Broken dental needle retrieval using a surgical navigation system: a case report and literature review

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This paper reports a case of fractured needle retrieval in the pterygomandibular space using the Medtronic surgical navigation system. Current literature on needle fracture and retrieval in the oral cavity was also reviewed. A literature search was conducted in the following databases: PubMed, MDConsult, The Cochrane Library, and Google. A variety of keywords were used, including "needle fracture," "broken dental needle," "needle injuries in dentistry," "foreign body retrieval," and "dental needle retrieval." Articles published after 1980 were reviewed. Seventeen articles that involved broken dental needle retrieval were selected. (Oral Surg Oral Med Oral Pathol Oral Radiol 2015;119:e55-e59)

There has been a decrease in needle breakage incidents since the introduction of flexible alloy and disposable hypodermic needle in the 1960s.[1] Despite the decrease in breakage events, needle fracture continues to be a significant complication in dentistry. Needle breakage most often occurs during the administration of inferior alveolar nerve blocks, and the needle fragment is commonly dislodged in the pterygomandibular space. The removal of broken needle in the pterygomandibular space poses as a surgical challenge because of a combination of difficult access, the close anatomic relationship to vital structures, and the small diameter of the dental needle fragment. Recent developments in computer-assisted surgery have brought significant changes to surgical approaches. The use of a surgical navigation system is becoming more widespread and is being applied to a range of surgeries, including stereotactic biopsy, endoscopic sinus surgery, and foreign body removal.[2] We report a case of broken needle retrieval in the pterygomandibular space using the Medtronic surgical navigation system. This reports also reviews the current techniques on broken needle retrieval.

MATERIALS AND METHODS

A literature search was conducted in the following databases: PubMed, MDConsult, the Cochrane Library, and Google. A variety of keywords were used, including "needle fracture," "broken dental needle," "needle injuries in dentistry," "foreign body retrieval," and "dental needle retrieval." Articles published after 1980 were reviewed. Seventeen articles that involved broken dental needle retrieval were selected.

RESULTS

Based on titles and abstracts, 17 articles were selected, which included 16 case reports and 1 review article. In the articles reviewed, all patients reported clinical symptoms secondary to retained broken needle. All surgeons were able to successfully locate and remove the needle fragments using various methods. Because of needle migration into the lateral neck space, one attempt to remove the needle fragment intraorally had to be aborted and the needle was subsequently removed transfacially.[3] In all cases, preoperative imaging studies were performed. More recently, there has been a shift to use computed tomography (CT) scanning instead of panoramic radiographs and plain films to accurately identify the position of the broken needle. For localization of the needle fragment, most authors favored the use of reference needles and intraoperative radiographic films. However, some procedures took as long as 3 hours to complete.[4] To reduce time spent on obtaining intraoperative radiographs, 4 authors used intraoperative C-arm fluoroscopy instead of plain radiographic films.[3,5-7] Recently, the use of intraoperative cone beam CT scanning was reported.[8] Gerbino also described a case using CT-guided navigation for intraoperative needle localization.[9]

CASE REPORT

An 18-year-old female patient was referred to the Department of Oral and Maxillofacial Surgery at Louisiana State University Health Science with a chief complaint of oral pain. One year before, she had been seen by a general dentist to have 4 wisdom teeth extracted. During the administration of inferior alveolar nerve block, a 27-gauge long needle was fractured and trapped in the soft tissue. The dentist was unable to retrieve the needle fragment at the time, and it was decided to leave the needle fragment in its place. The patient was observed for development of symptoms or needle migration.

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Since the incident, although there was no limitation in maximal incisal opening, the patient experienced persistent pain that was exacerbated during mouth opening and closing. One year later the patient presented to our department for evaluation. A panoramic radiograph confirmed the needle fragment in the right pterygomandibular space (Figure 1). Surgical exploration under general anesthesia was recommended and the patient desired to proceed with the surgery. A preoperative maxillofacial CT scan (1 mm slices) was performed less than 1 week before the surgery date. The DICOM data was uploaded to the Medtronic surgical navigation workstation.

The Medronic AxiEM navigation used an electromagnetic-based tracker system. After the patient was intubated, an electromagnetic field emitter device was mounted to the bed rail next to the patient's head. Next, a tracker device was adhered to the patient's mid-forehead. Patient registration was performed next. We used a tracer registration probe to trace out a series of points in the forehead, periorbital, and nasal regions (Figure 2). Then the registration software matched the previously traced points to their corresponding points on the patient's preoperative CT scan (Figure 3). After successful patient registration, movement of the probe instrument corresponded to the same movement on the preoperative CT scan, which was displayed on the workstation monitor. We then verified the accuracy of the patient registration by pointing the tip of the registration probe at various anatomic landmarks, such as the anterior nasal spine, medial canthus, and incisors, and ensuring that the software also pointed to the corresponding positions on the preoperative CT scan. The positional discrepancy was verified to be less than 1 mm.

The patient was then prepped and draped. The preoperative CT scan indicated that the broken needle was above the lingula and oriented superiorly toward the sigmoid notch. To gain access, a 4 cm vertical incision along the ramus was made. Subperiosteal dissection was carried out medially along the ramus. The lingula and the inferior alveolar nerve were identified. The broken needle could not be visualized or palpated because it was trapped within the medial pterygoid musculature. Next, we positioned the navigation probe until the tip of the instrument was at the most anterior point of the needle fragment on the preoperative CT scan (Figure 3). With the navigation probe still in position, blunt dissection was performed adjacent to the probe instrument. The tip of the needle fragment was identified, and the broken needle was removed with a hemostat (Figure 4 and Figure 5). Care was taken to ensure that the inferior alveolar nerve was protected during the dissection. No vital structures were injured. Incision was closed with 3-0 chromic sutures. Total intraoperative time was less than 30 minutes. The patient was discharged home on the same day, and there were no postoperative complications.

DISCUSSION

There remains some debate regarding management of a broken dental needle. Some advocate leaving the needle fragment in place as long as the patient is asymptomatic. Surgical exploration to retrieval needle fragment can itself lead to additional neurologic and tissue injury.

Fig. 1. Dental panoramic radiograph illustrating the position of the broken needle.

However, most believe that a broken needle should be removed not only because of medicolegal implications but also because of the risk of needle migration to damage vital structures in the head and neck. For instance, a needle in the pterygomandibular space may migrate to the lateral pharyngeal space, where the styloglossus muscle, the ascending pharyngeal artery, and the external carotid artery are located.[3] Rahman reported a case where a needle fragment migrated from the pterygomandibular space to the lateral neck within 2 weeks.[10] Another reason to consider removing the needle fragment is the psychological effect on the patient of having a sharp foreign object retained in the mouth.[11]

Initial investigations of a broken needle often involve Panorex and plain radiographic films taken at 90 degrees to each other. Though plain films are useful in approximating the position of the needle, they cannot provide accurate position of the needle relative to adjacent structures. A preoperative CT scan is therefore invaluable before surgical exploration. Palpation of the soft tissue should be avoided to prevent migration of needle fragment. In the maxillary region, broken needles are usually located in the molar area, where important structures are rarely affected.

Several intraoperative techniques for localizing broken needle in pterygomandibular space have been described. Thompson described the use of a stereotactic technique using 2 19-gauge venipuncture needles. Two reference needles are positioned sequentially until the 2 needles meet radiographically at the broken needle fragment. Blunt dissection is then carried down 1 or the other venipuncture needle until the tip of the broken needle fragment is encountered. Others have reported successes with similar technique.[12] However, intraoperative plain radiographic films are often difficult to obtain and are time consuming. Furthermore, it can be difficult to discriminate between small changes in position on the plain radiographs. Nezafati and Shahi reported using C-arm digital fluoroscopy to provide rapid radiography without disturbing the reference needles.[5] However, as with plain films, fluoroscopy only shows image in 2 dimensions and is unable to