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## Emancipators in oral sub mucous fibrosis: an update

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### Abstract

Oral submucous fibrosis is a chronic insidious oral mucosal condition causing trismus and reduced mouth opening and it is affecting predominantly Indian and other Asians. The treatment of trismus requires combination of pharmacological agents, surgical therapy and physiotherapy, the latter is essential for preventing relapse due to postoperative inactivity and scarring as well as for improvement of mouth opening. Computerized literature search was performed from 1993 till 2021 to select eligible articles from the following databases: PUBMED [MEDLINE], SCOPUS, SCIENCE DIRECT, and COCHRANE DATABASE using specific keywords. The search was limited to articles published as full text in English, which were screened by two reviewers for eligibility. This article describes in depth about various appliances, devices used in oral submucous fibrosis. The devices can be used along with pharmacological and surgical treatment modalities or can be used alone. Mouth exercise is also well-established method to improve mouth opening and also to prevent postsurgical relapse. This article is one of the rare article that describes all the appliances together either directly used or indirectly used for the case of microstomia due to oral sub mucous fibrosis.

**Keywords:** Appliances, Oral submucous fibrosis (OSMF), Exercises, Devices.

### INTRODUCTION

Oral sub-mucous fibrosis (OSMF) is a chronic, progressive, disease which is characterized by blanching, stiffening and fibrosis. OSMF leads to decrease the flexibility and increase the rigidity of tissue ultimately causing microstomia/ trismus. It causes tissue stiffness, loss of movement, and final inability to open the mouth [1].

OSMF is defined as "an chronic insidious disease affecting any part of the oral cavity and sometimes the pharynx. It is always associated with juxta-epithelial inflammatory reaction followed by fibroelastic changes of the lamina propria with epithelial atrophy leading to stiffness of the oral mucosa and causing trismus and inability to speak" in 1966 given by Pindborg and Sirsat [2].

Because the origin of OSMF is unknown and the condition is progressing, treatment for it primarily consists of patient counselling. Different treatment modalities are there for OSMF one is conservative (includes iron supplements, intra-lesional injection, vitamins etc) & another one surgical intervention (severe condition when interincisal opening less than 20 mm)

In this article we are discussing about various appliances that can be used to treat OSMF. From 1993 to 2021, a computerized literature search was conducted using particular keywords to find suitable publications in the following databases: PUBMED [MEDLINE], SCOPUS, SCIENCE DIRECT, and COCHRANE DATABASE. The search was limited to full-text papers published in English that have been vetted for eligibility by two reviewers.

Appliances can be two types, externally triggered equipment provide continuous or intermittent pressures that might be mild or heavy, elastic or inelastic. Because the elevator muscles can create forces, internally triggered gadgets rely on the patient's depressor muscles (rather than an external mechanical device) to extend the elevator muscles.

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The amount of force given, as well as the frequency and duration of stretching, are all dependent on the patient's strength and motivation. The stretching must be done by the patient on his or her own [9].

### Appliances for OSMF

Appliances is a device or piece of equipment designed to perform a specific task. It can be two types, externally activated appliances & internally activated appliances. Externally activated appliances impart continuous or intermittent, light or heavy and elastic or inelastic forces [3] and internally activated appliances rely on the patient's depressor muscles.

### Appliances Used In Trismus Due To OSMF

➤ **Externally Activated Appliances** Such appliances include the following;

1. **Inflatable Bite Opener:** The appliance consists of four basic components, the Maxillary & mandibular acrylic plates, an Inflatable rubber pediatric blood pressure bag, rubber blood pressure hand bulb with lock- nut attachment & connecting tubing. Pressure maintained 10 sec followed by 1 min rest. The procedure is followed for 10 minutes 3 times per day [3].
2. **Dynamic Bite Opener:** Drane [4] first described this and later Brown [5] was described this appliances. Most recently, Kouyoumdjiati [6] *et al.*, have described a variation on its design. The appliance consists of combination of maxillary & mandibular stents, with steel metal rods. 2 "U" shaped notches on lower rod on molar region at an angle of mandible helps to permit the use of elastic bands to apply bilateral opening force. For edentulous patient the rods are attached to buccal surface of denture [7]. This appliance provides continuous elastic force to depress the mandible, and the amount and direction of the force can be controlled. It is relatively complex to construct, and its appearance and the necessity for prolonged application do not encourage patient acceptance [8]. In the literature Jeckel *et al.* [9], described this appliance as a "Continuous-dynamic jaw extension apparatus", he advocated repeated isotonic contractions at a given degree of opening, followed by opening of the screw to a new pain threshold. The rationale for this approach is the idea that, to increase the range of opening, not only must the fibrotic or scar tissues be stretched but also the antagonistic limitation of the elevator muscles must be overcome.
3. **Threaded, Tapered Screw:** This appliance is constructed of acrylic resin, and is placed by the patient between the posterior teeth [12]. With gradual turns of the screw, the mandible is depressed and the maxillary and mandibular teeth are forced apart. The appliance provides a force (continuous or intermittent) controllable by the patient. Significant force can be generated, and anterior teeth in particular can become loosened if excessive force is applied [8, 38]. (Figure 1)



Figure 1: Threaded, Tapered Screw

4. **Shell- Shaped Mouth Opener:** The principle of leverage to superpose the convex surfaces of two shells was applied to develop a device for treating limitation of opening and called it the "shell-shaped mouth opener" and further improved it to adapt to complex mandibular movements. **Mechanism:** it involves a fulcrum

that superposes the convex surfaces of the main bodies, a power point that is formed when the patient grasps the edges of the bodies, and a point of action that involves the bite-parts. **Advantages:** the combination of leverage and hinge movements of this enables it to adapt to the left-right asymmetric mandibular movements and when the patient grasps and eases the edge of the main bodies, the rubber band at the base of the bite-part expands and contracts gently to prevent added torque to the teeth and masticatory muscles [10].

5. **Screw-Type Mouth Gag:** This appliance employs a screw-type component which provides a continuous, unilateral, and inelastic force, as described by Nakajima *et al.* [11] the amount of force applied can be controlled by the dentist or the patient. This appliance is less obtrusive in appearance than the dynamic bite opener.
6. **Tongue Blades:** In the literature since many years tongue blades have been recommended for use as a wedge (individual blades pried between the teeth) or as a mouth prop to sustain maximal opening once it is achieved. This approach can provide the same amount of force as the threaded, tapered screw and has the same limitations. Used as a wedge, tongue blades are effective only in a dentate patient [12, 13, 14].
7. **Fingers: Rouse** The patient depresses the jaw with his fingers, stretches the muscle to its greatest length, and then holds the posture for a slow count of ten. The patient does this activity throughout the day [3].
8. **TheraBite Jaw Motion Rehabilitation System:** The TheraBite® Jaw Motion Rehabilitation System™ (Atos Medical Inc., West Allis, WI, USA) is a patient-operated device used for passive rehabilitation therapy & used to treat the condition of mouth opening limitation [15]. It consists of two mouthpieces, inserted between teeth of the upper and lower jaws and the attached plastic handles. The patient's mouth can be opened by pressing together the plastic handles that force the mouthpieces to separate [16] The process is repeated five to 10 times, several times a day [17] As there is squeezing and releasing of the handles it helps to stretch the tissues intermittently As soft tissues are stretched, the elongation is in proportion to the magnitude of the locally applied load. There can be plastic or elastic deformation in the viscoelastic elements. In cyclic muscle stretching, the amount of deformation that occurs is determined by the number of cycles, the rate of deformation, and the amount and duration of force per cycle [18, 19].

**TheraBite exercises** [20] - Patient is advised to exercise four sessions each day, with 6–8 repetitions within each session, and hold the stretch for 10–15 s. Mouth opening was measured prior to TheraBite exercises and at regular follow-up appointments by using a slide caliper. On average, mouth opening improved 5.4 mm (SD 5.7) after TheraBite exercises.

9. **Mouth-Exercising Device (MED)** [21] a non-tooth-borne mouth-opening device applying force to two intraoral screws placed in the vestibule of the maxillary and mandibular bones that helps patients to squeeze or stretch the cheek, resulting in local tissue remodeling to increase the elasticity of the mucosa for improvement in mouth opening. **Mechanism:** The MED (due to massage effect) causes separation of the submucous fibers, which may increase the tissue pliability. The separation of the fibers may increase the subcutaneous matrix areas for improved circulation. This can be repeated three to five times a day for 10 minutes on each side at a time to ensure the steady state of increased blood flow. **Advantages-** MED as the sole treatment modality without any other regimen, it can be used in patients with poor dental conditions and also allows rehabilitation to start immediately after surgical trismus release. **Limitations-** The MED cannot be used to

treat fibrotic lesions in the retromolar region, soft palate, or mouth floor. The fatigue that develops in the wire over time may cause the coil to break. (Figure 2a, 2b, )



Figure 2a, 2b, 2c: Mouth exercising device

10. **EZ Bite device** [22] used specifically for improving mouth-opening performance. The EZBite is an open-mouth training gadget that measures 6.1 5.8 10 cm in length and weighs 78 grammes. As a result, the device is only for trismus patients with open-mouth ranges greater than 5 mm. The device's mechanical function consists of passive mouth-opening exercises, and the patient controls the EZBite. Both the top and bottom portions of the mouthpiece are inserted between the teeth of the maxilla and mandible. **Advantages**-The participants' health related quality of life (HRQL) significantly improved after using the EZBite device. Available to patients at a low price. **Disadvantages**- possibility of relapse, need periodic recall. (Figure 3)



Figure 3: EZ Bite device

11. **Shekar's appliance** 23: The appliance was designed and used by Dr. S. E. Shekar. This appliance has been successfully in the treatment of OSMF, osteo-arthritis of TMJ, myositis ossificans, and hardening of facial muscles due to radiotherapy in the treatment of oral cancer. The appliance consists of two acrylic plates—maxillary and mandibular, these plates are connected on either side by the springs. The appliance is activated by opening the coils. The distance between the maxillary and the mandibular plates can be increased by opening the side coils as per the existing amount of opening of the patient's mouth. If the maxillary (Upper) coil is opened, the appliance exerts more pressure on the posterior part of the mandible and if the mandibular (lower) coil is opened it exerts pressure more on the anterior part of the mandible or it can be made to exert pressure uniformly on the mandible depending upon the need. (Figure 4a,4b,4c)

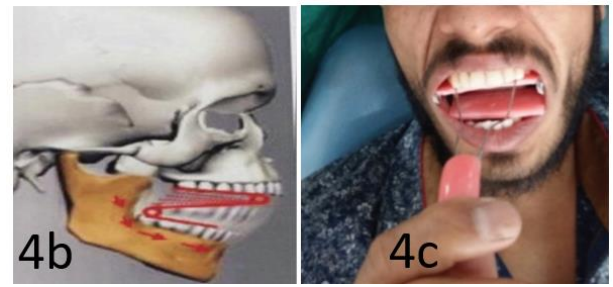
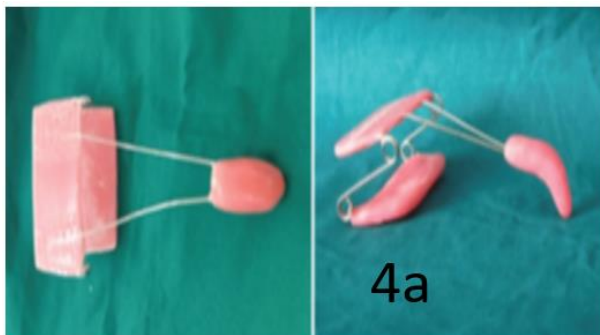


Figure 4a, 4b, 4c: Shekar's appliances

1. **Internally Activated Appliances** [3] The advantages of internally actuated appliances are their ease of use and the availability of progress feedback. The following are examples of internally actuated appliances as reported in the literature:
2. **Plastic Tapered Cylinder:** It is easier for the patient to apply. This appliance relies on the patient's depressor muscles to depress the mandible, whereas the threaded, tapered screw (externally activated appliance), is activated by an externally applied torque that forcibly pries the maxilla and mandible apart [7]. The patient is instructed to use the appliance four times daily, for 10 to 15 minutes each use. The patient is directed to stretch to the point of discomfort, but not pain.
3. **"Nallan C-H" [24] Appliances:** has been created and tested for the treatment of trismus, with positive results. For 8 weeks, patients were urged to wear the device 12 hours every night and followed up every week to check any improvement and encouraged to perform isometric mouth exercises daily according to their comfort. For every visit, the mouth opening was measured and the screw was released 1mm on each side to improve mouth opening. A follow-up of 2 months was performed on each patient. **Advantages**- The appliance can be fabricated in patients who are completely edentulous and also in those partially edentulous patients. **Limitations**:- Difficulty to insert intraorally during the initial phases of treatment, excessive salivation, reduced strength of appliance after weeks of usage may be due to fabrication errors. (Figure 5a, 5b, 5c)

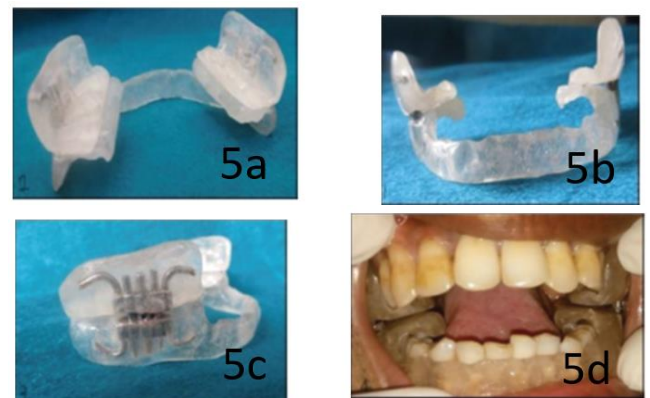


Figure 5a, 5b,5c,5d: A novel intraoral appliance—"Nallan C-H"

**A. Appliances Associated with OSMF**

1. **Sectional tray** [25] for oral submucous fibrosis with completely edentulous maxillary and dentulous mandibular arch. Fabrication of sectional single complete denture for patient with microstomia due to OSMF. The sectional prosthesis was fabricated into two pieces which were held together by magnets, enabling the patient to insert and remove the denture with ease.

**Advantages:** This technique can be employed in regular dental practice, without need of complicated machinery or attachment devices. The magnets are easily available at a nominal cost.

**Disadvantages:** This technique shares disadvantages common to all sectional tray/ prosthesis designs, such as additional time, labour, and materials. Hence, to determine the long term success of this technique, periodic recall, maintenance and further improvements in design are required. (Figure 6a, 6b, 6c)

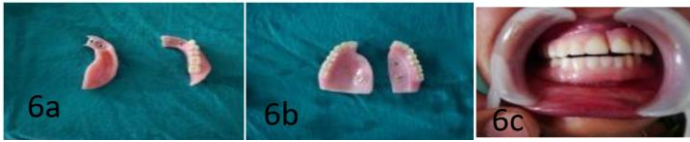


Figure 6a, 6b, 6c: Sectional tray

- An appliance (**Borle's appliance**) [26] fabricated, a technical innovation used to protect the flaps in the post-operative period to avoid trauma to the flap, preventing chances of failure, along with ability to speak and chew and that placing barrier between the flap and posterior teeth, after performing fibrotomy in OSMF cases. **Advantages:** it is a custom made appliance with good retention and stability. Active or passive mouth opening exercises can be carried out. Oral seal is achieved easily. Maintenance is easy and can be done by the patient regularly. It is cost-effective. **Disadvantages** – Inability to speak, chew, drooling of saliva. ( Figure 7a,7b)

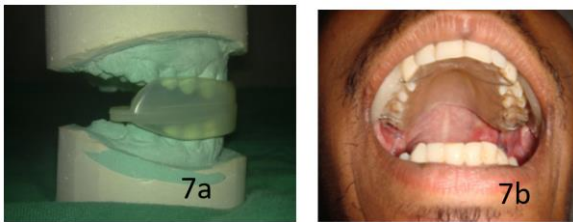


Figure 7a, 7b: Borle's appliance

- Oral screen** [27] used as a supplement to surgery to avoid recurrence. The appliance was then inserted in the patient's mouth positioning it in the labial and buccal vestibule as oral screen. The patient was encouraged to wear the appliance for 24 hours per day initially, for 1 week unless discomfort or injury occurs. After 1 week, the patient was told to use the appliance during the day time, and to remove at bed time for a month. The patient was scheduled for monthly recall visits for 6 months or longer. **Advantages**-The prosthesis helps to stabilize the secured flaps to and prevent it from being bitten into occlusion. **Disadvantages**- Being removable, it facilitates periodic examination of the surgical site. ( Figure 8a, 8b, 8c)



Figure 8a, 8b, 8c: Oral screen prosthesis

- Sectional stock tray** [28, 29] Hinges, plastic construction blocks, orthodontic expansion screws, or locking levers join the two independent sections of the segmented custom tray solely at the handle.
- Mandibular swing-lock complete dentures:** For prosthetic rehabilitation in OSF patients with restricted mouth opening, collapsible mandibular swing-lock dentures with a cast cobalt-chromium framework, a lingual hinge, and a traditional labial swing-lock can be utilised. This allows these prostheses to be foldable while yet maintaining structural integrity [30].
- Sectional complete denture with cast magnetic attachments:** The four studs are connected with an acrylic resin overlay that connects the two left and right portions of sectional full dentures. Because of the confined tongue space, these prostheses restore aesthetics but cause some pain. Fe-Pt dental magnetic attachments provide excellent adhesion and attractive force and are therapeutically effective [30].
- Graft stabilizing clip-** Le and Gornitsky used graft-stabilizing clips (GSCs) as oral stents for 6 months in OSF patients having surgery to correct mouth opening to avoid recurrence of the corrected mouth opening. This is a basic design that is straightforward to construct and guarantees that the graft makes good contact with the detachable recipient site. [31, 32] (Figure 9a, 9b, 9c)

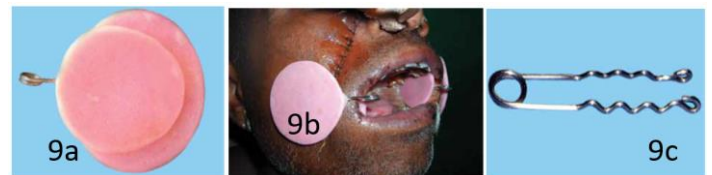


Figure 9a, 9b, 9c: Graft stabilizing clip

- Hister jaw opener:** To begin with, wooden spatulas and subsequently Heister's jaw opening were employed for both passive and active physiotherapy. However, they are beneficial in individuals who are dentulous yet have a good periodontal condition. Metal jaw openers can traumatise the edentulous ridge, resulting in poor postoperative patient compliance with physiotherapy. For postoperative physiotherapy, we propose using a modified Heister's jaw opening (RAI Modification) in such patients. The device has been developed to be both safe and cost-effective to use. The device can be used by the patient for postoperative physiotherapy. [42] (Figure 10a, 10b, 10c)

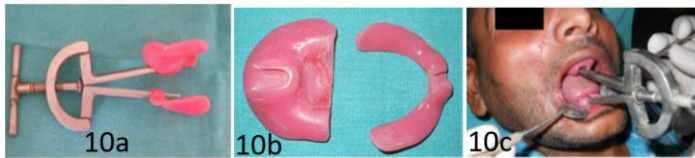


Figure 10a, 10b, 10c: Hister jaw opener

Summary of appliances in OSMF (Figure 11)

### Other Modalities

It has been attempted physiotherapy in the form of forced mouth opening and heat.

Heat –Short wave/Micro wave diathermy<sup>[33]</sup>: Lukewarm water, heated rinses, and targeted deep heating therapies like short wave or micro wave diathermy have all been employed<sup>[34]</sup>. It works by causing bands to physio-fbrinolyze. Microwave diathermy appears to be better to short wave diathermy because it selectively heats juxta epithelial connective tissue, restricting the treatment region<sup>[35]</sup>. Gupta DS *et al* used microwave diathermy at 2450 MC/s for 20 minutes daily at each site of the lesion with 20 to 25 watts of energy for 15 sittings and reported that the use of microwave diathermy was of great significance for moderately advanced stages, but the results were very poor in very advanced cases<sup>[36]</sup>.

Kneading is a type of massage treatment that helps to improve the suppleness of fibrous tissues and mobilise scar tissue. In physiotherapy, mild soft tissue massage is commonly utilised to improve their extensibility.

**Physiotherapy**<sup>[37]</sup> Exercise, which has been shown to have a significant influence on the treatment of OSMF, is included in physiotherapy management. These are cost-effective, comfy, and simple to maintain.

**Various exercises for OSMF patients** Tongue blade exercise, Tongue-in-Cheek Push, Side Tongue Stretch, Cheek Puff, Pucker, "O" Exercise, Lip Hold, Up and Down Tongue Stretch, Teeth Sweep are some of the exercises that may be suggested.

### CONCLUSION

OSMF is relatively common disease and requires long term treatment for which various appliances have been fabricated to increase the mouth opening. As the disease is progressive in nature, constant improvement of these appliances is required. Long term studies using these appliances should be carried out for significance results. Patient counselling, patient co-operation, periodic recalling and further design improvement help in patient management.

### Conflict of interest

The auther reports no conflicts of interest.

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