Original Article

Can Oral Submucous Fibrosis affect Hearing? A Cross-Sectional Study

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ABSTRACT

Introduction: Oral submucous fibrosis (OSMF) is a chronic disease, affecting any part of the oral cavity. The prevalence rate of OSMF in India is about 0.2–0.5%. Histological changes include appearance of excessive collagen fibers, edema, and excessive deposition of fibroblast and inflammatory cells infiltrate and this leads to atrophy of palatal and paratubal muscles, loss of cross striations, and edema of myoepithelium and these changes may lead to Eustachian tube dysfunction and hearing impairment. The present study was carried out to determine the effect of OSMF on hearing using tympanometry and audiometry. **Materials and Methods:** The cross-sectional study was carried on 50 patients of OSMF with 50 normal subjects as control at a tertiary care and teaching hospital in western Uttar Pradesh for a duration of 2 months from July 12, 2019, to September 11, 2019 and fulfilling the inclusion and exclusion criteria. All the case and control underwent pure tone audiometry (PTA) and tympanometry after a detailed examination. **Observation and Results:** Statistically, there was a significant difference on tympanometry in terms of Band C type of curve. The assessment of hearing on PTA found more of conductive hearing loss among OSMF cases and it was also statistically significant on comparing with control subjects. **Discussion:** All the subsites of oral cavity and oropharynx were variably affected by oral submucous fibrosis. Hard and soft palate including buccal mucosa and retromolar trigone were affected to a reasonably greater extent. Analyzing the maximum involved subsites, it can be established that muscles around the Eustachian tube are at more risk of being involved with fibrosis due to continuity to these structures and is the cause for the hearing deficit among cases of OSMF. **Conclusion:** OSMF is one of the causes of hearing loss and is usually a conductive type of deafness.

Key words: Oral submucous fibrosis, Eustachian tube dysfunction, areca nut, hearing impairment

INTRODUCTION

Oral submucous fibrosis (OSMF) is a chronic disease, affecting any part of the oral cavity. Although, occasionally preceded by and/or associated with vesicle formation, it is always associated with a juxta-epithelial inflammatory reaction and fibroelastic changes of the lamina propria, with atrophy of the epithelium leading to stiffness of the oral mucosa, causing trismus, and inability to eat.[1,2] It occurs at any age, but most commonly seen in young adults of 2nd–4th decade.[3]

It is commonly prevalent in Southeast Asia and Indian subcontinent. The prevalence rate of OSMF in India is about 0.2–0.5%. The malignant transformation rate of OSMF was found to be 7.6%. Incidence of OSMF in India is 6.3%.[3,4] A variety of etiological factors, including betel nut alkaloids, hypersensitivity, autoimmunity, genetic predisposition, and chronic

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iron and Vitamin B-complex deficiency have been suggested, the most common of which is chewing areca nut.[5]

Histological changes include appearance of excessive collagen fibers, edema, and excessive deposition of fibroblast and inflammatory cells infiltrate. In severe cases along with mucosa and submucosa, degenerative changes have been reported in deeper tissues including muscle fibers. The histological changes that have been reported include atrophy of palatal and paratubal muscles, loss of cross striations and edema of myoepithelium.[1] Changes in these muscles attached to Eustachian tube and soft palate may lead to eustachian tube dysfunction and hearing impairment.[1,6]

A genetic component is also believed to be involved in OSMF, because there are reported cases in the medical literature without any history of betel nut chewing or chili ingestion. Patients with OSMF have increased frequency of expression of gene for HLA-A10, HLA-B7, and HLA-DR3.[3]

An immunologic phenomenon is thought to play a role in the etiopathogenesis of OSMF. The increase in CD4 cells and cells with HLA-DR in these diseased tissues shows activation of most lymphocytes and increased number of Langerhans cells. These immunocompetent cells and high of CD4:CD8 ratio in OSMF tissues show the activation of cellular immune response which results in deranged immunoregulation and an altered local tissue morphology. These changes may be due to direct stimulation from exogenous antigens such as areca alkaloids or due to changes in tissue antigenicity, leading to an autoimmune response. The major histocompatibility complex Class I chain-related gene A (MICA), which is expressed by keratinocytes and epithelial cells, interacts with gamma/delta T-cells localized in the submucosa. MICA has got a triplet repeat polymorphism in the trans membrane domain, which results in five different allelic patterns. The phenotype frequency of allele A6 of MICA is higher in OSMF. Increased levels of proinflammatory cytokines and reduced antifibrotic interferon gamma (IFN-gamma) also contribute to the pathogenesis of OSMF.[3]

Areca nut chewing is one of the most common causes of OMSF which contains tannins (11–12%) and alkaloids such as arecoline, arecaidine, guvacine, and guvacoline. Out of all, arecoline is the main agent. With the addition of slaked lime to areca nut, causes hydrolysis of arecoline to arecaidine making this agent available in the oral environment which is an active metabolite in fibroblast stimulation and proliferation, thereby inducing collagen synthesis. Tannin present in areca nut reduces collagen degradation by inhibiting collagenases. OSMF is induced as a combined effect of tannin and arecoline by the mechanism of reducing degradation and increased production of collagen, respectively.[4]

This leads to reduced phagocytosis of collagen by fibroblasts, up or down regulation of key enzymes such as lysyl oxidase, matrix metalloproteinase, and tissue inhibitors of matrix metalloproteinase, leading to a large number of symptoms that include burning sensation of the oral mucosa, ulceration, pain, and restricted movement. Advanced cases show signs of hearing loss which can be explained by Eustachian tubes blockage and difficulty in swallowing occurring as a consequence of esophageal fibrosis.[5,7]

These studies substantiate both clinically and histologically the impairment of Eustachian tube function and hearing ability in OSMF.

The present study was carried out to determine the effect of OSMF on hearing using tympanometry and audiometry as the substances causing oral submucous fibrosis such as areca nut and other tobacco products are increasingly being used and affecting the young population and can affect the hearing of the person at a relatively early stage.

There is a paucity of the study on this topic, so the study is being conducted to see the effect of oral submucous fibrosis on hearing.

MATERIALS AND METHODS

The proposed cross-sectional study was carried on all the patients of OSMF of any grade attending the Department of Otorhinolaryngology and head and neck surgery, Rohilkhand Medical College and Hospital, Bareilly, a tertiary care and teaching hospital in western Uttar Pradesh for a duration of 2 months from July 12, 2019, to September 11, 2019 and fulfilling the inclusion and exclusion criteria were enrolled for the study. The study was approved by the Institutional Ethical Committee and the study was done and funded by Indian Council of Medical Research (ICMR) as a Short Term Studentship with Reference ID**:** 2019-01435.

Inclusion criteria were all the subjects of oral submucous fibrosis willing to give consent. Exclusion criteria were subjects with known head and neck malignancy or previous history of radiation and already with hearing deficit due to any factor other than OSMF.

A total of 50 OSMF cases (Case) and 50 normal cases (control) were taken for the study.

After the clinical examination, the diagnosis of OSMF was made on the basis of natural history and characteristic clinical features of the disease which include burning sensation in mouth, intolerance to spicy food, presence of palpable fibrous bands, and decreased mouth opening and all these cases were selected for the study and a written informed consent was obtained. They were subjected to a thorough ENT and head neck examination followed by pure tone audiometry (PTA) by "Audiometer Primus audit data" and tympanometry by "Interacoustic."

The findings of the tests were compared with those group of population who did not have OSMF (control).

- The results were tabulated, statistically analyzed and observations made accordingly.

OBSERVATION AND RESULTS

The following observations were made on 100 selected patients in 2 months:

The Chi-square value of this study is 7.4215 and $P = 0.1152$.

Majority of the cases were of age group 21–40 years. However, the data were found to be statistically not significant, thereby establishing that OSMF is not age dependent and can be seen in any age [Figure 1].

Tympanometry study was performed on the OSMF cases and 41(82%) cases had normal A type of curve, whereas type B and C was seen in 7(14%) and 2(4%) cases. On the contrary among control, all 50 subjects had normal A type of curve. Statistically, the result was found to be significant, and thus, Eustachian tube dysfunction can be considered as the probable cause of this finding. This also concludes that muscles regulating the Eustachian tube function and soft palate are affected by OSMF [Figure 2]

On PTA, a significant association is established between the cases and control in terms of hearing loss.

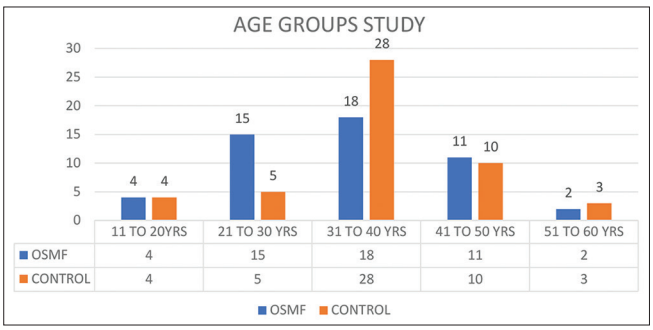

Figure 1: Age distribution of cases. The value of Chi-square for this study is 9.8901 and $P = 0.0071$ and it is significant

Cases of OSMF presented with more of conductive hearing loss in 36% cases and the reason can be due to Eustachian tube dysfunction as a result of involvement of paratubal muscle and soft palate. Sensorineural type of hearing loss was seen in 10% cases and the probable reason could be neurotoxicity affecting acoustic nerve as result of chemicals released by constituents of tobacco [Figure 3].

On considering the site of involvement by the OSMF among cases, soft palate and buccal mucosa were involved in 43 (86%) of the cases and it was followed by hard palate in 41 (42%) cases. Both hard palate and soft palate are in contiguity with the paratubal muscles and this is probably the cause of hearing deficit of conductive type and type B and C on tympanometry.

Lip and floor of mouth were least affected by OSMF [Table 1].

DISCUSSION

OSMF is an oral precancerous condition, characterized by inflammation and progressive fibrosis of the oral submucosal tissues causing marked rigidity and trismus, but there still remains a dilemma to the clinicians due to elusive pathogenesis and less well-defined classification systems.

In age distribution, the data were analyzed and Chi-square value of the data was 7.42 and $P = 0.1$ which is

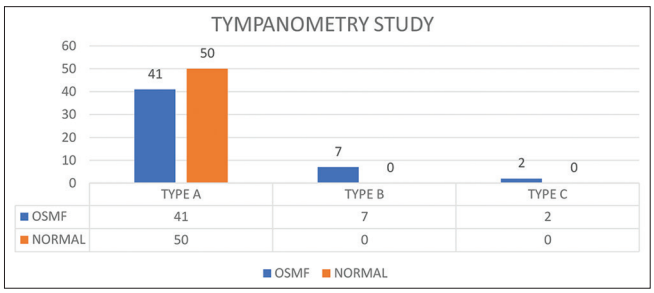

Figure 2: Correlation of oral submucous fibrosis with tympanometry. The value of Chi-square is 21.1197 and $P = 0.0000$ that is significant

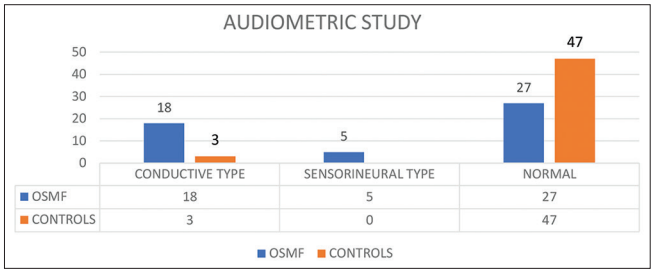

Figure 3: Correlation of OSMF with type of hearing deficit

Table 1: Correlation of site of involvement with hearing

Examination	Cases (%)
Buccal mucosa	43 (86)
Floor of mouth	5 (10)
Gums and teeth	14 (28)
Hard palate	41 (82)
Lip	1 (2)
Retromolar trigon	31 (62)
Soft palate	43 (86)
Tongue	8 (16)

not significant. Although while documenting the data, it seems to be some relations, because, in the study, majority of the cases were of age group 21–40 years but found no relationships.

In gender distribution study distributing the total cases to be examined for hearing deficit in OSMF, on data analysis, the Chi-square value was 0.10 and $P = 0.7$ that is not significant. Thus, it signifies that gender and OSMF are independent of each other. While during documentation data showed that males are mostly affected, and that must be due to exposure of males to areca nut, but analysis showed no relationships.

In tympanometry study, which was performed on the OSMF patients 82% type A, 14% type B, and 4% type C and on analyzing the data, the value of Chi-square for this study was 9.8901 and $P = 0.0071$ suggesting its significance and correlation between type of hearing loss with OSMF. Our study goes in agreement with the study done by Gupta *et al*.[1] who also found that out of 106 ears examined, normal tympanogram type A curve was recorded in 80 (75.5%), ears abnormal tympanograms included type B curve in 17 (16.0%), and type C curve in 9 (8.5%) of ears. Similar results were also seen by Shah *et al*.[2] Thus from these studies, it is evident that fibrosis of the muscles regulating the function of Eustachian tube has the bearing on the causation of conductive hearing loss.

On Pure tone Audiometry, out of OSMF cases, 54% had normal hearing, 36% were having conductive hearing loss and rest 10% Sensorineural type of hearing loss whereas amongst control normal hearing was seen in 94% with only 6% had conductive hearing loss. Data obtained from our study which shows a strong association hearing loss in OSMF which was statistically significant. Similar results were also seen in the study done by Nigan *et al*.,[8] Devi and Singh,[9] Gupta *et al*.,[1] and Shah *et al*.[2] Thus from above, it is evident that my study is in accordance to all previous studies, showing hearing loss is associated with OSMF.

All the subsites of oral cavity and oropharynx were variably affected by oral submucous fibrosis. Lips and tongue were least affected, whereas hard and soft palate are affected to a reasonably greater extent. Hence, the muscles around the Eustachian tube are at more risk of being involved with fibrosis due to continuity to these structures. Cannif *et al*.[4] have seen ultrastructural findings of muscle degeneration in OSMF. Gupta *et al*.[10] also established the involvement on the basis of histological changes and have also seen dysplasia in 13.2% patients, degenerative changes in palatal/paratubal muscles were found in the form of loss of cross striations, edematous muscle fibers, and atrophy. It was concluded that there was definite involvement of palatal and paratubal muscles in OSMF. Chandran *et al*.[11] also found an impact of OSMF on the impairment of hearing and have found a statistically significant result between mouth opening and auditory tube dysfunction, on the basis of auditory tube function test, the study also suggested that involvement of pharyngeal orifice by OSMF results in impairment of function and patency of auditory tube, leading to hearing loss.

CONCLUSION

OSMF affects the hearing and is usually causes conductive type of deafness as a result of fibrosis of the palatal muscles in association with muscles regulating the function of Eustachian tube and mucosa present around it. However, further studies with larger sample size and correlating with histopathological changes in palatal and paratubal muscles are an area of future research.

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