VERTICAL DISTANCE BETWEEN THE BONE RIDGE AND INTERPROXIMAL PAPILLA HEIGHT BETWEEN TWO ADJACENT IMPLANTS

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ABSTRACT

The aim of the study: Examine the influence of gender, age and length of prosthetic work on the height of interproximal papilla between the two adjacent implants.

Patients and Methods: Fifty patients participated in the study with implanted implants one after the other and their prostheses for at least two months. Measurements of the interdental papilla from the alveolar bone ridge to the tip of the papilla were performed in the study, measured along the straight line, linking these two points.

Results: Student t-test of independent samples did not demonstrate statistically significant differences in average papillae height between men and women with a probability of $p < 0.905$ ($t = 0.120$). When it comes to the height of the papilla in relation to the age of the respondent, it can be said that elderly subjects usually have somewhat higher average values of papillae height compared to those of younger age. However, these differences are not statistically significant ($p < 0.691$, $F = 0.372$). Also, the results of the research suggest that the average height of the papilla does not differ statistically significant when compared to the length of the prosthetic work on the implant, which is confirmed by the results of the Single Spectrum Analyzes (ANOVA).

Conclusions: There is no statistically significant difference in the average values of papillae height between two properly positioned adjacent implants between male and female subjects, as well as among younger and older respondents. The average height of papilla between two properly positioned implants is not statistically significant when regarded in relation to the length of the prosthetic implant work.

Key words: implants, height of interproximal papilla, length of prosthetic work wear

Introduction

Nowadays, there are lot of researches on the subject of papilla, its role in paradental theory and practice, with prevailing topics related to reconstruction of interdental papilla and osseointegration in general. At today's stage of development of dental implantology when replacing natural tooth by artificial, at least two conditions must be achieved: material compatibility and the mechanism of complete integration of inorganic material with human tissues. [1, 2, 3] In series of experiments, it was discovered that the peridental ligament is a specific structure having not only the role of tying the dental root and implant for the surrounding structure, but it also the role to absorb the impact factor. Author Joffe points out that four groups of collagen fiber bundles intensify interdental papilla, ensuring the resistance and tone of the required material and the integrity of the dentogingival fastener. [4]

In many works, the attention was also paid to papilla preservation techniques. The goal is to preserve interdental soft tissue by suppressing the root with maximum soft tissue after surgical procedure. In order to use the technique in regenerative procedures, Cortellini et al. described in their work the lobe design modification making this technique adequate to be uzed in regenerative processes. [5]

By increasing the patient's need for a more natural look in the aesthetic zone, clinicians must have the highest degree of knowledge and skills in maintaining or reforming the interdental papilla between two teeth, between teeth and implants or between two adjacent implants.

According to Tarnow and his associates, an average of 3.4 mm of soft tissue is needed over the interimplantary bone rim. [6]

Difficulties in forming papilla are more prevalent between two implants. In recent studies, it has been shown that the distance between the teeth and implants must be at least 3 mm to protect the interdental bone. This is linked to the horizontal component of the biological width around the implants. However, implant placement at a distance of 3 mm or more does not ensure the reformation of papilla. This meziodistically placed implant just prevents the extra loss of interproximal bone arising after exfoliation. Data from literature presents the success of the implantation and osseo-integration process itself. However, a question still stands: to what extent successful rehabilitation is possible from the aesthetic point of view (height of interdental papilla) after implant therapy. [7]

In the functional plan, the papilla has the role of a barrier protecting the basic periodontal structure. It is also necessary to maintain good oral hygiene by preventing food retention and bacterial accumulation, allowing long-term success in implantology. [8, 9, 10, 11]

From the aesthetic point of view, papilla is particularly important anatomical element. Indeed, its absence is marked by thenon aesthetic black triangle. This concept in dental aesthetics gains a completely different dimension in intercanina sector. The practitioner always has in mind the patient's age and requirements as well as the type of smile in order to assess the importance of the aesthetic role of papilla. We can also put an accent on participation of papilla in font perspective since its absence allows the passage of air in pronunciation of individual voices.

Positioning the implant is a delicate matter demanding great attention since it affects the shape of papilla and the recesses. [12, 13, 14]

Tarnow showed in his research that bone loss does not have only a vertical component but also a lateral component present in connecting a horizontal bone loss device of 1.34mm implant at mesial bone peak and 1.4mm at distal. He observes equally strong bone resorption even in the case where 3mm interimplant distance was not respected. [15]

This distance should be respected because an additional bone resorption may occur, which would increase the distance between the bone ridge-contact point, leading to the decrease of the papillae height, compared to one after extraction.

Salama M and others developed a classification respecting the degree of alveolar bone resorption in the aesthetic region:

- Class I: The bone ridge is present 2 mm away from the cement-enamel compound, resulting in a good prognosis

- Class II: The bone ridge is present 4 mm away from the cement-enamel compound, with a questionable prognosis.

- Class III: The bone ridge is present 5 mm (or more) away from the cement-cake compound, resulting in an unwanted esthetic prognosis. [16]

The aim of the study is to examine the influence of gender, age and length of prosthetic work on the height of interproximal papilla between the two adjacent implants.

Materials and Methods

The study involved 50 patients with implants and prosthetic works. This study was conducted at the Department of Dental Prosthetics with Dental Implantology at the Faculty of Dental Medicine of the University of Sarajevo, in accordance to the approval of the Management of the Faculty and Department itself. For the credibility, research discussions with potential respondents were conducted and appropriate documentation has been

prepared being the basis and the starting material for the planned research.

The Documentation consists of:

- Identity cardboard-own creation sheet;

- Written consent of voluntary participation in the research with the clear purpose of collecting required data.

- The identity cardboard contains general information about the respondent:

- Name and last name

- Age

- Gender

- Occupation

- Data obtained by clinical examination.

The selected subjects had implanted implants one after the other and prosthetic work on them for at least two months. The study included the front and back of the jaw regions (maxilla and mandibula) with implants (Straumann, Walderburg, Switzerland) in the natural bone with an abutment interface located between the coronary and the alveolar ridge, in liasson with bone conditions, references and surgent assesments.

Exclusion factors: Patients with certain bone augmentations performed were not included in this research.

The planned measurements were also carried out in the research process. Measurements were made according to the law of profession on adjacent properly positioned implants replacing the positions of two teeth.

Different positions have been selected, partially or totally toothless maxilla or mandibula. This created a database containing interdental papilla measurement from the alveolar bone to the tip of the papilla, measured along the right line, linking these two points.

Local anesthesia was initially applied to the patient-subject. A standardized parodontological probe was used, applying the vertical height of the papilla to the bone ridge. The measured values obtained are rounded to the nearest millimeter. These data were entered into the Identity cardboard.

Statistical analysis

All obtained results were processed by appropriate statistical tests using the PASW Statistics 20.0 program. Student t-test of independent samples was used to investigate the statistical difference in interdental papillae size between genders. One-way analysis of variance (ANOVA) test was used to investigate the difference in the average height of the interproximal papilla with respect to the variables of age and variable length of prosthetic work.

Results

The average value of papilla height in male subjects was 3.3 mm with a standard deviation of 1.03 mm, while in female subjects the average was somewhat higher and 3.26 mm with a deviation of 1.05 mm average. Student t-test independent samples did not demonstrate statistically significant differences in average papillae height between men and women with a probability of p <0.905 (t = 0.120), as shown in **Table 1**.

Table 1. Average papilla values according to gender and all cases

| | Gender | | | | Total | |
| | Male | | Female | | All cases | |
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
The papilla height (mm)	3,30	1,03	3,26	1,05	3,28	1,03

*t=0,120, df=48, p<0,905

The most common papilla height was 3 mm and it was measured in 40% of cases. **Table 2** shows the distribution of papillary frequencies, and it can be noticed that the height of the papilla has approximately normal distribution in the population, where values around the average occur most frequently, while the lower and the higher papillae levels are less frequent in the population.

Table 2. The papilla height distribution

	Fraquency	%	Cumulative %
1 mm	1	2,0	2,0
2 mm	10	20,0	22,0
3 mm	20	40,0	62,0
4 mm	13	26,0	88,0
5 mm	5	10,0	98,0
6 mm	1	2,0	100,0
Total	**50**	**100,0**	

When it comes to the height of papilla in relation to the age of the respondent, it can be said that elderly subjects usually have somewhat higher average values of papillae height compared to those of younger age. However, these differences are not statistically significant (p <0.691, F = 0.372), as shown in **Table 3**.

Table 3. The average papilla height according to the age

	n	Mean	Std. deviation	F p
38-50 yrs	22	3,14	1,08	
51-60 yrs	18	3,39	0,98	0,372 0,691
61-70 yrs	10	3,40	1,07	

F-value of Fisher test (ANOVA),
p-probability of rejecting the nult hypotheses with risk of 5%

The most common height of papilla in subjects aged between 38 and 50 years and subjects aged between 51 and 60 years was 3 mm, while in subjects aged 61 years the most common height of papilla was 4 mm. The results are presented in **Table 4**.

Table 4. Distribution of the papilla height according to the age of the subjects

The papilla height	Age					
	38-50 yrs		51-60 yrs		61-70 yrs	
	Count	%	Count	%	Count	%
1 mm	1	100,0	0	0,0	0	0,0
2 mm	4	40,0	3	30,0	3	30,0
3 mm	11	55,0	8	40,0	1	5,0
4 mm	4	30,8	4	30,8	5	38,5
5 mm	1	20,0	3	60,0	1	20,0
6 mm	1	100,0	0	0,0	0	0,0

Also, the results of the research suggest that the average height of the papilla does not differ statistically significant when compared to the length of the prosthetic implant work, which confirms the results of the Single Error Analysis (ANOVA) shown in **Table 5**.

Table 5. The average papilla height in relation to the duration length of prosthetic work on implants

	n	Mean	Std. deviation	F p
3-6 months	10	3,10	0,74	
7-12 months	21	3,14	0,73	
13-18 months	10	3,70	1,42	0,776 0,513
>18 months	9	3,33	1,41	

F-value of Fisher test (ANOVA),
p-probability of rejecting the nult hypotheses with risk of 5%

Discussion

Not much attention was paid to the influence of non-determinant factors on the average papilla height being the subject of this research. All these factors justify the choice of the topic, especially those influencing the quality and function of the interdental papilla (age of the patient, the gender of the patient, the position of dental implants, length of prosthetic work).

Better knowledge of the mentioned factors indicates that surgent individual abilities are important factor for therapeutic outcome since the consequent surgical technique and implant type will affect the clinical outcome. [17]

In this study, the most common papilla height was 3 mm and was measured in 40% of cases. By examining the distribution of the frequency of the papillae height, it can be seen that the height of the papilla has approximately normal distribution in the population, where average values occur most frequently, while the lower and the higher papillae levels are less frequent in the population.

Grunder (2013) released excellent results for individual implant restoration even when the distance between the contact points and implants was 9 mm. [18]

In the Soares NP research, Pimentel AC. and others (2013) concluded that the ideal distance implant - the tooth 2mm and the two adjacent implants 3mm. That gives the height of the papilla supported by the biological space without falling into the position of the implant at the level or above the bone. The distance between the crown to the bone ridge should have a mean value of 3.4mm. This height determines the area where the papilla will be, and the soft tissue will rarely fill out areas higher than 5mmin. [14]

In the Siqueira et al. (2012) study, the papillae was always present when the vertical distance between the contact point and the bone ridge was less than or equal to 5 mm and more frequently when the horizontal distance

between the two implants was greater than or equal to 4 mm. The black interdental space was smaller when the vertical distance was less than or equal to 5 mm and the horizontal distance greater than or equal to 4 mm. Bone width and soft tissue biotype did not influence the incidence of papillae appearance between adjacent implants in the esthetic zone. [19]

In the study of Kourkuta S., Dedi K.D. and others (2009) found that the median size of the interimplantary papilla (the tip of the papilla - the bone ridge) was 4.2 mm. The missing height of the inter-implantary papilla at the inter-implant site was 1.8 mm. The average proximal biological width was 7 mm. The most common contact of the coronary bone ridge was implanted on a 4.6 mm apical bone ridge. [20]

Shahidi (2008) concluded that changing the height of papilla between adjacent implants over time did not reach statistical significance. [13]

Dong-won Le and Associates concluded in 2005 that the width of keratinized mucous membranes between the two adjacent implants may be related to the size of the interproximal papilla between the two adjacent implants. The average radiolabel length of the papilla is 3.3mm plus minus 0.5mm, the width of the keratinized mucous 4.5mm plus minus 1.7mm, the mean point of the contact point-bone ridge 4.7mm plus minus 1.2m, the horizontal distance of the adjacent implant 3.1mm plus minus 0.5mm. [21]

Mark R.Ryser et al. (2005) investigated the correlation of papillae with a bone ridge around one implant. They concluded that increasing the distance between the contact point and the implant, increases the possibility of losing papilla. [22]

In the Gastaldo (2004) study, the effects of the vertical and horizontal distances of two adjacent implants on the incidence of the interproximal papilla appear. The papilla is visually determined and the distance from the contact point to the bone ridge (D1), the tooth implant or the distance between the two implants (D2) and the distance from the base of the contact point to the end of the papilla (D3) are measured. The authors concluded that in both groups papilla was more commonly 3.5 or 4 mm (P <0.05) when D2 was 3; and always absent when D2 was 2 or 2.5 mm (P <0.05). In addition, in group 2, papilla was more frequently present when D1 was between 3 and 5 mm (P <0.05). However, in group 1, papilla was often present only when D1 was 3.0 mm (P <0.05). For both groups, the analysis showed interaction between D1 and D2 (D2 <2.5 mm papilla was absent, and with D2> 3.0 mm was interaction between D1 and D2). The ideal distance from the base of the contact point with the bone abyss between the adjacent implants was 3mm, unlike the teeth and implants where the range was 3 to 5 mm. The lateral distance between the implant and between the teeth and implants is in the range of 3 to 4mm. [23]

Studies by Tarnow D., Elian N. and others (2003) found that the mean value of papillae height between the two adjacent implants was 3.4 mm in the range of 1 to 7 mm. [15]

Choquet et al (2001) published a retrospective study evaluating the radiographic height of the bone ridge relative to the height of papilla. The study assumes that the height of the contact point towards the bony ridge is relative. Distances greater than 5 mm are points beyond which it can not be predicted to fill interdental space with papilla. If the distance is less than or equal to 5 mm, a 100% is present during 1 and 2 years, and if the distance is 5.9 mm the first year is 100% and the second 81.8%. [24]

Conclusions

1. The average height of the papilla between two correctly positioned adjacent implants in male subjects was 3.3 mm and in female 3.26 mm.

2. There is no statistically significant difference in the average values of papilla height between two properly positioned adjacent implants between male and female subjects.

3. Elderly subjects tend to have slightly higher average papillae values between two correctly positioned implants compared to those younger, but these differences are not statistically significant.

4. The average height of papilla between two correctly positioned implants is not statistically significant when regarded in relation to the length of the prosthetic implant work.

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