Adapted Knife for Partial Hand-Amputation Patients

(hand, self-care, equipment)

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Independent living skills were impaired in a 26-year-old woman who suffered extensive right, dominant hand burns, resulting in the amputation of the right index finger at the proximal interphalangeal (PIP) joint, and the middle, ring, and little fingers at the metacarpal phalangeal (MCP) joints. A small portion of the right thumb tip had also been removed. The left hand is normal.

At the time of her referral, 7 months post-injury, her plastic surgical procedures were nearly completed, and she had been seen regularly by other therapists in regard to increasing the functional motions of her thumb, wrist, and palmar areas. The index MCP was permanently pinned in full extension. Active range of motion of the thumb was limited in adduction to 1 centimeter from the base of the index finger. Opposition movements were stronger between thumb and the base of the ring finger, but also lacked 1.3 centimeters of touching. The entire palmar surface had been grafted and had a lack of sensation, except to deep pressure.

Because sensation to tactile stimulation was increasing and strength was improving, increased functional use of the injured hand was stressed. She had learned to use nondominant (left-handed) techniques for self-care, homemaking, and leisure skills, but she complained that chopping food during meal preparation was still difficult. She felt uncoordinated when using her left hand to maneuver the knife.

A knife and cutting board device was specifically designed so that she was able to maneuver the knife with her right dominant hand despite her diminished ability to grip. The use of the knife requires pushing down with the right palm on the handle of the knife using the principles of a paper cutter, with the additional feature of freeing the knife to pivot for chopping food across the full width of the chopping board.

Construction
Materials. We used the following materials: Eastern maple lumber, 3 pieces 1 x 16 x 18 inches (2.5 cm x 40.6 cm x 45.7 cm); 10-inch French knife (selected for its lightweight, rust-free, and edge-retention qualities, and because of the rocking motion required for chopping); 1½ inch (3 cm) aluminum cotter pin (selected because of its rust-free, ease of care qualities); 2½-inch (5.5 cm) aluminum piston (bolt); and waterproof glue.

Procedure. Cut lumber into 15 strips, each 1½ inch (3.75 cm). laminate strips together with glue to make a 14 x 18 inch (35 x 45 cm) cutting board. Sand thoroughly. Saturate with mineral oil or a good grade commercial salad oil. Suction cups can be added to the bottom if more stability is needed. A commercially made cutting block can be...
purchased in the size specified (and is cheaper) if construction facilities are not available. We preferred a laminated board because warping is reduced by laminating, and the useful life of this device is thereby extended.

Drill a 3/4 inch hole through the top of the board 2 inches (5 cm) from the top edge and centered (Figure A). Countersink hole from bottom side 1 inch (2.5 cm) in size by 3/8 inch (.75 cm) deep (Figure B).

A piston (bolt) is made from 1-inch (2.5 cm) round aluminum stock. Shaft is 11/16 inch (1.7 cm) and the flange at the bottom is 15/16 inch (2.3 cm) round by 1/8 inch (.6 cm). A commercial carriage bolt that fits these dimensions can also be used. It is important to use an aluminum or metal bolt as opposed to plastic, because the weight helps to counterbalance the knife and therefore allows lifting the handle off the board so that downward pressure from the palm is what is mostly required to accomplish chopping. The bolt freely rotates in the board so the attached knife can move across the board in a 120-degree arc for better food placement, and greater ease in chopping.

When greater force is needed to raise the handle of the knife, a valve spring is fitted around the piston above the flange and assembled in place within the countersunk area of the board.

The hole to receive the cotter pin is drilled ¼ inch (.6 cm) down from the top of the bolt. A slot is cut in the top of the bolt to receive the knife (1 inch deep) (2.5 cm) (Figure C).

A hole is drilled in the top of the knife blade to match the hole in the piston. Mark and start the hole with a center punch; then use a high speed drill to complete it. The hole must be large enough to accept a cotter pin to hold the knife in place on the bolt. It may be necessary to heat the tip of the knife in order to drill a hole in it. Insert the knife in the slot on the bolt and fasten with a cotter pin. A lightweight copper, aluminum, or plastic, flat, 1-inch (2.5 cm) wide collar is cut out and placed loose around the exposed portion of the bolt and positioned on the board. This protects the board surface near the bolt from being gouged by the knife point (Figure D).

If the board is adapted with suction cups on the bottom, when the cotter pin is removed the bolt base will fall to the level of the table top or counter. The bolt top will then be flush or below the level of the board's chopping surface, making reassembly difficult. To prevent this problem, screw a lightweight aluminum, wood, or plastic, flat 1/4-inch (6.3 cm) square guard to the underside of the board, equally spaced to cover the bolt that is in place in the countersunk hole. This will ensure that the bolt top with knife slot and cotter pin hole will always remain above the level of the chopping surface for ease of assembly (Figure E).

By removing the cotter pin, the knife and board comes apart to be cleaned separately. This also frees the knife for sharpening or for other uses. (The patient could remove the pin without difficulty.) (Figures D, E, and F provide assembly instructions.)

In the event that the person using the board has the use of only one hand, aluminum nails (spikes, used and skewers) could be driven into the board to hold food for chopping. Also, the board and knife can be used separately for slicing simply by releasing the knife from the bolt. Separating the knife and board also facilitates cleaning and sharpening.

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