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Case Report

Preservation of the Inferior Alveolar Nerve during Mandibulectomy with Dynamic Implant Navigation System

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The inferior alveolar nerve (IAN) is often sacrificed during mandibulectomy. However, nerve injuries can affect the quality of life. A nerve-sparing approach may offer a better sensory function. Several guided designs to the mandibular canal were reported, which can reduce trauma and intraoperative time, but they could not present the depth of the IAN. Dissection of the neurovascular bundle is a meticulous and tedious work. We tried improving this problem by using a dynamic dental implant navigation system. A 71-year-old man revealed pain in the left mandibular side and lip numbness after the removal of the left inferior first molar. According to image survey, diagnosed as stage 2 medication-related osteonecrosis of the jaw, he underwent the sequestrectomy and mandibulectomy. IAN was marked and dissected with dynamic dental implant navigation system. The postoperative course was unremarkable, and the patient reported much improvement in chin sensation. This application could decrease neurosensory deficit about lateralization or IAN reposition under dental implant placement.

Keywords: inferior alveolar nerve preservation, mandibulectomy, sequestrectomy, medication-related osteonecrosis of the jaw, dynamic implant navigation system

1. Introduction

The inferior alveolar nerve (IAN) is often sacrificed during mandibulectomy. IAN damage can lead to permanent loss of sensation in the lower lip and chin. Injuries can affect the quality of life, leading to the inability to feel food and liquid on the lip and drooling (1). IAN preservation during resections was first described in 1984(2). The key in IAN-preserving mandibulectomy is the knowledge of its anatomy and variations. Thus, this procedure is often difficult to identify and takes time.

The accuracy and precision for implant placement were achieved using dynamic dental implant navigation. This dynamic computer–aided implant surgery system could increase the implant placement accuracy when compared with freehand implant placement and also seem to slightly decrease the angular deviation in comparison with static computer–aided implant surgery, which used stereolithographic templates during drilling and insertion of the implant system(3).

Computer-assisted surgery for mandibular resection and reconstruction is more common in current clinical applications (4). The course of the mandibular canal marked following mandibulectomy with several cutting guides was reported(5). With the special designs, there was no need to remove the cutting guide and the resection was performed according to the planned level. But the failure to preserve the nerve in three cases was still due to technical errors. Another case was presented

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with cutting guide and the cover-lifting technique to preserve the nerve (6) even thus, nerve dissection is still a meticulous task. We tried improving this problem by using a dynamic dental implant navigation system.

2. Case presentation

A 71-year-old man diagnosed with prostate cancer (cT2cN0M1b) came with an unhealed extraction wound and pus discharge in the posterior left part of his mandible with left lower lip numbness of 7 months duration, which was reduced sensation to light touch and pinprick. Zoledronic acid was started on February 2015 and changed to denosumab since January 2018. Denosumab drug holiday was started 7 months ago. Oral examination showed a bone exposed at approximately 2 × 1.5 cm with erythematous granulation and purulent discharge over the posterior left molar area (Figure 1). Panoramic radiography revealed an osteolytic area between the left mandibular premolar and left molar with an intact inferior border of the mandible. Stage 2 medication-related osteonecrosis of the jaw was diagnosed. Computed tomography (CT) revealed an ill-defined osteolytic and sclerotic lesion over the left mandible, including the left IAN and mental foramen, and residual inferior border of the mandible of approximately 5 mm in height (Figure 2). A reconstruction plate was adapted to a three-dimensional printed mandible model preoperatively. The digital imaging and communications in medicine

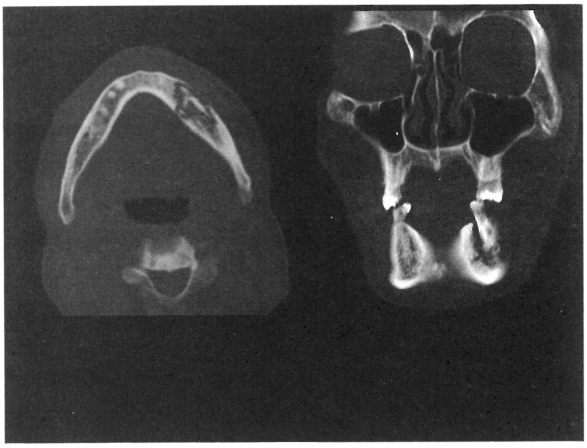


Figure 2. CT revealed an ill-defined osteolytic and sclerotic lesion over the left mandible, and left IAN was involved in the destructive area.

data set of CT was imported into the Navident software version R2.2 to analyze the case and trace the left IAN (ClaroNav Inc., Toronto, ON, Canada). General anesthesia was established. A curved incision was made on the skin 1.5 cm below the inferior border of the mandible, and the mandible was approached conventionally. Prior to tumor removal, the reconstruction plate was adapted by boring holes in it. A jaw tracker was attached to the posterior teeth of the lower right jaw with a bite registration. The plate was removed and dissected to expose the neurovascular bundle beginning from the mental foramen, which was performed using a Stryker handpiece (Stryker Corp., Kalamazoo, MI, USA) and a piezoelectric ultrasonic hand piece (VIATech Biomedical Co., Ltd,

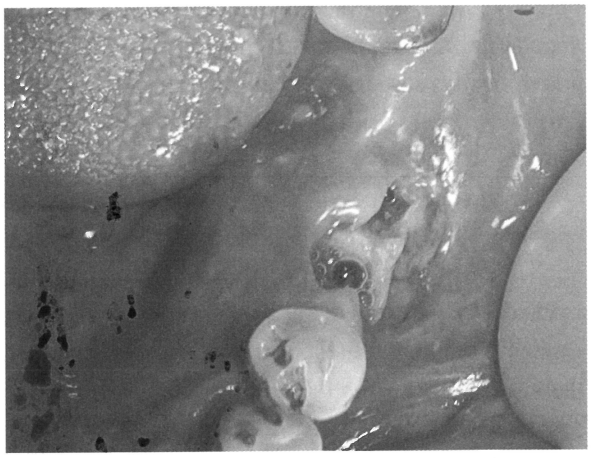


Figure 1. A bone exposed at approximately 2 × 1.5 cm over the posterior left molar area.

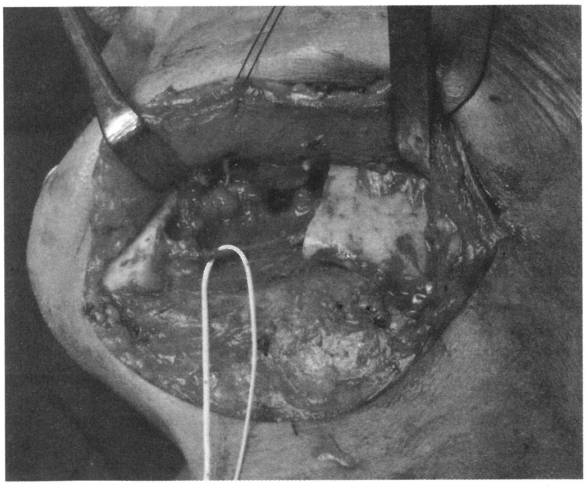


Figure 3. IAN preservation, sequestrectomy, and mandibulectomy.

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Taiwan) were attached to the tracer tag (Navident, ClaroNav Inc.) after trace registration to locate the clear infected bony margin, mental nerve, and mandibular canal. IAN dissection continued along the remaining portion of the embedded inferior alveolar nerve posteriorly until the borderline of the planned sequestrectomy area. We tried hard to separate the granulation and mental nerve; thus, we preserved the incisive branch of the IAN first, followed by sequestrectomy and mandibulectomy of the residual lower border, and then mental nerve approximation by 8-0 nylon (Figure 3). Wound closure was achieved after the reconstruction plate was reinstalled. The postoperative course was unremarkable, and the patient reported much improvement in chin sensation with shallow numbness around the mouth corner. (Supplemental data-1)

3. Discussion

Marschall et al(7) presented their 18 patients' retrospective study with management ofmandibular osteomyelitis with segmental resection, nerve preservation, and immediate reconstruction with nonvascularized bone grafts. In 54% of IAN neurosensory examinations revealed no meaningful recovery. IAN-sparing surgery showed it could not be effective for preserving patient IAN function. However, it is difficult to detect and dissect if IAN was involved between the radiopaque involucrum and the radiolucent sequestra.

General medical navigation surgery plays an important role in craniomaxillofacial surgery, but it is difficult to the mandible due to its mobility. Previous study had shown the application of a novel open position splint integrated with a reference frame and registration markers for mandibular navigation surgery.(8) Another application was reported the retrieval of displaced root tips from a mandibular third molar into the sublingual space under Medtronic StealthStation Navigation System with an acrylic bite block fabricated on stone casts mounted on semiadjustable articulator. (9) But these splints could make the operation field and mandibular movement limited.

Dynamic implant navigation offers real-time, motion-tracking optical assistance to track the implant placement to the planned position (10). It has been more commonly used in implant surgery. While navigation machines carry additional costs, we think more applications should be explored in the oral and maxillofacial field. A previous systematic review and meta-analysis investigated the accuracy of dynamic navigation showed that it resulted in higher accuracy than the freehand method (11) and such as Navident, are useful for real-time visualization of anatomical structures and infected bony margin check during dentoalveolar surgery, such as osteonecrosis of the jaw(12) and periapical lesion (13). The introduction of new application would allow surgeons to minimize potential errors and enhance accuracy.

Traditional IAN lateralization or reposition using rotating instruments or piezosurgery devices allows mobilization of IAN laterally without nerve transaction for subsequent implant. Neurosensory complications were the most prevalent(14). We think that it could also improve neurosensory deficit about IAN lateralization or reposition under dental implant placement (15).

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