

# Managing Complex Hand Injuries



ILLUSTRATION BY LISA WITTER

**BY MARK C. KOMOROSKI, MD,  
DEBBIE RIEVERT, OTR, AND  
MARY MOSHER, OTR**

Tom was enjoying time in his wood cutting shop. As is typical with most people who sustain injuries from a table saw, Tom had more than 20 years' experience with his hobby. Despite knowing the potential hazards of using a saw, he had removed the safety guards. While he pushed the board through the saw, his right hand came into contact with the turning blade. He felt a slight burning, but was unaware that his fingers were lacerated until he tried to feed the next board into the saw.

Tom was brought to Bay Medical Center in Bay City, Mich. As with many traumatic hand injuries, he had multiple sites and structures

that required the services of an experienced hand surgeon.

Following the surgery, the physician contacted the occupational therapist and provided details of the surgery. The repair included an amputation, joint fusion with pinning, flexor tendon repair, and repair to other neurovascular, skeletal and soft tissue structures. Hand rehabilitation was scheduled the following day.

Treating complex hand injuries such as Tom's may require modifying established protocols or procedures. Priorities are identified based on the type and method of surgical repair. Hand therapists must be familiar with the anatomy and physiology of various structures and their mechanisms of healing. To develop a comprehensive treatment plan, they also must identify and analyze problems.

The hand therapy program at Bay Medical Center uses an interdisciplinary team that includes the patient and family, an occupational therapist, a physical therapist, a physician and a case manager. Meeting weekly, the team plans comprehensive treatment and identifies potential problems early. Using this approach, communication among all members increases.

#### **Flexor Tendon Repair**

Hand lacerations may be superficial and require only a simple skin suture. But rehab is more difficult when hand lacerations involve extensor or flexor tendons, as they did with Tom. Immobilization following tendon repair remains the treatment of choice for children under the age of 10 or for patients who can't participate in the complexity of a rehabilitation program. A patient also may need a prolonged immobilization ▶

phase to protect other injured structures.

Numerous documented techniques exist for flexor tendon management, one of which is early passive mobilization, which requires a motivated patient who can follow the therapy regimen. Over the years, early passive mobilization protocols have been developed. In general, they are divided into three

stages: early stage (0 to 3 to 4.5 weeks), intermediate stage (3 to 7.5 to 8 weeks) and late stage (7.5 to 8 to 12 weeks).

**Early Stage:** During this "protective period," the patient is placed in a dorsal forearm-based postoperative splint that holds the wrist in 10 to 30 degrees flexion, the MP joints in 40 to 60 degrees flexion and the IP joints in full extension. Protected passive range of motion into flexion and extension and protected active exten-



PHOTO BY KATHLEEN THEILER/BAY MEDICAL EDUCATION

*A patient with a crush injury works in the clinic with equipment to enhance gripping and pulling abilities.*

sion is initiated during this phase. Therapeutic goals during this phase include edema reduction, splinting, protected range of motion and wound care. Therapists also provide a home program and review it frequently with the patient and family.

**Intermediate Stage:** During this stage, stress to the tendon is increased. At three to four weeks, the splint is modified or replaced with a wrist band. Active extension exercises within the

## FACTORS TO CONSIDER IN HEALING OF SPECIFIC TISSUES

### SKIN AND SUPERFICIAL SOFT TISSUE

- What closure/coverage has been used?
- How much protection does it need?
- Is healing expected by primary or secondary intention?
- What dressing is appropriate?
- Are there signs of any complications in wound healing, such as infection and contamination?
- Can problems be expected with wound contraction and secondary joint contracture, or with adhesions?

### BLOOD VESSELS

- Which vessels were repaired?
- Does immobilization for other injuries adequately protect repaired blood vessels?
- Is there a danger of arterial or venous insufficiency?

### NERVES

- Which nerves were injured? Are there any nerve grafts?
- Were nerves repaired under tension?
- How much immobilization will be needed?
- Sensory nerves: Is there total loss of sensibility? What areas will need protection because of impaired sensibility? What will be the functional effects? Is there a need for desensitization/sensory re-education?
- Motor nerves: What muscle imbalance can be expected, and will splinting be needed to improve function and prevent deformity?

### MUSCLE AND TENDON

- Which tendons were injured? What repair was performed?
- Were both flexors and extensors injured? If so, how can each be protected and mobilized without endangering other injured structures?
- Can heavy scar formation be expected?

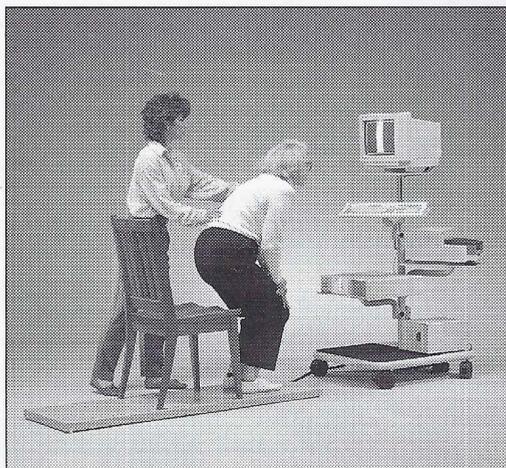
### BONE AND ARTICULAR STRUCTURES

- What structures were injured and need protection?
- What kind of fracture was sustained? How stable are the reduction and fixation? How will this affect the rate of healing, wound care and mobilization programs?
- What is the optimum position of immobilization?

(Hunter, Mackin & Callahan. (1995). *Rehabilitation of the Hand: Surgery and Therapy*. St. Louis Mosby-Year Book Inc.)

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limitations of the splint or wrist band are initiated. Fisting, digital blocking and sustained gripping also may be added. Therapeutic goals include modifying the splint, managing shortening of the flexor muscle-tendon, monitoring tendon gliding and progressing toward low-resistance, sustained gripping, coordination re-training and light hygiene activities.

**Late Stage:** During this phase, splinting is discontinued except for pulley rings. (Pulley protection continues for six months following surgery). Graded, sustained gripping activities that do not provoke inflammation are introduced. Manual labor work re-conditioning may be implemented at 10 weeks. Therapeutic goals include improved strength, functional coordination, return to work, job-site analysis and independence with ADLs.

**Crush Injuries**

Like lacerations, crush injuries are complex and may be caused by a traumatic crush to the hand. The amount of force, time in

which the hand was entrapped, and the resulting structural damage dictates the initial focus of the therapy program.

Because of the structural damage that may occur, crush injuries are difficult to manage and may require extensive therapy. Skeletal structures may require external/internal fixation devices for adequate healing. Because skin coverage is often inadequate due to the blow-out effect, prolonged healing or grafting may be needed. The patient also may have an insensate or hypersensitive hand because of the nerve compression or rupture.

Initial positioning for optimal function within the constrictions of the repair is important. Splints are used for support, protection and deformity prevention. If possible, a resting splint should position the wrist in 10 to 20 degrees of extension, MP flexion at 70 to 80 degrees and IP flexion at 0 to 15 degrees. Postoperative splints and strapping may have to be modified to protect external hardware. When edema is pre-

sent, the patient should apply the splint using an ace wrap, which is wrapped from distal to proximal in a figure-eight pattern.

Postoperative edema control is a priority, but it may be complicated by vascular insufficiencies. Many edema reduction tech-

physician to recommend an early return to work. In fact, the team at Bay Medical Center begins discussing return to work issues during the initial evaluations.

Patients' individual case managers are invited to attend scheduled clinic appointments, with

**As with lacerations, job analysis should be an ongoing process for the person with a crush injury. Early job analysis will decrease lost time at work and allow the physician to recommend an early return to work.**

niques are documented in the literature and include elevation, compressive wrappings or gloves, contrast bath and retrograde massage. Any technique must be used with discretion and adapted to individual needs. For example, light compressive wrapping can be completed with a coban wrap, which must be placed lightly onto the digit and wrapped from distal to proximal in a spiral pattern. If applied too tightly, the wrap will have a tourniquet effect, resulting in decreased circulation and a subsequent increase in swelling.

Range of motion and strengthening activities are introduced, and resistance is increased as tolerated. Therapists must monitor pain, strength and edema to determine the appropriate grading of exercise. Throughout the course of treatment, edema must be carefully controlled, and the patient must be cautioned against overuse.

When structures are adequately healed and strong enough to withstand stress, the team should consider dynamic splinting or serial splinting.

**Return to Work**

As with lacerations, job analysis should be an ongoing process for the person with a crush injury. Early job analysis will decrease lost time at work and allow the

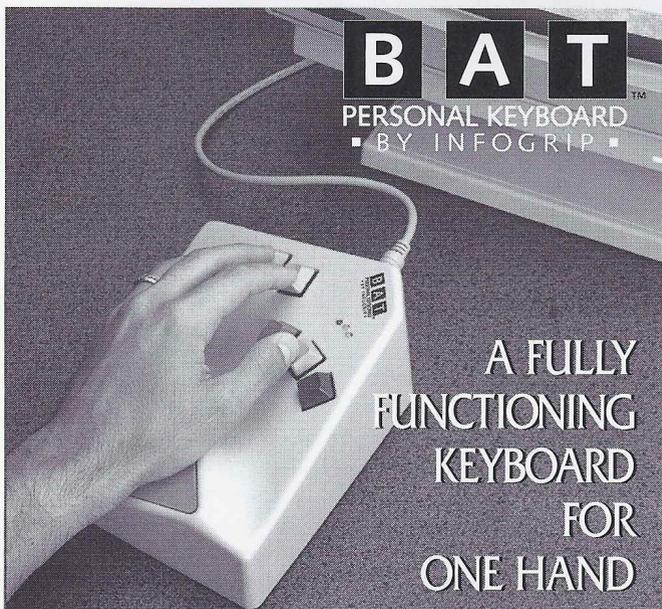
patient approval. Based on recommendations by the hand therapy team, the physician authorizes patients to return to modified work activities. Job modification or vocational rehabilitation may be necessary for those with more severe injuries.

Our mission at Bay Medical Center is to provide comprehensive treatment that promotes independence, maximizes function and minimizes the impact of disabling physical conditions for each patient. A hand clinic optimizes communication among team members and establishes a fully integrated delivery system that maintains cost and quality. The center provides patients and family members with coordinated, comprehensive rehabilitation at one location. ■

*Mark C. Komoroski, MD, is a board certified plastic surgeon whose practice entails hand surgery.*

*Debbie Rievert, OTR, is the occupational therapy supervisor at the Center for Rehabilitation, an outpatient facility of Bay Medical Center in Bay City, Mich. Rievert also is a guest lecturer at Saginaw Valley State University.*

*Mary Mosher, OTR, is a senior staff therapist at the Center for Rehabilitation. Mosher has specialized in hand therapy for 15 years and is a guest lecturer at Saginaw Valley State University.*



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