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Factors that influence the position of the peri-implant soft tissues: A review

Marco Sorní-Bröker [1], Maria Peñarrocha-Diago [2], Miguel Peñarrocha-Diago [3]

[1] Master in Surgery and Oral Implantology. University of Barcelona. Spain
[2] Teacher associated to the Master of Oral Surgery and Implantology. Faculty of Medicine and Dentistry. University of Valencia. Spain
[3] Professor of Oral Surgery. Director of the Master of Oral Surgery and Implantology. Faculty of Medicine and Dentistry. University of Valencia. Spain

Correspondence:
Avda. Primado Reig 179 2E
46020 Valencia. Spain,
marcosorni@hotmail.com

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Abstract

Introduction: The implantological rehabilitation of the anterior sector is one of the most demanding and complex treatments due to the necessity of obtaining an optimum esthetic result. At the level of the soft tissues, it involves obtaining the complete formation of the papilla and creating a harmonic contour of the gingival margin.

Objective: A bibliographical review has been carried out on the factors that influence the final position of the soft tissues.

Material and methods: A search has been carried out in the Pubmed database of articles written in English and Spanish. Articles that presented a clinical series of less than five patients and a monitoring of less than one year were excluded.

Results: At the level of the papilla, there are two decisive factors that play an influential role: the formation of the biological width and the distance between the alveolar crest and the contact point. The position of the gingival margin depends mainly of the height and width of the facial bone, as well as on the biotype. The surgical technique, as well as certain prosthodontics aspects related to the implant, can influence the final position of the soft tissues.

Conclusions: Although, today we know much more about the factors that influence the position of the soft tissues, there are still certain aspects that should be studied more in-depth, for example the influence of the micro and macro-structure of the implant in the position of the soft tissues.

Key words: *Soft tissues periimplantary, papilla, gingival margin, dental implants.*

Introduction

The implantological rehabilitation of the esthetic zone is one of the most demanding and complex treatments due to the necessity to obtain an optimum esthetic result. At the level of the soft tissues, it involves to create a harmonic gingival margin without abrupt changes in height, to obtain some adequate papilla, as well as a convex contour of the alveolar crest (1). This result should be predictable and stable, and it depends on the interaction of multiple variables that include biological factors (local anatomy, answer of the guest), surgical (placement of the implant in the three dimensions of the space), relating to the implant (dimension, surface, design) and prosthodontics.

Thanks to the investigations carried out in recent years, biology and the answer of the hard and soft tissues to the diverse treatments have been understood better. On the other hand, the articles that analyze the esthetic results obtained by implants are quite scarce. Neither a consensus exists on which are the esthetic parameters that should be valued neither which is the most adequate method. Some authors tried to value subjectively the esthetic result by means of questionnaires and visual scales that patients should complete (2,3). Other authors have developed scores to try to analyze it in an objective way (4). All of them share that at the level of soft tissues there are two parameters that are decisive to obtain a good esthetic result: the complete formation of the papilla and the creation of a harmonic contour of the gingival margin.

Because of it, the objective of this study has been to carry out a bibliographical review of the factors that influence the final position of the soft tissues. For it a search has been carried out in the Pubmed database of articles in English and in Spanish using the keywords "soft tissues", "papilla", "dental implants", "gingival margin", "esthetics" and combining them. Articles that presented clinical series of less than five patients and of a monitoring lower than one year were excluded.

Factors that influence the position of the papilla

Formation of the biological width. Up to now, the surgical protocol recommended to place the implants of two components at the level of the crest or even under it, on one hand to have a sufficient height to obtain a good emergency profile, and on the other hand to avoid seeing the metal of the implant through the gum in case of a possible subsequent retraction. Berglundhet al. (5) studied the dimension of the periimplant mucosa in dogs and concluded that a minimum of 3 mm of thickness was needed to form a functional barrier and that the body always tries to reestablish this dimension. Diverse subsequent studies have observed that around the implants, once they have been exposed to the oral cavity, a bone resorption in a vertical sense from between 1.5 mm and 2 mm is produced, coinciding with the first threat. Diverse theories exist that try to explain this phenomenon, but the most accepted hypothesis is that the biological width is probably formed as a defensive mechanism against the bacteria that are located between the implant and the abutment and that they produce an inflammation of the surrounding tissues (6,7). The deeper the implant is, the greater the vertical resorption. According to Tarnow et al. (8), this formation of the biological width is not only produced in a vertical sense, but there is a horizontal component of approximately 1.5 mm that affects the interproximal bone as well as the facial bone, what can carry a subsequent retraction of the soft tissues.

The biological width around a tooth and an implant presents some differences. While in the tooth the biological width is found supracrestal, in implants it is situated subcrestal when the platform is at the level of the crest. The width is usually greater around the implant (3 mm against 2 mm in the tooth). The histological composition is also different, since in the periimplant tissue there are more collagen fibers that flow parallel to the surface, acting as a scar tissue, with smaller adhesion, while in the tooth the supracrestal fibers flow perpendicularly and they are inserted in the radicular cement and the alveolar bone. The tissue is also less vascularisated, due to that it only receives contributing blood of the terminal branches of the periostium, while in the tooth there is also contribution of branches that come from the periodontal ligament. That could influence negatively in the answer of the periimplant tissue against a bacterial invasion.

Distance of the interproximal bone. In a classical study published by Tarnow et al. it was observed that the presence or complete formation of the papilla between two teeth depended on the distance between the alveolar crest and the contact point with the neighboring tooth (9). If the distance was less than 5 mm, the papilla was present in the 97% of the cases, while when the distance was 6 mm, the percentage descended to 57%. A similar study carried out in adjacent implants to natural teeth (10) obtained similar results, but with the particularity that the presence of the papilla depended on the location of the alveolar crest of the neighboring tooth, and not of the implant. If the distance was of 4.5 mm, the papilla was formed in the 100% of the cases, while if it was of 6 mm, the percentage was reduced halfway. In this study it also was concluded that the minimum distance between tooth and implant should be of 1.5 mm to compensate the lateral resorption after the formation of the biological width.

The presence of a papilla of more than 4.5 mm of height between implant and tooth is due to that it not only depends on the distance between the crest and the contact point, but also of the size of the biological width of the tooth. Although the width of this space is in general of

about 2-4 mm, this value can vary depending on the individual. Vacek et al. (11) measured the biological width in teeth of corpses and observed a width between 0.75 mm and 4.3 mm. It means that in some patients a height of 6 or 7 mm of the papilla can be normal and stable due to that the size of the biological width is of 3 or 4 mm. Because of this, in those cases where an implant is wanted to be place immediate post extraction, not only it is necessary to measure the distance of the contact point to the bony crest, but also the depth of the sulcus of the adjacent tooth to be able to predict the height of the future papilla. If the patient presents a height of the papilla of 6 mm and a depth of 2 or 3 mm, it will probably be stable after the treatment. If it presents a sulcus depth of 5 mm due to the presence of periodontal disease, this papilla is probably unstable and can suffer retraction (12).

Tarnow et al. (8) studied the presence of papilla between adjacent implants and observed that the average height was of 3.4 mm, that is, 1.5 mm less than between implant and tooth. This is due to that the formation of the biological width is formed subcrestal. On the other hand, it is important to maintain a minimum distance of 3 mm between implants to counteract the lateral component of the biological width and to avoid a complete resorption of the interimplant bone crest.

Factors that influence the position of the gingival margin

Periodontal biotype. The facial margin around the implant depends on the height of the facial bone, as well as of the thickness of the soft tissues. The form and the thickness of the tissue around a clinical crown can be defined as periodontal biotype. Diverse investigators have described two biotypes: the thick and the thin. The simplest way to differentiate one from the other is by means of the introduction of a periodontal probe in the sulcus. If the tip of the probe is visible through the gingiva, then it is a thin biotype. Both biotypes tend to respond in a different way to inflammation or to surgery. Maynard et al. (13) warned of the potential risk of soft tissue recession depending on the biotype and of the bone remaining. They indicated that when the gingiva and the vestibular cortical are thin, greater risk of recession exists. Another disadvantage of the thin biotype is that it is possible to observe in some occasions the grayish color of the implant or of the pillar through the mucosa. In a study carried out in mandibles of pigs (14) different materials were placed (titanium, ceramized titanium, zirconium and ceramized zirconium) under the vestibular mucosa in combination with connective tissue grafts of different thickness. Subsequently the color of the tissue was evaluated by means of a spectrophotometer. It was observed that all the materials induced changes in the color of the mucosa when this one presented a minimum thickness (1.5 mm), being the titanium the one that more changes produced. In thicknesses of 2 mm, only the titanium produced alterations of the color, while when the thickness was of 3 mm, changes with any of the materials were no longer observed. The authors concluded that when the periimplant mucosa is thin, is preferable to use pillars of zirconium to avoid alterations of the color.

The thick biotype is usually more stable to recession but has greater tendency to form pockets. Khan et al. (15) concluded that is more predictable to obtain a stability of the gingival margin in a thick biotype that in thin one. In a recent study no significant relation was found between the marginal bone loss and the esthetic result in cases of thick biotype (16). A disadvantage of the thick biotype is the predisposition to form scars after the execution of vertical incisions, for which one must adequately value the type of incision or the flap that is going to be carried out for the placement of the implant.

Width of the facial bone. Spray et al. (17) studied the relation between the vertical bone loss and the width of the facial bone and detected a greater loss when the vestibular bone had a thickness less than 1.4 mm, probably due to the formation of the biological width. They concluded that to avoid a vestibular bone loss and with it a possible recession, one must leave a minimum of 1.8 mm of external cortical. It is important above all in the previous sector in cases of fine biotype, where it is convenient to place the implant more towards palatine/lingual. It is advised that by each mm of palatine inclination to also submerge the implant mm to correct the angulations and to obtain a good emergency profile. On the other hand, there are authors that do not advice the use of wide implants in the previous sector, due to that a greater recession has been observed (1.58 mm against 0.57 mm in standard implants) (18).

Microstructure of the neck of the implant. Diverse studies have verified a smaller bone resorption around necks with rough surface than in polished necks (19,20), what can reduce the possibility of retraction of the gingival margin. Astrand et al. (21) described similar results in a greater number of implants, although the results were not statistically significant.

Macrostructure of the neck of the implant. Another of the variations that are being studied are the use of retention elements like microthreats. According to some authors, these threats favor the biomechanical adaptation to the functional loads, due to that the forces of shear are transformed into forces of compression, stimulating in this manner the surrounding bone (22,23) and reducing the bone resorption by the formation of the biological width.

Macrostructure of the implant-abutment connection. Recently the concept of "platform switching" has been introduced to preserve the periimplant bone (24). The base of this idea consists of the use of abutments of

smaller diameter on implants of greater diameter to displace the union implant-abutment and with it the formation of the biological width towards a more medial position, reducing the vertical component of the resorption. This effect was observed accidentally in the mid 80s, when different brands of implants (Ankylos, Friadent, Astra-Zeneca, Bicon) began to use wider implants with standard accessories (narrower) because abutments of the same diameter had not been yet marketed. According to Lazzara et al. (24), to displace the union implant-abutment toward medial permits, on one hand, to expose more surface of the platform of the implant where fibers of the connective tissue can be inserted. On the other hand, the inflammatory infiltrate of the bone crest moves away and its area of exposition is reduced to 50%. A clinical study with a monitoring of five years observed a marginal bone loss of 0.06 mm after the first year of load (25).

Connection of the prosthesis. Diverse studies have observed in many cases that after the placement of the prosthesis a recession of the gingival margin is produced that oscillates between 0.4 mm and 1.7 mm, after a variable period of time (26-28). In a longitudinal study carried out by Small and Tarnow, a vestibular recession was produced at the end of 3 months in 80% of the cases. The average was of 1 mm after a year (29). In this study, 98.6% of the cases presented keratinized tissue. Bengazi et al. (27) observed a greater recession in cases where there was keratinized tissue.

Surgical technique. Another factor to keep in mind in the final position of the soft tissues is the bone resorption that is produced after raising a flap of total thickness for the surgery of implants. Cardaropoli et al. (28) observed a resorption of the alveolar crest between 0.7 and 1 mm of height and of 0.4 mm of width during the period of integration of the implants to the connection of the pillars. Another study obtained a similar resorption in width of 0.7 mm (22). With respect to the design of the flap, in a study carried out by Gómez-Roman (30) it was verified that when a flap with vertical incisions is raised respecting the papillae of the adjacent tooth, the interproximal bone loss was smaller than the one observed in the cases where the papillae were included in the flap, thus diminishing the probabilities of obtaining a complete papilla.

Concluding, we can say that the position of the periimplant soft tissues is determined by biological factors like the biological width, the biotype, the width and height of the surrounding bone, and that these factors are seen influenced by the surgical technique (type of flap, position of the implant), as well as by prosthodontics factors or relative to the implant. There are still certain aspects that should be studied with greater severity as for example the influence of the micro and macro structure of the implant in the position of the soft tissues.

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