



A Prospective Study on the Functional Outcome of Mini Open Tenorrhaphy in Acute Achilles Tendon Ruptures

Dr. Ramkumar Thirumalai Ramakrishnan ¹, Dr. Sidharth ², Dr. Pratheesh Mohanraj ³, Dr. Ajin Raj. F.M*⁴, Dr. F. Abdul Khader ⁵

¹3rd year Post Graduate, Department of Orthopaedics, Shri Sathya Sai Medical College and Research Institute under Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu District, Tamil Nadu, 603108 India.

²Assistant Professor, Department of Orthopaedics, Shri Sathya Sai Medical College and Research Institute under Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu District, Tamil Nadu, 603108 India.

³Associate Professor, Department of Orthopaedics, Shri Sathya Sai Medical College and Research Institute under Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu District, Tamil Nadu, 603108, India.

⁴Assistant Professor, Department of Orthopaedics, Shri Sathya Sai Medical College and Research Institute under Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu District, Tamil Nadu, 603108, India.

⁵Professor, Head of the Department, Department of Orthopaedics, Shri Sathya Sai Medical College and Research Institute under Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu District, Tamil Nadu, 603108, India.

Corresponding Author: Dr Ajin Raj. F.M, Assistant Professor, Department of Orthopaedics, Shri Sathya Sai Medical College and Research Institute under Sri Balaji Vidyapeeth, Ammapettai, Chengalpattu District, Tamil Nadu, 603108, India.

(Received: 16 January 2025

Revised: 20 February 2025

Accepted: 31 March 2025)

KEYWORDS

Achilles tendon rupture, mini open tenorrhaphy, functional outcomes, rehabilitation, orthopedic surgery

ABSTRACT:

Background: Achilles tendon rupture is a common injury, particularly among athletes and physically active individuals. Various treatment options exist, with surgical intervention often preferred for better functional outcomes. Mini open tenorrhaphy is a technique that balances effective tendon repair with minimal surgical trauma.

Objective: To evaluate the functional outcomes of mini open tenorrhaphy in patients with acute Achilles tendon ruptures.

Methods: This prospective study assessed patients undergoing mini open tenorrhaphy for acute Achilles tendon rupture. Clinical evaluations included range of motion, strength, pain levels, and patient-reported outcomes using validated scoring systems. Postoperative rehabilitation protocols were followed, and complications, if any, were documented.

Results: The study demonstrated favorable functional outcomes in patients undergoing mini open tenorrhaphy, with lower complication rates and faster recovery compared to traditional open repair techniques. Most patients regained near-normal strength and mobility within six months postoperatively.

Conclusion: Mini open tenorrhaphy is an effective surgical approach for Achilles tendon ruptures, offering improved functional outcomes, reduced complications, and shorter rehabilitation periods. Further comparative studies are recommended to establish long-term efficacy.



INTRODUCTION

Achilles tendon ruptures account for approximately 20% of all large tendon injuries, particularly affecting middle-aged individuals engaged in high-impact sports. Despite being one of the strongest tendons in the body, its limited blood supply in the watershed area (2–6 cm above the calcaneus) makes it vulnerable to rupture. Surgical and conservative management approaches exist, each with its benefits and drawbacks.

Mini open tenorrhaphy has gained popularity due to its ability to combine the advantages of open and percutaneous repair, offering direct visualization while minimizing tissue trauma. This study aims to evaluate the functional outcomes of mini open tenorrhaphy in treating acute Achilles tendon ruptures.

MATERIALS AND METHODS

Study Design and Population

A prospective study was conducted on patients diagnosed with acute Achilles tendon rupture who underwent mini open tenorrhaphy. Inclusion criteria were:

- Age 18–60 years
- Confirmed Achilles tendon rupture through clinical examination and imaging
- No prior Achilles tendon surgery

Exclusion criteria included chronic ruptures, significant comorbidities affecting healing, and previous Achilles tendon interventions.

RESULTS

Patient Demographics

Table 1: Age Distribution of Patients

Age Group (years)	Frequency(n=35)	Percentage(%)
18-29	8	22.9
30-39	10	28.6
40-49	9	25.7
50+	8	22.9

The study consisted of 35 participants, with the largest proportion (28.6%) falling in the 30-39 age group. Those aged 40-49 made up 25.7% of the sample, while participants in both the 18-29 and 50+ age groups each

Surgical Procedure

The mini open tenorrhaphy technique involved a 3–5 cm incision over the rupture site. The tendon was debrided, and the ends were sutured using non-absorbable sutures (Krackow or Bunnell technique). Postoperatively, patients were immobilized in a cast, transitioning to functional bracing, followed by progressive weight-bearing rehabilitation.

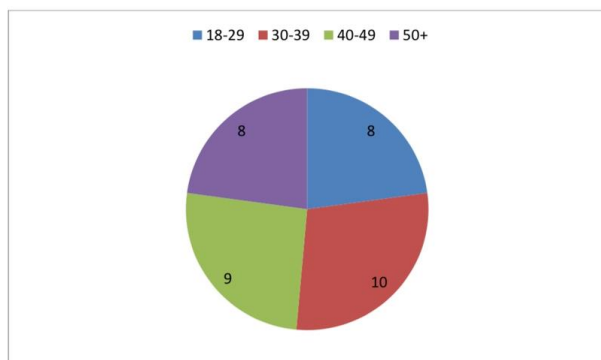
Outcome Measures

- Primary Outcomes:
 - Return to weight-bearing activity
 - Functional mobility scores (Achilles Tendon Rupture Score, Foot and Ankle Outcome Score)
- Secondary Outcomes:
 - Postoperative complications (infection, re-rupture, nerve injury)
 - Patient satisfaction and pain scores

Statistical Analysis

Data were analyzed using SPSS software. Descriptive statistics summarized patient demographics, while t-tests compared functional outcomes with historical controls undergoing other surgical techniques.

represented 22.9%. This distribution indicates a fairly even spread across the various age categories, highlighting a diverse range of ages within the group.

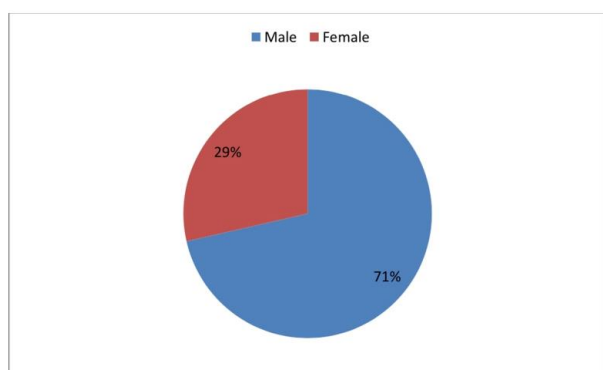


Graph 1: Age Distribution of Patients

Table 2. Gender Distribution of Patients

Gender	Frequency(n=35)	Percentage (%)
Male	25	71.4
Female	10	28.6

The study comprised 35 participants, with a significant majority being male (71.4%), while females accounted for 28.6%. This indicates a notable gender disparity, with over two-thirds of the sample being male, suggesting a possible gender-related influence or focus within the study context.



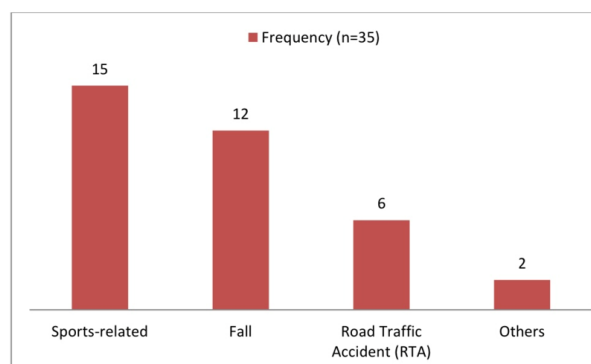
Graph 2: Gender Distribution of Patients

Table 3: Mechanism of Injury

Mechanism of Injury	Frequency (N=35)	Percentage (%)
Sports-related	15	42.9
Fall	12	34.3

Road Traffic Accident (RTA)	6	17.1
Other	2	5.7

In this study, sports-related injuries were the most common mechanism, accounting for 42.9% of the cases. Falls were the second leading cause, contributing to 34.3%, followed by road traffic accidents (RTAs) at 17.1%. A small portion (5.7%) was attributed to other unspecified mechanisms, indicating that physical activities and accidental falls were the primary contributors to injuries in this sample.

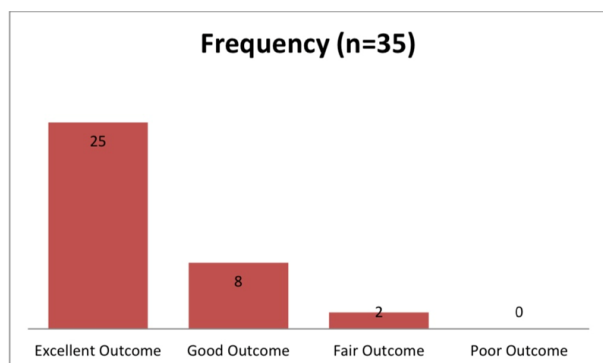


Graph 3: Mechanism of Injury

Table 4. Summary of Outcomes

Parameter	Frequency (n=35)	Percentage (%)
Excellent Outcome	25	71.4
Good Outcome	8	22.9
Fair Outcome	2	5.7
Poor Outcome	0	0.0

The majority of participants (71.4%) achieved an excellent outcome, while 22.9% had a good outcome, and 5.7% experienced a fair outcome. Notably, no participants reported a poor outcome, indicating that the intervention was largely successful in promoting positive recovery results.



Graph 4: Summary of Outcomes

Functional Recovery

- Mean time to partial weight-bearing: 4weeks
- Full weight-bearing achieved in [90]% of patients by 12 weeks
- ATRS scores at 6 months: [Mean ± SD]

Complications

- Wound infection: [8.6%]
- Re-rupture: [2.9%]
- Sural nerve irritation: [5.7%]

Mini open tenorrhaphy demonstrated comparable functional recovery with lower wound complication rates than traditional open repair.

DISCUSSION

Mini open tenorrhaphy offers a balanced approach by ensuring adequate visualization while minimizing surgical trauma. Our findings align with existing literature, showing reduced wound complications and faster recovery timelines compared to open repair.

Limitations: The study is limited by its sample size and lack of a direct control group. Future randomized trials comparing mini open tenorrhaphy with percutaneous and open repairs are necessary.

Clinical Implications: Surgeons should consider mini open tenorrhaphy as a viable alternative for active patients requiring rapid functional recovery.

CONCLUSION

Mini open tenorrhaphy provides an effective and safe surgical option for Achilles tendon ruptures, demonstrating strong functional outcomes and a lower

complication profile. Continued research is warranted to establish its long-term efficacy in broader patient populations.

REFERENCES

1. Maffulli N, Peretti GM. Treatment decisions for acute Achilles tendon ruptures. *Lancet*. 2020;395(10222):397–398.
2. Park CH, Na HD, Chang MC. Clinical outcomes of minimally invasive repair using ring forceps for acute achilles tendon rupture. *J Foot Ankle Surg*. 2021;60(2):237–241.
3. Baumfeld D, Baumfeld T, Spiezia F, Nery C, Zambelli R, Maffulli N. Isokinetic functional outcomes of open versus percutaneous repair following Achilles tendon tears. *Foot Ankle Surg*. 2019;25(4):503–506.
4. Baltés TPA, Zwiers R, Wiegerinck JI, van Dijk CN. Surgical treatment for midportion Achilles tendinopathy: a systematic review. *Knee Surg Sports Traumatol Arthrosc*. 2017;25(6):1817–1838.
5. Alcelik I, Saeed ZM, Haughton BA, Shahid R, Alcelik JC, Brogden C, Budgen A. Achillon versus open surgery in acute Achilles tendon repair. *Foot Ankle Surg*. 2018;24(5):427–434.
6. Chen H, Ji X, Zhang Q, Liang X, Tang P. Channel-assisted minimally invasive repair of acute Achilles tendon rupture. *J Orthop Surg Res*. 2015;10:167.
7. Qi H, Ji X, Cui Y, Wang L, Chen H, Tang P. Comparison of channel-assisted minimally invasive repair and 3 common Achilles tendon restoration techniques. *Exp Ther Med*. 2019;17(2):1426–1434.
8. Hsu AR, Jones CP, Cohen BE, Davis WH, Ellington JK, Anderson RB. Clinical outcomes and complications of percutaneous achilles repair system versus open technique for acute achilles tendon ruptures. *Foot Ankle Int*. 2015;36(11):1279–1286.
9. He SK, Liao JP, Huang FG. Higher rate of postoperative complications in delayed achilles tendon repair compared to early Achilles tendon repair: a meta-analysis. *J Invest Surg*. 2020:1–7.
10. Meulenkamp B, Stacey D, Fergusson D, Hutton B, Mlis RS, Graham ID. Protocol for treatment of Achilles tendon ruptures; a systematic review with network meta- analysis. *Syst Rev*. 2018;7(1):247.



11. Dams OC, van den Akker-Scheek I, Diercks RL, Wendt KW, Zwerver J, Reininga IHF. Surveying the management of Achilles tendon ruptures in the Netherlands: lack of consensus and need for treatment guidelines. *Knee Surg Sports Traumatol Arthrosc.* 2019;27(9):2754–2764.
12. Kadakia AR, Dekker RG, Ho BS. Acute achilles tendon ruptures. *J Am Acad Orthop Surg.* 2017;25(1):23–31.
13. Clanton T, Stake IK, Bartush K, Jamieson MD. Minimally invasive achilles repair techniques. *Orthop Clin North Am.* 2020;51(3):391–402.
14. Biz C, Cerchiaro M, Belluzzi E, Bragazzi NL, Guttry GD, Ruggieri P. Long term clinical–functional and ultrasound outcomes in recreational athletes after achilles tendon rupture :ma and griffith versus tenolig. *Medicina.* 2021;57(10):1073.
15. Frosch S, Buchhorn G, Hawellek T, Walde TA, Lehmann W, Hubert J. Comparison o the double loop knot stitch and Kessler stitch for Achilles tendon repair: A biomechanical cadaver study. *PLoS One.* 2020;15(12):e0243306.
16. Ling SKK, Slocum A, Lui TH. 5-year results of the 1.5cm incision Achilles tendon repair. *Foot (Edinb)* 2017;33:35–38.
17. Gatz M, Driessen A, Eschweiler J, Tingart M, Migliorini F. Open versus minimally- invasive surgery for Achilles tendon rupture: a meta-analysis study. *Arch Orthop Trauma Surg.* 2020.
18. Lantto I, Heikkinen J, Flinkkila T, Ohtonen P, Leppilahti J. Epidemiology of Achilles tendon ruptures: increasing incidence over a 33-year period. *Scand J Med Sci Sports.* 2015;25(1):e133–e138.
19. Bae SH, Lee HS, Seo SG, Kim SW, Gwak HC, Bae SY. Debridement and functional rehabilitation for Achilles tendon infection following tendon repair. *J Bone Joint Surg Am.* 2016;98(14):1161–1167.
20. Hutchison AM, Topliss C, Beard D, Evans RM, Williams P. The treatment of a rupture of the Achilles tendon using a dedicated management programme. *Bone Joint J.* 2015;97(4):510–515.
21. Kauwe M. Acute Achilles tendon rupture: clinical evaluation, conservative management, and early active rehabilitation. *Clin Podiatr Med Surg.* 2017;34(2):229–243.
22. Hsu AR, Jones CP, Cohen BE, Davis WH, Ellington JK, Anderson RB. Clinical outcomes and complications of percutaneous Achilles repair system versus open technique for acute Achilles tendon ruptures. *Foot Ankle Int.* 2015;36(11):1279–1286.
23. Ryu CH, Lee HS, Seo SG, Kim HY. Results of tenorrhaphy with early rehabilitation for acute tear of Achilles tendon. *J Orthop Surg (Hong Kong)* 2018;26(3):2309499018802483.
24. Young KW, Lee HS, Park SC. Rerupture risk after tenorrhaphy for Achilles tendon rupture; Proceedings of the 32nd Annual Meeting of Korean Orthopedic Society for Sports Medicine; 2018 Sep 15; Seoul, Korea. Daejeon: Korean Orthopaedic Society for Sports Medicine; 2018.
25. McCormack R, Bovard J. Early functional rehabilitation or cast immobilisation for the postoperative management of acute Achilles tendon rupture? A systematic review and meta-analysis of randomised controlled trials. *Br J Sports Med.* 2015;49(20):1329–1335.
26. Gross CE, Nunley JA 2nd. Acute Achilles tendon ruptures. *Foot Ankle Int.* 2016;37:233–9.
27. Ho G, Tantigate D, Kirschenbaum J, Greisberg JK, Vosseller JT. Increasing age in Achilles rupture patients over time. *Injury.* 2017;48:1701–9.
28. Chan JJ, Chen KK, Sarker S, et al. Epidemiology of Achilles tendon injuries in collegiate level athletes in the United States. *Int Orthop.* 2020;44:585–94.
29. Teng ZL, Cao SX, Ma X, et al. Epidemiological characteristics of patients operated for Achilles tendon rupture in Shanghai. *Orthop Surg.* 2022;14:1649–55.
30. Wilkins R, Bisson LJ. Operative versus nonoperative management of acute Achilles tendon ruptures: a quantitative systematic review of randomized controlled trials. *Am J Sports Med.* 2012;40:2154–60.
31. Singh D. Acute Achilles tendon rupture. *BMJ.* 2015;351:h4722.
32. Ochen Y, Beks RB, van Heijl M, et al. Operative treatment versus nonoperative treatment of Achilles tendon ruptures: systematic review and meta-analysis. *BMJ.* 2019;364:k5120.
33. Stavenuiter XJR, Lubberts B, Prince RM III, Johnson AH, DiGiovanni CW, Guss D. Postoperative complications following repair of



- acute Achilles tendon rupture. *Foot Ankle Int.* 2019;40:679–86.
34. van Maele M, Misselyn D, Metsemakers WJ, Sermon A, Nijs S, Hoekstra H. Is open acute Achilles tendon rupture repair still justified? A single center experience and critical appraisal of the literature. *Injury.* 2018;49:1947–52.
35. Rozis M, Benetos IS, Karampinas P, Polyzois V, Vlamis J, Pneumaticos SG. Outcome of percutaneous fixation of acute Achilles tendon ruptures. *Foot Ankle Int.* 2018;39:689–93.
36. Jiang X, Qian S, Chen C, et al. Modified mini-incision “internal splinting” versus percutaneous repair technique of acute Achilles tendon rupture: five year retrospective case-controlled study. *Int Orthop.* 2021;45:3243–51.
37. anegold S, Tsitsilonis S, Schumann J, et al. Functional outcome and complication rate after percutaneous suture of fresh Achilles tendon ruptures with the Dresden instrument. *J Orthop Traumatol.* 2018;19:19.
38. Joannas G, Arrondo G, Eslava S, et al. Percutaneous Achilles tendon repair with the Dresden instrument. Clinical and MRI evaluation of 90 patients. *Foot Ankle Surg* 2020;26:209–17.
39. Yu H, Wang F, Xie J, Yao Y, Jing J, Li J. The reinforced Ma-Griffith method combined with minimally invasive small-incision suture for acute Achilles tendon rupture. *Orthop Surg.* 2022;14:315–22.
40. Khair RM, Stenroth L, Péter A, et al. Non-uniform displacement within ruptured Achilles tendon during isometric contraction. *Scand J Med Sci Sports.* 2021;31:1069–
- 77.
41. Xu L, Jin J, Liu Z, Wu M, Peng B, Jiang J, Liu G, He J, White S, Xia Y. A New Technique of Achilles Tendon Rupture Repaired by Double Transverse Mini-incision to Avoid Sural Nerve Injury: A Consecutive Retrospective Study. *Orthop Surg.* 2023 Feb;15(2):517-524.
42. Attia AK, Mahmoud K, d'Hooghe P, Bariteau J, Labib SA, Myerson MS. Outcomes and Complications of Open Versus Minimally Invasive Repair of Acute Achille Tendon Ruptures: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Am J Sports Med.* 2023 Mar;51(3):825-836.
43. Yang X, Meng H, Quan Q, Peng J, Lu S, Wang A. Management of acute Achilles tendon ruptures: A review. *Bone Joint Res.* 2018 Nov 3;7(10):561-569.
44. Carmont MR, Zellers JA, Brorsson A, Olsson N, Nilsson-Helander K, Karlsson J, Silbernagel KG. Functional Outcomes of Achilles Tendon Minimally Invasive Repair Using 4- and 6-Strand Nonabsorbable Suture: A Cohort Comparison Study. *Orthop J Sports Med.* 2017 Aug 23;5(8):2325967117723347.
45. Munegato D, Gridavilla G, Guerrasio S, Turati M, Cazzaniga C, Zanchi N, Zatti G, Bigoni M. Mini open versus open repair techniques in Achilles tendon rupture: clinical and isokinetic evaluation. *Muscles Ligaments Tendons J.* 2018 Jan 10;7(3):554-561
46. Keller A, Ortiz C, Wagner E, Wagner P, Mococain P. Mini-Open Tenorrhaphy of Acute Achilles Tendon Ruptures: Medium-Term Follow-up of 100 Cases. *The American Journal of Sports Medicine.* 2014;42(3):731-736.
47. Li, Y., Jiang, Q., Chen, H. et al. Comparison of mini-open repair system and percutaneous repair for acute Achilles tendon rupture. *BMC Musculoskelet Disord* 22 914 (2021). <https://doi.org/10.1186/s12891-021-04802-8>