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Technical Note
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A strategy for removal of foreign body in mandible with navigation system

P. Li[1], Z. Li[2], W. Tian[2], W. Tang[2,]
[1]College of computer science, Sichuan University, Chengdu, China; [2]State Key Laboratory of Oral Disease, Sichuan University, Chengdu, China

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Abstract. Navigation surgery in the mandible has rarely been reported because of the complexities of navigating a mobile structure. In this article, we present a simple and novel strategy for removal of a foreign body in the mandible using a navigation system. A female diagnosed with a foreign body in the left mandible underwent navigation surgery using a BrainLAB system. We used a special open splint fabricated with acrylic resin to successfully perform the mandibular navigation. This strategy may be appropriate for many types of mandibular navigation surgery.

Key words: navigation system; foreign body; mandibular surgery.

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Many studies have reported surgical strategies for the navigation-guided removal of foreign bodies in the maxillofacial region.[1–3] Navigation systems are helpful in identifying the location of the foreign body and determining the optimal approach, and eventually performing the surgical invasion strategy; they also reduce the operation time.

Unlike other bones in the maxillofacial region, which are relatively stationary structures, the mandible is an independent and movable body. Because of the complexities of navigating a mobile structure, navigation surgery in the mandible has rarely been reported. Iwai et al.[4] reported a minimally invasive surgery technique performed under the guidance of a navigation system to remove a follicular cyst in the mandibular ramus. In this article, we present a simple and novel strategy for the removal of a foreign body in the mandible using a navigation system. We conclude that this strategy may be appropriate for many types of mandibular navigation surgery.

Technique

A 48-year-old female who had suffered chronic pain in an area of the left mandible for 6 months, was referred to our department. A detailed history was taken, in which the patient reported that her left lower molars had previously undergone multiple unsuccessful endodontic therapies over the past 5 years and had eventually been extracted. No other abnormality was found during the physical examination. However, a panoramic radiograph indicated a high density spot in the posterior region of the left mandible, close to the mandibular canal (Fig. 1). To remove the foreign body, which was suspected to be the cause of the chronic pain, and to avoid potential injury to the inferior alveolar nerve, navigation surgery was scheduled. This study was approved by the institutional ethics committee. Informed consent was obtained from the patient.

For the mandibular navigation, one open splint, which was situated between the upper and lower dentition so as to stabilize the mandible at a specific open site, was fabricated with self-curing acrylic resin. Using spiral computed tomography (CT) equipment (Siemens Sensation 16; Siemens, Munich, Germany), a head CT scan was performed with the open splint in the mouth. To avoid movements

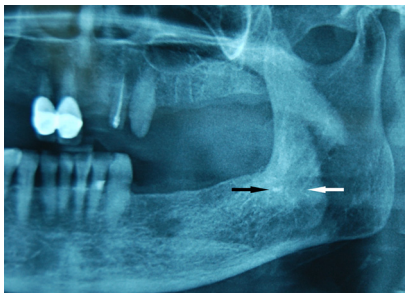

Fig. 1. Panoramic radiograph indicating a high density spot (black arrow) in the posterior bone of the left mandible, near the mandibular canal (white arrow).

of the mandible during the scan, the patient was instructed to clench the open splint with her teeth. The CT data in Digital Imaging and Communications in Medicine (DICOM) format, with 0.625-mm slice thickness, were imported into the software iPlan of the VectorVision2 navigation system (BrainLAB, Feldkirchen, Germany), as described previously. In iPlan, the foreign body was identified with a clear view on the virtual three-dimensional model and an appropriate operation approach was determined preoperatively (Fig. 2).

During the surgery, the reference frame was first fixed rigidly to the patient's head with a headband. Face scanning by Z-touch (a laser scanner) was then performed for surface registration with the open splint in the mouth (Fig. 3). Registration accuracy (0.8 mm) was verified using the navigation pointer. Next, the tip position and orientation of the probe was viewed continuously on screen. Using the navigation system, it was easy to detect the exact anatomical site of the object in the mandible, which enabled the calibrated surgical instruments to remove the object in a minimally invasive manner (Fig. 4). Eventually, under guidance of the BrainLAB system, removal of the foreign body was accomplished with a 1.5-cm mucosal incision and minimal abrasion of the superficial bone at the operation site. The whole procedure, including the installation and registration of the navigation system, took approximately 20 min. The removed foreign body had the appearance of the compound resins used for tooth filling (Fig. 5).

Within the 3 months of follow-up, the patient's clinical symptom of chronic pain in the left mandible disappeared. There were no postoperative complications.

Discussion

Several methods have been used to detect and localize foreign bodies, such as radiographs, ultrasound, CT, and magnetic resonance imaging (MRI). The presence of the object can be confirmed with these imaging tests, but an accurate determination of its position may be difficult, especially for a foreign body deep inside the maxillofacial region. It is also necessary to accurately determine the spatial location with reference to the important surrounding nerve and blood vessels. This is exactly the limitation of conventional methods. With the development of computer-assisted surgery (CAS), navigation-guided removal of foreign bodies in the maxillofacial region has been performed widely.[1–3] However,

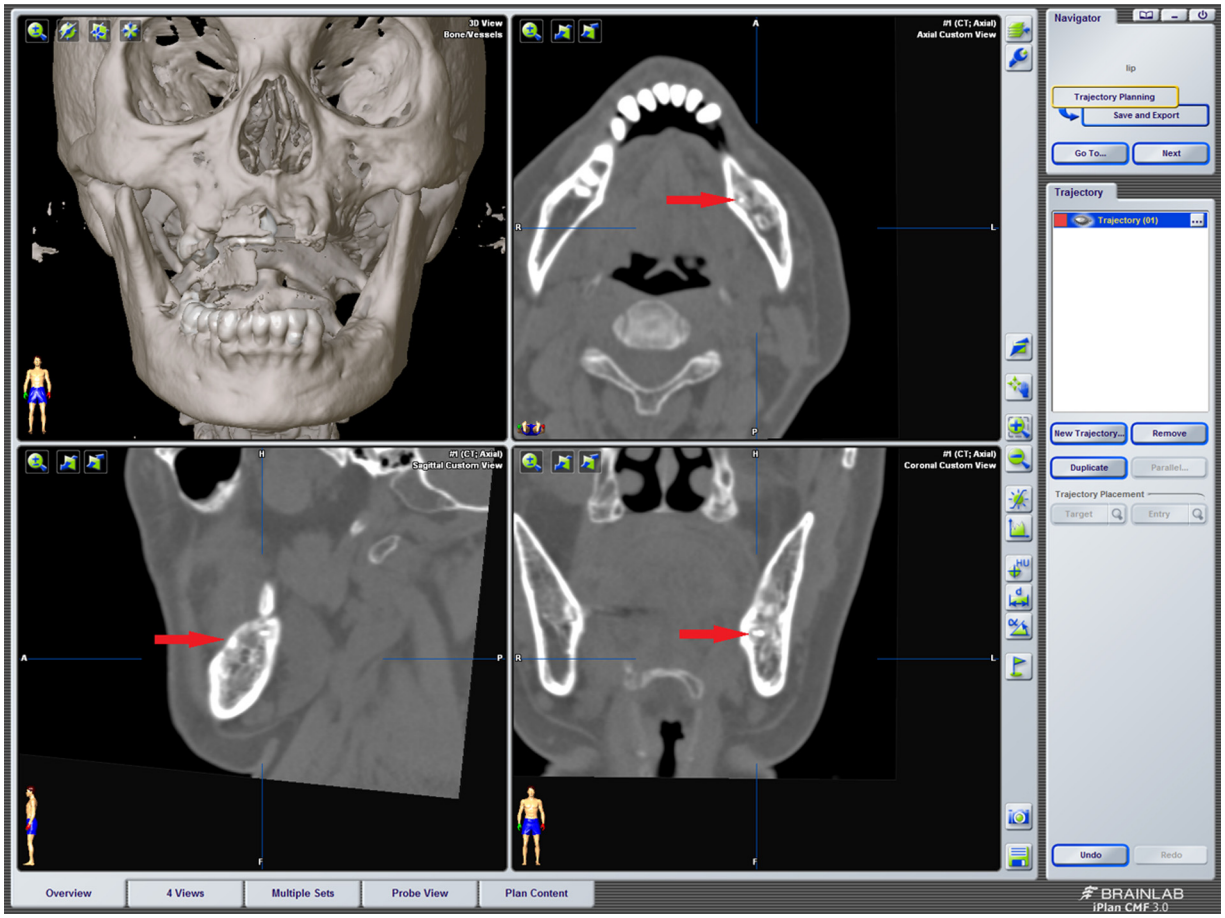

Fig. 2. Screen capture of the iPlan software accurately indicating the foreign body (red arrows). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)