Partial Explantation of Failed Dental Implants Placed in Mandibular Canal: A Case Report

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One of the most important concerns during posterior mandibular implant placement is avoiding the mandibular canal. Nerve injury can be very disturbing to the patient, possibly causing mild paresthesia to complete anesthesia. Explantation of a dental implant that gas violated the mandibular canal is the most recommended treatment. However, an osseointegrated implant that placed in the mandibular canal can be left if the patient shows no symptoms. In this case report, we describe a technique to maintain the apexes of the implants while partially removing fractured osseointegrated implants previously placed in the mandibular canal.

Key Words: explantation, inferior alveolar nerve, failed implant, injury

Introduction

The most common nerve injury intraorally is inferior alveolar nerve (IAN) injury. The most common reason for IAN injury (52.1%) is mandibular third molar extraction. In general, the mean incidence of neurosensory disturbance after implant placement is 7%, with a range of 0.6 to 39%.[1,2]

Mandibular canal involvement can be disturbing to the patient, causing problems eating or speaking, depression, and a decrease in the quality of life.[3] Such injury can result in mild paresthesia to complete anesthesia.[4] According to Sunderland,[5] nerve injury can be classified into five degrees: Grade 1: epineurial ischemia, Grade 2: axon injury, Grade 3: combined axon and endoneurial injury, Grade 4: complete crushing of the nerve with epineurium continuation, and Grade 5: loss of continuity. Complexity of response and recovery depends on severity of nerve injury. Permanent damage and minimal chance of recovery occur in both Grades 4 and 5.[5]

One of the most important concerns during posterior mandibular implant placement is avoiding the mandibular canal. During planning of dental implant placement, critical factors for successful placement are position, length, and diameter of the dental implant.[6,7] Cone beam computerized tomography (CBCT) is the gold standard tool to evaluate anatomical structures for the planned implant position.[6,7] In addition, CBCT-based intraoperative navigation has been recommended to minimize violating vital structures, including nerve damage.[8] In addition, Burstien et al[9] have recommended using intraoperative periapical radiographs during the drilling sequence as an inexpensive and reliable option.

Currently, there is no standardized protocol for management of implant-related nerve injury.[7,10] Many authors have indicated referral of injuries within 4 months of damage occurring. However, after 3 months, permanent peripheral sensory nerve change can occur, and surgical management may be late at this stage to repair the damage.[10] Hegedus and Diecidue[11] have recommended removing the implant immediately and replacing it several days later when initial healing has taken place, allowing optimal neural healing. Moreover, some mild IAN injury can be recovered several months after dental implant placement, and the clinician might choose follow-up protocol as the only management.[6,7] However, osseointegrated implants might fail due to nonrelated nerve injury and need to be removed.

Many techniques for explantation have been proposed in the literature. Stajcic et al[12] reviewed methods of explantation using burs, elevators, forceps, trephines, or torque wrench, and have shown good success rates with all these methods. However, the use of a torque wrench was the most predictable technique, allowing immediate placement of a new implant. In addition, a laser was used to cut the bone around the implant without burning the calcium phosphorous, thereby allowing the implant to be removed.[13] Moreover, heating the implant and inducing thermonecrosis of surrounding bone, facilitating explantation with an electrosurgery unit was shown to be effective and without complications.[14] Apicoectomy of the implants to relieve paresthesia was also described in literature.[15]

Case Report

A healthy 58-year-old Hispanic female was referred from her restorative dentist with a chief complaint of loss of implant

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crowns. The health history revealed no contraindications to dental treatment, and no parafunctional habits were detected.

Intraoral examination revealed fracture of 2 implants in the area of #30,31 (4×13 mm Calcitek Spline, Zimmer Dental Inc, Carlsbad, Calif), placed 21 years prior, with less than 2 mm of keratinized tissue (Figure 1). Periapical radiographs and CBCT showed a fracture of the external splines of both implants (Figure 2). The implants were osseointegrated with crestal bone loss of 2 mm. There was no sign of infection or exudate. The apexes of both implants were intruded into the mandibular canal within 1 mm. The patient reported a history of some degree of discomfort after implant placement, but the symptoms were completely resolved after 3 months. A two-point discrimination test was performed, and no abnormality was detected.

The implants were nonrestorable. Different treatment options were discussed with the patient, including submerging the implants and using a removable partial dental prosthesis, explantation and placing new implants, or remanufacturing of the prosthetic portion. The patient opted for the explantation and placement of new implants with a fixed dental prosthesis. The decision was made to perform partial explantation and implant replacement.

Buccal and lingual infiltrations were administrated with local anesthesia (2% xylocaine with 1:100 000 epinephrine, Novocol Pharmaceutical, Inc, Cambridge, ON, Canada). A crestal incision was made distal to tooth #29 following the direction of the crest of the ridge distally to the retromolar pad area. Sulcular incisions were made buccal and lingual to teeth #28,29. A full-thickness periosteal flap was reflected. Implants #30,31 were partially drilled out with a 703L drill (Ace Surgical Supply Co, Inc, Brockton, Mass) on surgical high speed from the platform apically to approximately 2 mm from the apex of the implants, using a round carbide bur under profuse irrigation with a series of periapical radiographs (Figure 3). Ridge preservation was performed by using corticocancellous bone allograft (MCBA, Puros, Zimmer Dental GmbH, Munich, Germany) and was covered with a collagen membrane (Biogide, Geistlich AG, Wolhusen Switzerland; Figure 4). The mucoperiosteal flap was repositioned and sutured with 4-0 polytetrafluoroethylene (PTFE) suture (Cytoplast, Osteogenics Biomedical, Lubbock, Texas). After 2 weeks, sutures were removed, and the patient did not report any pain or discomfort.

After 6 months, a crestal incision with 2 releasing vertical incisions were made, and 2 tapered bone level implants, 4.8–8 mm (BLT Roxolid SLActive, Straumann, Basel, Switzerland) were placed with single-stage healing abutments (RC healing abutment, Straumann). Initial stability was achieved with 35 Ncm. The ridge was exposed with the apically positioned flap, and free gingival grafting was performed to increase the amount of keratinized tissue. The flap was sutured with 4-0 PTFE suture and removed 2 weeks after surgery (Figure 5). During postoperative visits, the soft tissue healing around the implant and at the donor site was uneventful and the patient had minimal discomfort (Figure 6).

After 4 months of healing, a periapical X-ray was taken, and no signs of peri-implant bone loss was noted. Implants were restored with screw-retained fixed metal ceramic single crowns. A high standard of oral hygiene was reinforced, including tooth brushing and dental flossing techniques. Periodic follow-up visits were performed for about 1 year after prosthetic loading (Figures 7 and 8).

Discussion

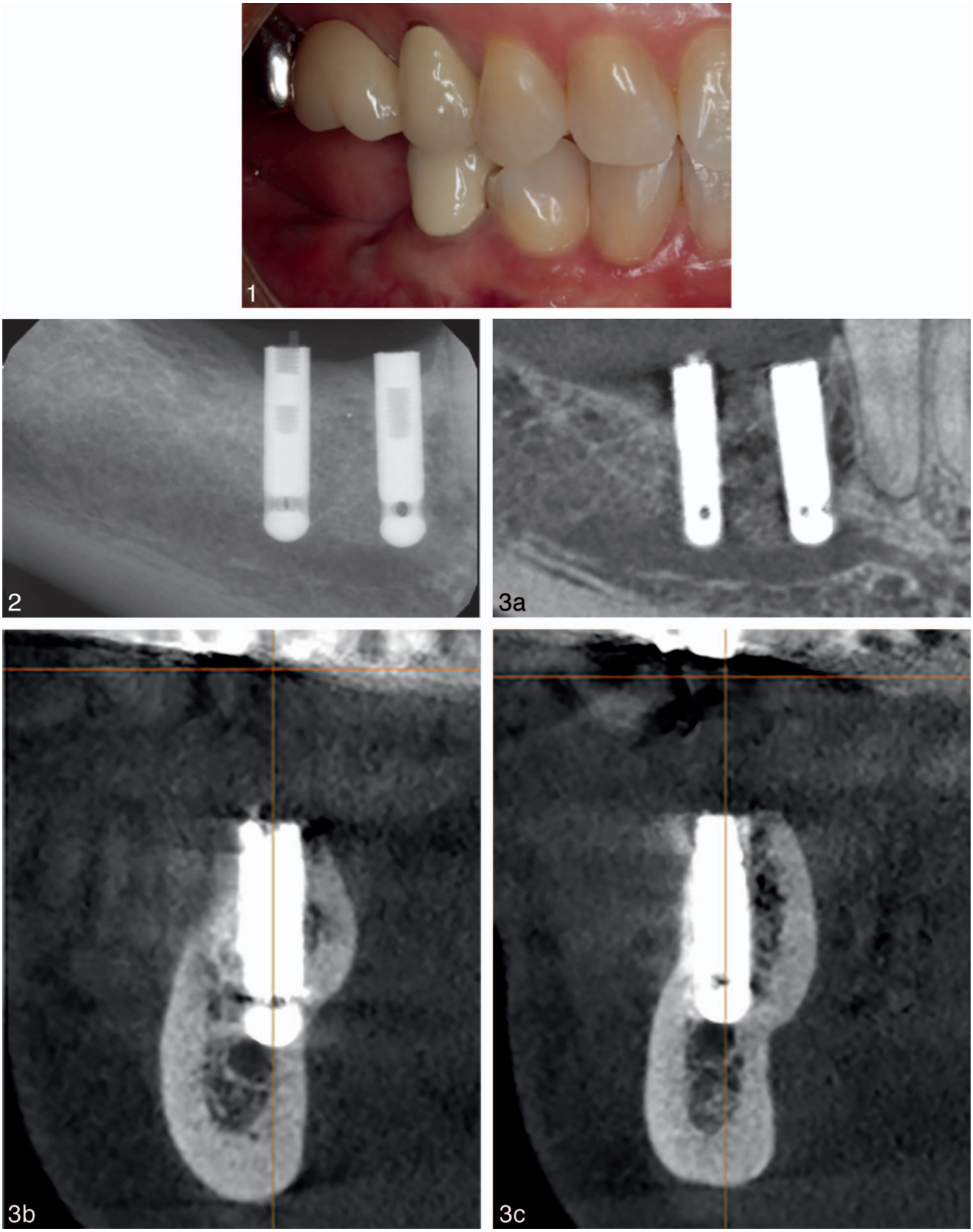
Mandibular canal involvement can be very disturbing to the patient, resulting in mild paresthesia to complete anesthesia.[3,4] IAN injuries are the most common intraoral nerve injuries and can be the result of dental implant placement in 11% of such injuries.[1] Early explantation is recommended for dental implants that caused IAN injury.[16] However, some mild IAN injury can recover completely without the need to surgically intervene.[4,6,7,11]

In this case report, the patient had fractured implants that violated the mandibular canal with a history of discomfort, which was resolved completely after 3 months of implant placement. In general, several factors can cause implant fracture: defect of the manufacturer's design, ill-fitting prosthetic framework, or occlusal overload.[17] Overload-induced implant fracture is the most common reason for implant fracture.[17] This patient presented with existing implant fracture at the spline, which is the most common failure mode for such a system secondary to overload.[18]

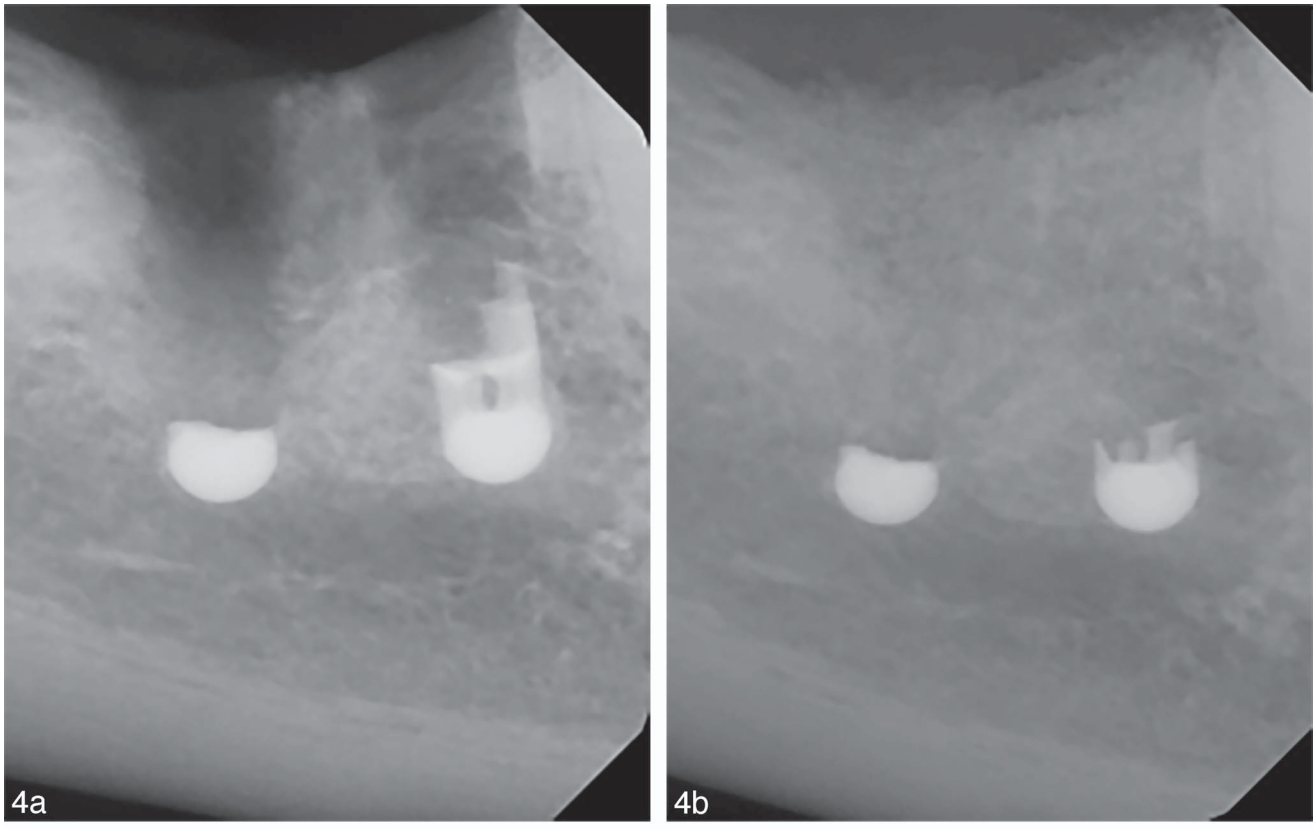
Balshi[17] has suggested three methods for treating fractured dental implants: (1) explantation and implant replacement, (2) modifying the existing prosthesis and burying of the osseointegrated part, and (3) remanufacturing of the prosthetic portion.

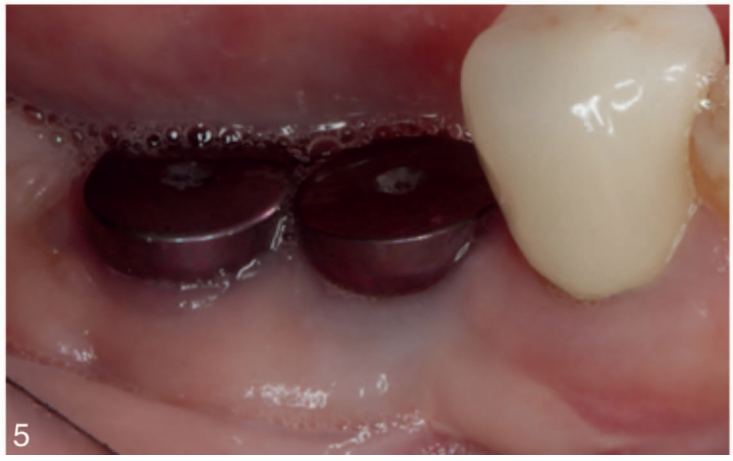
In this case, the decision was made to perform a combination method, that is, partial explantation and maintaining the apical osseointegrated part of the fractured implant that violated the mandibular canal, followed by implant replacement. The advantage of this technique is to avoid mandibular canal reentering by total explantation that likely can cause nerve injury by direct mechanical injury or indirect postoperative injuries due to infection, induced hematoma, or pressure that compresses the nerve.[6] Explantation after osseointegration in case of nerve injury does not always reduce the symptoms of neuropathy and can exacerbate the symptoms.[19,20] The apical part should be osseointegrated without any movement; therefore, this part works as a barrier to any mechanical injury by bone debris or chemical injury by anesthetic solution.[4,21] However, careful partial drilling out of the fractured implant with profuse irrigation is highly recommended to avoid dislocation of the apical part to the mandibular canal and reduce the likelihood of thermal injury of the IAN.[6,7,21] In addition, maintaining the apical part of the fractured implant leads to placing a shorter implant with at least 2 mm of bone between the new placed implant and the maintained apical part to avoid dislocation during the implant replacement or prevent chronic stimulation to the nerve when biting or chewing after restoration, which may end up as chronic neuropathy.[7,22,23] In this case, 8-mm lengths of dental implants were placed, which has comparable success rate to $\geq$10-mm dental implant length.[24,25]

It is not recommended to immediately place the new implant after the partial explantation but instead to periodically monitor any postoperative complications, which would facili-



Figures 1–3. Figure 1. Intraoral mandibular lateral view showing fractured dental implant in area of teeth #30,31. **Figure 2.** Periapical radiograph indicates fractured external splines of both implants. **Figure 3.** (a) Cone beam computerized tomography (CBCT) sagittal view of implant #30,31 showing intrusion of apex of implants into mandibular canal. (b) CBCT coronal view of implant #30. CBCT coronal view of implant #31.





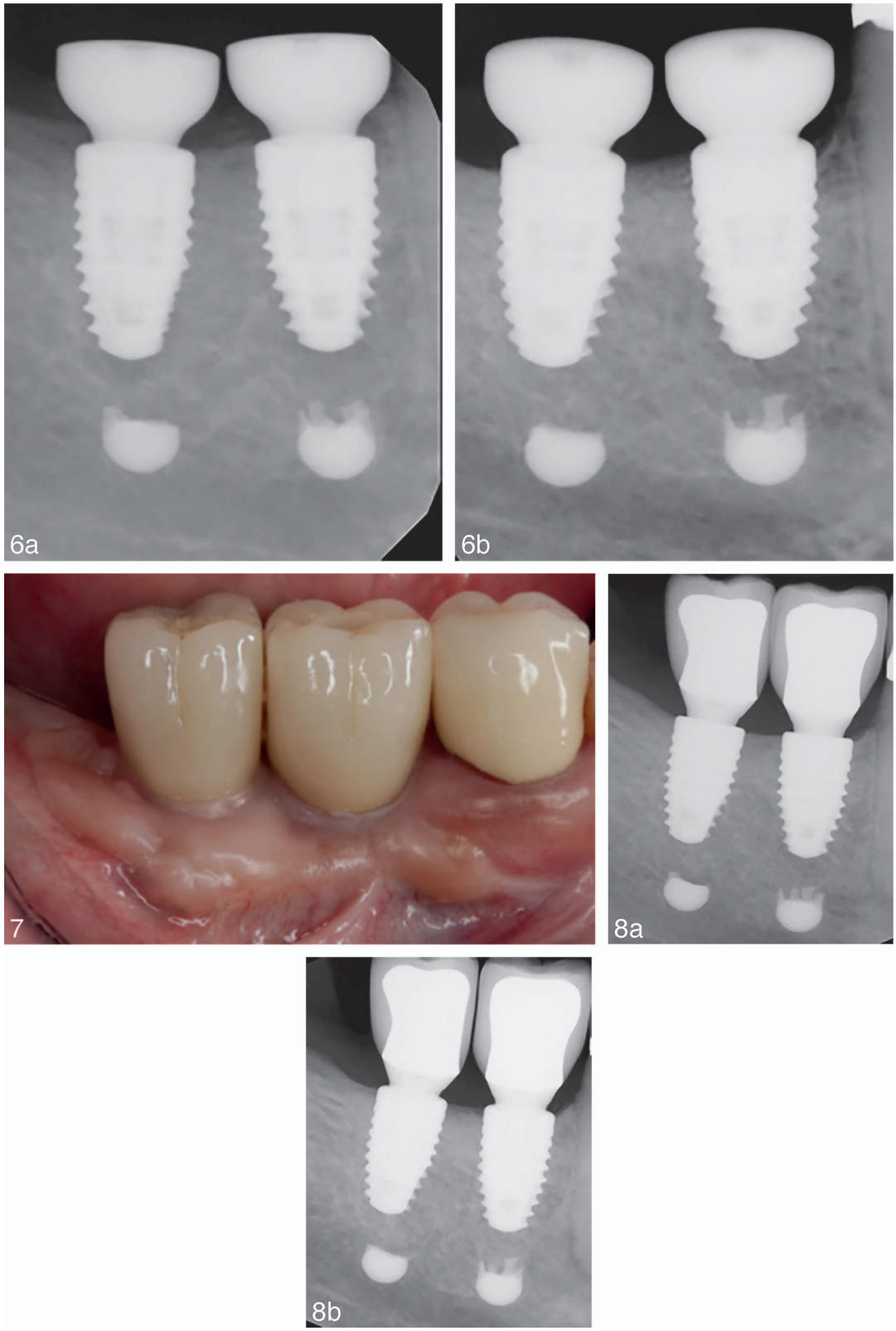
Figures 4 and 5. Figure 4. (a) Periapical radiograph showing partial explantation of both implants and maintaining apex of implants. (b) Periapical radiograph showing bone grafting after partial explantation. **Figure 5.** Four-months postoperative intraoral lateral view.

tate possible early intervention. The bone defect after partial explantation can be left to heal by blood clot or grafted with bone material.

In this case, implants were placed after 4 months of partial explantation and restored with screw-retained metal ceramic crowns, which could lead to easier retrieval in the case of any symptoms developing or prosthesis complications.[26,27] The prognosis is highly favorable, and the patient was followed up for 1 year with no significant soft or hard tissue changes observed. The patient did not report any discomfort or neurosensory alternation during the follow-up visits. Additionally, a case such as this should be monitored routinely for several years, allowing the clinician to assess prosthesis stability as well as any patient signs or symptoms of complications.

Conclusion

In this clinical report, we described a partial explantation of fractured osseointegrated dental implants that were previously placed in the mandibular canal. This technique is useful to avoid possible injury of a fully recovered IAN. The apexes of the osseointegrated implants can act as a barrier to further insults to the nerve.



Figures 6–8. Figure 6. (a) Periapical radiograph after dental implant placement. (b) Four-months postoperative periapical radiograph of dental implant placement. **Figure 7.** Screw-retained fixed implant supported single crowns. **Figure 8.** (a) Periapical radiograph at the delivery visit. (b) One-year periapical radiograph after prosthetic loading.

Abbreviations

IAN: inferior alveolar nerve

CBCT: cone beam computerized tomography

References

1. Tay ABG, Zuniga JR. Clinical characteristics of trigeminal nerve injury referrals to a university centre. *Int J Oral Maxillofac Surg*. 2007;36:922–927.

2. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JYK. Clinical complications with implants and implant prostheses. *Prosthet Dent*. 2003;90: 121–132.

3. Pogrel MA, Jergensen R, Burgon E, Hulme D. Long-term outcome of trigeminal nerve injuries related to dental treatment. *J Oral Maxillofac Surg*. 2011;69:2284–2288.

4. Alhassani AA, AlGhamdi AST. Inferior alveolar nerve injury in implant dentistry: diagnosis, causes, prevention, and management. *J Oral Implantol*. 2010;36:401–407.

5. Sunderland S. A classification of peripheral nerve injuries producing loss of function. *Brain*. 1951;74:491–516.

6. Juodzbalys G, Wang H-L, Sabalys G. Injury of the inferior alveolar nerve during implant placement: a literature review. *J Oral Maxillofac Res*. 2011;2:e1.

7. Juodzbalys G, Wang H-L, Sabalys G, Sidlauskas A, Galindo-Moreno P. Inferior alveolar nerve injury associated with implant surgery. *Clin Oral Implants Res*. 2013;24:183–190.

8. Gaggl A, Schultes G, Kärcher H. Navigational precision of drilling tools preventing damage to the mandibular canal. *J Craniomaxillofac Surg*. 2001;29:271–275.

9. Burstein J, Mastin C, Le B. Avoiding injury to the inferior alveolar nerve by routine use of intraoperative radiographs during implant placement. *J Oral Implantol*. 2008;34:34–38.

10. Khawaja N, Renton T. Case studies on implant removal influencing the resolution of inferior alveolar nerve injury. *Br Dent J*. 2009;206:365–370.

11. Hegedus F, Diecidue RJ. Trigeminal nerve injuries after mandibular implant placement–practical knowledge for clinicians. *Int J Oral Maxillofac Implants*. 2006;21:111–116.

12. Stajčić Z, Stojčev Stajčić LJ, Kalanović M, Đinić A, Divekar N, Rodić M. Removal of dental implants: review of five different techniques. *Int J Oral Maxillofac Surg*. 2016;45:641–648.

13. Smith L, Rose T. Laser explantation of a failing endosseous dental implant. *Aust Dent J*. 2010;55:219–222.

14. Massei G, Szmukler-Moncler S. Thermo-explantation. A novel approach to remove osseointegrated implants. *Eur Cell Mater*. 2004;7:48.

15. Levitt DS. Apicoectomy of an endosseous implant to relieve paresthesia: a case report. *Implant Dent*. 2003;12:202–205.

16. Bagheri SC, Meyer RA. Management of mandibular nerve injuries from dental implants. *Atlas Oral Maxillofac Surg Clin North Am*. 2011;19:47–61.

17. Balshi TJ. An analysis and management of fractured implants: a clinical report. *International Int J Oral Maxillofac Implants*. 1996;11:660–666.

18. Pedroza JE, Torrealba Y, Elias A, Psoter W. Comparison of the compressive strength of 3 different implant design systems. *J Oral Implantol*. 2007;33:1–7.

19. Al-Sabbagh M, Okeson JP, Bertoli E, Medynski DC, Khalaf MW. Persistent pain and neurosensory disturbance after dental implant surgery: prevention and treatment. *Dent Clin North Am*. 2015;59:143–156.

20. Renton T, Dawood A, Shah A, Searson L, Yilmaz Z. Post-implant neuropathy of the trigeminal nerve. A case series. *Br Dent J*. 2012;212:E17.

21. Diago MP, López AB, Pelayo JL. Update in dental implant periapical surgery. *Med Oral Patol Oral Cir Bucal*. 2006;11:429–432.

22. Jacobs R, Lambrichts I, Liang X, et al. Neurovascularization of the anterior jaw bones revisited using high-resolution magnetic resonance imaging. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2007;103:683–693.

23. Sammartino G, Marenzi G, Citarella R, Ciccarelli R, Wang H. Analysis of the occlusal stress transmitted to the inferior alveolar nerve by an osseointegrated threaded fixture. *J Periodontol*. 2008;79:1735–1744.

24. Malmstrom H, Gupta B, Ghanem A, Cacciato R, Ren Y, Romanos GE. Success rate of short dental implants supporting single crowns and fixed bridges. *Clin Oral Implants Res*. 2016;27:1093–1098.

25. Atieh MA, Zadeh H, Stanford CM, Cooper LF. Survival of short dental implants for treatment of posterior partial edentulism: a systematic review. *Int J Oral Maxillofac Implants*. 2012;27:1323–1331.

26. Wittneben JG, Millen C, Bragger U. Clinical performance of screw-versus cement-retained fixed implant-supported reconstructions–a systematic review. *Int J Oral Maxillofac Implants*. 2014;29(suppl):84–98.

27. Shadid R SN. A comparison between screw- and cement- retained implant prostheses. A literature review. *J Oral Implantol*. 2012;38:298–307.