Finger Extension Game

(equipment, therapeutic; exercise therapy, fingers)

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The finger extension game was designed in response to a learning exercise by two students on preclinical assignment. It is an activity designed to facilitate the rehabilitation process of the finger extensors on a subcortical level. Occupational therapy literature emphasizes exercise techniques rather than incorporating activities with exercise. This game allows the occupational therapist to provide activities that direct the patient's concentration away from the exercise itself. This article includes a description and a detailed plan for constructing the finger extension game.

Finger extension, although not designed for power, is essential for the functioning of the hand (1). The extensors allow the hand to perform its primary functions, grasp and release, by opening the fingers (2). This motion is especially affected by certain diseases such as stroke, radial nerve injury, and spinal cord injury. A finger extension game was designed to promote finger extension with resistance. This purpose adheres to the philosophy of occupational therapy to provide activity-oriented treatment rather than pure exercise as treatment.

Review of Literature

In a preclinical assignment at Holy Cross Hospital in Chicago, we were challenged to design an innovative activity for the rehabilitation of finger extension. We reviewed occupational therapy literature to learn of activities, games, or other devices that have been reported to improve function in finger extension.

Hand therapy through games provides the patient with an incentive to participate in the treatment by rousing interest and fostering a competitive spirit (3). Occupational therapy descriptions of treatment activities for finger extension emphasize exercise with finger pulleys, weights, and rubber bands (4–6). Other exercise devices include finger extension boards, which offer resistive exercises to all hand motions (7, 8).

Trombly (9) recommends that therapists use published electromyographic (EMG) studies to assist in activity selection and analysis. We reviewed EMG studies to learn more precisely the function of muscles during finger extension. An EMG study with normal subjects showed that the extensor digitorum was most recruited when lifting Velcro checkers and using theraplast extension (10, 11). This study supports using resistive exercise rather than unresisted exercises. Another EMG study showed that the extensor digitorum was recruited significantly more frequently during rapid finger extension (i.e., flicking a Ping-Pong ball) than during unresisted exercise (11). A third study with post-cerebral vascular accident (CVA) subjects also supported the use of rapid extension for the recruitment of the extensor digitorum (12).

The studies cited used simple exercises instead of purposeful activ-
ity as a treatment modality for finger extension. Activities described in the literature were making pottery (using a press mold) (13), flicking marbles into cups (1), and releasing a frisbee (14). Other activities we observed in clinical practice included releasing cones, using a rolling pin, and weaving Turkish knots (i.e., pushing up knots).

Historically, occupational therapy has used games and craft activity to improve function. Exercise usually has been a physical therapy modality. According to research (9, 15, 16), activity allows the patient to organize movement subcortically, which exercise does not. This need may be especially important for patients with brain damage who have some motor planning deficits or for those relearning to use tendon transplants (9).

The EMG studies reviewed show that the extensor digitorum, the dorsal interossei, and the lumbricals are the muscles most recruited during extension when the fingers are positioned in metacarpophalangeal (MP), proximal interphalangeal (PIP) and distal interphalangeal (DIP) flexion or extension (11, 17–20). Based on studies we referred to, the finger extension game we developed positions the fingers to recruit the desired muscle movement.

In line with current precepts that activity should be based on research evidence of the function being used, the literature on EMG was used as a basis for developing the finger extension game (9).

**Description**

The finger extension game is shown in Figure 1. The game consists of a wooden base with borders on all sides and an adjustable handrest with Velcro straps. A wooden backboard with four slots can be adjusted to three different distances as stated in the section on construction. Six Ping-Pong balls (weighted with fish weights) ranging from no resistance to 0.225 kg (½ lb) are used for resistive finger extension.

Functional Description

Figure 2 shows the hand positioned to emphasize MP extension. The hand can also be positioned to emphasize PIP and DIP extension (see Figures 3 and 4). The hand is held securely on the handrest by the straps. A movable block under the handrest allows for ten different heights. The height is adjusted to allow the relaxed fingers a 1.25 cm (½ in.) clearance from the base.
Figure 3
Hand position emphasizing PIP extension

Figure 4
Hand position emphasizing DIP extension

Figure 5
Target scores for finger extension game

The thumb is allowed free range by the cutouts provided on the handrest. A ball is placed in one of the three dimples in front of the relaxed fingers. The backboard is positioned at one of the three distances most appropriate to the patient's strength. At this point, the patient is prepared to flick the ball to one of the four targets using finger extension. A scoring system is used for the game. A number is assigned to each target, which enables the patient to accumulate points for a total score. Numbers increase when the distance of the backboard is further from the patient's fingers. The patient can compete individually or against others. The board with the scoring for each target is shown in Figure 5.

Construction

Construction materials comprise the following:

1) lumber cut 1.875 cm (¾ in.) thick:
   one baseboard—80 cm (32 in.) × 37 cm (14½ in.)
   one mobile block—10.62 cm (4⅓ in.) × 4.12 cm (1½ in.)
   one handrest—13.75 cm (5½ in.) × 22.5 cm (9 in.)

2) lumber cut 0.635 cm (¼ in.) thick:
   five borders—two 60 cm (24 in.) × 6.25 cm (2½ in.); two 11.25 cm (4½ in.) × 6.25 cm (2½ in.); and one 38 cm (15 in.) × 6.25 cm (2½ in.)
   backboard—one back 36.25 cm (14½ in.) × 5 cm (2 in.); and three dividers 6.25 cm (2½ in.) × 5 cm (2 in.)
Other materials needed are a hinge 8.75 cm (3½ in.) with screws, nails, foam rubber, vinyl material, 2.5 cm (1 in.) bolt with 1.58 cm (½ in.) head, and loop and hook Velcro.

Figure 6a shows the dimensions for cutting the baseboard and the locations for drilling three dimples (to hold ball) into the baseboard, six holes through the baseboard, and ten holes in the handrest portion of the baseboard.

The proper border sections are fastened to the baseboard using 2.5 cm (1 in.) nails as shown in Figures 6a and 6b.

To make the backboard, the dividers are nailed at the locations shown in Figure 7 onto the back piece using 1.25 cm (½ in.) nails. Two 2.5 cm (1 in.) finishing nails are nailed on the bottom of the backboard to fit the two holes drilled on the baseboard.

* See text for metric conversions.
A 0.48 cm (3/16-in.) hole is drilled through the center of the mobile block to fit the 1.58 cm (5/8-in.) bolt head and is countersunk (see Figure 8).

The handrest is cut as shown in Figure 9 and is sanded smooth. The vinyl material (27.5 cm × 20 cm or 11 in. × 8 in.) is placed over the foam rubber (22.5 cm × 12.5 cm × 1.25 cm or 9 in. × 5 in. × 1/2 in.) and stapled to the bottom of the handrest. Two 12.5 cm (5-in.) hook Velcro straps and 32.5 cm or 17 in. are secured with staples onto the bottom of the handrest.

After sanding all rough edges and varnishing all parts of the assembly, a hinge is screwed onto the baseboard as shown in Figure 10.

**Conclusion**

Based on findings in occupational therapy literature, this game provides the occupational therapist with an activity to promote finger extension. No controlled data have been gathered, but since the game was designed in 1983, it has been used at Holy Cross Hospital, University of Illinois Hospital, and Johnson R. Bowman Center for the Elderly, all in Chicago. Responses have been favorable.

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**REFERENCES**