# Current Practice of Primary Flexor Tendon Repair
## A Global View

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**KEYWORDS**

• Flexor tendon • Primary repair • Strong surgical repair • Core sutures • Flexor pulley • Pulley venting • Surgical techniques • Rehabilitation

**KEY POINTS**

- Primary or delayed flexor tendon repairs in the hand have become standard practice over the past 30 years; direct end-to-end repair in the digital sheath area using a multistrand core suture (4-strand, 6-strand, or 8-strand repair) has become widely adopted over the last 10 years.
- Although repair methods vary, basic principles include use of strong surgical repairs, slightly higher tension over the repair site, and ensuring sufficient core suture purchase (1.0 cm).
- 3-0 or 4-0 sutures are used for making core sutures, and 6-0 sutures are used for peripheral suturing. A strong core suture (6-strand or greater), made with proper tension over the repair site, may circumvent the use of peripheral sutures.
- In the past 10 years, the policy for preservation of the pulleys has been revolutionized. A part of the A2 pulley can be incised to free tendon motion, or the entire A4 pulley may be incised to allow repair and tendon movement if other pulleys are intact.
- Combined active-passive motion regimes are the mainstay of postoperative care, but the details of exercise protocols vary greatly. Rubber-band traction has been almost abandoned, and purely passive motion has declined in popularity.

Lacerated flexor tendons, especially those in the digital sheath area, were largely not considered candidates for primary surgical repair in the first half of the twentieth century. Primary repair of the flexor tendon in the digital sheath area was established in the 1970s to the 1980s, following conceptual changes brought about by pioneers such as Claude Verdan and Harold Kleinert in the 1960s. Although indications for primary repair are similar to those described decades ago, the surgical techniques, concepts regarding treatment of sheath and pulleys, and methods of postoperative care changed considerably. The ultimate goals remain to achieve close-to-ideal functional restoration and predictable clinical outcomes.

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This article reviews the evolution of treatment methods and provides global views and details of the surgical methods and rehabilitation regimes used in major hand units across the world. The surgical principles and key technical considerations underlying these diverse treatment options are also summarized.

## CURRENT PRACTICE ACROSS THE GLOBE

### *United States and North America*

Although exact statistical data are not available from members of the American Society for Surgery of the Hand (ASSH), in the last decade there has been a clear technical shift in core tendon repair, from conventional 2-strand core sutures to methods with 4 or more suture strands. The current methods of digital flexor tendon repair in the United States have been developed by units that have spent decades in the development of repair methods.

#### *Mayo Clinic*

The current practice is (1) use of a 3-0, low-friction suture material, with a 4-strand high-strength repair; (2) low-friction suture design, such as the modified Pennington, with locking loops[1]; (3) a running epitendinous finishing suture; (4) recourse to pulley trimming,[2,3] or excision of 1 slip of the flexor digitorum superficialis (FDS)[4] in cases of difficulty in tendon gliding in zone 2; (5) early motion after a few days' delay; (6) starting with a modified synergistic therapy,[5] and (8) progression to active motion as healing progresses.

The preference of Dr Amadio is a modified Pennington suture design for the core suture, because it locks the loops definitively by coming out of the tendon dorsally. He uses 2 such core sutures, made with either 3-0 or 4-0 TiCron, depending on tendon size. Other surgeons use double Tsuge sutures, made with 3-0 or 4-0 Supramid, with 1 on each side of the tendon, being sure to keep the surface loops lateral, to minimize friction. Some others prefer the modified Kessler repair.

The peripheral sutures used at Mayo commonly are simple running sutures of 6-0 nylon or Prolene, although Dr Amadio does prefer a running locking suture. The Lin locking suture is not used clinically, because it is difficult to perform and it causes more friction than other peripheral sutures.

There is no standard rehabilitation protocol used by all surgeons following tendon repair at the Mayo Clinic, and the specific details depend on the nature of the injury. They see many complex injuries in their practice, which receives referrals from a large agricultural region. Some of these patients return home for aftercare, and trained hand therapists may or may not be readily accessible. For a clean-cut injury in zone 2, the patient is initially placed in an extension block splint with the wrist and metacarpophalangeal (MCP) joints flexed. The Mayo Clinic no longer uses rubberband (Kleinert) traction to the finger tips.

Passive motion is typically started using a modified synergistic protocol[5] combined with passive joint mobilization within 3 to 5 days after surgery,[6] and this progresses to place-and-hold exercises once the finger joints are supple. In this protocol, the patient comes out of the splint to actively flex the wrist and extend the fingers simultaneously. Then, while keeping the MCP joints extended, the interphalangeal (IP) joints are flexed (for the first few days passively, then later actively) and the wrist is actively extended. The patient comes out of the splint for exercises, usually several times each day. Usually by 3 weeks the patients have begun gentle active-motion exercises, including both fist and hook grip positions. The splint can usually be discarded by 6 weeks, and the patient can begin light resistive exercises, progressing to heavier use gradually over the next 6 weeks. Most patients are dismissed from care by week 10 or 12 if they are doing well. If not, other modalities such as ultrasound or stretching may be added.

#### *Washington University (St Louis, MO)*

The current practice in this unit is as follows: (1) use of a 3-0 or 4-0 low-friction suture material such as a looped braided caprolactam, with an 8-strand Gelberman-Winters core suture technique[7]; (2) placement of a single knot within the repair site; (3) a simple running epitendinous suture of 5-0 or 6-0 Prolene placed deeply across the tenorrhaphy site; (4) early motion using a synergistic protocol combining wrist flexion with active finger extension against a dorsal block, and finger flexion (passive, with a gentle active component) combined with active wrist extension.

At Washington University, surgeons prefer to use a Gelberman-Winters core suture technique, using the 3-0 or 4-0 braided caprolactam suture (Supramid) for the following 2 reasons: first, it allows for the passage of 2 suture strands with the single passage of the needle, and, second, the tapered design of the needle minimizes damage to the tendon during core suture insertion. If an 8-strand core suture is not possible because of small cross-sectional tendon area (such as at the A4 pulley or distal to it, or in the small finger), then a 4-strand modified Kessler pattern is used followed by an epitendinous suture. Based on the data of Diao and colleagues[8] and Nelson and colleagues,[9] they prefer to use a simple running