Individuals with totally nonfunctional upper extremities rely heavily on the use of mouthsticks and push-button devices to control their environment. The degree to which a standard mouthstick can be used is largely dependent upon the availability of at least fair to fair-plus strength in trunk or neck musculature, or both. The physical problem of operating push-button devices such as a small pocket calculator or TV remote control switch, as well as performing writing and typing tasks, becomes magnified when a standard static mouthstick cannot be used.

Persons with high-level quadriplegia such as C2-3 lesions are rendered almost nonfunctional in performance of physical tasks because of insufficient strength of neck musculature. The lack of neck movements greatly limits the ability to use even a static mouthstick (e.g., wooden dowel with rubber tip and a mouthpiece) to operate the simplest push-button devices. In response to this problem, an alternative to other forms of dynamic mouthsticks was devised to compensate for the lack of voluntary neck motions.

The dynamic protractible mouthstick is tongue activated, and its distal end, which holds a pencil, brush, or other implements, protracts approximately 2 to 2.5 cm (3/4 to 1 inch) when the button on the proximal mouth end is depressed by the tongue (Figure 1). The distal end retracts passively when the tongue button is released.

**Construction**

The dynamic protractible mouthstick uses angle aluminum stock (6063-T52 alloy) 19 x 19 x 1.6 mm (3/4 x 3/4 x 1/16 inches) for the framework because of its light weight and durability. The overall length will vary depending on the needs or age of the patient. After the basic shape (Figure 2) is cut, the mouthpiece end is flattened and spread slightly to match the patient's bite (Figure 3a). An impression may be obtained by having the patient bite down on a piece of cardboard. Next, the distal end is shaped to hold a short section of 8 mm (5/16 inch) inside diameter plastic tubing (Figure 3b). This rigid tubing serves as a guide for the pencil to move in and out.

The slide mechanism is constructed from 1.6 mm (1/16 inch) stainless steel rod. The length will vary according to the overall length of the mouthstick, but should permit 2 to 2.5 cm (3/4 to 1 inch) excursion. As an example, for a 42 mm (16/2 inches) length mouthstick, the length of the slide mechanism will be 35.5 mm (14 inches). A clamp (Figure 4a) is silver-soldered onto the distal end of the steel rod and a 6-32 nut is soldered onto the clamp for the cap screw that holds the pencil or other implements in place. Two aluminum bushings (Figure 4b), 6.4 mm (1/4 inch) long and 6.9 mm (1/4 inch) diameter with a #36 drill hole through the center, are slipped onto the rod. A button-shaped piece of metal is soldered to the proximal end for the tongue plunger (Figure 4c). A small piece of 1.6 mm (1/6 inch) rod is silver-soldered onto the main rod to serve as the distal attachment for the rubber band (Figure 4d). One of the bushings acts as a stop to limit the excursion from the pull of the rubber band.

The mouthstick parts are then sandblasted and coated with an in-
Industrial shellac. The plastic tubing is then glued in place on the distal end of the framework, and the slide mechanism is secured at the bushings either by Crazy® glue or with a 4-40 screw. If a screw is used, it must be short enough so as not to impinge on the slide rod. An additional screw is placed in the proximal end bushing to serve as the proximal attachment for the rubber band. The mouthpiece and tongue button are then coated with Plastasol® (hypoallergenic polyvinyl chloride with plastisizers).

Summary
The dynamic mouthstick, which was developed to serve as an alternative to the standard mouthstick, compensates in part for the lack of active neck motion for mouthstick operation. It has the following advantages:

1. Increases functional capabilities by enabling activities such as typing on electric typewriters, painting, writing, and the operation of push-button devices (e.g., calculator and electronic games).

2. Does not promote fatigue because it is lightweight. The average mountstick is 56 gm (2 ounces).

3. Unlike spring mechanisms on other forms of mouthsticks, the small rubber band, which provides the mouthstick's retractability, can be easily and inexpensively replaced.

4. The "Y" mouthpiece allows the patient to swallow saliva and talk while holding the mouthstick between the teeth.

5. The mouthpiece provides stability within the mouth and minimizes stress on the teeth and periodontium. For maximal distribution of pressure, a dental impression of the patient's teeth may be taken and incorporated into the "Y" mouthpiece.

To date, the mouthstick has been successfully used with four pediatric patients, ranging in age from 4 to 18 years, with high cervical cord lesions. Its effective use with this patient population may be generalized to other diagnoses when upper extremity function or use of other forms of equipment is not possible.

Note: Materials needed to construct the mouthstick (angle aluminum, rigid plastic tubing, clamp, aluminum bushing, Plastasol) are generally available from most hardware stores.

The clamp was especially machined in our Orthotics Department but a purchased small hose clamp can also be used.

More detailed instructions are available from the Orthotics Department at Rancho Los Amigos Hospital.

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