ORIGINAL RESEARCH

Evaluation of suture bridge anchor technique in the repair of acute distal tendoachilles ruptures

[1]Dr. Kumar Rahul, [2]Dr. Saksham Mittal, [3]Dr. Pankaj Anand, [4]Dr. Amite Pankaj Aggarwal

[1,2]Clinical Fellow, Department of Orthopaedics, Fortis hospital, Shalimar Bagh, New Delhi, India
[3]Consultant, Department of Orthopaedics, Fortis hospital, Shalimar Bagh, New Delhi, India
[4]Head of Department, Department of Orthopaedics, Fortis hospital, Shalimar Bagh, New Delhi, India

Corresponding Author
Dr. Saksham Mittal
Clinical Fellow, Department of Orthopaedics, Fortis hospital, Shalimar Bagh, New Delhi, India

Received: 02Sept, 2023 Accepted: 25Sept, 2023

ABSTRACT
Achilles tendon sleeve avulsion are ruptures from the distal end of the tendon leaving behind a small stub distally (usually <1cm). The tendon stub is insufficient and incapable to hold sutures for traditional repair techniques. The purpose of this study is to introduce a new technique for such ruptures. 10 patients diagnosed with these ruptures underwent surgery with this new technique and were followed for 1 year. Clinical outcome were measures using American Orthopaedic Foot and Ankle Society (AOFAS) score and Visual analog scale (VAS). At final follow-up, the mean VAS improved from 6.1 to 0.2, AOFOS score improved from 48.3 to 98.4. Patients returned to their daily activity at 88.4 days. All these patients could walk brisk, perform heel rise test and hop comfortably at the final follow up. Our study utilized Krackow sutures along with suture anchors. The construct is strong and is a promising alternative. More studies however need to surface to find the best surgical technique.

Key words: Achilles tendon, distal rupture, sleeve avulsion, suture anchor, suture bridge anchor

INTRODUCTION

Commonly achilles tendon ruptures are seen in mid-substance around 5-6 cm above from its insertion over the calcaneum[1, 2]. Acute distal achilles tendon ruptures (<1cm from insertion site) are a rare entity [3] and literature lacks evidence on the best technique available for such distal ruptures [2, 4]. These distal ruptures, leave behind little or no stub of the tendon, making the traditional end-to-end repair difficult[5]. An ideal technique should be safe enough to have minimal soft tissue complications, effective enough to provide a stable construct, and reliable enough to have eliminated chances of re-ruptures. Suture anchor tenodesis[5]is being utilized in various newer techniques and has shown promising results. This study aims to evaluate the outcome of a novel technique, in these acute distal ruptures.

MATERIAL AND METHODS

This prospective interventional study was conducted at Fortis Hospital, Shalimar Bagh, New Delhi from August 2018 and August 2020. The diagnosis was made in terms of history and physical examinationincluding pain, difficulty in walking, weakness in dorsiflexion or a previous history of clicking sound on sudden dorsiflexion and thompson test.

The study included tendoachilles rupture within 1 week of injury. Only distal ruptures of the tendon, (< 1 cm from the insertion) were included in this study. Patients with a non-ambulatory lifestyle, compound injuries, peripheral artery disease, pregnancy, age less than 18 years, post carcinoma treatment were excluded from the study. X-ray was done in all the cases to rule out any bony avulsion. Detailed local and systemic examination and documentation were done by the same investigator in terms of age, sex, mechanism of injury, duration of the injury.

The suture bridge anchor technique, described later, was used in all the repairs. Check dress was done at 48 hours and the patient was discharged in a below-knee anterior slab in plantar flexion. Suture removal was done at 2 weeks. Patients were followed up at 4 weeks, 6 weeks, 8 weeksand 12 weeks following surgery.The Visual Analog Scale (VAS) and American Orthopaedic Foot & Ankle

Society (AOFOS) scoring was done preoperatively and at 12 months post-surgery.

SURGICAL TECHNIQUE

Patients were operated on in a prone position with a towel folded and kept beneath the ankle, under spinal anesthesia. Surgery was performed by the same surgeon in all the cases. A tourniquet cuff was applied at the proximal thigh to minimize blood loss. All patients received prophylactic antibiotics before the cuff was inflated. A 10 cm vertical incision (fig 1) at the posteromedial border was taken proximal and distal to the palpable defect. The Posterolateral approach was avoided to preserve the sural nerve which usually lies at the lateral border of the tendon. Full-thickness skin flaps were elevated.

Fig 1: Posteromedial incision to expose the torn stump of the tendon

The paratenon was excised sharply to expose the torn ends of the tendon. Proximal tendon margin was freshened and locking Krackow loops were passed through it with orthocord suture later to be used as pulling suture (Figure 2).

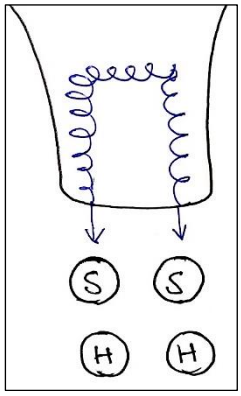

Fig 2: Schematic representation of krackow sutures in the tendon stump. The sutures along with the tendon stump is pulled distally. Calcaneum is prepared with 4 suture anchors as shown. to be pulled distally over the calcaneum.S : placement of 5.0 mm FASTIN RC w/ORTHOCORD w/Needles Titanium Anchor in calcaneum. H: placement of 4.75 HEALIX ADVANCE™ Knotless peek Anchors in calcaneum

Distal stub was excised and the footprint on the calcaneum was freshened. 2 holes were made in the calcaneum over the tendon footprint. The holes were directed towards the midline in a convergent fashion and 5.0 mm FASTIN RC w/ORTHOCORD w/Needles Titanium Anchor was screwed in each hole. The proximal stump of the tendon was pulled distally with the Orthocord sutures to cover the area where suture anchors were placed. The foot was held in plantar-flexion to avoid excessive stretching of the tendon. The threads of the suture anchors were passed through the substance of the tendon.Sutures strands were tied to each other in a criss-cross fashion. The suture threads from suture anchors and 2 ends of the orthocord were tightened and tensioned into the calcaneum with two 4.75 HEALIX ADVANCE™ Knotless peek Anchors, 1 cm distal to the end of the proximal stump of the tendon over the calcaneum as shown in figure 3.

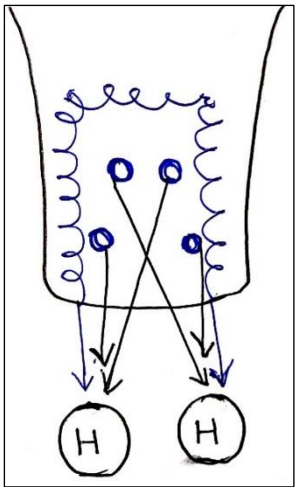

Fig 3: Tendon stump pulled and suture strands from the proximal row suture(S) anchors passed through the substance and are tied indicated as small circles. The suture strands are fixed to the distal row suture anchors (H) as shown

On table, passive movements were checked (Figure 4). The wound was closed in layers after copious irrigation. Aseptic dressing was done and a below-knee anterior slab was applied. Check X-rays were done (Figure 5).

Fig 4: Strength of the repair is checked on the table

Fig 5: Check X-ray post-surgery

POSTOPERATIVE PROTOCOL

Postoperatively, below knee slab support, was continued for 2 weeks after which suture removal is done. Passive mobilization without weight-bearing was started in a removable Controlled Ankle Motion (CAM) boot post suture-removal. The same boot was used to reduce the plantar-flexion gradually over the next 4 weeks.At the end of 6 weeks, partial weight-bearing (toe touch mobilization) was initiated. Patient was made to walk with full weight-bearing at 8 weeks and allowed to resume activities at 12 weeks. Final clinical outcomes were evaluated at 12 months (Figure 6).

3. RESULTS

3.1 HISTORY RELATED

The study included 10 patients out of which 8 were male and 2 females. The mean age of the patients was 54.4 years (range 36-64 years). 7 out of 10 patients experienced a clicking sound on sudden and forceful dorsiflexion of the foot. 4 patients had diabetes mellitus as a co-morbidity and 3 patients had a thyroid disorder.

3.2 SURGERY RELATED

The mean time from injury to the procedure was 3.4 days (range 1-7 days). The mean duration of surgery was 24 minutes (range 17- 34min). The average blood loss was 24.8 ml (range 20-42ml).

3.3 COMPLICATIONS

None of the patients experienced any major complications in the current study. The sutures were healthy and the wound healed well even in the diabetic patients without any infection. The recovery was smooth and uneventful. No re-rupture, nerve injury, venous thrombosis was observed.

3.4 FUNCTIONAL OUTCOME

From pre-operative stage to 1 year of follow-up the mean VAS score improved from 6.1 to 0.2 and the mean AOFOS score from 48.3 to 98.4. All the 10 patients started full weight-bearing at 8 weeks and returned to activity at 88.4 days (range 84-91 days). At the final follow-up, they were able to perform walk brisk, perform heel rise test and hop comfortably.

Fig 6: Patients were able to stand on toes and hop and perform heel rise test

4.DISCUSSION

Distal ruptures have been thought as sequelae of insertional tendinopathy of the Achilles tendon. Such ruptures, leave behind minimal tendon tissue at the distal end[6]. Since the strength of the repair depends directly on the tendon length[7], conventional tendon repair constructs in these cases is weak. Also, this short stump usually has degenerative changes and often was incompetent of hold sutures.

Different configurations and techniques have been studied for the effective tenodesis of the Achilles tendon. Teuffer *et al*.[8] used peroneus brevis tendon in a transcalcaneal tunnel to achieve a bony fixation but had significant skin necrosis. Besse *et al*.[9]harvested patellar tendon along with a small piece of tibial tuberosity with or without rectus femoris muscle in the transcalcaneal tunnel with fewer skin complications.

Historically synthetic materials such as polyester[10, 11],polyethylene[12]etc. have been tried.Apart from the need to have a transcalcaneal tunnel they were not well tolerated antigenically.

Hanna *et al.*[13]used suture anchors in acute rupture of tendoachilles as early as 1993 and thereafter it has been used extensively. Boin *et al.*[7] compared suture-only to suture-anchor augmented repairs in such ruptures and found the latter to be superior biomechanically. Suture-only repairs tend to break at the knots whereas suture anchors bypass the short distal fragment and give a strong bony fixation. The lack of a knot further added to the credibility of suture anchors. Cottom *et al.*[14]found suture anchors to be more effective than the conventional Krackow or minimally invasive repairs alone.

Table 1: Recent studies done of acute distal Achilles tendon ruptures

S. No.	Study	Year of Study	Sample size	Operative intervention used	Remarks
1.	Longo*et al*. [15]	2020	1	Percutaneous Modified Bunnel suture+ 2 suture anchors	Less skin and wound complications
2.	Isık*et al*. [2]	2017	21	Krackow + knot suture anchor (novel technique) Versus Only suture anchor	Better outcome in combination group
3.	Boin*et al*. [6]	2017	18	Suture only Versus Suture anchor augmented repairs	Suture anchorbiomechanically superior

Table 1 summarizes few recent studies which dealt with such injuries. Our study used a combination of Krackow sutures along with 4 suture anchors. We believe, the combination of suture anchor fixation with along with the Krackow sutures provide a strong biomechanical construct. This technique to the best of our knowledge has not been used earlier in such ruptures. Our study didn't encounter any case of re-rupture. There was no limitation to dorsiflexion of foot. Restricted dorsiflexion is an uncommon complication in these repairs. Most studies quote lengthening of the tendon during healing[16].Don *et al*.[17]proposed the lengthening conceivably accounts for decreased calf muscle strength even at 2 year follow up. This finding was inconsistent with our study. None of the patients complained of weakness in walking or dorsiflexion and was comparable from the uninjured side.

The study however has its limitations. The AOFOS score was satisfactory at the end of the final follow-up

but it was not compared with the contralateral healthy side. This novel technique in such distal ruptures has promising outcome but the possibility of complications being underrated can't be ruled out in the given the small cohort of patients.

CONCLUSION

This suture bridge technique is simple and effective. The construct is biomechanically strong. It has eliminated the knots otherwise known to cause irritation of soft tissue. The author believes, fixation of tendon to the bone provides confidence in initiating post-operative rehabilitation. This study appears to be the first to report suture bridge technique in repairing distal acute Achilles tendon ruptures.

CONFLICT OF DECLARATION

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Maniscalco P, Bertone C, Bonci E, *et al*. Titanium anchors fort the repair of distal Achilles tendon ruptures: preliminary report of a new surgical technique. J Foot Ankle Surg 1998; 37(2):96-100.
2. Işık, Ç., & Tahta, M. (2017). Primary repair of Achilles tendon avulsions: Presentation of a novel technique and its comparison with suture anchor repair. Journal of Orthopaedic Surgery, 25(3), 230949901773948
3. Tsailas PG (2017) Acute Distal Achilles Tendon Rupture Reconstruction with the Ipsilateral Semitendinosus Tendon and Review of the Literature. MOJ Orthop Rheumatol 8(5): 00331. DOI: 10.15406/mojor.2017.08.00331
4. Reddy SS, Pedowitz DI, Parekh SG, Omar IM, Wapner KL. Surgical treatment for chronic disease and disorders of the Achilles tendon.J Am Acad Orthop Surg. 2009;17:3-14
5. Keener BJ, Sizensky JA. The anatomy of the calcaneus and surroundingstructures. Foot Ankle Clin N Am 2005;10:413-25.
6. Boin, M. A., Dorweiler, M. A., McMellen, C. J., Gould, G. C., & Laughlin, R. T. (2017). Suture-Only Repair Versus Suture Anchor-Augmented Repair for Achilles Tendon Ruptures with a Short Distal Stump. Orthopaedic Journal of Sports Medicine, 5(1), 232596711667872
7. Kim JB, De Wit T, Hovius SE, McGrouther DA, Walbeehm ET. What is the significance of tendon suture purchase? J Hand Surg. Eur. Vol.2009;34:497-50.
8. Teuffer, A.P. Traumatic rupture of Achilles tendon: Reconstruction by transplant and graft using lateral peroneus brevis. Orthop. Clin. North Am. 5:89-92, 1974
9. Besse, J.-L., Lerat, J.-L., Moyen, B., & Brunet-Guedj, E. (1999). Achilles tendon repair using a bone-tendon graft harvested from the knee extensor system: Three cases. The Journal of Foot and Ankle Surgery, 38(1), 70-74.
10. Levy, M., Velkes, S.. Goldstein, J., Rosner, M. A method of repairfor Achilles tendon ruptures without cast immobilization. Clin. Orthop. 187:199-204, 1984
11. Lieberman, J. R., Lozman, J., Czajka, 1., Dougherty, 1. Repair of Achilles tendon ruptures with Dacron vascular graft. Clin. Orthop. 234:204-208, 1988
12. Ozaki, J., Fujiki, J., Sugimoto, K., Tarnai, S., Masuhara, K. Reconstruction of neglected Achilles tendon rupture with Marlex Mesh. Clin. Orthop. 238:204-208, 1989
13. Hanna, J. R., Russell, R. D., Giacopelli, J. A. Repair of distal tendo Achillis rupture with the use of the Mitek Anchor System. J. Am. Podiatr. Med. Assoc. 83(12):663-668, 199
14. Cottom, J. M., Baker, J. S., Richardson, P. E., & Maker, J. M. (2017). Evaluation of a New Knotless Suture Anchor Repair in Acute Achilles Tendon Ruptures: A Biomechanical Comparison of Three Techniques. The Journal of Foot and Ankle Surgery, 56(3), 423-427.
15. Longo UG, Candela V, Berton A, Di Naro C, Stelitano G, Maffulli N, *et al*. Less Invasive Fixation of Acute Avulsions of the Achilles Tendon: A Technical Note. Medicina (Kaunas). 2020 Dec 19;56(12).
16. Kiliçoğlu, Ö., Türker, M., Yildız, F., Akalan, E., & Temelli, Y. (2012). Suture anchor tenodesis in repair of distal Achilles tendon injuries. European Journal of Orthopaedic Surgery & Traumatology, 24(1), 117-122.
17. Don R, Ranavolo A, Cacchio A, *et al*. (2007) Relationship between recovery of calf-muscle biomechanical properties and gait pattern following surgery for achilles tendon rupture. Clin Biomech 22:211-220.