Predictable Biomechanics and Implications of Implant Crest Module: A Clinical Note

Sir
Biomechanical considerations in implant dentistry to a large extent follow simple mechanical rates, based on leverage principles and the implants initial stabilization. That is why; the sound knowledge of biomechanics will truly minimize the overload situations which control the long-term success of dental implants. Marginal bone loss around implants may pose a threat to its long-term survival. Some of the major factors constituting marginal bone loss are: (1) Designing sophistication and sensitivity of implant assembly; (2) infectious process; (3) excessive loading conditions; (4) the location, shape, and size of the implant-abutment microgap and its microbial contamination; (5) micro-movements of the implant and prosthetic components; (6) repeated screwing and unscrewing; and (7) traumatic surgical technique.[1]

Implant crest module is one of the segments of a two-piece dental implant that is designed to hold the prosthetic components and to create a transition zone to the load bearing implant body.[2] Its design, position in relation to the alveolar crest, and an abutment implant interface makes us believe that, it has a major role in integration to both hard and soft tissues. In other words, the crest module of an implant body is characterized as a region of highly concentrated mechanical stress [Figure 1]. This region of the implant is not ideally designed for load bearing, as evidenced by bone loss as a common occurrence regardless of design or technique. Many studies in the literature have shown that mean marginal bone loss of adjacent teeth recorded over the average time of examination (16 months) was 0.97 (1.46) mm and observed at upper lateral incisors facing a fixture in the canine or central incisor regions. In fact, bone loss has been observed so often, many implant crest modules are designed to reduce plaque accumulation once bone loss has occurred.[3,4] A smooth, parallel-sided crest module will result in shear stresses in this region, making maintenance of bone very difficult. An angled crest module of more than 20°, with a surface texture that increases bone contact, will impose a slight beneficial compressive component to the contiguous bone and decrease the risk of alveolar bone loss.[1]

Usually, the crest module of an implant ought to be faintly larger than the outer thread of implant diameter. The ideal seal created by the larger crest module also provides for greater initial stability of the implant following placement, especially in softer unprepared bone, as it compresses the region.[5,6] The larger diameter also increases surface area, which contributes to decrease in stress at the crestal region compared with crest modules of smaller diameter.[7] A polished collar of minimum height should be designed on the superior portion of the crest module just below the prosthetic platform. A biologic width of 0.5 mm has been reported apical to the abutment-to-implant connection. A 0.5 mm collar length provides for a desirable smooth surface close to the peri-gingival area, while preserving the biomechanical performance of the remaining portion of the crest module. Bone is subjected to unnecessary and excessive shear loading in implants characterized by a longer polished collar. Significant loss of crestal bone has been reported for implants with larger machined (smooth) corona regions.[8-10] This bone loss is attributed to the lack of effective mechanical loading between the machined coronal region of the implant and the surrounding bone. Such clinical dilemma is abridged by a biomechanical design that could minimize the shear collar surface area. Nevertheless, it is quite obvious that 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.[11] Furthermore, it has now been a universal clinical observation that bone is often lost to the first thread, regardless of the manufacturer type or design, after loading. Bone grows above the threads during healing, but after prosthesis loading the bone loss is often observed. The bone loss often stops at the first thread because, the first thread changes the shear forces of the crest module to a component of compressive force in which bone is strongest.

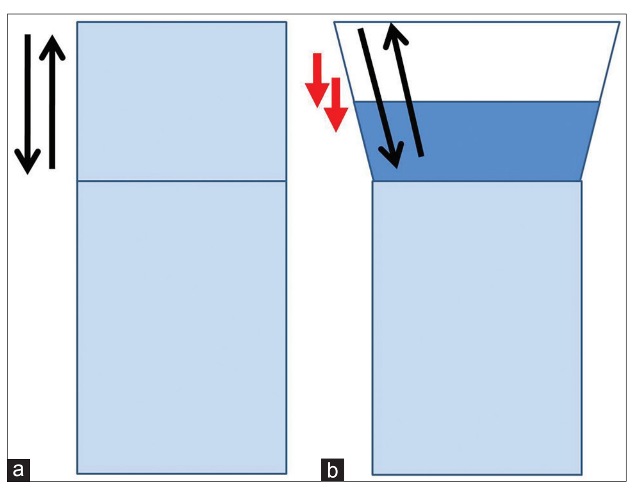

Figure 1: The crest module design can transmit different types of force to bone. (a) A polished collar as well as a straight crest module design transmits shear force however, (b) A rough surface on an angled collar may pose some compressive force to underlying bone

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