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A prospective, blinded, randomized-controlled study on regressive bone modeling around dental implants with different machined coronal portion

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Abstract. Scientific evidence showed variable degree of marginal bone loss around dental implants both during integration process and during function. Among the different factors that seem to influence this process, a crucial role is up to the crestal module of dental implant. In order to reduce marginal bone loss, different configurations of crestal module have been proposed. The aim of this study was to evaluate the efficacy of half treatment dental implants with a coronal smooth portion of 3.5 mm compared to rough surfaced implants with a smooth coronal portion of 0.5mm, to reduce peri-implant marginal bone resorption. The degree of marginal bone loss was assessed through radiological measures. In addition, soft tissues healing was evaluated through plaque index and gingival index. The results demonstrated a significantly ($p= 0.03$) lower value of MBL (mean 0.7mm), than HT implants (mean 1.03mm) after 1year functional loading. In conclusion, use of FT implants could be determine better results in order to reduce MBL.

Keywords: marginal bone loss, osteointegration, implants surface treatment.

INTRODUCTION

The clinical success of titanium dental implants is based on a high percentage of bone/implant contact, and for this purpose, dental implants surfaces have been treated in order to trigger cellular actions and enhance the proper integration of the implant with the surrounding bone. (Scarano et al., 2007) (Shin et al., 2006) The crest module of an implant is defined as the active part of the implant and serves as the region which receives the crestal stresses after loading. (Hermann et al., 2000) Some studies have demonstrated that peak stress, especially shear stress, was concentrated at the crestal bone area. (Hansson, 1999) for example a rough surface of suitable micro-architecture and/or a micro-thread. It is furthermore suggested that retention elements at the implant neck will counteract marginal bone resorption in

accordance with Wolff's law. This paper is a revision of: Hansson, S. (1997).

Others claimed that a smooth, parallel-sided crest module may result in shear stresses in this region and described a positive correlation between surface roughness parameters and interfacial shear strength and suggested that microthreads at implant neck may counteract marginal bone resorption. (Oh et al., 2002; Jung et al., 1996)

On the other side, Iezzi et al (Iezzi et al., 2012), showed that machined implants present higher bone-implant-contact percentage (92.7%) than sandblasted implants (85%). Thus, if on one hand, rough implant surfaces enhance initial bone formation and osteointegration, on the other hand they seem to increase adhesion and colonization of oral plaque. (Quirynen et al., 2006) split-mouth, single-blind study followed the colonization of 'pristine' sulci created in 42 partially edentulous patients during implant surgery (e.g. abutment connection

Implants with a shorter polished smooth collar have proven to be more effective in decreasing marginal bone loss. Nowadays, gold standard is represented by rough surface implants. Thus, the aim of the present study was to radiographically analyze MBL on HT and FT implants after 1 year follow-up.

MATERIAL AND METHODS

Three partially edentulous patients who needed two single implant supported restorations afferent to department of "Oral Surgery" at University of studies "G.D'Annunzio" Chieti-Pescara, Abruzzo, Italy, were recruited for this study.

Inclusion criteria

Patients between 21 and 75 years old of both sexes; partially edentulous who needed at least 2 single implant rehabilitations on both the upper and lower jaws;

Exclusion criteria

General contraindications to implant surgery; smoking more than 10 cigarettes per day; patients irradiated to the head or neck during preceding 2 years; patients undergoing chemotherapy during preceding 1 year; patients with uncontrolled diabetes; post-extraction sites with acute or purulent infections; patients with uncontrolled systemic or metabolic disease; patients with periodontal disease.

Patients were randomised according to a split-mouth design to receive one half treatment implant (HT) (Group I) and one full-treatment implant (FT) (Group II). Two different titanium dental implants surface (Resista, Omegna, VB, Italy) have been used:

- Full treatment implants (Fig 1, A):

Micro-Nano Dae surface treatment speeds up bone recovery processes, removing the manufacturing organic residuals along with Argon Plasma Cleaning. It increases surface and wettability improving the first fibrin bridges adhesion, protein adhesion and cellular adhesion through the nano-micrometric roughness suitable for actine filaments anchoring. Finally, it changes the chemical surface increasing cellular proliferation and vitality. (Giordano et al., 2006) (Morra et al., 2006) (Cassinelli et al., 2003) (Park and Davies, 2000) (Neugebauer et al., 2009) four different implants were used for immediate loading. The following implants were placed 3 months after tooth extraction: screw with low thread profile and anodic oxidized surface (LPAOS

- Half treatment implants, also named hybrid surface, present 3,5mm machined neck in order to reduce bacteria adhesion and plaque colonization. (Fig 1, B)

In order to evaluate radiographic change of the peri-implant bone, intraoral radiograph, applying the parallel ray technique, was realized at T0 and at 1-year follow-up. The mean value between mesial and distal region was used as the primary outcome measure for this study and indicated as marginal bone loss (MBL). The commercially available Rinn film holders, used for intraoral radiographs applying the parallel X-ray technique, were customized using a silicone key for the exact reposition in every subject, in order to obtain a highly reproducible and faithful radiograph. To evaluate the difference between the groups, Student's- test was used. Significance was set at $p < 0.05$.

Evaluation of soft tissues comprehended:

- Plaque index (PI)
- Gingival index (GI)

Probing depth of peri-implants pocket (PPD). (L e, 1967)

RESULTS

All implants were perfectly osseointegrated and clinically stable. No implant fractures occurred.

FT implants presented a significantly ($p=0.03$) lower value of MBL (mean 0.7mm), than HT implants (mean 1.03mm) after 1 year functional loading.

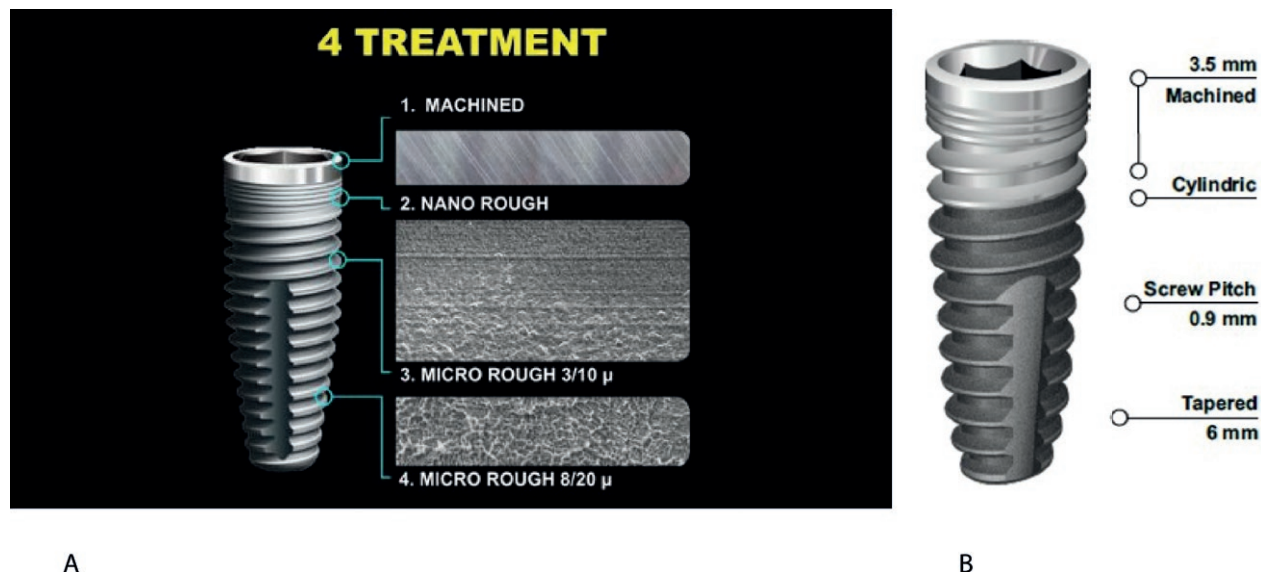


Figure 1. Full treatment implant (A) and Half treatment implant (B).

Table 1. Values of marginal bone loss (MBL) in one half treatment implant (HT) and one full-treatment implant (FT) at 1 year follow-up.

Pz	MBL 1Y	
	HT	FT
1	1	0.7
2	1.2	0.8
3	0.9	0.6

Table 2. Clinical parameters, Gingival index (GI), Plaque index (PI), Probing depth of peri-implants pocket (PPD) of soft tissues.

	GI	PI	PPD
HT	0.66	0.66	2.91mm
FT	1	1	2.33mm

DISCUSSION

Success of endosseous implants treatment is strictly related to maintaining of hard and soft tissues health and stability, in order to obtain osseointegration. Surface topography and roughness influence the early healing stages of bone integration. Also, surface properties such as wettability, topography, and charge are known to affect endothelial cells attachment and growth, likely by altering the rate of the amount of adsorbed proteins and their conformational change (Scarano et al., 2017).

In this study comparison were made between two different implants neck designs on soft and hard tissue responses. Results showed how after 1 year of functional loading, there is a largest share of MBL to hybrid surface implants than rough surfaced implants. As regards soft tissues health, HT implants revealed better results than FT implants. Results analysis confirmed literature scores. Presence of surface roughness on implants neck seems to reduce MBL. Soft tissues seem to benefice to smooth surface on implants neck, confirming the reduction of bacterial adhesion and plaque colonization.

This study can be intended as a pilot study since the small size patients examined does not allow to draw definite conclusions.

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