CASE REPORT

Rehabilitation of the Hand After an Explosion Injury

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Key Words: hand injuries • rehabilitation, hand

This paper describes the treatment of a young man whose hand had been damaged by an explosion injury. Explosion injuries involve multiple structures and require a team effort by the surgeon, therapist, and patient. Occupational therapy consisted of functional therapy, working splints, activities of daily living, and psychological support (Braun, 1982; Hopkins & Smith, 1971).

History

A 17-year-old boy was brought to the emergency room after a chemical mixture he had prepared exploded in his left nondominant hand. The injury resulted in traumatic amputations of the second and third ray to the metacarpal bases, dislocation of the fourth and fifth metacarpals, midshaft fracture of the fourth metacarpal, fracture of the first metacarpal, and dislocation of the carpometacarpal joint (see Figure 1). Sensation was intact and the vascular supply to the remaining digits was adequate. Surgical management included debridement, removal of the residue of the second and third metacarpals, and reduction of fracture dislocation of the first and fourth metacarpals with internal fixation with the use of metal pins.

Approximation of skin and almost complete closure was achieved, with the exception of two areas that measured 2 cm in length on the base of the first and fourth finger. Here two split thickness skin grafts taken from the flexor aspect of the forearm were applied. A plaster splint was applied to keep the hand in a functional position and to prevent motion of the graft. Nitrofurazone gauze dressings were changed daily. No sign of infection was detected, and wound healing proceeded uneventfully.

Occupational Therapy

Occupational therapy was begun immediately after the operation. Treatment consisted of the use of six dynamic splints designed to exercise each individual joint and to affect muscle function. Static night splints were applied to retain range of motion achieved with the working splints. Adaptive equipment for use in activities of daily living was made. Treatment also included frequent evaluations.

The aim of the occupational therapy program was to restore full motion of each joint involved, to provide full opposition of the thumb to the fourth and fifth finger, and to incorporate all these movements into purposeful activities, such as activities of daily living. Another aim was to help the patient adjust both physically and psychologically to what remained of his hand.

The Splinting Program

Two weeks after the operation, the initial cast was removed and a static wrist extension with removable thumb abduction component was made from thermoplastic ma-
material (see Figure 2). The removable component could be adjusted without disturbing the rest of the splint as abduction increased. As wrist movement was regained after 2 weeks of therapy (4 weeks after surgery) and the fractures healed, a smaller static splint for thumb opposition was made from thermoplastic material. The patient wore this resting splint when he was not active. A dynamic thumb splint provided passive thumb extension, and a dynamic wrist flexion splint provided full range of motion (both were constructed from thermoplastic material). The patient was given a written program for the use of the three splints.

A week later (5 weeks after surgery), as the thumb movement progressed to full range, another dynamic thumb splint was made of thermoplastic material to provide both passive extension and dynamic flexion of the distal phalanx (see Figure 3). Again, careful attention was given to positioning of the thumb in maximum opposition to the fourth finger. When full range was gained in this joint, another dynamic splint was made to provide both passive flexion and dynamic extension to the distal phalanx of the thumb (see Figure 4). Six weeks after injury, each joint gained maximum range and mobility, and the splints were discontinued in favor of active therapy. A daily exercise regimen was used. For example, four times daily, 10 active movements of flexion and extension of the joints with the splint on were performed, and more repetitions were added as progress was made.

At this point, the patient’s scar showed signs of hypertrophy. Therefore, a pressure glove was applied. The thumb web space was widened during 6 months of glove wear. (The pressure glove was preferred because the patient could function better with the glove than with bulky splints and conformers.)

The Activities of Daily Living Program
During meals, the thumb component on the splint shown in Figure 2 was removed, and the patient was provided with a sponge-padded fork to compensate for the reduced ability of the remaining finger flexors to grasp a fork (the European way of eating food is to hold the fork with the nondominant hand). However, the patient avoided the use of his injured nondominant hand and
depended only on his uninjured hand. Attention was given to reeducate the patient in bilateral activities, such as tying shoe laces or riding a bicycle with a padded left handle bar. Buttoning was initially difficult, but as range of motion increased, the patient was able to handle all activities of daily living, including buttoning.

**Functional Treatment**

The patient worked on an adaptive weaving loom to strengthen his wrist flexors and extensors and his grip. Several games were also used to increase range of motion and to strengthen the finger muscles (Van-Straten, 1986). Tightening nuts and bolts, opening spring clothespins with varying degrees of resistance, exercising with thermoplastic putty, and using water-filled eyedroppers were some of the activities used to achieve full range of motion. Magnetic darts, ball throwing, and two-handed games were used to integrate all movements of the upper extremities, thus preventing shoulder-hand syndrome and maintaining range of motion of the uninjured joints.

**Psychological Support**

It is common with hand injuries for the patient to have difficulty accepting the physical and functional changes, especially if he or she is an adolescent. A considerable effort was made to help the patient adapt to his injury and to show him that he would be able to perform daily activities. His high intelligence, ability to verbalize his feelings, and confidence in his treatment all helped him adjust to his disability.

**Final Evaluation**

Five months postinjury, full flexion and opposition were achieved (see Figure 5), and a functional evaluation (see Table 1) indicated that the patient was able to function...
Figure 5. End of treatment, at which time full flexion of the remaining digits was achieved.

completely with his left hand (thumb, fourth, and fifth fingers). Reconstructive surgery and adaptive equipment were not necessary although a small area of the volar aspect of the thumb remained without sensation. The patient was independent in all activities of daily living and was painfree.

Table 1
Patient's Functional Evaluation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
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<tbody>
<tr>
<td>Light pinch</td>
<td>Able to pick up a piece of paper from the table, turn the pages of a book, and pick up small nails.</td>
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<tr>
<td>Heavy pinch</td>
<td>Able to tear paper and light a match.</td>
</tr>
<tr>
<td>Lateral pinch</td>
<td>Able to turn a key in order to open a door.</td>
</tr>
<tr>
<td>Tripod pinch</td>
<td>Has difficulty with any object.</td>
</tr>
<tr>
<td>Heavy grip</td>
<td>Able to pick up 2 kg.</td>
</tr>
<tr>
<td>Precision pinch</td>
<td>Able to hold a pencil, hold a cube measuring 1 square inch, and open a clothespin.</td>
</tr>
<tr>
<td>Power pinch</td>
<td>Able to pinch thermoplastic putty and pull string through jar with no problem.</td>
</tr>
<tr>
<td>Stereognosis</td>
<td>Able to identify the following objects with no difficulty: cotton, key, screw, glove, coin, and cube.</td>
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References


Editor's Note. To continue the Case Report department, we need and welcome reports that document the practice of occupational therapy for specific clinical situations. Guidelines for writing case reports are available from the Editor.