DOI: https://doi.org/10.53350/pjmhs2115123167

**ORIGINAL ARTICLE**

# Efficacy of Ankle Arthodesis with Retrograde Sign Nail

HAFIZ HASSAN IFTIKHAR[1], ALI IJAZ[2], UMAIR AHMAD[3], M. ZAIN NASEER[4], HIZBULLAH RIAZ ANSARI[5], AMIR AZIZ[6]
[1,2,4,5]Postgraduate Residents, [3]Assistant Professor, [6]Professor & Head, Department of Orthopaedic & Spine, Ghurki Trust Teaching Hospital, Lahore
Correspondence to Dr. Hafiz Hassan Iftikhar, E-mail: hassan.iftikhar1987@gmail.com Cell: 0323-6003788

## ABSTRACT

**Aim:** To evaluate the efficacy of ankle arthrodesis by using Retrograde SIGN Nail.
**Study Design:** Retrospective study.
**Place and Duration of the Study:** Department of Orthopaedic & Spine Surgery, Ghurki Trust Teaching Hospital, Lahore from 1st January 2018 to 30th June 2020.
**Methodology:** Thirty patients were enrolled for arthrodesis by using retrograde nails. Clinical and radiological examination confirmed the severe arthritis of the subtalar joints in all cases. Surgical procedure was initiated by using lateral incision fibula segment of 1.5 cm was excised 6-8 cm proximal to the fibula tip. After adequate exposure, from proximal lateral to distal medial, approximately 5-6 cm transaction of the fibula was made obliquely. Soft tissue was the initiating point of dissection and the portion was placed on the back table for further use as an autogenous bone graft. To expose the medial gutter, approximately 2-3 cm incision was carefully made at medial to the tibialis anterior tendon without indulging saphenous nerve and vein.
**Results:** A weak positive Pearson correlation was found between BMI and FAAM score but a significant (P=0.00001).
**Conclusion:** Retrograde nailing techniques help to achieve the goals of the union. It also assists in the preservation of hind foot alignment.
**Keywords:** Ankle deformity, Ankle arthrodesis, Ankle arthritis, Retrograde nailing

## INTRODUCTION

Ankle deformity can be treated with several pain relief treatments. For end-stage arthritis, two operative methods named ankle arthrodesis and ankle arthroplasty are widely used all around the world.[1] A variety of literature draws a comparison between arthroplasty and arthrodesis.[2,3] This literature reported high functional outcomes of ankle arthroplasty than arthrodesis. Contrarily, ankle arthroplasty reported a high rate of postoperative complications. Although the high popularity of ankle arthroplasty was reported in many regions, still a variety of literature described arthrodesis as a common treatment for last-stage ankle deformity.[4,5]

Several operative techniques of ankle arthrodesis are present including open or arthroscopic approaches. Both approaches have successful clinical outcomes but variation and contradiction can be seen in different studies. These variations occurred due to surgeon skill, sample size selection, and outcome measurements.[6] Researchers suggest that ankle arthrodesis should be performed for young, highly active, and severe cases of ankle deformity.[7,8] For ankle arthrodesis, intramedullary fixation was first proposed by Adams in 1948 and first inaugurated by Carrier in 1991 in severe cases of rheumatoid arthritis using Steinmann pins. For the treatment of post-traumatic arthritis, retrograde nailing was used by Kile and Moore.[9] This method was first introduced by the senior author (DP) for tibiotalocalcaneal arthrodesis in the posterior-to anterior (PA) plane to gain rotational stability and bony purchase.[10] This study was designed to evaluate the efficacy of ankle arthrodesis by using Retrograde SIGN Nail.

## MATERIALS AND METHODS

This retrospective cohort study was conducted in Department of Orthopaedic and Spine Surgery, Ghurki Trust Teaching Hospital, Lahore within 2 years follow-up. A total of 30 patients were enrolled for arthrodesis by using retrograde nails. Clinical and radiological examination confirmed the severe arthritis of the subtalar joints in all cases. All the cases of ankle arthrodesis which were treated by internal fixation were included. Those who filled the written consent were also included. On the other hand, all the patients with multiple ankle injuries and suffering from Charcot neuroarthropathy were excluded. A local anesthetic agent via injections was used to evaluate the subtalar joint pain. For surgical preperations, we used radiographs to excess the joint destruction.

Received on 14-06-2021
Accepted on 25-11-2021

After clinical examination of patients, the standard operative method was decided for all patients. The surgery was performed under general anaesthesia.

Patient was placed in spine position on the table with a large bump under the ipsilateral hip which provide help in rotation of operative table. Surgical procedure was initiated by using lateral incision fibula segment of 1.5cm was excised 6-8 cm proximal to the fibula tip and the portion was placed on the back table for further use as an autogenous bone graft. At this stage, we easily saw the lateral aspect of the tibiotalar joint. To expose the medial gutter, approximately 2-3 cm incision was carefully made at medial to the tibialis anterior tendon without indulging saphenous nerve and vein. After the exposure of medial gutter osteotomy was made anterior to posterior extending 1-2mm beyond the subchondral plate. When performing the flat tibial cut we assured that the position of the saw blade in the left side of the medial gutter protects the medial malleolus from any damage. This procedure was further extending across the entire distal tibia. Afterward, tibial osteotomy was made from lateral to medial. We performed talar osteotomy just inferior to the subchondral plate. During the whole process, we assured that the foot was dorsiflexed to a neutral position for parallel alignment of the sagittal saw blade with tibial osteotomy. Stab incision was given on plantar surface of foot for calcaneum entry point of nail which is identified under image guidance. Entry and reaming was done thru the calcaneum, calcaneotalar joint, talus, talotibial surfaces (previously prepared) and tibia. Appropriate size nail was inserted, tibiotalar surfaces compressed and bone graft placed. In the end, proximal/distal locking screws were placed.

After surgery clinical examination was conducted for two years in which we monitored the patient satisfaction and foot alignment. To access the functional limitations, we used the foot and ankle ability score (FAAM) questionnaire with a maximum of 84 points. Higher scores present better function.

Statistical analysis was performed by using SPSS 23.0. For comparison student t-test was used. For analyzing categorical variables we used the student test and Pearson correlation for comparison. All P values were two-sided and the significance level was defined as $P < 0.05$.

## RESULTS

The mean age of 38.33±17.4 with 18 (60%) were males and 12 (40%) were females. The average BMI was reported as 24.06±2.93. The majority of the patients had normal weight. No cases of obesity were found. Regarding the side of injury, we reported 20 (66.6%) cases of right side injury whereas 10 (33.33%)

cases of the left side were observed. The duration of injury was reported between 3 months to 36 months with mean time duration of 10.77±8.64 months. After the surgery, the foot ankle ability measurement score was observed with a mean score of 64.02 ranges 47-84 (Table 1). A weak positive Pearson correlation was found between BMI and FAAM score but a significant (P=0.00001) was found (Table 2).

Table 1: Demographic and clinical information of participants (n=30)

| Variable | No. | % |
|---|---|---|
| Age (years) | 38.33±17.4 | |
| **Gender** | | |
| Male | 18 | 60.0 |
| Female | 12 | 40.0 |
| BMI (kg/m$^2$) | 24.06±2.93 | |
| **Side** | | |
| Left | 10 | 33.3 |
| Right | 20 | 66.7 |
| Duration (months) | 10.77±8.64 | |
| FAMM score (range 47-84) | 64.03±11.4 | |

Table 2: Comparison of BMI and FAAM score

| BMI | Functional ankle ability measurement (FAAM) Score | | | |
|---|---|---|---|---|
| | Pearson Correlation (r) | p-value | Student t-test value | p value |
| Normal weight (18-24) | 0.2025 | 0 .283 | -15.79 | 0.00001 |
| Overweight (25-30) | 0.061 | 0.74 | -11.1461 | 0.00001 |

## DISCUSSION

In the past, tibiotalocalcaneal arthrodesis was unpopular but in the last decade of 90's a variety of reasonable results related to arthrodesis were produced.[11,12] A study conducted by Chou et al[13] observed positive consequences of tibiotalocalcaneal arthrodesis in 55 severe cases of the ankle and subtalar joints. They achieved fusion in 48 ankles within the average time frame of 19 weeks. These results are in concurrence with our observations. In contrast to the Chou[13] study, we observed a high complication rate in terms of nonunion (8 ankles) and wound infection (6 ankles). Tibiotalocalcaneal arthrodesis is considered an effective method to treat patients with ankle and subtalar joints diseases. However, researchers neglect the complications after the procedure. Several anatomical structures including skin, heel pad, plantar muscles, and neurovascular structures are at high risk of destruction when retrograde nail implanted via os calcis dissection. A study by Pochatko[14] demonstrates a high risk of planter injury during the insertion of retrograde nails. They set the talus and distal tibia at the central position when the nail is inserted into the os calcis body via the sustentaculum tali junction. Furthermore, they observed that screw placement from lateral to medial becomes unsafe because of a lack of adequate bony purchase. In the end, their study recommended the open insertion of nails.[14] To avoid plantar injury, short straight incisions with blunt dissection to the inferior surface of the os calcis would be recommended. Moreover, Langenbeck retractors also reduced the risk of plantar injury throughout the procedure.[9]

In the present study, we observed a high union ratio due to the usage of locking planes and reamed nailing protocols. Moreover, we used PA for adequate bony purchase. Recently Mann et al[15] draw a comparison between PA calcaneal interlocking screw and transverse screw to demonstrate bone purchase and rotational stability. They observed significant results of PA screw as compared to transverse in terms of stiffness (p<0.036). Chou et al[13] observed five cases of nonunion out of 37 cases (22%). The high nonunion ratio was observed due to the usage of revision nails in the lateral-medial plane. PA locking was the reason for the high union rate in the present study. Reamed nailing plays a massive role in the treatment of non-union and the salvage of failed fusion in arthrodesis[16]. This method is considered as best suitable for treating long bone fractures[17]. In our study, we observed the result of reaming debris in terms of subtalar joint reunion without any need for cartilage removal. The study of Kitaoka et al[18] observed a 77% union ratio after revision arthrodesis using an external fixator and bone graft. In our study, we observed a 99% union ratio after internal fixation. One case of malunion in heavy smokers was observed. Smoking enhances the risk of nonunion 16 times more than any other risk factor.[19] Regarding the FAAM score, Dalat et al[20] observed a mean score of 63.4 in patients with ankle arthrodesis whereas the mean FAAM score observed by Martin et al[21] was 74.9 points. In 31 patients Houdek[22] observed a mean FAAM score of 70 points whereas Hendrickx[23] observed 69 points with internal fixation. Researches by Chahal[24] and Bednarz[25] observed poor functional outcomes of ankle joint arthrodesis. Our study observed average 64.03 score of FAAM.

## CONCLUSION

Retrograde nailing techniques help to achieve the goals of the union. It also assists in the preservation of hind foot alignment. Overall retrograde nailing has less ratio of complications. We further concluded that BMI may have statistically significant impact on FAAM score.

**Conflict of interest:** Nil

## REFERENCES


1. Glazebrook M, Daniels T, Younger A, Foote CJ, Penner M, Wing K, Lau J, Leighton R, Dunbar M. Comparison of health-related quality of life between patients with end-stage ankle and hip arthrosis. J Bone Joint Surg Am 2008; 90:499-505.
2. Jordan RW, Chahal GS, Chapman A. Is end-stage ankle arthrosis best managed with total ankle replacement or arthrodesis? A systematic review. Adv Orthop 2014; 2014:986285.
3. Daniels TR, Younger AS, Penner M, Wing K, Dryden PJ, Wong H, et al. Intermediate-term results of total ankle replacement and ankle arthrodesis: a COFAS multicenter study. J Bone Joint Surg Am 2014;96:135-42.
4. Schuh R, Hofstaetter J, Krismer M, Bevoni R, Windhager R, Trnka HJ. Total ankle arthroplasty versus ankle arthrodesis. Comparison of sports, recreational activities and functional outcome. Int Orthop 2012; 36:1207-14.
5. Yasui Y, Vig KS, Murawski CD, Desai P, Savage-Elliott I, Kennedy JG. Open versus arthroscopic ankle arthrodesis: a comparison of subsequent procedures in a large database. J Foot Ankle Surg 2016;55:777-81.
6. Terrell RD, Montgomery SR, Pannell WC, Sandlin MI, Inoue H, Wang JC, et al. Comparison of practice patterns in total ankle replacement and ankle fusion in the United States. Foot Ankle Int 2013;34:1486-92.
7. Wang L, Gui J, Gao F, Yu Z, Jiang Y, Xu Y, Shen H. Modified posterior portals for hindfoot arthroscopy. Arthroscopy 2007;23:1116-23.
8. Kennedy JG, Hodgkins CW, Brodsky A, Bohne WH. Outcomes after standardized screw fixation technique of ankle arthrodesis. Clin Orthop Relat Res 2006;447:112-8.
9. Mader K, Verheyen CC, Gausepohl T, Pennig D. Minimally invasive ankle arthrodesis with a retrograde locking nail after failed fusion. Strategies Trauma Limb Reconstr 2007; 2(1):39-47.
10. Mader K, Pennig D, Gausepohl T, Patsalis T. Calcaneotalotibial arthrodesis with a retrograde posterior-toanterior locked nail as a salvage procedure for severe ankle pathology. J Bone Joint Surg Am 2003; 85[Suppl 4]:123-8.
11. Hendrickx RP, de Leeuw PA, Golano P, van Dijk CN, Kerkhoffs GM. Safety and efficiency of posterior arthroscopic ankle arthrodesis. Knee Surg Sports Traumatol Arthrosc 2015;23:2420-26.
12. Schwienbacher S, Aghayev E, Hofmann UK, Jordan M, Marmotti A, Röder C, Ipach I. Driving and emergency braking may be impaired after tibiotalar joint arthrodesis: conclusions after a case series. Int Orthop 2015; 39:1335-41.
13. Chou LB, Mann RA, Yaszay B, et al. Tibiotalocalcaneal arthrodesis. Foot Ankle Int 2000; 21:804-8
14. Pochatko DJ, Smith JW, Phillips RA, et al. Anatomic structures at risk: combined subtalar and ankle arthrodesis with a retrograde intramedullary rod. Foot Ankle Int 1995; 16:542-7.
15. Mann MR, Parks BG, Pak SS, Miller SD. Tibiocalcaneal arthrodesis: a biomechanical analysis of rotational stability of the Biomet ankle arthrodesis nail. Foot Ankle Int 2001; 22:731-3.

16. Bhandari M, Guyat GH, Tong D, et al. Reamed versus nonreamed intramedullary nailing of lower extremity long bone fractures: a systematic overview and metaanalysis. J Orthop Trauma 2000; 14:2-9.
17. 25. Hak DJ, Lee SS, Goulet JA. Success of exchange reamed intramedullary nailing for femoral shaft nonunion or delayed union. J Orthop Trauma 2000; 14:178-82.
18. Kitaoka HB, Anderson PJ, Morrey BF. Revision of ankle arthrodesis with external fixation for non-union. J Bone Joint Surg Am 1992; 74: 1191-1200.
19. Cobb TK, Gabrielson TA, Campbell DC, et al. Cigarette smoking and nonunion after ankle arthrodesis. Foot Ankle Int 1994; 15:64-7.
20. Dalat F, Trouillet F, Fessy MH, Bourdin M, Besse JL. Comparison of quality of life following total ankle arthroplasty and ankle arthrodesis: retrospective study of 54 cases. OrthopTraumatol Surg Res 2014;100:761-6.
21. Martin RL, Irrgang JJ, Burdett RG, Conti SF, Van Swearingen JM. Evidence of validity for the Foot and Ankle Ability Measure (FAAM). Foot Ankle Int 2005;26:968-83.
22. Houdek MT, Wilke BK, Ryssman DB, Turner NS. Radiographic and functional outcomes following bilateral ankle fusions. Foot Ankle Int 2014;35:1250-4.
23. Hendrickx RP, Stufkens SA, de Bruijn EE, Sierevelt IN, van Dijk CN, Kerkhoffs GM. Medium- to long-term outcome of ankle arthrodesis. Foot Ankle Int 2011;32:940-7.
24. Chahal J, Stephen DJ, Bulmer B, Daniels T, Kreder HJ. Factors associated with outcome after subtalar arthrodesis. J Orthop Trauma 2006;20:555-61.
25. Bednarz P, Beal's T, Manila A. Subtalar distraction bone blokfusion:an assessment of outcome. Foot Ankle Int 1997;18:785-91.