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Evaluation of Hearing Deficit in Oral Submucous Fibrosis Patients: An Audiometric Analysis

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ABSTRACT

Background: Oral submucous fibrosis [OSMF] is a chronic, insidious and progressive disease, affecting any part of the oral cavity and sometimes the pharynx. The pathological changes in OSMF not only involve the mucosa & submucosa but also extend deeper to involve the underlying muscles leading to severe restriction in mouth opening. The function of the Eustachian tube during hearing is significantly influenced by the palatal, tubal, and Paratubal muscles. When the fibrosis spreads to the nasopharynx, it blocks the Eustachian tube entrance there, which results in hearing loss.

Aim: This study evaluates the possible effects of Eustachian tube function and hearing deficit in different stages of OSMF.

Methods: The study group comprised 30 OSMF patients of different stages who did not have any ear disease or anomalies. These OSMF patients were subjected to audiometric evaluation. 30 normal controls (60 ears) who were not having OSMF and any ear disease or anomalies were also subjected to audiometric evaluation for comparison. The results were statistically analyzed.

Result: According to our study, the OSMF group had a significant level of hearing loss than the control group.

Conclusion: We would want to conclude that a hearing deficiency assessment should be performed on all OSMF patients.

Keywords: *Audiometry, Eustachian Tube, Hearing deficit, OSMF, Quality of Life*

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1. INTRODUCTION

In the Indian subcontinent, Oral submucous fibrosis (OSMF) is one of the most common potentially malignant conditions found with a prevalence rate ranging from 0.03% to 7.21%. [1,2]It is an insidious, chronic disease affecting any part of the oral cavity and sometimes the pharynx. [3].As the fibrosis spreads to the nasopharynx or oesophagus, patients may develop a nasal voice, referred ear pain, and dysphagia to solids—all of which are often signs of more advanced disease.[4] Even though OSMF primarily affects the oral cavity, the fibrosis can also spread into the pharynx through the pillars and down to the pyriform fossa.[5]

Definite involvement of palatal &paratubal muscles of the soft palate was observed in OSMF patients leading to Eustachian tube dysfunction resulting in hearing deficit.[6]

Extensive literature is available on etiopathogenesis, clinical aspects, histological aspects and malignant transformation of OSMF. [7,8] However the literature contains a few information on the effect of fibrosis on the structures adjoining the areas of posterior oral mucosa like nasopharynx and the Eustachian tube which connect to the middle ear.

Although few investigators [9,10,11] have reported hearing deficiency amongst OSMF patients using various measures, the features of ear pain and hearing deficiency in OSMF patients are generally unnoticed by the clinicians during diagnosis and this can have a major impact on the quality of life of the affected individuals. [12]

Hence, the study was undertaken to evaluate hearing deficiency among patients with different grades of oral submucous fibrosis using audiometry to observe the association between OSMF and hearing deficiency.

AIM: This study evaluates the possible effects of Eustachian tube function and hearing deficit in different stages of OSMF.

2. METHODS

The study was conducted at the XXX Hospital. The audiometric analysis was carried out in the XXX Hospital. The ethical clearance (XXX/IEC/9958/2021) was taken before the start of the study from the institutional ethical and review board. A total of 60 subjects were selected out of which, 30 subjects were grouped as normal controls who were healthy individuals, not consuming areca nut or tobacco in any form, with no oral mucosal diseases. The other 30 subjects were grouped as study groups who were clinically diagnosed as OSMF patients based on history of areca nut use and clinical features. Written informed consent was obtained from the subjects before carrying out the diagnostic procedures. Individuals with a previous or current history of ear disease and other systemic diseases were not included in the research.

To make each interval exclusive for statistical analysis, the following clinical staging was used based on mouth opening, as per our convenience of sample size.

GRADE I: mouth opening >30mm

GRADE II: mouth opening 23-30mm

GRADE III: mouth opening <23mm

Following thorough oral examination, healthy controls and clinically diagnosed cases of OSMF were subjected to pure tone audiometric analysis for both right and left ears using an audiometer (ALPS Advanced Digital Audiometer AD2100). Audiometric results obtained were analyzed and interpreted by an audiologist.

The degree of deafness was assessed using the hearing impairment scale given by WHO 2019[13]:

Grade1. -10-15 dB - Normal hearing

Grade2. 16-25 dB - Minimal hearing loss

Grade3. 26-40 dB - Mild hearing loss

Grade4. 41-60 dB - Moderate hearing loss

Grade5. 61-80 dB - Severe hearing loss

Grade7. >81 dB - Profound deafness

Statistical Analysis

The statistical package for social science was used to analyze the data once it was entered into a Microsoft Excel sheet. (SPSS, V25.0 package).

P Value: Every statistical test's significance was predetermined at a (p) value of 0.05 or less at a 95% confidence interval.

3. RESULTS

Upon audiometric analysis we observed that in healthy control group 100% of them showed normal hearing whereas in OSMF group, 60% of them showed hearing deficiency and only 40% of patients showed normal hearing. We further categorized OSMF patients into three groups according mouth opening and compared hearing loss in them. We found that all the grade III patients (100%) showed hearing deficit, whereas in grade II, 60% of the patients showed hearing deficit and in grade I, 10% of them showed hearing deficit.

Table 1: Comparison Of Hearing Deficiency Between The Control Group And Osmf Group (In Percent)

DEGREE OF HEARING LOSS	CONTROL GROUP	OSMF GROUP
NORMAL HEARING	100 %	40%
HEARING LOSS	0	60%

Table 2: Grades Of Hearing Loss Among Osmf Patients (In Percentage)

GRADES OF HEARING LOSS	GRADE I (%)	GRADE II (%)	GRADE III (%)	X VALUE	P VALUE
NORMAL HEARING	90	30	0	14.01	0.005

MINIMAL HEARING LOSS	0	60	100		S
MILD HEARING LOSS	0	0	0		
MODERATE HEARING LOSS	10	10	0		

Table 3: Comparison Of Hearing Deficiency Amongst Osmf Groups On Right And Left Side Ears (In Percentage)

DEGREE OF HEARING LOSS	OSMF GROUPS								X-VALUE		P-VALUE	
	GRADE I (%)		GRADE II (%)		GRADE III (%)		TOTAL (%)		RIGHT SIDE	LEFT SIDE	RIGHT SIDE	LEFT SIDE
	RIGHT SIDE	LEFT SIDE	RIGHT SIDE	LEFT SIDE	RIGHT SIDE	LEFT SIDE	RIGHT SIDE	LEFT SIDE				
NORMAL HEARING	30	30	16.66	13.33	3.33	0	50	43.33	13.3	10.19	0.02 S	0.011 S
HEARING DEFICIENCY	3.33	3.33	16.66	20	30	33.33	50	56.66				

S: Significant

Table 4: Pearson's Correlation Test Between Three Variables

		NORMAL HEARING	MINIMAL HEARING LOSS	MODERATE HEARING LOSS
NORMAL HEARING	PEARSON CORRELATION SIG (2-TAILED), N	1 30	-0.997 0.048 30	-0.756 0.454 30
MINIMAL HEARING LOSS	PEARSON CORRELATION SIG (2-TAILED), N	-0.997 0.048 30	1 30	0.803 0.407 30
MODERATE HEARING LOSS	PEARSON CORRELATION SIG (2-TAILED), N	-0.756 0.454 30	0.803 0.407 30	1 3

*Correlation is significant at the 0.05 level.

4. DISCUSSION

OSMF is a chronic, insidious and potentially malignant disorder with a significant malignant transformation rate compared to other OPMDs. Initially, patients complain of a burning sensation or intolerance to spicy food, the presence of vesicles as early symptoms followed by the appearance of palpable fibrous bands eventually leading to restricted mouth opening. When fibrosis further progresses to involve the oropharynx, nasopharynx or oesophagus, patients may experience dysphagia, a nasal voice and referred pain to the ear. However, the latter symptom of referred pain to ears is generally not reported by the patients to dental clinicians nor assessed by the clinicians while diagnosing the case of OSMF. The affected people's quality of life may be significantly impacted by these latter symptoms.[14] Literature reports few studies [9,11] relating hearing deficiency among OSMF patients. However, there is a paucity of adequate data in the literature to link OSMF with hearing deficit. Hence, we intended to validate the hypothesis to see whether there is an association between OSMF and hearing deficiency. Our study group consisted of 30 healthy controls and 30 patients with OSMF. OSMF

patients were further categorized into three grades based on the degree of mouth opening. All the study subjects were subjected to audiometric analysis. The data obtained from audiometric values were entered and tabulated in XL sheets. These values were analysed statistically by using SPSS, V25.0 package.

Upon audiometric analysis, we observed that all 100% in the healthy control group showed normal hearing however in the OSMF group, 60% showed hearing deficiency and only 40% showed normal hearing, with a high statistical significance. (p=0.005). Among the OSMF group, 53.33% showed minimal hearing loss and 6.66% showed moderate hearing loss. The data were analysed statistically using Pearson's correlation analysis. A statistically significant positive correlation was observed between the OSMF group and hearing deficiency.(p=0.05)

Devi P. et al. [11] in their audiometric study on OSMF patients found hearing deficiency in 44% of patients whereas 56% of them showed normal hearing. Gupta et al [9] in their study of OSMF patients observed hearing deficiency in 20.8% of the patients whereas normal hearing in 79.2% Shah et al. [14]also reported that hearing loss was found in 33% of OSMF patients whereas hearing was normal in 67%. We also analysed and compared hearing deficiency in OSMF patients on the right and left sides ears. We observed that more of grade III patients showed hearing deficiency as compared to grade I patients on right and left side ears. The findings were statistically significant (p=0.02).

Chhabda V et al. [15] also found hearing deficiency in higher grades of OSMF patients on both right and left side ears. Chaudhary M et al. [10] in their audiometric study observed that the ability of the Eustachian tube to equalize air pressure within the ear is impacted in OSMF, as evidenced by the negative association between alterations in the right and left ear's perceptions of sound. As OSMF grades increased, the perception of sound as an air conduction mechanism of wave transmission reduced, changing these patient's reactions to loud noise. Our results support the study by Chaudhary M et al.[10] where the altered sound perception between the right and left ears resulting in minimal hearing loss as the severity of the OSMF increased. In advanced cases of OSMF, the progression of fibrosis in the posterior oropharyngeal region is more diffused which can have an effect on the Eustachian tube function on both the sides altering the hearing efficiency. Therefore, it is important to examine for hearing impairments in both the left and right ears. Ultrastructural studies on muscle alterations in OSMF have shown that the degree of muscle degeneration may influence the limited mouth opening in addition to sub-epithelial fibrosis.[6,16]

The Involvement of the palatal and paratubal muscles (levatorveli palatine, tensor tympani, tensor veli palatine and salpingopharyngeus), which control the function and patency of the pharyngeal aperture, affect the patency and function of the Eustachian tube, causing ear pain and hearing loss.[9] Even though hearing deficiency in advanced stages of OSMF patients is reported by several investigators, the precise mechanism is not clear. Dysfunction of the Eustachian tube caused by tubal and para tubal muscular involvement in OSMF is reported by Gupta et al. One of the main characteristics of advanced OSMF is the soft palate's involvement. Tensor veli palatine and levatorveli palatine, often known as palatal and paratubal muscles, are the primary muscles connected to the Eustachian tube and the soft palate, along with additional accessory muscles. The muscles and cartilaginous section of the Eustachian tube are dynamic organs. Involving these muscles may affect its patency and ventilatory function.[6]

Gupta et al. (2000) [9] in their histopathological studies on OSMF patients, found that fibrosis may affect the pharyngeal opening and spread into the nasopharynx. So, the palatal and paratubal muscles are definitely involved because they are connected to the soft palate, which causes Eustachian tube dysfunction and hearing loss. The findings made by Gupta et al. are supported by our discovery that hearing impairment is associated with an increase in the severity of OSMF. Chawla et al (2015) [16] observed that muscular condensation created a traction force over the muscle and concluded that reduction in muscle-epithelial distance may prove to be a significant predictor of OSMF progression. Misraet al. [5] observed that the oesophagus was involved in about two-thirds of their patients when they took multiple biopsies from the upper end of the oesophagus in OSMF patients. Oesophageal subepithelial fibrosis was more common in OSMF patients in their study. Sanwaletal (2023)[17] observed a significant association between OSMF and hearing deficit and suggested to implement more appropriate therapeutic interventions for hearing deficit in order to increase the success rate of treatment. Pottametal (2023)[18] evaluated Eustachian tube changes in OSMF patients using audiometry and CBCT and found that the length and volume of Eustachian tube decreased as the severity of disease increased possibly causing hearing deficit. Rathodetal (2023)[19] in their meta-analysis demonstrated an increased risk of hearing impairment in OSMF patients where they observed that the outcome is likely to be independent of the staging. Kritikaetal (2025)[20] in their systematic review investigated the association between OSMF and hearing impairment and observed a significant association between OSMF and hearing impairment indicating that the fibrosis not only involve the oral cavity but also the auditory structures, affecting hearing. Tomodaet al. [21] observed that with advancing age the muscle fibres of the human Eustachian tube were prone to atrophy. Since such an atropic degeneration of these muscles also occurs in OSMF that may lead to Eustachian tube function thereby causing hearing deficiency.

When it comes to patient treatment, quality of life (QoL) is an important health outcome indicator. The total quality of life is influenced by interactions across the many domains, which are impacted when one element of function is disrupted. Roy et al (2020) observed mild to minimal hearing loss in OSMF patients pre and immediate post-surgical treatment of fibrosis whereas 1 and 3 months follow up post-surgery showed normal hearing in the same patients upon audiometric analysis,

hence they concluded that surgical correction of OSMF can provide the patient a better mouth opening in turn actively open Eustachian tube there by improve middle ear function. QoL is largely dependent on oral health, and any issues that arise with the oral cavity that cause pain can ultimately lead to a decline in social communication and self-confidence.[12] Compared to other Oral Potentially Malignant Disorders (OPMDs), OSMF patients showed extreme levels of physical discomfort and functional restrictions of the oral cavity. QoL reduces when the patients of OSMF complain of a burning sensation to specific food and when they present with restricted mouth opening it impacts the comfort level further compromising the QoL.Our study is a preliminary / pilot study having a limitation of a smaller sample size. The findings of our study can be further validated and strengthened by conducting studies with a larger sample size correlating palatal muscle tissue involvement in causing Eustachian tube dysfunction which leads to hearing deficiency in OSMF patients.

5. CONCLUSION

From our study, we observed that higher grades of OSMF patients showed minimal to mild hearing loss. Our finding of hearing loss in the advanced stages of OSMF is a functional impairment resulting in decreased social communication and self-confidence thereby compromising the quality of life. Hence, hearing loss should be one of the measures to be noticed during clinical examination by clinicians that is generally unnoticed.

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