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Functional outcome of FHL transfer for treatment of chronic tendo Achilles (CAT) tear using single incision

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Abstract
Introduction: Chronic Tendo Achilles Tears are common and surgically challenging problems. FLexor Hallucis longus transfer is used to improve pain and functional outcomes. The aim of our study is to study clinical outcome of foot and ankle post-surgery. We also aim to study the effect of FHL transfer using AOFAS Hallux scores.
Materials and Methods: 24 cases were enrolled who had irreparable gap of tendon Achilles on MRI scans. 4 were lost in follow-up. 20 cases were studied. These cases had a gap between 2 cut ends of Tendo Achilles, as seen intraoperatively. The FHL was harvested by cutting distal end through the same incision. FHL cut end was sutured with whip stitch and tenodesed with a suture anchor in calcaneus at 40 degrees plantar flexion. Below Knee cast is applied. Patient was followed up at 3rd, 6th, 10th weeks. Later followed up every month.
Results: The average age of patients were 56.35 years (45-68). The Male to female ratio was 13:7. 6 patients had diabetes as medical comorbidity and 50% of patients had tobacco addiction. The mean BMI of patients was 32.55 (Range 25-38). The FAOS score improved from an average score of 58.05 preoperatively (Range 38-72) to average score of 88 postoperatively (Range 77-98). Wilcoxon Signed rank test was used which suggested the results are statistically significant. The effect of FHL transfer was gauged by AOFAS Hallux score postoperatively with mean score of 85.35 (Range 76-95).
Conclusion: We conclude that FHL transfer is an effective and safe method of surgical option in chronic Tendo Achilles tears, with minimal adverse effect on donor site based on AOFAS Hallux scores.

Keywords: Chronic tendon tear, tendo Achilles, FHL transfer, FOAS score, AOFAS score

Introduction
Chronic Tendo Achilles (CAT) tears are not uncommon. They cause considerable morbidity in terms of daily activity. Increased passive dorsiflexion and decease in plantar flexion torque causes considerable pain in active movement and rest [1]. Chronic Tendon Achilles tears are ridden with issues like retraction of tendon with a gap at cut ends, scar formation, calcification and degeneration of collagen. [2-5] Tendon Achilles tendon has a relative avascular zone 2 to 6 cm proximal to the calcaneal insertion [6-7]. These type of tears are also associated with decreased blood supply, causing delayed repair response [1-8].
Patients with medical comorbidities like diabetes mellitus have high predisposition to tendinopathy [9] and postoperative infections causing failure of tendon repair surgeries [9-10]. Addictions like smoking also causes high wound complication post CAT tear repairs [11].
Flexor Hallucis Longus (FHL) tendon transfer has shown good results in terms of improvement in pain and functional outcome [3-5-12-13]. FHL tendon transfer has several advantages. FHL is sufficiently wide and long to augment CAT tear repair [14-15]. FHL tendon has a long muscular belly which aids in repair and integration of FHL in Tendo achilles. FHL tendon is a strong plantar flexor with vector of action similar to Tendo Achilles [16-17] The neuromuscular activation of Tendo Achilles and FHL are similar. This Causes good synchronization especially in plantar flexion during push off phase in gait cycle [16-17] FHL is also in close proximity of Tendo Achilles which makes dissection and harvesting easy and can be approached with the same single incision. Our aim of study is to understand the functional outcomes of FHL tendon transfer in such chronic CAT tears.

Material and Methods

We conducted a prospective interventional study in 2 years of period. 24 cases were enrolled in study. 4 were lost in follow up. 20 patients evaluated and studied with a mean follow up period of 21.35 weeks (range 12-30). All preoperarive findings like age, sex, comobidites, addictions and FOAS score were taken.

The procedure of FHL transfer was published by Wagner *et al*. in1993 [11-18].

After imaging procedures like Xray, (Figure 1) MRI scan (Figure 2, 3) was done, the patient was sent for pre anesthetic fitness. Patient was administered general anesthesia with prone position under tourniquet applied in thigh region. The tear was opened with the standard midline approach. (Figure 4). Sural nerve was identified. The Parthenon was incised. The loose fibrous tissue between the ruptured ends of the Tendo Achilles were debrided. The gap between ends had a mean distance of 5.2 cms. Later the deep fascia was dissected and posterior neurovascular bundle retracted. FHL tendon is identified and harvested. Its connections with Flexor digitorum longus are released and FHL tendon is pulled out through the incision. Later the most distal part of the tendon which can be approached is cut from the same posterior incision. The distal portion of FHL retracts back **i**nto the foot tunnel. FHL tendon is sutured measured for its width and length, which was approximately 5 to 6 mm wide and 4 to 5 cm in length. The distal part of the cut FHL tendon is sutured with whip stitch with ethibond suture No 4. The insertion point on calcaneum is debrided and an entry point in made. A tunnel is made in calcaneus based on length and width of the FHL tendon. The tendon is passed in the tunnel and a tenodesis screw is used to fix it, in 40 degrees of plantar flexion. The FHL tendon is sutured side to side to proximal and distal portion of tendon Achilles tendon. The paratenon is sutured back. Wound is washed thoroughly and closed in layers. The patient was applied cast in plantar flexion. After 3 weeks the cast was removed. Skin sutures were removed. Skin gaping and superficial infections were addressed at this point with regular dressings in ward. The patient was given a second cast for 3 weeks in neutral position. After 3 weeks second cast was removed and patient was mobilised full weight bearing.

Patients were followed up and foot functions were assessed with FOAS and AOFAS hallux scores at 12 weeks.

Fig 1: Preoperative Xray.

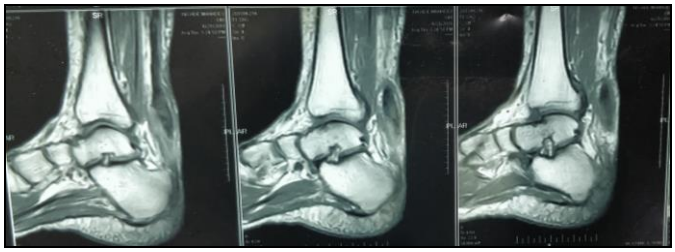

Fig 2: Preoperative MRI scans Saggital

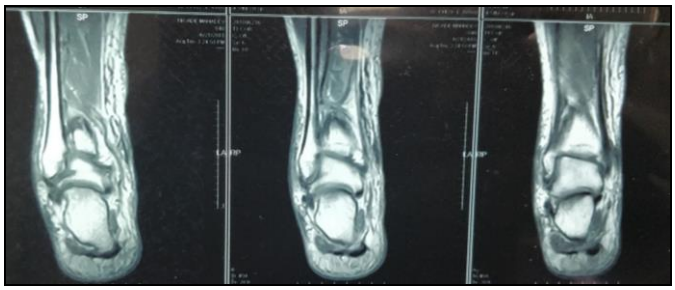

Fig 3: Preoperative MRI scans Coronal

Fig 4: Incision line marked.

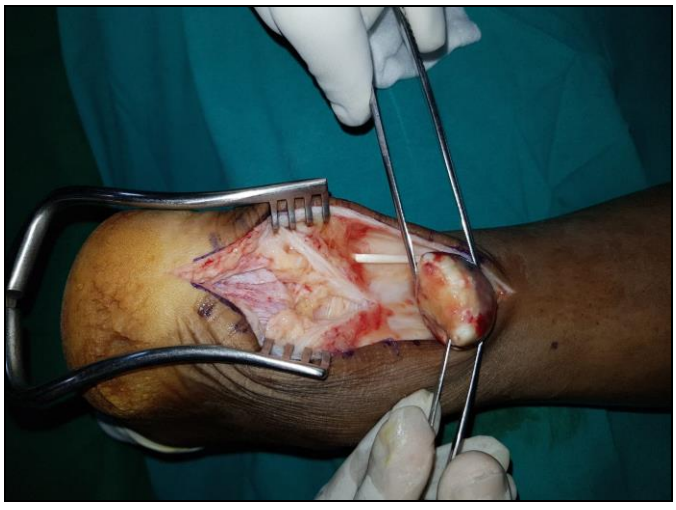

Fig 5: Debridement of CAT tears.

Fig 6: Whip stitch taken with Ethibond.

Fig 7: Tenodesis done with Titanium screw

Fig 8: FHL tendon sutured side by side to Torn ends of Tendo Achilles

Fig 9: Post-operative Xray showing Tenodesis screw

Results

The mean age of patients was 56.35 years (range 45 to 68 years). We had 13 male and 7 female patients in our study. 6 patients had diabetes which was controlled with medications preoperatively. 10 patients were chronic tobacco addicts with different ways of consumption like smoking, tobacco chewing or applying tobacco Mishra. The mean BMI of patients was 32.55 kg/m2 (range 38-25). The mean follow up period was of 21.35 weeks (range 12 to 30 weeks). The average FOAS score of foot preoperatively was 58.05 (Range 38-72). After surgery the scores significantly improved to a mean of 88 (range- 77-98). The AOFAS score which shows donor site dysfunction scored to a mean of 85.35 (Range 76-95). No patient had noticeable functional weakness of hallux in normal daily life. All patients had good to excellent results with full weight bearing mobilization at 6 weeks post-surgery. One superficial infection was noted as a complication in our study. This 68 yera old male patient was a daibetic male patient with tobacco addiction and obese with BMI of 38 kg/m2.

Statistics

As the data of FOAS scores was skewed, Wilcoxon sign rank test was applied to preoperative and postoperative scores using SPSS version 26. The W and Z value were 0 and -3.9199 with p value of 0.00008. The results are statistically significant as p value was <0.05.

Table 1: Master chart of Study.

Patient	Age	sex	Co mobidity	Addictions	BMI	Folow up weeks	FAOS Preop	FAOS Postop	AOFAS Hallux score Postoperatively
1	59	Male	diabetes	tobacco	27	16	57	96	83
2	64	Female			38	30	56	79	76
3	46	Male		tobacco	28	26	69	92	94
4	49	Male	diabetes		30	18	48	81	82
5	53	Male			36	26	69	95	91
6	58	Female		tobacco	28	16	56	82	86
7	45	Male		tobacco	36	16	40	78	82
8	67	Female			32	20	55	82	84
9	56	Female			31	24	71	91	87
10	49	Male		tobacco	30	18	67	98	88
11	66	Male	diabetes	tobacco	29	20	55	88	87
12	53	Male		tobacco	38	28	43	77	78
13	57	Male	diabetes		34	16	72	90	81
14	60	Female			38	30	46	84	95
15	51	Female		tobacco	34	26	38	82	84
16	65	Male			29	12	49	87	82
17	54	Male	diabetes		32	16	72	96	79
18	60	Male			38	28	66	93	85

19	68	Male	diabetes	tobacco	38	29	69	92	88
20	47	Female		tobacco	25	12	63	97	95
Average	56.35				32.55	21.35	58.05	88	85.35
Maximum	68				38	30	72	98	95
Minimum	45				25	12	38	77	76

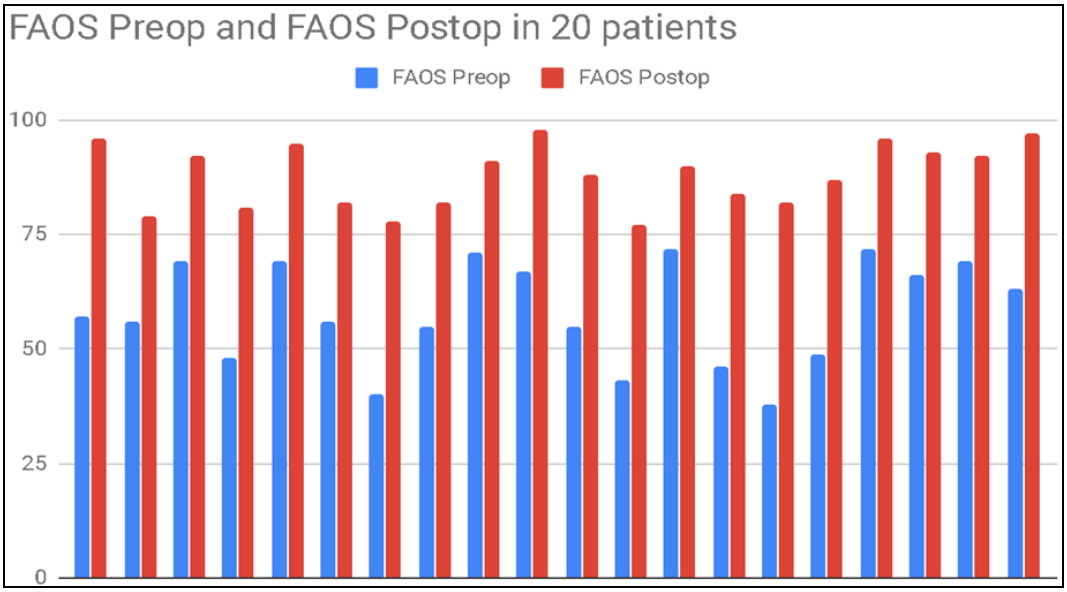

Fig 10: FAOS score improvement after surgery.

Discussion

There has been an increase in the number of CTA tears with increasing lifestyle diseases like diabetes. Pain and functional impairment have been leading cause of morbidity in cases of Tendo Achilles tendinopathy irrespective of presence of rupture [19].

Harvesting of FHL tendon can be done through the same incision or a separate distal incision. Distal incision gives an additional 3 cm of FHL tendon length [14]. But we think that if the tendon is adequately pulled and cut at the most distal end, we can harvest adequate length of FHL tendon for tenodesis in calcaneus. This saves the morbidity of an additional incision.

Tenodesis of Proximal part of FHL to FDL has shown to restore flexion force of great toe and lesser toes to pretransfer levels [20] We didn't do such tenodesis. In our experience the tendons get adhered to each other and surrounding tissue in due course of time. Additionally some other studies have shown FHL transfer morbidity to be clinically insignificant, even in good push off or balance in running sports [18-21] There are conflicting opinions about the preservation of distal stump of Tendo Achilles for better pain relief [19-22] In our study, we have preserved the distal stump with debridement done of only interposed fibrous tissue. In our experience, this distal stump is important for side to side tenodesis of the FHL tendon to tendon Achilles. This provides more strength and augments vascularity form FHL to Tendon Achilles. Hahn *et al.* [19] has also showed 100% integration of FHL tendon in 60% cases. FHL tendon hypertrophy of more than fifteen percent was seen in 80% cases. This suggests FHL tendon is taking up the function of Tendo Achilles of Plantar flexion.

The success of the FHL tendon transfer lies in the fact that it satisfies maximum principles of tendon transfer like donor or adequate strength, expendable donor, Straight line of pull, neuromuscular synergy and lastly single function per transfer i.e Plantar flexion [23].

There were few limitations of our study. The sample size is less. Our time of follow-up is small. A large sample size with longer follow up would have given a better understanding of long term adverse effects.

In our conclusion, in cases of chronic Tendo Achilles tear with agap of around 5 cms, FHL transfer is a simple, viable and effective option.

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