Implants Placed in the Nasopalatine Canal to Rehabilitate Severely Atrophic Maxillae: A Retrospective Study With Long Follow-up

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To assess the survival rate of implants placed in the nasopalatine canal for the rehabilitation of patients with atrophic maxillae and the level of satisfaction of these patients. A retrospective study was performed between 2000 and 2009 of patients with severe atrophy of edentulous maxillae (Cawood and Howell’s class V) rehabilitated with implant-supported prostheses with 1 implant placed in the nasopalatine canal. A preoperative computed tomography scan was obtained of all patients and all surgeries were performed by the same surgeon. The following parameters were assessed: neurosensory status of the anterior palate (using the pointed/blunt discrimination method); implant success rate according to criteria described by Albrektsson et al; patient satisfaction with the prosthetic treatment (using visual analogue scales). Thirteen patients with a mean age of 54.8 years were treated, 5 men and 8 women. Seventy-eight implants were placed: 13 in the nasopalatine canal, 6 in the zygomatic bone, 12 in the pterygomaxillary region, 2 in the frontomaxillary buttress and 45 in other locations. Six patients reported a slight decrease in sensitivity in the anterior palate after surgery, which disappeared in all cases within a few weeks. Two early failures (before prosthetic loading) and no late failures (after prosthetic loading) of nasopalatine implants were recorded, yielding a success rate for these implants of 84.6% after a mean follow-up of 70 months (range 24 to 132 months. High patient satisfaction with the prosthetic restoration was generally achieved in terms of comfort, stability, function, esthetics, and ease of cleaning. Residual bone is associated with the nasopalatine canal, even in patients with severe maxillary atrophy. This canal may be considered a possible location for an anterior implant when rehabilitating atrophic patients using implant-supported prostheses.

Key Words: nasopalatine canal, maxillary atrophy, dental implants

INTRODUCTION

The rehabilitation of atrophic maxillae with implant-supported prostheses is complicated by low bone quantity and quality.1 After the loss of teeth, a vertical and horizontal resorption of the anterior maxilla occurs.2 The nasopalatine canal tends to lengthen and the neurovascular bundles inside may ultimately emerge from the ridge crest.3,4 Even in cases of severe resorption, dense cortical bone remains anterior to this canal.2 In patients with severe maxillary atrophy, anchorage of implants in the bone remaining around the nasopalatine canal is an alternative to bone grafting that provides sufficient anterior support to enhance the biomechanics of the implant-supported prosthesis.

The incisive canal ranges in length from 4 to 26 mm and is related to maxillary bone height; it has...
an axis of 70° (57–89.5°). The nasal process of the maxilla rises 2 to 3 mm above the nasal floor; as a result, when 8 to 10 mm or above are present below the nasal floor, a large osteotome may be used, permitting the placement of a 10–13 mm-long implant.2,5

There are few references in the literature to implants placed in the nasopalatine canal. The technique was described by Scher2 and Misch;5 using a large round drill, the soft tissue from the canal site was curetted and then drills of progressively increasing diameter up to 2 mm were used coronal to the final depth of the canal until the implant osteotomy diameter was reached. The literature review performed in preparation for the present study also located 3 further studies.6–8 Rosenquist and Nyström6 filled the incisal canals with autogenous bone in 4 patients who had lost 1 or both central maxillary incisors due to trauma. After a healing period of 4–5 months, implant surgery was performed; in all cases the canal appeared to have been replaced by cancellous bone and the implants were placed partially into the grafted area. After a 12-month follow-up none of the implants had been lost. Artzi et al7 reported the case of a patient with an enlarged incisal foramen; at the time of implant placement a corticocancellous block graft was adjusted to fit the foramen and the soft tissue was pushed back but not removed. Nine months later, solid bone support was observed embracing the implant body and although the size of the incisal foramen had decreased significantly, the nasopalatine branches were still evident. In a pilot study, Peñarrocha et al8 reported the use of implants inserted in the nasopalatine canal after removal of the neurovas-

FIGURE. (a) Initial panoramic radiograph showing severe maxillary atrophy. (b) Axial view of the preoperative computerized tomography (CT) scan; the nasopalatine canal can be observed. (c) Planning of implant positions on the CT scan. (d) Identification of the nasopalatine canal after flap elevation. (e) Removal of the neurovascular bundle with a drill. (f) Preparation of the implant site using osteotomes. (g) Occlusal view of the implant site in the nasopalatine canal prepared using osteotomes. (h) Placement of particulated bone graft in the nasopalatine canal.
cular bundle to rehabilitate 7 patients with severely atrophic maxillae. After an observation period of 12 months, only 1 nasopalatine implant had been lost due to lack of osseointegration.

The aim of the present study was to make a retrospective analysis of the long-term (2 to 11 years) outcome of implants placed in the nasopalatine canal to rehabilitate patients with severe maxillary atrophy.

**Materials and Method**

**Patients and implants**

This clinical retrospective study was carried out at the Oral Surgery Unit of Valencia University Dental Clinic and analyzed patients treated between 2000 and 2009 with implants placed in the nasopalatine canal using the technique described in an earlier pilot study. Patients with class V of Cawood and Howell classification of maxillary atrophy were rehabilitated using implants placed in the nasopalatine canal supporting full-arch fixed prostheses, and monitored over a follow-up period of at least 24 months after loading. All patients gave written consent to take part, having been provided with full information about the treatment plan.

**Surgery and prosthetics**

Preoperative radiographic examination included panoramic radiographs and computerized tomography (CT) scans in all cases to assess the bone available, the dimensions and configuration of the nasopalatine canal and any presence of sinus pathology (Figure a–c).

All surgeries were performed by the same surgeon under local anesthesia (4% articaine with...
implants in the Nasopalatine Canal

Table

Clinical data of the patients

<table>
<thead>
<tr>
<th>Case number</th>
<th>Sex</th>
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</tr>
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</table>

Follow-up and studied parameters

Recall visits were scheduled in all cases at 1, 3, and 6 months after implant placement and annually after prosthesis placement.

A neurosensory evaluation of the anterior palate of each patient was performed using the pointed/blunt discrimination test: a ball burnisher and a pointed dental probe were pressed lightly and randomly on the palate to check the patient’s ability to differentiate between pointed and blunt objects. All patients underwent evaluation 1 week (at the suture removal visit) and 1 month after implant placement. Those patients reporting neurosensory alterations were recalled weekly to check on progression until this had disappeared.

Twelve months after prosthesis placement and annually thereafter, patients were recalled for clinical and radiographic evaluation. Prostheses,
with the exception of the single case treated with a cemented prosthesis, were removed to be thoroughly cleaned and allow better clinical examination of the peri-implant tissues. Paralleled digital intraoral radiographs were obtained to assess marginal bone levels around the implants (Figure p).

At the first annual control visit, patient satisfaction with the treatment was also assessed. Ten-cm visual analogue scales (VAS) were used to estimate patient satisfaction.10–13 These measurements assessed general satisfaction with the implant-retained prosthesis, comfort and stability, ability to speak, ease of cleaning, aesthetics, self-esteem, and function. The anchor words were “totally dissatisfied” and “completely satisfied.” Patients marked the scale independently, although a research assistant was available to offer help or explanations when required.10,12,13

Implant success was assessed using clinical and radiologic criteria as described by Albrektsson et al14: (1) absence of clinical mobility of the implant, (2) absence of exudate, persistent inflammation, pain or bleeding, (3) absence of periapical radiolucency, and (4) absence of bone loss progressively greater than 0.2 mm annually after the first year of implant placement.

**RESULTS**

Thirteen patients, 5 men, and 8 women, with a mean age of 54.8 years (range 30 to 76 years) were treated. The average follow-up was 70 months (range 24 to 132 months). Three patients smoked less than 10 cigarettes per day and 10 were nonsmokers. Regarding systemic conditions, one patient had anhidrotic ectodermal dysplasia15 and 2 had epidermolysis bullosa;16 the remaining were healthy patients with severe maxillary atrophy – Class V of Cawood and Howell.9 The procedure for implant insertion in the nasopalatine canal was exactly the same for patients with ectodermal dysplasia or epidermolysis bullosa as for healthy patients. Soft tissue healing was uneventful in all cases.

A total of 78 implants were placed (5–7 per patient): 13 were anchored in the nasopalatine canal, 6 in the zygomatic bone, 12 in the pterygomaxillary region, 2 in the frontomaxillary region, and 45 in other locations. All implants used were Phibo implants with Avantblast surface (PhiboDental Solutions S.L., Barcelona, Spain; Table).

<table>
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<td>3</td>
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<td>11</td>
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<tr>
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</table>

Two early failures—during the osseointegration period—of implants placed in the nasopalatine canal occurred but there were no late failures following prosthesis placement. All surviving implants fulfilled the success criteria of Albrektsson et al,14 with implants in the nasopalatine canal yielding a success rate of 84.6%. Both failures occurred in
healthy patients. None of the implants placed in other locations failed.

Average patient general satisfaction was 9.0 (range 8 to 10). All patients were satisfied with comfort and stability (mean VAS score 9.7; range 9 to 10), ability to speak (mean VAS score 9.5; range 8 to 10), function, esthetics, self-esteem (mean VAS 8.5; range 7 to 10) and ease of cleaning (mean VAS score 9; range 8 to 10).

**DISCUSSION**

In the present study, the nasopalatine canal was used as an anatomic buttress in which residual bone allowed placement of dental implants. The technique of implant placement directly in the nasopalatine canal was first described by Scher in 1994 and later mentioned by Misch in his 1999 book. However, Rosenquist and Nyström had published a previous report of the use of the nasopalatine canal for dental implant placement. These authors treated 4 patients with absent central incisors. The canal was filled with autologous bone graft and 5 months later implants were placed partially in the grafted area; no fixture was lost after 12–15 months. Artzi et al treated a patient with an implant in the nasopalatine canal without removing the neurovascular bundle. These authors adapted a corticocancellous bone block graft to the canal and, without removing the soft tissue, pushed the block backwards; the implant was placed in the same surgical procedure. No complications were observed during a 9-month follow-up. In a pilot study prior to the present study, Penarrocha et al treated 7 patients with implants placed in the nasopalatine canal after removing the neurovascular bundle. These authors adapted a corticocancellous bone block graft to the canal and, without removing the soft tissue, pushed the block backwards; the implant was placed in the same surgical procedure. No complications were observed during a 9-month follow-up. In a pilot study prior to the present study, Penarrocha et al treated 7 patients with implants placed in the nasopalatine canal after removing the neurovascular bundle and preparing the implant site using drills and osteotomes. One early failure occurred 3 months after implant insertion but no late failures occurred, yielding an implant survival rate of 85.7%. In the present study, 13 implants inserted in the nasopalatine canal were monitored for 24 to 132 months (average 70 months); a total success rate of 84.6% was achieved.

The nasopalatine canal starts at a point situated towards the front of the floor of each nasal cavity. Each canal opens into the midline incisive foramen on the median plane of the palatine process of the maxilla, posterior to the central incisor and transmits the nasopalatine nerve and the terminal branch of the descending nasopalatine artery, branches of the maxillary division of the trigeminal nerve and the maxillary artery. Although the nasopalatine canal has been identified as an important anatomical landmark for the implant surgeon, the risks and clinical implications of damaging the canal and its neurovascular structures have not been addressed in the literature. Mraiwa et al pointed out the variability of both the dimensions and the morphological appearance of the nasopalatine canal. To avoid disturbing the neurovascular bundles and cause any complications, this important dimensional variability should be taken into account when dealing with surgical procedures such as implant placement in the central incisor region. In the present study, cone beam CT scans were used to assess the nasopalatine canal, and in all cases the dimensions and morphology were considered adequate for implant insertion according to the results achieved in the earlier preliminary study.

Lack of osseointegration and sensory alterations are the 2 main complications that have been associated with implant placement in this region. Implant contact with the neural tissue may result in osseointegration failure. In the present study, the soft tissues of the nasopalatine canal were curetted, then the preparation of the implant sites began with the first drills of the implant system and finalized with osteotomes of increasing diameters that allowed bone particle condensing at the floor of the implant site. Two implants failed during the osseointegration period but none failed following prosthetic loading. This yielded a success rate of 84.6%, which was slightly low in comparison to success rates generally reported for dental implants placed using conventional techniques.

Removal of the complete soft tissue content in the incisive canal can result in possible sensory loss in the anterior palatal region; altered mucosal sensation following surgical trauma due to implant placement in the region of the mental foramen has also been reported. However, this sensation in the anterior third of the palatine mucosa usually recovers within 2 to 3 months through the compensatory action of the branches of the greater palatine nerves. Of the 13 patients treated in the present study, 6 experienced a slight loss of sensitivity, which disappeared completely without treatment. All patients had class V atrophy of
Cawood and Howell’s classification⁹ and this could explain why no sensory alterations occurred. Similarly, Artzi et al⁷ treated a patient with severe atrophy with the technique of the corticocancellous bone block in the nasopalatine canal and observed no loss in sensitivity in the anterior region of the palate. Filippi et al,²⁴ who surgically removed palatally displaced canines in 59 patients, reported damage to the nasopalatine nerve in all patients. During the first week after surgery, sensory disorders were found in all patients but after 4 weeks no neurologic deficit was detected in any patient. Magennis²⁵ studied sensitivity in 18 patients after the elevation of a palatal flap with or without sectioning the nasopalatine nerve. This author observed a temporary loss of sensitivity in 2 patients and no alteration in all the others.

Regarding patient satisfaction with the treatment, the visual analogue scale used made it possible to evaluate subjective parameters that would be difficult to standardize and analyze statistically by other means. Patients reported no problems with the ability to speak, comfort, function, esthetics, self-esteem, or ease of cleaning. Peñarrocha et al²⁶ assessed satisfaction of completely edentulous patients with and without severe maxillary atrophy rehabilitated with full arch fixed prostheses and found no differences between the 2 groups.

**CONCLUSIONS**

Residual bone is associated with the nasopalatine canal even in patients with severe maxillary atrophy. Favorable outcomes and no complications were associated with the placement of implants in this canal. The nasopalatine canal should therefore be considered a possible location for an anterior implant when rehabilitating patients with atrophic maxillae using implant-supported prostheses.

**ABBREVIATIONS**

CAS: computer-assisted surgery  
CT: computerized tomography  
ISQ: instability quotient  
IT: insertion torque  
ITV: insertion torque value  
PTV: Periotest value  
RFA: resonance frequency analysis  
VAS: visual analog scale

**REFERENCES**


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