International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

A Single Approach Flexor Hallucis Longus Tendon Transfer in Elderly Patients with Chronic Insertional Achilles Tendon Pathologies: A Retrospective Review using Validated Ankle Scores

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Abstract: ***Purpose: Augmentation and reconstruction of chronic Achilles tendon pathologies with the flexor hallucis longus tendon with a single interference screw is a safe, reproducible and reliable outcome for elderly patients. This study aims to show the reliability of this procedure in elderly Asian patients with validated ankle scores. Methods: This is a single centre case series performed by a single surgeon where patient reported satisfaction and outcome were compiled on 6 patients. Preoperative and post operative scores measured were visual acuity scores (VAS), Foot and Ankle Disability Index (FADI) and American Orthopaedic Foot & Ankle Society (AOFAS) score. The range of motion following surgery was also collected to determine function and success at 2 years after surgery. Results: Mean age of patients was 55 years (Range 53-59 years). All ankle scores improved at 2 year follow up. Overall patient satisfaction was 100%. No complications or re-rupture was observed during the period of study. Conclusion: Chronic insertional Achilles tendinopathy treatment with FHL tendon transfer has reliable and good outcomes. A larger sample size and longer follow up will be useful.***

Keywords: Haglund's Deformity, Flexor hallucis longus, tendon transfer, validated ankle scores

1. Introduction

Insertional Achilles tendinopathy and ruptures affects gait and causes chronic pain and swelling. This limits plantarflexion and ability to tip toe and affects activities off daily living[1,2]. Significant tendon gap may result in difficulty opposing the tendons and re-attachment to the calcaneus intraoperatively[3]. Flexor hallucis longus tendon transfer has been widely reported to show good outcomes[4]. The flexor hallucis longus is the second strongest plantar flexor of the ankle, the proximity to the Achilles tendon makes it an easy and recommended tendon to transfer with the contractile force in a similar axis to the Achilles tendon[5,6]. A short tendon transfer of the flexor hallucis longus tendon transfer harvested at the level of the ankle joint at the beginning of the fibro-osseous tunnel has shown to have good results which was used in this study [1,6]. Following flexor hallucis longus tendon transfer there is no pressure change to the first metatarsophalangeal joint following treatment for Achilles tendon tendinosis or rupture[7,8].

In elderly patients, the pathology may be traumatic, inflammatory or degenerative, however the exact pathology is still not fully understood[9]. Hansen et al in 1991 first suggested the use of the Flexor hallucis tendon transfer in cases where the Achilles tendon substance was excised greater than 50%[10].

2. Materials and methods

This was a retrospective study done in a single centre by a senior foot and ankle consultant (IM). All patients identified with chronic insertional Achilles tendon pathologies which were non-responsive to conservative treatment of more than 4 months who were surgically operated during the study period (September 2021 to August 2022) were analysed. A total of twelve patients were initially identified. However, only six patients fit the strict study criteria which were patients above 50 years of age with at least 24 months follow-up and Insertional Chronic Achilles tendon pathology which did not respond to conservative treatment for twelve weeks. A chronic Achilles tendon rupture was defined as a rupture or diagnostic delay of more than six weeks. Four of the patients had a presence of a Haglund's deformity without rupture and two patients had a chronic insertional rupture with a pre-existing Haglund's deformity. All patients diagnosis were confirmed by clinical examination, plain radiographs and ultrasound. The two patients with suspected chronic Achilles tendon ruptures were confirmed with magnetic resonance imaging (MRI)[11].

2.1 Surgical technique

A single incision technique was utilised for all patients. Patients were placed in a prone position and a tourniquet applied to the proximal thigh. Lower leg tourniquet was not applied over the calf to prevent any interference in the gastrocnemius-soleus complex during tensioning of the tendon. A longitudinal midline incision measuring 5-6cm over the Achilles tendon including the insertion was made. The ends of the Achilles tendon were debrided removing any degenerative thickened fibres of the tendon as well at the torn ends. Any osseous fragments within the tendon were meticulously removed to preserve as much tendon as possible (Figure 1). The Haglund deformity was removed by micro saw and completed in a bevelled manner to ensure a smooth calcaneus tuberosity without any sharp bony prominences

(Figure 2). Deep retrocalcaneal tissue was debrided to allow easy visualisation of the tendon and deep compartment fascia released to allow the muscle belly of the flexor hallucis to migrate posteriorly (Figure3). The flexor hallucis longus tendon is identified as running lateral to medial direction deep to the Achilles tendon. From the same incision, a short tendon harvest is done by following the tendon to the level of the medial malleolus as it passes through the calcaneus tunnel and released.

The whipstitch was used over the distal stump of the flexor hallucis tendon and measured[12]. A calcaneal tunnel was made in the midline around 1-1.5cm anterior to the origin of the insertion of the native Achilles tendon and care was taken for the tunnel to exit about 1cm anterior to the calcaneal tuberosity over the plantar surface in the midline. The proximal tendon was dissected to allow better excursion as it passes through the tunnel. Tunnel edges are carefully smoothened to allow smooth tendon gliding. The tendon was tensioned with the knee flexed in 90 degrees with the affected ankle in a resting gravity equinus position using the contralateral ankle as a guide where possible. An appropriate size absorbable screw (bio-tenodesis screw) was used to secure the tendon, usually 0.5mm-1mm larger than the previously drilled tunnel circumference. The debrided Achilles tendon is then repaired independently and if necessary a two row bone anchor suture was used to secure the Achilles tendon in position. The Achilles tendon is not secured onto the flexor hallucis tendon either proximally or distally.

Figure 1: Pre operative radiograph showing a patient with chronic insertional Achilles tendinopathy with large irregular ossification seen within the distal Achilles tendon

Figure 2: Post operative lateral radiograph shows the smooth superior surface of the calcaneus following Haglund excision and bio-interference screw tunnel exiting in front of the calcaneal tuberosity inferiorly.

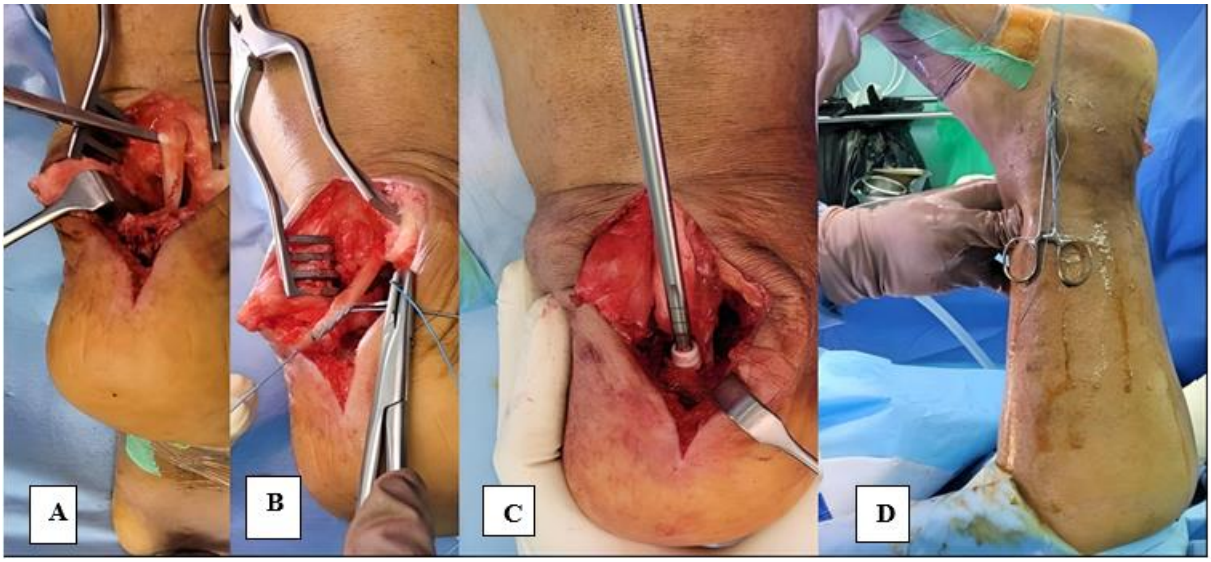

Figure 3: Intraoperative photos demonstrating (A) – Identification of flexor hallucis longus tendon deep to the Achilles tendon in a lateral to medial direction. (B) Use of a whipstitch at the terminal end of the flexor hallucis longus tendon to allow easy passage through the calcaneal tunnel. (C) Insertion of the bio interference screw. * Note the approximation of the muscle belly up to the entrance of the calcaneal tunnel to ensure proper tensioning of the tendon. (D) The ankle position is checked intraoperatively. The desired ankle position is comparable to the contralateral resting equinus position of the ankle.

2.2 Post Operative Rehabilitation & Protocol

Post operatively as shown in (Table.1), all patients are placed on a rigid below knee equinus plantar slab which was changed to a thermoplastic splint prior to discharge after wound inspection. Patients were changed to an ankle walker boot with a wedge at two weeks post operatively, physiotherapy was initiated and allowed early weight bearing as tolerated. At 4 weeks postoperatively, the wedge was removed and ankle moved to neutral position and patients were allowed full weight bearing as tolerated. At eight weeks boots were removed. Active range of motion exercises up to ankle neutral position were initiated as a form of accelerated rehabilitation to prevent tendon adhesions from the second week up to the sixth week. From the sixth to twelfth week, active range of motion beyond neutral was encouraged. Passive range of motion of the ankle was advised only after three months postoperatively.

Table 1: Table illustrating our rehabilitation protocol in our centre for patients following flexor hallucis longus tendon transfer.

Time frame	4 weeks	Next 4 weeks	Next 4 weeks	After 3rd month
Ankle position	Plantar flexion gravity equinus	Immediately move to neutral and maintain until 8th week	Off cast/boot	
Weight bearing	From 2nd week	Onwards (walker)		
Active ROM (up to neutral)	From 2ndweek up to 6th week			
Active ROM (dorsiflexion beyond neutral)		From 6th week	Till 12th week	
Passive ROM (dorsiflexion beyond neutral)				Allow

2.3 Statistical Analysis

Statistical analysis was performed using MS Excel Software. Data were tabulated and calculated in the MS Excel software. Postoperative AOFAS score & FADI scores more than ten were considered clinically relevant.

3. Materials & Methods

This study was approved by the hospital's ethics committee (RPBH 2022/314) and carried out in accordance to the standard of ethics as laid down in the Declaration of Helsinki 1964. Written and informed consents were taken from all patients.

3.1 Demography

All patients with surgery done during the study period September 2021 to August 2022 with chronic insertional Achilles tendinitis were identified. Total number of patients were 12. Only 6 patients were included in the study following the criteria. The rest did not fulfil the study criteria or were lost to follow up or declined to be included in the study. They were equal number of male and female patients in the study (50%). Mean age of patients was 55 years (Range 53-59 years). Co-morbidities were present in 4 of the patients. Three patients had pre-existing diabetes mellitus and another patient had hypertension with ischaemic heart disease. Only one patient was a smoker in our study group. Average patient weight was 78.16kg (Range 66-88kg). Four of the patients had a presence of a Haglund's deformity without rupture and two patients had a chronic insertional rupture with a pre-existing Haglund's deformity.

3.2 Results

All patients were followed up for a minimum of 24 months and average of 26.5 months (Range 24-30 months). The Foot and Ankle disability index, the American Orthopedic Foot and Ankle Scale and the Visual Analogue scale were analysed in our study. The post operative range of motion of the ankle at 24 months was also included in our study.

Foot and Ankle Disability Index

The Foot and Ankle Disability Index (FADI) as published by Martin et al in 1999 was used to analyse the patients pre-operatively and at 6 monthly intervals[13]. The mean FADI scores preoperative value of 38 (Range 33-43) shows significant improvement at six months post operative at 72 (Range 65-78), which represents 69% on the FADI scale. This improvement of FADI scores is still seen at 1 year, 18 months and at 24 months the mean score 86.8 (Range 81-94) as shown in Figure 4.

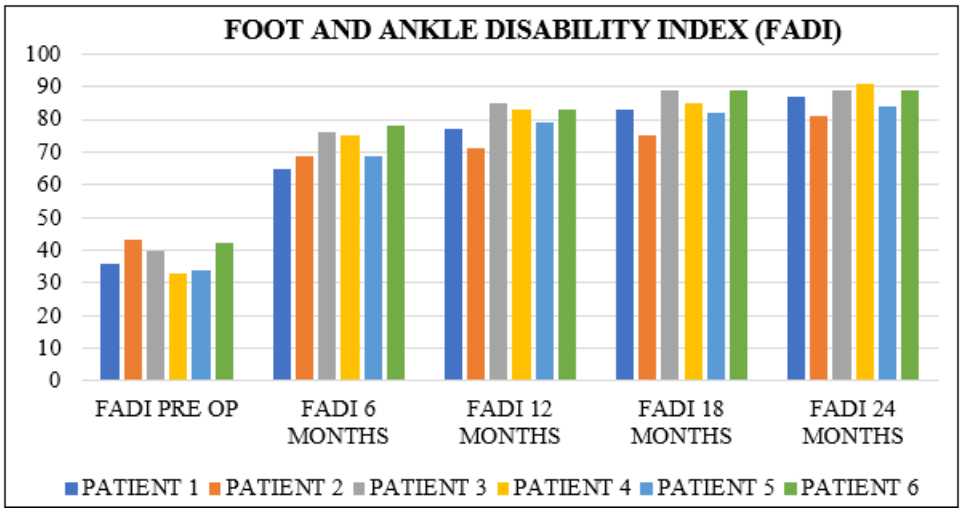

Figure 4. Simple bar chart showing the improvement progress of each patient over time.

American Orthopedic Foot and Ankle Scale (AOFAS)

Patients showed significant improvement postoperatively in the initial six months post operatively similar to the Foot and Ankle Disability Index with improvement in ankle function improving over the following 18 months. The initial mean preoperative score was 57 (Range 52-62), the most significant improvement in scores was seen in the initial 6 months following surgery with an average of 70.17 (Range 58-75). The scores showed a moderate improvement in scores with six monthly assessment with final mean AOFAS scores of 87 (Range 74-92) as shown in Figure 5.

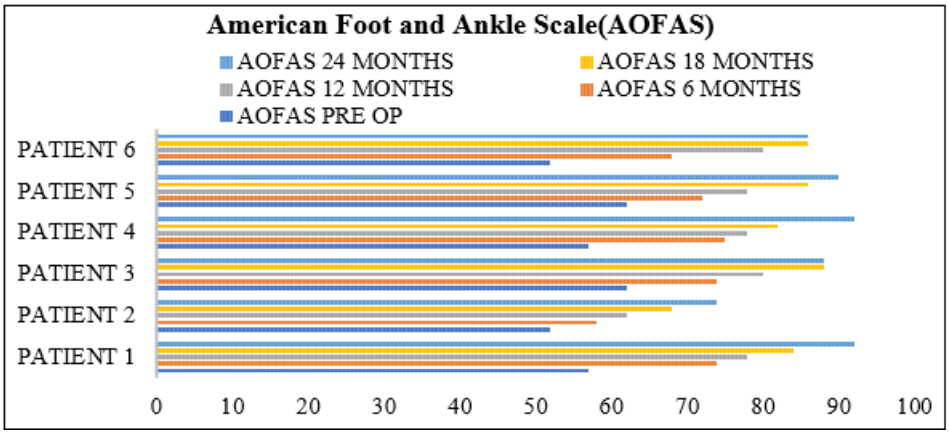

Figure 5: Representation of the AOFAS scores at 6 monthly intervals show peak improvement in scores in the first 6 months following surgery with gradual improvement in scores over the following 18 months.

Visual Analogue Scale

Visual Analogue scale was used to quantify each patients pain preoperatively and overall improvement in pain at 24 months post operatively. There is significant improvement in scores with majority of patients having minimal to moderate pain only at six months following surgery. Most patients have relatively no pain or minimal pain at 1 year with no further worsening of symptoms during the study period as shown in Figure 6.

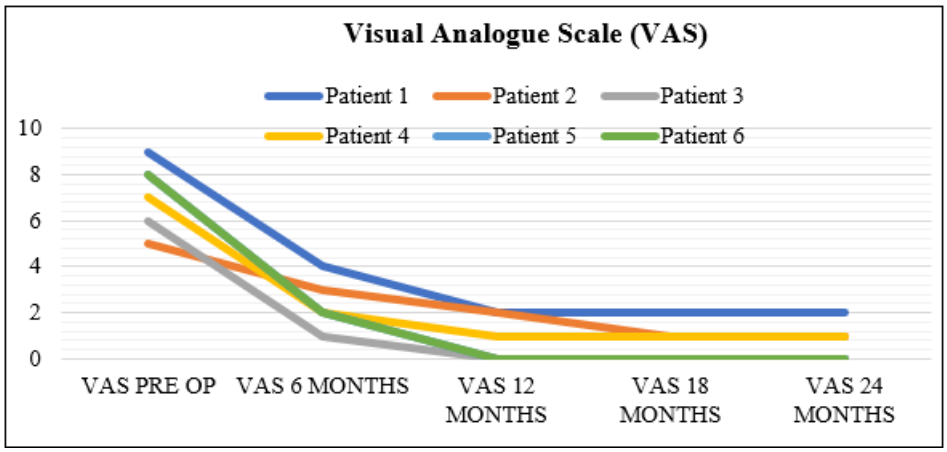

Figure 6: Rapid improvement of symptoms within 6 months of surgery and almost complete resolution of insertional heel pain within a year following surgery.

Range of motion

Range of motion of the ankle was clinically examined and evaluated on follow up. Physiotherapy as part of the accelerated rehabilitation showed good range of motion in all our patients as shown in Figure 7.

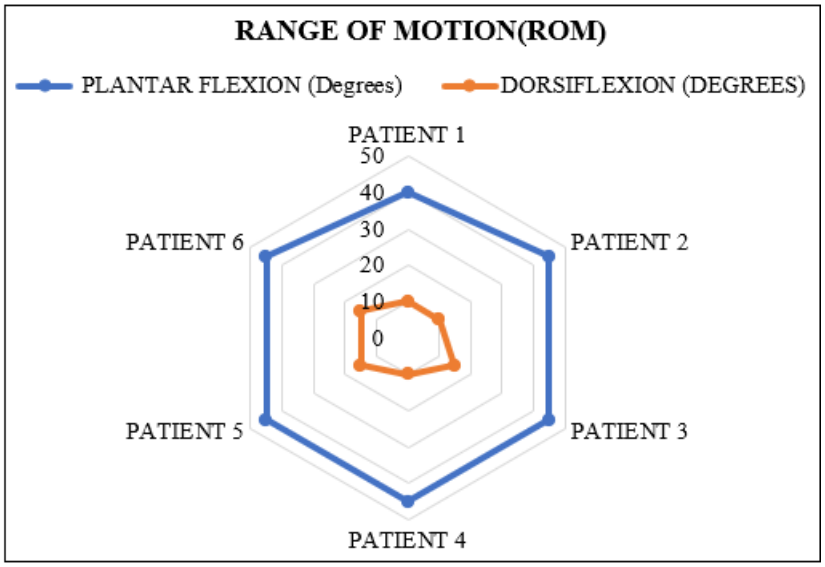

Figure 7: Scatter plot shows the individual patients ankle range of motion following surgery at 24 months.

Complications

They were no major complications observed in our study. They were no complaints of weakness of the great toe during this short term study. However, a longer case study may show a different outcome if any. No major complications such as wound breakdown or deep vein thrombosis or re-rupture was observed in our study however with a small sample size, this may need to be evaluated further in a larger series.

4. Discussion

Chronic insertional Achilles tendinopathy and ruptures are not uncommon foot and ankle pathologies. The optimal surgical treatment of chronic Achilles insertional tendinopathy is still undetermined. More so in elderly patients where the degeneration of the insertion of the Achilles tendon makes it challenging to repair following debridement and the resulting tendon gap difficult to bridge. The increased vulnerability to wound breakdown in complex reconstruction procedures is well documented[14]. Chronic Achilles insertional has a varied presentation from a mild heel pain to severe discomfort affecting gait and weak plantarflexion.

The treatment of choice also depends on the size of the gap following tendon debridement such as end to end repair, V-Y advancement and tendon transfers[15,29]. Tendon transfers such as flexor hallucis longus tendon transfers[15], flexor digitorum longus tendon transfers[16], peroneus brevis tendon transfers[17] and even free gracilis tendon grafts[18] have been described. The flexor hallucis longus tendon has length, strength and durability and the acts synergistically with the Achilles tendon for plantar flexion of the ankle during gait. Proximity of the vascularized muscle belly of the flexor hallucis tendon to the injured Achilles tendon may result in its repair and reintegration over time[25].

This study demonstrates the single incision and short tendon harvest of the flexor hallucis longus tendon and fixation with a bone interference screw can be performed with a small skin incision with relatively low morbidity especially in elderly patients with co-morbidities where bone quality and wound healing is a potential issue[19,20]. Single incision technique has shown reliable outcomes and low morbidity with interference

screw fixation[12,20,21]. In our study the remnant of the Achilles tendon was preserved and repaired where possible and the use of anchor suture when needed, we reported no failure of the flexor hallucis tendon transfer. The flexor hallucis tendon has the potential to hypertrophy up to 52% of its original size[22]. The flexor hallucis longus tendon has the potential to adapt to the increased load demands with the loss of the gastro-soleus complex[23].

The most important finding of the above study shows significant improved FADI and AOFAS scores in the first six months following surgery and continued gradual improved function up to 24 months post operatively. The visual analogue scale also shows marked improvement with minimal pain and discomfort within a year of surgery. This is similar to studies published which show improvement and return to preinjury levels of activity in similar studies[24]. The study showed no serious complications albeit the small sample size but this is keeping with similar studies which demonstrated 'less is more' approach in the treatment of chronic Achilles tendon pathologies[25,26].

A concern of flexor hallucis longus tendon transfer may cause weakness of plantar flexion of the hallux especially in younger more active sportsmen but not in activities in daily living[27]. Hunt et al found no significant weakness in hallux flexion in his study[20,28]. In elderly patients with keen early functional recovery, flexor hallucis longus tendon transfer may be an appropriate method of treatment, however a larger sample size with a more dynamic and active elderly group may be needed to assess the functional outcomes following tendon transfers for Chronic insertional Achilles tendon pathologies.

5. Conclusion

Single incision with a short harvest flexor hallucis tendon transfer is a safe and reliable procedure for elderly patients with co-morbidities allowing good functional outcome, early return to activities of daily living and validation of the outcome with good ankle scores. However, further studies with larger sample study size with and longer follow-up duration will be more beneficial.

Declaration of competing interests
The authors declare that they have no conflict of interest.

Funding
The authors received no financial support for the article, research and publication of this article.

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