Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Index Copernicus value = 85.10

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Review Article

Ultrasonography- An aid in the diagnosis of Oral Submucous Fibrosis: A Brief Review

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ABSTRACT:

In modern times, advanced diagnostic imaging techniques in oral and maxillofacial radiology mainly involve computed tomography (CT), cone-beam CT (CBCT), magnetic resonance imaging, nuclear medicine, ultrasonography (USG), xeroradiography, and arthrography to name a few. From the time of its discovery, USG has been used in the field of medicine for the diagnosis of lesions as well as for remedial purpose. USG is a technique based on sound waves that acquire image in real time without the use of ionizing radiation. USG is more diagnostic for soft-tissue lesions than hard-tissue lesions. This article reviews the applications of ultrasound imaging in dentistry.

Keywords- OSMF, ultrasonography.

Received: 23/08/2020 **Modified:** 26/09/2020 **Accepted:** 28/09/2020

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This article may be cited as: Kulkarni S, Bansod R, Chandak R, Sathawane R, Lajekar A, Lajri. Ultrasonography- An aid in the diagnosis of Oral Submucous Fibrosis: A Brief Review. J Adv Med Dent Scie Res 2020;8(10):158-161.

INTRODUCTION

Oral Submucous Fibrosis (OSMF) is defined as a premalignant condition which is insidious and a chronic disease affecting any part of the oral cavity and sometimes may affect the pharynx, although occasionally preceded by and or associated with juxta epithelial inflammatory reaction followed by fibroelastic changes of lamina propria, with epithelial atrophy leading to stiffness of oral mucosa causing trismus and inability to eat. It is a premalignant condition affecting the oral mucosa and the soft tissue structures of the oral cavity causing blanching, burning sensation, formation of vesicles, ulcerations, excessive salivation, stiffening of the oral mucosa, and reduction in mouth opening.[1]

The other names for OSMF are idiopathic scleroderma of mouth, juxta epithelial fibrosis, idiopathic palatal fibrosis, submucous fibrosis of the palate and pillars, sclerosing stomatitis. OSMF can occur at any age but is most commonly seen occurring in young and adults between 25 and 35 years.[2] The prevalence of OSMF in India is about 0.2 %- 0.5%. This increase in the prevalence is due to increased use of the areca nut, tobacco product

gutkha, pan masala, flavoured supari, etc prepared commercially.[2,3] The rate of malignant transformation of OSMF was found to be 7.6%. Clinical examination of this condition may be subjective alone and may be insufficient to characterize the severity of the disease.[4,5]

Since biopsy is a minor surgical procedure it has its own limitation like being more time consuming and causing discomfort to the patient sometimes. Moreover, the tissue obtained from the site of interest may not be representative of the true extent of the disease.[4]

No definitive treatment exists for OSMF.[6] Due to the emperical nature of each approach which is inevitable presently, the evaluation of the merits and demerits of individuals items in management is not possible owing to the usage of combined treatment strategies and protocols.[6]

Nowadays ultrasound is used therapeutically and extensively in physical medicine with a considerable success outcomes. The aim behind using an ultrasound treatment is to accelerate healing, increase the extensibility of collagen fibres and to provide relief from pain. This article is a brief review about the use of ultrasound for the treatment of OSMF.

History of Ultrasonography in Dentistry

With time, several authors have worked upon on USG and its mechanism of action. As clinicians came to know about its physiological and biological effects on tissues, the role of USG in bone repair began to gather more attention in the 1980s.

During 1990s, many research articles were published regarding the potential therapeutic effects of USG on maxillofacial bones.[7] Over the years, the role of USG has been found in various studies in increasing the likelihood of successful implantation, diagnosis of precancerous lesion and conditions, swellings in the maxillofacial region, lymph node metastases, etc.[8,9,10]

Physiological Effect of Ultrasound

In order to fully understand the role of USG, it is mandatory to understand the biological effects of USG on hard and soft tissues. Ultrasound is an acoustic pressure wave passing through tissue and may cause changes in the biological system due to heat, acoustic micro streaming, radiation forces, etc. As the ultrasonographic wave passes through the tissues, vibrations may occur which in turn can give biological signals to the cells. USG may cause thermal as well as nonthermal effects. The thermal effects of USG may result in increased extensibility of the tissues and also increase in the vascularity to the given region. USG also leads to reduction in muscle spasm due to increase in the vascularity to the affected site. USG also causes a reduction in the joint stiffness, hence owing to its thermal effect properties. The nonthermal effect of USG is more efficient and significant in treating soft-tissue injuries than thermal effect. The nonthermal effect of USG is mediated by acoustic streaming (stable and unstable) and cavitation.[11]

The basis for applications of all diagnostic ultrasound applications are based on the detection and display of acoustic energy reflected from interfaces within the body. Due to the unique imaging attributes of ultrasound, it has made USG an important and versatile medical and dental imaging tool. Ultrasound scanners are one of the most complex and sophisticated imaging devices currently in use. Despite of their complexity, all scanners consist of similar basic components used to perform key functions – a transmitter or pulser to energize the transducer, the ultrasound transducer itself, and a receiver and a processor to detect and amplify the backscattered energy and to manipulate the reflected signals for display. The interaction of ultrasound with tissues can be marked by its five properties: attenuation, reflection, scattering, refraction, and diffraction.

A transducer is a device that converts one form of energy into another. In case of an USG, the transducer converts an electric signal into mechanical energy and vice versa. This property of transducer is called the piezoelectric effect. Different types of transducers come with different depth focus. Diagnostic ultrasound utilizes focus beam and converts the electric energy provided by the transmitter into acoustic pulses directed into the patient later. The range of frequency produced by a given transducer is termed as its bandwidth.[12]

Similar to X-rays, sound beams from ultrasound imaging are waves that transmit energy. The signals of USG may be displayed in various modes such as A-mode, M-mode, B-mode and real time.[13] USG imaging technique can be used for the examination of either normal or pathological lesions affecting the hard and soft tissues, TMJ imaging, detection of salivary stones, and in detection of fractures and vascular lesions.[14]

Depending on the application and ultrasonic intensities, ultrasound can be divided into two types: diagnostic and therapeutic ultrasound. In diagnostic ultrasound, the ultrasonic intensities used are typically in the range of 5–500 mW/cm^2 and in therapeutic ultrasound, the ultrasonic intensities used are in the range of 1–3 W/cm^2.

Ultrasonography in OSMF

USG helps in demonstrating the length, number, thickness of the fibrotic bands and pattern of overall vascularity in the affected area. It also helps in the diagnosis of feeble fibrotic bands in clinically normal buccal mucosa. The mucosa overlying the band possesses less flow velocity as compared to the mucosa in between the bands where vascularity was found to be normal. Oral submucous fibrosis (OSMF) shows increased hyper echoic areas indicating presence of fibrous bands or diffuse fibrosis with

normal/decreased vascularity and peak systolic velocity.

Furthermore, in cases of OSMF, masseter muscle hypertrophy has been found in various studies worldwide.[14] USG has been found to be a non-invasive, zero radiation tool for assessing the progression of OSMF. It has also been used for assessing systemic sclerosis, localized scleroderma, etc. For imaging superficial structures of the head and neck region ultrasonography (USG) is suitable particularly. USG provides both qualitative and quantitative assessment. Qualitatively, it provides information on the nature of a lesion and its relation to adjacent normal structures.[15] Quantitatively, it assesses the dimensions of the lesion, its distance from the skin surface and its relative proximity to skin and mucosal surfaces.[16] Up till now and despite extensive studies, there is no conclusive evidence of adverse biological effects of the use of USG as it does not produce ionizing radiation.[17]

USG imaging is a safe, readily available, non-invasive, non-ionising, and cost-effective real-time modality that can be used to image superficial tissues.[18] Because of its non-invasive nature and safety, it has better patient acceptance. In addition, because of the wider area that can be imaged, USG may a valuable tool to determine the extent and severity of the disease as well as to monitor the response to the treatment, thus supplementing clinical and histological details[19-21]. The use of USG in the evaluation of OSMF draws inspiration from its application in scleroderma, where USG has been used for diagnosis as well as follow-up, based on the alteration in the thickness and the echogenicity of the dermis. OSMF is similar in many aspects to scleroderma, where continuous and uncontrolled fibrosis accompanies a chronic inflammatory reaction. Manjunath et al. reported that USG can delineate feeble fibrotic bands in clinically normal appearing buccal mucosa in OSMF patients. They also show decreased vascularity (PSV) in the affected area. Thus, patients with poor vascularity in the affected area responded poorly to treatment, suggesting the need to alter the treatment schedule[20,22,23]

The diagnostic accuracy of USG is found to be useful in the diagnosis of various malignant tumours, periapical pathologies, and TMJ disorders.[24]

USG is based on the principle of an inverse piezoelectric effect.[31] USG is a non-invasive, real-time, non-ionising, comfortable, less expensive technique that is suitable for visualisation of changes in the superficial structures like buccal and labial mucosa. It can examine a larger area in less time. The diagnostic potential of USG has been reported by Shetty et al.[25] and Sureshkannan et al.[26] in metastatic cervical lymph nodes, Tiwari et al.[27] in periapical pathologies, Sharma et al.[28] in facial space infection, Gandhi et al.[29] in OSCC, and Kundu et al.[30] in TMJ disorders. Despite these advantages of USG, very few studies have been conducted on USG in OSMF patients.

LIMITATION

Ultrasound is operator dependent and reading of the scan is dependent on the radiologist's experience. A probe with a higher frequency to penetrate effectively and produce good quality images is essential to be diagnostic.

CONCLUSION

USG is a valuable, radiation free and non-invasive diagnostic tool for the evaluation of OSMF. In some OSMF cases, USG evaluates feeble fibrotic bands in clinically appearing normal buccal mucosa. USG helps in monitoring the progress or otherwise of the lesion. It helps in alteration of the treatment schedule in selected cases and allows for post treatment follow-ups and assessment. USG provides a more accurate evaluation of fibrous bands and vascularity in OSMF cases. USG is a valuable, non-invasive, affordable, and zero radiation diagnostic tool, which is easily accepted by patients and less time consuming. It can be used as adjuvant diagnostic method or established methods to clinical and histopathological evaluation. So, USG can be a promising tool for diagnosis, for assessment of the severity and for evaluation of prognosis of OSMF.

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