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Original Article

ASSESSMENT OF FIBROTIC BANDS, MUSCLE THICKNESS AND VASCULARITY IN ORAL SUBMUCOUS FIBROSIS BY ULTRASONOGRAPHY

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ABSTRACT

Background: Oral submucous fibrosis (OSMF) is well recognized as one of the most potential premalignant condition of the oral mucosa. It is characterized by mucosal rigidity of varying intensity due to the fibroelastic changes of the juxta epithelial layer, resulting in a progressive inability to open the mouth. Diagnosis and treatment outcome of OSMF is usually assessed clinically, but clinical examination alone may be insufficient to characterize the disease severity and to assess prognosis. Hence the present study was undertaken to measure the submucosal changes in OSMF patients during pre and post treatment using Ultrasonography (USG) imaging.

Materials and methods: 20 clinically diagnosed OSMF patients were recruited for the study. Maximum Mouth opening,VAS score, USG assessment of fibrous bands, muscle thickness and vascularity of buccal mucosa before and after treatment were assessed and compared.

Results: The parametric paired t tests for all parameters pre and post treatment were found to be statistically significant**.** Pearson correlation done to correlate clinical findings with USG findings showed weak negative correlation.

Conclusion: USG can be used to determine the disease severity and prognosis after treatment in OSMF

patients, but was not found to be an adjunct tool for clinical examination.

Keywords: Oral submucous fibrosis, Masseter muscle thickness, Vascularity, Ultrasonography,VAS score

INTRODUCTION

Since the time of Sushruta, Oral submucous fibrosis has been well-established in Indian medical literature. In India, Joshi (1953) was the first to describe the condition and he called the condition"submucous fibrosis of the palate and pillars".[1]

OSMF is well recognized for its malignant potential.[2] Alkaloid and flavonoid components plays a major role in the pathogenesis of OSMF by causing an abnormal increase in collagen production which initially affects the lamina propria, as the disease progresses there is fibrosis of submucosal layer,[3] leading to decreased vascularity, epithelial atrophy and fibrosis of the underlying muscles.[4]

Diagnosis and treatment outcome of OSMF is usually done clinically by assessing mouth opening, blanching of oral mucosa and palpation of vertical fibrotic bands.5 But accuracy of clinical assessment has been questioned because of intra or inter observer variability and possibility of impalpable fibrous band in very early stages.[6]

This study is undertaken to evaluate the submucosal changes like fibrotic bands, masseter muscle thickness and vascularity of buccal mucosa in OSMF patients using Ultrasonography.

MATERIALS AND METHODS

The study group consists of twenty OSMF patients visiting outpatient Department of Oral Medicine and Radiology, Daswani Dental College & Research centre, Ranpur, kota(Rajasthan). All patients were selected according to the set inclusion and exclusion criteria. The whole study process was described to the patients and informed consent was taken.

Selection criteria:

Inclusion criteria

Patients with positive history of chewing arecanut or one of its commercial preparations for more than 6 months with clinical features of OSMF like burning sensation on eating spicy food,blanching of oral mucosa, palpable fibrous bands and restricted mouth opening (<35 mm)

Exclusion criteria

1.Patients with infections and inflammatory causes of trismus

2.Myofascial pain dysfunction syndrome

3.Masseter muscle hypertrophy due to malocclusion, bruxism, and other deleterious habits.

4.Patients with chronic illness and systemic diseases like diabetes mellitus,

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sjogren's syndrome with symptoms of xerostomia and burning sensation.

Clinical examination:

The subjects were comfortably seated on a conventional dental chair. The patient's personal history was recorded according to frequency, duration of the habit and area of the quid placement. After eliciting detailed history of habits, patient's symptoms like burning sensation to normal food or spicy food were recorded using Visual Analog Scale (VAS) of 0-10, where 0 indicated no burning sensation and 10 indicated the worst possible burning sensation. This was recorded at baseline and weekly intervals.Maximum mouth opening (distance from mesio-incisal angle of upper central incisor to mesio-incisal angle of lower central incisor) was measured using geometric divider and scale and was recorded in millimeters (mm). Blanching of the oral mucosa was recorded as present or absent.Buccal mocosa was palpated for fibrous bands and was recorded as absent or present.

History and clinical examination data were entered in the pre prepared proforma based on the mouth opening all 20 OSMF patients were classified into different stages of OSMF based on **Khanna JN, Andrade NN.**[19]

Ultrasonographic examination:

All 20 OSMF patients were subjected to ultrasonographic evaluation. Ultrasonographic evaluation and interpretation was done by senior radiologist with 12 years experience in the specialization. Imaging was done using Philips HD6/7 Ultrasound Unit and linear-phased array transducer. Patients were made to lie down in the supine position with the head turned sideways to provide good access for the probe and transducer was placed extraorally in contact with the both right and left cheek after applying an ultrasound cellulose dextrose gel.

To record the muscle thicknesss, the transducer is oriented to the bulkiest part of the superficial portion of the muscles. Fibrotic bands were measured by moving transducer over all the surfaces of the cheek. The vascularity (peak systolic value) of buccal mucosa was monitored by Ultrasonography Color Doppler and Spectral Doppler modalities.

Treatment schedule:

Each patient was educated about the disease and malignant potential of OSMF, and they were

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motivated to discontinue the use of areca nut, tobacco or any other abusive habit in any form.

Patients with burning sensation were advised to take antioxidants (SM fibro-8mg/30days). All the subjects were treated by administering intralesional injection of dexamethasone 1.5 ml, hyaluronidase 1500 IU with 0.5 ml lignocaine HCL at multiple sites of buccal mucosa using 26 guage needle, given biweekly for 8 weeks.After 8weeks the patients were assessed for VAS score, mouth opening, burning sensation, masseter muscle thickness, fibrotic bands and vascularity of buccal mucosa.

Statistical analysis:

The pre and post treatment data obtained were tabulated and statistically analyzed to draw a

conclusion. All the values were analyzed for mean (or median as applicable), standard deviation,errors and range. The Student Paired T test was used in order to assess mean difference in all parameters before and after the intervention. And the mean difference between pre and post treatment will be considered statistically significant at 'P' value less than 0.05.Pearson correlation test was done to assess correlation between clinical findings and USG findings.

RESULTS

The study group included a total of 20 patients who were clinically diagnosed as having OSMF.Number of fibrotic bands, masseter muscle thickness and vascularity of buccal mucosa in OSMF patients were measured ultrasonographically pre treatment and post treatment.

BASIC CHARACTERISTICS

The basic characteristics of OSMF patients at presentation (enrolment) are summarized in Table1. The age of patients ranged from 18-45 years with mean ± SD (31.45 ± 9.14) and median 32 years. Among 20 patients, 17 (85.0%) were males and 3 (15.0%) females.

A) Pre and post treatment clinical outcome measures

i) Burning sensation

The pre and post treatment burning sensation (VAS) of OSMF patients are summarized as shown in table 3 .The pre treatment burning sensation (VAS) of patients ranged from 1-7 with mean 3.85 while at post treatment it ranged from 0.0-3.0 (VAS) with mean 1.05. Paired t test showed 72.7% decrease in burning sensation.

ii) Maximum mouth opening

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The pre and post treatment maximum mouth opening (mm) of OSMF patients are summarized in as shown in table 4.The pre treatment maximum mouth opening of patients ranged from 15-33mm with mean 23.80mm and at post treatment it ranged from 22.0-38.0 with mean 31.5mm. Paired t test showed 32.3% increase in maximum mouth opening.

B) Pre and post treatment USG outcome measures

i) Masseter Muscle thickness- The pre and post treatment thickness of left and right masseter muscle are summarized as shown in Table 5a,b.Pre treatment ultrasonographic imaging showed increase of hyperechoic bands in the masseter muscle suggestive of increase thickness of muscle. Pre-treatment thickness of right masseter muscle ranged from 7.1-15.4 mm with mean 10.47mm and thickness of left masseter muscle ranged from 7.6- 14.6mm with mean 10.55mm. The post treatment thickness of right masseter muscle ranged from 6-13mm with mean 10.22mm and thickness of left masseter muscle ranged from 6- 12.1mm with mean 9.7mm. Paired t test showed 2% decrease in the thickness of right masseter muscle and 8% decrease in thickness of left masseter muscle.

ii) Number of fibrotic band

Pre treatment ultrasonographic imaging showed increased hyperechoic areas suggestive of diffuse fibrosis . In 5 of 20 Patients showed an echogenecity pattern with the areas of irregular hyperechoic linear streaks suggestive of increased fibrous deposit .Post treatment there was slight reduction in fibrosis and 100.0% decrease in fibrotic bands.

iii) Pre and post treatment Vascularity (peak systolic velocity) of buccal mucosa in OSMF patients

Vascularity of buccal mucosa is measured by the peak systolic velocity in the affected area. The pre and post treatment peak systolic velocity (cm/sec) of buccal mucosa is summarized as shown in Table 7a,b.The pre treatment peak systolic velocity of right buccal mucosa ranged from 4.7-11.8 cm/sec with mean 7.34 cm/sec and on left it was 4.1- 11.0 cm/sec with mean 6.65. The post treatment peak systolic velocity of right buccal mucosa ranged from 5.3-16.8 cm/sec mean 8.44 and on left it was 6-12.1 cm/sec with mean 8.32. Paired t test showed 15.0% increase in peak systolic velocity at right and 25% increases in peak systolic velocity in left.

C) Correlations of clinical findings with USG findings pre and post treatment

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Correlation of clinical findings with ultrasonography finding were done using Pearson correlation test. Correlation of stage 2 maximum mouth opening with stage 2 masseter muscle thickness showed R value of -4.43 and -0.174 in pre and post treatment respectively. The obtained 'R' value showed weak negative correlation and was statistically insignificant.

Correlation of stage 2 maximum mouth opening with stage 2 vascularity showed R value of -0.048 and -0.58 in pre and post treatment respectively. The obtained value 'R' showed weak

negative correlation and was statistically insignificant.

Correlation of stage 2 maximum mouth opening with stage 2 fibrotic bands showed R value of 0.0464 and NaN in pre and post treatment respectively. The obtained value 'R' showed weak negative correlation and was statistically insignificant.

Correlation of stage 3,4a maximum mouth opening with stage 3,4a masseter muscle thickness showed R value of 0.107 and -0.110in pre and post treatment respectively. The obtained 'R' value showed weak positive correlation in pre treatment and weak negative correlation. The obtained value was statistically insignificant.

Correlation of stage 3,4a maximum mouth opening with stage 3,4a vascularity showed R value of -0.58 and 0.115in pre and post treatment respectively. The obtained value 'R' showed weak negative correlation and was statistically insignificant.

Correlation of stage 3,4a maximum mouth opening with stage 3,4a fibrotic bands showed R value of -0.52 and NaN (not a number) in pre and post treatment respectively. The obtained value 'R' showed weak negative correlation and was statistically insignificant.

Table 1. Basic characteristics of OSMF patients

Basic characteristics	No. of patients (N=20)
Age(yrs): Mean ± SD, median	18-45 yrs 31.45±9.14, 29.5
Sex: Male Female	17 (85.0%) 3 (15.0%)
Burning Sensation	20(100%)

Table 2. Sample distribution according to Khanna JN, Andrade NN Classification

Stages	Number of Patients	%
Stage 2	09	45
Stage 3	10	50
Stage 4a	1	5
Total	**20**	**100%**

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Table 3. Pre and post treatment burning sensation (Mean ± SD) of OSMF patients

Pre treatment (VAS)	Post treatment (VAS)	Mean change (Pre-Post)	% mean change	t value	P Value
3.85 ± 1.63 (1-7)	1.05 ± 0.76 (0-3)	2.8 ± 0.40	72.7	11.85	.000

The result is significant at $p < .05$

Table 4. Pre and post treatment maximum mouth opening (Mean ± SD) of OSMF patients

Pre treatment (mm)	Post treatment (mm)	Mean change (Post-Pre)	% mean change	t value	P Value
23.80 ± 5.3 (15-33.0)	31.5 ± 4.43 (22.0-38.0)	7.75 ± 1.54	32.3	17.83	.000

The result is significant at $p < .05$

Table 5a. Pre and post treatment Right muscle thickness (Mean ± SD) of OSMF patients

Pre treatment (mm)	Post treatment (mm)	Mean change (Pre-Post)	% mean change	t value	P Value
10.47 ± 1.77 (7.1-15.4)	10.22 ± 1.43 (6-13)	0.25 ± 0.50	2.0	0.79	<0.001

The result is significant at $p < .05$

Table 6a. Pre and post treatment right Peak systolic velocity (Mean ± SD) of OSMF patients

Pre treatment (cm/sec)	Post treatment (cm/sec)	Mean change (Post-Pre)	% mean change	t value	p value
7.34 ± 2.45 (4.7-11.0)	8.44 ± 2.26 (5.3-16.8)	1.1 ± 0.74	15.0	1.1	<0.001

The result is significant at $p < .05$

Table 6b. Pre and post treatment left Peak systolic velocity (Mean ± SD) of OSMF patients

Pre treatment (cm/sec)	Post treatment (cm/sec)	Mean change (Post-Pre)	% mean change	t value	P Value
6.65 ± 2.03 (4.1-11.0)	8.32 ± 2.5 (6-12.1)	1.6 ± 0.7	25.0	2.2	<0.001

The result is significant at $p < .05$

Table 7. Correlations of clinical findings with USG findings pre and post treatment

Stages	N	Clinical findings with USG findings	Pearson Correlation		P value	
			Pre treatment	Post treatment	Pre treatment	Post treatment
Stage 2	09	Mouth opening (mm) with muscle thickness (mm)	-0.439	-0.174	0.237	0.655
	09	Mouth opening (mm) with vascularity (cm/sec)	-0.048	-0.58	0.748	0.10
	09	Mouth opening (mm) with fibrotic bands	0.0464	NaN	0.90	0
Stage 3,4a	11	Mouth opening (mm) with muscle thickness (mm)	0.107	-0.110	0.754	0.74
	11	Mouth opening (mm) with vascularity (cm/sec)	-0.58	0.115	0.52	0.73
	11	Mouth opening (mm) with fibrotic bands	-0.5239	NaN	0.098	0

NaN- not a number

DISCUSSION:

Oral submucous fibrosis is one of the most common premalignant conditions that occur in oral cavity. The geographical distribution of OSMF shows confinement to tropical areas primarily the Indian subcontinent with prevalence rate of 0.2% -1.2%[18]

Fibrotic Bands

In our study, pre treatment USG imaging showed increased diffuse hyperechoic areas suggestive of fibrosis and echogenecity pattern with the areas of irregular hyperechoic linear streaks suggestive of fibrous bands in submucosal layer. Only 5 patients showed fibrotic bands. Post treatment showed reduction in hyperechoic areas and 100% decrease in

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number of fibrotic bands ($P < 0.001$). This 5 OSMF patients were in the stage III and stage IVa with reduced mouth opening[6] ranging from 14mm to 24mm, showing that there is an increase in severity of submucosal fibrosis as the lesion advances beyond Stage II. The results obtained in the present study are similar to **Devathambi et al(2013)**[5] which showed increase in fibrosis with advancing stage of OSMF.

Vascularity of Buccal mucosa

In USG, fibrosis can be studied in relation to vascularity in affected region which helps in monitoring the disease severity. Patients with poor vascularity (PSV) in affected area had poor response to treatment and poor prognosis.

The pre treatment PSV of right buccal mucosa ranged from 4.7-11.8 cm/sec (mean 6.65 cm/sec) and PSV of left buccal mucosa ranged from 4.1-11.0 cm/sec (mean 6.65cm/sec). Post treatment showed 15.0% increase of PSV on right and 25% increase of PSV on left. The results were found to be similar to study conducted by **Manjunath et al(2011)5** which state that there is increase in peak systolic velocity after intralesional steroid injection. Statistical analysis revealed that significant difference was present in mean PSV values showing good prognosis after our treatment schedule.

In the present study, parameters like masseter muscle thickness, fibrosis and vascularity of both left and right buccal mucosa in the pre and post treatment was assessed ultrasonographically. Post treatment, showed significant difference in masseter muscle thickness, fibrosis and vascularity of buccal mucosa in OSMF patients.

Correlating relationship between clinical finding with Ultrasonographic findings (Pearson Correlation)

When the pre and post treatment maximum mouth opening of different clinical stages (**Khanna JN, Andrade NN)** were correlated with the pre and post treatment ultrasound findings showed weak negative correlations with no statistical significance between stage II, stage III and stage IVa.

But Stage 3,4a pre treatment Mouth opening with pre treatment muscle thickness showed a positive correlation but not statistically significant. However our study failed to elucidate significant value between different stages of mouth opening with USG findings and this can be due to less number of subjects among different clinical stages.

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The interpretation of the present study is that USG can be a better tool in providing information about the changes in the submucosal tissues pre and post treatment which provides information about efficacy of the treatment and assessing prognosis of disease.

CONCLUSION

OSMF is a diffuse disease in which the severity varies from site to site in the oral cavity; it requires a multimodal approach for effective assessment, management and follow-up. In addition to the established methods of clinical and histopathological evaluation, ultrasonography provides a new third dimension by permitting tissue characterization of the entire buccal mucosa which is not possible by other methods.

USG also helps in evaluating patient response to the treatment as repeated biopsy will cause pain and discomfort to the patient.Based on the present study, we conclude that USG can be a tool to measure changes in submucosa before and after treatment in OSMF patients which provides information about the efficacy of the treatment.

Future Recommendation

The limitation of our present study was smaller sample size and unequal number of subjects in each staging of OSMF. Future research can be carried out on a large patient sample to correlate clinical grading with USG findings which will be helpful in grading OSMF ultrasonographically.

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