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Growth Characteristics and Clinical Manifestations of the Paranasal Sinus Osteomas

Fuat Buyuklu, MD¹, Mehmet Volkan Akdogan, MD¹, Cem Ozer, MD², and Ozcan Cakmak, MD³

Abstract

Objective. To investigate the clinical features of paranasal sinus osteomas and to estimate the growth rate of these tumors in a large series of patients.

Design. Case series with chart review.

Setting. University hospital, tertiary referral center.

Subjects and Methods. The authors retrospectively reviewed the paranasal sinus tomography scans that were taken between January 1997 and April 2008 to find patients with paranasal sinus osteomas. A questionnaire was performed to evaluate the possible clinical symptoms associated with sinus osteomas, and control paranasal sinus computed tomography was taken for patients in whom paranasal computed tomography examination had been done at least 1 year ago.

Results. A total of 17,154 paranasal sinus computed tomographies of 14,137 patients were reviewed, and 243 cases of paranasal sinus osteomas were found. The lesions were located in the frontal sinus in 183, ethmoid sinus in 48, maxillary sinus in 5, and sphenoid sinus in 7 patients. Eighty-nine patients with paranasal sinus osteomas were readmitted. The mean follow-up was 54 months in this group. In 46 of 89 patients, an increase in the size of osteomas was detected. The mean growth rate of osteomas was estimated to be 0.79 mm/y in the cephalocaudal direction and 0.99 mm/y in the mediolateral direction. No significant differences were found in the growth rate according to location and growth directions.

Conclusion. Neither a specific growth pattern nor a specific factor affecting the growth rate of these tumors could be demonstrated. Follow-up is necessary because of the potential severe complications.

Keywords
paranasal sinus, benign tumor, osteoma, growth

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intervention is required for asymptomatic cases unless they extend beyond the sinus boundaries, continue to enlarge on repeated radiological examinations, or are located near the frontal nasal duct.6,7

Information on the clinical features (ie, etiology, symptomatology, and growth characteristics) of paranasal sinus osteomas (PSOs) is limited. The purpose of this study was to present the clinical features of PSOs and to evaluate the growth characteristics of these neoplasms.

Materials and Methods

The study was designed as a case series with chart review in the Department of Otorhinolaryngology at Baskent University Hospital, Ankara, Turkey. All paranasal sinus CTs that were taken at the Ankara Research and Training Hospital and Adana Application and Research Center of Baskent University, between January 1997 and April 2008, were reviewed to identify patients with PSOs. Site of osteomas was noted during radiological examination. Data, including age and sex of the patients, were also obtained from the patient charts. Patients who had PSOs were invited to the hospital for reevaluation. The study protocol was approved by the Research Ethical Committee of Baskent University, and written informed consent was obtained from all patients.

Patients admitted to the hospital were asked to complete a questionnaire consisting of 3 sections. The first section addressed the personal data (eg, age, sex, job) of the patients, and the second part addressed the possible symptoms associated with osteomas (eg, recurrent facial pain or headache [including type, frequency, location, and severity as rated on a 5-point scale from not present to severe], nasal obstruction, and postnasal drip). The third section of the questionnaire allowed us to estimate the etiology of the osteoma, including history of severe or recurrent sinusitis, head trauma, and any other systemic diseases. A complete head and neck examination was done, and a control paranasal sinus CT was taken in patients in whom paranasal CT examination had been done at least 1 year ago to evaluate the size and the growth rate of osteomas. CT examinations were performed with a multislice scanner (Somatom Sensation 16, Erlangen, Germany) with a tube voltage of 120 kV and a current of 200 mA. The window width was 4000 Hounsfield units, and the window level was centered at 600 Hounsfield units. In addition, 3-mm-thick contiguous high-resolution coronal CT sections were obtained. Computed tomography scans of all patients were evaluated by the same authors (F.B. and M.V.A.), and lesions that appeared as osteomas (ie, well-defined, round or oval-shaped, homogeneous radiopaque mass with smooth margins) during the first CT scans were evaluated. Mediolateral (ML) and cephalocaudal (CC) diameters of osteomas were measured at a matching section of tumor that was presenting its largest diameter in both the first and the control CT scans (Figure 1). The diameters obtained from control paranasal CT scans were compared with those obtained from previous CT scans.

For statistical analyses, SPSS for Windows v. 15 (SPSS, Inc, an IBM Company, Chicago, Illinois) was used. Fisher exact and Pearson χ² tests were used in comparison of the qualitative data. The 1-way analysis of variance (ANOVA) was used to analyze differences among the growth rates at different anatomic sites. The results were assessed within 95% reliance, and a value of *P* < .05 was accepted as statistically significant.

Results

In total, 17,154 paranasal sinus CT scans of 14,137 patients were reviewed, and 243 (1.7%) cases of PSO were found. There were 126 (51.8%) men and 117 (48.2%) women with a mean age of 48.6 years (range, 18-78 years). The male/female ratio was 1.07:1. We did not find a significant sex predilection (*P* > .05, Fisher exact test). Among 243 patients, reasons for paranasal sinus CT scans were suspicion of sinusitis in 134 (55.0%), nonspecific headache in 36 (15.0%), conchal pathologies such as concha bullosa in 29 (11.5%), and other (septal deviations, maxillofacial trauma, nasal polyps or polyposis, etc) in 44 (18.5%) patients.

Osteomas were located in the frontal sinus in 183 (75.3%), ethmoid sinus in 50 (20.5%), sphenoid sinus in 7 (2.9%), and maxillary sinus in 5 (2.1%) of the patients. In 2 (0.8%) patients, multiple PSOs (1 frontal and 1 ethmoid) were detected (Table 1).
Table 1. Location of the Paranasal Sinus Osteomas

<table>
<thead>
<tr>
<th>Location</th>
<th>Present Study</th>
<th>Koivunen et al¹¹</th>
<th>Larrea-Oyarbide et al¹</th>
<th>Erdogan et al⁹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal sinus, no. (%)</td>
<td>183 (75.3)</td>
<td>33 (75.0)</td>
<td>16 (59.3)</td>
<td>24 (37.5)</td>
</tr>
<tr>
<td>Ethmoid sinus, no. (%)</td>
<td>50 (20.5)</td>
<td>7 (16.0)</td>
<td>3 (11.1)</td>
<td>35 (54.6)</td>
</tr>
<tr>
<td>Maxillary sinus, no. (%)</td>
<td>5 (2.1)</td>
<td>3 (7.0)</td>
<td>6 (22.2)</td>
<td>4 (6.2)</td>
</tr>
<tr>
<td>Sphenoid sinus, no. (%)</td>
<td>7 (2.9)</td>
<td>1 (2.0)</td>
<td>2 (7.4)</td>
<td>1 (1.5)</td>
</tr>
<tr>
<td>Total</td>
<td>243</td>
<td>44</td>
<td>27</td>
<td>64</td>
</tr>
</tbody>
</table>

*Two (0.8%) patients had multiple osteomas, 1 frontal and 1 ethmoid.

Among 243 patients with the diagnosis of PSO, 89 patients were readmitted to our clinic. Of these patients, 42 (47.2%) were men and 47 (52.8%) were women with a mean age of 50.5 years (range, 18-77 years). The site of the osteoma was frontal sinus in 71 (79.8%), ethmoid sinus in 16 (18%), and sphenoid sinus in 2 (2.2%) of the cases.

Questionnaire analysis of these patients revealed a recurrent facial pain or headache in 27 (30.3%) cases. In addition, patients noted that their headaches were not relieved specifically with acetylsalicylic acid. Headache was found in 23.9% of the frontal, 56.3% of the ethmoid, and 50% of the sphenoid sinus osteoma patients. Headache was reported significantly more frequently in patients with frontal sinus osteoma (P < .05, Pearson χ² test), but there was no significant relationship between the presence of osteomas and headache (P > .05, Pearson χ² test).

In 18 (20.2%) patients, a history of recurrent sinusitis was present. Recurrent sinusitis history was found in 21.1% of the frontal, 12.5% of the ethmoid, and 50% of the sphenoid sinus osteoma patients. There was no significant relationship between the site of osteoma and recurrent sinusitis (P > .05, Pearson χ² test). A nonspecific postnasal drip was present in 25 (35.2%) of 71 patients. Recurrent sinusitis was present in 5 (75%) of 71 patients. There was no significant relationship between the site of osteoma and recurrent sinusitis (P > .05, Pearson χ² test).

Table 2. Questionnaire Analysis of 89 Patients Who Were Readmitted to the Hospital

<table>
<thead>
<tr>
<th>Location</th>
<th>Headache, No. (%)</th>
<th>Recurrent Sinusitis, No. (%)</th>
<th>Nasal Obstruction, No. (%)</th>
<th>Postnasal Drip, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal sinus</td>
<td>17/71 (23.9)</td>
<td>15/71 (21.1)</td>
<td>5/71 (7.0)</td>
<td>25/71 (35.2)</td>
</tr>
<tr>
<td>Ethmoid sinus</td>
<td>9/16 (56.3)</td>
<td>2/16 (12.5)</td>
<td>4/16 (25.0)</td>
<td>7/16 (43.8)</td>
</tr>
<tr>
<td>Sphenoid sinus</td>
<td>1/1 (50.0)</td>
<td>1/1 (50.0)</td>
<td>2 (100.0)</td>
<td>1/1 (50.0)</td>
</tr>
<tr>
<td>Total</td>
<td>27/89 (30.3)</td>
<td>18/89 (20.2)</td>
<td>11/89 (12.4)</td>
<td>33/89 (37.1)</td>
</tr>
</tbody>
</table>

Discussion

Osteomas are the most common benign tumors of the paranasal sinuses. In previous studies, their incidence has been reported to vary between 1% and 3%. Age distribution of the patients at the time of diagnosis covers a broad spectrum. Paranasal sinus osteomas can be seen at any age, but most patients are diagnosed in the fifth and sixth decades. However, because the diagnosis of PSO is established incidentally in most cases, it is not possible to know the exact time of initiation of the disease. A male predominance has also been noted in many studies. In our study, we have examined the largest series of CT scans to date by involving 14,137 patients and found the incidence of PSOs to be 1.72%. These data coincide with those reported by previous studies.

The age range of the patients was similar to those reported in previous studies, but we did not find a significant sex predilection (P > .05, 1-way ANOVA test). Koivunen et al,¹¹ Larrea-Oyarbide et al,¹ and Erdogan⁹ found the frontal sinus to be the most affected site of involvement in their series (75%, 59%, and 38% of the cases, respectively; Table 1). In line with these reports, frontal sinus was the most involved site (75.3% of the cases) in our study, followed by the ethmoid, sphenoid, and maxillary sinuses. However, in the study by Erdogan et al,⁹ osteomas were located most frequently (55%) in the ethmoid sinuses, among 1889 scans that had been reviewed. The reason the frontal sinus is affected in most cases is unknown, but it may be attributed to a greater risk of exposure to external trauma compared to other paranasal sinuses. Trauma may trigger a reactive mechanism, resulting in osteoma formation in the
Table 3. Growth Rates of the Paranasal Sinus Osteomas (n = 89)

<table>
<thead>
<tr>
<th></th>
<th>Mediolateral (ML) Variation, mm, Mean ± SD</th>
<th>Cephalocaudal (CC) Variation, mm, Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ML First</td>
<td>ML Control</td>
</tr>
<tr>
<td>Frontal sinus (n = 71)</td>
<td>6.32 ± 4.06</td>
<td>7.08 ± 4.70</td>
</tr>
<tr>
<td>Ethmoid sinus (n = 16)</td>
<td>5.60 ± 2.44</td>
<td>6.35 ± 2.82</td>
</tr>
<tr>
<td>Sphenoid sinus (n = 2)</td>
<td>3.20 ± 1.76</td>
<td>3.90 ± 0.84</td>
</tr>
</tbody>
</table>

Oxparanasal sinuses. On the other hand, in this study, the difference between sinuses with regard to head trauma history was statistically insignificant.

The clinical symptoms and potential complications associated with PSOs depend on the size, location, growth rate, and growth direction of the tumors. A recurrent headache or facial pain was observed in 27 (30.3%) of 89 patients during questionnaire analysis. Although it was not clear whether headache in these patients was associated with sinus osteomas, headache was reported significantly less in patients with frontal sinus osteoma (P < .05). This finding may be explained by the larger size of the frontal sinus compared to the ethmoid sinuses, which, in turn, prevents the tumor from compressing neighboring mucosa and causing headache. Moreover, episodic or chronic tension-type headache is reported in 20% to 30% of the population in the literature.12

Questionnaire analysis of 89 patients also revealed a non-specific postnasal drip in 33 (37.1%) and a nasal obstruction that was mostly related to septum deviation or hypertrophy of the inferior turbinates in 11 (12.3%) patients. In none of the patients were these symptoms thought to be associated with sinus osteomas.

Paranasal sinus osteomas have a potential to grow, as was demonstrated by Koivunen et al.,11 who analyzed the growth rate of sinus osteomas with the help of radiographs in 23 patients. They found some growth in 13 (56.5%) of 23 patients. The mean growth rate of those 23 osteomas was estimated to be 0.91 mm/y, varying from 0 to 6 mm/y. Similarly, we observed an increase in the size of osteomas in 46 (51.6%) of 89 patients. The mean growth rate of osteomas was calculated to be 0.79 mm/y, varying from 0.53 to 1.30 mm/y, in the CC direction and 0.99 mm/y, varying from 0.50 to 1.62 mm/y, in the ML direction. We did not find a significant difference in the growth rate of osteomas according to location and growth directions (P > .05, 1-way ANOVA test). Together with the study of Koivunen et al.,11 we have demonstrated that the growth rate of PSOs changes from case to case.

The growth rate can be as much as 6 mm/y, as reported by Koivunen et al.11 On the other hand, there was no increase in the size of osteomas in almost half of the patients, even after a long follow-up period. It is difficult to explain why some osteomas have an obvious tendency to grow but others do not differ in size. No specific factors affecting the growth rate of osteomas could be demonstrated. In our study, we investigated the possible role of trauma and infection for the growth of osteomas. In 18 (20.2%) of 89 patients, a history of recurrent sinusitis was observed. This rate was obtained based on patients’ declarations, and we did not use any specific diagnostic criteria such as physical or radiological examination or symptom scoring systems. Under this circumstance, no significant relationship was found between the growth rate of osteomas and recurrent sinusitis history (P > .05). Also, in only 6 (6.7%) of 89 patients, a history of head and neck trauma was present.

There is a consensus for the surgical treatment of symptomatic PSOs.1,5-7 However, the management of asymptomatic cases is still controversial. Savic and Djeric6 suggested surgical removal for asymptomatic frontal sinus osteomas extending beyond the sinus boundaries, continuing to enlarge on repeated radiological examinations or located near the frontonasal duct. In 46 (51.6%) of 89 patients, an increase in the size of tumor was observed. However, surgical intervention was not recommended for any of these patients because none of the osteomas had the risk for the development of potential complications at the time of evaluation. Follow-up with periodic imaging, in every 1 to 2 years, to avoid potential life-threatening complications for these cases was recommended.

To the best of our knowledge, our study investigates, for the first time, the relation between osteoma and etiology, symptomatology, and growth characteristics. However, our results disclose the prevalence of osteoma in patients undergoing paranasal sinus CT scans for sinonasal symptoms, not the exact prevalence of osteomas in paranasal sinuses. To determine the real prevalence of PSOs, further studies need to be conducted in healthy individuals. Although the tumors have a potential to grow, most cases remain asymptomatic for a long time. Follow-up is necessary because of potential severe complications. For stable cases, 1 year may be considered a short time interval between consecutive CT controls. We suppose that 2 years may be considered an optimal time interval between consecutive CT controls. The decision for surgical removal depends on the size, localization, growth tendency and rate, and expansion of the tumor to the orbit or cranium. No specific growth pattern or specific factor affecting the growth rate of these tumors could be demonstrated.

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Author Contributions

Fuat Buyuklu, conception and design, collection and analysis of data, writer; Mehmet Volkan Akdogan, collection of data; Cem Ozer, collection of data; Ozcan Cakmak, conception and design, supervision.
Disclosures
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