Clinical Case Report

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Computed tomography-guided navigation assisted drainage for inaccessible deep neck abscess

A case report

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Abstract

Rationale: Deep neck infections (DNIs) in the head and neck area are difficult to treat due to the anatomical complexity of the cervical region. Since inflammation causes changes in anatomy, it is often difficult to find the exact location of the abscess, which leads to failed surgical drainage.

Patient concern: A 76-year-old female patient was referred to our clinic with trismus and right-side facial swelling. After extraction of her lower third molar 2 weeks ago, due to chronic periodontitis, her trismus had aggravated and her maximal mouth opening was 20 mm.

Diagnoses: Computed tomography (CT) revealed an approximately 2.5 cm-sized abscess pocket with cellulitis in the right pterygomandibular space.

Interventions: Since the first surgical drainage attempt using the intraoral approach under general anesthesia had failed and conservative antibiotic treatment was also ineffective, a second surgical procedure with a CT-guided navigation system was performed and the pus was successfully evacuated.

Outcomes: After drainage with CT-guided navigation, the clinical symptoms and septic conditions of the patient showed remarkable improvement, and there was no recurrence of infection within a year after the procedure.

Lessons: Drainage with CT-guided navigation can be used as a successful surgical tool to aid in the surgery of patients with DNI when it is difficult to accurately target the abscess due to inflammation.

Abbreviations: CT = computed tomography, DNI = deep neck infection.

Keywords: deep neck infections, image-guided surgery, navigation system, pterygomandibular space

1. Introduction

The prevalence of deep neck infections (DNIs) is decreasing due to the development and use of antibiotics. However, delayed diagnosis and treatment can lead to severe complications, such as airway obstruction, mediastinitis, respiratory distress syndrome, aspiration pneumonia, septic shock, and disseminated intravascular coagulation.[1–8] In the case of abscess formations that do not respond to antibiotics, early surgical treatment is often needed, especially for older and immunocompromised patients with airway compromise and sepsis.[9,10] Patients with acute DNIs require careful attention during surgery because the anatomical landmarks are not clearly distinguishable.[11,12] Since major blood vessels, such as the carotid artery and the jugular vein, are located in the cervical area, as well as various cranial nerves, the precise drainage of the abscess pocket is extremely difficult.

To accurately identify the complex anatomical structures, image-guided surgery system using preoperative computed tomography (CT) images have been introduced to assist surgeons in otolaryngology area.[13–16] These techniques are used to facilitate determination of the exact location of the lesion site in the narrow nasal cavity and to minimize complications, such as vascular injury and damage to the surrounding structures, during endoscopic sinus surgeries.[17–19] Here, we report our experience of successful CT-guided navigation assisted drainage of an inaccessible DNI. Informed consent was obtained from patient before this case report.

2. Case report

A 76-year-old female patient was referred to our clinic with right-side facial swelling, which began after the extraction of the lower third molar 2 weeks ago, as the chief complaint. There was no pertinent past medical history, and the patient complained of trismus and a sore throat. Upon clinical examination, there was tenderness in the right cheek area, facial swelling with hardness and

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Figure 1. Preoperative head and neck computed tomography images. An approximately 2.5 cm-sized, rim enhanced abscess pocket was noted in the right pterygomandibular space (white arrow). (A) Axial view. (B) Coronal view.

trismus (maximal mouth opening: 20 mm), and patient had fever (38.4°C). No abnormal findings were noted on laryngoscopic examination. Blood tests showed a white blood cell (WBC) count of 14,860/mm^3, an erythrocyte sedimentation rate (ESR) of 74 mm/h, and a C-reactive protein (CRP) level of 21.3 mg/dL. The CT scan showed an approximately 2.5cm-sized lobulated abscess pocket in the right pterygomandibular area (Fig. 1). Since it was difficult to surgically access the abscess, empirical antibiotic therapy was first provided (3rd generation cephalosporin, aminoglycoside, clindamycin); however, the patient's symptoms did not improve within 24 hours. The trismus worsened, and she complained of mild dyspnea. Sepsis was suspected based on follow-up blood tests, so surgery was performed under general anesthesia. The nasotracheal intubations were performed by highly skilled anesthesiology professor with Macintosh curved laryngoscope and Magill forceps. The patient was grade 2, which showed only posterior part of glottis according to the Cormack–Lehane classification system, but intubation proceeded successfully. The patient was placed in the supine position and her mouth was opened as wide as possible using a Denhardt mouth gag. The surgery was performed using a transoral approach. The outside of the medial pterygoid plate was palpated, and a 1-cm long incision was made parallel to the pterygomandibular raphe. Subsequently, blunt dissection was performed using tonsil forceps. The surrounding tissues were swollen, and severe adhesion hindered accurate identification of the anatomical location. There were also risks of damage to the surrounding blood vessels and nerves. Therefore, blunt dissection was halted, and aspiration of the abscess was attempted with a 21G needle. However, the pus did not drain through the needle. Even when the dissection was continued at the location where the abscess pocket was expected based on the CT images, the pus did not drain, and only bleeding was observed. Therefore, the surgery was once again halted.

The fact that the abscess pocket could not be accessed and that drainage failed was explained to the patient, and the patient was followed up with conservative management. Although antibiotic treatment was continued for 3 days, neither facial swelling nor trismus improved. Since blood tests did not show any improvement in the infection, another CT scan was performed, which revealed the abscess pocket in the same location as before (Fig. 2). Therefore, the decision to re-operate was made. This time, navigation-guided drainage using pre-operative CT images

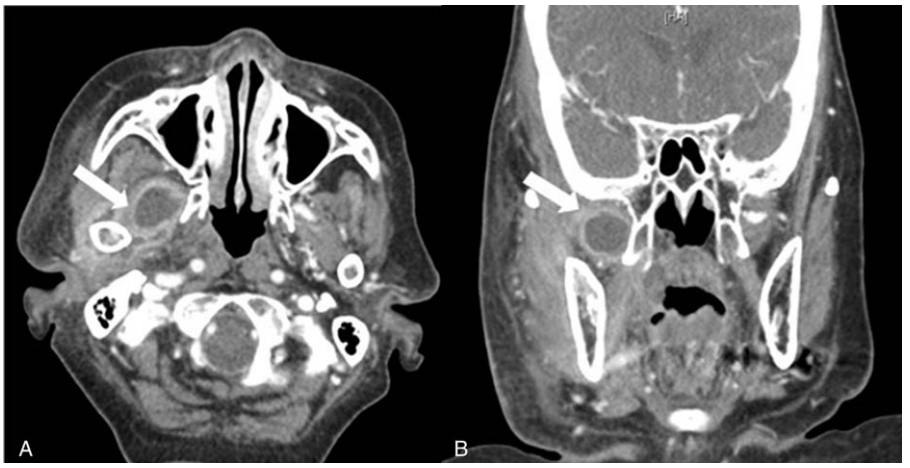

Figure 2. During the first surgery, the abscess pocket could not be accessed and the drainage was failed. After surgery, the abscess pocket was still noted in the right pterygomandibular space (white arrow). (A) Axial view. (B) Coronal view.

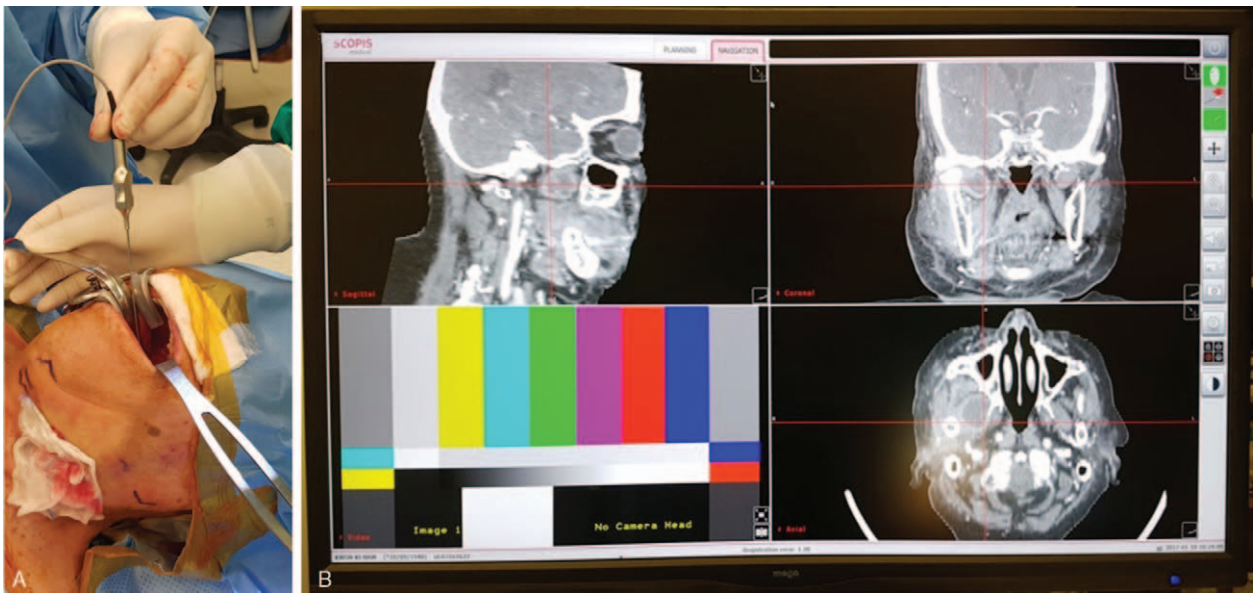

Figure 3. Computed tomography guided navigation assisted drainage procedure. (A) Navigation proves (seeker-tracker) was inserted into oral cavity. (B) The red lines crossing each other were accurately indicated the abscess pocket.

was planned for the re-operation since a more accurate anatomical location for the abscess was required. CT-guided navigation-assisted drainage was performed using a transoral approach (Scopis Hybrid Navigation System, Mega Medical Corporation). As with the previous surgery, an incision was made parallel to the pterygomandibular raphe, and blunt dissection was performed with 0° endoscope and tonsil forceps. Using the navigation system, it was 3-dimensionally confirmed that the seeker-tracker accurately indicated the abscess pocket (Fig. 3). Tissue dissection was continued in the direction of the abscess, and the pus was successfully evacuated (Fig. 4). Subsequent drainage was performed, and samples were aseptically collected and sent for bacterial culture. A silicone drain tube was inserted to facilitate the drainage of the remnant abscess, and the operation was completed after primary repair of the surgical site. No bacteria were identified in the microbiological examination of the abscess fluid, and conservative treatment with intravenous antibiotics was provided to the patient after the surgery. Facial swelling and trismus improved, and no post-operative complications, including hematoma and necrosis, were observed. The silicone tube was removed when no more pus was drained and inflammation improved according to blood tests. On post-operative day 7, CT was performed again to confirm the absence of a remnant abscess pocket, and the patient was discharged (Fig. 5).

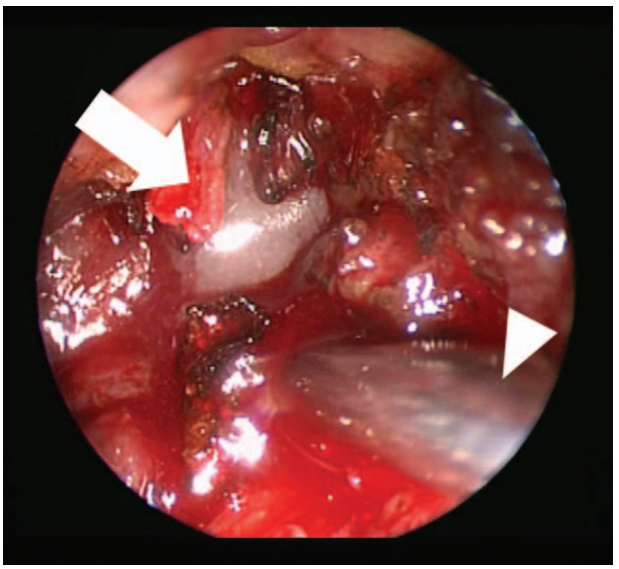

Figure 4. Endoscopic view of drainage of the pterygomandibular abscess. The pus (white arrow) was successfully evacuated by suction (white arrow head).

3. Discussion

Image-guided drainage techniques have been used for abdominal and liver abscesses. Generally, ultrasound is used to determine the location of the abdominal abscess in real-time, and drainage is performed through minimal incision.[20] However, this technique is difficult to apply to cases where the abscesses are difficult to reach or deep within the abdomen. For example, ultrasound-guided liver abscess drainage is limited when the abscess is unilocular or the boundary is unclear.[21,22] In order to overcome these limitations, preoperative CT images have been used to confirm the exact position of the anatomical structures in a real-time surgical field, using a frame-based guidance technique.[13,14] In Neurosurgery, CT-guided surgery is used for brain and spine lesions, to facilitate a sophisticated surgical area approach. Advantages of this technique are that it can minimize the surgical incision, reduce soft tissue damage, reduce operation-related complications, and have superior surgical results compared to an open drainage approach.[23,24] In Otolaryngology, CT-guided navigation surgery is primarily used for endoscopic sinus surgeries. The 3-dimensional view achieved through CT-guided navigation minimizes tissue damage around the skull base and enables a precise surgical approach with an error range of 1 to 2 mm.[17,18,25]

For head and neck surgeries, it is particularly difficult to access the pterygomandibular space. The boundary of the pterygo-

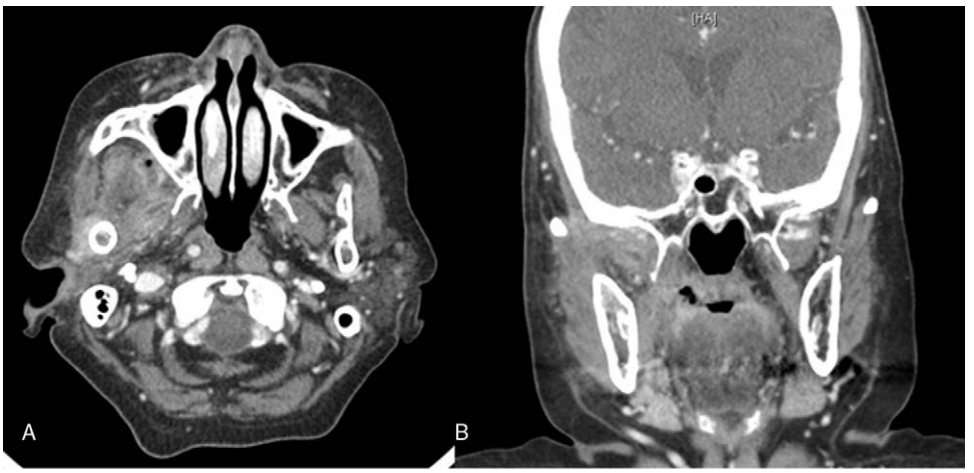

Figure 5. Computed tomography shows remission of abscess in the right pterygomandibular space after drainage. (A) Axial view. (B) Coronal view.

mandibular space is as follows: medial pterygoid muscle on the medial side, medial surface of ramus on the lateral side, pterygomandibular raphe on the anterior side, parotid gland on the posterior side, and lateral pterygoid muscle on the superior side. Abscesses in this area often arise due to odontogenic causes and require active treatment since they can spread to the infra-temporal space.[10,26] The pterygomandibular area contains important structures, including the inferior alveolar bundle, lingual nerve, internal maxillary artery, pterygoid plexus of veins, and posterior temporal artery, so caution is required when operating in this area. Although intraoral approaches can be attempted, it is often difficult to access the lesions in this region.

In our first surgical attempt, the accurate depth of the surgical tool could not be confirmed due to the characteristics of the pterygomandibular space, so drainage could not be easily performed. However, when CT-guided navigation was used, dissection could be continued while confirming the location of the abscess pocket in real-time using the seeker-tracker; therefore, the pus could be drained accurately and quickly. Although the first operation took 45 minutes, the second operation required 33 minutes including navigation setting time. For unskilled surgeons, using tools that provide surgical guidance would help decrease the time required for the operation and aid in the patient's fast recovery. This is especially applicable to patients who have deep neck abscesses, which are characterized by great variations in the anatomical structure.

There are certain limitations associated with the application of navigation systems to DNI surgeries. First, since DNI is not an indication for navigation guided surgery in our country, it is not generally covered by the public health insurance. Therefore, there are financial burdens to the use of navigation systems in patients with DNI. Second, there may be a slight difference between the preoperative image and the actual endoscopic view during the operation. Because preoperative CT scan was performed without neck extension, whereas in the operating room, the neck was extended after general anesthesia.

To our knowledge, this is the first report of the treatment of a pterygomandibular abscess using navigation system. This might not be applicable to all DNI cases, but this navigation technology might be helpful to reduce the difference between preoperative imaging and surgical operative findings. In patients with pterygomandibular abscess where accurate targeting is difficult due to inflammation, CT-guided navigation-assisted drainage can be considered as a useful surgical tool.

Author contributions

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