Original Article

International Journal of Dental and Health Sciences
Volume 05,Issue 03

EVALUATION OF EUSTACHIAN TUBE DYSFUNCTION AND HEARING EFFICIENCY IN ORAL SUBMUCOUS FIBROSIS USING AUDIOMETRY AND TYMPANOMETRY

Veenu Gurpal Chhabda[1], Ajit Mishra[2], Anil Govindrao Ghom[3], Ankita Sharma[4]

1.PG student, Department of Oral Medicine and Radiodiagnosis, Maitri Dental College and Research Centre, Anjora, Durg
2.Reader, Department of Oral Medicine and Radiodiagnosis, Maitri Dental College and Research Centre, Anjora, Durg
3.HOD, Department of Oral Medicine and Radiodiagnosis, Maitri Dental College and Research Centre, Anjora, Durg
4.Audiologist, Bal Gopal Hospital, Raipur.

ABSTRACT:

***Background*:** Oral Submucous Fibrosis (OSMF) is a potentially malignant disorder (PMD) characterized by changes in the connective tissue fibers of the lamina propria and deeper parts leading to stiffness of the mucosa and restricted mouth opening. The aetiology of OSMF is multifactorial but arecanut chewing is the main causative agent. Once initiated, OSMF is not amenable to reverse at any stage of the disease process even after cessation of the putative causative factor of arecanut chewing. Though there are many studies of OSMF reporting fibrosis and hyalinization in the sub-epithelium, there is a lack of information related to the involvement by fibrosis of areas adjoining the oral cavity eg. Ear (Eustachian tube), Oro-pharynx and Pharynx. In OSMF, there can be failure of eustachian tube to effectively regulate air pressure. As eustachian tube function worsens, air pressure of middle ear falls and ear sounds are perceived as muffled and may cause impaired hearing.

***Objectives*:** To evaluate the Eustachian tube function and hearing efficiency with respect to different clinical and functional stages of Oral Submucous Fibrosis (OSMF)

***Material and methods*:** 75 subjects having OSMF were evaluated for the Eustachian tube dysfunction and hearing efficiency with tympanometery and audiometry respectively and compared with 30 controls without OSMF. The data obtained was analyzed statistically. All the variables in the study were subjected to statistical analysis using SPSS 11.5 software package by applying Annova and Chi-square test.

***Result*:** The study revealed a significant correlation between the control and study group. There was a significant correlation of OSMF Groups having Eustachian Tube Dysfunction depending upon the clinical and functional stage of OSMF. The statistical analysis stood significant in the Stage III OSMF where there was involvement of ET along with hearing impairment.

Keywords:OSMF(Oral Submucous Fibrosis),Audiometry,Tympanometry,Eustachion tube dysfunction)

INTRODUCTION:

Oral Submucous Fibrosis (OSMF) is a potentially malignant disorder (PMD) characterized by changes in the connective tissue fibers of the lamina propria and deeper parts leading to stiffness of the mucosa and restricted mouth opening.[1,2] It is a condition predominantly seen among people of Indian origin.[3] It was first reported by Schwartz in 1952 among five Indian females from Kenya and he designated the term 'atropica idiopathica mucosae oris' to this condition.[4] In 1953, Joshi described this condition as 'submucous

*Corresponding Author Address: Dr. Veenu Gurpal Chhabda. E-mail: drveenuchhabda@gmail.com

fibrosis'.[2,5] Pindborg et al defined the condition as "an insidious chronic disease affecting any part of the oral cavity and sometimes pharynx". Although occasionally preceded by and/or associated with vesicle formation, it is always associated with juxtaepithelial inflammatory reaction followed by fibroelastic changes in the lamina propria, with epithelial atrophy leading to stiffness of the oral mucosa causing trismus and difficulty in eating[6]. It is a chronic insidious scarring disease of oral cavity, characterized by progressive inability to open the mouth due to loss of elasticity and development of vertical fibrous bands in labial and buccal tissues. OSMF is preceded by symptoms like burning sensation of the oral mucosa, ulceration and pain.[7]

The aetiology of OSMF is multifactorial but arecanut chewing is the main causative agent. Once initiated, OSMF is not amenable to reverse at any stage of the disease process even after cessation of the putative causative factor of arecanut chewing. The condition may remain either stationary or become severe, leaving an individual handicapped, both physically and psychologically.[2,7,8]

The characteristic features of OSMF are loss of pigmentation of oral mucosa, blanching and leathery texture of oral mucosa, depapillation and reduced movement of tongue, progressive reduction of mouth opening and sunken cheeks. The changes of OSMF are similar to those of systemic sclerosis (scleroderma) but are limited to oral tissues.[7] OSMF is most commonly found in the age group of 20–40 years although it can occur in any decade. It may be associated with oral leukoplakia and other potentially malignant disorders or with oral malignancy.[4,9]

Abnormal or impaired eustachian tube functions (i.e., impaired opening or closing owing to the proximity with the palatal muscles, which gets fibrosed in OSMF) may cause pathological changes in the middle ear. This in turn can lead to hearing disabilities.[10]

The main muscles attached to the eustachian tube and the soft palate are the tensor veli palatine and levator veli palatine. These two muscles and the other accessory muscles are referred to as palatal / paratubal muscles. The cartilaginous portion of the eustachian tube and its musculature is dynamic organ and its ventilatory function and patency may be impaired if these muscles are involved.[11] In OSMF, there can be failure of eustachian tube to effectively regulate air pressure. As eustachian tube function worsens, air pressure of middle ear falls and ear sounds are perceived as muffled and may cause impaired hearing.[12,13]

Very few studies in the literature have specified and correlated the stage of OSMF and its association with Eustachian tube functions.

MATERIALS AND METHODS:

The Prospective cross-sectional study was done in department of Oral medicine and Radiodiagnosis of Maitri Dental College and research centre, Durg (C.G.) from June 2015 to August 2017. The study took progression after obtaining clearance from the Institutional Ethical committee. The patients involved in the study (both control and study group) were informed about the study in their respective vernacular languages and an informed consent was obtained. The patients with OSMF visiting the E.N.T. Department, Government Medical College and Hospital, Raipur, Chhattisgarh, India were included in the study. The study comprised of 105 total subjects. Group I comprised of 30 normal patients (control group), 60 ears with no deleterious habits and without any ear disorders. Group II comprised of 75 patients (study group), 150 ears diagnosed with Oral Sub Mucous Fibrosis, which were in turn classified in to 3 sub groups based on their clinical and functional staging. Clinical and Functional staging was done according to Haider and Minal et al.[14,15]

Group A: 30 OSMF patients with stage 1 mouth opening 40 and >40mm
Group B: 30 OSMF patients with stage 2 mouth opening 20-39mm
Group C: 15 OSMF patients with stage 3 mouth opening ≤ 19mm
Diagnosis of OSMF was made as per the criteria given by Pindborg (1989) i.e. Presence of burning sensation, blanching of oral mucosa, Restricted tongue protrusion, Restricted mouth opening and Palpable fibrous bands.

Inclusion criteria of the study were 1) Patients diagnosed clinically and functionally with OSMF within the age limit of 18-45 years. 2)Healthy volunteers with no deleterious habits within age group 18-45 years were considered as the control group.

Exclusion criteria were 1) Patients with previous history of middle ear infection/otitis media, ear disorders or surgery. 2)Patients with common cold at the time of ENT evaluation. 3) Patients with hearing loss since childhood.

Audiological assessment was done in the Department of Audiology and Speech therapy by using AC40 Audiometer for Pure Tone Audiometry (P.T.A). and eustachian tube function was determined by GSI TympStar Pro for Tympanometric Evaluation-Impedance Audiometry (I.A).

For pure tone audiometry: 125-20000Hz separated in two ranges 125-8000Hz and 8000-20000Hz were used and with intensity range of -20 to +120 dB. For impedance audiometry, including eustachian tube function test, GSI TympStar Pro Tympanometer with probe tone frequency of 226 Hz with pressure range +400 to -600daPa (decaPascals) was used.

Procedure of Audiometry[15]

Pure tone is delivered to the ear through headphone for air conduction and by bone vibrator for bone conduction. Hearing level in decibel above the normal threshold is plotted. The frequency tested usually ranged from 250 to 8000 Hz.

Interpretation of Audiogram

The pure tone average is the average of the hearing threshold levels at 500, 1000, 2000 Hz only. The deafness can be graded into several categories by air conduction threshold [15,16].

10-25 dB - Normal Hearing, 26-40 dB - Mild, 41-55 dB - Moderate, 56-70 dB - Moderate to Severe ,71-90 dB – Severe, above 90 dB is profound deafness.

When there is a hearing loss, the next step is to try and determine whether the loss is caused by a sensory problem (sensorineural hearing loss) or a mechanical problem (conductive hearing loss). This distinction is made by using a bone vibrator, which bypasses the mechanical parts of the middle ear. If hearing is better using bone than air, this suggests a Conductive Hearing Loss (C.H.L.). In the present study, all the patients were evaluated using both air conductive and bone conductive audiometry.

Procedure of Tympanometry [17]

The patient's ability to equalize the pressure difference between the surroundings and the middle ear is called the tube function. If the patient's tympanic membrane is intact, this measurement is performed in Autotymp mode. The audiometer can automatically give the patient a constant over/under pressure of 200 daPa in the auditory canal. The patient must swallow 8–10 times so that the over/under pressure that the tight tympanic membrane has caused in the middle ear is equalized. The examiner records the compliance graph, and if the eustachian tube functions correctly, the middle ear pressure must now have moved in the opposite direction of the static pressure. Thus, the shifted compliance peaks show that eustachian tube functions are good. If there is no shifting of compliance peaks, then it is poorly functioning.

By charting the compliance of tympano-ossicular system against various pressure changes, different types of tympanograms are obtained. The above-mentioned procedure was performed on both the ears after explaining patient about the procedure. Interpretation of the tympanograms was made on the basis of shape of the tympanogram and values of compliance and pressure at maximum compliance.

The tympanograms were classified depending upon their shape as follows.

1. Type A: It is a normal tympanogram with peak compliance (admittance) at or near 0 daPa. This pattern reflects a normal, air filled middle ear.
2. Type AD: Signifies a tympanogram with an unusually high peak and is

found in cases of tympanic membrane and ossicular abnormality.

3. Type As: Denotes a tympanogram with reduced amplitude, characteristic of ossicular function and some form of otitis media.
4. Type B: Tympanogram is flat and occurs in the presence of middle ear effusion, and other space occupying lesions of the middle ear.
5. Type C: It has a negative tympanometric peak pressure, indicating negative middle ear pressure.
6. Type D: Shows sharp notching, characteristic of scarred tympanic membrane or hypermobile tympanic membranes.
7. Type E: It is characterized by broad smooth notching and is most commonly found in cases of partial or complete ossicular discontinuity.

Statistical Analysis- The data obtained was analyzed statistically. All the variables in the study were subjected to statistical analysis using SPSS 11.5 software package by applying Annova and Chi-square test.

RESULTS:

In the present study, there was male predominance with most of the cases being in 2nd and 3rd decade of life.

On tympanometry evaluation of study group in right ear , group A and group B had type A curve in 100% whereas in group C, 13 (86.66%) had type A curve and 2 (13.33%) had type C curve. [Table 1, Figure 1]

On tympanometry evaluation of left ear in study group, group A had type A curve in 100%. In group B, 28(93.33%) had type A curve and 2 (6.66%) type C curve. In group C, 11(73.33%) type A and 4 (26.66%) type C curves were recorded.[Table2 , Figure 2]

On audiometric evaluation of 75 subject of study group, 12 (11.42%) revealed hearing loss in right ear and 23(21.90%) in left ear. On stratification of samples in study group, in group A there was no hearing loss in either ear whereas in group B there were 4 (13.33%) mild hearing loss in right ear and 11(36.66%) in left ear. In group C, 8 (53.33%) had mild hearing loss in right ear and 10(66.66%) in left ear. [Table3,4, Fig.3,4].

On tympanographic comparison of OSMF and Control group, out of 150 OSMF ears, 142 (94.33%) revealed A type tympanograph and 8(5.33%) showed type C tympanograph. While in control group of 60 ears all had Type A tympanograph.

On comparison of audiometric evaluation between OSMF and Control group, of 150 OSMF ears 117(78%) had normal hearing while 33(22%) had mild conductive hearing loss.

DISCUSSION:

Early symptoms of OSMF include a burning sensation in the mouth, appearance of vesicles, and recurrent generalized inflammation of the mucosa.

As the disease progresses, there is evident blanching along with fibrosis of the oral mucosa. With progressive fibrosis, there is stiffening of areas of the mucosa, leading to difficulty with mouth opening, speaking, and swallowing, as well as taste alteration. Involvement of the nasopharynx may cause pain in the ear and nasal twang.[18]

Traditionally, four muscles are commonly cited as being associated with the Eustachian tube: the tensor veli palatini, levator veli palatini, salpingopharyngeus, and tensor tympani. At one time or another, each has been directly or indirectly implicated in tubal function. Usually the eustachian tube is closed, but it opens during actions such as swallowing, yawning, or sneezing, thereby permitting the equalization of middle ear and atmospheric pressures.[19] The patency and ventilatory function of the eustachian tube may be impaired if any of these muscles is affected by OSMF.[15]

The mean age in this study group was 31.30 years. The study group comprised of 75 males with no females indicating male predominance.

The tympanometric analysis with respect to ear volume revealed normal ear volume in all subjects both in the study group and in the control group.

Analysis with respect to compliance showed all the subjects in the study as well as in the control groups having normal values

Analysis with respect to middle ear pressure revealed significantly reduced pressure in 2 right ears (13.33%) and 4 left ears (26.66%) of Group C, 2 left ears (6.66%) of Group B, compared to that of control group. These values indicate the altered subjective dynamic function of the eustachian tube secondary to the involvement of palatal/paratubal muscles due of the OSMF.

Statistical significance with a p-value of 0.001was obtained in intra and intergroup comparisons further potentiating the effect of ET function in OSMF.

Overall in tympanometric evaluation, out of the 150 ears in the OSMF group, type A curve was obtained in 142 (94.66%) ears and type C curve was found in 8 (5.33%) ears as compared to the normal group in which type A curve was obtained in 150 (100%) ears.

Overall on audiometric evaluation of 150 ears, 117(78%) ears had normal hearing whereas 33 (22%) had mild hearing loss. 3(2%) patients had bilateral mild hearing loss.

Statistical significance was obtained with a p- value of 0.001 in intra- group and inter-group comparison.

Shah et al.[20] reported that out of 54 ears in their OSMF group, hearing was normal in 67%, mild sensorineural hearing loss was found in 22%, and moderate mixed hearing loss was present in 11%.

Gupta et al.[21] reported normal hearing in 79.2% of ears, mild to moderate conductive

hearing in 18.0%, and sensory neural hearing loss in 2.8%

P. Devi et al.[22] revealed on pure tone audiometry of 80 ears in 40 OSMF patients hearing was normal in 56%, mild conductive hearing loss was present in 39%, mild sensorineural hearing loss was present in 4%, and moderate sensorineural hearing loss was evident in 3%. There was no significant difference in mean hearing loss for OSMF groups A and B, whereas a significant difference in mean hearing loss was observed in OSMF groups C and group D as compared with the control group. Group D was significantly associated with mild conductive hearing loss, and normal hearing was significantly associated with the control group as compared with any other group in both the right and left ears ($P < 0.01$; highly significant).

Thus, our study revealed a significant correlation between the control and study group with a significant correlation between OSMF Group and associated Eustachian Tube Dysfunction depending upon the clinical and functional stage of OSMF. The statistical analysis stood significant in the Stage III OSMF where there was involvement of ET which was substantiated by ETFT. Though faucial pillars and soft palate are thought to be involved first in OSMF there was no definitive involvement of ET in Stage I OSMF. Subjects with abnormal Tympanogram i.e. Type C revealed mild CHL potentiating the review of literature. There was male preponderance in our study group owing to the habit of chewing ghutka and betalnut.

CONCLUSION:

It can be concluded that eustachian tube function may be affected in OSMF as the stage progresses. Thus conductive hearing loss is evident as the disease progresses. So, while treating OSMF, hearing disability due to eustachian dysfunction has to be kept in mind because treatment of hearing disability without taking care of OSMF will not be successful.

REFERENCES:

1. Antony G, Sreenivasan BS, Sunil S, Varghese SS, Thomas J, Gopakumar D, et al. Potentially malignant disorders of oral cavity. J Oral Maxillofac Pathol 2011 Jan– Jun;2(1):95–100.
2. Pundir S, Saxena S, Aggrawal P. Oral submucous fibrosis a disease with malignant potential – report of two cases. J Clin Exp Dent 2010;2(4):215–8.
3. Radhakrishna Pillai, PhD, Prabha Balaram, PhD,t and Kannan Sankara Reddiar, MSc, Pathogenesis of Oral Submucous Fibrosis Relationship to Risk Factors Associated With Oral Cancer, Cancer April 25, 2992, Volume 69, No. 8
4. Patidar KA, Parwani RN, Wanjari SP. Correlation of salivary and serum IgG, IgA levels with total protein in oral submucous fibrosis. J Oral Sci 2011;53(1):97–102.
5. Ahmad MS, Ali SA, Ali AS, Chaubey KK. Epidemiological and etiological study of oral submucous fibrosis among gutkha chewers of Patna, Bihar, India.

J Indian Soc Pedod Prev Dent 2006 June;24(2):84–9.
6. Santosh Patil, Sneha Maheshwari.Proposed new grading of Oral Submucous Fibrosis based on cheek flexibility. Clin Exp Dent.2014; 6(3): e255-8.
7. 7) More CB, Asrani M, Patel H, Adalja C. Oral submucous fibrosis-a hospital based Retrospective study. J Pearldent 2010;1(4):25–31.
8. 8) Mehta F, Hamner II JE. Oral submucous fibrosis. In: Mehta F, Hamner II JE, editors. Tobacco-related oral mucosal lesions and conditions in India. Tata Institute of Fundamental Research; 1993. p. 56–67.
9. Sultana N, Pallagatti S, Mohamed AI. P53 expressions in oral submucous fibrosis and oral squamous cell carcinoma. Int J Oral Maxillofacial Pathol 2011;2(1):9–14.
10. Alagiri Chandran and Nalini Aswath, Hearing Impairment in OSMF Journal of Clinical and Diagnostic Research. 2016 Sep, Vol-10(9): ZC13-ZC15
11. Schames J, Schames M, King K, Ulansey S, Boyd J, et al. (2002) Trigeminal pharyngioplasty: Treatment of the forgotten accessory muscles of mastication which are associated with Orofacial Pain and Ear Symptomatology. AJPM 12: 102-112.
12. S.C.Gupta, Mangal Singh, Sanjay Khanna, Sachin Jain (2004) Oral submucosal fibrosis with its possible effect on eustachian tube functions: A Tympanometric study. Indian Journal of Otolaryngology & Head & Neck Surgery 56: 183-185.
13. Chung-Hung T, Shun-Fa Y, Yu-Chao C (2007) The upregulation of cystatin C in oral submucous fibrosis. Oral Oncol 43: 680-685.
14. Haider SM, Merchant AT, Fikree FF, Rahbar MH. Clinical and functional staging of OSMF. Br Jol of Oral and Maxillofac Surg 2000; 38:12-15.
15. Minal S Chaudhary, Mohite DP, Gupta R, Patil S, Gosavi S, et al. Evaluation of Hearing Efficiency in Patients with Oral Submucous Fibrosis. Otolaryngology 3: 143.
16. Anirban Biswas. “Clinical audio-vetibulometry for otologists and neurologists”. nd2 edn, Bhalani Publishing House, Bombay; 1995.
17. Moos KF, Madan DK. Submucous fibrosis. Br Dent J. 1968 Apr 2; 124(7):313-7.
18. Arakeri G, Brennan PA (2013) Oral submucous fibrosis: an overview of the aetiology, pathogenesis, classification, and principles of management. Br J Oral Maxillofac Surg 51, 587-593.
19. Ramírez LM, Ballesteros LE, Sandoval GP (2007) Tensor tympani muscle: strange chewing muscle. Med Oral Patol Oral Cir Bucal 12, E96-100.
20. Maulik Shah, A Katarkar,P Shah et al. Tympanometric study of Eustachian tube function in Oral Submucous Fibrosis.Indian J Otol.April 2011;17(2):e 80-3.
21. SC Gupta,M Singh,S Khanna et al, Oral Submucous Fibrosis with its possible effects on Eustachian Tube functions: A Tympanometric study. Indian.J.Otol.Head and Neck Srgy.July 2004;56(3).
22. Parvathi Devi, Ipsa Singh, Ravindra Setru, Kuber Tyagi, Dharamveer Singh, and Bellona Thiyam, Evaluation of hearing deficit in patients with oral submucous fibrosis, Journal of Oral Science, Vol. 57, No. 2, 109-113, 2015

TABLES:

I. TYMPANOGRAPHIC EVALUATION OF THE RIGHT EAR IN BOTH CONTROLS AND STUDY GROUP.

	RT EAR TYMPANOGRAM		
	TYPE A CURVE	TYPE C CURVE	TOTAL
CONTROL GROUP	30 (100%)	0 (0%)	30
GROUP A	30 (100%)	0 (0%)	30
GROUP B	30 (100%)	0 (0%)	30
GROUP C	13 (86.66%)	2 (13.33%)	15
TOTAL	103 (96.19%)	2 (3.80%)	105

II. TYMPANOGRAPHIC EVALUATION OF THE LEFT EAR IN BOTH CONTROLS AND STUDY GROUP

	LT EAR TYMPANOGRAM		
	TYPE A CURVE	TYPE C CURVE	TOTAL
CONTROL GROUP	30 (100%)	0 (0%)	30 (100%)
GROUP A	30 (100%)	0 (0%)	30 (100%)
GROUP B	28(93.33%)	2 (6.66%)	30 (100%)
GROUP C	11(73.33%)	4 (26.66%)	15 (100%)
TOTAL	99(94.28%)	6 (5.71%)	105(100%)

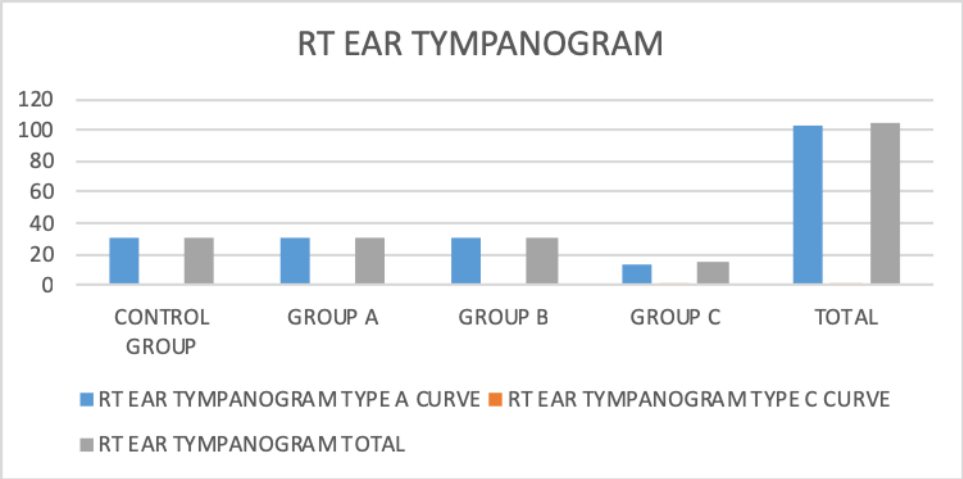
III. AUDIOMETRIC EVALUATION OF THE RIGHT EAR IN BOTH CONTROLS AND STUDY GROUP**.**

	NUMBER OF PATIENTS	NORMAL HEARING	HEARING LOSS IN RT EAR
CONTROL GROUP	30 (100%)	30 (100%)	0 (0%)
GROUP A	30 (100%)	30 (100%)	0 (0%)
GROUP B	30 (100%)	26 (86.66%)	4 (13.33%)
GROUP C	15 (100%)	7 (46.66%)	8 (53.33%)
TOTAL	105 (100%)	93 (88.57%)	12 (11.42%)

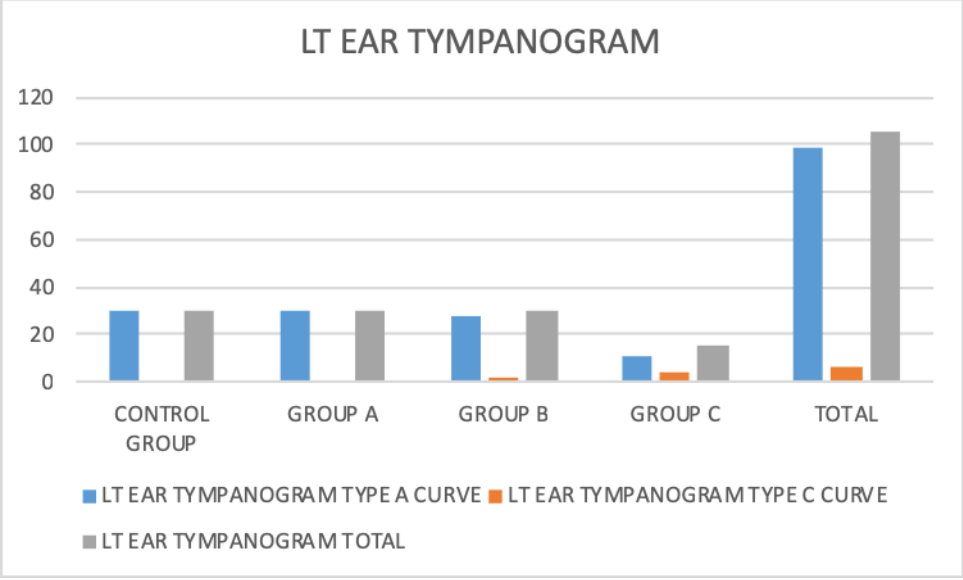
IV. AUDIOMETRIC EVALUATION OF THE LEFT EAR IN BOTH CONTROLS AND STUDY GROUP.

	NUMBER OF PATIENTS	NORMAL HEARING	HEARING LOSS IN LT EAR
CONTROL GROUP	30(100%)	30 (100%)	0 (0%)
GROUP A	30(100%)	30 (100%)	0 (0%)
GROUP B	30(100%)	19(63.33%)	11(36.66%)
GROUP C	15(100%)	5 (33.33%)	10(66.66%)
TOTAL	105(100%)	82(78.09%)	23(21.90%)

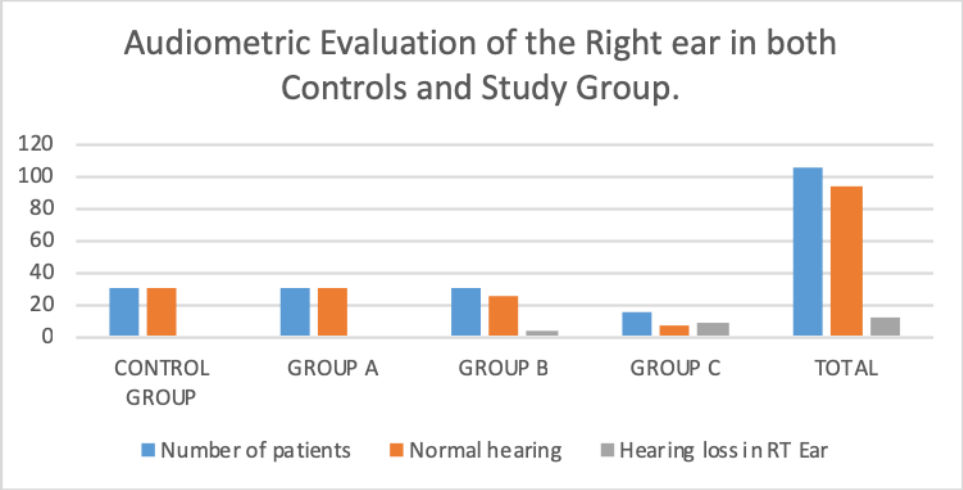
GRAPHS:



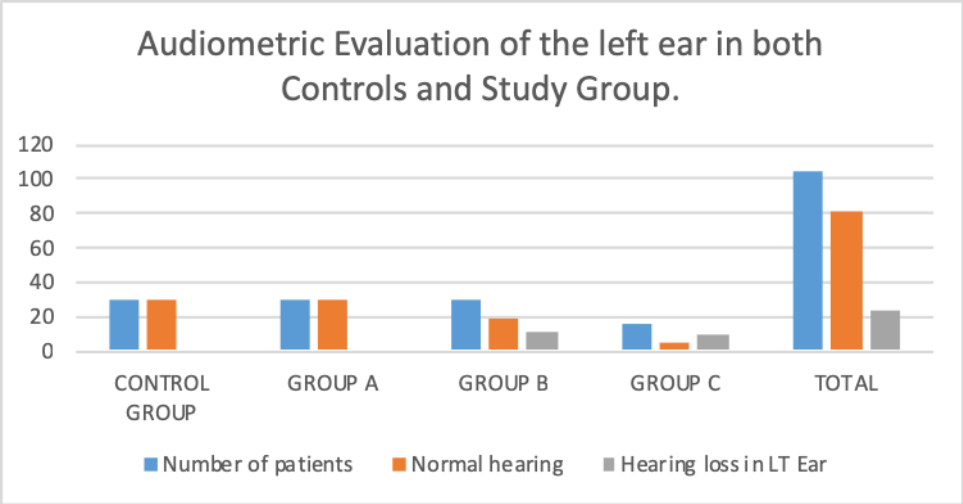
I. Tympanogramic Evaluation of the Right ear in both Controls and Study Group



II. Tympanogramic Evaluation of the left ear in both Controls and Study Group



III. Audiometric Evaluation of the Right ear in both Controls and Study Group



IV. Audiometric Evaluation of the left ear in both Controls and Study Group