Surgical Exposures of the Hand

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KEYWORDS

• Metacarpal • Phalanx • Hand trauma • Approach • Exposure

KEY POINTS

- Surgical approaches to the hand are designed to correct injury or deformity with minimal morbidity.
- Useful surgical approaches are versatile, safe, preserve critical structures, and have an acceptable aesthetic outcome.
- Choice of an appropriate surgical approach requires a detailed understanding of normal and structural pathology.
- Dorsal approaches are common and are generally safe.
- Volar approaches allow for fixation in a specialized subset of injuries including intraarticular injuries.

INTRODUCTION

Choosing the appropriate surgical approach to any structure in the hand requires a detailed understanding of the normal anatomy and the structural pathology associated with the particular injury or disease process being treated. The goal of any surgical approach is simple: To correct deformity or injury while avoiding morbidity. Execution, however, remains more complex. Any surgical approach to the hand should be versatile, providing sufficient exposure of the structures requiring repair. It should also provide the ability to expand the exposure proximally and distally to introduce necessary devices for fixation. In addition to versatility, surgical exposures should be safe. Critical structures should be easily identified, preserved, and reconstructed. Surgical exposures should also preserve inherent stability and strength of the tendons and ligamentous structures of the hand. Consideration should also be given to the functional and aesthetic units of the hand and the resultant scar.

We have reviewed pertinent hand anatomy and common surgical approaches to the hand, with a principal focus on treatment of metacarpal and phalangeal injuries. Each surgical approach is evaluated with respect to the core principles of versatility, safety, preservation of stability, and aesthetics.

ANATOMY OF THE HAND AND DIGITS

Knowledge of the cutaneous, osseous, ligamentous, musculotendinous, vascular, and nerve anatomy of the hand is an essential prerequisite for designing and performing surgical approaches in the hand.

Cutaneous Anatomy

The cutaneous envelope of the hand is highly specialized, reflecting both structure and function. The dorsal skin of the hand is thin and pliable, allowing for nearly unrestricted motion. Landmarks including the extensor tendons and bony

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structures may be easily palpated dorsally. The skin of the palm is glabrous and devoid of hair follicles, with a thickened dermal component. The skin of the palm is durable and has a unique capacity for robust secondary wound healing.[1]

Osseous and Ligametous Anatomy

The bony anatomy of the metacarpals and phalanges takes origin from the distal carpal row. The distal carpal row forms a solid architectural arch with the capitate as its keystone.[2] This fixed transverse arch is carried distally to the more mobile adaptive transverse arch of the metacarpal heads and is complemented by the volar convexity of the metacarpals. This anatomy ensures that the palm is convex in both the proximal–distal and radial–ulnar dimensions, which allow the palm to hold convex objects.

With the exception of the thumb carpometacarpal (CMC) joint, the CMC joints of the fingers are relatively immobile. Mobility increases ulnarly with the index and long fingers nearly fixed whereas the ring and small finger exhibit a 15° to 25° arc of flexion–extension.[3] The thumb CMC is unique as a biconcave–convex saddle joint that imparts versatile cone of thumb motion. The metacarpophalangeal (MCP) joints afford significantly more mobility. These joints are condyloid, allowing not only flexion and extension but radial and ulnar deviation (abduction and adduction). Radial and ulnar motion at the MCP is stabilized by collateral ligaments. Because of the cam structure of the MCP joint, these ligaments are lax with the MCP in extension and taught with the MCP in flexion. The net effect is that the MCP is more stable in flexion during lateral pinch.[4] Although the collateral ligaments constrain lateral displacement, the firm volar plate resists hyperextension, and the intervening extensions between the volar plate—the intermetacarpal ligament—stabilizes the distal metacarpal arch.

The thumb consists of a proximal and distal phalanx, whereas the index, long, ring, and small fingers are composed of 3 phalanges. Each interphalangeal joint is stabilized against radial- and ulnar-directed stress with proper and accessory radial and ulnar collateral ligaments (UCLs). Stout volar plates prevent hyperextension at the proximal interphalangeal (PIP) joint level and to a lesser degree at the distal interphalangeal (DIP) joint level. The UCL of the thumb is of particular clinical relevance because it is prone to both acute disruption (skier's thumb) and chronic attenuation (gamekeeper's thumb). The proper UCL of the thumb stabilizes the thumb MCP joint against radially directed forces such as those generated in pinch activities with the MCP in slight flexion whereas the accessory collateral ligament and volar plate contribute to stability in full MCP extension.

Musculotendinous Anatomy

The musculotendinous structure of the hand relies on the balanced coordination of extrinsic and intrinsic structures. The thumb is powered extrinsically by the extensor pollicis longus (EPL) and flexor pollicis longus. The EPL traverses the wrist in the third dorsal compartment, inserting onto the base of the distal phalanx. In its course, the EPL tendon forms the dorsal–ulnar border to the anatomic snuff box. The flexor pollicis longus tendon travels through the carpal tunnel and travels via a stout fibroosseous canal to insert on the volar base of the distal phalanx. The abductor pollicis longus (APL) and extensor pollicis brevis (EPB) serve as additional extrinsic movers of the thumb. At the level of the wrist, the APL and EPB tendons traverse the first dorsal compartment and insert on the bases of the thumb metacarpal and proximal phalanx, respectively. In this course, they form the radial–volar border of the anatomic snuff box, a critical landmark; the dorsal branch of the radial artery traverses this interval. The intrinsic musculature of the thumb consists of the abductor pollicis brevis, flexor pollicis brevis, and opponens pollicis. These musculotendinous units act primarily across the CMC joint, allowing for abduction, flexion, and opposition of the thumb. The small finger maintains analogous abductor, flexor, and opponens muscles comprising the hypothenar musculature.

The index, long, ring, and small fingers are similarly powered both by intrinsic and extrinsic musculotendinous units. The extensor digitorum communis (EDC) powers each finger via a common extrinsic muscle belly. These tendons contribute to the complexity of the dorsal extensor apparatus of the finger. The tendons emerge from the fourth dorsal compartment and are centralized over the MCP joints by radial and ulnar sagittal bands. Over the proximal phalanx, the extensor tendon becomes broad, receiving contributions from the intrinsic interossei and lumbricals. These contributions create the well-defined lateral bands of the extensor mechanism. The central substance of the extensor hood terminates via insertion into the base of the middle phalanx. The lateral bands continue distally to insert onto the dorsal base of the distal phalanx. The index and small fingers have additional proper extensor tendons (extensor indicis proprius and extensor digiti minimi) that travel ulnar and just deep to

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