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Peri-implant hard tissue response to glow-discharged abutments: Prospective study. Preliminary radiological results

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SUMMARY

In the literature has been demonstrated that when an implant is placed in the oral environment, changes in peri-implant hard tissue level may occur. Several clinical procedures have been advocated to clinically minimize this bone resorption. However, minimal attention was paid to the soft- and hard-tissue abutment interaction. The present clinical preliminary study is intended to radiologically analyze the effect of glow-discharged abutments on hard tissue level changes after 18 months of prosthetic loading.

Five patients needing an implant supported restoration in the anterior maxillary area with thin gingival tissue biotype and healed bone were recruited. An implant was inserted and a titanium abutment was glow-discharged with an Argon plasma treatment in a plasma reactor and, immediately after, definitively screwed at 30 N. Provisional restoration was therefore positioned. Three months later, definitive restoration was performed. Digital periapical standardized radiographs were taken at the time of surgery, 6 and 18 months thereafter. Radiographic analysis was carried out using image analysis software. At baseline, interproximal radiographs revealed no bone defect around implants in both groups. After 6 months from baseline, the postoperative interproximal radiographs revealed an average bone loss of 0.09 mm (range 0.0–0.3 mm, SD = 0.144 mm). After 18 months from baseline, the periapical X-ray showed a stable condition of bone remodeling (mean value: 0.09, range 0.0–0.5 mm, SD = 0.08 mm).

Within the limit of this study, glow-discharged abutments have been demonstrated to positively affect hard tissue reaction to implant restoration.

1. Introduction

In the literature has been demonstrated that when an implant is exposed to the oral environment, changes in peri-implant hard tissue level may occur (Hermann et al., 1997). The amount of this bone remodeling remains stable after one year (Manz, 2000). Several factors may affect peri-implant bone resorption. According to the literature, they can be didactically divided into four groups: local and systemic patient related-, surgical-, implant related-, post-restorative-factors (Schou et al., 2006). In addition, microbiological factors may longitudinally affect the stability of this biological phenomenon (Lang et al., 2011). However, from a clinical point of view, the most relevant group seems to be the post-restorative factors. Actually, it represents the soft and hard tissue response to the bacterial invasion of the implant/abutment micro-leakage (Cochran et al., 1997). Several techniques have been advocated to clinically minimize this contamination: mechanical improvement of the implant/abutment connection stability (Van Assche et al., 2011), implant/abutment microgap shifting from the vital bone (Atieh et al., 2010), diminishing of the abutment dis/reconnection (Canullo et al., 2010a,b). Despite these conservative approaches, minimal bone response can be observed longitudinally (Canullo et al., 2010a). These level changes might be related to the contaminants present on the abutment after technical phases and to the microbiological contamination of the abutment during the soft tissue healing period.

Several authors have demonstrated, in fact, that physical treatment of the titanium implant surface, such as Plasma of Argon, can affect osteoblast adhesion, activating the surface and, thus, enhancing the osteoblast adsorption on titanium (Junker et al., 2009). Plasma of Argon treatment, in fact, was demonstrated to have a double effect on titanium: cleaning and corrosion protection increasing surface energy of the cleaned surfaces (Tavares et al., 2009). Both these phenomena have a synergistic effect on cell adhesion. Positive effects of glow discharge techniques could also be applied to the abutment, since it is often in contact with vital hard and soft tissues.

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Table 1
Subject and study site inclusion and exclusion criteria.

Subject inclusion criteria
Need for fixed implant-supported prosthesis in the anterior maxillae (from the 1st left to 1st right premolar)
Thin gingival tissue biotype according to Kan et al.
Missing teeth extracted at least 6 months before surgery Age > 18 years
No relevant medical conditions
Non-smoking or smoking ≤ 10 cigarettes/day (all pipe or cigar smokers were excluded)
Full Mouth Plaque Score and Full Mouth Bleeding Score ≤ 25%
Possibility for follow-up for 18 months after prosthetic loading
Presence of a wide ridge of bone allowing the insertion of a 4 mm platform implant according to the Branemark protocol
Specific subject and site exclusion criteria
Sites with acute infection
Pregnant and lactating patients
Sites needing horizontal regenerative procedure
Patients with a history of Bisphosphonate therapy

The present clinical prospective study is aimed to present a radiological analysis of the effect of glow-discharged abutments on hard tissue level changes after 18 months of prosthetic loading.

2. Materials and methods

From January to April 2010, patients needing an implant supported restoration in the anterior maxillary area with thin gingival tissue biotype were selected. Inclusion/exclusion criteria are summarized in Table 1.

All procedures and materials in the present study were approved by the local ethical committee (ref number: 20100218 20:20:49). The subjects were informed about the study protocol and required to sign a consent form.

2.1. Clinical procedures

Before the surgical procedure, a full mouth professional prophylaxis appointment was scheduled. One day preoperatively and for 5 days postoperatively, patients underwent antibiotic therapy.

Premium Khono Switching Platform implant 13 mm in length and 4.2 m in diameter (Sweden & Martina, Padua, Italy) were inserted according to flapless protocol (Marcelis et al., 2011). The edge of the implant platform was placed at the margin of the buccal bone wall, thus 2–3 mm sub-crestally at the mesial and distal aspects.

An impression was taken immediately after implant insertion. Two hours later, a definitive titanium abutment and provisional restoration was delivered to the clinician. The final titanium abutment was duplicated in polyurethane resin following a specific laboratory procedure (Cocchetto et al., 2010), and a resin structure for the final restoration was fabricated.

Titanium abutment was glow-discharged with an Argon plasma treatment in a plasma reactor (Colibri, Gambetti Company, Binasco, Milan, Italy) and immediately thereafter definitively screwed at 30 N.

Provisional restoration was therefore positioned. Occlusal centric and eccentric contacts were not permitted on the provisional restorations, following the guidelines for immediate non-functional loading (Esposito et al., 2010). Digital periapical standardized radiographs with paralleling technique were taken. These radiographs were used as a reference point (baseline: T_0) for the following radiographic evaluations.

Three months thereafter, a soft tissue impression was recorded using the resin coping and the final master cast was produced using the polyurethane duplicated abutment. One week later, at final crown connection, periapical radiographs were made using customized film holders.

2.2. Clinical follow up

Every follow up appointment after the final prosthetic restoration, clinical assessments (bleeding on probing = BOP, probing pocket depth = PPD) and periapical radiographs were taken at 6 (T_1) and 18 months (T_2).

Radiographic analysis was carried out using an image analysis software (Autocad 2006, version Z 54.10, Autodesk, USA) able to compensate radiographic distortions and calculate peri-implant bone remodeling at the mesial and distal aspects (Canullo et al., 2010b).

3. Results

At the 18-month follow-up, 5 consecutive patients (2 men and 3 women) were included in this study. At the time of implant insertion, the patients ranged in age from 42 to 55 years (mean age: 49.1 years). During the study, all implants were clinically osseointegrated, stable, and showed no sign of infection.

In all the five treated cases, at the time of the abutment connection, blood flowed over the titanium, demonstrating its hydrophilic capability.

3.1. Periodontal parameters

For the duration of the study, no bleeding on probing was detected on any implant and probing pocket depths (PPD) did not exceed 3 mm.

3.2. Radiographic results

A baseline and two follow-ups radiographic evaluations were performed during this study.

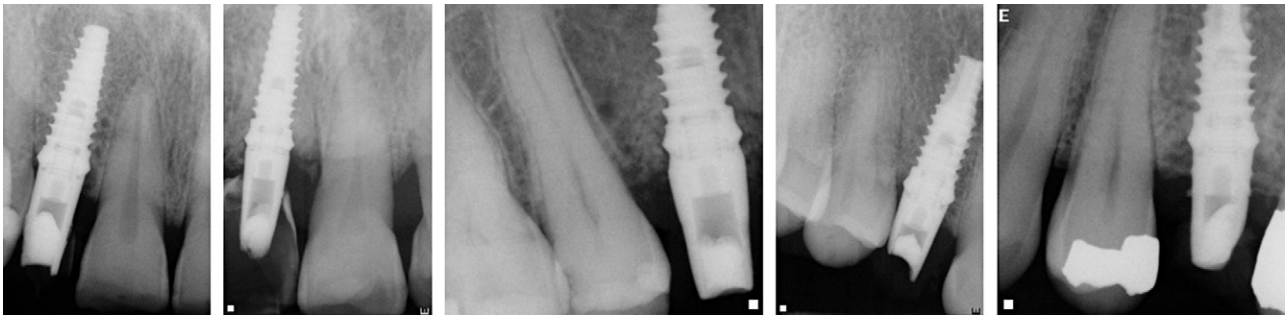

Fig. 1. Periapical radiographs of T_0: no bone resorption can be noted at the time of implant insertion.