DOI: https://doi.org/10.53350/pjmhs2023174652

ORIGINAL ARTICLE

An Analysis of the Occurrence of Bone Erosion on Computerized Tomography Scans in Allergic Fungal Rhinosinusitis

MUHAMMAD ARIF KHAN[1], MUHAMMAD SALEEM[2], ADNAN SALEEM UMAR[3], ALI HUSNAIN SHEIKH[4], ANDLEEB IQBAL[5], RABIA JAVED[6], KHURRAM SHAHZAD[7]

[1]*Asst Prof of Public Health, AFPGMI, Rawalpindi*
[2]*Associate Professor of ENT Aziz Fatima Medical and Dental Collage Faisal Abad*
[3]*ENT Specialist, HOD ENT, PAC Hospital Kamra Cantt.*
[4]*Associate Professor Akhtar Saeed Medical and Dental College/Akhtar Saeed Trust Hospital Lahore*
[5]*Consultant Radiologist, Rawal Institute of Health Sciences*
[6]*General Practitioner, Department of General Medicine, Riaz specialist medical centre , Sharjah , UAE*
[7]*HIESS, Hamdard University, Karachi, Pakistan*
Correspondence to: Muhammad Arif Khan, Email: pafsurgeon@gmail.com

ABSTRACT

Objective: Bone erosion on a CT scan may be an indication of osteoarthritis, rheumatoid arthritis, or bone infections, among other diseases. Tumors and other bone conditions may also be to blame. A doctor would need to analyze the CT scan and maybe do other tests or imaging investigations to identify the source of bone degradation. The study's goal is to examine the prevalence and locations of bone erosion on computed tomography scans in Pakistani patients with allergic fungus rhinosinusitis.

Methods: This retrospective observational study was conducted at The study was conducted in PAC Hospital Kamra, Pakistan, between January 2013 and December 2022. 85 of the patients who had bone erosions on a computed tomography scan out of a total of 230 instances of allergic fungal rhinosinusitis were included in the research. Evaluation of bone erosion in various paranasal sinuses and their sub-sites. Patients were categorized into three groups based on how much bone erosion they had: mild, moderate, and severe. Mild instances were those with erosion at a single site, moderate cases had erosion at two subsites, and severe cases had erosion at more than two subsites.

Results: In 85 (36.9%) of the patients, bone erosion was discovered after a thorough analysis of the computed tomography scan of the paranasal sinuses. The average impacted age was 23.96 ± 12.71. There were 33 women and 52 men, or 61.1% of the total. The ethmoid sinus was the sinus that had bone erosions the most often. Frontal sinus 24 (16.6%), maxillary sinus 55 (38.19%), sphenoid sinus 27 (18.75%), and maxillary sinus 38 (26.38%) are listed in that order. Out of 85 patients, 15 (17.6%) had a severe illness, 22 (25.8%) had moderate disease, and 48 (56.1%) had mild disease.

Implication: The radiological evaluation of illness, regardless of the method and scoring system employed, is crucial because it allows the otolaryngologist and the radiologist to stratify the severity of the disease in instances of AFRS and aids in clinical evaluation and the avoidance of problems

Conclusions: Bone erosion occurs frequently in allergic fungal rhinosinusitis. The ethmoid sinus is the most frequently affected paranasal sinus in terms of bone erosion, and computerized tomography (CT) scan is a crucial and efficient inquiry in detecting these erosions.

Keywords: rhinosinusitis, bone erosion, sinusitis, radiological evaluation

INTRODUCTION

Out of the more than 400,000 fungal species that are known, around 400 are human diseases [(1)]. It is unknown what function fungi serve in the paranasal sinuses and nose. Even though fungi may be cultivated from the respiratory droplets of even a fit person, specific fungal diseases in humans are linked to a high death rate [(2)]. A distinct kind of chronic rhinosinusitis that exclusively affects immunocompetent hosts, allergic fungal rhinosinusitis (AFRS) is different from invasive fungal infection. Most sufferers have such a background of allergic rhinitis, which is assumed to be a reaction to inhalational atmospheric fungus, often of the causative agent type, bipolar (Curvularia, Alternaria), and very rarely Aspergillus [(3)]. A Gell and Coombs type I hypersensitivity reaction to fungi, the formation of nasal polyps, an accumulation of eosinophilic mucus and fungal mycelium in the sinuses, and all of these pathognomonic CT abnormalities are present in this condition.

An atopic host will generally inhale fungal allergens, which will trigger an IgE-mediated response and cause sinonasal inflammation, which will then cause edema, sinus blockage, and stasis. Nasal polyps and mucus buildup are caused by the chronic inflammation's final stages. The immune system is still stimulated by the trapped fungus, which sets up a vicious cycle that results in bone enlargement and erosion, and deformation of the sinonasal architecture [(4)]. Bone erosion in AFRS is a well-known occurrence that often affects the orbit and the base of the skull. It occurs anywhere from 20 to 90% of the time depending on the location. Bone remolding and pressure necrosis are the two main causes of bone erosion [(5)].

The CT scan is crucial in making the diagnosis. A non-contrast CT scan of the affected sinuses shows opacification with central hyperattenuating as a result of the concentration of various metals by fungi, including iron, magnesium, and manganese [(6)]. Additionally, bone erosion, another characteristic that is currently included in the minor diagnostic criteria, is superlatively identified by a CT scan [(7,8)].

Our research sought to determine the prevalence of bone erosions in various sinuses and their subsites that were apparent on CT scans in AFRS. AFS is managed in a multifaceted way that includes both medicinal and surgical intervention. When bone borders are dehiscent, effective endoscopic nasal treatment may have potentially fatal consequences. Therefore, a thorough CT scan analysis that identifies regions of bone erosion and evaluates the severity of the illness is a necessary need for a successful surgical procedure.

MATERIAL AND METHODS

This research was done retrospectively at the study was conducted in PAC Hospital Kamra between January 2013 and December 2022 with the hospital ethics committee's permission. In this study, 230 patients with allergic fungal rhinosinusitis who fulfilled the Bent and Swain criteria, including 85 people who had bone erosions on their CT scans, were examined. In this research, patients of any age and gender were included. The research excluded individuals with Sino nasal tumors, those who were immunocompromised, diabetic patients, those who used medicines that affected immunity (antibiotics, steroids, and immunosuppressive drugs), and people with immune impairment.

Before surgery, CT scans of the paranasal sinuses were performed on all patients. A skilled radiologist took three images of the coronal, axial, and sagittal sections, focusing particularly on the

locations of bone erosions and soft tissue tensions. Each sinus is further broken down into its sub-sites (Table 3). Patients who had a questionable diagnosis, soft tissue or cerebral extension, or tumor suspicion had MRIs.

CT scans were examined for the typical AFRS features of central hyper attenuation, double thickness shadows, development of sinus mucoceles, and extension of sinuses, combined with unilateral or bilateral opacification of numerous sinuses. A feature of AFRS is intrasinus hyper attenuation, which is used as a diagnostic marker. The most prevalent sinus affected as well as the frequency of bone erosion at various sinus sub-locations were assessed. Based on how serious the bone erosions were, patients were divided into three groups: severe moderate, and mild. Mild instances were those with erosion at a single site, moderate cases had erosion at two subsites, and severe cases had erosion at more than two subsites.

RESULTS

Out of 230 cases of AFRS, 85 patients with bone erosion on CT scans and allergic fungal rhinosinusitis were selected for our study. In 36.9% of AFRS patients, bone erosion was often seen. With a standard variation of 12.71 years, the mean age of the disease with bone erosion in 85 people was 23.96 years. Out of 85 patients, 52 (61.1%) were men and 33 (38.9%) were women. 74 (87%) of the patients had a bilateral illness, while 11 (13%) had unilateral diseases. 5 (5.78%) of the unilateral instances had a right-sided illness, whereas 6 (7.05%) exclusively had left-sided disease (Figure 1).

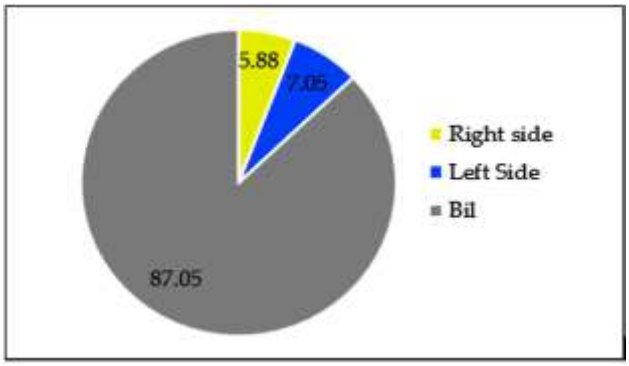

Figure 1: The disease's laterality

Out of 85 patients, 48 (56.1%) had bone erosion at one sinus subsite and were classified as having a mild illness, whereas 22 (25.7%) had bone erosion at two sinus subsites and were classified as having the moderate disease. There were 15 patients (17.6%) with severe illness brought on by bone erosions at several subsites. Thus, 144 erosions in total were observed in these 85 individuals (Table 1).

Out of 15 severe instances, 10 (66.6%) had bone erosions at three subsites, three (20%) had erosions at four, and two (13.3%) had erosions at five subsites of various sinuses (Table 2).

Additionally, we discovered that 55 (38.19%) of the ethmoid sinuses often had bone erosions. The incidence of bone erosion in the ethmoid sinus lamina papyracea was greatest at 35 (24.3%). Maxillary sinuses had a total of 38 (26.38%) cases of bone erosion, with 12 (8.3%) of those cases occurring on the roof of the sinus. Out of all bone erosions, the sphenoid sinus had 26 (18.75%) and the frontal sinus had 24 (16.6%). The participation of several subsites is further broken down in (Table 3).

Table 1: Disease severity depending on the number of eroded bones

Severity	Severe	Moderate	Mild	Total
Frequency	15	22	48	85
%	17.6	25.8	56.4	
Cumulative	52	44	48	144

Table 2: A breakdown of instances with a severe illness and several erosions of the bones

Cases	2	3	10
Bone Erosion (n)	5	4	3
Total	10	12	30
%	13.33	20	66.6

Table 3: Bone erosion at various locations and subsites.

Primary Site (Sinus)	Subsite	n	(%)	Cumulative n	%
Maxillay Sinus	Roof	12	8.33%	38	26.38%
	Ant Wall	10	6.94%		
	Post Wall	10	6.94%		
	Lat Wall	6	4.16%		
Sphenoid Sinus	Planum	10	6.94%	27	18.75%
	Post Wall	6	4.16%		
	Lat Wall	8	5.55%		
	Clivus	3	2.08%		
Frontal Sinus	Ant Wall	4	2.77%	24	16.66%
	Post Wall	8	5.55%		
	Floor	12	8.33%		
Ethmoid Sinus	Lamina papyracea	35	24.30%	55	38.19%
	Roof of Ethmoid	20	13.88%		

DISCUSSIONS

In contrast to invasive fungal infection, allergic fungal rhinosinusitis (AFS) affects immuno-competent hosts and is a separate kind of chronic rhinosinusitis [9]. The majority of patients suffer from allergic rhinitis, however, fungus in aerosol form is to blame. Its distinguishing characteristics include the growth of nasal polyps, the buildup of eosinophilic mucus in the afflicted sinus, and nearly pathognomonic CT findings. Both sexes are equally afflicted by this condition, which affects young individuals with an average infected age of 21.9 ±10.6 years [10,11].

Nasal polyposis, Gell and Coombs type I (IgE-mediated) hypersensitivity to fungi, distinct radiographic abnormalities, eosinophilic mucin without fungal infiltration into sinus tissue, and positive fungal stain of sinus components eliminated after surgery were identified as five common features as a generally accepted diagnostic standard for AFS [12]. Later, this criterion for the diagnosis of AFRS was amended by separating it into minor and major criteria [11]. Bone erosion in AFRS is a well-known condition that frequently affects the orbit and the base of the skull. It occurs anywhere from 20 to 90% of the time depending on the location [13]. Bone remolding and pressure necrosis are the causes of bone degradation. A high-resolution CT scan without contrast is necessary for every instance with AFRS because it is the best test for finding bone erosions in the paranasal sinuses. It is possible to gauge the severity of the condition and help with the fungal diagnosis by seeing the usual occurrence of a double-density shadow in the afflicted sinuses [14].

This condition may be treated medically or surgically. Preoperatively and postoperatively, corticosteroids are administered to decrease the inflammatory/allergic response, which in turn aids in controlling preoperative bleeding and incidence [15,16]. Primary and revision surgeries aim to eliminate mechanical obstructions, remove sinus contents, and build suitable outflow routes while preserving mucociliary function [17]. Before surgery, it is crucial to identify regions of bone erosion by the detection of defects in the orbit and base of the skull to avoid major consequences [18]. Therefore, our study aimed to have a detailed interpretation of CT scans together with an evaluation of bone erosion incidence and its most common location [19]. 85 (36.9%) of the 230 AFRS cases we examined had bone erosion, according to a CT scan. Its frequency ranges from 20% to 90%, and our study found that it was around 40% in our nation. Despite claims that AFRS is a disease of hot, muggy weather, only 20% of AFRS patients have bone erosion, according to one study. In line with other studies, the average affected age in our study was 23.9 ±12.7 years [19,20]. Furthermore, our study revealed that of the 85

patients who were afflicted, 52 (61.1%) were men and 33 (38.9%) were women, making up the bulk of the patient population. According to multiple studies that have shown a 56% frequency of bone erosion in AFRS, African American men are reportedly 15 times more likely to be affected than Caucasians and African American women combined [22].

In our research, the maxillary sinus (26.38%), sphenoid sinus (18.75%), and frontal sinus (16.6%) were the four sinuses that were most commonly impacted. The ethmoid sinus (38.19%) was the least frequently afflicted sinus. According to other research, the Ethmoid sinus, the Maxillary Sinus, the Sphenoid, and the Frontal Sinus all experience bone degradation at a rate of 77%, 68%, 58%, and 53%, respectively [23].

We also discovered that the lamina papyracea, which is similar to findings from several other studies, was the most common site of erosion in the ethmoid sinus (24.3%) [24]. Research that attempted to stage diseases objectively by using a scoring system based on CT scans neglected the clinical history, the chance of recurrence, and the degree of systemic allergy [25]. They proposed a 24-point scale and gave each sinus a specific value. Based on bone growth and degradation, scores are assigned. Additionally, they connected the number of erosions and expansions with disease severity. The development of possible surgical complications and the course of the illness without treatment are both significantly impacted by radiological staging [26-28].

The radiological evaluation of illness, regardless of the method and scoring system employed, is crucial because it allows the otolaryngologist and the radiologist to stratify the severity of the disease in instances of AFRS and aids in clinical evaluation and the avoidance of problems.

CONCLUSIONS

Bone erosion is a common complication of allergic fungal rhinosinusitis, and a CT scan is a crucial, efficient, and accurate way to assess it before having any surgical intervention. The ethmoid sinus, which is located in the lamina papyracea, has the greatest prevalence of bone erosion among the paranasal sinuses, followed by the maxillary, sphenoid, and frontal sinuses. Functional endoscopic sinus surgery can assist minimize potentially fatal consequences by keeping in mind bone erosions and dehiscent bony walls.

REFERENCES

1. Elmokadem, A. H., Bayoumi, D., Mansour, M., Ghonim, M., Saad, E. A., & Khedr, D. (2022). COVID-19-associated acute invasive fungal sinusitis: Clinical and imaging findings. Journal of Neuroimaging, 32(4), 676-689.
2. Khalid, S., Dhanani, R., Mughal, A., Khan, H., & Wasif, M. (2022). Diagnostic accuracy of CT scans in allergic fungal sinusitis: A cross sectional study. J Clin Images Med Case Rep, 3(11), 2145.
3. Raiesi, O., Hashemi, S. J., Yarahmadi, M., Getso, M. I., Raissi, V., Amiri, S., & Boroujeni, Z. B. (2022). Allergic fungal rhinosinusitis caused by Neoscytalidium dimidiatum: A case report: Allergic fungal rhinosinusitis due to Neoscytalidium dimidiatum. Journal of Medical Mycology, 32(1), 101212.
4. Tadros, D., Tomoum, M. O., & Shafik, H. M. (2022). Orbital complications of chronic rhinosinusitis: two years' experience in a tertiary referral hospital. Ocular Immunology and Inflammation, 1-6.
5. Wang, Y. (2022). Clinical, radiological, and histopathological patterns of allergic fungal sinusitis: a single center retrospective study. Authorea Preprints.
6. Luong, A. U., Chua, A., Alim, B. M., Olsson, P., & Javer, A. (2022). Allergic Fungal Rhinosinusitis: The Role and Expectations of Biologics. The Journal of Allergy and Clinical Immunology: In Practice, 10(12), 3156-3162.
7. Bracanovic, D., Janovic, A., Antic, S., Rajkovic, K., Bracanovic, M., Tomic Spiric, V., ... & Barac, A. (2022). CT and CT image-based texture image analysis in radiological diagnostics of allergic fungal rhinosinusitis. Mycoses, 65(5), 551-559.
8. Almomen, A., Albaharna, H., AlGhuneem, A. A., & AlZahir, B. Z. (2022). The Endonasal Endoscopic Approach to Different Sinonasal Fungal Balls. International Journal of Otolaryngology, 2022.
9. Almomen, A., Al-Enzi, O., Alshammari, R., Molani, F., Alshakhs, A. A., Al Ameer, M. A., ... & Marhoon, J. A. (2022). Bilateral proptosis—an unusual presentation of extensive allergic fungal sinusitis. Journal of Surgical Case Reports, 2022(10), rjaa564.
10. Sable, A., Tivaskar, S., Barai, J., & Luharia, A. (2022). Role of Computed Tomography in Paranasal Sinuses–A Review Article. Journal of Pharmaceutical Negative Results, 13(3), 893-900.
11. Spatola, A., Aspromonte, M., Marino, M. A., Miano, S. M., Zagaria, A., Galletti, B., ... & Sofia, C. (2022). Fungal ball in concha bullosa as incidentaloma: A case report and the review of the literature. Radiology Case Reports, 17(3), 997-1001.
12. John, D. S., Shyam, K., Andrew, D., Cicilet, S., & Deepalam, S. R. (2022). Utilizing CT soft-tissue markers as a screening tool for acute invasive fungal sinusitis. The British Journal of Radiology, 95(1132), 20210749.
13. Plantier, D. B., Pilan, R. R., Athanazio, R., Olm, M. A. K., Gebrim, E. M., & Voegels, R. L. (2022). Computed Tomography Evaluation of the Paranasal Sinuses in Adults with Primary Ciliary Dyskinesia. International Archives of Otorhinolaryngology.
14. Uwiera, R. R., Vijayasekaran, S., Wallace, A. M., Reese, D. J., Walsh, A. L., Uwiera, T. C., ... & Vitali, S. D. (2022). Fungal Rhinosinusitis Caused by a Curvularia sp. Infection in a Female Sumatran Orangutan: A Case Report. Pathogens, 11(10), 1166.
15. Husain, U., Tilak, R., Aggarwal, S. K., Priyadarshi, K., & Dhameja, N. (2022). Time to speed up the diagnostic evaluation in clinically suspected rhinosinusitis patients: A debate on the conventional versus molecular workup to establish fungal infective etiology for prompt management. Current Medical Mycology.
16. Byale, M., & Pattanshetti, R. Spectrum of Imaging Findings of Rhino-Orbital-Cerebral Mucormycosis during COVID-19 Pandemic: A Case Series Study. Ann Clin Case Rep. 2022; 7, 2211.
17. Ho, N. H., Hung, L. T., Kuan, E. C., Ho, C. Y., Hsu, C. C., & Lan, M. Y. (2022). Combining sinus plain film and sinus ultrasound as a screening tool for maxillary fungal sinusitis. Journal of the Chinese Medical Association, 85(3), 375-380.
18. Zhang, Z., Yu, L., Jiang, J., Wang, L., Zhou, S., Hao, D., & Jiang, Y. (2022). Development and Validation of a Clinical Prediction Model to Diagnose Sinonasal Inverted Papilloma Based on Computed Tomography Features and Clinical Characteristics. Ear, Nose & Throat Journal, 01455613221134421.
19. Rupa, V., Peter, J., Michael, J. S., Thomas, M., Irodi, A., & Rajshekhar, V. (2022). Chronic Granulomatous Invasive Fungal Sinusitis in Patients With Immunocompetence: A Review. Otolaryngology–Head and Neck Surgery, 01945998221097006.
20. Hallak, B., Bouayed, S., Ghika, J. A., Teiga, P. S., & Alvarez, V. (2022). Management Strategy of Intracranial Complications of Sinusitis: Our Experience and Review of the Literature. Allergy & Rhinology, 13, 21526575221125031.
21. Shipman, P., Highland, J., Witt, B., & Alt, J. (2022). Non-invasive fungal sinusitis as a complication of a steroid-eluting stent following endoscopic sinus surgery: a case report. Annals of Otology, Rhinology & Laryngology, 131(6), 678-682.
22. Mughal, Z., Daffu, K., Adeoti, R., Swaminathan, R., & Henney, S. (2022). Retrospective analysis of the risk of neoplasia associated with unilateral maxillary sinus opacification on computed tomography. The Journal of Laryngology & Otology, 136(12), 1259-1264.
23. Jiang, C., Zhen, X., Zhang, X., Guo, L., Han, J., Cui, Z., & Zhou, X. (2022). The nonlinear association between albumin levels and risk of noninvasive fungal rhinosinusitis. European Archives of Oto-Rhino-Laryngology, 279(10), 4977-4983.
24. Ritter, A., Barzilai-Birenboim, S., Rapana, O. G., Fischer, S., Levy, I., Soudry, E., & Gilony, D. (2022). Changing trends in the survival of immunosuppressed children with invasive fungal rhinosinusitis. American Journal of Rhinology & Allergy, 36(5), 568-573.
25. Ebied, K., Yacoub, A., Gamea, M., & Mahmoud, M. S. (2022). COVID-19-related acute invasive fungal rhinosinusitis: risk factors associated with mortality. The Egyptian Journal of Otolaryngology, 38(1), 1-9.
26. Douglas, J. E., Patel, T., Rullan-Oliver, B., Ungerer, H., Hinh, L., Peterson, E. L., ... & Craig, J. R. (2022). Odontogenic sinusitis is a common cause of operative extra-sinus infectious complications. American Journal of Rhinology & Allergy, 36(6), 808-815.
27. Farid G, Warraich NF, Iftikhar S. Digital information security management policy in academic libraries: A systematic review (2010–2022). Journal of Information Science. 2023:01655515231160026.
28. Khalid A, Malik GF, Mahmood K. Sustainable development challenges in libraries: A systematic literature review (2000–2020). The Journal of academic librarianship. 2021 May 1;47(3):10234