Outcome of Achilles Tendon Repair using Four Strand Cross Locked Cruciate Repair Technique

Dhoju D, Thapa J

Department of Orthopaedic and Traumatology,

Dhulikhel Hospital, Kathmandu University Hospital,

Kathmandu University School of Medical Sciences,

Dhulikhel, Kavre, Nepal.

Corresponding Author

Darshan Dhoju

Department of Orthopaedic and Traumatology,

Dhulikhel Hospital, Kathmandu University Hospital,

Kathmandu University School of Medical Sciences,

Dhulikhel, Kavre, Nepal.

E-mail: docdhoju@hotmail.com

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ABSTRACT

Background

Four strand cross locked cruciate tendon repair technique for Achilles tendon rupture has shown promising result.

Objective

To evaluate the outcome of all acute traumatic Achilles tendon rupture case treated by a novel repair technique of four strand cross locked cruciate.

Method

A total of 40 cases of acute traumatic Achilles tendon rupture from 2011 to 2018 treated by four strand cross locked cruciate repair technique were retrospectively evaluated using Achilles Tendon Total Rupture Score.

Result

Average age of patient was 29.45 years. Male preponderance was seen. Most of the patient (97.5%) had complete rupture of Achilles tendon. Most of the patient (92.5%) had open injury. The average length of hospitalization was 7 days. All the patients recovered to the level of physical activity previous to the tendon lesion. The achilles tendon total rupture score significantly improved from 6 month post op period to 12 months (p=0.02) and 2 years post op period (p=0.038).

Conclusion

The optimum method of suturing technique for acute traumatic rupture of Achilles tendon remains controversial. The four strand cross locked cruciate repair technique provides a stable and reliable construct for the Achilles tendon repair. The technique requires further investigation with direct comparison with other mostly used techniques like Krackow and Gift box suture technique.

KEY WORDS

Achilles tendon, Locked cruciate, Repair technique

INTRODUCTION

Achilles tendon is the strongest and thickest tendon in a human body.[1,2] Achilles tendon rupture is a common injury seen by orthopaedic surgeon. Common cause of the tendon rupture is sporting activities resulting in forced plantar flexion of ankle or rapid eccentric dorsiflexion in a plantar flexed ankle.[2,3] Other factors such as gender, changes related to ageing, drugs, intrinsic structural variation may also contribute to the injury.[4] Besides these direct trauma by sharp object, avulsion injury, lacerated wound over posterior aspect of ankle are also the leading cause of injury to the Achilles tendon. The primary goals of the treatment of acute Achilles tendon rupture are to ensure rapid return to full function and to minimize complication.

There is no common consensus regarding its optimal treatment.[5] Treatment of acute Achilles tendon rupture can be classified into non-operative and operative.[2] Operative repair of Achilles tendon broadly falls into open or minimally invasive techniques.[6] Previously described methods for open end to end repair include Bunnell, Kessler, Krackow, triple bundle and gift box techniques.[2,7] Four strand cross locked cruciate tendon repair technique has been shown to have comparably high resistance to gap formation and ultimate tensile strength.[8] This repair seems to demonstrate a good compromise between strength, simplicity and bulk without excessive tissue handling.[8] The aim of this present study was to evaluate the range of motion, Achilles tendon total rupture score (ATTRS), complication at 12 months following surgery in patients with acute Achilles tendon rupture treated using four strand cross locked cruciate tendon repair technique.

METHODS

This single centre, retrospective, case series study included all the patients from January 2011 to December 2018 who had a complete traumatic Achilles tendon rupture and had been treated at Dhulikhel Hospital, by open repair using a four strand cross locked cruciate repair technique. Patients were excluded if they had a degenerative rupture, previous injury to the same tendon, functional impairment on contralateral side; and/or history of vasculopathy, diabetes, systemic disease requiring immunosuppressive agents, hyperuricemia or corticosteroid injection. Diagnosis of the patients with closed rupture due to sports injury was confirmed on the basis of clinical examination and ultrasonography.

Operative techniques

The choice of anaesthesia was determined by the anaesthesiologist. All cases were performed in a prone position. A pneumatic tourniquet was placed at the level of thigh before positioning the patient. After painting and draping, tourniquet was inflated to maintain the blood less field.

A 6 to 10 cm longitudinal incision centred over the tear site was made at the posterior aspect of the Achilles Tendon (fig. 1a,b). Careful soft tissue dissection was done to expose the paratenon which was then incised sharply to create full-thickness flap. The tendon was exposed and the damaged ends are sharply incised until the healthy tissue appears (fig. 1c). A non-absorbable, braided, surgical suture composed of Poly (ethylene terephthalate) (Ethibond Excel no. 2) was then woven through proximal and distal end in locking cruciate pattern to form a four strands (fig. 1d,e). A knot was tied within the four strands with the knee in 90 degree of flexion and ankle 15 degree more plantar flexion than the uninjured site. The repair was then reinforced with 3-0 polypropylene monofilament suture (Prolene) in interrupted fashion around the tear site taking caution to prevent injury of the core suture strands. The paratenon was closed with 2-0 absorbable polyglactin suture. Subcutaneous layer sutured with 2-0 absorbable polyglactin suture. Skin layer was closed with 3-0 non absorbable polypropylene monofilament suture (fig. 1f). Tourniquet was deflated after skin was sutured. Below knee anterior slab was applied to maintain the plantar flexion of the ankle.

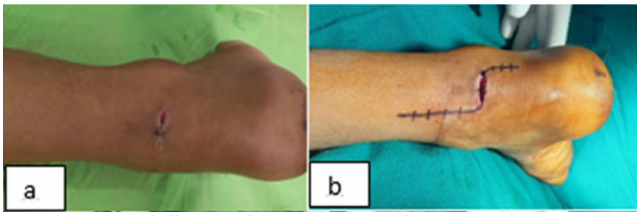

Figure 1(a,b). Achilles tendon tear site and incision planning

Figure 1(c). Achilles tendon preparation

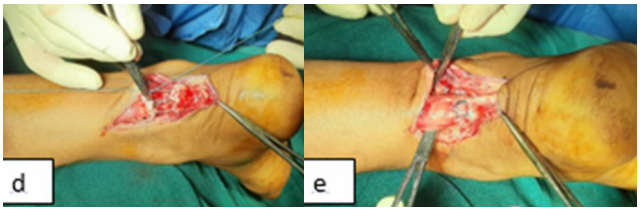

Figure 1(d,e). Four strand cruciate lock suture, final apposition

Figure 1(f). Final closure of skin

Post-operative management and follow – up and clinical evaluation

Wound was dressed at ward on 2nd and 4th post-operative day. Depending on the nature of the wound the patient was discharged after 4th post-operative day, and asked to follow up at 14th post-operative day for suture removal.

Patient was advised to walk on non-weight bearing crutch walking for 12 weeks. At 2 weeks follow up below knee cast was applied maintaining 15 degree plantar flexion. Cast was removed at 6 weeks post-operative period and patient was advised to visit physiotherapy team to achieve neutral dorsiflexion and which was gradually increased the dorsiflexion to 15 to 20 degree by next 6 weeks. At 3 months post - operative period the patient was allowed to gradually bear weight under the guidance of physiotherapist. The patients were followed up at 6 and 12 months and 24 months post - operative period. All patients were contacted and asked to visit the hospital for final clinical evaluation.

Achilles tendon total rupture score (ATTRS) was used to evaluate all the patients. This patient-reported instrument was developed to quantify outcome after treatment for Achilles tendon rupture. It has 10 questions each with likert scale of 1 to 10, hence the maximum score of 100, which corresponds to no symptoms and full function. Recommended minimal important change values are 13.5 and 28.5 to consider ATR patients as improved and greatly improved between 3 and 6 months after ATR.[9]

Data were entered and analysed using SPSS (version 23.0, IBM corp). Continuous parametric data were calculated as mean and standard deviation, students' t-test was used to detect significance. Frequencies were calculated as percentages.

RESULTS

The total of 40 patients included for the study over the period of 8 years (2011 to 2018). The average age of the patients was 29.45 ± 15.18 years. The male: female ratio was 25:15. Of the patients studied, 97.5% (39 patients) presented with a complete rupture of Achilles tendon, while 2.5% (1 patient) was diagnosed with a partial rupture. Three patients (7.5%) had associated heel pad avulsion injury.

Closed rupture due to sports injury was seen in 7.5% (3 patient), whereas, 92.5% (37 patients) had open injury. Most common mode of injury was cut by glass in 37.5% (15 patients) followed by 32.5% fall injury over sickle in (13 patients), 20.0% bike spokes injury (8 patients) and 2.5% road traffic accident (1 patient) with associated lateral malleolus fracture.

All the patients in the study who had open injury were primarily lavaged and washed in the emergency on the day of admission and the cases were operated the next day. All cases were operated by consultant orthopedic surgeon. Reverse sural flap for wound closure was needed for 3 cases with associated heel pad avulsion injury.

The average length of hospitalization was 7.25±2.24 days. No significant losses of the functional status were recorded, all the patients recovered to the level of physical activity previous to the tendon lesion. The achilles tendon total rupture score (ATTRS) at 6 months, 12 months and 2 years post-operative period were 75.25±8.02, 85.68± 8.02 and 92.20±6.96 respectively. There was significant improvement in ATTRS from 6 month post op period to 12 months (p=0.02) and 2 years post op period (p=0.038) (fig. 2).

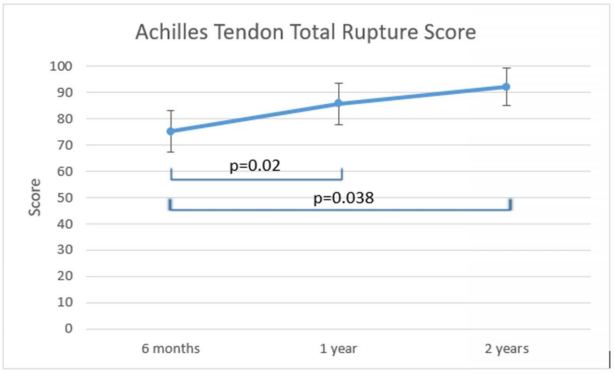

Figure 1(f). Achilles tendon total rupture score at 6 months, 1 year and 2 years

Wound infection was observed in 3 patients; 2 patients of them had associated heel pad avulsion injury and 1 patient had tendon injury following RTA. Secondary rupture at 3 weeks post-operative period was seen in one patient, for which revision surgery with same suturing technique was done.

DISCUSSION

Our results showed that the four strand cross locked cruciate repair technique used for Achilles tendon ruptures showed good functional outcome at the end of 1 year. Furthermore we found, re-rupture rates were comparatively lower than those seen in studies done by other repair techniques.

In our study all the patients received open repair via an innovative technique of four strand cross locked cruciate repair technique. Trends in treatment method of Achilles tendon rupture has been primarily based on re-rupture rates. A landmark randomised trial by Keating et al. in 2011 showed re-rupture rates were 5% of open technique and 10% for traditional casting immobilisation regime.[10] With time many mini open techniques have evolved. However a meta-analysis of RCT studies done by Samuel et al. in 2010 showed no significant differences between re-rupture rates, deep infection, DVT, tissue adhesion and sural nerve injury.[11] Hence we continue to do open repair techniques.[11]

There are various suture techniques for open repair of the Achilles tendon rupture. These include the Krackow, Gift box, Kessler, Bunnell, and the triple bundle technique.[12-17]

Various studies has demonstrated that the Krackow repair is stronger than Kessler, Bunnell. Jaakkola et al. showed that a triple bundle repair was stronger than the Krackow.[14] A portion of the improvement in strength was thought to be due to increased suture strands across the repair site which may also be a source of vascular compromise.

Labib et al. in his biomechanical study showed Gift box technique had increased strength than the Krackow technique which could allow early rehabilitation.[7] A biomechanical study in cadaver done by Rao et al. in 2008 showed four strand cruciate repair required greater force to produce 2 mm gap and had maximum failure force modified Kessler and Strickland technique.[18] The attributed reasons for high tensile strength of four strand cruciate was 4 number of strand while other methods had only 2 strands. Lotz in an analytical model proved that four strand cruciate has more tensile strength. In repairs with same number of strands, design of core repair determines the strength.[19]

The mode of failure depends on core suture design and whether suture is locking or grasping type. The locking configuration is one in which the transverse component is passed superficial to the longitudinal so that suture passes around a bundle of tendon fiber and usually prevents pullout. In grasping type, the transverse component passes deep to longitudinal one so that suture does not pass around or lock and is more prone for pull out. In our study, all repairs were grasping which exhibits strong pull out resistance due to 4 strands and cruciate design. The locking designs are known for more gliding resistance and adhesions than grasping types. The location of knot in four strand cruciate is away from the repair site. This helps in decreasing bulk at repair site and assuring perfect apposition of tendon ends.

The result of this Achilles tendon repair technique compare favorably with the data reported previously. Khan et al. in Cochrane review reported re-rupture rate of 2.3% to 5% after tendoachilles repairs while in our study there was 2.5% (1 patient) case of re-rupture.[20] This re-rupture had occurred at 3 weeks post-operative period as the patient was non-compliant with physiotherapy protocol and was on partial weight bearing walking. We had 7.5% (3 patients) superficial wound infection. Among them two had already compromised wound state due to the avulsed heel pad lesion in which the reverse sural flap got superficially infected. The other patient had associated lateral malleolus fracture.

At one year post-operative period, the average ATRS score in our study was 85.6 ± 8.02, which is similar to average ATRS score of 81.2 ± 16.5 in study evaluating the Achilles tendon repair done by modified Gift box technique by Travis et al.[2] Rao et al. in his study of four strand cruciate repair technique has found good functional outcome at 6 months period with mean AOFAS score of 87.125 which is equivalent to our study where mean ATRS score was 75.25 ± 8.02 which is good functional outcome.[18]

As in our study the Achilles tendon repair done by four strand cruciate repair technique we have found less complication rate, less re-rupture rate and comparable functional outcome with respect to other techniques overall we have found this technique to be good with sustainable persistent good results and without any major complication.

Since this study is a single center retrospective observational study with limited sample size, outcome could not be attributed to the suturing technique. Biases and confounding variables that might have played role in the outcome.

CONCLUSION

The four strand cross locked cruciate repair technique provides a stable and reliable construct for the Achilles tendon repair with good functional outcome and less complication and re-rupture rates. However this technique requires further larger biomechanical and clinical studies with direct comparison with other mostly used techniques like Krackow and Modified Gift box suture technique.

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