

MINIMALLY INVASIVE FIXATION FOR JOINT DEPRESSION FRACTURES OF CALCANEUSTomichan M. C¹, Imith Kodungookaran²¹Additional Professor, Department of Orthopaedics, Medical College, Kottayam, Kerala.²Orthopaedic Surgeon, Department of Orthopaedics, Al-Hilal Medical Centre, Manama, Bahrain.**ABSTRACT****BACKGROUND**

Calcaneus is the most injured tarsal bone mainly due to axial load resulting in intra-articular fractures. The treatment of displaced intra-articular fractures with surgery using extensile approaches are fraught with complications as high as 30%. 30 patients with displaced intra articular fractures are treated with minimally invasive surgical approach with use of multiple K wires. Results using AOFAS scoring showed average score of 82.03 at 28 weeks. 13, 33% scored above 90, 40% scored 80-90 and 46.66% scored below 80. There is significant correlation between the AOFAS Score and age of the patient, smoking habit, Diabetes, restoration of Bohler's angle after surgery and loss of reduction of the fracture during treatment. There is no significant association for sex, side or mechanism of injury and time of surgery since trauma with AOFAS scoring. Even though no association was seen for infection with smoking, Diabetes is found to be associated with increased infection rate.

MATERIALS AND METHODS

This study was conducted in Medical College Kottayam which is a tertiary referral centre in Orthopaedics during the time period from JAN 2013 TO DEC 2013. 30 cases of fracture calcaneus with joint depression were selected for treatment. Open fractures, fracture in insensate or an immobile person, fracture presented after 3 weeks were excluded. Demographic profile of the patient, history of other co-morbid illnesses, personal history of addictions were recorded. Patients were thoroughly examined and radiological investigations including CT scanning were used.

RESULTS

During the study period 30 patients were treated for joint depression type of calcaneal fractures. Majority of patients were in the age group of 30-40 (60%) with a mean age of 35.53. Males constituted 90% of all the cases. 70% of injuries were due to fall from height. Right side was involved in 60% of cases. Only 40 % of cases were operated before 12 hours. Of the patients 3 were diabetic (10%) and 6 patients were smokers (20%)

CONCLUSION

Minimally invasive technique for the treatment of joint depression type of calcaneus fractures was able to produce results comparable to open techniques with a lower rate of serious complications. In the majority of cases, an almost identical Bohler's angle and geometry of the calcaneus was achieved. Simple removal of the Kirschner wires and shorter surgery time decrease patient stress and must be recognized as an advantage of this minimally invasive technique. Thus, we feel that our minimally invasive technique is a viable alternative for the treatment of joint depression type of calcaneal fractures.

KEYWORDS

Fracture calcaneus, AOFAS Scoring, minimally invasive fixation.

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BACKGROUND

The calcaneus is the most frequently injured tarsal bone.¹ Approximately 75% of these injuries are intra-articular, and almost all occur due to an axial load such as a fall from a height or a motor vehicle accident. Approximately 10% of injuries are bilateral and fewer than 5% are open.² Many calcaneal fractures are work-related, as they result from a

fall from height, especially in males of age 35-45 years. These fractures frequently result in long-term disability with potentially severe economic impact on the patient. Essex Lopresti divided posterior facet fractures into two types.³ If the fracture line producing the posterior facet fragment exits behind the posterior facet and anterior to the attachment of the Achilles tendon, the injury is called a joint depression type of calcaneal fracture.

Historically, treatment of displaced intra-articular calcaneal fractures has varied from non-operative management with or without closed reduction, to open reduction with internal fixation by various surgical approaches, to primary arthrodesis. The popularity of non-surgical treatment was related to the potential for surgical wound complications and possibly osteomyelitis in some patients. However, over the past two decades the pendulum

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Corresponding Author:

*Dr. Tomichan M. C,
Kochumattaom, Arpookkara East P. O.,
Kottayam - 686008, Kerala.*

E-mail: mtomichan@hotmail.com

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has swung back towards surgical management due to improved surgical techniques and less soft tissue stripping.

Extensile lateral approach is the most common method of open reduction. But soft tissue complication after this approach is as high as 30%.⁴ Several studies revealed that a minimal approach is associated with less postoperative morbidities. This study analysed results of minimally invasive fixation of joint depression type of calcaneal fractures with K wires and bone grafting.

MATERIALS AND METHODS

This study was conducted in Medical College Kottayam which is a tertiary referral centre in Orthopaedics during the time period from Jan 2013 to Dec 2013. 30 cases of fracture calcaneus with joint depression were selected for treatment. Open fractures, fracture in insensate or an immobile person, fracture presented after 3 weeks were excluded. Demographic profile of the patient, history of other comorbid illnesses, personal history of addictions were recorded. Patients were thoroughly examined and radiological investigations including CT scanning were used. Under proper aseptic precautions and preoperative antibiotic cover the surgeries were done. Under image intensification, with the patient in the lateral position, a large Steinmann pin was placed in the posterior calcaneal tuberosity. This was used as a joystick for re-establishing calcaneal length.

A small incision about 2 cm was made under fluoroscopy centered over the fracture. This allowed the surgeon to insert an elevator beneath the depressed fragment, lift it up and in this way restore joint congruity. For maintenance of reduction a lamina spreader was used. Careful examination under image intensifier established when the reduction is complete. 5 to 7 K wires were used to maintain the calcaneal reduction. Two K wires were applied horizontally & one of them was used for fixation into talus or cuboid bones. The Large bone defect was filled with bone substitute which assisted in maintaining the elevated fragment in position. It also helped to accelerate bone healing. Below knee slab was applied. Post operatively regular wound inspections were done, followed by suture removal on tenth postoperative day. The slabs were removed after 4 weeks. The K-wires were removed after 8 weeks and partial weight-bearing was allowed with full weight-bearing at 12 weeks. Reviews were done at 12 weeks, 20 weeks and 28 weeks after the index procedure and functional outcome was recorded using AOFAS⁵ scoring system.

Statistical Analysis

Data was entered in Excel software and analysis done using SPSS software. The results were analysed at the end of the study using tests of significance. ANOVA test was used to calculate the association between age and AOFAS score. Association between smoking loss of reduction restoration of Bohler's angle and time of surgery since trauma with AOFAS score was calculated using Independent sample T test. Association of diabetes mellitus with post-operative infection was tested with chi square test.

RESULTS

During the study period 30 patients were treated for joint depression type of calcaneal fractures. Majority of patients were in the age group of 30-40(60%) with a mean age of 35.53. Males constituted 90% of all the cases. 70% of injuries were due to fall from height. Right side was involved in 60% of cases. Only 40% of cases were operated before 12 hours. Of the patients 3 were diabetic (10%) and 6 patients were smokers (20%)

Following surgery 2 patients developed superficial infection which subsided with use of appropriate oral antibiotics. Bohler's angle which is a predictor for restoration of articular surface was restored in 26 patients, but loss of reduction was seen in 2 patients. The average AOFAS at 28 weeks was 82.03. 4 cases scored more than 90 and 14 cases scored less than 80. The overall score was comparable to previous studies.

Statistical analysis using ANOVA showed that there is statistically significant association between age and AOFAS scoring at 10% level of significance. (p value 0.089) Analysis using Independent T test showed significant association between smoking habit and AOFAS scoring at 5% level of significance. (P value 0.05) between restoration of Bohler's angle and AOFAS scoring at 5% level of significance. (P value 0.027) and between loss of reduction and AOFAS scoring at 5% level of significance. (P value 0.023).

Statistical analysis using Independent sample T test showed that there is no statistically significant association between time of surgery since trauma and AOFAS scoring. (p value 0.96). Chi-square test showed that there is statistically significant association between diabetes mellitus and infection. (p value 0.05)



Figure 1. Preop X-Ray



Figure 2. Minimally Invasive Fixation Using K Wire & Lamina Spreader

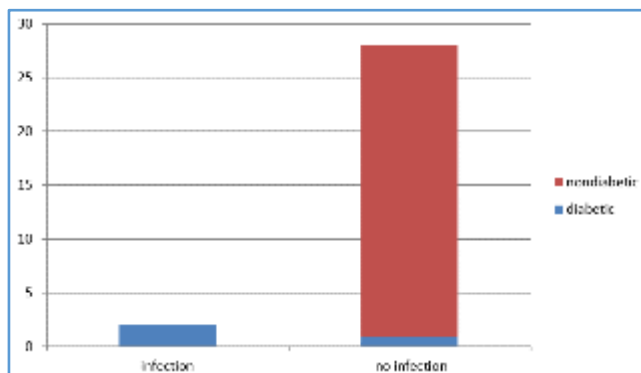
Pain (40 points)		
	None	40
	Mild occasional	30
	Moderate daily	20
	Severe always	0
Function (50 points)		
Activity limitation and support	No limitation; no support	10
	Limitation of recreational activities only no support	7
	Limited daily & recreational activities crane	4
	Severe limitation of all activities walker crutches wheelchair	0
Max walking distance in blocks	Greater than 6	5
	4 - 6	4
	1 - 3	2
	Less than 1	0
Walking surface	No difficulty in any surface	5
	Some difficulty in uneven surfaces, stairs ladders, inclines	3
	Severe difficulty in uneven surfaces, stairs ladders, inclines	0
Gait abnormality	None/slight	8
	Obvious	4
	Marked	0
Sagittal motion (flexion+extension)	30° or more	8
	15° - 29°	4
	less than 15°	0
Hind foot motion (inversion+eversion)	75% - 100%	6
	25% - 74%	3
	Less than 24%	0
Ankle-hind foot stability	Stable	8
	Definitely unstable	0
Alignment (10 points)		
	Good; plantigrade foot; midfoot well aligned	15
	Fair; plantigrade foot; mild midfoot malalignment; no symptoms	8
	Poor; nonplantigrade foot; severe malalignment; symptoms	0

Table 1. AOFAS Scoring (Max 100 Points)

Age group	Mean AOFAS	P value
20 - 30 (n= 4)	89.5000	0.089
30 - 40 (n=18)	81.2778	
40 - 50 (n=7)	78.5714	
50 - 60 (n=1)	82.0000	

Table 2. Comparison Between Age and AOFAS

Parameters	Mean AOFAS		P Value
	Yes	No	
Smoking	76.8333 (n=6)	83.000 (n= 24)	0.05 (significant)
Restoration of Bohler's angle	83.166 (n = 24)	76.166 (n = 6)	0.027 (significant)
Loss of reduction	71.000 (n = 2)	82.5357 (n=28)	0.023 (significant)
Surgery within 12 hrs.	81.833 (n=12)	81.722 (n=18)	0.96 (not significant)



Graph 1. Showing Relation between Infection and Diabetes

DISCUSSION

Using AOFAS scoring⁵ the average score at 28 weeks was 82.03.13.33% scored above 90, 40% scored 80 -90 and 46.66% scored below 80. These results are comparable to previous similar studies as described by J. Stulik, J. Stehlik⁶ and Tim Alexander Walde, B. Sauer, J. Degreif, and H.-J. Walde⁷ using minimally invasive fixation. The average age at time of calcaneal fracture was 35.53 years (range 22-50 years) and most patients were male (90%). The cause of fracture was fall from varying heights in 21 (70%) of cases and motor vehicle accident in 9 (30) of cases. Although age group is lower, these findings were comparable to studies by Tim Alexander Walde, B. Sauer, J. Degreif, and H.-J. Walde.⁷ In our study most of the patients were operated after 12 hours of trauma (60%). This may be because of the

delay in reporting to the casualty or due to insufficient infrastructure in our institute to do semi-emergency surgeries in casualty theatre. But statistical analysis showed that there is no significant association between time of surgery and functional outcome (p value -0.967). In our study Bohler's angle was restored in 80% (24) of the cases. This result is better than the study conducted by J. Stulik, J. Stehlik⁶ (73.9%). This may be due to small sample size in our study and they included all type of intra-articular type of calcaneal fractures in the study. The complications such as infections were very few in our study. Only 2 cases (6.66%) had minimal superficial infection and which was effectively treated by antibiotics. With open reduction, skin and soft tissue necrosis with possible cutaneous flaps have been reported in scattered cases. Folk et al⁸ demonstrated that in 25% of cases, wound complications required an additional surgery after open reduction of calcaneus fractures 84% of the time. In the current study infections happened in patients who were diabetic. So in our statistical analysis we got a strong correlation between diabetes and infection. Similar technique used by Tim Alexander Walde, B. Sauer, J. Degreif, and H.-J. Walde⁷ got a superficial infection rate of 9.8% and Stulik⁶ got a rate of 7%. These results are comparable to my study. During the follow up two patients (6.66%) had loss of reduction due to pin loosening. These patients were treated by removal of the pins and cast application. Loss of reduction is an important parameter which determines the outcome. There is statistically significant difference in AOFAS score in patients with loss of reduction (p value 0.023). The incidence of loss of fixation is comparable to previous similar studies by Stulik et al.⁶

Overall, satisfactory mobility of the joints adjoining the calcaneus was achieved with our surgical technique. In approximately half of our patients, complete range of motion in the upper ankle joint was achieved and in the lower ankle joint, approximately 60% of patients had no or low movement restriction. Similar mobility in the upper and lower ankle joints has been reported in the literature after open reduction and osteosynthesis with a plate.⁹

Statistical analysis showed that there is positive correlation between AOFAS scoring and restoration of Bohler's angle and negative correlation between AOFAS scoring and age, loss of reduction and smoking. There is no significant difference in case of time of surgery and AOFAS scoring (p value 0.967). There is a strong association between diabetes and infection. There is no significant association between infection with smoking (p value 0.272) and time of surgery. (p value 0.765).

Tornetta¹⁰ reported 46 patients treated with percutaneous fixation, of whom 39 had a Sanders type-IIC fracture and seven a type-IIB. He believes that Sanders type-IIC fractures, where the entire posterior facet is in continuity with the tuberosity fragment and the facet itself is intact, are best suited for percutaneous fixation. He reported 85% excellent or good results, and concluded that for selected fracture types the method gives comparable or possibly better results than open fixation. Levine and Helfet¹¹ in their series of intra-articular fractures of the

calcaneus treated with a minimally-invasive technique, were surprised that subtalar movement was almost completely preserved despite an articular surface reconstruction described as 'nearly anatomical'. They believed that minimal dissection results in less post-operative swelling, less peri-articular scarring and an improved range of movement than formal open reduction, despite imperfect restoration of the joint surface. Thermann et al⁹ advised minimally-invasive fixation for cases with severe soft-tissue contusion, compound and Sanders type-IV fractures, and in multiply-injured patients. Rammelt et al¹² advocated percutaneous reduction of fractures of the calcaneus with severe soft-tissue compromise, and in patients in whom there are systemic contraindications to open surgery. He believes that it is suitable for Sanders type-IIC fractures and that, if used for Sanders type-IIA or IIB fractures, should be performed under arthroscopic control of reduction of the articular fragment.

In summary the minimally invasive fixation of Joint depression type of calcaneal fractures is a viable method with less post-operative wound complications. The outcome of the procedure depends on many factors. There are various studies to support the use of this technique in carefully selected cases. The main importance of this study is the decreased rate of postoperative infections (6.66%). Folk, Starr and Early⁸ reported that in 190 fractures, four patients required amputation, there was a 25% wound complication rate, 22 patients required early removal of their implants and 11 needed flap cover. Abidi and Gruen¹³ reported problems with wound healing in 32% of their cases.

CONCLUSION

Minimally invasive technique for the treatment of joint depression type of calcaneus fractures was able to produce results comparable to open techniques with a lower rate of serious complications. In the majority of cases, an almost identical Bohler's angle and geometry of the calcaneus was achieved. Simple removal of the Kirschner wires and shorter surgery time decrease patient stress and must be recognized as an advantage of this minimally invasive technique. Thus, we feel that our minimally invasive technique is a viable alternative for the treatment of joint depression type of calcaneal fractures.

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