

The concept of “platform switching” in implant dentistry

A literature review—Part II

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Discussion

There is an association between bone and soft tissue preservation around implants with direct influence on aesthetics.

Some authors have proposed different methods to maintain supporting bone: improved implant micro-geometry and implant surface treatment, improved implant abutment connection (elimination of bacterial reservoir, absence of movements under bending forces) as well as the use of wide implants with smaller sized abutments (platform switching concept).

An alternative in preserving marginal bone levels around implants is the platform switching concept that refers to the use of a smaller diameter abutment on a larger diameter implant platform. This connection shifts the perimeter of the implant–abutment junction (IAJ) inward towards the central implant axis.

Lazzara and Porter demonstrated that the inward movement of IAJ also shifts the inflammatory cell infiltrate inward and away from the

bone implant interface, creating a horizontal biologic width that will limit bone resorption around the coronal aspect of the implant.

From a biomechanical perspective, stress in the bone is concentrated around the crestal region because of the difference in modulus of elasticity between bone and implant, as demonstrated in photo - elastic and finite element analysis studies.¹⁴

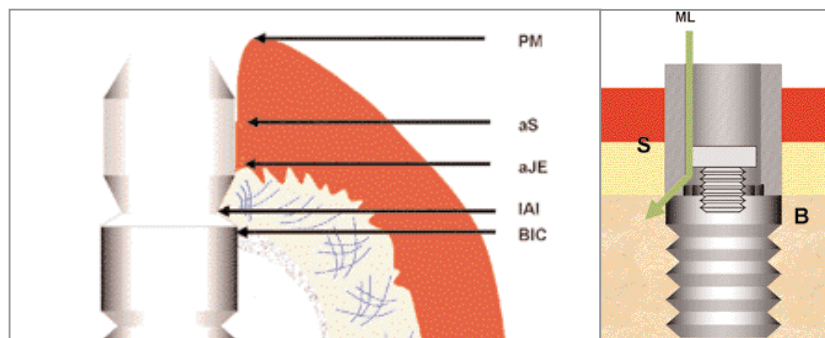
Peak bone stresses occurring in marginal bone have been hypothesized to cause bone micro-fracture and may be responsible, at least partially for peri-implant bone loss with saucerization patterns after prosthetic loading.

The issue of whether platform switching may affect stress patterns by minimizing peak bone stresses in the marginal bone has not been demonstrated yet.

The original criteria established for assessing implant success and survival⁶ identified marginal bone levels as an important indicator for measuring the response of the peri-implant tissues to functional loading.

More recent studies have considered the effect of stresses established in bone by the direct influence of non passive prosthetic work to be a causative factor in marginal bone loss.^{7,8}

Another more recent explanation of marginal bone loss is the theory of establishing the biologic width directly related to the position of the implant-abutment microgap and its associated microbial flora.^{9,10}



In addition, some studies have shown that certain designs in the geometry of implant coronal part may contribute to bone loss, while other studies have indicated that such bone loss can be prevented by incorporating a biomechanical stable connection and a more retentive surface on the implant collar.^{11, 12}

Prevention of horizontal and vertical marginal peri-implant bone resorption during the post-loading period is fundamental in maintaining stable gingival levels around implant-supported restorations.¹³ It has been demonstrated that peri-implant marginal bone loss is time-related with significantly more acute bone loss during the preloading period than in the following loading phases (two years after surgery) and also during the first year after loading (six months to one year after surgery) than in the second one (one year to two years after surgery).

Aesthetic outcomes cannot be attributed to a single parameter. They are the result of a number of important factors, especially in the aesthetic area.

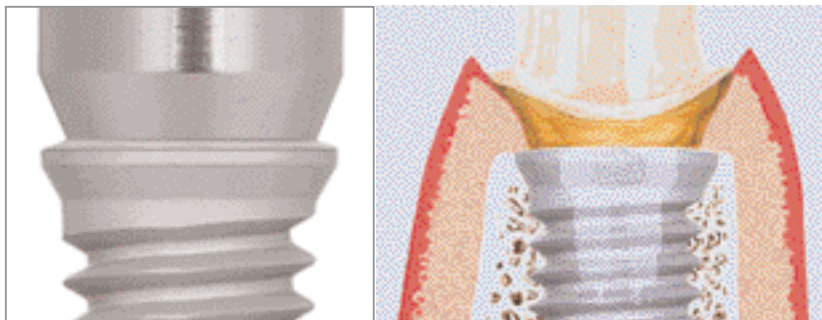
Both biologic width and the integration of platform switching concept are of utmost significance in preserving a stable marginal bone level around implant neck. It is important to understand mainly the meaning of biologic width.

Hence, the stable bone serves as a support for the soft tissue determining the long-term aesthetic and functional treatment, the outcome stability being ensured in this manner.

The following points should be noted:

- The use of a single post for temporary and final prosthetic work;
- As long as the frequent replacement of parts is not avoided, repeated destruction of the connective-tissue attachment of the biologic width occurs increasing the risk of bone resorption;
- A special implant and abutment design (a ledge and integration of the biologic width/tapered shape of the post) facilitates nonsurgical lengthening and thickening of the peri-implant soft tissue.

This leads to the establishment of a wider and more resistant zone of connective tissue. A micro-rough and nano-rough titanium surface extending to the implant shoulder in conjunction with the platform switching concept provides osseous integration along the entire length of the implant.



A fine thread optimally distributes the masticatory forces in the region of the implant neck, avoiding further bone loss in this region.¹⁵

Possible interactions amongst factors contributing to peri - implant bone loss.

These factors include:

- Surgical and anatomical considerations such as mucoperiosteal flap design, thickness of buccal and lingual cortical plates of bone remaining after osteotomy preparation, bone quality, healing technique submerged or non-submerged, early unintentional cover screw exposure by mucosal dehiscence and amount of keratinized Gingiva;
- Patient risk factors such as medical and pharmacological status, habits including cigarette smoking, poor oral hygiene, excessive alcohol consumption, mucosal erosive pathology like lichen planus, previous or present periodontitis (chronic or aggressive);
- Biologic width related factors such as level of the micro-gap, platform switching and implant-tooth or implant-implant distance;
- Implant design including geometry, surface, length and diameter;
- Biomechanical factors including time of loading, type of loading, type of prosthesis, habits like bruxism.

Flap design

It was reported in the literature long time ago³² that, whenever a mucoperiosteal flap is reflected about a tooth, some crestal bone resorption will occur. Similarly elevating a flap to place a dental implant will lead to crestal bone loss and there is evidence suggesting a direct relationship between size of full thickness flap and the resulting post op bone loss.

Other studies³³ reported no statistically significant differences using more traditional histological evaluation of retrieved specimens after twelve weeks of site healing. Becker reported the same magnitude of difference in buccal vertical



bone loss as Jeong, one millimeter less for flap-less approach.

Alveolar bone thickness

The main blood supply for buccal alveolar bone is supplied by vessels in the overlying muco periosteum³⁴ and is greatly affected by elevating a full thickness flap to facilitate placement of a dental implant. Studies suggest that if residual facial bone thickness is less than 2 mm and/or if dehiscences or fenestrations of facial bone occurred during osteotomy preparation, consideration should be given to augmenting facial bone thickness with GBR procedures.^{35,36}

Premature exposure of an implant cover screw through the overlying mucosa may result where mucosal tissues fail to achieve primary closure, or are too thin to avoid dehiscence, or have been traumatized with the transitional prosthesis. It was reported in the literature that patients with prematurely exposed cover screws suffered 3.9 times greater bone loss than non-exposed ones.³⁷

Quantity of keratinized tissue

Adequate keratinized tissue may be more important around implants than natural teeth for several reasons: supracrestal collagen fibers are oriented in a parallel rather than in a perpendicular configuration adjacent to transmucosal surfaces of implants³⁸, providing less resistance to local trauma and microbial penetration. Peri-implant mucosa may have a reduced capacity to regenerate itself due to compromised number of cells and poor vascular supply.³⁹

Oral hygiene, smoking, alcohol abuse

Patients with poor oral hygiene and/or existing periodontal disease experience greater peri-implant crestal bone loss than patient with good oral hygiene and stable periodontal status. Both

current and lifetime cigarette are associated with deterioration in bone quality and impaired wound healing.⁴⁰ Smoking has been shown to be one of the most significant factors predisposing to implant failure.⁴¹ Individuals who use alcohol in excess may have inadequate nutrition including vitamin deficits which may compromise initial site healing.⁴²

Diabetes

It is well known that diabetic patients are at higher risk for developing periodontitis and are also more prone to infection.⁴³ It is very likely that performance of dental implant will be affected as well. Poor metabolic control in diabetic patients increases the risk of peri-implantitis.⁴⁴

Biologic width

Crestal bone remodeling to establish "biologic width" or soft tissue seal in peri-implant mucosal tissues is considered to be an important factor contributing to early crestal bone loss with all types of endosseous dental implants (Fig. 4).^{45,46}

Factors known to affect this crestal bone loss include the level of micro-gap in relation to the bone crest, platform switching achieved either by implant body design and/or by using an abutment smaller in diameter than the implant body and tooth-implant or inter-implant horizontal distance. Another factor with deleterious effect on crestal bone resorption is considered to be the repeated removal and replacement of abutments because of disruption of the soft tissue seal.⁴⁷

The biologic width has changed horizontally within the platform switched implant.

Level of the micro-gap

The connection between implant body and prosthetic abutment is termed "micro-gap" and, in most cases, it is susceptible to microbial seeding and micro-movements between the parts during clinical function. Both micro-gap and micro-movements may lead to localized inflammation and associated crestal bone loss if the micro-gap is within a minimum distance from the alveolar crest. Biologic width around the neck of a dental implant constitutes a mucosal seal intended to protect the underlying bone. It is formed apically to the micro-gap and requires a minimum of about 1.5 mm of fibrous connective tissue between bone and epithelial attachment of the gingival sulcus of the implant (Fig. 5).^{48,49}

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Platform switching

This design feature can be created in an implant body or achieved by the clinician using a compatible abutment of a narrower diameter than the implant platform. It can be acquired even with the healing abutment in case of non-submerged approach. The purpose of platform switching is to create a horizontal component for the total linear distance between micro-gap and bone crest required for biologic width⁵⁰ and eventually to shift the stress concentration away from the cervical bone-implant interface.⁵¹

Generally, the horizontal component created by platform switching is around 0.5 mm (Fig. 6), sufficient to result in significantly less radiological detectable crestal bone loss in humans.^{51, 52} Not only does this concept reduce the risk of peri-implantitis in the future but also has the benefit in the aesthetic zone of providing better soft tissue support.⁵³

Implant-tooth or inter-implant distance

For single tooth dental implants, a minimum horizontal distance of 1.5 mm must be left between the implant and the two approximating tooth root surfaces in order to avoid crestal bone loss after biologic width accommodation.

When two implants are placed side by side, the crestal bone loss that occurs between them has a more complicated aetiology. First and foremost, inter-implant crestal bone loss will be affected by the horizontal distance between the two implants which should be minimum 3 mm (Fig. 7). It will also be influenced by the level of micro-gap, biologic width, and whether platform switching was used or not. A clear tendency for increased inter-implant vertical bone loss occurs as the distance between two implants decreases below 3 mm.^{54, 55}

Histological data from animal experiments using 2-piece, moderately rough surface, submerged implants, showed that vertical inter-implant bone loss decreased from 1.98 mm for a 2 mm inter-implant distance to 0.23 mm for 5 mm inter-implant distance.⁵⁶

Conclusion

Significant differences in marginal bone loss have been identified between implants with platform switching and implants without platform switching only in the first year after loading. It may be concluded that the platform switching concept represents a bone preserving technique.

Preservation of crestal bone around dental implants cannot be attributed to a single parameter. That is the result of a number of important factors, especially in the challenging aesthetic zone.

It is important to understand the mechanism that permits the implant-abutment connection to maintain a seal against the bacterial ingress before and after loading due to absence of micromovements.

An appropriate understanding of the importance of biologic width and the use of platform switching concept in the routine treatment is of real support in maintaining a more stable marginal bone level around implants.

This stable marginal bone as a support of the soft tissue is determinant for the long-term aesthetic stability.

Further neutral clinical studies are required to demonstrate the importance of micro-gap, biologic width and platform-switching in crestal bone preservation around dental implants.

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Editorial note: The literature list can be requested from the author.

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