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Platform switching for marginal bone preservation around dental implants: A systematic review

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Abstract
For maintaining peri-implant bone levels, Platform switching has gained popularity among implant manufacturers in the past few years. Greater magnitude and occurrence of bone loss during first year of prosthetic loading. However, the assumption that the inward shifting of the implant-abutment junction may preserve crestal bone was primarily based on serendipitous finding rather than scientific evidence. This paper reviews the literature regarding platform switching, the crestal bone preservation and its endurance.

Keywords: Platform switching, dental implants, crestal bone loss

Introduction
The integration between the implant and the intraoral hard/soft tissue determine the success of dental treatment, as implants are highly dependent on this factors. Successfully osseointegrated endosteal implants regardless of surgical approaches, the initial breakdown of the implant-tissue interface generally begins at the crestal region can cause implant failure [1]. One of the most important breakthroughs in contemporary dental practice in the oral rehabilitation of partially or fully edentulous patients, is the development of Osseo integrated implants. Branemark (University of Gothenburg, Sweden) and Schroeder (University of Berne, Switzerland), are the pioneers in this field who first proposed the concept of Osseo integration and functional ankylosis, respectively. In the past two decades, implant dentistry has subsequently seen some major advances. Extremely challenging aspect of dental implant therapy is the placement and subsequent restoration of implants in the esthetic zone. The crestal bone changes that commonly occur around endosseous implants and the subsequent soft tissue reaction to the osseous changes should be clearly understood by the dental practioner in order to decide the treatment to satisfy patient's esthetic expectations.

Biologic Width: Biologic width is the circumferential rim of space around teeth where the junctional epithelium and the under the combined width of connective tissue and junctional epithelial attachment formed adjacent to a tooth and superior to the crestal bone. A connective tissue attachment of 1.07 mm and an epithelial attachment of 0.97 mm, the biologic width is commonly stated to be 2.04 mm [3, 4], which represents the sum of the epithelial and connective tissue measurements. Known as biologic width, this dimension is a key determinant of esthetics. The amount of bone loss and location of the biologic width may be associated with the thickness of the soft tissue around the implants. Gingival inflammation ensues, if the margins of the restorations violate the biologic width. It can lead to bone loss, if left untreated.

Factors affecting crestal bone loss [5, 6]
1. Surgical trauma
2. Microgap
3. Biologic width
4. Occlusal Overload
5. Crest module

Surgical trauma

Surgical Trauma because of heat generated during drilling elevation of the periosteal flap and excessive pressure at the crestal region during implant placement may contribute to implant bone loss during the healing period. Wilder Mann *et al*. reported that even though a larger surface area of the bone was exposed during surgery, bone loss due to periosteal elevation was restricted to the area just adjacent to the implant. Bone loss after osseous surgery in natural teeth is more vertical. However, early implant bone loss is in the form of horizontal saucerization. In successfully Osseo integrated implants signs of bone loss from surgical trauma and periosteal reflection are not commonly observed at the implant stage II surgery. Thus, early crestal bone loss is unlikely to occur due to surgical trauma [7].

Biological Width / Seal

Within the first six weeks after the implant/abutment junction has been exposed to the oral cavity, Biological width forms. It acts as a barrier against bacterial invasion and food ingress implant-tissue interface. The ultimate location of epithelial attachment following phase 2 surgery in part, determines early post-surgical bone loss. Thus, implant bone loss is in part, a process of establishing the biological seal [2, 3, 5].

Microgap

A micro gap exists between the implant and the abutment at or below the alveolar crest, in most of the 2 stage implant systems, after abutment is connected. The crestal bone levels are dependent upon the location of the micro gap 2mm below it, for all 2 stage implants. The countersinking is done to minimize the risk of implant interface movement during bone remodeling, to prevent implant exposure during healing and also to enhance the emergence profile [8].

Countersinking keeps the implant micro gap below the crestal bone. Independent of surgical approaches, Hermann *et al*., who for the first time, demonstrated that the micro gap between the implant/abutment has a direct effect on crestal bone loss. Epithelial proliferation to establish biological width could be responsible for crestal bone loss found about 2mm below the microgap.

Occlusal Overload

Excessive stress on the immature implant bone interface in the early stage of prosthesis in function is likely to cause crestal bone loss. Cortical bone is least resistant to shear force, which is significantly increased in bending overload. However, bone loss from occlusal overload is considered to be progressive rather than limited to the first year of loading.

Crest Module

The transosteal region of the implant receives crestal stresses after loading. The crest module design can transmit different types of forces onto the bone, which depends upon its surface texture and shape. A polished collar and a straight crest module design transmit shear force, whereas a rough surface with an angled collar transmits beneficial compressive force to the bone [3, 9].

Platform switching: Platform switching (the concept was introduced in the literature by Lazzara, Porter and Gardner), limits the circumferential bone loss around dental implants by using prosthetic components having a platform diameter undersized when compared to the diameter of the implant platform. In this way, the implant abutment junction is displaced horizontally inwards from the perimeter of the implant platform, and further away from the bone. This creates an angle, or step, between the abutment and the implant. Because it essentially is resting on the outer circumference of the implant platform, the inflamed connective tissue does not extend laterally to the same extent as it does with a traditional matched implant-abutment junction.

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 [10].

The crestal bone clinically and radiographically appears to maintain its position, while the soft tissue appears not to recede as much as it does with traditional “matched” configurations. In a sense, this implant configuration appears to limit biologic width reformation because the ledge of the implant platform, to a significant extent, may isolate the underlying bone. It is important to note that for platform switching to be effective, the under sizing of the components must be carried out during all phases of the implant treatment, i.e. from placement of the implant through to final restoration [10].

Clinical relevance of platform switching

Increased biomechanical support: Where anatomic structures such as the sinus cavity or the alveolar nerve limit the residual bone height, the platform switching approach minimizes the bone resorption and increases the biomechanical support available to the implant [7].

Effect on soft tissue esthetics around dental implants: 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 one another (interimplant distance 3 mm or less [11]) the inter-implant bone height can resorb below the implant-abutment connection, reducing the presence of an inter-implant papilla. This may affect the clinical result in the esthetic zone. Platform switching reduces this 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 impaction [7].

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 loading. 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 reduced stress to a greater degree in the microthread model compared to the smooth- neck model [12].

Conclusion

Considering the foregoing biological and biomechanical analysis, the concept of platform switching appears to limit crestal resorption and seems to preserve peri-implant bone levels. A certain amount of bone remodeling one year after final reconstruction occurs, but significant differences concerning the peri-implant bone height when compared with the non-platform-switched abutments, are still evident one year after final restoration. The reduction of the abutment of 0.45 mm on each side (5 mm implant/4.1 mm abutment) seems to be sufficient to avoid peri-implant bone loss. It is certain that this concept of platform switching holds promise as a simple method to reduce crestal bone loss, physiological prosthetic contours and optimum aesthetics.

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