Review

Short Implant Vs Sinus Elevation

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Introduction

A natural sequela of the loss of maxillary molars is the loss of crestal bone height. Once teeth are removed, the remaining ridge can lose 30% to 60% of its height and width within the first 3 years. The maxillary sinus can pneumatize and become larger, and this too will result in a decrease in the remaining osseous ridge height [1].

Implant treatment options for rehabilitation of the posterior maxilla are dictated by the available alveolar bone height, type of bone, and interact space [2].

Definition of short implant according to the literatures:

1-Depend on the Implant length variation.
- A dental implant with length of 7 mm or less [3].
- Any implant under 10 mm in length referred to as a short implant [4].
- A device with an intra-bony length of 8 mm or less [5].

2-Depend on the Implant width variation.
- Wide implant defined as a fixture with 4.5 mm or more in diameter, and a “narrow” implant as one in which this was less than 3.5 mm in diameter[5].

Literature Review

Early Research

Review of short implants in clinical studies between 1981 and 1997 a higher failure rate and implant loss with short implants than with long implants [6].

Higher failure rate with poor bone quality and short implant placement in the atrophic maxilla or following bone-grafting procedures [7].

Buser et al 1997 reported 91.4% cumulative survival rate for 8 mm long implants with a plasma-sprayed surface [8].

Friberget al.1997 also found a high success rate for short implants, with a 95.5% five-year survival rate [9].

Recent Research

Rocchieta et al 2008 did a systematic review on a short implant versus long implant or short implants versus adjunctive surgical procedures that required to place a longer implant and he found survival rates of implant placed in augmented sites over 1-7 years was 92.1% to 100% for GBR and 76% to 100% for only bone grafts[10].

Cumulative survival rate of implants placed in the augmented maxillary sinus was 95% (follow-up, 6-144 months) and that in the guided bone regeneration technique protocols ranged from 92% to 100% (follow-up, 6-133 months)[11].

Telleman et al 2011 did a systematic review of the prognosis of short 10 mm dental implants placed in the partially edentulous patient and he found:
- Growing evidence that short implants can be placed successfully in the partially edentulous patients.
- Increasing survival rate per implant length.
- Short dental implant in the mandible has a better prognosis over maxilla.
- The results of studies excluding smokers revealed higher implant survival rates [12].

Monje et al 2012 concluded in his meta-analysis on prospective clinical trials study, short dental implants had an estimated survival rate of 88.1% at 168 months while standard of dental implants has a similar estimated survival rate of 86.7%, the peak failure rate of short dental implants was found to occur between 4-6 years of function compared to 6-8 years for standard implants.

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Monje et al. 2012 concluded that in the long-term implants less than 10mm were as predictable as longer implants [13].

Esposito et al. 2014 did experimental comparison study between two groups on posterior atrophic jaws rehabilitated with prostheses supported by group 1) 6mm long, 4mm wide implants, and group 2) by longer implants in augmented bone.

Esposito found on short-term data (5 months after loading) indicate that 6mm long implants with a conventional diameter of 4mm achieved similar result to longer implants placed in augmented bone.

Short implants might be a preferable choice to bone augmentation, since the treatment is faster, cheaper and associated with less morbidity [14].

Francesco et al. 2012 did a randomized clinical trial (RCT) study on rehabilitation of the atrophic posterior maxilla using short implants or sinus augmentation with simultaneous standard-length implant placement and followed for 3 years after loading.

Francesco concluded related to implants failures, complication, operation time, postoperative pain and swelling, soft tissue parameters, marginal bone levels, and implant stability values:

- Both treatment approaches achieved successful and similar outcomes after 3 years of function.
- Short implants take considerably lower operation time with decreased surgical complication and postoperative patient discomfort.
- More RCTs with longer follow-up times and larger sample sizes are necessary to validate the current findings.
- Implants length engaged in alveolar bone does not appear to influence the degree of peri-implant bone resorption after a medium-time period of 3 years [15].

Gulje et al. 2014 did a Multicenter trial on (six study centers) 95 subjects were included, his subjects were randomly allocated to receiving implants in posterior maxilla or mandible with lengths of ether 6 to 11mm both with a diameter of 4mm (Osseo Speed TM 4.0 S, Astra).

Sufficient bone height for placement of at least 11mm in length, 2 or 3 implants were placed per subject using one-stage surgery.

They were restored with a screw-retained splinted fixed prosthesis.

Clinical and radiographic examinations were performed preoperatively, post surgery, at loading, 6 and 12 months after prosthesis placement.

A total of 208 implants were inserted in 49 subjects receiving 6mm implants and 46 subjects receiving 11mm implants.

Two 6mm implants failed before loading, one 6mm and one 11mm implants failed before 1 year evaluation.

From loading to the 12 months follow-up, a mean marginal bone gain of 0.06mm in the 6mm group and 0.02mm in the 11mm group was found (p=0.487).

Soft tissue behavior was equal in both groups.

Clinical and one year data indicated that treatment with the 6mm implants is as reliable as treatment with the 11mm implants.

Future randomized controlled clinical trials required to validate predictability of the findings [16].

Thomas DS et al. 2015 did a multicenter randomized controlled clinical trial on short dental implants (6mm) versus long dental implants (11–15mm) in combination with sinus floor elevation procedures for 3-year follow up. Thomas concluded that implants with a length of 6 mm as well as longer implants in combination with a lateral sinus lift may be considered as a treatment option provided a residual ridge height of 5–7 mm in the atrophied posterior maxilla is present [17].

Nedir R et al. 2015 concluded in his randomized controlled prospective study, there was no significant difference on short implants placed with or without grafting in atrophic sinuses for 3-year follow up [18].

Rossi F et al. 2015 did a prospective cohort study on moderately rough surface (6mm) short implants, with early loading supporting single crowns, over 5-year period, and his result was 4 failed of 30(6mm) short implants vs1 failed of 30(10mm) regular implants [19].

Nedir R et al. 2017 concluded that atrophic posterior maxillae can be predictably rehabilitated using osteotomy sinus floor elevation with a simultaneous implant placement. The new bone formed around implants after 1 year was stable after 5 years, irrespective of the presence or the absence of graft. Grafting was unnecessary to achieve an average bone augmentation of 3.8 mm, but more bone was gained with grafting [20].

Pohl V et al. 2017 concluded that implants with a length of 6 mm as well as longer implants in combination with a lateral sinus lift may be considered as a treatment option provided a residual ridge height of 5-7 mm in the atrophied posterior maxilla is present [21].

Survival of Short Implants

Kotsivilis et al. 2009 did a systematic review and meta-analysis on the effect of implant length on the survival of rough-surface dental implants. He concluded that survival of short implants is not different from longer implants [22].

Ateh et al. 2012 did a systematic literature review on survival of short dental implants of posterior partial edentulous.

- 5 randomized clinical studies.
- 16 prospective, nonrandomized, noncontrolled studies.
- 12 retrospective, nonrandomized studies.
- 1 study with both prospective and retrospective data.
Atieh concluded there is no significant difference of short versus long implants [23].

Srinivasan et al 2014 did a review of the literature and meta-analysis on the survival rates of short (6 mm) micro-rough surface implants; a total of 690 short implants 6 mm were evaluated in the reviewed studies. The pooled early clinical success rate (CSR) calculated in this meta-analysis was 93.7%.

Overall CSR maxilla: 94.7%.
Overall CSR mandible: 98.6%.

Atieh concluded that short dental implants provide a predictable treatment option [24].

**Contributing Factors Affecting Success of Short Implant**

**Surgical Protocol:**
- Undersized implant bed preparation.
- Lateral bone condensation.

Bone density seems to represent the major determinant of primary stability in maxillary sinus augmentation with simultaneous implant placement (as well as 5–6 mm short implants in the maxillary sinus floor). Preoperative bone density assessment may help to avoid stability-related complications in one-stage implant treatment of the atrophic posterior maxilla [25].

**Implant Selection:** Implant with geometrical designs that increased primary stability:
- Modified shape.
- Self-tapping threads.
- Tapered profiles.
- Flared necks.
- End cutting.
- Depth threads.

Thread geometry affects the distribution of stress forces around the implant. A decreased thread pitch may positively influence implant stability. Excess helix angles in spite of a faster insertion may jeopardize the ability of implants to sustain axial load. Deeper threads seem to have an important effect on the stabilization in poorer bone quality situations. The addition of threads or micro threads up to the crestal module of an implant might provide a potential positive contribution on bone-to-implant contact as well as on the preservation of marginal bone; nonetheless this remains to be determined [26].

**Implant Surface Characteristics:** Rough implants offer extensive surface for osseointegration and therefore allow the clinician to consider usage of short implants [27]. Survival rate of implants with roughened surface (96.6%) is significantly higher than the survival rate of implants with machined (88%) [11]. It is apparent that rough-surfaced dental implants have significantly higher success rate compared with implants with smoother surfaces [12].

**Crown to Implant Ratio:** Tawil et al 2006 placed 262 Bran mark implants (10mm or less in length) the patients were followed 12 to 108 months and evaluate marginal bone loss.

He concluded that when the load distribution is favorable, increased crown to implant ratios are not major risk factor.
- Reduction of the occlusal table.
- Flattening of the cuspal inclines [28].

**Crown to Implant Ratio and Occlusal Forces:** (Nedir et al 2006) 7 years study of implant to crown ratio ranged from 1.05 to 1.80 and no detrimental consequences on the final success rate were noted [29].

(Blanes et al.2007) reported the results of 10 years prospective study with 192 implants placed in the posterior region. A total of 51 implants showed a clinical crown to implant ratio equal to or greater than 2. Three implants failed, giving a cumulative survival rate of 94.1%. [30].

(Blanes 2009) Systematic review the current literature shows that the crown to implant ratios of implant-supported reconstructions do not influence peri-implant crestal bone loss [31].

Anitua E et al 2015 also found crown to implant ratio had not a significant influence on MBL on first year post loading [32].

**Crown to Implant Ratio Has No Influence on Marginal Bone Loss:** Systematic review on influence of crown ratio to implant ratio on marginal bone loss

57 Articles selected. A significant negative association between the crown to implant ratio and the marginal bone loss was found (P = 0.012). However, no statistically significant difference was found [33].

**Discussion**

Clinical choice of the most appropriate implant therapy modality should be based on assessment of the residual alveolar bone height, width, and sinus morphology with a cone beam computed tomography (CBCT) scan, current scientific evidence, surgical skills and experience of the surgeon, and the patient’s preferences. Following a good surgical protocol and excellent oral hygiene maintenance program are fundamental elements in achieving a successful and predictable outcome.

The use of short implants allows treatment of patients who are unable to undergo complex surgical techniques for medical, anatomic or financial reasons. By reducing the need for complex surgeries short implants reduce morbidity, cost and treatment time.

The available evidence on short dental implants in early research was not significant comparing with the longer dental implants; the surface treatment is improving now than before for this reason. Recently short implants offer a less invasive treatment alternative in
resorted ridge cases.

Situations that limit placement of long implant:
- Height of existing available bone at maxillary sinus or mandibular canal.
- History of chronic sinusitis.
- Cystic fibrosis.
- Pathological lesions.
- Patient acceptance for adjunctive surgical procedures to place longer implant.

Short implant as an alternative:
- Increases patient’s acceptability.
- Less surgical procedures.
- Lower costs.
- Fewer complications.
- Quicker rehabilitation time.

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<td>Septa</td>
<td>Residual Alveolar</td>
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<td>Bone Quality</td>
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<td>Bone Quantity</td>
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<td>Residual B-L Width</td>
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Table - Comparison between sinus floor elevation and short implant placement.

Conclusion
In cases, where bone volume is not enough to place an implant, using a short implant may avoid complex augmentative procedures and has some advantages:
- Similar implant and reconstruction survival rate.
- Keep vital structures and vascularization.
- Maintain more bone when placing the implant.
- Less morbidity.
- Faster and cheaper.

References


