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RESEARCH ARTICLE

MARGINAL BONE LOSS,BIOLOGICAL WIDTH AND GEOMETRIC SHAPE OF THE ABUTMENT:7-YEAR FOLLOW-UP OF AN ABUTMENT CALLED Trumpet R

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Abstract

Background. Marginal bone resorption observed around osseointegrated implants after the first year is particularly dangerous, especially if the implants are sandblasted and etched. In this case, this MBL can open the way to bacteria that, by colonizing the implant surface, can trigger peri-implantitis and the loss of the implants and the prosthesis screwed onto them.

The aim of this work was to evaluate the MBL around implants inserted with a mathematical protocol and prostheticized with a one-time abutment called Trumpet.

Materials and Methods: 10 patients were considered who needed an all-on-six rehabilitation (5) and single rehabilitations (5). Measurements of the soft tissue thickness and the distance between the crest and the implant neck (CI) were performed at the time of surgery and at a distance of 1.3 and 7 years.

Results: Clinical and radiographic controls performed at a distance of 1.3 and 7 years of the treated patients showed the same CI distance (Crest - Implant) in all patients without observing marginal bone loss.

Conclusions: The use of a mathematical model that takes into account the soft tissue thickness for the positioning of the implant with respect to the bone crest and the use of abutments that give more space to the soft tissues to respect the biological width seems to be the correct way to avoid the loss of marginal bone around the implants.

Keywords: Cholesterol, serum, lipids, mouth, dyslipidemias

INTRODUCTION

The use of osseointegrated implants is now a consolidated practice with a scientific literature that is very abundant and in agreement on the medium and long-term efficacy. It is possible to find consensus both for traditional implantology performed with cylindrical implants[1-4], and that performed with the new Rex blade implants [5] or the new generation subperiosteal ones [6].

During the first surgical phase, it is possible that different aspects can influence optimal healing; on the one hand, the way in which the implant site is prepared and on the other, the materials with which the implants are constructed and the way in which their surface is conditioned.

With regard to the implant site, the results of a study [7] are interesting, in which the role of the shape of the drills and the way in which the temperature generated during the preparation of the implant site changes are highlighted. This factor, often underestimated, could cause bone necrosis in the deepest part of the drill and far from irrigation and cooling. Always in this perspective, we emphasize the published works regarding the great advantages of preparing the implant site with the piezosurgery method [8].

The piezoelectric method has in fact been demonstrated by the research group of Trisi et al [9] not to generate heat unlike the drills and the cut performed with reciprocating saws that instead generate heat in the areas furthest from cooling. For this reason, the use of piezosurgery in the preparation of the implant site is desirable and advisable.

As regards the materials used for the construction of the implant, there are many studies supporting different technologies that over the years have tried to improve the BIC (Bone Implant Contact); in this regard, important works are those regarding the Nano Tite surface [10], those supporting TiUnite [11] and those related to the use of SLA Active hydrogen peroxide by Straumann [12].

Also very interesting in the literature are the scientific works that concern the modification of the surface with Raloxifene [13-15], with Bisphosphonates [16] and with the use of static magnetic fields applied using magnetically charged neodymium iron boron cap screws and healing screws [17-19].

While in the latter we mainly observe a greater differentiation of the osteoblasts, not cell multiplication but with an increase in matrix production, in the majority of the modified surfaces we want to obtain a greater response of the osteoblasts in terms of cell recruitment. Therefore, while with static magnetic fields we observe a simple effect linked to the physical presence of the cap screw or the healing screw in the presence of the same titanium surface, in all other ways we observe a substantial and definitive modification of the implant surface with all the risks that this can entail in the medium and long term.

However, very recent studies [20-21] demonstrate that the best surface, i.e. the one capable of obtaining the highest BIC, has not yet been found, and many mechanisms that are at the basis of the production of the matrix are still unknown. Immediate loading, for example, is able to have a stimulating effect on undifferentiated osteoblasts [22] and to be able to increase the BIC. Having made this fundamental premise, the loss of marginal bone is strictly correlated to the type of surgery [23], to the respect of the biological width, to the type of material used to construct the abutments, to the way in which the conditioning of the soft tissues is carried out and to the position of the implant with respect to the bone crest.

As regards the type of surgery, the immediate post-extraction implant performed with the one time abutment technique respects the concept of the Chamber Concept expressed by Degidi et al [24-25]; in particular the shape of the abutment and the incarceration of the clot seem to be important for the neo angiogenesis and in the maintenance of the vascular support to the vestibular and palatine or lingual bone crests.

Berglundh et al in 1996 with the famous experiment on Beegle dogs [26-27] demonstrated that it is essential to have 3 millimetres of soft tissue above the implant, of which 2 millimetres of epithelium and 1 millimetre of connective tissue. In particular, Abrhansoon demonstrated in 1998 [28-29] that titanium stimulates a hemi-desmosomal junction by epithelial cells and in particular the loosening and tightening maneuvers of the healing screws [30] as well as those related to the impression taking [31-33] trigger an inflammatory response that ends up producing keratin and reduces the possibility of a hemi-desmosomal attack; Kawahara et al [34-35] define this attack as a biological seal that appears to be particularly valid with the epithelium and zirconium with a reduced production of pro-inflammatory cytokines [36-40].

Based on the work of Bergludh, it is important to cite the scientific work [41] regarding the exact position of the implant that must be sunk in proportion to the reduction in the thickness of the soft tissues. In practice, considering with X the thickness of the soft tissues, with K the biological width that must be 3 (mm), the position of the implant with respect to the bone Y will result from the following formulaY=X-3. To respect the biological width, we can therefore move the implant away in an intra-osseous position so as to be able to obtain those 3 millimeters of biological width necessary to be able to maintain the implant without observing Marginal Bone Loss. Always in this vein, studies on platform switching are important[42-44] which in fact distribute the biological width on a horizontal area of the implant collar.

The aim of this work is to evaluate the Marginal Bone Loss at 7 years on a sample of 30 implants in which an abutment called Trumper was used and designed to increase the surface available to the soft tissues in compliance with the biological width [45-50].

Materials and methods

The study was conducted at one clinical center in conformity with the Good Clinical Practice Guidelines, following the recommendations of the World Medical Association Declaration of Helsinki ethical principles for medical research involving human subjects, as revised in Fortaleza (2013).

10 patients were considered who had to have implants inserted both in single areas and for works with multiple implants; they were used.

The inclusion criteria were as follows:

Age >18 years old;

General good health (ASA I–II);

Adequate oral hygiene (full mouth plaque score

≤20%, full mouth bleeding score ≤20%);
Presence of one or more hopeless teeth requiring extraction.
The exclusion criteria were as follows:
Pregnancy or lactation;
Untreated periodontitis;
Osteometabolic disease;
Intravenous bisphosphonate therapy;
History of chemotherapy or radiation therapy in the neck–head area;
Heavy smoking (>15 cigarettes per day);
Absence of buccal bone plate.
The selected population was as follows:
Age 31–77 years old;
7 men and 3 women.
Written informed consent was provided by all patients for both the clinical procedure and participation in this study. Preoperative CBCT was performed. Patients were administered antibiotic prophylaxis starting the day before extraction with amoxicillin and clavulanic acid at 2 g per day for 6 days.
The implants used were TTi (Biosaf In, Ancona Italy) with a diameter of 4 mm and variable length; for all the implants, Trumpet type abutments were used (Biosaf In, Ancona Italy). This abutment patented by Biosaf In and designed by Fabrizio Bambini has the peculiar characteristic of having a 3 mm surface that is not straight but curvilinear; the curved surface has therefore developed a larger surface compared to the straight surface (fig. 1,2).

Figure 1.TTi implant by Biosaf In and Trumpet Abutment.

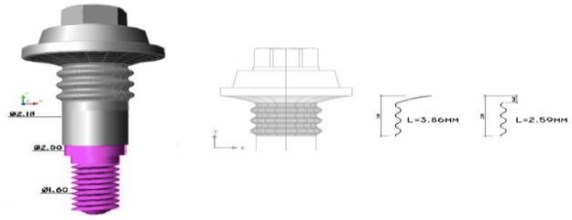

Figure 2. Trumpet concept

Surgery was performed following the above protocol:
• Non-traumatic extraction of the terminal tooth, flap less
• Preparation with a dedicated Biosaf In kit for insertion of TTi type implants and under preparation of the implant
• Positioning of the implants using the formula Y=X-3 where X represents the thickness of the soft tissues measured with the CBCT by increasing the contrast
• Measurement of the distance between the crestal bone peak and the crestal point of the implant (Crestal-Implant CI)
• Simultaneous insertion of the Trumpet and tightening to 30 Ncm
• Tightening of Trumpet abutments (T Base) and blocking them with resin …. O
• Impression with Trumpet transfer
• Tightening of resin prosthesis within 24 hours and tightening of screws at 20 Ncm
• Delivery of definitive prosthesis after 60 days
• Measurement of CI segment at the time of radiographic checks (fig 4 and 5)
• Radiographic checks at 30 60 90 days, cbct check at 1 year, 3 years and 5 years

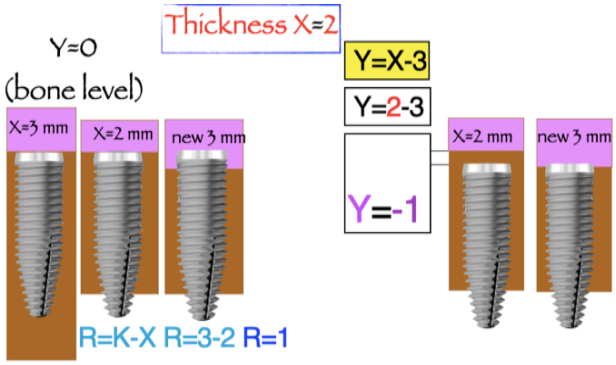

Figure 3. Example of position of implant

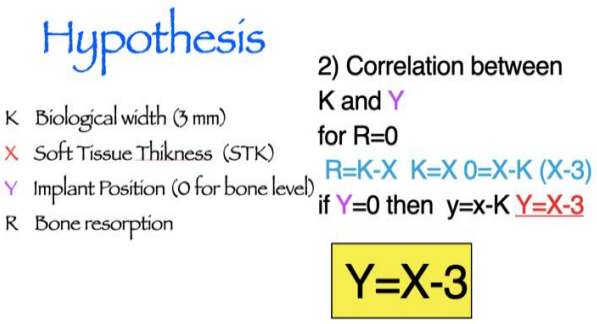

Figure 4. Mathematical rational of Hypothesis

In the figure 5 and 6 we describe the 2 red points on Crestal bone and on Implant neck: CI segment that we measure at time 0, and after 1, 3 and 5 years (table 1 of Reslts).

Figure 5. RX of CI Segment at time 0
Figure 6. RX of CI after 5 years

In the figures 7-12 the clinical situation and OPG of a female patient with an all on six executed with Biosaf-In implants, TTi type, with Trumpet abutment inserted ad modum "one time abutment" respecting Y=X-3 cresta implant position and with the provisional crowns screwed at 24 hours after surgery.

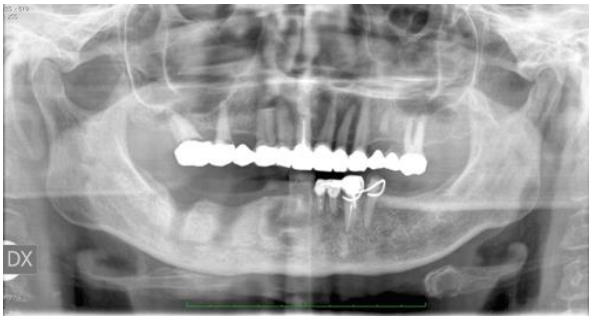

Figure 7. Pre Operative OPG

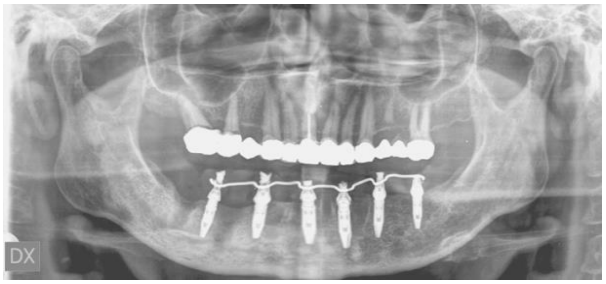

Figure 8. Post operative at 24 hours OPG

Figure9. Post operative with provisional crowns at 24 hours intra oral situation

Figure 10. Clinic Control after 1 year

Results
The 10 patients operated on inserted a total of 35 implants, of which 5 all on six and 5 single elements. The CI segments measured in the materials and methods were measured and were indicated in the table 1 and figure 5,6.
• Thickness of the soft tissues (X)
• Position of the implant with respect to the bone crest (Y), giving Y=0 the crestal position of the implant, negative values for subcrestal position of the implant
• Initial CI (distance from Crestal bone to Implant)
• CI at 0 days
• CI at 1, 3 and 5 years
• Prosthetic complications (screw loosening on Trumpet, fracture of the prosthesis, implant loss).

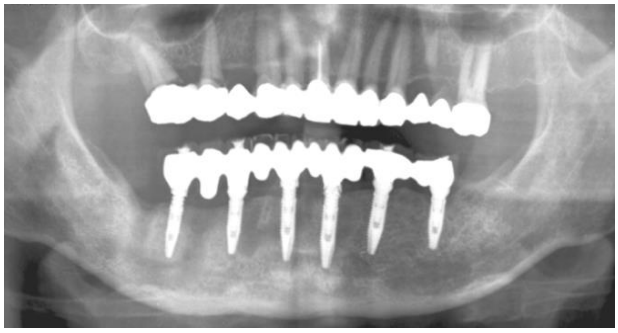

Figure 11. 1 year control OPG

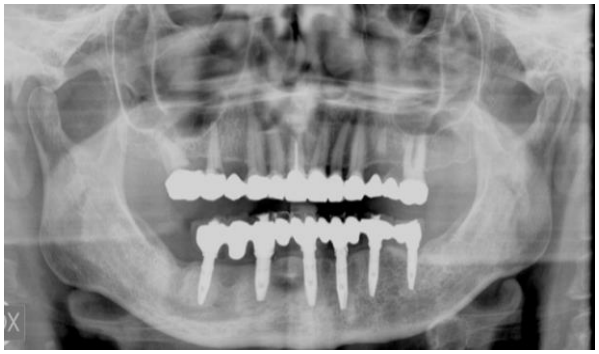

Figure 12. 5 years control OPG

Table 1. measurements in mm of X, CI after 1,3 5 years and type of complications

	X	Y	CI 0	CI 1	CI 3	CI 5	Complic
1 (Ao6)	2 (mean)	-1	1	1	1	3	Unscrew
2 (Ao6)	2 (mean)	-1	1	1	1	3	0
3 (Ao6)	2 (mean)	-1	1	1	1	3	0
4 (Ao6)	1 (mean)	-3	3	3	3	3	0
5 (Ao6)	1 (mean)	-3	3	3	3	3	0
6	2	0	0	0	0	0	0
7	1	-2	2	2	2	2	Unscrew
8	1	-2	2	2	2	2	0
9	1	-2	2	2	2	1	0
10	2	-1	1	1	1	0	0

The 5 patients subjected to all on six had the CI distance unchanged in % of cases while in 2 cases this segment was reduced by one millimeter (figure 4 and 5 with CI segment reduced).

In the 5 patients who underwent therapy for the replacement of a single element, the CI segment remained unchanged, while in one patient it was necessary to re-tighten the crown due to the fracture of the crown tightening screw on Trumpet.

Discussion

The possibility of solving simple and complex cases with osteo-integrated implants is now a widespread therapy and the insertion protocols are within the reach of all dental clinicians. However, the long-term maintenance of the implants seems to be more linked to the fundamental role that the soft tissues play in protecting the implants from bacterial insult. The initial thickness of the soft tissues is a fundamental point that is often not considered by the clinician in such a fundamental way.

When the patient presents for the visit to insert osseointegrated implants, he is subjected to the evaluation with CBCT to establish if the hard tissues can be sufficient to support an implant therapy; many scientific works are aimed at the use of computer-guided surgery. Although in fact the causes that can lead the clinician to propose implant therapy, there is always the problem of the biotype that the patient has and that can influence the medium and long-term not good prognosis of the proposed implant therapy. Patients with a thin biotype are more exposed to marginal bone loss and exposure of the first thread of the implant and the initial peri-implant mucositis is difficult to control.

Peri-implantitis that follows simple mucositis is a pathology whose resolution becomes very unpredictable. It is also true that the marginal bone resorption that is observed starting from the first year onwards often places the clinician in front of the need to perform connective tissue grafts that are not always within the technical reach of all clinicians. The initial idea was to design an abutment that could have a longer transmucosal path than a traditional abutment in line with the indications given by Bergludh in 1996 regarding the biological width. Trumpet and platform switching can represent a simple strategy and in the hands of all dentists to protect the implant from bacterial invasion by actually increasing the amount of soft tissue for implantation without resorting to additional mucogingival surgery.Furthermore, being able to calculate with a simple mathematical formula the correct position of the implant with respect to the bone crest, thus having precise and non-arbitrary references, appears to be, for the data in our possession, a simple and safe clinical conduct.

The possibility of solving simple and complex cases with osteo-integrated implants is now a widespread therapy and the insertion protocols are within the reach of all dental clinicians. However, the long-term maintenance of the implants seems to be more linked to the fundamental role that the soft tissues play in protecting the implants from bacterial insult. The initial thickness of the soft tissues is a fundamental point that is often not considered by the clinician in such a fundamental way. It is also true that the marginal bone resorption that is observed starting from the first year onwards often places the clinician in front of the need to perform connective tissue grafts that are not always within the technical reach of all clinicians. Prospective studies with a large number of patients will be necessary to consolidate this data which, although limited, we can consider non-preliminary

Conclusions

The use of a mathematical model that takes into account the soft tissue thickness for the positioning of the implant with respect to the bone crest and the use of abutments that give more space to the soft tissues to respect the biological width seems to be the correct way to avoid the loss of marginal bone around the implants.

DECLARATIONS

Conflicts of interest and financial disclosures

No conflict percentage and there was no external source of funding for the research in question.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Source of funding

The work was not funded.

Ethical approval

The study was approved by the Institutional Ethics Committee and was conducted in accordance with the Declaration of the World Medical Association.

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