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A comparative clinical study on physiotherapy outcomes with wooden tongue depressors versus Heister jaw opener in oral submucous fibrosis patients

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ABSTRACT

Objective: The aim of this study was to compare mouth opening exercise outcomes with wooden tongue depressors (WTDs) versus Heister jaw opener (HJO) in improving mouth opening after reconstruction of the surgical defect with buccal fat pad (BFP) in oral submucous fibrosis (OSF) patients.
Materials and methods: Fifty consecutive patients were divided randomly into two groups (25 patients in each group) corresponding to postoperative physiotherapy with WTDs (group 1) and HJO (group 2) respectively. Groups 1 and 2 were evaluated for maximum interincisal distance at 3, 6 and 12 months of follow up. In groups 1 and 2, mouth opening differed substantially at all periods of follow up from preoperative values.
Results: The increase in mouth opening was greater in group 2 at 3 ($P = 0.003$) and 6 ($P = 0.010$) month follow up visit respectively. No relevant difference was observed in mouth opening between groups 1 and 2 at 12 months ($P = 0.066$). The mean increase in mouth opening at 12 months compared with the preoperative value was 22.2 mm in group 1 and 25 mm in group 2.
Conclusion: We conclude both WTDs and HJO are effective in improving postoperative mouth opening in OSF surgical patients.

1. Introduction

Oral submucous fibrosis (OSF) is a chronic, debilitating, progressive, precancerous and potentially malignant condition of oral mucosa.[1,2] OSF is clinically characterised by remission and relapses of vesicle formation, blanching, ulceration, burning sensation, dryness of mouth, stiffness of the oral mucosa, intolerance to spicy food, tongue depapillation, and difficulty in speech.

There is evidence that OSF is a result of collagen dysregulation. Although OSF is thought to be multifactorial, primary aetiological factor is areca nut chewing, predominantly seen in Indian subcontinent.[2–6] Betel quid and gutkha are the most commonly available freeze dried areca nut products. Other possible aetiological factors include capsaicin in chillies, iron, zinc, and deficiencies in essential vitamins.[2] To aid treatment planning, a classification system for OSF based on histological and clinical features was developed - very early; early, moderately advanced, advanced and advanced with premalignant and malignant changes.[6] OSF has a malignant transformation rate of 7–30%.[2]

Numerous treatment modalities have evolved overtime. Various surgical or non surgical treatments have been described for managing patients with OSF. As the condition progresses, treatment becomes challenging. Incision of fibrous bands with placement of graft is required for advanced cases.[6] Additional surgical procedures such as temporalis myotomy, coronoidectomy, masseter muscle stripping have been described to enhance mouth opening and aid in intensive postoperative physiotherapy.[1] Various devices used for physiotherapy after OSF surgery include HJO, WTDs, acrylic cone, Shekhars appliance.[7] However, WTDs and HJO are commonly used.

The aim of this study was to compare the postoperative physiotherapy outcomes with WTDs versus HJO in improving mouth opening after reconstruction of surgical defect with BFP in OSF patients.

2. Patients and methods

This study was carried out at the Department of Oral and

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Maxillofacial Surgery between 2012 and 2016. The study protocol was approved by the institutional ethics committee and written informed consent was obtained from each patient before the procedures.

The study comprised of 50 consecutive patients who attended as outpatients to the Department of Oral and Maxillofacial Surgery with chief complaint of long standing limited mouth opening and a positive history of areca nut chewing, betel quid, supari, tobacco chewing with or without lime. After thorough general and local examination in a standardized format, patients with a mouth opening no greater than 25 mm (i.e. clinically moderately advanced (stage III) to advanced (stage IVa) cases; Khanna and Andrade[6] classification system of OSF), diagnosed after clinical and histological confirmation, palpable fibrous bands in buccal mucosa, blanched oral mucosa, burning sensation, reduced elasticity of mucosa and limited tongue movements were selected for the study. The exclusion criteria were patients with malignant transformation, medically compromised patients, patients not willing to quit the habit of areca nut chewing, patients who cannot perform mouth opening exercises on their own, patients who were unwilling to be part of the study, and patients who were uncooperative to post-operative physiotherapy regimen. The patients included in the study were grouped by simple randomization using the envelope method of sampling, resulting in a double blind study. In the process of grouping the patients matching was done by sex, medical history, stage of OSF and frequency and duration of habit to minimize confounding factors.

Before surgery, each patient was thoroughly counselled to stop all deleterious habits of pan masala, gutkha, tobacco, betel nut chewing. All patients were operated under general anesthesia with fiberoptic nasotracheal intubation.[8] Initially fibrous bands were incised deep to connective tissue extending posteriorly from the pterygomandibular raphe and/or anterior faucial pillars including buccinator muscle to as far as corner of the mouth anteriorly depending on the extent of palpable fibrous bands. The fibrous bands were disentangled with finger dissection and manipulation until no restriction was felt. Then, bilateral release of temporalis muscle fibre attachments from the coronoid process and anterior border of ramus of the mandible and bilateral coronoidectomy was performed. Mouth was opened and intraoperative interincisal opening was recorded (Fig. 1). The maxillary or mandibular third molars, if present were extracted. Later, buccal fat pad (BFP) was released, mobilized without tension with milking phenomenon and reconstructed the surgical defect. The BFP almost covered the main surgical defect to prevent possibility of secondary epithelialization. A pre-sterilized collagen sheet was used to cover the most anterior surgical defect and ungrafted area.

Postoperatively each patient received analgesics and antibiotics and feeding through nasogastric tube for 1 week. Mouth opening exercises were started at 36 h postoperatively and intensive exercise was

Fig. 2. Physiotherapy by wooden tongue depressors.

continued for at least 6 months at a frequency of 5–6 times daily for 30 min. Physiotherapy should last as long as 1 year with reduced frequency.

Group 1 (n = 25) was rehabilitated by inter-positioning WTDs (Fig. 2) by adding new wooden spatulas between teeth whereas group 2 (n = 25) by HJO (Fig. 3) by opening the blades of the instrument between the teeth postoperatively.

Demographic data such as age and gender, stage of OSF (III and IVa), and duration of quit of the habit before surgery were assessed. All patients were strictly asked to follow the regular recall visits to prevent complications. Patients fulfilled questionnaire to assess burning sensation on 10 points using visual analog scale (VAS). Zero being the no burning sensation while 10 being the maximum burning sensation that the patient can imagine. Compliance of patients to physiotherapy with WTDs or HJO was assessed on a three point scale - excellent, good and fair. The mouth opening (between upper and lower incisor edges) in millimetres measured with a metal ruler was recorded preoperatively, intraoperatively, and at 3, 6 and 12 months follow up. Two blinded investigators recorded the mouth opening and ratings of outcomes at regular follow up.

2.1. Statistical analysis

Statistical analysis was done with the help of SPSS version 18 (SPSS, Inc, Chicago, USA). The chi square test, paired and unpaired *t*-test and Mann Whitney *U* test were used as appropriate. Statistical significance was set $p < 0.05$. Probabilities of less than 0.05 were accepted as

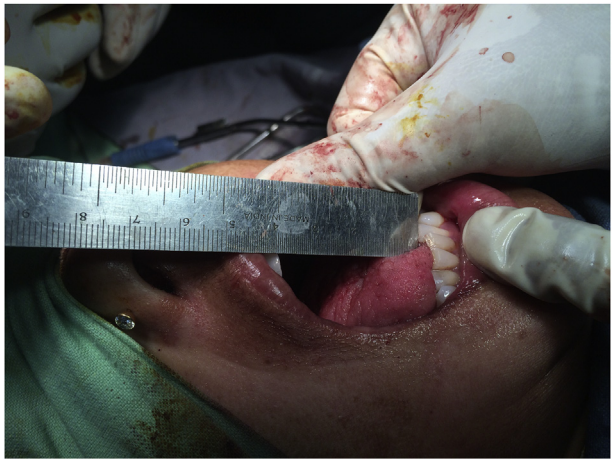

Fig. 1. Intraoperative interincisal opening.

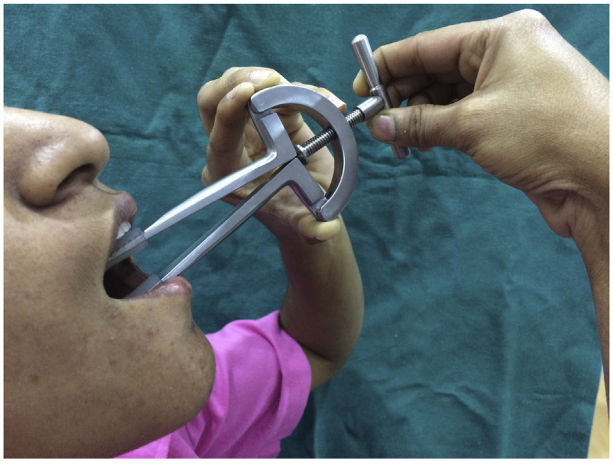

Fig. 3. Physiotherapy by Heister jaw opener.

Table 1
Age, gender, durationa of quit of the habit, and stage OF OSF.

	Group 1	Group 2	*P* Value
Age mean (SD); range, years	37.64 (9.49); 22-58	38.84 (8.61); 21-57	0.642
Gender			
Male	18	16	0.544
Female	7	9	
Duration of quitting the habit before surgery			
5–6 months	15	17	0.556
3–4 months	10	8	
Stage of OSF			
III	19	18	0.747
IVa	6	7	

significant.

3. Results

Of the 50 patients suffering from OSF, 34 were males and 16 were females with the age ranged from 21 to 58 years, mean age 38.24 ± 8.99 years. Group 1 and 2 did not differ in terms of age, gender, stage of OSF and duration of quit of the habit before surgery (Table 1). All patients had quitted the habit 3–6 months before surgery to reduce the symptoms of OSF like burning sensation and ulceration.

In all patients, fibrosis predominantly involved pterygomandibular raphe, retro molar pad, buccal mucosa and palatal mucosa. Upper and lower vestibule with labial involvement was also noted. All patients had varying amounts of restriction of tongue movement and soft palate function.

In groups 1 and 2, mouth opening significantly improved at all periods of follow up compared to the preoperative value (paired *t*-test). In group 1 and 2, mouth opening significantly decreased at 6 month compared to the 3 month value and also at month 12 compared to the 6 month value (Table 2). The probable reason for gradual decrease in mouth opening towards the end of follow up period of 12 months may be with gradual epithelisation of the BFP with the adjacent tissue.

Table 3 presents the statistical comparison of mouth opening between groups 1 and 2 (*t*-test). No relevant difference was observed between 2 groups at preoperatively and intraoperatively. The study showed a significant difference in mouth opening at 3 ($p = 0.003$) and 6 ($p = 0.010$) month follow up visit. At 3 and 6 month follow up visit, the increase in mouth opening was greater in group 2. However, no relevant difference was observed between 2 groups at 12 month follow up visit. In addition, regardless of the technique used, there was gradual decrease in mouth opening toward the 12 month follow up compared to the intraoperative mouth opening.

During postoperative evaluation, 2 patients in group 1 and in group 2, 1 patient developed infection and gaping which was managed by antibiotics and analgesics. In remaining patients, epithelialization of graft was uneventful. At 12 month follow up visit, each patient showed elasticity and improvement in physiologic function of cheeks. No fibrous bands were noted at final follow up visit. No malignant transformation was noted during the follow up visits. Each patient underwent medical management after surgery to manage symptoms like burning sensation and ulceration. Medical management included vitamin A (50000IU), vitamin B complex 200 mg, vitamin C 500 mg, B-carotene supplements with topical application of triamcinolone acetonide 0.1% applied over the surgical area for at least 6 months postoperatively.[1]

Regarding burning sensation, there was no significant difference among the 2 groups. (p = 0.617). Compliance to physiotherapy was excellent in 12 patients with WTDs and 13 patients with HJO. However, compliance was fair in 2 patients with WTDs and 1 patient with HJO. Compliance was good in remaining 11 patients in each group. There was no significant difference among the groups (p = 0.373) (Table 4).

The mean improvement in interincisal opening at month 12 compared with the preoperative value was 25 mm in group 2 and 22.2 mm in group 1. This effective increase in mouth opening was statistically significant in group 2 ($p = 0.046$) at the end of 12 months.

Table 2
Intragroup comparison of mouth opening in groups 1 and 2.

	Mean	Mean	*P* - value
Group 1			
Preoperatively and intraoperatively	10.12	42.08	0.000
Preoperatively and at 3 month	10.12	34.24	0.000
Preoperatively and at 6 month	10.12	33.20	0.000
Preoperatively and at 12 month	10.12	32.32	0.000
At 3 and 6 month	34.24	33.20	0.000
At 6 and 12 month	33.20	32.32	0.000
Group 2			
Preoperatively and intraoperatively	7.92	41.44	0.000
Preoperatively and at 3 month	7.92	35.20	0.000
Preoperatively and at 6 month	7.92	34.12	0.000
Preoperatively and at 12 month	7.92	32.92	0.000
At 3 and 6 month	35.20	34.12	0.000
At 6 and 12 month	34.12	32.92	0.000

Table 3
Comparison of mouth opening in groups 1 and 2 AT regular intervals of follow-up.

Follow up visit	Group A mean ± SD	Group B mean ± SD	*P* Value
Preoperative	10.12 ± 5.6	7.92 ± 4.1	.119
Intraoperative	42.08 ± 1.9	41.44 ± 1.7	.226
At 3 month	34.24 ± 1.3	35.20 ± 0.7	.003
At 6 month	33.20 ± 1.2	34.12 ± 1.1	.010
At 12 month	32.32 ± 1.2	32.92 ± 0.9	.066
At preoperatively, intraoperatively – non significant At 3 month - highly significant At 6 month – significant At 12 month – non significant			

4. Discussion

OSF is a chronic, crippling condition of the mouth caused by limited mouth opening and making the patient unable to perform daily routine activities. It results in health and social problems, which may interfere with dental treatment and regular inspection for cancer, adequate nutritional intake, dental hygiene and speech.[1] The aim of treatment of moderately advanced to advanced OSF patients is to provide good release of fibrosis and long term improvement in mouth opening.

Depending on severity of the condition, OSF can be treated non-surgically or surgically. Nonsurgical approaches include vitamins and mineral (iron) supplements, intra-lesional injections of hyaluronidase, placental extracts, steroids.[1,2] Surgical treatment is only option available for advanced cases of OSF. Therefore, various intraoral grafts,

Table 4
Burning sensation and compliance to physiotherapy.

	Group 1	Group 2	*P* Value
Burning sensation	1.52	1.32	0.617
Compliance to physiotherapy			0.373
Excellent	12	13	
Good	11	11	
Fair	2	1	

extraoral grafts, microvascular free flaps, and alloplasts grafts have been described in the literature to the cover surgical defect.[2]

The use of post-surgical physiotherapy in cases of OSF is as important as the surgical procedure itself for treatment success to prevent recurrence. The purpose of the study was to compare the efficacy of postoperative mouth opening exercise outcomes with WTDs versus HJO in improving mouth opening after fiberotomy, bilateral coronoidectomy and reconstruction of surgical defect with BFP in advanced OSF patients.

The BFP has been commonly used for intraoral defects. Yeh[9] first described the use of BFP in OSF cases. The average weight of each BFP was found to be 9.3 g, and its average volume was 9.6 ml (range 8.33–11.9 ml) and defect up to 3 × 5 cm can be covered without compromising the blood supply.[10] The quick epithelialization of the uncovered fat is the characteristic feature of the pedicled BFP flap.

Yeh[9] first described the use of BFP in 9 OSF cases. Mean mouth opening in his study was 12.1 mm preoperatively and 31.1 mm postoperatively over a follow up of 21.3 months. In a study by R Sharma et al.[10] conducted on 28 patients diagnosed clinically and histologically were divided into 2 groups, group I (n = 15) and group II, (n = 13) corresponding to stage III and IV respectively. The mean preoperative mouth opening was 19.6 mm in group 1 and 12.92 mm in group 2. The mean postoperative mouth opening after 1 year was 35 mm in group I and 31.76 mm in group II. In these both studies, mouth opening exercises were advised within 36 h postoperatively and carried out for at least 3 months and it last as long as 1 year. However, the device used, and frequency and duration of mouth opening exercises daily were not described. Yeh[9] and R Sharma et al.[10] encountered relapse in 2 patients in their study. This study had a large sample size of 50 patients grouped into WTDs and HJO for better distinction between 2 methods of physiotherapy and used BFP. The mouth opening results in the 3 studies were comparable. We also advised mouth opening exercises within 36 h postoperatively but continued for at least 6 months intensively and it last for 1 year. With this physiotherapy regimen, we did not found any relapse.

In a study by Mehrotra et al.[11] conducted on 100 patients randomly allocated to 4 different surgical groups, with 25 patients per group. Group I was treated with BFP, group II with tongue flap, group III with nasolabial flap, and group IV with split skin graft. The mean preoperative mouth opening was 14.82 (SD 4.38) mm and ranged between 4 and 25 mm. Statistically, there was no significant difference among the 4 groups. The mean postoperative mouth opening at 1 month was 36.36 (SD 2.64) mm in group I, 35.36 (SD 29) mm in group II, 35.64 (SD 2.94) mm in group III, and 35.80 (SD 3.24) mm in group IV. The total score for pain, esthetics, and function at 1 month after surgery was highest (11.29) in group I, indicating better results. They advised mouth opening exercises from 5th postoperative day at least 5 times a day for a minimum of 6 months using WTDs. In our study, mouth opening exercises were started from 2nd postoperative day with either WTDs or HJO. Frequency of physiotherapy daily was similar in both studies, but duration of physiotherapy daily was not described in their study.

In a study by Kothari et al.[1] conducted on 10 stage III-IV OSF patients, used masticatory myotomy and coronoidectomy as adjuvant procedures followed by reconstruction of raw surgical defect with BFP graft. In his study, mean mouth opening was 14.7 mm preoperatively and 33.1 mm postoperatively over the follow up period of 1 year. They began physiotherapy from the third postoperative day, for 4 times a day for half an hour using wooden sticks, acrylic cone, HJO or Shekhars appliance. They found relapse in 1 patient. The postoperative mouth opening results and physiotherapy regimen in the 2 studies were comparable.

Postoperative mouth opening exercises plays an important role after surgical treatment in OSF. Relapse and failure to perform postoperative physiotherapy was mainly due to pain intolerance caused by stretching action of the degenerated masticatory muscles. Bilateral coronoidectomy release the stretching action of the strong degenerated muscles. This aids in aggressive postoperative mouth opening exercises to maintain intraoperative mouth opening in the long term.[1]

Khanna and Andrade[6] considered surgical treatment was the only solution for stage III and IV OSF with bilateral temporalis myotomy and coronoidectomy as a highly effective surgical procedure. Many studies[1,12,13] also recommended masticatory myotomy and coronoidectomy as adjuvant procedures in stage III and stage IV OSF to facilitate postoperative physiotherapy and to maintain mouth opening without relapse in the long term.

After surgery, postoperative physiotherapy can modify tissue remodelling in OSF to increase mouth opening and maintain maximum interincisal distance. Depending on improvement of postoperative mouth opening, the frequency and duration may be increased later until the intraoperative mouth opening values were reached. Moreover, postoperative mouth opening was satisfactory in patients who had performed adequate mouth opening exercises and those who were cooperative.

The present study supports the null hypothesis that there is no relevant difference between WTDs and HJO for postoperative physiotherapy at the end of 12 months follow up. Physiotherapy using WTDs is the manual technique of adding new spatulas and HJO is the mechanical device mediated technique of opening the blades of the instrument between the teeth. Both techniques maintain the released stretching action of mucosa and masticatory muscles to prevent relapse. However, WTDs are economical compared to the HJO. In our experience, using either WTDs or HJO mouth opening exercises should be started at 36 h postoperatively. This intensive exercise should be carried out daily for at least 6 months at a frequency of 5–6 times daily for 30 min and with reduced frequency for as long as 1 year to achieve long term success.

The study has certain limitation. Patients needed to be counselled and motivated for postoperative physiotherapy to strictly adhere to the regimen and for regular follow ups. Long follow up studies for at least 3–5 years and postoperative histopathological evaluation would give more details as we confined ourselves to only 1 year follow up and clinical evaluation.

In conclusion, both WTDs and HJO are effective in improving postoperative mouth opening in advanced OSF surgical patients.

Funding

None.

Conflicts of interest

None.

Conflicts of interest

We have no conflict of interest.

Ethics statement/confirmation of patient permission

Institutional review board approved the study and all patients gave informed consent for photographs.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jobcr.2019.06.006.

References

1. Kothari MC, Hallur N, Sikkerimath B, Gudi S, Kothari CR. Coronoidectomy, masticatory myotomy and buccal fat pad graft in management of advanced oral

submucous fibrosis. *Int J Oral Maxillofac Surg.* 2012;41:1416–1421.
2. Arakeri G, Brennan PA. Oral submucous fibrosis: an overview of the aetiology, pathogenesis, classification, and principles of management. *Br J Oral Maxillofac Surg.* 2013;51:587–593.
3. Arakeri G, Rai KK, Hunasgi S, Merkx MAW, Gao S, Brennan PA. Oral submucous fibrosis: an update on current theories of pathogenesis. *J Oral Pathol Med.* 2017;46:406–412.
4. Arakeri G, Patil SG, Ramesh DN, Hunasgi S, Brennan PA. Evaluation of the possible role of copper ions in drinking water in the pathogenesis of oral submucous fibrosis: a pilot study. *Br J Oral Maxillofac Surg.* 2014;52:24–28.
5. Arakeri G, Colbert S, Patil SG, Hale B, Merkx MA, Brennan PA. Salivary pooling: is it specific to particular regions in oral submucous fibrosis? *Br J Oral Maxillofac Surg.* 2015;53:275–278.
6. Khanna JN, Andrade NN. Oral submucous fibrosis: a new concept in surgical management. Report of 100 cases. *Int J Oral Maxillofac Surg.* 1995;24:433–439.
7. Shekhar S. TMJ ankylosis and physiotherapy – a review. *Indian J Oral Surg.* 1981;1:1–6.
8. Vadepally AK, Sinha R, Subramanya Kumar AVSS, Anmol A. Quest for an ideal route of intubation for oral and maxillofacial surgical manoeuvres. *J Maxillofac Oral Surg.* 2016;15:207–216.
9. Yeh CJ. Application of the buccal fat pad to the surgical treatment of oral submucous fibrosis. *Int J Oral Maxillofac Surg.* 1996;25:130–133.
10. Sharma R, Thapliyal GK, Sinha R, Menon PS. Use of buccal fat pad for treatment of oral submucous fibrosis. *J Oral Maxillofac Surg.* 2012;70:228–232.
11. Mehrotra D, Pradhan R, Gupta S. Retrospective comparison of surgical treatment modalities in 100 patients with oral submucous fibrosis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2009;107 e1–e10.
12. Chang YM, Tsai CY, Kildal M, Wei FC. Importance of coronoidotomy and masticatory muscle myotomy in surgical release of trismus caused by submucous fibrosis. *Plast Reconstr Surg.* 2004;113:1949–1954.
13. Canniff JP, Harvey W, Harris M. Oral submucous fibrosis: its pathogenesis and management. *Br Dent J.* 1986;160:429–434.