Review Article

ASSESEMENT OF MUSCLE ACTIVITY USING ULTRASONOGRAPHY, ELECTROMYOGRAPHY AND COMPUTED TOMOGRAPHY IN ORAL SUBMUCOUS FIBROSIS– A BRIEF REVIEW

Abstract

Oral Submucous Fibrosis (OSMF) is a chronic, progressive, and insidious disease that affects the mucosa of the oral cavity and may also affect the pharynx. Muscle dystrophy is a typical complication of OSMF. It shows a steady increase in the rigidity of mucosa in the oral cavity, which may lead to a restriction in mouth opening. Submucous fibrosis has become more common in India as a result of the introduction of 'Areca-nut' or 'Paan-Masala,' which is a source of concern for oral and maxillofacial surgeons. Chewing areca nuts induces ischemic alterations in the masticatory muscles, such as the masseter, as well as fibrosis, hypertrophy, and scarring. Muscle thickness has risen as a result of over activity. Advanced cases of OSMF demonstrate involvement of the masticatory muscles is required to be assessed to ascertain about the progression of the disease. Ultrasonography, Electromyography and Computed Tomography scans are all commonly utilised modalities for assessing the muscular function in OSMF. The current review focuses on these modalities and their application for evaluating the muscle activity in OSMF which will further guide the clinicians in order to fabricate a prompt treatment plan leading to desired outcomes.

Keywords: Computed Tomography, Electromyography, Oral submucous fibrosis, Ultrasonography

Introduction

Oral Submucous Fibrosis (OSMF) is a chronic condition that has an adverse effect on the oral cavity and may involve the pharynx. Schwartz was the first to describe it in 1952, and Pindborg

was the first to define it in 1966. [1, 2] They defined OSMF as "a chronic, progressive premalignant condition with juxta epithelial deposition of fibrotic tissue followed by muscular degeneration and limitation in oral opening."[1] Khanna and Andrade (1995) classified this premalignant condition depending on the extent of mouth opening and subsequent muscular degeneration found histopathologically. [3] OSMF has become more common in India as a result of popularity of "Paan Masala," or Areca nut, which is a topic of concern for oral and maxillofacial surgeons. [4]

Muscle dystrophy is present in the majority of OSMF patients. [5] It also causes gradual stiffness of the oral mucosa and ultimate inability to open the mouth. [3] Fibrotic bands appear underneath an atrophic epithelium in the latter stages of the illness.

The length, quantity, and thickness of fibrotic bands, as well as the pattern of general vascularity in the afflicted region are conveniently demonstrated with Ultrasonography (USG). Even in clinically normal buccal mucosa, it aids in the detection of faint fibrotic bands. When compared to the mucosa in between the bands, where vascularity was determined to be normal, the mucosa atop the band has a lower flow velocity. With normal/decreased vascularity and peak systolic velocity, OSMF displays increased hyper echoic regions, suggesting the presence of fibrous bands or widespread fibrosis. Furthermore, masseter muscle hypertrophy has been documented in many researches throughout the world in instances of OSMF. USG has been discovered to be a non-invasive, radiation-free method of evaluating OSMF development. [6]

Electromyography (EMG) is a newer electrodiagnostic method for assessing and recording the electrical activity of active skeletal muscles. EMG, according to Pullman et al (2000), is the sole accurate approach for recording a patient's muscle function. [7] Advanced cases of OSMF show involvement of masticatory muscles which is required to be assessed to ascertain about the progression of the disease. The frequently used modalities for assessing muscular function in OSMF include USG, EMG and computed tomography (CT) scans. The

current review focuses on these modalities and their application for evaluating the muscle activity in OSMF.

Etiology & Pathogenesis

The alkaloid arecoline, found in the areca nut, promotes fibroblast proliferation and collagen formation. Catechin and tannins help to stabilise collagen fibrils, making them less susceptible to collagenase breakdown. [8, 9] Over activity in the masticatory muscles, such as the masseter, is also linked to ischemic alterations, fibrosis, hypertrophy, and scarring while eating areca nuts. [10] The increasing thickness is thought to be related to higher muscular demand. [11] Excessive glycogen consumption occurs as a result of muscular over activity, resulting in glycogen depletion. When the muscle is in active state for a prolonged time, muscular degeneration and fibrosis occurs. There is also decreased blood supply as a result of abnormal histopathology caused by extensive OSMF. [4]

Binnie and Cawson (1972) found a homogenous collagenous sub epithelial zone, as well as muscle fibre degradation. [12] This was the first report of OSMF muscle involvement. El-Labban and Caniff found muscle deterioration in OSMF patients based on electron microscopic data in a separate investigation. [13] Decreases in the inter-incisal distance of about 15–25 mm was noticed in moderately advanced instances of OSMF. Khanna and Andrade (1995) noticed stiffened and compact collagen fibres intermingled with muscle fibres, as well as substantial degradation of the fibres in radical cases. [4]

Assessment of Muscles in OSMF

In order to diagnose muscle dysfunction, palpation and visual inspection aren't always

enough. Since the muscle activity and function in OSMF patients needs to be assessed, various modalities are used for the same.

1. **Ultrasonography (USG) :**

In dentistry, ultrasonography (USG) is utilised to diagnose soft tissue pathologies such salivary gland disorders, cervical lymphadenopathy, and masticatory and neck muscles. The echogenicity of superficial anatomic structures is determined by the difference in the acoustic impedance between various structures, according to the USG principle. The echogenicity rises as this divergence grows. [14]

Chakarvarty et al (2014**)** suggested that during mastication, the masseter muscle is said to receive the most force. Excessive use of any striated muscle can result in hyperplasia and a change in muscle fibre composition, which increases muscular strength and resistance to fatigue. This holds true for the other masticatory muscles too. Long-term intense activity of these muscles resulted in physiological changes in masseter muscle which can be seen as increased ultrasonographic thickness and maximal bite force. [15]

Oral submucous fibrosis patients suffer from muscle hypertrophy. Kamala et al (2010) conducted a research utilising ultrasound to examine masseter muscle hypertrophy in OSMF patients and found that the hypertrophy was more constricted in individuals with oral submucous fibrosis. The contraction of the tissue caused by fibrosed buccal mucosa gives a sunken cheek look.[11] When the biting force is increased, like in the case of prolonged and repeated chewing of hard solids like gutkha, the masticatory muscles become hypertrophic.

Iyengar et al (2016) researched this topic using ultrasonography to analyse the internal echogenic pattern of the masseter muscle in participants with varied masseter muscle disorders. In all of the cases, an ultrasonographic examination of the masseter was done, and the echogenic pattern was categorised as Type I, II, or III. In participants with myofascial pain/myositis and

OSMF, the echogenic pattern changed considerably from controls, however it did not differ significantly from controls in people with frequent tobacco/arecanut chewing and bruxism. [16]

Devathambi et al (2013) evaluated thickness of the mucosa in the buccal mucosa as well as masseter muscle hypertrophy by Ultrasound (10-15 MHz) in 60 subjects, 30 of whom had OSMF and 30 of whom did not. The outcome was determined using one-way ANOVA, Chi-square test, and t-test. When comparing the research group to controls, it was shown that as the phases of OSMF progressed, there was enhanced thickness in the muscles both in the relaxed and contracted states. [17]

Dupare et al (2018) conducted a research on 150 patients, which were divided equally into six groups (Group I: 25 healthy subjects; Group II: 25 healthy subjects with habit; Group III: 25 OSMF stage I; Group IV: 25 OSMF stage II; Group V: 25 OSMF stage III; and Group VI: 25 stage OSMF IVA). The grading of OSMF was done according the clinical classification given by Khanna and Andrade (1995). They were ultrasonographically evaluated bilaterally for thickness of the submucosa. The results were judged to be very significant after statistical analysis. Between OSMF stages I, II, III, and IVA, there was a considerable rise in submucosal thickness and a drop in Peak systolic velocity. Because it is a non-invasive technique that causes no discomfort to the patient and offers both qualitative and quantitative information about the illness, USG has been found to be a very effective tool for diagnosing OSMF. [18]

Nandendla et al (2018) used ultrasound to determine the thickness of the submucosa of the labial mucosa, as well as the front and posterior sections of the buccal mucosa of both sides in 64 individuals, 32 of whom had OSMF and 32 of whom did not. The significance of the difference in submucosal thickness between the groups was determined using a one way analysis of variance. According to the findings, as OSMF progresses, the research group's submucosal thickness of the buccal mucosa thickens, compared to controls. [19]

Bakke M et al (1992) conducted research that revealed a link between masseter thickness and muscle function, as well as factors that are commonly related with masseter muscle function. The force of mastication, tooth to tooth contact, and cephalometric data were found to correlate consistently and substantially with the increase in crosssectional dimensions in the anterior section of the superficial area. Finally, ultrasonic scanning allows you to determine the dynamic of the jaw muscle and its connection with the stomatognathic system in a simple and reproducible manner. [14]

The examination of the sectional dimensions of the involved muscles has been done with ultrasonography. It can provide clearer image as compared to CT or MRI. According to Kulkarni et al (2020) USG has distinct advantages of being uncomplicated, having easier clinical availability, non-invasiveness and cost effectiveness compared to other modalities. [6]

2. Electromyography (EMG) :

Patient's muscular function can be assessed more objectively by, electromyography. Electrodiagnostic tests such as Electromyography are used in medicine to localize and characterize neuromuscular disorders. It is a gold standard test for assessing the function of muscles. [20] EMG is based on the mechanical function of a muscle that reflects the electrical events of a contraction. These include the rate of cross-bridge creation during activation, as well as the time course of calcium release from the sarcoplasmic reticulum and its binding to troponin. The amount of muscle force may be calculated using the amplitude of an EMG signal. The signal measured at an EMG electrode is the voltage differential caused by the combined influence of numerous motor units depolarizing at varying distances from the electrode.

More motor units are recruited in the contracted state of the muscle, which are highly reliant on muscular force output, such as fibre length and velocity. Hence the contracted state of the muscle was assessed. According to Mills (2005) [21], during maximal voluntary contraction,

an interference pattern of EMG amplitude is formed, which is a full recruitment pattern.

The effect of OSMF on masticatory function and other muscles has been widely studied. A study was conducted by Amarsena et al (2007) in individuals with early OSMF. They assessed mastication and swallowing in individuals with OSMF, masticatory and swallowing performance, maximum bite force, oral stereognosis and surface EMG activity of the buccinators. The researchers found that individuals with early OSMF may have poorer masticatory and swallowing abilities, as well as weakened buccinator muscle activity. [22]

The evaluation of muscle activity has revealed greater effect of OSMF on masseter muscle and the buccinators as compared to other muscles. Kant et al (2014) conducted a control trial including 40 patients with OSMF. Ultrasonography and electromyography were used to assess the cross-sectional thickness and activity of the masseter, anterior temporalis, and orbicularis oris muscles in patients with OSMF. They came to the conclusion that the masseter muscle was involved in early OSMF earlier than other muscles. [23]

In a study by Sinha et al (2018) 60 individuals presenting with advanced OSMF were subjected for treatment. The study group, as well as the control group, had their EMG activity of the masseter and orbicularis oris muscles assessed prior and post treatment with OSMF. Individuals with OSMF received an intralesional injection of triamcinolone acetonide 10 mg/ml deposited at 0.2 ml per site in the buccal mucosa twice a week for three months, as well as hyaluronidase 1500 IU twice a week. When compared to individuals with OSMF, the control group's EMG activity of the muscles (Orbicularis Oris and Masseter) demonstrated statistically substantial lower activity while there was a significant decrease in EMG activity in post treatment individuals. The authors concluded that EMG can serve as a useful aid in detecting the involvement of the muscles of mastication and muscle of facial expression in patients with OSMF and effect of the treatment on the muscular activity in patients with OSMF. [24]

3. Computed Tomography (CT scan)

CT and MRI can also be utilised to assess the cross sectional areas and volumes but they are largely replaced by other modalities to assess the activity and function.

Naik et al (2020) did a study on 25 people with OSMF who had masseteric hypertrophy and had been chewing betelnut or gutkha for more than 5 years. The Siemens Somatom Sensation 4-slice CT scanner was used to obtain the computed tomography (CT) scans. The patients were instructed to keep their mouths gently closed and relaxed during the scanning procedure. The masseter muscles were examined in axial regions of CT images. Image-analysis software was used to calculate the muscle thickness, and the measurements were taken in millimetres (mm). The researchers discovered that the thickness of the right side masseter muscle was greater than the left side in all but one subject, and that the difference was statistically significant. They concluded that there exists an association of masseter muscle hypertrophy with OSMF, and CT scan measurements of masseter muscle thickness were found to be statistically significant. [25]

In clinical and scientific work, dynamic activity of the masticatory muscles measured by EMG has been less extensively studied. Electromyographic alterations offer information about muscle electrical activity, which complements clinical biochemical tests in the diagnosis of muscle illnesses such as OSMF. Electromyography has the benefit of being beneficial in circumstances when there are several sites involved.

Conclusion

Oral Submucous Fibrosis is a deceptive, chronic disease that has a detrimental effect on an individual's health and quality of life. It is important to correctly diagnose the disease using appropriate imaging techniques. Through this review it is observed that in case of patients having OSMF, evaluating muscle activity in initial stages plays an important role via using EMG, USG and

CT scan. Assessment of the muscle activity guides in order to determine the prognosis of the disease and aids in fabricating desired treatment plan. Hence evaluation of the muscle activity of mainly masseter and orbicularis oris plays an important role to guide the clinician to achieve the desired functional results in such patients.

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