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The Effect of Tooth Loss on the TM-joint Articular Eminence Inclination

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ABSTRACT

The inclination between the posterior wall of the articular eminence and the referential plane (Frankfurt line) was measured on 137 dry skull specimens (78 with complete dental arches and 59 edentulous). Both left and right joints were measured using direct craniometric method. The results were compared with respect to the loss of teeth, side and sex. A large range of measured values of the eminence inclination shows great individual differences, so that the mean values can have only orientational significance. The mean value of eminence inclination for all measured specimens was 61.9 angular degree. The difference between the two groups established upon dental status is very small and without any statistical significance ($P > 0.05$). The right joint shows a slightly steeper eminence inclination compared to the left one, but without any statistical significance ($P > 0.05$). Asymmetry between the right and left joint appears almost as a rule, while maximum measured differences reach up to 33° , with mean absolute difference of 6.9° . The group of edentulous specimens shows a greater symmetry and less differences between the left and right joint, which indicates that different biomechanical conditions in the joint, due to tooth loss might lead to remodelling of the articular eminence. The eminence inclination was significantly steeper in male specimens in all subgroups ($P < 0.001$), which confirms sexual dimorphism.

Introduction

The osseous parts of TM-joint, in addition to other factors, exert important in-

fluence upon the magnitude of the lower jaw movement. Particularly, the slope of

the posterior wall of the articular eminence and its inclination determine the condyle path which leads mandibulae in its movements. At birth, the articular eminence is completely flat, and its full size and shape are reached at the age of twelve¹. Its development depends upon the intensity of mechanical forces produced by the condyle². The investigation of skull specimens indicates that with years the articular eminence inclination becomes steeper, and reaches its final shape at the early adulthood³. Average inclination values are often used in everyday practice, particularly in work with articulators, despite the fact that the articular eminence inclination varies interindividually, that there is a difference between the left and right joint, and despite sexual dimorphism manifested by steeper inclination in males⁴⁻⁶. On one hand some authors have found a connection between the loss of teeth and the articular eminence inclination^{7,8}, while on the other such a relationship has not been statistically proven in other investigations^{3-6,9,10}. A number of recent studies have also approached the problem using different methods or different anatomic parameters¹¹⁻¹⁵.

The aim of the study is to investigate the relationship between the articular eminence inclination and the loss of teeth based on direct measurements of the largest available number of specimens from the existing osteologic collection.

Material and Methods

A total of 137 dry skull specimens from the osteologic collection of the Institute of Anatomy, School of Medicine, University of Zagreb were included in the study. All selected specimens were without damage in the measured area (tuberculum articulare, meatus acusticus externus and orbitae), and they all had complete data on age and sex. All speci-

mens were selected on the basis of dental status and divided into two groups: 78 specimens with complete dental arches, including some with a few teeth missing, but with preserved occlusal contacts in molar and premolar region (dentulous), and 59 specimens without teeth (edentulous). Table 1 shows that in the dentulous group the average age of specimens was 33.4 years, and in the group of the edentulous the average age was 68.7 years. There were more male specimens (93 or 67.9%), in relation to the female ones (44 or 32.1%). As a consequence of the intention to include in the study the largest possible number of specimens from the collection, there is a certain asymmetry in the number of specimens regarding their dental status and sex. The articular eminence inclination (Figure 1) is the angle between the posterior wall of the articular eminence and the line which connects cephalometric points Porion-Orbitale (Frankfurt line). The measurements were performed by direct craniometric method, using triangle with goniometer and thin metal rod. The triangle was positioned in such a way that the point 0° on the goniometer was leaned against the most prominent point of the articular eminence and the longest side of the triangle was set along the Frankfurt line. The thin metal rod was set against the posterior wall of the articular eminence, and its projection on the goniometer was the expected inclination expressed in angular degrees (Figure 2). The results were statistically analysed by SPSS program for Windows Release 6.1. at the level of descriptive statistics (mean – X, standard deviations – SD and coefficient of variations – CV), while the differences between arithmetic means were tested for significance by the T-test. The percentage of equality and the mean absolute difference were made in order to show asymmetry of the measured inclination of the right and left joint on the same skull.

TABLE 1
SPECIMENTS IN GROUPS WITH AVERAGE AGE AND SEX

	No.	Males	Females	Average Age	Age-range
Dentulous	78	54	24	33.4	18–56
Edentulous	59	39	20	68.7	55–88
Total	137	93	44	45.7	18–88

Results

The mean measured value for the eminence inclination in all measured specimens was 61.9° with the range of values from 30° to 94°. The right inclination was slightly steeper than the left one, but this difference was not statistically significant ($P > 0.05$). The mean value obtained in the edentulous group was slightly higher than the one obtained in the dentulous group (62.5°–61.5°), and without statistical significance ($P > 0.05$). The eminence inclination in males in all measured specimens was significantly ($P < 0.001$) steeper than in females, at the average for 6.5°. This result was repeated in selected groups, only with different level of significance ($P < 0.05$). Examining the symmetry between the right and left joint

of each particular skull (Table 3), showed the equal values in only 5.1% of the total studied specimens. In the edentulous group this value was higher (8.9%) as compared to the dentulous group (1.3%), while the range of differences was very wide (–28° to +33°). When comparing the absolute mean differences (difference obtained by subtraction of the value for the left joint from the value for the right joint, regardless of sign «+» or «–») the edentulous group shows a lower difference (5.1°), while in the dentulous group that value is higher (7.7°). A higher percentage of equality and lower value for the mean absolute difference, proves that more symmetry and less difference of the left and right joint is present in Edentulous skulls.

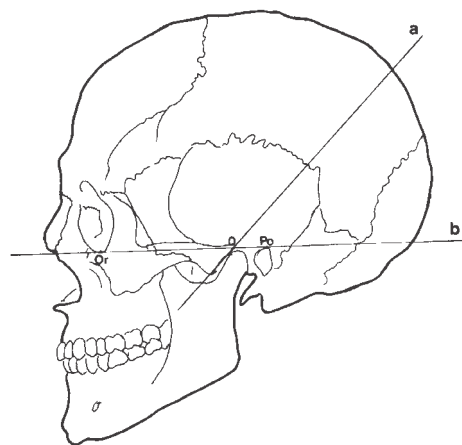


Fig. 1. The inclination between the posterior wall of articular eminence (a) and frankfurt line: porion-orbitale (b).

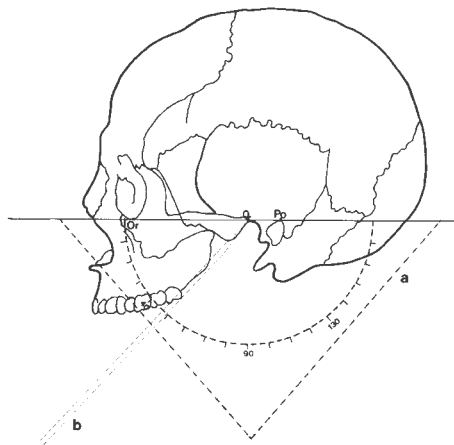


Fig. 2. Method of measuring the degree of the articular eminence inclination by triangle with goniometer (a) and metal rod (b).

TABLE 2
 DESCRIPTIVE STATISTICAL PARAMETERS OF THE ARTICULAR EMINENCE INCLINATION
 IN ANGULAR DEGREES (M = male, F = female, L = left, R = right)

		Dentulous				Edentulous			
		\bar{X}	Min-max	SD	CV	\bar{X}	Min-max	SD	CV
M	L	63.57	40–94	10.50	16.52%	65.48	35–94	10.51	16.05%
	R	63.35	31–88	12.60	19.98%	64.41	33–86	11.64	18.07%
	Total	63.46	31–94	11.55	18.20%	64.95	33–94	11.24	17.30%
F	L	54.83	38–80	12.72	23.19%	58.05	30–77	13.95	24.03%
	R	59.75	43–88	11.19	18.72%	57.95	34–77	13.44	23.31%
	Total	57.29	38–88	12.11	21.13%	57.85	30–77	13.52	23.37%

TABLE 3
 INDIVIDUAL SKULL VALUES OF THE DIFFERENCES BETWEEN RIGHT AND LEFT INCLINATION,
 DONE BY FORMULA: RIGHT INCLINATION MINUS LEFT INCLINATION (negative value means
 steeper left inclination, and positive value means steeper right inclination)

Inclination subtracted	Dental status	Mean difference	Mean absolute difference	% of equality
Right-Left	Dentulous	1.36	7.69	1.3%
	Edentulous	-0.85	5.11	8.9%
	Total	0.4	6.88	5.1%

Discussion

The wide range of inclination values obtained interindividually in the study indicates that the average values can be used just as an orientational information and that it is not advisable to use them in everyday practice. The same results were found in several other investigations, in which similar or different methods were used^{3-6, 10, 16-19}. The mean value of inclination (61.9°) is much higher than the value (40°) found by Angel in 1948³. Somewhat lower values (55°–61.7°) have been obtained by recent studies^{6, 20, 21}. With almost the same mean inclination values in both selected groups in terms of the dental status, it might be concluded that the loss of teeth has no effect upon the articular eminence inclination. Some previous investigations show the same relationship^{4-6, 9, 10}, while the other claim just the

opposite^{7, 8}. This study shows that the right joint has slightly steeper inclination, considering the average values, while some other authors find the inclination of the left joint steeper^{6, 16-18}. The previous theory of the asymmetry of the articular eminence inclination of the left and right joint, has been confirmed by the present study. The symmetry is found in only 5.1% of all specimens, while some other authors, in similar investigations, found a higher percentage of equality (about 12%)^{6, 18}. The difference between the left and the right joint is probably caused by the predominant usage of one side of the dental arches during chewing, and consequently the distribution of the biomechanical forces is not similar in both joints. In the edentulous specimens more symmetry and less difference in inclination of both joints is found, as confirmed elsewhere^{6, 18}. Thus, different bio-

mechanical conditions caused by ageing and influenced by the loss of teeth, might have some effect upon remodellation and reshaping of the articular eminence. The steeper inclination in males in relation to females, confirms the sexual dimorphism found by other investigations^{4–6}, which, however, was not statistically significant^{16,17}.

Conclusions

1. The range of the values for the articular eminence inclination is wide and it differs interindividually, regardless of the loss of teeth, side or sex.

2. The average inclination values have only orientational significance.

3. The loss of teeth shows no statistically significant correlation with the eminence inclination.

4. The right joint has steeper, but not statistically significant eminence inclination.

5. The asymmetry between the left and right joint is almost a rule, and the difference reaches up to 30°.

6. With the loss of teeth, the articular eminence inclination between the left and right joint shows more symmetry and less differences.

7. Sexual dimorphism is confirmed by statistically significant steeper eminence inclination in males, regardless of the side or loss of teeth.

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UTJECAJ GUBITKA ZUBI NA NAGIB KONDILNE STAZE TM-ZGLOBA

SAŽETAK

Na 137 preparata lubanja, 78 sa sačuvanim zubnim lukovima i 59 bez zubi, izmjeren je kut između stražnje stijenke zglobne kvržice i referentnog pravca – Frankfurtske horizontale. Na istom preparatu mjeren je lijevi i desni zglob, a mjerenje je izvršeno direktnim kranimetrijskim postupkom. Rezultati mjerenja su uspoređivani u odnosu na zubni status, stranu i spol. Veliki raspon izmjerenih vrijednosti pokazuje da je nagib kondilne staze individualno vrlo različit, tako da srednje vrijednosti imaju samo orijentacijski značaj. Srednja vrijednost za nagib kondilne staze u ukupnom uzorku je 61.9°. Uspoređujući odabrane skupine po vrsti ozubljenosti, razlika je vrlo mala i nije statistički značajna ($P > 0.05$). Za desni zglob izmjeren je nešto strmiji nagib kondilne staze, ali ta razlika u odnosu na lijevi nije statistički značajna ($P > 0.05$). Asimetrija lijevog i desnog zgloba je gotovo pravilo i srednja razlika iznosi 6.9°, a najveća izmjerena razlika je čak 33°. U skupini preparata bez zubi uočena je veća simetrija i manje razlike između lijevog i desnog zgloba, što upućuje da drugačiji biomehanički uvjeti u zglobu, nastali gubitkom zubi, mogu utjecati na remodelaciju zglobne kvržice. Statistički značajno je strmija kondilna staza kod muških preparata, kako u ukupnom uzorku, tako i po skupinama ($P < 0.001$), što govori u prilog spolnog dimorfizma.