Alveolar distraction before insertion of dental implants in the posterior mandible

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SUMMARY. We investigated the efficacy of alveolar distraction for reducing crown height:implant length ratio in the posterior mandible. Ten alveolar distractions were done in seven patients. The pre-distraction ratio of required crown height to bone height available for implantation was in all cases ≥1. Two implants were placed in each distracted area (total 20 implants). Before distraction, the mean (SD) predicted crown height was 12.8 (2.1) mm; mean bone height available for implantation was 7.8 (1.5) mm. After distraction and insertion of implants, mean crown height was 8.1 (1.9) mm, and mean implant length was 11.3 (1.9) mm. Before distraction, the mean required crown height:available bone height ratio was 1.7 (0.3); after distraction and insertion of implants, the mean crown:implant ratio was 0.7 (0.2) (P > 0.0005). Alveolar distraction is effective for increasing the height of the alveolar ridge in the posterior mandibular region, and should be considered when the height of the predicted crown that is required is greater than or equal to the maximum height of bone available for implantation.

INTRODUCTION

One of the most common problems in oral implantology is insufficient bone height between the alveolar ridge and the dental canal, as a result of mandibular atrophy from edentulism. The edentulous mandible atrophies progressively, losing up to 50% of its original volume, and in severe cases this atrophy affects both the alveolar ridge and the mandibular basal bone. Ulm et al. reported that the mandible loses 60% of its bone volume during progressive atrophy, and that most is lost in the early stage of the process. The areas showing most loss are the molar and premolar regions (the posterior mandible). Insufficient bone height often means that the crown height:implant length ratio is too great, which is likely to reduce the implant’s useful lifespan, because of the leverage effect (degree of force acting on the implant site). It has been suggested that the length of the crown should be no more than 50% of total length of the prosthesis. Another technique is to place short implants above the mandibular canal. However, these implants are anchored only in the superior cortex, which compromises their load-bearing capacity. Insertion of implants lingual to the nerve canal, through both superior and inferior cortex, has also been described. Neither of these techniques resolves the problem of excessive length of the crown. Another approach is autologous bone grafting, but such grafts are reabsorbed to a variable extent. An additional operation is also required to obtain the bone for grafting, and in some cases sufficient bone may not be available.

In recent years, another technique has gained increasing acceptance, namely alveolar distraction, which allows the height of the alveolar ridge to be increased so that implants can have shorter crowns. A key early figure in bone and soft-tissue distraction was Ilizarov, who initially used it in long bones. Subsequently, distraction techniques have been applied to facial bones and soft tissues, and more specifically to the alveolar ridge, for which a number of specially designed distractors are now available.

In the present study we investigated the efficacy of alveolar distraction to increase the available height of bone in patients requiring implants in the posterior mandibular region.
Patients and Methods

Seven patients (5 men and 2 women; mean age (SD) 43 (7) years) were studied. All patients had unilateral ($n = 4$) or bilateral ($n = 3$) partial edentulism in the posterior mandible, with varying degrees of alveolar atrophy. None of the patients had teeth missing from the anterior mandible, or teeth remaining posterior to the edentulous sites. A total of 10 alveolar distractions were done, and 20 implants inserted (16 International Team for Implantology Straumann, Switzerland, and 4 Friadent, Friadent, Germany). In all cases opposing teeth were present in the upper jaw.

Investigations before distraction

The distance between the alveolar ridge and the dental canal was measured by computed tomography (CT) (Dentascan, Siemens, Somatom AR SP, Erlangen, Germany) (Fig. 1). The height of bone available for implantation was estimated as this distance minus 1 mm (to ensure the integrity of the dental canal). The required crown height (without distraction) was measured with the aid of plaster casts mounted on a Dentatus articulator (Hägersten, Sweden) (Fig. 2). Both measurements were made by a person who was unaware that distraction was under consideration. The required crown height:bone height ratio available for implantation was calculated (Index A). Alveolar distraction was limited to those patients in whom index A was $\geq 1$ (all those cases in the present study).

Surgical technique and alveolar distraction

In all patients we used Lead System distractors (Leibinger, Germany), following the procedure described by Chin.

We made an incision in the mucosa at the level of the alveolar crest, raised a vestibular mucoperiosteal flap, and left the lingual mucoperiosteum adhering to the bone (Fig. 3). One week after fitting the distractor, we

Fig. 1 Preoperative measurement by computed tomography of bone height (B) between the dental canal (A) and the alveolar border.

Fig. 2 Preoperative plaster casts of a patient who had alveolar distraction in the posterior section of the mandible. The casts are mounted on a Dentatus articulator for measurement of crown height.

Fig. 3 Insertion of a Lead System distractor: (A) Threaded rod; (B) transport plate anchored to the mobile bone segment; (C) base plate fixed to basal bone.
started distraction at a rate of 0.5 mm every 12 hours for 5 days, with the aim of increasing the height of the alveolar ridge by 5 mm. Once this had been achieved, the distractor was left in place for 3 months to ensure bony consolidation, then removed to allow insertion of implants. The prothesis was constructed 3 months after implantation. Follow-up ranged from 6 months to 2 years.

Follow-up after implantation

We measured the height of the crown the length of the implant in each case. Crown height was measured by the same person as before operation, again unaware of the treatment that had been used. The crown:implant length ratio was calculated (Index B).

Results are expressed as means (SD).

RESULTS

The mean predicted height of crown required (as estimated before distraction) was 12.8 (2.1) mm. The mean available height of bone was 7.8 (1.5) mm. After distraction and implantation, the mean height of the crown was 8.1 (1.9) mm, while the length of the implant was 11.3 (1.9) mm. The mean ratio of predicted crown height to bone available before distraction was 1.7 (0.3) (Index A), and the mean ratio of crown height to length of implant after distraction was 0.7 (0.1) (Index B). These two means differed significantly ($P < 0.0005$) (Fig. 4).

Fig. 4 Box plots showing: A = ratio of predicted crown height to available bone height before distraction (Index A), and B = ratio of actual crown height to actual implant length after distraction (Index B). Each plot shows the median, quartiles, and range (excluding outliers).

DISCUSSION

We used two measurements of available bone. Before distraction we used CT to measure the height available between the alveolar ridge and the dental canal. This measurement is obtained routinely in all patients who are being considered for dental implants. After distraction, however, we used panoramic radiography to calculate implant length (total bone height minus 1 mm), because of the high cost of a second CT and the higher dose of radiation it would entail. We consider that the two measurements are objective, subject to minimal error, and perfectly comparable.

We consider that alveolar distraction is an attractive option for this type of cases of this type, the advantages of which include the lack of any need for an additional operation as in autologous bone grafting and minimal risk of nerve damage compared with displacement of the dental nerve. It is also easy to achieve a crown:implant ratio of less than 1, as alveolar distraction acts both to reduce crown height and to permit increased implant length. However, the technique is not without drawbacks, such as the discomfort caused by the distractor, which may interfere with eating.

In addition, as with any other technique, alveolar distraction may have complications. We have used intraosseous distractors because they can be adapted to the posterior region of the body of the mandible, where space is limited (particularly when opposing teeth are present, as in all the cases treated by us). They are also considerably cheaper than juxtaosseous distractors.

In conclusion, alveolar distraction in the posterior mandible is indicated in cases in which the ratio of predicted required crown height:available bone height is greater than or equal to 1, with the aim of achieving a ratio of crown:implant length of less than 1. Full evaluation of the effectiveness of alveolar distraction in the 20 implants studied by us will require long-term follow-up. However, good results have been obtained in animal models 1 year post-operatively.

REFERENCES

1. Alveolar distraction before insertion of dental implants


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