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Research Paper

Platform Shifting in Dental Implants: A Paradigm Shift in Peri-Implant Bone Preservation

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Abstract
The goal of modern dentistry is to provide patients with good oral health in a predictable fashion. The partial and completely edentulous patients may not have normal masticatory function, good esthetics and phonation with a traditional removable prosthesis. An implant prosthesis allows normal muscle function and the implant stimulates the bone and maintains its dimension in a manner similar to that of healthy natural teeth. Crestal bone loss can result in increased bacterial accumulation, resulting in secondary peri-implantitis. It can further result in loss of bone support, which leads to occlusal overload resulting in implant failure. Platform Switching for maintaining the peri-implant bone levels has gained popularity among implant manufacturers over the last few years. The platform switching concept involves the reduction of the restoration abutment diameter with respect to the diameter of the dental implant. The platform switching configuration led not only to a relative disease in stress levels compare to narrow and wide standard configurations, but also to a notable stress-free shift from bone towards the implant system, potentially resulting in lower crestal bone overloading. The purpose of this article is to review the biomechanical behavior of platform switching and its influence on bone crestal levels and on peri-implant soft tissues.

Keywords: *Crestal bone remodeling, Implant-abutment connection, Micro gap, Platform switch, Bone loss.*

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I. Introduction

Dental implants have achieved long term success due to osseointegration of highly biocompatible titanium integrating to the surrounding bone.[1] When wearing a removable denture, usually the patient's masticatory ability reduces to one-sixth of the level formerly experienced to natural dentition.[2]An ideal implant prosthesis can bring back normal muscles 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. Correct location of the soft tissues in dental implant restoration depends on the preservation of bone crestal height.

Consequently, the hard tissues are the principle determinant of esthetic outcome. Various studies indicated greater magnitude and occurrence of bone loss during 1st year of prosthetic loading.[3] In implant dentistry platform switching is a method which involves reducing the restoration abutment diameter, in comparison with the diameter of the dental implant. This concept also referred to as **Platform Matching (PLM).**

This article is a literature review of the rationale, benefits, and application of platform switch implants (PLSI).

History

The platform switching was accidentally established in 1980s and in early 1990s when different commercial dental implant manufactures introduced implants of larger diameter before producing the corresponding abutments of the same measures. 14 years later, evaluation of those Implants was done in which abutments of lesser diameters were used. This revealed better hard and soft tissue preservation than treatment in

which matched diameter abutments were used. The consequence of this form of treatment was unintentional 'change of platform' which 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 systems even for narrower body implants.

Rationale
Bone resorption around implant neck depends on the biological and mechanical factors such as:

- Surgical trauma to the periosteum
- Characteristics of the implant neck design
- Location of the implant abutment junction
- Micromovements of the implants
- Prosthetics components
- Size of the micro-gap between the implant and abutment
- Bacterial colonization of the implant sulcus
- Biologic width
- Imbalance in host parasite equilibrium

Various studies indicated greater magnitude and occurrence of bone loss during first year of prosthesis loading, averaging 1.2mm with a range of 0-3 mm.[3] Crestal bone loss can lead to increased bacterial accumulation resulting in secondary peri-implantitis which can further result in loss of bone support leading to occlusal overload and again crestal bone loss.[4] (Fig 1)

A number of investigations have zeroed on the proposed inflammatory cell infiltrate that forms a zone around the implant-abutment-junction (IAJ). IAJ is always encircled by an inflammatory cell infiltrate (0.75mm above and below the IAJ). To protect the underlying bone from inflammatory cell infiltrate and microbiological invasion, 1mm of healthy connective tissue is needed to establish a biologic seal comparable to that around natural tooth.[5]
Platform Switching: The use of smaller diameter abutment on a larger diameter implant collar is explained by the idea of 'platform switching'. This connection causes the implant perimeter to change the inward direction of central axis at the midway of IAJ. Implant innovations debuted 5-6mm diameter implants with matching restorative platforms (i.e. seating surface) in 1991. In cases where platform switching was used, the usual radiographic pattern of crestal bone resorption was not seen after 5 years. (fig.2)

How does it reduce the crestal bone loss:
According to Lazzara and Porter's theory, this happened because moving the IAJ inward also caused the inflammatory cell infiltrate to be relocated and contained inside a 90^0 region that was not next to the crestal bone. However, it was believed that more research was necessary to demonstrate the true benefits of this method.[6]
It produces a circular horizontal step that allows the biologic width to be extended horizontally, decreases alveolar bone loss, lessens the possibility that a micro-gap will affect the crestal bone, lowers stress level in the peri-implant bone, and increases the force in and around the screw.[7] (Fig.3)

Biologic width and Platform Switching: The junctional epithelium and connective tissue make up the peri-implant soft tissue seal. A 3-4mm wide zone of this biologic soft tissue covers the implant supporting bone. According to Tarnow et al. the biologic width around implants has a lateral component in addition to progressing apically. When two adjacent implants are positioned < 3mm apart, the lateral component is 1.04mm, when implants are positioned more than 3mm apart, it is 0.45mm. [8] (Fig.4)
The primary factors influencing the biologic width's stability are implant type (one versus two piece) and the crestal bone which further impacts the peri-implant tissue's state of health and eventually the implants long term success counselling.

The horizontal component of the biologic width is the thickness of bone loss that surrounds the implant at its most coronal aspect and measures about 1.4mm.
The overlap of each implant's horizontal biologic width components increases the effective vertical crestal bone loss between implants if they are positioned too closely together.
With PLS, implants can be positioned nearer to one another and to teeth while preserving more crestal bone. It has been demonstrated that PLs can potentially reduce vertical bone resorption by up to 70%. (Fig.5)

Indications for platform switched implant:

- If residual bone height is limited by anatomic structures
- In case of narrow edentulous ridge where implants are placed <3 mm apart
- If shorter implants are used in atrophic areas
- In anterior maxillary region where esthetic is major concern.[9]

Advantages:

- The angle produced at the interface confines the inflammatory cell infiltrate that surrounds the IAJ in a collar-like manner, preventing it from extending further apically along the implant and causing inflammatory alteration to the bone crest.[10]
- The horizontal dimension of the step provides more space for biologic attachment, which reduces the amount of bone crest physiologic remodeling required to make room for the biologic zone.[11]
- Optimum administration of healing environments. The interdental papillae continue to have support since the crestal bone has been intact in both horizontal and vertical direction. Preserving the height of midfacial bone contributes to gingival tissues of the face.
- Improved bone support for shorter implant.[12]
- Shifting the junction inward from the bone crest may reduce the potential impact of micro gap on bone resorption.[6] (Fig.6)

Disadvantages

- Need for the component that have similar design
- Need for sufficient space to develop proper emergence profile.[13]

Soft tissue responses:

The creation of new biological space has been the most extensively researched theory among those put forth to explain the remodeling of maxillary bone following the implantation of dental implants. As a defensive mechanism, the development of this mechanical barrier stops germs from the oral environment from penetrating. There are histological distinctions in the arrangement and dispersion of fibers, resulting in a larger biological gap between an implant and a normal tooth. The biological space of an epicrestal implant forms at subcrestal level, whereas the space in a normal tooth form at supracrestal level. These distinctions are not limited to location.[14] The microstructure of the IAJ and micro and macro structure of the neck determine the morphology of the gingival margin. These factors are also influenced by implant design. According to Tarnow et al. 2010 demonstration, maintaining a 3mm between implants provides enough margin to restore the biological space of both restorations.

Bone crest is seen to be 57% greater in implants with an extended platform integrated into their macrostructure and ensuring the previously indicated spacing between implants than in typical restoration designs.[15]

1mm away from IAJ, a void is formed in horizontal plane and supported by the platform's outside edge. Furthermore, with a 50% decrease in occupation surface, this process prevents the inflammatory infiltration from approaching the crestal bone boundary.[16]

II. Conclusion

Platform switching is a valuable approach in dental implantology that can contribute to better esthetic and functional outcome by preserving bone and reducing marginal bone loss. By shifting the abutment platform inward, the stress distribution around the implant may be improved, leading to less bone resorption, especially in the first few years after implant placement. Also more favorable load distribution is achieved around the implant which may reduce the risk of implant failure or complications. It is important for dental professionals to consider individual patient needs, the quality of bone and other clinical factors before implementing this technique.

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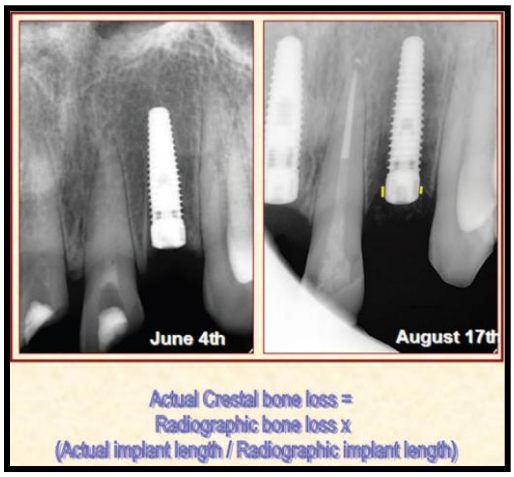

Fig. 1[4]

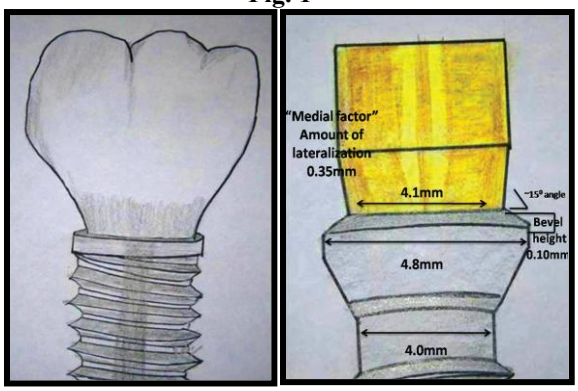

Fig. 2 ***Design details of platform switched implant restoration***[3]

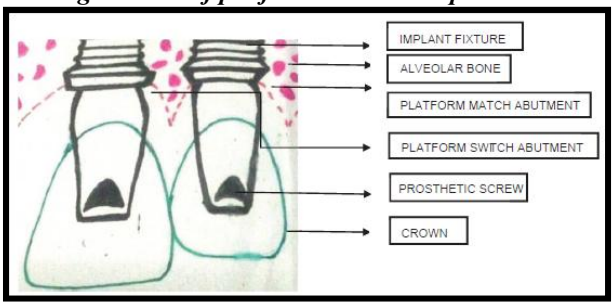

Fig 3[7]

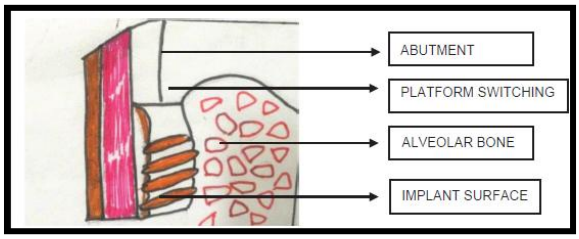

Fig 4[8]

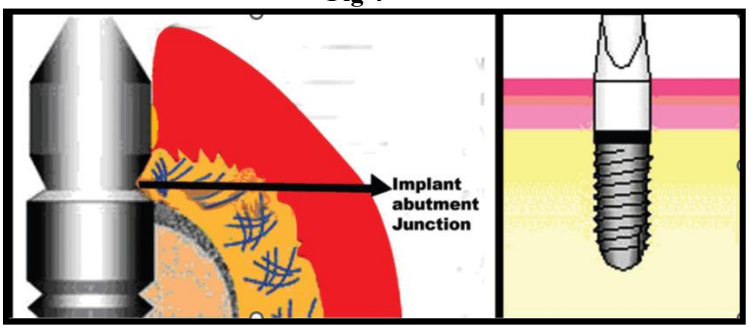

Fig.5 One piece versus two-piece implant[8]

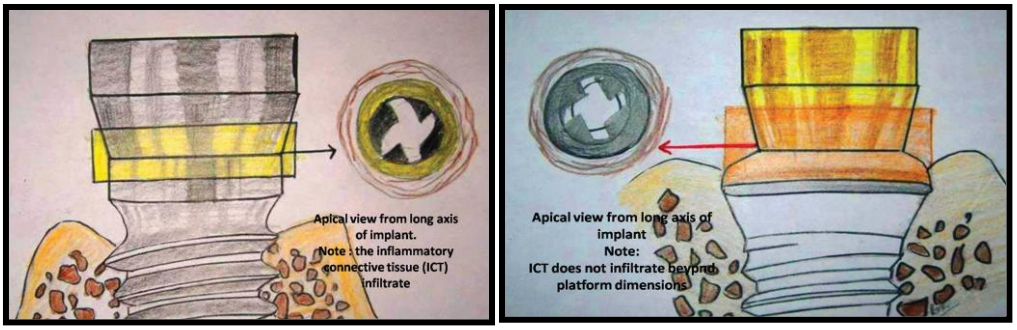

Fig.6[6]