
Tendon Gliding Exercises

Marwan A. Wehbé

Key Words: exercise therapy • fingers • hand • tendon injuries

An exercise program for tendon gliding is introduced for use in hand treatment and rehabilitation. The program incorporates thumb range of motion and three basic fist positions: hook, fist, and straight fist. The anatomic and experimental basis of this program is discussed. The exercises allow the flexor tendons to glide to their maximum potential and can greatly facilitate therapeutic activities when incorporated in a comprehensive program of occupational and hand therapy.

Joint motion and tendon gliding are prerequisites for finger motion and the basis of any hand activity. In addition, tendon gliding dictates motion and strength and is, as a result, a major determinant of hand function.

The flexor tendons in each finger are encased in a sheath that holds the tendons snugly against each other and against the underlying bone. Tendon gliding translates into joint motion, and the maximum amount of tendon gliding is called tendon excursion. Since the muscle-tendon unit is elastic, tendon excursion varies with finger and wrist position as well as effort. The two flexor tendons in each finger have different excursions and can glide separately, which is called differential tendon gliding.

Trauma and disease often compromise the intricate arrangement of the flexor tendons, usually by producing adhesions. These adhesions bind a tendon to the neighboring sheath and bone, as well as to contiguous tendons, resulting in loss of tendon gliding and loss of joint motion and, therefore, loss of strength as well as dexterity. Many exercises have been used in the past to promote tendon healing and improve hand function (Bunnell, 1956). These exercises have been based on intuition, good judgment, and experience, but there has rarely been a scientific justification for them.

Napier (1956), who discussed patterns of hand function and finger position extensively, described three types of grip: power, precision, and hook. Power grip, or regular fist making, is a natural finger motion and is very widely used in hand exercise programs. Napier felt that the hook position had very limited use in everyday life, but hand surgeons and therapists have long used this finger position as an exercise (Mayo Clinic, 1982). The straight-fist position, which has not been described previously, is now introduced as an element of hand exercises; it holds the terminal joint (distal interphalangeal joint) extended while the other joints (metacarpophalangeal, and proximal interphalangeal) are flexed (Wehbé & Hunter, 1985b).

The extent of tendon excursion in vivo has only recently been determined (Wehbé & Hunter, 1985a). In that study, flexor tendons were tagged intraoperatively in one digit in each of 48 hands, with a buried wire suture. Radiographs taken postoperatively showed the amount of gliding of each tendon, with the digits and wrist in various positions.

The radiographs showed that the fist position provides maximum profundus tendon excursion (see Table 1). The straight-fist position provides maximum superficialis tendon excursion. The hook position provides maximum differential gliding by providing much more profundus than superficialis excursion. Thumb flexion is not as complex, since it involves only one flexor tendon, the flexor pollicis longus.

Marwan A. Wehbé, MD, is Medical Director, Pennsylvania Hand Center, PO Box 241, Bryn Mawr, Pennsylvania 19010.

Table 1
Flexor Tendon Excursions

Hand Position	FDS (mm)	FDP (mm)
Straight fist	28	27
Hook	13	24
Fist	23	34

Note FDS = flexor digitorum superficialis tendon FDP = flexor digitorum profundus tendon From "Flexor Tendon Gliding in the Hand. Part II Differential Gliding" by M. A. Wehbé and J. M. Hunter, 1985, *Journal of Hand Surgery, IOA*, p 577 Copyright 1985 by the *Journal of Hand Surgery*. Adapted by permission.

Maximum flexor pollicis longus gliding is obtained by flexing the interphalangeal and metacarpophalangeal joints of the thumb fully

This study also indicated that wrist motion and effort greatly amplify tendon excursion in the fingers as well as in the thumb (see Table 2) Making an effort while attempting to make each position also increases excursion, although not to the same extent as wrist motion (see Figure 1) When a fist is made, both the superficialis and profundus tendons glide proximally (see Figure 1A); when effort is added, the gliding increases further for both tendons (see Figure 1B) Wrist motion increases tendon gliding even to a greater extent than effort (see Figure 1C & 1D)

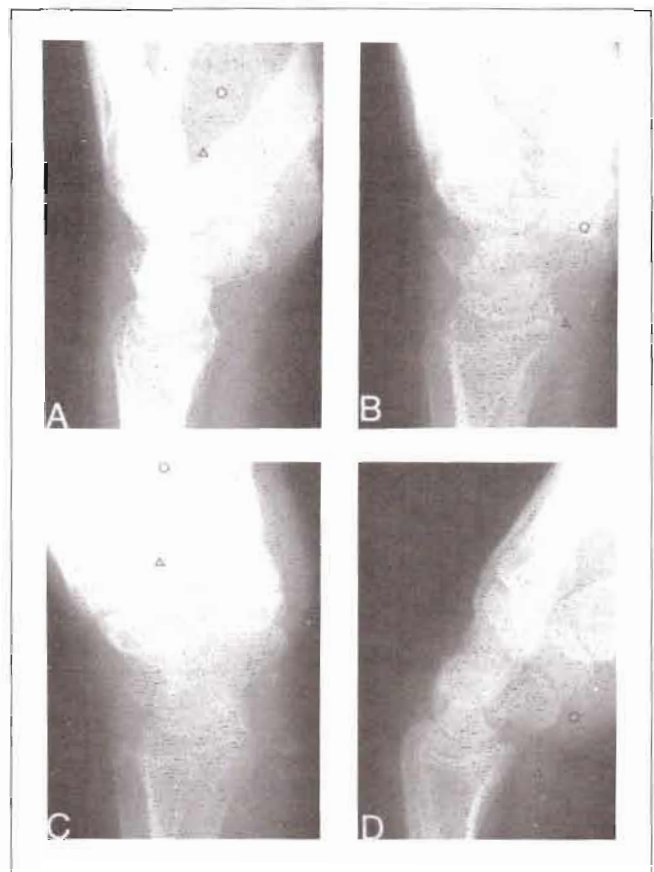
The author first presented the concept of differential tendon gliding exercises to the American Society for Surgery of the Hand in 1984 (Wehbé, 1984) The three finger positions described here were incorporated in an exercise program which is used for hand therapy and rehabilitation to prevent adhesions and to promote tendon healing (see Figure 2) The thumb is also taken through a full range of motion Range of motion exercises for the wrist and other joints are added as needed This program has since been adopted by hand surgeons and therapists (Jaeger & Mackin, 1984, Stanley, 1986) The patient initially does these exercises with the wrist in the neutral position, for simplicity But once the patient understands the exercises well and performs them easily,

Table 2
Effect of Wrist Motion and Effort on Flexor Tendon Excursion

Effect	FDS	FDP	FPL
Excursion with wrist neutral (mm)	24	32	27
Increase of excursion with wrist motion (%)	104	56	30
Increase of excursion with effort (%)	21	16	—

Note FDS = flexor digitorum superficialis tendon, FDP = flexor digitorum profundus tendon FPL = flexor pollicis longus tendon From "Flexor Tendon Gliding in the Hand Part I. In Vivo Excursions" by M. A. Wehbé and J. M. Hunter, 1985, *Journal of Hand Surgery, IOA*, p 573 Copyright 1985 by the *Journal of Hand Surgery*. Adapted by permission.

Figure 1
Radiographs Showing Excursion of Superficialis (○) and Profundus (△) Tendons: A, Light Fist; B, Tight Fist; C, Light Fist and Wrist Extension; D, Light Fist and Wrist Flexion



maximum effort and wrist motion may be incorporated in the program to further increase tendon excursion.

Because effort alone increases tendon gliding, it follows that a patient who makes an effort to do the tendon gliding exercises will receive the benefit of tendon excursion, even if joint motion is restricted (see Figure 3) When the patient attempts to make a hook, differential tendon gliding occurs (widening between tendon tags) even though range of motion is limited. When the patient makes a fist, overall excursion increases further for both tendons, but less differential gliding takes place. Arthritis is therefore certainly not a contraindication to doing the tendon gliding exercises. In fact, the exercises allow each joint in the digits to go through a full range of motion, thus improving cartilage nutrition and joint motion (American Academy of Orthopaedic Surgeons, 1984)

Tendon adhesions that may result after trauma or surgery or after subacute and chronic synovitis can be prevented or minimized by the use of tendon gliding exercises, which allow each tendon to reach its maximum excursion and promote differential gliding.


Figure 2
Patient Handout on Tendon Gliding Exercises, Designed by Author

Pennsylvania Hand Center Bryn Mawr, PA 19010. Tel. (215)525-1000


TENDON GLIDING EXERCISES

This exercise program is a very important part of your treatment.


There are three ways to make a fist:




STRAIGHT



HOOK



FIST



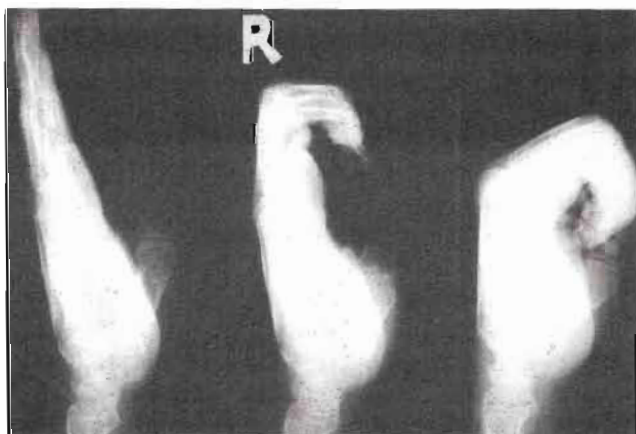
STRAIGHT FIST

1. Start with your fingers straight every time.
2. Make one type of fist at a time with your fingers.
3. Curl your thumb down in your palm as much as possible, then stretch it out as far as possible.
4. Do each exercise _____ repetitions, _____ times daily.

They can also improve synovial edema and diffuse hand swelling by mechanically displacing excess interstitial fluid.

Conventional blocking exercises can be used in conjunction with tendon gliding exercises. Blocking exercises can provide isolated gliding of the superficialis or profundus tendons, but these exercises provide markedly reduced excursion because of the restricted joint motion inherent to these maneuvers.

Figure 3
Radiographs Showing Excursions of Superficialis (○) and Profundus (Δ) Tendons in a Patient Who Is Unable to Make a Good Hook or Fist With His Hand



Bunnell's (1956) blocking exercise holds the metacarpophalangeal and proximal interphalangeal joints immobile, and the profundus blocking exercise to isolate superficialis tendon function also interferes with metacarpophalangeal flexion (American Society for Surgery of the Hand, 1983). Maximum tendon and joint motion can be obtained only with the tendon gliding exercises.

The tendon gliding exercises have the added benefit of forcing the extensor tendons to glide, producing isometric contraction of the extrinsic muscles and stretching of the intrinsic mechanism. These positions also provide maximum range of motion at each finger joint, as well as gliding of the extensor and intrinsic tendons. They are beneficial for stiff hands as a warm-up prior to occupational therapy. The exercises are particularly useful in the treatment of tenosynovitis and degenerative joint disease and after flexor and extensor tendon repair, tenosynovectomy or tenolysis, and tendon grafting, as well as in any situation in which joint or tendon adhesions are likely to occur.

As with any other exercise program, the criteria for the use of differential tendon gliding exercises are flexible. The frequency should be tailored to each person's needs. An average program may be 10 repetitions each, twice daily. The usual precautions of hand therapy apply; the tendon gliding exercises

should be avoided if there is an unstable fracture or if undue tension on a tendon repair is feared.

The tendon gliding exercises will, of course, not replace specific therapy, such as therapy needed for a single stiff joint. They can, however, be incorporated in therapeutic activities such as working with clay or wood to improve dexterity and strength. Tendon gliding exercises may be as important to the hand as aerobic exercise is to the heart.

References

- American Academy of Orthopaedic Surgeons. (1984) *Orthopaedic knowledge update I*. Chicago: Author.
- American Society for Surgery of the Hand. (1983). *The hand: Examination and diagnosis*. New York: Livingstone.
- Bunnell, S. (1956). *Surgery of the hand* (3rd ed.) Philadelphia: Lippincott.
- Jaeger, S. H., & Mackin, E. J. (1984) Primary care of flexor tendon injuries. In J. M. Hunter, L. H. Schneider, E. J. Mackin, & A. D. Callahan, (Eds.), *Rehabilitation of the hand* (2nd ed.) (pp. 261-272) St. Louis: Mosby.
- Mayo Clinic. (1982) *Patient handout*. (Available from Service of Hand Surgery, Department of Orthopaedic Surgery, Mayo Clinic, Rochester.)
- Napier, J. R. (1956) The prehensile movements of the human hand. *Journal of Bone and Joint Surgery*, 38B, 902-913.
- Stanley, B. G. (1986). Flexor tendon injuries: Late solution, therapist's management. *Hand Clinics*, 2, 139-147
- Wehbe, M. A. (1984) Differential tendon gliding in the hand. *Journal of Hand Surgery*, 9, 596.
- Wehbe, M. A., & Hunter, J. M. (1985a) Flexor tendon gliding in the hand. Part I. In vivo excursions. *Journal of Hand Surgery*, 10A, 570-574.
- Wehbe, M. A., & Hunter, J. M. (1985b). Flexor tendon gliding in the hand. Part II Differential gliding. *Journal of Hand Surgery*, 10A, 575-579.