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Tooth Morphology in Function of Selfprotective Mechanism

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ABSTRACT

The degree of curvature of vestibular and oral tooth surfaces is determined by the shape sequence from the tooth crown to the epithelial attachment and the alveolar bone, and directly influences the health of gingiva and the entire tooth support system. The goal of this research was to determine vestibulo-oral planes of upper and lower permanent premolars and molars and the thickness of the associated alveolar osseous wall, and 2,727 measurings were processed using pertinent statistical procedures. The results have shown the degree of curvature of vestibular and oral tooth surfaces to be higher in upper teeth than in lower ones (p>0.05); vestibular convexities higher than oral ones and especially noticeable at the junction from the meandle to the lower third of the crown. Higher vestibular curvature also entailed thicker osseous wall. All results were higher than the ones found in literature. We consider our results to be relevant for our population. The research on the relationship of teeth and the alveolar bone should be continued by using even more test points and more sophisticated research procedures.

Introduction

The anatomy and physiology of teeth and corresponding alveolar bone are inseparable disciplines whose goal is to research the homogeneity relationship of tooth shapes and their functions. The part of the tooth crown touching the teeth of the opposite jaw constitutes the »working area«, and the other parts help stabilize teeth, acting as a response to the load caused by lower jaw movement and adding to the protection of the support structure. Health of teeth is directly tied to the strain made by chewing.

The shapes, arrangement, vestibulo -lingual tooth inclination and the shapes

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of cement-enamel (occlusion) junction are some of the special particularities of the tooth, lip, tongue and cheek self-protective system. The parts of the crown especially important in self-protective respect are, firstly, the curvatures of proximal planes, especially the areas which touch the teeth, then the size of interdental spaces, shapes of cement-enamel border, which determines the height of epithelia attachment, but also the occlusive thirds of crowns, and especially the curvature of vestibulo-oral planes in the meandle and neck thirds[1–5].

Histological studies have proven that, under overconvex planes, the mucous and osseous layer is thicker and resistant to mechanical loads. Osseous tissue is especially reactive to mechanical loads, and its structure is most properly observable at adequate axial teeth loads. It reacts to non-physiological loads with re-absorption at the burden spot or compensatory self-production of osseous tissue in places away from the burden spot. Literature check revealed that the attempt at objective assessment of the degree of change on alveolar bone margins still contains numerous problems. Measures of the degree of vestibular and oral tooth planes curvature, especially of lateral teeth did not yield satisfactory results, probably due to the use of inadequate research models. Furthermore, there have been no complete studies on the relation of teeth crowns and the corresponding alveolar bone[5–12]. Wheeler and associates have also measured curvatures of vestibulo -oral planes[12] using two pairs of measure points on the vestibular and oral area of teeth, and Keros and associates[13] using three measure points.

The said facts were an incentive to research the relations between the dimension of vestibulo-oral crown curvatures and thickness of corresponding alveolar walls on an adequate number of teeth and alveolar bone samples.

Materials and Methods

The research was done on ostheologic samples; permanent upper and lower premolars and corresponding segments of alveolar bones.

Samples consisted of 303 healthy and undamaged teeth with corresponding alveoli on which we measured nine variables. They gave us 2,727 results which were then statistically processed. Research contained teeth of post-canine sector because of their characteristic shapes and pronounced curvature of vestibular and oral planes, which allowed exact picking of three measuring points important for determining curvature of such planes. At the same time, the higher compactness of alveolar bone is present in premolar and molar areas, and dehiscence and fenestration is rarer than in the incisor and canine regions, ensuring exact measurements of bone thickness of each alveolar segment. Third molars were not included in the research study due to high variability. Teeth measures were done using slide rule, modifying Wheeler's[12] procedure. Three points were chosen on vestibular and oral planes of tooth crowns, which is a minimum for defining the curvature.

The assumption was that the measurements of both the right and the left sides of the jaw were the same. The parameters taken into consideration for measuring were gender and age, because it is known most of tooth and osseous tissue differs between women and men, and there are differences in the look of bones through aging as well.

The teeth were measured first; the first measuring point (T1) was placed in the occlusal third of the crown, the second point (T2) in the meandle part of vestibular and oral planes, and the third point (T3) in the junction between the meandle and cervical third of the crown, and the differences T2–T1 and T2–T3 were noted as R1–R2. The teeth were then carefully taken out of alveoli, after which the thickness of the osseous wall (T4, T5) of their alveoli was measured on the furthest end points the measuring instrument could reach.

The total number of measures was 2,727, and the precision of procedures was checked with three consequent measures from three different researchers. The advantage of this procedure is its simplicity and repeatability. Gained data was then processed using appropriate statistical methods.

Results and Discussion

Accepting the assessment system based on choosing three measuring points on the vestibular and oral teeth surface, assuming such dimensions are the same on both sides of upper and lower lateral teeth all variables are marked by measures T1, T2, and T3. Then, in order to determine which curvature is more intensive, we subtracted the measure in the occlusal (T1) and the cervical (T3) parts from the maximal curvature in the tooth's meandle third (T2), in this way determining the difference between the upper and lower half of measured planes (R1=T2–T1, R2=T2–T3). Thus we gained maximum area curvatures of both levels. In order to understand the self-protecting mechanisms, we need to examine not only the shape, but also the thickness of corresponding vestibular and oral parts of the alveolar bone of each tooth examined, which was done by measurements T4 and T5. Table 1 shows mean values of upper premolar vestibular and oral dimensions of crowns and alveoli.

Based on values reached, mutual relationship between the curvatures of vestibular and oral planes and the thickness of the corresponding alveolar part was researched; R1:T4; R2:T4; R1:T5; R2:T5. We have determined whether higher curvatures match with thinner or thicker alveolar bone. Such ratios were then tested using mean values and arithmetical mean values. Table 2 shows the relationship between the minimum and maximum curvatures and arithmetical mean values of vestibular and oral planes and the alveolar bone in front upper premolars.

This research has shown there are significant differences in curvatures of vestibulo-oral planes of lateral teeth of the same jaw half, but also in relation to the opposite jaw. The differences between the jaws were noticeable in front premolars

TABLE 1
VALUES OF VESTIBULAR AND ORAL MEASUREMENTS OF FRONT UPPER PREMOLAR CROWNS AND THEIR ALVEOLI: 4 | 4 UPPER JAW

No.	Gender	Age	T1	T2	T3	R1	R2	T4	T5
1.	F	39	7.98	9.55	8.10	1.57	1.45	0.30	0.37
2.	M	38	8.22	9.78	8.38	1.56	1.40	0.30	0.45
3.	F	39	7.97	9.59	8.20	1.62	1.39	0.29	0.29
4.	M	36	8.25	9.88	8.50	1.63	1.38	0.30	0.42
5.	M	39	8.24	9.84	8.47	1.60	1.37	0.30	0.45
6.	M	37	8.20	9.83	8.38	1.63	1.45	0.28	0.44
	Total		–	–	–	9.61	8.44	1.77	2.42
	X		–	–	–	1.60	1.40	0.29	0.40

R1=T2–T1; R2=T2–T3

TABLE 2
RATIO OF MINIMUM AND MAXIMUM CURVATURES AND MEAN VALUES OF VESTIBULAR AND ORAL PLANES OF FRONT UPPER PREMOLARS AND CORRESPONDING ALVEOLAR BONE: 4 | 4 UPPER JAW

Gender	R1	R2	T4	T5	R1:T4 R2:T4	R1:T5 R2:T5
Max. curv. R1	1.63	–	0.28	0.44		
Max. curv. R1	–	1.45	0.28	0.44		
Aritm. mean. X	1.60	1.40	0.29	0.40	5.51 4.82	4.00
Min. curv. R1	1.56	–	0.30	0.45		3.50
Min. curv. R2	–	1.37	0.30	0.45		

(upper 8.10–8.20, lower 6.97–7.10), front molars (upper 11.39–11.55, lower 10.66–11.00), and back molars (10.29–10.41, lower 9.15–9.21).

Specific properties and mutual relations of vestibulo-oral planes and the thickness of the corresponding bone segment in the area of upper and lower lateral teeth shows, with no doubt, some valid patterns, but also some digression from the usual perception on the relationship between these two morphologic entities. The curvature of front upper premolar vestibular and oral planes is greater than that of lower premolars ($p > 0.05$). The greater the curvature of the vestibular tooth surface, the thicker the bone. Lower front premolars, which also have a more convex vestibular wall, also entails a thicker alveolar bone, even though this difference is not as noticeable as with upper teeth (2.88 : 2.43). Back upper premolars have a somewhat greater curvature of plane than the lower ones (4.23 : 3.71), and the greater curvature is also complemented by a thicker osseous wall, which is in tune with the set relations of shapes and functions. In back lower premolars, the greater curvature of the vestibular wall corresponds to the thicker bone. The curvature of vestibulo-oral surfaces in upper front molars is somewhat greater than in lower ones, and the alveolar bone in lower front molars is thicker than in lower ones on both sides. In both upper and lower front molars, the more convex vestibular area is coupled with thicker bone. In back molars the differences in curvatures of vestibulo-oral planes are smaller, but the bone of lower back molars is significantly thicker on both sides of the lower jaw than the upper jaw, which corresponds to the position of lower back molars closer to the entry branch of the mandible.

The highest values of vestibulo-oral measurements are found in points T2 and T3, especially in upper lateral teeth. These values are higher than the ones in literature. We feel these results are relevant for our population, and should be ties with the measured results of the oral-facial system.

Examining the thickness of the alveolar bone and tooth shape is characteristic of conservative stomatology (shaping fills), and paradenthology. The changes in periodonthal pressure, which occur due to overbearing occlusive pressure to the teeth soon also entail morphologic changes of tooth supporting structures[14]. Comparison of hypo and hyper functions influences, or its total loss on the morphology of the alveolar bone, could be useful in estimating the influences of occlusion forces on bone growth and mineralisation.

Tests done on rats have shown that even a short time loss of teeth functions entails significant change in bones[15–21]. For example, extraction of rodent's molars causes hyper function of molars on the opposite side of the jaw and changes to bone forming in on the margins of alveola. Hyper function causes retardation of osseous matter forming in the alveola, which is remedied by normalization of the chewing function within three weeks of the operation, attesting to the ability of alveolar bone to adapt to the conditions of increased pressure[9,15].

Johnson[9], Baumrind[21], Osborn[22], and Kinoshita and associates[23] have examined the changes in periodonthal pressure due to the shape and the position of teeth and overbearing occlusion, and have concluded that the change in shape or function of teeth significantly changes the number of Sharpey's filaments in the cement.

Our findings significantly differ from the predominant belief that decreased curvature (hypoconture) is, because of higher load, damaging to the supporting system of teeth. Even though such alveolar bone is somewhat thinner, it is healthier and functioning more normally, so the bigger problem are highly rounded – hypercontoured tooth planes, because such areas are favorable for plaque build-up and appearance of caries. This should be taken into consideration during any restorative teeth work. Leaning too much toward the natural shape of the tooth crown does not necessarily mean successful therapy. New anatomical relations should exclude expletive and needless crown convexities, in this way establishing the continuity in crown shape and tooth roots. Similarly, good prosthesis work is done by merging shape (aesthetics) and function, during which any surplus aesthetics care should be kept in check.

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MORFOLOŠKA OBILJEŽJA ZUBA U FUNKCIJI SAMOZAŠTITNIH MEHANIZAMA

S A Ž E T A K

Stupanj zaobljenosti vestibularnih i oralnih zubnih površina uvjetuje slijed oblika od zubnih kruna prema epitelnom pričvrstku i alveolarnoj kosti, te izravno utječe na zdravlje gingive i cjelokupnog potpornog sustava zuba. Zadaća je ovog istraživanja bila utvrditi vestibulooralne površine gornjih i donjih trajnih pretkutnjaka i kutnjaka i debljine koštane stijenke pripadajućih im alveola, a dobivena 2.727 izmjera obrađena su primjerenim statističkim postupcima. Rezultati ukazuju da su stupnjevi zaobljenosti vestibularnih i oralnih površina izrazitiji u gornjih nego u donjih zubi ($p > 0,05$), pri čemu su vestibularni konveksiteti veći od oralnih i posebice su izraženi na prijelazu srednje u donju trećinu krune. Većoj vestibularnoj zaobljenosti odgovara i deblja koštana stijenka. Svi su izmjeri bili veći od podataka u literaturi. Dobivene podatke smatramo relevantnim za našu populaciju. Istraživanja suodnosa zubi i alveolne kosti treba nastaviti korištenjem još većeg broja mjernih točaka i sofisticiranijih istraživačkih postupaka.