

Bony erosion patterns in patients with allergic fungal sinusitis

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ABSTRACT

Objective: To investigate bony erosion patterns in allergic fungal sinusitis (AFS) and to determine whether the extent of erosion correlates with demographics and preoperative clinical parameters.

Study Design: Retrospective review of prospectively collected data.

Methods: Seventy-four patients with a histopathologic diagnosis of AFS were identified. Preoperative computed tomographies (CT) were reviewed to determine sites with bony erosion. The 20-item Sinonasal Outcomes Test (SNOT-20) scores, endoscopy scores, and Lund-Mackay CT scores were compared between patients with and without bony erosion. Patients with bony erosion were further classified based on the extent of erosion. Statistical analysis was performed by using the Student's *t*-test and the χ^2 test of independence.

Results: Of the 74 patients, 39 (52.7%) had bony erosion and 35 (47.3%) did not. Bony erosion was found to be associated with younger age (27.5 versus 36.0 years; *p* = 0.011) and African American race (*p* = 0.041). Preoperative CT scores correlated with the presence and extent of bony erosion (*p* = 0.010). Sex, race, number of previous surgeries, SNOT-20 scores, and endoscopy scores did not correlate significantly.

Conclusion: Younger age and African American race were found to significantly correlate with bony erosion in AFS, which indicated that a more severe inflammatory response was mounted in these patient groups. As expected, higher Lund-Mackay scores correlated with the severity of erosion. The lack of correlation with SNOT-20 scores indicated the insidious nature of this destructive disease. The level of evidence is 4.

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Allergic fungal sinusitis (AFS) is a severe form of chronic rhinosinusitis that can lead to pronounced morbidity. Initial symptomatology is often characterized by seemingly innocuous nasal congestion, nasal obstruction, postnasal drainage, and anosmia. As the disease advances, bony erosion and extension of fungal debris into the intracranial cavity and orbit can ensue. At this point, the patients present with more serious findings, such as visual disturbances, proptosis, and mental status changes.^{1–5} Results of studies have demonstrated rates of bony erosion that range from 20 to 56% in patients with AFS.^{2–4,6} The aim of this study was to evaluate the extent of bony erosion in our series of patients with AFS and to determine whether the extent of erosion correlates with demographic factors as well as preoperative clinical parameters, such as CT, endoscopy, and SNOT-20 quality-of-life scores.

METHODS

Approval for this study was granted by the Georgia Regents University Institutional Review Board. Prospectively collected data from the senior investigator's (S.E.K.) tertiary care academic rhinology practice were analyzed. Patients with AFS who underwent endoscopic sinus surgery at our institution between 2003 and 2012 were identified. The diagnosis of AFS was made based on nasal endoscopy and preoperative imaging as well as the presence of allergic mucin, Charcot-Leyden crystals, and noninvasive fungal elements on histologic analysis of surgical specimens. The initial patient evaluation consisted of a complete history and physical examination, including nasal endoscopy. All the patients underwent a thin-slice helical computed tomography (CT) of the paranasal sinuses before surgery. Preoperative symptoms were quantified with the 20-item Sinonasal Outcomes Test (SNOT-20). Nasal endoscopy

Table 1. Incidence of bony erosion by anatomic site on preoperative CT imaging

Sites of Bony Erosion	Incidence of Erosion, no. (%)
Lamina papyracea	33 (28)
Medial maxillary wall	29 (25)
Posterior/lateral walls of sphenoid	20 (17)
Posterior table of frontal	16 (14)
Skull base	12 (10)
Septum	3 (3)
Pterygopalatine fossa	3 (3)

findings were graded by using the Lund-Kennedy scoring system, and CTs were graded by using the Lund-Mackay scoring system.

Bony erosion was determined by a resident (L.C.W.) and rhinology fellow (D.W.J.) evaluating each patient's preoperative CT for both the presence and extent of bony erosion. Bony erosion was defined as bone demineralization in combination with gross expansion of the bony wall. Patients with AFS and without bony erosion were compared with those with bony erosion. Statistical analysis was performed by using the Student's *t*-test and the χ^2 test of independence.

RESULTS

Seventy-four patients with a diagnosis of AFS were identified. The mean age at the time of surgery was 31.7 years (range, 8–84 years). The sex distribution was equal, with 37 men and 37 women. Forty-five patients (61%) were African American, 28 (38%) were white, and one (1%) was Asian.

The mean Lund-Mackay score was 14.6 ± 6.3 . The mean preoperative SNOT-20 score was 21.7 ± 10.9 , and the mean preoperative endoscopy score was 6.97 ± 3.7 . On analysis of CTs, 39 of the 74 patients (53%) had evidence of bony erosion that involved at least one subsite. The most common site of erosion was the lamina papyracea, followed by the medial maxillary wall. Distribution of erosion sites is listed in Table 1.

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Table 2. Comparison of patients with and without bony erosion

Patients With AFS	With Bony Erosion	Without Bony Erosion	<i>p</i> Value
Age (years)	27.5 ± 11.5	36 ± 17.3	0.011*
No. surgeries	1.95 ± 1.34	2 ± 1.03	0.474
SNOT-20	19.5 ± 9.2	23 ± 11.9	0.306
Endoscopy score, no.	6.5 ± 4.4	7 ± 3.1	0.508
Lund-Mackay score	16.6 ± 6.2	13 ± 5.8	0.0097*
Race, no.			
White	11	17	0.041*
African American	28	17	
Asian	0	1	
Sex, no.			
Male	21	16	0.485
Female	18	19	

*Statistical significance. Mean ± standard deviation.

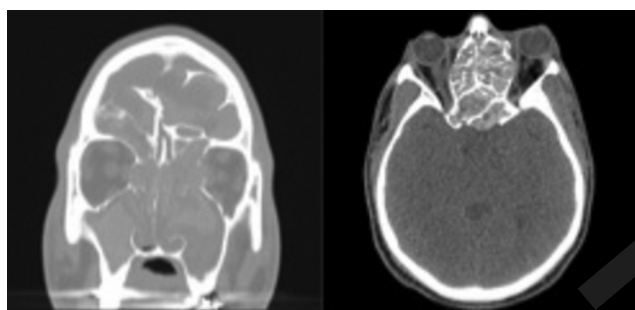


Figure 1. Axial and coronal views of maxillofacial computed tomography of patient with allergic fungal sinusitis demonstrating bony erosion at maxillary wall, lamina, frontal and ethmoid sinuses.

When comparing the patients with bony erosion with those without bony erosion, the patients with bony erosion were significantly younger at the time of presentation (27.5 versus 36.0 years old; $p = 0.011$) and were more likely to be African American ($p = 0.041$). There was no correlation with sex. Lund-Mackay CT scores were significantly higher in patients with bony erosion (16.6 versus 13.0; $p = 0.0097$), whereas no difference in SNOT-20 scores ($p = 0.31$) and endoscopy scores ($p = 0.51$) was found. These findings are listed in Table 2.

DISCUSSION

AFS is a severe form of chronic rhinosinusitis in which individuals who are immunocompetent develop an intense inflammatory reaction to airborne fungus. The pathophysiology is unclear, and surgical debridement with postoperative steroid therapy is the mainstay of treatment. The disease course is insidious because patients will often have bony erosion and remodeling, with extension of disease intracranially and intraorbitally (Fig. 1), which leads to serious sequelae and creates for a more difficult navigation through the surgical field and places vital structures at risk.⁷

The incidence of bony erosion in our series (53%) is consistent with other reports. We also found that African American patients were more likely to have bony erosion at presentation, which is consistent with the existing literature.^{3,4,8–12} The pathophysiology of AFS is not well understood, and it remains unclear as to why some patients develop an intense inflammatory reaction to airborne fungus. The higher incidence of AFS in African American patients suggests a genetic susceptibility to development of this disease.

In contrast to race, there was no sex predilection for bony erosion in our study. On reviewing the literature, there has been inconclusive

data on sex variations in AFS because some studies showed no sex predilection, whereas other studies showed both male and female predominance.^{3,12,13} Finally, we found that younger patients were more likely to have bony erosion, which concurs with the findings by Ghegan *et al.*¹²

Preoperative Lund-Mackay CT scores correlated with the presence of bony erosion. However, SNOT-20 scores and Lund-Kennedy endoscopy scores did not correlate with the presence of bony erosion, which further highlights the insidious nature of AFS because the patient may remain relatively asymptomatic during chronic and gradual remodeling of bone. Often, it is the development of severe proptosis, visual changes, and intracranial sequelae that prompts patients to seek medical attention. Awareness of this insidious disease course is important in the prompt diagnosis of patients with AFS. Although nasal endoscopy is a highly useful tool for the evaluation of chronic rhinosinusitis, nasal endoscopy may play a more limited role in evaluating the extent of disease in AFS. Obtaining a CT early on may be prudent in patients who are at risk for severe disease.

Our findings also have implications for postoperative follow-up in patients with AFS. Long-term follow-up, even in the absence of symptom recurrence, may be necessary because SNOT-20 scores did not correlate well with the presence of bony erosion. Although nasal endoscopy is a highly useful tool in the postoperative sinus cavity, having a low threshold for imaging during follow-up may allow for early detection of disease relapse.

CONCLUSION

This study is one of the largest single institution series of AFS. As with previous studies, we found that younger age and African American race were associated with a higher incidence of bony erosion. Our study was unique in that it was the first to analyze SNOT-20 quality-of-life scores and endoscopy scores as they relate to bony erosion. We found that both SNOT-20 scores and endoscopy scores did not correlate with the incidence of bony erosion, which has important implications for the initial evaluation and postoperative follow-up in patients with AFS.

REFERENCES

1. Bent JP, and Kuhn FA. Diagnosis of allergic fungal sinusitis. *Otolaryngol Head Neck Surg* 111:580–588, 1994.
2. Nussenbaum B, Marple B, and Schwade ND. Characteristics of bony erosion in allergic fungal rhinosinusitis. *Otolaryngol Head Neck Surg* 124:150–154, 2001.

3. Wise SK, Rogers GA, Ghegan MD, et al. Radiologic staging system for allergic fungal rhinosinusitis (AFRS). *Otolaryngol Head and Neck Surg* 140:735–740, 2009.
4. Marfari MS, Jawaid MA, Shaikh SM, and Thaheem K. Allergic fungal rhinosinusitis with skull base and orbital erosion. *J Laryngol Otol* 124:161–165, 2010.
5. Campbell JM, Graham M, Gray HC, et al. Allergic fungal sinusitis in children. *Ann Allergy Asthma Immunol* 96:286–290, 2006.
6. Kinsella JB, Rassekh CH, Bradfield JL, et al. Allergic fungal sinusitis with cranial bone erosion. *Head Neck* 18:211–217, 1996.
7. Glass D, and Amedee RG. Allergic fungal rhinosinusitis: A review. *Oschner J* 11:271–275, 2011.
8. Katzenstein AL, Sale SR, and Greenberger PA. Allergic *Aspergillus* sinusitis: A newly recognized form of sinusitis. *J Allergy Clin Immunol* 72:89–93, 1983.
9. Robson JM, Hogan PG, Benn RA, and Gatenby PA. Allergic fungal sinusitis presenting as a paranasal sinus tumour. *Aust N Z J Med* 19:351–353, 1989.
10. Aribandi M, McCoy VA, and Bazan C 3rd. Imaging features of invasive and non-invasive fungal sinusitis: A review. *Radiographics* 27:1283–1296, 2007.
11. Ponikau JU, Sherris DA, Kern EB, et al. The diagnosis and incidence of allergic fungal sinusitis. *Mayo Clin Proc* 74:877–884, 1999.
12. Ghegan MD, Lee FS, and Schlosser RJ. Incidence of skull base and orbital erosion in allergic fungal rhinosinusitis (AFRS) and non-AFRS. *Otolaryngol Head Neck Surg* 134:592–595, 2006.
13. Liu JK, Schaefer SD, Moscatello AL, and Couldwell WT. Neurosurgical implications of allergic fungal sinusitis. *J Neurosurg* 5:883–890, 2004. □

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