

# AUGMENTATION OF THE NEGLECTED ACHILLES TENDON RUPTURE REPAIR WITH USE OF THE RESTORE PATCH™

*Keith F. Tyson, DPM*

## INTRODUCTION

The functional benefits of surgical treatment of Achilles tendon ruptures have been noted, with a lower rate of rerupture after this treatment.<sup>1</sup> However, despite sophisticated diagnostic techniques, there are still patients in whom the original diagnosis is missed or who never sought acute medical treatment. Incorrect diagnosis of a ruptured Achilles tendon has been reported to occur 25% of the time.<sup>2</sup> Altered ambulation in these patients usually resumes after the acute discomfort dissipates. This increases the gap and atrophy between tendon ends, as well as filling with poorly organized fibrovascular tissue. This makes treatment as well as diagnosis more difficult.

Chronic ruptures of the Achilles tendon can be very debilitating injuries, which in the past have proven to be difficult to treat effectively. There is usually a considerable amount of gap between the ends of the tendon, retraction, and scarring of the calf muscles. The terms chronic, neglected, and late repair have all been used to describe the delay in diagnosis prior to treatment or the actual treatment itself. A literature review of this topic fails to provide a specific number of weeks before an Achilles tendon rupture is considered to be "chronic." However, 4 weeks is the most often cited amount of time.<sup>3</sup>

The diagnosis of a chronic Achilles tendon rupture may be difficult. Unlike the familiar acute rupture, the chronic rupture may not present with pain, a palpable defect, or instability. These patients often present with muscle atrophy as well as endurance complaints. Defects that were previously palpable may have now been filled with fibrotic debris, making the diagnosis more problematic. Upon physical examination, weakness of the triceps surae maybe masked, secondary to recruitment of other ankle plantarflexors, including tibialis posterior, long flexors, and peroneus brevis.

Chronic tears of the tendon result either in

lengthening of the tendon from progressive microtears and scarring, or in a large fixed gap from a complete rupture with secondary contraction of the gastrosoleus complex.<sup>4</sup> Neglected ruptures must be approached in a different manner. The scar tissue will heal poorly compared with acute ruptures, retraction of the tendon ends will be accentuated with ambulation, and the resultant gap may fill with fibrovascular tissue that is poorly organized and has poorer tensile strength. The late sequelae of neglected Achilles tendon ruptures is often a patient with an apropulsive gait. The ability to produce tension in an over-lengthened musculo-tendinous unit has shown to be poor. Elftman<sup>5</sup> stated that the most important characteristic of a muscle fiber is its length at time of excitation. The length of the muscle fiber determines its ability to produce tension. Therefore, the patient with an over-lengthened posterior muscle group secondary to neglect will ambulate in an apropulsive manner.

## Techniques for Repair

Various techniques have been described to address the dilemma of neglected Achilles tendon ruptures. These include gastrocnemius recession, tendon transfers, allografts, or synthetic augmentation. Various gastrocnemius recession procedures have been described. These procedures will not be discussed in detail in this article, but they all have a similar goal in mind, to bridge the deficit in tendon continuity and provide a gliding action in the overlying skin envelope. Tendon transfer possibilities include peroneal brevis,<sup>6</sup> fascia lata, flexor hallucis longus, and tibialis anterior, however these procedures can be difficult and are not performed without later sequelae. Synthetic materials such as a Dacron vascular graft, absorbable polymer carbon fiber, and Marlex mesh have all been described with varying amounts of success. In this article, a new technique for augmentation of neglected Achilles tendon ruptures repairs will be described utilizing the Restore Patch™ synthetic graft.

### The Restore Patch™

The Restore Patch™ is made from porcine small intestinal submucosa (SIS). It is a naturally occurring extra-cellular collagen-based matrix, which is a non-cross-linked agent. The graft comes in a 10-ply, 2.5 inch diameter circular sheet. It contains cytokines and growth factors and has been shown to act as resorbable scaffold *in vivo* that promotes host soft tissue regeneration with little scar tissue formation. Successful applications of SIS in animals have included rotator cuff repair, abdominal and bladder wall repair, as well as restoration of spinal ligaments. Several studies have been performed to evaluate the composition of SIS. The collagen content represents >90% of the dry weight of the SIS. The types of collagen that exist within the matrix are Type I, III, IV, V, and VI. Five glycosaminoglycans are present within SIS, including chondroitin sulfate and hyaluronic acid.<sup>7</sup> The growth factors that exist include fibroblast growth factor-2 and transforming growth factor- $\beta$ .

In 1999, Badylak et al examined the utilization of SIS in musculoskeletal repair and in particular the histopathologic results.<sup>8</sup> Their research showed that any inflammatory response that was created by the host disappeared in the later stages of remodeling, and that the histologic appearance of the SIS versus the control was indistinguishable at 12 months. In an earlier study by Badylak et al, an evaluation of the tissue response to SIS was performed when used to repair an experimentally induced Achilles tendon defect in dogs.<sup>9</sup> They sectioned 1.5 cm of Achilles tendon, and repaired it with SIS. Then the animals were sacrificed and the neotendons were examined for uniaxial tensile strength, morphologic appearance, collagen content, and the disappearance of originally implanted SIS material over time. The most dramatic result that they discovered was the amount of connective tissue that was present between the 4 and 8 week time points. This amount of time correlates with the removal of external bracing. In determining the ultimate strength of the tendon, the remodeled tendon proved to be stronger than the origin or the bony insertion. They found it to impossible to determine the total strength because the failure point was not within the remodeled tendon tissue itself. Their immuno-histochemical studies suggested that the SIS material became degraded within the first 8 weeks, and served as temporary scaffold around which the body deposited appropriate organized tissue. In addition, SIS was not associated with complications such as infection, foreign body reaction, or disorganized scar tissue formation.

### Operative Technique

The operation is performed with the patient in a prone position under general or spinal anesthesia. A pneumatic thigh tourniquet may be used unless contraindicated. A 10-15 cm incision is made from the middle one-third of the leg to the insertion of the Achilles tendon. The incision is deepened to the level of the paratenon with care taken to identify and retract the small saphenous vein and the sural nerve. The paratenon and deep fascia is then incised longitudinally and all fibrotic scar tissue is debrided to the level of viable tendon or muscle. The deficit is then measured with the foot in the desired postoperative position or slight equinus. The procedure of choice for repair of the rupture is performed, and the ends of the tendon are reapproximated. At this point, the tendon is now ready for the application of the Restore Patch™. Preparation of the graft is then performed. The graft is opened, and placed in a basin of normal sterile saline, and allowed to soak for 7-10 minutes. The graft is removed, and placed between 2 moist sponges. The patch is then placed on the repair and the repaired tendon is enveloped within the graft. Small dimples are observed on the surface of the Restore Patch™, these are due to the drying process. To determine adequate tension on the graft, the dimples should disappear upon application. The graft is then tagged into place utilizing either 0 or 2-0 nonabsorbable suture. The deep fascia is then closed utilizing a 2-0 absorbable suture in an over-and-over type fashion. Wound closure by layer is then completed.

### SUMMARY

Neglected Achilles tendon ruptures present a difficult scenario for the podiatric physician. There are several different theories described in how to treat these patients, however; the end goal is similar: to enable the patient to ambulate with a plantigrade foot with a small chance of rerupture. This may be accomplished via free tendon grafts, tendon transfers or gastrocnemius recessions. When using any of these techniques in order to optimize the repair, augmentation may be used, and the Restore Patch™ is graft that allows for host cell migration and differentiation, resulting in a tissue that is structurally and functionally similar to the original host tissue.



Figure 1.

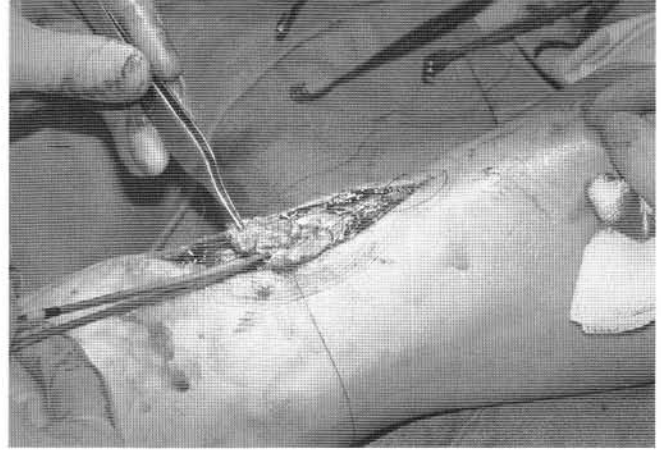


Figure 2.



Figure 3.

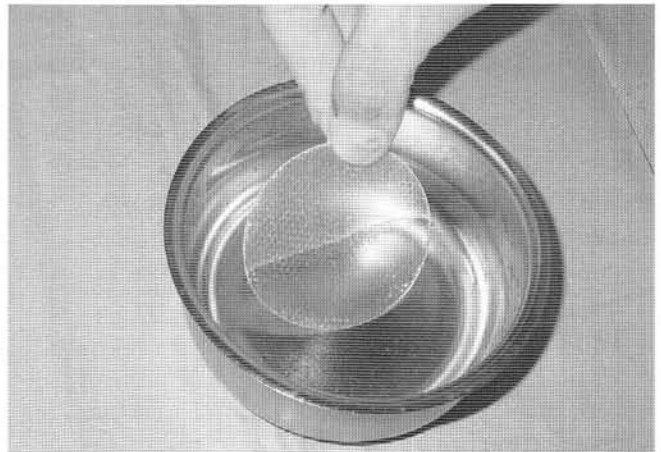


Figure 4.

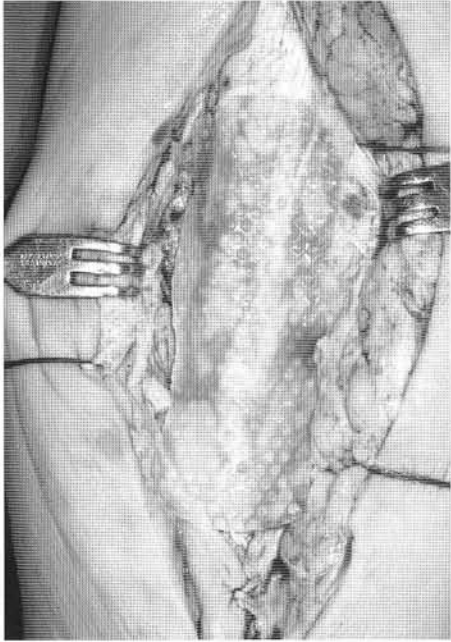


Figure 5.



Figure 6.

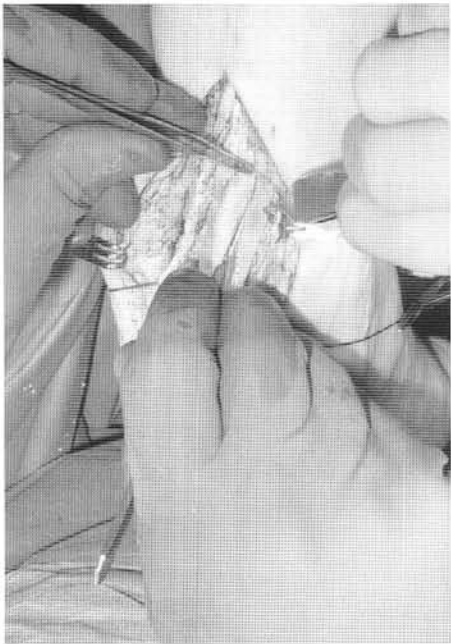


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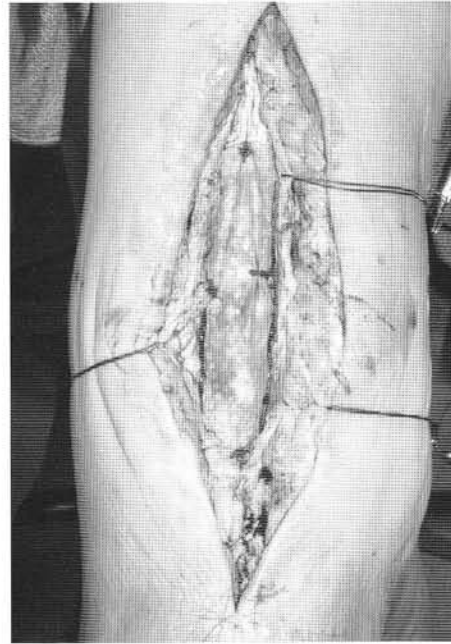


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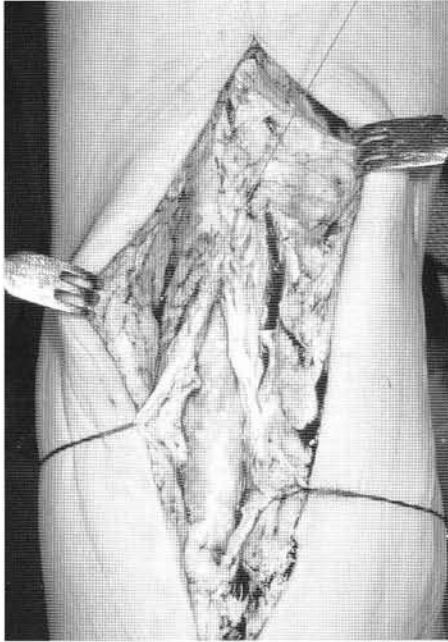


Figure 9.

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