

# The Saviors: Appliances used for the Treatment of Trismus

## Abstract

The term trismus denotes a “motor disturbance of the trigeminal nerve, especially spasm of the masticatory muscles, with difficulty in opening the mouth.” Trismus is a condition that impairs eating, interferes with oral hygiene, restricts access for dental procedures, and may adversely affect speech and facial appearance. The success of treatment depends on recognition of the cause and initiation of appropriate management. Ideally trismus appliances are used in conjunction with physical therapy and are most effective when the condition is the result of muscle fibrosis or scar tissue that has not yet matured. This article describes the various appliances used in treatment of trismus which acts either externally or internally and the forces they impart can be continuous or intermittent, light or heavy and elastic or inelastic.

## Key Words

Trismus; internally activated trismus appliances; externally activated trismus appliances; therabite

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## INTRODUCTION

Trismus is an inability to open the mouth. According to Dorland's Illustrated Medical Dictionary 1 trismus (Greek Trimos: 'grating', 'grinding') is a motor disturbance of the trigeminal nerve, especially spasm of the masticatory muscles, with difficulty in opening the mouth, a characteristic early symptom of tetanus.<sup>[1]</sup> Trismus can result from pathosis in a variety of structures: the trigeminal nerve, one or both Temporomandibular joints (TMJs), the muscles of mastication, or fibrous adhesions of scar tissue between the maxilla and mandible or within areas of skin covering the maxilla, mandible, or neck<sup>[2,3]</sup> and various drugs.<sup>[4]</sup> Trismus may also manifest as a complication associated with systemic disorders such as scleroderma, tetanus and rheumatoid arthritis.<sup>[5]</sup> Localized pathologic conditions such as ankylosis or derangement of the TMJ,<sup>[6]</sup> infections,<sup>[7]</sup> neoplasm,<sup>[7,8]</sup> elongation of the coronoid<sup>[9]</sup> or styloid<sup>[10]</sup> processes, or presence of a foreign body,<sup>[11]</sup> conditions affecting the central nervous system and psychogenic causes may also be associated with trismus.<sup>[4]</sup> Trismus can occur subsequent to trauma or following the prolonged

and extreme stretching of the masticatory musculature during surgery or following a period of maxilla-mandibular fixation. It occurs subsequent to radiation therapy when the fields of radiation involve the muscles of mastication or the TMJs.<sup>[12]</sup>

The complications associated with trismus includes impairment of the ability to incise and masticate food, poor oral hygiene maintenance, restricts access for dental procedures, compromise or prevent the construction and use of removable dental prostheses or appliances and may adversely affect speech and facial appearance.<sup>[13]</sup> The main objectives of the various modalities used in treatment of trismus include the following- removal of edema, soften and stretch fibrous tissue, increase the range of joint motion, restore circulatory efficiency, increase muscular strength, and retain muscular dexterity.<sup>[14,15]</sup> Treatment for trismus should be directed at eliminating its cause. Diagnostic assessment should be made before any type of therapy is applied.<sup>[4]</sup> When the trismus is caused by muscle fibrosis or by immature scar tissue in the reparative healing phase (before maturation and the formation of dense scar tissue), physical therapy and a trismus appliance are

effective in combination. Heat, cold, electrotherapy, massage,<sup>[14,15]</sup> appropriate antibiotic /analgesics (if trismus associated with infection),<sup>[4]</sup> exercise<sup>[13]</sup> hyperbaric oxygen, pentoxifylline, botulinum toxin injection and surgical coronoidectomy can all be used.<sup>[16]</sup> This review article highlights the design features, potential indications and a clinical application of various appliances used in the treatment for jaw motion rehabilitation, and also helps the medical and dental practitioners in expanding their knowledge and attitude towards the treatment of patients reporting with trismus.

## DISCUSSION

Various types of appliances have been described in literature for treating trismus. Ideally, they are used in combination with the physical therapies mentioned above.<sup>[13]</sup> The rationale for the design of a device for jaw motion rehabilitation is that, ideally, in order to improve jaw function and range of motion, the following requirements should be satisfied; a) wide range of mouth opening; b) adjustable maximum force applied to the jaw; c) sustained and constant stretch at the desired range of motion; d) periodic repetition of the exercise at invariant conditions also in case of non-cooperating subjects or patients with reduced muscle force. In addition, a suitable device should be easily used by the patient him/herself for the entire exercise session without help from an external operator.<sup>[17]</sup>

### EXTERNALLY ACTIVATED APPLIANCES

Externally activated appliances impart forces that can be continuous or intermittent, light or heavy, and elastic or inelastic. Such appliances include the following:<sup>[13]</sup>

#### 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 handbulb 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.<sup>[18]</sup>

#### Dynamic Bite Opener

This appliance was described first by Drane<sup>[19]</sup> and later by Brown.<sup>[20]</sup> Most recently, Kouyoumdjati *et al.*,<sup>[5]</sup> have described a variation on its design. The appliance consists of combination of maxillary & mandibular stents, with steel metal rods extending through commissures of mouth to occlusal plane, the maxillary rod 10-15mm buccal to mandibular

one, till temporal region and then it bent downward & forward in a reverse u- shaped in molar region. 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 pt the rods are attached to buccal surface of denture.<sup>[18]</sup> 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.<sup>[13]</sup>

In the literature Jeckel *et al.*, described this appliance as a "Continuous-dynamic jaw extension apparatus", it consists of a contra-rotating extending screw attached to the maxillary and mandibular arches by two resilient stainless steel wire arms that are connected to acrylic resin splints. The apparatus distributes the forces generated by the screw over the entire dental arch covered by the splints. The force provided is continuous, bilateral, and elastic. Jeckel *et al.* 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. The authors stated that the pain reflex limiting the stretching of these elevator antagonists can best be overcome with repeated isotonic contractions at successively greater degrees of opening, and offer electromyographic evidence to support their rationale.<sup>[21]</sup> Construction of the appliance is somewhat more complex than that of the typical orthodontic retainer and requires some care in application.

#### Threaded, Tapered Screw

This appliance is constructed of acrylic resin, and is placed by the patient between the posterior teeth.<sup>[12]</sup> 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, although the force is not generally sustained for lengthy periods of time. The force imparted is not elastic, and its direction is limited by the mechanical pressure available between the posterior teeth. Use of this appliance is restricted to dentate or partially edentulous patients. Significant force can be generated, and anterior teeth in particular can become loosened if excessive force is applied.<sup>[13]</sup>

### 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. The device is made up of acrylonitrile-butadiene-styrene (ABS) resins and consists of two main bodies and bases, two rods, two bite-parts and bases, mouth pads, and a rubber band. The main bodies superpose at their convex surfaces and the bite-part is attached to the body base. A stainless steel rod (2 mm diameter) penetrates through the bite-part and body base, contributing to its flexibility. The base of the bite-part overlaps the body base and the two main bodies are held together with a rubber band. The bite-parts are fitted with mouth pads made of polyethylene foam sheets, which act as a buffer and counterbalance the mechanical stress and torque against teeth. The mechanism of the “shell-shaped mouth opener” 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. The leverage at the main bodies and bite-parts and the hinge movement at the main bodies act together adjusting the complex three-dimensional movements. The advantages includes the following: the combination of leverage and hinge movements of the “shell-shaped mouth opener” 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.<sup>[16]</sup>

### 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.*<sup>[22]</sup> 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. It is relatively complex to construct, and meticulous attention is required in the adjustment of the tension screw. Application is limited to dentate or partially edentulous patients.<sup>[22]</sup>

### 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. The number of tongue blades required can make application somewhat cumbersome. Used as a wedge, tongue blades are effective only in a dentate patient.<sup>[12,23,24]</sup>

### Fingers

Rouse, described the use the fingers by the patient to depress the mandible, stretch the musculature to the maximum, and then maintain the position for a slow count of ten. This exercise is repeated by the patient throughout the day. Although this approach allows complete control of the stretching schedule, the extent of opening depends on the patient's subjective perceptions. Little opportunity for objective feedback is available to the patient so that he or she might recognize progress.<sup>[25]</sup>

### TheraBite Jaw Motion Rehabilitation System

The Therabite system is a patient-operated device used for passive rehabilitation therapy of the TMJ. TheraBite® Jaw Motion Rehabilitation System™ (Atos Medical Inc., West Allis, WI, USA) have been used to treat the condition of mouth opening limitation.<sup>[26]</sup> The TheraBite® appliance has shown greater efficacy than any other treatments.<sup>[27]</sup> It is a useful appliance for patients with sustained trismus particularly for those having undergone treatments for head and neck cancers.<sup>[27,28]</sup> It consists of two mouthpieces and the attached plastic handles. The mouthpieces are inserted between teeth of the upper and lower jaws. The patient's mouth can be opened by pressing together the plastic handles that force the mouthpieces to separate.<sup>[29]</sup> The horse-shoe shaped surface which comes in contact with the teeth helps to spread the load across 10 anterior teeth at upper and lower jaw. This generates less force on the incisors.<sup>[30,31]</sup> The mouth opening is stretched for several seconds at a time. The process is repeated five to 10 times, several times a day.<sup>[32]</sup> As there is squeezing and releasing of the handles it helps to stretch the tissues intermittently.<sup>[30,31]</sup> This intermittent stretching is cyclic in nature. 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. Elastic stretching is reversible, and the tissue returns to the original length when the load is removed. Plastic stretching is irreversible, and the tissue does not return to its original length, even when the load is removed. Prolonged low load stretch results more of plastic

elongation of the connective tissue. 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.<sup>[33]</sup> The Therabite system is listed in the US Food and Drug Administration (FDA) Center for Devices and Radiological Health database as a Class I device without a requirement for approval through the Premarket Approval (PMA) or 510(k) process.<sup>[32]</sup>

### **INTERNALLY ACTIVATED APPLIANCES**

Internally activated appliances rely on the patient's depressor muscles (not on an external mechanical device) to stretch the elevator muscles, since the elevator muscles can generate forces that are ten times greater than those generated by the depressor muscles,<sup>[2]</sup> the mechanical advantage gained through use of the depressor muscles are somewhat limited. The amount of force delivered depends on the strength and motivation of the patient, as do the frequency and duration of stretching. The stretching must be accomplished through the patient's own efforts.<sup>[13]</sup> The advantages of the internally activated appliances include: its ease of application and the availability of feedback on progress.<sup>[13]</sup> The types of internally activated appliances described in the literature include the following;

#### **Tongue Blades**

A stack/group of tongue blades held together with adhesive tape is used for opening and extending the masticatory muscles. Here in this form the force delivered is imparted by the depressor muscles alone, and thus the tongue blades are not used as a wedge (as used in externally activated appliances).<sup>[24]</sup>

#### **Plastic Tapered Cylinder**

Its effect is similar to that of the taped stack of tongue blades, except that it is easier for the patient to apply. The wedge shape allows the patient to easily identify the maximal maxilla-mandibular distance on initial stretching, by noting which ring on the taper is reached when both the maxillary and mandibular teeth come into contact with the tapered cylinder. 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. The frequency and duration of stretching in the plastic tapered cylinder are controlled by the patient: the separate rings allow the patient to appreciate the progress made in increasing the

maxilla-mandibular opening.<sup>[21]</sup> The designing of an acrylic resin tapered cylinder is of approximately 10 mm at one end and 35 mm at the other end, with about twelve gradations of 2 mm each between the ends. The patient is instructed to use the appliance four times daily, for 10 to 15 minutes each use. The patient is directed;

1. To stretch to the point of discomfort, but not pain.
2. To place the appliance between the incisor teeth (or any anterior landmarks) until snug.
3. To measure the degree of opening achieved by noting which ring on the tapered cylinder is in contact with the teeth (eg, the fourth ring from the small end).
4. To hold for 20 seconds.
5. To withdraw and rest for 10 seconds.
6. To insert to the same degree of opening for 20 seconds.

This sequence is repeated for the duration of the 10- to 15-minute stretching session. The stretching force applied with this appliance is limited by the strength of the patient's depressor muscles. If adequate force cannot be generated by these muscles, then an externally activated appliance should be considered to apply force sufficient to depress the mandible.<sup>[21,13]</sup>

### **CONCLUSION**

Based on the researches presented in various reviews in the literature, it is clear that incorporating trismus rehabilitation into the dental and medical practice is of great importance and effectiveness. The treatment for trismus should primarily be directed toward its etiology and prompt diagnostic assessment should be made before any type of therapy is applied, in patients reporting with trismus to our clinical practice. An important complication associated with delay in treatment of trismus may lead to permanent impairment of function, thus prompt treatment is important in patients reporting with trismus. The treatment objectives are to remove whatever edema is present, soften and stretch fibrous tissue, increase the range of joint motion, restore circulatory efficiency, increase muscular strength, and retain muscular dexterity. Patient's motivation and compliance to the physical therapy delivered by the appliance plays a vital role in choice of appliance to be used for the treatment of trismus for a particular patient.

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