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Intraarticular Calcaneal Fractures Treated by Plating with and Without Bone Grafting - A Comparative Study

Medical Science

KEYWORDS : Intraarticular calcaneal fractures, ORIF with bone grafting, ORIF alone

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ABSTRACT

***AIM**: Compare functional & radiological outcome of type-III sanders intraarticular calcaneal fractures treated by internal fixation with plating with and without bone grafting.*

***MATERIALS AND METHODS**: 30 patients who presented to casualty of Government Medical College, Kozhikode between 2011 March – 2015 March with type-III sanders intraarticular calcaneal fractures were observed for a period of 2 years. 15 were treated by internal fixation with iliac crest bone grafting and 15 were treated without a bone graft. Functional outcome compared by Maryland foot score, foot & ankle disability index and radiological outcome by Bohlers angle, Gissane angle.*

***RESULTS**: Study shows comparable functional outcome in both groups. Bohlers angle, Gissane's angle are better maintained in group with bone grafting*

***CONCLUSION**: Using iliac crest bone graft while internal fixation of type-III sanders intra articular calcaneal fractures, Bohler's and Gissane's angle are better maintained but functional outcome comparable in both groups.*

INTRODUCTION

Calcaneus is the most commonly fractured tarsal bone and are among the most challenging for the orthopaedic surgeon. Of the calcaneal fractures, 90% occur in males between 21 and 45 years of age, with the majority being in industrial workers also has a major socioeconomic impact, given that patients with this injury typically sustain long periods of time off from work (i.e., lost patient productivity).

Goals common to treatment of calcaneal fractures are as follows: 1) restoration of congruency of posterior facet of subtalar joint, (2) restoration of height of calcaneus (Böhler's angle), (3) reduction of width of calcaneus, (4) decompression of subfibular space available for peroneal tendons, (5) realignment of tuberosity into a valgus position, and (6) anatomic reduction of calcaneocuboid joint if fractured.

Intraarticular calcaneal fracture fixation can be done using multiple methods, approaches, and implants. There is no consensus regarding best method of fixation. Various methods include closed reduction and casting, open reduction with plate and screw fixation with or without an autogenous bone graft or bone graft substitutes.

MATERIALS AND METHODS

It was a prospective study. Study group consisted of patients with sanders type III intra-articular fractures [IIIAB, IIIBC, IIIAC] of calcaneum in age group 20-60, both females and males who presented to orthopedic casualty between 2011 March – 2015 March. Patients with Open fractures, Spine fracture with neurological deficit, Surgery delayed more than 2 weeks and associated same limb fractures were excluded from the study

All patients were treated by initial resuscitation and temporary stabilization of fracture by below knee POP slab and immediate evaluation with X-ray ankle AP and Lateral, foot AP and oblique, calcaneum axial views. X-rays of opposite limb were also taken. Bohler angle and crucial angle of Gissane were measured. It was followed by Computerised tomographic scan. Later treated by definitive surgery as soon as the wrinkle test is positive. All patients were given preoperative antibiotics. Surgery was performed within the first 14 days of injury to prevent difficulties with reduction. Complete muscle relaxation was preferred. If spinal anaesthesia was not available iliac crest bone graft was not taken, such cases were done under sciatic-lumbar nerve block.

Open reduction and internal fixation was done through lateral extensile exposure technique by Benirschke and Sangeorzan to avoid the Sequelae of peroneal tendonitis and devascularisation of anterior skin flap. The peroneal tendons were left in their sheath. The sheath was stripped off the lateral wall of calcaneus subperioseally and held subluxed anterior to the fibula by two K-wires. One in fibula and one in talus. This "no-touch" technique not only retracted peroneal tendons, but also obviated the need for manual retraction of anterior skin flap. The calcaneofibular ligament was identified, sharply cut off the calcaneus and retracted anteriorly. The lateral wall was gently retracted laterally to expose fracture fragments. After clot removal, depressed posterior facet fragment was rotated out from within the body of calcaneus. This immediately decompressed the lateral wall. Preliminary reduction was obtained using K-wires. If acceptable, 3.5-mm lag screws were employed to maintain joint reduction. The body was reduced and a malleable Y plate or calcaneal locking plate was used to maintain the body reduction and buttress the lateral wall. Iliac crest bone graft was placed in defect within calcaneal body. Closure was performed over a drain and final films taken. Patient were given a below knee plaster slab after surgery.

Photo 1



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Photo 2



Plaster slab was maintained until wound healing and suture removal was done at 10 days. Following this all patients were given below knee plaster cast for 6 weeks. After sixth postoperative week, active range of motion of ankle and subtalar joint were instituted. . No weight bearing was allowed till union was documented with radiographs.

Clinical and roentgenographic follow-up (AP and Lateral) examination was performed at follow up.

Photo 3



Functional outcome was assessed in this study by employing Maryland foot score & Foot and ankle disability index (FADI) score and Radiological outcome by Bohler's angle & crucial angle of Gissane

RESULTS

A total of 30 patients having Sanders type III calcaneal fractures (IIIAB, IIIAC, IIIBC) were assessed in the study. 15 were treated with open reduction and internal fixation with iliac crest bone graft and 15 with open reduction and internal fixation without a bone graft. Follow up of all patients were obtained till 2 years.

Out of 30 patients, 27 were males and 3 were females. Age distribution ranged from 22 to 58 with 43.33% in the 30's, 23.33% in the 20's, 20% in the 40's.

In the final analysis of Maryland foot score, in ORIF + Bone grafting group, 20% have excellent results, 53.33% got good, 20% fair results and 6.67% got poor results. In ORIF without bone grafting group 26.67% have excellent results, 40% good, 26.67% fair and 6.67% poor results. Difference in each group is insignificant (p value>0.05)

In the final analysis of Disability Index Scoring, in ORIF + Bone grafting group, 13.33% have excellent results, 53.33% got good, 20% fair and 13.33%poor results. In ORIF without bone grafting group 20% have excellent results, 60% good, 13.33% fair and 6.67% poor results. Difference in each group is statistically insignificant p value >0.05.

Mean scores in Maryland foot score were 77.4 and 78 in open reduction internal fixation with bone grafting and open reduction-internal fixation without bone grafting respectively. Mean Maryland foot score has got a p value 0.903, which means no statistical significance in the difference of Maryland foot scores in both groups.

Disability index ranged from 60.6 to 94.5 with a mean of 81.84 in ORIF+Bone grafting group. In ORIF alone group, its range is 62.5 to 94.5 with a mean of 83.19, p value for difference in mean of disability index is 0.675, which is statistically insignificant.

Table 1: Functional Outcome scores

Functional scores	cases	Excellent	Good	Fair	Poor	Mean	Std. Deviation
Maryland foot score	ORIF+ bone graft	20	53.33	20	6.67	77.4	12.235
	ORIF alone	26.67	40	26.67	6.67	78	14.427
Disability index	ORIF+ bone graft	13.33	53.33	20	13.33	81.84	9.20
	ORIF alone	20	60	13.33	6.67	83.19	8.33

Age and Maryland foot score

As age advances Maryland foot score is gradually decreasing and number of fair and poor results are more in more aged group. P value found to be significant when considering each age group p value<0.05

Age and Disability index

As age increases Disability index scoring values become poor. More excellent and good results are seen in younger age groups. Statistically the difference is significant when considering each age group p value<0.05

Bohler's angle

On comparing Bohler's angle, 40% of both groups are in normal range of 20-40*. 33.33% of patients in ORIF + Bone grafting group and 26.67% in ORIF alone group had mild deviation from normal range. 13.33% of ORIF + Bone grafting group patients and 20% of ORIF alone group had moderate difference from normal Bohler's angle. 13.33% patients had severe difference in Bohler's angle in both groups.

Crucial angle of Gissane

33.33% patients of ORIF+Bone grafting and 40% patients of ORIF alone had Gissane angle in normal range. 40% of ORIF+Bone graft patients and 20% ORIF alone patients had mild increase in angle of Gissane. 13.33% and 20% of patients had moderate increase of Gissane angle respectively. Severe increase of Gissane angle seen in 13.33% of ORIF+Bone graft patients and 20% of ORIF alone patients. The difference in the Bohler's angle and difference in angle of Gissane were found to be statistically significant with a p value <0.05

Maryland foot score and Bohler's angle in all cases

As Bohler's angle increases the Maryland foot score increases. Excellent Maryland foot scores were obtained for normal Bohler's angle with significant p value <0.05

Maryland foot score and Gissane angle

In the study as angle of Gissane decreases from normal, Maryland foot score also decreases. There is a significant relation between this angle and functional outcome p value <0.05

Disability index and Bohler's angle

As Bohler's angle decreases from normal, disability scoring also decreases. There is a significant relation between both variables with p value <0.05

Disability index and crucial angle of Gissane

In results of my study disability score falls with increase in Gissane angle from normal with significant p value <0.05

Infection
Only 6.67% of patients in ORIF+Bone grafting group had superficial infection and none had deep infection. In ORIF alone group, none had superficial or deep infection. One patient who developed superficial surgical site infection, underwent debridement immediately.

Table 2: Infection

Cases	Superficial infection		Deep infection	
ORIF+Bone grafting	1	6.67%	0	0%
ORIF alone	0	0%	0	0%

DISCUSSION

There were total 30 patients in this study, 15 cases of ORIF+Bone grafting and 15 cases of ORIF without a bone graft. Concerning the age, sex, mechanism of trauma, our case is comparable to the one in the literature.

Analysis of the age distribution shows that this fracture affect most commonly the most productive age group. Nearly 70% of the cases come in age group 20 to 40 which has a major socioeconomic impact, in terms of loss of productivity

Final outcome of fractures
Since most of the previous studies used a different scoring system or a different classification system it is difficult to get a direct comparison. No study previously has compared type III calcaneal fractures alone, using Maryland foot score. Some studies about the role of autogenous bone grafting at the time of open reduction and internal fixation are there, most of which suggest there is no particular advantage in the final functional result. Better restoration of Bohler's angle and early weight bearing are the suggested advantages. Final functional and efficacy outcome found to be comparable. Since the mean follow up time was shorter, long term and large sample comparative studies are necessary. General comparison of results is possible as most of the studies use similar criteria to classify the results.

Maryland foot score in comparison with other studies
Results obtained in the present study for ORIF with bone grafting were comparable with previous studies. In our study 73.33% of patients had excellent-good results, which is comparable with studies by Yang Y, Zhao H[(1)] and D Schino, Bensaida M[(2)] which reported 75% and 64.7% of patients had excellent-good results respectively. On comparing the results of present study with other studies of ORIF without a bone graft, comparable results were obtained.

Table 3: Functional score in comparison with other studies

Functional result	ORIF+BG			ORIF Alone		
	Present study	Yang Y, Zhao H[(1)]	D schino, Bensaida M[(2)]	Present study	Vaclav Rak, Daniel Ira[(3)]	D Makki[(4)]
Excellent	20%	35%	64.7%	26.67%	32%	38.3%
Good	53.33%	40%	-	40%	37%	36.2%
Fair	20%	21%	17.6%	26.67%	18%	6.3%
Bad	6.67%	4%	17.6%	6.67%	13%	19.2%

Mean score of 77.4 for ORIF+Bone grafting group and 78 for ORIF alone group in the present study is comparable to the previous studies.

Table 4: Mean functional score in comparison with other studies

	Present study	Yang Y, Zhao H[(1)]			D schino, Bensaida M[(2)]	D Makki[(4)]
	ORIF+BG	ORIF	ORIF+BG	ORIF	ORIF+BG	ORIF
Mean functional Score	77.4	78	71.4	80.5	70	81.2

Bohler's tuber joint angle and crucial angle of gissane
Bohler's tuber joint angle is commonly assessed when evaluating calcaneal fractures. A severe heel fracture will result in a significant decrease or loss of this angle. In 1992, Janzen et al[(5)] reported that a loss of Bohler's angle was associated with a poor clinical outcome ; Fernandes studied 33 patients and 38 intra-articular calcaneal fractures , II and III by Sanders, with at least 24 months followed up, he found correlation with the angle of Böhler and functional outcome; however, more recently Hutchinson and Huebner[(6)] have indicated that Bohler's angle at follow-up did not correlate with the final clinical result.

On comparing the results of ORIF alone group with other studies of ORIF with bone grafting, similar results are obtained. Better restoration of Bohler's angle and angle of Gissane are the suggested advantages of bone grafting, which is proved in this study also. The final outcome is comparable in both groups as suggested in previous studies.

In our study we found that Maryland foot score has got an important correlation with Bohler's angle and angle of Gissane. Patients demonstrated a diminished outcome with a lower Böhler's angle or with increase in angle of Gissane.

Complications
Rate of superficial wound infection in the present study was 6.67%. No other complications of neurovascular injury or flap necrosis happened in the study group. Similar incidence of complications happened in present study compared to previous studies.

Table 5: Complications in comparison with other studies

Current study	6.67%
Buckley and Meek 1992[(7)]	12.5%
Benirschke and Sangeorzan 1993[(8)]	3.75%
Sanders 2000[(9)]	7.57%
Stephenson 1987[(10)]	7.3%

CONCLUSION

Calcaneal fractures are relatively common in clinical practice they assume significance because of a higher likelihood of long term morbidity following this injury. Computed tomographic scanning has allowed an understanding of the pathological anatomy of these fractures, and two-dimensional computed tomographic scans in both the coronal and the transverse plane are recommended. When considering the final outcome, there is no specific advantage in using an autogenous bone grafting to fill the bone defect during open reduction and internal fixation. Bohlers angle and angle of Gissane are better maintained when iliac crest bone graft is used, but the final outcome found to be comparable in both groups.

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