Endoscopic management of frontal sinusitis associated with the use of bone wax after transfrontal craniotomy

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ABSTRACT

OBJECTIVE: We aimed to determine whether frontal sinusitis is associated with bone wax use after transfrontal craniotomy.

METHODS: A retrospective review was performed on patients with frontal sinusitis after transfrontal craniotomy between March 2011 and February 2017.

RESULTS: The cases of three patients who presented with gradual frontal sinusitis due to bone wax use after transfrontal craniotomy were evaluated. In all three cases, computed tomography(CT) examination showed the presence of bone wax within the frontal sinus; this frontal sinus wax was removed endoscopically and with frontal crypt drainage. The patients were followed up for more than 6 months.

CONCLUSIONS: Frontal sinusitis following transfrontal craniotomy can occur due to bone wax use. This can be treated by cleaning out the bone wax and inflammatory granulation tissue
and by expanding the frontal recess.

SIGNIFICANCE: Otolaryngologists and neurosurgeons should consider the use and removal of bone wax after transfrontal craniotomy to prevent frontal sinusitis.

Introduction

Neurosurgeons routinely perform frontal incision debridement and drainage, remove the residual mucosa from the sinus and close the frontal sinus cavity with bone wax.Bone wax is a wax-softening agent widely used to control bleeding from bone surfaces and cut edges. It has been commonly used for decades as a physical barrier to

maintain hemostasis on the bone surface in neurosurgical operations. Bone wax acts as a stent to facilitate healing of small cranial base defects.It prevents fibrin from filling the small defect and prevents spontaneous closure.There have been developments in the technology of nasal endoscopic frontal sinus surgery in recent years, and progress in computed tomography (CT) imaging and anatomical study of the frontal fossae.[1]

However very limited reports exist on frontal sinusitis associated with the use of bone wax after transfrontal craniotomy. Therefore,a report on this complication would be highly valued by otolaryngologists and neurosurgeons as it can lead to serious intracranial infections.

A retrospective review of records from the clinical practices of the senior author revealed three patients treated by minimally invasive nasal endoscopic surgery for frontal sinusitis complicated with the use of bone wax after inferior frontal approach craniocerebral surgery. Each of these patients had previously undergone surgery for meningioma or craniopharyngioma using the inferior frontal approach and the frontal sinus cavity had been filled with bone wax for hemostasis. The first patient underwent a transfrontal approach to the right meningioma 6 years after surgery complicated with frontal sinusitis; the second patient underwent a transfrontal craniotomy for the right meningioma and a large Rathke's pouch cyst 3 years after surgery complicated with frontal sinusitis; and the third patient underwent a transfrontal approach to a right meningioma 4 years after surgery complicated with frontal sinusitis. This article dicusses the mechanisms and treatment of frontal sinusitis associated with the use of bone wax after transfrontal craniotomy and illustrates the clinical findings,shortcomings, and prevention of the use of bone wax to control bleeding after transfrontal craniotomy.

Description

A 53-year-old woman presented six years after transfrontal craniotomy for a meningioma. Persistent nasal obstruction developed three years after the operation,with left focus, accompanied by early-morning runny nose, occasional yellow abscess,and forehead pain; no diagnosis or regular treatment were performed. Five years after surgery, the nasal obstruction was aggravated after a second episode of cold,accompanied by sneezing, and yellow ductile material was ejected from the left nasal cavity,measuring approximately 2 cm × 2 cm. The forehead pain was alleviated, and there was no bloody nose or nasal hemorrhage. Recently, due to aggravation of the nasal congestion and frontal pain, nasal CT was performed, which revealed that the bilateral frontal sinuses and the left ethmoid sinus were filled with low-density soft tissue shadow (Fig. 1, 2); additionally, MRI showed the bilateral frontal sinuses and ethmoid sinus to have equal T1 and long T2 signal (Fig. 3).

Nasal endoscopy (2% tetracaine +0.1% epinephrine) and 4 mL cotton pads were used to shrink the nasal mucosa under general anesthesia. Hard, waxy, yellow endoplasm was seen within the left middle nasal passage and the cleft of the nose. There were many

gray-white translucent masses around, and red secretions were seen in the right middle nasal passage. The left-side operation was carried out first, and careful exploration was conducted around the nasal parenchyma hard objects; no obvious adhesion was noted. The hard objects were removed, which measured approximately 3.0 cm × 0.8 cm, with a rough surface; considering the patient's medical history, use of bone wax was considered (Fig. 4). In the middle nasal passage, hypertrophic hooks, compression deformation and hypertrophic middle turbinate were observed. The left middle nasal tract polypoid growth was excised and examined. Mucosal edema was clearly visible within the ethmoid sinus; polypoid lesions were observed, which were thoroughly removed. Then, the forehead fossae were opened, the frontal sinus mucosa around polypoidal lesions was cleared, expanding and exposing the frontal sinus, in which sinus mucosal edema was observed. The maxillary sinus was opened and expanded, and mucosal edema was observed around the sinus mouth. The lesions were removed and a large amount of white purulent secretions was observed in the sinus. This was followed by the complete removal and flushing of the maxillary sinus; the mucosa in the sinus was smooth. Right-side surgery was performed to complete the removal of herniation and ethmoid vesicles, and the entire group of ethmoid sinuses were opened to reveal mucosal edema and polypoid lesions in the ethmoid sinus; complete clearance was conducted. The frontal recess was opened to further expand the frontal sinus mouth, clear the bone wax in the frontal sinus, and open drainage by resecting the frontal sinus between the orbital border and the ventral border of the olfactory groove. The maxillary sinus was opened and expanded, and mucosal edema was observed around the sinus mouth. A large volume of purulent secretion was observed, which was completely cleared; the mucosa in the sinus was smooth. Nasal endoscopic examination 2 months after the operation showed vesicular growth in the frontal recess (Fig. 5). The patient was followed up for 2 years without recurrence.

Discussion

The use of transfrontal craniotomy provides treatment options that were previously not available to patients. However, the procedures involved in transfrontal craniotomy are challenging because of limited exposure and adjacent critical structures. Traditional methods of achieving hemostasis are not directly applicable in transfrontal craniotomy procedures. When pledget application fails to control bleeding, bone wax is commonly used.[2]

However, rare cases of granuloma, thrombosis, allergic reaction, and impaired bone healing have been reported. To date, there are few reports of frontal sinusitis associated with the use of bone wax after transfrontal craniotomy. In a retrospective analysis of three cases of transcranial frontal craniotomy, it was found that all patients had frontal sinusitis within half a year after surgery, which was correlated with the subfrontal approach before and after brain surgery, and the lateral group of frontal sinusitis had undergone lateral frontal lobe surgery and frontal sinus exposure. The treatment of open

frontal sinus during subfrontal approach craniocerebral surgery involved pushing or scraping of the submucosa in the sinus, and the frontal sinus was closed with the same amount of bone wax, which inevitably caused obstruction of the frontal sinus drainage channel. Mucus secretion still occurred in the mucosa clearance in the frontal sinus, making the occurrence of frontal sinusitis inevitable. These data suggest that inadequate frontal sinus drainage channel closure and retention of bone wax in the sinus are the main risk factors for frontal sinusitis complicated by transfrontal craniotomy. The reaction is characterized by the presence of giant cells, plasma cells, fibrous tissue, and a lack of bone formation, which eventually may trigger an allergic reaction or granuloma formation.[3] Complications related to bone wax use are mostly related to the fact that it is a nonabsorbable agent and remains in the body indefinitely. Therefore,removal of the bone wax after a certain period of time may be considered if practically feasible.

This kind of frontal sinusitis as a complication of transfrontal craniotomy should be actively treated once it occurs. Because of concerns about cerebrospinal rhinorrhea after opening and drainage of the frontal sinus, neurosurgeons routinely perform incision debridement and drainage of the forehead swelling area and re-scrape the mucosa of the frontal sinus, as well as completely closing the frontal sinus with bone wax. Because the frontal sinus is adjacent to the anterior ethmoidal artery, orbital plate, and skull base, the air space structure of the frontal sinus is complex and varies greatly, and there are some frontal sinus lesions that are difficult to treat. Therefore, frontal sinus surgery is still the difficult part of intranasal surgery. With the development of nasal endoscopic techniques in recent years, especially the improvement of frontal sinus drainage channels, frontal crypt CT imaging, and anatomical studies, surgical techniques of frontal sinus under nasal endoscopy have been further developed.[3] These preconditions make it possible to treat complex frontal sinusitis with bone wax and other foreign bodies in the sinus under nasal endoscopy. In this study, three patients were treated via an open frontal recess to remove the mucosal polypoid tissue around the frontal sinus mouth, and the frontal sinus mouth was further expanded by resection of the frontal sinus between the orbital cardboard and the septum before the ventral border of the olfactory groove. The results showed that the crypt was spacious, drainage was unobstructed, and the therapeutic effect was good. The authors believe that all such patients can be treated by performing nasal endoscopy first. For cases with an abscess or fistula on the forehead, if there is unsatisfactory drainage between the abscess or fistula and the frontal recess after the opening of the frontal sinus under nasal endoscopy, an external approach is still needed to achieve good drainage between the abscess or fistula and the frontal recess.

CONCLUSION

Bone wax is the most widely used hemostatic bone sealant because of its availability, ease of use, immediate action, and relative safety. However, frontal sinusitis after transfrontal craniotomy is associated with the non-absorbability of bone wax. Based on

a comprehensive review of the literature and a comprehensive evaluation of our patients, we suggest that the use of absorbable and non-reactionable products should be considered for use in subfrontal approach craniocerebral operations. Newer hemostatic agents, such as gelatin foams, PEG/MFC composite, oxidized cellulose, and fibrillar collagen agents, may be a better choice for hemostasis of bone intraoperatively.[4-5] With the advent of these newer agents, it is our opinion that the use of bone wax should be avoided in transfrontal craniotomy.

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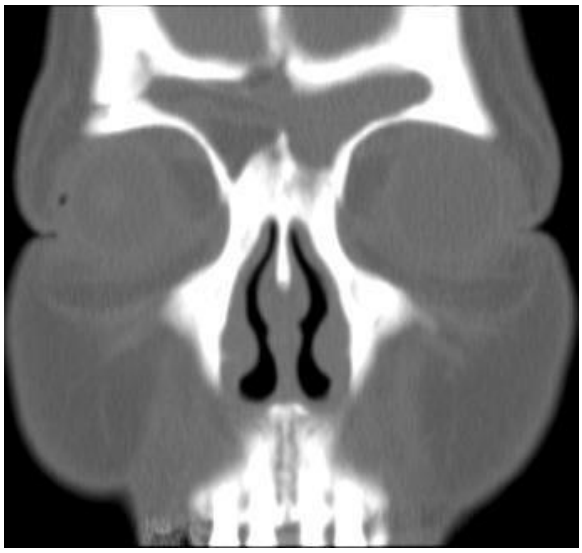

Figure 1. In coronal CT, a low-density soft tissue shadow in the frontal sinus and an incomplete bone structure on the right side of the frontal bone can be seen.

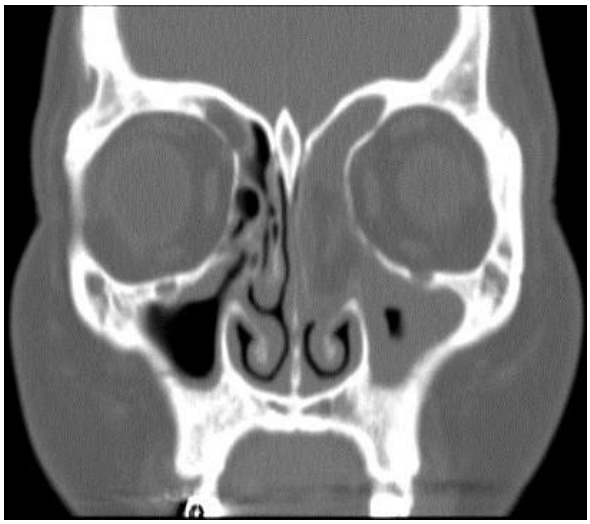

Figure 2. In coronal CT, the left ethmoid sinus is seen to be filled with low-density soft tissue and calcification is observed. This low-density soft tissue was found to be bone wax on surgical exploration. A soft-tissue shadow is seen on the left maxillary sinus, and the mucosa is thickened on the right maxillary sinus.

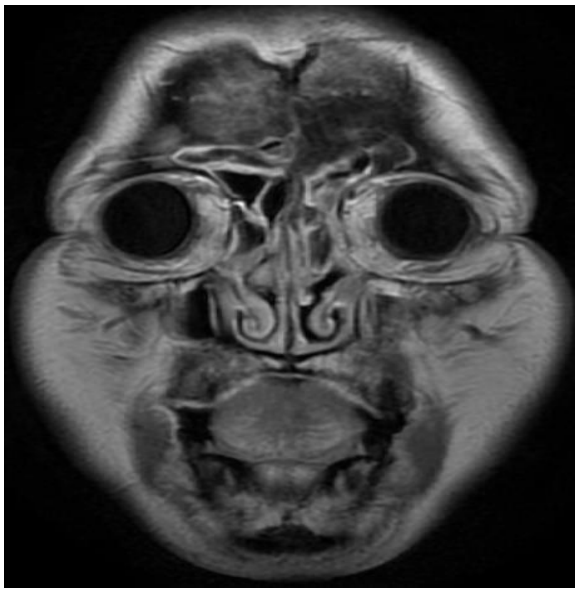

Figure 3. In coronal MRI, an incomplete local bone structure of the right frontal bone, local thickening of the subdural, and a visible enhancement in enhanced scanning are seen. The mucosa of the bilateral frontal sinus, ethmoid sinus, maxillary sinus, and sphenoid sinus were thickened, with equal T1 long and T2 signals.

Figure 4. A fragment of bone wax approximately 3 cm in length was removed from the left ethmoid sinus and frontal sinus.

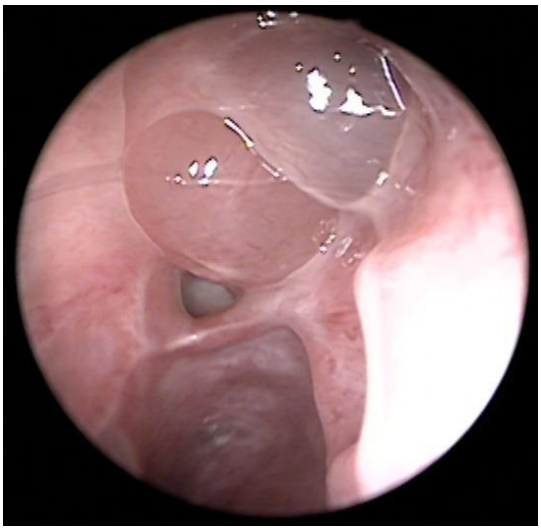

Figure 5. Two months post operation, growth was observed in the frontal recess follicular vesicle and the frontal sinus was unobstructed.