

Outcome Assessment of Intra Articular Calcaneum Fracture Managed Surgically with Plate Fixation: a Prospective Study

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Abstract

Aim: The aim of this study was to evaluate the functional and clinical outcome of intra-articular calcaneal fractures managed by open reduction and internal fixation with a plate.

Methodology: This prospective study was carried out at Department of Orthopaedics, Darbhanga Medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India from March 2019 to Feb 2020 . A total of 50 patients with intra-articular calcaneal fractures meeting the inclusion and exclusion criteria were chosen for the study. After admitting the patients who met the inclusion criteria, relevant investigations were done and fitness for surgery was taken. Appropriate measures were taken to reduce the swelling, such as below knee slab with cotton padding, limb elevation, and ice pack application. Pre-operative x-rays-lateral and axial view of the calcaneum and CT scan of calcaneum were obtained and pre-operative planning was done. Pre-operative Bohler's and Gissane's angles were measured using radiographs and fractures were classified using Sander's classification with the help of a CT-scan. Ankle range of movements were started at 2nd post-op week. Patients were followed up regularly in OPD at 6 weeks, 12 weeks, 24 weeks and 1 year and clinical and radiological assessments were done. Radiological assessment was done by measuring bohler's and gissane's angles, union rate. Functional outcome was measured using American Orthopaedics Foot and Ankle Society (AOFAS) score. A score of 90-100 is taken as an excellent outcome, 75-89 as good, 55-74 as fair and a score less than 50 is considered a poor outcome.

Results: In our study, patients between the ages group 18-60 years with a mean age of 32.56 years were included. The majority of the patients in the study were males, with 90% of the study population. In this study, 54% of the patients had right side involvement and 46% of the patients had left side involvement. The most common mode of injury in the study group was falling from height (82%) followed by RTA (18%). The most common fracture type in our study was Sander's type II (42%), followed by type IV (32%). Type III was the least common (26%). The average time period for the radiological union was 14.26 weeks in the study population. About 70% of patients had a bohler's angle between 10 -20 degree and in 30% of patients, it was < 10 degree in the pre-operative period, with a mean bohler's angle of 13.25 degree. Whereas in the post-operative period, 50% of patients had a bohler's angle between 21-30 degrees and 50% had it between 30-40 degrees, with a mean post-operative bohler's angle of 31.34 degrees. The difference between pre-operative and post-operative mean bohler's angle and mean Gissane's angle was statistically significant with a p value <0.01.

Conclusion: In displaced intra-articular calcaneum fractures, open reduction and internal fixation with calcaneum locking plates and screws result in a good number of satisfactory outcomes. Hence, it can be a better option of treatment in displaced intra-articular calcaneum fractures.

Keywords: Calcaneum, intra-articular, Bohler's angle, Gissane's angle.

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Introduction

The calcaneum (Oscalcis) is the largest and most often fractured tarsal bone. It is the major weight bearing osseous structure of the foot and is one of the components of the tri-tarsal articulation and has important functional tasks with regard to ambulation. With a bone so vital to the normal mechanics of locomotion, it is easy to see why a fracture of calcaneum is attended by considerable morbidity. Calcaneal fractures account for up to 75% of all foot fractures and 1–2% of all fractures [1], being more common in males and those who work in an industrial profession.

These fractures can be classified broadly into intra-articular and extra-articular types, with the intra-articular variant being more common, representing 70-75% of all these fractures frequently resulting from axial loading with varying degrees of shear force. These fractures are uniformly caused by an axial load mechanism, such as a fall from height or a motor vehicle accident, and may be associated with other axial load injuries such as lumbar, pelvic, and tibial plateau fractures [2].

Because of its unique shape, difficulties arose in understanding the geometry of the calcaneal fractures. Over the last two decades, however, marked advances in imaging technology have allowed a better understanding of fracture geometry and provided the basis for newer classifications, which has revolutionized the treatment of calcaneal fractures [3]. The management of intraarticular calcaneal fractures remains controversial, with strong arguments supporting both conservative & operative managements.

Significant controversy remains over the results of nonoperative versus operative treatment. The lack of standardization of results has made it difficult to compare studies that have evaluated outcomes [2]. Historically, there have been dramatic changes in management protocols as our understanding of the fracture has evolved. The historical statement by Cotton that “the man who breaks his calcaneus is done” [4].

Over the past 25 years, however, marked advances in anesthesia, prophylactic antibiotics, CT scanning, and fluoroscopy have allowed surgeons to improve outcomes when operating on fractures, and these techniques have been applied to calcaneal fractures as well. Overall, operative treatment of acute fractures has become the standard of care for many authors who, critically evaluating their results, have concluded that good outcomes are possible. The aim of this study was to evaluate the functional and clinical outcome of intra-articular calcaneal fractures managed by open reduction and internal fixation with a plate.

Materials and Methods:

This prospective study was carried out at Department of orthopaedics, Darbhanga medical College and Hospital, Laheriasarai, Darbhanga, Bihar, India, from March 2019 to Feb 2020 . A total of 50 patients with intra-articular calcaneal fractures meeting the inclusion and exclusion criteria were chosen for the study.

Inclusion Criteria 1. Patients aged between 18-60yrs 2. Intra-articular fracture of calcaneum (Sanders classification) 3. Ability to understand the content of the subject information/informed consent form and to be willing to participate in the clinical investigation. 4. Gave written informed consent.

Exclusion Criteria 1. Patients with extra-articular fracture 2. Open fracture (Gustillo-Anderson type 2 and 3) 3. Patients medically not fit for surgery 4. Paraplegia/paraparesis as they interfere with the assessment of the functional outcome of the surgery 5. Old ankle fractures. 6. Fracture in osteoporotic bone 7. Fracture of the long bone in the ipsilateral limb 8. Chronic local infection 9. Sanders type I calcaneal fracture.

After admitting the patients who met the inclusion criteria, relevant investigations were done and fitness for surgery was taken. Appropriate measures were taken to reduce the swelling, such as below knee slab with cotton padding, limb elevation, and ice pack application. Pre-operative x-rays-lateral and axial view of the calcaneum and CT scan of calcaneum were obtained and pre-operative planning was done. Pre-operative Bohler's and Gissane's angles were measured using radiographs and fractures were classified using Sander's classification with the help of a CT-scan.

After obtaining informed consent from the patients and ethical committee clearance, the patients were taken up for surgery once the swelling was reduced and the wrinkle sign was positive. After the patient is anaesthetized, the patient is placed in the lateral decubitus position over a radiolucent table with the operative side up. The lower extremities are positioned in a scissor-like configuration. Protective padding is placed beneath the contralateral limb to protect the peroneal nerve and a pillow is placed between the legs. A pneumatic thigh tourniquet is used, and the

limb is exsanguinated with an Esmarch bandage to provide a dry operative field. The limb is painted and draped till mid-calf region and the fracture is approached with a lateral extensile incision starting 2 cm above the tip of the lateral malleolus and just lateral to the Achilles tendon and taking it up to the base of the 5th metatarsal in an L-shaped fashion. The knife is taken "straight to bone" at this level, taking care not to bevel the skin.

Once the initial incision is made, the corner of the flap is now raised as a subperiosteal, full-thickness flap. One K-wire (1.5mm) is passed in the fibula, talar neck and cuboid each to retract the flap using the "no-touch" technique. Fracture reduction and correction of calcaneus varus, height and width were done under direct vision and with the help of fluoroscopy. K wires were used for the temporary stabilization of fracture fragments. Application of locking calcaneal compression plate and locking screws is done. Intraoperative radiographic evaluation with image intensifier with lateral, axial and Anteroposterior view. Wound wash was given with normal saline. Wound closed with non-absorbable suture (Ethilon) using Allgower-Donati technique. Bulky cotton dressing is done. Patients were given below- knee slab and limb elevation in the post-op period, till wound healing and suture removal, which was usually done on the 14th day.

Ankle range of movements were started at 2nd post-op week. Patients were followed up regularly in OPD at 6 weeks, 12 weeks, 24 weeks and 1 year and clinical and radiological assessments were done. Weight-bearing was allowed after 3 months depending upon the fracture union. Radiological assessment was done by measuring bohler's and gissane's angles, union rate. Functional outcome was measured using American Orthopaedics Foot and Ankle Society (AOFAS) score. A score of 90-100 is taken as an excellent outcome, 75-89 as good, 55-74 as fair and

a score less than 50 is considered a poor outcome.

Results:

In our study, patients between the ages group 18-60 years with a mean age of 32.56 years were included. The majority of the patients in the study were males, with 90% of the study population. In this study, 54% of the patients had right side involvement and 46% of the patients had

left side involvement. The most common mode of injury in the study group was falling from height (82%) followed by RTA (18%). The most common fracture type in our study was Sander's type II (42%), followed by type IV (32%). Type III was the least common (26%). The number of days from the injury to surgery varied from 2 to 15 days with an average of 8.2 days.

Table 1: Demographic details, mode and type of injury, and time interval between injury and surgery

Variables		No.	%
Age (in years)	18-30	21	42
	31-40	17	34
	41-50	7	14
	51-60	5	10
Gender	Male	45	90
	Female	5	10
Side	Right	27	54
	Left	23	46
Mode of injury	RTA	9	18
	Fall from height	41	82
Type of fracture (Sander's classification)	Type 2	21	42
	Type 3	13	26
	Type 4	16	32
Time interval between injury to surgery	1-5 days	11	22
	6-10 days	30	60
	11-15 days	9	18

The average time period for the radiological union was 14.26 weeks in the study population. About 70% of patients had a bohrer's angle between 10 -20 degree and in 30% of patients, it was < 10 degree in the pre-operative period, with a mean bohrer's angle of 13.25 degree. Whereas in the post-operative period, 50%

of patients had a bohrer's angle between 21-30 degrees and 50% had it between 30-40 degrees, with a mean post-operative bohrer's angle of 31.34 degrees. The difference between pre-operative and post-operative mean bohrer's angle and mean Gissane's angle was statistically significant with a p value <0.01.

Table 2: Radiological union time, functional outcome and complications in patients.

Variables		No.	%
Time for radiological union (in weeks)	10-13	27	54
	14-16	14	28
	17-19	9	18
Functional outcome using AOFAS score	Excellent	9	18
	Good	30	60
	Fair	8	16

	Poor	3	6
Complications	Ankle and foot stiffness	3	
	Deep infection	2	4
	Superficial wound infection	4	8
	Implant prominence	3	6
	No complications	38	76

Table 3: Bohler's and Gissane's angles

Variables		Pre-operative	Post-operative
Bohler's Angle	<10 degrees	15	00
	10-20 degrees	35	00
	21-30 degrees	00	25
	31-40 degrees	00	25
	Mean	13.24 degrees	31.34 degrees
Gissane's score	110-120 degrees	00	35
	121-130 degrees	07	15
	131-145 degrees	38	00
	>145 degrees	05	00
	Mean	136.8 degree	115.6 degree

Discussion:

The calcaneum is the most commonly fractured tarsal bone. The prognosis for an extra articular fracture is uniformly good, but that for an intra-articular fracture is varied. The management of every aspect of intra-articular calcaneal fractures is controversial. Although some studies have demonstrated good results after open reduction and internal fixation of intra-articular calcaneal fractures [5-7]. The best choice of treatment remains controversial because a few other studies say otherwise [8, 9]. Further, the method of internal fixation remains a point of debate, with various proponents advocating fixation with pins, screws or plate fixation with screws. There are many methods of stabilization of calcaneum fractures, each having their own merits and demerits. Even there is no consensus regarding the surgical approach, with many having been described, including medial, lateral, combined medial and lateral, extended lateral and sinus tarsi approaches.

The treatment of choice for intraarticular calcaneum fractures remains controversial. Surgical treatment was associated with a

significant incidence of wound complications, particularly sepsis [10]. However, the conservative treatment also has its share of complications, such as subtalar joint pain, heel varus and peroneal tendon impingement [11]. Sanders et al. confirmed that the learning curve for operative treatment of this fracture is steep. Sanders observed that the clinical results are a surgeon-dependent learning curve and requires 35 to 50 cases or about 2 years' experience [12, 13]. Pendse et al. [14] concluded that open reduction and internal fixation with a plate in intra-articular calcaneus fractures to restore anatomical articular congruency, early mobilization and primary option for subtalar arthrodesis if needed. Schepers et al. [15] observed that ORIF was the mainstay among all modalities of treatments

Almeida, et al [16] studied 44 patients with intra-articular calcaneal fractures, managed by open reduction and internal fixation with Reconstruction or Y plate, and outcomes were assessed with AOFAS score. At the final follow up, excellent results were achieved in 31.8%, good

results in 11.4%, fair result in 29.5%, and poor result in 27.3%. They concluded open reduction and internal fixation can be recommended as a very good alternative to conservative treatment in intra articular calcaneal fractures.

Santosha, et al [17] evaluate the functional outcome after open reduction and internal fixation of displaced intra-articular fractures of the calcaneum by locking calcaneal plates in 24 patients. According to the AOFAS score results were excellent in 43.3% of the patients, good in 33.3%, fair in 10%, and poor in 13.3% of patients. They concluded Open reduction and internal fixation of intraarticular fractures of the calcaneum with locking calcaneal plate gives good results.

In the study by Rak et al [18] the overall results according to the AOFAS score were good or excellent in 30/34 (85%) in patients treated by open reduction and fixation with calcaneum locking plate and screws.

Shresth R, et al [19] evaluated the outcome of calcaneum fracture using Maryland Foot Score (MFS) managed by open reduction and internal fixation with Locking Branched Calcaneal Plates through the extensile lateral approach. Seventeen cases (77.13%) had good, four cases (18.2%) had fair, and one case (5.5%) had a poor outcome score, similar to our study. They concluded displaced intra-articular calcaneal fractures treated operatively with open reduction and internal fixation with locking branched calcaneal plates through the extended lateral approach, with proper planning of operation and surgical techniques in soft-tissue handling, results in good clinical as well as radiological outcomes.

Conclusion:

In displaced intra-articular calcaneum fractures, open reduction and internal fixation with calcaneum locking plates and screws result in a good number of

satisfactory outcomes. Hence, it can be a better option of treatment in displaced intra-articular calcaneum fractures.

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