

Evaluation Of Internal Echogenic Pattern And Thickness Of Masseter Muscle With Ultrasonography In Chronic Areca Nut/ Tobacco Chewers And Oral Submucous Fibrosis Patients In A Tertiary Care Hospital Chengalpattu District, Tamilnadu

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ABSTRACT

Introduction: Ultrasonography (USG) serves as a valuable, non-invasive tool to monitor these changes, providing insights into the muscle's structure and function. The normal thickness of the masseter muscle differs by gender, with males generally having thicker muscles both at rest and during contraction compared to females. Oral submucous fibrosis (OSMF), a potentially malignant disorder, significantly increases the risk of oral cancers, particularly squamous cell carcinoma.

Aims and objective: To evaluate the difference in cross-sectional thickness and internal echogenic pattern of masseter muscle at rest and at maximum clenching position using ultrasonography in chronic areca nut /tobacco chewers, OSMF patients and control groups.

Materials and methods: The study participants were categorized into three groups with 75 participants ,consisting of 25 participants each with the following conditions; Group 1 with chronic chewers, group 2 with OSMF and group 3 with healthy individuals as controls. An ultrasonographic examination of masseter was performed in all subjects for masseter muscle thickness and echogenic pattern, the echogenic pattern was classified into Types I, II and III. Differences in masseter muscle thickness and echogenic pattern between study groups and control group was evaluated.

Results: the age group were between 20 and 50 years of age with significant male predominance. The thickness of the masseter muscle was significantly greater in chronic chewers, both in the relaxed and contracted states, on both sides, when compared to both the OSMF group and the control group. In contrast, the OSMF group exhibited a decrease in masseter muscle thickness compared to the control group.

Conclusion: The findings revealed a statistically significant increase in masseter muscle thickness in chronic chewers, both in the relaxed and contracted states, on both sides, when compared to both OSMF patients and the control group. A slight muscle atrophy that is decrease in the muscle thickness was observed in OSMF patients in comparison to the control group.

Keywords: ultrasonography, chronic chewers, OSMF, masseter, echopattern, thickness.

1. INTRODUCTION

Masseter muscle hypertrophy refers to the benign enlargement of the masseter muscle, which can occur on one side or both sides of the face. This condition is often a result of the repetitive and prolonged chewing of substances like areca nut, betel quid, and tobacco, which impose excessive force on the masticatory muscles ^[1]. Over time, this strain can lead to muscle hypertrophy and alter the echogenic pattern of the masseter muscle, making it more prominent on imaging. Oral submucous fibrosis (OSMF), a potentially malignant disorder, significantly increases the risk of oral cancers, particularly squamous cell carcinoma. This condition causes progressive fibrosis of the buccal mucosa, resulting in tissue stiffness and restriction of movement, which may contribute to a "sunken cheek" appearance ^[2,5].The normal thickness of the masseter muscle differs

by gender, with males generally having thicker muscles both at rest and during contraction compared to females. OSMF is divided into four stages according to its severity, and as the disease advances, there is an observable increase in the thickness of both the masseter muscle and the submucosal tissue, as well as changes in the echogenic patterns of the buccal mucosa and muscle. Ultrasonography (USG) serves as a valuable, non-invasive tool to monitor these changes, providing insights into the muscle's structure and function^[4]. However, the effectiveness of USG is influenced by the operator's skill and the quality of the equipment used. The internal echogenic pattern of the masseter muscle can be categorized into three types: Type I, where fine muscle bands are clearly visible; Type II, where the bands appear thickened and echogenic intensity is reduced; and Type III, where these bands either disappear or significantly decrease in number^[6]. Ultrasound imaging can effectively track these variations, allowing for a better understanding of the underlying pathological processes in OSMF. By identifying these changes early, ultrasound can help prevent the further progression of OSMF, potentially reducing the risk of developing oral cancer.

2. AIMS AND OBJECTIVES

This study aims to evaluate the difference in cross-sectional thickness and internal echogenic pattern of masseter muscle at rest and at maximum clenching position using ultrasonography in chronic areca nut /tobacco chewers, OSMF patients and control groups.

3. MATERIALS AND METHODS

Our study was designed and conducted among patients visiting the Department of oral medicine and radiology Karpaga Vinayaka Institute of medical sciences and research Centre. The study was conducted after obtaining the ethical clearance from the institutional ethical committee. This is a cross-sectional study with three groups, test and control in which the test group includes chronic chewers and clinically diagnosed OSMF and the control group includes non- chewers. All the patients included in this study were based on the inclusion and exclusion criteria. In the study we have taken around 75 patients and grouped into three with 25 in each group.

Inclusion criteria:

- Patients with Gutka or Areca nut chewing habit for more than two years and duration of chewing for more than five minutes, and they were defined as chronic chewers.
- Clinically diagnosed OSMF patients
- For the control group – age, sex, body mass index matched healthy subjects with no history of areca nut or tobacco chewing.
- No appreciable malocclusion.
- No bruxism
- No known mucosal lesions

Exclusion criteria:

- Patients, who do not want to take part in the study
- Patients with systemic illness, Masticatory muscle disorders, parotid pathology, temporomandibular joint disorders, developmental anomalies, affecting the maxillofacial region

A complete clinical history followed by general physical examination and ultrasound is done. These data are then analysed to know the evaluation of masseter muscle thickness and the internal echogenic pattern in chronic Areca nut or tobacco chewers and OSMF of patients.

In a study, every patient included or subjected to ultrasound imaging in the Department of Radiodiagnosis for recording the thickness of masseter muscle. In our institution, we use grey scale esaote my lab x6 ultrasound machine. Ultrasound study was performed in all patients using multi frequency (7-12 MHz) linear probe. The patients should be positioned in the supine posture with the head turned towards the side of examination. The transducer is placed transversely along line joining the commissure of the mouth to the lower part of the tragus of the ear (Fig 1). The visibility of the internal echogenic bands and thickness of the masseter muscle is assessed on both sides (Fig 2). The internal echogenic pattern was categorized into the following types, as proposed by Ajit Y. et al.

Type I: which is defined by the clear visibility of fine transverse bands;

Type II: which is marked by the thickening and reduced echogenic intensity of the bands;

Type III: which is characterized by the absence or a decrease in the number of the bands.



Fig 1 :Measurement point used for USG evaluation of masseter muscle (P- posterior, M-middle , A-anterior)

Data will be collected and will be entered statistical package for the social sciences (SPSS, version 25). Data will be statistically described in terms of range, mean, SD, frequencies (number of cases), and percentages when appropriate. To test the association between groups the Chi-square test is used. To test the difference between 3 groups Anova is used.

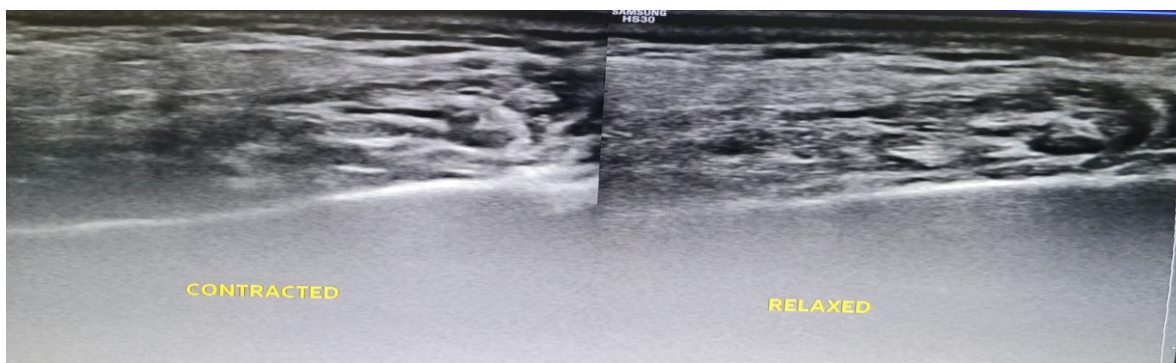


Fig 2:Ultrasonography image of the masseter muscle in a healthy person -contracted and relaxed state.

4. RESULTS

Table 1 provides a detailed breakdown gender distribution in both the group of the participants in the current study. There seem to be a significant male predominance in regards with gender distribution in this study. Participants in this study were between the age group of 20 and 50 years of age. The mean age among the chronic chewers was 31.64 ± 5.96 years, OSMF was 34.54 ± 4.86 years and in control group was 33.6 ± 5.87 years.

There are three types in the echogenic patterns in which the chronic chewers had more of type 2 echogenic pattern with 64% followed by type 3 and then type 1. In OSMF patients most of the patient had type 3 echo pattern followed by type 2. None of them presented with type 1 echo pattern. Comparing it with the control group, majority of the participants had type 1 echo pattern. On the right side, in individuals who are chronic chewers, there is a notable increase in the average thickness of the masseter muscle, both when it is contracted (15.76 ± 0.58 mm) and when it is relaxed (13.03 ± 0.61 mm), in comparison to other groups. Conversely, in subjects with Oral Submucous Fibrosis (OSMF), the mean masseter thickness is reduced in both the contracted (12.98 ± 0.53 mm) and relaxed states (10.18 ± 0.32 mm) when compared to the control group, which has measurements of 13.22 ± 1.11 mm for the contracted state and 10.75 ± 1.22 mm for the relaxed state.

On the left side, in individuals who are chronic chewers, there is a marked increase in the thickness of the masseter muscle, both in the contracted state (15.82 ± 0.57 mm) and the relaxed state (13.35 ± 0.63 mm), when compared to the other groups. In contrast, subjects with Oral Submucous Fibrosis (OSMF) show a slight reduction in masseter muscle thickness, with measurements of 13.15 ± 0.5 mm for the contracted state and 10.48 ± 0.24 mm for the relaxed state. These values are lower compared to the control group, which has a masseter thickness of 13.54 ± 1.12 mm when contracted and 10.84 ± 0.99 mm when relaxed.

The average muscle thickness in the control group, on both sides, was found to be lower than that in chronic chewers but higher than in the OSMF group for both the contracted and relaxed states with significant association. However, the reduction

in muscle thickness observed in the OSMF group, when compared to the control group, was not statistically significant.

Table 1: Gender distribution

Group	No of patients	Sex		Total
		Male	Female	
Chronic chewers	N	21	4	25
	%	84	16	100
OSMF	N	23	2	25
	%	92	8	100
Control	N	19	6	25
	%	76	24	100
Total	N	63	12	75
	%	84	16	100

Table 2: Internal echogenic patterns

	Chronic chewers	OSMF	Control group
Type 1	3 (12%)	0	19 (76%)
Type 2	16 (64%)	9 (35%)	5 (20%)
Type 3	6 (24%)	16 (64%)	1 (4%)

Table 3: Mean thickness of masseter muscle in both groups on both sides

Groups	No of patients	Right relaxed	Right contracted	P value	Left relaxed	Left contracted	P value
Chronic chewers	25	13.03±0.61	15.76±0.58		13.35±0.63	15.82±0.57	
OSMF	25	10.18±0.32	12.98±0.53	0.04*	10.48±0.24	13.15±0.5	0.04*
Controls	25	10.75±1.22	13.22±1.11		10.84±0.99	13.54±1.12	

Table 4: Mean difference of the masseter muscle thickness among the test and control group:

Dependent variable	Group A	Group B	Mean difference	P value
Right relaxed	Chronic chewers	OSMF	3.05	<0.001
		Controls	2.48	<0.001
	Controls	OSMF	0.57	0.07
Right contracted	Chronic chewers	OSMF	3.12	<0.001
		Controls	2.51	<0.001
	Controls	OSMF	0.61	0.04
Left relaxed	Chronic chewers	OSMF	3.03	<0.001

Left contracted		Controls	2.98	<0.001
	Controls	OSMF	0.05	0.4
	Chronic chewers	OSMF	2.65	<0.001
		Controls	2.24	<0.001
	Controls	OSMF	0.41	0.12

5. DISCUSSION

Ultrasonography is commonly employed to measure the thickness of the masseter muscle in both experimental and clinical research settings. Ultrasonography works by converting electrical energy into sound waves and vice versa, allowing clinicians to visualize and differentiate anatomical structures during examination. This method is accurate, convenient, simple to use, and cost-effective. Traditionally, ultrasonography has served as a quick, non-invasive technique for observing deeper areas of the body [7]. Recently, however, the development of high-frequency echography has enabled more detailed investigation of superficial regions. Ultrasonography is particularly suitable for measuring the thickness of the masseter muscle. It can detect significant variations in masseter muscle thickness both between individuals and within the same individual in relaxed and contracted states.

Oral Submucous Fibrosis (OSMF) is a premalignant condition that has become a growing area of concern due to its increasing prevalence and potential for malignancy. While it was once primarily observed in Southeast Asia, this condition is now found globally, possibly linked to the rising prevalence of quid chewing, which is the primary known cause of OSMF [8]. The literature extensively documents that the fibrosis of the buccal mucosa in OSMF leads to the characteristic sunken cheek appearance, making the masseter muscle appear enlarged. Conditions such as scleroderma could be considered as differential diagnoses; however, these can be distinguished from OSMF based on the patient's history of areca nut chewing and the presence of burning sensations, which are commonly experienced in OSMF.

As OSMF progresses, there is an increase in submucosal thickness and masseter hypertrophy, while the internal echogenic pattern diminishes [9]. Comparing the different stages, a reduction in the number of echogenic bands in an inflamed muscle is observed, suggesting that these echogenic bands serve as important indicators of masseteric inflammation. Type I is likely associated with normal muscle conditions, while Types II and III may indicate pathological changes. This information is useful in evaluating treatment prognosis and in preventing the progression of OSMF to squamous cell carcinoma.

The current study aimed to measure the thickness and internal echogenic pattern of the masseter muscle in a sample of 75 participants, consisting of 25 individuals diagnosed with OSMF, chronic chewers in test group each and 25 healthy individuals in control group. There was similar study done by Anusha Vaddi et al [3], the findings of their study are consistent with the results observed from our research.

6. CONCLUSION

This study was conducted to assess the differences in the thickness of the masseter muscle among chronic chewers, OSMF patients, and a control group. The findings revealed a statistically significant increase in masseter muscle thickness in chronic chewers, both in the relaxed and contracted states, on both sides, when compared to both OSMF patients and the control group. A slight muscle atrophy that is decrease in the muscle thickness was observed in OSMF patients in comparison to the control group. In chronic chewers, the echogenic pattern was type 2 while in OSMF patients it was type 3. The control group without any substance abuse, had type 1 echogenic pattern. To further confirm these results, prospective studies with larger sample sizes are recommended, since we have done the study with less number of participants.

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