Therapy Concepts for the Proximal Interphalangeal Joint

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KEYWORDS

• Therapy • Proximal interphalangeal joint • Stiffness • Modalities • Orthoses

KEY POINTS

- Injuries to the proximal interphalangeal joint follow 3 phases of healing—inflammatory, fibroblastic, and remodeling.
- Blocking, static, and dynamic orthoses have multiple applications, including protecting injured structures and preventing and treating finger stiffness.
- Hand therapists use modalities, including edema wraps, cryotherapy, scar massage, ultrasound, electrical stimulation, and contrast baths.
- Modalities have multiple purposes, including edema control, pain reduction, desensitization, and neuromuscular reeducation.

INTRODUCTION

The anatomy of the hand is complex, with little room for edema and low tolerances for scar formation. A disruption in the delicate balance in 1 structure often leads to dysfunction in other structures in the same finger. For example, a mallet injury of the distal interphalangeal joint (DIPJ) may lead to hyperextension at the proximal interphalangeal joint (PIPJ).[1] Adjacent fingers may also become affected, such as the quadriga effect from flexor digitorum profundus scarring or overtightening.[2] Comprehension of the nature of the specific PIPJ disorder is, therefore, necessary when designing a hand therapy program. The program requires not only focus on PIPJ motion but also positioning and motion of adjacent joints and fingers. Furthermore, the program changes depending on the timing of the injury and the phases of healing of soft tissues and bone.

Although improving motion in the hand and fingers is crucial in the improvement of patient function, additional hand therapy techniques focus on edema, atrophy prevention, neuromuscular reeducation, and desensitization. The efficacy of a hand therapy program hinges on communication between physician and therapist, the relationship between the therapist and patient, and the active participation of the patient.

PHASES OF HEALING

Inflammatory Phase

The inflammatory phase, as its name suggests, is characterized by increased blood flow and increased inflammatory mediators, such as tumor necrosis factor α and transforming growth factor β.[3–5] Neutrophils and macrophages egress from vasodilated blood vessels and begin the process of phagocytosis and wound healing with

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production of collagen III.[4] The process lasts from approximately several days to 1 week, with variation depending on the degree of injury, patient age, and patient health status.[4]

Treatment during the inflammatory phase focuses on pain control, immobilization, and edema control.[6] Range-of-motion activities are generally begun as soon as possible but are often limited by the immobilization modality or patient pain tolerance during the inflammatory phase. The simplest method for edema control is elevation of the extremity and is recommended in nearly all injuries and postoperative conditions. Prefabricated pillows and shoulder slings, which place the hand at heart level, are used routinely. Other modalities used during the inflammatory phase include cryotherapy and retrograde massage.[5]

Fibroblastic Phase

The fibroblastic phase begins after the acute inflammatory phases wanes during the first week and lasts approximately 3 weeks.[6] The period is characterized by increased fibroblast activity and deposition of disorganized collagen.[6] The resulting tissues repaired with cross-linked collagen may have less elasticity than the native tissue, and cross-links may occur across tissue planes leading to stiffness.[7] In earlier stages, this stiffness is often characterized by a soft endpoint but may become a hard endpoint with maturation.[3] Edema, hyperemia, and pain may further limit motion during the earlier phases.

Thus, therapy during the fibroblastic period continues to focus on edema control with increasing emphasis on active and passive motion exercises to reduce the risks of joint contractures and soft tissue adhesions.[8] Depending on the injury sustained or surgery performed, patients may use orthoses for protecting injured structures and remove the orthoses for therapy exercises. Dynamic or blocking orthoses are commonly used. Motion exercises focus on tendon gliding or joint immobilization. Scar massage is initiated after incisions are well healed.[9]

Remodeling Phase

The remodeling phase is characterized by continued collagen synthesis and maturation of collagen cross-linkages.[6] Contractures with a soft endpoint may progress to firm endpoints and permanent contracture if not treated promptly and appropriately. Increasing emphasis is placed on regaining or maintaining range of motion. Care should be taken with passive flexion of the PIPJ because aggressive tension can lead to attenuation of the central slip and extensor lag.[10]

Stiffness and anxiety related to the injury can lead to further disuse resulting in a cascade of further edema, muscle atrophy, and contracture. In some patients this cascade may lead to complex regional pain syndrome (CRPS) or variants thereof. Modalities, including contrast baths, heated ultrasound, paraffin baths, and initiation or continuation of active range-of-motion exercises, are beneficial. In patients with a history of CRPS or those with signs concerning for its onset, mirror therapy may be beneficial.[11–13]

Joint contractures in some patients develop from chronic disorders. Examples include chronic inflammation (eg, rheumatoid arthritis) or neurologic (stroke) or chronic musculotendinous abnormalities (eg, chronic boutonniere deformity). A carefully designed therapy program with orthoses can still be beneficial in long-standing contractures despite remodeling.[10,14]

MOTION EXERCISES

In the early phases of healing, hand therapy exercises focus on the prevention of tendon adhesions. The normal smooth gliding of tendons is maintained by the lubricating synovial fluid within the tendon sheath. Disruptions to this environment may occur with direct tendon trauma, with opening of the tendon sheath incision for surgical exposure, or from surrounding inflammatory processes. Passive and active motion are begun as soon as the nature of the surgery or injury allows.

Contributors to increased tendon gliding resistance include postoperative edema, annular pulleys, extensor tightening, and joint stiffness.[15] Cao and Tang[16] showed that resistance was greatest in the first 4 days after surgery and correlated with edema. Resistance significantly decreased after 6 cycles of passive motion. The investigators recommended starting motion exercises on postoperative days 4 to 7, depending on the severity of edema. Starting the therapy session with passive motion exercises and then proceeding to active motion exercises lessens gliding resistance and improves subsequent tendon excursion with the active exercises.[16]

Active joint motion exercises produce up to 79% more tendon excursion than passive motion exercises.[17] Active motion exercises should, therefore, be used whenever possible when trying to prevent tendon adhesions.

Differential tendon gliding exercises mobilize 1 tendon with minimized motion to adjacent tendons sharing the same sheath or compartment to prevent tendon to tendon adhesions. For example, the PIPJ may be held in extension to immobilize the flexor superficialis tendon while isolated