Original Article

Evaluation of Internal Echogenic Pattern of Masseter in Subjects with Myofascial Pain/ Myositis, Oral Submucous Fibrosis, Chewers, Bruxers and Healthy Individuals- A Preliminary Ultrasonographic Study

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KEY WORDS
Ultrasonography;
Masseter;
Echogenic Pattern;
Myofascial Pain;
Bruxism;

ABSTRACT

Statement of the Problem: The masseter is generally involved in myofascial pain, myositis, oral submucous fibrosis (OSMF), bruxism, and in subjects with habitual tobacco/arecanut chewing. In all the above conditions, changes in the internal echogenic pattern on ultrasonography of the muscle may be observed.

Purpose: The present study aimed at evaluating the internal echogenic pattern of masseter by ultrasonography in subjects with various conditions affecting masster muscle.

Materials and Method: The study subjects were categorized into 5 groups consisting of 20 subjects each with the following conditions; Group 1: myofascial pain or myositis, Group 2: oral submucous fibrosis (OSMF), Group 3: habitual chewing of tobacco/arecanut without OSMF, Group 4: bruxism. Group 5 consisted of 20 healthy subjects. An ultrasonographic examination of masseter was performed in all subjects and the echogenic pattern was classified into Types I, II and III. The images were examined by two observers and inter-observer variability was assessed. Differences in internal echogenic pattern between study groups and control group was evaluated using Chi- square test.

Results: A good inter observer agreement was noted (k value= 0.8). An equal distribution of Types II and III echogenic pattern was noted in myofascial pain/myositis group. Type II was predominant in subjects with OSMF, habitual tobacco/arecanut chewing and bruxism. Type I was predominant in controls. The echogenic pattern differed significantly from controls in subjects with myofascial pain/myositis and OSMF (p=0.00001*, 0.0237* respectively), whereas in subjects with habitual tobacco/ arecanut chewing and bruxism, it did not differ significantly from controls (p=0.2482, 0.1223 respectively).

Conclusion: Ultrasonographic examination of the echogenic pattern may help in understanding the nature of the disease process affecting the masseter muscle in various conditions.

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Introduction

The masseter muscle is an important muscle of mastication. It has a role in elevation of the mandible and provides force and precision for chewing. It is also involved in speech, facial expressions and proprioception. [1] Masseter may be affected in temporomandibular joint disorders such as myofascial pain, oral submucous fibrosis (OSMF), subjects with parafunctional habits such as bruxism etc. [2]

Myofascial pain is the most common form of chronic orofacial pain. [3] It essentially arises from over activity of the muscles of mastication, leading to painful swelling and reduced function. [4] Studies have shown masseter muscle involvement in 85% of the cases. [3]

Bruxism is a movement disorder of the masticatory system characterized by teeth-grinding and clenching during sleep (Sleep bruxism) as well as wakefulness (Awake bruxism). It is considered to be the most detrimental among the parafunctional activities of the stomatognathic system, being responsible for tooth wear, periodontal tissue lesions and muscular damage. In severe, chronic cases, bruxism can lead to myofascial pain and arthritis of the temporomandibular joints. [5]

Oral submucous fibrosis is a well-recognized, common potentially malignant condition of oral mucosa in India and Southeast Asia caused by usage of arecanut. Frequent and prolonged chewing of areca products exerts excessive forces on muscles of mastication. [6]

In the above mentioned conditions, a long-term low-level contraction of the masseter due to psychological stress or prolonged over activity of the muscle may cause an edematous change in the muscle resulting in alteration of the internal echogenic pattern and hypertrophy of the muscle. [7]

Various modalities including pressure-pain threshold measurement, electromyography, bite force measurement, and near-infra-red spectroscopy have been applied to evaluate the masticatory muscles. [7]

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. [8] USG has been widely used in the evaluation of the masseter muscle. [7] The internal structure of the muscle is more clearly evident on USG than in CT or MRI. [9] Most of the studies in literature conducted on masseter muscle have assessed the thickness of masseter muscle and very few have analyzed the internal echogenic pattern. Further, these studies have assessed the echogenic pattern in subjects with temporomandibular joint disorders (TMDs) and none have analyzed the echogenic pattern in subjects with, OSMF, habitual chewers of gutka, pan and arecanut and bruxers to the best of our knowledge. With the above background, the present study was designed to visualize the internal echogenic pattern of the masseter muscle in TMD subjects with muscle involvement (myofascial pain and myositis), subjects with OSMF, habitual chewers without any clinical evidence of OSMF and bruxers and compare it with the internal echogenic pattern of masseter muscle in healthy individual's.

Materials and Method

For this prospective case-control preliminary study, the subjects were selected from the outpatient of department of Oral Medicine and Radiology. A total of 100 subjects above 18 years of age were included in the study and were divided into 4 study groups and 1 control group. A written consent was obtained from all the subjects and ethical clearance was obtained from the institutional review board for the study. The study group was further divided into five groups.

Group 1 that included 20 subjects with myofascial pain or myositis who satisfied the Research Diagnostic Criteria/Temporomandibular Disorders AXIS: I and Mc Neil's criteria [10] respectively. Subjects with acute and chronic dental conditions with trismus, history of craniofacial neuralgias, subjects with prior treatment for the muscle disorder, subjects with not more than one missing tooth and those wearing removable prosthesis were excluded from the study

Group 2 included 20 subjects with OSMF, who satisfied the clinical criteria proposed by Mathur and Jha. [11] Subjects with previous treatment for OSMF were excluded from the study.

Group 3 included 20 subjects with the habit of chewing arecanut or other commercial variants of arecanut for 6 months or more with no clinical evidence of OSMF.

Group 4 included 20 subjects with bruxism who satisfied the ICSD (International Classification of Sleep Disorders) criteria, [12] and who had clinical signs such as enamel wear with dentine exposure, shiny spots on restorations and excessive mobility of teeth in absence of local factors like calculus. Subjects with congenital/

developmental anomalies affecting the orofacial region, history of orthodontic treatment, history of trauma to the orofacial region and neuro-muscular disorders affecting the orofacial region were excluded from the study.

Group 5 (control group) consisted of 20 age- and gender-matched healthy individuals without any signs and symptoms of myofascial pain/ myositis, OSMF, history of habitual chewing of arecanut/tobacco and bruxism.

Prior to conducting the study, a detailed case history was obtained, a thorough clinical examination was done and this was followed by ultrasonographic examination of the masseter. Ultrasonographic evaluation was performed with the use of ultrasound machine (2 D, LOGIQ 100 PRO, Wipro GE Medical Systems, Wisconsin) equipped with a wide band width linear active matrix transducer with a frequency of 7.5 MHz (Model 2274907, serial 168 WPS, Wipro GE Medical Systems Ltd, Bangalore, India). The subjects were positioned in the supine posture with the head turned towards the side of examination. The transducer was placed transversely along the line joining the commissure of the mouth to the lower part of the tragus of the ear. The visibility of the internal echogenic bands of the masseter muscle was assessed by two observers individually. The internal echogenic pattern was classified into the following types as suggested by Ariji Y. *et al.* [7] Type I; characterized by the clear visibility of transverse fine bands (Figure 1). Type II; characterized by the thickening and weakened echo-intensity of the bands (Figure 2).

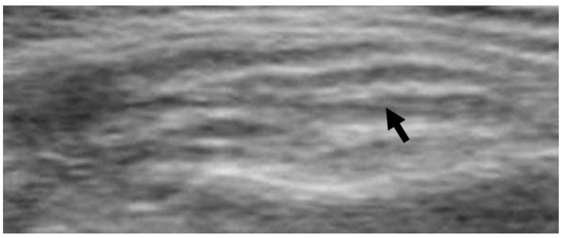

Figure 1: Type I, characterized by the clear visibility of transverse fine bands

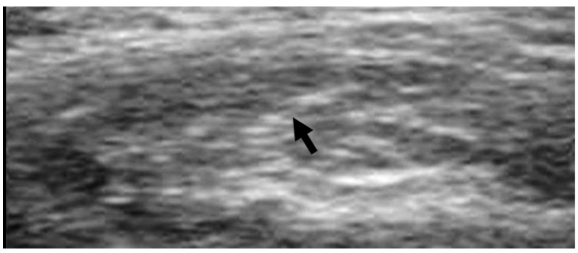

Figure 2: Type II, characterized by the thickening and weakened echo intensity of the bands

Type III; characterized by the disappearance or reduction in number of the bands (Figure 3).

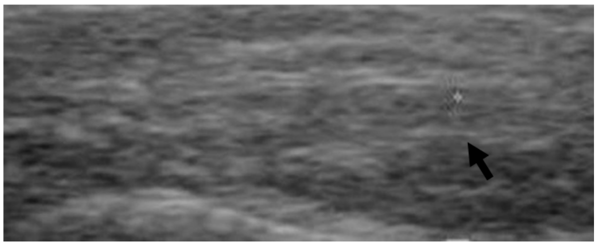

Figure 3: Type III, characterized by the disappearance or reduction in number of the bands

The inter observer agreement for the appearance of internal echogenic pattern was assessed by Cohen's kappa statistics and a good inter-observer agreement was achieved with the kappa value= 0.8.

For comparison of the internal echogenic pattern in the each study group with that of the control group, a chi-square(X^2) test was used.

In group 1, the observation made on the side which was more severely affected was considered for tabulation and statistical analysis. The severely affected side was identified on the basis of visual analogue scale (VAS) score. In the remaining four groups, the observations made by the first observer was considered due to a good inter observer agreement. Further, the observations made on the left masseter were considered for tabulation and analysis as there was no significant difference between the values obtained on the right and left side.

In subjects with OSMF i.e., group 2, the distribution of echogenic patterns was compared with the clinical stages of the condition.

Results

The age and gender distribution of the subjects in the present study has been elaborated in Table 1. A higher number of females were noted in group 1 and group 4, whereas, males were predominantly seen in groups 2 and 3 (Table 1).

Table 1: Age and gender distribution of study and control groups

Groups	Males	Females	Mean Age
Myofascial Pain/ Myositis	9	11	33.9
OSMF	16	4	38.05
Chewers	18	2	36.95
Bruxers	9	11	31.1
Control	10	10	27.75

A good inter observer agreement of 94.5 % (kappa value =0.8) was noted.

In group 1, types II and III echogenic patterns were equally distributed and none of them presented with type I. In groups 2, 3 and 4, type II echogenic pattern was predominantly seen followed by types I and III. Whereas in the control group, type I was predominantly noted followed by types II and III. A significant difference was noted with regard to the echogenic patterns in all the 5 groups (Chi- square, *p*= 0.0020) (Table 2).

Table 2: Distribution of echogenic pattern in study and control groups

Groups	Type I Number (%)	Type II Number (%)	Type III Number (%)
Myofascial pain/myositis	0(0%)	10(50%)	10(50%)
OSMF	5(25%)	10(50%)	5(25%)
Chewers	8(40%)	9(45%)	3(15%)
Bruxers	7(35%)	9(45%)	4(20%)
Control	13(65%)	6(30%)	1(5%)

(*p*= 0.0020*, *- *p*< 0.05)

On comparison of the echogenic pattern of individual study groups with the control group, groups 1 and 2 differed significantly from the control group (Chi-square, *p*- 0.00001, 0.0237 respectively), whereas groups 3 and 4 did not differ significantly from the control group (Chi- square, *p*- 0.2482, 0.1223 respectively) (Table 3).

Table 3: Comparison of internal echogenic pattern between the study and control group

Groups vs. Controls	p value
Group 1 vs. controls	0.00001*
Group 2 vs. controls	0.0237*
Group 3 vs. controls	0.2482
Group 4 vs. controls	0.1223

(*- *p*<0.05)

In subjects with OSMF i.e., group 2, the echogenic patterns were compared with the clinical stages of the condition (Table 4).

Table 4: Distribution of echogenic pattern in different stages of OSMF

Clinical stages of OSMF	USG diagnosis		
	Type I Number (%)	Type II Number (%)	Type III Number (%)
Stage I (n=3)	1(5%)	1(5%)	1(5%)
Stage II (n=14)	3(15%)	7(35%)	4(20%)
Stage III(n=3)	1(5%)	2(10%)	0(0%)

It was noted that all the 3 types of echogenic patterns were equally distributed in stage I whereas type II was predominantly noted in stages II and III followed by types I and III. Statistical analysis was not possible due to the small sample size.

Discussion

The echogenic pattern of superficial anatomical structures evident on ultrasonography is related to the difference in the acoustic impedance between the tissues. Greater the difference in the impedance between the tissues, greater is the echogenicity. In normal muscles, fine transverse hyperechoic bands are usually observed on USG images. These bands probably correspond to the internal fascia or tendon and are sometimes referred to as septa. [13-14] Studies have demonstrated a reduction in the number of echogenic bands in an inflamed muscle (edema confirmed histopathologically) and hence, it has been suggested that echogenic bands are significant indicators of masseteric inflammation. [15-16] Based on the above explanation, Type I may be associated with normal muscles and Types II and III may be associated with pathologic changes.

In group 1 (subjects with myofascial pain/ myositis), type II and type III echogenic patterns were equally distributed (50%) and none of the subjects demonstrated the type I pattern (Table 2). The appearance of types II and III echogenic patterns in subjects with myofascial pain can be attributed to the edematous change in the muscle as a result of inflammation. The edematous change probably reduces the impedance of the tissues resulting in reduced echogenicity. [7] Psychological stress with resultant long-term contraction of the masseter may be responsible for muscle inflammation in subjects with myofascial pain/myositis. [7] The findings of the present study are in accordance with a few other studies conducted in literature. Ariji *et al.* reported that most of the subjects with myofascial pain (64%) presented with type II pattern and very few had types I and III. There was significant difference in the distribution of the echogenic patterns between patient and healthy groups. [7] In another study by Jun Sasaki *et al.*, a similar finding was noted wherein most of the TMD subjects had type II pattern followed by types I and III. [15] Imanimoghaddam *et al.* reported that 65.9% subjects presented with type II followed by types I and III and a significant difference was noted. [17]

It is a well-established fact that if a 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. Underdevelopment of masticatory muscles are noted when bite forces are weakened, and when the forces are increased it leads to an overdevelopment of the masticatory muscles. [18] In groups 2 and 3 (subjects with OSMF and chewers), prolonged chewing of arecanut and other commercial variants, results in hypertrophy of the masseter muscle. [6] This hypertrophy of the muscle leads to stretching of the fascia in the muscles which in turn may alter the echogenic pattern of the muscles. [19] In the present study, in groups 2 and 3, type II echogenic pattern was predominant followed by types I and III. However in group 3, there was no significant difference in the distribution of the types I, II and III echogenic patterns (Table 2). This could be ascribed to variations in the consistency of the quid, frequency, duration and force with which the subject chews the quid.

Further in the OSMF group, a comparison of the echogenic patterns with the clinical stages of OSMF was done. It was noted that all the 3 types of echogenic patterns were equally distributed (5% each) in stage I whereas type II was predominantly noted in both stages II and III (35% and 10% respectively) (Table4). However, a larger sample size is required to conclude on this correlation between clinical stages of OSMF and the internal echogenic pattern.

In the present study, most of the bruxers demonstrated the type II echogenic pattern. The masseter muscle undergoes hypertrophy in bruxers and this may be unilateral or bilateral leading to asymmetry of the face. [20] The degree of hypertrophy depends on the frequency of bruxism and the force applied during grinding. The long-term low-level contraction of the masseter in bruxers can also result in edematous changes. Hence, it may be postulated that both hypertrophy and edema in the masseter may influence the internal echogenicity. [19]

In the present study, 65% of controls presented with type I echogenic pattern, 30% presented with type II and 5% with type III. A similar finding has been reported in a study by Ariji *et al.* wherein 70% of controls demonstrated type I and 30% with type II. [7] Further, Imanimoghaddam *et al.* also found that in healthy subjects, the highest frequency of echogenic pattern was type I (90%) followed by type II (10%). [17]

Conclusion

USG revealed a significant change in the internal echogenic pattern of masseter muscle in disorders like myofascial pain/ myositis, bruxism, OSMF, habitual chewers when compared to healthy subjects. Therefore ultrasound examination of the echogenic pattern may help in understanding the nature of the disease process affecting the masseter muscle. Future studies can investigate the changes of internal echogenic pattern of masseter muscle in assessment of treatment outcome.

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Conflict of Interest

No conflict of interest.

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