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ORIGINAL ARTICLE **OPEN ACCESS**

The Advantage of Ultrasonographic Evaluation over Clinical Examination in the Evaluation of Fibrotic Bands in Oral Submucous Fibrosis-A Case Control Study

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ABSTRACT

To evaluate the usefulness of USG in the assessment of fibrotic bands in oral submucous fibrosis (OSMF). 33 OSMF patients were clinically diagnosed as per Khanna et al. Initial clinical examination was done to assess the number of the palpable fibrotic bands that were running from the upper to lower vestibule. Then, all the patients were subjected to USG of right and left buccal mucosa was noted. The hyperechoic lines which were consistent on repeated examination by the transducer were considered as fibrotic bands. Those which were not consistent were discarded as artefacts and not counted. The number of bands counted was noted. The thickness of each band was measured in a horizontal direction parallel to the mucosal surface. The number of bands examined by clinical and USG were compared. The thickness of the bands was compared between the left and right. The number and thickness of bands was also compared among the various clinical stages of OSMF. The values were statistically analysed using SPSS software version 21.0. Ultrasonography delineates normal mucosa from a uniform fine mottled appearance in OSMF with interspersed hypoechoic areas. Clinical examination of all OSMF patients revealed the palpable fibrotic bands running from upper vestibule to lower vestibule but could not assess the thickness of bands whereas ultrasonographic evaluation revealed number of fibrotic bands bilaterally and the thickness of each band in horizontal direction. Ultrasonography demonstrated higher number of fibrotic bands (mean=4.78125, maximum =8 and minimum =2) than on clinical examination (mean=3.969697 maximum =7 and minimum =1). Objective measurement of the thickness of the fibrotic bands was possible using USG with a mean of 0.137273 in right buccal mucosa and 0.126667 in left buccal mucosa which was not possible in clinical examination. It was observed that in USG showed 8% increase in bands in grade I, 9 % in grade II and 26% in grade III respectively. Ultrasonography is a non-invasive diagnostic tool for OSMF. It could be a better diagnostic tool compared to clinical examination for the evaluation of number and thickness of fibrotic bands in OSMF as the values can be measured objectively.

Keywords: *Buccal mucosa, number & thickness of bands, OSMF, ultrasonography.*

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INTRODUCTION

Oral submucosal fibrosisis characterizedby chronicity, debilitating nature, and resistance to treatment [1]. The prevalence rate of OSMF in India ranges from 0.2–2.3% and 1.2–4.6% in males and females with an age range of 11 to 60 years [2]. OSMF undergoes various changes like inflammation, ulcerations, pigmentation, loss of resilience, and pliability, to a significant blanched and fibrosed appearance [3]. Clinically signs of blanching of buccal mucosa with a leathery texture with fibrous bands can be appreciated [4]. Clinical examination alone is subjective and may not be sufficient to fully classify the severity of the disease, assess the efficacy of treatment and long term follow up. Moreover, a biopsy cannot be performed repeatedly for following the progress of the lesion or to assess the response to the treatment [5]. So, in this background, a sensitive examination tool like USG or MRI may be helpfulto assess the progression of disease as well as response to the treatment [6].

USG of Oral submucous fibrosis (OSMF)shows submucosal fibrosis as hyperechoic areas with decreased vascularity and peak systolic velocity. Literature shows 10 studies towards ultrasonographic evaluation of various parameters in OSMF like thickness of mucosa, submucosa, vascularity and thickness of masseter.[7]However, there are no reports available on the evaluation of the number and thickness of

bands quantitatively on each side of buccal mucosa and also on comparison of values of USG and clinical examination.
Hence in this cross sectional study a new method was designed for evaluation of number and thickness of fibrotic bands in OSMF using Ultrasonography and the same is compared with clinical examinations.

MATERIAL AND METHODS

Armamentarium:

A. For clinical examination of the patient:

Dental chair with an illuminating light source, mouth mirror , probe , tweezer , sterile gloves , patient drape , digital vernier calliper

B.For Ultrasonographic examination:

1. GE(Logic F8 Expert) ultrasonographic device with a high-frequency linear probe, probe , ultrasound jelly – Dexlab ultrasound transmission gel , tissue paper , gloves ,water path.

GE Logiq F8 Specifications:

GE Logiq F8 Electrical Power:

- Nominal input voltage: 100-240 VAC
- Power consumption maximum: 400 VA with peripheral
- Software Version R2.0.4DICOM 3.0
- Monitor Resolution - 1280*1024

Probe specifications :

- Type of Transducer- High-frequency linear probe
- Frequency - 5-10 MHz
- Default contrast view- dual view
- Visualization- contrast

Participants for the study were selected from the OSMF patients reporting to the OPD of oral medicine and radiology. The study protocol was explained to the patient and written informed consent was obtained. The study was approved by the institutional ethics committee.

Detailed case history including demographic data, personal history and dietary history and detailed clinical examination was carried out for all the cases and registered in a customized case history proforma.

30 adult patients of either sex with symptoms and signs of oral submucous classified according to Khanna et al [8] were included as per inclusion and exclusion criteria.

The inclusion criteria were patients both males and females attending the OPD of the Department of Oral Medicine And Radiology and giving consent/willingness to participate were selected for the study and were clinically diagnosed as a patient of OSMF with habit of chewing areca nuts, gutka, betel quid, or any of its commercial products and clinical features like blanching of the mucosa, palpable fibrous bands, and difficulty in mouth opening, classified as per Khanna et al [8].

The exclusion criteria included severe trismus caused by conditions other than OSMF, a history of skin or other systemic diseases manifesting with the fibrosis of the oral mucosa, oral cancer, prior OSMF treatment or biopsy, other co-existing oral mucosal lesions, and severe OSMF cases where it was difficult to place a water path.

METHODOLOGY

The patients were screened for a positive history of chewing of areca nut, betel quid, gutka, or any of its commercial preparation and habit index was calculated. Inter incisal distance, blanching, vesiculations, burning sensation were noted. For the examination of clinical bands, patient was made to lie down in supine position and, buccal mucosa was examined for palpatory fibrous bands. Bidigital palpation of bands was done by placing index finger on inner side of buccal mucosa and thumb on the outer side. Fingers were run from upper vestibule to lower vestibule. Firm lines running from upper vestibule to lower vestibule on palpation were considered as bands. The faint, doubtful bands were not counted. The documentation of the number of fibrous bands on right and left buccal mucosa was done. However, the assessment of thickness of bands on clinical palpation was difficult, highly subjective, and not measurable. Two examiners conducted the entire examination and inter-examiner agreement was estimated. After these clinical measurements, an Ultrasonographic examination was requested, and the number and thickness of fibrotic bands were evaluated. Two qualified medical radiologists transcutaneously performed B-mode ultrasonography on both cheeks for each individual as part of the ultrasonographic evaluation. A medical ultrasound machine was the tool used for the scan (Logiq F8 unit). A linear transducer with a size of 4.5 1 cm and a frequency range of 5–10 MHz was employed. To prevent potential bias in the evaluation of echo texture, the technical parameters of the scan (depth, gain, focus, and time-gain compensation) were maintained throughout the investigation.

The patients were placed in the supine posture for the scan. The buccal mucosa was in contact with a glove finger that was moistened with water, which acted as a water channel and enhanced the contrast between the mucosa and the empty oral cavity. The scan for the buccal mucosa was carried out independently on each side after coupling gel was applied and the transducer was placed on the cheek extraorally along the line connecting the angle of the mouth to the tragus of the ear. The mucosal lining, submucosa, buccinator muscle, buccal pad of fat, superficial muscles of facial expression, subcutaneous tissue, and cheek skin, as reported in past studies, could all be scanned together to represent the whole thickness of the cheek [9, 10]. The echo texture of the mucosa is hyperechoic which is just adjacent to water path and submucosa was noted as hypoechoic which was beneath the mucosa.
The fibrous bands appeared as linear echogenicity at the junction of mucosal and submucosal surfaces (Figure 1). The probe was moved several times once the band was detected and the hyperechoic lines which consistently persisted for a longer duration during each sweep were considered as bands and other lines which were not consistent in repeated motions were considered as artefacts. Then, the number of bands was counted on both the right and left side. The thickness of individual bands was measured in horizontal direction in centimetres and a mean of the same was taken for the calculation. The clinically palpable bands showed higher thickness on USG, compared to the additional small bands detected on USG, in other areas, which were clinically marked diagnosed as no bands.
SPSS® software was used to analyse the data that was collected (SPSS 21.0). The distribution of the data was described using straightforward descriptive statistics including mean, standard deviation, and percentages. Mann Whitney u Test is used as the data was not normally distributed.

RESULT

The study group of 33 patients (age range 19-52 years, 30 males and 3 females)were classified as being in different stages of OSMF – Stage I (*N* =9), Stage II (*N* = 13), and Stage III (*N* =11). Stage IV cases with severe trismus were not included as placement of the water path was difficult. All patients reported mouth burning and various degrees of mouth opening restriction (mean=13-45mm). The greatest interincisal mouth openness measured during the intra-oral examination ranged from 13 to 45 mm, and it got smaller as OSMF progressed through the stages. All 33 patients had buccal fibrous bands and blanching. (Graph 1).

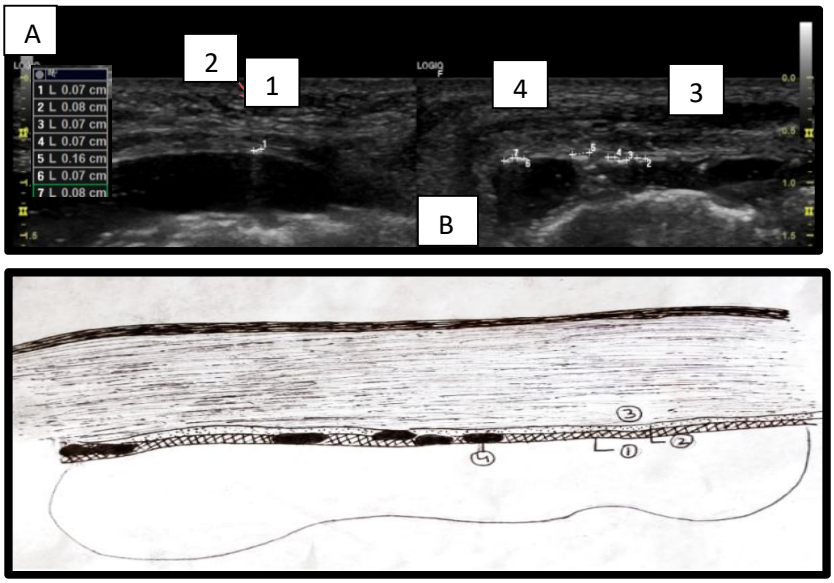
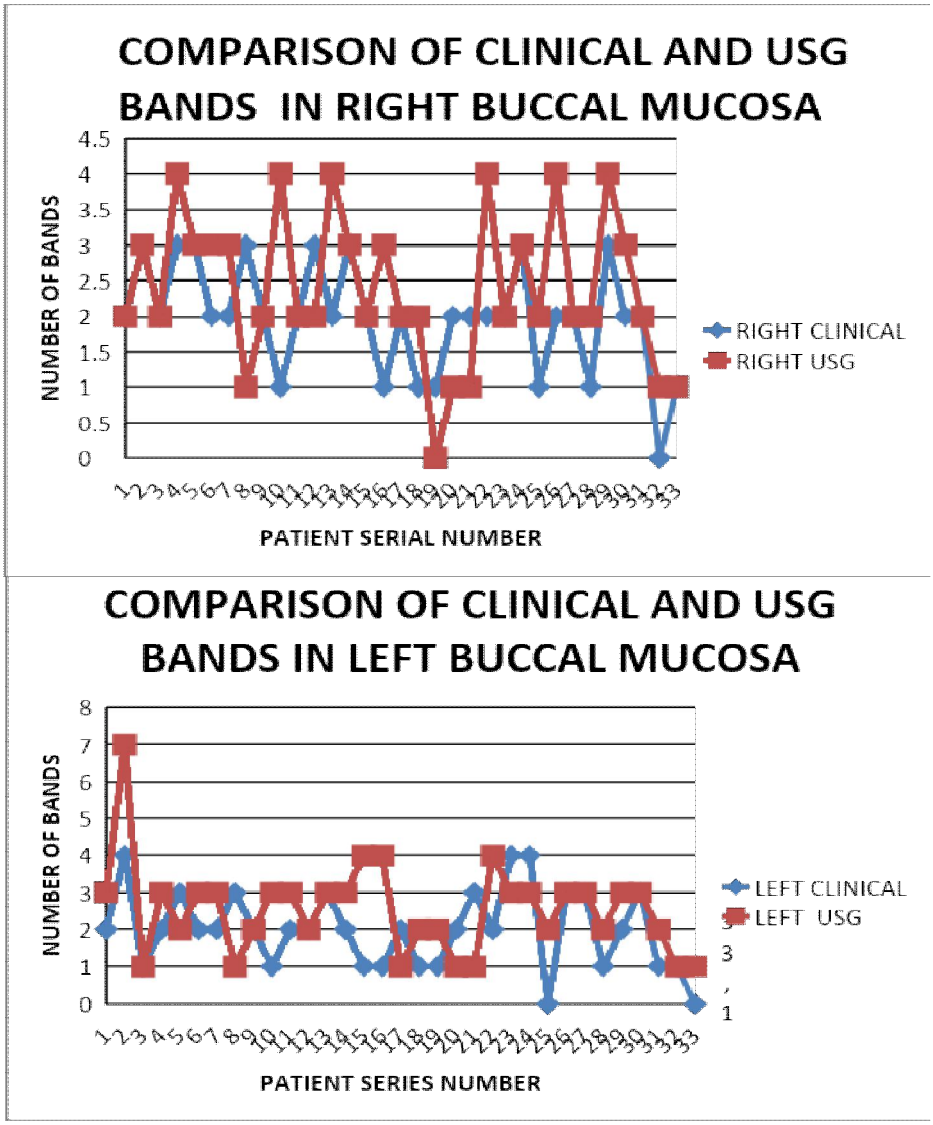
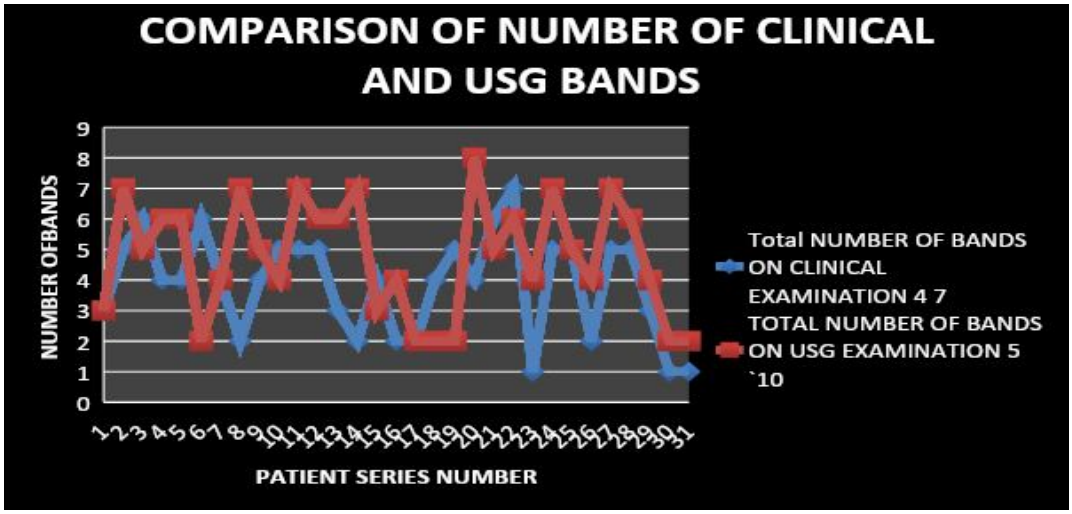


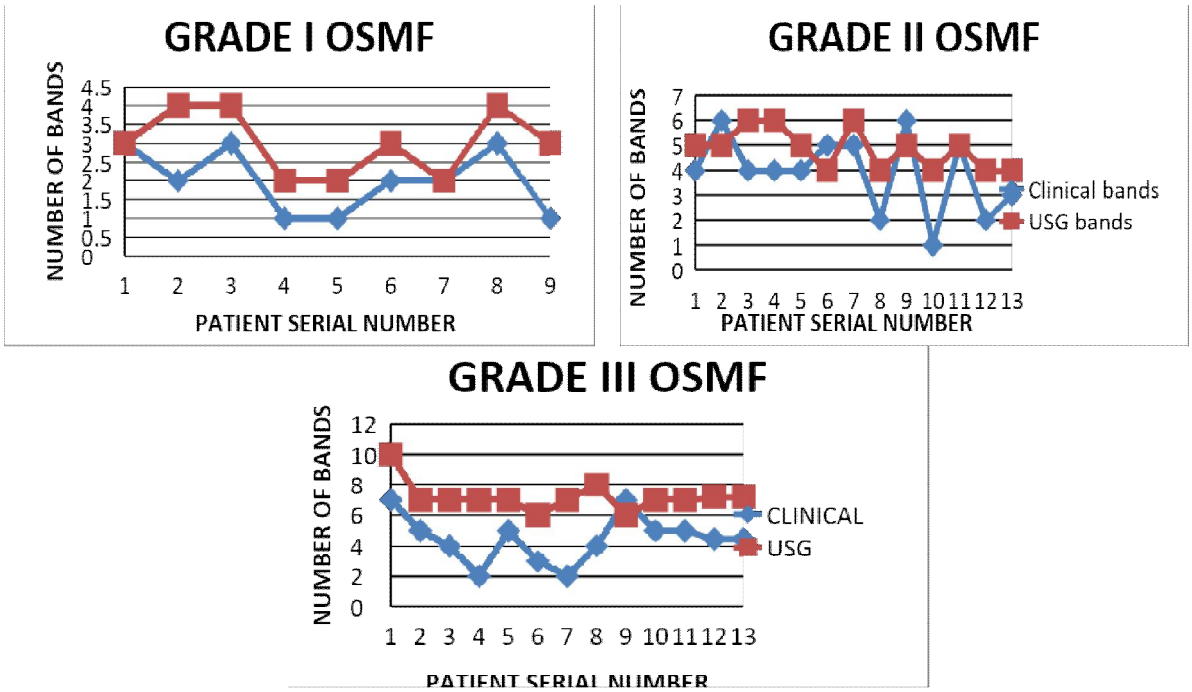
Figure 1: a) Imaging findings b) Diagrammatic representation of imaging findings in which:

1- Mucosa (hyperechoic)
2- Submucosa (hypoechoic)
3- Connective tissue , muscles, buccal pad of fat
4- Band (Hyperechoic fibrous band appreciable at the junction of mucosa &submucosa)





Graph 1, II and III show the number of bands detected on clinical and USG examination.



Graph 1- Comparison Of Clinical And USG Bands In Right and Left Buccal Mucosa

Graph 2 – Comparison of Clinical and USG bands according to grades.

Graph 2 shows the USG's effectiveness of detecting the number of bands increased with increasing severity of the disease.

Table 2 Comparison of mean number of bands on Clinical And USG Examination.

	CLINICAL				USG	
	GRADE I	GRADE II	GRADE III	GRADE I	GRADE II	GRADE III
TOTAL NUMBER	18	50	49	27	62	79
MEAN	3.6	3.923077	4.454545	3.9	4.846154	7.181818
RANGE	1-3	1-6	2-7	2-4	4-6	6-10

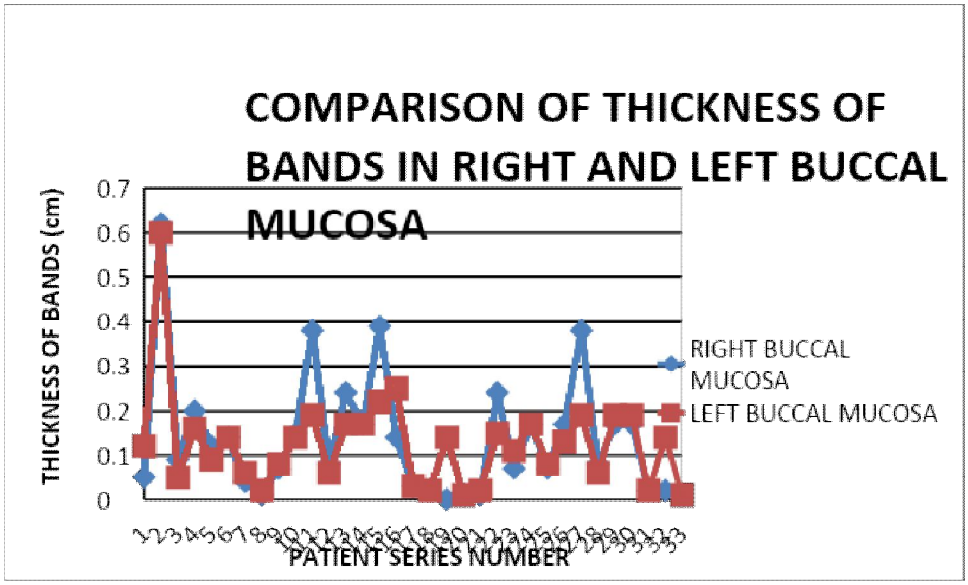
Table 2 shows increase in the mean number of bands with increase in the clinical severity of the disease.

TABLE 3- Comparison of mean thickness of bands in right and left buccal mucosa

	RIGHT BUCCAL MUCOSA	LEFT BUCCAL MUCOSA
GRADE I	0.03(0.01-0.07)	0.06(0.01-0.14)
GRADE II	0.13(0.2-0.38)	0.10 (0.02-0.19)
GRADE III	0.24 (0.14-0.62)	0.23 (0.13-0.6)

Table 3 shows in Grade I, II and III, mean thickness of bands of 0.03, 0.13 , 0.24 in right buccal mucosa and 0.06, 0.10, 0.23 on left buccal mucosa .

It was observed the mean thickness of bands on right and left side did not differ significantly in all the grades of OSMF. The mean thickness of bands increased with increase in the severity of disease.



GRAPH 3- Comparison Of Thickness Of Bands In Right And Left Buccal Mucosa

Graph 3 shows that the mean thickness of bands did not differ significantly on right and left buccal mucosa.

DISCUSSION

It is a well established fact that due to fibrosing condition of buccal mucosa and thickening of masseter in OSMF patients, mouth opening reduces significantly with increasing severity of the disease [11]. As a response to inflammation, it involves stimulated fibroblasts laying down connective tissue including collagen and glycosaminoglycans resulting in scarring and thickening of the affected tissue [12]. Physiologically, fibrosis can interfere with or totally disrupt the normal architecture and function of the underlying organ or tissue [13].

OSMF is a complex fibrosing disease with multifaceted pathogenesis, results in significant morbidity due to the limiting effects of fibrosis. The underlying pathology is a response to the juxtaepithelial inflammatory process. Despite extensive research the disease is still not fully understood. This is a result of lack of quantitative assessment of the underlying tissue changes like fibrosis, vascularity, thinning of mucosa. This has resulted in umpteen number of exploratory treatment choices, but none with universally applicable efficacy. The management and follow-up of the disease, is still being experimented.

The excessive deposits of fibrotic tissue bring about various clinically appreciable changes that lowers the quality of life of an OSMF patient. These changes include decrease in mouth opening- ranging from few centimetres to complete inability to open the mouth, **c**hanges in the buccal mucosa– loss of pigmentation, ulceration and pain **;** persistent, white mottled blanching, reduced thickness of the epithelium; and reduced blood supply. These changes may be seen throughout the mucosa of tongue, hard palate, soft palate, palatal fauces, lips, gingiva, floor of the mouth, uvula ear, nose, and throat.

Although the cause of OSMF is multifaceted, areca nut and its byproduct are thought to be the primary culprit [14].

Formation of fibrous bands in OSMF is a hypothesised as follows. A micro-traumatic injury to oral mucosa by alkaloids and tannins from betel quid, leads to chronic inflammation. A fibrotic response will result in excessive accumulation of extracellular matrix components and fibrosis of lamina propria. Continuous repeated injury will increase accumulation of fibroblasts and lysyl oxidase which with the help of MMP-9 and flavonoids. Their combined action results in degradation of type IV and V collagens and increase cross linking of collagen and inhibit collagenase which eventually results in formation of excessive fibrosis.

K Manjunath *et al*. in 2011 [7], Krithika C *et al*. in 2013 [15] evaluated the presence or absence of bands in OSMF patients using USG. It stated that USG may demonstrate number, length and thickness of fibrotic bands but did not report any data on the same. It was feasible to detect the number and thickness using USG in our study. Mehrotra *et al* [20] examined unilateral or bilateral location of the bands and found that in 90% of bands in buccal mucosa were bilateral and 10% were unilateral. In our study where bands on clinical examination counted as 1-3 , 1-6 and 2-7 in Grade I ,II ,III respectively were lower than the bands which we counted on USG as 2-4,4-6 and 6-10 respectively.

They mentioned that USG showed higher number of bands compared to clinical examination. The studies most often report the presence or absence of bands. No study has reported on the examination of number

of bands and thickness of bands. As fibrosis and fibrotic bands is the characteristic of OSMF, the progress of the disease, staging of the disease, the efficacy of a treatment, prognosis of the disease all depend on the number and bulk of the fibrosis.

Clinical parameters such as interincisal distance and number of bands are essential measurements during monitoring the progress of the OSMF patient. Measurement of clinical parameters and the monitoring of changes in their measurements are essential parts of patient care. An objective evaluation of the fibrous bands in terms of number and thickness may greatly assist in the above mentioned scenarios.

In the present study the novel method adopted to assess the number and thickness of bands is a step towards a quantitative measurement of the tissue changes in OSMF. The observations were repeatable, measurable and comparable due to the inbuilt measurement tools which are available in all the commonly used USG machines. The procedure described here for the examination of the number and thickness showed a good interobserver agreement.

Our investigation has shown us that an ultrasonogram is a non-invasive, radiation-free method for monitoring OSMF progression. The degree of submucosal fibrosis varies between stages, according to USG. Vertical bands can be felt clinically at any stage, although they are unmeasurable and subject to observer fluctuation. Even though histopathology is the Gold Standard for diagnosing OSMF, not all patients have a biopsy because it worsens the illness by causing more post-healing scarring. Ultrasonogram can be used to assess the progression of the disease as well as to assess the prognosis. Bands which are in the early formative stage can also be easily delineated by USG. This method definitely will help in staging the fibrosis, treatment planning, comparison of various treatment methods, as well as follow up. In the present study, the percentage increase of bands detected by USG increased with increase in the severity of the disease. This can be explained on the basis that as the clinical severity of cases increases, the bands become less distinct as leathery palpable feeling sets in instead of discrete palpable fibrous straight like band. Also, the reduced mouth opening makes it difficult for clinical assessment of individual band,however, USG could discretely read the increase in the number of bands in all the clinical stages of OSMF.

We also fully believe that much higher frequency and resolution ultrasonographic transducers could shed more light on the tissue characterisation in OSMF over the entire oral mucosa, which will aid in determining the severity of the condition and tracking how well it is responding to treatment. We are furthering the study, to assess the usefulness of USG in the comparison between normal and OSMF patients, pre and post treatment alterations in the tissue characterization, long followup of patients once the treatment completed. In advanced stages of the disease, the procedure described here was not feasible as the water path placement was not feasible. Such cases may require a modification.

The results need to be tested on a large population for its reliability. The examination needs training of the radiologist for the understanding and standardizing the measurements.

CONCLUSION

To analyse, manage, and follow up on OSMF effectively, a multimodal strategy is necessary. USG adds a brand-new third dimension to the established methods of clinical and histological examination. Thus, USG holds promise as a technique for OSMF diagnosis, severity assessment, and prognosis assessment.. So we conclude that USG is useful in assessment of number and thickness of fibrotic bands. It may be a reliable tool in the staging of the disease, pre-post treatment evaluation to determine the efficacy of a treatment, and assessment of relapse of the disease.

SOURCES OF CONFLICT

No potential conflicts of interest.

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