CHAPTER **2**

REPAIR OF CHRONIC TENDON RUPTURES

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ANATOMY AND PHYSIOLOGY

Chronic tendon ruptures can occur with any tendon in the foot, ankle and leg. For a successful repair, it is necessary for the foot and ankle surgeon to understand the anatomy and physiology of tendons.

Tendons are the link between muscle and bone. They connect muscle to bone and transmit the force produced by muscle across joints. Tendons are flexible and relatively inelastic. They are composed of 30% collagen, 2% elastin, and 68% ground substance. The majority of collagen is type I. The collagen fibers are grouped together and form fascicles and a bundle of fascicles are surrounded by an epitenon to form a tendon. Tendons are smooth and are either flat or round (Figure 1).

The blood supply to tendons comes from 3 sources; 2 minor and 1 major. The 2 minor sources include vessels from the bone and periosteum near the insertion point and from the muscle belly. The major source comes from the vessels within the paratenon. It is important to preserve this structure because not only does it supply the blood supply to the tendon, it prevents formation of adhesions during tendon repair.

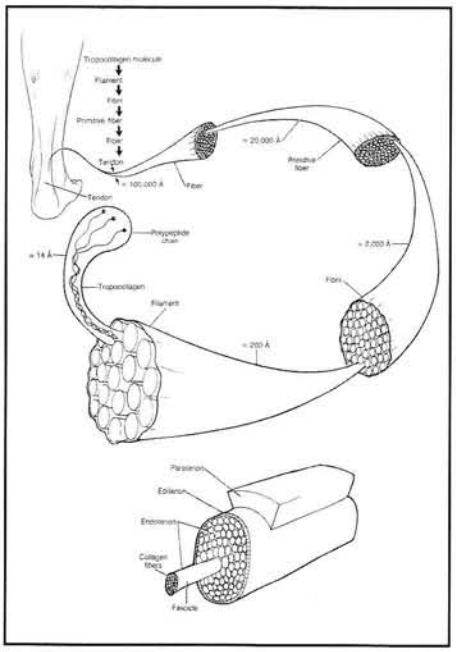

Figure 1. Tendon Anatomy (used with permission from "Principles of Muscle-Tendon Surgery and Tendon Transfer," McGlamry's Comprehensive Textbook of Foot and Ankle Surgery, vol. 2, third edition, Lippincott Williams & Wilkins, 2001.)

TENDON HEALING

There are 3 stages of tendon healing: inflammatory phase, fibroblastic phase, and remodeling phase. Tendons take approximately 4 weeks before healing is sufficient for gradual weightbearing to occur. During week 1, a fibroblastic splint develops between the two ends of the tendon. The fibroblastic splint is an inflammatory exudate that contains phagocytes that remove debris. During this phase, the overall strength of the tendon repair is equal to the suture.

During the second week, there is increased vascularity and proliferation of fibroblasts. The fibroblasts proliferate and form an amorphous mass to bridge the gap between the tendon ends. The overall strength of the tendon continues to be equal to the suture. Immobilization of the tendon repair is important during the first 2 phases in order not to disrupt the tendon repair.

During the third week, collagen fibers are formed and begin to align longitudinally to form new tendon fibers. Continued non-weightbearing of the repaired tendon is necessary; however, the new tendon fibers are strong enough to allow delicate active range of motion. The active range of motion increases the strength of the tendon and reduces adhesion formation.

During the fourth week, the collagen fibers continue to gain strength. At this time, the tendon is strong enough to allow protected weightbearing. Gradual return to full activity is imperative because at the four week mark, the tendon has not fully repaired. Weight bearing stimulates cross linkages between collagen fibers and this increases the tensile strength of the tendon. It takes approximately eight weeks for a tendon to completely repair and be able to withstand full muscle contraction during weightbearing.

TENDON REPAIR

Surgical repair of tendon ruptures depends on the quality of the tendon. Generally acute ruptures can be repaired end to end. The tendon ends are relatively strong; there is not development of fibrosis within the tendon ends. There are many suture techniques described in the literature that can be performed. Each technique has its advantages and disadvantages.

Chronic tendon ruptures require a different surgical strategy. Generally, there will be significant fibrosis in the ends of the tendon. The gap between the 2 tendon ends will contain tendon that is weak and inelastic. When surgically repairing chronic tendon ruptures, it is necessary to resect all fibrotic tissue between tendon ends. After resection of fibrotic tendon, there will be a void between tendon ends. There are times when the surgeon is able to perform an end to end repair. However, if the tendon ends are unable to re-approximate, a graft is necessary to bridge the gap between the tendon ends.

Autograft and allograft tendons can be used to repair chronic tendon ruptures. When selecting an autograft, it is necessary to select a graft that is similar in size. Any tendon in the foot and ankle can potentially be used for a graft. Plantaris, peroneus tertius, partial Achilles tendon, and peroneal brevis are some popular tendons that can be used to repair tendon ruptures. When harvesting a partial tendon graft, studies have shown that up to 60% of the tendon can be harvested without losing tendon strength or function of the donor tendon. The advantage of autograft tendon is the repair process is more rapid than allograft tendon. There is no tissue host response to the autograft tendon. The disadvantage of autograft tendon is that normal tissue must be sacrificed.

With advancement in technology, allograft tendon has become increasingly popular. Currently there are many types of tendon allografts that can used for the foot and ankle. The technique for tendon repair is the same as for autograft tendon. The allograft acts as a scaffold for the development of new tenocytes. The main advantage of allograft is the ability to repair a tendon without compromising normal tissue. However, the disadvantage for allograft is the potential of foreign body reaction and disease transmission.

POSTOPERATIVE MANAGEMENT

Cast immobilization is important for the tendon to heal and restore its vasculature. The cast can be removed after 3 weeks and a removable cast can be used. Continued nonweightbearing is necessary for approximately one additional week; however, beginning the third week, gentle active range of motion exercises against no resistance can begin. The early passive range of motion can help reduce tendon adhesions and help stimulate and strengthen the tendon.

CASE STUDY

A 59-year-old female presented to an emergency room with a laceration on the dorsum of the left foot. The laceration was primarily repaired in the emergency room. Approximately 2 weeks later, she noticed that she was starting to trip as the left hallux would catch the ground during early swing phase of gait. Physical examination revealed 2/5 muscle strength of the extensor hallucis longus (EHL). Past medical history revealed EHL rupture was as a result of the above stated laceration on the dorsum of the foot. Conservative treatment failed and the patient elected to have surgical intervention performed approximately 6 months post-injury. Treatment consisted of an autogenous graft from the peroneus brevis tendon to fill the gap created between the ends of the EHL. The following figures demonstrates the delayed repair of extensor hallucis longus with autogenous peroneal brevis tendon graft (Figures 1-4).

Postoperatively, the patient was placed in a below knee cast for 4 weeks. Physical therapy was instituted 6 weeks postoperatively to regain full strength of the EHL. The patient continued to progress well with full recovery of the EHL function and released after 4 months.

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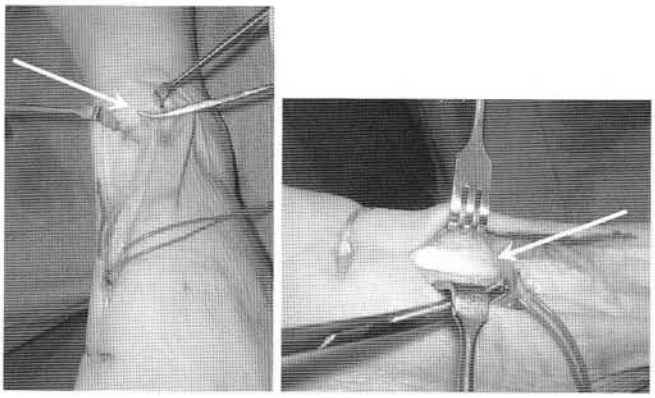

Figure 2. (Left) Incision approach and identification of proximal stump of lacerated EHL. (Right) Distal stump of lacerated EHL.

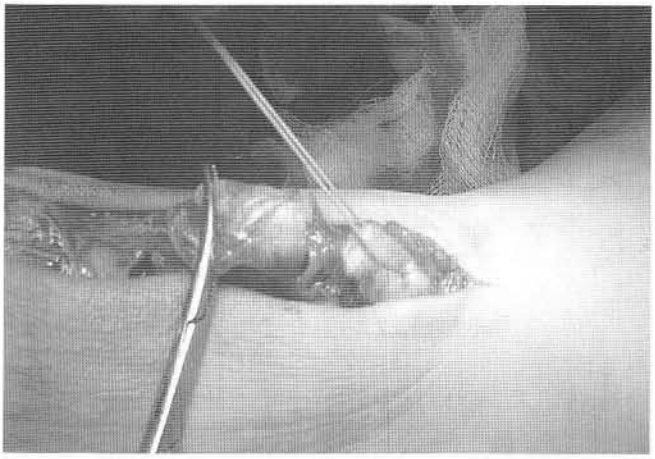

Figure 3. Resection of abnormal hypertrophic tendon.

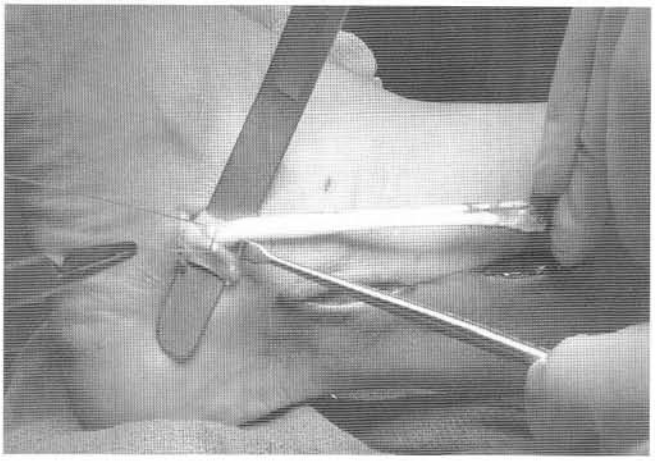

Figure 4. Harvest of peroneal brevis tendon.

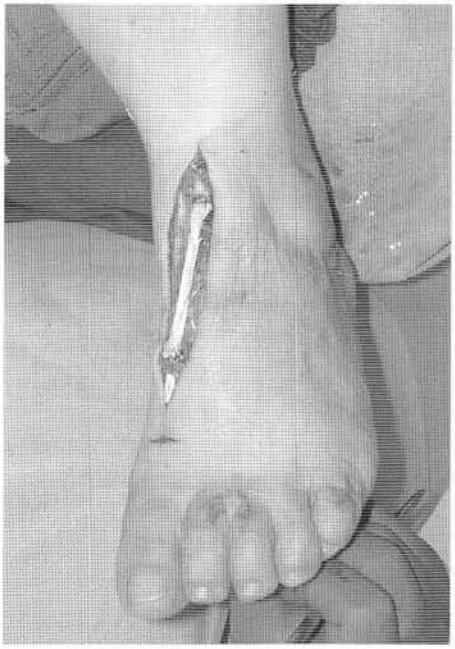

Figure 5. Anastomosis of tendon ends with autogenous peroneal brevis tendon graft.

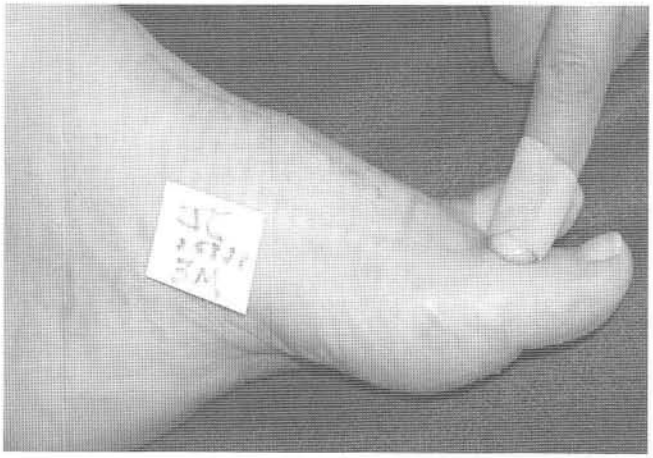

Figure 6. Three month postoperative clinical demonstrating active resistance of repaired EHL. Muscle strength revealed 4/5.