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Research Article

Assessment of the Effect of Platform Switching Concept on Osseo-Integration of Dental Implants

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Abstract

The goal of the implant therapy satisfactory result is the successful osseointegration of the implant, functional esthetic restoration surrounded by stable peri-implant tissue levels that are in harmony with the existing dentition. The maintenance of peri- implant bone is a major in the prognosis of prosthetic rehabilitation supported by implants. The crystal bone loss can also lead to a collapse of soft tissues and adversely affect the aesthetics of implant-prosthetic elements. After the insertion of the implant and its prosthetic connection, crystal bone undergoes remodeling and resorption processes. The crystal bone levels resulted from approximately 1.5 - 2 mm below the implant - abutment junction. In this study, there is no significant difference between the conventional implant and platform switching. It needs longer time up to two years to give the accurate assessment between regular implant and platform switching. In this study, 24 implants used with 12 patient in two grouped have missing upper anterior teeth to be replaced by delayed implants, free from any systemic disease that may affect normal bone healing. Patients were equally divided into involving sex patients with platform switching implants all together with the regular implant for comprise. All implants were placed in the upper anterior region using standard technique under local anesthesia. After loading of implants, 3, 6, 9, months respectively X-ray cone beam to assess crystal bone.

Keywords: *Osseo-Integration; Dental Implants*

Introduction

The platform switching concept involves the reduction of the restoration abutment diameter concerning the dental implant diameter in aesthetic areas, the use of dental-implant as replacement for lost permanent teeth remain as implant challenge due to the difficulty of restoring the natural sulcus and papillary anatomical appearance around the implants.

Correct location of soft tissues in dental implants restoration depends on the preservation of bone crystal height.

The platform switching effect was accidentally established in 1980, and early 1990, which different commercial dental implant manufactures introduced implants of large diameter before producing the corresponding abutment of the same measure.

This leads to study the effect of platform switching on the preservation of both soft and hard tissues using this technique in anterior lost teeth replacement with dental implants.

Review of Literature

Dental implant

Dental implants have become a predictable treatment option for restoring missing teeth. The purpose of tooth replacement with implants is to restore adequate function and esthetics without affecting adjacent hard and soft tissue structures. The use of dental implants in oral rehabilitation has currently been increasing since clinical studies with dental implant treatment have revealed successful outcomes.

The term bone quality is commonly used in implant treatment and reports on implant success and failure. Lindh., *et al*. (2004) emphasized that bone density (Bone Mineral Density, BMD) and bone quality are not synonymous [1].

During all stages of atrophy of the alveolar ridge, characteristic shapes result from the resorptive process. It is difficult to obtain implant anchorage in bone that is not very dense. Sufficient bone density and volume are therefore crucial factors for ensuring implant success. Bone quality is broken down into four groups according to the proportion and structure of compact and trabecular bone tissue [2].

Platform switching involves diminishing the restoration abutment diameter in comparison with the diameter of the dental implant.

When platform switching, a narrower abutment diameter for a given implant platform diameter is used; for example, a 4.8 mm-wide implant may be restored with a 3.8 mm-wide or 4.2 mm-wide abutment.

Biomechanical behavior

The close relationship between the bone and the implant is the essence of osteointegration. The bone changes occurring at the margins adjacent to the dental implants have been the subject of many clinical and experimental studies.

Implant design also affects the morphology of the gingival margin- both the neck micro- and macrostructure, and the macrostructure of the implant-abutment junction. In turn, assuring a minimum distance of 3 mm between implants allows sufficient margin to restore the biological space of both restorations, as demonstrated by Tarnow., *et al* [3,4].

Space is created in the horizontal plane one millimeter from the implant-abutment junction, supported over the external margin of the platform. Also, this procedure keeps the inflammatory infiltrate away from the crestal bone margin, with a 50% reduction in occupation surface [5].

In turn, many hypotheses have been proposed about the physiological processes that intervene in crystal bone stabilization. Although the etiological factors underlying bone loss have not been fully established, the main causal factors of crystal bone loss are occlusal overload and peri-implantitis. Characteristics such as implant design, crystal bone geometry and the location within the oral cavity must be taken into consideration for the optimum support and distribution of occlusal loading forces to the bone components [6,7].

In 2009, Hsu., *et al*. analyzed the behavior of lessened platform restorations in the context of a finite element study in three dimensions. Their results revealed a 10% decrease in all the prosthetic loading forces transmitted to the bone-implant interface [9].

Rodriguez-Ciurana., *et al*. [8] in a two-dimensional biomechanical study involving platform switching integrated into the implant design, failed to obtain peri-implant bone force attenuation values as high as those reported in earlier studies when comparing platform expansion with a traditional restoration model. On the other hand, this concentration of forces along the axis of the implant, transmitted through the retention screw, raises the possibility of abutment fracture and thus may lead to failure of the global restoration [10].

The crestal bone around dental implant

Alveolar process anatomy consists of:

1. An external plate of cortical bone.
2. Inner socket wall- Alveolar bone proper.
3. Cancellous trabeculae- Supporting alveolar bone. The various causes of alveolar bone loss are:
    i. Extension of gingival inflammatio
    ii. Trauma from occlusion.
    iii. Systemic factors
    iv. Orthodontic treatment.
    v. Periodontitis.
    vi. Periodontal abscess.
    vii. Food impaction.
    viii. Overhanging restoration.
    ix. Adjacent tooth extraction
    x. Ill-fitting prosthesis.

Aim of the Study

This study aims to assess clinically and radiographically the effect of platform switching on the osseointegration of implant.

Patients and Materials

Patient selection

Twenty four implants in 12 patients were inserted for implant- supported restorations in the anterior maxilla.

All patients were randomly selected from the out-patient clinic, of Oral and Maxillofacial Surgery Department, Faculty of Oral and Dental Medicine, Cairo University.

Twelve patients were included in this study. All patients are free from any systemic or local diseases could interfere with implant success.

The implants (Global, Sweden and Martina, Padua, Italy), platform diameter of 3.0-4.3mm, were inserted in a standardized way in the anterior maxilla. The length of the implant used was between 11 to 14 mm.

Patients selected for this study were seeking for rehabilitation of their mouth after lost anterior teeth in the upper jaw and lower jaw.

Preoperative preparation

All patients were subjected to clinical and radiographic examination (digital panoramic x-ray and cone beam C.T.) to detect any periapical pathology and examine the available bone height Clinical and radiographic data were reported for each patient.

Patient's grouping

Twenty four implants were included in this study, twelve implants in each group. Patients in the present study were equally divided into two groups:

1. Group I (study group): Involved twelve implants with platform switching abutments (PS).
2. Group II (study group): Involved twelve regular implants.

Surgical phases

Pre-surgical preparation

Before the surgical procedure, a full-mouth professional prophylaxis appointment was scheduled. Patients received 1g amoxicillin/clavulanate 1h before surgery and continued with 2 g/day for six days.

Anesthesia

First, application of topical anesthesia on the oral mucosa before infiltration, then infiltration anesthesia was applied in the area of operation (both labial and palatal injection) in the maxillary region. A field block anesthesia was also applied.

Surgical protocol

Under L.A. platform switching implants were inserted in the partially edentulous upper anterior maxilla.

In the same times, regular implants were placed beside or apart from the platform implant according to the case.

24 implants, 12 platform switching and 12 regular implants were inserted two in each patient in the anterior maxilla.

The regular implants will serve as a control for the platform switching implants.

Operative procedure

Crestal incision was performed after anesthesia. A sequence of drilling started from 2.8mm up to 5 mm according to the needed diameter for every implant, and consequently, the implant needed. When the needed drilling was done for the length and diameter decided before for the implant. Another irrigation was done after drilling for removal of all debris and necrotic tissues with saline and hydrogen peroxide 10%.

The implant (implant diameter 4, 4.5 and 5 mm) was inserted inside the prepared socket-using ratchet to be installed inside the prepared socket to be flushed with bone margins. A minimal distance of 2.5 mm between implants and between implants and teeth was always observed. Cover screw was inserted to cover the implant and suturing both labial and palatal mucosa with black silk 000 suture.

Patients were commanded to have a soft diet and to avoid chewing in the treated area until the suture removal. Oral hygiene at the surgical site was restricted to soft brushing for the first two weeks. Regular brushing in the rest of the mouth and rinse with 0.12% chlorhexidine were prescribed for two weeks. After that, conventional brushing and flossing were permitted. After two weeks, sutures

were removed. Implants were allowed for a submerged healing. Two to 3 months later, the uncovering procedure was carried out. Only uneventfully healed implants were accepted in this study.

Postoperative follow up

Three-to-four months after the first surgery, by performing a crestal incision just over the area corresponding to the implant, the cover screws were exposed and removed. The attached keratinized mucosa was present both on the palatal and buccal aspect around all implants.

Subsequently, a 3.0-healing abutment was inserted. A 3.0 mm coping transfer was used, and an impression was taken. For restoration, in the study and control groups, always a 3.0 abutment was used. All restorations were a splinted single-unit crowns to protect implants from inhomogeneous loading. Two weeks after the there-opening procedure, crowns were cemented using a provisional cement.

Postoperative follow up was done for every patient. Cone Beam C.T. radiographs were done for every patient postoperatively. Immediate con beam CT, at 3-to-4 month preloading, and after 3, and six months postoperatively were done for every patient.

Results

From December 2013 to November 2014, consecutive patients (twelve), which eight females and four males were included in this study.

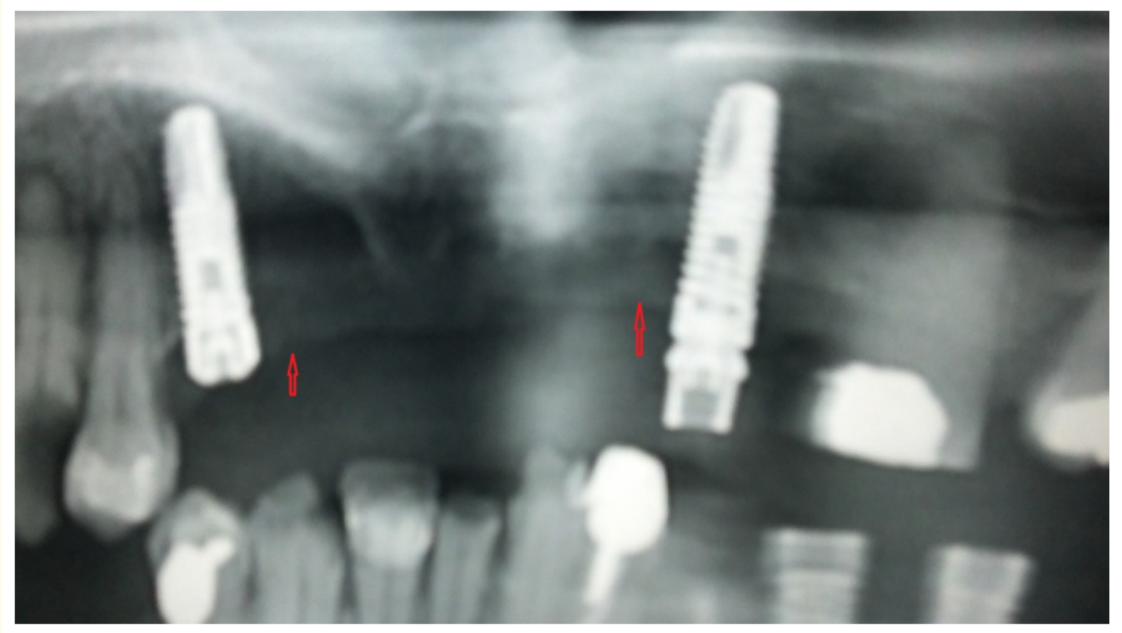

Figure 1: *9th-month post-loading x-ray.*

In association with implant insertion, cone beam C.T. x-ray was used immediately postoperative.

All twelve patients were followed up to 9 months post-loading (Figure 1). Implants were excluded from this study because of early unintentional cover screw exposure was done.

Thus, the rest implants in twelve patients were included in the analysis after nine months post-loading.

Time	Platform Switching Implant	Regular Implant
3rd-month post-loading	0.29 mm (SD: ± 11 mm)	0.34 mm (SD: ± 21 mm)
6th-month post-loading	0.56 mm (SD: ± 21 mm)	0.63 mm (SD: ± 22 mm)
9th-month post-loading	0.87 mm (SD: ± 32 mm)	1.09 mm (SD: ± 40 mm)

Table 1: *Mean of marginal bone level of implants*

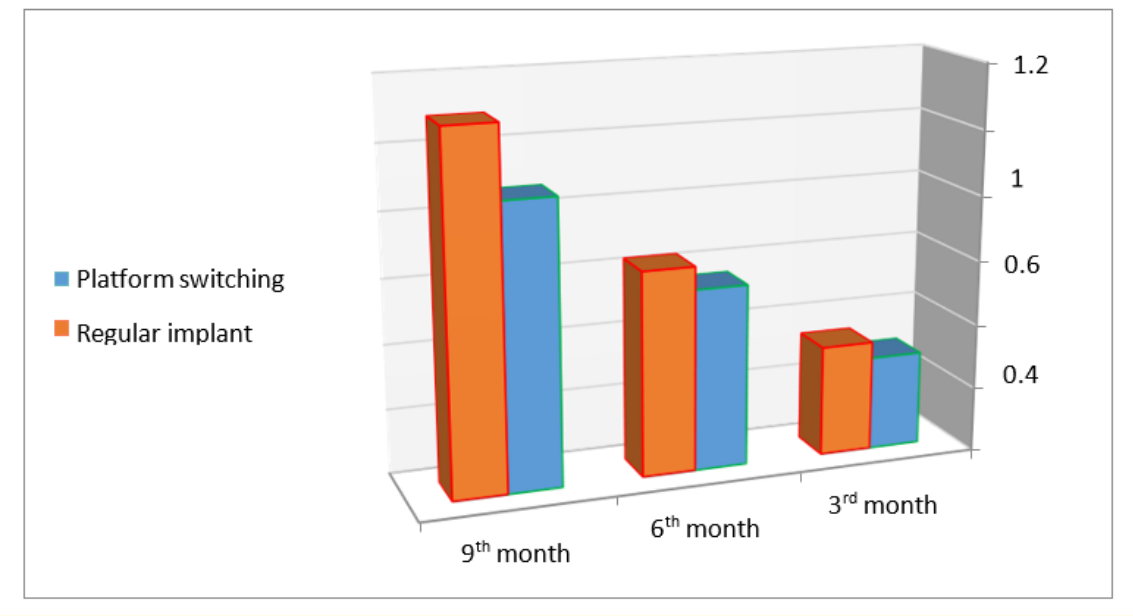

Figure 2: *Marginal bone loss chart.*

Periodontal parameters

For the duration of this study, BOP was not detected at any implant, and PPD did not exceed 3 mm.

Radiographic results

Discussion

The present study was designed to evaluate the influence of platform switching on crestal bone-level changes at non-submerged titanium implants over a period of 3, 6 and nine months in a human.

It is apparent from the results of this study that the platform-switching concept, as used in the present study, was useful in preserving inter- proximal crestal bone levels. In 12 (76%) and 12 (71%) of the 24 radiographs studied, no bone loss occurred on the mesial and distal aspects, respectively, from the time of implant placement to the 9 months.

In fact, regular implant 96.8% of the mesial and distal surfaces showed a total loss of less than 1mm of crestal bone when measured over this period. This is well within the criterion for bone loss defined earlier for implant success, which was < 1.0 to 1.5 mm for the first year and less than 0.2 mm for each succeeding year [11].

The reason for the success of the platform-switching concept has been the subject of different explanations. A biomechanical analysis suggested that platform switching shifted the stress concentration area away from the coronal bone-implant interface, thus reducing bone resorption [12].

For 22 of 24 implants, the results using the wide platform-switching technique show a high degree of bone preservation (0.19 mm bone loss). This compares with an average crestal bone loss of 0.95 mm found around implants for which a standard platform-switching technique was employed [13]. Average bone loss around the standard, non- platform- switched implants has been widely reported as 1.5 to 2 mm.

Although placement of the implants crestally might have made it slightly easier to assess any subsequent bone loss, the manufacturer recommends placing the platform 1 mm below the crest, and this recommendation was followed.

Supracrestal positioning may reduce peri-implant bone resorption, but it can also lead to esthetic problems with the restoration. While subcrestal placement can reduce such prosthetic problems, the bone resorption resulting from standard, non-platform-switched implants and abutments can change the profile of the soft tissue.

Also, through use of the wide or regular platform switching, the original peri-implant crestal level can be maintained, improving the final biomechanical support for the implant and almost eliminate the bone loss commonly seen when using traditional prosthetic protocols. The important goal of modern dentistry is to provide a healthy and beautiful smile that is accompanied by a functional and comfortable dentition.

There are various treatment modalities available for the replacement of missing teeth.

The most extensive marginal bone level alterations were seen at the first follow-up after nine months, whereas, in the 2-year observation period, after that, an only minor further bone loss could be observed. Previous experimental and clinical studies [14].

During the first year of loading, particularly two-piece implants were frequently associated with crestal bone loss of about 1.5 - 2 mm [15].

In the present study, there little a significant inverse correlation between using the platform switching implants and regular implants system. After nine months from loading observed the marginal bone resorption around regular implant higher than at platform switching implant.

Conclusion

- It can conclude from the present study that platform switching implants plays a role in the prevention of crystal bone resorption.
- The insignificant difference between standard implants (regular) and platform switching implants me by due to the short time of post loading follow up.

Recommendation

- We recommend the use of longer time of post loading assessment to check crystal bone resorption around the dental implant.
- The use of C.B.C.T (cone beam) is essential in the evaluation of post loading crestal bone resorption.

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