Original Article

Evaluation of Pneumatization in Articular Tubercle and Roof of the Glenoid Fossa with Cone-Beam Computed Tomography

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ABSTRACT

Introduction: Pneumatization refers to the development of air-filled cavities in bone. Detection of pneumatizations nearby to the temporomandibular joint (TMJ) area is important, as they represent sites of minimal resistance and facilitate the spread of various pathologies into the joint as inflammation, tumor, or fractures and serve as a possible complicating factor in TMJ surgery. Since CT is not subjected to super-imposition, it exceeds the diagnostic accuracy of panoramic radiographs in the evaluation of temporal air spaces. The aim of the present study was to determine the prevalence and characteristics of pneumatization of the articular tubercle (PAT) and roof of the glenoid fossa (PRGF) using cone-beam computed tomography (CBCT).

Methodology: Acquired images of 106 patients (212 TMJs) were evaluated. The presence of pneumatization was recorded at the articular eminence and roof of the glenoid fossa. Age and gender were recorded for all patients and type (unilocular or multilocular) and laterality were noted for the cases of pneumatization.

Results: The age range of the study group was 18-80 years. Among all the patients, 56% had PAT, while 9% had PRGF. 26% of the patients had PAT bilaterally. The percentage of PAT was higher for females than males.

Conclusion: It is possible that PAT is a more frequent condition than is commonly perceived. CBCT images are an accurate and reliable means of detection of the exact size and type of pneumatization and the relationship of pneumatization to the adjacent tissues. This is especially significant before a surgical intervention is planned in this region, in order to make a sound diagnosis.

Keywords: Articular tubercle, cone-beam computed tomography, glenoid fossa, pneumatization, temporo-mandibular joint.

INTRODUCTION

Pneumatizations are air filled cavities that are commonly found in the skull. When they exist within the zygomatic process of the temporal bone, they are known as the pneumatized articular eminence (PAT) and the roof of the glenoid fossa (PRGF).[1,2]

Tremble reported the distribution of air cells in the temporal bone.[3] Ten locations where accessory air cells could be found within the temporal bone were identified, including one area in the zygomatic process of the temporal bone.[4] Tyndall et al[5] indicated that the pneumatized articular eminence (PAT) of the temporal bone has been identified as an asymptomatic radiolucent defect in the zygomatic process of the temporal bone with an appearance similar to mastoid air cells.

Panoramic radiographs were considered the initial method to check for these defects because panoramic radiography is more advantageous than CT for visualization of the articular eminence owing to the low cost and radiation dose. However, since CT is not subjected to super-imposition, it exceeds the diagnostic accuracy of panoramic radiographs in the evaluation of temporal air spaces. Moreover, a less superficially located region, such as the medial portion of the articular eminence, may only be visible on CT.[6]

There are very few studies where CBCT has been used to

evaluate pneumatization; hence the present study was done to evaluate the prevalence and characteristics of pneumatization of articular eminence and glenoid fossa.

METHODS

The present study included 106 patients who had existing CBCT scans in the department archives. Out of enrolled patients, 50 were male while 56 were female. The age of the patients ranged from 18 to 80 years. Patients with a fracture or pathology in the region of the articular eminence were not included in the study. A CBCT scanner Carestream (CS 3D imaging V.3.5.7; Carestream health New York, USA) was used with an amorphous silicon flat-panel image detector using FOV of 17x11cm. Tube voltage ranged from 68-90 kVp, tube current was 4 mA, with an exposure time of 11.30 seconds. 3D reconstructions were created by axial CBCT scans and the images were oriented before measurements. Written informed consent was taken from each patient.

Images were assessed in a dark quiet room with dual monitors. The contrast and brightness of the images were adjusted using the image-processing tool in the software to ensure optimal visualization.

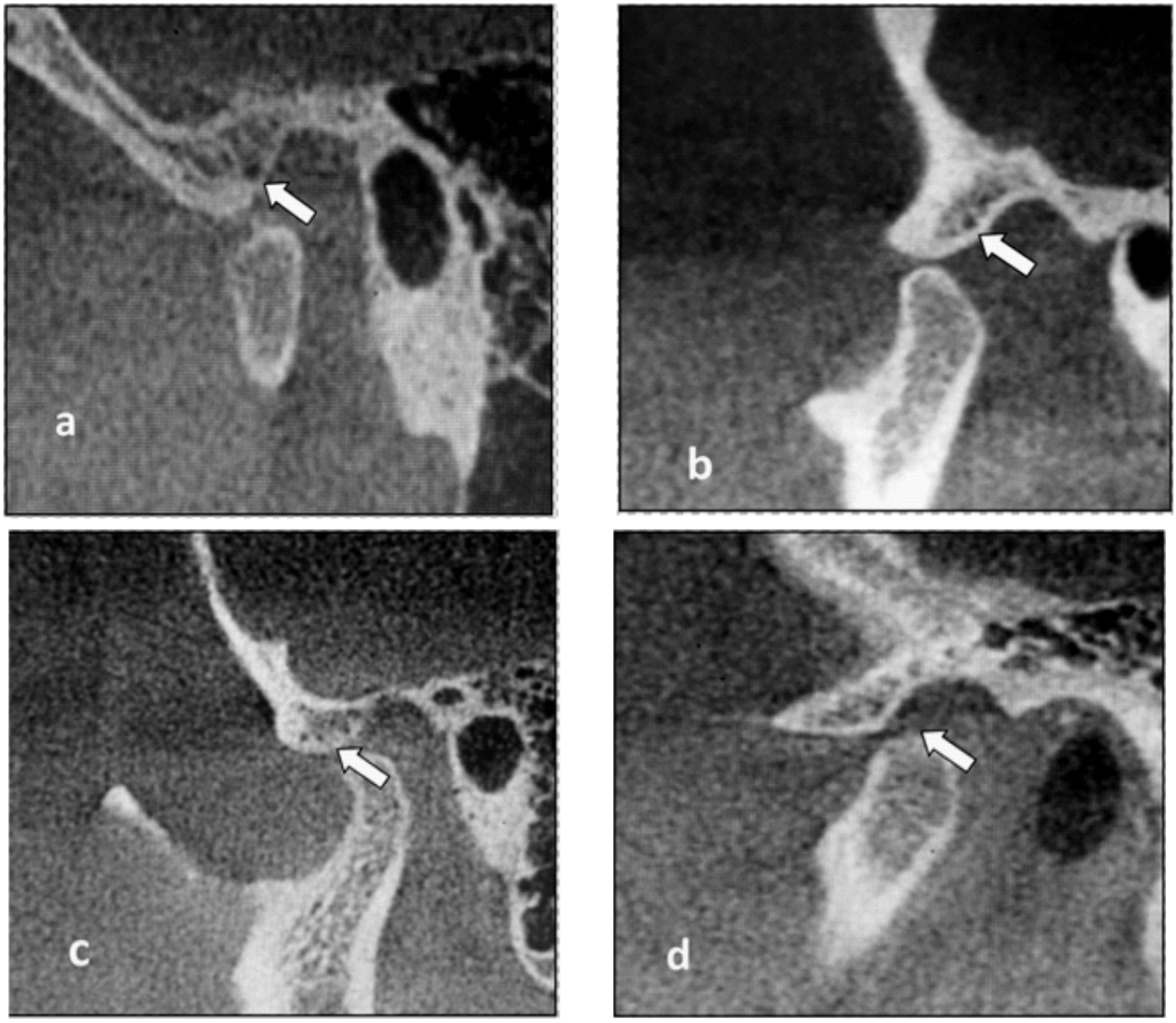

Figure 1: Sagittal cone beam computed tomography images of a unilocular pneumatized articular eminence (a, b), a multilocular pneumatized articular eminence (c), a pneumatized roof of the glenoid fossa (d).

The presence of pneumatization was recorded at the articular eminence and roof of the glenoid fossa. Identification of PAT on the images was achieved only if the characteristics described by Tyndall et al[5] were found: a radiolucent defect in the zygomatic process of the temporal bone with the appearance similar to mastoid air cells, extending anteriorly to the articular eminence but not beyond the zygomatico temporal suture, with no enlargement or cortical destruction of the zygoma. If the radiolucent defect was located on the roof of glenoid fossa above the condyle, it was defined as PRGF. The defects were also classified as unilocular or multilocular. Unilocular pneumatization was a single radiolucent oval defect with well-defined bony borders, whereas multilocular pneumatization described numerous radiolucent small cavities (Figure 1 (a-d)). All data were recorded on both sides. Consequently, 212 sites were analyzed. SPSS 20.0 was used for statistical analysis. The chi-square test was used to compare the differences between the variables.

RESULTS

The mean age of the study group was 40.11 ± 13.41 years. 50 patients (56%) presented PAT, while 10 (9%) had PRGF. 14 (13%) patients had PAT bilaterally, while 3 (2.8%) of them presented PRGF bilaterally. The sample was divided into age groups and there was no statistically significant difference between age groups and the presence of PAT and PRGF ($p>0.05$) (Figure 2, 3). Percentage of PAT was higher for females (53%) than males (47%) on CBCT scans. For PRGF, no statistically significant correlation was found with gender.

Table 1: Frequency distribution of the study participants

	N	%
Gender		
Male	50	47.2
Female	56	52.8
PAT		
Unilocular	38	35.8
Multilocular	21	19.8
Unilateral	44	41.5
Bilateral	14	13.2
PRGF		
Unilocular	9	8.5
Multilocular	1	0.9
Unilateral	7	6.6
Bilateral	3	2.8

DISCUSSION

The pneumatized articular eminence of the temporal bone is an air cell cavity that is similar to air cells in the mastoid process and ethmoid bone.[5] Diagnosis of pneumatization of the articular eminence and TMJ fossa is important as it facilitates the spread of tumors, inflammation, and fractures due to minimal resistance.[7] Wherever it becomes necessary to surgically manipulate the articular eminence, PAT should be considered a complicating factor.[5,8] The anatomical relationship of PAT to mastoid air cells is interesting. Perhaps PAT can be thought of as extensions of the mastoid air cells similar to extensions of the paranasal sinuses. Dentists are aware of alveolar and tuberosity extensions of the maxillary sinuses and the occasional extension of the sphenoid sinus superiorly into the dorsum sellae.[5]

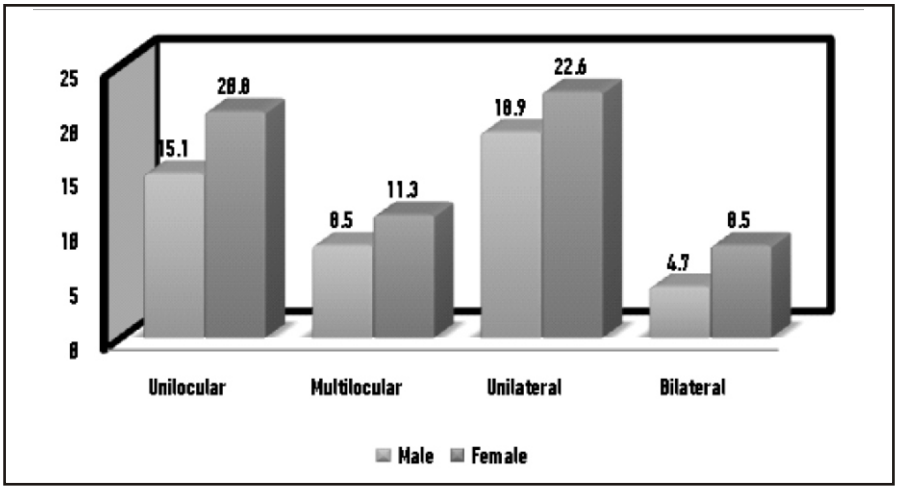

Figure 2: Descriptive data of pneumatized articular eminence (PAT) among the study participants.

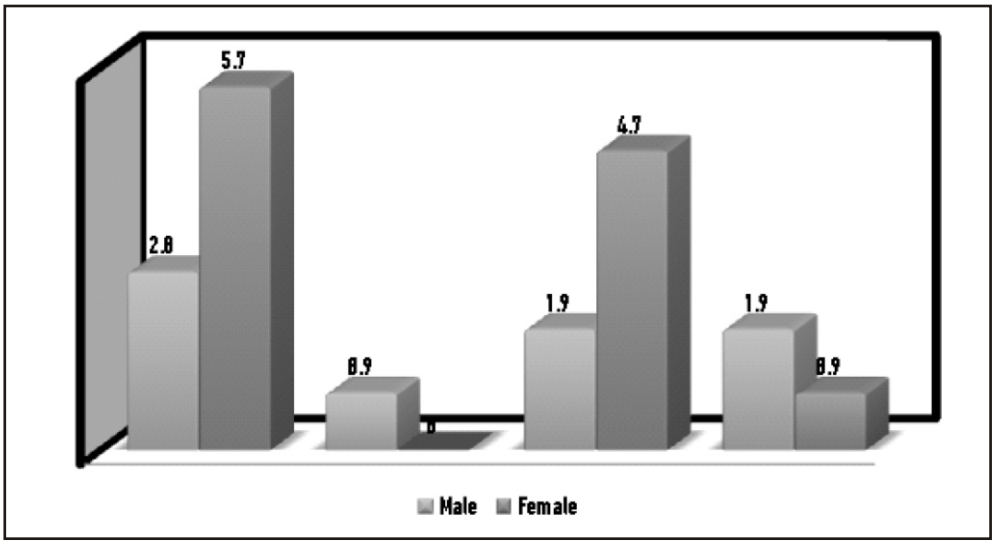

Figure 3: Descriptive data of pneumatization in roof of glenoid fossa (PRGF) among the study participants.

In the present study, the mean age of patients with PAT was 40.11±13.41 years, similar to that found in the literature ranging between 43.0 and 48.86 years. In the present study the age range was wide (18-80 years), in accordance with other studies.

Tyndall et al[5] studied panoramic radiographs of 1,061 patients and reported that 28 patients or 2.6% of the study population had pneumatized articular eminences. They attempted to classify the radiographic types of pneumatized articular eminences into three types: unilocular, multilocular, and trabecular variant of multilocular type. Kaugers et al[9] reviewed 784 panoramic films and reported only eight patients or 1.0% of the study population to have pneumatization of the articular eminence. The incidence of PAT was previously assessed on panoramic radiographs, and the prevalence was reported to be between 1% and 3.42%.

Conventional panoramic radiographs however have inherent problems, including a wide focal zone and superimposition of adjacent structures. High-resolution CT is considered the method of choice for the assessment of bony structures and air spaces in the base of the skull. Since CBCT is not subject to superimposition, it exceeds the diagnostic accuracy of panoramic radiographs in the evaluation of temporal air spaces.[6]

In the literature, a few studies have assessed the prevalence of PAT on CBCT images. The first study performed by Miloglu et al[6] reported a rate of 8%. The second study by Ladeira et al[2] also stated a higher rate (21.3%). Another study also stated a higher rate (66%).[10]

In the present study, the prevalence of PAT on CBCT scans was found to be 56%. Previous studies have shown that the unilateral to bilateral ratio was 2.5:1 in cases of PAT. In the present study unilateral cases were higher than bilateral ones where as a study done by Ilguy[10] showed bilateral cases more than unilateral.

In previous studies most researchers found an almost equal distribution of unilocular and multilocular types, except Ladeira et al[2] and Ilguy et al[10], who reported a higher incidence of the multilocular type 98.7% and 86.1%, respectively. The present study determined a higher prevalence of the unilocular type for PAT.

In this study, no correlation was found between gender and the percentage of PAT and PGRF on CBCT scans. These data are consistent with the results of the previous studies, which found no difference between females and males. In terms of PRGF, previous studies performed by Ilguy et al[10], studies have reported the prevalence to be 11%, 38.3%, and 51%, respectively.[1,2] In the present study, the prevalence was found to be 9%.

PAT must be differentiated from other radiolucencies within the zygomatic arch, including aneurysmal bone cyst, haemangioma, giant cell tumour, eosinophilic granuloma, fibrous dysplasia, and metastatic tumor deposits.[5,11,12] PAT can be detected incidentally on radiographs as an asymptomatic radiolucency with non-

expansile charac-teristics. All of the other entities in the differential diagnosis have been reported to be characterized by painful enlargement of the cheek and seen radiographically as expansile, destructive lesions. CT images can be considered where there is a differential diagnosis of suspected cases.[6]

CONCLUSION

It becomes important to distinguish PAT and PRGF from pathological conditions as it is an incidental finding and does not present any clinical symptom. CBCT act as a reliable tool to detect the exact size and type of pneumatization and their relationship to adjacent tissues and becomes more significant before a surgical procedure is carried out in this region.

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