TECHNICAL NOTE

Salvage technique for postoperative infection and necrosis of the Achilles tendon

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Summary Surgery of the Achilles tendon is associated with postoperative morbidity related to wound healing. Necrotic infection of the tendon is a rare but serious complication that may be associated with increasingly invasive surgical treatments using various free flap transfers proposed in the literature. Dealing with this complication, we prefer the technique of managed wound healing suggested by Dautry. The surgical procedure includes radical debridement of the infected tissue and necrotic Achilles tendon followed by managed wound healing with daily irrigation. Fifteen cases were treated between 1994 and 2003. Healing was achieved after 30 to 100 days. MRI results show scar tissue continuity suggesting a neotendon formation. Function was very satisfactory in 9/15 ankles. The salvage technique presented here for cases of infection and necrosis of the Achilles tendon is simple with low morbidity and results in effective wound and tendon healing with satisfactory functional and anatomical results.

Introduction

Surgical treatment of tears or tendinopathies of the Achilles tendon is associated with postoperative repair wound complications because of the fragility and limited vascularization of the skin. In the meta-analysis by Cetti et al. [1], the estimated rate of infection of the surgical site was between 0.2 to 3.6%. The risk factors reported by Pajala et al. [2] were: age over 60 years old, tobacco use, corticosteroid therapy, diabetes, surgery delayed by more than 7 days, the presence of pain in the tendon before the accident. According to Nyssönen et al. [3], surgery that is delayed by more than 15 days and/or a surgical procedure including tendon reconstruction, significantly increases the risk of postoperative complications, in particular the risk of infection. Infection of the Achilles tendon is a difficult entity and treatment has not been well defined, as there are numerous therapeutic options in the literature.

Numerous locoregional or free flap transfers have been suggested to treat postoperative skin and tendon defects in the Achilles tendon: short fibular, flexor digitorum, lateral supramalleolar cutaneoaponeurotic, [4,5], lateral arm [2,6–9], and finally the latissimus dorsi muscle [10]. Besides these free cover transfers, so called reinforcement flaps have also been described to respond to the specific problem of necrosis of the Achilles tendon. These are usually

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small series limited to a few cases, which have proposed the tensor fascia lata, palmaris longus, extensor carpi radialis and the musculus plantaris to reconstruct or reinforce the Achilles tendon [2,6,8].

However, management with a free flap transfer with the associated morbidity to the recipient and donor sites is not the only therapeutic option. Two publications have proposed debridement and managed wound healing in the treatment of necrosis of the Achilles tendon: Dautry et al. [11] with 12 cases in 1975 and Bénazet et al. [12] with eight cases in 1994. In our center, we have performed managed wound healing using a modified technique based on that by Dautry et al. [11]. The aim of this article was to present this technique and our retrospective results in healing and function.

Surgical technique

Our treatment of necrosis and infection of the Achilles tendon is based on that suggested by Dautry et al. [11]. This includes radical debridement of necrotic and infected tissue then resection, which is usually total, of the necrotic tendon (total resection in 13 cases, partial in two cases). Only the site of tendon insertion and the first few centimeters were always preserved because they were not infected (Fig. 1). After thorough pressurized lavage with saline solution, a tulle gras bandage was placed on the wound, which was left open. The ankle was immobilized in an anterior equinus cast for 45 days then replaced by a walking boot for 3 weeks.

Management of the wound after surgery was the most important point. The day after surgery, the wound was irrigated with saline solution for 30 to 45 minutes. Normally 2 L of saline was used, administered by drip irrigation on the wound. When the first bandages were changed, blood clots were removed mechanically to allow irrigation of living tissue. After irrigation, the wound was dried and tissue defects were filled with a bandage. Tulle gras was used if the wound was not oozing or an absorbent bandage if it was. Irrigation was performed daily at first, then every 2 days until the tissue defects had healed. The new tissue grew into a bulb that gradually covered the epidermis.

The edges of the wound were pulled together after a few days using a Steri-strip or gradually closed with a temporary suture (Fig. 2). There was only one skin graft in our series and debridement—sutting of the edges of the wound in one case.

The series

Patients

Between 1994 and 2003 we treated 15 cases of postoperative infection and necrosis of the Achilles tendon in our unit. There were 12 men and three women, mean age 40.8 years old (24–66). The initial indication was surgical repair of a traumatic tear in 12 cases, surgery for a tendinopathy in one case, lengthening of the Achilles for a fixed equinus deformity in one case and a transfer in one case. There was necrotic infection of the entire tendon in 13 cases and partial in two cases.

Infection developed between 7 to 90 days after surgery in 13 of the 15 patients. In two patients, infection was delayed and developed after 1 year. General symptoms were limited. Only one patient presented with fever. Pain was never a primary symptom. The infection was only discovered when the initial cast was removed in three cases. On the other hand, there were always one or several local signs: a fistula was found in seven cases, wound dehiscence in four cases, wound necrosis in three cases and simple local inflammation in one case.

The local risk factors were delayed surgery in six cases (between 15 days and 7 months) and repeat surgery in six cases. Technically, five patients underwent a Bosworth procedure and three a V-Y tendinous flap, two multiple suture repair and one reinforcement associated with tendon suture. Only one patient received simple suture repair for a recent tear. There was no history of corticosteroid infiltration. The general risk factors were: type II diabetes in two cases, open fracture of the same leg associated with the Achilles tendon injury in two cases, and obesity (BMI > 30) in two cases.
<table>
<thead>
<tr>
<th>Case</th>
<th>Initial surgery</th>
<th>Delay of infection</th>
<th>Germ(s)</th>
<th>Duration of antibiotics (days)</th>
<th>Duration of hospitalisation (days)</th>
<th>Time to healing (days)</th>
<th>Additional surgical procedure</th>
<th>Clinical status at follow-up (6 months minimum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Old tear (V-Y)</td>
<td>45</td>
<td>Enterobacter cloacae Escherichia coli</td>
<td>5</td>
<td>25</td>
<td>56</td>
<td>No</td>
<td>Limited strength Reduced mobility</td>
</tr>
<tr>
<td>2</td>
<td>Recent tear</td>
<td>7</td>
<td>E. cloacae Acinetobacter sp.</td>
<td>3</td>
<td>20</td>
<td>?</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Neurological foot (tendon transfer)</td>
<td>10</td>
<td>S. aureus méti-S</td>
<td>45</td>
<td>30</td>
<td>30</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Recent tear</td>
<td>35</td>
<td>S. aureus méti-S</td>
<td>30</td>
<td>19</td>
<td>70</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Tendinitis</td>
<td>420</td>
<td>S. aureus méti-S</td>
<td>16</td>
<td>30</td>
<td>?</td>
<td>Excision at day 75</td>
<td>Tricipital amyotrophy ++ Single leg stance + Scar: OK</td>
</tr>
<tr>
<td>6</td>
<td>Open leg fracture (bone reinsertion)</td>
<td>50</td>
<td>Pseudomonas aeruginosa E. coli</td>
<td>10</td>
<td>11</td>
<td>45</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Recent tear</td>
<td>25</td>
<td>Streptococcus G S. aureus méti-S</td>
<td>8</td>
<td>30</td>
<td>70</td>
<td>No</td>
<td>Normal, sport + Scar: OK</td>
</tr>
<tr>
<td>8</td>
<td>Old tear</td>
<td>300</td>
<td>P. aeruginosa</td>
<td>0</td>
<td>26</td>
<td>300</td>
<td>Skin graft at day 300</td>
<td>Normal strength Reduced mobility Tricipital amyotrophy +</td>
</tr>
<tr>
<td>Case</td>
<td>Initial surgery</td>
<td>Delay of infection</td>
<td>Germ(s)</td>
<td>Duration of antibiotics (days)</td>
<td>Duration of hospitalisation (days)</td>
<td>Time to healing (days)</td>
<td>Additional surgical procedure</td>
<td>Clinical status at follow-up (6 months minimum)</td>
</tr>
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<tr>
<td>9</td>
<td>Recurrent old tear (multiple sutures)</td>
<td>90</td>
<td><em>E. cloacae</em> and <em>Bacteroides</em> sp.</td>
<td>8</td>
<td>11</td>
<td>400</td>
<td>Scar excision at day 150</td>
<td>Normal strength Normal walk Incomplete scar</td>
</tr>
<tr>
<td>10</td>
<td>(Reinsertion + sutures + fascia graft)</td>
<td>30</td>
<td><em>P. aeruginosa</em> and <em>S. aureus</em> méti-S</td>
<td>14</td>
<td>15</td>
<td>120</td>
<td>Excision at day 90</td>
<td>Dorsal flexion: &lt; 5° Plantar flexion: normal Single leg stance + Scar: OK</td>
</tr>
<tr>
<td>11</td>
<td>Recurrent old tear (Bosworth)</td>
<td>23</td>
<td><em>Staphylococcus epidermidis</em></td>
<td>27</td>
<td>28</td>
<td>100</td>
<td>No</td>
<td>Mobility 80% Tip walk + Scar: OK</td>
</tr>
<tr>
<td>12</td>
<td>Recurrent tear 5 months (Bosworth)</td>
<td>33</td>
<td><em>S. epidermidis</em></td>
<td>18</td>
<td>26</td>
<td>30</td>
<td>Two-times scar excision</td>
<td>Normal mobility Sport + Scar: OK</td>
</tr>
<tr>
<td>13</td>
<td>Recurrent tear (Bosworth + V-Y tendinous flap)</td>
<td>31</td>
<td><em>Propionibacterium acnes</em> and <em>Peptostreptococcus</em> sp.</td>
<td>0</td>
<td>31</td>
<td>50</td>
<td>No</td>
<td>Dorsal flexion: normal Single leg stance Tip walk Scar: OK</td>
</tr>
<tr>
<td>14</td>
<td>Recurrent tear 3 months (suture + lengthening)</td>
<td>15</td>
<td><em>S. aureus</em> méti-S</td>
<td>10</td>
<td>22</td>
<td>90</td>
<td>No</td>
<td>Normal strength Reduced mobility (50%) Sport +</td>
</tr>
<tr>
<td>15</td>
<td>Fixed equinus deformity (lengthening + Bosworth)</td>
<td>28</td>
<td><em>Streptococcus G</em> and <em>S. aureus</em> méti-S</td>
<td>10</td>
<td>11</td>
<td>90</td>
<td>No</td>
<td>Mobility: 90% Moderate pain Scar: OK</td>
</tr>
</tbody>
</table>
Sixty percent of the infections were due to *Staphylococcus* (10 cases) including *Staphylococcus aureus* in seven cases and coagulase-negative *Staphylococcus* in three cases. Gram-negative bacteria represented 30% of infections. The remaining 10% were divided into type *G Streptococcus* and purely anaerobic germs. The presence of two different germs was identified in 40% of the cases (Table 1).

**Results**

Tissue and tendon defects gradually healed after 10 to 20 days with the development of a neotendon. In 13 cases, the wound healed in a mean 61 days (between 30 and 100 days). Complete epithelialization was more difficult in two cases: in one case a skin graft was performed 10 months postoperatively, in the other case complete epithelialization was obtained 13 months after management of the wound was begun. A second operation was necessary in two cases for additional debridement because of persistent infection at 2.5 and 3 months. The neotendon that developed was always adherent to the skin in the intermediate term (Fig. 3). This adhesion resulted in a fragile epidermis requiring protection of the wound by applying greasy ointment to the skin for the first 6 months. Persistent amyotrophy of the triceps was noted in all patients who were followed up.

The estimated recovery of range of motion was between 50 and 80% at 6 months and it continued to improve for 1 year. Only four patients had recovered the same range of motion as the contralateral side at the final follow-up. Ability to stand on one foot was generally achieved after 6 months with normal strength in 9/15 cases. The two athletes who underwent surgery (international level) were able to return to sports after 1 year at the same level as before the injury. The main functional limitation was discomfort with stiffness in the morning. Anatomically, the four cases that underwent MRI showed healing with continuity at the site of the Achille’s tendon (Fig. 4).

**Discussion**

Necrotic infection of the Achilles tendon is luckily rare, and it is difficult to treat. This article describes a method to manage this entity based on radical debridement, immobilization, and managed wound healing with irrigation. The main difference with the technique that was first described by Dautry et al. [11] is in relation to the thin skin graft, which was performed 3 to 5 weeks after debridement. Nevertheless the author stated that this graft could be avoided in half of the cases. In our experience, a skin graft should never be performed as primary treatment. We obtain healing after a mean 61 days (48 days for Dautry et al. [11] and 87 days for Bénazet et al. [12]). The use of an early skin graft in 50% of the cases in the series by Dautry et al. [11], probably explains the more rapid healing. In our series only one patient received a skin graft (too) late due to insufficient epithelialization resulting in cutaneous micro-tears during movement. This problem of effort-induced micro-fissures was not mentioned by other authors.

The functional results obtained with free transfers were good in the reports by Ademoglu et al. [6] and Leppilahti et al. [8] in three out of four cases, the range of motion obtained was close to that on the contralateral side and patients returned to their activities after 6 to 12 months. Two out of four patients in the series by Kuo et al. [13] who underwent reconstruction with the fascia lata received isokinetic tests during long-term follow-up. They showed an objective lack of strength despite good range of motion; the author was studying functional morbidity in the donor site. The functional results in the nine cases reported by Pajala et al. [2] were mediocre. There were several different treatments: a thin skin graft in six cases, local transfer in one case, repeated debridement followed by the use of free flap transfer in two cases (including one vascular failure). After managed wound healing in eight athletes who were treated...
by surgery in the series by Bénazet et al. [12], six returned to sports at the same level and only one stopped because of his/her tendon. Four out of six athletes returned to sports at the same level in the series by Dautry et al. [11]. The main difficulty identified by these two authors was stiffness in the morning, and a reduction in tibiotalar range of motion, which was an estimated $10^\circ$ for Bénazet et al. [12]. Overall, it is difficult to directly compare the functional results of our cases with those in the literature. However, the functional results after managed wound healing seem to be as good as after free flap transfer reconstruction of the Achilles. The anatomical results in our study show the presence of tendon continuity, simulating the signal of the Achilles tendon in four cases on MRI. Characterization of MRI tissue could not be confirmed but it is probably fibrous scar tissue rather than actual neotendon regrowth.

**Conclusion**

Infected necrosis of the Achilles tendon is a serious surgical site infection with numerous and often complex treatments proposed in the literature. We propose a simple technique of radical debridement of infected tissue followed by managed wound healing with irrigation. This technique was simple to perform and was associated with low morbidity. The functional and anatomical results at the final follow up were satisfactory. This is our first choice of treatment for postoperative infection of the Achilles tendon.

**Disclosure of interest**

The authors declare that they have no conflicts of interest concerning this article.

**References**


