Abstract:

The hand is one of the most frequently injured parts of a child's body. Thorough knowledge of the pediatric hand anatomy is necessary to guide the evaluation and management of children presenting with hand injuries. Appropriate and timely management strategies have important functional and cosmetic outcomes and thus should be individualized to the patient's skeletal maturity, injury type, and severity, avoiding complications such as physeal damage and/or growth arrest. Ultimate outcome depends upon initial care. All pediatric hand fractures require close follow-up with the proper specialists for long-term monitoring. After emergency department evaluation, patients and families should be provided with complete and clear instructions including when to return to care, anticipatory guidance, and cast or splint care.

Keywords:

pediatric hand injury; fracture; boutonniere deformity; boxer's fracture; scaphoid fracture; mallet finger; skier's thumb; gamekeeper thumb; jersey finger

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Pediatric Hand Injuries

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Knowledge of the detailed anatomy of the hand will help clinicians successfully assess pediatric hand injuries. The bones of the hand include 8 carpals, 5 metacarpals, and 14 phalanges. Each finger has 3 joints: the metacarpophalangeal (MCP), the proximal interphalangeal (PIP), and the distal interphalangeal (DIP) joints. The thumb has one MCP and one interphalangeal joint. The extrinsic muscles of the hand originate in the forearm and their tendons pass through the wrist and insert in the hand. These extrinsic muscles are responsible for flexion and extension of the wrist and digits. The extrinsic extensor tendons join to form the extensor hood at the MCP. The central portion of the extensor hood forms the central slip, which inserts onto the middle phalanx and acts to extend the PIP joint.

The intrinsic muscles of the hand have their origins and insertions in the hand. They make up the thenar and hypothenar eminences as well as the lumbricals and interosseous muscles. The lateral bands are formed from the deep head of the dorsal interossi combining with the volar interossi. The lateral bands insert into the dorsal surface of the distal phalanx, along with the extensor hood, to extend the DIP joint. The radial and ulnar arteries supply blood to the hand through a series of arches. Innervation of the hand is supplied by the radial, ulnar, and median nerves.

Hand movements are complex. These include: supination and pronation of the forearm; extension, flexion, ulnar deviation, and radial deviation of the wrist and extension, flexion, abduction, and adduction of the fingers. The thumb's movements include flexion, extension, opposition, palmar abduction, and radial abduction.[1]

Particular attention should be paid to the physes in the management of pediatric hand fractures and during reductions. Pediatric bones have a strong periosteum and adjacent joint capsule and ligaments. This periosteum gives children great remodeling potential. However, the growth plate is the weakest area of a child's bone and is therefore most vulnerable to fracture.[2] Although variation exists, typically physes exist on the proximal ends of the

Figure 1. Normal hand x-ray of a 3-year-old girl demonstrating typical physes locations.

phalanges, the proximal end of the thumb metacarpal, and the distal end of the finger metacarpals (Figures 1 and 2). Salter and Harris devised a classification scheme for fractures involving the physis. Salter-Harris type I is a fracture involving only the growth plate and may appear normal on imaging. A Salter-Harris type II fracture extends through the metaphysis and the physis. Salter-Harris type III fractures include those extending through the physis and the epiphysis. Salter-Harris type IV fractures involve the metaphysis, physis, and epiphysis, and finally, Salter-Harris type V is a crush injury involving the physis. Although any fracture involving the physis can risk future growth, those at the greatest risk are Salter-Harris type III, IV, and V fractures.[3]

Figure 2. Normal hand x-ray of a 12-year-old boy demonstrating typical locations of physes.

APPROACH AND EXAMINATION OF PEDIATRIC HAND INJURIES

The mechanism of injury can help determine forces that were applied to the patient and resultant injury patterns. On examination of the hand, the examiner must assess the skin's integrity as well as the motor and sensory function of the hand. Often, the best functional examinations can be done while young children play with parents and siblings. First, a clinician should observe the patient, taking note of the hand's position and spontaneous movement, before a hands-on examination. For instance, a rotational deformity can be found with observation. As fingers are flexed all should be pointed toward the scaphoid, without overlapping or scissoring (Figure 3). A rotational deformity must be corrected, frequently by surgical pinning, as this could lead to permanent functional disability. Motor function of the fingers can be assessed by testing both the muscle strength and tendon function. With a cooperative patient's palm facing upward on the examination table, the physician can apply 2 fingers to the involved finger just proximal to the DIP joint, holding the injured finger against the table. One can assess the distal muscle strength and the integrity of the flexor digitorum profundus tendon, by asking the patient to flex the tip of their affected finger. Similarly, a clinician can assess the proximal muscle strength and the flexor digitorum superficialis tendon by holding the adjacent noninjured fingers

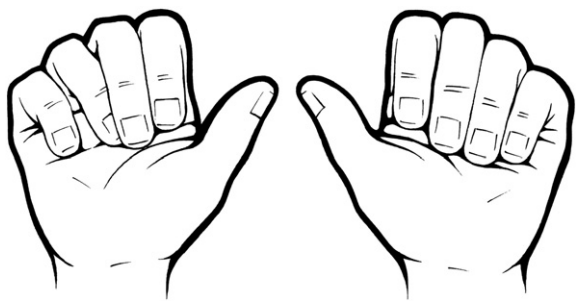

Figure 3. Rotational deformity can be detected with observation. When flexed, all fingers should point toward the scaphoid (on right), without overlapping or scissoring (on left) indicating a rotational deformity (illustrated by Erika Pasciuta, MD).