Chronic Achilles Tendon Ruptures

Jean-Luc Besse, MD, PhD
- Hospices Civils de Lyon, Centre Hospitalier Lyon-Sud, Service de Chirurgie Orthopédique et Traumatologique, 69495 Pierre-Bénite Cedex, France
- Université Lyon 1, IFSTTAR, LBMC UMR-T 9406 - Laboratoire De Biomécanique Et Mécanique Cedex, France

Abstract
A wide spectrum of Achilles tendon disorders are common, related to increased sports activities in developed countries. Consequently, the incidence of acute and chronic rupture and tendinitis is increasing. For chronic ruptures, several treatment options are available, ranging from conservative management to complex surgical reconstruction procedures such as Achilles tendon augmentation or tendon transfer.

Key-words: Achilles tendon, chronic rupture, surgical procedures.

ETIOLOGIES
The concept of chronic rupture covers 3 situations:
- acute Achilles tendon rupture that goes undiagnosed either from inattention to pathognomic signs (deficit of physiological equinus in ventral decubitus and Thomson's manoeuvre), or from misdiagnosis as partial rupture, often due to a complementary ultrasound scan
- iterative rupture, often following conservative management by cast immobilisation (10-15%) or functional treatment (5-15%), but also percutaneous surgery (4-10% in Tenolig's reports) or, much less frequently, open surgery (<2%);
- Achilles tendon elongation, due to faulty conservative or surgical management: posterior below-knee cast with insufficient equinus, lack of patient cooperation, or too early rehabilitation.

DIAGNOSIS
Treatment of chronic rupture involves specific issues when diagnosis is made more than 2 months after trauma. Until the 3rd month, simple open surgical repair is possible.
• Functional impairment varies from patient to patient and due to loss of impulsion force.
• Clinical diagnosis is straightforward: any increased passive dorsiflexion in the affected as compared to the contralateral foot is the sign of an Achilles tendon that is elongated or ruptured.
• Ultrasound can confirm diagnosis in case of doubt. Systematic preoperative MRI is recommended to assess the extent of the defect, and its location with respect to the calcaneal.

**TREATMENT INDICATIONS**

• **Non-surgical treatment**
  Given the functional disturbance caused by neglected rupture, non-surgical management is appropriate only in case of specific contraindication: arteriopathy, diabetes with associated neuropathy and/or arteriopathy, longcourse corticotherapy, advanced age, etc...

• **Surgical treatment**
  Unless specifically contraindicated, surgery is the attitude of choice. It may consist in partial resection of fibrosis and end-to-end suture; but this entails a risk of secondary distension, so that real tendon reconstruction is to be preferred.

**SURGICAL RECONSTRUCTION TECHNIQUES**

A variety of techniques have been described in the literature. They involve either tendon augmentation plasty using the triceps (Bosworth, V-Y plasty, etc.) or local tendons (plantaris, peroneus, etc.), or actual tendon transfer using the peroneus brevis or flexor tendons.

● **Tendon augmentation**
  1. **Plasty using triceps aponeurosis**
     • **Proximal reversed flap, or Bosworth method**
       Described by Bosworth in 1956, this was the first reconstruction technique reported. This technique is recommended as reinforcement of insecure end-to-end suture or in poor quality tissue, rather than as a reconstruction technique in itself.

     • **Bosworth variants**
       Several variants have been described. One we recommend is to harvest as long (up to 10-12 cm) and wide (up to 3 cm) an aponeurotic band as possible, while remaining partial with respect to thickness. After harvesting, it is separated into 3 strips. Each of these is reversed and passed through the inferior extremity of the proximal fragment, then forward through the distal fragment, to emerge either posteriorly or laterally and be sutured onto itself. This to-and-fro variant fills the defect and reconstructs a real tendon.

     • **V-Y myo-aponeurotic flap plasty**
       This technique, described by Abraham in 1975, consists in V-Y myo-tendinous lengthening. The aponeurosis is incised in full thickness with a V incision (point of the V upward) at the muscle/tendon junction. The myoaponeurotic flap is translated downward and sutured to the distal fragment. The harvesting site is closed in an inversed Y.

  2. **Plantaris muscle tendon plasty**
     This was described in 1956 by Chigot as a complement to direct suture in recent rupture. Taken alone, this procedure is insufficient, but may serve to reinforce triceps aponeurosis plasty.
3. Plasty using peroneus brevis and longus muscle hemi-tendons
Described by Moyen in 1981, this technique was inspired by Perez Teuffer's peroneus brevis tendon transfer.

Half of the peroneus brevis and longus tendons are harvested, leaving them pediculated proximally. The two hemi-tendons are passed under the sural pedicle and introduced inlay (anteroposteriorly) into the proximal part of the ruptured Achilles tendon; they then bridge the defect, passing intratendinously into the distal extremity of the tendon. If hemi-tendon length permits and the defect is not too extensive, a return passage can be made, suturing them again to the proximal extremity of the Achilles tendon, thus providing 4-strip reconstruction.

● Tendon transfer
1. Peroneus brevis muscle tendon transfer (Perez Teuffer)
Described in 1972 by Perez Teuffer, this was the first reconstruction technique involving transcalcaneal fixation. Other authors recommended a variant, mobilising the peroneus brevis muscle body after releasing its fibres from the lateral side of the fibula so as to fill the defect, and suturing them to the extremities of the remaining Achilles tendon.

2. Flexor digitorum muscle tendon transfer
More recently, in 1991, other tendon transfer techniques were described:
- Flexor digitorum longus (FDL) (Mann)
  On a second incision in the inferomedial side of the foot under the navicular bone, the FDL tendon is sectioned just before its division. The FDL tendon is taken from the main posterior approach and fed through a transcalcaneal tunnel, brought back and sutured onto itself or onto the Achilles tendon as in the peroneus brevis technique.

- Flexor hallucis longus (FHL) (Wapner)
  Described in 1991, this transfer uses the FHL, a stronger muscle than the FDL and with a more easily accessible tendon and a muscle body just in front of the Achilles tendon. It moreover extends more distally towards the ankle than does the FDL, so that after transfer its vascularisation helps revascularise the Achilles tendon. Since it was first described, several variants in terms of tendon harvesting, tunnel drilling and fixation have been reported.

● Other techniques
Many other techniques have been described.
- Artificial materials
  They have, however, been abandoned due to biologic intolerance, the most striking examples being the black tissue-tattooing effect induced by carbon fibres and a propensity for fatigue fracture. They should no longer be used.

- Fascia lata
  This may be in the form of autologous or preserved allografts of fascia lata strips.
- Allograft
  Allografts, described by Nellas in 1996, entail a risk of viral transmission and are slower to incorporate. They now need to come from a high-security tissue bank: Leemrijse, in Brussels, uses Achilles allograft in halluces longus transfer augmentation in severe Achilles defect.
• Free flap
Exceptionally, Achilles tendon repair has to be associated to reconstruction of the bony calcaneal insertion and cutaneous soft tissue, and for this Wei, in 1988, reported clinical cases using various free flap techniques such as vascularized inguinal flap.

• In case of severe infectious and/or cutaneous complication secondary to Achilles surgery, as an alternative to (often free) muscular flaps, the technique described by Dautry for suppurated necrosis needs to be known. It consists in complete resection of the infected tendon, conserving the insertion area, with directed cicatrisation and daily irrigation, as in Papineau's method for treating bone defects

INDICATIONS
Indications are founded on preoperative MRI, according to defect size after fibrosis resection and location with respect to the calcaneal insertion.

• "Recent" neglected rupture and/or 1-2 cm defect
For recent neglected rupture treated within 2 months and for small (1-2 cm) defect, resection and end-to-end suture is feasible, reinforced if necessary with plantaris tendon.

• 2-4 cm defect
Despite American recommendations, our own experience with V-Y plasty has been disappointing, with very long recovery times and prolonged muscle/tendon junction pain. We therefore prefer a modified Bosworth technique: the reverse triceps aponeurosis flap slit into several straps effectively fills the defect with an inlaid to-and-fro construction in the proximal and distal parts of the Achilles tendon. If need be, reinforcement can use a hemi-peroneus brevis or longus.

• >4 cm defect
In extensive (≥5 cm) defect or in case of insertional involvement, flexor hallucis longus transfer is now our attitude of choice, with a modification of the original technique to reinforce the transfer either with residual fibrotic Achilles flaps or a Bosworth reverse triceps flap rather than the V-Y plasty described elsewhere.

SUMMARY (important points)
• Management of chronic rupture is surgical, unless specifically contraindicated.
• Operative planning is on MRI (defect size and location).
• The reconstruction technique depends on defect size after fibrosis resection.
• For extensive defect, FHL tendon transfer is the technique of choice.