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Review Article

Short Implants- An alternate to adjunctive implant surgical procedure- A review

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Abstract: Reduced alveolar bone height due to post extraction atrophy becomes a major challenge in placement of conventional implants. In these conditions, various ridge augmentation procedures have been suggested. However, these are not without drawbacks. As an alternate, the use of short implants has been advocated. The review focuses on the use of short implants in the cases with reduced alveolar bone height.
Keywords: Reduced alveolar bone height, post-extraction atrophy with short implants

INTRODUCTION

During the last few decades, implants have become a highly predictable surgical procedure for replacing single or multiple teeth [1]. In the posterior regions however, reduced alveolar bone height due to post extraction atrophy become a major challenge. An insufficient residual bone height not only limits the application of implant therapy but also increases the probability of invasive damage to anatomical structures, such as the inferior alveolar nerve, maxillary sinus and nasal cavity [2]. In such clinical scenarios, various ridge augmentation procedures such as guided bone regeneration (GBR) procedures [3], alveolar distraction osteogenesis [4], onlay bone grafting [5] and the use of interpositional bone graft [6] have been suggested.

Ridge augmentation procedures have been reported to be technically demanding, associated with significant postoperative morbidity, more expensive, may require hospitalization and longer rehabilitation periods [7]. As an alternative technique to alveolar ridge augmentation for severely resorbed alveolar ridge in posterior region of mandible, the transposition of the inferior alveolar nerve has been suggested in the literature by providing the space for placement of longer implants [8]. However, this procedure has been found to be technically demanding and could be associated with a sensible number of transient or permanent loss of nerve sensitivity and therefore it is seldom used nowadays. In atrophic posterior maxilla, sinus augmentation procedures like lateral window sinus lift technique [9] and crystal sinus lift [10] have been reported in the literature to increase alveolar bone height. Although sinus augmentation procedures are widely used, these techniques imply greater morbidity, longer treatment time and higher costs.

Recently short implants, as an alternative approach have been advocated to improve patients comfort during the post operative period, while reducing morbidity and possible complications [11]. The use of short implants in atrophic ridges avoids more invasive surgical procedures like ridge augmentation, transposition of inferior alveolar nerve and augmentation of maxillary sinus. Esposito *et al.;* [12] reported that use of short implant (5-8 mm) could be effective with fewer complications than longer implants placement using more complex techniques. However, there is no consensus on the definition of a short implant. Some authors[2] considered short implants to have a length of 7- 10 mm, where as other authors considered short implant are those with a length of 8 mm or less [13]. The survival rates of implants shorter than 10 mm have been reported to be comparable to the longer implants [14]. The possibility to restore the dentition without the need for significant pre-surgical augmentation should give widened treatment options and simplify implant rehabilitation. This may increase patient acceptance, make it available to more patients and contribute to a better oral functions and general health [15].

COMPARISON OF SHORT IMPLANT WITH LONG IMPLANT

A short implant has also been defined as an implant with a specific maximum designed intrabony length [13]. In the past, short implants have been associated with lower survival rates. However, a number of publications advocated that the failure rates of short implants were not higher than those for implants 10 mm or longer. Various investigators have examined effectiveness of short implant in presence of reduced vertical bone height without adjunctive surgery like sinus augmentation in maxilla and lateralization of inferior dental nerve in case of mandible. Long term studies conducted by investigators have shown that survival rate of short implants (less than 10 mm) are comparable with that of long implants [16-19].

INFLUENCE OF OCCLUSAL LOAD ON SURVIVAL OF SHORT IMPLANTS

Short implants are still widely perceived to be at a greater risk of failure than standard- length implants, especially in posterior regions where generally less favourable bone quality has and are exposed to greater occlusal loads than anterior regions [20]. Proper transfer of occlusal loading to the bone through the implant components is an important factor in biomechanical success [21]. The use of short implants in association with an atrophic mandible has been proposed as a biomechanical risk because of the increased maxilla-mandibular space[22] and the likelihood of an unfavourable crown-to-implant (C/I) ratio [22, 23]. The greater crown height acts as a lever, creating a bending movement in the presence of lateral forces [22, 24].This moment can induce a stress concentration at the bone-to-implant interface and in the prosthetic components, eventually resulting in peri-implant bone loss [25] or prosthetic complications [26]. In addition to occlusal loading and the C/I ratio, the restorative material [27] and retention system [28] may influence the distribution of stresses arising from mastication [24]. Moreover, bone quality and cortical bone thickness (CBT) are an important factors determining the primary stability of implants, since thickness of cortical bone also affects bone stresses and strains in implants.

Various investigators have shown the influence of short implants on crown root ratio, [29] retention system, restorative material and occlusal loading of stress concentrations [30], in cortical and cancellous bone. It has been observed that traumatic occlusion and high crown to implant ratios made the largest contributions to increased stress concentrations in crowns supported by short implants [31]. It has been shows that splinting short implants may provide a even distribution of strain during the off axis loading and that biomechanical performance are identical in two short splinted implants as well as with short and a long implant. Short implants may be used for different cortical bone thickness (CBT) and it was observed that stress values were smaller than required to induce plastic deformation of the implant or any component of prosthetic system and short and wide implants can be placed in D4 bone quality. It has been found that increased crown-to-implant ratio and offset placement of the prosthesis were not significantly correlated to marginal bone loss around extra-short implants [32]. Therefore, prosthetic rehabilitation plays a crucial role in survival of short implants.

ROLE OF SURFACE MODIFICATION

In recent years, numerous implant manufacturers opted to produce implants with surface modifications, and in general, rougher surfaces to improve the osseointegration and the amount of bone contact at the interface level [13, 33-35]. It has been demonstrated that differently processed surfaces might lead to greater osseointegration and a higher percentage of bone to implant contact. The greater osseointegration resulting from advances in surface and design has enabled implant length to be shortened. Various surface modifications of short implants like SLA implants, rough surface, oxidized surface implants have survival rate that could be comparable to that of standard length implants when used with careful treatment planning and an appropriate clinical protocol.

USE OF SHORT IMPLANTS WITH ADJUNCTIVE SURGICAL PROCEDURES

To facilitate implant placement in posterior atrophic maxilla, the use of a crestal lift procedure could be a less invasive alternative to the conventional lateral widow procedure. While the crestal approach is less invasive, there are some disadvantages associated with it: the amount of bone that can be gained using a crestal approach is less than what can be obtained with the lateral window technique, and a minimal amount of crestal bone height of about 3 mm is required to stabilise the implant at placement [36]. Therefore, in presence of reduced residual bone height, along with crestal sinus lift procedure, placement of short implants have been attempted to reduce the rehabilitation period [37-39].

Also, implants installed into alveolar sockets immediately after tooth extraction have been shown to yield predictable outcomes [40, 41]. The use of this procedure reduces the number of surgical sessions and may also reduce the time between surgery and prosthetic delivery [42]. For this placement modality the need for implants that are longer than the remaining extraction sockets has been propagated under the assumption that implant stability may be guaranteed in the area beyond the apex of the extraction socket [43, 44]. However, because of the presence of anatomical structures such as the maxillary sinus or the inferior alveolar nerve, bone may not be available beyond the apex of the socket. Therefore various investigators have studied effectiveness of short implants placed in animal models and have found promising results in immediate extraction sockets [45].

SUMMARY

The bone density of the remaining bone after tooth loss is often less in the posterior regions than the anterior sections of the mouth. Conflicting results have been reported for short implants with success rates ranging from 80% to 96%. The survival of short implants may be influenced by number of factors, including location and bone quality, crown height, higher biting forces as well as design, type, and diameter of the implant. Combining short implants with regular length implants in fixed prosthetic constructs, surface modification of implant surface have been recommended to improve survival rate of short implants. Various investigators have evaluated survival of short implants, less than 10 mm and have shown that short implants have equal survival rates compared with longer implants. The use of short implants in combination with osteotome technique for sinus floor elevation, have been tried to provide clinicians more conservative options of the treatment. Short implants can be a good treatment alternative for specific cases in which there is absence of enough residual bone for installation of conventional implants. This type of implant can make the rehabilitation treatment less costly and less traumatic to the patients, for it avoids adjunctive surgeries of bone grafting. Therefore, in clinical situations with little bone availability, short implants may be a viable, simple, and predictable alternative.

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