Achilles Tendon Turndown with Flexor Hallucis Longus Transfer for Management of Neglected Insertional Rupture of Tendoachilles

Ahmed Abdelazim Abosalem, MD and Ahmed Naser Elbarbary, MD

Lecturers of Orthopaedic Surgery, Faculty of Medicine, Menoufia University, Shebin El-Kom, Menoufia, Egypt

Correspondence to: Ahmed Abdelazim Abosalem.
Postal Address: Department of Orthopaedic Surgery, Faculty of Medicine, Menoufia University, Shebin El-Kom, Menoufia, Egypt.
Email:
ahmed.abosalem@med.menofia.edu.eg
ORCID: 0000-0002-1957-2629
Telephone: +201064348989

The Egyptian Orthopedic Journal; 2022 supplement, December, 57: 37-43

ABSTRACT:

Background:
Surgical reconstruction of neglected insertional rupture of tendoachilles (TA) is technically challenging as there is a large defect after proper debridement and scar excision. Different procedures and techniques were described for the management of such patients. This study aimed to evaluate functional outcomes of management of 21 patients presented with neglected insertional rupture of tendoachilles by Achilles tendon turndown with flexor hallucis longus (FHL) tendon transfer.

Patients & Method:
From May 2018 to January 2021, 21 patients with neglected insertional rupture of tendoachilles were managed by Achilles tendon turndown with flexor hallucis longus tendon transfer. A biodegradable interference screw was used for the fixation of the transferred FHL tendon, and a 5 mm titanium anchor was used for the reattachment of the Achilles tendon turndown flap. The mean follow-up period was 15±2.8 months. Visual Analogue Scale (VAS) and American Orthopaedic Foot and Ankle Society (AOFAS) scores were used to evaluate the outcome.

Results:
There was a significant improvement in both VAS and AOFAS scores. At one year follow-up, the mean VAS score was 0. The mean AOFAS score was 95.82±4.23. The mean operative time was 73±15 minutes. Two patients (9.5%) had superficial wound infections that were managed by repeated dressing and antibiotic therapy. One patient (4.7%) had a sural nerve neuroma that necessitated surgical excision and burying of the proximal stump.

Conclusion:
Achilles tendon turndown with flexor hallucis longus tendon transfer is a reliable and effective method in the management of neglected Insertional rupture of tendoachilles.

Keywords:
Flexor hallucis transfer, Achilles turndown, Neglected Tendoachilles rupture.

INTRODUCTION

The Achilles tendon (AT) is the conjoint tendon of the three-headed triceps surae muscle formed by the two heads of the gastrocnemius muscle and soleus muscle [1].

The average length of the AT is 15 cm. The mean width at its origin is 6.8 cm, 1.8 cm at its midsection, and 3.4 cm at its insertion site over the posterior surface of the calcaneus [2].

The blood supply of the AT is age-dependent and decreases with age. The AT has three main vascular areas: the proximal and distal parts of the tendon are supplied by the posterior tibial artery while the midsection of the tendon is supplied by the peroneal artery [3].

The AT is anatomically made up of non-insertional (proximal) and insertional (distal) portions. The insertional component is composed of a pre-insertion site, located about two centimeters above the calcaneum, and a calcaneal insertion, where the tendon is attached to the bone [1].

Tendinopathy means failure of the healing response of the tendon with disruption of collagen fibers, increase in the non-collagenous matrix, and disorganized proliferation of tenocytes. Tendinopathy predisposes the tendon to develop mechanical instability and eventually rupture. Insertional Achilles tendinopathy is located at the insertion of the AT onto the calcaneus with bone spurs and calcifications in the tendon proper at the insertion site may exist [4].

Rupture of the AT is commonly presented in middle-aged patients (30 to 40) years with an incidence of 13.4 per 100.000 adults [5-6].

Achilles tendon rupture is considered chronic when there is a four-week delay before management. The rupture AT causes weak plantar flexion of the ankle, and difficulty in climbing stairs with an alteration in the gait mechanics [7].

The treatment of chronic insertional AT rupture is challenging as tendon ends are retracted and atrophied with a large defect that makes it difficult to compensate or reconstruct after proper debridement and scar excision [8].

Many procedures were described for the reconstruction of such injury. Some used local flaps to compensate for the defect such as gastrocnemius V-Y plasty with gastrosoleus fascial turndown flap [9] and proximal AT turn-down flap [10].

Other surgical procedures used free autologous tendon grafts for the reconstruction of the chronic tear of AT ruptures such as gracilis [11] and semitendinosus tendons [12].

Other techniques preferred for local tendon transfer in chronic neglected injuries such as FHL transfer [13-14], flexor digitorum longus transfer [15], and peroneus brevis tendon transfer [16].

In this study, we evaluated the functional outcomes of management of neglected insertional rupture of tendoachilles by AT turndown with flexor hallucis longus (FHL) tendon transfer.

PATIENTS AND METHODS

Patient selection

We conducted a prospective case series study of 21 patients with neglected insertional rupture tendoachilles who had been admitted to the Menofia University Hospital from May 2018 to January 2021 with a minimum one-year follow-up. A single orthopedic surgeon performed all the operations. The study was approved by Menoufia University Institutional Review Board (IRB) and the ethical committee. Written consent about the procedure and possible complications was taken.

Inclusion criteria were (a) age was above eighteen years; (b) neglected chronic AT insertional rupture of more than 3 months.

Exclusion criteria were (a) AT rupture of fewer than 3 months; (b) AT rupture in patients with chronic debilitating diseases and not fit for surgery; (c) history of prior surgical interference. Patients had to complete at least one year of follow-up to be considered for the study.

Preoperative evaluation

A detailed history was obtained for assessment of the chronicity of the AT rupture. The general and local examination was done for evaluation of the patient's general condition, fitness for surgery, the neurovascular status of the limb, local skin condition, preoperative VAS, and AOFAS scores. A plain X-ray lateral view of the injured foot and ankle and MRI were obtained for assessment of the insertion calcific tendinitis, Haglund deformity (enlargement of the posterosuperior tuberosity of the calcaneus), gap size, and the atrophic changes of the gastrocnemius muscle, Fig.1. Laboratory investigations as preoperative assessment in the form of complete blood count, bleeding profile, liver function tests, kidney function tests, and blood sugar. In all patients, a single prophylactic antibiotic was administered 2 hours before surgery in the form of a third-generation cephalosporin injection, and the dose was adjusted according to the weight of the patient.

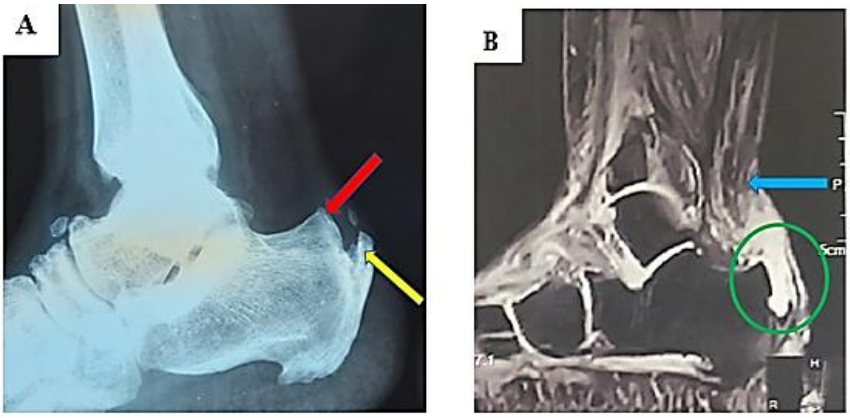

Figure 1: A: preoperative X-ray shows insertional calcific AT tendinitis (yellow arrow) with Haglund deformity (red arrow). **B:** MRI shows insertional AT rupture (green circle) with retracted proximal stump (blue arrow)

Surgical technique

Spinal anesthesia was used in all patients. A pneumatic tourniquet was applied over smooth padding at the mid-thigh. The procedure was done with the patient in the prone position and the ankle was placed at the edge of the operating table Fig. 2-A. After sterilization and draping of the affected limb, a sterile Esmarch bandage was used to exsanguinate the limb followed by inflation of the pneumatic tourniquet to pressure 150 mm Hg more than the systolic blood pressure. A straight midline posterior skin incision (15 cm long) was done over the ruptured Achilles tendon with proper exposure of the calcaneal insertion. The proximal stump of

the AT and the plantaris tendon were identified, Fig. 2-B. Debridement of the scarred tissue of the proximal part of the tendon followed by excision of the Haglund bony prominence (if present) and the calcified part of the tendon at its insertion with the refreshment of the calcaneal bed, Fig. 2-C. The FHL tendon was identified in the depth of the wound after incision of the deep fascia of the leg, Fig. 3-A, B. Adequate length of the tendon was obtained by deep dissection of the tendon in its tunnel and harvested while the ankle and big toe were maximally plantarflexed, Fig. 3-A, B, C. All the FHL tendons were harvested from the same surgical incision and there was no need to harvest the tendon by making another plantar incision. Tendon weaving sutures were done by making three or more locking loops placed along each side of the tendon using number 0 Vicryl sutures, Fig. 3-D. A vertical calcaneal tunnel was created for the passage of The FHL tendon which was placed just posterior to the insertion using a 6 mm drill bit and exited through the plantar aspect of the calcaneus, Fig. 4-A. A seven mm bioabsorbable interference screw was used for fixation of the FHL tendon while the ankle was placed on 30 degrees plantar flexion and maximum tension was applied to the transferred tendon during the application of the screw. Then the middle third of the proximal stump of the AT was identified and divided on either side then proximally. The length of the divided middle third was double the length of the defect from the distal end of the proximal stump to the calcaneal insertion. Then, the divided middle third was turned toward AT calcaneal insertion and fixed to calcaneus using a 5 mm titanium anchor, Fig. 5-A, B. The defect on the proximal stump after turning down its middle third was approximated using number one vicryl sutures. The plantaris tendon was spread and sutured as a sheet over the AT to act as an epitenon to decrease the incidence of adhesions around the tendon, Fig. 5-C. The pneumatic tourniquet was deflated, and proper homeostasis was done followed by the closure of the subcutaneous tissue and skin. Sterile dressing was applied over the wound and below-knee plaster of Paris (POP) was done while the ankle was at 30 degrees plantar flexion.

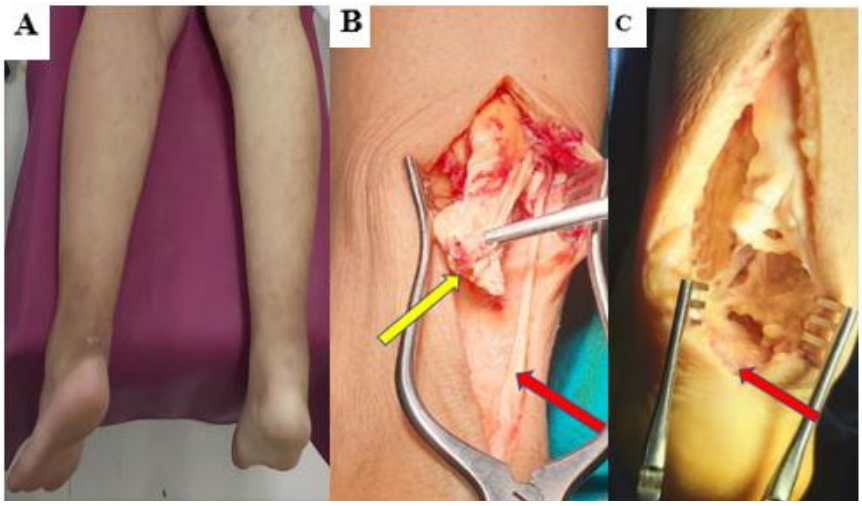

Figure 2: A: Patient position**. B:** The proximal stump of the AT (yellow arrow) and the plantaris tendon (red arrow) were identified**, C.** Refreshment of the calcaneal bed**.**

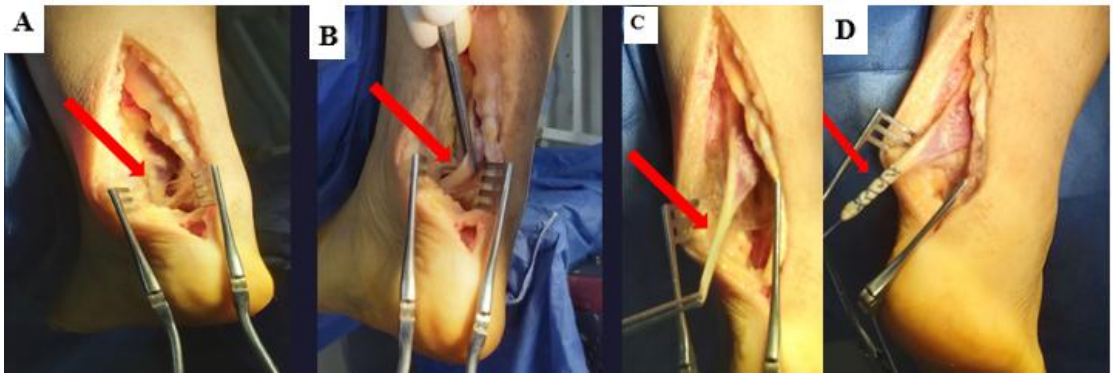

Figure 3: A-B: Identification of the FHL tendon. **C:** The tendon was harvested from the same wound. **D:** Tendon weaving sutures were done.

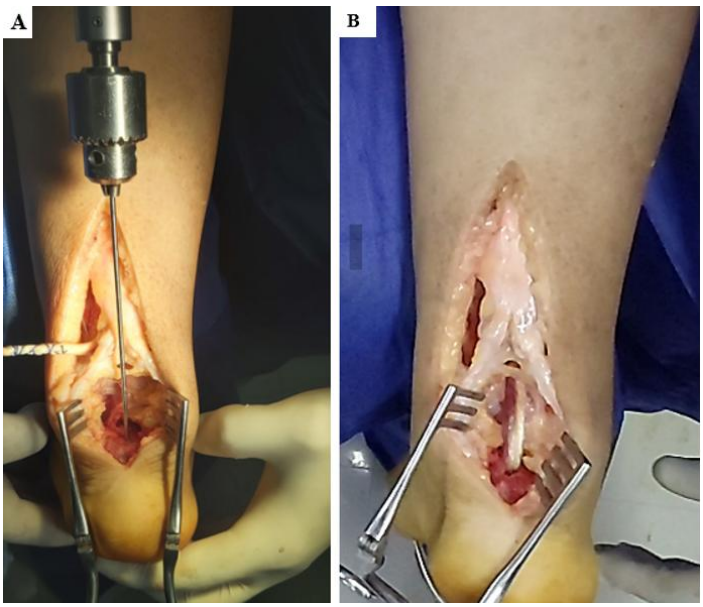

Figure 4: A: A vertical calcaneal tunnel was created for the passage of The FHL tendon**. B:** Fixation of the transferred FHL tendon using a biodegradable interference screw (yellow arrow).

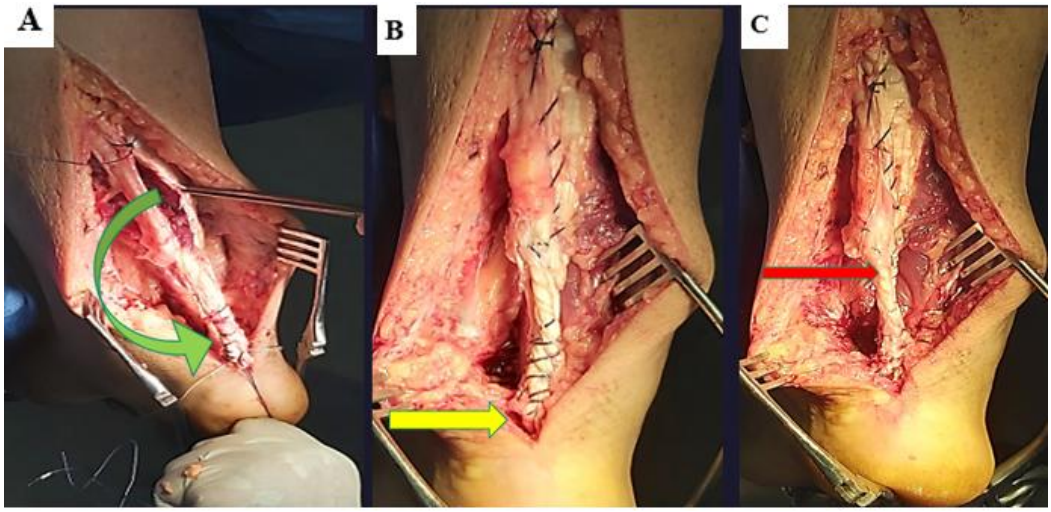

Figure 5: A: The middle third of the AT was turned down (green arrow)**. B:** Fixation of the turned-down middle third using A 5 mm titanium anchor (yellow arrow). **C:** The plantaris tendon (red arrow) was spread and sutured as a sheet over the AT.

Postoperative care and functional evaluation

A plain X-ray lateral view of the ankle was done on the first postoperative day to assess the excision of the Haglund bony prominence and the position of the titanium anchor, Fig. 6-A.

Follow up in outpatient clinic for assessment of wound status and suture removal after two weeks. Three weeks postoperatively, the POP was changed from 30 degrees ankle plantar flexion to a plantigrade position for another three weeks. Six weeks postoperatively, a rehabilitation program was started for strengthening exercises, partial then full weight bearing, and range of motion (ROM) of the ankle joint. Six months postoperatively, the patient returned to full activities.

Final clinical evaluation was done after one year of follow-up, Fig. 6-B. Visual Analogue Scale (VAS) and American Orthopaedic Foot and Ankle Society (AOFAS) score were used to evaluate the functional outcome. The ability to do single-leg heel rising was used to evaluate the push-off strength. Postoperative complications were noted.

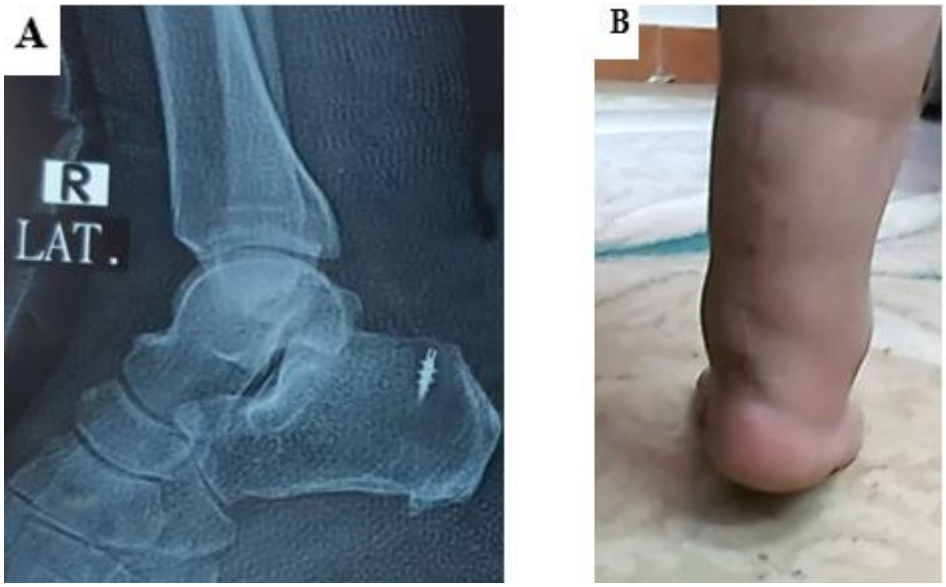

Figure 6: A: Postoperative X-ray shows excision of the Haglund bony prominence and proper positioning of the titanium anchor**. B:** One year postoperative with proper wound healing and adequate single-leg heel rising.

Statistical analysis

At the end of the study, the data were collected, tabulated, and statistically analyzed by SPSS (Statistical Package for Social Science) version 23 on IBM IBM-compatible personal computer. The Chi-square test, Wilcoxon test, and Mann-Whitney's test were utilized for comparative statistical analysis when appropriate. P-values less than 0.05 were set as the significance level.

RESULTS

Twenty-one patients with neglected AT rupture were included in this study, 17 (80.95%) males and 4 (19.05%) females. The average age was 54.7± 9.4 (range, 39-67) years. The left side was affected in 15 (71.4%) patients, and the right side was affected in (28.6%) patients. The mean duration of the chronicity of the AT rupture was 7 ± 3.83 (range, 3-11) months. The mean preoperative AOFAS score was 55.36 ± 5.87. The mean follow-up period was 15±2.8 months. The mean operative time was 73±15 minutes.

All the patients regained the ability to perform a single-leg heel rise. There was a significant improvement in both VAS and AOFAS Ankle-Hindfoot scales. At one year follow-up, the mean VAS score was 0. The mean postoperative AOFAS Ankle-Hindfoot score was 95.82±4.23. Two patients (9.5%) had superficial wound infections that were managed by repeated dressing and antibiotic therapy. One patient (4.7%) had a sural nerve neuroma that necessitated surgical excision and burying of the proximal stump.

DISCUSSION:

Insertional rupture of AT is very disabling causing very weak plantar flexion of the ankle, and difficulty in climbing stairs with an alteration in the gait mechanics [7]. It may be passed unnoticed by the patient for a long time, especially in those who complain of chronic pain at the AT insertion secondary to Haglund syndrome. Delay in treatment of such injury results in proximal retraction of the tendon and atrophy of the calf muscle [17]. A large defect usually occurs after proper debridement and scar excision of the diseased chronically ruptured tendon which makes it a challenge to reconstruct in the presence of atrophied gastrocnemius muscle with poor strength [8].

Many procedures were described for the reconstruction of such injury. Some used local flaps to compensate for the defect such as gastrocnemius V-Y plasty [9]; however, it has a limitation to the amount of gap (maximum 5 cm gap) that can be reconstructed, and also there is always suspicious about the quality of tissue of the chronically disused muscle. Proximal AT turn-down flap can reconstruct a bigger gap of up to 6 cm [10].

Other surgical procedures use free autologous tendon grafts for the reconstruction of the chronic tear of AT ruptures such as gracilis [11] and semitendinosus tendons [12]; however, they are non-vascularized grafts require a healthy environment to enhance their healing and this may not be achieved in all patients, especially in AT ruptures secondary to longstanding tendinopathy. In addition to, the donor site morbidity of the free graft transfer.

Other techniques preferred for local tendon transfer in chronic neglected injuries such as FHL transfer [13-14], flexor digitorum longus transfer [15], and peroneus brevis tendon transfer [16]. The FHL tendon transfer has many advantages over the other tendon transfer such as it is the second strongest plantar flexor of the ankle after gastrosoleus muscle, it can be harvested from the same incision with lower donor site morbidity than peroneus brevis tendon harvesting that may lead to ankle instability. The presence of an inter-tendinous connection between FHL and FDL maintains the power of plantar flexion of the big [18].

In this study, we aimed to get the benefits of both the AT turndown flap with flexor hallucis longus (FHL) tendon transfer in the management of neglected insertional rupture of tendoachilles. Wegrzyn et al. treated 11 patients with chronic Achilles tendon rupture reconstruction using a modified flexor hallucis longus transfer. The distal end of the FHL tendon was harvested through a separate medial arch incision. They reported that the mean pre-operative AOFAS score was significantly improved from 64 points to 98 points (range, 90–100) at the last follow-up. Ankle range of motion was close to the non-involved ankle with an average of 12° of dorsiflexion and 45.5° of plantar flexion with No major complications regarding wound healing but the reported loss of plantar flexion of the big toe [5].

Koh et al compared flexor hallucis longus transfer versus turndown flaps augmented with flexor hallucis longus transfer in the repair of 40 patients with chronic Achilles tendon rupture. At one year follow-up, they reported that both techniques demonstrated significant improvement in both VAS and AOFAS scores. The mean VAS score was 0 for both groups. The mean AOFAS Ankle-Hindfoot score was 90 ±11 (FHL) and 95 ±10 (FHL with turndown flaps). They concluded that FHL transfer required significant-ly less operative time compared to turndown flaps augmented with FHL transfer, with comparable outcomes [19]. Ozer et al. treated 19 patients with neglected AT injury by FHL tendon transfer and lengthening of the native tendon with a V-Y plasty with the weaving of the FHL muscle belly through the AT to construct a united structure. The FHL tendon was harvested from the same posterior incision. They reported that the AOFAS score was significantly improved to 93.83. They concluded that the repair of neglected AT rupture with FHL tendon transfer restores good functional outcomes with a low complication rate [20].

In this study, All the patients regained the ability to perform a single-leg heel rise. There was a significant improvement in both VAS and AOFAS scores. At one year follow-up, the mean VAS score was 0. The mean postoperative AOFAS score was 95.82±4.23. Two patients had superficial wound infections that were managed by repeated dressing and antibiotic therapy. Two patients (9.5%) had superficial wound infections that were managed by repeated dressing and antibiotic therapy. One patient (4.7%) had a sural nerve neuroma that necessitated surgical excision and burying of the proximal stump. Our results are comparable to the results of Wegrzyn et al., Koh et al., and Ozer et al. studies. The FHL tendon was harvested from the same posterior midline incision with preservation of the plantar flexion of the big toe through the inter-tendentious connection of the distal stump with the FDL with avoidance of a second medial arch incision. We believe that the reconstruction of the AT through AT turndown flap restores some of the native physical function of the neglected ruptured tendoachilles and when it is augmented by FHL tendon transfer, it provides very well functional outcomes with a low risk of complications but with a longer operative time.

CONCLUSION:

Achilles tendon turndown with flexor hallucis longus transfer for management of neglected insertional rupture of tendoachilles was a reliable and effective method for the treatment of such injuries with a low complication rate.

REFERENCES

1. Del Buono A, Chan O, Maffulli N. Achilles tendon: Functional anatomy and novel emerging models of imaging classification. Int Orthop. 2013;37(4):715–21.
2. Apaydin N, Bozkurt M, Loukas M, Vefali H, Tubbs RS, Esmer AF. Relationships of the sural nerve with the calcaneal tendon: An anatomical study with surgical and clinical implications. Surg Radiol Anat. 2009;31(10):775–80.
3. Chen TM, Rozen WM, Pan WR, Ashton MW, Richardson MD, Taylor GI. The arterial anatomy of the Achilles tendon: Anatomical study and clinical implications. Clin Anat. 2009;22(3):377–85.
4. van Dijk CN, van Sterkenburg MN, Wiegerinck JI, Karlsson J, Maffulli N. Terminology for Achilles tendon related disorders. Knee Surgery, Sport Traumatol Arthrosc. 2011;19(5):835–41.
5. Wegrzyn J, Luciani JF, Philippot R, Brunet-Guedj E, Moyen B, Besse JL. Chronic Achilles tendon rupture reconstruction using a modified flexor hallucis longus transfer. Int Orthop. 2010 Dec;34(8):1187-92.
6. Levi N. The incidence of Achilles tendon rupture in Copenhagen. Injury 1997; 28: 311-3.
7. Maffulli N, Ajis A. Management of chronic ruptures of Achilles tendon. J Bone J Surg (Am) 2008; 90: 1348-60
8. Panchbhavi VK. Chronic Achilles tendon repair with flexor hallucis longus tendon harvested using a minimally invasive technique. Tech Foot Ankle Surg 2007; 6: 123-9
9. Raju S, Singhi PK, Somashekar V, Ajari A, Chidambaram M. Long-Term Outcomes of Gastrocnemius V-Y Plasty Gastrosoleus Fascial Turndown Flap for Chronic Tendo-Achilles Injuries with Complex Gap (Kuwada Type IV Injuries). Indian J Orthop. 2021;56(3):421-8.
10. Pavan Kumar A, Shashikiran R, Raghuram C. A novel modification of Bosworth's technique to repair zone I Achilles

tendon ruptures. J Orthop Traumatol. 2013 Mar;14(1):59-65.
11. Maffulli N, Spiezia F, Testa V, Capasso G, Longo UG, Denaro V. Free gracilis tendon graft for reconstruction of chronic tears of the Achilles tendon. J Bone Joint Surg Am. 2012;94(10):906-10.
12. Maffulli N, Longo UG, Gougoulias N, Denaro V. Ipsilateral free semitendinosus tendon graft transfer for reconstruction of chronic tears of the Achilles tendon. BMC Musculoskelet Disord. 2008;9:100-9.
13. Howell MA, Catanzariti AR. Flexor Hallucis Longus Tendon Transfer for Calcific Insertional Achilles Tendinopathy. Clin Podiatr Med Surg. 2016;33(1):113-23.
14. Lui TH, Chan WC, Maffulli N. Endoscopic Flexor Hallucis Longus Tendon Transfer for Chronic Achilles Tendon Rupture. Sports Med Arthrosc Rev. 2016;24(1):38-41.
15. De Cesar Netto C, Chinanuvathana A, Fonseca LFD, Dein EJ, Tan EW, Schon LC. Outcomes of flexor digitorum longus (FDL) tendon transfer in the treatment of Achilles tendon disorders. Foot Ankle Surg. 2019;25(3):303-9.
16. Maffulli N, Spiezia F, Pintore E, Longo UG, Testa V, Capasso G, et al. Peroneus brevis tendon transfer for reconstruction of chronic tears of the Achilles tendon: a long-term follow-up study. J Bone Joint Surg Am. 2012;94(10):901-5.
17. Pendse A, Kankate R. Reconstruction of chronic Achilles tendon ruptures in elderly patients, with vascularized flexor hallucis longus tendon transfer using single incision technique. Acta Orthop Belg. 2019;85(1):137-43.
18. Pichler W, Tesch NP, Grechenig W, Tanzer K, Grasslober M. Anatomical variations of the flexor hallucis longus muscle and the consequences for tendon transfer. A cadaver study. Surg Radiol Anat 2005; 27: 227-31
19. Koh D, Lim J, Chen JY, Singh IR, Koo K. Flexor hallucis longus transfer versus turndown flaps augmented with flexor hallucis longus transfer in the repair of chronic Achilles tendon rupture. Foot Ankle Surg. 2019;25(2):221-225.
20. Ozer H, Ergisi Y, Harput G, Senol MS, Baltaci G. Short-Term Results of Flexor Hallucis Longus Transfer in Delayed and Neglected Achilles Tendon Repair. J Foot Ankle Surg. 2018;57(5):1042-7.