

# Management of chronic Achilles tendon tear by reverse gastrocnemius turndown flap and augmentation with FHL tendon – A case series



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## ABSTRACT

**Background:** Chronic Achilles tendon ruptures are defined as tears that occur 4–6 weeks after injury and also those that fail to heal at 6–12 weeks. Reduced plantar flexion, discomfort, trouble walking, chronic pain, poor wound healing, and rerupture are all problems of chronic tears. The V-Y flap, turndown flap, peroneus tendon graft, flexor digitorum graft, and flexor hallucis longus (FHL) graft are just a few of the operations proposed and claimed to have great post-operative clinical results. **Aims and Objectives:** This study aims to evaluate the functional outcome of tendon debridement, gastrocnemius turndown flap, and augmentation with FHL tendon to reconstruct a chronic Achilles tendon tear. **Materials and Methods:** This study included 12 patients with chronic Achilles tendon rupture. The gastrocnemius turndown flap, which was augmented with FHL tendon, was used to treat all of the patients in the study. The American Orthopaedic Foot and Ankle Society (AOFAS) score, Achilles Tendon Total Rupture Score (ATRS) score, and ability to do repetitive single affected side heel raises were the outcomes evaluated in this study. **Results:** After a year of follow-up, the mean AOFAS score increased from 61.17 points preoperatively to 86.67 points. The mean ATRS improved significantly from 41.91 points preoperatively to 84.41 points at the most recent follow-up ( $P < 0.05$ ). One of the patients developed a superficial wound infection, treated with wound debridement, and antibiotics. One year after surgery, all patients could do single-leg heel raises. There was no sign of rerupture. **Conclusion:** Reverse gastrocnemius turndown flap with FHL tendon is a well-tolerated and effective treatment of chronic TA rupture.

**Key words:** Achilles tendon total rupture score; American Orthopaedic Foot and Ankle Society score; Plantar flexion

## INTRODUCTION

The Achilles tendon is the most frequently torn ligament in the lower leg.<sup>1-4</sup> It is more prevalent in active young- to middle-aged adults with an average age of 37–44 years.<sup>5,6</sup> Clinically, acute Achilles tendon rupture is frequently easy to diagnose and cure; yet, a large proportion of cases is still undetected due to factors such as a lack of therapy or a failure to provide adequate patient care at the time of injury. Typically, the Achilles tendon ruptures between 2 and 6 cm from its insertion into the calcaneal tuberosity.<sup>7,8</sup> This region is referred to as the watershed zone because of its decreased vascularity.<sup>9</sup>

Chronic Achilles tendon ruptures occur after 4–6 weeks between injury and surgery.<sup>2</sup> There is frequently a deficiency of tendinous tissue inside the paratenon at the defect location. Thick scar tissue fills the space between the proximal and distal tendon stumps.<sup>10,11</sup>

Due to tendon contraction, a lack of blood flow to the area, and gaps left following tendon damage, chronic Achilles tendon rupture becomes more difficult to repair than acute Achilles tendon rupture. Reduced plantar flexibility, restlessness, walking difficulty, persistent chronic pain, poor wound healing, and rerupture are consequences of chronic tears.<sup>12</sup>

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Several surgical procedures for chronic rupture have been developed, including the V-Y flap, turndown flap, peroneus tendon graft, flexor digitorum graft, and flexor hallucis longus (FHL) graft. However, there is still no standard or acknowledged surgical treatment for this.

This study aimed to see how well a technique that involved tendon debridement, a gastrocnemius turndown flap, and local tendon augmentation (FHL) worked for chronic Achilles tendon rupture restoration.

### Aims and objectives

This study aims to evaluate the functional outcome of tendon debridement, gastrocnemius turndown flap, and augmentation with FHL tendon to reconstruct a chronic Achilles tendon tear.

## MATERIALS AND METHODS

### Study design and participant

The present work was a retrospective cohort study conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines. This study was performed at the Department of Orthopaedic Surgery in a tertiary care, a publicly funded institution in North India, by the ethical guidelines of the Declaration of Helsinki. Informed consent had been previously collected from the patients or their attendants at the time of presentation for future research activities.

All adult patients (>18 years) with chronic TA rupture at our institution from May 2016 to June 2019 who had undergone gastrocnemius turndown flap and augmentation with FHL tendon were included in this study. Patients with a history of local infection near tendon rupture, open Achilles tendon rupture, a concomitant disease with fracture, poor skin condition, acute Achilles tendon rupture, varicose vein, deep vein thrombosis, ruptured gap of <6 cm, blood vessel rupture, or nerve rupture were excluded from the study. All patients were diagnosed with a full-thickness tear by ultrasonography and a physical examination that included heel raise and ankle movement. Patients were unable to perform a single-limb heel rise because of a neglected or chronic TA rupture. Localized soreness, a palpable posterior gap at the tear site, greater dorsiflexion relative to the contralateral ankle, and inability to complete a single-limb heel rise with the injured lower extremity were among the physical indicators present before surgery. All patients had an ultrasound before surgery. None of the patients had a sports injury.

### Study outcomes

The study's end measures were the American Orthopaedic Foot and Ankle Society (AOFAS) and

Achilles Tendon Total Rupture Score (ATRS) scores and the capacity to complete a repeating single affected side heel rise at baseline and after a year. The pre- and post-operative AOFAS, ankle-hindfoot scores, and ATRS assessed the patient. The capacity to do repetitive single affected side heel raises, ankle range of motion (ROM), and surgery-related complications were also evaluated in the clinic.

### Care pathway and surgical technique

These patients with chronic TA rupture underwent a thorough clinical, biochemical, and radiological examination preoperatively. Comorbidities were assessed and a complete pre-anesthetic workup was performed. Under spinal anesthesia and a thigh tourniquet, the procedure was conducted in the prone position with the foot hanging at the end of the operating table. A straight incision was made over the posterior portion of the lower leg, diverging medially over the foot (Figure 1a). The dissection was continued into the fascia and tendon sheath to get to the ruptured tendon. Achilles tendon debridement was performed (Figure 1b). With the ankle plantar flexed up to 30°, the scar and degenerative tissue between the ruptured tendons was debrided and the length of the defect was measured using a ruler. The medial or lateral straps were marked over the gastrocnemius at the myotendinous junction, leaving the center zone and a piece of each medial and lateral tendon intact. To keep the gliding surface, the flaps were detached from the underlying muscle bellies and rotated 180° (Figure 1c). The two straps were then centrally sutured together. FHL was detected taking care of the neurovascular bundle medially with an incision made directly posterior and deep through the fascia. The FHL tendon was extracted (Figure 1d) and sutured to the Achilles tendon's distal stump (Figure 1e). With the foot slightly plantarflexed, the flap grafts were sutured into the distal intact Achilles tendon stump (Figure 1f). Proximal gastrocnemius defect was sutured (Figure 1g), and the wound was irrigated with normal saline and closed in layers.

### Data collection and follow-up

Data were collected through paper charts. Functional assessment of included patients had been carried out both preoperatively and at 1-year follow-up. Patients had been reviewed regularly at 6 weeks, 12 weeks, 6 months, and 1 year. The ankle was held in plantar flexion (up to 20°) for 6 weeks after surgery with a below-knee cast. Under rehabilitation standards, patients were instructed to engage in physical exercises. Limited weight-bearing crutch ambulation was allowed after 6 weeks. Patients were allowed to bear full weight at 12 weeks after surgery. Following a 12-month surgical period, sports activities were permitted.



**Figure 1:** Surgical techniques. (a) Marking the incision, (b) debridement, (c) medial and lateral flaps, (d) harvested FHL tendon, (e) FHL tendon stitched to calcaneus, (f) flap graft sutured to Achilles tendon stump, and (g) proximal gastrocnemius deficits sutured to flap

### Statistical analysis

Mann–Whiney U-test was used to compare pre-operative AOFAS and ATRS scores to post-operative AOFAS and ATRS values. For all data analyses, IBM Corp., Armonk, NY, used the Statistical Package for the Social Sciences, version 21 (IBM Corp., Armonk, NY).

## RESULTS

A total of 12 patients were included with the characteristics of included individuals are described in Table 1. Eight males and four females were included having a mean (SD) age of  $39.6 \pm 6.9$  years. The patients were followed up for 1 year. The ruptured tendon gap measured between 6 and 9 cm, with a mean defect of 7.340 cm (Table 1). After a year of follow-up, the mean AOFAS score increased from 61.176.7 to 86.675.2. The mean total rupture score (ATRS) of the Achilles tendon improved significantly from 41.91 preoperatively to 84.41 ( $P=0.05$ ) (Table 2, Figure 2). Debridement and oral antibiotics were used to treat a superficial wound infection in one patient. One year after surgery, all patients were able to do single-leg heel raises. At any follow-up, no rerupture was observed.

## DISCUSSION

Chronic Achilles tendon rupture can result in significant disability. Surgery is generally the best option for avoiding morbidity. After debridement of the scar tissue in between the ruptured tendons, there is a significant tendon

**Table 1: General characteristics of subjects**

Characteristics	
Age	39.6±6.9
Sex (m/f)	8/4
Follow-up	16.1±3.9
Defect	7.34±0.9

\*Data were represented as mean±SD, \*values are given as frequency. SD: Standard deviation

deficiency that demands the use of a method to bridge the gap and provide a strong repair. Several surgical procedures for chronic rupture have been developed, including the V-Y flap, turndown flap, peroneus tendon graft, flexor digitorum graft, and FHL graft.<sup>13-15</sup>

This study finds that reverse gastrocnemius turndown flap and augmentation with FHL tendon is a safe and efficacious surgical modality for the management of chronic tendoachilles rupture.

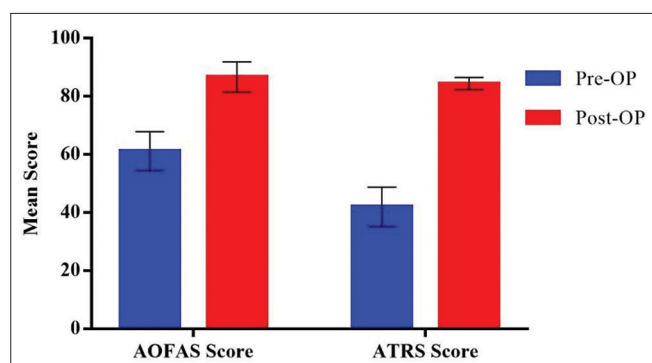
In our study, the mean age of patients was  $39.6 \pm 6.9$  years. This was much less than the reported age (59.2 years) by Park and Sung.<sup>16</sup> This difference is justifiable as we dealt with elsewhere managed cases of chronic TA rupture who were relatively younger population.

Patients in this study had significant functional improvement as evident by their AOFAS score and ATRS score. The mean ATRS score at 1-year follow-up was 84.41 which was a significant improvement from the pre-operative ATRS score of 41.91. The mean AOFAS score improved significantly from 61.17 to 86.67 at the 1-year follow-up.

**Table 2: Follow-up analysis**

Clinical scores	Pre-operative	Post-operative	95% CI	P-value
AOFAS score	61.17±6.7	86.67±5.2	-30.59--20.41	0.0001
ATRS score	41.91±6.8	84.41±2.1	-47.04--38.04	0.0001

\*Data were represented as mean±SD, \*difference between groups was calculated using Mann-Whitney U-test (P-value considered satisfactory significant). SD: Standard deviation, AOFAS: American Orthopaedic Foot and Ankle Society, ATRS: Achilles tendon total rupture score



**Figure 2:** A follow-up analysis of AOFAS and ATRS scores

Park and Sung evaluated 12 patients in their study and reported similar results with a mean AOFAS score of 98 (range: 88–100) and an ATRS score of 92.9 (range: 84–100).<sup>16</sup>

Many studies have reported several techniques for reconstruction during neglected chronic rupture depending on the rupture gap between the remaining tendons after elimination of the scar tissue formed in between the ruptured tendons.<sup>13-16</sup> In our study, we reported reconstruction of the ruptured gap of 6–9 cm (average defect was 7.34 cm) using gastrocnemius fascial turndown flap and augmentation with FHL tendon. According to the study by Park and Sung, for those with gaps of 5–10 cm, gastrocnemius fascial turndown flaps were used.<sup>16</sup> If the state of the remaining tendon was poor, concomitant FHL tendon transfer was performed. These patients had good outcomes. Abraham and Pankovich described an inverted V advancement of the musculotendinous junction that allowed them to patch wounds up to 6 cm long.<sup>13</sup> The V–Y advance flap is adequate for gaps of 3–5 cm according to Khiami et al.<sup>14</sup> V–Y advancement was utilized by Lin et al., for gaps of 3–9 cm.<sup>15</sup> Christensen.<sup>17</sup> was the first to describe a surgery in which a 2 cm by 10 cm facial turndown flap was used to fill the defect. Other authors have effectively treated chronic Achilles tendon rupture with modified gastrocnemius fascial turndown flaps.<sup>18,19</sup> Gilcreest E., described a gastrocnemius turndown flap in a similar way. Only the flap was rotated 180° before bridging distally.<sup>20</sup>

To support the reconstruct the Achilles tendon, local tendon transfers such as plantaris, peroneus brevis,

flexor digitorum longus, or FHL can be used alone or in combination with an advanced flap.<sup>21-24</sup> The FHL is the plantar flexor and is stronger than the peroneus brevis and flexor digitorum longus.<sup>25</sup> Its axis of contractile force more closely resembles that of the Achilles tendon, and it works in phase with the gastrocnemius-soleus complex.<sup>16</sup> The FHL muscle belly extends into the distal Achilles tendon reconstruction region, which is an avascular zone, and it allows the recruitment of increased blood supply to the repaired tendon.<sup>26</sup>

In a magnetic resonance imaging-based postoperative study, Hahn et al., found complete integration of the FHL tendon in 60% of patients, with no degeneration of the FHL muscle belly in 85% of patients, demonstrating the benefits of the theoretical principle of FHL tendon transfer.<sup>27</sup>

In three patients, Park and Sung<sup>16</sup> executed gastrocnemius fascial turndown flaps with gaps (7 cm) without tendon transfer since intraoperative investigations revealed that the remaining tendon and fascia were in good condition. Although these patients had good outcomes, more study is needed to evaluate whether FHL tendon transfer is necessary for neglected chronic rupture.<sup>19,28</sup>

This procedure's advantages include the ability to bridge a large ruptured gap, the use of FHL tendon, which has a larger muscle belly than the FDL tendon, the ability to complete the procedure through a single incision, and the creation of a stronger repair that allows the patient to regain lower extremity function after an Achilles tendon rupture.<sup>29</sup>

#### Limitations of the study

Several limitations restrict the conclusions of this study. First, the sample size was small and therefore did not allow for multivariate regression analysis to identify predictors of our key clinical outcomes. Second, the follow-up was limited.

## CONCLUSION

The extent of the gap created by an Achilles tendon rupture might be used to determine a treatment regimen. The FHL tendon with reverse gastrocnemius turndown

flap is safe and successful in the treatment of chronic TA rupture. Before the method is widely used, a larger study may be required to give further proof of its safety and efficacy.

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**Authors Contribution:**

**DR-** Concept and design of the study, prepared first draft of manuscript; **MM and SWU-** Interpreted the results, reviewed the literature, and manuscript preparation; and **SK and SKS-** Concept, coordination, statistical analysis and interpretation, preparation of manuscript, and revision of the manuscript.

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