

Retained Bone Wax on CT at One Year after Dacryocystorhinostomy: A Case Report

누낭비강문합술에서 사용된 골밀납의 영상소견: 증례 보고

Seung Hyun Kim, MD¹, Dongwoo Park, MD^{1*}, Jeongah Lee, MD², Youngjun Lee, MD²,
Jinhyeok Jeong, MD³

¹Department of Radiology, Guri Hospital, Hanyang University College of Medicine, Guri, Korea

²Department of Radiology, Seoul Hospital, Hanyang University College of Medicine, Seoul, Korea

³Department of Otolaryngology Head and Neck Surgery, Guri Hospital, Hanyang University College of Medicine, Guri, Korea

A 71-year-old man with chronic rhinosinusitis presented with a purulent, foul-smelling nasal discharge and obstruction. One year earlier he had been treated with a dacryocystorhinostomy for nasolacrimal duct obstruction. During the procedure, bone wax had been used to control bleeding in the anterior upper nasal cavity. On computed tomographic imaging, a fat-density lesion was seen in the anterior upper sinonasal cavity and was found to be hypointense or signal-void on all magnetic resonance imaging sequences. The lesion, which proved to consist of bone wax, was surgically removed. Here, we present the imaging features of retained bone wax in a patient with clinically diagnosed chronic rhinosinusitis after dacryocystorhinostomy.

Index terms

Bone Wax
Dacryocystorhinostomy
Rhinosinusitis
Tomography Scanners, X-Ray Computed
Magnetic Resonance Imaging

INTRODUCTION

Bone wax has been widely used in craniofacial surgery to mechanically control bleeding from bone surfaces and cut edges, since it was introduced to the field of surgery by Victor Horsley in 1892 (1). Bone wax acts as a molding tamponade, providing a mechanical barrier to hemorrhage. It is inert, pliable, and sturdy enough to fill bony defects; however, it is minimally resorbable and may induce inflammatory reactions, interfere with bone healing, and increase infection rates (2).

Several case reports have described symptomatic complications that developed after the use of bone wax to control bleeding in craniofacial surgery (3-8). But, to our knowledge, rarely have

there been patients in orbital surgical series that presented with complications due to the use of bone wax (5), and only a small number of reports have described the features of bone wax as detected on CT and MRI (3, 4, 6). Here, we describe the imaging features of bone wax in a patient with clinically diagnosed chronic rhinosinusitis after a dacryocystorhinostomy.

CASE REPORT

A 71-year-old man presented with a purulent nasal discharge with a foul odor and obstruction after having undergone a dacryocystorhinostomy one year earlier. During this procedure, bone wax had been used to control bleeding from the lacrimal

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*Corresponding author: Dongwoo Park, MD

Department of Radiology, Hanyang University College of Medicine, Guri Hospital, 153 Gyeongchun-ro, Guri 11923, Korea.

Tel. 82-31-560-2543 Fax. 82-31-560-2551

E-mail: dwpark@hanyang.ac.kr

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bone. Endoscopic examination revealed a whitish, mass-like lesion in the right anterior upper nasal cavity around the upper attached part of the middle turbinate, as well as a right lacrimal bone defect adjacent to the lacrimal sac (Fig. 1).

CT and MRI scans were then obtained to evaluate this sinonasal lesion. CT revealed a lesion of about the density of fat [about -70 Hounsfield units (HU)] filling the right anterior upper nasal cavity and lacrimal bone defect (Fig. 2). The nasolacrimal duct remained patent but was slightly compressed by the lesion. MRI showed a hypointense or signal-void lesion on all sequences with no contrast enhancement after gadolinium injection (Fig. 3). Differential diagnosis included surgical or packing materials, dermoid cyst, and entrapped orbital fat tissue.

Endoscopic sinus surgery was performed, and a whitish foreign body was found at the right middle meatus. It was removed by forceps and clarified as the bone wax that had been applied during the dacryocystorhinostomy. A pathological examination revealed chronic inflammation of the nasal mucosa, fragmented chondroid, and calcified materials (Fig. 4).

DISCUSSION

The development of modern bone wax has been attributed to Horsley in 1892 (1). It is a hemostatic and sealant agent that is smeared across bleeding edges of bone surfaces to block holes



Fig. 1. Endoscopic view showing a whitish, glittering foreign body filling the anterior upper nasal cavity, medial to the upper attached part of the right middle turbinate.

and cause immediate bone hemostasis through a tamponade effect. It is a sterile and opaque mixture of 85 to 90% white beeswax and 10 to 15% isopropyl palmitate, a wax-softening agent, with or without pure paraffin wax (2).

CT attenuation by bone wax generally falls between the low attenuation of fat and the intermediate attenuation of water (4), which we observed by imaging a lump of bone wax floating in a cup of water (Fig. 2D). With the appropriate window settings, CT can clearly discriminate air, bone wax, and surgical instruments, but it might be difficult to differentiate bone wax from lesions consisting of adipose tissue, such as lipomas, dermoid cysts, and entrapped fat tissue. MRI can be used to exclude such lesions based on their high signal intensities on T1-weighted images and intermediate signal intensities on T2-weighted images.

Bone wax is a semicrystalline, solid substance with a very short T2 value. Because it does not generate a signal detectable by means of conventional MRI techniques, bone wax imaging results in a signal void or one of low intensity on all MRI sequences. This characteristic is typical of all crystalline materials, such as ice crystals (9). In our experiment, we observed this signal void on MRI sequences by imaging a lump of bone wax floating in a cup of water (Fig. 3D, E). Signal voids on postoperative MRI can reflect a variety of materials, such as entrapped air, the presence of packing materials, and surgical instruments or other artifacts; however, the signal voids in such cases can be differentiated from those due to bone wax based on their geometry and location. In addition, magnetic susceptibility artifacts generated by paramagnetic surgical instruments have characteristic bright signal margins that are not seen with bone wax because its magnetic permeability is similar to that of water and soft tissue.

Although bone wax is generally a safe material, it can cause chronic inflammation, act as a mechanical barrier to bone regeneration, impair bacterial clearance in cancellous bone, and precipitate the formation of a foreign-body granuloma (2). Complications related to the use of bone wax have been reported in several types of craniofacial operations (3-8, 10).

In 1994, Allison (10) reported foreign-body reactions to bone wax applied in mandibular surgery, including histological findings such as infiltration of lymphocytes, macrophages, and giant cell infiltration. This author also proposed that a foreign-body reaction may be related to the amount of bone wax used and would occur more readily when bone wax is used in a large area.

A year later, Hadeishi et al. (4) described seven cases in which bone wax had migrated to the sigmoid sinus after retromastoid craniectomy. Postoperative CT scans revealed hypodensities (-34 to -79 HU) in the ipsilateral sigmoid sinus indicating the presence of bone wax. They concluded that application of a large quantity of wax to control bleeding from the large emissary veins could risk such migration.

In 1996, Katz and Rootman (5) noted bone wax granulomas of the orbit as a remote surgical complication in two patients and suggested that the wax may indeed act as a nidus for infection and may induce chronic granulomatous giant-cell foreign-body inflammation.

As reported by Kamide et al. (8) in 2009, bone wax-induced os-

teohypertrophy presented as exophthalmos 9 years after a craniotomy. It is thought that osteohypertrophy is caused by chronic foreign body-induced inflammation that eventually extends into the bone marrow, resulting in osteoblast activation and osteogenesis.

Excess bone wax may have a mass effect. If it obstructs the natural ostium, it can cause acute paranasal sinusitis. Kim et al. (7) described recurrent acute frontal sinusitis caused by bone wax used in a frontal lobe operation. The authors proposed that obstruction of the natural ostium can induce stasis of secretions and ciliary dysfunction and can impair the clearance of bacteria from the paranasal sinus. Similarly, in our patient, excess bone wax may have blocked the drainage pathway from the anterior ostio-meatal complex, leading to chronic rhinosinusitis.

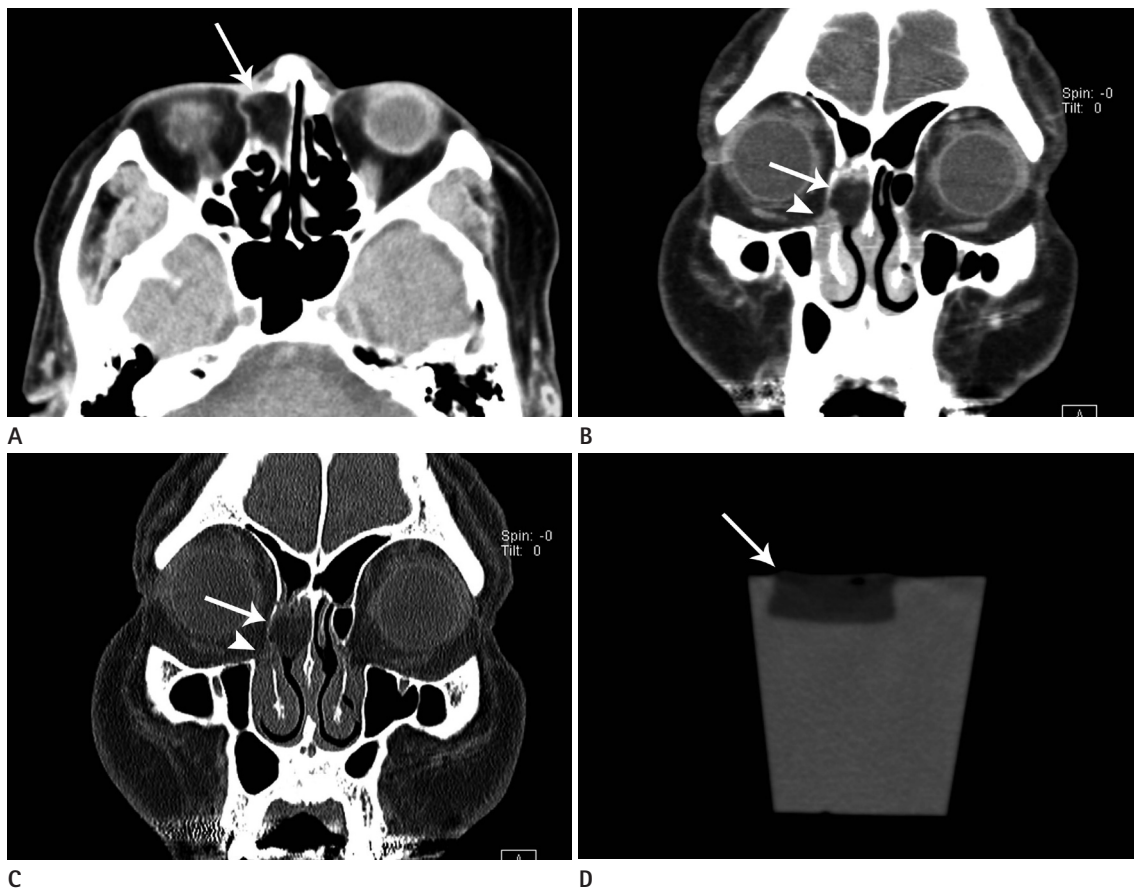


Fig. 2. CT images obtained in a 71-year-old man with chronic sinusitis that developed one year after dacryocystorhinostomy.
A. A pre-enhanced axial CT scan of the paranasal sinus shows a fat-density lesion (about -70 HU) filling the right anterior upper nasal cavity (arrow).
B, C. Post-enhanced and coronal reformatted CT images in a bone window setting show a fat-density lesion (arrow) around the upper attached part of the middle turbinate and a right lacrimal bone defect adjacent to the lacrimal sac. The nasolacrimal duct remained patent (arrowhead) but was slightly compressed by the lesion.
D. On axial CT scanning, a lump of bone wax (arrow) floating in a cup of water shows the low attenuation of fat (about -100 HU), as compared with the intermediate attenuation of water (about 0 HU).
 HU = Hounsfield units

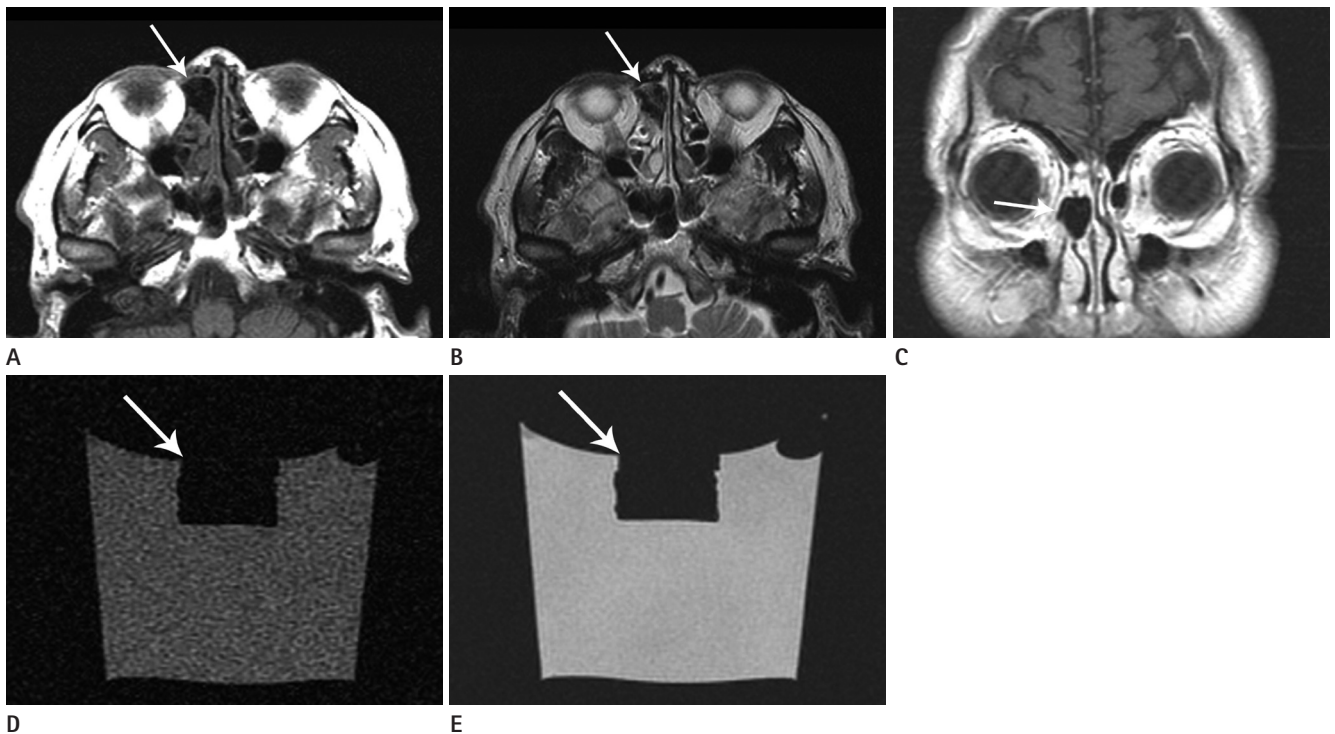


Fig. 3. After gadolinium injection, MRI scans were obtained showing a hypointense or signal-void lesion (arrow) on all sequences, including T1-weighted (A), T2-weighted (B), and axial and coronal contrast-enhanced T1-weighted (C) images. Signal-void coronal T1-weighted (D) and T2-weighted (E) MRI scans of a cube of bone wax floating in a cup of water.

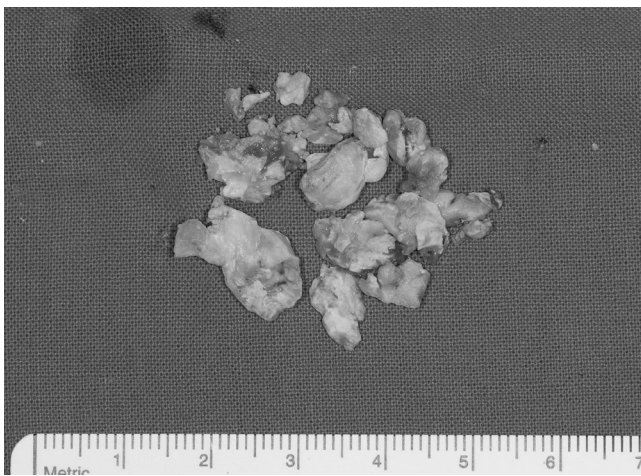


Fig. 4. Endoscopic sinus surgery was performed, and pieces of bone wax of various shapes and sizes (to a maximum of about 1.5 × 1.5 cm) were found and recovered.

The presence of bone wax can cause complications both immediately after craniofacial surgery and later. Thus, it is important to consider the possible presence of bone wax in postoperative MRI examinations so that it is not mistaken for residual air, surgical instruments, or artifacts. The careful evaluation of bone wax as detected on CT and MRI may allow this differentiation.

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누낭비강문합술에서 사용된 골밀납의 영상소견: 증례 보고

김승현¹ · 박동우^{1*} · 이정아² · 이영준² · 정진혁³

71세 남자가 비누관 폐색으로 1년 전 누낭비강문합술 후 화농성 콧물, 비폐색과 악취를 동반한 만성비부비동염을 보였다. 수술 당시 비강 전상방의 출혈 조절을 위해 골밀납이 사용되었다. 지방음영의 병변이 전산화단층촬영 영상에서 비강 전상방에 보였고, 이는 모든 자기공명영상 시퀀스에서 저신호 혹은 무신호였다. 병변은 수술적으로 제거되었고 골밀납으로 판명되었다. 저자들은 누낭비강문합술 후 임상적으로 진단된 만성비부비동염 증례에서 골밀납의 영상소견들을 기술하고자 한다.

¹한양대학교 의과대학 구리병원 영상의학교실, ²한양대학교 의과대학 서울병원 영상의학교실,

³한양대학교 의과대학 구리병원 이비인후과학교실