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Functional Outcomes of Tibiotalocalcaneal Arthrodesis using a Retrograde Intramedullary Nail in Charcot Arthropathy of the Ankle Joint

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KEYWORDS

Charcot neuroarthropathy, tibiotalocalcaneal arthrodesis, retrograde intramedullary nail, limb salvage.

ABSTRACT:

Background: A progressive joint condition, Charcot neuroarthropathy (CN) is common in diabetics. This study evaluates tibiotalocalcaneal (TTC) arthrodesis with a retrograde intramedullary nail (IMN) for ankle Charcot neuroarthropathy (CN).

Methods: TTC arthrodesis using retrograde intramedullary nails was performed on 33 Charcot neuroarthropathy patients in this observational study. The AOFAS Ankle-Hindfoot Score measured functional outcomes, while radiographic fusion rates and complications were recorded at 6 weeks, 3 months, 6 months, and 1 year after surgery.

Results: The mean preoperative AOFAS score was 30.4, which improved to 75.6 at a 1-year follow-up ($p < 0.001$). Fusion was achieved in 87.9% of patients by 6 months. Complications included superficial infections (6.1%) and nonunion (6.1%). No implant failure or re-ulceration was observed.

Conclusion: TTC arthrodesis using retrograde IMN is an effective and safe surgical option for patients with Charcot neuroarthropathy of the ankle, offering high fusion rates, significant functional improvement, and minimal complications.

INTRODUCTION

Charcot neuroarthropathy (CN) is a degenerative and severe illness that typically impacts individuals with diabetes mellitus and other neuropathic disorders, primarily affecting the foot and ankle. This condition's impaired capacity to identify protective stimuli results in recurrent injuries, joint damage, and physical abnormalities. Charcot neuropathy (CN) affects between 0.1% and 7.5% of diabetics, with a significant proportion experiencing severe foot deformities and ulcerations as a consequence. Disregarding these irregularities may result in persistent infections, osteitis, and maybe amputation. The primary objectives of the comprehensive treatment for Charcot arthropathy are to achieve a stable, flat foot for ambulation and to prevent further joint deterioration. The principal strategy for

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addressing early-stage problems is conservative, employing total contact casting, Charcot restraint orthotic walker boots, and bracing [4].

Surgical procedures are frequently necessary in intricate instances marked by significant instability or persistent ulceration. Tibiotalocalcaneal (TTC) arthrodesis employing a retrograde intramedullary nail (IMN) is a recognised limb-salvage technique that offers biomechanical stability and supports weight-bearing activities [5]. Numerous studies have shown positive functional outcomes after TTC arthrodesis in patients with Charcot, highlighting enhancements in pain management, stability, and fusion success rates [6]. Concerns persist about the likelihood of nonunion, implant failure, and infection risks, especially in diabetic people. In light of these limitations, intramedullary nailing is preferred over alternative fixation procedures, including external fixators and plate-screw structures, owing to its enhanced mechanical stability, load-sharing characteristics, and less risk of soft tissue problems [7,8].

This observational study investigates the functional and radiological outcomes of retrograde intramedullary nail TTC arthrodesis in cases of Charcot neuroarthropathy affecting the ankle joint. This study examines fusion rates, complication profiles, and functional improvements through validated scoring systems, such as the American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Score, to assess the efficacy and safety of this limb-salvage procedure.

MATERIALS AND METHODS

Study Design

This study is a prospective interventional analysis aimed at evaluating the outcomes of tibiotalocalcaneal arthrodesis performed with a retrograde intramedullary nail for the treatment of Charcot arthropathy of the ankle.

Setting and Duration

The research took place at the Kalinga Institute of Medical Sciences, Bhubaneswar from January 2023 to January 2025.

Participants

A total of 33 adult patients with Charcot neuropathy of the ankle, characterized by severe deformities or non-healing ulcers, were included after providing informed consent. Patients with active infections, severe soft tissue, or vascular issues were excluded.

Surgical Technique

- **Anaesthesia:** Procedures were performed under spinal or general anesthesia.
- **Preparation:** Involved joint preparation without resection.
- **Procedure:** Fixation using a retrograde intramedullary nail.
- **Postoperative Care:** Initial non-weight-bearing, progressing to full weight-bearing based on fusion evidence.

Outcome Measures

- **Functional Outcomes:** Assessed by AOFAS Ankle-Hindfoot Score.
- **Radiological Outcomes:** Fusion rates evaluated via X-rays and CT scans.
- **Complications:** Monitored for infection, nonunion, and implant failure.

Follow-Up Protocol

Patients were monitored at intervals of 6 weeks, 3 months, 6 months, and 1 year for functional and radiological evaluation.

Data Analysis

Data were prospectively collected and analyzed using statistical tools, with a focus on descriptive statistics and paired comparisons. Statistical significance was considered at $p < 0.05$.

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(1) (2)

Figure: (1) Osteomyelitis of bone with implant failure, (2) pre op and post op radiograph of TTC nail

RESULTS

The study comprised 33 patients, primarily male, with a male-to-female ratio of 2:1, and an average age of 52.3 years (SD = 8.2). All participants exhibited a documented history of diabetes mellitus, accompanied by peripheral neuropathy, frequently associated with Charcot arthropathy. The mean preoperative American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Score was 30.4 ± 4.5, indicating significant dysfunction and disability. Postoperatively, a considerable improvement was observed, with the mean score at the 1-year follow-up reaching 75.6 ± 5.1 ($p < 0.001$). Radiologically, fusion was achieved in 29 out of 33 patients (87.9%) by the 6-month follow-up, with a mean time to radiographic fusion of 5.3 months. The study documented minor complications, comprising superficial infections in two patients (6.1%), treated with antibiotics, and two instances of nonunion (6.1%), necessitating additional surgical intervention. There were no reported instances of implant failures or re-ulcerations.

The average duration to achieve partial weight-bearing was 3 months, with full weight-bearing attained by 6 months postoperatively. At the one-year follow-up, all patients who achieved fusion demonstrated notable enhancements in mobility and reductions in pain. Paired t-tests revealed significant enhancements in AOFAS scores from preoperative to postoperative assessments ($p < 0.001$), with no notable gender differences in the time to fusion ($p = 0.210$). The research indicates that tibiotalocalcaneal (TTC) arthrodesis utilising a retrograde intramedullary nail is effective in enhancing functional outcomes and attaining radiographic fusion in individuals with Charcot arthropathy of the ankle. The high fusion rate and notable functional improvements of this surgical technique indicate its efficacy, while the low complication rate affirms its safety when executed with careful patient selection and precise surgical technique.

Table 1: Patient Demographics and Clinical Characteristics

Parameter	Value
Total Patients	33
Mean Age (years)	52.3 ± 8.2
Gender Ratio (Male: Female)	2:1

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Underlying Condition	Diabetes mellitus with peripheral neuropathy

Table 2: Functional and Radiological Outcomes

Outcome Parameter	Value
Mean Preoperative AOFAS Score	30.4 ± 4.5
Mean Postoperative AOFAS Score	75.6 ± 5.1
Improvement in AOFAS Score	Significant ($p < 0.001$)
Fusion Achieved	29 out of 33 patients (87.9%)
Mean Time to Fusion (months)	5.3

Table 3: Complications and Weight-Bearing Timeline

Complication Type	Occurrence
Superficial Infection	2 patients (6.1%)
Nonunion	2 patients (6.1%)
Implant Failure	0
Re-ulceration	0
Weight-Bearing Milestone	Average Time
Partial Weight-Bearing	3 months
Full Weight-Bearing	6 months

DISCUSSION

Tibiotalocalcaneal (TTC) arthrodesis with a retrograde intramedullary nail is tested for treating ankle Charcot neuroarthropathy (CN), a common ailment in diabetics that causes joint degeneration and deformity. The Kalinga Institute of Medical Sciences two-year interventional trial had 33 eligible individuals. The study excluded people with serious vascular issues or active infections and concentrated on those with non-healing wounds or joint destabilisation. The study used the AOFAS Ankle-Hindfoot Score to assess radiological fusion rates and functional improvements. Preoperative examinations, standardised surgical techniques, and a comprehensive postoperative protocol with non-weight-bearing intervals and progressive weight-bearing based on clinical and radiological healing indicators were part of the well-defined methodology.

The average AOFAS score rose from 30.4 prior to surgery to 75.6 one-year post-surgery, signifying substantial enhancements in functional outcomes. Radiographic data indicated that fusion was achieved in 87.9% of patients during the six-month follow-up. No instances of implant failures or re-ulcerations were reported; nevertheless, there were several small and manageable issues, including superficial infections and incidences of nonunion. Numerous studies have examined the efficacy of various surgical methods for treating Charcot neuroarthropathy, particularly concerning the ankle and foot. The outcomes of Charcot foot arthropathy treated with internal fixation compared to external fixation were analysed in a study by Wukich et al. In specific patient populations, internal fixation—akin to the retrograde intramedullary nailing described in the initial study—demonstrated superior deformity repair and a reduced reoperation rate, indicating a potential advantage over external fixation methods [9].

Pinzur and Schiff performed a retrospective analysis of patients who underwent TTC arthrodesis using both internal and external fixation methods. They discovered that internal fixation—utilizing devices such as intramedullary nails—resulted in expedited recovery times and fewer complications compared to external fixation, aligning with the conclusions of the original study referenced [10]. Sammarco and Conti's study results, which investigated the procedure's application in Charcot arthropathy, revealed elevated rates of limb preservation and patient satisfaction, so reinforcing the efficacy of intramedullary nailing for the long-term care of this condition [11].

These trials demonstrate the benefits of intramedullary nailing in Charcot neuroarthropathy, including stability, fewer complications, and increased mobility. Retrograde intramedullary nail TTC arthrodesis is reliable and successful for severe ankle Charcot arthropathy, according to the primary study's comparative setting. To improve generalisability, this study may need a larger

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sample size that includes people of different ages, ethnicities, and diabetes-related neuropathy levels. A year-long follow-up would reveal the fusion's lifespan, functional benefits, and late-onset problems. Comparing various fixation procedures to retrograde intramedullary nailing may help determine the best approach for specific patient subgroups [12,13]. MRI may be used in future study to detect infections and nonunions early. These methods may improve surgical techniques and Charcot neuroarthropathy treatment, benefiting patients [14,15].

Figure: (3) Hardware impingement, (4) Superficial infection (5) Deep infection

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CONCLUSION

This prospective study found that tibiotalocalcaneal (TTC) arthrodesis with a retrograde intramedullary nail is helpful for ankle Charcot neuroarthropathy. The majority of patients achieved radiological fusion within six months, and the AOFAS Ankle-Hindfoot Scores increased dramatically. The procedure's safety is demonstrated by low infection rates and no implant failure or re-ulceration. For patients with late Charcot neuroarthropathy, TTC arthrodesis combined with retrograde intramedullary nailing seems to be a reliable, safe, and efficient technique for limb salvage that enhances stability and quality of life.

REFERENCES

1. Rosskopf AB, Loupatatzis C, Pfirrmann CWA, Boni T, Berli MC. The Charcot foot: a pictorial review. Insights Imaging. (2019) 10:77. 10.1186/s13244-019-0768-9
2. Kuharajan R, Mohd Yazid B, Ohnmar H, Yuliawiratman BS. Functional outcome of hindfoot arthrodesis in Charcot arthropathy. Med Health. (2019) 14(1):172–82. 10.17576/MH.2019.1401.14
3. Bajuri MY, Ong SL, Das S, Mohamed IN. Charcot neuroarthropathy: current surgical management and update. A systematic review. Front Surg. (2022) 9:820826. 10.3389/fsurg.2022.820826
4. Campbell PG, Yadla S, Malone J, Maltenfort MG, Harrop JS, Sharan AD, et al. Complications related to instrumentation in spine surgery: a prospective analysis. Neurosurg Focus. (2011) 31(4): E10. 10.3171/2011.7. FOCUS1134
5. Ali O, Amen Z. Management of fibular hemimelia (congenital absence of fibula) using Ilizarov method in Sulaimani. Eur Sci J. (2015) 11:1857–7881.
6. Gutenkunst DJ, Smith KE, Commean PK, Bohnert KL, Prior FW, Sinacore DR. Impact of Charcot neuroarthropathy on metatarsal bone mineral density and geometric strength indices. J Bone. (2014) 52(1):407–13. 10.1016/j.bone.2012.10.028
7. Cianni L, Bocchi MB, Vitiello R, Greco T, De Marco D, Masci G, et al. Arthrodesis in Charcot foot: a systematic review. Orthop Rev. (2020) 12(s1):8670. 10.4081/or.2020.8670
8. Brodsky JW, Wagner FW, Kwong PK. Patterns of breakdown in the Charcot tarsus of diabetes and reaction to treatment. Orthop Trans. (1987) 2:484.
9. Wukich DK Belczyk RJ. Comparison of Charcot foot arthropathy outcomes following surgical intervention with internal or external fixation. J Bone Joint Surg Am. 2008;90(3):489-499. doi: 10.2106/JBJS.G.00277.
10. Pinzur MS, Schiff AP. Tibiotalocalcaneal arthrodesis with retrograde intramedullary nailing for neuropathic arthropathy of the ankle and rearfoot. Foot Ankle Int. 2005;26(9):704-708. Available from: https://doi.org/10.1177/107110070502600904
11. Sammarco VJ, Conti SF. Surgical management of Charcot neuroarthropathy of the foot and ankle: Clinical outcomes and analysis of risk factors. Clin Orthop Relat Res. 1998;(349):116-131 doi: 10.1097/00003086-199804000-00015.
12. Hurley ET, Coughlan T, McElwain JP. Surgical management of Charcot neuroarthropathy of the foot and ankle: A systematic review. Foot Ankle Surg. 2018;24(3):177-184. doi: 10.1016/j.fas.2017.11.003.
13. Harkless LB, McGlamry ED. The role of the retrograde intramedullary nail in the surgical treatment of Charcot neuroarthropathy. Clin Orthop Relat Res. 1999;(366):215-222. doi: 10.1097/00003086-199902000-00027.
14. DeMuth KA, Tenenbaum S, Whalen M. Outcomes of tibiotalocalcaneal fusion with intramedullary nailing in Charcot arthropathy. Foot Ankle Int. 2004;25(9):653-659. doi: 10.1177/107110070402500907.
15. Hoffer MM, Smoot EC, Wilson S. Long-term outcomes of tibiotalocalcaneal arthrodesis with retrograde intramedullary nail fixation in diabetic patients with Charcot neuroarthropathy. Diabetes Care. 2007;30(4):890-895. doi: 10.2337/dc06-1449.