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REVIEW ARTICLE

PLATFORM SWITCHING: BLISS TO IMPLANT DENTISTRY

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ABSTRACT

The success of dental implant therapy depends upon a good amount and quality of bone present around the implant. During the first year of implant placement, most of the crestal bone undergoes resorption and this rate of resorption is 1.5-2mm around the dental implants after the prosthetic restoration which is clinically acceptable. This crestal bone resorption is restricted by many modifications in the implant system. Platform switching is one such concept which can be applied clinically to maintain the crestal bone level and consequently preserving the normal soft tissue contours. Placement of a small diameter abutment on a large diameter implant platform has been proposed as an effective way to control circumferential bone loss around dental implants. The purpose of this review is to discuss the literature dealing with platform switching concept to preserve the crestal bone, the mechanism by which it contributes to maintenance of marginal bone.

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INTRODUCTION

These days, patients receiving implant treatments not only expect restoration of masticatory function, but also expect that the prostheses should be aesthetically pleasing, easy to clean, and permanent. To maintain long-term implant stability, it is important to minimize bone loss around the implant, as well as soft tissue atrophy that accompanies it. Osseo integrated dental implants have become the standard of care for tooth replacement. The goals of modern implant therapy entail more than just the successful osseointegration of the implant. The final result must also include a restoration with stable soft and hard tissue level. For the short term and long term prognosis of oral implants, the quality and stability of soft tissue interface with implant and abutment along with crestal bone preservation are of prime importance (Abrahamsson and Berglundh, 2009). When dental implants are placed into function, stress concentration occur at the coronal region of the implant which leads to crestal bone remodelling (Pillar *et al*., 1991). Various authors advocated that post restorative crestal bone remodeling occur as a result of localized inflammation within the soft tissue located at implant abutment interface (Ericsson *et al*., 1995; Abrahmsson *et al*., 1998) and is a result of the soft tissue's attempt to make a biological seal around the top of dental implant, peri-implant inflammatory infiltrate, (Broggini *et al*., 2006) micromovements of the implant and prosthetic components, (Hermann *et al*., 2001; King *et al*., 2002) and repeated screwing and unscrewing (Abrahamsson *et al*., 1997).

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Other factors which are responsible for crestal bone loss are (Deshpande and Sarin, 2009):

- Surgical trauma
- Biologic width/seal
- Microgap
- Occlusal overload
- Crest module

According to (Smith and Zarb, 1989) the criteria for implant success is vertical bone loss of <0.2mm annually are following first year of implant function. Historically, approximately 1.5mm apical to the IAJ or the first thread has been used as one of the criteria for post-restorative success of a dental implants (Smith and Zarb, 1989; Albrektsson *et al*., 1986). Recently, various techniques have been evolved to diminish marginal bone loss such as the non-submerged technique, scalloped implant, rough surface implant neck with micro threads, progressive loading and immediate implant. Platform Switching (PS) is one such concept (Richard *et al*., 2006), which refers to use of a smaller diameter abutment on a larger diameter implant collar. This connection shift the perimeter of the IAJ inward toward the central axis. (i.e the middle) of the implant.

Method of literature search: Pub Med, Google scholar and textbooks were used to find out the studies related to platform switching for crestal bone preservation.

Inclusion Criteria

- Human subjects involving, males and females,
- Using hexed implants,
- Papers in which modified platforms in dental implants are studied (platform switching concept),
- Using different surgical techniques and clinical situations (immediate loading, delayed loading) with or without immediate provisionalization.
- Experimental studies of animals with a minimum follow-up of one month and 3D finite element models simulating implants and surrounding bone.

Exclusion Criteria

- Those papers for which only the abstract was available (incomplete information).
- Studies with no results.
- No indexed manuscripts.

Concept of platform switching

The concept of "platform switching" refers to the inward horizontal repositioning of implant abutment junction (IAJ) so as to minimize the circumferential bone loss. This concept accidentally came into existence in 1991, when implant innovation, Inc. introduced 5mm and 6mm diameter implants with sealing surfaces of the same diameter. The dimensional mismatch between the fixture and prosthetic component credits 0.45mm or 0.95mm circumferential horizontal difference. After 5 years period, reduced crestal bone loss was observed in radiographs of patient in whom platform switch system was used. Lazzara and Porter (Richard *et al*., 2006) advocated that because of shifting the IAJ inward, the inflammatory cell infiltrate also repositioned itself away from the crestal bone and confined it within 90° area. (Baumgarten *et al*., 2005) stated that the potential application of platform switching include situations where a larger implant is necessary but prosthetic space is limited, in the aesthetic zone where preservation of crestal bone can lead to improved esthetics and where shorter implant must be used. (Gardner, 2005) stated that the main advantage of Platform switching is it can control circumferential bone loss around implants. He concluded that platform switching needs further investigation and also noted several disadvantages of platform switching. The disadvantage being, that the components have similar designs and need adequate space to develop a proper emergence profile.

Rationale of platform switching

- It moves the implant abutment junction (IAJ) medially.
- Allows biological width to be established horizontally.
- It shifts the stress concentration zone away from crestal bone

Switching the platform

Platform Switching can be achieved by

- Using abutments with a diameter smaller than the implant neck or body width (Figure 1) (Singla *et al*., 2015).
- Using an implant design where the neck diameter is increased with respect to the implant body width (Figure 2) (Singla *et al*., 2015).
- Using inherently platform‑switched implants and conical emergence abutments, with a variable height of 1.5-2 mm, freeing the extension of the implant platform between 0.5-0.75 mm (Figure 3) (Canay and Akça, 2009).
- Using implants with a reverse conical neck (Figure 4) (Carinci *et al*., 2009), referred to as Bone Platform Switching.

Figure 1. Platform-switched implant, with an abutment diameter less than the implant platform diameter

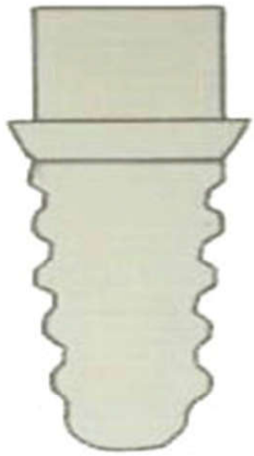

Figure 2. Expanded implant platform with equal implant and abutment diameter

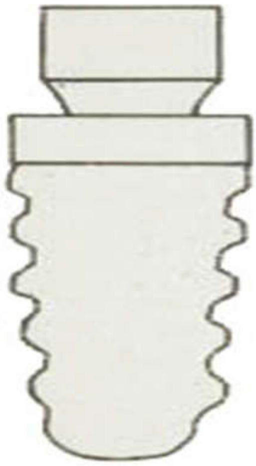

Figure 3. Inherently platform-switched implants using conical emergence

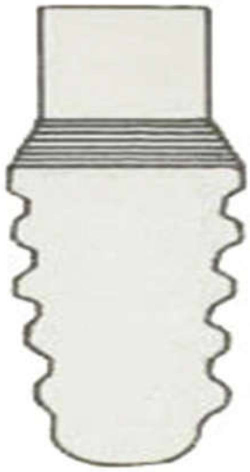

Figure 4. Implant with a reverse conical neck abutments

Applications

- In situations where larger implant is desirable but prosthetic space is limited
- In the esthetic zone where preservation of crestal bone can lead to improved esthetics
- Where shorter implants must be utilized.

Advantages

- Formation of a leak-proof peri-implant soft tissue cuff.
- Improve esthetics as crestal bone preservation helps preserve papilla Maintenance of the mid facial bone height which helps to maintain facial gingival tissues.
- Less shear force exerted on the cortical bone in the PS model.
- Improved Bone Support for Short Implants.

Disadvantages

- Need for sufficient space to develop a proper emergence profile.
- It increases the stress in abutment or the abutment screw.

DISCUSSION

(Adell *et al.*, 1981) did a retrospective study and noted that 1.2mm marginal bone loss from the first thread during healing and in the first year after loading with an average bone loss of 0.1mm annually thereafter. In addition, (Berglundh and Lindhe, 1996) studied peri implant soft tissue dimensions in beagles and concluded that an adequate biologic mucosal barrier was necessary to protect the bone. This mucosal barrier consists of sulcular epithelium (1.5-2mm) and connective tissue (1-2mm) rich in collagen fibers but poor in cells. (Herman *et al.*, 2001) demonstrated that when a bone loading surface that had been sandblasted and acid etched extended coronally within 0.5 mm of IAJ, the location of newly formed crestal bone remain constant. This finding provides direct evidenced that the biological process result in the formation of the biologic dimensions has greater capacity to resorb bone than does the ability of fixture to resist resorptive process. (Todescan *et al.*, 2002) stated that when the IAJ is placed more deeply in the bone, vertical bone loss increases. However the final position of the crestal bone from the IAJ never exceeds 2 mm.

(Vela-Nebot *et al.*, 2006) concluded that platform switching improves aesthetic results and when biological width violation is less, bone loss also get reduced ($p<0.0005$). He also said that further microbiological, pathological and clinical studies are required to confirm both these results as well as the study's working hypothesis. Markus (Hurzeler *et al.*, 2007) concluded that platform switching seemed capable of limiting crestal resorption and preserving peri-implant bone level. Another study by (Cappiello *et al.,* 2008) observed that vertical bone loss for the platform-switched cases varied between 0.6 and 1.2 mm (mean: 0.95 ± 0.32 mm), where as for the non-platform switched cases, the bone loss was between 1.3 and 2.1 mm (mean: 1.67 ± 0.37 mm).An average of 1–2 mm of bone loss occurs in non– platform-switched implants as compared to platform-switched implants. Rodriguez (Ciurana *et al.*, 2009) did a finite element analysis and concluded that platform switched implant with an internal hexagon connection; showed the smallest distortions in stress distribution after bone modeling as compared to other platform switched model with external hexagon connection and also the design, with smaller-diameter abutment with larger-diameter implant showed better results.

(Degidi *et al.*, 2008) assesed the histology and histomorphology of three morse cone connection implants in a real case report and explained that when there is zero microgap and no micromovement, platform switching shows no resorption. The combination of features some implants system (Ankylos) have the one size diameter abutment,90° step external implant–abutment connection and a Morse taper internal connection decreased the crestal bone resorption, assured a bacteria proof seal and diminishes peri-implant inflammation. (Maeda *et al.*, 2008) used a 3D finite element model and examined the biomechanical advantages of platform switching. He noted that this procedure shifts the stress concentration away from the bone-implant interface, but these forces are concentrated more in the abutment or the abutment screw. (Luango *et al.*, 2008) examined biopsy specimen and found out the biological process occurring around platform switched implants. They observed that inflammatory connective tissue infiltrate was confined over the entire surface of the implant platform and approxiamately 0.35mm coronal to IAJ but did not reach the crestal bone, which may be the reason for crestal bone preservation by platform switching.

Jason (Schrotenboer *et al.*, 2009) manufactured a two-dimensional model to analyze the bone–implant interactions under masticatory forces. Two abutment diameters, 4.5 mm representing platform switching and 5 mm representing a standard platform, were used in conjunction witha 5-mm diameter fixture. A 100 N force was applied vertically and obliquely to the abutments. They concluded that when vertical forces and oblique forces of 100N were applied to platform switched (4.5mm) and standard platform (5mm); decreases in Von Mises stresses in the crestal region of cortical bone in the platform switched implant but needed further clinical trials before any firm conclusion could be drawn. (Hsu *et al.*, 2009) did a finite elements study in three dimensions and concluded that platform switched implants transmit 10% less prosthetic loading forces to the bone-implant interface. (López-Marì *et al.*, 2009) analysed published articles dealing with platform switched implants in order to assess survival rates and clarify their influence on the marginal bone loss and on soft tissue. The Authors concluded that the platform switching is capable of reducing crestal bone loss to a mean of 1.56 mm ± 0.7 mm;

it also contributes to maintaining the width and height of crestal bone and the crestal peak between adjacent implants. (Wagenberg *et al*., 2010) did prospective study about implant survival and crestal bone levels around implants that used the platform – switching concept, with a follow-up period ranging From 11 to 14 years. The results of this research showed that 99% of all the surfaces examined had ≤ 2.0 mm of bone loss over this observation period, confirming that the platform switching concept was effective in preserving interproximal crestal bone levels. (Cocchetto *et al*., 2010) studied both clinically and radiographically the biologic effect of using wide platform-switching restorative protocol in human. The results of this preliminary study showed that, when properly selected, patients receiving wide platform-switched implants may experience less crestal bone loss than that resulting from the use of regular platform-switching ornon-platform-switching approaches. In the study by, (Bilhan *et al*., 2010) they compared bone around platform-switched and regular platform implants that supported removable prostheses and found that, after a period of 36 months, the marginal bone loss was significantly lower in platform-switching situations.

Conclusion

Once the implant is exposed to the oral environment bone remodels downward along the implant body and then stops at some predefined position. Such changes in crestal bone height have been attributed to implant loading and concentration of forces, the counter sinking procedure during implant placement, and localized soft tissue inflammation. Various methods have been tried to overcome this problem that includes submerged implant technique, bone grafts/bone crushes, usage of sealants to reduce the bone loss around the crestal region, apart from modifying the design of the implants around the collar region. The use of prosthetic abutments with a reduced diameter in relation to the implant diameter (platform switching) limits the crestal resorption usually observed during the year following loading. It not only maintains the biological width but helps in improved esthetics by preserving the interproximal papilla. So, Platform switching should be clinically applied in every case of implant placement if clinical situations permit. Though the survival rate of matched and platform switched implants are similar, further long term longitudinal studies are required to validate this concept.

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