Global Journal of Medical research
Diseases
Volume 13 Issue 3 Version 1.0 Year 2013
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4618 & Print ISSN : 0975-5888

Study of Mastoid Air Cells Diseases using Spiral CT

By Raga Mohammed Musa, Ikhlas Abdelaziz Hassan, M. E.M. Gar El Nabi & Hussein Ahmed Hassan
Sudan University of Science and Technology

Abstract - This study aimed to study the mastoid air cells diseases and their complications using spiral CT, it was conducted in Alfaisal Specialized hospital and Ibn Elhaitham Diagnostic center in the period between September 2012 to January 2013, Hundred patients of different ages and different genders who were suspected of having mastoid air cells pathologies underwent Spiral CT scan of their temporal bones using 4MDSCT (Toshiba medical system),then the scanning was done with collimation of (1-2) mm, 2mm slice thickenings ,120 Kvp ,160 MA and 1 second rotation time. after that The results were confirmed that the mastoid air cells diseases were very common and they had serious complications, (The diseases of mastoditis and mastoditis with CSOM had higher frequency (83 patients among 100 patients).and they had pathological changes of anatomical structures of the temporal bones which contains organs of hearing and balance). Finally the study has found that Spiral CT scan is an effective imaging modality in studying of mastoid air cells diseases and their complications. Also it was more affective to explain the complex anatomical structures of the temporal bones and to know the pathological changes within it.

GJMR-F Classification : NLMC Code: WV 233

STUDY OF MASTOID AIR CELLS DISEASES USING SPIRAL CT

Strictly as per the compliance and regulations of:

Study of Mastoid Air Cells Diseases using Spiral CT

Raga Mohammed Musa [α], Ikhlas Abdelaziz Hassan [σ], M. E.M. Gar El Nabi [ω] & Hussein Ahmed Hassan [¥]

Abstract - This study aimed to study the mastoid air cells diseases and their complications using spiral CT, it was conducted in Alfaisal Specialized hospital and Ibn Elhaitham Diagnostic center in the period between September 2012 to January 2013, Hundred patients of different ages and different genders who were suspected of having mastoid air cells pathologies underwent Spiral CT scan of their temporal bones using 4MDSCT (Toshiba medical system),then the scanning was done with collimation of (1-2) mm, 2mm slice thickenings ,120 Kvp ,160 MA and 1 second rotation time. after that The results were confirmed that the mastoid air cells diseases were very common and they had serious complications, (The diseases of mastoditis and mastoditis with CSOM had higher frequency (83 patients among 100 patients).and they had pathological changes of anatomical structures of the temporal bones which contains organs of hearing and balance). Finally the study has found that Spiral CT scan is an effective imaging modality in studying of mastoid air cells diseases and their complications. Also it was more affective to explain the complex anatomical structures of the temporal bones and to know the pathological changes within it.

I. Introduction

The Mastoid air cells are open spaces containing air that are located throughout the mastoid bone, the prominent bone located behind the ear that projects from the temporal bone of the skull. The air cells are connected to a cavity in the upper part of the bone, which is in turn connected to the middle ear.

Mastoid air cells considered to be an important contributor to the physiology of middle ear function. the mastoid air cell system served as an reservoir of air and serves as buffer system to replace air in the middle ear cavity temporarily in case of Eustachian tube dysfunction. The mean volume of air in the mastoid air cell system could be about 5-8 ml. CT scan evaluation of temporal bone is considered to be the best modality to assess mastoid air cell system (1).

Mastoid air cells diseases most commonly refers to infection or inflammation involving the mastoid air cells. Frequently, an infection will start in the middle ear space (for example, otitis media, a very common problem) and then subsequently involve the mastoid air cells - since they are anatomically connected. Severe cases of the disease may lead to meningitis, which is an infection of the membranes surrounding the brain. Mastoid air cell disease is often diagnosed these days by CT scanning - which shows opacification (e.g. fluid accumulation) in the air cells. (1)

A computerized tomography (CT) scan of the mastoid process reveals the air cells as small, dark spaces separated by lighter areas of dense bone cells. Inflamed or infected cells will appear as gray or white areas on the scan where the darkened spaces would be expected to be located. When these abnormal looking cells are present, they are called mastoid cell opacification(2).

Helical CT has become the method of choice for many routine and new clinical applications. It provides good image quality for body imaging applications at table advancement per rotation of 1 to 2 times the x-ray beam collimation (3&4). Using 3D, multi-planar reformation ~MPR! Or maximum intensity projection ~MIP! Techniques would be benefited by improved volume coverage speed performance (3&4). Recent advances in 32, 64 and now 128-slice CT scanners allow the acquisition of high-resolution, volumetric data that allows image reconstruction in any plane. The advent of high-resolution CT scanning in the 1980s has revolutionized diagnostic imaging of the temporal bone. CT scanning offers the greatest structural definition of any currently available imaging modality (5&6). Temporal bone is a complex structure which contains organs for hearing and balance. Large vessels and nerves pass through temporal bone. Because of its complex anatomic structure and functional properties temporal bone is one of the most challenging organs for radiologists to detect diagnostic findings. It is obligatory to have a good knowledge of its anatomy and functions in order to accomplish optimal radiological evaluation (7).

CT is a standard examination technique in diagnosing and treatment of temporal bone diseases (7&8) Slices in different planes can be obtained by CT and it is possible to understand the complex relationship of ana¬tomical structures. Its capability of obtaining slices less than 1 mm and the development of specific examination techniques for restricted density regions increased the imaging rate of detailed examinations. With the advent of multislice CT after gaining axial 3D

Author σ : College of Medical Radiologic Science Sudan University of Science and Technology P.O.Box 1908, Khartoum, Sudan.
E-mail : Ikhlas_Abdelaziz@yahoo.com

volumetric scan¬ning coronal and sagittal reformatted slices can be ob¬tained. By this technique total radiation dose can be decreased using 0.5 mm slice thickness. A CT with a sub-milimetric spatial resolution, slice thickness of 2 mm or less, wide window settings, bony detail reconstruction algorithm, having target reconstruction and high quality image reformatting programs is very efficient in evalua¬tion of inflammatory middle ear pathologies (9 &10). The most important advantage of spiral CT in temporal bone imaging is its perfect visualization of the contrast between bony structures and the air in the middle ear. In addition to detailed evaluation of the bony structures it also permits assessment of soft tissue components as well. (8 &11). This study aimed to study the mastoid air cells diseases and their complications using spiral CT, it was conducted in Alfaisal Specialized hospital and Ibn Elhaitham Diagnostic center.

II. Materials & Methods

a) Materials

i. Machine

Toshiba (4 multi slice detector) Spiral CT scanner which is not different in external appearance from conventional CT scanner However, there are significant differences in several major equipment components

ii. Patient's Population

Hundred patients (58 female & 42 male) their ages between (15 -70) years who were suspected of mastoid air cells pathologies were referred to CT department centers for CT scan of the temporal bones.

b) Methods

i. Technique

We obtained the temporal bone scans using 2 mm collimation with a 2 mm slice thickness at 120 kVp, 160 mA, 1 second rotation time and a 240 mm field of view with a matrix size of 512 x 512. The initial data sets were then reconstructed at 2 mm intervals. All studies were therefore obtained with the neck flexed such that the infra-orbito-meatal line was parallel to the scanning plane when obtaining images in the axial plane. A zero degree gantry tilt when obtaining such images ensured no distortion of the post-processed 3D images. Volume-rendered 3D images were generated from the original 2D data with different soft tissue and bone

All post-processed images, axial scans and coronal MPR were studied by senior technologist and diagnosed by radiologist.

ii. Data Analysis

The data were collected by using questionnaire and medical reports and were analyzed by using statistical package of social science (SPSS).

III. Results

This study carried out in 100 patients their ages between (15 to 70) years old, whom suspected of mastoid air cells pathologies using 4 MDSCT (Toshiba medical system), the study was done according to gender, clinical diagnosis, side of lesion, signs & symptoms, anatomical variations and CT diagnosis and the results obtained as following.

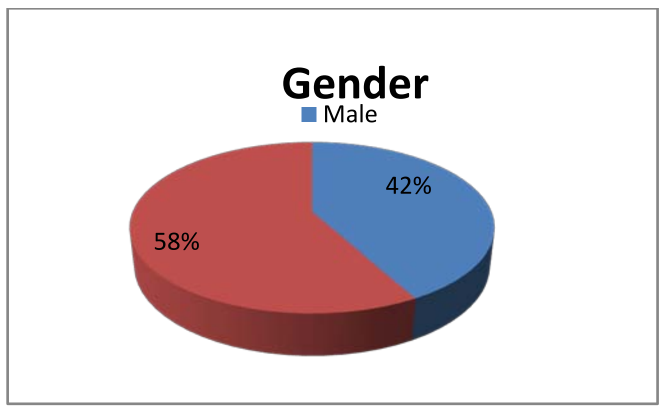

Figure (4.1) : Shows gender distribution

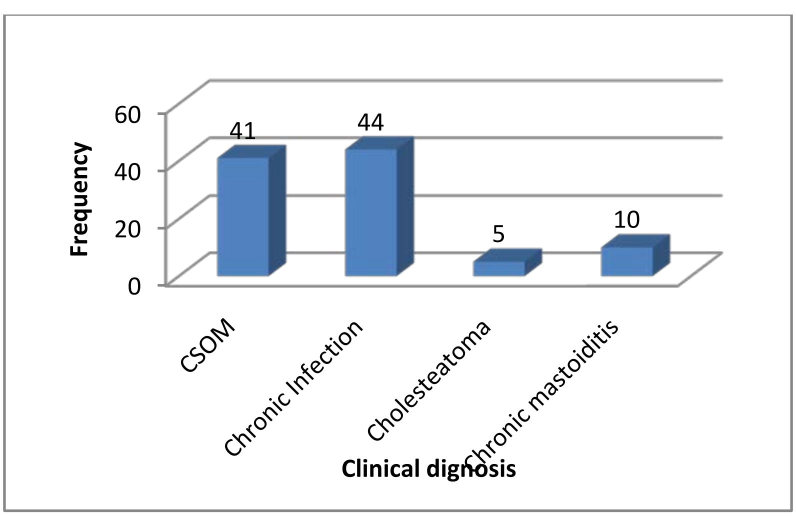

Figure (4.2) : Shows clinical diagnosis frequency

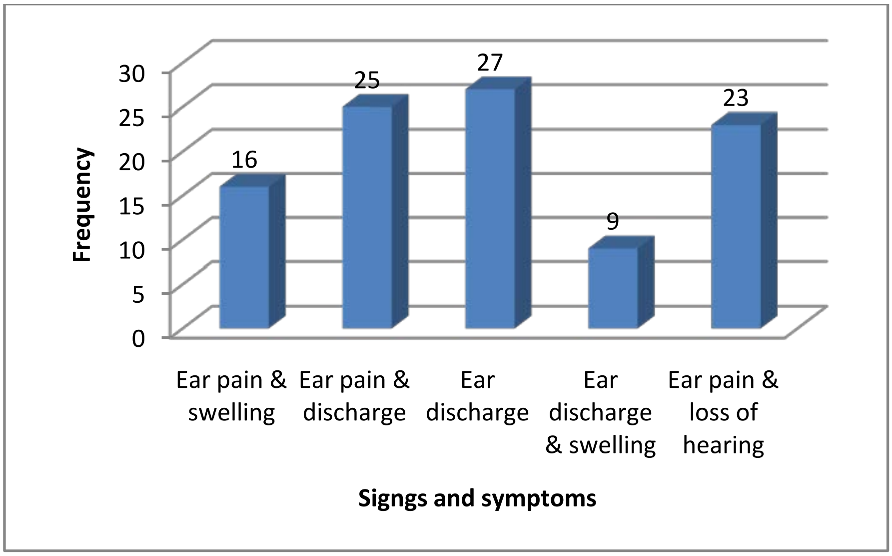

Figure (4.3) : Shows signs &symptoms frequency

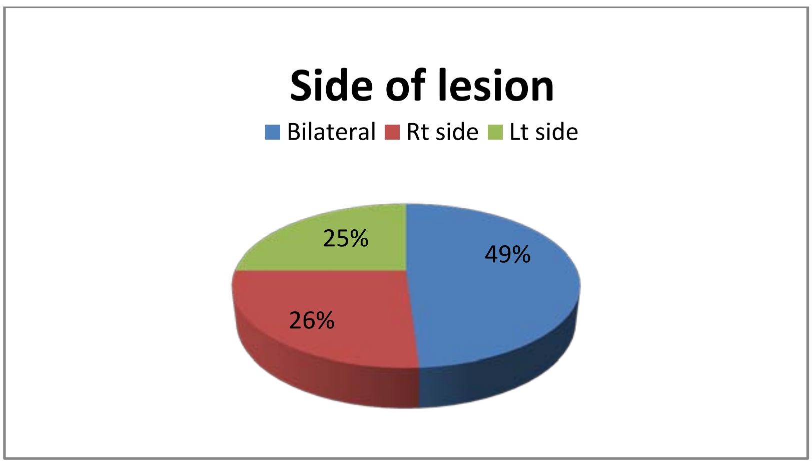

Figure (4.4) : Shows side of lesion distribution

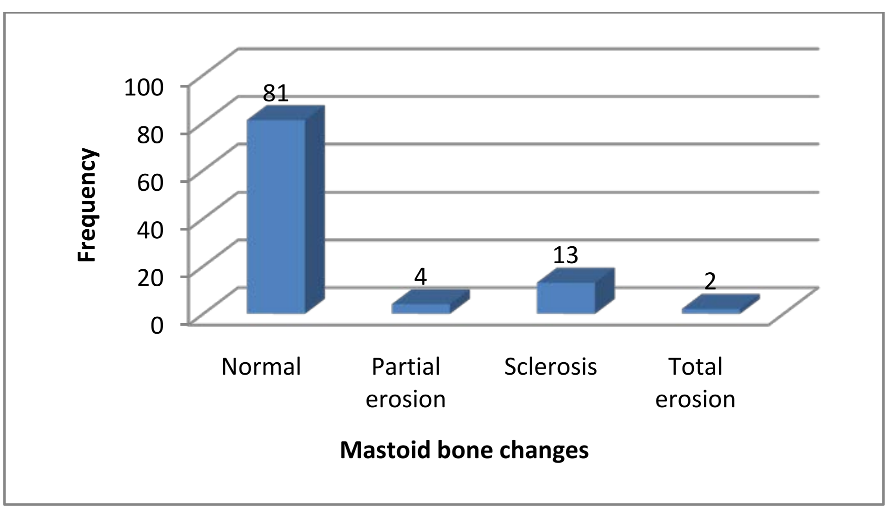

Figure (4.5) : Shows mastoid bone changes frequency

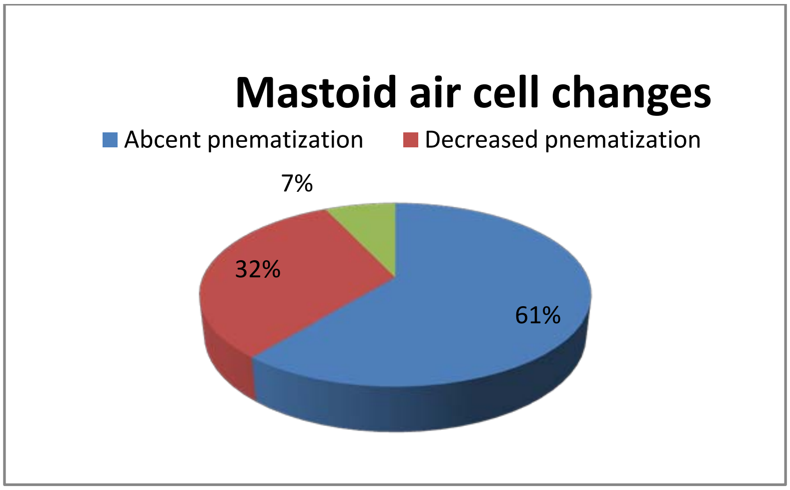

Figure (4.6) : Shows mastoid air cells changes distribution

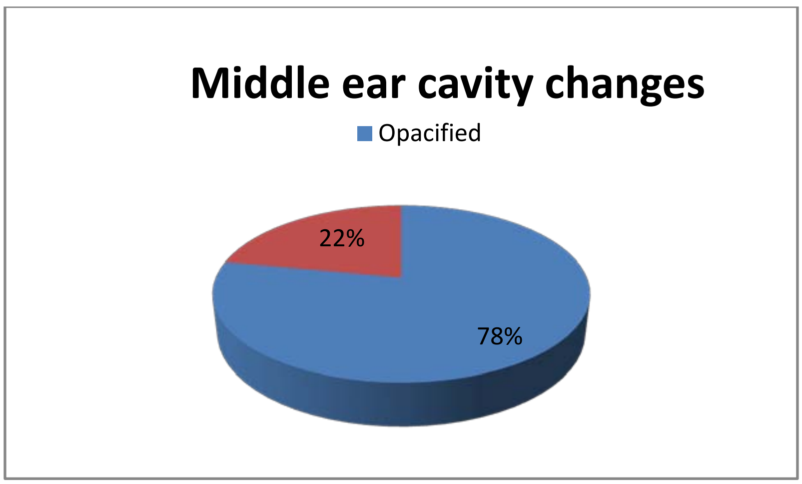

Figure (4.7) : Shows middle ear cavity changes distribution

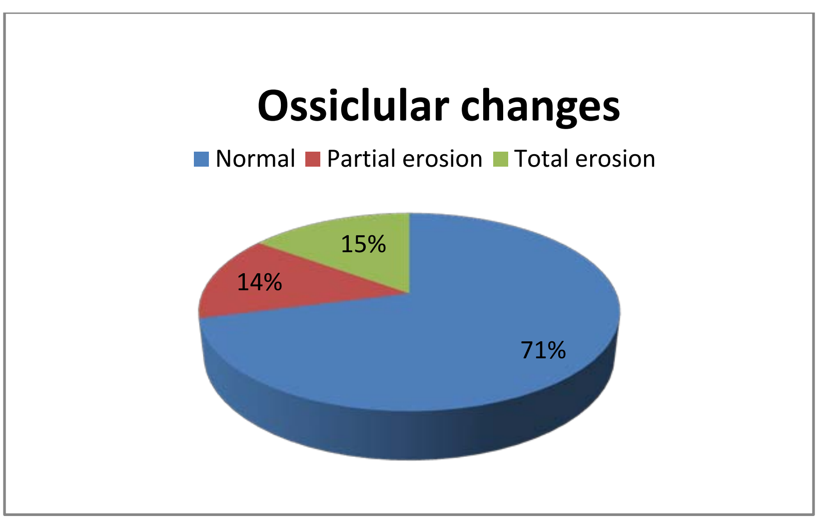

Figure (4.8) : Shows ossicular changes distribution

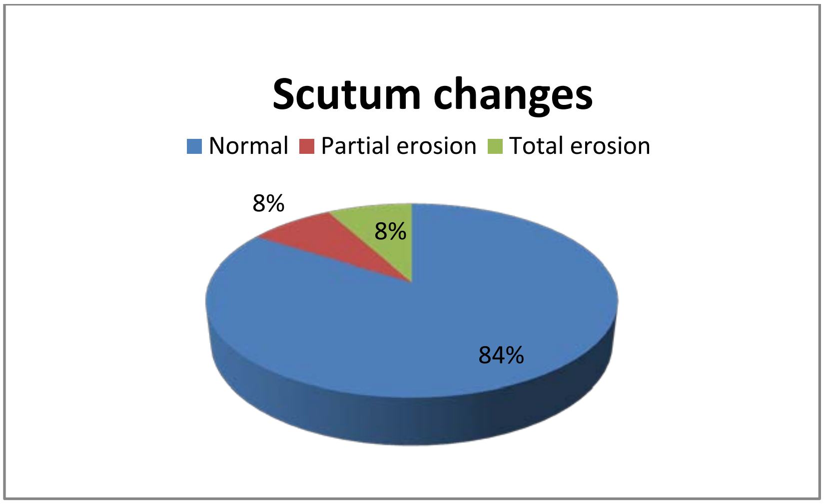

Figure (4.9) : Shows scutum changes distribution

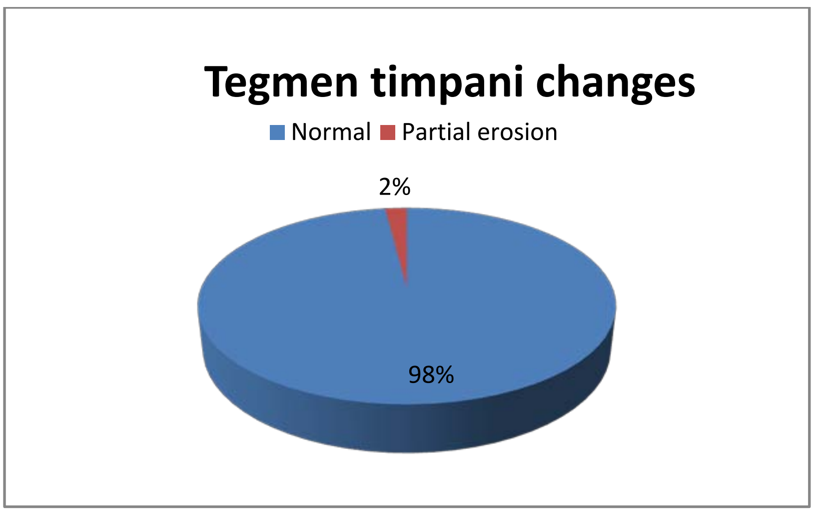

Figure (4.10) : Shows tegmen timpani changes distribution

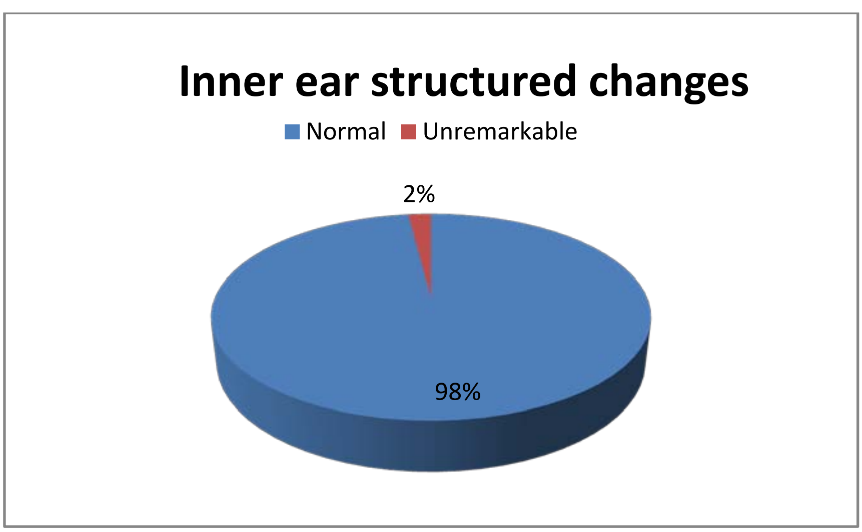

Figure (4.11) : Shows inner ear structures changes distribution

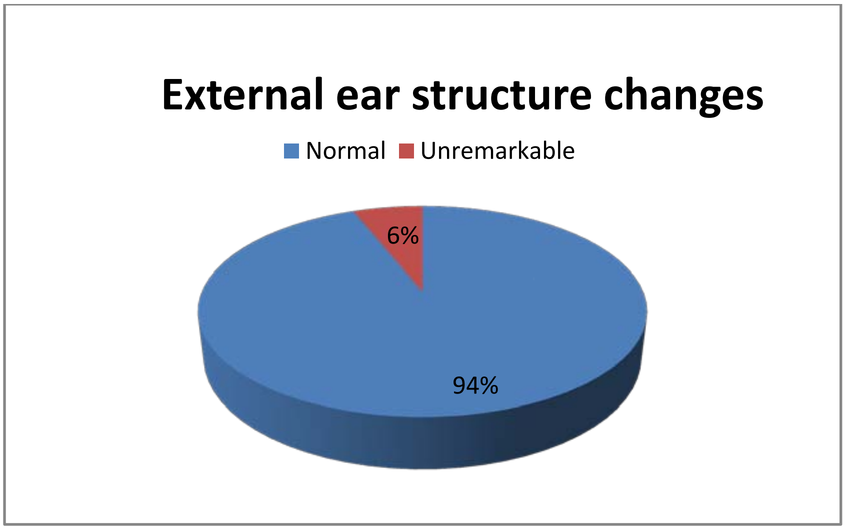

Figure (4.12) : Shows extremer ear structures changes distribution

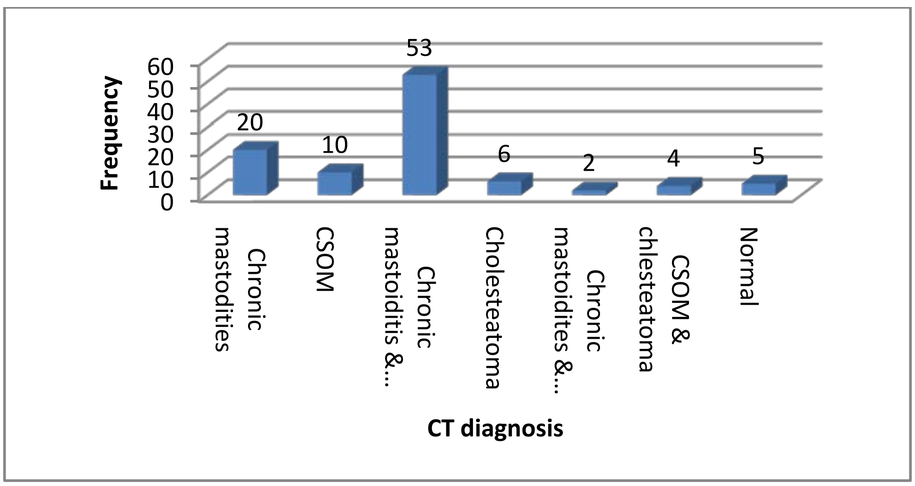

Figure (4.13) : Shows CT diagnosis frequency

Table (4.1) : Demonstrates CT diagnosis * Clinical diagnosis Cross tabulation

CT diagnosis	Clinical diagnosis				Total
	CSOM	Chronic Infection	Cholesteatoma	Chronic mastoiditis	
Chronic mastodities	2	14	0	4	20
CSOM	8	2	0	0	10
Chronic mastoditis& CSOM	28	19	0	6	53
Cholesteatoma	0	2	4	0	6
Chronic mastoidites & cholesteatoma	1	1	0	0	2
CSOM & chlesteatoma	1	2	1	0	4
Normal	1	4	0	0	5
Total	41	44	5	10	100

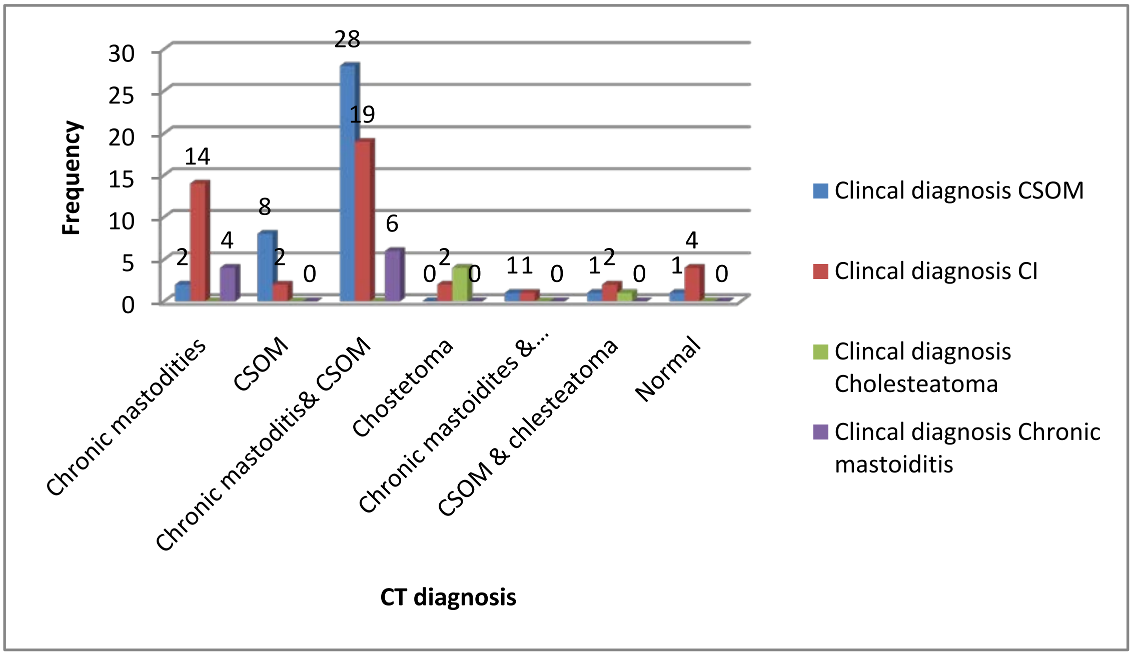

Figure (4.14) : Shows CT diagnosis & clinical diagnosis Cross tabulations

Table (4.2) : Demonstrates CT diagnosis * signs & symptoms Cross tabulation

CT diagnosis	Signs & amp; symptoms					Total
	Ear pain & swelling	Ear pin & discharge	Ear discharge	Eear discharge & swelling	Ear pain & loss of hearing	
Chronic mastodities	4	5	7	2	2	20
CSOM	2	2	3	2	1	10
Chronic mastoditis &CSOM	8	13	17	5	10	53
Cholestetoma	1	0	0	0	5	6
Chronic mastoidites & cholesteatoma	0	0	0	0	2	2
CSOM & cholesteatoma	1	0	0	0	3	4
Normal	0	5	0	0	0	5
Total	16	25	27	9	23	100

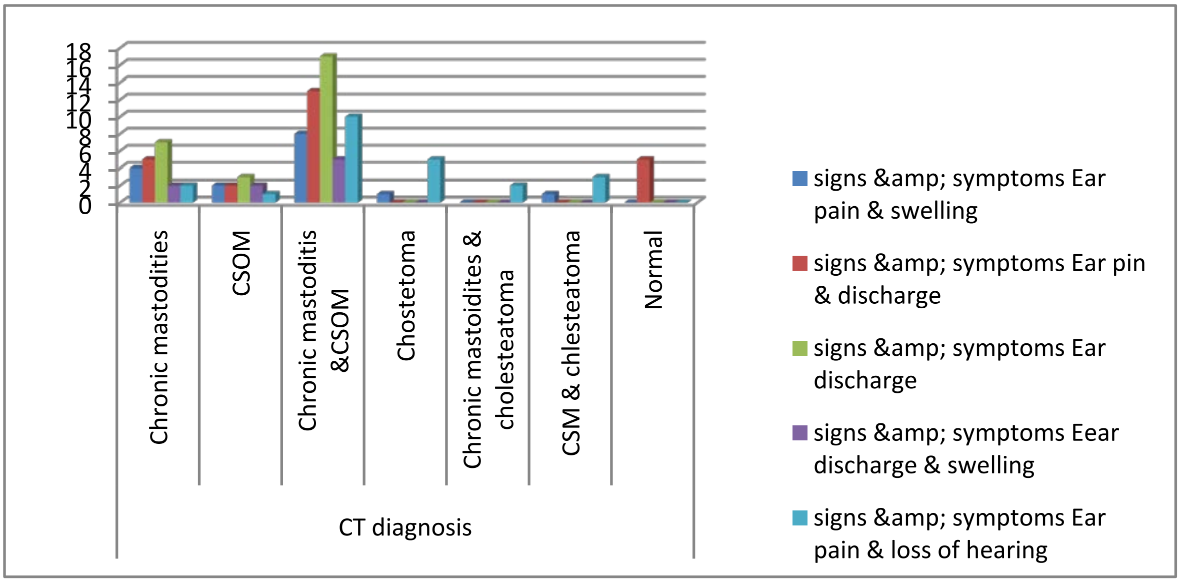

Figure (4.15) : Shows CT diagnosis & signs and symptoms cross tabulation

Table (4.3) : Demonstrates CT diagnosis * Side of lesion Cross tabulation

CT diagnosis	Side of lesion			Total
	Bilateral	Rt side	Lt side	
Chronic mastodities	10	3	7	20
CSOM	4	5	1	10
Chronic mastoditis & CSOM	30	10	13	53
Cholesteatoma	1	3	2	6
Chronic mastoidites & cholesteatoma	1	1	0	2
CSM & cholesteatoma	3	1	0	4
Normal	0	3	2	5
Total	49	26	25	100

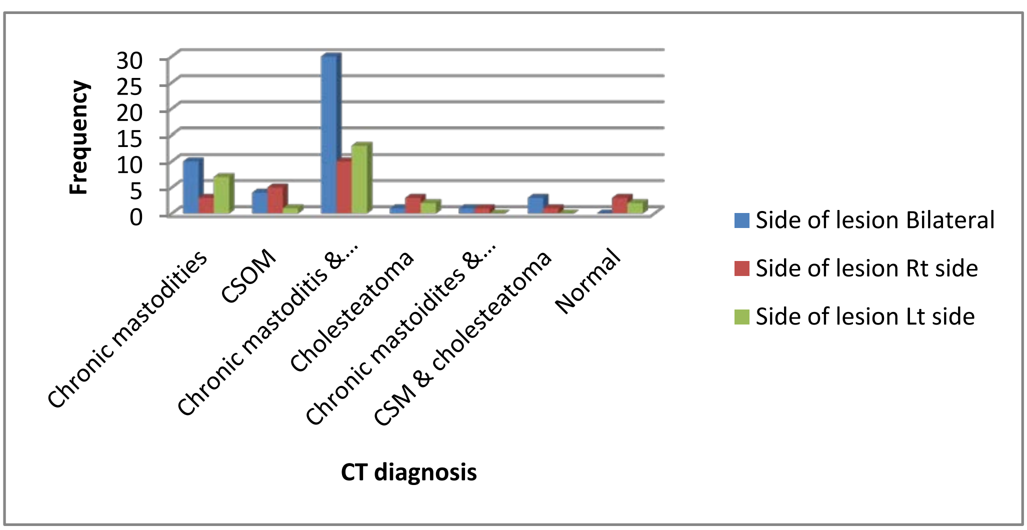

Figure (4.16) : Shows CT diagnosis & side of lesions cross tabulation

Table (4.4) : Demonstrates CT diagnosis * Mastoid bone changes Cross tabulation

CT diagnosis	Mastoid bone changes				Total
	Normal	Partial erosion	Sclerosis	Errigular	
Chronic mastodities	15	1	4	0	20
CSOM	10	0	0	0	10
Chronic mastoiditis & CSOM	43	1	8	1	53
Cholesteatoma	5	0	1	0	6
Chronic mastoidites & cholesteatoma	1	1	0	0	2
CSOM & chlesteatoma	2	1	0	1	4
Normal	5	0	0	0	5
Total	81	4	13	2	100

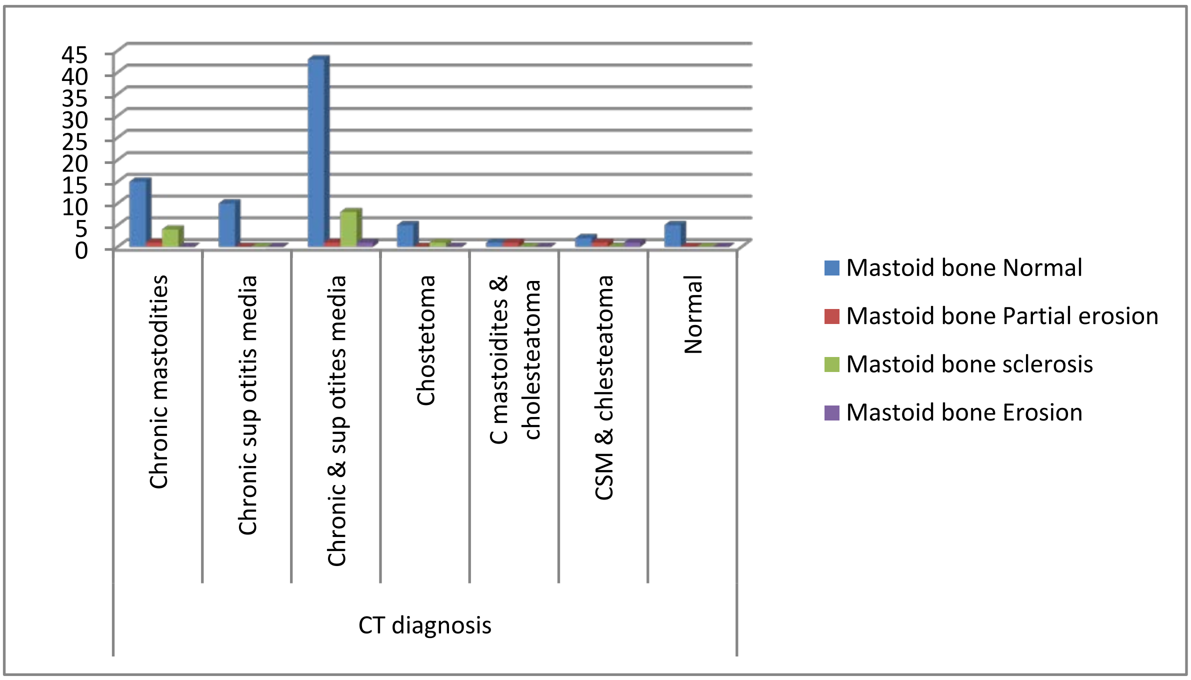

Figure (4.17) : Shows CT diagnosis & mastoid bone changes Cross tabulation

Table (4.5) : Demonstrates CT diagnosis * mastoid air cells changes Cross tabulation

CT diagnosis	Mastoid air cells changes			Total
	Abcent pnematization	Decreased pnematization	Normal	
Chronic mastodities	13	7	0	20
CSOM	4	5	1	10
Chronic mastoiditis & CSOM	36	17	0	53
Cholesteatoma	4	1	1	6
Chronic mastoidites & cholesteatoma	1	1	0	2
CSOM & cholesteatoma	3	1	0	4
Normal	0	0	5	5
Total	61	32	7	100

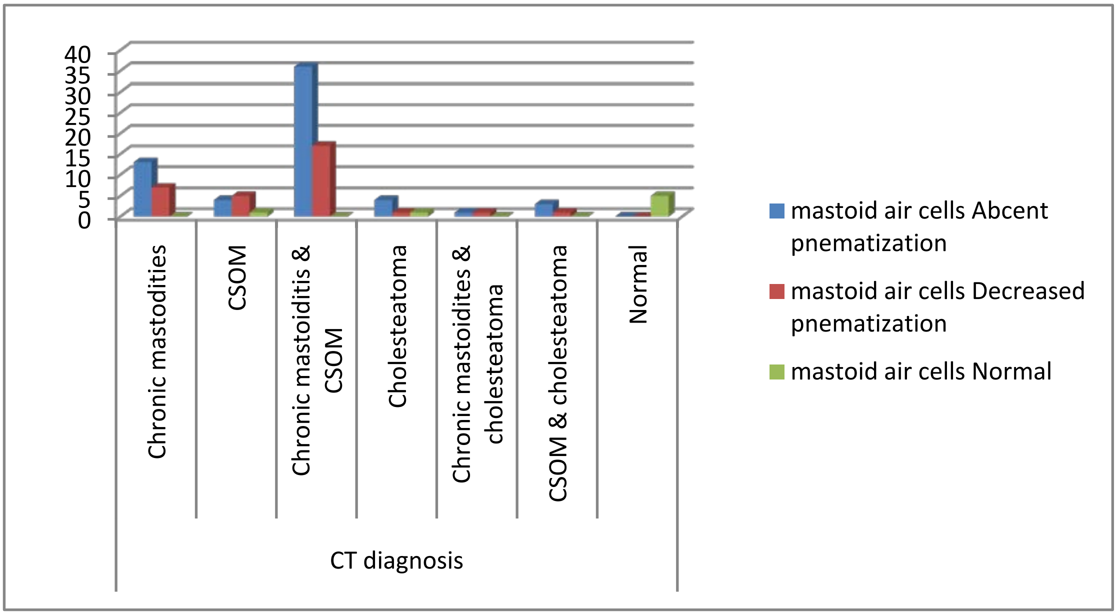

Figure (4.18) : Shows CT diagnosis & mastoid air cells changes Cross tabulation

Table (4.6) : Demonstrates CT diagnosis & middle ear cavity changes cross tabulation

CT diagnosis	Middle ear cavity changes		Total
	Obacified	Normal	
Chronic mastodities	5	15	20
CSOM	9	1	10
Chronic mastoiditis&CSOM	53	0	53
Cholesteatoma	6	0	6
Chronic mastoidites & cholesteatoma	1	1	2
CSOM & cholesteatoma	4	0	4
Normal	0	5	5
Total	78	22	100

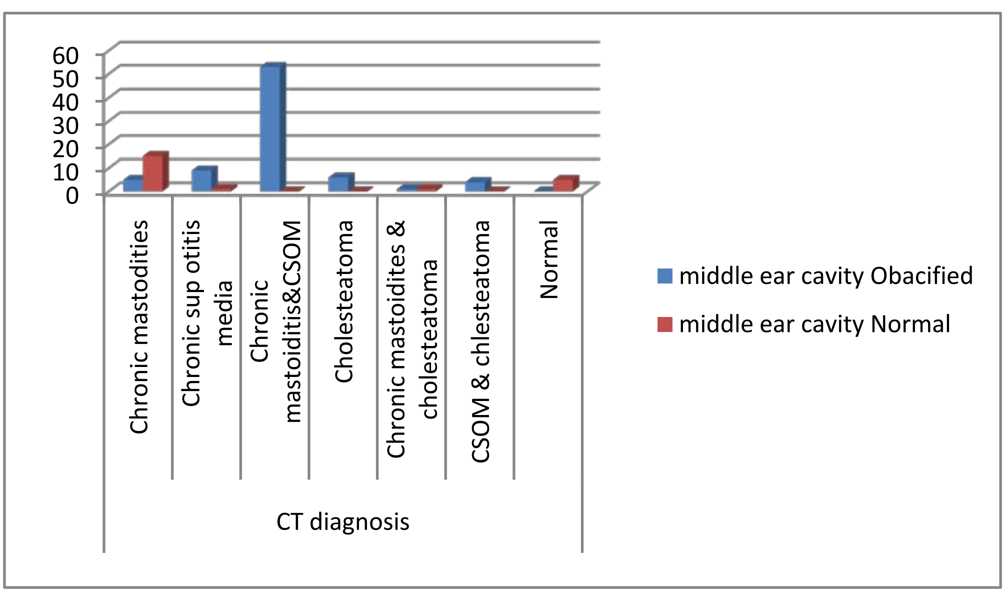

Figure (4.19) : Shows CT diagnosis & middle ear cavity changes Cross tabulation

Table (4.7) : Demonstrates CT diagnosis * Ossicular changes Cross tabulation

CT diagnosis	Ossicular changes		Total
	Normal	Erosion	
Chronic mastodities	18	2	20
CSOM	04	6	10
Chronicmastoiditis &CSOM	40	13	53
Cholesteatoma	2	4	6
Chronic mastoidites & cholesteatoma	0	2	2
CSOM & cholesteatoma	2	2	4
Normal	5	0	5
Total	71	29	100

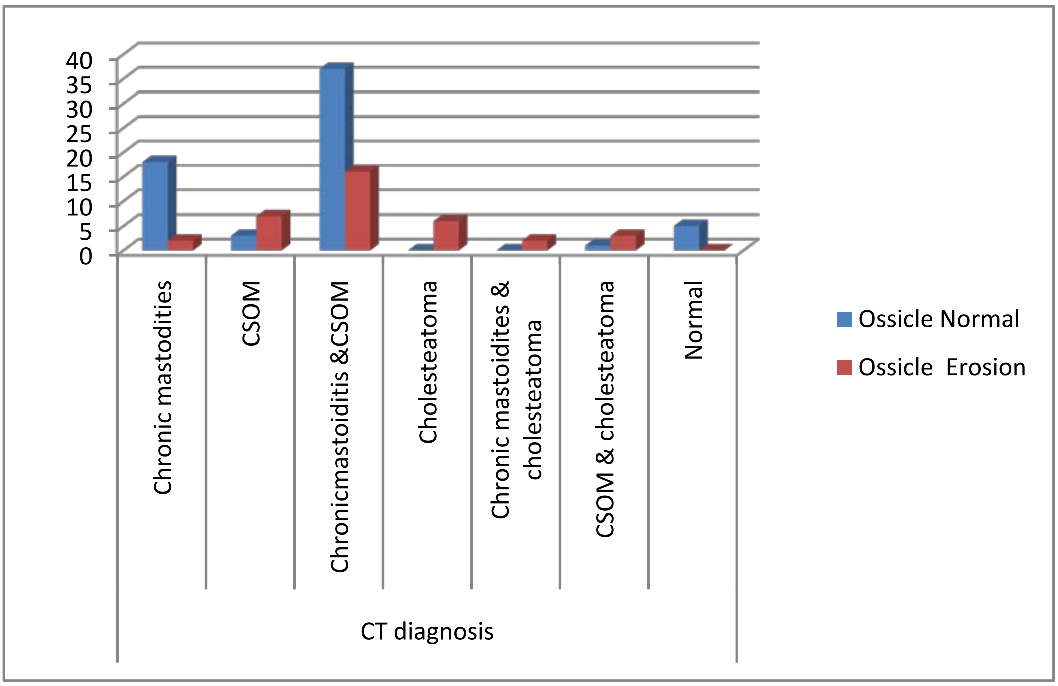

Figure (4.20) : Shows CT diagnosis & ossicular changes Cross tabulation

Table (4.8) : Demonstrates CT diagnosis * scutum changes Cross tabulation

CT diagnosis	Scutum changes			Total
	Normal	Partial erosion	Total erosion	
Chronic mastodities	19	0	1	20
COM	10	0	0	10
Chronic mastoiditis &CSOM	50	2	1	53
Cholesteatoma	0	3	3	6
Chronic mastoidites & cholesteatoma	0	2	0	2
CSOM & chlesteatoma	0	1	3	4
Normal	5	0	0	5
Total	84	8	8	100

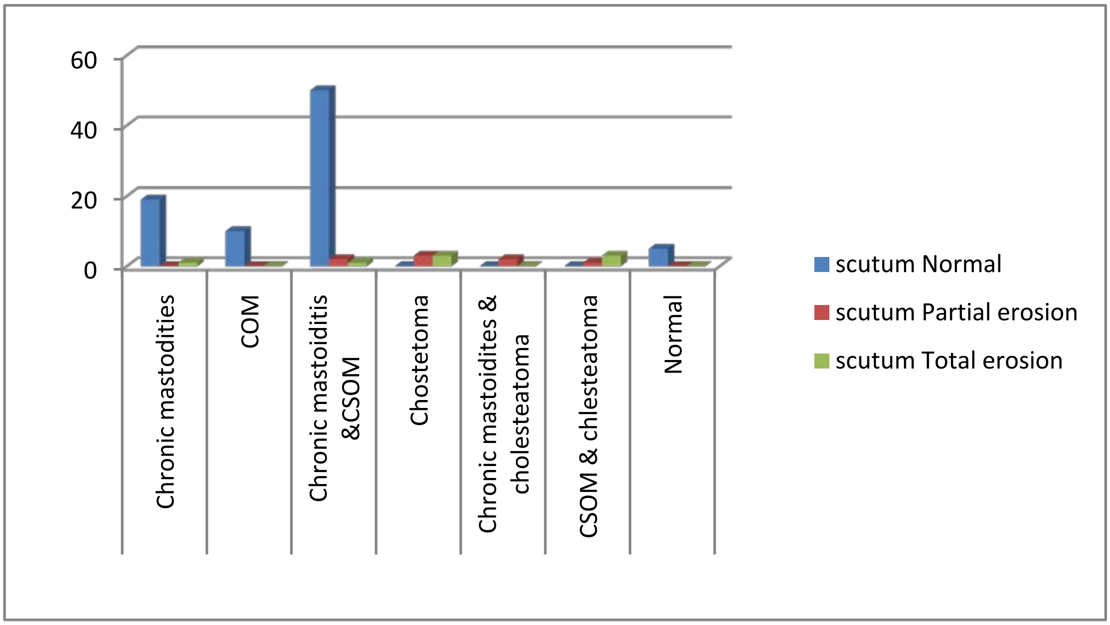

Figure (4.21) : Shows CT diagnosis & scutum changes Cross tabulation

Table (4.9) : Demonstrates CT diagnosis * tegmen timpani changes Cross tabulation

CT diagnosis	Tegmen timpani changes		Total
	Normal	Partial erosion	
Chronic mastodities	19	1	20
CSOM	10	0	10
Chronic mastoiditis &CSOM	53	0	53
Chostetoma	6	0	6
Chronic mastoidites & cholesteatoma	2	0	2
CSOM & chlesteatoma	3	1	4
Normal	5	0	5
Total	98	2	100

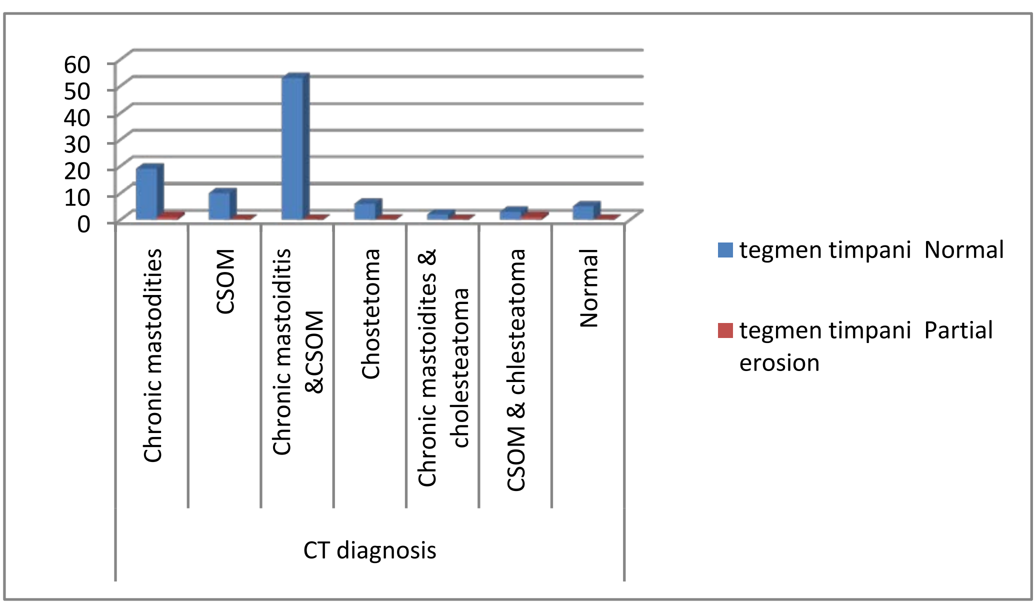

Figure (4.22) : Shows CT diagnosis & tegmen timpani changes Cross tabulation

Table (4.10) : Demonstrates CT diagnosis * inner ear structures changes Cross tabulation

CT diagnosis	Inner ear structures		Total
	Normal	Unremarkable	
Chronic mastodities	19	1	20
CSOM	10	0	10
Chronic mastoditis & CSOM	53	0	53
Chostetoma	6	0	6
Chronic mastoidites & cholesteatoma	2	0	2
CSOM & chlesteatoma	3	1	4
Normal	5	0	5
Total	98	2	100

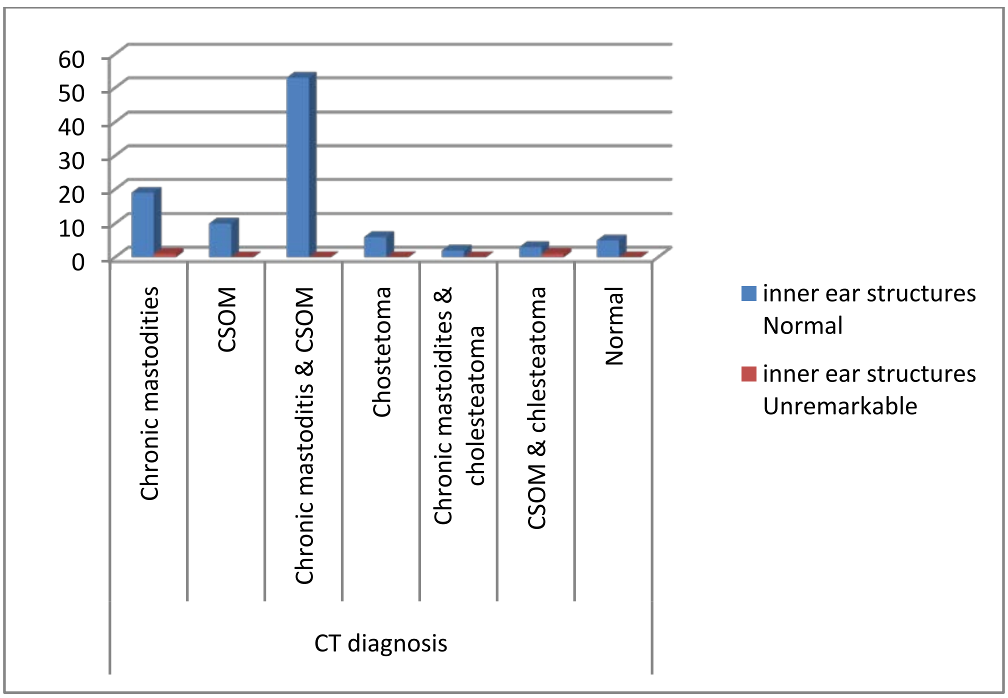

Figure (4.23) : Shows CT diagnosis & Inner ear structure change Cross tabulation

Table (4.11) : Demonstrates CT diagnosis * external ear structures changes Cross tabulation

CT diagnosis	External ear structures		Total
	Normal	Unremarkable	
Chronic mastodities	20	0	20
CSOM	10	0	10
Chronic mastoiditis & CSOM	49	4	53
Chostetoma	5	1	6
Chronic mastoidites & cholesteatoma	2	0	2
CSOM & chlesteatoma	3	1	4
Normal	5	0	5
Total	94	6	100

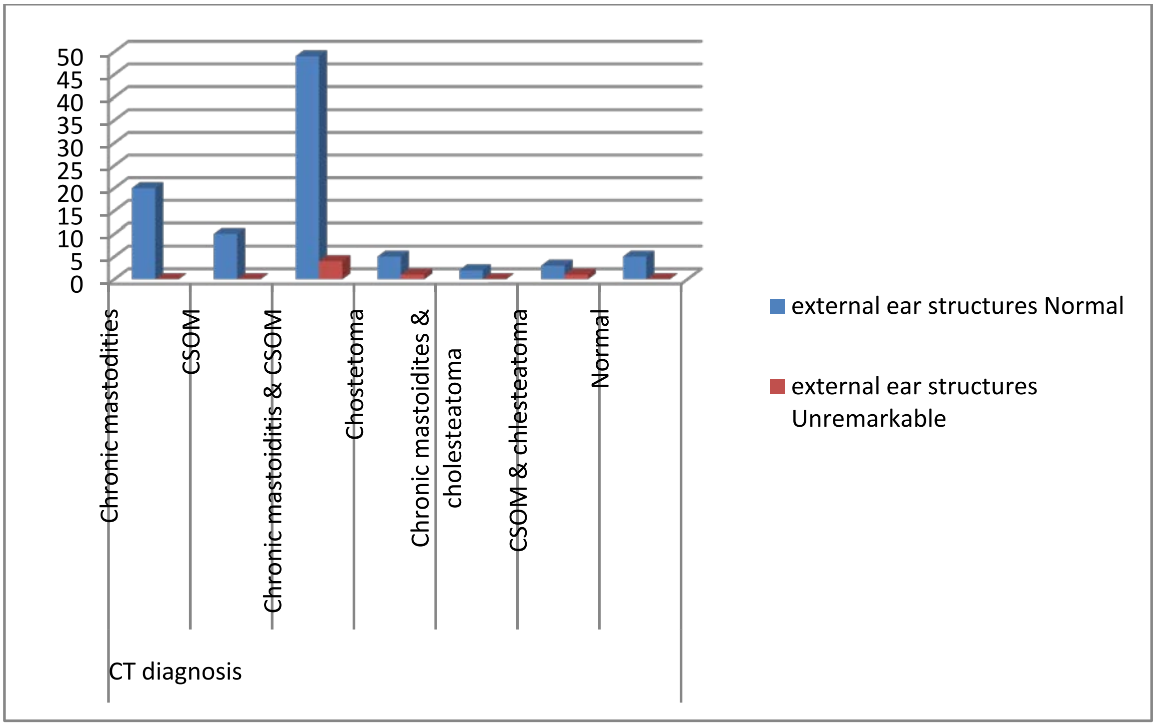

Figure (4.24) : Shows CT diagnosis &external ear structure changes Cross tabulation

IV. Discussion

This study was performed in 100 patients (58 female & 42 male) their ages between (15 -70 years) whom suspected of mastoid air cells pathologies and they were referred to CT department centers for CT scan of the temporal bones using 4 MDSCT (Toshiba Medical System) and the results as the following:

The gender distribution was 58 female & 42% male as explained in figure (4.1). 41% of them were diagnosed clinically as having CSOM (figure 4.2) while by CT 28% of them were diagnosed of having chronic mastoiditis & CSOM , 8% were diagnosed of having CSOM, 2% having chronic mastoiditis and 2% having cholesteatoma &CSOM as shown in table(4.1) & figure (4.14).

44 % of patients were diagnosed clinically as having chronic infection (figure 4.2), while by CT, 19% of them were diagnosed as having chronic mastoiditis &CSOM, 14% as having chronic mastoiditis,7% as having cholesteatoma & CSOM and 4% as normal.

10% of patients were diagnosed clinically as having chronic mastoiditis, while by CT they were diagnosed as follows; 6 % of them having chronic mastoiditis & CSOM and 4% of them having chronic mastoiditis, figure (4.14).

5% of patients were diagnosed clinically as having cholesteatoma (figure 4.2), also by CT they were diagnosed as having cholesteatoma (figure 4.14). This means that cholesteatoma can be diagnosed clinically and by CT. The high variations between clinical and spiral CT diagnosis, represent the accuracy of spiral CT in diagnosing mastoid air cells diseases. The signs & symptoms was; 77% of patients were having ear pain, discharge & swelling (figure4.3), all of them were diagnosed by CT as having chronic mastoiditis & CSOM, 23% of patients were having ear pain & loss of hearing, most of them (13patients) were diagnosed as having chronic mastoditis &CSOM and the others (10 patients) were diagnosed as having cholesteatoma (table 4.2 & fig 4.15).

The side of lesions in 49% of patients was bilateral (fig 4.4), most of them were diagnosed by CT as chronic mastoiditis & CSOM (table 4.3&fig 4.15), 26% of them at the right side and 25% at the left one.

The pathological changes on the mastoid bone was explained as 13patients with mastoid bone sclerosis (fig 4.5) all of them were diagnosed by CT as having chronic mastoiditis & CSOM , 6 patients with mastoid bone erosion 4 of them were diagnosed by CT as having cholesteatoma & 81 patients with normal mastoid bones ,as shown in table (4.4 & fig 4.17).

The mastoid air cells changes as follows; 61% of patients were absent pnematization (figure 4.6), 53 patients of them were diagnosed by CT as having chronic mastoiditis & CSOM while 8 patients were diagnosed as having cholesteatoma, 32% of patients with decreased pnemataization, 29 patients of them were diagnosed by CT as having chronic mastoiditis & CSOM while 3 patients were diagnosed as having cholesteatoma and 7 patients with normal pnematization as shown in table (4.5 & figer 4.18)). This result indicate that the helical CT had effective role in diagnosing mastoid air cells changes and it was superior to the clinical diagnoses.

The middle ear cavity opacification noted on 78% of patients (fig 4.7) 67 patients of them were diagnosed by CT as having chronic mastoiditis &CSOM while 11patients of them were diagnosed as having cholesteatoma. (Table 4.6 & fig 4.19). This was also indicate the efficiency of helical CT to detect middle ear cavity opacification.

The ossicular changes were detected in 29% of patients, 14% of them with partial erosion, while 15% of them with total erosion as shown in figure (4.8).21 patients of them were diagnosed by CT as having chronic mastoiditis & CSOM while 8patients of them were diagnosed as having cholesteatoma. (Table 4.7 & fig 4.20).

These results were compared with the previous study of (Keskin 2011) who was studied 56 patients by helical CT and he found that there was 43 patients of ossicular erosion in their middle ear cavity whom diagnosed with CSOM in 13 patients of them with cholesteatoma and 30 without cholesteatoma. Scutum changes were detected in 16% of patients, 8% patients of them with partial erosion & another 8%patients with total erosion of the scutum as shown in fig (4.9), 12 patients of them were diagnosed by CT as having cholesteatoma while 4 patients of them were diagnosed as having chronic mastoiditis & CSOM (Table 4.8 & fig 4.21).

This study also relative to (Keskin 2011) who detect 35 patients of scutum erosion by helical CT, 28 patients of them were confirm by surgery.

The tegmen timpani erosion were detected in only 2% of patients as shown in table (4.9) & fig (4.22). Also this result was compared with (Keskin2011), there were no tegmen erosion in surgery among 11 patients whom diagnosed as having tegmen erosion by CT, but no tegmen erosion detected by surgery or CT among 44 patients.

Inner ear and external ear structures changes were very low (2% of patients & 6% of patients) respectively, table (4.10) & (4.11) figure (4.23 & 4.24). These results indicate that the middle ear structures were affected more than the inner and external ear structures, thus there was correlation between middle ear diseases and mastoid air cells diseases.

V. Conclusions

Spiral CT is an effective imaging modality in studying mastoid air cells diseases and their complications. The diseases of mastoiditis with CSOM had higher frequency and also their complications (ossicular erosion, scutum erosion, and loss of hearing). There was correlation between mastoid air cells diseases and middle ear diseases, and with the help of spiral CT it is possible to acquire multiple slices and understand the complex relationships of anatomic structures. CT with a spatial resolution below 1 mm, ≤ 2 mm slice thickness, wide window, having bone – detail reconstruction program, target reconstruction and high quality image reconstruction programs is very efficient in studing of mastoid air cells and middle ear pathologies. Using 3D, multi-planar reformation ~MPR! Techniques would be benefited to detect and diagnosed the complications of mastoid air cells diseases. The advent of high-resolution CT scanning has revolutionized diagnostic imaging of the temporal bone. Spiral CT scanning offers the greatest structural definition of any currently available imaging modality.

References Références Referencias

1. Tumarkin A. (1957) The Nature and vicissitudes of the Accessory Air Spaces of the Middle Ear. J the Nature and Significance of Tumarkin A. 71; 210-248
2. Diamant M. (1940) Otitis and Size of the Air Cell System. ActaRadiol (Stockh) 21: 543-8.
3. Brink (1992) ''Spiral CT: Decreased Spatial Resolution In vivo due to Broadening of Section-Sensitivity Profile,'' Radiology 185, 469–474.
4. Brink (1994) ''Helical CT: Principles and Technical Considerations,'' Radio graphics 14, 887–893.
5. Fujii N. (2010). Temporal Bone Anatomy: Correlation of Multiplanar Reconstruction Sections and three-dimensional Computed Tomography images. 28(9): Jpn J Radiol: 637-48.
6. Schwab SA (2011), Comparison of 128-Section Single-Shot Technique with Conventional Spiral Multisection CT for Imaging of the Temporal Bone.
7. Virapogse C, (1983), High Resolution Comput-ed Tomography of the Temporal Bone. 1; 4:107-12.
8. Swartz JD (1982). High Resolution Computed Tomography of the Middle Ear and Mastoid. Radiology; 148:449-54.
9. JAM (2011). Computed Tomography of the Petrous Bone in Otosclerosis and Meniere's disease; 8(1):24-30.
10. Akan H. (2008); MN Medical- Nobel, 2:104.
11. Mafee MF, (1983) Computed Tomography of the Middle Ear in the Evalu-ation of Cholesteatomas and other Soft Tissue Masses: Comparison with pluridirectional tomography. Radiology 148:465-72.

Global Journal of Medical Research (F) Volume XIII Issue III Version I Year 2013