



## Does Advancing Stages of OSMF Affect Degree of Hearing Impairment & Eustachian Tube Function?

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### ABSTRACT:

**Aim:** Assessment of degree of hearing impairment and Eustachian tube dysfunction (ETD) along with its correlation with various stages of Oral Submucous Fibrosis (OSMF).

**Patients and Methods:** Present study was conducted on 102 individuals including 51 OSMF patients (102 ears) and 51 healthy controls (102 ears). All were evaluated for hearing impairment and ET function by Pure Tone Audiometry and Impedance Audiometry, and correlated with various stages of OSMF.

**Results:** Hearing impairment and ETD was found to be statistically significant in OSMF patients as compared to normal patients. Severity of Hearing Impairment was found more in advanced stage of fibrosis i.e Clinical Stage III & Functional stage C. Mild to Moderate type of Hearing loss was seen more in Stage IIIC. ETD was also predominantly present in Stage IIIC OSMF patients. Correlation of age with various clinical & functional stages was found to be positive. Correlation of different clinical & functional stages of OSMF with Hearing Loss after Pure Tone Audiometry, ETD after Impedance Audiometry was found to be positive.

**Conclusions:** From the present study it is evident that that with advancing stages of OSMF conductive hearing impairment increases as well as ETD.

**Key Words:** OSMF, Hearing Impairment, Audiometry, Tympanometry, Eustachian tube dysfunction (ETD)

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## 1. INTRODUCTION

Oral Submucous fibrosis (OSMF) is an insidious, chronic disabling disease of obscure etiology that affects the entire oral cavity, sometimes the pharynx and rarely the larynx [1]. Contrary to conventional wisdom, of atrophy being limited to the juxtraepithelium, the disease extends beyond the confines of the epithelium to involve the underlying muscles, in the form of atrophy, loss of cross striations and edema of myoepithelium[2-4]. Normally the muscles of the soft palate, Muscles of soft palate viz Tensors, Salpingopharyngeus equilibrates the Middle Ear pressure by regulation of ET Function. Levators, and Tensor veli palatine(TVP), Levator veli palatine(LVP), Salpingopharyngeus, and Tensor tympani(TT) are associated with the ET function, which through a complex interaction, assist with equilibrating middle ear pressure. Normal opening of the ET equalizes the middle ear pressure, and closing protects the middle ear from unwanted pressure fluctuations and loud sounds. Abnormal or impaired ET functions, may cause pathological changes in the middle ear. Thus involvement of these muscles may lead to ET dysfunction and in turn can lead to hearing disabilities[5]

Ample of literature is available regarding the involvement of muscles of soft palate in OSMF[2-4], and literature for associated ETD and hearing impairment is deplete[6-8]. However there are no studies available on assessing the degree of hearing impairment, presence of ETD and its correlation with clinical stages of OSMF, and its association with increase or decrease in the severity of the disease. We hypothesize that with increasing severity of the disease, hearing impairment and ETD increases.

Therefore, present study was deliberated, to evaluate the degree of hearing impairment, ET function in OSMF patients and to correlate it with various clinical stages of the disease.

## 2. MATERIAL & METHODS

The present study was conducted on 102 subjects ( 204 ears), 51, systemically healthy OSMF patients and 51 age and gender matched healthy controls with no oral mucosal lesion or deleterious habits after obtaining a written informed consent, and approval from the Institutional Ethical Committee. Patients within the age limit of 17-60 yrs clinically diagnosed with SMF belonged to study Group, based on the diagnostic criteria given by Bailoor and Nagesh[9] i.e Presence of burning sensation, Blanching of oral mucosa, Restricted tongue protrusion, Restricted mouth opening, Palpable fibrous bands. Patients with no deleterious habits and without any ear disorders, formed the control group.

Patients with previous history of middle ear infection/ otitis media, ear disorders (Tympanic Membrane perforation, cholesteatoma) previous ear surgery, hearing impairment since childhood, Tinnitus or Vertigo and Operated/ Treated cases of SMF were excluded from the study.

## 3. METHODOLOGY

Clinical and functional staging was done according to Haider et al[10]. For functional staging, Interincisal mouth opening was calculated, taking incisal edges of maxillary and mandibular central incisors as reference points. And the mean of two values were taken and recorded. Patients with inadequate reference point for measuring the interincisal distance were excluded from the study.

Detailed clinical examination of the ear was done by the qualified Otorhinolaryngologist to rule out any disorders of the ear, affecting the hearing ability and

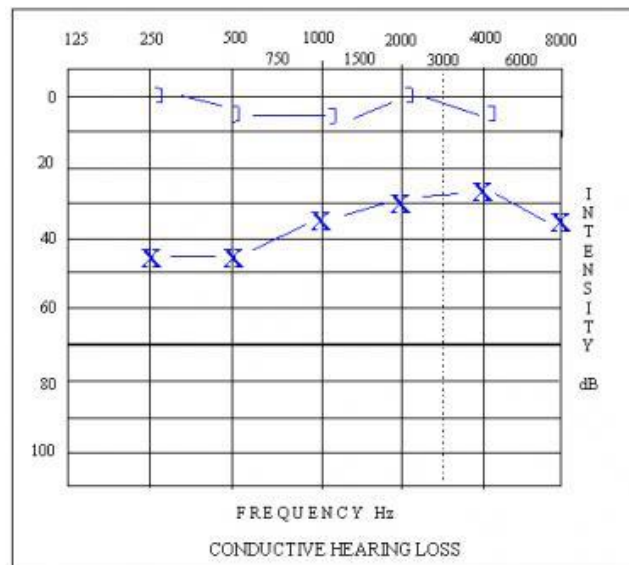
ET function and patients were subjected for audiological assessment by using a clinical Audiometer Wlesch Allyn, followed by *Pure tone Audiometry & Impedance Audiometry* by expert Audiometrician.

#### *PURE TONE AUDIOMETRY (PTA)*

Was done by Audiometric equipment, ALPS AD 2000 and Interpretation of Audiogram according to WHO Classification[11]

The deafness can be graded into several categories by air conduction threshold. [Fig 1]

1. 10-15 db- Normal Hearing
2. 16-25 db- Minimal Hearing Loss
3. 26-40 db- Mild
4. 41-55 db- Moderate
5. 56-70 db- Moderate to Severe
6. 71-90 db –Severe
7. Above 90 db is profound deafness



**Fig 1:** Showing Conductive Hearing Loss

IMPEDANCE AUDIOMETRY was done by, MAICO Impedance Audiometer[11]. Recorded graphs were assessed for ETD by:

Interpretation of TYMpanogram[11]

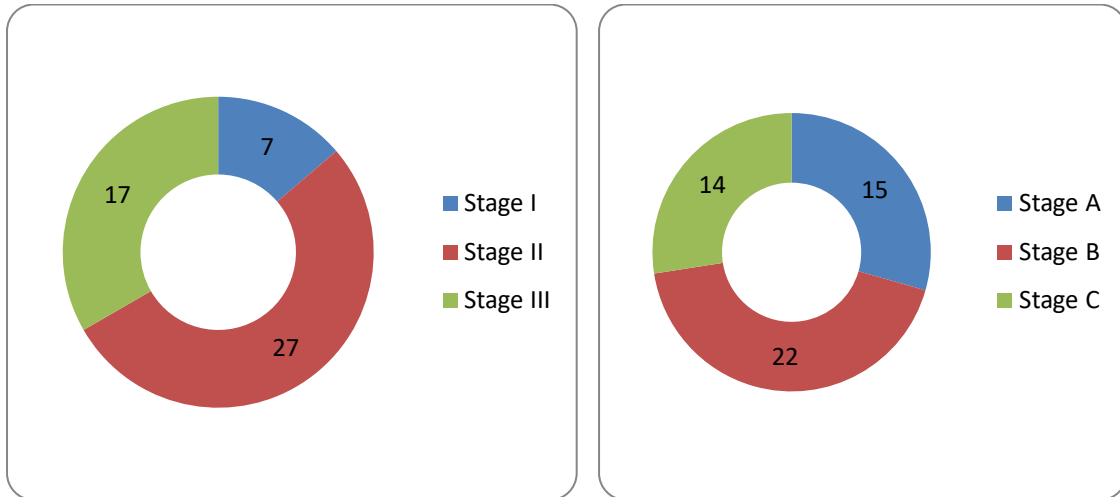
- Type A- Normal
- Type As- Shallow curve, suggesting stiffened middle ear system.
- Type Ad- deep curve suggesting flaccid ear drum or middle ear system, ossicular disruption.
- Type B – Flat/ DOME SHAPED GRAPH, Implies TM perforation
- Type C- *Maximum compliance occurs with negative pressure in excess of 100mm H<sub>2</sub>O. Suggests a significant negative pressure in the middle ear, or ETD.*

In cases of TM perforation, it is difficult to assess the Tympanogram. In such situations an indirect assessment was done by increasing the probe pressure in the external ear canal, asking the patient to swallow and then assessing whether the ET is able to clear the increased pressure applied to the external ear canal

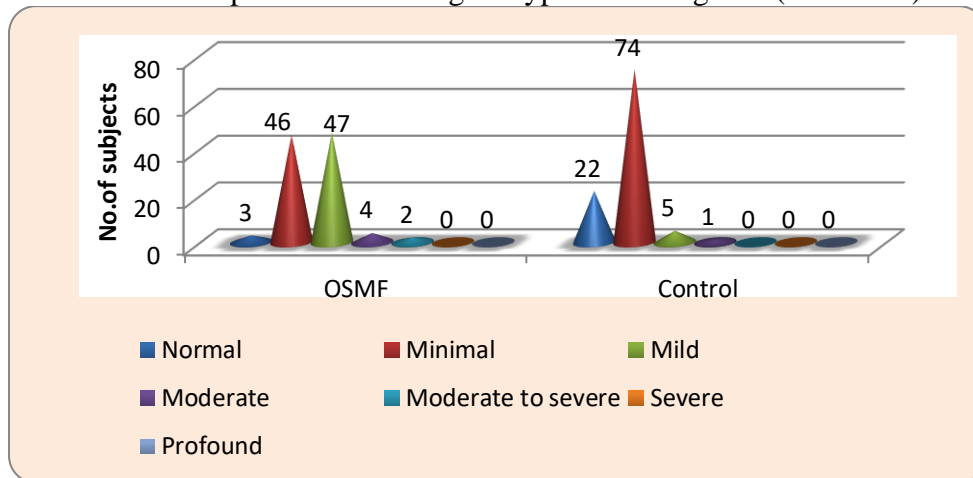
#### 4. RESULTS & OBSERVATIONS:

Statistical analysis was done using SPSS version 17, and Chi Square test & Pearson’s Chi square test was used to assess the hearing impairment and its correlation between various stages of OSMF. Subject and Control group comprised of 42 males and 9 females. [Graph 1]

**Graph 1** Distribution of OSMF patients according to clinical stages and functional stages of OSMF



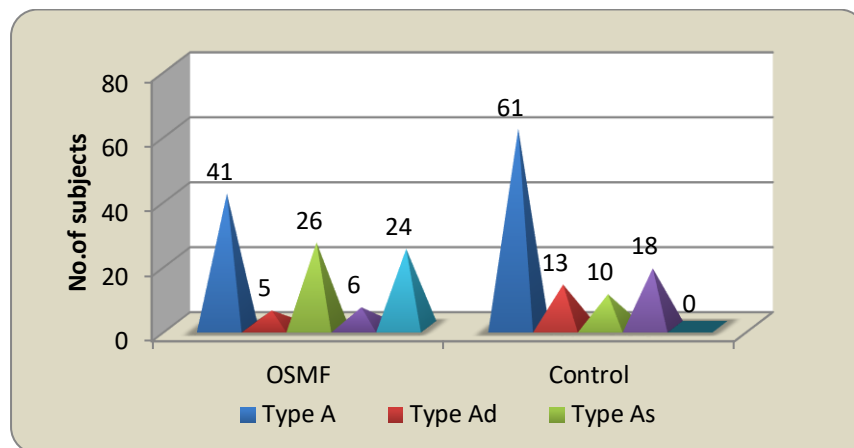
**Graph 2** Distribution of patients according to Type of hearing loss (after PTA) for Total Ears



On PTA, Mild Type of Conductive hearing loss (C.H.L) (54.9%) was prevalent in OSMF patients, followed by Minimal hearing loss (36.3%), moderate hearing (3.9%), and Moderate to Severe and Normal hearing (2%). In control group all except 1 patient had moderate C.H.L, maximum ears had Minimal C.H.L (n=74, 72.5%), followed by Normal hearing (n=22, 21.6%), followed by Mild C.H.L (n=5, 4.9%). [Graph 2].

On correlation hearing loss was found to be positively correlated with clinical and functional stage of OSMF for both right and left ear, which was significant ( $p < 0.05$ ). C.H.L was found to be directly proportional with increasing stage of OSMF.

**Graph 3** Distribution of patients according to Types of Tympanogram on Impedance Audiometry for Total Ears



On Impedance Audiometry, out of 102 ears normal Tympanogram Type A curve was recorded in 41 ears (40.2%) followed by Type As in 26 ears i.e (25.5%), followed by Type C curve in 24 ears (23.5%), followed Type B and Type Ad in 6 ears and 5 ears respectively (i.e 5.9% and 4.9%). On Tympanometry of control group patients, out of 102 ears, curve was found to be Type A in 61 ears (59.8%), followed by Type B in 18 ears (17.6%), followed by Type Ad in 13 ears (12.7%), and followed by Type As (9.8%) curve, and Type C was not present. [Graph 3]

On further comparison between both the groups the results of tympanometry were found to be statistically significant ( $p < 0.05$ ).

In OSMF patients Type C tympanogram was recorded in 24 ears and therefore ETD was present in the same number of ears. While in Control group Type B Tympanogram was recorded in 18 ears and Type C in none. Therefore indirect assessment was done, and found 18 ears with Type B, 12 ears presented with ETD.

On correlation with increasing severity of the Clinical and Functional stage ETD increased.

## 5. DISCUSSION:

Oral submucous fibrosis a disabling potentially malignant condition which is characterized by gradual stiffening of the oral mucosa, and reduction in the mouth opening. Disease is found to be prevalent in Indian subcontinent. It affects the entire oral cavity and sometimes pharynx and rarely larynx[1].

From the 1950s till date various authors[2-4,12-20] suggested histological changes, from the changes in the epithelium to involvement of the muscles in the OSMF, but definitive involvement of the palatal and paratubal muscles was suggested by Gupta SC et al in 2000[21]. Since then the urge to prove the ETD and hearing impairment in patients with OSMF has come into existence. Therefore various studies were performed in which audiometry and Tympanometry was done, to evaluate the hearing deficit and ETD. Gupta et al[6], concluded that ET function may be affected in OSMF patients. Maulik Shah et al[7], and Sanna Noor Siddiquie et al[8] concluded significant relation between OSMF and ETD. Minal et al[22], conducted audiometry and observed conductive deafness, alongwith significant relation with varying degree of OSMF. Devi et al[23] conducted PTA, and

concluded significant relation of OSMF and hearing impairment. Also Mild C.H.L was more in advanced stages.

Therefore, present study was deliberated to evaluate, the effect of OSMF on middle ear function & hearing, by performing 2 different tests i.e PTA and Impedance Audiometry. PTA emphasizes on the Type of hearing loss and Impedance Audiometry emphasizes on ETD

In the present study, distinct male predilection (82.35%) was seen in patients with OSMF. This is owing to the fact that incidence of chewing tobacco and betel nut is higher among male which is in agreement with previous studies[24], however lately female predominance was also reported[25].

As the age increases, it becomes a major risk for hearing loss. Ageing related degenerative changes may affect the neural fibres, stria vascularis, and inner ear and outer hair cells causing progressive hearing impairment.

In the present study, 2<sup>nd</sup> and 3<sup>rd</sup> decade patients were found to be more affected with OSMF. Youngest patient was 17years old. A study by Gupta et al[6] and Shah et al[7] reported similar observation. Tomada et.al[26], in 1984 observed that with increasing age, atrophy of the muscle fibres starts, leading to deterioration of functions of tensor palatini and levator palatini thus causing hearing impairment.

Also in this study, the sequence of involvement for clinical and functional stages of OSMF from highest frequency to lowest frequency was Stage II>III>I, and Stage B>A>C.

On PTA, maximum number of patients presented with Mild Type of C.H.L (54.9%), and least number of patients with Normal Hearing (2%). This was in contrary to the studies conducted by Gupta et al[6], and Shah et al[7], this might be due to the difference in the assessment criteria for the type of hearing loss. In addition to the 4 criterias of Gupta[6] and Shah et al[7] viz. Normal, mild moderate & severe for assessing hearing impairment, additional criterias as per the recommendations by WHO classification[11] were used viz. normal, minimal, mild, moderate, and moderate to severe, severe hearing loss and profound deafness. Also there was no range description of assessing the hearing threshold given in their study for selection of these criteria

Significant difference was found on further comparison of both the groups with type of hearing loss. This might be due to the prevalence of more number of ears affected with mild type of hearing in OSMF patients as compared to control group of patients.

Moreover, results depicted that, irrespective of the clinical or functional stages, 13 patients had differences bilaterally with Type of Hearing Loss. This might be due to the differences in the severity of the fibrous bands bilaterally. However to prove this, larger sample size will be required.

On correlation, C.H.L was found to be directly proportional with increasing stage of OSMF, which was clinically significant ( $p < 0.05$ ), for both right and left ear.

On Impedance Audiometry, out of 102 ears maximum ears give Type A Tympanogram 41 ears (40.2%) with least number of ears with Type B (n=6) and Type Ad (n=5) curve (5.9% and 4.9%). In control group patients, maximum number of patients Type A in 61 ears (59.8%), and least showed Type As (9.8%) curve, and Type C was not present.

On further comparison between both the groups the results of tympanometry were found to be statistically significant ( $p < 0.05$ ).

*In Gupta et al[6]<sup>6</sup> and Shah et al[7] studies results were depicted in the form of the normal Tympanograms (Type A) and abnormal Tympanograms (Type B and Type C) and have done the interpretation accordingly, contrary to our study in which the interpretation*

was done on the basis of 5 types of Tympanograms. Therefore, If the type As and Ad curve are included along with Type A then the normal Tympanograms will account to be 70.6% for OSMF group, and 75.5% for control group. The said observations can be attributed to be consistent with studies conducted by Gupta et al[6], Shah et al[7] and Sanna Noor Siddiquie et al[8]

It suggests that the difference in percentage could be because of different types of Tympanograms considered for interpretation in the studies. Moreover the only difference in present study and Gupta et al was between the least type of Tympanograms, B and Ad curve were least and in their study C type of curve.

In OSMF group 24 ears had **ETD** out of 102 ears (23.5%) while in the control group 12 ears (11.8%) showed ETD, which is in lieu with the study of Gupta et al[6] showing that on testing the compliance ETD was seen in 24 ears (22.7%), while in control group 4 ears (10%) showed ETD. This is also in accordance with the study conducted by Shah et al[7] where they depicted no shift of compliance peaks in 5 ears (10%) ears with -200 daPa pressure changes after swallowing. On contrary the study conducted by Sanna Noor Siddiquie et al[8] revealed that 21 ears (53%) in OSMF group and 6 ears (15%) in control group no shifting of compliance peaks was seen which was much higher than the present study and studies by Gupta et al[6] and Shah et al[7].

Further, on correlation of Impedance Audiometry and ETD, with increasing severity of the disease was found positive, which was clinically significant.

*In some patients different results were present bilaterally. Thus, justification for patients showing different results bilaterally irrespective of the clinical and functional stage, could be attributed to differential fibrosis bilaterally.*

The, severity of Hearing Impairment was found more in Advanced stage of fibrosis i.e Clinical Stage III & Functional stage C. Mild to Moderate type of Hearing impairment was seen more in Stage IIIC. ETD was also predominantly present in Stage IIIC OSMF patients. Positive correlation was found between different clinical & functional stages of OSMF with Hearing Loss after PTA, Impedance Audiometry after ETD.

## 6. CONCLUSION:

From the analysis of the result and within the limitations of the study, it could be concluded that OSMF is more prevalent in younger generations with male predilection. As it gradually progresses and involves the oral cavity, and extends into the nasopharynx with involvement of palatal and paratubal muscles, like TVP, LVP, TT and Salpingopharyngeus. This hampers the functioning of the ET which in turn hampers the middle ear functioning causing ETD and hearing Impairment.

Every study has its limitations, thus in this study, Hearing Impairment was more prevalent in 2<sup>nd</sup> and 3<sup>rd</sup> decade, may be because of more number of patients in these age group compared to other ages in the study population. Inability to assess the regions near ET in advanced stage of fibrosis. It is a cross sectional study, so the gradual effect of the disease on the hearing could not be assessed. This is the inherent limitation of all the cross sectional study. Thus we recommend to conduct the study in advanced stage of fibrosis as the changes were more evident in advanced stages. Biopsies should be taken before operating, and sent



for ultrastructural studies in order to confirm fibrosis of the palatal and muscles and their impact on hearing as well as ET. Also the amount of deviation found in function of the ET is non contributing to cause a conductive hearing loss. However, the results can be further justified by studies involving voluminous sample size and patient with more severe OSMF. MRI with contrast should be taken to study the extent of fibrosis. Further prospective studies should be conducted to assess the progression of the disease and its impact on hearing.

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