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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/14835
DOI URL: http://dx.doi.org/10.21474/IJAR01/14835

RESEARCH ARTICLE

CHARACTERISTICS OF HALLER'S CELLS A PREVALENCE BASED PANORAMIC RETROSPECTIVE ANALYSIS

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Manuscript Info

Manuscript History
Received: 31 March 2022
Final Accepted: 30 April 2022
Published: May 2022

Key words:-
Characteristics, Digital Panoramic Radiographs, Haller's cells, Prevalence

Abstract

Background: Haller's cells, seen as incidental findings on radiographs, are located at the floor of the orbit and superior most aspect of the maxillary sinus. These cells are attributed to the anatomical variations in the growth and development of nose and paranasal sinuses leading to clinically significant symptoms such as headache, chronic cough, sinusitis, orofacial pain, impaired nasal breathing and various maxillofacial region associated pathologies.Therefore, the present study was carried out on haller's cells considering their clinical significance.

Aims and Objectives: To determine the prevalence and radiographic characteristics of haller's cells using digital panoramic radiographs.

Materials and Methods: The present retrospective study was carried out in a diagnostic setup, dental hospital, Bengaluru, Karnataka over the period of two years. Initially, the study group consists of 2376 participants, out of which 1800 met the inclusion criteria and were randomly enrolled in the studywith age range of 10 - 60 years. The digital panoramic images obtained were interpreted for presence and characteristics of haller's cells by trained oral and maxillofacial radiologists according to Ahmad M etal's criteria.

Results:Out of 1800 digital panoramic radiographs; the haller's cells were seen in 214 radiographs of study participants, stating the prevalence rate of 11.88 %. The mean age of the study participants with haller's cells were 27.46 ± 17.93 years.Majority of cells seen on digital panoramic radiographs wereround (35.98%) and triangular (5.14%) in shape with unilocular appearance. A significant difference was observed with the shape of the haller's cells with p value of 0.001.

Conclusion: The prevalence and characteristics of the haller's cells is in accordance with the various studies published in literature with highest number of panoramic radiographs taken into consideration till our knowledge. The incidental appearance of haller's cells on panoramic radiographs has its own significance in diagnosing various pathologies along with avoiding intraoperative complications in endonasal surgeries.

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Introduction:-

Haller's or infraorbital ethmoidal or maxillo ethmoidal cells were first described and named after Albert von Haller, the Swiss anatomist in 1765. They are referred as air cells located at the floor of the orbit and superior most aspect of the maxillary sinus.Such cells are thought to arise in individuals with pneumatization of the lateral crus. Haller's cells are attributed to the anatomical variations in the growth and development of nose and paranasal sinuses leading to clinically significant symptoms such as headache, chronic cough, sinusitis, orofacial pain, impaired nasal breathing and various maxillofacial region associated pathologies.[1-3]Studies published in literature showed significant association between haller's cells and maxillary sinusitis. This is attributed to the position of these cells medial to the orbital floor which hampers the mucociliary flow pattern and leads to recurrent sinusitis.The presence of haller's cells may leads to complexity in approaching the maxillary sinus and anterior ethmoidal cells during endonasal surgeries. Therefore, for a performing surgeon, the identification of such anatomical structures and their variationsmay reduce the risk of various intra-operative complications.[4-6]

Haller's cells are usually seen as incidental findings in the panoramic radiographs, taken in the diagnostic setup to rule out various oral and maxillofacial pathologies.In a published literature, Ahmad M et al have been described the haller's cells as well-defined round, oval or teardrop-shaped radiolucencies associated with smooth border, may or may not be corticated. These cells can be unilocular or multilocular, located medial to the infraorbital foramen. Due to its clinical significance in endonasal surgeries, the present study was carried out to determine the prevalence and radiographic characteristics of haller's cells using digital panoramic radiographs.

Materials and Methods:-

The present retrospective study was carried out in a diagnostic setup,dental hospital, Bengaluru, Karnataka among individuals referred for dentomaxillofacial indications over the period of two years, from August 2018 to August 2020. The study participants were randomly selected through convenient sampling procedure including both males and females with age range of 10 - 60 years. Individuals with developmental defects, craniofacial syndromes, systemic (endocrinal or metabolic) diseases affecting the head and neck growth and development, or with the history of trauma, fracture or pathologies related to maxillofacial region, were excluded from the study. The digital panoramic radiographs identified with positioning or magnification errors, artifacts or superimposed anatomical structures were also excluded from the study.

Initially, the study group consists of 2376 participants, out of which 1800 met the inclusion criteria and were randomly enrolled in the study. The panoramic radiographs were taken using Kodak 8000 C imaging software at standard exposure parameters of 8 - 12 mA and 70 - 80kvp. The digital panoramic images obtained were interpreted for presence and characteristics of haller's cells by trained oral and maxillofacial radiologists according to Ahmad M etal's criteria. [1]The structured proforma including demographic data (such as age, gender, address, educational qualifications, socioeconomic status, etc.), presence or absence and characteristics (unilateral/bilateral, shape,locularity,etc) of haller's cells was used in the present study. (Figure 1 and 2)

Statistical analysis:-

The data obtained was tabulated and analyzed using SPSS software, version 21.0 (SPSS Inc., Chicago, IL, USA).The descriptive data including mean values with standard deviation, numbers and percentages were also calculated. The Chi square test was used to determine the significance of obtained data with p value less than 0.05 to be considered as significant.

Results:-

In the present study, the mean age of the study participants was 34 ± 14.05 years with 1084 males and716 females. Out of 1800 digital panoramic radiographs; the haller's cells were seen in 214 radiographsof study participants, stating the prevalence rate of 11.88%. The mean age of study participants with haller's cells was 27.46 ± 17.93 years. (Graph 1)

According to age, the study participants were further divided as 10 – 19 years, 20 – 29 years, 30 – 39 years, 40 – 49 years, and 50 – 59 years.Out of 214 study participants with presence of haller's cells, majority of individuals belongs to 10 – 19 years (40.65 %) and 20 – 29 years (38.78 %) of age group, followed by 40 – 49 years (9.81 %), 30 – 39 years (6.54 %) and 50 – 59 years (4.20 %). As the age advances, the haller's cells were less evident in the present study with p value less than 0.05, to be considered as statistically significant. (Table 1)

Out of 214 study participants, haller's cells were seen in 124 males and 90 females. Majority of cells seen on digital panoramic radiographs were bilateral (138), followed by right side (49) and left side (27) respectively. (Graph 2) Unilocular cells (197) were seen in majority of study participants while only 17 participants were having multilocular cells.The present study revealed thatthe majority ofthe cells were oval (45.32%) in shape, followed by round (35.98%) and triangular (5.14%) shape. A significant difference was observed with the shape of the haller's cells with p value of 0.001. (Table 2)

The majority of study participants belong to 10 – 19 years (40.65 %) and 20 – 29 years (38.78 %) of age group. The study observed no significant correlation between age groups and shape of the cells (p value = 0.0738), gender and shape of the cells (p value = 0.281), shape of the cells and loculae(p value = 0.373) with p value less than 0.05. The significant correlation was observed between the shape and sides of the cells with p value of 0.019. (Table 3)

Discussion:-

In the 10th week of intrauterine life, the development of ethmoidal sinus starts, which further grows rapidly and attains the mature size by 10 -12 years of age. During their development, these ethmoidal cells grow and lead to the formation of extramural cells thereby occupying the available space and the phenomenon is known as "the struggle for space of the ethmoid" by Seydel. The migration of these extramural cells into the floor of the orbit forms haller's cells. The radiographic appearance of haller's cells varies according to age, side, shape and locularity. The detection of infraorbital ethmoidal (haller's) cells radiographically plays a significant role in diagnosing atypical orofacial pain and preventing intraoperative complications during endonasal surgeries. Therefore, the present study was conducted to determine the prevalence and radiographic characteristics of thehaller's cells using digital panoramic radiographs.

In the present study, the prevalence of these cells was 11.88% which is in accordance with the studies published in literature concluding the prevalence rate of haller'scells between 4.7 % - 45.1 %. [1, 3,7-9]Another study population by Chaudhari RS et al. comprising 300 radiographs using convenient sampling methodology concluded with the prevalence rate of 10 %. [10] Study by Solanki J et al. (2014) accounted the prevalence of 19.2 % with 1000 panoramic radiographs among healthy individuals. [6]A retrospective study published by Nedunchezhian K et al. (2018) on 600 radiographs determining the prevalence rate of haler's cells in the dental institution. The authors concluded the prevalence to be 23.61 %. [5]Another similar study published by Ahmed et al. (2006) concluded a much higher prevalence of 38.2 %. [1] These studies published in literature are in accordance with the present study. The variation in the prevalence rate of haller's cells can be due to variation in geographic locations, sample sizes of study participants or the subjective perception of the observers.

The present study comprising of 1800 study participants between 10 – 60 years with majority of individuals belonging to 10 – 19 years (40.65 %) and 20 – 29 years (38.78 %) of age groups. As the age advances, the haller's cells were less evident in the present study. The present study is in consonance with the study published by Chaudhari et al concluding that the maximum number of individuals belongs to 19 – 28 years of age. [10]This can be attributed to increased aesthetic awareness among younger generation due to modernization. The majority of study population comprises of male (57.9 %) participants in the present study. These findings are consistent with the studies published by Raina et al (2012) with 59.3 % of male study participants with haller's cells. [2]The study published by Solanki et al (2014) and Chaudhari et al (2019) shows female predominance. [6,10]

The majority of the haller's cells seen was bilateral (64.48 %), followed by right (22.89 %) and left (12.61 %) sides respectively. The bilateral appearances of these cells were seen in 26 – 50 % of population. The present study is in harmony with the study published by Nedunchezhian K et al with majority of bilateral presence of cells.[5] The majority of studies published in literature showed unilateral occurrence compared with bilateral. [1.2.6.10] The unilocular appearance of the haller's cells were seen in 92 % of study participants, hereby maintaining the harmony with the studies published in literature by Raina A et al (2012), Solanki J et al (2014)andChaudhari RS et al (2019) with 98 %, 91.7 % and 93.33 % of haller's cells with unilocular appearance respectively. [2,6,10] In an another similar study by Nedunchezhian K et al (2019) even concluded that the unilocular type of haller's cells were more as compared to bilocular type. [5]The studies published in literature concluded that majority of haller's cells were ovoid and round in shape which is in accordance with the present study with 45.32 % of oval and 35.98 % of round shaped cells. [2.5.6.10]

Till our knowledge, in present study maximum numbers of panoramic radiographs were evaluated to determine the prevalence and characteristics of haller's cells. The use of panoramic radiographs have proven to be a cost effective, less time consuming with minimum exposure of the patients as compared to advanced cone beam computed tomography. The incidental findings determining the haller's cells while screening radiographic procedures can be helpful in diagnosing various oral and maxillofacial pathologies. Further, the present study was single centered and we would recommend similar studies should be conducted in different geographic locations.

Table 1:- Agewise distribution of study participants.

Age (years)	Total (n)	Presence of Haller's cells (%)	p value
10 – 19	648	87 (40.65)	0.01
20 – 29	681	83 (38.78)	
30 – 39	206	14 (6.54)	
40 – 49	176	21 (9.81)	
50 – 59	89	9 (4.20)	
Total	1800	214	

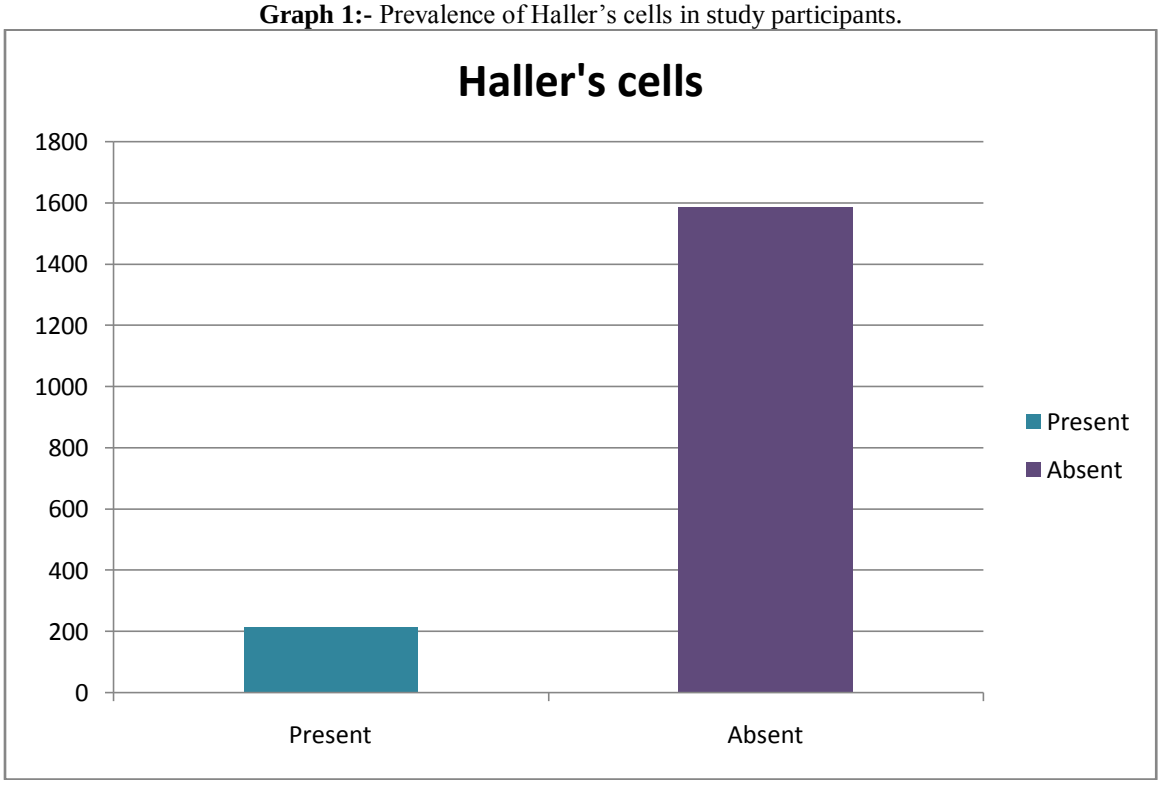
Table 2:- Shape-wise distribution of Haller's cells**.**

Shape	n (%)
Oval	97 (45.32)
Round	77 (35.98)
Triangular	11 (5.14)
Pyramidal	6 (2.80)
Heart	9 (4.20)
Teardrop	8 (3.73)
Combination	6 (2.80)
Total	214

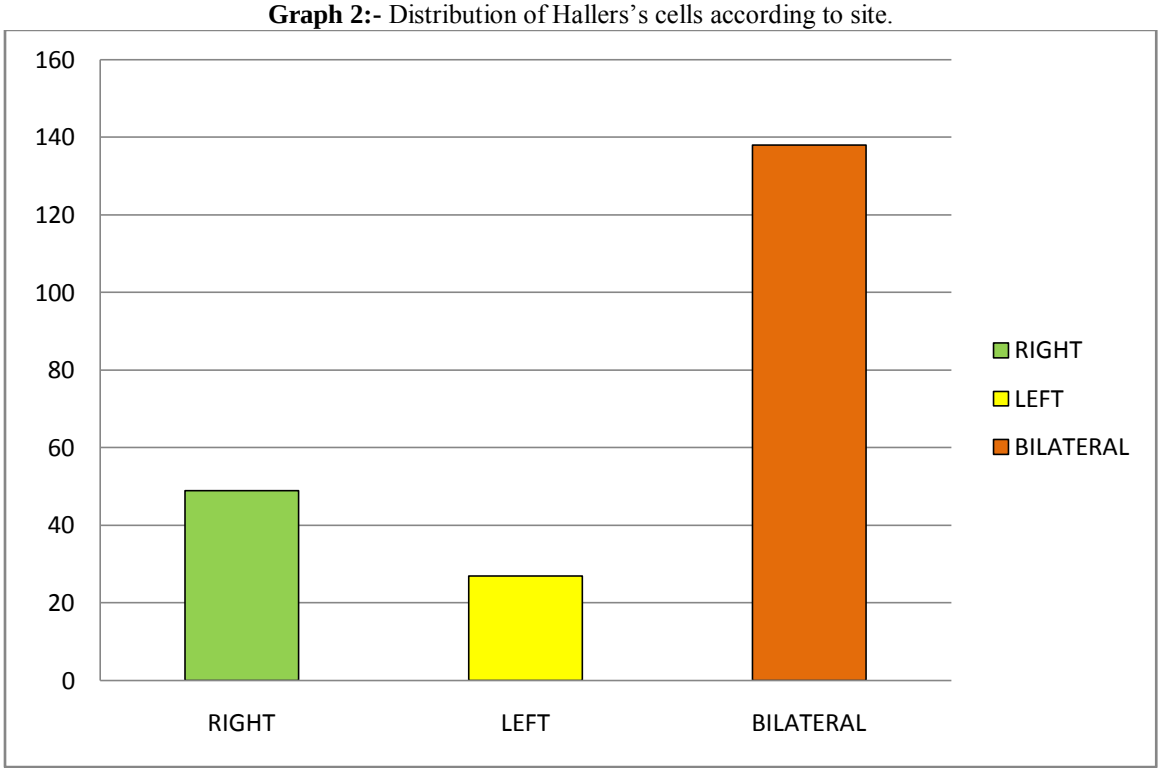
Table 3:- Shapewise and sidewise distribution of Haller's cells in study participants**.**

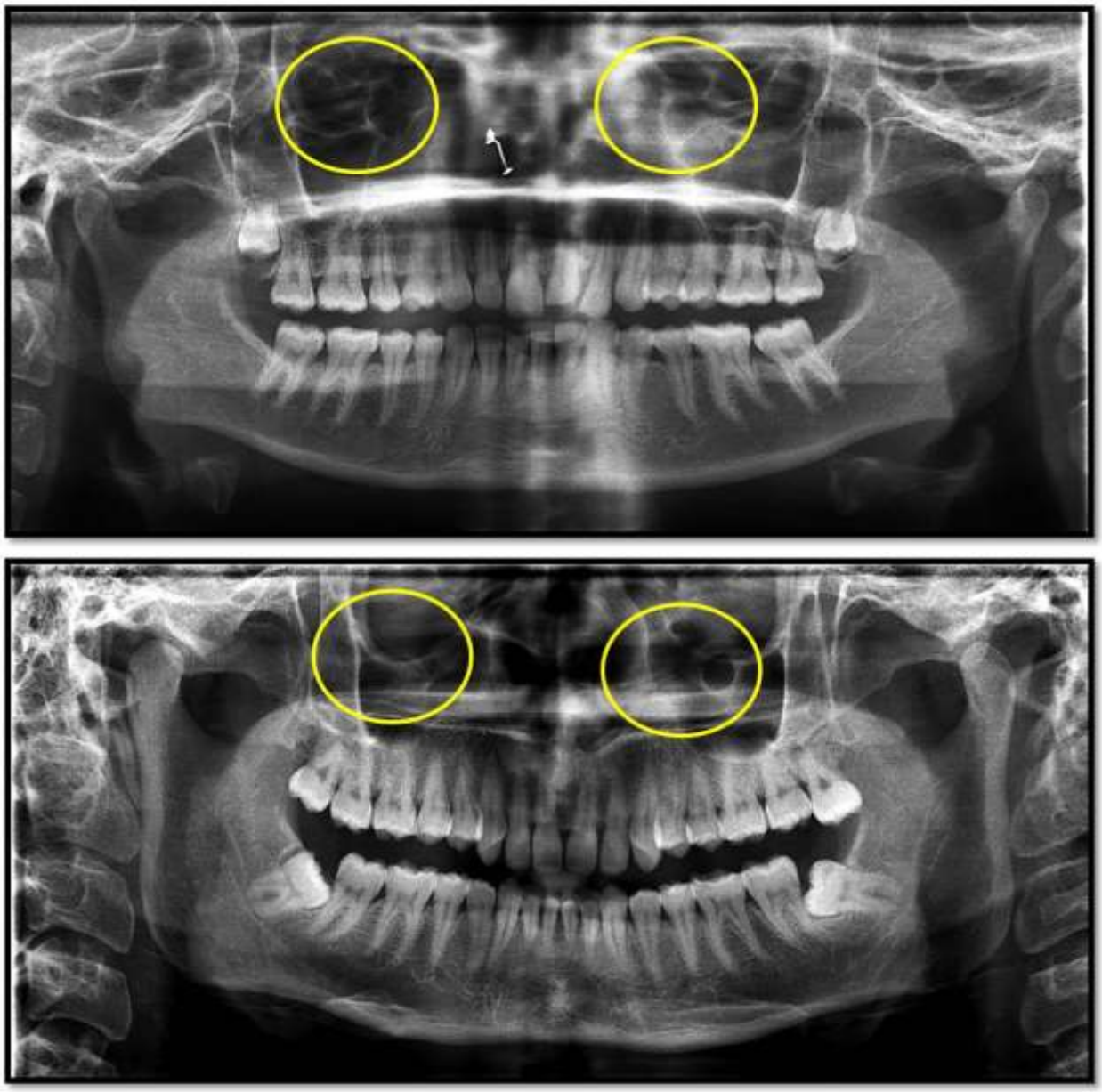
Shape				n (%)	p value
	Right	Left	Bilateral		
Oval	20	14	63	97	0.019
Round	21	7	49	77	
Triangular		4	7	11	
Pyramidal	2	1	3	6	
Heart	3		6	9	
Teardrop			8	8	
Combination	3	1	2	6	
Total	49	21	138	214	

Graph 1:- Prevalence of Haller's cells in study participants.



Graph 2:- Distribution of Hallers's cells according to site.





Legends:
Figure 1: The panoramic radiograph showing left side heart shaped haller's cells and right side tear drop, round shaped haller's cells.
Figure 2: : The panoramic radiograph showing left side oval shapedhaller's cells and right side round haller's cells.
Table 1: Agewise distribution of study participants**.**
Table 2: Shape-wise distribution of Haller's cells**.**
Table 3: Shapewise and sidewise distribution of Haller's cells in study participants**.**
Graph 1: Prevalence of Haller's cells in study participants**.**
Graph 2: Distribution of Hallers's cells according to site**.**

Conclusion:-

The prevalence and characteristics of the haller's cells is in accordance with the various studies published in literature with highest number of panoramic radiographs taken into consideration till our knowledge. The incidental appearance of haller's cells on panoramic radiographs has its own significance in diagnosing various pathologies along with avoiding intraoperative complications in endonasal surgeries. The parameters in the present study

arebased on the two dimensional modality such as panoramic radiographs while we further recommend similar studies with three dimensional modalities for more precise description of the cells.

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