

Operative treatment of displaced intra-articular fractures of Calcaneum: Is it worthwhile?

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Abstract

Objective: To compare the results of operative treatment for displaced intra-articular fractures of calcaneum with conservative treatment.

Methods: The retrospective non-randomised comparative study using purposive non-probability convenient sampling was conducted at the Combined Military Hospital, Rawalpindi, and comprised treatment records from March 2010 to October 2013 of patients who had been treated either by Plaster of Paris casting (Group A) or managed by open reduction internal fixation (Group B). Functional outcome was assessed using Foot and Ankle Disability Index.

Results: Of the 42 records in the study, 20(47.6%) related to Group A and 22(52.4%) to Group B. The mean age was 41 ± 7.82 years (range: 28-55 years) in Group A, and 31 ± 6.35 years (range: 21-43) in Group B. Male-to-female ratio was 10:1 in Group A; 9:1 in Group B. Union was achieved in all (100%) cases. Bone substitute was used in 16(72.7%) in Group B to fill void during reconstruction of collapsed calcaneum. Wound complications were noted in 2(9.1%) Group B patients. There was loss of reduction in 1(4.5%). Mean Foot and Ankle Disability Index score in Group A was 45 ± 10.68 compared to 67.9 ± 10.04 in Group B ($p=1.99$).

Conclusion: For displaced intra-articular fractures, operative treatment is associated with better functional outcome in terms of absolute functional scores and should be the treatment of choice although factors such as age, soft tissue injury and surgical expertise may influence the decision.

Keywords: Calcaneal fractures, Displaced fractures. (JPMA 64: S-161 (Suppl. 2); 2014)

Introduction

Displaced Intra-articular calcaneal fractures pose a treatment challenge to modern orthopaedic surgeons. Regardless of the treatment, they are associated with numerous complications and poor outcomes with significant long-term quality-of-life issues. Calcaneal fractures can be extra-articular (not involving the sub-talar joint) or intra-articular. Extra-articular fractures involving the body, anterior process, or tuberosity should be treated with cast or brace immobilisation and non-weight-bearing for 6 weeks. Exceptions are displaced tuberosity avulsion fractures, which serve as the attachment of the Achilles tendon and avulsion of the anterior process of the calcaneus by the bifurcate ligament.¹

Intra-articular fractures make up 75% of all fractures of calcaneus and, as would be expected, have worse prognosis than extra-articular fractures. In the past, most of these were treated non-operatively but many authors now favour open reduction and internal fixation (ORIF).

At the study site, significant incidence has been noted of

poor outcome in intra-articular calcaneal fractures if treated conservatively. Calcaneus fractures may result in a varus heel deformity, loss of calcaneal height and heel-widening and also sub-talar joint incongruence. ORIF allows accurate reduction, avoiding deformities, restoring the anatomic morphology of the calcaneus, and results in more normal biomechanics and function of the hindfoot.² Preventing widening of heel prevents impingement of peroneal tendons from lateral wall blowout of the calcaneus. ORIF also allows for anatomic reduction and rigid internal fixation of the sub-talar joint, which is integral for the foot to adapt on uneven surfaces with inversion and eversion. For this reason, more recently ORIF is preferred over conservative treatment.

The purpose of this study was to compare the outcome in terms of Foot and Ankle Disability Index (FADI) score in patients treated non-operatively versus outcome in patients treated by ORIF, to objectively assess the usefulness of the operative treatment.

Material and Methods

The retrospective non-randomised comparative study was carried out at Combined Military Hospital (CMH), Rawalpindi, and comprised records related to a period from March 2010 to October 2013. The inclusion criteria

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comprised all operated cases of displaced intra-articular calcaneal fractures who had a minimum follow-up of 6 months. Fractures without displacement or articular involvement were excluded.

Patients who were treated by traditional non-operative methods worked as the controls (Group A).

We used lateral approach to gain access to calcaneus and

fixed it with oblique-angled 3.5mm T-shaped Locking Compression Plate (T-LCP) after reduction under direct vision.

Patients presenting in emergency department (ED) were given initial treatment, including Plaster of Paris (POP) back slabs, analgesics, as needed, and necessary radiographs were obtained. Group A patients were

Patient Name: _____		Date: _____	
Please answer every question with one response that most closely describes your condition within the past week by marking the appropriate number in the box. If the activity in question is limited by something other than your foot or ankle, mark N/A.			
0	Unable to do	2	Moderate difficulty
1	Extreme difficulty	3	Slight difficulty
		4 No difficulty	

Standing		Walking up hills	
Walking on even ground		Walking down hills	
Walking on even ground without shoes		Going up stairs	
Walking on uneven ground		Going down stairs	
Stepping up and down curbs		Squalling	
Sleeping		Coming up to your toes	
Walking initially		Walking 5 minutes or less	
Walking approximately 10 minutes		Walking 15 minutes or greater	
Home responsibilities		Activities of Daily Living	
Personal Care		Light to moderate work (standing, walking)	
Heavy work (push/pulling, climbing, carrying)		Recreational activities	

Pain related to the foot and ankle:

0	Unbearable	2	Moderate Pain	4	No Pain
1	Severe Pain	3	Mild Pain		

General level of pain		Pain at rest	
Pain during your normal activity		Pain first thing in the morning	

Annexure: Foot and Ankle Disability Index (FADI).⁹

treated by manipulation and casting as soon as the swelling subsided and skin condition was favourable. Long POP boot was then applied and left in place for 8-12 weeks.

The rest of the patients (Group B) were treated by surgical ORIF after skin condition improved within 10-14 days. Fluoroscope was used in both groups to assess reduction.

In Group B, surgery was delayed for 10 to 14 days to allow soft-tissue swelling to resolve enough for the skin to wrinkle. During this period, bulky Jones dressings were applied, foot was elevated and ice was applied to hasten the resolution of oedema. Anti-inflammatory medications were given to control pain and to reduce oedema in selective cases. Computed tomography (CT) scan was obtained in all cases to delineate fracture pattern for preoperative planning.

All patients were operated by a single consultant surgeon under tourniquet control in a lateral position via lateral approach. Incision was taken down to periosteum protecting the sural nerve. Periosteal flaps were elevated off the lateral wall, exposing the lateral wall of the calcaneus, calcaneo-cuboid joint and posterior facet. To prevent wound complications, care was taken to raise full-thickness flaps. Reduction was performed to restore relationship between anterior process, sustentacular fragment and posterior facet, and provisionally fixed with K-wires. Then depression of posterior facet was corrected by elevation of articular surface and the gap, if present, was filled with bone substitute (TCH®). A lateral plate, oblique-angled 3.5mm T-LCP, was then applied extending from the anterior process to the most posterior aspect of tuberosity. We selected this implant as availability of AO calcaneal plate was an issue. Its formidable cost also drove us to find an appropriate alternative. This plate with its very low profile and locking screw options made us to prefer its use over conventionally used 3.5mm recon plate by majority surgeons. Reduction and placement of screws was assessed under C-arm, and then flaps were closed without the placement of drain and postoperative POP back slab was applied for 2 weeks.

Postoperatively, the patients were followed clinically and radiologically monthly till fracture union was achieved and periodically thereafter.

Weight-bearing was started once fracture union was visible. However, range-of-motion (ROM) exercises at ankle were started on the first postoperative day. Patients were advised to take foot out of slab a few times a day and carry out ROM exercises. Stitches were removed at 2-3 weeks depending upon the healing observed. For

patients treated with POP, clinical union was considered once patient was pain-free. Radiological union was declared when bridging callus was seen among the fracture fragments. Significant mal-union was defined as large lateral wall exostosis and more than 10 degrees of hind foot varus deformity.

FADI score was assessed at last follow-up. FADI score takes into consideration answers to 26 questions, each scored from 0 to 4 (Annexure). The net score achieved on the questionnaire determines patient's functional outcome. Higher the score, better the outcome.³

Data was analysed using Microsoft Excel worksheet. Comparison between variables was done using paired t test. A p value >0.05 was considered significant.

Results

Of the 42 records in the study, 20(47.6%) related to Group A and 22(52.4%) to Group B. The mean age was 41 years

Table-1: Salient features of patients.

1	Age	
	Group A: Conservative	41±7.82 (28-55)
	Group B: ORIF	31±6.35 (21-43)
2	Male: Female	
	Group A: Conservative	10:01
	Group B: ORIF	9:01
3	Type of Injury	
	Closed	38
	Open	4
4	Type of Plate	
	3.5mm Oblique angle T-LCP	22
5	Duration of surgery	55 to 85 min
6	Hospital stay	3-14 days

ORIF: Open reduction internal fixation

T-LCP: T-shaped Locking Compression Plate.

Table-2: Post-operative results.

Parameters	Group A Conservative	Group B ORIF
1 Infection in closed fractures	NONE	Superficial n=2
2 Implant failure	N/A	n=1
3 Radiological Results (Bohler's angle)	Acceptable reduction: n=5	Anatomical Reduction: n=14
Anatomical= 30-40°		
Acceptable =25-30°	Comminuted reduction: n=15	Acceptable reduction: n=6
Comminuted=20-25°		Comminuted reduction: n=2
4 Functional outcome Mean FADI SCORE	45.4±10.68	67.9±10.04

FADI: Foot and Ankle Disability Index.

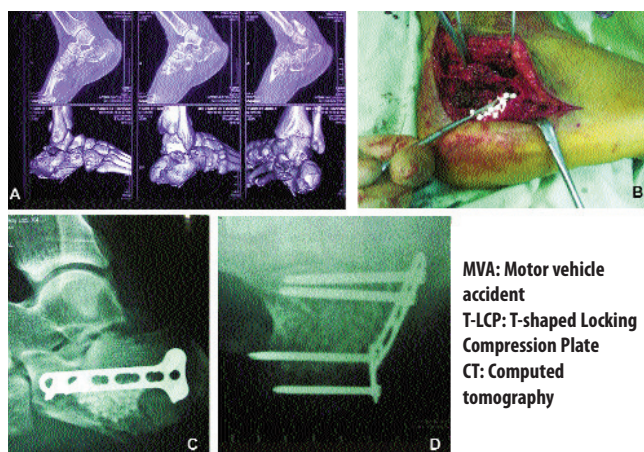


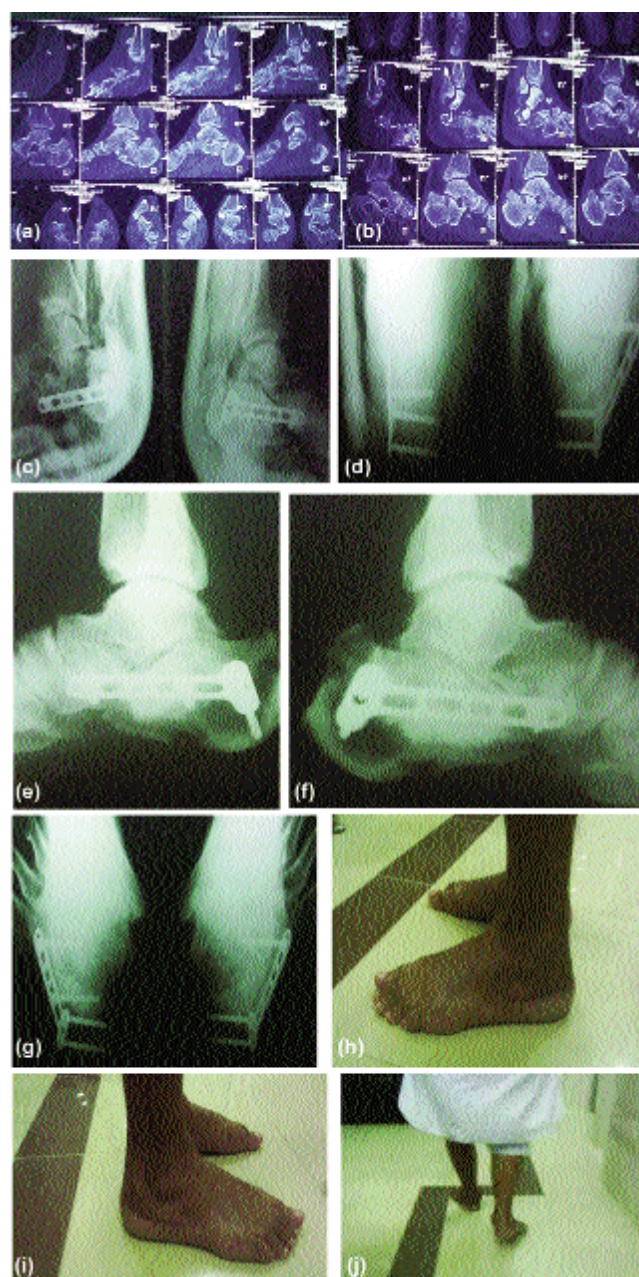
Figure-1: 28-year-old male with MVA. Fracture fixation with T-LCP. (a) CT SCAN (b): Exposure of calcaneum and filling of bone substitute(c) and (d): Post op X-Rays.

(range: 28-55 years) in Group A, and 31 years (range: 21-43) in Group B. Male-to-female ratio was 10:1 in Group A; 9:1 in Group B (Table-1).

Overall, 38(90.5%) cases had closed injuries, while 4(9.5%) had open injuries. Mean duration of surgery was 65 min (range: 55-85 min). Mean hospital stay was 5 days (range: 3-14 days). T-LCP was used in all (100%) operated cases, while bone substitute was used in 16 (72.7%) of operative cases. Union was achieved in all (100%) cases. Mean time to union was 15 weeks in Group A (range: 14-35 weeks) and 19 weeks (range: 15-35 weeks) in Group B.

Wound complications, dehiscence and infection, was noticed in only 2 (9.1%) patients in Group B who were treated successfully with antibiotics and dressings. There was loss of reduction in 1(4.5%) case due to non-compliance with weight-bearing precautions. No nerve or tendon injuries occurred in Group B cases. Mean FADI score in Group B was 67.9 and in the patients treated non-operatively it was 45.4 (Table-2).

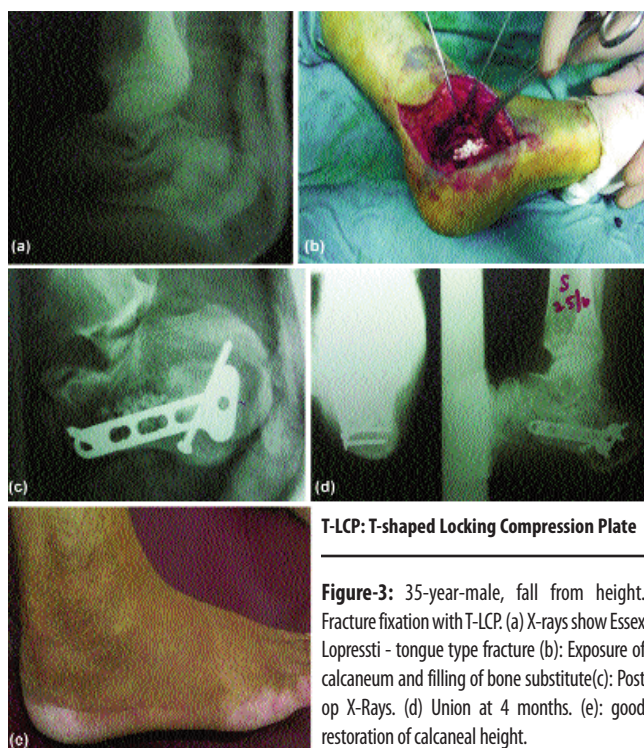
The mean follow-up time was 8.5 months (range: 6-14 months). Within Group B, quality of reduction achieved was analysed postoperatively by determining Bohler's angle on X-rays. Three subgroups were identified. Anatomic Reduction, defined as angle 30-40, was obtained in 14(64%) cases and these patients had the highest FADI score (mean 70). Acceptable Reduction, with angle 25-30, was achieved in 6(27.3%) patients with a mean FADI score of 66. Comminuted Reductio, with angle 20-25, was seen in 2(9.1%) patients who had the lowest mean FADI score of 60. Better functional result, as such, had direct relation to the quality of reduction achieved as a result of ORIF.



**T-LCP: T-shaped Locking Compression Plate
CT: Computed tomography**

Figure-2: 40-year-old male with bilat fractures after fall from height. Fixation with T-LCP. (a) CT SCAN (b): CT SCAN (c): Post op X-Rays (d): Post op X-Rays (e): union at 5 months (f): union at 5 months (g): union at 5 months, (h): good restoration of heel height (i): good restoration of heel height (j): good restoration of heel width with surgery and patient is able to ambulate without pain.

Although there was an obvious difference in terms of absolute values of mean FADI scores amongst patients treated conservatively compared to those who underwent surgery, but there was no statistically



T-LCP: T-shaped Locking Compression Plate

Figure-3: 35-year-male, fall from height. Fracture fixation with T-LCP. (a) X-Rays show Essex Lopresti - tongue type fracture (b): Exposure of calcaneum and filling of bone substitute(c): Post op X-Rays. (d) Union at 4 months. (e): good restoration of calcaneal height.

significant difference in functional outcome in the two groups ($p=1.99$).

Discussion

Displaced intra-articular calcaneal fractures remain a complex clinical entity to treat. Review of literature reveals different methods and recommendations for treatment of these fractures ranging from non-operative treatment with POP to K-wire fixation after reduction through small medial incision and ORIF through extensile lateral approach with plates. In closed management, it is difficult to obtain accurate reduction and to maintain reduction, whereas in open reduction, soft tissue stripping impairs blood supply which in turn delays union. Most of these injuries have been treated non-operatively in the past, with various methods described in literature.⁴ More recently, studies have favoured operative treatment for the management of displaced intra-articular fractures of calcaneus in selected patients.⁴ Findings included significantly better outcome scores in operated patients, especially women,⁵ but complication rate was also higher and subsequent need for sub-talar arthrodesis was similar in its two groups. The outcome was better if posterior facet was anatomically reduced and fixed. Our experience has also been similar with much better functional outcome if anatomic reduction was achieved operatively. A study⁶ also found that accurate surgical

reduction of sub-talar joint produces better clinical outcome. Another study suggested that severely displaced calcaneal fractures should not be treated non-operatively.⁷ We started operating on these patients after review of current literature in which many authors favoured ORIF for fractures of calcaneum. Open reduction also appears to be an acceptable method of treatment for displaced calcaneal fractures in elderly patients. We agree with the assertion that careful patient selection is necessary because individuals with severe osteopenia, inability to walk or home-only ambulators and patients whose medical conditions preclude surgery should be considered candidates for non-operative care.⁸ We were careful in selecting relatively younger patients with none or a few co-morbidities for operative treatment.

Regarding the operative technique, plating through lateral approach is most widely used, allowing reduction under direct vision and fixation with implant of choice. Most calcaneal fractures are of the joint depression type or the tongue type, both of which are also amenable to reduction by the medial approach technique.⁹ Lateral incision may be needed for accurate reduction if medial approach has been used initially, as the final restoration of calcaneal width is accomplished by reducing the lateral bulge of the tuberosity by applying direct pressure over the lateral heel. However, we were comfortable operating on all our patients through the lateral approach (Figures-1-3). This allowed for better reduction of lateral blowout deformity, which produces significant morbidity, and must be completely reduced as has been reported earlier.^{7,10}

Conclusion

Displaced intra-articular calcaneal fractures are difficult to manage. We recommend ORIF, preferably with low-profile 3.5mm locking plates, as treatment of choice for these fractures as it is associated with better functional outcome in the long term and greater patient satisfaction. However, factors such as age, soft tissue injury and surgical expertise may influence the decision to operate.

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