

## Original Research Article

# Prospective study of fracture calcaneus with Allan's procedure- bone grafting without implants

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### ABSTRACT

**Background:** Calcaneum is usually fractured following high energy axial traumas such as seen in cases of fall from height or road traffic accidents. If not properly managed these fractures can be a cause of prolonged morbidity in the form of pain, stiffness and deformities. We have conducted this prospective study of fracture calcaneum with the method described by Allan et al which constitute of open reduction and bone grafting without any implants. The objective of the study was to determine the clinical approach, described by Allan et al for treatment of fracture calcaneum and to discuss in short the results, pitfalls and challenges associated with this.

**Methods:** A prospective study was done on 42 patients who were diagnosed with intra-articular calcaneal fractures depending upon a predefined inclusion and exclusion criteria. All fractures of the study subjects were treated using a lateral approach by Allan's procedure. Final outcome was assessed on the basis of modified Rowe score.

**Results:** In this study a total of 42 patients with intra-articular calcaneal fractures and treated by open reduction and bone grafting without any implants were studied. There were 36 men and 6 women. Majority of the patients tolerated the procedure well and most of the patients (95.23%) had a complete or partial restoration of heel shape. Significant residual pain was seen in only 1 (2.38 %) patient. 36 patients (85.71 %) had excellent outcome 5 patients (11.90%) had good and 1 patient (2.38%) had satisfactory outcome.

**Conclusions:** The management of intra-articular calcaneal fracture by open reduction and bone grafting without any implants give good results with excellent functional outcome. Since no implants are used in this technique this can be a preferable procedure in rural areas and in patients with low socioeconomic status.

**Keywords:** Intra-articular calcaneal fracture, Morbidity, Bone grafting, Functional outcome

### INTRODUCTION

Calcaneum fractures are the most common of all tarsal fractures (60%), and account for almost 1-2% of all adult fractures. High energy axial traumas such as road traffic accidents or falling from the height is the usual cause of these fractures. The patients usually present with pain, swelling and erythema with restricted movements.<sup>1</sup> Radiographs for the diagnosis must include

anteroposterior, lateral, oblique and axial views. Subtalar and calcaneocuboid joints must be assessed. The fracture can be better appreciated on 3D CT of the affected Calcaneum and surrounding joints.<sup>2</sup> Most of these calcaneal fractures are intra-articular and displaced making them difficult to manage and causing complications like persistent pain, stiffness, arthritis and peroneal impingement.<sup>3</sup>

The best treatment for calcaneal fractures continues to be an unsolved dilemma for treating orthopedicians and there is a lack of consensus as to which is the ideal procedure for treating these fractures notorious for causing complications.<sup>4</sup> Usually the line of management depends upon the factors such as classification of fracture, condition of the local site and age of the patient. Since the early 1990s enthusiasm for certain surgical procedures for carefully selected fractures in appropriately selected patients has been increased.<sup>5</sup>

The authors have tried many methods including conservative method, closed methods of elevation of fragments by Steinmann pin, open reduction with plating with lateral extensile L-shaped approach. The problems of conservative approach being peroneal tendon entrapment with lateral ankle pain which at time needs decompression by excising lateral wall of calcaneum. The patients with Steinmann pin elevation neither achieved good anatomical reduction nor could give good long term function. With extensile approach, though the radiology appears good; the cosmetic and soft tissue problems are more. Many studies found that after a standard extensile L shaped approach with two layer flap closure, wound complications developed in more than 20% of the patients requiring surgery for such complications.

In 1955, Allan et al described the procedure of open reduction and bone grafting for the treatment of calcaneum fracture.<sup>6</sup> The procedure consisted of taking a modified Kocher incision beneath the lateral malleolus and incising peroneal tendon retinaculum posteriorly and finally dividing and reflecting the calcaneo-fibular ligament and exposing the subtalar joint. A narrow osteotome was then introduced into compressed bone under articular surface. The large hole created in the centre of the cancellous bone was filled with the autologous bone graft and after that lateral walls of calcis were compressed. The peroneal tendons were then returned to their sheaths and the wound was closed. Cast was then applied and patient was advised no weight bearing on the affected foot for six weeks. The authors found this approach to be promising method of treating these difficult to manage fractures.

In a rural setup with limited resources in hand we undertook this prospective study of fracture calcaneum and its treatment by the method described by Allan et al comprising of open reduction and bone grafting without any implants.

## **METHODS**

This study was conducted at department of orthopedics of Bharati Vidyapeeth Deemed University Medical College, Sangli, Maharashtra, India. The study was duly approved by institutional ethical committee and the study period was 2 years from October 2015 to September 2017. This was a prospective study consisting of 42 adult patients having intraarticular fracture of calcaneum.

### ***Inclusion criteria***

- Patients of either sex between 18 -60 years of age with displaced intraarticular fractures of Calcaneum.

### ***Exclusion criteria***

- Patients with condition affecting their gait like hemiparesis, hemiplegia or paraplegia etc.
- Patients with multiple fractures.
- Patient who refused consent.
- Patient lost to follow up.

All the patients were diagnosed on the basis of X-rays. 3D CT of calcaneum was done in some patients. The information which was recorded included demographic profile (age, sex and address), history, clinical examination with a special emphasis on location of swelling and nature of pain, presence of erythema and local skin condition. Reports of investigations like complete blood count and other biochemical investigations. Whenever available, additional clinical and diagnostic results were also noted. The treatment consisted of Allan's procedure (bone grafting without implants). Patients were followed up for 36 months and outcome was assessed by modified Rowe Score. Patients who didn't come for follow-up were excluded from the study. The results were studied using appropriate statistical methods. Data analysis was carried out using SPSS16.0 version software. Microsoft word and excel were used for generating charts and graphs.

### ***Surgical procedure***

Patient was placed in lateral position in a patient holder with injured side up, with a pillow in between legs and the normal leg was tied to the table with the same pillow. The position was such that the non-injured foot does not come in way of image intensifier view of injured limb intra operatively. The injured limb was kept free so that it can be maneuvered easily for imaging as well as varus stressing of heel for good subtalar vision of the joint. A small 4-5 cms incision beginning 1cm proximal to posterior border of fibula curving 1cm distal to tip of fibula then extending straight anteriorly parallel to sole for 2-3 cm till level of anterior border of fibula was reached. It was part of combination of Ollier approach to tarsus and Kocher lateral approach to tarsus. This modification allowed easy exposure of peroneal tendon sheath. In proximal part of incision just behind the lower end of fibula, an artery forceps was dipped directly into peroneal tendon sheath to visualize peroneal tendon through small spread of artery forceps. Care was taken not to elevate the skin flaps at all to avoid soft tissue problems. With the help of a pair of scissors the window in the peroneal sheath was extended distally to visualize both peroneal tendons. Distally the peroneals were dissected subcutaneously for about 2 cm without incising the skin. The peroneal tendons were hooked around a

right angled retractor & retracted cranially over lower end of fibula. With an assistant holding the retractor in one hand as if stressing the heel in varus to open the subtalar joint, the surgeon cleared the blood clots and soft tissues with 15 number blade. This made the interior of subtalar joint clearly visible including depressed posterior facet, middle facet and primary fracture line with sustentacular fragment. On lateral edge of depressed posterior facet, a 1 cm wide osteotome was passed in sagittal plane to retract the lateral wall along with skin to visualize the inferior most part of depressed posterior facet which was then elevated with the same osteotome in anatomical position to match at primary fracture line and distally to anterior facet. Care was taken in elevation of depressed posterior facet by lifting at cortical edge of lateral wall under vision to prevent crushing of cancellous bone which is a

disadvantage of blind elevation. It is important not to dissect between lateral wall and skin to avoid soft tissue problems later. With a small incision of 2 to 3 cms directly over same side iliac crest, cortico-cancellous bone grafts were procured. Grafts were packed into the cavity inside calcaneum and lateral wall was pushed with strong pressure. This achieved the normal shape and height of heel with decompression of the peroneal tendons. The peroneal tendons were replaced and the tendon sheath was sutured with continuous 1-0 vicryl sutures. The skin was sutured with interrupted 3-0 mattress sutures. Dressing was done. Cotton roll was then applied around foot and ankle and pressure bandage was done. The tourniquet was released and below Knee slab was applied.



**Figure 1: Various steps of surgical procedure for calcaneum fracture described by Allan.**

### ***Post-operative management***

Perioperative and postoperative intravenous antibiotics were given for five days after which oral antibiotic were given till stitch removal. Oral analgesics were used as and when required. The limb was elevated on the day of surgery until the next day. The wound was dressed removing slab two days after operation. Slab/cast immobilization was continued for six weeks. No weight bearing was allowed for first six weeks. Non weight bearing ambulation was continued from second day. Repeat dressing of the wound was done on 5th day and 12th day at which suture removal was done. At the time of first dressing check X-rays were taken without slab. At six weeks, the slab/cast was removed and repeat X-rays were taken. Patient was allowed weight bearing usually partial (25-50%) for first fifteen days and then

gradually increased to full weight bearing by 12 weeks and again check X-ray was taken thereafter lateral view was repeated at six months and one year & then as necessary.

### **RESULTS**

This was a prospective study in which patients between 18 -60 years of age with displaced intraarticular fractures of Calcaneum were included with a view to study outcome of fracture calcaneum and its treatment by the method described by Allan et al comprising of open reduction and bone grafting without any implants. There were 42 patients enrolled in this study out of which 36 were males and 6 were females with a M:F ratio being 1:0.16.

The analysis of age groups of the studied patients revealed that the most common age group affected was 21-30 years (42.85 %) followed by 31- 40 years (28.57 %), 41-50 years (14.28 %) and 51-60 years (11.90 %). Only 1 (2.38 %) patient below 20 years was found to have fracture of calcaneum. Patients less than 18 years were excluded from the study since age more than 18 years was an inclusion criteria.

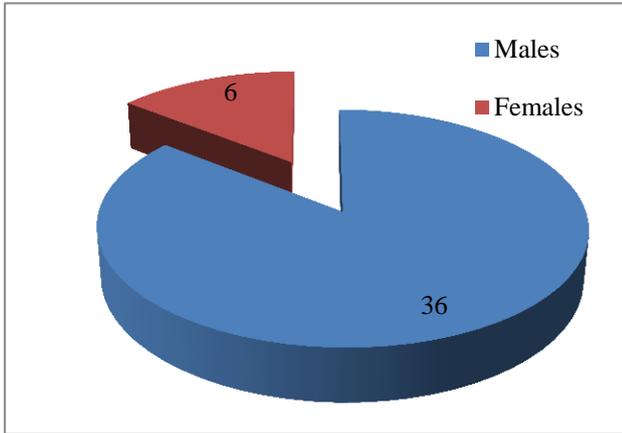


Figure 2: Gender distribution of the studied cases.

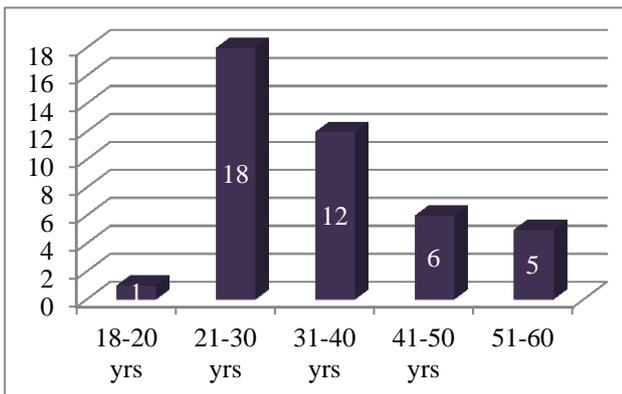


Figure 3: Age distribution of the studied cases.

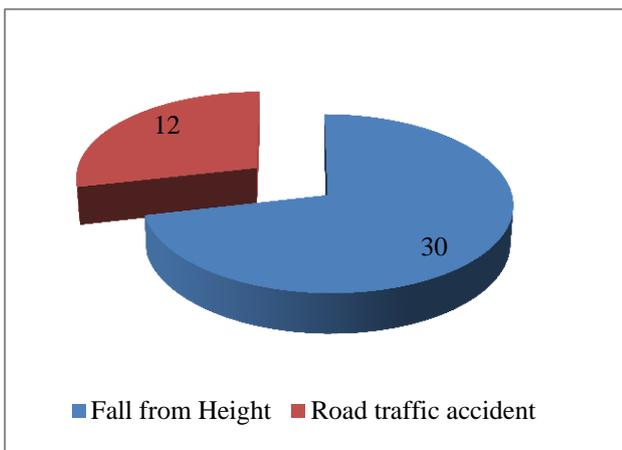


Figure 4: Mechanism of fracture of calcaneum in studied cases.

The most common cause of fracture of calcaneum was found to be fall from height which was seen in 30 patients (71.42 %) followed by road traffic accidents which were seen in 12 (28.58 %) patients.

Right calcaneum was fractured in 31 patients, while left calcaneum was fractured in 11 patients. There was no patient with bilateral calcaneum fractures.

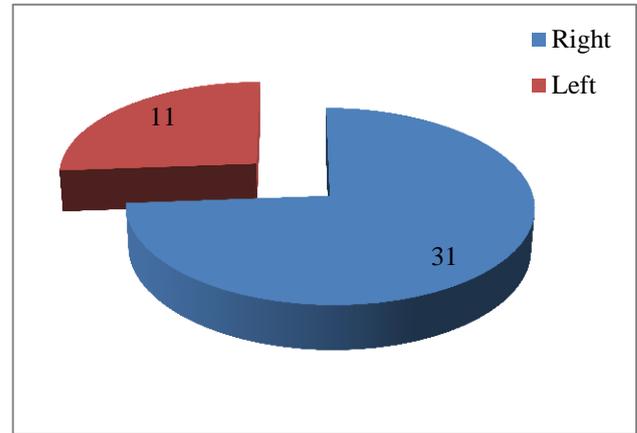


Figure 5: Side of calcaneum fracture in studied cases.

The analysis of clinical features seen in these patients revealed that the most common signs or symptoms were pain and swelling at the affected site which was present in all 42 (100%) patients followed by erythema which was present in 14 (33.33 %) and local skin lacerations (19.04%).

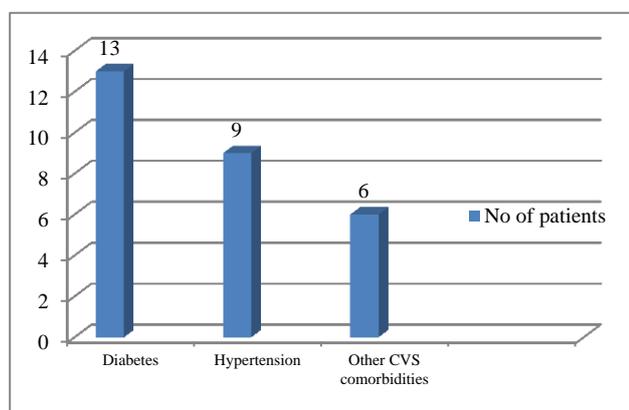
Table 1: Signs and symptoms in the studied cases.

Sign and symptoms	No of patients	Percentage (%)
Swelling at the affected site	42	100
Pain	42	100
Erythema	14	33.33
Skin lacerations	8	19.04

The analysis of patients with a view to know presence of systemic illness revealed that there were 13 patients having hypertension and 9 patients with diabetes. While other cardiovascular comorbidities were present in 6 patients.

All patients underwent open reduction and bone grafting without any implants (Allan’s procedure) and all of them tolerated the procedure well. Majority of the patients (95.23%) patients had complete or partial restoration of heel shape. Postoperatively only 1 patient (2.38 %) had the pain sufficient enough to divert the attention during daily activities. Out of the treated patients 35 (83.33 %) patients could stand on 1 leg after 8 weeks of surgery and all the patients could resume their pre-injury work routine after 8 weeks of surgery and no patient required a

revision surgery or subtalar arthrodesis later. The outcome of the surgery was estimated to be excellent, good, satisfactory or poor on the basis of modified Rowe score.<sup>7</sup>



**Figure 6: Presence of associated systemic illnesses in studied cases.**

Most of the patients had an excellent outcome (85.71), 5 patients (11.90 %) had good and 1 patient (2.38 %) had satisfactory outcome. There was no patient with poor outcome.

**Table 2: Modified Rowe score for determination of outcome after surgery.**

Grading	Score
Excellent	>85
Good	71-85
Satisfactory	55-70
Poor	<55

## DISCUSSION

The management of displaced intra-articular calcaneal fractures remains controversial and the question whether operative treatment improves outcome is debatable. Randle et al in a metaanalysis stated that "there is a trend for surgically treated patients to have better outcomes; however, the strength of evidence for recommending operative treatment is weak.<sup>8</sup> In support of Randle et al and Bridgman et al in his Cochrane review stated that 'randomized trials of management of calcaneal fractures are few, small and generally of poor quality. Even where there is some evidence of benefit of operative compared with nonoperative treatment, it remains unclear whether the possible advantages of surgery are worth its risks'.<sup>9</sup>

The ideal treatment for any displaced intraarticular fracture is anatomical reduction, stable fixation and early joint mobilization.<sup>10</sup> Complications resulting from intra-articular calcaneal fractures include malunion, post-traumatic subtalar osteoarthritis, chronic foot pain, peroneal tendonitis and lateral impingement syndrome.<sup>11</sup> Historically, the type and number of fragments of

calcaneal fractures were the most important variables with the aims of operative treatment to restore of the overall shape and correct Bohler's angle to prevent long-term disability.<sup>12</sup> Catani et al showed that those in whom geometry of the Calcaneum and joint was restored by surgery had better compensation of gait and a better clinical and functional score.<sup>13</sup> Benirschke and Sangeorzan reported the preliminary results of more than 100 calcaneal fractures with improved outcomes compared to other published reports of conservative treatment.<sup>14</sup>

Options for treating displaced calcaneal fractures are conservative or operative.<sup>15</sup> Leung et al compared 44 patients treated by surgical methods with 19 patients treated conservatively according to the results of three-year follow-up on average. Comparing pain, ease of movement, return to job and swelling at the back of the foot, they found that the results of the group treated surgically were significantly better.<sup>16</sup> Other studies have shown that conservative management provides comparable outcomes with operative treatment.<sup>17</sup> Kundel et al reviewed 63 patients and reported more complications in patients treated operatively. They also found no difference in functional outcome between the operated and conservative groups at 10 years follow-up.<sup>18</sup>

Kennedy et al found that conservative treatment was a safe, effective and cost-effective method of management and functional outcomes were similar between operated and conservative groups.<sup>19</sup> Buckley and Meek reported a matched cohort study of 34 patients and found no significant difference in clinical and radiographic outcomes between those treated operatively and conservatively. Buckley et al in the largest multicentre prospective randomized controlled trial compared operative and non-operative treatment of intra-articular calcaneal fractures and demonstrated that operative treatment as a whole provides no improvement over non-operative treatment.<sup>20</sup>

In our study Allan procedure i.e. open reduction and autologous bone graft was found to be effective treatment for intraarticular calcaneal fractures. It's not only economical but also gives good functional results as seen by excellent results in our study.

## CONCLUSION

Treatment of intraarticular calcaneum fractures by open reduction and autologous bone graft without any implants (originally described by Allan) is an economical alternative to open reduction and internal fixation by implants. Moreover it gives good anatomical & functional outcome. Though some studies point out the problem like wound dehiscence, necrosis and infection associated with bone grafting with proper technique immediate postoperative soft tissue problems can totally be avoided in almost all patients.

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## REFERENCES

1. Gougoulias N, Khanna A, McBride DJ, Maffulli N. Management of calcaneal fractures: systematic review of randomized trials. *Br Med Bull.* 2009;92:153-67.
2. Born CT, Tahernia AD. Imaging of calcaneal fractures. *Clin Podiatr Med Surg.* 1997;14(2):337-56.
3. Lim EV, Leung JP. Complications of intraarticular calcaneal fractures. *Clin Orthop Relat Res.* 2001;(391):7-16.
4. Li Y, Bao RH, Jiang ZQ, Wu HY. Complications in operative fixation of calcaneal fractures. *Pakistan J Med Sci.* 2016;32(4):857-62.
5. Rak V, Ira D, Masek M. Operative treatment of intra-articular calcaneal fractures with calcaneal plates and its complications. *Indian J Orthop.* 2009;43(3):271-80.
6. Allan JH. The Open Reduction of Fractures of the Os Calcis. *Annals Surg.* 1955;141(6):890-900.
7. Lamichhane A, Mahara D. Management of intra-articular fracture of calcaneus by combined percutaneous and minimal internal fixation. *J Nepal Health Res Coun.* 2013;11(23):70-5.
8. Randle JA, Kreder HJ, Stephen D, Williams J, Jaglal S, Hu R. Should calcaneal fractures be treated surgically: a meta-analysis. *Clin Orthop.* 2000;377:217-27.
9. Bridgeman SA, Dunn KM, McBride DJ, Richards PJ. Interventions for treating calcaneal fractures. *Cochrane Database Syst Rev.* 2002;2:Cd001161
10. Griffin D, Parsons N, Shaw E, Kulikov Y, Hutchinson C, Thorogood M, et al. Operative versus non-operative treatment for closed, displaced, intra-articular fractures of the calcaneus: randomised controlled trial. *BMJ.* 2014;349:4483.
11. Zeman P, Zeman J, Matejka J, Koudela K. Long-term results of calcaneal fracture treatment by open reduction and internal fixation using a calcaneal locking compression plate from an extended lateral approach. *Acta Chir Orthop Traumatol Cech.* 2008;75(6):457-64.
12. Loucks C, Buckley R. Bohler's angle: correlation with outcome in displaced intra-articular calcaneal fractures. *J Orthop Trauma.* 1999;13(8):554-8.
13. Catani F, Benedetti MG, Simoncini L. Analysis of function after intra-articular fracture of the os calcis. *Foot Ankle Int.* 1999;20:417-21.
14. Benirschke SK, Sangeorzan BJ. Extensive intraarticular fractures of the foot. Surgical management of calcaneal fractures. *Clin Orthop Relat Res.* 1993;(292):128-34.
15. Nouraei MH, Moosa FM. Operative compared to non-operative treatment of displaced intra-articular calcaneal fractures. *Journal of Research in Medical Sciences. Official J Isfahan Univ Med Sci.* 2011;16(8):1014-9.
16. Leung KS, Yuen KM, Chan WS. Operative treatment of displaced intra-articular fractures of the calcaneum. Medium-term results. *J Bone Joint Surg Br.* 1993;75(2):196-201.
17. Aldridge JM 3rd, Easley M, Nunley JA. Open calcaneal fractures: results of operative treatment. *J Orthop Trauma.* 2004;18(1):7-11.
18. Kundel K, Funk E, Brutscher M, Bickel R. Calcaneal fractures: operative versus nonoperative treatment. *J Trauma.* 1996;41:839-45.
19. Kennedy JG, Jan WM, McGuinness AJ, Barry K, Curtin J, Cashman WF, et al. An outcomes assessment of intra-articular calcaneal fractures, using patient and physician's assessment profiles. *Injury.* 2003;34:932-6.
20. Buckley RE, Meek RN. Comparison of open versus closed reduction of intraarticular calcaneal fractures: a matched cohort in workmen. *J Orthop Trauma.* 1992;6:216-22.

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