Original article

Too-long calcaneal process: Results of surgical treatment and prognostic factors

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A B S T R A C T

Introduction: The too-long anterior process (TLAP) can be responsible for ankle pain or repeated sprains in children or adolescents. The objective of this study was to assess the results of TLAP surgical treatment and to analyze influencing factors in case of this surgery’s failure.

Material and methods: Retrospective single-center study conducted from 2009 to 2012 including all patients under 18 years of age for a TLAP with follow-up equal to or longer than 1 year. The results of surgical treatment were assessed using the AOFAS score. Failure was defined as no significant improvement in the AOFAS score at the last follow-up.

Hypothesis: Predictive factors of the result of surgical treatment for TLAP can be identified.

Results: At the mean follow-up of 2.5 years, 35 patients (43 feet) fulfilled the inclusion criteria. Thirteen feet (30%) presented surgical failure. According to the AOFAS score, the results were excellent in 30 feet (70%), good in four (9%), fair in five (12%), and poor in four (9%). Surgical failure was influenced by the patient’s age at the onset of symptoms and at the time of surgery, the degree of functional limitation, the duration of symptoms before surgery, the number of sprains, and gender (P<0.05).

Conclusion: Firstly, in this pediatric population with its high functional demand, the overall rate of failure of TLAP surgery was 30%. Secondly, the factors associated with failure demonstrated made it possible to identify the ideal patient for this surgery: male, with symptom onset between 7 and 10 years of age, who had experienced fewer than 15 sprains, and undergone surgery in the 3 years following the beginning of symptoms.

Level of evidence: IV.

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1. Introduction

Congenital calcaneonavicular coalitions can be bony (synostoses), cartilaginous (synchondroses), or fibrous (syndesmoses). They were defined by Harris and Beath [1] in a large epidemiological study. Later, in 1983, Hardy and Pouliquen [2] and then Rouvreur et al. [3] defined the rudimentary form of these coalitions, calling them too-long anterior processes (TLAPs). This was an abnormally long anterior process of the calcaneum, between the cuboid and the head of the talus, causing impingement with the navicular bone. According to Leonard [4], the normal distance between the anterior process of the calcaneum and the navicular bone should be between 5 and 10 mm: a distance less than 5 mm as demonstrated on MRI is a strong argument in favor of TLAP. The presence of a calcaneal spur causes an impingement on the navicular bone upon supination of the foot, responsible for a “nutcracker” effect. Bilateral forms are frequent, ranging from 42 to 72% of cases [5,6].

Clinically, the TLAP manifests by repeated sprains in children or adolescents. It also causes sub- and mediotalal pain when the foot is in supination, during sports, or on palpation of the tarsal sinus. Pain and repeated immobilization periods limit activities and result in a handicap in daily activities. Conservative treatment with a cast or orthotics is associated in two-thirds of cases with poor results according to Pouliquen et al. [6]. The results of surgical treatment for TLAP have not been sufficiently described in the literature [3,6–8].

The working hypothesis was that predictive factors of the results of surgical treatment could be identified. The main objective of this study was to report the results of surgery as reflected by the AOFAS Ankle-Hindfoot Scale score (AOFAS AHS) [9]. The second objective was to identify the factors associated with this surgery’s failure.

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2. Material and methods

2.1. Description of the cohort

We conducted a retrospective study including all patients under 18 years of age operated on for TLAP from 2009 to 2012 in our institution. We excluded patients with postoperative follow-up less than 1 year, patients presenting associated ligament lesions, synchondrosis, and complete tarsal synostosis.

Clinical suspicion of TLAP (number of sprains > 3, tarsal pain when participating in sports, subtalar joint stiffness) was confirmed by an oblique view of the medial foot (Harris projection) (Fig. 1) and an MRI of the tarsus (Figs. 2–4), showing an anteromedial process of the extended calcaneum, located between the talus and the cuboid and navicular bones with a distance less than 5 mm (oblique sagittal views in the plane of the first metatarsal in T1-weighted, proton density [PD] fat saturation, BASG, T2, and a DP fat saturation axial sequence).

2.2. Surgical technique

The same surgical technique was used for each intervention [10–12] with no interposition at the resection site [13,14]. The surgery was performed with a tourniquet cuff, via an approximately 3-cm diagonal incision in a skin fold, centered on the anterior process of the calcaneum. The skin and the subcutaneous tissue were folded back and the short extensor of the toes was incised. A spatula was used to identify the anterior process of the calcaneum as well as the talonavicular, talocalcaneal, and calcaneocuboid joints (Fig. 5). The TLAP was then resected en bloc using an osteotome. The residual bone fragments were removed using a bone nibbler to leave the interval between the navicular and calcaneum completely free (Fig. 6). Horsley wax was applied on the bone resection, and after testing the subtalar joint range of movement, the wound was closed in two planes. Postoperatively, the wound was protected with a simple bandage and early mobilization was encouraged. Walking was authorized the day following the intervention, assisted by a physical therapist.

![Fig. 1. Foot X-ray, three-quarter view: the too-long anterior process is visible.](image1)

![Fig. 2. MRI; sagittal T1-weighted view: the too-long anterior process is visible. Distance from anterior process to navicular bone < 5 mm.](image2)

![Fig. 3. MRI; sagittal BASG view: the too-long anterior process is visible. Distance from anterior process to navicular bone < 5 mm.](image3)

![Fig. 4. MRI; sagittal DP Fat-Sat view: the too-long anterior process is visible. Distance from anterior process to navicular bone < 5 mm.](image4)
2.3. Evaluation of the results

All the patients were evaluated by an independent observer (OR) during a follow-up consultation. Failure of the surgery was defined as absence of significant improvement on the AOFAS AHS score at the last follow-up. The AOFAS AHS score is considered excellent between 90 and 100, good between 65 and 90, fair between 40 and 65, and poor below 40 or for any patient presenting a decrease in the score after the intervention. Gender, age at the onset of symptoms, age at surgery, duration of follow-up, complications, prior treatments, bilaterality, the number of prior sprains, pain, functional limitations, and range of movement of the subtalar joint were also noted.

We then analyzed the surgery failures and investigated the associated factors.

2.4. Statistical analysis

The Shapiro-Wilk test was used to verify the data distribution. The normally distributed data were compared using the paired t-test. The Chi² test was used to compare the qualitative data. The significance level was set at \( P = 0.05 \). The statistical analyses were done using XLSTAT.

3. Results

Out of 60 TLAP cases operated responding to the inclusion criteria, 17 were lost to follow-up; the study population therefore included 43 feet in 35 patients.

The sex ratio was three girls to one boy. The mean age at symptom onset was 8 years (range: 5–13 years) and the age at surgery was 13 years (range: 9–18 years). The mean time between symptom onset and surgery was 4 years (range: 1–11 years). The mean follow-up was 2.5 years (range: 15–48 months).

Before the intervention, all the patients complained of repeated sprains and/or tarsal pain (mean VAS: 7.5; range: 1–10). There was no objective clinical instability in the ankle. The MRI always showed an anteromedial process of the long calcaneum, less than 5 cm from the navicular bone. There were no cases of synostosis and no associated ligament lesions.

3.1. TLAP failures and complications

Four cases of complications were observed: cutaneous necrosis requiring prolonged local care resulting in healing with no need for surgical revision, one case of algoneuropathy, and two cases of calcified hematomas.

At the last follow-up, the overall failure rate defined by the absence of significant improvement of the AOFAS AHS score was 30% (Table 1). The patients with an excellent result all showed significant improvement in terms of pain and function (VAS: 0; range: 0–4). The patients with a poor result all showed a significant decrease in the AOFAS score, associating, other than residual pain (mean VAS: 8; range: 5–10), skin healing problems. The intermediary results (good and fair) showed no significant progression in the AOFAS score, but a simple tendency toward improvement for the good results. After analysis of all the pre- and intraoperative data, we determined the factors associated with TLAP surgery failure \( P < 0.05 \) (Table 2):

- more than 3 years between onset of symptoms and surgery;
- first symptoms appearing before the age of 7 years or after 11 years of age;
- more than 15 sprains before the intervention;
- a clear limitation in preoperative sports activity;
- female gender;
- age at the time of surgery > 11 years.

3.2. Prognostic score

A prognostic score (Table 3) was created by weighting the risk factors associated with surgical failure. This score was then calculated for each patient, and an analysis of the ROC (Fig. 7)
Table 1
Overall AOFAS Ankle-Hindfoot Scale score, and pre- and postoperative details.

<table>
<thead>
<tr>
<th></th>
<th>Preoperative AOFAS</th>
<th>Postoperative AOFAS</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall series</td>
<td>Overall score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>62 (45–94)</td>
<td>85 (38–100)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Pain</td>
<td>13 (0–40)</td>
<td>31 (0–40)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Function</td>
<td>39 (35–50)</td>
<td>45 (28–50)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Surgery success</td>
<td>Overall score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>65 (45–94)</td>
<td>99 (90–100)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Function</td>
<td>40 (35–44)</td>
<td>49 (40–50)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Surgery failure</td>
<td>Overall score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>10 (0–20)</td>
<td>22 (20–30)</td>
<td>0.1</td>
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<td>Function</td>
<td>40 (35–46)</td>
<td>43 (36–50)</td>
<td>0.3</td>
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<tr>
<td>Surgery failure</td>
<td>Overall score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>60 (45–76)</td>
<td>75 (66–85)</td>
<td>0.2</td>
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<tr>
<td>Function</td>
<td>45 (45–46)</td>
<td>45 (40–49)</td>
<td>0.8</td>
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</table>

Table 2
Univariate and multivariate analysis of factors associated with surgery failure.

Univariate analysis

<table>
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<th>Factors</th>
<th>P</th>
<th>RR</th>
<th>95% CI</th>
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<tr>
<td>Time from symptom onset to surgery &gt; 3 years</td>
<td>0.02</td>
<td>2.2</td>
<td>1.09–4.26</td>
</tr>
<tr>
<td>Number of sprains &gt; 15</td>
<td>0.001</td>
<td>3</td>
<td>2.01–4.48</td>
</tr>
<tr>
<td>Age at time of surgery &gt; 11 years</td>
<td>0.02</td>
<td>2.9</td>
<td>1.18–7.14</td>
</tr>
<tr>
<td>Age at symptom onset &lt; 7 years or &gt; 11</td>
<td>0.015</td>
<td>2.2</td>
<td>1.37–4.12</td>
</tr>
<tr>
<td>Gender: female</td>
<td>0.04</td>
<td>3.2</td>
<td>1.05–9.53</td>
</tr>
<tr>
<td>Limitation in sports</td>
<td>0.02</td>
<td>2.3</td>
<td>1.35–3.88</td>
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Multivariate analysis

<table>
<thead>
<tr>
<th>Factors</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Time from symptom onset to surgery &gt; 3 years</td>
<td>0.01</td>
</tr>
<tr>
<td>Age at symptom onset &lt; 7 years or &gt; 11</td>
<td>0.03</td>
</tr>
<tr>
<td>Gender: female</td>
<td>0.04</td>
</tr>
<tr>
<td>Limitation in sports</td>
<td>0.03</td>
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Table 3
Prognostic score.

<table>
<thead>
<tr>
<th>Gender: female</th>
<th>1.5</th>
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<tbody>
<tr>
<td>Age at time of surgery &gt; 11 years</td>
<td>1.5</td>
</tr>
<tr>
<td>Number of sprains &gt; 15</td>
<td>1.5</td>
</tr>
<tr>
<td>Age at symptom onset &lt; 7 years or &gt; 11</td>
<td>1</td>
</tr>
<tr>
<td>Limitation in sports</td>
<td>1</td>
</tr>
<tr>
<td>Time from symptom onset to surgery &gt; 3 years</td>
<td>1</td>
</tr>
</tbody>
</table>

4. Discussion

To our knowledge, this is the largest series reported in the literature on TLAP surgery and the first to propose a prognostic score for the result of surgical treatment. The sex ratio and the rate of bilateral cases are in agreement with the literature [3,5–8].

We chose to confirm the TLAP diagnosis with MRI, because standard X-rays have limited sensitivity despite direct (calcaneonavicular distance < 5 mm) or indirect signs (cupped talar neck, hypoplasia or osteophytes of the talar head [2,15]). Several authors [16–20] report up to 30% intraoperative diagnosis with a negative radiographic workup. CT gives good results when complete synostosis is sought, but performs poorly in cases of synchondrosis or fibrous bridge. MRI allowed us to make the diagnosis and search for other possibly associated anomalies (malunion of the lateral malleolus, collateral lateral ligament tear, osteochondritis, or talar dome) [20].

Few studies [3,6–8] have assessed the results of TLAP surgical treatment, and the evaluation criteria vary. In 1990, Gonzalez and Kumar [8] reported the results of TLAP resection using subtalar joint range of movement as the main endpoint. In their series, the treatment was considered a failure when a bony bridge reappeared on the postoperative X-ray. In the present study, we chose a clinical score, the AOFAS AHS, to match the patients’ symptoms as closely as possible. With the rigor of the AOFAS AHS score, the failure rate of the surgery in our series was greater than what has been reported previously (10–25% [3,6–8,21]). In addition, it should be noted that this rate is partly explained by the cutaneous complications that could be prevented with arthroscopic resection of the TLAP, as has been suggested by certain authors [22–25]. This approach would also have the advantage of assessing the lesions in the area,
associating the search for abnormalities of the talar head, the subtalar joint, and the tarsal sinus.

In this study, prognostic factors of the surgical treatment, which to date had only been suggested, have now for the first time been demonstrated [6–8].

The prognostic score proposed and tested in this series has allowed us to separate the patients into two groups, each with a significantly different prognosis, 78% surgical success for a score less than 4 and 70% surgical failure for a score greater than or equal to 4. Nevertheless, we are aware that, to be validated, this score must be confirmed and tested in a prospective study, preferably multicentric. It should also be noted that today we have no other therapeutic alternative to propose to patients for whom the prognostic score suggests a poor outcome.

This study has several limitations, first of all its retrospective design, and these results now need confirmation in a prospective study. Second, we lost 17 patients to follow-up, accounting for 25% of the initial cohort, but finding and contacting this young, active population is difficult [25]. Finally, we chose the AOAFS AHS score, even though it has no pediatric validation, to assess the T/LAP surgical results because we believe this score is the most relevant in evaluating patient symptoms.

In conclusion, this work shows that the overall failure rate of T/LAP surgery is 28%. The prognostic factors demonstrated make it possible to describe the ideal patient for this surgery: a boy in whom the symptoms began between the age of 7 and 10 years, who had had fewer than 15 sprains, and who underwent surgery within 3 years of the initial symptoms.

Disclosure of interest

The authors declare that they have no competing interest.

References