Surgical Management of Oral Submucous Fibrosis with the "Opus-5" Diode Laser

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Abstract: Any treatment modality for oral submucous fibrosis (OSMF) should not only depend on relieving trismus but also should monitor the malignant transformation because it is a precancerous condition.[8, 9, 12-14]Of particular importance is the fact that it has mainly been reported amongst people of Indian origin.[9,10] Wide ranges of treatment such as general, medical and/or surgical have been attempted in the past with unpredictable results because the exact pathogenesis is not known. The general treatment consists of biopsy, stoppage of habits, treatment of anemia, vitamin supplements and removal of third molars, if it is required. Whereas in medical treatment, submucosal injection of various fibrinolytic and anti-inflammatory agents are employed, none of them has proved to be a complete cure for this disease.

Surgical treatment is directed towards releasing the fibrotic bands. It yielded good results, immediately giving relief from trismus, but showed only further scar formation and recurrence of trismus in the long-term follow up. This could be prevented only by covering the raw areas with graft material. Many grafting materials, such as split-thickness skin graft, tongue flap, palatal island flap, naso-labial flap, buccal pad fat graft, have been tried. They showed some drawbacks, eg, donor site morbidity, infection, lack of tenure or hair growth, and lengthy surgical procedure for harvesting of graft.

Innovate Smile Design Centre, Surat, India carried out a study to evaluate the efficacy of laser excision of the fibrous band and its long-term effects in OSMF.

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Laser is an acronym for Light Amplification by Stimulated Emission of Radiation. The energy emitted in the laser beam interacts with target tissues according to the individual wavelength, having mainly four effects:

- **Reflection:** The laser energy may reflect off a tissue layer in a direct or diffuse manner.
- **Absorption:** This is the most beneficial tissue interaction. It is very important to achieve treatment results with a photothermal effect.
- **Transmission:** Passes directly through the tissues without any effect.
- **Scattering:** It causes a diffuse absorption over a larger area. The energy or the photothermal effect is not at the desired level to give precise incisions.

The use of lasers in dental and maxillofacial soft tissue surgery is reported as early as 1964. With more advances in lasers, its clinical applications in various cases are increasing day by day. The diode laser with its contact mode application and precision beam delivery are gaining acceptance in multiple applications for soft tissue surgery.

More than any other speciality, lasers have played integral part in the evolution of oral surgery practice. Many procedures can be executed more efficiently and with less morbidity using lasers compared to scalpel or electrocautery. Many different wavelengths have been used with various advantages, for instance, in terms of coagulation properties and incision quality.

The new semiconductor diode lasers are portable and compact, with efficient delivery systems. They can be used in continous or pulsed mode and with a contact or noncontact handpiece.

Uses of Lasers in Oral Surgery

- Frenectomies
- Fibroma
- Mucocele
- Gingival lesions
- White lesions
- Incisional and excisional biopsies
- Vestibuloplasties
- Uvuloplasty
- Peri-implant surgery
- Hyperplastic tissue removal

AIMS AND OBJECTIVES

In 1966, Pindburg et al[9] defined OSMF (oral submucous fibrosis) as "An insidious chronic disease affecting any part of the oral cavity and sometimes the pharynx. [...] although occasionally preceded by and/or associated with juxta epithelial inflammatory reaction followed by a fibroelastic change of the lamina propria, with epthelial atrophy leading to stiffness of the oral mucosa and causing trismus and inability to eat."

Thus, it is a disabling condition resulting in many psychological problems. To overcome these problems, the present study was carried out using an Opus 5 diode laser (Opus dent, Natania, Israel) with the following aims and objectives:

1. To relieve trismus caused by oral submucous fibrosis
2. To evaluate the efficacy of surgical excision with laser without any graft to cover wounds
3. To maintain mouth opening postoperatively by physiotherapy.

HISTOLOGY OF ORAL SUBMUCOUS FIBROSIS[9]

A. Connective tissue changes (Fig 1): Except in the cases which begin with vesicles, oral submucous fibrosis stalls in the connective tissue. Pindburg et al (1966) have described four consecutive stages:
   1. Very early stage: It is characterized by a finely fibrillar collagen, dispersed with marked oedema. The fibroblastic response is strong, with plump young cells containing abundant cytoplasm. The blood vessels are sometimes normal, but more often they are dilated and congested. Inflammatory cells, mainly polymorphonuclear leukocytes with an occasional eosinophil, are present.
   2. Early stage: The juxta-epithelial area shows early hyalinization. The collagen is still seen as separate bundles, which are thickened. Plump young fibroblasts are present in moderate numbers. The blood vessels are often dilated and congested. The inflammatory cells are mostly mononuclear lymphocytes, eosinophils, and an occasional plasma cell.
   3. Moderately advanced stage: The collagen is moderately hyalinized, amorphous change starting from the juxta-epithelial basement membrane. Occasionally, thickened collagen bundles are still seen separated by slight residual oedema. The fibroblastic response is less marked, the cells present being mostly adult fibrocytes with elongated spindle-shaped nuclei and scanty cytoplasm. Blood vessels are either normal or constricted as a result of increased surrounding fibrous tissue. The inflammatory exudate consists of lymphocytes and plasma cells, although an occasional eosinophil is seen.
   4. Advanced stage: The collagen is completely hyalinized and is seen as a smooth sheet, with no separate bands discernible. Oedema is absent. The hyalinized areas are devoid of fibroblasts, although a thin, elongated cell or vestigial nucleus is seen at rare intervals along the fiber bundle. Blood vessels are completely obliterated or narrowed. The inflammatory cells are lymphocytes and plasma cells.

      Characteristically, the melanin-containing cells in the lamina propria become surrounded by dense collagen which explains the clinically observable loss of pigment.

B. Epithelial changes: The oral epithelium in the clinically affected areas is markedly atrophic compared to the thickness of normal oral epithelium. The rete pegs are completely lost. The buccal mucosa shows varying degrees of keratinization. The epithelium also exhibits intercellular oedema (18% cases), signet cells (13% cases), and epithelial atypia (7% cases).

The atrophy of the oral epithelium is probably secondary to the connective tissue changes.

PREVALENCE AND INCIDENCE

Pindburg et al[11] noted a prevalence rate of oral submucous fibrosis in India of 0.2% to 0.4% with a higher percentage from the southern area of the country. According to Pindburg,[15] the disease occurs almost exclu-

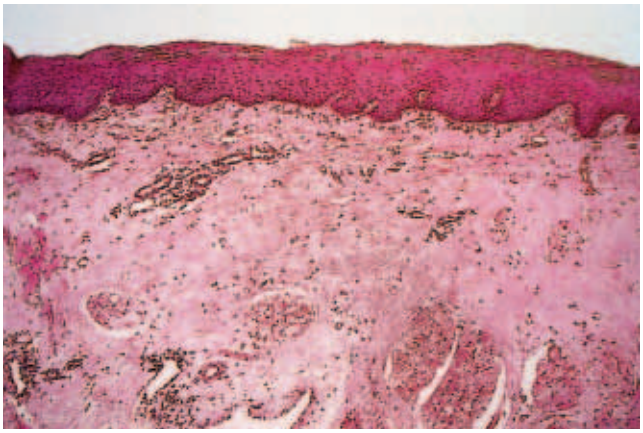

Fig 1 OSMF.

Fig 2 Etiological factors for OSMF.

sively among Indians, Pakistanis and Burmese, but sporadic cases have been observed in China, Nepal, Thailand, and South Vietnam. Occasional cases involving Europeans have also been recorded.

Gender/Age: It is preponderant in males and has been reported in the second to fourth decade of life by various authors.

Areca Nut: The impairment of the oral wound healing response by areca nut constituents (arecnoline and tannins) may be one etiological factor of oral submucous fibrosis, because tissue damage and subsequent impairment of mucosal healing has been shown to be a major continuing factor of tissue fibrosis. Moreover, lime ($Ca(OH)_2$) present in the saliva of betel quid chewers changes the saliva to a more alkaline condition, which causes the areca nut ingredients to release reactive oxygen species (ROS), which in turn leads to structural changes in the oral mucosa.

Chillies: Capsiacin, the active irritant in chillies, produces changes in the connective tissue.

Tobacco: According to authors, the precarcinogen polycyclic aromatic hydrocarbons found in tobacco smoke and the carcinogen N-nitrosonornicotine predominant in chewing tobacco are the main etiological agents which are responsible for pathogenesis in OSMF (Fig 2).

CLINICAL FEATURES ACCORDING TO PAISSAT[7]

A Initial symptoms
1. Burning sensation in the mouth experienced whenever patient is eating spicy food.
2. Ulceration or recurrent stomatitis with excessive salivation.
3. Defective gustatory sensation and dryness of the mouth.
4. Difficulty in opening the mouth.
5. Inability to whistle or blow out candles.
6. Difficulty in swallowing.

B. When the fibrosis extends to the pharynx the patient may complain of
1. Referred pain in the ears.
2. Occlusion of the Eustachian tubes

Signs

1. The mucosa becomes blanched and slightly opaque.
2. Scar-like formations may be seen especially in the lateral parts of the soft palate.
3. The uvula is often reduced in size.
4. The mucosa feels stiff and the soft palate is greatly reduced in mobility. Fibrosis may also spread past the pharynx and down into the pyriform fossa.
5. Patient looks anaemic and debilitated.
6. Massetric hypertrophy and elongated gonial angles may be seen.

Buccal mucosa

1. The mucosa becomes pale and firmly attached to the underlying tissues.
2. Fine vertical fibrous bands can be seen in the premolar area.

3. In the lip, the circular band of fibrosis may extend around the entire rima oris.
4. Atrophy of the vermillion border.
5. Bilateral, dark brown, hyperpigmentation of the commissure may also occur.

Tongue

Frequently, the tongue becomes progressively immobile and shows a diffuse papillary atrophy.

Trismus

Reduced mandibular opening and inability to maintain oral hygiene.

CLINICAL STAGES

The clinical stages suggested by Ahuja and Agrawal[1] are as follows:

Grade I (mild): Localized fibrous bands in cheek extending from superior to inferior vestibular formix. These were located on lips, to first molar and second molar region.

Grade II (moderate): Generalised diffuse hardening of subepithelial tissue extending from cheek and hard palate, uvula and pilars of fauces and sometimes pharynx.

Grade III (severe): Oral submucous fibrosis, a precancerous condition.

The possible precancerous nature of OSMF was first described by Paymaster in 1956, who reported the development of slow-growing squamous cell carcinoma in one third of the cases of OSMF seen among patients in Tata Memorial Hospital in Bombay. Pindburg[12] studied 220 biopsy specimens from patients of OSMF in India; epithelial atypia was seen in 7.7% to 23.8% with an average of 13.2%.

LITERATURE REVIEW OF OSMF TREATMENTS

In 1981, Paissat[7] evaluated OSMF as a precancerous condition. He observed that early OSMF responded favourably to weekly doses of 7.5 mg of hydrocortisone injected submucously into the fibrous area. In more advanced cases, a proportionally larger dose (15 mg of hydrocortisone weekly) was needed. As conservative treatment, it is advised to stop the consumption of chillies and other irritants, treat the anemia, and give vitamin-B supplements to the patients. He also suggested a modern surgical technique (grafting) for the treatment of oral submucous fibrosis, which offers a better prognosis.

Vigas experienced difficulty in closing the posterior part of the releasing incision when attempting to correct the trismus due to oral submucous fibrosis with bilateral inferiorly based nasolabial flaps. Kavarana[25] divided a nasolabial flap after 3 weeks in such a way that an extra 2 to 2.5 cm is available for covering the defect on the remaining portion of the oral mucosa.

Chin-Jyh Ych described the use of a pedicled buccal fat pad (BFP) in treating trismus of patients with oral submucous fibrosis. Patients underwent incision of fibrotic bands and coverage of buccal defects with pedicled BFP.

MATERIALS AND METHODS

Ten cases clinically diagnosed as oral submucous fibrosis involving buccal mucosa, retromolar pad area, were surgically treated by releasing fibrotic bands with laser. All the cases were operated under general anesthesia by the same surgical team.

Criteria for Patient Selection

1. Patients with restricted mouth opening caused by oral submucous fibrosis were randomly selected irrespective of age, gender, caste, religion, etiological factors, or degree of involvement. The age range was from 19 to 42 (average 27) years (Table 1). Patients were clinically grouped according to Khanna and Andrade[16] into 4 categories (Table 2).
2. Patients had no underlying systemic diseases.
3. Patients had been previously treated with local and/or medical therapy (vitamin supplements, intralesional injections of fibrinolytic and antiinflammatory agents) with subsequent recurrence.
4. Patients with a conclusive diagnosis of oral submucous fibrosis by clinical examination.

Prior to surgery, all the patients were motivated to cease indulging in the habits (eg, betel nut chewing, tobacco chewing, etc.) causing oral submucous fibrosis. The patients were apprised of the final outcome of this disease, since it was essential at the onset of the treat-

Table 1 Age distribution of patients

Age in years	No. of Patients
21-30	08
31-40	01
41-50	01
	Total: 10

Table 2 Clinical grouping (Khanaa and Andrade)

Group	Mouth opening (in mm)	No. of Patients
I: very early cases	Normal	0
II: early cases	20-25	6
III: moderately advanced cases	15-20	4

ment to avoid unrealistic expectations. Preoperatively, mouth opening was evaluated and recorded with distance between incisal edges in millimeters, and orthopantomograms (OPG) were taken to rule out any pathology in the jaws, teeth, and TMJ region, also to determine the necessity of removing the third molars.

INSTRUMENTATION

An Opus 5 diode laser (Opus dent, Natania, Israel) was used (Fig 3). Protective eyewear was worn by the entire operating team and the patient. A 0.3-mm-diameter cable was used for delivery of the beam. Straight or contraangled handpieces were used to place the incision at the desired site.

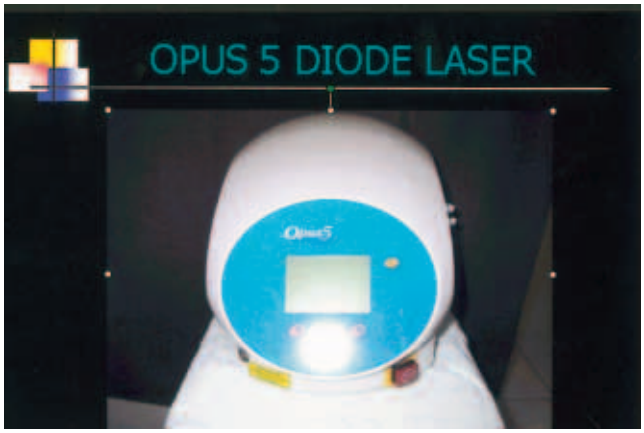

Fig 3 Laser used.

Surgical Technique

Incisions were lased bilaterally from the retromolar area extending up to the premolar region or angle of mouth. The incisions were made approximately 2 mm deep until the muscle layer was reached, incising only the fibrous mucosa and submucosal layer. A similar second incision was placed inferior to this by beginning from 1/3 of the superior incison in third molar area extending to the former incision to form a inverted "Y". The laser beam was delivered at 5 W. After the excision of fibrous bands, the mucosa was bluntly separated. A similar incision was placed bilaterally, and the mouth was then forced open (intraoperatively) with Fergusson's mouthgag.

Mouth opening was recorded with the help of vernier calipers. The mouth opening was measured from the edges of the maxillary and mandibular central incisors.

Postoperative physiotherapy exercises were started 10 days after surgery, and patients were trained to continue the physiotherapy exercises daily.

Follow-up

Follow-up examinations of patients were conducted 10 days and 3 months postoperatively to measure the mouth opening (Figs 4 and 5). Wound healing was clinically evaluated every week for first month and then every month. Improvement in physiological junctions of buccal mucosa (suppleness and elasticity) was evaluated on follow-up visits.

RESULTS

Our preliminary clinical findings include sufficient haemostasis, precise incision margins, and less postoperative oedema and pain in all the cases.

Slight sloughing was observed on the incisal wound postoperatively, possibly due to the stretching of mucosa and tissue rupture from vigorous jaw-opening exercises and physiotherapy.

Table 3 presents the results on mouth opening.

Fig 4 Mouth opening and wound healing was checked at follow-up examinations.

Fig 5 Mouth opening and wound healing was checked at follow-up examinations.

Table 3 Mouth opening

Pat. no.	Preoperative spontaneous mouth opening (in mm)	Intraoperative forced mouth opening (in mm)	Post-operative spontaneous mouth opening (in mm)	
			After 10 days	After 3 months
1.	22	38	34	32
2.	24	42	35	36
3.	16	34	30	28
4.	15	32	28	30
5.	22	40	28	-
6.	21	32	28	31
7.	18	32	28	28
8.	17	39	35	36
9.	20	36	28	-
10.	20	42	38	-

DISCUSSION AND CONCLUSIONS

Our review of the literature for treatment of OSMF yielded no reports of laser excision of bands to relieve trismus. In all of our cases, the expected immediate intraoperative mouth opening was achieved, and in correlation with other surgical techniques employed for release of trismus. Using laser, the charred tissue provided a protective environment for the incised raw areas until the initial healing took place, resulting in less scar-tissue formation.

There was a slight reduction in mouth opening after the 10th day postoperatively, which could be due to the tissue shrinkage and scar formation following the healing at the operated site, but it was similar to those findings where the raw surgical surfaces were covered with a graft. We found that in all the cases, in spite of not performing grafts to cover the laser incision, patients did not experience postoperative pain, infection, or wound dehiscence. Moreover, there was no marked difference in the jaw opening compared to the procedure in which the surgical surface was covered with a graft.

"Behind a restricted mouth lies a restricted personality." This is more or less true for the patients suffering from the highly perplexing disease called oral submucous fibrosis. Oral submucous fibrosis has been extensively described in the literature and is now con-

sidered a major oral health problem. Of particular importance is the fact that oral submucous fibrosis is most frequently found amongst Indians and Southeast Asians. This might be due to the deep-rooted tradition of betel-nut chewing in these societies, where it has been cited as a prime etiological factor causing oral submucous fibrosis.

In present study, patients' preoperative spontaneous mouth opening ranged from 16 to 24 mm (Table 3). All the patients were categorized as in the early or moderately advanced stages. Drug therapy in the form of antioxidant vitamins and intralesional injections of various fibrinolytic and anti-inflammatory agents proved successful only in the treatment of early cases. Surgical treatment is the method of choice in patients with marked limitation of mouth opening.[2,3]

During the follow-up period, slight improvement in mouth opening (intraoperative forced mouth opening) was noted (Table 3). This might be due to intensive physiotherapy postoperatively. Improvement in physiological functions of the buccal mucosa, such as suppleness and elasticity, was noted in all the cases. Our results are comparable to those obtained by Yeh[16] and Malik et al.[5]

Despite minor complications, the ultimate outcome of the study was excellent. The average increase of mouth opening was 15.0 mm in group III (moderately advanced cases) and 17.0 mm in group II (early cases) over a follow-up period of 3 months. The average mouth opening was 32 mm, and no wound dehiscene was noted in any patient. We attribute this to the use of laser. No second site surgery to cover the raw area was required. Less scar formation led to more supple and elastic mucosa. This is one of the major reasons that there was no recurrance or tissue shrinkage after surgery, maintaining good mouth opening even after 3 months. We also noted that due to less pain and discomfort because of less inflammation and oedema, patients were able to start physiotherapy from the first postoperative day itself. From the results obtained, vigorous daily physiotherapy was found to be mandatory for maintaining the mouth opening achieved intraoperatively.

To date, there is no method which can be seen as the definitive treatment for oral submucous fibrosis. Although laser excision is not a panacea for oral submucous fibrosis, it is a simple surgical procedure with effective results in the management of this disease. A more extensive study involving a greater number of cases and including more parameters is necessary to come to final conclusion about this surgical technique and to evaluate the efficacy of lasers in the surgical management of oral submucous fibrosis.

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