A Tomographic Study Of Air Cell Pneumatization Of The Temporal Components Of The TMJ In Patients With Temporomandibular Joint Disorders.

Wafaa Al-Faleh*, Mohamed Ekram I.H.**

Pneumatization by definition is the presence or development of air filled cavities in a bone. In addition to the pneumatization of the mastoid process. However, accessory air cell may affect the whole temporal component. Conventional tomograms for 300 patients who had been referred to the radiology specialty clinic, college of dentistry, King Saud University were were examined on both sides. in this study. Pneumatization was noted in both males and females both unilaterally and bilaterally with variable distributions of air cells. Pneumatization may render the temporal component of the TMJ more fragile. Furthermore, in some cases, the roof of the glenoid fossa is extensively weakened by pneumatization. Therefore, a severe traumatic injury may cause impingement of the head of the condyle on the middle cranial fossa. Conventional tomography is recommended in patients with air cell defect in the temporal bone components of the TMJ before any surgical procedures involving the eminence to determine the extent of the pneumatization.

Introduction

Pneumatization by definition is the presence or development of air filled cavities in the bone. Pneumatization takes place in the mastoid process of the temporal bone after puberty and subsequently achieves full size in several years (1). In addition to the pneumatization of the mastoid process, accessory air cell may develop in the numerous locations in the temporal bone, including the root of the zygomatic arch and the articular eminence (2,3). Pneumatization of the articular eminence has been well documented in the literature; however, its incidence not uncommon (4).

Tyndall and Matteson coined the phrase ‘Zygomatic air cell defect (ZACD) to describe accessory air cells that occur in the root of the Zygomatic arch and articular eminence of the temporal bone (5).

Patients with temporomandibular joint (TMJ) disorders may need surgical treatment particularly for those who need reduction of the articular eminence as a treatment for chronic recurrent dislocation of the TMJ (6). In patients with degenerative disease, the joint is subjected to abnormal forces, this may lead to various types of destruction of the articular surface. Therefore, the radiographic demonstration of this anatomic cavity is important in patients with TMJ disorders.

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The aim of this study is to assess the degree of air cell Pneumatization through the temporal component of the temporomandibular joint in patients with TMJ disorders.

**Material and methods**

Conventional tomograms for 300 patients who had been referred to the radiology clinic, college of dentistry, King Saud University were used in this study. The patients have been referred to the radiology clinic complaining of a diversity of symptoms denoting various temporomandibular disorders.

These records belonged to 176 female and 124 male patients. Their ages ranged between 10 to 70 years, with an average 29.2-year. The tomograms of the 300 patients were meticulously examined for the presence of air cell defect within the temporal components of the temporomandibular joint.

The examination done under standard conditions of radiographic interpretation as a dim room lightening, blocking of the film periphery by black papers, using a viewer with even distribution of light and variable light intensity and using a magnifying glass.

The TMJ tomograms for all patients were carried out using a hypocycloidal multisection tomography by means of a Multidirectional tomographic machine* . The x-ray tube specifications were a tube voltage of, 50-90 kvp, tube amperage 5 to 10 mA, with a focal spot size 0.5 mm, beam limiter 2” x 2” and with a constant magnification ratio of 26% in all directions.

The screen –film combination included T-mat G films size 5” x 12” **, and using lanex intensifying screens***. All films were processed using an automatic processor****. and following the manufacturer's instructions.

The sagittal and coronal tomographic sections were examined and evaluated for the presence of air cell within the temporal component of the TMJ. The extent of the pneumatic spaces of the temporal bone was determined individually for the right and left TMJ in each patient.

** Eastman Kodak CO, Rochester, USA  
*** Kodak Ektavision Eastman Kodak CO, Rochester, USA  
**** Kodak RP X-OMAT Processor Model M7B
A grading system was especially advocated to classify pneumatization as follows (Table 1). Figure 1 show the radiographic appearance of different grades of air cell defect through the temporal bone.

Table (1): The grading system for air cell pneumatization

<table>
<thead>
<tr>
<th>Grade</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The air cell are limited to the mastoid process.</td>
</tr>
<tr>
<td>1</td>
<td>The air cells extended between the mastoid process and the deepest point of the glenoid fossa.</td>
</tr>
<tr>
<td>2</td>
<td>The air cells extended from the deepest point of the glenoid fossa to the crest of the articular eminence.</td>
</tr>
<tr>
<td>3</td>
<td>The air cells extended beyond the crest of the articular eminence.</td>
</tr>
</tbody>
</table>

Method of statistical analysis
The statistical Package for the Social Sciences (SPSS) was used for the statistical analysis. Comparison between different sexes for the extent of TMJ’s involvement by air cell peumatization was calculated using Pearson’s Chi-Square test (P < 0.05).

Results
In this study, 300 tomograms were evaluated retrospectively. The temporomandibular joint was checked bilaterally for each case. Therefore, the total number of the joints examined was 600 joints.

Out of the 300 patients investigated, there were 102 patients who demonstrated air cell defect within the temporal components of the TMJ either on one or both sides. The other 198 patients demonstrated only air cell only within the mastoid process (Grade 0) The patients with air cell defects were 54 females (52.9 %) with a mean age of 26.8 years (15-48 years) and 48 males (47.1%) with a mean age of 26.7 years (14-49 years).

Symmetrical distribution of pneumatization was observed in 40 females and 33 male patients. However, involvement of one joint was only observed in 14 female and 15 male patients. There was no statistical significant difference in both gender distribution and joint involvement between males and females included in this study (P >0.05). The incidence of air cell defect in both males and females is shown in Table (2)
Table 2: The incidence of air cell defect unilaterally and bilaterally for both sex.

<table>
<thead>
<tr>
<th>Gender</th>
<th>No</th>
<th>Mean age</th>
<th>One joint</th>
<th>Two joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>54</td>
<td>26.8</td>
<td>14 patients</td>
<td>40 patients</td>
</tr>
<tr>
<td>Male</td>
<td>48</td>
<td>26.7</td>
<td>15 patients</td>
<td>33 patients</td>
</tr>
</tbody>
</table>

The frequency of air cell pneumatization of the different grades in the right temporal components was noted in 86 patients. In females, the right temporal components were affected in 48 patients (88%), while in males it was noted in 38 patients (79.2%). There was no statistical significance difference between males and females (P > 0.05). The frequency of air cell pneumatization in the left temporal components was noted in 89 patients of both sexes. It was present in 43 male patients (89.6%) and in 46 female patients (85.2%). There was no statistical significant difference between them (P > 0.05).

Observably, the highest incidence of air cells in the right and left temporal component was that of grade I, followed by grade II, and the least incidence was that of grade III. The distribution of different grades of air cell pneumatization in the temporal component of the right and left side in both sexes are presented in tables 3 and 4 respectively.

Table 3: the distribution of air cell pneumatization in the temporal component of the right side in both sexes.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Grade 0</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>10(20.8%)</td>
<td>30(62.5%)</td>
<td>6(12.5%)</td>
<td>2(4.2%)</td>
<td>48 (100%)</td>
</tr>
<tr>
<td>Female</td>
<td>6 (11.1%)</td>
<td>43(79.6%)</td>
<td>4(7.4%)</td>
<td>1(1.9%)</td>
<td>54 (100%)</td>
</tr>
<tr>
<td>total</td>
<td>16(15.7%)</td>
<td>73 (71%)</td>
<td>10(9.8%)</td>
<td>3 (2.9%)</td>
<td>102(100%)</td>
</tr>
</tbody>
</table>

Table 4: the distribution of air cell pneumatization in the temporal component of the left side in both sexes.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Grade 0</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>5(10.4%)</td>
<td>29(60.4%)</td>
<td>11(22.9%)</td>
<td>3(6.3%)</td>
<td>48 (100%)</td>
</tr>
<tr>
<td>Female</td>
<td>8 (14.8%)</td>
<td>33 (61.1%)</td>
<td>11(20.4%)</td>
<td>2(3.7%)</td>
<td>54 (100%)</td>
</tr>
<tr>
<td>total</td>
<td>13(12.7%)</td>
<td>62(60.8%)</td>
<td>22(21.6%)</td>
<td>5(4.9%)</td>
<td>102(100%)</td>
</tr>
</tbody>
</table>
Figure 1: Sagittal tomogram showing mastoid air cell in various locations through the temporal bone. a. Grade 0, b. Grade I, c. Grade II, d. Grade III.
Discussion

The temporomadibular joint (TMJ) is a synovial joint, which provides the articulation between the movable mandible and the fixed temporal bone of the cranium. The mandibular (glenoid) fossa is composed of the articular fossa and the articular eminence of the temporal bone. The mandibular fossa is a concave depression in the inferior side of the squamous part of the temporal bone that forms a small portion of the floor of the middle cranial fossa. Anteriorly, the fossa is bounded by a ridge of bone described as the articular eminence, which is also involved in the articulation. \(^{(7,8)}\)

The mastoid process begins to develop during the second year of life, with downward growth of the squamous portion and partially as a result of extensions of the Petrous portion. These two parts of the mastoid process come together at the petrosquamous suture line. Air cells grow down from the antrum vertically toward the mastoid tip and laterally radially into the squamous portion. A dividing bridge of bone separating these two cell tracks is known as Koerner’s septum. This is visible radiographically as a pointed, bony spicule originating from the antral roof and directed obliquely downward. \(^{(9)}\)

With further maturation of the mastoid, the thin, incomplete infantile ring that constitutes the tympanic portion of the bone grows laterally and inferiorly to form the osseous portion of the previously completely cartilaginous external auditory canal. Two suture line are formed: the tympanosquamous suture arising in the anterosuperior meatal line wall and the posteriorly positioned tympanomastoid suture. The mastoid portion has a rough surface and serves as the origin of a portion of the occipital posterior auricular muscles. In the adult the mastoid portion is continued inferiorly into a conical projection, the mastoid process. This process gives attachment to the sternocleidomastoid, splenius capitis, and longissimus capitis muscles. \(^{(9)}\)

The mastoid process is hollowed to form a number of spaces, the mastoid cells that vary greatly in size and number. In the upper and anterior part of the process, these cells are large and irregular, toward the middle part they diminish in size, and those in the apex of the process frequently are small \(^{(9)}\).

There is numerous Temporomadibular disorders (TMD) that constitutes a complex set of specific entities with a reported prevalence of 5-12%. \(^{(10-12)}\)

TMD can be defined as pain and/or dysfunction in the muscles of mastication or temporomadibular joint. It is not easy to exclude joint pathology in TMD patients only upon initial clinical examination \(^{(13)}\). Therefore, radiographic examination is of great value in detecting changes in the osseous component of the TMJ. Osteoarthritides, are the most frequent changes that occur in the bony components of the TMJ's \(^{(14)}\). It appears radiographically in the form of both bone formation and resorption \(^{(15)}\).

In the previous studies \(^{(16-18)}\), the prevalence of air cell defect was studied using panoramic radiography. In a standard panoramic radiograph, interpretation of changes in the bony structure of the TMJ can generally be performed only on the lateral pole of the condyle because of the oblique orientation of the beam with respect to the long axis of the condyle.
Panoramic radiography is recommended only as screening tool in patients with TMJ problems for detection of gross bony changes in the condyle (19). The depiction of the articular eminence and fossa is only adequate for diagnosis gross changes in the shape and structure because of superimposition encountered by the base of skull and zygomatic arch (20).

In this study, in contrast to other studies (16-18), a hypocycloidal tomographic movement was used. This mode is known to be more efficient than any other conventional method for demonstrating bone abnormalities in the TMJ (21,22). It provides multiple thin sections through the region of interest, which can provide more detailed and accurate information of the hard tissues components of the joint (20).

Computed tomography (CT) may be an alternative for hard tissue examination (23,24). However, this technique is relatively expensive and not always available. Therefore, conventional tomography is more widely used for TMJ examination (25).

Kaugars and associates described Pneumatization of the articular eminence in eight (1.7 %) out of 784 panoramic radiographs reviewed. (16) All cases were found in adults. The average age of the adult group, which comprised 61% of the total sample, was 42,2 years, female affected more than male in the study, pneumatization of the articular eminence were found bilaterally in four patients and unilaterally in four patients. The sample selected in that study included patients with different selection criteria as long as the chronological and developmental ages are considered.

Carter et al (17) studied the prevalence of zygomatic air cell defect (ZACD) in general population, the patients were free from TMD problem. The panoramic radiographs of 2734 patients were examined for the presence of ZACD. It has been found in 40 patients (1.5 %). Bilateral ZACD were found in eight patients (20%) and thirty-two cases were unilateral. No gender predilection was found in this study, a finding that was detected by Carter et al.

Orhan et al (18) retrospectively evaluated 1006 panoramic radiograph among an outpatients dental clinic population. They found ACD in 19 patients (1.88 %) with mean age of 36.6 years (SD 21.06), twelve cases (63.1%) occurred in female and 7 cases (36.9%) occurred in male. Seven patients (36.9%) had the pneumatized articular tubercle bilaterally.

Few studies conducted to assess the presence of air cell defect through the temporal components of the TMJ, Murtuza and Suk yee (26) reported a case of an adult male patient with temporomandibular joint disorder where the panoramic radiograph has shown multilocular radiolucencies in the zygomatic process of temporal bone bilaterally. Further investigation using CT revealed extensive pneumatization in all parts of temporal, mastoid, Petrous, squamous and zygomatic bone. The roof of the right glenoid fossa was very thin (< 1 mm). The diagnosis was made of TMJ pain dysfunction syndrome, with an incidental finding of extensive pneumatization of the temporal bones.
In this study, the incidence of air cell defect which extends anterior to the crest of the articular eminence was an infrequent finding in patients with TMJ disorders. It was found in six cases, two cases were bilaterally and four cases were unilaterally. This result possesses a lower score than the result obtained by other investigators\(^{(16,18)}\), This could be attributed to the small sample size in this study.

In this study, most of the cases the air cells were extending from the mastoid air cell to the deepest point of the fossa. In these cases, the roof of the glenoid fossa was weakened by the pneumatization. Therefore, a severe traumatic force may lead to impingement of the head of the condyle on the middle cranial fossa. Regarding the pneumatization of the anterior slope of the fossa between the deepest point of the fossa and the crest of the articular eminence, it was affected to lesser degree, this finding should be strongly considered in patients with chronic condylar dislocation. Any surgical procedure involve reduction of the height of the articular eminence may lead to surgical complication, therefore, detailed radiographic assessment is needed before any surgical procedures.

**Conclusion**

Air cell pneumatization is an incidental finding that can be detected in a considerable number of persons. This may renders the temporal component of the TMJ more fragile. Furthermore, in some cases, the roof of the glenoid fossa is extensively weakened by pneumatization. Therefore, a severe traumatic injury may cause impingement of the head of the condyle on the middle cranial fossa. Conventional panoramic radiograph is not suitable for radiographic assessment of patients with air cell defect who need eminectomy or emionplasty. Therefore, conventional tomography is recommended for radiographic assessment before any surgical procedures in the temporal component of the TMJ.
References


