DIFFERENT PERFORMANCE OF PLATFORM SWITCHING IN EQUICRESTAL POSITION IMPLANT: AN HISTOLOGICAL STUDY

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SUMMARY
Objective. In this study we tested two different type of implant systems that were selected on the basis of differences in macrogeometry of platform switching in order to evaluate the behavior in term of BIC on the platform.
Material and Method. The patients were divided in two groups (Group I and II); group I was composed by 4 patients that each received in the posterior areas of mandible one type A implant (3,6 mm in diameter and 6,5 mm in length GTB-Plan1Health Amaro (UD) Italy) one type B implant (4 mm in diameter and 8 mm in length OsseoSpeed Astra Tech, Dentsply Molndal, Sweden). Group II was composed by 3 patients that each received in the posterior areas of jawsbone one type A implant [3,6 mm in diameter and 6,5 mm in length GTB- Plan1Health Amaro, (UD), Italy] one type B implant (4 mm in diameter and 8 mm in length OsseoSpeed Astra Tech, Dentsply Molndal, Sweden). All the implants were placed, by the same operator, in equicrestal position using "one stage" technique with a healing abutment at an adequate gingival height. After 12 weeks of healing all the implants of both groups were harvested with the peri-implant bone tissues. BIC upon platform was calculated considering as implant surface the platform length.
Results. Our results showed that the mean percentage of BIC value related to platform surface placed in equicrestal position was higher in patients with type A implant than patients receiving type B implant independently from mandibular or maxillary positions. Moreover the mean percentage of BIC related to platform surface was significantly ($p<0.05$) higher in Group II/A than Group I/A.
Conclusions. Our data highlights that the particular features of the Bioplatform of Type A implant systems guarantee a higher value of BIC even if the implants were placed equicrestally.

Key words: histomorphometry, microgeometry, macrogeometry.

Introduction

The long-term survival rate of dental implants is influenced initially by implant primary stability. Implant configuration and surface characteristic has considered as an essential requirement for implant success.
In fact, many factors could affect the osseous healing of implants such as surface topography of biomaterial, the status of the bone/implant site, implant loading conditions, surgical technique and implant design (1-4).
After implant placement, primary implant stability is achieved by passive mechanical fixation within the host bone. Subsequent steps of bone resorption and new bone formation enable secondary implant stability through osseointegration. The attainment of osseointegration and secondary implant stability are essential to successful implant treatment (5-7).
The importance of the implant geometries and

surface characteristics, in an effort to achieve better bone anchorage, has been clear for a long time and, in fact, various implant systems have been introduced over the past several years in order to achieve a faster bone integration (8, 9).
One of the most important innovation was the introduction of the platform switching, that has determined important benefit in term of biomechanical behavior, influence upon bone crestal level, and soft tissue response.
The platform switching effect was accidentally established in the 1980s and early 1990s when different commercial dental implant manufacturers introduced implants of larger diameter before producing the corresponding abutments of the same measures. Currently, evaluation of those treatments in which abutments of lesser diameter were used revealed better preservation of the hard and soft tissues than treatment that use abutments with diameters matched to the implant (10-12).
All Authors agree that the use of implants with platform switching improves bone crest preservation and leads to controlled biological space reposition. According to the different papers, this expanded platform obtains excellent aesthetic outcomes.
Moreover, the introduction of alternative implant surfaces to the well-known and experimented turned surface, improperly called "smooth" has been motivated by better biological responses which the "rough" surfaces seemed to produce, especially in a bone of poor quality and/or associated to regenerative therapies (13-20).
Even though histological tests on humans are limited in literature, they have confirmed that there is a superior integration which is expressed in bone-to-implant contact (BIC) percentage values greater than those reachable with the turned surfaces (21-30).
The aim of this study was to evaluate the BIC upon the platform of 2 different implants systems characterized by different micro and macrogeometry, that were placed in equicrestal position in the posterior maxillary and mandibular jaws of humans, clinically unloaded and retrieved for histomorphometric analyses after 12 weeks.

Materials and methods

Implants

We tested two commercially available implant systems with a different macro and microgeometry. One implant systems – Type A [GTB-Plan1Health Amaro, (UD), Italy] is characterized by a controlled and gradual load distribution through double threads with gradual height profile and a geometrically complex horizontal and vertical platform shifting (BioPlatform, patent pending), with a single prosthetic platform for all diameters. The implant screws are entirely covered, up to the interface fixture-abutment, with Osseogrip®, characterized by a micro-sandblasting through HA of medical degree and Sa = 0.5 μm.
The second one – Type B (Astra Tech, Dentsply Molndal, Sweden) characterized by single threads maintaining the same angle and height profile for all the length of the fixture with minute threads on the implant neck (MicroThreadsTM) and fluoride-modified nanostructure implant surface (OsseoSpeedTM) with a Sa = 1.6 μm.

Patient selection and evaluation

Candidates for this study were consecutive patients from private practice who presented with atrophic, edentulous posterior maxillae or mandible. The patients who were motivated for implant treatment, fairly good oral hygiene, well healed edentulous ridges, adequate inter arch space (10 mm), non-smokers, and patients with no systemic disturbances and bone metabolic disorders were included in the study. Patients

having systemic disease (diabetes, hypertension, osteoporosis, cardiac complications), smokers, patients having poor oral hygiene, supra eruption of opposing teeth, periodontitis were excluded from the study.
The patients were divided in two groups (Group I and II); Group I was composed by 4 patients that each received in the posterior areas of mandible one type A implant [3,6 mm in diameter and 6,5 mm in length GTB- Plan1Health Amaro, (UD), Italy] one type B implant (4 mm in diameter and 8 mm in length OsseoSpeed Astra Tech, Dentsply Molndal, Sweden).
Group II was composed by 3 patients that each received in the posterior areas of jaws bone one type A implant [3,6 mm in diameter and 6,5 mm in length GTB- Plan1Health Amaro, (UD), Italy] one type B implant (4 mm in diameter and 8 mm in length OsseoSpeed Astra Tech, Dentsply Molndal, Sweden).
All the implants were placed according to the suggested procedures provided by each manufacturer. In particular, all the implants were placed, by the same operator, in equicrestal position using "one stage" technique with a healing abutment at an adequate gingival height.
After 12 weeks of healing all the implants of both groups were harvested with the peri-implant bone tissues. In the remaining sockets new implants were placed following a planned restoration for the patient.
Each samples were retrieved en bloc and placed in 10% formaldehyde for 24 hours, thereafter were subjected to a series of dehydration and in filtration procedures; finally, the samples were embedded in a methacrylate-based resin (Technovit 9100; Heraeus Kulzer GmbH, Wehrheim, Germany) according to the manufacturer's instructions. After polymerization, the embedded samples were cut at the center of the implant along its long axis with a diamond saw (Isomet 2000; Buehler, Ltd., Lake Bluff, IL), were subjected to grinding and polishing using a series of SiC abrasive papers to a final thickness of approximately 30mm, and were then toluidine blue sand fucsin stained; finally, the sections were histomorphologically evaluated under light optical microscope. Histomorphometry of bone–implant contact percentage was carried out using a light microscope (·20 to ·100 magnification) connected to a high resolution video camera and interfaced to a monitor and personal computer. This optical system was associated with a digitizing pad and a histometry software package with image-capturing capabilities.

Mean percentage of BIC and statistical analysis

This parameter indicated the surface of the implant directly apposed by bone matrix and was expressed as the percentage of the implant surface at each side and for each section. We consider, as implant surface, the length surface of the platform, i.e. Group I platform length = 630 μm, Group II platform length = 430 μm, and we detect the BIC value referred to that values (Figure 1).
The mean of two different counts and percentages were calculated by considering both side of the platform.
Statistical significance was determined using the 2-tailed paired Student t test. A P value of < 0.05 was considered significant.

Results

Our results showed that the mean percentage of BIC value related to platform surface placed in equicrestal position was higher in patients with type A implant than patients receiving type B implant independently from mandibular or maxillary positions (Figure 1).
Moreover the mean percentage of BIC related to platform surface was significantly ($p<0.05$) higher in Group II/A than Group I/A (Figure 2).
Instead, no significant differences in percentage of BIC were found among Group I/B *versus* Group II/B.

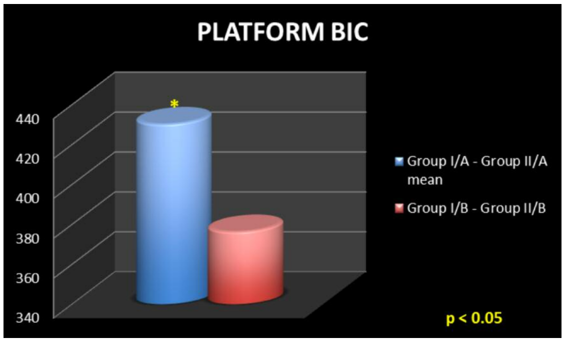

Figure 1
The mean percentage of BIC relate to the length of platform in Group I/A and Group II/A *versus* Group I/B and Group II/B. Group I/A and Group II/A demonstrated a statistically significant higher mean percentage of BIC than Group I/B and Group II/B (2-tailed paired Student t test. $P < 0.05$).

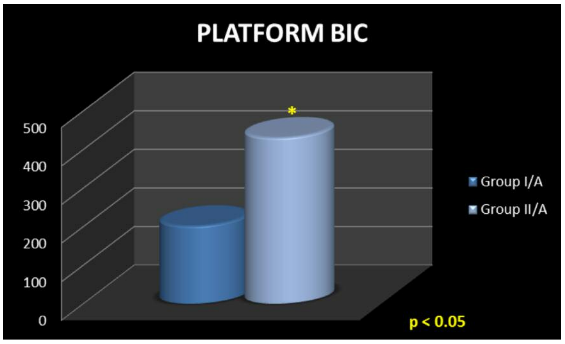

Figure 2
The mean percentage of BIC relate to the length of platform in Group I/A *versus* Group II/A. Group II/A presents a higher mean percentage of BIC upon the platform than Group I/A (2-tailed paired Student t test. $P < 0.05$).

Discussion

In this study we tested two different type of implant systems that were selected on the basis of differences in macrogeometry of platform switching in order to evaluate the behavior in term of BIC on the platform.
Type A implant systems were characterized by a conical connection, with a particular type of platform named Bioplatform with a length of 630 µm; type B implant systems were characterized by a conical connection and a platform switching with a platform length of 430 µm.

In addition, we placed both implant systems in equicrestal position that represents the suitable placement for Type B implant systems but not for Type A, that ideally, as suggested by manufacturer, could be placed subcrestally.
In this way we evaluate the performance of Type A implant system in term of BIC upon the platform placing the implant in equicrestal position that sometime represent the only chance to insert an implant due to anatomical bone disponibility of the patient.
Our results highlight that the mean percentage of BIC value related to platform surface was higher in patients with type A implant than patients receiving type B implant independently from mandibular or maxillary positions even if both types of implant systems were placed equicrestally.
This result may be partially explained by the characteristics of the Bioplatform macrogeometry of Type A implants that guarantee a higher surface disponibility for the bone growth as demonstrated in Figures 3 and 4.
The differences in term of percentage of BIC in Group I/A *versus* Group II/A may be in some measure related to the histological features of the bone where the implant were placed.
In particular, mandibular bone is characterized by a higher rate of cortical bone respect those in

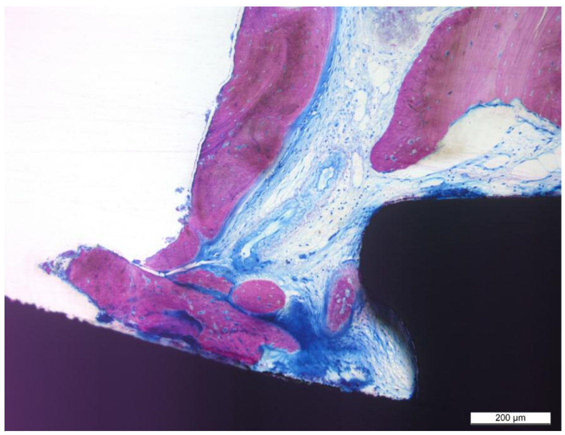

Figure 3
Histologic section of Group II/A – a platform section. The bone growth is on and inside the BioPlatform in equicrestal position on maxillary bone (*haematoxylin and eosin stain*).

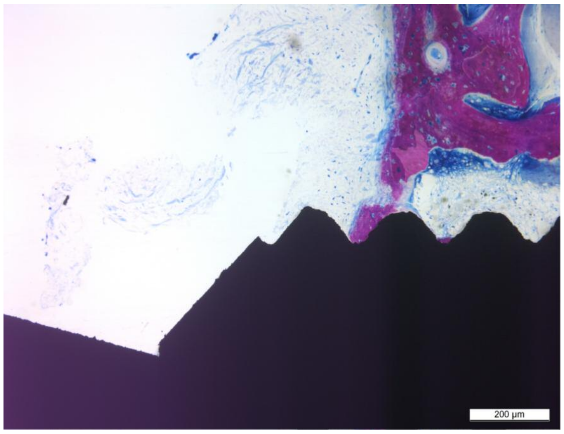

Figure 4
Histologic section of Group II/B – a platform section. The bone growth under the platform in equicrestal position on maxillary bone (*haematoxylin and eosin stain*).

maxillary bone so this histological characteristic may influences the percentage of BIC in equicreastal position.
Within the limit of the study we find out that the particular features of the Bioplatform of Type A implant systems guarantee a higher value of BIC even if the implants were placed equicrestally. Undoubtedly more studies are necessary to address the maintenance of the BIC upon the platform in equicrestal position after the mechanical loading of both implant system tested.

Conflict of interest

None.

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