Review Article

Platform switch dental implants – Search for evidence: An overview

R. Vijayalakshmi, T. Ramakrishnan[1]

Department of Periodontics, Meenakshi Ammal Dental College and Hospital, Maduravoyal, Chennai, [1]Department of Periodontics, AadhiParasakthi Dental College and Hospital, Melmaruvathur, Tamil Nadu, India

ABSTRACT

An implant prosthesis allows normal muscle function, and the implant stimulates the bone and maintains its dimensions in a manner similar to healthy natural teeth. Crestal bone loss can result in increased bacterial accumulation resulting in secondary periimplantitis which can further result in loss of bone support, which in turn can lead to occlusal overload resulting in implant failure. In implant dentistry, platform switching is a method used to preserve alveolar bone levels around dental implants. The concept refers to placing restorative abutment of narrower diameter on implants of wider diameter, rather than placing abutments of similar diameter, referred to as platform matching. This article is a literature overview of studies on platform switch implants and their effect on crestal bone loss.

Key words: Implant abutment, microgap, periimplantitis, platform switch dental implants

INTRODUCTION

The goal of modern dentistry is to provide patients with good oral health in a predictable fashion. The partial and completely edentulous patient may not have normal masticatory function, good esthetics, and phonation with a traditional removable prosthesis. When wearing a removable denture, usually the patients masticatory ability will be reduced to one-sixth of the level formerly experienced with natural dentition.[1] An ideal implant prosthesis can bring back normal muscle activity and thereby improving the masticatory function to near normal limits as well it stimulates the bone and maintain its dimension in a similar way done by healthy natural teeth.

The most important criteria for the success of dental implants are the presence of good quantity and quality of bone around the implants. Adell *et al.*[2] were the first to qualify and report marginal bone loss. Their study indicated greater magnitude and occurrence of bone loss during the 1st year of prosthetic loading.

Crestal bone preservation should always be considered while planning for implant placement. Crestal bone loss can result in increased bacterial accumulation resulting in secondary peri-implantitis and loss of bone support, which leads to occlusal overload resulting in implant failure. Apart from this, resorption of marginal bone will affect the gingival contours and may result in loss of inter proximal papilla.

Address for correspondence:
Dr. R. Vijayalakshmi,
Department of Periodontics, Meenakshi Ammal Dental College and Hospital, Maduravoyal, Chennai - 600 095, Tamil Nadu, India.
E-mail: srvijayalakshmi@rediffmail.com

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In implant dentistry, platform switching (PLS) is a method used to preserve alveolar bone levels around dental implants. The concept refers to placing restorative abutment of narrower diameter on implants of wider diameter, rather than placing abutments of similar diameters, referred to as platform matching (PLM).[3]

This article is a literature review of the rationale, benefits, and application of platform switch implants (PLSI) and includes a discussion of studies conducted till date.

HISTORY

Discovered by accident in the late 1980's, the benefits of PLS have become the focus of implant related research with increasing frequency. It can be considered a means of preventing initial peri-implant bone loss.

Introduction of wide diameter implants in the late 1980s created a situation, in which mismatch standard diameter abutments were used simply because of lack of commercial availability of components to match the wide-diameter implants. The consequence of this form of treatment was an unintentional "change of platform," which became known as "PLS."

Serendipitously, it was found that these implants exhibited less than expected initial crestal bone loss. Several early clinical reports demonstrated enhanced soft and hard tissue responses to these platform-switched implants, leading many implant companies to incorporate PLS into their implant systems even for narrower body implants.

RATIONALE

It has been observed that some degree of bone resorption occurs at the crest of bone following implant placement. Bone resorption around the implant neck depends on both biological and mechanical factors such as surgical trauma to the periosteum, characteristics of the implant neck design, location of the implant abutment junction (IAJ), micromovements of the implant and prosthetic components, size of the microgap between the implant and abutment, bacterial colonization of the implant sulcus, biologic width, and imbalance in host parasite equilibrium.

The remodeling of crestal bone occurs in response to the stress that develops between the neck of an implant system and cortical bone. Since cortical bone is 65% more susceptible to shear forces than compressive forces, the bone loss may be explained by the lack of mechanical stress distribution between the coronal portion of the implant and the surrounding bone.[4] Peak bone stress that appear in marginal bone have been hypothesized to cause bone microfracture and may be responsible, at least in part, for peri-implant bone loss with saucerization patterns after prosthetic loading.

Prevention of horizontal and vertical marginal peri-implant bone resorption during the postloading period is fundamental in maintaining stable gingival levels and profiles around implant-supported restorations. Reduced stress in the coronal portion of PLSI helps to prevent crestal bone loss.[5]

Also, the extent of bone resorption is related to both the surfaces of the implant and abutment and the morphology of the IAJ. A number of investigations have zeroed on the proposed inflammatory cell infiltrate that forms a zone around the IAJ. The IAJ is always encircled by an inflammatory cell infiltrate (0.75 mm above and below the IAJ). To protect the underlying bone from this inflammatory infiltrate and microbiologic invasion, 1 mm of healthy connective tissue is needed to establish a biologic seal comparable to that around natural teeth.[6] Thus, the current theory of the benefit of PLS is related to the physical repositioning of the IAJ away from the outer edge of the implant and the surrounding bone, thereby containing the inflammatory infiltrate within the width of the platform switch.

Also, the magnitude of the implant abutment diameter mismatch makes a statistically significant difference in bone levels when the implant abutment diameter mismatch was >0.8 mm, providing a 0.4 mm circumferential width of platform switch when the center of the abutment is aligned with and fixed to the center of the implant.

HOW PLATFORM SWITCH HELPS

It results in a circular horizontal step, which enables a horizontal extension of the biologic width and diminution in alveolar bone loss reduced the potential influence of microgap on the crestal bone and decreased stress levels in the peri-implant bone and increases the force in and around the screw.[7] Also, provides the clinician with additional surgical and prosthetic treatment options for use with wide diameter implants [Figure 1].

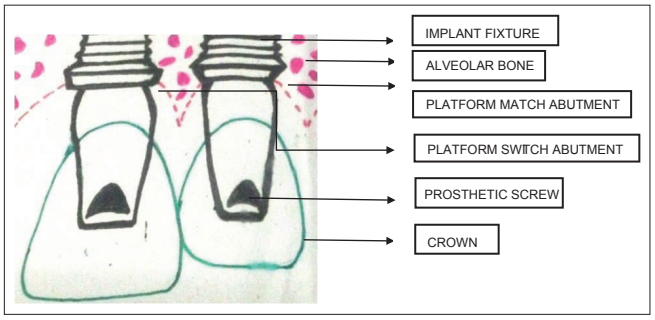

Figure 1: Platform switch implant versus platform match implant

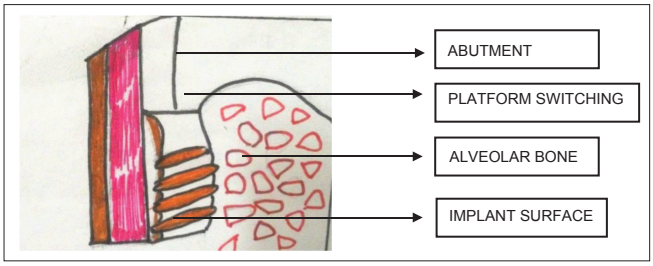

Figure 2: Platform switch implants in relation to alveolar crest

BIOLOGIC WIDTH AND PLATFORM SWITCHING

The peri-implant soft tissue seal comprises of a junctional epithelium and connective tissue. This biologic soft tissue coats the implant supporting bone in a 3–4 mm wide zone. Tarnow *et al.*, showed that not only this width progresses apically, but also a lateral component of the biologic width exists around implants. This lateral component varies from 1.04 mm when two adjoining implants are placed <3 mm apart to 0.45 mm when the implants are placed more than 3 mm apart.[8]

The thickness of bone loss that exists as a halo around the implant at its most coronal aspect has been termed the horizontal component of the biologic width, and it is approximately 1.4 mm [Figure 2].

If the implants are placed too close together, the overlap of the horizontal components of each implants biologic width serves to increase the effective vertical crestal bone loss between the implants.

By PLS implants can be placed closer to teeth and to each other while maintaining more crestal bone. PLS has been shown to have the potential to reduce the vertical bone resorption by as much as 70%.

INDICATIONS FOR PLATFORM-SWITCHED IMPLANTS

- If anatomic structures limit the residual bone height
- Where implants are placed <3 mm apart in narrow edentulous ridge
- If shorter implants are used in atrophic areas
- To achieve good esthetic results in anterior maxilla.[9]

ADVANTAGES

- Inflammatory cell infiltrate which surrounds the IAJ in a collar-like fashion is contained within the angle formed at the interface, and thus prevented from spreading further apically along the implant resulting in inflammatory changes to bone crest
- The horizontal dimension of the step allows for an additional area where biologic attachment can take place, thus limiting the extent of physiologic remodeling of the bone crest needed to accommodate the biological zone
- Optimal management of restorative space with the crestal bone preserved both horizontally and vertically, thus support is retained for the interdental papillae. Maintenance of midfacial bone height helps to maintain facial gingival tissues
- Improved bone support for shorter implants.[9]

DISADVANTAGES

- Need for components that have similar design
- Need for sufficient space to develop proper emergence profile.[9]

The microbiota associated with implants restored with platform switching

Canullo *et al.*, in 2010[10] examined differences between the composition of the peri-implant microbiotas associated with implants restored with the platform-switching approach and implants restored with a standard internal connection protocol. 48 implants were examined in 18 subjects, of which 33 implants were restored with PLS, and 15 implants were restored using the traditional approach. Thirty-six months after prosthetic loading, subgingival plaque samples were taken from the mesio- and disto-buccal aspects of each implant and from one tooth adjacent to one of the implants in each subject. The levels of 40 subgingival species were measured using checkerboard DNA-DNA hybridization. Microbiologic parameters were averaged within each subject and across subjects in each clinical group (PLS versus control) and site category (implants versus teeth) separately. There were no statistically significant differences between groups for any of the species. The platform-switching group showed a small trend for lower levels of early colonizer members of the *Actinomyces*, purple and yellow complexes, *Campylobacter* species, *Tannerella forsythia* (previously *Tannerella forsythensis*), and *Porphyromonas gingivalis*. Teeth and implants presented similar microbial profiles.

DISCUSSION

The presence of at least one well-conducted randomized controlled trial (RCT) is considered the highest level of evidence. In this article, we have reviewed RCTs, controlled clinical trials (CCTs) and systematic reviews which have analyzed RCTs conducted until date in English only that compared platform-switched implants (PLSI) to platform-matched implants (PLMI) with a minimum follow-up period of 1 year.

A systematic review (also systematic literature review or structured literature review, SLR) is a literature review focused on a research question that tries to identify, appraise, select, and synthesize all high-quality research evidence relevant to that question. Systematic reviews of high-quality

RCTs are crucial to evidence-based medicine. Systematic reviews often, but not always, use statistical techniques meta-analysis (MA) to combine results of the eligible studies, or at least use scoring of the levels of evidence depending on the methodology used.

The following table lists out the various articles in this regard.

From the studies included in the table, it is evident that almost all studies are in favor of PLSI with respect to reduction of crestal bone loss except for the RConfounding factors not addressed in most of the studies are:

- Patient and site characteristics
- Implant/abutment geometry
- Dimension of the horizontal offset
- Surgical technique
- Prosthetic protocol
- Maintenance care
- Apico-coronal position of implants in relation to crestal bone
- The presence of various implant microtextures
- The degree of platform switch
- The reliability of examination methods.

Consensus statements regarding platform switching

- The detailed analysis of various studies regarding PLSI favored them since they were known to prevent or minimize marginal bone loss compared with PLMI
- It was recommended in the consensus that future studies should have a uniform and comparable study design, taking into account the effect of confounding factors
- Among the selected studies, there was a high degree of heterogeneity because the factors that influence bone levels were not balanced between the groups
- The factors to be explored in future studies are the long-term effect of PLS on soft tissue health and the biomechanical stability of the implant-abutment connection.[11-27]

Clinical recommendations regarding platform switching

- The indications for PLSI are the same as for PLMI
- Irrespective of the design of the implant–abutment connection, there is evidence of microleakage
- It is up to the clinician to choose a stable implant–abutment complex to minimize the potential impact of micromovement and microbial leakage on crestal bone remodeling.[27]

Implications for future research

- There is a need for more well-designed, randomized, parallel-arm CCTs to further evaluate the impact of implant–abutment configuration and the positioning of the machined collar/microgap on crestal bone level changes in humans
- In some systematic reviews, both animal and human studies are compared which is not practically acceptable
- Also, certain SLRs have confronted so much heterogeneity that MA is not feasible
- In some studies, when influence of PLSI on crestal bone loss had to be studied, control group was not included
- Also, there might be chances of publication bias that needs to be addressed
- Split-mouth studies should be recommended when two implant types are compared
- Universal guidelines should be set for a study involving dental implants. These guidelines should be simple, feasible and practical
- A complete set of guidelines for an implant study should be set up – based on the need of the study, whether it is histologic, *in vitro*, *in vivo*, animal, human, human or radiographic
- Most of the studies have not mentioned the power of the study that is considered essential before the start of the study
- The potential influence of relevant confounding clinical factors should be carefully addressed.[27]

CONCLUSION

Having reviewed the available literature, we have reached the conclusion that PLS contributes to maintaining the width and height of crestal bone and the crestal peak between adjacent implants and it also limits the circumferential bone loss. We conclude that the implant design modifications involved in PLS offer multiple advantages and potential applications, which includes situations where a larger implant is desirable but the prosthetic space is limited and in the anterior zone where preservation of the crestal bone can lead to improved esthetics.

Essential changes in studies including using the control group for accurate interpretation of results and long-term observation, particularly through randomized, prospective, multicenter trials with large numbers of participants and implants are necessary.

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Conflicts of interest

There are no conflicts of interest.

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