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Short Dental Implants: Rationale and Success

"Short dental implants seem to be a valid alternative with reasonable evidence of high success rate to bone augmentation procedures in the treatment of atrophic alveolar ridges"

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COLUMN ARTICLE

In the treatment planning for dental implants, the length of dental implant is usually determined by the available bone height, which is measured from the crest of the edentulous ridge to the opposing landmark. Generally, sufficient bone height to receive implants at least 10 mm long in the mandible or 13 mm long in the maxilla is a prerequisite for successful dental implants [1]. However, this requirement is usually compromised by the atrophy of alveolar bone, which is mostly accelerated during the first year after teeth loss and progresses beyond it if the patient uses tissue-borne dentures with poor adaptation or improper occlusal scheme [2].

The surgical and restorative procedures at the posterior region of both the maxilla and the mandible present a complex task. The posterior regions usually exhibit less favourable bone quality and volume than the anterior regions. Anatomic structures such as the inferior alveolar nerve and maxillary sinus as well as narrow alveolar bone width may restrict the available bone at the implant site, and interfere with the determination of optimal length, diameter, and position of implants [3,4]. From the restorative aspects, the closer the teeth or the restorations are to the temporomandibular joint, the greater the occluding forces. Hence the posterior regions of the jaws tend to exhibit higher occlusal bite forces (≥ 500N) than those of the anterior regions (≤ 100N) [5], causing occlusal overload on the restorations placed in posterior regions [6,7].

Surgical modification of the patient's anatomy has been proposed to overcome the anatomic limitations of the posterior maxilla and mandible. Sinus augmentation technique is one solution applicable to maxillary sinuses exhibiting pneumatisation, or when severe resorption of the alveolar process occurs [8]. Several graft techniques for vertical bone augmentation at implantation sites have also been used [9-11]. However, so far there is no agreement on the

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best grafting approach to be used with implants dentistry that make the predictability of grafting procedures uncertain. Furthermore, infections, broad irretentive residual ridges, and rapid loss of the graft due to resorption are the common complications with grafting procedures. The recovery period associated with these surgical procedures in general is somehow long; requires at least 6 months during which they are unable to wear their mandibular dentures [3,12]. Short implants therefore are used as an alternative to these surgical procedures and appropriate adaptation for the existing anatomy of the jaw [3,13].

The justification of using short implants based on the observation that magnitude of stresses distributed to the apical third of an implant is less than that subjected to the crestal third [14]. Also maximum bone stress was demonstrated to be always constant and independent of implant length [15,16], thus wider rather than longer implants are usually recommended for better implant anchorage [17] (Figure 1 and 2).

Figure 1: Three-dimensional finite element analysis of an implant under load in a bone model demonstrates the highest strain patterns are around the crestal 5 mm of an implant body [7].

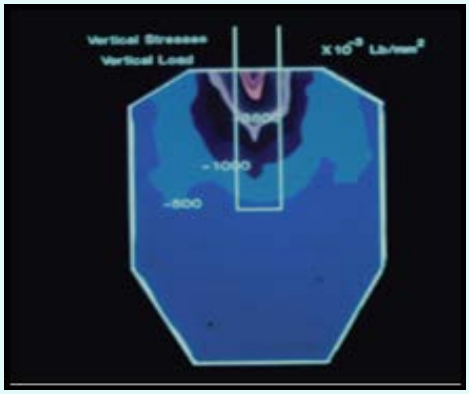

Figure 2: An implant is threaded into a block of acrylic with a similar modulus of elasticity as cortical bone [7].

Short dental implants are of benefit to both patient and surgeon. For the patient, short implants provide alternative and successful treatment modality to the invasive surgical augmentation procedures and thus eliminate the associated negative consequences such as donor site morbidity, sensory alterations, pain or discomfort [7,12], long recovery period, and high cost [18,19]. For the surgeon, short osteotomy preparation is a simplified procedure, offers direct and easy access for water irrigation and implants insertion, resulting in less potential for bone overheating. It also provides better implant's angulation to the load in comparison to preparations for longer implants. In addition, the surgeon has the ability to offer implant therapy to a patient population who are not suitable to undergo surgical interventions [7,12].

Authors proposed clinical and loading recommendations to reduce the bio-mechanical complications and ensure long-term success of short implants. They include; avoid using polished or machined short implants [20,21], avoid placing short implants in bone with poor quality [3,22], consider primary splinting of crowns supported by short implants if the implant-crown ratio is unfavourable [18], avoid using short implants in patients with parafunctional habits [22], consider using narrow occlusal table, anterior incisal guidance, and avoid lateral forces or cantilevers [7,18,22].

The evidence on the high success of short implants in partially edentulous patients is highly growing, most probably due to the advancement in implant surfaces and designs [12,23]. Recent studies on short implants reported survival/success rates ranging from 99%-100% [12,24-29].

Gentile., *et al*. [30] and Testori., *et al*. [31] reported comparable survival rates of short and long implants. Fugazzatto., *et al*. [27] demonstrated 7- years cumulative survival rates between 98.1% and 99.7% of all implants shorter than 10mm. A meta-analysis to investigate the survival rate of short rough surface implants (≤ 8 or <10 mm) in partially edentulous patients, showed a survival rate of 97.06% for the implants ≤ 8 mm in length in comparison to 98.33% for implants < 10 mm in length [32]. Felice., *et al*. [33] investigated the use of short implants in an atrophic posterior mandible as an alternative to standard implants with adjunctive vertical bone augmentation procedures. The study results showed no significant differences in bone loss between the two groups, though the augmentation procedure associated with longer healing time, required more technical skills and increased treatment costs in a highly statistically significant manner. Furthermore, a recent clinical trial prospectively evaluated and compared the success of Bicon and Ankylos short implants placed in the posterior mandible, and demonstrated comparable clinical and radiographic outcomes between the two systems with an overall one-year success rate of 100% [34].

The provision of short implants to rehabilitate the reduced partially edentulous jaws appears to be highly predictable. Clinicians can use short implants whenever the placement of standard longer implants is not possible or necessitates advanced surgical procedures to augment the alveolar bone at the implant site.

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