

CURRENT POSSIBILITIES OF TREATMENT OF ACHILLES TENDON RUPTURE. A REVIEW

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Abstract

Achilles tendon rupture in the working age population has been becoming increasingly common. Major currently used methods of treatment are surgical, mini-invasive, and conservative. Surgical repair allows the shortest immobilisation and the fastest rehabilitation, it also shows the smallest re-rupture rate, but represents the highest risk of wound healing complications. Mini-invasive treatment slightly reduces the risk of wound healing complications while showing a higher re-rupture risk, longer immobilisation, and slower rehabilitation. Conservative treatment eliminates peroperational and post-surgical complications, but represents a significantly higher risk of re-rupture and of tendon healing in elongated position with consequent deterioration of function. It also shows longer immobilisation and slower rehabilitation.

Key words

Achilles tendon rupture

INTRODUCTION

Achilles tendon rupture appears, usually without prior warning, predominantly in healthy working age population. Whereas in the nineteenth century Achilles tendon rupture was rare and treated conservatively, it has currently been becoming more common as a result of more frequent physical activity. The incidence of this injury is related mainly to sport and recreational activities. The patients are mostly men (5-10 times more often than women) between 30 and 50 years of age (1). The injury is frequent in recreationally sporting people who return to their former sport activity following a period of inactivity.

Most injuries happen indirectly, under closed skin cover. Rupture occurs as a result of disparity between the solidity of the tendon and exercised tensile strength. A single rupture of a healthy Achilles tendon is very rare and occurs only in cases of extensive force (with the foot caught and the shin pushed forward (2)).

Achilles tendon can be weakened either by immobilisation (atrophy) or by chronic straining, which hastens degenerative processes in the tendon. Degeneration

of the tendon is the most frequent cause of its weakening followed by rupture. Physiological ageing, chronic overworking of the tendon with microtraumas, medications, and inflammation participate in degenerative processes. There are four basic types of degeneration: hypoxic degeneration, mucoid degeneration, lipomatosis, and calcification of the tendon. These changes can be diagnosed as tendinitis and peritendinitis.

Rupture can also be inflicted by a direct impact with a blunt object. The incidence of Achilles tendon rupture can be influenced by a number of illnesses, such as rheumatism, hyperuricemia, diabetes, kidney diseases, lipid metabolism disorders, etc. The risk factor is significantly increased by complete or local application of corticoids and fluoroquinolones (1). We also have to mention iatrogenic injury of the tendon caused by incorrect indication and improper application of glucocorticoids into the tendon or its insertion. Rupture can also be conditioned by other elements reducing the tensile solidity of the tendon, such as lower ambient temperature and pH values (in case of lactate increase in excessively exercising athletes).

The diagnostics of an acute Achilles tendon rupture requires anamnesis, clinical examination (obliterated contour, palpable pain, palpable tendon interruption, weakening of muscle strength – impossibility to tiptoe, and the Thompson test), X-ray of the heel bone to rule out possible fracture of “Duck Bill”, and possibly ultrasonic scan in case of doubt (2).

The first mention of a treatment of Achilles tendon rupture dates back to 1575 (Parré). Until the 1920s, the treatment of Achilles tendon rupture was provided exclusively by the use of the conservative method. Following the 1920s, surgical repair started coming in on a larger scale and gradually it has become the standard form of therapy. In 1976, Arnd writes: “In principle, surgical repair should be favoured in case of every serious suspicion of Achilles tendon rupture – both complete and partial.” Despite the prevalence of surgical repair in contemporary medical practice, there are a number of current studies favouring conservative therapy. Conservative therapy is being revived namely in the English-speaking countries and in Scandinavia (1, 3, 4).

MATERIALS AND METHODS

Surgical methods can be divided into closed or open.

The first closed surgery, percutaneous suture, was described by Ma and Griffith, and in the Czech Republic Trč and Pacovský described their modified technique (Fig. 1) (5). Another interesting technique is represented by percutaneous fixation with Kirschner wires connecting the two ends of a ruptured tendon – the proximal tendon stub and the heel bone.

An interface between closed and open methods is represented by the least invasive open Kakuichi method – modified percutaneous suture, in which the approximation of the tendon ends is controlled through a two-centimetre long longitudinal incision in the location of the rupture (6). This method serves as the basis for the instrumentation for a minimally invasive suture of Achilles tendon – the Achillon System (Stryker). A considerably more invasive method is the end-to-end suture through a short horizontal incision according to Aldam (6).

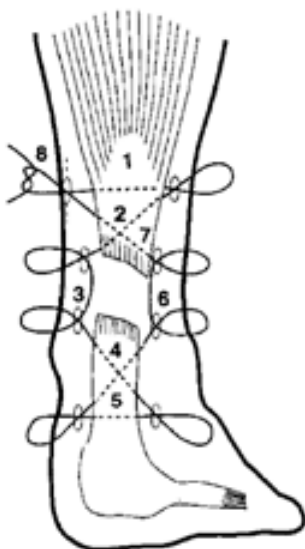


Fig. 1
Percutaneous suture (Trč and Pacovský)

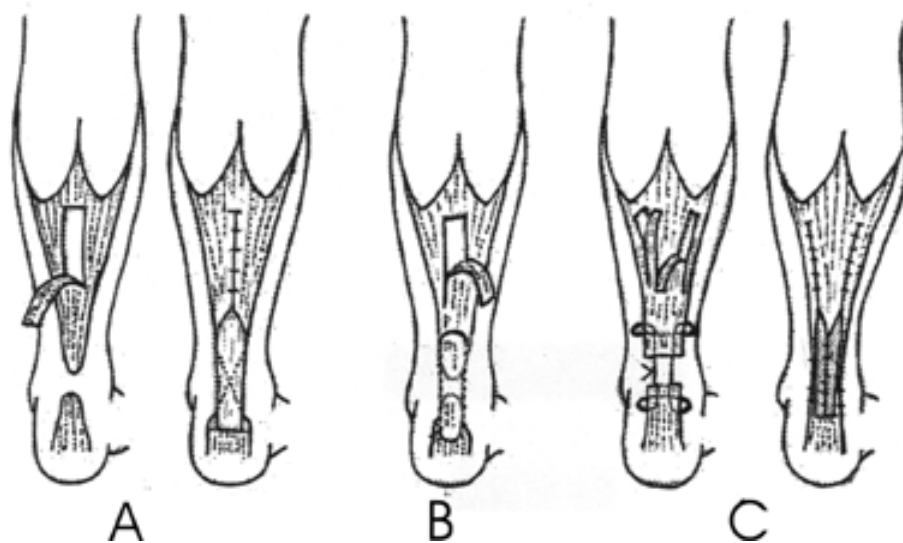


Fig. 2
Augmentation suture techniques. A Silverskjold's technique, B modified Christensen and Gebhardt-type, C Lindholm's technique.

One of the open surgical methods is the end-to-end suture, most commonly using a Kessler-type suture with absorbable material PDS 1.,0 and a longitudinal suture with PDS 2/0 or PDS 3/0 suitable for achieving better adaptation of frayed tendon ends. Some medical workplaces also use Kirchmayer- or Bunnel-type sutures with nonabsorbable material (*1, 7, 8, 9, 10, 11*).

Other open surgical methods are represented by augmentation suture techniques using various tissues: one or two flaps from the proximal end of the ruptured tendon, tensor fascia lata, the tendons of the peroneus brevis muscle, the tendons of the plantaris muscle or the tendons of the flexor hallucis longus muscle. Augmentation is used when the tendon ends are destroyed due to degeneration or late treatment. Suture of destroyed ends of Achilles tendon is overlapped by quality tissue from the proximal tendon end or from some other tendon (*8, 12, 13, 14*).

Surgical Methods

CLOSED

percutaneous suture (*Ma, Griffith, 1977; Trč, Pacovský, 1996*)

percutaneous fixation with two Kirschner wires (*Nada, 1985*)

OPEN

1) sutures

- percutaneous suture with a two-centimetre vertical incision for the control of tendon end approximation (*Kakiuchi, 1995; Achillon System by Stryker*)

- end-to-end suture through a four-centimetre horizontal incision (*Aldam, 1989*)

- end-to-end suture

2) augmentation

- by means of a backfolded flap from the proximal tendon end (*Bosworth, 1956; Silverskjold*)

- by means of 2 backfolded flaps from the proximal tendon end (*Lindholm, 1959*)

- by means of tendons of the plantaris muscle (*Linn, 1966*)

- by means of tensor fascia lata (*Bugg, Boyd, 1968*)

- by means of tendons of the peroneus brevis muscle (*Teuffer, 1980*)

- by means of tendons of the flexor hallucis longus muscle (*Wagner, 1993*)

Most surgeons operate acutely using local or general anaesthesia. Due to the possibility of a wound-healing per secundam risk some surgeons use preventive intravenous application of antibiotics and low-molecular-weight heparin as prevention of venous thrombosis. Most common surgical approaches are longitudinal directly above the tendon, medial, paramedian, or S-shaped. All of them sparingly cut fascia and peritenoneum, which are reconstructed following tendon suture. Great emphasis is placed on careful surgical technique avoiding tissue damage. This represents the most important prevention of wound healing per secundam and wound infection.

The most common type of open surgery of Achilles tendon rupture is the end-to-end suture. In late and shortened ruptures, augmentation is recommended, most commonly the Silverskjold-type augmentation by means of a flap from the tendon of the gastrocnemius muscle, rotated and distally turned, or of a modified Christensen and Gebhardt type, or Lindholm's technique by means of two flaps from the tendon of the gastrocnemius muscle, distally turned (*Fig. 2*), (*2, 3, 12, 13, 14*). A lot of ruptures result from tendon degeneration and therefore the tendon is not suitable for end-to-end suture, and then augmentation is also used.

Postsurgical Treatment

There are significant differences between both surgical methods and postsurgical procedures used in different medical workplaces.

High dorsal splint in semiflexion in the knee joint and maximal plantar flexion, after two weeks suture removal and replacement with high circular plaster. Six weeks after the surgery fixation removal and start of rehabilitation with short hospitalisation (*3, 8*).

High plaster fixation in semiflexion in the knee joint and maximal plantar flexion for two weeks, followed with knee flexion relaxation and setting at the 90 degrees angle. After another two weeks,



Fig. 3

The plaster cast with a spring pushing the instep into plantar flexion. It allows walking without support and exercising ankle movement in relaxed position of Achilles tendon.



Fig. 4

VacoAchill brace /GPS Olfa/

application of a plaster heel and start of gradual weight load on the limb. Six weeks after the surgery plaster fixation removal and start of rehabilitation (7).

Postsurgical immobilisation under the knee in maximal plantar flexion for two weeks, followed with semiplantar flexion for four weeks. The total fixation period is six weeks, followed by rehabilitation – shoes with heels heightened by two centimetres (2).

U-splint along both sides of the shin providing fixation allowing relief from pressure on the injured tendon in plantar flexion. After the surgery wound heals, a walking strap is attached together with a spring pushing the instep into plantar flexion (Fig. 3). The plaster cast is cut out so that it allows sagittal movement of the ankle joint. The patient walks with crutches, later without support, actively raising the front part of the foot against the spring, thus exercising ankle movement in relaxed position of the rear muscles (including Achilles tendon). In this way, there is no massive pressure on the suture (this method is similar to Kleinert-type rehabilitation in finger tendon injuries). Six weeks after the surgery fixation removal, with the patient's ankle already limbered up. Eight weeks after the surgery the patient can walk with full weight load (9). A similar fixation is possible with plastic material fixation (10).

Early functional treatment. After the surgery, plaster fixation is applied under the knee in plantar semiflexion. As soon as the patient's condition allows it, after the pain subsides or becomes bearable and tolerated by the patient, the plaster fixation is removed and replaced with a walking brace keeping the ankle in neutral position. The patient tries to estimate the position and amount of weight load according to subjective conditions. After six weeks of load relief with crutches, the brace can be removed and the patient starts intensive rehabilitation (I, II).

Combination of the two above-mentioned methods (4, 5) with the application of Vaco-Achill brace /GPS Olfa/ with adjustable angle setting and possible ankle movement provides another modification of postsurgical treatment (Fig. 4). Postsurgical fixation in plantar flexion is then gradually adjusted to 90 degree flexion and after three or four weeks the brace allows limited movement, to be actively practiced by the patient. The heels are changed simultaneously with position adjustment. The fixation can be removed for hydrotherapy or treatment of the surgical wound. The fixation is removed after six weeks, and by that time the patient's ankle is already limbered up.

Percutaneous Suture

Percutaneous suture is a compromise between surgical repair and conservational therapy. It was first described by *Ma and Griffith* (1977), and in the Czech Republic *Trč and Pacovský* (1996) described their modified technique (Fig. 1). This suture can be used only on ruptures occurring 4–6 cm above the tendon insertion, with precise palpate localisation of both tendon ends. It is advisable to verify the localisation with the use of a sonograph.

The postsurgical treatment recommended includes fixation in a high dorsal splint in semiflexion in the knee joint and plantar flexion in the ankle joint for four weeks, followed by release of knee fixation and one or two weeks later by adjustment of the plantigrade position of the ankle joint and plaster heel application. As of week 7 or 8, the patient starts rehabilitation and gradually starts putting weight load on the limb. Achilles tendon is fully healed after 8 weeks.

This method requires clinically easily palpable tendon ends and sonograph verification. The use of long-acting absorbable suture material provides sufficient time for healing and its degradation releases possible blood clot in the area above the rupture.

Conservative Therapy

A number of contemporary studies regard conservative treatment as an equal alternative to surgical repair. Conservative therapy is being revived namely in the English-speaking countries and in Scandinavia. In deciding about the form of treatment, sonography plays an important role, especially in precise localisation of tendon ends in 20-degree plantar flexion. Complete or nearly complete (with defects smaller than 5 mm) approximation of the tendon ends palpated in this position and verified by the sonograph is, according to some authors, indication for conservative therapy (II).

Its principle lies in the application of plaster fixation or use of a special brace applied for eight weeks, reaching under the knee, with a gradual reduction of plantar flexion and increasing weight

load on the limb. The VacoAChill brace /GPS Olfá/ with adjustable angle setting and possible ankle movement with a variable heel is the most frequently used type of fixation (*Fig. 4*). Contact between tendon ends is checked regularly by means of sonography and possible tendon interruption indicates conversion to surgical repair. Eight weeks after the surgery the fixation is removed, except for a one-centimetre heel, and the patient is allowed full weight load on the respective foot. The heel can be removed after 12 weeks and the patient can return to former sporting activities 16 weeks following the injury (*11*).

DISCUSSION

Advantages of percutaneous suture: - it has no influence on the physiological healing process, it is simple and feasible even in relatively poorly equipped medical workplaces only in local anaesthesia. It is more agreeable for patients. This modification reduces the risk of sural nerve damage (*5*). The complication rate of skin cover healing is at the lower limit for open surgery complications (5-10 %) (*15*).

A major disadvantage of percutaneous suture is the re-rupture rate (3-7 %). According to a number of studies, the incidence of re-rupture following percutaneous suture is higher than in open surgeries. Another disadvantage is the relatively long immobilisation and its form. In case of earlier mobilisation, the number of complications, both skin complications and re-ruptures increases (*15*).

Advantages of conservative treatment: - reduced strain of surgical procedure on the patient (minimal advantage in case of local anaesthesia), no wound healing complications (5-15 % in surgical repair), the treatment is cheaper, formerly stated faster recovery of full function of the limb (in some surgeries, however, the fixation period is shorter and the recovery of full function and full weight load is the same or even faster).

Major disadvantages of conservative treatment are: relatively high re-rupture rate; according to some authors, it is 10-12% compared to 3-7% in percutaneous suture and 1-2% in open surgical repair, and relatively frequent healing of the tendon in elongated, limiting position (*1, 2, 3, 5, 9, 11, 15*).

Longer immobilisation of knee and ankle joints in conservative as well as surgical treatment shows a higher complication rate related to enzymohistochemical changes. These include mainly muscle atrophies in the area of the medial head of the gastrocnemius muscle and also coordination disorders in the adjacent joints and proprioception disorders. Studies have proved that after four weeks of combined immobilisation of knee and ankle joints, the tensile strength of Achilles tendon decreases significantly more than in just under-knee fixation. This results from the irregular organisation of collagenous fibres in combined knee and ankle fixation as opposed to their parallel organisation in single joint fixation. The above-mentioned facts and the elimination of need for rehabilitation are major arguments for the use of a single, under-knee fixation for six weeks (*1*). There is another, even more progressive method of a six-week postsurgical fixation by means of a special plaster under-knee fixation or a brace allowing full load (see above). Methods allowing

early mobilisation show a smaller complication rate in terms of re-rupture and skin cover healing (15). A disadvantage of plaster fixation is movement limitation in the ankle joint and more frequent limitations in dorsal flexion (subjective feelings of stiffness in the ankle joint). A possible problem connected with postsurgical under-knee fixation can be healing of Achilles tendon in slightly elongated position, caused by ignoring the two-headed character of the gastrocnemius muscle. Clinical manifestations of an elongated tendon are a limited heel lift and a decreased strength of plantiflexion (1). There are also compromise methods combining fixation under and over the knee.

According to recent studies, postsurgical fixation over the knee is considered unnecessary, under-knee fixation is recommended for two weeks in maximal plantar flexion, followed by four weeks in flexion reduced by 50 %. The total fixation period is six weeks (2).

In our own methodology we unambiguously give preference to surgical repair, except in biologically old patients representing a high risk of wound-healing complications.

Of the techniques described, in fresh ruptures we use open end-to-end PDS suture, or other long-acting absorbable material. In cases of serious degenerative changes and inveterate ruptures we use Lindholm- or Silverskjold-type augmentation. We apply antibiotic prophylaxis – one dose preoperatively. For prevention of venous thrombosis we use low-molecular-weight heparin. We recommend S-shaped or longitudinal medial surgical approach. Our complication rate of skin cover healing is at the lower limit for open surgery complications we also have zero re-rupture record. For the treatment of fresh ruptures we have recently repeatedly used the Achillon System (Stryker), allowing percutaneous suture with only a two-centimetre incision in the location of the rupture. So far, the results have been outstanding (neither wound-healing complications nor re-ruptures have been recorded). Following negative experience with several cases of infected nonabsorbable gauzes used in other workplaces, which were dealt with co-operatively with a plastic surgeon, we are opposed to augmentation suture using nonabsorbable materials.

CONCLUSION

Achilles tendon rupture has been becoming increasingly common, namely in connection with recreational sport. The most satisfactory results have been achieved in cases of early suture, despite possible complications. The above-listed account of treatment possibilities and types of fixation suggests that there is not a single, ideal method, and therefore it is essential to consider the best method in each individual case.

SOUČASNÉ MOŽNOSTI LÉČBY RUPTURY ACHILLOVY ŠLACHY

S o u h r n

V současnosti roste incidence ruptury Achillovy šlachy postihující populaci v produktivním věku. Hlavní současné metody léčby jsou operační, miniinvazivní a konzervativní. Otevřená operační léčba umožňuje nejkratší imobilizaci, nejrychlejší rehabilitaci, má nejmenší procento reruptur, ale největší riziko komplikací hojení rány. U miniinvazivní terapie je mírně sníženo riziko komplikací hojení rány, větší je však riziko reruptury šlachy, delší je imobilizace s pomalejší rehabilitací. Konzervativní terapie eliminuje peroperační a pooperační komplikace, zvyšuje však výrazně riziko reruptury a zhojení šlachy v prodloužení s následným zhoršením funkce; nevýhodou je i delší imobilizace a pomalejší rehabilitace.

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