Therapy after Flexor Tendon Repair

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KEYWORDS

• Early motion • Dorsal protective orthosis • Tendon gliding • Tendon protocol • Place-hold • Excursion • Adhesions • Passive motion

KEY POINTS

- The goal of therapy after flexor tendon repair is the early restoration of tendon gliding and prevention of restrictive adhesion formation while protecting the repair from rupture and the maintenance or restoration of digital joint mobility.
- The selection of a postoperative protocol after flexor tendon repair whether passive, active, or active/passive is based on the surgical procedure performed and the surgeon's assessment of the capacity of the repair to withstand the forces imparted to the tendon during motion; as well as the patient's ability to understand and follow directions and be compliant with the home program instructions and precautions.
- Tendon protocols are meant to serve as guidelines for postoperative management and not as rigid timetables for when different exercises may be introduced. Rather, clinical judgment and reasoning must be used to advance a patient's therapy program and should be based on patient's progress or lack of progress.
- Immoderate tendon loading with exercises and use risks tendon rupture and therefore progression of the therapy program after flexor tendon repair must be done with care and collaboration between the surgeon and therapist.
- A not uncommon problem encountered after flexor tendon repair during the rehabilitation process is flexion contracture of the PIP joint of the involved digit. The first and best approach is prevention of contractures by careful orthosis fabrication and positioning of the involved digit. Ongoing monitoring of the fit of the dorsal block orthosis at each therapy visit is essential to prevent the loss of appropriate positioning from the reduction in edema and dressings.

INTRODUCTION

Rehabilitation after flexor tendon repair has evolved during the last several decades and has been based on the evolving understanding of tendon nutrition and healing and the factors that influence it. These factors include the development of suture repair techniques, the response of the tendon to applied stress (motion), and prompted by the goal of improved and consistent outcomes. This evolution is reflected in the progression in clinical practice from initial immobilization of repaired tendons to early controlled passive motion to the current practice of early active motion combined with passive. Numerous protocols have been developed with variations in patterns of motion, timing, and orthosis designs and positions. The common goal of all of the protocols is the early restoration of tendon gliding while protecting the repair from rupture and the maintenance or restoration of digital joint mobility.

The authors have nothing to disclose.
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Hand Clin 39 (2023) 181–192
https://doi.org/10.1016/j.hcl.2022.08.019
0749-0712/23/

hand.theclinics.com

HISTORICAL PERSPECTIVE

Mason and Allen's experiments in 1941[1] supported the practice of initial immobilization of repaired flexor tendons. In their studies of the rate at which a repaired tendon regains its tensile strength in a canine model, Mason and Allen reported 2 significant findings. First, there was a profound decrease in tensile strength of the tendon repair with the lowest values measured 4 to 5 days after repair. The tendon stumps had little holding power, and the suture pulled out of the tendon when stress was applied. Although tensile strength gradually increased for up to 10 days, the repair was considered incapable of responding to externally applied stress during this time. The second finding was that, after 19 days, the tensile strength of the repair increased directly with the stresses applied to it. These findings influenced clinicians to immobilize repaired tendons for 3 weeks before allowing attempts at active tendon gliding.

Potenza's research reported in 1963[2] also supported the practice of initial immobilization of flexor tendon repairs. In a canine model, he studied the healing response of repaired tendons that were encased in a synthetic tube to block the ingrowth of adhesions. He found necrosis of the tendon repair at 32 days after repair, with no intrinsic healing activity observed in the tendon itself, and thought that the degeneration of the tendon within the tube represented an avascular phenomenon. Potenza concluded that no intrinsic fibroblastic response from the injured tissue occurred and that healing depends on extrinsic cellular ingrowth. Rather than prevent adhesions, Potenza concluded that adhesions were necessary and should be allowed to form without disruption, thus supporting the concept of immobilization during the early weeks following flexor tendon repair.

Peacock in 1965[3] subsequently proposed the "one wound concept," which supported the extrinsic healing theory. The "one wound concept" refers to the fact that the early process of wound healing is the same in all tissues involved in the injury. During the first stage of healing—the inflammatory stage—the tendon wound site is filled uniformly with leukocytes, macrophages, fluids, and other inflammatory elements, which leave the vascular system. During the second stage of proliferation or fibroplasia, fibroblasts synthesize and extrude collagen. Peacock stated that the fibroblasts migrated from adjacent areas and that the tendon itself did not contain many cells capable of synthesizing collagen. Initially, the collagen is in a random network that links all parts of the wound. It is during the next phase of remodeling that differentiation of healing between different parts of the wound occurs. With a successful repair, the collagen between the tendon ends becomes reoriented into polarized parallel bundles that have great strength similar to normal tendon, whereas the collagen between the tendon and adjacent tissues remains elastic and mobile and randomly oriented.[4]

What factors influence this remodeling and differentiation? Peacock[3] found that the amount of trauma and subsequent tissue damage was related to the extent of remodeling. The lesser the trauma, the more successful and complete the remodeling. Moreover, he thought that newly synthesized scar remodels in response to inductive influences of the tissue with which it is in intimate contact. Other factors relevant to postoperative management are motion and stress. Longitudinal stress and shearing force transmitted by muscle pull along a repaired tendon provokes polarization of the collagen fibers and hence promotes developing strength.[4] The reality, however, is that scar remodeling following initial immobilization of a repaired flexor tendon is not a predictable process and that tendon adherence with some limitation of motion invariably results. The desire to improve the functional outcome of flexor tendon repairs led to the investigation of alternative mechanisms of healing.

Because the response of the tendon to injury depends on its nutrition, the next focus of investigation was on defining more precisely the nutrient pathway to the flexor tendon within the sheath. The tendon passes freely through the sheath with attachment solely by 2 narrow bands of tissue known as vincula. Early investigators thought that these provided a mechanical supporting function but ultimately recognized the vincula as the vascular line to the tendon. Vascular injection studies revealed an intricate intratendinous network derived from 3 sources: the vinculum longum, vinculum brevi, and longitudinal palmar vessels.[5] These studies showed that the intratendinous vessels are located on the dorsum of the tendon and that there are significant areas of avascularity on the volar surface of the tendon and in the zones of the pulleys. These studies led some to conclude that a cooperative system of nutrition, including the intrinsic vasculature and the synovial fluid, was involved in nourishing the tendon.

Manske and colleagues,[6,7] in the late 1970s, in a series of experiments found that the process of synovial fluid diffusion functioned more quickly and completely than did perfusion and was a relatively more important pathway for nutrition.

About the same time, based on their studies, Lundborg and Rank[8] concluded that an intrinsic healing potential existed with nutrition supplied by synovial fluid.

With the existence of an intrinsic healing potential fueled by a synovial fluid nutrient pathway established, studies turned to those factors thought to promote intrinsic healing. Because immobilization supports adhesion formation, investigations turned to the effects of early motion following tendon repairs. Gelberman and colleagues[9] (1980–1982) studied the effects of motion on the healing of canine flexor tendons compared with immobilization and found that the tendons treated with early motion showed higher tensile strength and improved gliding function over the immobilized tendons at each postoperative interval assessed. Early motion stimulated a reorientation of blood vessels to a more normal pattern, whereas immobilization beyond 3 weeks resulted in a random vascular pattern. DNA content was assessed as an indicator of tissue cellularity and repair activity. The tendons that were treated with motion showed a significant increase in DNA, whereas the immobilized tendons were not altered. Gelberman and colleagues[10] also found an absence of adhesion formation and restoration of a gliding surface with the early motion group compared with the dense adhesions seen with the immobilized tendons, which obliterated the space between the tendon and the sheath. They concluded that early motion was the trigger for stimulating an intrinsic repair process and would yield better results than initial immobilization.

The concept of early motion was not a new one. In the 1970s, Kleinert[11] and Duran[12] advocated early controlled motion as a means of producing less restrictive adhesions and thus resulting in better tendon glide. Both techniques initiated passive flexion and blocked extension, with Kleinert advocating active extension (**Fig. 1**, A, B) and Duran and colleagues describing passive extension (**Fig. 2**, A–C). Later investigators described passive programs that incorporated elements of both approaches such as the Washington regimen.[13] These protocols and modifications will be discussed in more detail later in the article.

Clinical studies[14] comparing early passive motion with immobilization found that tendons treated with early motion had a greater average total active motion (TAM) and a greater percentage of excellent results when compared with tendon treated with immobilization. However, the technique of early controlled motion was not without complications and results were not consistently good. Kessler[15] and others questioned whether passive motion produced any significant tendon motion at all. The suture site may not glide proximally during passive flexion; rather the segment of the tendon distal to the repair site may kink or buckle during passive flexion and then be stretched during limited active extension. Kessler[15] pointed out that gliding of the suture site takes place only by *active* flexion of the operated digit, thus pointing the way toward the development of suture techniques capable of withstanding the forces imparted to the tendon, with active motion combined with the development of orthotic fabrication and controlled active motion protocols. Early examples of these active motion protocols include those of Strickland and Cannon,[16] Silfverskiold and May,[17] and Evans and Thompson.[18] Relatively more recent protocols include the Saint John protocol,[19] the Nantong protocol,[20] the Manchester Motion protocol,[21] and a Relative Motion program for zone I/II flexor digitorum profundus (FDP) repairs.[22]

PHASES OF REHABILITATION

Postoperative rehabilitation for flexor tendon repairs is generally guided by the stages of wound healing and can be conceptualized in phases. Phase one can be termed the Protective Phase from 0 to 4 weeks when the strength of the repair is basically that of the suture and any motion program must observe the tensile limits of the repair. Any scar tissue that has formed is weak and easily disrupted by force. The transitional phase is from 4 to 6 weeks when repair strength increases with the beginning of scar tissue maturation and the tensile demands on the repair can be increased but caution must still be observed so as not to disrupt the repair. The extent of scar formation is assessed at this point by the initial tendon excursion. The better the excursion at this phase, the more the tendon is protected from excessive force because adhesion formation is assumed to be minimal, and the tendon may be at a greater risk of rupture. The third phase is full mobilization, which generally begins at 6 weeks and is gradually increased over time as the repair increases in tensile strength. A Pyramid of Progressive Force application has been introduced by Groth[23] and is useful as a clinical reasoning tool to determine when and how to progress motion programs for individual patients.

CLINICAL EVALUATION

Following tendon repair and rehabilitation, total active motion (TAM) and total passive motion (TPM) measurements are used to assess outcome. TAM is calculated by adding the

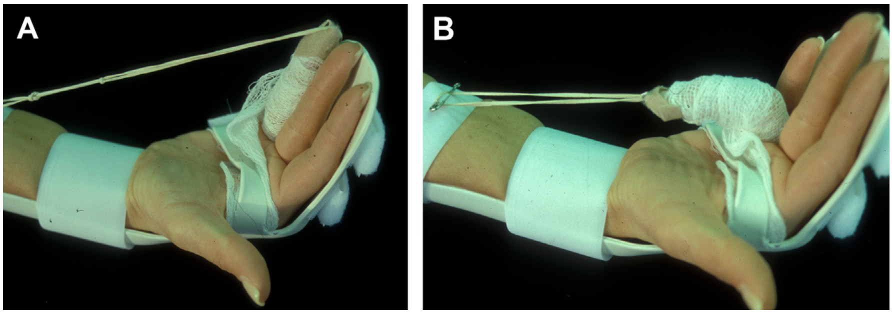

Fig. 1. (*A*, *B*) *Kleinert program* of controlled passive motion. (*A*) Active extension against the resistance of the elastic band (*B*) with a passive pull back to flexion.

measurement of metacarpophalangeal (MCP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joint flexion in a fisted position and subtracting the sum of extension deficits at these joints. Strickland[24] advocates a formula, which omits the measurement at the MCP joint. TAM is calculated using only the measurements at the PIP and DIP joints and is divided by 175 multiplied by 100 to give the percentage of normal PIP and DIP motion. A score of 175 represents the normal TAM of these joints in most individuals.

Strickland [24] grades flexor tendon repairs from poor to excellent based on the return of normal motion. Excellent means 75% to 100% of return; good means 50% to 74% of return; fair equals 25% to 49% of return; and poor is 0 to 24% of return.

APPROACHES AND PROTOCOLS

Early motion programs involve controlled motion of the tendon repair starting within the first week and continuing until 3 to 4 weeks postoperatively. Early motion programs require patients who can follow directions, attend therapy, and are reliable; a knowledgeable therapist (ideally a certified hand therapist); and no concomitant injuries precluding early motion. Programs involve passive, active, or synergistic motion and relative motion programs for FDP repairs zone I/II.

Active motion—Widely used, these programs begin at 3 to 5 days after surgery and involve a light active flexor muscle contraction, through either a place and hold partial or full fist, or with "true active motion" with a half a fist. It is important to note that active programs require a suture technique capable of withstanding the forces imparted to the tendon with active motion—usually a strong multistrand core suture method with a simpler peripheral suture.[25] Representative protocols include the following:

Nantong protocol[25] (*Jin Bo Tang*): A combined passive–active motion starts at 4 to 6 days postoperatively. The wrist is positioned in the orthosis at neutral with the hand in a resting position. Partial midrange active finger flexion is preceded by passive finger flexion/extension and is allowed in the first few weeks after surgery (Fig. 3 A, B). Before attempting active motion, full passive finger flexion and extension exercises—10 to 30 repetitions—are incorporated for patients with edema and/or stiffness to lessen resistance encountered by the repaired tendon with active motion efforts. Starting in weeks 4 to 5 a full range of active finger flexion is allowed and the orthosis is discontinued after week 6.

Saint John *Protocol*:[19] This program calls for combined passive–active motion at 3 to 5 days after surgery. A dorsal block orthosis (DBO) is used with the wrist in 45° extension, the MCP joints in 30° flexion, and the interphalangeal (IP) joints in full extension. Exercises include passive motion of all digits; full IPJ extension with the MCP in full

Fig. 2. (*A–C*). *Duran technique* to prevent cross union between the repaired FDS and FDP. (*A*) Passive PIP, DIP flexion; (*B*) passive DIP extension with MCP and PIP flexed glides the FDP suture site away from the FDS suture site; and (*C*) passive PIP extension with the MCP and DIP flexed glides both suture sites away from the site of injury.

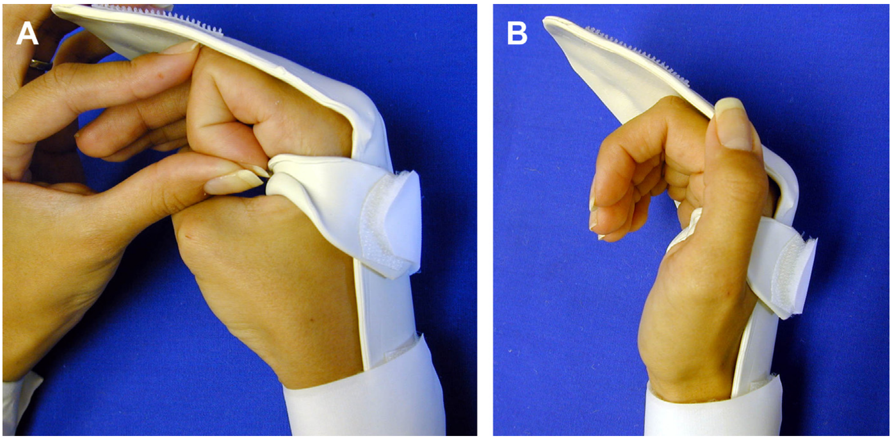

Fig. 3. (*A*, *B*) *Nantong program*–combined passive and active program. (*A*) First, full digit passive flexion and extension within the dorsal protective orthosis to lessen resistance encountered by the repaired tendon with active motion efforts; (*B*) active extension and partial midrange active finger flexion until weeks 4 to 5 at which time a full-range active finger flexion is allowed.

flexion; true active flexion (not place-hold) up to one-third to one-half a fist (active hook fist). At 2 to 4 weeks after surgery, the DBO is shortened as in the Manchester Short Splint (**Fig. 4**). Active synergistic exercise is performed in the short orthosis. Active motion is advanced from half to a full active fist by 6 weeks. Full IP extension is allowed with MCPs in full flexion. At 6 weeks, the orthosis is discontinued.

Manchester Program:[21] This program initiates combined passive/active motion on the fourth to fifth postoperative day. The Manchester Short orthosis extends from the proximal wrist crease to the fingertips and permits full wrist flexion and up to 45° extension with a block of 30° MCP joint extension (**Fig. 4** A–D). Full passive IP joint flexion exercises precede active motion exercises. Digital flexion exercises are performed in the orthosis; finger extension is

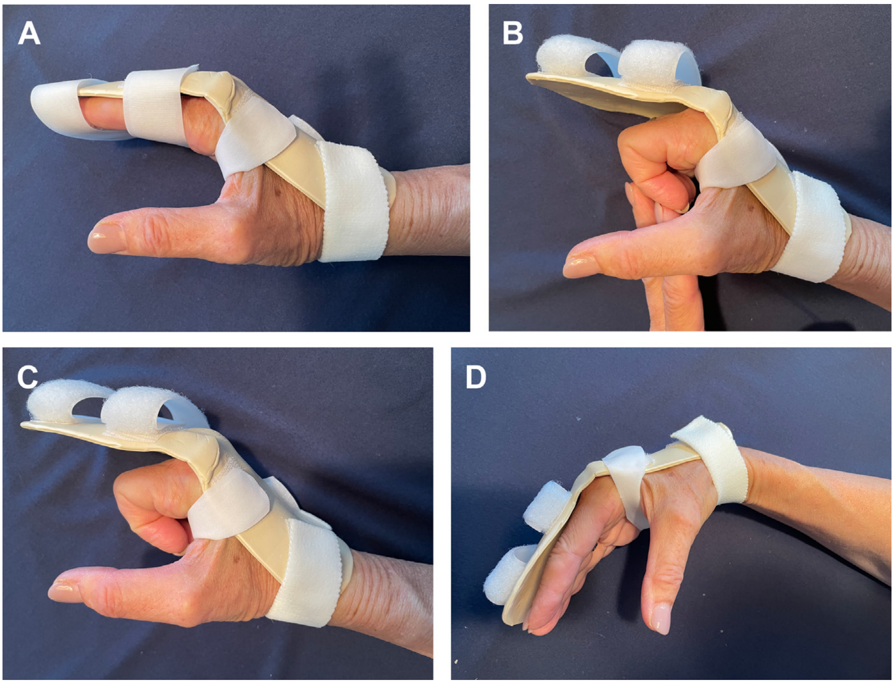

Fig. 4. (*A–D*) *Manchester program* (*A*) short orthosis allows full wrist flexion and 45° wrist extension: (*B*) Full passive IP joint exercises precede (*C*) active flexion performed in the Manchester orthosis with the wrist at the 45° allowed by the orthosis. (*D*) Finger extension with wrist flexed.

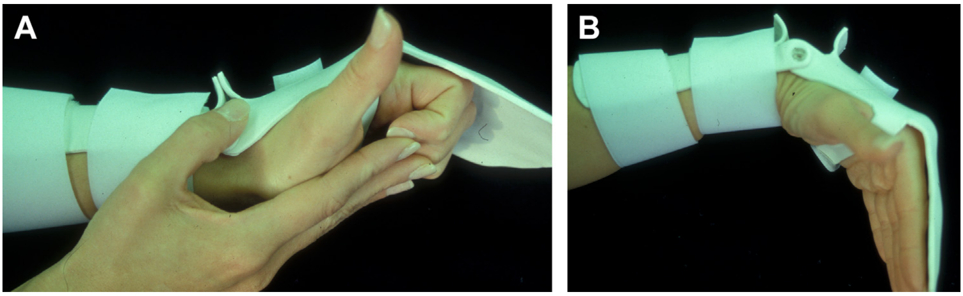

Fig. 5. (*A*, *B*) *Indiana program hinged wrist orthosis*. (*A*) The patient passively flexes the digits and actively extends the wrist to the 30° allowed by the orthosis with the MCP joints positioned at 45° to 60° of flexion; the patient then lightly holds the digits in the flexed posture. (*B*). Next the patient relaxes and allows the wrist to fall into flexion with the digits extending to the limits of the orthosis through tenodesis effect.

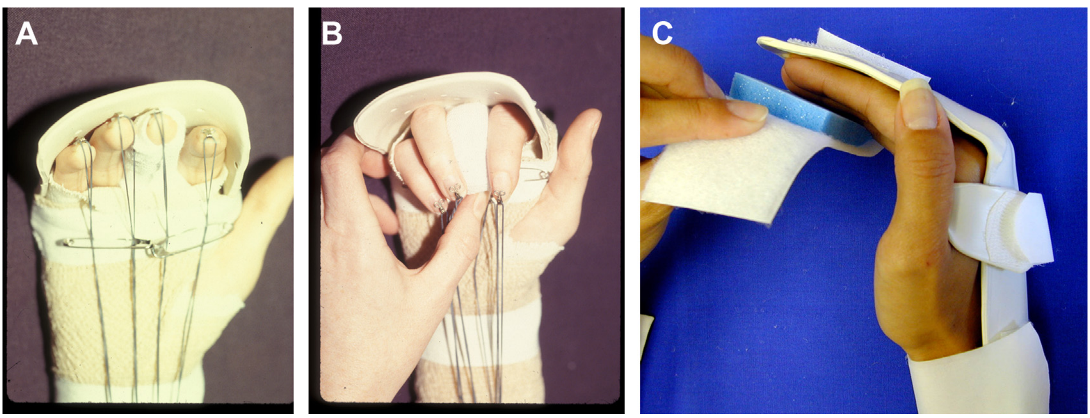

Fig. 6. (*A–C*) *Silferskiold program*.[17] (*A*) Finger extension against resistance of 4-finger elastic traction pulled to a volar attachment point. All 4 fingers are included; (*B*) fingers relax and are pulled back to a flexed position by the elastic traction with further manual passive flexion of the digits; With the passive flexion maintained, the patient attempts an active hold. No unassisted active flexion hold is allowed. (*C*) Elastic traction is released at night with Velcro strap in place to prevent flexion contractures from developing.

Fig. 7. (*A–C*) *RMF orthoses (RMFO) for zone I, II flexor tendon repairs*.[22] (*A*) RMFO positions the ring MCP joint in 30° to 40° flexion relative to the adjacent MCP joints; (*B*) close-up of RMFO; and (*C*) RMFO worn with a static prefabricated wrist orthosis with wrist at 0° to 20° of wrist extension.

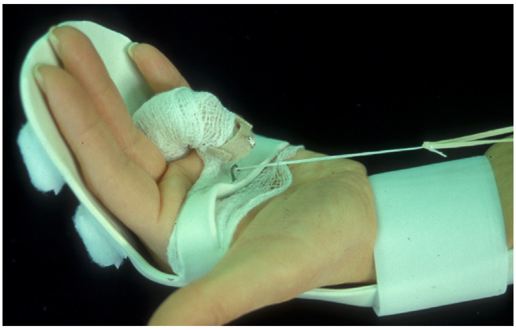

Fig. 8. *Washington regimen* combines the Kleinert and Duran program with the addition of a palmar pulley to increase DIP flexion/FDP excursion.

performed with the wrist flexed. Orthosis use continues until 6 weeks postoperatively.

Indiana Program:[16] This program incorporates 2 orthoses: a dorsal static protective orthosis with wrist at 15° to 30° extension, MCP joints at 45° of flexion and IP joints in extension; and a hinged wrist orthosis, which is worn during an active place and hold exercise. The hinged orthosis allows 30° of wrist extension and positions the MCP joints between 45° and 60° of flexion. Within the orthosis passive placement of the digits in a composite fist position is followed by passively extending the wrist. The patient then actively holds the fisted position. This is followed by relaxing the hand and allowing the wrist to drop into flexion (**Fig. 5**A, B). Exercises are advanced at 4 to 6 weeks.

Silfverskiold Program:[17] This program allows active extension and passive/active flexion. The DBO with wrist neutral and the MCP joints blocked at 60° is used. Elastic traction is attached to all digits pulled through a palmar pulley and secured to a proximal attachment point. Patient performs active extension against the resistance of the elastics within the orthosis; patient then relaxes allowing passive pull back into flexion by the elastics followed by further manual passive flexion to the distal palmar crease. The patient then attempts to hold the digits flexed with the simultaneous flexion positioning by the elastics (place and active assisted hold). The program is progressed after 4 weeks with unassisted active flexion and extension exercises (**Fig. 6** A–C).

Relative Motion:[22] A retrospective case series was published of FDP 4 strand repairs in zone I/II using a relative motion flexion (RMF) orthosis for 8 to 10 weeks in combination with a static dorsal blocking orthosis for the initial 3 weeks. The RMF orthosis positioned the involved digits MCP joint in 30° to 40° of flexion relative to the adjacent MCP joints (**Fig. 7** A–C). The DBO positioned the wrist at 0° to 20° of flexion. Both orthoses were used full time for the first 3 weeks. Exercises included passive composite IP joint flexion and active IP joint extension exercises to neutral with MCP joints flexed, and active finger motion in the RMF orthosis. At 3 weeks, the RMF orthosis continued full time and the DBO was worn at night and for selected “at risk” situations. At 6 weeks, the DBO was discontinued, and the RMF orthosis and all restrictions were discontinued between 8 and 10 weeks postop.

Passive Motion: Less widely used, these programs involve passive digit flexion with no active contraction of the flexor muscle tendon unit. Wrist position is fixed within a DBO.

Kleinert Program:[11] Introduced in 1977, this program was developed to influence adhesion formation to be elongated and less restrictive. Beginning within 24 hours postop, active blocked and resisted finger extension and passive flexion by elastic traction applied to the nail of the involved and adjacent digits (see **Fig. 1** A, B). Program is advanced at 4 weeks.

Duran protocol:[12] Introduced in 1975, this program was designed for repairs in zone 2 to prevent cross union between the flexor digitorum superficialis (FDS) and FDP. Passive DIP extension with the PIP and MCP flexed glides the FDP suture

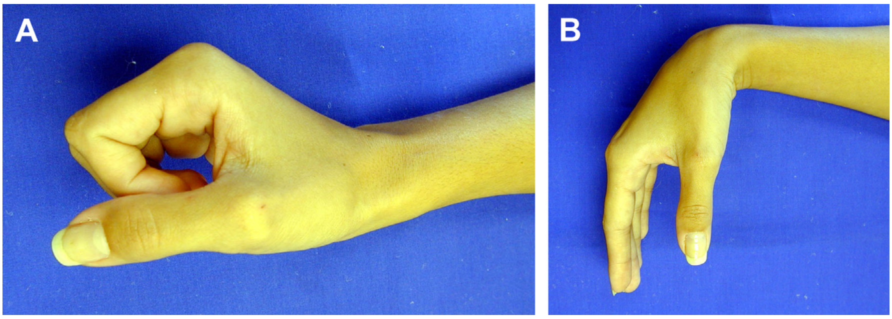

Fig. 9. Synergistic motion[26] is intended to produce a passive proximal glide of the tendon repair site through (*A*) extension of the wrist through a controlled range, resulting in a proximal pull on the tendon with resultant flexion of the digits. (*B*) As the wrist flexes, the fingers extend with the tendon repair site pulled distally.

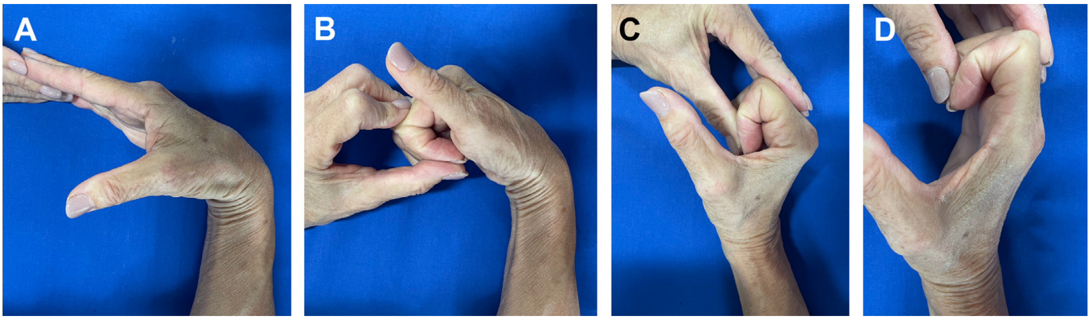

Fig. 10. Modified synergistic motion[27] developed to promote greater proximal pull on the tendon. (*A*) With the wrist flexed to 60°, passive MCP joint extension and PIP and DIP joints fully extended, the flexor tendon is pulled distally; (*B*) passive full flexion of the fingers with wrist flexed to 60°; and (*C*) extension of the wrist to 60° with fingers fully flexed, the tendon is pulled proximally. (*D*) Gradual extension of the MCP joints to 45° while maintaining flexion of the IP joints.

site away from the FDS suture site. Passive PIP extension with the MCP and DIP flexed glides both suture sites away from the injury site. The program is progressed at 4.5 weeks (see **Fig. 2**).

Washington Regimen:[13] A passive motion protocol that combines the Kleinert and Duran programs (**Fig. 8**).

Synergistic Motion:[26] A passive motion protocol designed to produce a passive proximal glide of the tendon repair site through extension of the wrist through a controlled range, resulting in a proximal pull on the tendon with resultant flexion of the digits. As the wrist flexes, the fingers extend with the tendon repair site pulled distally (**Fig. 9** A,

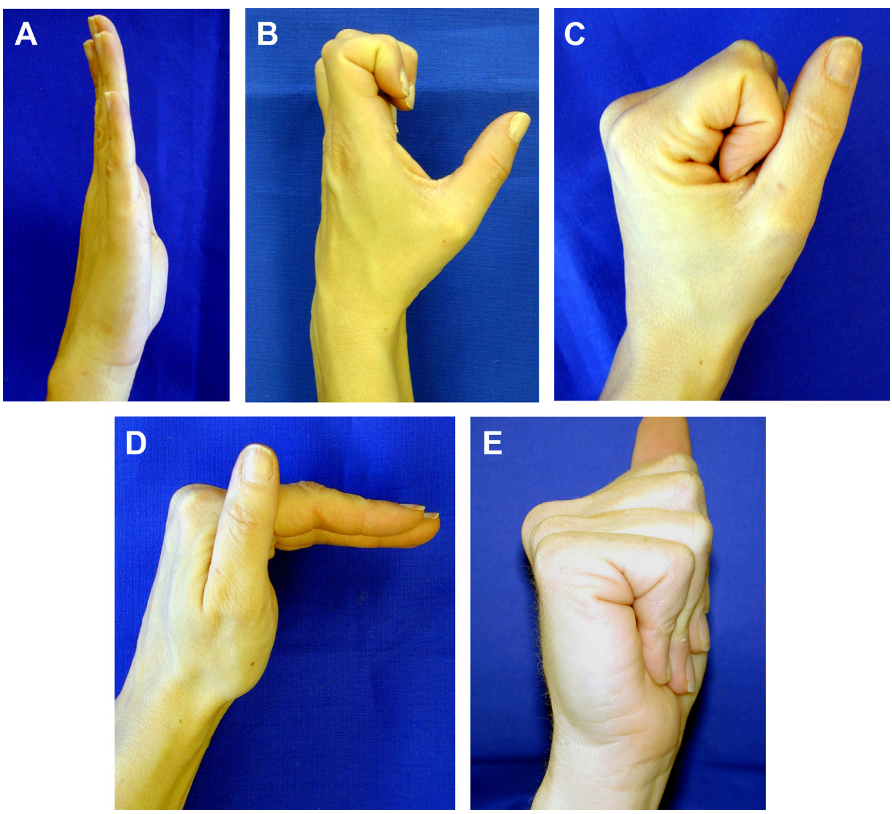

Fig. 11. *Tendon Gliding Exercises described by Hunter and Wehbe*[32,33] based on their study of FDP and FDS tendon gliding and differential gliding in different hand positions: (*A*) Full finger extension, (*B*) hook fist, (*C*) full fist, (*D*) tabletop position, and (*E*) straight fist. Hook fist requires maximum differential gliding between the FDS and FDP; full fist requires maximum FDP glide; and straight fist requires maximum FDS glide.

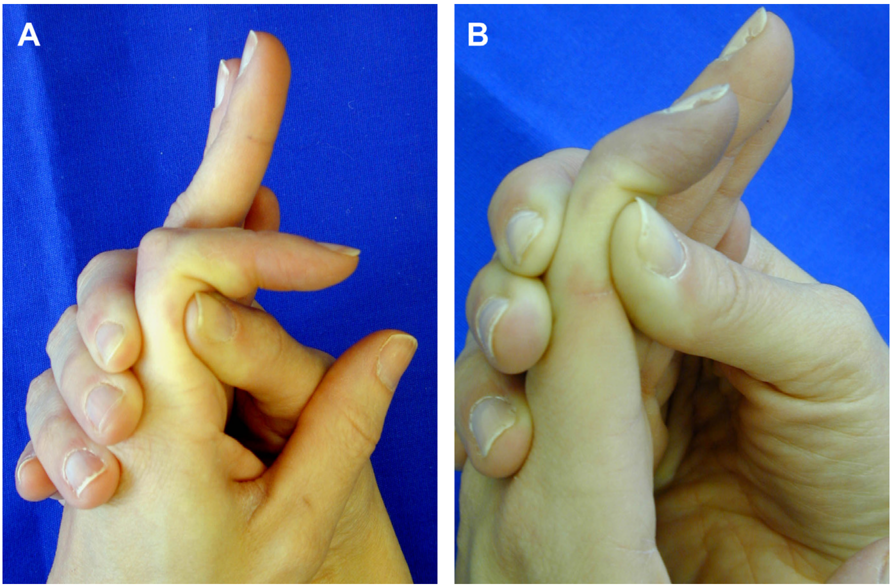

Fig. 12. Isolated joint/blocking exercises. (*A*) Manual or orthotic stabilization of the proximal phalanx with blocking of the MCPJ allows isolated motion of the PIP and DIP joints and promotes differential gliding of the FDP and FDS. (*B*) Manual or orthotic stabilization of the proximal and middle phalanges with blocking of PIP joint motion allows isolated DIP joint motion and promotes FDP glide.

B). *Modification of the synergistic motion approach*[27] was developed to promote greater proximal pull on the tendon by including passive MCP extension following wrist extension (Fig. 10 A–D).

Initial Immobilization: This protocol allows no active or passive motion for 3 weeks after tendon repair. Used for children or those incapable of complying with the early motion programs, or those with concomitant injuries, which preclude early passive and/or active motion. Cifaldi Collins and Schwarze[28] developed a protocol for tendons treated with initial immobilization.

CLINICAL REASONING/PROBLEM-SOLVING

Selection of postoperative protocol: In general, it is the surgeon's decision regarding the choice of the postoperative approach, whether passive, active, or active/passive based on the surgical procedure performed and the surgeon's assessment of the capacity of the repair to withstand

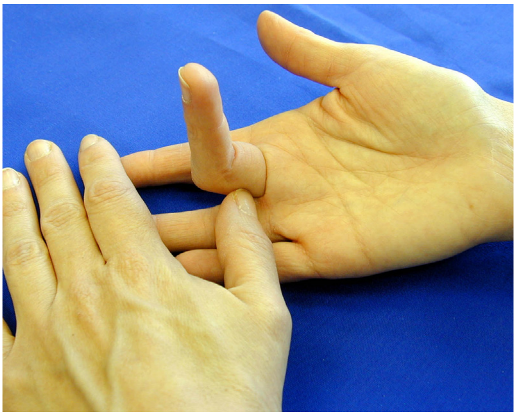

Fig. 13. Isolated FDS glide—Adjacent digits are held in extension with active PIP joint flexion of the involved digit isolating gliding of the FDS.

Fig. 14. Resistive fisting is composite flexion of the digits against a resistance such as graded putty.

the forces imparted to the tendon during motion. The knowledgeable therapist, who understands the extent of the injury and the procedures performed, will have valuable input and suggestions regarding the specific protocol chosen and any modifications, the progression of exercises, and feedback regarding the patient's response to therapy. Throughout the rehabilitation process, surgeon–therapist communication and collaboration is critical.

When to Start Motion

The early passive motion programs called for starting motion immediately[29] or within 2 to 3 days[11] after surgery. The more currently used active motion programs typically start within 3 to 5 days after surgery based on studies which examined when following tendon repair the work of flexion (WOF) was the least. WOF refers to the work required of the repaired tendon to actively flex the digit. Tendon loading must be great enough to overcome the WOF but if resistance to motion exceeds the repair strength, rupture or gap formation may occur. Factors that influence the WOF include internal factors such as surface friction and bulk effect of the tendon repair and adhesions and external factors such as edema, joint stiffness, and resistance of antagonist muscles. Zhao and Amadio[30] determined that the WOF was lowest at postoperative day 5 in a canine model with the best combination of tendon tensile strength and low peak resistance force at day 5 and the worst at day 7. Halikis and Manske[31] and colleagues found that a period of delayed mobilization before the institution of active motion protocols is beneficial in decreasing the forces need to flex the digit. Tendons immobilized for 3 days showed the least increase in the WOF compared with those started immediately and at 5 days.

Progression of exercises: The timetables included with the previously described clinical protocols are meant to serve as guidelines and not as rigid prescriptions for when different exercises may be introduced. Rather, clinical judgment and reasoning must be used based on patient's progress or lack of progress. A clinical reasoning approach termed Pyramid of Progressive Force Application has been described by Groth[23] to assist in the progression of exercise after flexor tendon repair. The system consists of a series of 8 exercises in a pyramid format. The base of the pyramid signifies exercises that impart the lowest level of force to the repaired tendon and the pinnacle of the pyramid imparts the maximum loads. Rather than emphasizing the time elapsed since surgery to introduce specific exercises, this model emphasizes a patient's individual tissue response as reflected in tendon excursion. Patients begin exercises at the lowest level and progress upward only as determined necessary to achieve the desired tendon gliding. Progression up the pyramid must be done with care and collaboration between the surgeon and therapist. The levels from least stressful to the most as described by Groth are as follows:

1. Passive protected digital extension
2. Place and hold finger flexion
3. Active composite fist
4. Hook and straight fist[32,33](**Fig. 11**A–E)
5. Isolated joint motion (blocking (**Fig. 12**A, B; **Fig. 13**).
6. Discontinuation of protective splinting
7. Resistive composite fist—Composite flexion of the digits against a resistance such as graded putty (**Fig. 14**)
8. Resistive hook and straight fist
9. Resisted isolated joint motion

Flexion contractures: Prevention is the best approach through careful orthosis fabrication and positioning of the involved digit. The fit of the DBO must be monitored on an ongoing basis at each therapy visit. If a contracture develops, emphasis can be placed on PIP joint extension

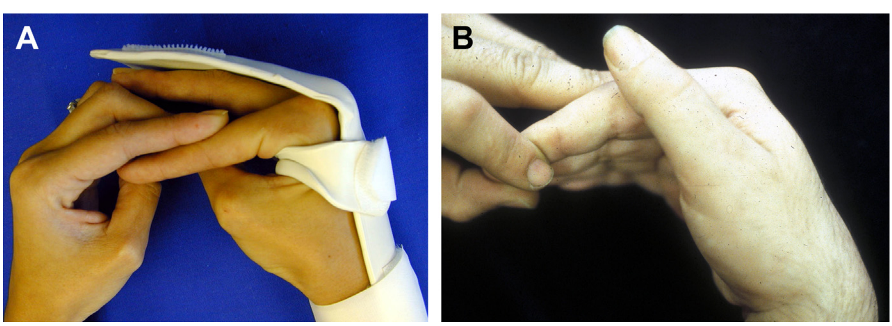

Fig. 15. In the case of a developing PIP joint flexion contracture, emphasis is placed on PIP joint extension performed with (*A*) the MCP joint flexed within a DBO and (*B*) outside of the orthosis.

exercises while the MCP joint is maintained in maximum flexion within the confines of the orthosis (**Fig. 15**).

SUMMARY

Rehabilitation after flexor tendon repairs is a challenging process. The repaired tendon must be simultaneously protected from disruption and moved in a controlled fashion. Although measures are necessary to protect the repaired structures, early controlled motion is required to enhance healing and function. Appropriate intervention at the correct phase of healing is based on an understanding of tendon healing and the factors that influence it. Coordination and communication between the surgeon and therapist is essential. Tendon injuries can profoundly affect hand function and appropriate rehabilitation is essential to preserve function to the fullest extent possible.

CLINICS CARE POINTS

- The goal of therapy after flexor tendon repair is the early restoration of tendon gliding while protecting the repair from rupture.
- The selection of a postoperative protocol after flexor tendon repair whether passive, active or active/passive is based on the surgical procedure performed and the surgeon's assessment of the capacity of the repair to withstand the forces imparted to the tendon during motion.
- Tendon protocols are meant to serve as guidelines and not as rigid timetables. Rather, clinical judgement and reasoning must be used to advance a patient's therapy program and should be based on patient progress or lack of progress.
- Immoderate tendon loading with exercises and use risks tendon rupture and therefore progression of the therapy program after flexor tendon repair must be done with care and collaboration between the surgeon and therapist.
- A not uncommon problem encountered after flexor tendon repair during the rehabilitation process is flexion contracture of the PIP joint of the involved digit. The first and best approach is prevention of contractures by careful orthosis fabrication and positioning of the involved digit. Ongoing monitoring of the fit of the dorsal block orthosis at each therapy visit is essential to prevent loss of appropriate positioning from the reduction in edema and dressings.

ACKNOWLEDGMENTS

None.

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