Abstract

Aims: Haller Cells refer to the ethmoidal pneumatization and are the extensions of anterior ethmoid sinus into the floor of the orbit and superior aspect of the maxillary sinus, basically an anatomic variation. They may be associated with orofacial pain, sinusitis, nasal obstruction, impaired nasal breathing, headache, chronic cough, and mucocele. The aim of the present study was to identify, determine the prevalence and characteristics of Haller’s cells on Digital orthopantomographs in patient’s reporting to a dental institution in Chennai. Settings and Design: This was a retrospective, cross-sectional study. Subjects and Methods: The study group comprised 600 radiographs inclusive of both genders (379 females and 221 males) with an age range of 20–80 years. Retrospectively panoramic radiograph for each of the patients was viewed and interpreted for the presence of Haller’s cells. The data collected was subjected to statistical analysis: frequencies/percentages, descriptive statistics to obtain the results. Statistical Analysis Used: Frequencies/percentages, descriptive statistics using SPSS for Windows Version 20 (SPSS Inc., Chicago, IL, USA), to obtain the results. Results: Haller’s cells were noted in patients, accounting for a prevalence of 23.61%. The majority of the cells were circular, ovoid, and irregular in shape. Conclusions: This study has attempted to explore the characteristics of Haller’s cells on panoramic radiographs. A description of Haller’s cells on these radiographs may prove vital in enumerating the differential diagnosis for patients afflicted with intractable orofacial pain and reduce the risk of untoward intraoperative complications during endonasal procedures.

Keywords: Digital panoramic radiographs, Haller’s cells, infraorbital ethmoid air cells, orofacial pain

Introduction

Haller’s cells also known as maxillo-ethmoidal cells, orbito-ethmoidal cells, or infraorbital ethmoid cells[1] are defined as air cells situated beneath the ethmoid bulla along the roof of the maxillary sinus and the most inferior portion of the lamina papyracea, including air cells located within the ethmoid infundibulum.[2]

Haller’s cells [Figure 1], first described by the Swiss anatomist Albert von Haller in 1765.[3,4] They are thought to arise in individuals with pneumatization of the lateral crus.[5] They refer to the ethmoidal pneumatization of the superior aspect of the maxillary sinus and floor of the orbit. They are seen in 40% of patients.[6]

Although Haller’s cells are anatomical variations in the development of the nose and paranasal sinuses (PNSs), they have been held responsible for patient’s symptoms and are thus clinically significant.[2,3] In addition to distressing orofacial pain and sinusitis, numerous pathologies and symptoms associated with this entity include nasal obstruction, impaired nasal breathing, headache, chronic cough, and mucoceles.[2,3,7-10] It has been well documented that some of the anatomical variations of the PNSs can predispose to sinus pathology or can even complicate sinus surgery, and Haller cells are no exception.

The position of Haller cells in the medial portion of the orbital floor, lateral to the maxillary infundibulum, places them in a key position to disturb the normal pattern of mucociliary flow and predispose to recurrent maxillary sinusitis.[7,11,12] Several radiographic studies have shown a significant relationship between Haller cells size (>3 mm) and maxillary sinusitis.[13-15] Haller’s cells can also restrict access to the maxillary sinus or the anterior ethmoidal cells during endonasal procedures, making it imperative for the surgeon to be aware...
of such variations that may incline the patient to increased risk of intraoperative complications.\cite{5,7}

Infraorbital ethmoid cells have been described as well-defined, round, oval, or teardrop-shaped radiolucencies (single or multiple), unilocular or multilocular with a smooth border which may or may not appear corticated and are located medial to the infraorbital foramen according to a panoramic radiographic study.\cite{3}

These cells are frequently seen as incidental findings in orthopantomographs (OPG’s), which are taken in dental hospitals to have an overall coverage of the orofacial region to rule out dental, temporomandibular joint (TMJ), and maxillary sinus-related pathologies leading to orofacial pain. When all the odontogenic and TMJ-associated entities are ruled out clinically and radiographically, evidence for Haller cells can be traced out radiographically with the help of OPG’s to rule out PNS-related pathologies readily. The clinical importance cum radiographic visibility of these entities initiated this retrospective study with an aim to identify, determine the prevalence and characteristics of Haller’s cells on digital OPG’s in patient’s reporting to a dental institution in Chennai.

**Subjects and Methods**

The present study was carried out in the Department of Oral medicine and radiology, Sree Balaji Dental College and Hospital, Chennai, India. 600 Digital OPG’s were retrieved from the digital imaging and communications in medicine archive folder from the existing records of various dentomaxillofacial indications such as orthodontic, temporomandibular joint evaluation, prosthetic, and restorative purposes were included in the study. Digital OPG’s with trauma and/or surgically treated maxillofacial region, evidence of developmental anomalies/pathologies affecting the maxillofacial region were excluded from the study.

The study group was selected by simple random sampling method. It included both genders with an age range of 20–80 years (379 females and 221 males). The radiographs obtained were serially interpreted for the presence of Haller’s cells under ideal viewing conditions.

Three observers (oral and maxillofacial radiologists), who were initially trained toward the observation of Haller cells did the interpretation. The recognition of Haller’s cells was made if an anatomical variation fulfilled the criteria suggested by Ahmad et al.\cite{3}

1. Well-defined round, oval, or tear-drop-shaped radiolucency, single or multiple, unilocular or multilocular, with a smooth border, which may or may not appear corticated
2. Located medial to infraorbital foramen
3. All or most of the border of the entity in the panoramic section is visible
4. The inferior border of the orbit lacks cortication or remains indistinguishable in areas superimposed by this entity.

The observations pertaining to the Haller’s cells were entered in the subject’s pro formas. The data collected was tabulated and subjected to statistical analysis, namely, frequencies/percentages, descriptive statistics using SPSS Version 20 (15-day trial version) for Windows (SPSS Inc., Chicago, IL, USA) to obtain the results.

**Results**

The study was done to identify and assess the characteristics and prevalence of Haller’s cells in digital OPG’s. 600 digital OPG’s belonging to an age group of 20–80 years were included in the study, out of which 379 were female, and 221 were male.

Various variables associated with Haller cells such as presence, shape, loculae, number, and side were studied. After interpretation of 600 OPG’s, the mean prevalence of Haller cells was 23.61% [Table 1 and Figure 2].

It was observed that most of the cells were oval, circular, and irregular in shape [Figures 3-5]. Table 2 shows the intraobserver variability.

**Discussion**

The present study is distinctive in that there have been analyses performed to determine the variations of Haller’s

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**Table 1: The mean prevalence of Haller cells**

| Number of cases | Number of cells | Prevalence (%) | Unilocal Bilateral | Unilocal | Multilocular |
|-----------------|-----------------|----------------|-------------------|----------|-------------|
| OBS 1           | 132             | 217            | 22                | 113      | 104         | 198         | 19       |
| OBS 2           | 144             | 263            | 24                | 68       | 195         | 224         | 39       |
| OBS 3           | 149             | 265            | 24.83             | 64       | 201         | 231         | 34       |
| Mean            | 141.6           | 248.3          | 23.61             | 81.6     | 166.6       | 217.6       | 30.66    |

**OBS**=Observer
cells with respect to gender, type, number, and shape which has been remotely documented in the past. Such a description of the infraorbital ethmoid (Haller’s) cells may prove useful in clear identification of these entities and aid in charting out the differential diagnosis for patients suffering from intractable orofacial pain, thereby avoiding other expensive and invasive diagnostic modalities. Detection of Haller’s cells may also forewarn the surgeons before endonasal procedures, thus preventing any untoward intraoperative complications.

The prevalence (4.7%–45.1%) of infraorbital ethmoid cells using CT images has been reported in the literature.\textsuperscript{[2,3,7,9,13,16–19]} In the present study, the prevalence rate of Haller’s cells (23.61%) falls within the range of previous studies. A much higher prevalence of (38.2%) has been cited according to the study conducted by Ahmad \textit{et al.} in 2006.\textsuperscript{[3]} In a study by Solanki \textit{et al.},\textsuperscript{[30]} in 2014, a lower prevalence of (19.2%) has been reported. This disparity could have resulted from variations in the populations studied, sample sizes, and the subjective judgment pertaining to the presence or absence of Haller’s cells.

Out of 600 OPG’s examined Haller cells were noted with a prevalence of 10.78% in males (65) and 12.83% in

| Table 2: Intra-observer difference |
|-----------------------------------|
| Intra class correlation (%) | 95% CI          |
| Total                          |                |
| OBS 1 versus OBS 2             | 56   44 66    |
| OBS 1 versus OBS 3             | 79   74 84    |
| OBS 2 versus OBS 3             | 58   47 68    |
| Right                          |                |
| OBS 1 versus OBS 2             | 43   36 67    |
| OBS 1 versus OBS 3             | 67   59 75    |
| OBS 2 versus OBS 3             | 41   22 63    |
| Left                           |                |
| OBS 1 versus OBS 2             | 45   28 59    |
| OBS 1 versus OBS 3             | 70   43 89    |
| OBS 2 versus OBS 3             | 32   23 47    |

CI=Confidence interval, OBS=Observer

Figure 2: The mean prevalence of Haller cells between the 3 observers

Figure 3: Depiction of various shapes of Haller cells from cropped orthopantomograph’s
female (77) subjects. Results indicated a slight increase in
the presence of Haller’s cells among female subjects. The
distribution of Haller’s cells with respect to gender was not
statistically significant. This is consistent with the results of
a CT imaging study on Haller’s cells by Basić et al.,[13] who
reported no difference in the prevalence of Haller’s cells
between males and females.

The presence of bilateral occurrence of Haller’s cells was
found to be more compared to unilateral occurrence in the
present study. Most of the studies reported in literature
suggest to have more unilateral occurrence compared to
bilateral.[3,7,16,15] This variation could be attributed to the
difference in the study population, cell definition, and
scanning technique. The presence of bilateral Haller’s cells
varies from 26% to 50%.[16]

In the present study, the occurrence of Haller’s cells on
the right side was 371 (30.91%), and the left side was
374 (31.16%), which is in concordance with the study
done by Ahmad et al.[3] In the study by Ahmad et al.,[13] an
almost equal distribution of Haller’s cells was found on
the right (48) and left sides (50). In the panoramic
study conducted by Ahmad et al.,[3] both unilateral and
bilateral Haller’s cells were combined while estimating side
distribution. In the present study, the same was followed.

The unilocular type of Haller’s cells was more compared
to multilocular type in the present study. In addition, the
majority of the Haller’s cells were round, ovoid, and
irregular in shape with very few cases depicting a teardrop,
trapezoid, heart or square shaped which is in concordance
with Raina et al.[21] and Jitender Solanki et al.[20]

A study by Mathew et al. showed a significant association
between Haller cells and orbital floor dehiscence. They
recognized dehiscence as loss of bone density with
only mucoperiosteal covering separating the Haller cell
from the orbit. Dehiscent orbital floor could make the
orbit vulnerable either in the event of Haller cell disease
or during surgical instrumentation of the ostiomeatal
complex.[22] Sebrechts et al., presented three case reports
of unilateral orbital cellulitis, resulting from isolated
inflammation of Haller cells, and management required
endoscopic incision and drainage of infected Haller cells.

Correspondingly, they considered the pathology of Haller
cells to be the potential factor of unilateral orbital cellulitis
and also postulated that in the case of inflamed Haller cells,
a concurring orbital floor dehiscence should always be
considered unless otherwise proven.[23]

There is enormous variability in the prevalence of Haller
cells between the present study and other studies; this
difference could be attributed to the inconsistency in
definition of Haller cells in the literature. Kennedy and
Zinreich considered Haller cells as ethmoid cells projecting
below the ethmoid bulla within the orbital floor in the
region of the opening of the maxillary sinus.[24] Bolger
et al. defined Haller cells as any cell located between the
ethmoid bulla, the orbital lamina of the ethmoid bone, and
the orbital floor.[13] Kainz et al. recognized Haller cells as
cells within the orbital floor.[14] The variability could also
be explained on the basis of the sample size, patients age
group, and ethnic origin, and on the radiographic techniques
used in determining the prevalence of Haller cells.

Conclusion

The present study was carried out to identify the presence
of Haller Cells in digital OPG. The results of this study
indicate that panoramic radiographs can depict and provide
a clear delineation of Haller’s cells in a certain number of
cases estimating to a prevalence of 23.61%. The distribution
of Haller’s cells with respect to gender indicated a slight
increase in presence among female subjects. Similarly, the
side of distribution of Haller cell between (right and left)
was equal.

The identified Haller cells were found less unilaterally and
more bilaterally in distribution. The shapes of the Haller
cells studied in this study were circular, oval, teardrop,
triangular, trapezoid, square, heart-shaped, and irregular,
out of which majority of the Haller’s cells were round,
ovoid, and irregular in shape. The Haller Cells were
also unilocular and multilocular in their characteristic
appearance.

Computed tomography (CT)/cone beam CT (CBCT) are
the golden standard in providing a confirmatory diagnosis.
OPG is simple, readily available, and cost-effective.
Thought it suffers distortions and overlapping it can be used as a preliminary screening tool to rule out the existence of Haller cells before subjecting the patients to unnecessary radiation exposure and expensive radiographic procedures. Thus, we conclude OPG does serve as a preliminary two-dimensional representation tool in determination of Haller cells. However, for definitive detection and to have a proper anatomical and pathological relationship associated with the signs and symptoms associated with these Haller cells, an advanced three-dimensional radiographic imaging modalities such as CT or CBCT evaluation may be necessary.

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Conflicts of interest
There are no conflicts of interest.

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