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Audiometric and Tympanometric Assessment in Patients with Oral Submucous Fibrosis

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Authors' contributions

This work was carried out in collaboration between all authors. Author MBS designed the study. Author Peeyush Shivhare wrote the protocol and wrote the first draft of the manuscript. Author MY managed the literature searches. Author Pulivarthi Sushma wrote the manuscript. Author PK analyses the study and author SL approved the final manuscript. Author SS performed the experimental process.

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ABSTRACT

Background: Oral submucous fibrosis (OSMF) is regarded as a potentially malignant condition. It is characterized by a mucosal rigidity of variable intensity because of the fibroelastic changes of the juxta epithelial layer, resulting in a progressive inability to open the mouth. Oral submucous fibrosis can cause fibrosis and degeneration of tubal and paratubal muscles extending to nasopharynx causing alteration in eustachian tube function. So, this study was carried out with an aim to determine the effect of OSMF on the function of the eustachian tube.

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Materials and Methods: 80 ears of 40 patients with OSMF and 40 ears of 20 normal persons had undergone audiometry and tympanometry after a thorough history taking and clinical examination.
Results: Out of the 80 ears in the OSMF group, Type A curve in 44 (55%) ears. Type As 13 (16.3%) ears, type Ad in 7 (8.8%) ears, type B in 9 (11.3%) and type C in 7 (8.8%) ears (Table 3, Graph 2). The control group showed type A curve in all individuals. On pure tone audiometry (PTA) of study group hearing was found to be normal in 47 (58%) ears; mild hearing loss was found in 28 (35%) ears and moderate hearing loss in 5 (6.3%) ears while it was normal in all subjects in the control group. When tympanometry curves were compared in different groups of oral submucous fibrosis (according to Khanna et al), a significant relation was found. Type A curve was decreased as the group progress from 1 to 4 while reverse was true for type As, Ad and C curve with significant value of .0009.
Conclusion: The data obtained were analyzed statistically using chi-square test, which suggested a significant association between different stages of OSMF and eustachian tube function. Therefore, it can be concluded that eustachian tube function may be affected in OSMF.

Keywords: Oral submucous fibrosis; audiometry; tympanometry.

1. INTRODUCTION

Oral submucous fibrosis (OSMF) has been regarded as one of the most potentially malignant disorder of the oral mucosa in India. It is characterized by a mucosal rigidity of varying intensity due to the fibroelastic changes of the juxta epithelial layer, resulting in a progressive trismus. Various factors like the chewing of betel nut, use of tobacco, consumption of chillies, genetic susceptibility, autoimmunity, nutritional deficiencies etc. have been attributed to the pathogenesis of OSMF. Based on clinical, epidemiological and animal experimental studies arecanut is considered as a main predisposing factor for OSMF. The pathological changes in this condition not only affect the mucosa and submucosa, but the underlying muscles and deeper tissues are also affected with progressive limitation in mouth opening and tongue movements [1-4].

Tympanometry is a method used to evaluate the function of the middle ear. It provides a graphic representation of the air pressure in the external ear canal to impedance (resistance to movement) of the eardrum and middle ear system. The tympanometer has a handheld probe that is inserted into the ear. Inside the probe there are three tubes with a loudspeaker, a microphone and a pump. The probe is inserted into the ear canal and forms an airtight seal from the pressure of the ear tip against the canal wall. A tone is delivered through the loudspeaker as the pressure changes within the sealed canal. Then the microphone measures the amount of sound that is reflected back during the pressure sweep (sound wave coming from the eardrum). This information is then displayed in graph form – the tympanogram. Different type of tympanometry graph and its significance are tabulated in Table 1 [5,6].

Pure-tone audiometry a behavioral test measures hearing sensitivity. Hearing loss can be of three types, i.e. Conductive, sensorineural and mixed type.

Conductive hearing loss has normal bone-conduction threshold, but air-conduction thresholds decreases than the normal by at least 10 dB. Conductive hearing loss is secondary to an outer or middle ear abnormality, which includes abnormalities of the tympanic membrane. The abnormality decreases the effective intensity of the signal through air-conduction to reach the cochlea, but there is no effect on the bone-conducted signal that does not pass through the outer or middle ear [7-9].

The threshold of bone- and air-conduction sensorineural hearing loss is within 10 dB of each other, and thresholds are higher than 25 dB. Sensorineural hearing loss is secondary to cochlear abnormalities and/or an abnormality of the central auditory pathways or auditory nerve. Because the outer and middle ear do not reduce the intensity of the air-conducted signal, hence both air- and bone-conducted signals are effective in stimulating the cochlea. Pure-tone conduction (air and bone) thresholds are within 10 dB.

Mixed hearing loss has sensorineural and conductive components. This defect has sensorineural and conductive components. Pure-tone air-conduction thresholds are lower than bone-conduction thresholds by more than 10 dB, and bone- conduction thresholds are less than 25 dB [7-9].

Table 1. Different types of tympanometry graph and its significance

Type	Significance
Type A	Tympanometry showed normal middle ear pressure and static compliance.
Type As	Tympanometry showed normal middle ear pressure with decreased static compliance, consistent with a hypomobile tympanic membrane.
Type Ad	Tympanometry showed normal middle ear pressure with increased static compliance, consistent with a hypermobile tympanic membrane.
Type B	Tympanometry showed no measurable middle ear pressure or static compliance, consistent with middle ear pathology.
Type C	Tympanometry showed significant negative middle ear pressure in the presence of normal static compliance, consistent with Eustachian tube dysfunction/middle ear pathology.

Atrophic and degenerative changes of the tubal and paratubal muscles (tensor veli palatini and levator veil palatini with accessory muscles) may lead to Eustachian tube dysfunction [10-11]. This study was done to see the effect of OSMF on Eustachian tube function and the associated hearing impairment.

2. MATERIALS AND METHODS

The present study was performed in the Department of Oral Medicine and Radiology, Rajarajeswari dental college and hospital, to evaluate hearing deficits in patients with OSMF. The study protocol was approved by the Ethical Committee and after obtaining written informed consent, the clinical profiles of the patients were taken from a thorough case history and clinical examination. The patients were referred to an ENT specialist for clinical examination of the ear to rule out any ear infections and other abnormalities. Patients diagnosed as having OSMF were included in the study and those with pathology of the middle ear, e.g., Tympanic membrane perforation or previous surgery was excluded. The study group comprised 40 subjects, who were classified into four groups of 15 patients each according to Khanna et al 1995 [4]. The control group comprised 20 healthy subjects. Audiological assessment was done using ELKON eda 3N3 multidiagnostic audio meter. Both the ears (both sides) were evaluated in all the subjects for air and bone conductive hearing loss. Tympanometry was done by MAICO MI24 tympanometer.

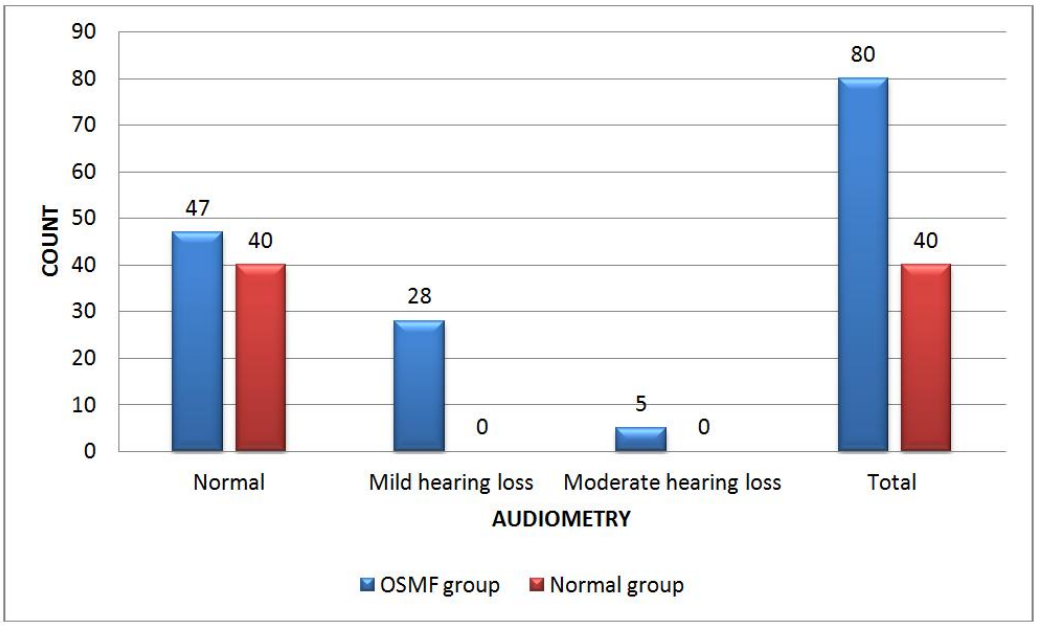
All patients who had OSMF underwent pure tone audiometry and Tympanometry. ELKON eda 3N3 multidiagnostic audio meter was used for checking pure tone audiometry. The frequencies tested were from 250 Hz - 8 KHz for air conduction threshold estimation. 250 Hz- 4 KHz were tested for bone conduction threshold estimation in terms of octaves. The thresholds estimated were plotted on a graph called “audiogram”. The degree and type of loss also have been calculated. Tympanometry was also done. MAICO MI24 was the tympanometer used for the test. Probe tip was placed in the ear canal of the patient and pressure was varied form +200dapa to -200dapa. The movement of the tympanic membrane across was plotted on a graph called “Tympanogram”. Ears having normal compliance were plotted as “A” type tympanogram. Reduced compliance <0.3 mm plotted as “As” type tympanogram. The compliance value >1.75 ml plotted as “Ad” type tympanogram. The pressure of middle ear exceeding -200dapa were plotted as “C” type tympanogram, which is indicative of Eustachian tube dysfunction.

3. RESULTS

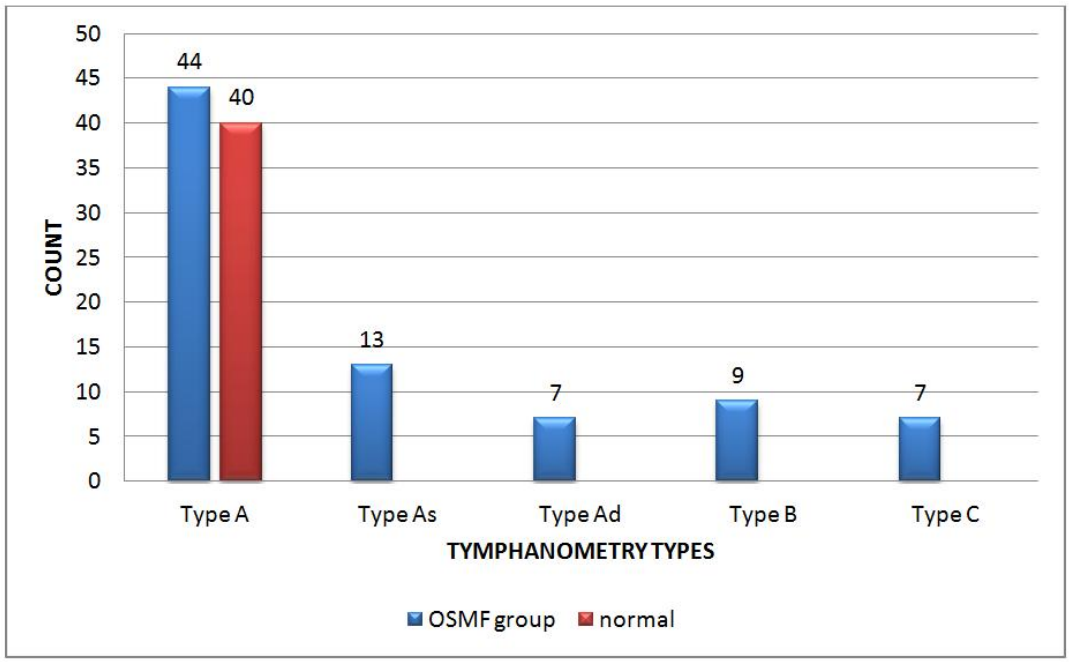
On pure tone audiometry (PTA) of study group hearing was found to be normal in 47 (58%) ears; mild conductive hearing loss was found in 28 (35%) ears and moderate conductive hearing loss in 5 (6.3%) ears while it was normal in all subjects in control group (Table 2, Graph 1).

Tympanometry of study group showed type A curve in 44 (55%) ears. Type As 13 (16.3%) ears, type Ad in 7 (8.8%) ears, type B in 9 (11.3%) and type C in 7 (8.8%) ears (Table 3, Graph 2). The control group showed type A curve in all individuals.

When tympanometry curves were compared in different groups of oral submucous fibrosis (according to Khanna et al), a significant relation was found. Type A curve was decreased as the group progress from 1 to 4 while reverse was true for type As, Ad and C curve with significant value of.0009 (Table 4, Graph 3).



Graph 1. Audiometry in OSMF group



Graph 2. Tympanometric curves in OSMF group

4. DISCUSSION

Oral submucous fibrosis (OSMF) may be defined as "a potentially malignant disorder which is slowly progressive chronic fibrotic disease of the oral cavity and oropharynx, characterized by fibro elastic change and inflammation of mucosa, leading to a progressive inability to open the mouth, swallow or speak." Various terminologies have been given to this disease in past like Atropica idiopathica (Tropica) mucosae oris, Submucous fibrosis of palate and pillars, Idiopathic scleroderma of the mouth, Submucous fibrosis of palate and cheek, Submucous fibrosis

of palate and mucous membrane, Idiopathic palatal fibrosis, Juxta epithelial fibrosis etc. Various etiologic factors are hypothesized, but the Areca nut is proven to be the most causative agent for OSMF. Initial symptoms of oral submucous fibrosis include a burning sensation in the mouth, the appearance of vesicles, petechiae, increment or decrease salivation, in advanced stages, there will be diffuse blanching along with fibrosis of the oral mucosa. Progressive fibrosis causes stiffening of areas of the mucosa, leading to difficulty in mouth opening, speaking, and swallowing, and taste alteration as well. Involvement of the nasopharynx may cause pain in the ear and nasal twang [1-4].

Table 2. Comparison of audiometry between OSMF group (n=80 ears) and normal group (n=40 ears)

	OSMF	Control
Total	80 ears	40 ears
Normal	47 (58.7%)	40 (100%)
Mild hearing loss	28 (35%)	00
Moderate hearing loss	5 (6.3%)	00

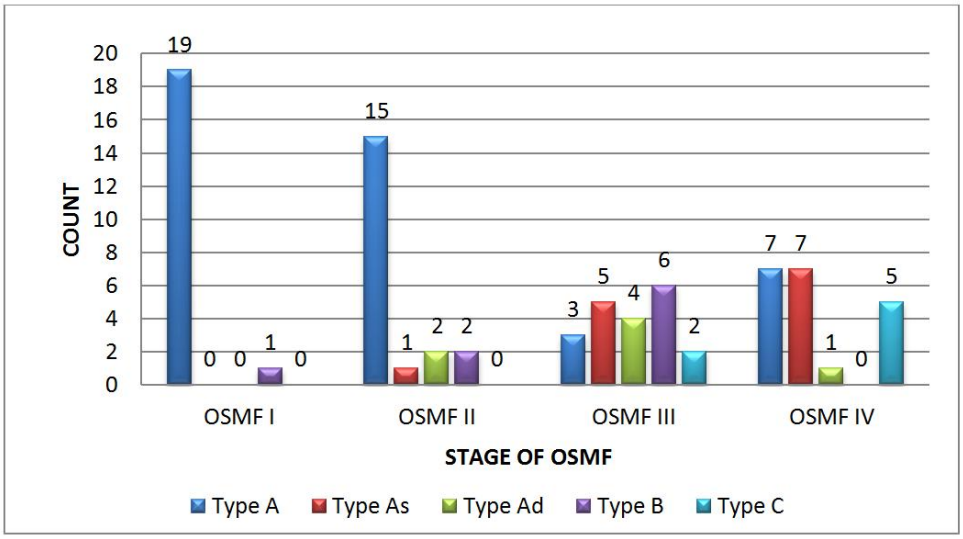
There are many studies which confirmed that OSMF causes degenerative changes on muscles which can involve palatal and paratubal muscles and can extend upto nasopharynx [10-15].

Dysfunction of the eustachian tube in OSMF may be due to fibrosis of the palatal muscles, leading to loss of conductive hearing. Gupta SC, et al in 2000 conducted a study to analyze the histological changes in the muscles (palatal and paratubal) of OSMF patients. Their study reported histopathological changes in palatal muscles, it also described atrophy and oedematous infiltration of tubal and paratubal muscles. The study confirmed the extension of fibrosis into nasopharynx involving the pharyngeal orifice of the Eustachian tube and changes in the muscles affect the functions of the Eustachian tube [10-11].

Table 3. Comparison of tympanograph between OSMF group (n=80 ears) and normal group (n=40 ears)

	OSMF group	Normal group
Type A	44 (55%)	40 (100%)
Type As	13 (16.3%)	0
Type Ad	7 (8.8%)	0
Type B	9 (11.3%)	0
Type C	7 (8.8%)	0

Pure tone audiometry was performed in the present study in 40 OSMF patients for 80 ears, which revealed that hearing was normal in 58%, the mild conductive hearing loss was present in 35% and moderate conductive hearing loss in 5 (6.3%) ears. A study done by Gupta et al. showed normal hearing in 79.2% of ears, mild to moderate conductive hearing loss in 18.0%, and sensory neural hearing loss in 2.8%. Shah et al. [16] reported that hearing was normal in 67%, the mild sensorineural hearing loss was found in 22%, and moderate mixed hearing loss was present in 11%.



Graph 3. Comparison of tympanograph in different stages of OSMF

Table 4. Comparison of tympanograph in different stages of OSMF

	OSMF group 1	OSMF group 2	OSMF group 3	OSMF group 4	p value
Type A	19	15	3	7	.0009
Type As	0	1	5	7	.0009
Type Ad	0	2	4	1	.0009
Type B	1	2	6	0	.0009
Type C	0	0	2	5	.0009

****Pearson Chi square = 48.416dF= 12*

Our study showed type A curve in 55%, type As in 16.3, type Ad in 8.8%, type B in 11.3% and type C in 7 (8.8%) ears. The comparison of OSMF group and Tympanometery curve is found to be significant, i.e. as the stage progresses curve will be shifting from A to C type suggestive of eustachian tube involvement. Shah et al. [16] reported that type A curve in 77.80%, type B curve in 0%, type C curve in 22.20%. So our study is consistent with other study and showed hearing loss and more of a type C curve in an advanced condition of OSMF.

5. CONCLUSION

Our study is in accordance with other study and confirmed that oral submucous fibrosis can cause a hearing deficit and altered tympanometric test. Oral Submucous Fibrosis determine a hearing deficit and alterations of tympanometric test, and with extension to nasopharynx, cause a blocking of the Eustachian Tube opening, being mandatory the evaluation in advanced cases for auditory.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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