Enucleation of the Incisive Canal for Implant Placement: A Comprehensive Literature Review and Case Report

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INTRODUCTION

Replacement of missing teeth in the anterior maxilla is challenging from both a surgical and restorative standpoint. Ideal 3-dimensional implant placement, which is dependent on residual ridge dimensions, is critical to provide an acceptable esthetic result.[1] Unfortunately, the high resorption rate of the anterior maxilla after extraction can jeopardize the implant position if additional augmentation procedures are not performed.[2–5] Occasionally, due to excessive resorption and/or enlargement of the incisive canal, the neurovascular contents of this anatomic structure are in the path of the ideal osteotomy. It is surmised that placement of a titanium fixture in direct contact with the incisive canal can lead to complications such as a nasopalatine duct cyst[6,7] or implant failure.

The incisive canal is located in the midline of the maxilla posterior to the central incisors. The nasopalatine nerve and terminal branch of the nasopalatine artery pass through the canal, which provides innervation and vascularization to the palatal region from canine to canine. These structures also form anastomoses with the greater palatine nerve and artery, so there is collateral neurovascular supply. Large variations in the size and shape of this canal have been documented, stressing the need for 3-dimensional imaging in cases in proximity to this structure.[8–11] Additionally, studies have shown that the size of the canal increases with ridge atrophy.[9]

The main concern with removing canal contents is neurosensory disturbances. Magennis et al[12] retrospectively evaluated neurosensory disturbance after sectioning of the nasopalatine nerve after elevating a palatal flap. Eighty-five patients were divided into 2 groups: 1 with nerve sectioning and 1 without. None of the patients were aware of altered sensation, but 2 patients in the severed group experienced sensory loss. It appears that due to the additional supply from the greater palatine nerve and artery, there is immediate revascularization and gradual reinnervation of the anterior palate. Moreover, the following reports support this finding (summarized in the Table).

Rosenquist et al[13] first described a technique treating 4 patients where the contents of the canal were obliterated and filled with autogenous cancellous bone harvested from the chin. Implants were placed after 6 months of healing, and implant survival at 12–15 months was 100%. No patients complained about altered sensation in the anterior palate. Penarrocha et al[14] presented a report on 7 patients where implants were placed into the incisive canal after content removal and placement of autogenous bone chips. Each patient received 1 implant in the canal as part of a full arch fixed prosthesis. One implant failed to osseointegrate in the first 3 months, and the remaining were successful after an average follow-up of 5 years. Five patients noticed a slight decrease in sensitivity at the 1-week postoperative visit, which disappeared in all cases. This primary author also presented a long-term retrospective evaluation[15] (mean, 70 months of follow-up) of 13 implants placed in the nasopalatine canal of 13 patients. Two early failures of these implants occurred, but there were no late failures (implant success of 84.6%), and all 6 sensory disturbances resolved within 6 weeks.

Sher et al[16] described a technique and presented a report of 3 cases where the canal contents were curetted out and a mixture of demineralized freeze dried allograft (DFDBA) and tricalcium phosphate was placed. The implants survived under short-term follow-up (<3 years), and the patients had no complaints about sensory disturbance.

Artzi et al[17] reported a technique to preserve sensory function whereby the contents of the canal were displaced posteriorly using an autogenous symphiseal cortico-cancellous block graft to fit the foramen. The implant was placed simultaneously with the graft, and a 9-month re-entry procedure demonstrated clinically solid bone. Although the implant was restored and functional, the follow-up period was not reported.

Verardi and Pastagia[18] published a case report on 2 patients whereby the contents of the canal were removed, and a collagen plug placed into the apical portion of the canal. In 1 case, guided bone regeneration was performed with a cancellous particulate allograft and porcine collagen membrane, and in the other case, an autogenous/bovine xenograft mixture and expanded polytetrafluorethylene (ePTFE) membrane. Implants were installed after 6–7 months of healing and were placed in ideal positioning. Slight numbness was noticed in 1 patient at the 1-week postoperative visit, which resolved by 4 weeks. Follow-up at 24 months was reported as successful.

Other authors have placed implants into the canal without placement of graft material. Spin-Neto et al[19] removed the contents in 1 patient and placed 1 implant into the canal, which appeared to be successfully integrated at second-stage surgery. Sensory disturbances were not reported.

The following case report documents the removal of the contents of the canal in conjunction with placement of an allogeneic block graft. Successful use of these grafts has been documented in the literature,[20] with the greatest predictability

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TABLE

Human case reports and studies of incisive canal enucleation in preparation for implant placement

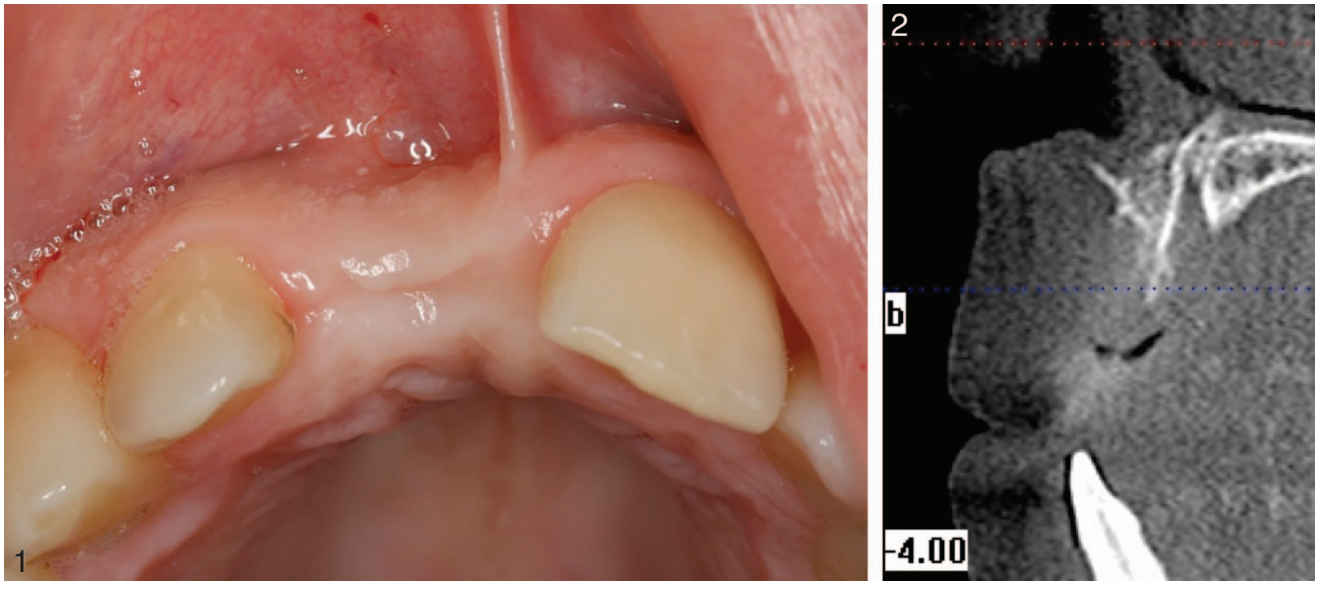
Author	No. of Patients	No. of Implants	Graft Material	Implant Survival	Sensory Disturbances
Rosenquist et al[13]	4	7	Autogenous cancellous bone (chin)	100% at 12–15 months	None
Scher[16]	2	2 (8 total placed, 2 in canals)	Demineralized freeze-dried bone allograft and calcium sulfate	100% (1 at 3 years)	Not reported ("patients were not concerned about possible sensory loss)"
Artzi et al[17]	1	1	Corticancellous block, canal not enucleated	9-month reentry successful	None
Penarrocha et al[14]	7	7 placed into canal, all part of fixed full arch prosthesis	Autogenous chips or β tricalcium phosphate, osteotome preparation	1 early failure, no late failures after 2-year mean follow-up	Slight loss of sensation initially, resolved in all cases
Spin-Neto et al[19]	1	2 (1 in canal)	None placed	Stage 2 completed with CT graft	None
Verardi et al[18]	2	2	Collagen plug apically, and cancellous particulate allograft in case 1, bovine xenograft and autogenous (tuberosity) in case 2	Stage 2 and provisional in 1 case, implant place in case 2 and clinical bone present	None
Penarrocha et al[15]	13	78 (13 in canal) as part of fixed full arch prosthesis	Autogenous bone and β-TCP, osteotome preparation	2 early failures, no late failures (mean follow up of 70 months)	Six patients had decrease in sensitivity to point/blunt technique at 1 week, spontaneously disappeared in all cases within 6 weeks

in the anterior maxilla.[21] To the author's knowledge, this is the first report where one was used in conjunction with incisive canal enucleation.

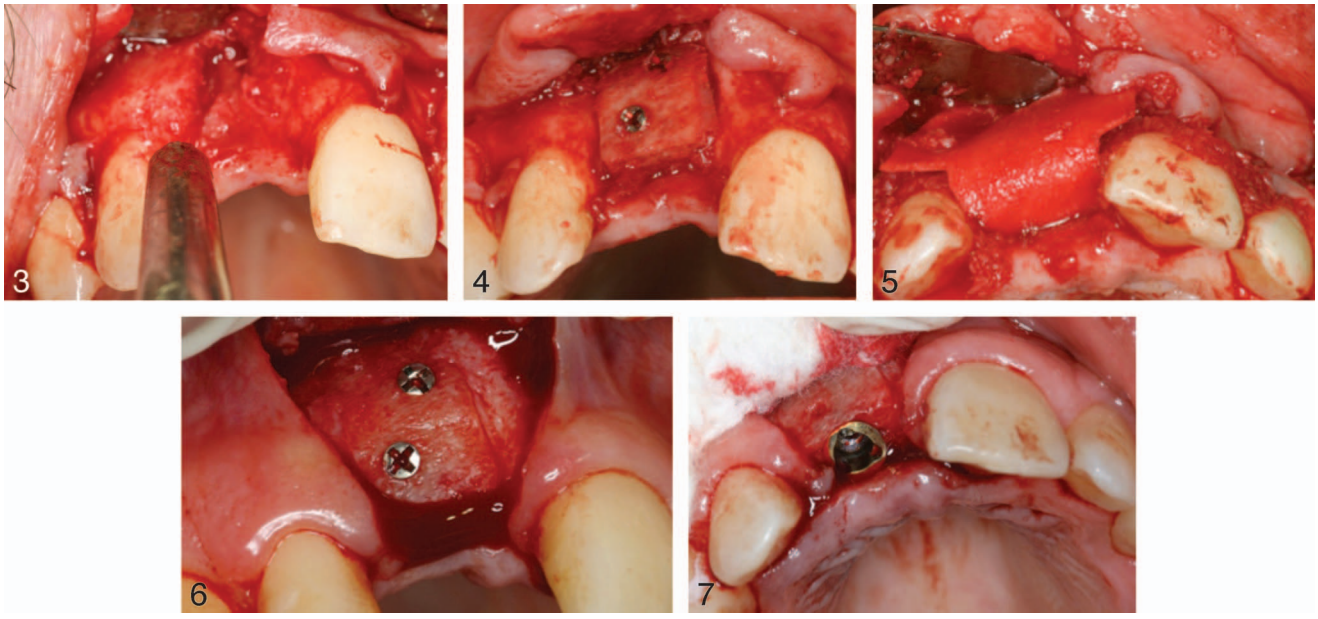
Case Report

A 52-year-old white man presented to a private dental clinic to replace missing tooth #8, which was extracted over 5 years prior after recurrent endodontic infection and crown fracture. The patient's medical history was noncontributory, and he denied tobacco use. Clinical examination revealed a deficient maxillary ridge (Figure 1). A cone beam computerized tomography (CBCT) scan demonstrated severe bone loss in the area of #8 in close proximity to the incisive foramen (Figure 2). Implant surgery consent was reviewed with the patient, and the possibility of canal enucleation and associated risks was discussed.

The patient was premedicated with 2 g amoxicillin and 600 mg ibuprofen 1 hour before the procedure. The surgical procedures were completed under local anesthesia with buccal and nasopalatine infiltration (3% Articaine, 1:100 000 epineph-



Figures 1–2. Figure 1. Presurgical intraoral appearance. **Figure 2.** Preoperative cone beam computerized tomography.



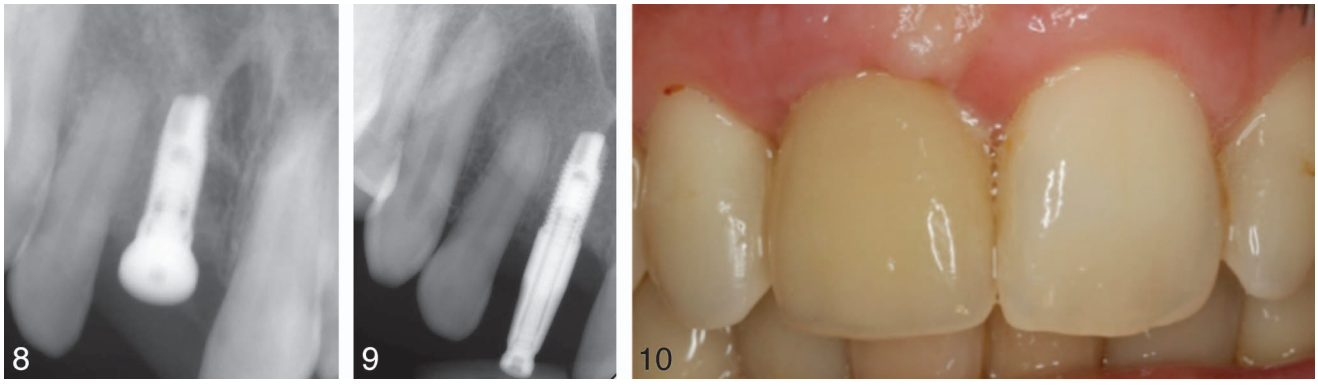
Figures 3–7. Figure 3. Canal encountered. **Figure 4.** Block graft fixated. **Figure 5.** Membrane in place. **Figure 6.** Re-entry surgery. **Figure 7.** Implant installation.

rine). Following full-thickness flap reflection with vertical releasing incisions, the contents of the incisive canal were encountered after defect debridement (Figure 3). The coronal portion of the canal was enucleated using curettes and debridement burs with copious irrigation. Freeze-dried particulate cortical allograft (FDBA) (Liftenet Health, Virginia Beach, Va) was placed into the canal, and a cancellous allogeneic block graft (Lifenet Health) was secured using 2 fixation screws (Figure 4). Additional FDBA was placed into the voids and over the buccal aspect of the block, and a bovine collagen membrane (Osseoguard, Biomet 3i, Palm Beach Gardens, Fla) was placed over the grafts (Figure 5). Passive primary closure was obtained via periosteal releasing incisions and polyglycolic acid sutures, and the site was allowed to heal for 6 months prior to implant placement. The patient was wearing an interim partial denture, which was adequately relieved to avoid contact with the surgical site. Postoperative medications included an antibiotic (amoxicillin 500 mg, 3 times per day for 10 days), analgesic (ibuprofen 600 mg, every 6 hours as needed), and an anti-inflammatory (Medrol dose pack, Pfizer Inc, New York, NY).

The 6-month re-entry surgery (Figures 6 through 8) demonstrated adequate bone for implant placement (4.3 × 10-mm Nobel Biocare Replace Select, Nobel Biocare, Yorba Linda, Calif), which allowed 35 N·cm of primary stability. A healing abutment was placed for nonsubmerged healing, and the interim prosthesis was relieved. A final impression was taken 5 months later (Figure 9), and the abutment and crown were delivered 1 month thereafter (Figure 10). After 6 months of follow-up, the implant was within normal limits, and the patient noted no sensory disturbances.

Conclusion

A limited number of case reports have documented successful placement of dental implants into the incisive canal after removal of its neurovascular contents. Neurosensory disturbances in the anterior palate, although infrequently reported,



Figures 8–10. Figure 8. Implant insertion. **Figure 9.** Impression coping seated. **Figure 10.** Final crown.

appear to be temporary. Performing guided bone regeneration in conjunction with canal debridement has yielded adequate bone for implant placement, and implant survival in these cases is comparable with implants placed in native sites. However, the data should be interpreted with caution, as they are limited to uncontrolled case reports/case series with short-term follow-up. This report demonstrated a similar outcome, consistent with other studies, with enucleation of the incisive canal and subsequent guided bone regeneration using block and particulate allograft and collagen membrane.

Abbreviations

DFDBA: demineralized freeze-dried bone allograft

ePTFE: expanded polytetrafluorethylene

FDBA: freeze-dried bone allograft

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