Review Article

Short Implants – A Literature Review

Sudhanshu Shekhar*, Veronika Dogra*, Sanjeev Mittal**

*PG Student, **Professor, Department of Prosthodontics, Maharishi Markandeshwar University, Haryana.

Dr. Sudhanshu Shekhar is from the BDS - batch 2012 from Dr Harvansh Singh Judge Institute of Dental Sciences and Hospital, Punjab University, Chandigarh. He is currently doing MDS (Final year) Prosthodontics from Maharishi Markandeshwar University, Mullana,Ambala. He is also the co-ordinator for Infinity Smiles India, Oral health campaign.

Corresponding author - Sudhanshu Shekhar (sshekhar62@gmail.com)

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Abstract

Osseointegrated implants have become a routine solution for treating patients who are either completely edentulous, partially edentulous, or missing a single tooth. Studies have confirmed that dental implants have a favorable long-term prognosis as compared to conventional fixed prosthodontics. Although the use of short implants seems to be an obvious alternative in cases where conventional implants are not an option without additional procedures, short implants have been associated with decreased implant success rates. On the other hand, many authors have shown similar success rates with short implants as compared with conventional length implants and attribute these similar success rates to the improvement in both surgical/restorative technique and implant material. The use of short implants has been proposed as a viable alternative in patients with resorbed posterior regions unwilling to undergo ridge augmentation procedures. In addition to the avoidance of additional surgery, some studies have shown that the benefits of short implants include an easier fixture insertion, a simplified osteotomy preparation, and a decreased potential for overheating the alveolus.

Key Words: Short dental implants, Bone augmentation, Implant survival

Introduction

Dental implants, ideally designed to replicate a critical support system attached to the tooth, the root, are probably the smallest prosthetic devices ever. The root, which is the most important part in the entire setting as in supporting both the tooth for strength and stability while having a symbiotic relationship with the jaw bone. Now, usually as an implant, a tiny titanium screw is used to mimic this functioning of the natural root, and this provides for a base upon which a new fake tooth or a dental crown is placed[1].

As the popularity of dental implants has grown exponentially, and have made people realize that tooth loss no more changes the way of living, their innovations and progress has also taken leaps. Also, studies done have confirmed that dental implants have a favorable long-term prognosis as compared to conventional fixed prosthodontics[2]. Success rates even higher that 90% have been reported for many implant systems[3].

Rationale behind the use of short implants

Despite the high success rates, there are definite limitations to the available single-tooth implant placement and the associated success have, mainly for the posterior regions of the dental arches[2]. Now, it has been noted that implants placed in the posterior region have been associated with higher rates of failure than those placed in the anterior region. Posterior regions of the dental arches generally have less available bone height, poorer bone quality and teeth in this region are all the more, exposed to greater occlusal loads, compared to the anterior regions (Fig1). This poorer bone height and quality have been associated time and again with an increased chance of failure of these implants. Further, because of the reduced alveolar bone height and density in the posterior regions, often preceded or accompanied by tooth loss, anatomic limitations to implant placement, such as the maxillary sinus and the mandibular nerve also exist. Surgical procedures to compensate for this tissue deficiency, such as sinus and/or ridge augmentation procedures have proved to be successful in to vertically increase the bone volume in atrophic maxilla when the RBH ranges from 6 to 8 mm[4]. Nevertheless, these procedures are often associated with an increased cost, surgical time, morbidity, and healing time[2].

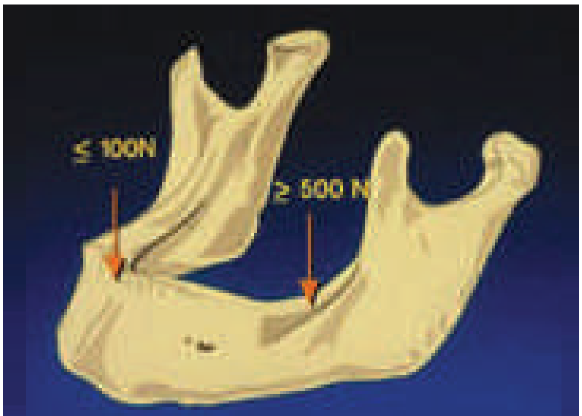

Fig - 1: The posterior regions of the mouth have higher bite forces than the anterior regions. The available bone height is usually less in the posterior than the anterior sections

Alternatives to performing these additional augmentation procedures are zygomatic and short implants[2,4]. Despite the shortcomings like decreased implant success rates, authors from different groups have shown similar success rates between short implants and the conventional length implants. Similar success rates among the two, however, attributable to the improvement in both surgical/restorative techniques and the implant material[2].

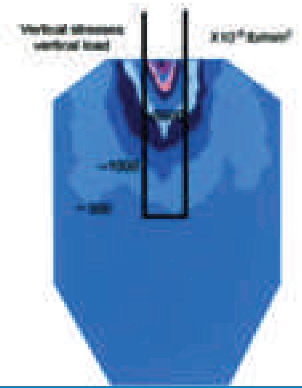

Fig - 2: A 3-D model of an implant in bone demonstrates the highest strain applied to the bone area in the crestal 5 mm of the implant body.

Short implants and the modifications they need

Classically defining them, they come in dimensions of implant length of less than 11 mm, 10 mm or 8 mm[4]. A number of standard Branemark implants (3.75 mm) have been introduced for the treatment of edentulous jaws. These started with the 10mm long implant in 1971. But, considering the need of atrophic jaws, the 7mm standard implant was introduced next in 1979[5]. This implant was used either alone or with longer implants in the edentulous jaws. But, eventually it was used in the treatment of partial edentulism as well[5,6]. When brought into function, these implants showed a list of failures among the short implants in their 1, 3, 5 and 10 year results[7,8].

To counter this issue, wide-diameter implants were introduced to fulfill two problems, poor bone quality and/or quantity and replacement of a failing standard implant[9], so as to facilitate this replacement of the failing standard implant and to improve the success rate in such compromised situations[5,10]. It was then reported by some that, when the length of the implant was compromised as in situations where residual alveolar height was less, wide-diameter implants were successful.

A comprehensive review on short implants by Karthikeyan I, et.al.[5], has shown data on short implants from 12 prospective, non-randomized, non-controlled trials, 10 retrospective, non-randomized, non-controlled trials, one randomized controlled trial and the rest from clinical follow-up studies. In this review, the authors have concluded that short implants, could be a preferable choice, with the treatment becoming faster and cheaper, and also, associated with less morbidity than the vertical bone augmentation. They also saw that even when the residual bone height over the mandibular canal is 5–7 mm, these short ones achieved better results[5].

The biomechanics and the load resistance

Discussing the distribution of the stress at the implant site, it has been studied by Finite Element Analysis (FEA), that stresses distributed to the apical third of an implant are of much less magnitude than those in the crestal third. The commonly used endosteal dental implants are fabricated from alloyed or pure titanium with elasticity (modulus) or stiffness approximately 5 times greater than the dense cortical bone[11]. As per a basic mechanical principle, when 2 materials of different moduli are placed together with no intervening material and one of them is loaded, a stress concentration can be observed at the point where the 2 materials first come into contact[12,13]. These stress contours form a v-shaped or u-shaped pattern at the crest of the bone showing a greater magnitude near the point of first contact. For an implant in bone of adequate density with a direct bone contact, the greatest magnitude of stress is concentrated in the crestal 5 mm of the bone-implant interface (Fig2). The alveolar bone however, adapts its strength to the applied mechanical loading by means of bone modeling or remodeling[14,15,16]. The type of attachment system here provides different degrees of horizontal and vertical resistances against dislodging forces that might lead to different magnitudes of loading transmission to the implant-bone interface. However, this does not seem to evoke bone resorption around conventional implants[17,18].

Evidence, as in different biomechanical studies done suggest a high predictability of short implants. These suggestions have been put forth that maximum bone stress is practically independent of the implant length[19] and that implant width is a more important parameter, compared to the additional length[20]. Relying on these reports, it is presumed that with an optimized implant design and surgical protocol, short implants may play an outstanding role in oral implantology, reducing the indications for procedures such as sinus lift and additional grafting techniques[14].

Short dental implants: Clinical indications

A well-planned and well-executed prosthesis is essential to avoid excessive and unnecessary forces on bone and implant components. Predicting how bone and implant components would behave, considering each patient's unique jaw anatomy, quality of bone, and amount of occlusal force exerted on the prosthesis, demands full comprehension of both mechanical and biologic events. The main clinical indication for the use of short implants is when in the posterior upper and lower jaw, there is extreme residual bone resorption above the maxillary sinus and the mandibular[14]. Another reliable and successful clinical option to short implants is to omit implants in posterior jaw and provide a cantilever solution. But here also, so as to provide an additional support in the distal region, additional short implants might be inserted[14].

Also, when the height of the alveolar bone in the lateral side of the mandible is not sufficient for a conventional implant length, bone augmentation is thought of as a lucrative option to short implants, even though it is more complicated and less predictable than bone augmentation in the sinus area[21]. But, an interesting alternative and a therapeutical option to vertical augmentation, short implants in this region offer faster and cheaper treatment, associated with less morbidity[22].

It may be kept in notice that when height limitation is not considered properly and a longer implant is chosen, the supplying nerve may get injured[14]. As reported by Greenstein and Tarnow[23], the guidelines for implant placement suggest leaving a 2mm safety zone between an implant and the coronal aspect of the nerve, which makes the observation of the inferior alveolar nerve and mental foramen on panoramic and periapical films prior to implant placement essential. Other experts also agree on the above point so as to maintain a spatial distance of 2mm or more for safety reasons in three dimensional planning[24].

Conclusion

Short implants, propose to be a successful alternative to the techniques for bone augmentation. Special consideration however is to avoid the lateral loading of the implants that is caused by the improper occlusal relation, and optimization of the occlusion of the final restoration needs to be done. Long-term clinical studies might help improve the picture since the experimental and numerical investigations do depict a relative high strain of the bone bed around short implants in comparison to the conventional implants (Table1).

Table 1: Some summarized studies reviewed to see the survival rates of the implants:

Study	Length of Implant	Study Length	Survival rate
Rossi et.al.[25]	6mm	2 years	95%
Arlin[26]	6mm	2 years	94%
Van Assche et.al.[27]	6mm	2 years	99%
Anitua & Orive[28]	< 8.5mm	24-48 months	98 to 99 %
Misch et.al.[29]	7 & 9mm	6 years	98.9%
Griffin & Cheung[30]	6 & 8mm	68 months	100%
Pieri et.al.[31]	4 & 6mm	2 years	96.8%

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