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Review

Clinical outcomes of dental implants after use of tenting for bony augmentation: a systematic review

F. Pourdanesh [a], M. Esmaeelinejad [b,*], F. Aghdashi [a]

[a] *Department of Oral and Maxillofacial Surgery, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran*
[b] *Department of Oral and Maxillofacial Surgery, School of Dentistry, Semnan University of Medical Sciences, Semnan, Iran*

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Abstract

The reconstruction of severely atrophic ridges is often challenging and complicated. We searched the Medline, Embase, and Cochrane databases for articles up to October 2015 that reported the success of all types of tenting for bony regeneration. We extracted data on the size and site of the defect, the number of patients, vertical and horizontal augmentation, survival of dental implants, and complications. Thirteen studies were included, which yielded data on 423 patients with 1111 dental implants. Follow-up periods were more than five years, severely resorbed mandibles were augmented vertically by up to 10 mm, and the survival rate of the implants was over 97%. The mean (SD) gain in horizontal width by screw tenting was 3 (0.63) mm, and over 97.6% of dental implants in cortical tenting investigations survived. A tenting approach may reduce the need for large autogenous bone grafts in the reconstruction of severely atrophic ridges and local bony defects, and improves the survival of implants.

Keywords: Alveolar ridge augmentation; Atrophy; Bone grafting; Dental implants

Introduction

Bony regeneration and reconstruction in patients with severely atrophic ridges have been always controversial, and although many techniques have been suggested there is no consensus about the most efficient technique.[1] The rehabilitation of edentulous patients with severely atrophic ridges is difficult and surgeons need experience in the field.[2] Autogenous bone is still the gold standard for reconstruction,[3,4] but resorption, particularly of iliac bone grafts, is a serious drawback.[5,6] The quantity and quality of regenerated bone must be considered.[7] Although several techniques can be used, it can be difficult to find an appropriate technique that provides bone with properties similar to those of the recipient site.[8,9]

Tenting has been advocated for the initial reconstruction and subsequent regeneration of maxillofacial defects. Various techniques have been reported, the first of which was the tent-pole technique.[10] The two other modifications, cortical autogenous tenting and screw tenting, are usually used for smaller oral defects. Studies have shown that they can all be used to augment bone effectively.[10–12]

Although several reviews and trials have been done in the field of bony regeneration and reconstruction of atrophic ridges and defects of the jaw,[13–17] we know of no comprehensive review of the different tenting techniques in oral and maxillofacial surgery. We therefore systematically reviewed the long-term outcomes of dental implants after the use of tenting to repair severely atrophic ridges and local bony defects.

* Corresponding author. Tel: +98 21 66 05 04 80; Fax: +98 21 22 43 99 76.
E-mail address: esmaeelinejad@semums.ac.ir (M. Esmaeelinejad).

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Methods

Focused question

The PICO (population, intervention, comparison, and outcome) question was stated as follows: In partially or completely edentulous patients with inadequate bone for implant insertion (P), does the tenting technique (I) in comparison to other methods of vertical bone augmentation or no augmentation (C), increase bony height and implant survival/success rates (O)?

Search strategy

This review followed the preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement.[18] We searched the Medline, Embase, Scopus, and Cochrane databases to find studies that were published up to October 2015. The terms used included "Tenting technique" OR "Screw tenting" OR "Tent-pole" OR "Bone screw"[Mesh] "Cortical tenting" AND the Mesh terms related to bony reconstruction, which included "Severely atrophic ridge" AND "Alveolar ridge augmentation" OR "Mandibular ridge augmentation".

We assessed the abstracts of all the papers to exclude those that were not related, and then read the full texts. Clinical trials and human studies with no language restriction, which were published up to October 2015 and which evaluated the effects of the tenting technique to augment intact ridges (without fracture) in systemically healthy and non-syndromic patients, were included. Case reports, letters to the editor, technical notes, grey literature, reviews, and animal studies, were excluded.

Data extraction

All searches and data extraction were done independently by two of the authors and checked by the third. The quality of the articles was assessed by the third author as a part of the data extraction process. The title of the journal and the authors' identity were blocked out before review of the final articles to prevent reviewer bias. The data, which were recorded on a pre-prepared data collection form, included the number of patients and dental implants, mean age of the patients, site and size of the defect, and the material used to fill the gap; also the mean augmentation rate, follow-up period, survival of implants, major complications, and other important results and findings. These were then categorised in tables.

Results

Fig. 1 shows the selection process. Table 1 shows the reasons why five papers that were closely related to the topic were excluded.[19–23] Thirteen articles were finally included.

Three studies related to the tent-pole technique (Table 2).[10,24,25] All patients (mean (range) age 62 (44–81) years) had severely atrophic mandibles. The mean (range) gain in bony height was 8.25 (4–13) mm. The follow-up period ranged from 4.9 to 6 years and the survival rate of the implants was more than 97%.

Four papers evaluated the effects of screw-tenting on bony augmentation (Table 3).[11,13,26,27] The mean (range) age of the patients was 50 (22–73) years, and the mean (range) gain in bony height was 5.68 (0.5–10) mm. All the implants survived.

Six papers related to cortical autogenous tenting (Table 4).[12,14,15,28–30] The mean (range) age of the patients was 50 (20–73) years, and the augmented ratio was more than 5 mm. The mean (range) gain in bony height was 4.46 (less than 2–6) mm, and the survival rate of the implants was more than 97%.

Discussion

The vertical augmentation of atrophic ridges has always been controversial, and no regenerative technique has been effective in all cases.[31,32] The tenting technique, which originated from the principles of guided bone regeneration, involves raising the periosteum like a tent to allow osteoblasts to migrate into the gap to start osteogenesis. The gap that is made is then filled with osteoconductive or osteoinductive materials, and in some cases, both. The migration of epithelial cells can be prevented by the application of a barrier-like collagen membrane or other component.[33] The technique is divided into three categories that depend on the method that is used to keep the periosteum up.

Ten-pole technique

In this procedure dental implants are used to make a gap between the periosteum and the bone (Fig. 2), and in most cases the gap is filled with bone grafts.[34] It was first described by Marx et al and was the first modification of the tenting technique.[10]

Three studies investigated its effects on bony augmentation in patients over 62 years of age with severely atrophic mandibles. Although the anterior mandible was reconstructed, the whole mandibular ridge was severely atrophic, and posterior iliac bone grafts were harvested for reconstruction. Long-term follow up showed minimum resorption. Survival of the dental implants, which were placed at that same time, was good.

The major complications were transient or permanent paraesthesia of the inferior alveolar nerve and the need for a second operation such as vestibuloplasty. The other important disadvantage was incorrect angulation of the implants. Marx et al reported that they were not able to make prostheses in 5.1% of the cases because the inclination was incorrect.[10]

Use of the technique resulted in gains of up to 10 mm in bony height. Long-term follow up (more than five years)

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