REVIEW ARTICLE

SHORT DENTAL IMPLANTS : AN EMERGING CONCEPT IN IMPLANT TREATMENT.

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ABSTRACT

The edentulous posterior maxilla is often characterized by reduced bone volume, due to severe post-extraction alveolar crest resorption coupled with sinus pneumatization. Similar case scenario can occur in mandibular posterior areas leading to less available bone height over the inferior alveolar nerve. This anatomic limitation is a problem that can affect osseointegration and the fabrication of a functional and aesthetic implant-supported restoration. Augmentation process can cause increase morbidity as well as increase cost and time. The use of short implants has been suggested in recent years as an option for facilitating prosthetic restoration in jaws with reduced bone height. This review was intended to infer whether short dental implants could be an alternative to longer implants in the cases with reduced bone volume in posterior maxilla and mandible.

KEY WORDS

short, survival rate, immediate loading

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INTRODUCTION

The use of dental implants has become a highly predictable and effective treatment modality for the rehabilitation of complete and partial edentulism. Studies have reported high survival rates of approximately 89%-96% over a 10year periodusing different dental implant systems in various patient populations.[1,2]

The posterior regions of the mouth often have less available bone height and less dense bone than the anterior regions. Extraction of maxillary posteriors leads to increased volume of the maxillary sinus and, in consequence, to bone atrophy beginning from the sinus surface. It is assumed that the air pressure inside the sinus and features of the mucosa that lines the sinus play important roles in this process[3,4,5,6] In such clinical situations, the use of standard-length implants is contraindicated due to the presence of vital anatomical structures such as the maxillary sinus and the inferior alveolar nerve. In order to rehabilitate such reduced volume sites, treatment options are either non-invasive therapy that adapts to the clinical situation like short/angulated/zygomatic implants or additional surgical therapy that relies on augmentation procedures in order to increase bone volume like Guided Bone Generation and sinus floor elevation either by direct or indirect technique. Many patients are unwilling to submit to this type of surgical approach because it is costly and demands multiple surgical procedures, or due to poor general health. Inferior alveolar nerve transposition procedures also raise the risk of paresthesia.[7,8]

Short implants has been suggested as an alternative to such surgical options for prosthetic restoration in resorbed jawbones. Short implants offer the advantage of limiting the number of surgical procedures required and minimizing the surgical trauma involved. Patients benefit from less morbidity and less postoperative discomfort. However, they too are not exempt from possible complications due to their higher crown-implant ratio and prevalence of peri-implantitis, presenting a great concern, given their insubstantial length[9,10,11]

The nomenclature of short implant has been changed from time to time, such as short (≤8 mm) or extra short (≤ 6 mm) implants[8,9]. Authors have used

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this term for implants up to 11 mm, or 8 mm, or 7 mm long, but it is generally agreed that implants less than 10 mm in length can be definitely defined as short. The recently introduced extra-short implants have been defined as having an intra-bony length of no more than 5 mm[12,13,14]. The term ultrashort is used to describe implants with an integrable component between 4 and 6 mm (Deporter et al. 2008). However, as with short implants, there is as yet no consensus on this definition either.

MATERIALS AND METHODS

This systematic review was performed according to the guidelines of the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) statement. The PICOS Question was "In patient with posterior dental implant restorations, do short implant compared to longer implants demonstrate similar survival rates and minimal complications". An electronic (PubMed) search was conducted for studies published up to January, 2022, evaluating the clinical performance of short dental implants in posterior jaws. The search keywords were used as follows: "Posterior Maxilla" OR "Posterior Mandible" AND "Short implant" AND "Survival Rate" AND "Marginal Bone Loss" AND "Biologic complications" AND "Prosthetic complications and failure" AND "Immediate loading".108 articles published before January 2022 was identified. Out of these 38 articles were excluded being duplicate articles. From the remaining 70 articles, after reviewing of the full texts of the manuscripts, 6 studies satisfied the inclusion criteria. The inclusion criteria were Randomized clinical trials and prospective cohort and retrospective studies of minimum 5-year follow-up period. The exclusion criteria were the case reports, in vitro studies and studies published in language other than English.

RESULTS

Total six studies satisfied the inclusion criteria. The parameters assessed were survival rate and implant failure, marginal bone level change, biological complications, prosthetic complications and failure and immediate loading.

SURVIVAL RATE AND IMPLANT FAILURE

Efforts have been made to analyse the performance of short implants compared to standard length implants. Ravida et al. 2019, in their systemic review concluded that the overall survival rate of the extra-short implants in different follow-up years throughout the studies was 97.1%, and the individual survival rate for the extra-short and long implants was 96.69% and 97.5%, respectively.[15] Malchiodi et al. 2020, reported with sample size of 50 ultra-short SPS implants inserted in 41 patients that was followed up for a mean 9.5 years, with implant success and survival rates (94%). The failure rate was 6%, after three implants were lost due to rapid-onset peri-implantitis.[16] However, short implants are fully embedded in native bone, whereas longer implants are placed partly in vertically augmented cases. The splinting of implants is mandatory for increased survival in years to come. The follow-up to 4 years shows stable peri-implant bone, survival rates of 100% and 95%, respectively, were reported for short and standard-length implants at the 3-year follow-up (Bechara et al 2017).[17] One year follow-up randomized controlled trial by Thoma et al. 2005, tested whether the use of short (6-mm) fixtures results in a survival rate similar to that for sinus grafting with placement of long implants (11–15 mm). The result was, short implants were considered more favorable with respect to short-term patient morbidity and treatment time and cost[18] On the opposite view, Lemos et al. 2016, reported that short implants with length less than 8 mm (4-7 mm) should be used with caution because they present greater risks to failures compared to standard implants.[19]

MARGINAL BONE LEVEL (MBL) CHANGE

Malchiodi et al.2020, reported that, despite a resulting Crown/Implant ratio greater than 3:1, implant success rate and crestal bone levels of ultra-short implants were not adversely affected even after a mean follow-up of nearly 10 years. Monje et al.2014, concluded that short dental implants (<10 mm) had similar peri-implant Marginal bone level (MBL) as standard implants (≥ 10 mm) for implant-supported fixed prostheses. Therefore, it could not be concluded that implant length had an effect on peri-implant MBL.[20]

Bechara et al.2017, reported that mean MBL was significantly higher in the standard-length (≥10-mm) implants group than in the short (6-mm) implants, both at 1 year (0.14 mm vs. 0.21 mm, P = 0.006) and at 3 years (0.20 mm vs. 0.27 mm, P = 0.01). With respect to the short implants, there were no statistically significant differences in MBL between the different subtypes at 1 year (P = 0.2) and 3 years (P = 0.12). MBL values of the different groups.[17]

BIOLOGICAL COMPLICATIONS

Ravida et al.2019, reported that biological complications were significantly higher in the maxillary sinus augmented sites compared to the extra-short group. However, in vertically augmented mandibular arches receiving long implants, a statistically significant difference was not demonstrated. Similarly, the impact of augmentation procedures on the biological complication rate in both jaws was not significant.[15]

PROSTHETIC COMPLICATIONS AND FAILURE

Ravida et al.2019, reported, one year prosthetic complication rate showed no significant differences

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between the extra-short and long implant groups the 3 year prosthetic complications showed a significantly higher rate in the short implant group. At the 5-year follow-up, there was no statistically significant difference between the two groups

The prosthesis failures were most often related to the implant's failures. Non-splinted crowns and increased crown height space can decrease the success of short implants,

IMMEDIATE LOADING

Weerapong et al.2019, stated that immediate loading of short implants is comparable to conventional length implants in terms of implant survival, marginal bone level change, and implant stability quotient value.[21] Wu et al. 2021, in their seventeen studies, 5 RCTs and 12 OS studies, with a total of 2461 dental implants concluded that there was not enough evidence to show that short dental implants under immediate loading may have higher implant failure risk compared to standard implants under immediate loading and short implants under early or delayed loading. Therefore, an immediate loading protocol may not increase the failure risk of short dental implants.[22]

DISCUSSION

The use of short implants is based on the biomechanical rationale that most load-bearing stress is generated at the neck portion of an implant, whereas a very small amount is transmitted to the apical portion. However, initial clinical research reported lower survival rates for short dental implants than for standard-length implants. The overall survival and success rates of short implants have increased and their prognosis has become more predictable, possibly due to the recent improvements in the mechanical properties and surface morphologies of implants.[23,24] Bitaraf et al.2019, in their systemic review Short and standard implants showed comparable marginal bone level changes, implant failures, and prosthetic failures. Biological complication of short implant was significantly lower when compared to standard implant up to 1-year follow-up in both jaws.[25]

Researchers have argued that implants shorter than 10 mm often have a higher failure rate than longer implants. These complications may be related to an increase in crown height, higher bite forces in the posterior regions, and less bone density. As a result, biomechanical methods to decrease stresses to the implant-bone interface are warranted. The forces to the implants may be reduced by eliminating lateral contacts in mandibular excursions and eliminating cantilevers on the prosthesis. The area of forces applied to the prosthesis may be increased by increasing the implant number, increasing the implant diameter, increasing the implant design surface area, and splinting the implants together. As a result of these biomechanical methods to decrease stress, Misch, et al. 2005, reported a 99% implant survival with 7-mm and 9-mm implants in the posterior regions of the jaws. It is interesting to note that the natural teeth follow a similar biomechanical approach to accommodate the higher bite forces in the posterior regions of the mouth. The molar teeth do not become longer than the anterior teeth. The diameter is increased, the design of the roots is different, and the roots are splinted together. The anterior teeth have incisal guidance and eliminate posterior lateral forces to the posterior teeth in all mandibular excursions. A similar biomechanical approach is logical for posterior implants, especially when shorter implants are used to support the prosthesis.[26] SLA surface on implants, generates a macro-roughness on the titanium surface by using a large-grit sandblasting technique, superposes a micro-roughness by acid-etching, resulting topography offers an ideal structure for cell attachment. The SLActive surface is an advancement of SLA concept. SLActive dental implant surfaces optimizes its molecular structure that enabled a further reduction of the average healing time from 6-8 weeks to 3-4 weeks thus promoting faster osseointegration process and higher implant stability in short implants less than or equal to 6mm in length.[27]

CONCLUSION

In circumstances where sufficient bone is available, the safest option is to place a standard-length implant. But in deficient available bone, short implants represents a reasonable alternative to standard length implants, capable of reducing patient's morbidity, treatment time and costs in unfavourable anatomical conditions. Furthermore, in these situations, short implants simplify the surgical procedure as they demand less surgical skill and incurfewer surgical complications. This allows more patients to benefit from this treatment option.

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