DOI: 10.14260/jemds/2015/758

ORIGINAL ARTICLE

A COMPARATIVE STUDY OF PLAIN X-RAY MASTOIDS WITH HRCT TEMPORAL BONE IN PATIENTS WITH CHRONIC SUPPURATIVE OTITIS MEDIA

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HOW TO CITE THIS ARTICLE:
Sunitha M, L. Asokan, A. P. Sambandan. "A Comparative Study of Plain X-Ray Mastoids with HRCT Temporal Bone in Patients with Chronic Suppurative Otitis Media". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 30, April 13; Page: 5190-5197, DOI: 10.14260/jemds/2015/758

ABSTRACT: BACKGROUND: Chronic suppurative otitis media is inflammation of the middle ear cleft. Inflammation of the middle ear affects the mastoid pneumatisation and this can be assessed radiologically. **PURPOSE OF THE STUDY:** The present study was undertaken to assess and to compare regarding the status of pneumatisation in patients with chronic suppurative otitis media by x-ray both mastoids and HRCT temporal bone. **MATERIALS AND METHODS:** A prospective study was done from January 2014 to December 2014 on 45 patients presenting with chronic suppurative otitis media. **RESULTS:** The pneumatisation of air cells was better appreciated with HRCT when compared to x-ray mastoids. **CONCLUSION:** A well taken x-ray mastoids provides the mastoid pneumatisation status. The air cells detected in HRCT is superior as compared to x-ray of the mastoid. Also the extent of disease involving the mastoid air cells and mastoid antrum is better with HRCT.

KEYWORDS: Chronic suppurative otitis media (CSOM), X-ray mastoids, High resolution computed tomography (HRCT) temporal bone, Pneumatisation.

INTRODUCTION: The mastoid air cell system forms an important contribution to the middle ear ventilation and acts as a surgitank of air. Depending on the presence of air cells, mastoid is classified as pneumatised, diploeic or sclerosed. In chronic suppurative otitis media there is concomitant involvement of the mastoid air cell system. The extent of mastoid air cell involvement depends on the type of CSOM.

Regarding the relation between the mastoid pneumatisation and the middle ear diseases has been controversial. This is explained by two theories. According to the Diamant's hereditary theory, the extent of pneumatisation is genetically determined and reduced pneumatisation predisposes for acute or chronic otitis.[1] According to environmental theory by Tumarkin, middle ear diseases are the cause of the reduced pneumatisation in infants and children.[2]

The tegmen of the mastoid and the attic is usually oriented in the horizontal plane, slightly lower than the arcuate eminence, which is formed by the top of the superior semicircular canal. In coronal sections, the floor of the middle cranial fossa deepens to form a groove lateral to the attic and labyrinth. Low lying dura may cover the roof of the external auditory canal. The sigmoid sinus forms a shallow indentation on the posterior aspect of the mastoid. Occasionally, the sinus courses more anteriorly and produces a deep groove in the mastoid, best seen in axial section.[3]

Routinely x-ray mastoids are advised as a pre-operative imaging modality. Only few centres focus on computed tomography of temporal bone as a pre-operative radiological imaging modality. Excellent resolution of computed tomography provides unprecedented detail of the temporal bone.[4]

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MATERIALS AND METHODS: A prospective study was done on 45 patients presenting with chronic suppurative otitis media from January 2014 to December 2014. After a thorough history and complete clinical examination, these patients were subjected for both x-ray of the mastoids and high resolution computed tomography of the temporal bone.

X-ray mastoids were obtained by Law's view bilaterally and high resolution computed tomography of the temporal bone was obtained with 1mm cuts in axial and coronal planes.

Purpose of the study:

1. To compare regarding the pneumatisation in chronic suppurative otitis media with x-ray both mastoids and HRCT temporal bone.
2. Presence of cavities, low lying dura and anteriorly placed sigmoid sinus.

Statistics was done by sensitivity and specificity, and chi-square test.

RESULTS: Among the 45 cases of chronic suppurative otitis media, there were 20 male and 25 female patients. 34 patients (76%) were between 20-50 years age group. The youngest patient was 9 years old and the oldest patient was 52 years old. The mean age group was 31 years.

Among the 45 patients, 36 were diseased unilaterally and 9 cases bilateral. So there were 54 diseased ears. By clinical diagnosis, tubotympanic type of CSOM was seen in 37 cases with 16 cases on the right side and 21 cases on the left side, and atticoantral type of CSOM was seen in 17 cases with 10 cases on the right side and 7 cases on the left side.

The findings regarding the pneumatisation on x-ray both mastoids and HRCT temporal bone in CSOM patients are as shown in the tables below.

Pneumatisation status	X-ray mastoids		HRCT	
	No. of cases (n=54)	%	No. of cases (n=54)	%
Pneumatised	14	25.9%	18	33.3%
Diploeic	4	7.4%	2	3.7%
Sclerosed	31	57.4%	29	53.7%
Diseased cavity	5	9.3%	5	9.3%

Table 1: Status of mastoid pneumatisation on x-ray and HRCT in diseased ears

In diseased ears, x-ray of the mastoids revealed pneumatised mastoid in 14(25.9%), diploeic in 4(7.4%), sclerosed mastoid in 31(57.4%) and diseased cavity in 5(9.3%) cases. HRCT temporal bone revealed pneumatised mastoid in 18(33.3%), diploeic in 2(3.7%), sclerosed mastoid in 29(53.7%) and diseased cavity in 5(9.3%) cases. Pneumatised mastoid on x-ray mastoids and HRCT temporal bone as shown in fig. 1.

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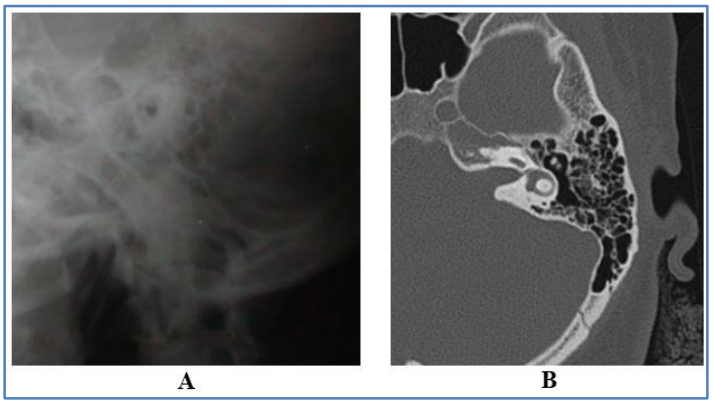

Fig. 1: Pneumatised mastoid on A) X-ray & B) HRCT

Pneumatisation status	X-ray mastoids		HRCT	
	No. of cases (n=36)	%	No. of cases (n=36)	%
Pneumatised	22	61.1%	22	61.1%
Diploeic	1	2.8%	2	5.6%
Sclerosed	13	36.1%	12	33.3%

Table 2: Status of Mastoid pneumatisation on x-ray and HRCT in opposite normal ears

On normal side, x-ray of the mastoids revealed pneumatised mastoid in 22(61.1%), diploeic in 1(2.8%) and sclerosed mastoid in 13(36.1%) cases. HRCT temporal bone revealed pneumatised mastoid in 22(61.1%), diploeic in 2(5.6%), and sclerosed mastoid in 12(33.3%) cases.

Diagnosis				HRCT temporal bone: Pneumatised	Diploeic	Sclerosed	Diseased cavity	Total
TT type	X-ray mastoids	Pneumatised	Cases	13	0	0		13
			% of Total	35.1%	.0%	.0%		35.1%
		Diploeic	Cases	2	0	0		2
			% of Total	5.4%	.0%	.0%		5.4%
		Sclerosed	Cases	0	1	21		22
			% of Total	.0%	2.7%	56.8%		59.5%
	Total		Cases	15	1	21		37
			% of Total	40.5%	2.7%	56.8%		100.0%
AA type	X-ray mastoids	Pneumatised	Cases	1	0	0	0	1
			% of Total	5.9%	.0%	.0%	.0%	5.9%
		Diploeic	Cases	2	0	0	0	2
			% of Total	11.8%	.0%	.0%	.0%	11.8%
		Sclerosed	Cases	0	1	8	0	9
			% of Total	.0%	5.9%	47.1%	.0%	52.9%
		Diseased cavity	Cases	0	0	0	5	5
			% of Total	.0%	.0%	.0%	29.4%	29.4%
	Total		Cases	3	1	8	5	17
			% of Total	17.6%	5.9%	47.1%	29.4%	100.0%

Table 3: Crosstabulation showing status of mastoid pneumatisation in tubotympanic and atticoantral type of CSOM

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Of the 37 cases in tubotympanic type, x-ray of the mastoids revealed pneumatised mastoid in 13(35.1%), diploeic in 2(5.4%) and sclerosed mastoid in 22(59.5%) cases. HRCT temporal bone revealed pneumatised mastoid in 15(40.5%), diploeic in 1(2.7%), and sclerosed mastoid in 21(56.8%) cases.

Of the 17 cases in atticoantral type, x-ray of the mastoids revealed pneumatised mastoid in 1(5.9%), diploeic in 2(11.8%) and sclerosed mastoid in 9(52.9%) cases. HRCT temporal bone revealed pneumatised mastoid in 3(17.6%), diploeic in 1(5.9%), and sclerosed mastoid in 8(47.1%) cases. Cavity was seen in 5(29.4%) cases. Low lying dura was seen in 4 cases and anteriorly placed sigmoid sinus was seen in 3 cases. Sclerosed mastoid and cavity on x-ray mastoids and HRCT temporal bone as shown in fig. 2 and fig. 3 respectively.

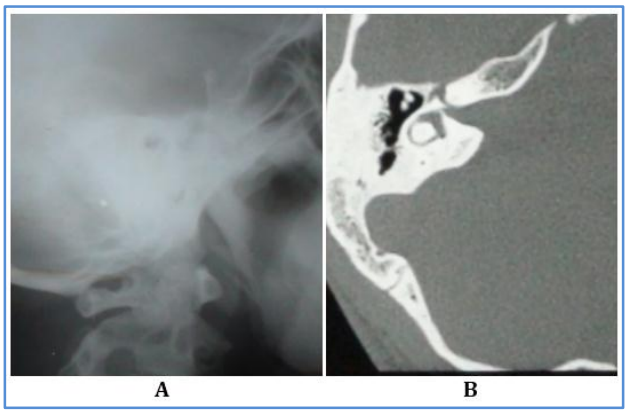

Fig. 2: Sclerosed mastoid on A) X-ray & B) HRCT

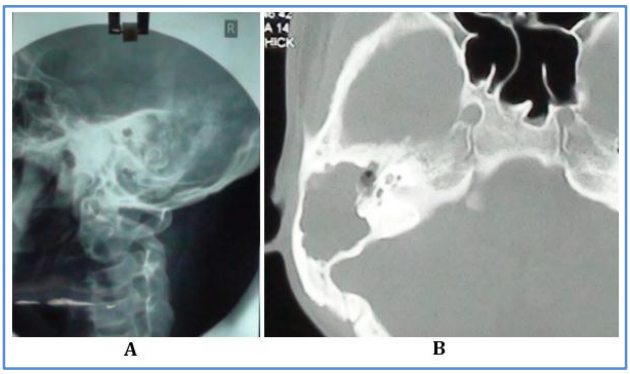

Fig. 3: Cavity on A) X-ray & B) HRCT

	Coinciding	Difference
Normal ear	97.2%	2.8%
Diseased ear	88.9%	11.1%

Table 4: Similarity and difference of the x-ray and HRCT in normal and diseased ears

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In normal ears, the coincidence of x-ray and HRCT findings of status of mastoid was 97.2% except in one case (2.8%) there was a difference as shown in table 4. In this case it was sclerotic on x-ray but diploeic on HRCT. In diseased ears, the coincidence of x-ray and HRCT findings of status of mastoid was 88.9%, the difference was seen in 11.1%. The difference between x-ray and HRCT in diseased ears in 6cases is as shown in table 5.

X ray	HRCT
2 sclerosed	2 diploeic
4 diploeic	4 pneumatised

Table 5: The difference in 6 cases between x-ray and HRCT

DISCUSSION: Pneumatisation may be defined as the process of air-space formation within the temporal bone. The process of pneumatisation begins with the resorption of mesenchyme early in the third foetal month. The potential air spaces do not contain air until the child is born.[5] Resorption of mesenchyme progresses rapidly during the first two months of infancy.

It is practically complete in the middle ear by the sixth month and in the mastoid antrum by the first birthday. From this time onwards, pneumatisation of the mastoid is solely a matter of resorption of the haemopoietic marrow in the diploeic bone.[5]

Radiological evidence of pneumatisation in the mastoid is not usually present until about the third year of childhood.[5]

The pneumatisation of the mastoid region may be divided into three parts:

1) Pneumatic mastoid.
2) Diploeic mastoid.
3) Sclerotic mastoid.

The non-pneumatised areas are the bone marrow (in the diploeic mastoid) and the dense bone (in the sclerotic mastoid).

Allam's more simple classification of pneumatisation of the temporal bone are as follows.[6]

- The mastoid (the antrum, central mastoid tract, tegmental, sinodural, sinal, facial,and tip cells).
- Perilabyrinthine (supralabyrinthine and infralabyrinthine areas).
- Petrous apex (peritubal area and apical area).
- Accessory region (zygomatic, squamous, occipital, styloid).

These patterns were well appreciated on HRCT.[7]

The mastoid antrum may be the only airfilled space in the mastoid process when the name acellular or sclerotic is applied. This occurs in 20% of the adults with chronic suppurative otitis media.[8]

Normally, the pneumatisation is symmetrical in 72-99%.[9, 10] When pneumatisation is affected, the ear is suspected to be diseased with possibility of new bone formation and hence sclerosis. In studying temporal bone pneumatisation, high resolution computed tomography (HRCT) must be used, because this technique has the advantage that it shows the complete pneumatisation with excellent resolution as observed by Virapongse et al.[7]

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Holmquist stated that the success of the middle ear surgery depends on the degree of the mastoid pneumatisation.[11]

In our study in diseased ears, x-ray of the mastoids revealed pneumatised mastoid in 25.9%, diploeic in 7.4%, sclerosed mastoid in 57.4% and diseased cavity in 9.3% of the cases. These findings were similar to a study by Tripti.[12] HRCT temporal bone revealed pneumatised mastoid in 33.3%, diploeic in 3.7%, sclerosed mastoid in 53.7%. These findings were similar to Tripti.[12]

On normal side, x-ray of the mastoids revealed pneumatised mastoid in 61.1%, diploeic in 2.8% and sclerosed mastoid in 36.1% of the cases. HRCT temporal bone revealed pneumatised mastoid in 61.1%, diploeic in 5.6%, and sclerosed mastoid in 33.3% of the cases. In a study by Sethi et al, in the normal ear, 84% had well pneumatized mastoid air cell system and 16% had poor pneumatization on x-ray.[13]

Of the 37 cases in tubotympanic type, x-ray of the mastoids revealed pneumatised mastoid in 35.1%, diploeic in 5.4% and sclerosed mastoid in 59.5% of cases. HRCT temporal bone revealed pneumatised mastoid in 40.5%, diploeic in 2.7%, and sclerosed mastoid in 56.8% of the cases.

In atticoantral type out of 17 cases, pneumatised mastoid on x-ray was observed in 5.9%, diploeic in 11.8% and sclerosed in 52.9% of the cases. Sclerotic mastoid was seen in x-ray mastoids of all patients with cholesteatoma in a study by Santosh et al.[14] HRCT temporal bone revealed pneumatised mastoid in 17.6%, diploeic in 5.9% and sclerosed in 47.1% of the cases. Cavity was seen in 5(29.4%) cases. These findings were similar to Kataria et al.[15]

P value less than 0.05 using chi-square test, statistically significant.

Low lying dura was seen in 4 cases and anteriorly placed sigmoid sinus was seen in 3 cases on HRCT. These findings were similar to Karaca et al**.** [16] Contracted antrum was seen in 3 cases.

Among the pneumatised mastoids on HRCT, different type of mastoid air cell groups observed were squamomastoid type of air cells in all, with perilabyrinthine type of air cells in 25%, petrous apex pneumatisation in 10% and accessory pneumatisation in 25%.

X-ray and HRCT findings correlated well in 48 cases except in 6 cases where HRCT could detect pneumatisation better. The diploeic mastoid on x-ray was detected by HRCT as pneumatised mastoid in 4 cases and sclerosed mastoid on x-ray as diploeic in 2 cases on HRCT.

The sensitivity and specificity of x-ray and HRCT are 100%. However x-ray showed different findings, HRCT provides a thorough detail regarding the air cells. The types of air cells can be better known with HRCT. HRCT predicts the type of mastoid pneumatisation accurately, which correlates with studies by Vlastarakos et al. (2010), who found strong agreement for mastoid cell aeration. [17]

CONCLUSION: A well taken x-ray mastoids provides the mastoid pneumatisation status. However the air cells and the pneumatisation pattern, low lying dura, anteriorly placed sigmoid sinus are better detected in HRCT. Also the extent of disease involving the mastoid air cells and mastoid antrum is well appreciated with HRCT. Initially an x-ray mastoid can be taken and depending on the disease and surgical plan HRCT temporal bone needs to be taken.

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DOI: 10.14260/jemds/2015/758

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FINANCIAL OR OTHER COMPETING INTERESTS: None

Date of Submission: 17/03/2015.
Date of Peer Review: 18/03/2015.
Date of Acceptance: 01/04/2015.
Date of Publishing: 13/04/2015.