

# Osteoma of the Frontal Sinus with Secondary Subdural Empyema Formation

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Osteomas of the paranasal sinuses rarely lead to intracranial manifestations. The authors report an unusual case of a frontal sinus osteoma leading to subdural empyema formation. A 19-year-old man presented with headache and fever one month after minor facial trauma. Neuroradiological studies revealed subdural empyema in left frontal lobe with moderate cerebral edema and a osteoma in the left frontal sinus with sinusitis of maxillary sinus. The patient was surgically treated in one stage operation of decompressive craniectomy, removal of subdural empyema with frontal sinus osteoma, and endoscopic sinus surgery via cranial and nasal route. The patient recovered very well after surgery and postoperative antibiotic therapy. The etiology of intracranial infection and the treatment strategy are to be discussed.

**KEY WORDS :** Osteoma · Frontal sinus · Subdural empyema · Endoscopic sinus surgery.

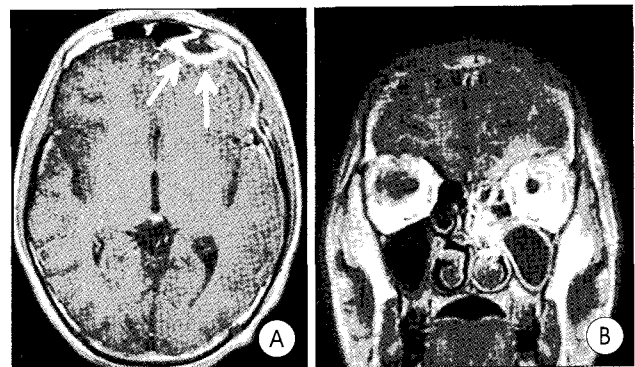
## Introduction

Osteomas of the paranasal sinus(PNS) are uncommon<sup>21</sup>. They are benign tumors and frontal sinus is the most common site that 80% of the PNS osteoma occurs in the frontal sinus alone<sup>1,7,11,12,19</sup>. The etiology of PNS osteoma has controversy. Some authors suggested trauma or infection as a cause of PNS osteoma<sup>20</sup>. The majority of osteomas remain occult, and incidence in the general population has been shown to be from 0.01% to 0.43%<sup>2,5,7</sup>. They are usually asymptomatic and diagnosed incidentally by radiologic studies, and osteomas of the PNS rarely lead to intracranial manifestations<sup>20</sup>. The authors present an osteoma causing subdural empyema combined with sinusitis which was successfully treated with one stage operation combining craniotomy and endoscopic sinus surgery.

## Case Report

A 19-year-old serviceman had past medical history of nasal bone fracture after minor facial trauma. He was managed conservatively for several days and discharged without any sequelae. After one month, he presented with headache and fever, however, neurological examination was

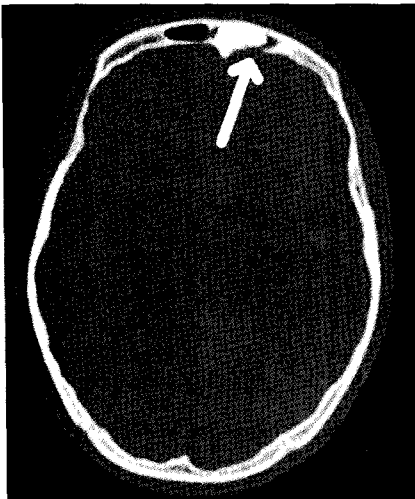
free. Non-enhanced computed tomography(CT) of brain at military hospital revealed no abnormal finding. Six days after, he complained aggravation of severe headache and brain magnetic resonance(MR) imaging with gadolinium enhancement showed subdural empyema, focal cerebritis in the left frontal lobe (Fig. 1A), and sinusitis of left maxillary sinus and nasal cavity (Fig. 1B). He was transferred to authors'



**Fig. 1.** Preoperative magnetic resonance images, A : Gadolinium enhanced T1-weighted axial image shows cortical enhancement of the left frontal lobe adjacent to the left frontal frontal sinus (white arrow). It is consistent with subdural empyema. B : Gadolinium enhancement T1-weighted coronal image shows strongly enhanced irregular lesions of the left maxillary sinus and nasal cavity. It means maxillary sinusitis.

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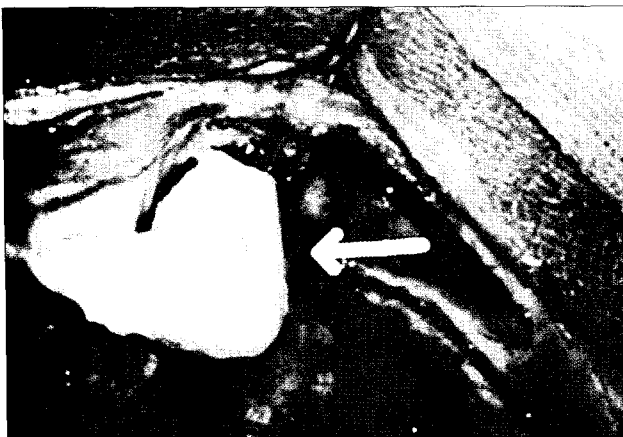
**Fig. 2.** Computed tomography of paranasal sinus demonstrates high attenuation lesion in the left frontal sinus (white arrow). Its finding was compatible with paranasal sinus osteoma.

institute and PNS CT revealed left frontal sinus osteoma (Fig. 2).

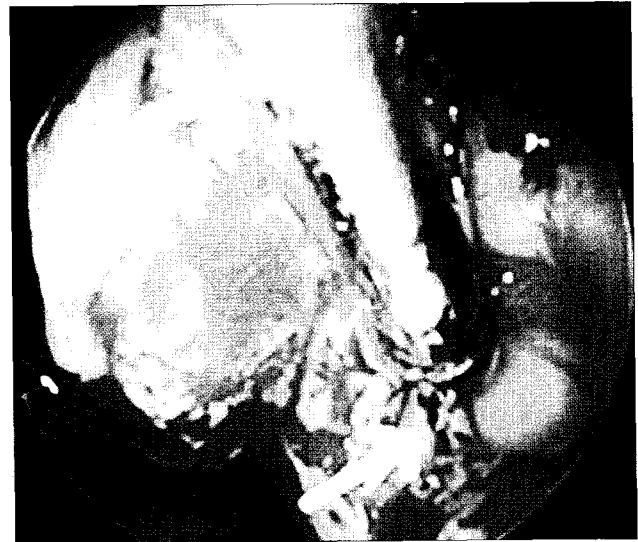
#### Operation

Decompressive left fronto-temporal craniectomy, and partial removal of frontal sinus osteoma were done (Fig. 3). There were linear skull crack and dural defect behind osteoma and surrounding inflammato-

ry changes were detected. After dural incision, the pus was seen on the cerebral cortex. Hyperemic edematous cerebral cortex and inflamed arachnoid membrane were seen. Meticulous removal of pus and massive irrigation with antibiotics mixed saline were done. After brain surgery, endoscopic surgery was done by otolaryngologist (JWK). Residual osteoma in the frontal sinus and mucosa of left frontal sinus were removed under endoscopic surgery via cranial route. After complete removal of osteoma and mucosa, the defect in the sinus was packed with temporalis fascia. After that endoscopic sinus surgery through nasal cavity was done and the pus in the maxillary sinus same as that of brain was observed. It was sticky and ivory color (Fig. 4). The pus was completely removed and it was collected for the culture study.



**Fig. 3.** Intraoperative microscopic photograph shows osteoma in the left frontal sinus (white arrow) which was fractured during craniotomy. The majority portion of this mass was removed by neurosurgeon (CYK) and the origin of the mass was completely removed by the otolaryngologist (JWK).



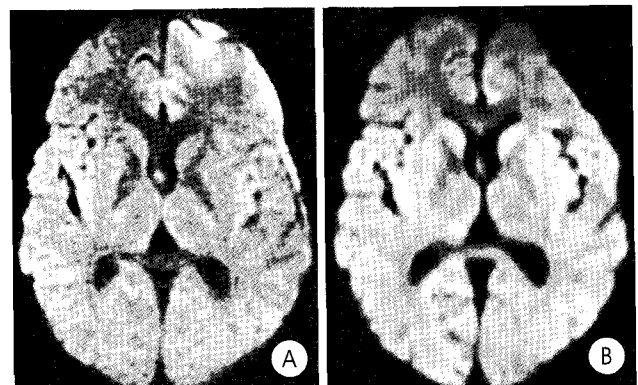
**Fig. 4.** Intraoperative endoscopic photograph shows pus in the left maxillary sinus (white arrow) through nasal cavity. It had same nature as that of intracranial one. The pus was the same nature as that found in the intracranial lesion.

#### Postoperative course

The patient was fully recovered without any complications. Coagulase negative *Staphylococcus* were identified in culture dishes of samples taken from operation. We continued to use broad spectrum antibiotics (Vancomycin, Ceftriaxone, and Metronidazole) for one month based on culture results and prophylaxis. One month after operation, diffusion weighted MR (DW-MR) imaging study showed no evidence of residual intracranial infection (Fig. 5). The patient exhibited no clinical signs of infection, and returned to his work three months after the operation.

#### Discussion

PNS osteomas with intracranial abscess has been reported, however osteoma in the sinus with empyema such as



**Fig. 5.** A : Preoperative diffusion weighted magnetic resonance (DW-MR) image shows high signal lesion of left frontal lobe along the cortical surface suggesting subdural empyema. B : Three months after surgery follow-up DW magnetic resonance image shows no abnormal signal intensity lesion in the left frontal lobe.

this case has never been reported before to our best knowledge. In 1927, Harvey Cushing described his experience with four cases of orbito-ethmoidal osteomas, one of which was found to be associated with a frontal abscess at craniotomy<sup>8</sup>. This patient reported a history of trauma to the midfrontal region, leading Cushing to postulate his theory of trauma as an etiology of osteoma formation. In Hallberg and Begley's series of 51 osteomas in 1950, two cases were reported to be associated with brain abscess<sup>13</sup>. Most recently, Summers et al. reported a case of frontal sinus osteoma associated with cerebral abscess formation<sup>20</sup>.

Although pathogenesis of osteoma is unknown, the role of osteoma in the development of intracranial infection can be postulated. Some authors have proposed that altered physical conditions and subsequent inflammation may trigger a metaplastic process originating from osteogenic cells<sup>4</sup>. This enlarged osteoma can make contribution to evolve bone crack in the wall of the sinus concomitantly with trauma<sup>20</sup>. Furthermore, trauma also can make dural defect. Thus, infection source would pass into intracranial portion via bony and dural defect<sup>2,14,21</sup>. Accordingly intracranial lesions such as brain abscess or subdural empyema should be taken into account when a patient with PNS osteoma presented with fever and headache especially after head or facial trauma.

The treatment of asymptomatic osteoma has been debated. However, the symptomatic patient such as this case must be treated immediately<sup>15-19</sup>. Surgical removal may be the excellent treatment modality. For the last 30 years, the osteoplastic flap approach to the frontal sinus has been a standard approach to diseases of the frontal sinuses<sup>17,19</sup>. Some authors found that a two-stage operation was necessary to remove the osteoma and brain abscess completely<sup>9</sup>. Cranial approach by itself has limitations and cannot treat sinusitis completely<sup>3</sup>. The authors decided to treat their patient with combined approach via craniotomy and endoscopic sinus surgery in one time. Osteoma and intracranial lesion were treated via craniotomy. Simultaneously, the authors treated the sinusitis more actively using endoscopic sinus surgery.

The authors suggest that active one stage combined surgical treatment may be good treatment strategy. Frontal sinus obliteration followed by osteoma and empyema removal can be done via craniotomy. In addition, concurrent endoscopic sinus surgery should be done for more effective treatment of sinusitis. Matter of course, postoperative antibiotics therapy must be maintained. Serial DW-MR imaging study with apparent diffusion coefficient (ADC) map during the management of cerebral infection helps to assess the response to treatment. Decreased signal intensity on trace DW images and increasing ADC values in the abscess consistent with successful treatment. Conversely, persisting or reappearing high signal

intensity in the abscess on trace DW images and low ADC values indicating restricted diffusion were seen in cases of treatment failure and were correlated with pus reaccumulation<sup>6</sup>. Findings in successfully and unsuccessfully treated brain abscesses were similar on conventional MR images and did not allow for their differentiation<sup>6,10</sup>.

Thus the authors recommended the following diagnostic work up and treatment strategy for the patients with symptomatic osteoma. When a patient with osteoma presented with intracranial symptoms neuroradiologic studies such as enhanced CT or MR imaging of the brain should be obtained. Especially it has to be remembered that minor head trauma can make bony defect as well as dural tearing in patient of frontal sinus osteoma. If intracranial infection would be presented on neuroradiological examination, craniotomy for intracranial lesion with concurrent endoscopic sinus surgery in one stage should be considered. Adequate antibiotics therapy for sufficient period has to follow surgical intervention and serial DW-MR imaging study with ADC maps during the management of cerebral infection may be useful in assessing the response to treatment.

## Conclusion

The authors describe a case of an osteoma with subdural empyema combined with sinusitis. The patient was successfully treated with one stage operation, craniotomy and endoscopic sinus surgery.

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