Augmentation in Proximity to the Incisive Foramen to Allow Placement of Endosseous Implants: A Case Series

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Purpose: To assess whether augmentation in the proximity of the incisive foramen with an intraoral bone graft to allow for reliable placement of implants is achievable, not jeopardizing the nasopalatine nerve and vessels in a way causing patients’ distress.

Patients and Methods: Five patients who had lost a central maxillary incisor due to trauma, and in whom a deficiency of bone at the palatal side was present in the proximity of the incisal canal, were augmented with autogenous cancellous bone harvested from the retromolar region. After a healing period of 3 months, implants were inserted. Patients’ acceptance, complications, and postoperative morbidity of the procedure were prospectively evaluated by standardized clinical and radiographic examinations up to 12 months after augmentation.

Results: At the time of implant surgery, in all cases there was sufficient bone for insertion of the implants with adequate primary stability. Up to now (follow-up of 12-15 months) no fixtures have been lost and all peri-implant tissues have a healthy appearance. All patients were satisfied.

Conclusion: Augmentation in the proximity of the incisive foramen to enable implant placement appears to be feasible, both from the perspective of the patient and the professional.

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Implant-supported single tooth replacements in the esthetic zone remain a complex restorative challenge because of several variables affecting the esthetic and functional outcome. Among others, reliable rehabilitation of the alveolar ridge with endosseous implants aiming for good long-term prognosis requires proper quality and quantity of the alveolar bone at the implant site.1 However, particularly in the esthetic zone, the local condition of the alveolar ridge is often unfavorable for implant treatment. For example, postextraction resorption of the alveolar process and bone loss from periodontal disease or trauma has often resulted in an insufficient bone volume at the planned implant location, rendering implant placement impossible or incorrect from a prosthodontic and esthetic point of view. Preimplant local ridge augmentation is necessary in such cases.

A great diversity of surgical techniques and augmentation materials are available for improving the ridge conditions that jeopardize the placement of an endosseous implant, in particular for defects of the labial wall of the maxilla.2,3 Most techniques have focused on reconstruction of a labial wall deficiency, which is the most common bone deficiency occurring in the esthetic region. However, a high resorption rate of the premaxilla in the postextraction phase, bone loss from trauma, and an enlarged incisive foramen, can all result in local bone deficiency at the palatal site.4,5 Also, considering the orofacial dimensions, the implant should be placed at the ideal point of emergence between the imaginary line connecting the point of emergence of the adjacent teeth.6 An implant placed too far facially will result in the potential risk of soft tissue recession and/or potential pros-
thetic complications, such as implant axis problems, making the implant difficult to restore.

Because a local palatal deficiency is occasionally present in the anterior zone, the aim of the present case series was to assess whether bone augmentation in proximity to the incisive foramen would allow for reliable placement of an implant without jeopardizing the nasopalatine nerve and vessels.

Patients and Methods

PATIENTS

A total of 5 patients (3 men and 2 women, mean age $21.7 \pm 4$ years, range 19 to 26 years) were included in the present case series. All 5 had been referred to the Department of Oral and Maxillofacial Surgery because of the traumatic loss of a single maxillary anterior tooth (central incisor). All patients wished for an implant-supported crown to replace this lost incisor. The clinical and radiographic examinations revealed insufficient bone volume at the palatal site (Fig 1).

SURGICAL AND PROSTHODONTIC PROCEDURES

All surgical procedures were performed with the patient under local anesthesia (articaine with epinephrine). Antibiotic prophylaxis was given for 1 week (amoxicillin 500 mg), starting 1 hour preoperatively and continued every 8 hours postoperatively. An incision was made on the top of the alveolar ridge. A pedicled mucoperiosteal flap was raised to the labial and palatal side. All patients had an extensive osseous defect on the palatal bone related to traumatic loss of the palatal bone wall and an enlarged incisive foramen. The width of the alveolar process, mainly consisting of the labial wall, was 1 to 2 mm (Fig 2A). The nerve was mobilized to the palatal side. Next, an autologous bone graft was harvested from the retromolar area of the mandible using the procedure described by Raghoebar et al. The bone was shaped with a bur and fit to the palatal bone defect. The cortical bone of the receptor site was perforated with a small round bur to create a bleeding bone surface and to open the cancellous bone.


The bone graft was fixed with a screw to the buccal bone (Fig 2B).

At 3 months after removal of the tooth and reconstruction of the alveolus, the implants were placed. After raising the mucoperiosteal flap, the screw used to fix the bone graft was removed. Next, the implant site was prepared using a surgical guide. The template design was based on a restoration-driven approach with indications for a correct 3-dimensional implant placement, respecting the comfort zones. The endosseous dental implant (Nobel Biocare AB, Gothenburg, Sweden) was placed 2 to 3 mm deeper than the ideal cervical border of the future crown, as indicated on the surgical guide.9 The wound was closed with Ethilon 4-0 suture (Ethicon; Johnson & Johnson, Amersfoort, The Netherlands). The implants were uncovered after 3 months. Then, a provisional crown with an adequate emergence profile was fabricated and placed to guide and shape the peri-implant tissue before definitive restoration. Careful oral hygiene instruction with emphasis on how to clean the peri-implant region was given to all patients. The final impression of the implant was made approximately 3 months after placement of the provisional crown. Subsequently, an all-ceramic crown was fabricated on a customized titanium abutment (Procera, Nobel Biocare AB).

**CLINICAL AND RADIOLOGIC ASSESSMENTS**

Routine clinical examinations (among other questions, the patients were queried regarding preoperative and postoperative complications and pain at the donor site) were performed at 2 and 6 weeks and 3, 9, and 12 months after surgery. Wound healing was recorded. The sensibility of the palate was evaluated. Tactile sensibility was tested by lightly brushing the palate with a wisp of cotton (the subject should be able to count the number of contacts with the eyes closed), and superficial pain was tested with a needle (the subject should be able to determine whether contact with the palate was made with a sharp or dull instrument with the eyes closed). In addition, patients were asked whether they had experienced any altered sensation in the mucosa. The long-term morbidity of the donor site was assessed by a questionnaire and a thorough, standardized clinical examination 12 months after surgery. The questionnaire consisted of multiple choice questions on the duration and severity of postoperative pain at the donor site, meteorotropism, sensory loss, duration of subjective rehabilitation, postoperative symptoms at the donor and recipient sites, and the patient’s acceptance of the procedure.8 Pain severity was graded on a 10-cm visual analog scale, with 0 representing no pain and 10 representing severe pain. To estimate the subjective acceptability of the bone harvesting, the patients were requested to judge the procedure using a number from 0 to 10, with 0 indicating “a very bad experience” and 10 “no problems at all.”

Radiographic examination was performed after placement of the definitive crown and 12 months after loading and included standardized intraoral radiographs with a long-cone paralleling technique.

**Results**

No complications were observed during the surgical procedure (no extensive bleeding after removal of the bone graft or during mobilization of the nasopalatine nerve). No objective signs of infection were observed during the follow-up period. After the augmentation procedure and subsequent healing period, sufficient bone was available in all patients to insert the implants with good initial stability (>45 N/cm, determined using the Osseocare, Nobel Biocare AB; Fig 3) and an appropriate length of 13 mm or longer.

After 1 year of function, all implants were stable, and none had lost osseointegration (Fig 4). The peri-implant tissues were healthy, and no pockets were deeper than 3 mm on the palatal side. The mean mesial and distal bone resorption at 1 year after placement of the definitive crown was 0.21 ± 0.11 mm and 0.23 ± 0.13 mm, respectively. No marginal bone loss exceeding 1 mm was observed at the mesial and distal aspects of any implant.

Prolonged postoperative pain (>1 week) at the donor site was experienced by 1 patient that had resolved within 1 month. Three patients perceived an altered sensation in the palate region postoperatively for 6 weeks. These complaints had spontaneously resolved within 3 months.

Objectively, no disturbed sensibility of the palatal mucosa was observed in any patient 12 months after
surgery. All patients reported that the postoperative course was in accordance with their expectations. All patients were willing to repeat the procedure if necessary. The mean subjective acceptability of the procedure was rated as 8.3 ± 0.3.

Discussion

The nasopalatine canal tends to enlarge in all dimensions after tooth extraction and with age. Insufficient bone volume at the palatine site can also result from trauma and orthodontic treatment. Extraction of an anterior tooth will be followed by progressive bone loss of the alveolar ridge in the apicolingual direction. Thus, in the premaxillary region, the residual ridge will shift in a palatine direction (ie, it moves toward the incisive foramen). In traumatic cases, next to the loss of bone resulting from resorption, some traumatic loss of the palatine bone could have occurred when the tooth has been displaced in a palatine direction. Orthodontic therapy, in particular, treatment of a Class II malformation, can result in displacement of the maxillary incisors toward the incisive foramen (all our patients had undergone orthodontic treatment in the past). Thus, all these conditions can result in a local anatomy that challenges proper implant placement at the required location.

Kraut and Boyden described the difficulties and anatomic limitations regarding the location of the incisive canal in relation to maxillary central incisor implants. In about 4% of the cases they evaluated, the incisive canal was of a size that would have been detrimental to the placement of root-formed implants in this particular area. This unfavorable situation can be resolved by either pushing or removing the soft tissue content of the incisive foramen posteriorly, followed by reconstruction of this area with an intraoral corticocancellous block graft and placement of the implant when proper initial implant stability can be achieved, or by first reconstructing this area, followed by implant placement at a later point. In all our patients, we had to use the latter approach, because no primary implant stability could be achieved owing to the dimensions of the defect to be reconstructed. Cutting the nasopalatine neurovascular bundle might be necessary when operating on a severely resorbed anterior maxilla or when the nasopalatine canal is wide. Removal of the complete soft tissue content in the incisive canal could result in possible sensory loss in the anterior palatal region. Because this area is densely innervated (the maxillary nerve has many branches that provide sensory innervation to the palate), the contribution of the nasopalatine to the innervation of the anterior palate is minor. Furthermore, even when some early sensory disturbance has resulted from damage to the nasopalatine nerve, this disturbance will not be a concern. This is because sensation in the anterior third of the palatine mucosa usually recovers within 2 to 3 months owing to the compensatory action of the branches of the greater palatine nerves.

In contrast to the techniques described by Scher and Artzi et al, who placed the implant and then occupied the remaining space around the implant with either bone substitutes or chin bone, the implants in our patients had to be placed in closer vicinity to the foramen. As such, we could not achieve primary stability of the implants. Thus, a 2-stage technique was required, as we described in our report. Furthermore, in all our patients, we used retromolar bone instead of chin bone. The advantages of the retromolar donor site over the chin include minimal patient concern for an altered facial contour and decreased complaints of discomfort (fewer problems during eating and with speech). Given the better acceptance by the patients and moderate subjective complaints, bone harvesting from the mandibular retromolar region is the best option for reconstruction of local bone defects, especially when combined with removal of the third molar.

To achieve a good long-term prognosis, including esthetics and phonetics, the position of an implant in a crucial site such as the anterior maxilla requires a proper quality and quantity of alveolar bone at the implant site. In the present case series, a successful novel technique was described to augment the palatal side of the anterior maxilla.

References