



© J ORTHOP TRAUMA SURG REL RES

15(1) 2020

Research Paper

Transfibular ankle arthrodesis for ankle arthritis with more than 15 degree of coronal plane deformity: analysis of 28 feet treated by arthrodesis with autologous fibular graft

JIN WOO JIN, SUNG JIN SHIN, JIN WOO KIM

Department of Orthopaedic Surgery, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, Korea

Address for correspondence:

Dr. Sung Jin Shin, Department of Orthopaedic Surgery, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, Korea
orthoshin@gmail.com

Statistics

Figures	03
Tables	01
References	19

Received: 09.01.2020

Accepted: 24.01.2020

Published: 31.01.2020

Abstract

Introduction: This study reviewed the outcome of 28 patients with ankle arthritis treated by ankle arthrodesis with autologous bone grafts using a transfibular approach in ankles with end-stage ankle arthritis with 15° or more deformity of the coronal plane.

Methods and Materials: Between January 2012 and September 2018, 28 ankle arthrodesis with fibular grafts using transfibular approaches were performed in patients with ankle arthritis with deformities. Varus and valgus deformity of the coronal plane was measured from standing ankle anterior-posterior radiographs and hindfoot alignment angle and hindfoot alignment ratio were measured on hindfoot alignment radiographs. The clinical outcomes were evaluated using American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hind foot scores and Visual Analog Scale (VAS) pain scores. Paired t-tests were used to analyze the preoperative and postoperative HAA, HAR, AOFAS scores, and VAS scores.

Results: The mean time to bone union was 10.7 weeks. Twenty-six of 28 patients (92.8%) had a bony fusion within six months. In the radiographic parameters, the mean hindfoot alignment ratio ranged from $0.51^\circ \pm 0.39^\circ$ preoperatively to $0.28^\circ \pm 0.13^\circ$ postoperatively and the mean hindfoot alignment angle was improved from $-10.56^\circ \pm 13.54^\circ$ preoperatively to $2.25^\circ \pm 3.79^\circ$ postoperatively. With regard to clinical outcomes, the AOFAS scores and VAS pain scores had improved at follow-up. The radiographic and clinical outcomes were significantly improved ($p < 0.05$).

Conclusion: Transfibular ankle arthrodesis with an autologous fibular graft can be an excellent treatment option for ankles with more than 15 degrees of coronal plane deformity.

Keywords: ankle joint, arthritis, fibular strut, arthrodesis

INTRODUCTION

Ankle arthrodesis is the gold standard surgical treatment for end-stage arthritis, rheumatoid arthritis, and traumatic arthritis [1,2]. The union rate of ankle arthrodesis is more than 90% and many techniques for the procedure have been introduced in the literature [1,3-10]. Transfibular ankle arthrodesis has been modified since Horwitz [8] first described it in 1942. The technique can make visualization of the entire ankle joint easy and offer a biologic strut or bone graft and additional stability [10].

This study reviewed the outcome of 28 patients with ankle arthritis treated by ankle arthrodesis with autologous bone grafts using a transfibular approach in ankles with end-stage ankle arthritis with 15° or more deformity of the coronal plane.

MATERIALS AND METHODS

This study was approved by the IRB committee of Samsung Medical Center.

Between January 2012 and September 2018, 28 ankle arthrodesis with fibular grafts using transfibular approaches were performed in patients with ankle arthritis with deformities. Fifteen patients were men and 13 were women. In 28 patients, the diagnoses were traumatic arthritis (8), osteoarthritis (9), a history of septic arthritis or osteomyelitis (6), talar necrosis (4), and polio sequelae (1). The mean age was 60.07 ± 14.07 . Patients who had deformities of less than 15 degrees on preoperative weight-bearing ankle radiographs and who were not be followed for less than one year after arthrodesis were excluded from the study.

All patients underwent transfibular ankle arthrodesis based on Mann's technique [7] (Fig. 1 and 2). Depending on the severity of the ankle joint deformity, either autologous cancellous bone grafting or a strut graft was used [4]. Splinting was used to control pain and swelling and casting was applied until there was evidence of an osseous union. Weight-bearing was allowed gradually four weeks after surgery.

Varus and valgus deformity of the coronal plane was measured from standing ankle anterior-posterior radiographs and hindfoot alignment angle and hindfoot alignment ratio were measured on hindfoot alignment radiographs [11,12]. The Hindfoot Alignment Angle (HAA) was defined as the angle created between the tibial axis and the calcaneal axis and the Hindfoot Alignment Ratio (HAR) was defined as the ratio resulting from dividing the width of the calcaneus medial to the tibial axis by the calcaneal width [13] (Fig. 3).

Radiographic union was defined when bony trabeculae bridging was seen on three of four cortices on anteroposterior and lateral radiographs of the ankle. Delayed union was defined when there was no evidence of an osseous union until six months after ankle arthrodesis [9,14].

The clinical outcomes were evaluated using American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hind foot scores [15] and Visual Analog Scale (VAS) pain scores.

Paired t-tests were used to analyze the preoperative and postoperative HAA, HAR, AOFAS scores, and VAS scores. When the p-value was less than 0.05, statistical significance was determined.

RESULTS

The mean time to bone union was 10.7 weeks. Twenty-six of 28 patients (92.8%) had a bony fusion within six months. Revision arthrodesis was performed in the non-union cases. There were two

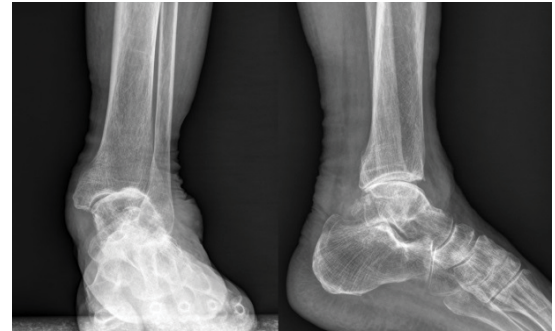


Fig. 1. Preoperative radiographs of the ankle showing ankle osteoarthritis with valgus deformity

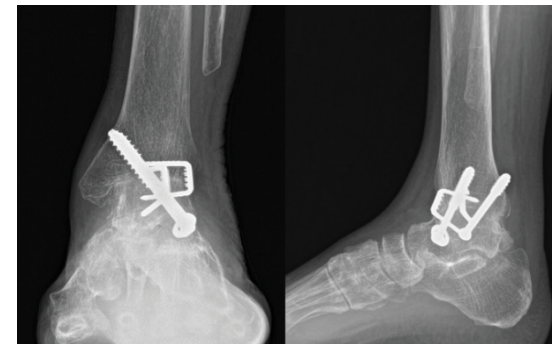


Fig. 2. Radiographs of the ankle at Follow-up showing fusion of the ankle joint



Fig. 3. Measurements of Hindfoot Alignment Angle (HAA) and Hindfoot Alignment Ratio (HAR); The Hindfoot Alignment Angle (HAA) was defined as the angle created between the tibial axis and the calcaneal axis and the Hindfoot Alignment Ratio (HAR) was defined as ratio dividing the width of the calcaneus medial to the tibial axis (B) by calcaneal width (A)

Table 1. The statistics for radiographic and clinical outcomes

	Pre-operative	Post-operative	p-value (paired t-test)
HAR	0.51 ± 0.39	0.28 ± 0.13	0.003
HAA	-10.56 ± 13.54	0.25 ± 3.79	<0.001
AOFAS score	31.75 ± 8.18	75.36 ± 4.96	<0.001
VAS	6.71 ± 0.60	1.86 ± 0.89	<0.001

HAR: Hindfoot Alignment Ratio; HAA: Hindfoot Alignment Angle; AOFAS: American Orthopaedic Foot and Ankle; VAS: Visual Analog Scale

cases of post-operative infection, but all cases involved superficial inflammation and healed completely after the administration of antibiotics.

In the radiographic parameters, the mean hindfoot alignment ratio ranged from $0.51^\circ \pm 0.39^\circ$ preoperatively to $0.28^\circ \pm 0.13^\circ$ postoperatively and the mean hindfoot alignment angle was improved from $-10.56^\circ \pm 13.54^\circ$ preoperatively to $2.25^\circ \pm 3.79^\circ$ postoperatively. With regard to clinical outcomes, the AOFAS scores and VAS pain scores had improved at follow-up. The radiographic and clinical outcomes were significantly improved ($p < 0.05$) (Table 1).

DISCUSSION

Arthrodesis using the transfibular approach has been modified since Horwitz [8] first described it in 1942. Although variations in transfibular ankle arthrodesis have been made in screw positioning and the numbers or methods of bone grafting, this approach has a strong advantage in that it allows for access to the entire ankle joint, including the subtalar joints, and makes it easier to correct deformities of the entire ankle [1,3,7,8]. In addition, a thick soft tissue envelope on the lateral side of the ankle can lead to fewer wound complications [1,3,5,7].

When the deformity exceeds 10° or more, the medial malleolus and medial gutter of the talus are usually eroded and the deltoid ligament is hypertrophied and shortened and ankle joint becomes unstable due to a lax lateral ankle ligament [16-19]. Coetzee [16] reported that the failure rate was 50% when total ankle arthroplasty was performed in patients with varus deformities of 20° and the patients were converted to ankle fusions within three years. Wood et al. [17] suggested that arthroplasty should not be performed when the deformity exceeds 15° . Although Lee et al. [11] reported that total ankle arthroplasties in ankles with deformities of 20° or more showed satisfactory clinical outcomes, additional bone, and soft tissue procedures were performed concomitantly to restore ankle alignments. Sung et al. [19] reported that various additional procedures were performed to achieve neutral alignment during total ankle arthroplasty in ankles with deformities.

A high union rate of more than 90% has been reported in ankle arthrodesis using the transfibular approach [1,4-8]. In this study, the

fusion rate was 92.8% and adequate alignment of the ankle was achieved without additional concomitant procedures. This technique provides excellent surgical fields of view of the ankle to correct deformities and a wide contact area for fusion [3,12]. In addition, an autologous fibular graft using the fibula can be performed simultaneously when there is a huge bone defect around the ankle joint and add to the mechanical stability of the fixation [4,10].

To obtain satisfactory results, the ankle position should be kept at 0° to 5° of the valgus angulation [9]. In our patients, the mean hindfoot alignment angle and the hindfoot alignment ratio were slightly valgus. Resection of the fibula is considered to play a key role in the correction of ankle deformities. Kim et al. [3] reported that valgus angulation of the ankle joint was achieved using transfibular ankle arthrodesis. Lee et al. [9] suspected that the osteotomized and removed fibula using the transfibular approach affected the proper position of the talus against the tibia.

CONCLUSION

Transfibular ankle arthrodesis with an autologous fibular graft can be an excellent treatment option for ankles with more than 15 degrees of coronal plane deformity.

In addition, staying in the same wrong position for a long time without observing ergonomics in daily living activities triggers low back pain.

ACKNOWLEDGEMENT

This study was approved by the IRB committee of Samsung Medical Center.

CONFLICT OF INTEREST

The authors declare that authors have no conflict of interest.

FINANCIAL SUPPORT

There was no internal and external funding source.

References:

1. Sung W., Greenhagen R.M., Hobizal K.B., et al.: Technical guide: transfibular ankle arthrodesis with fibular-onlay strut graft. *J Foot Ankle Surg.* 2010;49:566-570.
2. Ferguson Z., Anugraha A., Janghir N., et al.: Ankle arthrodesis: A long term review of the literature. *J Orthop.* 2019;16:430-433.
3. Kim J.G., Ha D.J., Gwak H.C., et al.: Ankle arthrodesis: A comparison of anterior approach and transfibular approach. *Clin Orthop Surg.* 2018;10:368-373.
4. Jeong E., Mahapatra P., Nathan S.: Fashioning autologous bone graft from the fibula in the transfibular approach to open ankle arthrodesis. *Foot Ankle Surg.* 2014;20:149-150.
5. Napiontek M., Jaszczak T.: Ankle arthrodesis from lateral transfibular approach: analysis of treatment results of 23 feet treated by the modified Mann's technique. *Eur J Orthop Surg Traumatol.* 2015;25:1195-1199.
6. Adams J.C.: Arthrodesis of the ankle joint: experiences with the transfibular approach. *J Bone Joint Surg Br.* 1948;30:506-511.
7. Mann R.A., Van Manen J.W., Wapner K., et al.: Ankle fusion. *Clin Orthop Relat Res.* 1991;268:49-55.
8. Horwitz T.: The use of the transfibular approach in the arthrodesis of the ankle. *Am J Surg.* 1942;55:550-552.
9. Lee H.J., Min W.K., Kim J.S., et al.: Transfibular ankle arthrodesis using burring, curettage, multiple drilling, and fixation with two retrograde screws through a single lateral incision. *J Orthop Surg.* 2016;24:101-105.
10. Colman A.B., Pomeroy G.C.: Transfibular ankle arthrodesis with rigid internal fixation: An assessment of outcome. *Foot Ankle Int.* 2007;28:303-307.
11. Lee G.W., Lee K.B.: Outcomes of total ankle arthroplasty in ankles with $>20^\circ$ of coronal plane deformity. *J Bone Joint Surg Am.* 2019;101:2203-2211.
12. Choi J.Y., Song S.J., Kim S.J., et al.: Changes in hindfoot alignment after high or low tibial osteotomy. *Foot Ankle Int.* 2018;39:1097-1105.
13. Lee H.S., Wapner K.L., Park S.S., et al.: Ligament reconstruction and calcaneal osteotomy for osteoarthritis of the ankle. *Foot Ankle Int.* 2009;30:475-480.
14. Kennedy J.G., Hodgkins C.W., Brodsky A., et al.: Outcomes after standardized screw fixation technique of ankle arthrodesis. *Clin Orthop Relat Res.* 2006;447:112-118.
15. Kitaoka H.B., Alexander L.J., Adelaar R.S., et al.: Clinical rating systems for the ankle-hindfoot, midfoot, hallux, and lesser toes. *Foot Ankle Int.* 1994;15:349-353.
16. Coetzee J.C.: Surgical strategies: Lateral ligament reconstruction as part of the management of varus ankle deformity with ankle arthroplasty. *Foot Ankle Int.* 2010;31:267-274.
17. Wood P.L., Sutton C., Mishra V., et al.: A randomized, controlled trial of two mobile-bearing total ankle replacements. *J Bone Joint Surg Br.* 2009;91:69-74.

18. Doets H.C., Brand R., Nelissen R.G.: Total ankle arthroplasty in inflammatory joint disease with use of two mobile-bearing designs. *J Bone Joint Surg Am.* 2006;88:1272-1284.
19. Sung K.S., Ahn J., Lee K.H., et al.: Short-term results of total ankle arthroplasty for end-stage ankle arthritis with severe varus deformity. *Foot Ankle Int.* 2014;35:225-231.