INTRODUCTION

The crestal bone level changes, frequently observed at dental implants, after exposure to the oral environment have become a topic of growing interest. The etiology of this peri-implant crestal bone resorption is still unknown, even if several causes have been proposed: surgical trauma, peri-implantitis, occlusal overload, formation of a biological width, macroscopic and microscopic characteristics of the neck of the implant, implant-abutment interface design, bacterial infiltration of the microgap, position of the microgap (1).

Increasing esthetic demands require, frequently, a subgingival placement of restoration margins (2). The more apical positioning has, however, been associated with an increased crestal resorption of the alveolar bone (2). It has been shown that a crestal bone loss of about 2 mm occurs in the submerged 2-piece approach, dependent on the location of the microgap in relation to the bone crest (3).

This gap has been a matter of intense investigation and research in the past two decades (4-10). Less bone loss and inflammation were observed if the 2-piece implants were placed with the microgap exactly at the bone crest level, and the least bone resorption/peri-implant inflammation occurred if the microgap was located 1 mm above the crest (3,4). The placement of an interface in a location apical to the alveolar crest would result in the greatest amount of bone loss (4,11).

A bacterial colonization of the microgap has been described with the presence of an inflammatory cell infiltrate at the implant-abutment junction (IAJ) (4-10,12). The presence of infiltrated connective tissue (ICT) shows, probably, a response of the immune system to bacteria colonizing the IAJ (13). If the ICT is responsible for bone remodelling, shifting the
microgap inward would, probably, shift the ICT further from the alveolar crest (13). Moving the IAJ away from the external edge of the implant shoulder and from crestal bone could help to reduce bone resorption by containing the inflammatory cell infiltrate within the angle formed at the interface, away from the adjacent crestal bone (14). Moreover, with a platform-switched abutment, a 90° step is created, compared to what happens to implants with a matching implant-abutment diameter, where a 180° step is present; the resulting confined area may produce a restriction of the ICT to this region (15). This can be obtained with the use of platform-switched implants (PLS), in which an abutment smaller than the implant shoulder is used (16). The aim of the present study was a histologic analysis of an implant with a platform switched implant-abutment connection.

MATERIALS AND METHODS

A 32-year-old male patient participated in this study. The study protocol was approved by the Ethical Committee of the UnG (University of Guarulhos, São Paulo, Brasil) and the patient signed a written informed consent form. The patient was partially edentulous and he needed a bilateral posterior mandibular restoration. Four implants were inserted: two implants in the right mandible (3i® implant with Nanoflite surface; Implant Innovations, West Palm Beach, FL, USA), and 2 implants in the left mandible (Ankylos® plus implant; Dentsply-Friadent, Mannheim, Germany). All implants were loaded, without occlusal contact, with a fixed provisional prosthesis the same day of the implant surgery and immediately the same day of insertion. The implants had been splinted. Once the implant was retrieved, together with the abutment which was never removed, with a trephine bur after a 6 weeks healing period. Before retrieval the implant had been inserted 1 mm below the crest.

Processing of specimens

The implant and the surrounding tissues were stored immediately in 10% buffered formalin and processed to obtain thin ground sections with the Precise 1 Automated System (Assing, Rome, Italy) (17). The specimen was dehydrated in an ascending series of alcohol rinses and embedded in a glycolmethacrylate resin (Technovit 7200 VLC, Kulzer, Wehrheim, Germany). After polymerization, the specimen was sectioned longitudinally along the major axis of the implant with a high-precision diamond disc at about 150 µm and ground down to about 30 µm. Three slides were obtained. The slides were stained with acid fuchsin and toluidine blue and then washed under tap water, dried, immersed in basic fuchsin for 5 min, and then washed and mounted.

Histomorphometry of bone-implant contact (BIC) percentage was carried out using a light microscope (Laborlux S, Leitz, Wetzlar, Germany) connected to a high resolution video camera (3CCD, JVC KY-F55B, JVC, Yokohama, Japan) and interfaced to a monitor and PC (Intel Pentium III 1200 MMX, Intel, Santa Clara, CA, USA). This optical system was associated with a digitizing pad (Matrix Vision GmbH, Oppenweiler, Germany) and a histometry software package with image capturing capabilities (Image-Pro Plus 4.5, Media Cybernetics Inc., Immagini & Computer Snc Milano).

RESULTS

A 1 mm resorption of the peri-implant crestal bone was present on one side with the bone located at the same height of the shoulder of the implant. A 0.6 mm gap was observed, on one side, between implant and bone, at the height of the shoulder of the implant. Inside this gap it was possible to observe newly formed bone trabeculae. The location of the first bone to implant contact (BIC) was found at about 0.7 mm from the implant shoulder (fig. 1). Inside this gap, there were no inflammatory cell infiltrate, osteoclasts or areas of bone resorption. Bone trabeculae were seen 1 mm above the level of the implant shoulder, about 1 mm from the implant. A 0.2 mm gap was present between the shoulder of the implant and the newly-formed bone, on the other side of the implant. Inside this gap, osteoblasts were depositing osteoid matrix in an apico-coronal and implantopetal direction.

At the level of this portion of the interface, located near the shoulder of the implant, it was possible to observe only the presence of newly-formed bone. The BIC was located 0.3 mm from the implant shoulder (fig. 2). Also inside this gap no inflammatory cell infiltrate, osteoclasts, or areas of bone resorption were observed. At the interface with the abutment it was possible to observe the presence of connective tissue. A detachment of this connective tissue from the metal surface due, probably, to an artefact produced during retrieval or processing of the specimen, could be observed in some areas. This loose connective tissue presented only with a few, scattered inflammatory cells and a few small vessels (fig. 3).

Newly-formed bone was found at the interface with the implant, and osteoblasts deposited osteoid matrix directly on the implant surface (fig. 4, 5). In some portions of the interface, newly-formed bone was located in tight contact with the metal surface.
No gaps, connective fibrous tissue was found at the interface, and no epithelial downgrowth was present. The BIC percentage was 65.1 ± 6.3% (fig. 7).

**DISCUSSION AND CONCLUSION**

Peri-implant bone level has been used as one of the criteria for assessing the success of dental implants (14). It is an important prerequisite in order to preserve the integrity of the gingival margins and interdental papillae (14). The inward shift of the IAJ due to PLS, with a shift of the inflammatory cell infiltrate to the central axis of the implant, can be considered a desirable morphological feature that may prevent the horizontal saucerisation and preserve the vertical crestal bone levels (14,18,19). With PLS, the ICT is contained mainly above the implant platform and the peri-implant bone is shielded from the ICT (20).

In a study in dogs it was found that PLS was not able to reduce crestal bone level changes to a significant
found no infraosseous pockets, Howship’s lacunae nor osteoclasts on the coronal segment of the implant (13). Moreover, PLS produced a reduction in the dimension of the ICT and its extension in an apical direction (13). It is likely that PLS was able to reduce the immune response of the organism to the presence of the microgap (13).

The present study results showed that PLS could produce, around the implant shoulder, an area that could help to protect the peri-implant soft and mineralized tissues. This could, probably, determine the reduced bone resorption seen in the present histologic report. A very high BIC was found in the implant analyzed. This could be related to the fact that the implant had been immediately loaded and to the microstructured type of surface (26).

In conclusion, the use of PLS could help to maintain the height of the peri-implant crestal bone, and to partially reduce crestal bone remodeling.

ACKNOWLEDGMENTS

This work was partially supported by the Ministry of Education, University, Research (M.I.U.R.), Rome, Italy

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