

Assessment of thickness and echogenic pattern of masseter in subjects with OSMF, chewers and healthy controls- An ultrasound study

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Abstract

Introduction: Oral submucous fibrosis (OSMF), a potentially malignant disorder is associated with prolonged chewing of arecanut which results in fibrosis of the lamina propria. A positive correlation has been observed between masseter thickness and clinical progression of OSMF in previous studies. The increased thickness of the masseter may in turn alter the echogenic pattern of the muscle. Hence, the aim of the present study was to assess the thickness and echogenicity of the masseter in subjects with OSMF and chewers, by ultrasonography and compare with controls.

Materials and Methods: Fifteen subjects with OSMF, fifteen subjects with history of chewing arecanut without OSMF and thirty controls were included in the study. The thickness and the internal echogenic pattern of the masseter were evaluated in all the subjects. The echogenic pattern was classified as Types I, II and III. The data obtained was tabulated and subjected to statistical analysis.

Results: The mean thickness of masseter was highest in the OSMF group followed by chewers and controls, although the difference was not statistically significant. Type II was the most common echogenic pattern observed in all the study groups, followed by Type I (the difference was not significant). None of the groups presented with Type III.

Conclusion: The masseter thickness may be used as an additional diagnostic criterion in OSMF subjects. Studies with larger sample and use of a high resolution ultrasound machine may give a better understanding of the echogenic pattern of masseter in subjects with OSMF. Ultrasonography was found to be a reliable and a reproducible method for evaluating the masseter.

Keywords: Oral Submucous Fibrosis, Ultrasonography, Masseter Thickness, Echogenic Pattern.

Introduction

Oral submucous fibrosis (OSMF) is a chronic disorder that can affect any part of the oral cavity and sometimes even the pharynx.⁽¹⁾ Individuals with OSMF carry a high risk of developing oral cancer.⁽¹⁾ OSMF is found predominantly among people of South Asia and India and is closely linked with the habit of chewing betel quid and tobacco containing products.⁽¹⁾ Histologically, OSMF is characterized by fibrosis of the lamina propria, which progresses to involve the submucosa and deeper tissues, including the muscles of the oral cavity.⁽²⁾

Orofacial muscle involvement in OSMF was first reported in the year 1972.⁽³⁾ Prolonged chewing of arecanut and other commercial variants by OSMF subject results in hypertrophy of the masseter muscle.⁽⁴⁾ A positive correlation has been observed between the thickness of masseter and progression of clinical disease in previous studies.⁽⁴⁾ However degeneration of the muscle has been noted in the advanced stage.⁽⁴⁾ Diminished blood supply following connective tissue changes probably contributes to muscle degeneration.⁽⁴⁾ Further, the glycogen depletion which occurs as a result of increased muscle activity may also be response for the degeneration of masseter in later stages of OSMF.⁽⁴⁾ The hypertrophy/ degeneration of masseter observed in OSMF subjects alter the fascia within the muscle, which in turn affects the echogenic pattern of the masseter.⁽⁵⁾

The masseter can be evaluated by various imaging modalities like CT, Magnetic Resonance Imaging (MRI) and Ultrasound (US). Ultrasonography (USG) is a safe, non-invasive imaging modality capable of portraying soft tissue structures with considerable detail, particularly superficial structures of the head and neck region such as masticatory muscles, salivary glands, and lymph nodes.⁽⁶⁾ Ultrasonography can also demonstrate the internal structure of the masseter more vividly than CT and has been accepted as a reliable method for evaluation of thickness of masseter in OSMF.⁽⁷⁾

Although a few studies have analysed the thickness of masseter in OSMF, limited studies have assessed the echogenic pattern of masseter in subjects with OSMF and habitual chewers of areca nut. With the above background, the present study evaluate the cross-sectional thickness and internal echogenicity of masseter muscle in subjects with OSMF, chewers and healthy controls using ultrasonography and compare between the groups.

Materials and Methods

The subjects for the present study were selected from those visiting the department of Oral Medicine and Radiology and were categorised as follows,

OSMF group:- Fifteen subjects who satisfied the clinical criteria of OSMF as proposed by Mathur and Jha.

Chewers group:- Fifteen subjects with history of chewing arecanut and its commercially variants without OSMF.

Controls:- Thirty age and gender matched healthy individuals.

Subjects below 18 years, pregnant and lactating women, subjects with previous treatment for OSMF and subjects with any other collagen diseases were excluded from the study. The study was approved by the Institutional Review Board and a written consent was obtained from all the individuals prior to conducting the study.

In subjects with OSMF, the relevant history and a thorough clinical examination were done. This was followed by examination of the masseter in OSMF, chewers and control groups with the help of an ultrasound machine, (2D, LOGIQ 100 PRO, GE Medical Systems, Milwaukee, WI, USA) equipped with a wide bandwidth linear active matrix transducer with a frequency of 7.5 MHz (Model 2274907, serial 168 WPS, Wipro GE Medical Systems Ltd., India).

For ultrasonographic evaluation of the masseter, the subject was positioned in a semi-reclined position on the dental chair with the head turned to the opposite side of examination(Fig. 1).



Fig. 1: Patient positioning for ultrasound evaluation of masseter muscle

The transducer was placed perpendicular to the anterior border of the muscle and surface of the ramus at approximately 2.5 cm above and parallel to the inferior border of the mandible with minimum pressure. The thickness and echogenic pattern of the masseter muscle was assessed bilaterally in the relaxed state.

The thickness of masseter corresponded to the maximal distance between the outer fascia of the muscle and the lateral surface of the ramus. (Fig. 2)

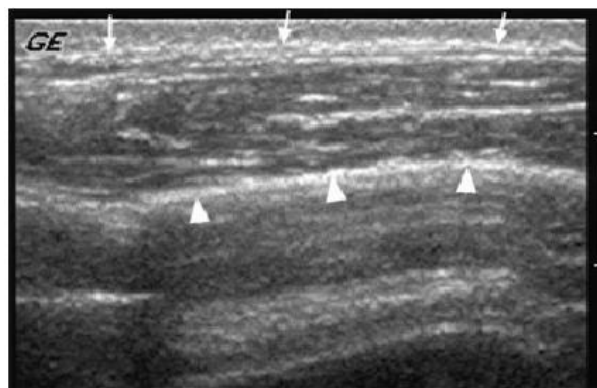


Fig. 2: Masseter muscle thickness – between the outer fascia of the muscle (arrow) and the lateral surface of the ramus (arrow head)

Masseter thickness was measured twice by 1 observer with an interval of 1 week between the measurements. The echogenic pattern was assessed by 2 observers. The first observer assessed the echogenic pattern twice with an interval of 1 week between the assessments. The echogenic pattern was categorised as suggested by Arijji Y et al,⁽⁹⁾ into Type I- characterized by the clear visibility of the fine bands, Type II- thickening and weakened echo-intensity of the bands. Type III- disappearance or reduction in number of the bands.(Fig. 3).

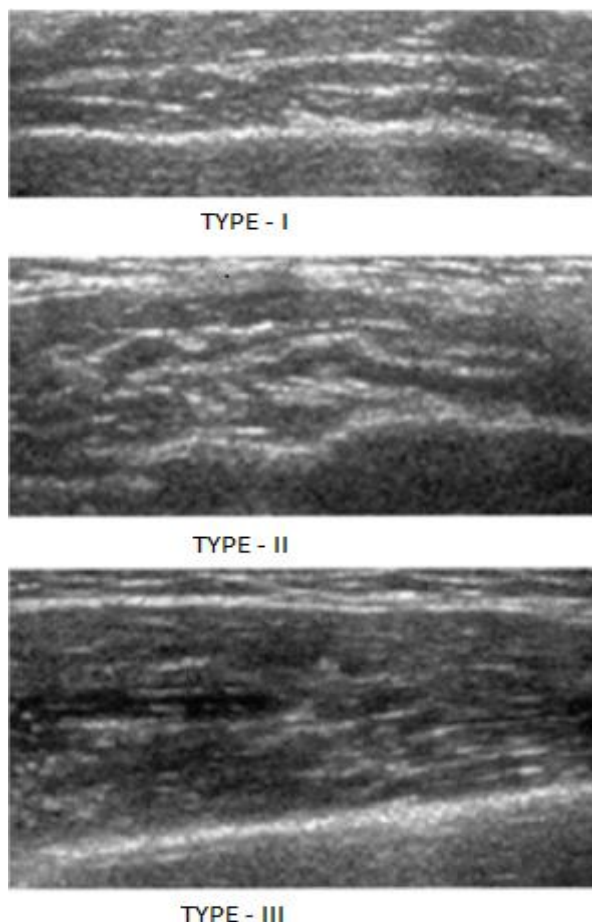


Fig. 3: Types of Internal ecogenicity

The data obtained was tabulated and subjected to statistical analysis. Anova and Mann-Whitney U test were used to compare masseter muscle thickness in subjects with OSMF, chewer and healthy controls. Independent t test used to compare masseter muscle echogenicity between the 3 groups. An intra-observer analysis was done using paired t test. Kappa statistics was used to assess inter observer agreement.

Results

Most of the subjects with OSMF (80%) and chewers (80%) were in the age group of 20 to 40 years of age. A higher number of males were observed in both OSMF (80%) and chewers group (86.67%) as compared to females. The most common symptom in subjects with OSMF was burning sensation (100%) followed by reduced mouth opening (80%). With regard to clinical staging of OSMF, a higher number of subjects (73.33%) were noted in stage II, followed by 20% in stage III and 6.67% in stage I. The mean mouth opening was least in OSMF subjects (32.93mm) followed by chewers (43.67mm) and controls (44mm), and the difference was statistically significant (p value = 0.0001). The mean mouth opening was found to decrease with progression of clinical disease in OSMF subjects (stage I- 40mm, stage II -32.83mm, stage III-20mm). The buccal mucosa

was the most frequently involved site (86.67%) followed by soft palate and tongue (13.33%).

There was no significant difference between the intra-observer measurements (p value >0.05) of the masseter thickness and inter-observer measurements (p value = 0.001) of the echogenic pattern in all the three study groups. The mean thickness of masseter was highest in the OSMF group followed by chewers and controls. (Fig.4)

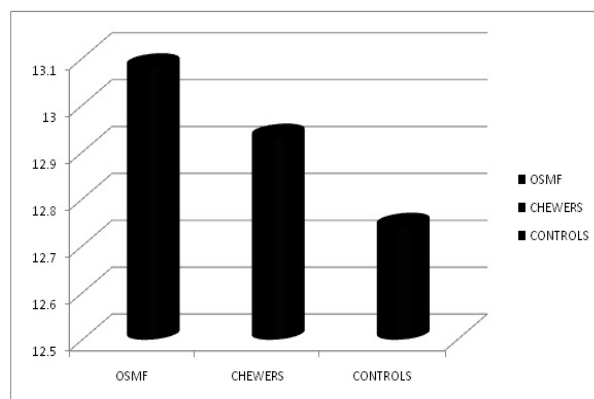


Fig. 4: Mean thickness of masseter in the study groups (in mm)

Although the difference was not statistically significant (p value = 0.7966). It was observed that type II was the most common echogenic pattern noted in all three study groups followed by type I and none of the study groups presented with type III pattern (Fig.5).

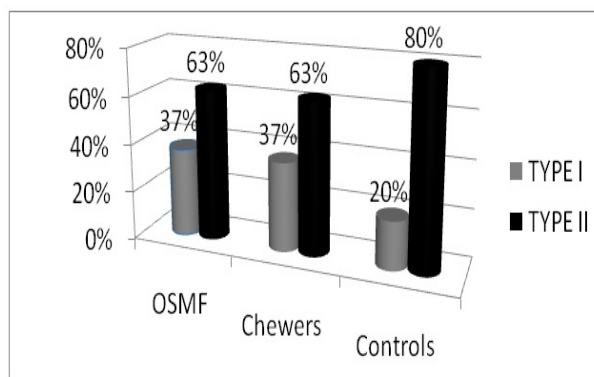


Fig. 5: Distribution of echogenic pattern in the study groups

There was no significant difference in the distribution of the types I and II echogenic pattern in all the study groups (p value-0.9542). A higher number of stage II OSMF subjects demonstrated type II pattern as compared to stage I and stage III, although it was not significant (p value-0.9132, Table 1).

Table 1: Distribution of echogenic pattern in different stages of OSMF

Stages	Type - I		Type - II	
Stage I	1	3.33%	1	3.33%
Stage II	8	26.67%	14	46.67%
Stage III	2	6.67%	4	13.33%

Discussion

OSMF generally occurs in the second to third decade of life with a mean age of 34.3 years.⁽⁹⁾ The increased usage of arecanut and its commercial variants in the younger age group can be attributed to the changing life styles, high levels of stress and peer pressure. In the present study, most of the subjects with OSMF were in the age group of 20 to 40 years of age which is in accordance with several previous studies [Sirsat et al(1960), Sinor et al(1990), Shah et al(1998), Ahmed MS et al(2006)].⁽⁹⁾ A higher number of males were observed in OSMF group in the present study. Similar findings have been observed in other Indian studies.⁽⁹⁾ A case-control study in Chennai revealed a male-to-female ratio 9.9:1. An OSMF study in Patna (2002-2004) found a male-to-female ratio of 2.7:1.⁽⁹⁾ Male predominance may be attributed to easy accessibility to areca nut and its products than females.⁽⁹⁾ However in a study from Durban, South Africa, a distinct female predominance (13:1) was demonstrated.⁽⁹⁾

The least number of subjects (6.67%) were noted in stage I. This could be due to the fact that most of the subjects are asymptomatic until the disease has considerably progressed. Further OSMF afflicts the younger age group who generally have high tolerance levels to burning sensation and hence do not seek consultation. The initial symptoms of OSMF include burning sensation in the oral cavity when consuming spicy food, appearance of ulcers/vesicles especially in the palate, ulcerations or recurrent generalized inflammation of the oral mucosa, excessive salivation, dryness of the mouth and defective gustatory sensation.⁽¹¹⁾ In the later stages of OSMF, subepithelial and submucosal fibrosis occurs which leads to stiffness of the oral mucosa and deeper tissues with progressive limitation in opening of the mouth and protrusion of the tongue, thus causing difficulty in eating, swallowing and phonation.⁽¹¹⁾ In the present study, the most common symptom was burning sensation (100%) followed by reduced mouth opening (80%). Studies have also revealed that as the clinical stage of OSMF increases, the mouth opening decreases. This was evident in the present study. In an epidemiological study on OSMF, buccal mucosa was involved in all the subjects (100%) examined, palate in 76% of subjects, labial mucosa and tongue in 40% subjects. Similar findings were observed in the present study.

It is a well-established fact that if a skeletal muscle is not used for a long interval of time, it can atrophy. Similarly increased work load on the muscles may result

in hypertrophy. This applies to the muscles of mastication as well. Under development of masticatory muscles are noted when bite forces are weakened and vice versa. Masseter is one of the major muscles of mastication. In subjects with OSMF and chewers, prolonged chewing of arecanut and other commercial variants, results in hypertrophy of the masseter muscle. The mean thickness of masseter in the present study was highest in the OSMF group followed by chewers and controls. Significant increase in the masseter muscle thickness in OSMF as compared to chewers and controls has been reported in other Indian studies (Table 2).^(1,2,4,7,8)

Table 2: Mean thickness (mm) of masseter among different Indian studies

	Present study	Karnataka	Haryana	Tamil nadu	Uttar pradesh
OSMF	13.08	9.4	9.8	11.13	11.35
Control	12.74	7.7	10.4	9.1	7.9

The mean thickness of masseter in OSMF subjects was found to be higher in the present study as compared to other Indian studies. This could be attributed to other factors such as body mass index age, gender, type of occlusion, facial morphology, dietary habits, number and size of muscle fibre.

In normal muscles, fine transverse hyperechoic bands are usually observed on USG images.⁽¹⁰⁾ These bands probably correspond to the internal fascia or tendon and are sometimes referred to as septa.⁽¹⁰⁾ The masseter hypertrophy in OSMF and chewers leads to stretching of the fascia in the muscles altering the echogenic pattern of the muscles.⁽¹⁰⁾ In the present study, there was no significant difference in the distribution of the types, I and II echogenic patterns in all the study groups, although type II was more common. The results of the present study are in accordance with another similar study conducted in the same institution,⁽¹⁰⁾ wherein type II echogenic pattern was commonly noted in OSMF subjects and chewers. However, Type I was the most common pattern noted in controls which is in contradiction to the present study. The above variation in the results can be attributed to the difference in number of controls (higher number of controls in the present study). Also, the observers in both the studies were different. Thus in our opinion, the assessment of echogenic pattern is subjective in nature.

In another Indian study the echo texture of the submucosa was studied in OSMF, chewers and controls in relation to the muscle layer.⁽²⁾ The buccal mucosa in OSMF demonstrated increased submucosal echogenicity and reduced echo differentiation between submucosa and muscle layer as compared to chewers and controls.⁽²⁾

Conclusion

The thickness of masseter was found to be higher in subjects with OSMF as compared to chewers and

controls and hence masseter thickness may be used as an additional diagnostic criterion in OSMF subjects. No definitive conclusions can be drawn with regard to the echogenic pattern of masseter in OSMF as a similar echogenic pattern was observed in all the study groups. Studies with larger samples and use of a high resolution ultrasound machine may result in a better understanding of the echogenic pattern of masseter. Ultrasonography was found to be a reliable and a reproducible method for evaluating the masseter in OSMF.

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