Are short implants acceptable as an alternative to longer implants with sinus floor elevation in the posterior maxilla?

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A critical appraisal of a systematic review: D.S. Thoma, M. Zeltner, J. Hüsler, C.H.F Hämmerle, R.E. Jung. Short implants versus sinus lifting with longer implants to restore the posterior maxilla.
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Summary

Systematic review conclusion

The outcomes of the systematic review demonstrated high implant and reconstruction survival rates for short implants, and sinus floor elevation (SFE) with simultaneous placement of longer implants. Both treatment options are safe and predictable for implant therapy in the posterior maxilla. Biological complications are frequent, but mainly associated with SFE. The increased biological complications, costs and surgical time associated with SFE with longer implants, favors the use of shorter dental implants in the posterior maxilla.

Critical appraisal conclusion

The evidence suggests the use of short implants (5 to 8.5 mm long) as an alternative to SFE with longer implants (≥10 mm) for rehabilitation of the posterior maxilla. The outcomes indicate that there are less intra-operative complications when short implants are used. There is limited evidence that less post-operative complications with short implants and prosthesis will occur after loading compared to longer implants with SFE. The evidence presented should be interpreted and applied with caution because studies are limited, not all the important outcomes were measured and the duration of follow-up was less than 18 months.

Implications for clinical practice:

Implant treatment options for rehabilitation of the posterior maxilla are dictated by the available alveolar bone height, type of bone and inter-arch space. The evidence suggests that both short implants or SFE with longer dental implants can be recommended for implant therapy in the posterior maxilla presenting with limited alveolar bone height, provided careful case selection and evidence-based clinical protocols are followed. Where short implants are indicated, the best way to compensate for reduced implant surface and to ensure best possible primary stability

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is to use a wider diameter (4 – 6 mm) implant. Until more evidence is available it would be prudent for clinicians to avoid placing short implants in single free-end cases; follow a 2-stage implant surgery approach; allow for longer periods of osseointegration; avoid immediate loading; and consider splinting of prosthesis. 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 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.

Clinical question

Are short implants comparable to longer implants with SFE in terms of i) morbidity and surgically related complications ii) clinical and radiographical outcomes?

Review methodology

Search strategy

An electronic MEDLINE (PubMed) search was performed for controlled clinical studies, published from January 1990 up to 31 October 2014, comparing short implants (≤8 mm) (Group A) to longer implants (>8 mm) with lateral window sinus floor elevation (SFE) (Group B) for rehabilitating the posterior maxilla. The search was limited to the English, German, Italian and French language. The search was complimented by an additional hand search of the selected papers and reviews published between 2011 and 2014. Reference list of all included publications were screened for relevant studies.

Inclusion criteria

Eligible studies were selected based on the following inclusion criteria (i) human trials with a minimum amount of 20 patients, (ii) randomized controlled trials (RCT) or controlled clinical trials (CCT), (iii) short implants with an intrabony length of ≤8 mm, (iv) SFE in combination with longer implants with an intrabony length of >8 mm, (v) screw-type implants with a moderately rough surface, (vi) implants placed within the alveolar bone and the augmented sinus floor, and (vii) patients needed to be examined clinically.

Data extraction

Two authors independently screened the titles and abstracts derived from the search. Eligible articles were then obtained in full text. Disagreements regarding eligibility of studies and data extraction between authors were resolved by discussion and consensus. Cohen's Kappa coefficient was calculated to measure agreement between the two readers. The primary outcomes were survival rates of implants and reconstructions. Secondary outcomes included complication rates for implants and reconstructions, radiographic bone levels, as well as patient related outcome measures, surgical time, costs and the feasibility to perform the two procedures.

Method of analysis and Quality assessment

Two reviewers independently evaluated the methodological quality of all included studies using the Cochrane Collaboration's tool for assessing risk of bias in randomized trials. Any disagreement was discussed until consensus was achieved. Survival rates with corresponding 95% confidence intervals (95%CI) were calculated with implants as unit.

Main results

Eight RCTs comparing short implants with longer implants with SFE met the eligibility criteria. Studies were well conducted with respect to randomization, allocation, data collection and reporting, thus resulting in a low risk for selection, attrition and reporting bias. All of the studies presented with a high risk of performance bias due to a lack of blinding of patients and surgeons. Four studies had a high risk of bias from blinding of outcome assessment (detection bias). Surgeons placed implants in specialized clinical settings.

A total of 406 implants were placed in 217 patients with a mean age of 54 years. 197 implants were placed in the short implant group (Group A) and 209 implants in the longer implant with SFE (Group B). Length of short implants varied between 5 and 6 mm, with either, 4, 5, or 6mm diameter. Length of longer implants ranged between 10 and 15 mm. Lateral window SFE in Group B were performed simultaneously with implant placement.

Based on the pooled analyses of longer follow-ups (5 studies, 16–18 months), the survival rate of longer implants with SFE amounted to 99.5% (95% CI: 97.6–99.98%) and for shorter implants 99.0% (95% CI: 96.4–99.8%). For shorter follow-ups (3 studies, 8–9 months), the survival rates

of longer implants were 100% (95% CI: 97.1–100%) and for shorter implants 98.2% (95% CI: 93.9–99.7%). Complications were predominantly sinus floor membrane perforations. Patient reported outcomes, i.e. morbidity, surgical time and costs were generally in favor of shorter dental implants.

Conclusion

The analysis demonstrated predictably high implant and reconstruction survival rates for both groups. Given the higher number of biological complications, increased morbidity, costs and surgical time of longer dental implants with SFE, shorter dental implants may represent the preferred treatment alternative.

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Commentary

Background and importance

Alveolar bone height will often fall short of the optimum 10mm in the posterior maxilla due to alveolar bone loss and sinus pneumatization. Clinicians are consequently faced with the challenge of optimizing success and limiting complications when placing implants where there is reduced alveolar ridge height and poor bone quality (type IV) in the rehabilitation of the posterior maxilla.

In cases presenting with reduced alveolar bone height in the posterior maxilla, SFE procedures using either a lateral or crestal approach have traditionally been the treatment of choice to increase bone height to allow the placement of dental implants of optimal length (≥10mm). SFE procedures are however associated with increased risk of complications, higher patient morbidity, longer treatment time and costs, and require advanced skills. To avoid the complications and disadvantages associated with SFE's, the use of shorter dental implants (<10 mm in length) has been advocated as an alternative treatment option. Simultaneously, implant texture and design have been improved to compensate for situations with compromised bone quality and quantity.

The survival rates, complications and patient related outcomes of short implants in the posterior maxilla have never been compared to those of longer implants in combination with SFE for the same indications. The literature comparing the two treatment options in well-designed controlled clinical trials was scarce for many years, but more recent evidence suggests that both treatment options are reliable and predictably successful. [1, 2]

Are the results valid?

The individual studies presented with various methodological limitations that could potentially increase risk of bias and thus affect the validity of the evidence.

Inadequate blinding of participants and investigators; short follow-up time; small samples sizes and calculation of sample sizes based on secondary outcomes contributed towards a high risk for bias. Heterogeneity or group imbalances such as using different study designs, assessment tools, differing implant diameters; splinting of reconstructions within and between groups may also potentially affect the estimate of the outcome. The authors did not report whether tests for heterogeneity were conducted.

Overall, the limited number of studies, variation in study design, heterogeneity and limitations in research methodology amongst individual studies could potentially result in increased risk of bias that may affect the estimates of effect and thus affect the validity of the evidence.

What are the key findings?

The pooled survival rates for shorter implants were similar to that of longer implants with SFE. Due to heterogeneity in observation periods, no meta-analysis was conducted for the eight studies combined. The meta-analysis of the pooled data for short-term (8-9 months) (3 studies) and longer term (16-18 months) (5 studies) showed high implant and reconstruction survival rates for both the short implant group as well as with longer implants with SFE. The high survival rates should be interpreted with caution due to the relatively short follow-up observation period (maximum 18 months). Although the survival results were consistent throughout individual studies, the confidence intervals were wide indicating that the estimate of survival of implants was lacking precision. This could be ascribed to the limitations in the research methodology.

In all of the studies, except one, the differences between the two groups with respect to complication rates were statistically insignificant. More intra-operative biological complications were observed in the longer implant group, the most frequent complication being sinus floor membrane perforation. The data in this review suggest that the risk of complications increased by threefold with sinus floor elevation procedures. There were no statistically significant differences in marginal bone level changes between short implants and longer implants with SFE.

Available data indicate less morbidity and greater patient acceptance associated with the use of shorter implants. Comparison between the two groups is difficult because only four studies reported patient-related outcome data. To complicate matter further, different assessment tools were used. Qualitative analysis of descriptive statistics were further hampered due to small sample sizes, different study designs and variations in intervention within same populations (i.e. number of implants placed) The single study that assessed surgical time and costs.[3] showed that surgical time increased by 50% when a SFE procedure was performed compared to just using a short dental implant. It can be inferred that increased surgical time may be associated with the increase in morbidity, complication rate and negative patient-related outcomes. Shorter implants accounted for only half the costs compared to longer implants with SFE. Although the availability of data was limited, patient-reported outcomes, morbidity, costs and surgical time were all in favor of shorter dental implants.

Most of the studies included in the review did not report on all the secondary outcomes. Only three studies reported on changes in marginal bone levels, and four provided data on patient-related outcome measures. The four studies reporting on patient-related outcome lacked standardization in methods and criteria thus ruling out an appropriate comparative analysis.

Important patient-related outcomes such as post-operative pain or discomfort, morbidity, impact on quality of life, surgical time and costs were largely not reported on. Secondary outcomes were only reported on descriptively and not subjected to meta-analysis. No data was provided on initial alveolar bone height, alveolar ridge width, type of bone, systemic conditions, smoking habits, periodontal health, para-functional habits, sinus morphology and inter-arch relations. These variables may be critical to clinical decision-making.

The evidence reported in this review supports that of a previous systematic review, namely that there is not enough evidence to show whether SFE techniques are more or less successful in reducing the implant and prosthetic failures when compared to simply using short implants, up to one year after loading and that there were fewer complications when short implants were used without SFE.[4]

How are the results of this review applicable in clinical practice?

Increasing implant and prosthesis success rates, minimizing complications and morbidity, and improving patient acceptance and satisfaction with implant therapy are key factors in clinical decision-making. For the patient, costs and limiting surgical interventions and associated discomfort also play an important role when making choices between treatment options.

Considering that SFE requires more treatment time, greater costs, have more complications and more advanced surgical skills, the use of shorter dental implants may open dental implant therapy to a broader spectrum of clinicians and subsequently a broader patient population may benefit from this treatment option. Clinicians may elect to use short implants in cases where SFE are contra-indicated (i.e. chronic sinusitis, abnormal sinus morphology, smoking), provided there is adequate alveolar bone volume (≥ 5 mm). Implant surface roughness and increasing the diameter of the implant for achievement of sufficient primary stability at time of implant placement may contribute to the long-term survival of the implant and prosthesis.[5]

Proper case selection is essential to achieve a predictable and successful outcome, irrespective of which choice of treatment is selected. Cone beam computed tomography (CBCT) is critical tool for proper case selection and treatment planning. Important factors that must be considered include: patient related factors (systemic conditions, smoking habits, periodontal health, para-function); biological factors (residual alveolar bone height, alveolar bone width, bone quality and sinus morphology); surgical considerations (one or two stages, skills of the surgeon; and prosthetic considerations (splinted or not).

Clinical resolution

Today, both patients and practitioners demand simplified, minimally invasive, affordable and predictable approaches to increase acceptance and success of implant therapy. Restoring the edentulous maxilla with dental implants is challenging due to reduced residual alveolar bone and proximity of the maxillary sinus. Short implant can be a successful minimally invasive treatment alternative to placing longer implants with SFE in cases where the alveolar bone height in the posterior maxilla is ≥ 5mm. Using short implants in the posterior maxilla with reduced alveolar ridge height has several advantages for the patient including less surgical intervention and intra-operative complications, reduced waiting period for treatment completion and less costs. It may also render implant treatment accessible to a larger pool of patients. The evidence presented in this systematic review offers modest evidence for placement and restoration of short implants so long as clinicians understands the limitations, indications and risk factors thereof. The results from this

review should however be interpreted with caution due to lack of good quality studies and longer follow-up. SFE may still be the procedure of choice for surgeons that do not elect to use short implants or when short implants are contra-indicated. The use of short implants is promising but there are still many unanswered questions that require more research. Firstly, we do not know what the long-term success rates of short implants are from a biological and prosthetic perspective. Secondly, what is the optimum bone-to-implant contact surface (implant geometry, length and width) that will ensure the best primary and secondary stability, and a predictable and successful osseointegration. Further controversies include whether short implants should be used single or two-stage, should longer time for healing and bone maturation be allowed before loading, and should prosthesis on short implants be splinted?

Disclosure and Disclaimer

Dr Johan Hartshorne is trained in clinical epidemiology, biostatistics, research methodology and critical appraisal of research evidence. This critical appraisal is not intended to, and do not, express, imply or summarize standards of care, but rather provide a concise reference point for dentists to aid in understanding and applying research evidence from referenced early view or pre-published articles in top ranking scientific publications and to facilitate clinically sound decisions as guided by their clinical judgement and by patient needs.

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