PLATFORM SWITCHING: A SYSTEMATIC REVIEW

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BACKGROUND: The platform switching concept involves the reduction of the restoration abutment diameter with respect to the diameter of dental implant. Long-term follow up around these wide-platforms showed higher levels of crestal bone preservation.

AIM: The aim of this article is to carry out a literature review of studies which deal with the influence of platform-switched implants in hard and soft oral tissues.

MATERIALS AND METHODS: All papers involving "platform switching" that are indexed inPubmed were used. Clinical cases, experimental and nonexperimental studies were included, as well as literature reviews.
RESULTS: Literature search revealed studies involving concepts of platform switching, influence of platform switching and studies with histological and finite element analyses regarding platform switching.
CONCLUSIONS: All papers written by different researchers show an improvement in peri-implant bone preservation and satisfactory aesthetic results. Further long-term studies are necessary to confirm these results.

INTRODUCTION

The most important criterion for the success of dental implant is the presence of good amount and quality of bone around the implants, especially the crestal bone. However, early peri-implant bone loss has been commonly observed. Adell et al1 were the first to quantify and report marginal bone loss. Their studyindicated greater magnitude and occurrence of bone loss during first year of prosthetic loading.Crestal bone preservation should be thought of even before the treatment planning for implant placement. Various approaches have been described in the literature to prevent the crestal bone loss, Platform switching is one of them. The platform switching concept is based on the use of an abutment smaller than the implant neck; this type of connection moves the perimeter of IAJ to the center of implant axis. It is likely that moving the IAJ inward brings out bacteria more internally and, therefore, away from the bone crest; this would explain the limitation in bone resorption.

MATERIAL AND METHODS

The present study offers a review of the literature dealing with the impact of platformswitched implants on the oral hard and soft tissues. To this effect, a Medline search was carried out, using the PubMed search engine with the key words "platform switching", "crestal bone loss', biologic width", "crestal bone remodeling", "bone implant contact (BIC)" and, as well as combinations of these key words.The principal aspects of the consulted articles refer to the factors affecting crestal bone loss, platform switching concept and behavior ,importance of platform switching on preservation of crestal bone loss its microstructuraland its clinical relevance .A total of 20 articles were analyzed out of which 1 was 3D finite element study and 1 was 2D finite element study .

INFERENCE

Marginal bone loss seems to be unavoidable after implant placement. This is especially true after abutments are connected. It has been suggested that asuccessful implant might lose an average of 1.5 mm of bone during the first year in function and less than 0.2 mm annually in subsequent years.1–3The causes of marginal bone loss are complex, with a combination of mechanical and biologic factors contributing to crestal bone loss.

Factors affecting crestal bone loss :3,4

1)Surgical trauma :Wildermann et al reported that bone loss due to periosteal elevation was restricted to the area just adjacent to the implant, even though a larger surface area of the bone was exposed during surgery. Surgical trauma is unlikely to cause early crestal bone loss.

2)Microgap : The crestal bone levels are dependent upon the location of the microgap and are approximately 2 mm below it.

3)Biologic width : It acts as a barrier and seals against bacterial invasion and food debris ingress into tooth tissue interface .

4)Crest module : A smooth crest module may actually contribute to the crestal bone loss. A smooth, parallel-sided crest module may result in shear stresses in this region, and an angled crest module of more than 20 degrees with a surface texture that increases bone contact might impose a slight beneficial compressive and tensile component to the contiguous bone and decreases the riskof bone loss.

In an attempt to improve long-term bone maintenance around implants, a new implant-to abutment connection referred to as "platform switching" has been proposed.

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In 1991, the 3i Implant Innovations Inc. (Palm Beach Gardens, FL) introduced wide diameter 5.0 and 6.0 mm implants that had identically dimensioned platforms. These were designed to be used mainly for poor quality bones to achieve improved primary stability. However, when introduced, there were no matching wide-diameter prosthetic components available, and as a result, most of the initially placed implants were restored with standard 4.1 mm diameter components, which created a 0.45 mm or 0.95 mm circumferential horizontal difference in dimension. Many platform switched restored implants exhibited no vertical loss in crestal bone height. Thus, the discovery of the concept was a coincidence.4

The mechanism by which platform switching can contribute to maintain the crestal bone height could be due to four reasons discussed below:

- Shifting the inflammatory cell infiltrate inward and away from the adjacent crestal bone.
- Maintenance of biological width and in-

creased distance of IAJ from the crestal bone level.

- The possible influence of micro-gap on the crestal bone is diminished.
- Decreased stress levels in the peri-implant bone.

Implant abutment connections are based on the design model allowing for a clearance fit, which permits the two parts (abutment and implant) to fit together. The very nature of this "clearance fit" creates a microgap, both microscopically and macroscopically. this microgap not only allows for movement of bacteris and their toxins to and from the abutment-implant external interface, but also allows for micromovement of the abutment within the implant.4

Micromovement can create movements and stresses on the abutment screw which causes loosening and a "micropumping effect" that expels additional bacterial byproducts and toxins at implant-soft tissue interface and eventually at the osseous crest. With a concentration of toxins, the body's defenses come into play, including increased inflammatory cells at the osseous crest, causing soft tissue detachment and crestal bone loss. The implant design that displays the smallest microgap consists of dental abutment connections called the "press fit", "conus", or conical connections.6

In a recent article in Implantologic, Zipprich and coworkers observed micromovements at the implant abutment interface when average occlusal forces were placed on them. All but a few conical designs showed broad evidence of a developing microgap on loading, micromovement and creation of the "micropumping effect" mentioned previously. The implant design that displayed the smallest microgap function fell into a second group of dental abutment connections called the "press fit", " conus", or conical connections.2 Press fit designs employ the "Moser taper" connection. This conical connection is used in several implant designs of various lengths and angles. This allows for a bacterial seal unlike the "clearance fit" connection and nearly eliminates micro-movement. Retention of the abutment, elimination of the microgap and micromovement are all achieved by the "press fit" conical connection. This allows this unique two-piece implant design with a "conus" connection to behave like a "one-piece" implant. A tight microgap and a lack of micro-movement will insure bone stability at or above the shoulder of the implant, thereby producing a lasting papilla and soft tissue contours around the implant crown.5,6its main clinical references are listed below:

1. Short implants

Shorter implants are usually required in the posterior aspect mandible with minimal bone height above the inferior alveolar canal. A higher failure rate has been reported for short implants. A potential explanation for this phenomenon is that after traditional implant placement, typical post-restorative crestal bone loss occurs and the shorter implant is left with less than ideal bone/implant contact. However, with placement of a platform switched implant, there may be less bone loss because the implant/abutment junction has been moved medially, away from the crestal bone. This offers the possibility of preserving more bone at the coronal aspect of the short implant and may increase the amount of bone/implant contact.7

2. The anterior esthetic zone

Tarnow et al. showed how the presence of the dental papilla is influenced by the distance between the implants. When two implants are placed close to each other (inter-implant distance 3mm or less8) the inter- implant bone height can resorb below the implant-abutment connection, reducing the presence of an inter-implant papilla. This effect the clinical result in the esthetic zone. Platform switching reduces the physiologic resorption, moving the microgap away from the inter-implant bone that supports the papilla. Maintenance of midfacial bone height helps to maintain facial gingival tissues. This helps to avoid cosmetic deformities, phonetic problems, and lateral food impactions.9

3. Effect on crestal bone stress levels in implants with microthreads

A finite element analysis was done to study the effect of microthreads and platform switching on crestal bone stress levels. It was reported that microthreads increase crestal stress upon loading13. When the concept of platform switching was applied by decreasing the abutment diameter, less stress was translated to the crestal bone in the microthread and smooth-neck groups. The study concluded that platform switching reduce stress to a greater degree in the micro thread model compared to the smooth-neck model.10

DISCUSSION:

Platform switching is one of the methods which reduces the crestal bone loss to a great extent. This was theorized by Lazzara and Porter[4]that the inward positioning of the implant-abutment interface allowed the biologic width to be established horizontally, since an additional horizontal surface area was created for soft tissue attachment. This meant that less vertical bone resorption was required to compensate for the biologic seal. Furthermore, this design might increase the distance between the inflammatory cell infiltrate at the micro gap and the crestal bone, thereby minimizing the effect of inflammation on marginal bone remodeling.

It was substantially contributed by Luongo[11] on biopsy specimen that an inflammatory connective tissue infiltrate was localized over the entire surface ofthe implant platform and approximately 0.35 mm coronal to the IAJ but did not reach the crestal bone, which may be the reason for crestal bone preservation by platform switching. In animal experiments Becker[16,17] could not differentiate the PLS and control groups statistically but concluded that PLS could prevent the apical down-growth of the barrier epithelium in 28 days.

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 assessed by López-Marì[12] . A study by Hürzeler[18] observed that a certain amount of bone remodeling occurred 1 year after final reconstruction. During the first year of loading the establishment of an abutment ICT may explain the crestal bone changes. However, biologic aspects such as the establishment of an adequately dimensioned biological width have also been observed to be associated with crestal bone resorption at sites with a thin mucosa.[15] Furthermore, there are several potential disadvantages of this procedure such as the need for components that have similar designs (the screw access hole must be uniform) and the need for enough space to develop a proper emergence profile.[19]

The bio mechanical advantages was noticed by Maeda[13] through 3D finite element model and noticed that this procedure shifts the stress concentration away from the bone-implant interface, but these forces are then increased in the abutment or the abutment screw.But,the force dissipation in the platform switching restoration is slightly more favorable in an internal than in an external junction, since it improves distribution of the loads applied to the occlusal surface of the prosthesis along the axis of the implant contributed by Rodriguez-Ciurana[14]

For stress at interface Canay[20] designed eight different implant–abutment connections. Implant–abutment micro-gap at bone level was hypothetically set-off inward toward the central axis of implant to create "diameter shifting" or "platform switching" concept. He concluded in his study that stresses are confined to the cortical bone region around the implant neck. For the designs with greater horizontal offset, intensity of stresses are higher at the abutment part resting above the bone level. Thus, platform switching may risk the mechanical properties of abutments if horizontal set-off is increased. Though decrease in abutment diameter decreases the stresses generated around the implant, the differences are very slight. He remarked that platform switching may not be related to changes in load transfer.

SUMMARY AND CONCLUSION

How important is the loss of crestal bone in the overall function and long-term performance of implants given that all other parameters are taken care of. Majority of the implants which have been having a successful tenure in the oral cavity over a span of several years are in fact non-platform switched. The clinician does need to consider an array of options and choose the best one for the patient and probably platform switched implants also happen to be one of the techniques that have to be carefully chosen especially if the restorative stresses are going to be concentrated on a smaller mass of restorative material.

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