Magnetic Splint for Object Retrieval

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A quadriplegic patient with C-4 (incomplete) and C-5 (complete or incomplete) injury often can learn to be independent in many activities of daily living with the use of a universal cuff. However, the independence is often limited because the patient cannot retrieve objects and manipulate them into the universal cuff. The following is a description of an adaptive device designed to aid the patient in picking up commonly used objects (for example, eating utensils, typing stick, pencil, and toothbrush).

The device, or magnetic splint, compensates for the patient's lack of ability to grasp. In general, the splint is appropriate for patients with spinal cord injuries who cannot pick up objects due to a lack of efficient tenodesis action and who are not using an assistive splint. The motions necessary to use the device include fair shoulder abduction, poor-to-fair shoulder flexion, poor-to-fair external rotation, fair elbow flexion, and poor-to-fair supination. These motions may be assisted by a mobile arm support or overhead slinging, if needed. Requirements for passive range of motion are humeral abduction and flexion 0 to 90°, humeral rotation 0 to 80° internal and 0 to 30° external, elbow flexion/extension 0 to 140°, and pronation 0 to 90° (1). Lateral trunk stability is essential and may be provided by the use of lateral supports if the patient does not have innervated trunk musculature. In addition, limited endurance for a prolonged upper extremity task is important.

Contraindications for use include moderate-to-severe upper extremity spasticity and ataxia. For patients with C-5 incomplete and C-6 complete or incomplete injury, the device may be used as a training tool or as an intermediate device for those who are anticipating tendon transfers or the fitting of external flexor hinge splints. The effective use of utensils in a universal cuff is a prerequisite for training with this device. Utensils may need to be bent to compensate for the patient's inability to pronate or supinate (or both).

The device was originally developed for a 20-year-old quadriplegic patient who had a C-4/5 injury. The patient had function of C-4 on the right and C-5 on the left, and could not use bilateral motions to retrieve objects, there-
fore eliminating the possibility of using a ratchet splint. By using an overhead sling and a magnetic splint, the patient became independent in retrieving commonly used objects that could be inserted into the universal cuff. Subsequently, the device has been used successfully with two patients; both had C-5 injuries.

**Materials/Construction**
The device consists of a magnet attached to a wrist support fastened to a universal cuff (see Figure 1). A horseshoe magnet of sufficient strength (2-lb or 0.9-kg pull) is needed. Such a magnet can be purchased at a hardware store. The magnet is enclosed in thermoplastic material and attached to the splint by rivets. Trial and error is necessary to ensure the effective placement of the magnet.

The commonly used objects to be retrieved are each fitted with a metal piece (see Figure 2). The metal piece is a 3/4-inch (1.9-cm) square that is attached to the object in such a way that it does not interfere with the insertion of the object into the universal cuff. For efficient retrieval, the metal piece should be flat. The metal square should be placed at a point approximately 2/3 the length of the object. The metal square is attached by molding a small strip of metal around the object and soldering it to the square. If soldering equipment is not available, the metal square may be riveted to an adhesive-backed, pile Velcro strip, and then attached to the object.

The objects are placed in a holder with compartments designed to position the objects vertically. Each compartment is fabricated from Plexiglas tubing of 3/4-inch (1.9-cm) diameter, which

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**Figure 2**
Objects with metal squares placed in individual compartments of holder

**Figure 3**
Suggested dimensions for alternate holder construction
is cut into 3-inch (7.6-cm) lengths and attached to a 4 1/4 × 8 1/4 × 3/4-inch (10.8 × 21 × 1.9-cm) Plexiglas base (see Figure 2). The base keeps the patient from tipping the holder when either retrieving or replacing the object.

Other possibilities for the holder include fabrication from 1/4-inch (0.6-cm) plywood, as shown in Figure 3, the use of Plexiglas pencil holders (similar to those in desk sets), a plywood block in which holes of 3/4-inch (1.9-cm) diameter are drilled, and thermoplastic material that can be molded into a cylindrical form similar to that of the Plexiglas model.

The holder is placed on the lapboard or an accessible table so that the patient can touch the object with the magnet. The patient then brings the object to his or her mouth and manipulates it into the universal cuff. Conversely, when wishing to remove the object, the patient uses his or her teeth to pull the object from the universal cuff, touches the object with the magnet, and returns it to the holder (see Figure 4).

Summary

The magnetic splint and complementary adapted objects allow patients with high-level spinal cord injuries independence in retrieving commonly used objects. This device has proved effective for patients with high-level spinal cord injuries who are not presently using an assistive splint and who are capable of bringing the hand to the mouth, often with the assistance of a mobile arm support or overhead sling.

REFERENCES