l6-MSR); L(r6-rJ) – L(l6-lJ) no statistically significant difference was found
3. L(r7-MSR) – L(l7-MSR) revealed statistical difference of $p<0.05$ using Dunnett's test

To confirm the results, we examined Cephalometric data in direct projection for both control and comparison groups (reference Table 4). As a result, based on the biostatic analysis of parametric and nonparametric indicators from the two groups, we found differences between the average indicators that suggest the asymmetry of length and angles in the development of the dental apparatus in the experimental group.

Table 4. Comparative characteristics of Cephalometric indicators

(rJ-MSR)° – (lJ-MSR)°								
Group	Qty	Avg	Stand Dev	Stand Error	Min	Max	L(95%CI)	R(95%CI)
Experimental	38	2.01	1.63	0.26	0.1	7.1	1.47	2.55
Control	Qty	Median	I Q	III Q	Min	Max	L(95%CI)	R(95%CI)
	21	1.4	0.7	2.6	0.25	3.8	0.7	2.6
(r7-MSR)°– (l7-MSR)°								
	Qty	Avg	Stand Dev	Stand Error	Min	Max	L(95%CI)	R(95%CI)
Experimental	38	3.67	2.503	0.4	0	11.64	2.85	4.49
Control	21	0.63	0.49	0.1	0	1.65	0.41	0.86
(r6-MSR)°– (l6-MSR)°								
Experimental	38	3.39	2.53	0.41	0.01	11.04	2.561	4.22
Control	21	0.76	0.5	0.11	0.1	1.73	0.53	0.99
L(r7-MSR)– L(l7-MSR)								
Experimental	38	2.689	2.081	0.33	0.1	7.4	2	3.3
Control	21	1.72	0.91	0.2	0.1	3.1	1.3	2.1
L(r7-rJ) – L(l7-lJ)								
Experimental	38	1.74	1.24	0.2	0.1	5.3	1.3	2.1
Control	Qty	Median	I Q	III Q	Min	Max	L(95%CI)	R(95%CI)
	21	0.6	0.4	0.8	0.1	2	0.4	0.8

When performing a correlation analysis between (rJ-MSR)°, (lJ-MSR)°, (r7-MSR)°, (r6-MSR)°, (l7-MSR)°, (l6-MSR)°,L(rJ-MSR), L(lJ-MSR), L(r7-MSR), L(r6-MSR), L(l7-MSR), L(l6-MSR), L(r7-rJ), L(r6-rJ), L(l7-lJ), L(l6-lJ) of the control and experimental groups, the following was found:

1. The emergence of new correlations in the experimental group (in contrast to the control group), which reflects the asymmetric interaction in the nature of growth and development of the upper jaw: negative, strong in the degree of correlation (r = -0.956) between (rJ-MSR)° and (1J-MSR)°; weak, negative relationship (r = -0.3) between (rJ-MSR)° and L (r7-MSR); weak, negative relationship (r = -0.3) between (rJ-MSR)° and L (r6-MSR); moderate, negative relationship (r = -0.6) between (rJ-MSR)° and (l6-MSR)°; moderate, positive relationship (r = 0.62) between (r7-MSR)° and (rJ-MSR)°; positive, strong correlation (r = 0.86) between (r7-MSR)° and (r6-MSR)°; moderate, negative relationship (r = -0.6) between (r7-MSR)° and (lJ-MSR)°; negative, strong correlation (r = -0.92) between (r7-MSR)° and (l7-MSR)°; negative, strong correlation (r = -0.88) between (r7-MSR)° and (l6-MSR)°; negative, strong correlation (r = -0.88) between (l7-MSR)° and (r6-MSR)°; medium, positive relationship (r = 0.58) between (l7-MSR)° and (lJ-MSR)°; positive, strong correlation (r = 0.91) between (l7-MSR)° and (l6-MSR)°. This data indicates developmental disorders of the upper jaw, the influence of pathological factors on the monolithic structure of the upper jaw via rotational action around the axis.
2. A strong positive correlation was maintained in both the experimental (r = 0.73) and control group (r = 0.91) between L (rJ-MSR) and L (r7-MSR); a strong, positive in the control (r = 0.83), medium degree in the experimental group (r = 0.67) correlation between L (rJ-MSR) and L (r6-MSR); the average degree of positive correlation in both the control (r = 0.47) and in the experimental group (r = 0.54) between (rJ-MSR)° and (r6-MSR)°; moderate, positive in the control (r = 0.56), weak in the experimental group (r = 0.32) correlation between L (rJ-MSR) and L (l6-lJ); strong degree, positive in the control (r = 0.795), weak degree in the experimental group (r = 0.37) correlation between L (rJ-MSR) and L (r7-rJ); the average degree of positive correlation in both the control (r = 0.67) and in the experimental group (r = 0.48) between L (rJ-MSR) and L (r6-rJ). The obtained results indicate the preservation of proportional, unilateral, consistent horizontal growth and inclination at the level of the upper jaw-occlusal plane around tooth number 6 and 7. Therefore, (rJ / lJ –MSR) and (r7 / l7-MSR, r6 / l6-MSR) develop in length and change angle simultaneously in both control and experimental groups.
3. In the experimental group, there was a positive, moderate correlation (r = 0.55) between L (rJ-MSR) and L (lJ-MSR); medium correlation (r = 0.64) between L (rJ-MSR) and L (l7-MSR); medium

correlation (r = 0.61) between L (rJ-MSR) and L (l6-MSR). This data indicates the symmetrical growth of the right and left parts of the upper jaw, something that is absent in the experimental group.

Conclusions

1. Among the total sample of 59 patients, the probable risk of developing lateral displacement of the articular heads in maxillary deformities is 10.5 (95% CI 2.79-39.8) with a frequency of 91.6%. This indicates a close relationship between dentoalveolar deformities and TMJ, in contrast to persons without dentofacial deformities of the maxilla, but with a lateral displacement of the articular heads of 8.7%.
2. Among the five clinical subgroups, depending on the dental deformity and displacement of the articular heads of the mandible, the largest is the first group (representing 63.16% of the patients). This group experiences asymmetric inclination of the angles of the right and left upper jaw and occlusal plane around tooth number 6 and 7.
3. 79.94% of patients in the experimental group recorded a displacement of the mandible <89 ° dental deformity, which may be the primary method to diagnose TMJ.
4. After conducting a correlation analysis between the experimental and control groups, we found the following in the experimental group:

- New correlations, specifically, the asymmetric degree arrangement between the right and left parts of the upper jaw, around tooth number 6 and 7. This indicates the influence of pathological factors on the monolithic structure of the upper jaw via rotational action around the axis
- As the length of the right and left part of the upper jaw increases, the length to tooth number 6 and 7 also increases. This suggests bilateral symmetrical growth at 3 levels – the length of the upper jaw and length to tooth number 7 and 6. Contrary to the experimental group, control group experienced parallel lengthening of both right and left parts of the upper jaw and length to tooth number 6 and 7. As such, this may indicate a delay in the horizontal growth of a separate part of the upper jaw under the influence of pathological factors
- As both groups experienced positive correlations between the height from tooth number 6 and 7 to the chin buttress and the width of the upper jaw on the right and left, this may indicate the uniformity of the vertical growth
- Finally, the experimental group revealed certain patterns: as the angle of inclination of the right part of the upper jaw increases, so does the angle to tooth number 6 and 7, while their distance to the midsagittal reference line decreases. This indicates concurrent effect of the pathological factor on both the upper jaw and the occlusal plane

The research aimed to find new etiological factors impacting the formation of TMJ, recorded growth and developmental disorders of the facial skull in the experimental group. Specifically, ramifications of the pathological factors via rotational, simultaneous, one-sided, and three-level move with a delay in the horizontal growth of the dental apparatus.

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Conflict of Interest Disclosure. None declared

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