

A highly versatile bicycle spoke appliance for habilitation of the quadriplegic patient

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Introduction

Quadriplegic patients rely on mouth-controlled devices to perform a variety of tasks and enhance their intellectual well-being. The mouthpiece or mouthstick allows these patients to express their artistic abilities, communicate with written words, utilize a computer keyboard, and perform functions which would otherwise seem impossible.^{1, 2} A variety of mouthstick designs are available; however, no single design can be used for every function.^{3, 4}

The mouthstick appliance described in this paper was fabricated for a 7-year-old quadriplegic male with paralytic scoliosis, including weakness of the right neck and facial muscles. The appliance was constructed in coordination with the child's occupational therapist, who was dissatisfied with those presently available. This appliance has enhanced the child's ability to communicate, learn, and better enjoy the pleasures of childhood.

Mouthstick Construction

Following initial oral examination, alginate impressions and an occlusal wax record were obtained and the models mounted in centric relation on an articulator. The screw portion of a stainless steel bicycle spoke (Wheelsmith Fabrications, Inc., Menlow Park, CA) was placed on the cast perpendicular to and directly behind the maxillary central incisors. Next, a maxillary bite plate with a uniform thickness of approximately 2 mm was fabricated in occlusion with the mandibular model

using orthodontic cold cure acrylic.^{5, 6} The spoke screw was embedded in the resin with the screw entry hole left exposed to allow attachment of the spoke. The acrylic covered the occlusal surfaces of the teeth, and the palate, and ended at the junction of the hard and soft palate. To enable additional retention, the acrylic engaged the buccal height of contour of the teeth. The appliance was equilibrated and then polished. A Klick pencil holder (Fred Sammons, Inc., Brookfield, IL) was soldered to the bicycle spoke end. A pencil, brush, stylus or any other desired device now could be secured firmly in the holder's spring-loaded rollers (Figs 1a and 1b).

Discussion

This appliance was simple to construct, economical, adaptable, and readily acceptable to a quadriplegic patient. The mouthpiece is lightweight, durable, stable in the oral environment, and easily and quickly inserted with minimal modification. It proved to be comfortable for the patient and has required very little training. Initially, the patient was only able to tolerate the appliance for several minutes before tiring; now he uses it for hours at a time. In only two weeks, he was able to begin using watercolors with a brush, punch a computer keyboard, and dial a telephone (Fig 2, next page). A special drawing table has been constructed for this patient; it can be moved up and down with his mouthpiece. This appliance has provided him with a more

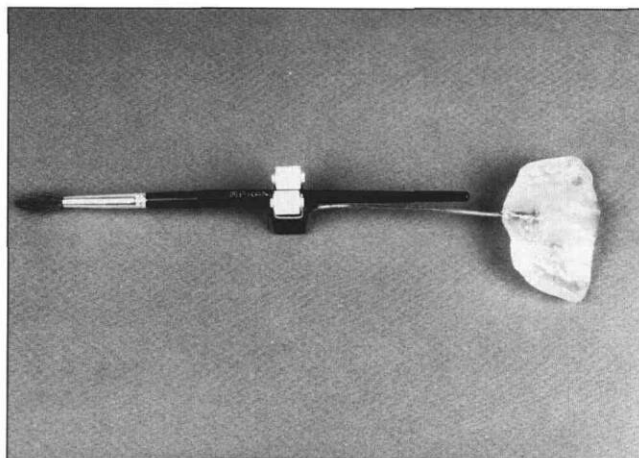


Fig 1a. The mouthpiece incorporates a versatile bicycle spoke and commercially manufactured holder.

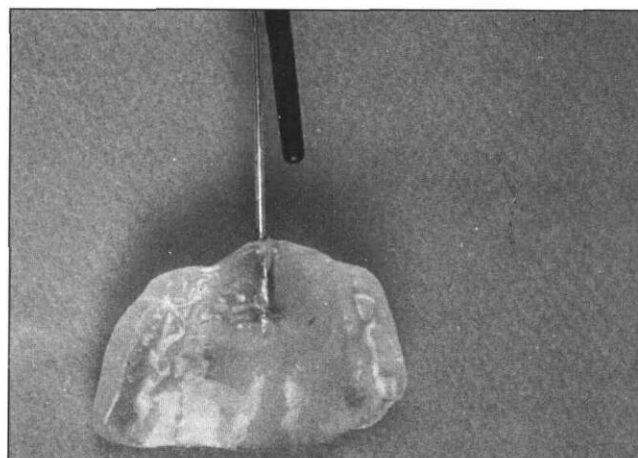


Fig 1b. This is a magnification showing the screw-to-bite plane orientation.

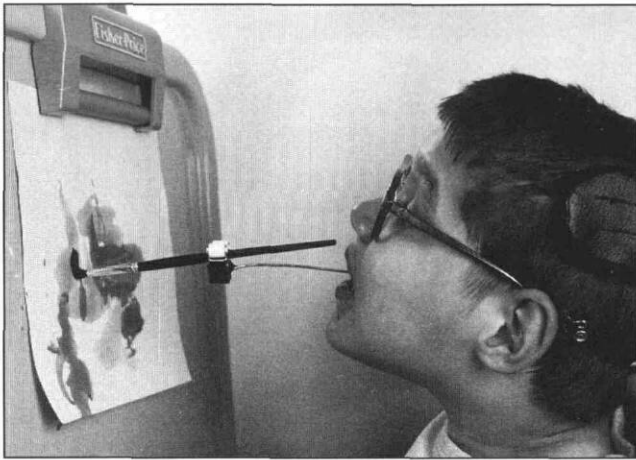


Fig 2. The young boy is expressing his artistic talents with watercolors. Note the bicycle spoke connecting the mouthpiece to the brush holder.

positive attitude, boosted his morale, and increased his motivation by opening a whole new world of activities.

An individual may not accept the appliance, so it is advisable to construct a trial mouthpiece.⁷ To test this patient's tolerance, a vacuum-formed soft mouthguard initially was fabricated. According to Hemley,⁸ the deposition of vertical alveolar bone may be disrupted by abnormal pressures when permanent teeth erupt. If a patient has a mixed dentition, the appliance design should allow for this normal bone development.⁵ In this mouthpiece, anterior teeth were left uncovered, and the area immediately above the occlusal surfaces of the six-year molars was relieved to allow for their continued eruption and normal bone growth. The mouthpiece would function best with the anterior and posterior teeth fully covered, incorporating the buccal surfaces, but in this case the anterior teeth were not included, and the appliance proved stable. These modifications should enhance the fit of the appliance and decrease the need for future adjustments and fabrications.^{5, 9} Following complete eruption of the anterior teeth, a new appliance including coverage of these teeth should be constructed to prevent their overeruption. One also must anticipate remaking the appliance between ages 10 and 12 to accommodate the remaining permanent teeth. Continued use of this appliance is needed to decide if these modifications are justified, and to determine the effects on occlusion.

Fourteen principles outlined by Blaine and Nelson⁵ for the design of mouth-controlled appliances are summarized below.

1. The mouthpiece should be free of interference and not exert pressure upon erupting teeth.
2. The mouthpiece should contact all fully erupted teeth.

3. The prosthesis should be stabilized by the opposing dentition.
4. Biting forces should be distributed to as many teeth as possible.
5. The prosthesis should not act as an orthodontic appliance.
6. The appliance should be retained lightly in the mouth.
7. The appliance should utilize wide occlusal coverage to give lateral stability.
8. Patients should be able to insert, remove, and replace the prosthesis by themselves.
9. The materials used should be sanitary, easily cleaned and not disagreeable in taste, odor, color, or texture.
10. The prosthesis should be reasonably inexpensive and easily fabricated.
11. The prosthesis should be sturdy and unbreakable in normal usage.
12. The mouthpiece should be easily adaptable to accommodate various attachments.
13. The attachments should be out of the patient's line of vision.
14. Patients should be able to talk, swallow, and wet their lips while the mouthpiece is in place.

This mouthpiece has satisfied all of these principles except No. 8. It would not be difficult to construct a docking station incorporated into the movable table, enabling the patient to insert and remove the mouthpiece and desired tips independently. Several docking stations which can be customized easily for use with this appliance are available through a health care catalog (Fred Sammons, Inc., Box 32, Brookfield, IL 60513-0032).

The incorporation of a bicycle spoke makes this appliance unique. Individual spokes are easily inserted into and removed from the embedded screw and can be modified through shortening or bending to the desired length and angle. The attached holder further enhances the appliance's versatility. This patient continually expresses excitement about and appreciation for the availability of his new appliance. Using this special mouthpiece, the patient has every chance to better develop and enhance his own cognitive skills, resulting in a more productive and fulfilling life.

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