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Management of Neglected Tendo-Achilles Ruptures

An Essay Submitted For Fulfillment Of Master Degree
In Orthopedic Surgery

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Abstract:-

Ruptures of the Achilles tendon are especially common in middle-aged men who occasionally participate in sports. In some cases, a patient sustains a rupture, but this is not diagnosed and the patient presents with a chronic rupture four to six weeks later. Although there is still much controversy about how to manage acute ruptures, most surgeons agree that chronic ruptures should be treated operatively when possible, as they are associated with considerable functional morbidity. Several surgical methods have been described to address this problem such as lengthening flaps, V-Y plasty, and augmentation with tendon transfer, free graft; synthetic grafts or allografts, this augmentation is beneficial for the healing and the strength of the reconstructed Achilles tendon.

Key words: - Achilles tendon; neglected ruptures; reconstruction; management.

The Achilles tendon is the strongest and largest tendon in the body. It is the conjoined tendon of the gastrocnemius and the soleus muscles, and may have a small contribution from the plantaris **(O'Brien M, 2005).**

Although Achilles tendon is the largest tendon in the body it is vulnerable to injury because of its limited blood supply and combination of forces to which it is subjected. The sedentary life style results in decreased blood flow and nutrition to Achilles tendon, this situation is compounded by the effects of aging on the vascular supply. Recreational physical activities that intermittently stress the ischemic Achilles tendon, without giving it time to adapt may lead to spontaneous Achilles tendon rupture **(Siria et al. 1995).**

Most of the ruptures occur during sports activities mainly in males and usually at the age of 30-40 years and the rupture may be misdiagnosed because the patient is able to planterflex the foot with the toe flexors and peroneal muscles, so delayed or misdiagnosis of Achilles tendon rupture is relatively common, approximately 25% of all Achilles tendon ruptures **(Maffulli, 1999).**

Neglected or chronic Achilles tendon ruptures can be defined as ruptures with a time period greater than 4 weeks between injury and diagnosis **(Pintore et al. 2001).**

At about one week after rupture the tendon tissue will typically retract and atrophy to create a gap that will fill with fibrous tissue. Although the tendon may appear to have healed, the inability of the complex to produce tension in the over lengthened musculotendinous unit may impair the functional ability of this construct, so running, jumping and activities such as ascending or descending stairs are severely compromised **(Saltzman et al. 1998).**

Taking good history and specific physical examination are essential to make the appropriate diagnosis and facilitate a specific treatment plan **(Mazzone et al. 2002).**

Despite of the relative frequency of tendoachilles ruptures, the methods of treatment and the nature and the timing of rehabilitation remains a matter of controversy **(Tafuri et al. 2001).**

The treatment of a neglected Achilles tendon rupture presents as a challenge to the surgeon due to the retraction of the tendon. Surgical repair is the treatment of choice, due to the poor prognosis after conservative management **(Wapner et al. 1995)**.

Several surgical methods have been described to address this problem such as lengthening flaps, V-Y plasty, and augmentation with tendon transfer, free graft or synthetic grafts, this augmentation is beneficial for the healing and the strength of the reconstructed Achilles tendon.

AIM OF THE WORK

The aim of this essay is to discuss the recent modalities of diagnosis and management of neglected Tendoachilles ruptures and focusing on the advantage and the disadvantage of surgical procedures used in treatment of this problem.

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Anatomy of Achilles tendon: -

The formation of the Achilles tendon from the gastrocnemius and soleus muscles has been described in detail by **Cummins et al. (1946)**. The medial and lateral heads of gastrocnemius arise from the femoral condyles and their contribution to the Achilles tendon commences as a wide aponeurosis at the lower ends of these muscular bellies. The soleus arises entirely below the knee, largely from the tibia and fibula, and its tendinous contribution to the Achilles is thicker but shorter. A broad sheet of connective tissue begins on the posterior surface of the soleus muscle belly, at a position more proximal than the start of the aponeurosis of gastrocnemius (Fig.1).

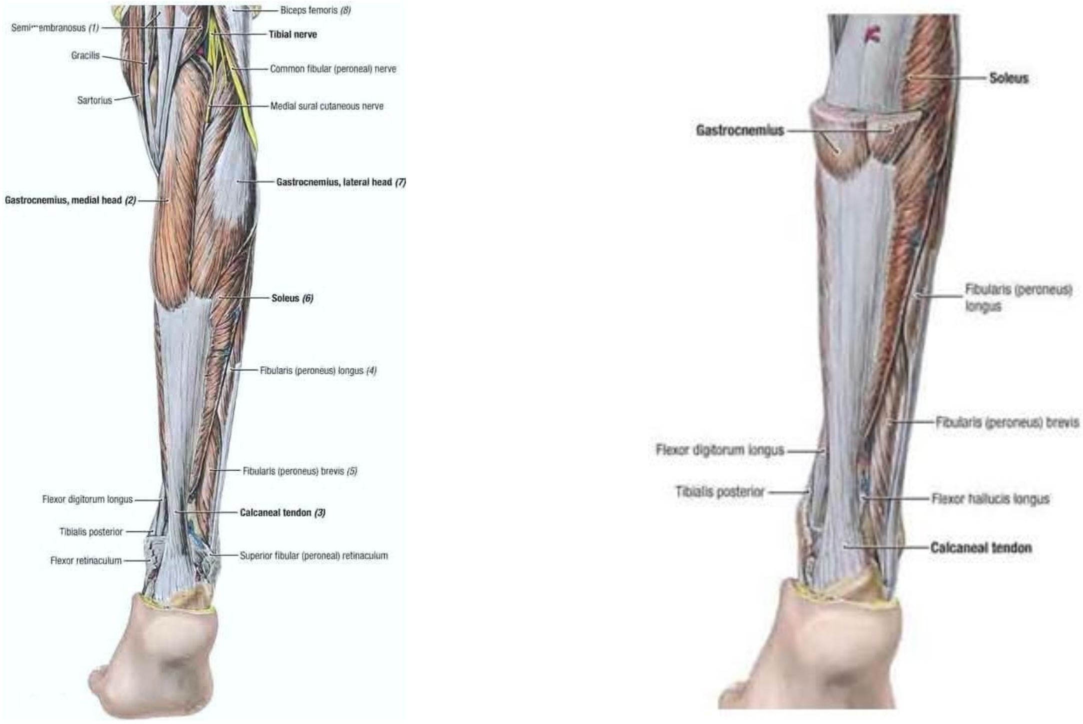

Fig. 1. Muscles of the posterior compartment of leg **(O’Brien M, 2005).**

The sheet of connective tissue on the posterior surface of soleus is attached to the gastrocnemius aponeurosis by fascia at a variable point near the middle of the calf. The combined aponeurosis continues to run distally over the posterior surface of the soleus, receiving further tendinous contributions from the muscle as it descends. Full incorporation of the soleus and gastrocnemius tendons into the Achilles tendon is evident 8–10 cm above the calcaneal attachment site, but occasionally the tendon of soleus can remain separate from that of gastrocnemius as far as the insertion itself **(Mellado et al. 1998).**

As the tendon fibers derived from gastrocnemius and soleus descends, they converge so that the Achilles tendon narrows. However, the fibers of gastrocnemius rotate around those of soleus, so that they ultimately come to be attached to the calcaneus laterally, whereas those of soleus (which also rotate) attach more medially. This rotation becomes more obvious in the terminal 5–6 cm of the tendon. The spiraling of the tendon fascicles results in less fiber buckling when the tendon is lax and less deformation when the tendon is under tension. This reduces both fiber distortion and interfiber friction **(Ahmed et al. 1998).**

The shape of the Achilles tendon varies considerably from proximal to distal. As with many tendons elsewhere in the body, the Achilles tendon flares out as it nears its bony attachment site. This contributes to the marked anterior-posterior flattening, and slight anterior concavity of the tendon, evident at the level of its enthesis. Typically, the distal part of the tendon does not exceed seven millimeter in thickness and anything greater than that is suggestive of pathology **(Sadro et al. 2000).**

At the insertion site itself, where the tendon is extremely flattened, it is approximately 3 cm wide and 2–3 mm thick. The Achilles tendon lacks a true synovial tendon sheath but has a false sheath or “paratenon” that forms an elastic sleeve permitting the tendon to glide relative to adjacent structures. The paratenon essentially consists of several closely packed, membranous sheets of dense connective tissue that separate the tendon itself from the deep fascia of the leg. It is rich in blood vessels and nerves and, together with the epitenon, which adheres to the surface of the tendon itself, is sometimes referred to as the peritenon. It can stretch 2–3 cm as the tendon moves **(Koch & Tillmann 1995).**

The deep fascia of the leg immediately superficial to the sheath of the Achilles tendon fuses with the tendon sheath near the calcaneus, and serves as a retinaculum for the tendon. It thus contributes to the slight anterior curvature of the tendon and prevents the tendon from bowstringing in a plantar flexed foot Thus; it plays an important role in minimizing insertional angle changes that occur at the enthesis during foot movements. This in turn reduces wear and tear **(Loetzke, 1956 & Schnorrenberg, 1962) .**

The sural nerve lies in close contact with the Achilles tendon sheath and commonly crosses its lateral border approximately 10 cm above the tendon enthesis **(Webb et al. 2000).**

The vestigial muscle belly of plantaris arises adjacent to the lateral head of gastrocnemius and its long tendon runs along the medial side of the Achilles tendon to end in a variable fashion. Usually, it attaches to the calcaneus on the medial side of the Achilles tendon (47% of cases according to Cummins et al.) but in 36.5% of the 200 specimens with a plantaris tendon examined by these authors, the tendon inserts slightly anterior to the medial aspect of the Achilles. In the third variation of the plantaris insertion reported in 12.5% of cases the tendon fans out distally to invest the posterior and medial aspects of the Achilles tendon. Finally, in 4% of individuals, the plantaris tendon fuses with the Achilles tendon proximal to the calcaneal attachment **(Cummins et al. 1946)**.

The Achilles tendon is surrounded by two bursae near its calcaneal insertion site, a superficial bursa between the skin and the tendon that promotes skin movement and a deep (retrocalcaneal) bursa between the tendon and the superior calcaneal tuberosity that promotes tendon movement. Into the retrocalcaneal bursa there is a wedge-shaped, fatty, synovial-covered fold that represents the distal tip of Kager's fat pad which is a mass of adipose tissue between the flexor hallucis longus muscle and the Achilles tendon **(Frey et al. 1992).**

The Achilles tendon attaches to a rectangular area in the middle third of the posterior surface of the calcaneus with a greater surface area of the tendon attached medially than laterally the tendon flares out considerably at its enthesis, dissipating the region of stress concentration. Four zones of tissue have been described at the enthesis itself: dense fibrous connective tissue, uncalcified fibrocartilage, calcified fibrocartilage, and bone **(Benjamin & McGonagle 2001)**.

There is absence of any substantial layer of cortical bone beneath the Achilles tendon enthesis However, there is a highly ordered array of trabeculae orientated along the long axis of the Achilles tendon, linking the tendon enthesis to that of the plantar fascia. The trabecular pattern suggests that there is a line of force transmission within the bone, linking these two soft tissues. In younger individuals, in particular, there can also be soft tissue continuity between the Achilles tendon and the plantar fascia **(Milz et al. 2002).**

Blood Supply of Achilles tendon:-

The Achilles tendon receives part of its blood supply from vessels running in the paratenon that are largely derived from the posterior tibial artery **(Carr & Norris 1989 – Schmidt Rohlfing et al. 1992).** The vessels enter the tendon via a structure that is comparable to a mesotenon. The mid-region of the tendon is relatively poorly vascularized and this may contribute to the vulnerability of the tendon to rupture, 2–6 cm above the calcaneus. The proximal part of the tendon receives an additional supply from the muscle bellies that continues into the tendon via the endotenon, but this contribution is not believed to be significant. The distal region of the tendon also receives vessels from an arterial periosteal plexus on the posterior aspect of the calcaneus. This supply starts at the margin of the insertion and extends up the endotenon for approximately 2 cm proximally **(Zantop et al. 2003).**

Innervations of Achilles tendon:-

The Achilles tendon is supplied by sensory nerves from the contributing muscles and via twigs from neighboring cutaneous nerves, notably the sural nerve. The paratenon is more richly innervated than the tendon itself, and it contains Pacinian corpuscles, presumably important in proprioception **(Stilwell, 1957 & Lang, 1960).**

Jozsa et al., 1997 studied human tendons anatomy and physiology and found that there are four types of receptors. Type I, Ruffini corpuscles are pressure receptors that are sensitive to stretch but adapt slowly. Type II, Vater-Pacinian corpuscles are activated by any movement. Types III, the Golgi tendon organs, are mechano- receptors monitor increases in muscle tension, rather than length. Type IV receptors are the free nerve endings that act as pain receptors.

Structure of the Achilles tendon Midsubstance: -

As with all tendons, the Achilles tendon is dominated by type I collagen, which accounts for its considerable tensile strength **(Waggett et al. 1998).**

Type I collagen fibrils are grouped successively into fibers, fiber bundles, and fascicles, so that a tendon is analogous to a multistranded cable **(Birk et al. 1990).**

Although the normal Achilles tendon consists almost entirely of type-I collagen, a ruptured Achilles tendon also contains a substantial proportion of type-III collagen. Fibroblasts from ruptured Achilles tendons produce both type-I and type-III collagen on culture. Type-III collagen is less resistant to tensile forces and may therefore predispose the tendon to spontaneous rupture (**Waterston and Maffulli, 1997**).

The normal Achilles tendon shows a well organized cellular arrangement. Tenocytes, which are specialized fibroblasts, appear in transverse sections as stellate cells with a broad, flat cell processes that extend laterally from the cell bodies and partition the collagen fibers into bundles, and these cells arranged in rows in longitudinal sections **(McNeilly et al. 1996).**

Biomechanics of the Achilles tendon:-

Tendons act as contractile force transmitters enabling skeletal movement. Fulfilling this role, however, tendons do not behave as rigid links between muscles and bones, but exhibit a viscoelastic behavior**.** The gastrocnemius-soleus musculotendinous unit spans the knee, tibiotalar (ankle), and talocalcaneal (subtalar) joints. Contraction of this complex flexes the knee, plantar flexes the ankle, and supinates the subtalar joint **(Saltzman and Tearse et al., 1998).**

Role of Achilles tendon in the gait cycle:

The gait cycle consists of a stance phase (62%) and a swing phase (38%), the stance phase consists of heel strike, foot flat, heel rise, push off, while, the swing phase consists of acceleration, toe clearance, deceleration (fig.2) (**Waters et al., 1978).**

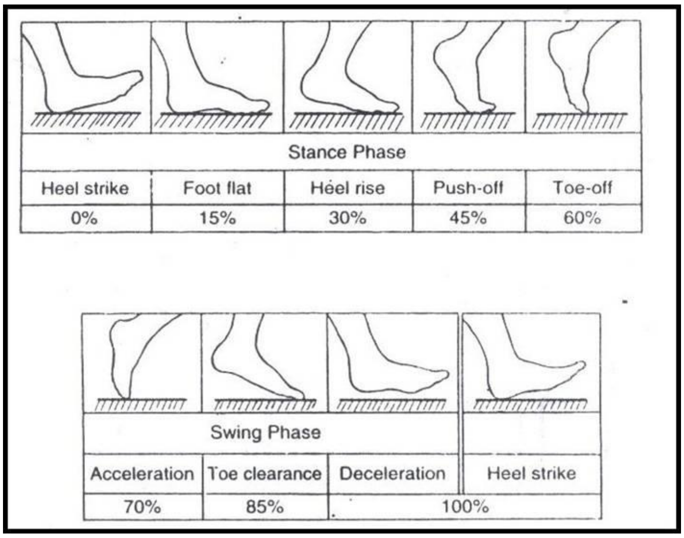

Fig.2: The normal gait cycle 62% spent in stance phase and 38% in swing phase **(Waters et al., 1978)**.

The gastrocnemius soleus unit plays an important role in the normal gait cycle. During the heel strike phase the tibialis anterior contracts as a part of the peritibial musculature to slow down the descent of forefoot and prevent foot