

Vertical Distance from the Crest of Bone to the Height of the Interproximal Papilla Between Adjacent Implants

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Background: As patient demand increases for more natural restorations in the esthetic zone, clinicians must have the highest level of skill and knowledge to maintain or reform the interdental papilla between teeth, between implants and teeth, and between adjacent implants. To date, there are no reports that have measured the distance from the contact point to the bony crest between implants. One reason for this may be the fact that, with two adjacent implants, the contact point of the crown can be established at any distance from the gingival margin according to the restorative dentist's specifications. Therefore, in this study, the height of the soft tissue to the crest of bone was measured between two adjacent implants independent of the location of the contact point. The purpose of this study was to determine the range and average height of tissue between two adjacent implants.

Methods: A total of 136 interimplant papillary heights were examined in 33 patients by eight different examiners in five private dental offices. After administration of appropriate local anesthesia, a standardized periodontal probe was placed vertically from the height of the papilla to the crest of bone. The measurements were rounded off to the nearest millimeter.

Results: The mean height of papillary tissue between two adjacent implants was 3.4 mm, with a range of 1 mm to 7 mm.

Conclusions: Clinicians should proceed with great caution when placing two implants adjacent to each other in the esthetic zone. In most cases, only 2, 3, or 4 mm of soft tissue height (average 3.4 mm) can be expected to form over the interimplant crest of bone. These results showed that modification of treatment plans may be necessary when esthetics are critical for success. *J Periodontol* 2003;74:1785-1788.

KEY WORDS

Dental esthetics; dental implantation; dental papilla/anatomy and histology; soft tissue/anatomy and histology.

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The presence or absence of the interdental papilla between teeth, between implants and teeth, and between adjacent implants has received much attention in the past decade. With increasing demands for more natural-looking restorations in the esthetic zone, clinicians must maintain a high level of skill and knowledge.

A clinical study related the presence or absence of the papilla between two teeth to the distance from the crest of bone to the contact point between the teeth.¹ When this distance was 5 mm or less, the papilla completely filled this space almost 100% of the time. When the distance was 6 mm, the interdental space filled about 55% of the time; and at 7 mm, the interdental space was completely filled about 25% of the time.

When an implant is placed adjacent to a tooth, a <5 mm distance between the contact point and the crest of bone shows similar results regarding presence or absence of papilla to that between two adjacent teeth. Grunder presented 10 case reports of single-tooth implants and stated that all the papillae reformed after the final crowns were placed on the implants.² The critical factors in all 10 cases were 1) the existence of healthy bone on the adjacent tooth and 2) the location of this bone at a distance of 5 mm or less from the contact point. Grunder's study agreed with earlier research findings of the existence of the papillae between two teeth. It was interesting to note that the vertical position of the implants did not determine the

outcome of papillae formation. This was also confirmed in a study on single-tooth implants by Choquet et al.³

The difficulty of generating a papilla seems to be more prevalent between two implants.⁴ To date, there is no published research that measures the distance from the contact point to the alveolar crest between implants. This measurement is in fact artificially determined by contact point manipulation, which can be placed at any height at the discretion of the clinician. Therefore, this measurement has little meaning as far as soft tissue biology is concerned.

In a recent report, it was shown that the distance between two adjacent implants should be at least 3 mm apart in order to preserve the interdental bone.⁵ This is related to the horizontal component of the biologic width around the implants. However, placing implants 3 mm or more apart does not ensure that the papilla will reform. This mesial distal implant distance only prevents additional interproximal bone loss over what has occurred after extraction.

Garber et al. measured the height of the papilla to the base of the pocket around two adjacent implants⁴ and showed that this distance averaged 4.5 mm. However, the crest of bone was not considered in this particular study. Elian et al., in a series of case reports, showed that obtaining a 5 mm height of tissue between two adjacent implants was not routinely possible.⁶ In fact, only about 3 mm of soft tissue height could be expected. Therefore, the purpose of the present study was to measure the average height of tissue from the crest of the bone to the tip of the papilla between two adjacent implants.

MATERIALS AND METHODS

Patients from five private dental offices who had implants placed adjacent to each other and who had a fixed prosthesis in place for at least 2 months were asked to participate in the study. All patients consented to be part of the study and to allow the measurements to be taken.

Included in the study were anterior and posterior sites implanted with commercially available implants of various types, designs, and surfaces. Those surfaces included smooth "turned," titanium dioxide blasted, titanium plasma sprayed, sandblasted, and acid-etched and sandblasted. In this retrospective study, implants were placed in regenerated as well as in natural bone, with the implant abutment interface located at or coronal to the alveolar crest, depending on the bony conditions, implant design, manufacturer's recommendations, and operator preference. Measurements were performed on adjacent implants that, according to position, replaced two adjacent teeth with no intervening pontic. Included in this study were adjacent implants located in various areas of partially or fully edentulous maxillary and mandibular arches.

The data reported in this investigation represent

measurements of the height of the interdental papillae from the crest of the alveolar bone to the top of the papillae, measured along a straight line connecting these two points.

One- and two-stage implants were also included. In the latter cases, abutment insertion was accomplished using full or partial flaps or local gingivectomy exposure.

A total of 136 interimplant papillary heights were examined in 33 patients. After administration of appropriate local anesthesia, a standardized periodontal probe was placed vertically from the height of the papilla to the crest of bone (Fig. 1). The measurements were rounded off to the nearest millimeter.

RESULTS

The mean height of tissue of the papilla between two adjacent implants was 3.4 mm, with a range of 1 mm to 7 mm. The most frequently probed heights were 2 mm (16.9%), 3 mm (35.3%), and 4 mm (37.5%), and these comprised 90% of the total measurement (Table 1, Fig. 2).

DISCUSSION

The present study investigated the clinical problem of the difficulty of maintaining or reforming a papilla between two implants. One reason for this difficulty is that the biologic width around an implant is apical to the implant abutment connection.⁷ In the esthetic zone, the implant is usually placed approximately 4 mm apical to the height of the buccal tissue of the adjacent teeth.⁸ Because all implants presently on the market have flat platforms at the top, this results in the implant almost always being positioned below the interimplant bone crest. This location of the implant platform interdentally places the biologic width subcrestally. This differs from a natural tooth, because the biologic width of a healthy tooth always forms supracrestally. There-

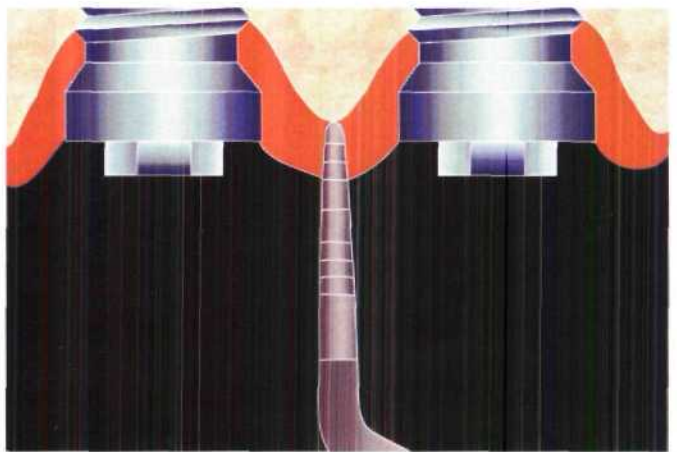


Figure 1.

A standardized periodontal probe was placed vertically from the height of the papilla to the crest of bone.

Table 1.
Distribution of Papillary Height

Papillary Height (mm)	Number	Percent
1	2	1.5
2	23	16.9
3	48	35.3
4	51	37.5
5	8	5.9
6	1	0.7
7	3	2.2
Total	136	100%

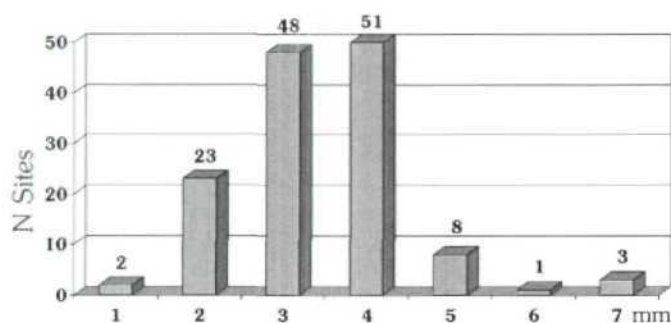


Figure 2.
The mean height of tissue of the papillae between two adjacent implants was 3.4 mm, with a range of 1 to 7 mm.

fore, the interdental tissue lacks the crestal support that exists between an implant and a tooth or two adjacent teeth (Fig. 3).

The clinical significance of these results is extremely important for the treatment planning of cases with two adjacent implants in the esthetic zone. If there are natural healthy teeth with normal-shaped papillae adjacent to these two implants, then the height of the papilla between these implants will almost always be more apical in position than that of the healthy adjacent teeth. This will be true if there was minimal interproximal bone loss after the extraction of the two teeth, even where the implants were placed 3 mm apart to preserve the bone. Because the biologic width is apical to the crest of bone in the interproximal area next to an implant, the connective tissue attachment and the epithelial attachment will not be supportive of the papilla. This is in contrast to the situation of two healthy adjacent teeth or when an implant is placed next to a healthy tooth.

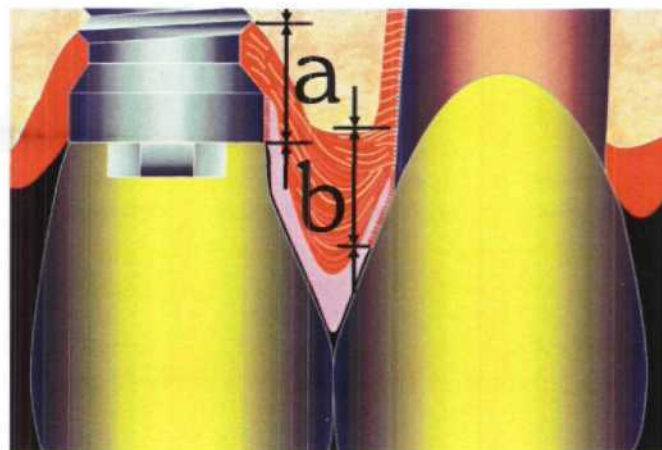


Figure 3.
Interdental tissue does not have the same level of support on an implant (a) as it does on a tooth (b).

The results in the present study concern re-formation of the papillae between two adjacent implants. These findings must also be considered before placing implants in the esthetic zone. First, it may be necessary to augment the interproximal bone before placing two adjacent implants. This vertical bone augmentation would then have to be maintained by placing the implants at least 3 mm apart. Another option would be to place one implant and cantilever a pontic. The clinician can then construct an ovate pontic in the edentulous area and perform soft-tissue augmentation (i.e., a connective tissue graft) if needed. This approach may result in a more predictable esthetic outcome. The last option would be to splint the implant crown to the adjacent tooth if it were going to be crowned and to include an ovate pontic for the now three-unit bridge. This would have to be done with rigid connections to avoid possible intrusion of the natural tooth from under the bridge.

It should be noted that this retrospective study contained many variables – type and shape of implant, regenerated and natural bone, implant placement in partially or completely edentulous maxillas or mandibles, vertical location of the implant crest, and exact mesial-distal distance of the adjacent implants – that may have affected the average vertical height of the interproximal papillae between adjacent implants. Each of these variables warrants further investigation. However, the fact that independent measurements from 33 patients in five different offices with 136 sites measured were obtained and analyzed adds weight to the trends reported in this study.

CONCLUSIONS

An important conclusion from the research findings of this study is that the clinician should proceed with

great caution when placing two adjacent implants in the esthetic zone. The findings indicate that 2 mm to 4 mm (3.4 mm average) of soft tissue height can be expected to cover the interimplant crest of bone. This represents a deficiency of 1 to 2 mm of what is needed to duplicate the interproximal papillae of the adjacent teeth. Thus, this could result in anesthetic failure as far as the patient is concerned, even though the dentist performed all procedures properly. Therefore, modifications in treatment planning may be necessary when the clinician is presented with this esthetically challenging situation. One solution may be to place one implant and splint it to a cantilevered ovate pontic. Alternate implant designs may also be indicated to help support the interimplant crest of bone and papillae. Further research is needed to verify the results of this paper.

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