

LATERAL APPROACH UNDER FLUROSCOPIC GUIDANCE WITH NONLOCKING CALCANEAL PLATE IS AN EFFECTIVE TECHNIQUE FOR CLOSED CALCANEAL FRACTURE

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ABSTRACT: Intra-articular calcaneal fractures which accounts for about 75% of calcaneal fractures is usually associated with poor functional outcome. The present was under taken to evaluate the efficacy of open reduction and internal fixation of displaced articular fractures of calcaneum in adults through lateral approach under fluroscopic guidance with non-locking calcaneal plate and ipsilateral iliac crest bone graft. 30 adult patients (25 males and 5 females) with closed displaced intra articular fractures of calcaneum of less than 15 days constituted the study group. All cases were operated by lateral approach as described by Seligson, a modification of Gould's technique under spinal anaesthesia. All machers Arthrosis Rating Scale were used for the evaluation of posttraumatic posterior facet degenerative changes. Primarily 27 of all 35 wounds (77%) healed without any form of wound complications. Excellent to good results noted in 3 (100%) patients with preoperative Bohler's angle larger or equal to 20° (n = 3) whereas patients with preoperative Bohler's angle smaller than 20° (n=32) achieved excellent to good results in 16 cases (50%) Clinically significant subtalararthrosis (Allmacher grade 2-4) noted in 7 cases (20%) cases with Bohler's angle smaller than 20° (n=32). In 5 cases, clinically significant complaints (Allmachers Arthrosis Rating Scale grades II to V) noted. Therapeutic success of such fracture depends on timely open reduction and internal fixation with proper fracture reduction and early rehabilitation. Thus management of these injuries as well as complications should be performed in a specialized orthopaedics or traumatology center.

KEYWORDS: Closed Calcaneal Fracture, open reduction, internal fixation, subtalararthrosis.

INTRODUCTION: For years it was seen that outcomes in patients with calcaneal fractures were not as good as outcomes in patients with other orthopaedic fractures of small bones.¹ In particular, Intra-articular fractures account for approximately 75% of calcaneal fractures and historically have been associated with poor functional outcome.² These fractures are uniformly caused by an axial load mechanism, such as a fall or a motor vehicle accident, and may be associated with other axial load injuries, such as lumbar, pelvic, and tibial plateau fractures.³

The Essex-Lopresti⁴ system has been used for many years and is useful in describing the location of the secondary fracture line and can be evaluated by plain X- ray. Though CT guided Sanders classification⁵⁻⁷ is helpful for location and number of fracture lines through the posterior facet, it also cannot give clue regarding descriptions of other important aspects of these fractures including heel height and width, varus-valgus alignment and calcaneocuboid involvement. Besides CT scan may underestimate sagittal plane rotation of the depressed fragment.

It was seen that non-operative treatment for calcaneal fractures often led to pain, loss of function, which increased in the second decade after injury.

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Objective of the present study was to treat open reduction and internal fixation of displaced articular fractures of calcaneum in adults through lateral approach under fluroscopic guidance with nonlocking calcaneal plate and ipsilateral iliac crest bone graft and to evaluate efficacy of the procedure.

MATERIALS AND METHODS: The study population consists of 30 adult patients with closed displaced intraarticular fractures of calcaneum of less than 15 days duration attending outdoor and emergency. Average age of patients were 32 (range 19 – 60 years). There were 25 males and 5 females. No cases of open fractures was included in this study. Serious medical ailments and poor soft tissue envelope were excluded from this study. No patient was treated with primary subtalar arthrodesis. Patients were evaluated in details preoperatively, per operatively and postoperatively both clinically and radiologically with X-ray imaging, including Broden's oblique views on the 4th, 8th, and 12th week, and then 6th, 12th and 24th month after the surgery.

Detailed history of the cases were taken regarding age, sex, occupation, socio-economic status, duration of fracture, trauma to any other site, any concurrent medical illness, relevant past illness, previous musculoskeletal injury or surgery etc. Radiographs of the patients were taken in AP, LAT and Broden views of injured ankle.

All of the patients presented with swelling around ankle heel. A crepe bandage⁸ was applied and plaster of Paris below knee back slab was applied. Foot was elevated by a pillow under heel. Intermittently crepe was removed and ice was applied directly. Usually we had to wait 5 to 10 days (average 7days) to allow soft-tissue swelling to resolve enough for the skin to wrinkle⁵. All cases were operated by lateral approach described by Seligson, a modification of Gould ⁹ under spinal anaesthesia. After subtalar capsulotomy, the entire lateral calcaneus, calcaneocuboid joint and subtalar joint were exposed.

A short Schanz pin was placed from lateral to medial at the posterior inferior corner of the calcaneal tuberosity, as described by Benirschke¹⁰. A K-wire was placed from the back of the heel through the posterior tuberosity and into the medial sustentacular component, making sure the wire did not interfere with subsequent joint reduction. Once the surgeon was satisfied with the reduction, at least two K-wires were placed across the fracture fragments (to prevent rotation of the fragment), and further visual evaluation was performed to assess the joint reduction. The articular fragments were repositioned with 3.5mm cortical lag screws placed from the lateral cortex. The calcaneal body was then evaluated.

The cavity was filled with ipsilateral iliac crest bone graft. Once this was performed, the lateral wall remnant is placed back and an appropriately sized nonlocking calcaneal plate was selected and positioned. The final reduction was verified fluoroscopically and all K-wires were removed. The patients were followed up for 12-32 months after the surgery. For the evaluation of posttraumatic posterior facet degenerative changes, Allmachers Arthrosis Rating Scale was used.

Incidence and severity of posttraumatic subtalar arthrosis depends on the fracture type, calcaneal shape, and position after the osteosynthesis, chondral injury of the subtalar joint, and articular facet congruency. Patients were evaluated by a unified scoring system AOFAS Clinical Rating System, the Ankle Hind foot Scale for calcaneal area (100 points total, 90-100 points, excellent; 80-89 points, good; 70-79 points, fair, less than 70, poor).

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RESULTS: 27 of all 35 wounds (77%) healed primarily without any form of wound complications. 8 out of 35 wounds (23%) got superficial defects (wound edge necrosis, oedema blisters). There were no serious wound healing complications occurred causing implant removal. All defects healed conservatively.

Patients with preoperative Bohler's angle larger or equal to 20° (n = 3) achieved excellent to good results in three cases (100%); patients with preoperative Bohler's angle smaller than 20° (n=32) achieved excellent to good results in 16 cases (50%) (Table 1).

Patients with preoperative Bohler's angle larger or equal to 20° (n = 3) achieved no clinically significant subtalararthrosis (Allmacher grade (0-1). Patients with Bohler's angle smaller than 20° (n=32) suffered clinically significant subtalararthrosis (Allmacher grade 2-4) in 7 cases (20%) cases (Table 2). Both were assessed at 1 year follow up.

Clinically significant complaints (Allmachers Arthrosis Rating Scale grades II to V) occurred in 5 cases. There were 2 cases of implant removal after one year of surgery due to hardware problems. In 3 cases with non-restoration of anatomy secondary subtalar arthrodesis was done at 18month. Patients with collapse at 1year > equal to 2 degree (9 patients) had fair to poor AOFAS SCORE Collapses were more on patients with age more than 50 years (5 out of 5patients). Patients with tourniquet time more than one hour had higher wound complication rate.

DISCUSSION: In the last two decades, open reduction and internal plate fixation of dislocated intra-articular calcaneal fractures has become a standard surgical method with low complication rate and better quality of life after the surgery. Brauers cost-effectiveness analysis of surgery versus conservative treatment for intra-articular calcaneal fractures showed economical advantage of ORIF¹¹. In 2004, the comparison of five multicentric studies regarding conservative and operative treatment (issued in medline between January 1999 and March 2004) was published.

Results of these comparative studies also favored operative treatment over conservative one. Most of the conservatively treated patients underwent arthrodesis procedure. Poorer health and social prognosis is related to males, heavy workers, patients with B-angle smaller than 0° and bilateral fractures.¹²

Conclusions of Bajammal who analyzed 20 publications dealing with operative vs. conservative treatment showed significant benefits of surgical therapy for females, young males, patients with lighter workload, and patients with initially high B-angle or with simple, minimally dislocated fractures, whereas older males and those who have an occupation involving heavy workload had benefited from the conservative therapy¹³.

Buckley¹⁴ (analysis of 559 calcaneal fractures) and Tufescuet al¹⁵ reported similar findings and both definitely recommended operative treatment. Her scoviciet al¹⁶ proved that there were no significant risks of wound healing for patients older than 65. In our series the patients more than 50 years age did not have a higher wound complication rate. We operated five patients older than 50; four wounds of five healed by primary intention.

Rate of wound healing complications that achieved in our study is comparable with the results published in literature of the last decade. In 2004, Zwipp et al¹⁷ presented one of the biggest studies of calcaneal fracture treatment: 496 patients with 553 fractures (90% treated operatively; 95% lateral approach, 1.5% bilateral approach, 1% medial approach, 2.2% percutaneous mini invasive osteosynthesis, and primary fusion in 0.3%). He used intra-operative open arthroscopy to

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control articular joint reduction. In this study the implanting of LCP enabled to decrease the use of bone grafting from 53% (non-locking plates) to 3.8% (LCP). In the group of 453 fractures treated by ORIF apical wound necrosis was noticed in 6.7%, evacuated hematoma in 4.7%, soft tissue infection in 4.3% and bone infection in 2.2%.

Limb amputation was not performed but compartment syndrome occurred in 2.2%. Good or excellent results were achieved by 72% of patients. In this study of 30 patients, no limb amputation had to be performed and no deep infection or no bony infection occurred. We operated within first two weeks after injury because the surgery in the third week from injury is burdened with higher percentage of soft tissue healing complications and ORIF performed with more than three weeks delay is not recommended.^{1,10,17}

In our analysis, we confirmed correlation between the Bohler's angle size and patient satisfaction. This fact, proved and verified by a lot of other authors, confirms the role of Bohler's angle size as a predictive factor for subsequent late complications.^{14,18} Louckset al¹⁹ in a prospective randomized study pointed out that initial negative size of Bohler's angle negatively influences postoperative results irrespective of therapy choice.

In accordance with other authors, by intra-articular calcaneal fracture treatment, we emphasize right operation timing, knowledge in anatomy, sufficient size of lateral approach, no-touch technique, perfect posterior facet fragment reduction in subtalar joint, restoration of calcaneal height, width and length with calcaneal-cuboid joint revision, proper tourniquet time control. Inaccurate reduction and malposition leads to persistent complaints.

In 3 cases of comminuted fractures with non-reducible subtalar joint facet, we performed secondary subtalar arthrodesis using calcaneal plate with calcaneal shape restoration. Non-operative treatment or poor intra-operative calcaneal shape restorations of these injuries results in irreparable late sequelae and patient complaints^{1,10,17,20} Knowledge in anatomy especially anatomy of the lateral hind foot vascularity with its standard architecture is important prevention of wound healing complications. Our experimental study supported the importance of precisely performed L shaped incision that respects the blood supply.

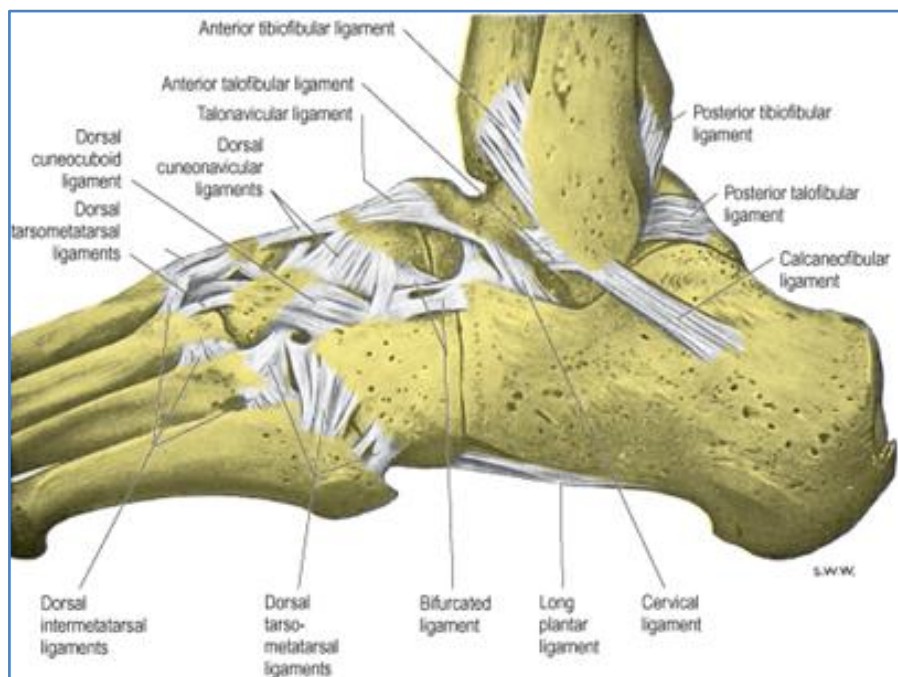
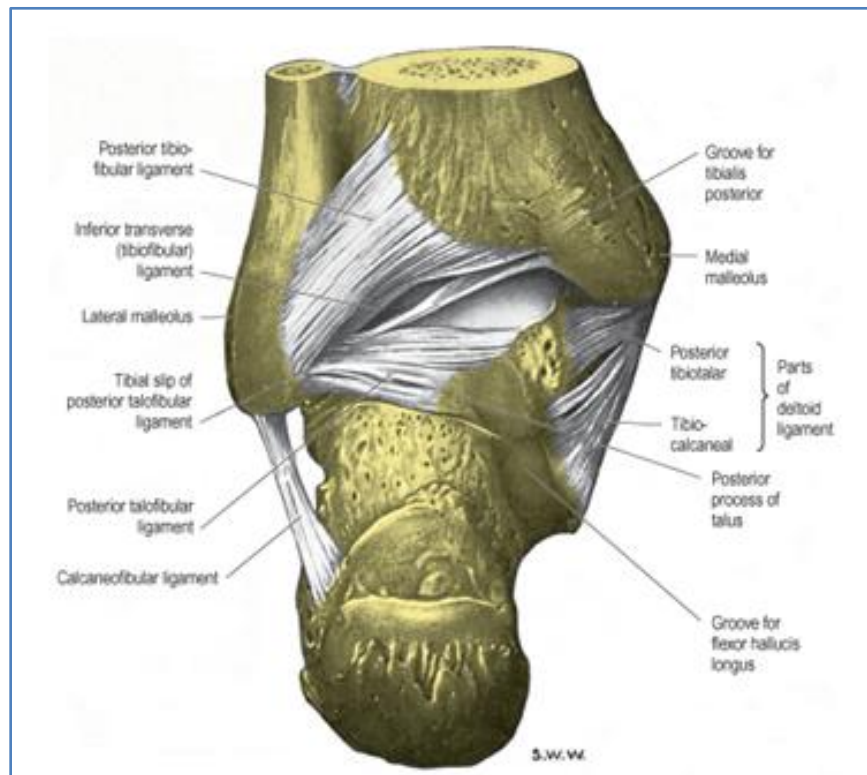
The blood supply of lateral hind foot had standard course and forms arterial arch. The course of arch defined the outline of the lateral extended approach incision for calcaneal fractures that lied fairly close to lateral outline of this vascular arcade. Inaccurate making of incision with injuring the vessels result inevitably in serious ischemic complications.²¹

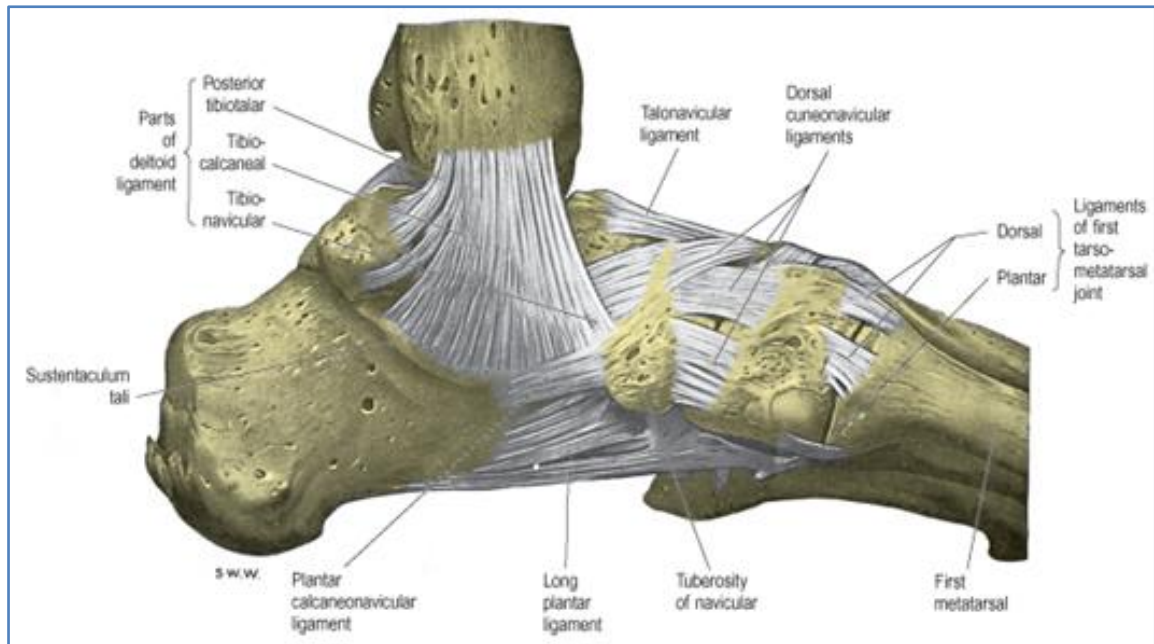
Andermahr and co-workers dissection study of 10 and 13 cadavers verified the standard course of the great arterial arch. Lateral impaction of the fragments, inappropriate operative incision and fracture immobilization with lateral splint (that may lead to aseptic necrosis of the fracture fragments) can result in lateral calcaneal artery injury.^[22, 23] Borrelli et al in a study of 24 cadavers published similar results and emphasized the importance of no touch technique and arterial arch preserving when operative incision were performed.^[24,39]

CONCLUSION: Well-timed open reduction and internal fixation in an indicated case, respecting soft tissue envelope, proper fracture reduction and early rehabilitation lead to therapeutic success. Standard operation incisions with sufficient access approach are precautions to soft tissue coverage healing complications. In general these fractures are operated with some delay. Considering the rare incidence of these fractures and due relevant experience, the primary management of these injuries

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as well as complication treatment should be centered in specialized departments of orthopedics or traumatology.





REFERENCES:

1. Zwipp H, Rammelt S, Barthel S. Fracture of the calcaneus. *Unfallchirurg* 2005; 108: 737-48.
2. Lim EA, Leung JP. Complications of intraarticular calcaneal fracture. *Clin Orthop Rel Res* 2001; 391: 7-16.
3. Zwipp H, Tscherne H, Wülker N, Grote R. Intra-articular fracture of the calcaneus. Classification, assessment and surgical procedures. *Unfallchirurg* 1989; 92: 117-29.
4. Essex Lopresti P. The mechanism, reduction technique, and results in fractures of the os calcis. *Br J Surg* 1952; 39: 395-419.
5. Sanders R. Intra-articular fractures of the calcaneus: present state of the art. *J Orthop Trauma* 1992; 6: 252-65.
6. Sanders R, Fortin P, DiPasquale T, Walling A. Operative treatment in 120 displaced intraarticular calcaneal fractures. *Clin Orthop Rel Res* 1993; 290: 87-95.
7. Sanders R. Current Concepts Review. Displaced intra-articular fractures of the calcaneus. *J Bone Jt Surg* 2000; 82: 225-50.
8. Thordarson DB, Greene N, Shepherd L, et al. Facilitating edema resolution with a foot pump after calcaneus fracture. *J Orthop Trauma* 1999; 13: 43-46.
9. Gould N. Lateral approach to the os calcis. *Foot Ankle* 1984; 4: 218-220.
10. Benirschke SK, Kramer PA. Wound healing complications in closed and open calcaneal fractures. *J Orthop Trauma* 2004; 18: 1-6.
11. Brauer CA, Manns BJ, Ko M, Donaldson C, Buckley R. An economic evaluation of operative compared with non-operative management of displaced intra-articular calcaneal fractures. *J Bone Joint Surg* 2005; 87: 2741-9.

ORIGINAL ARTICLE

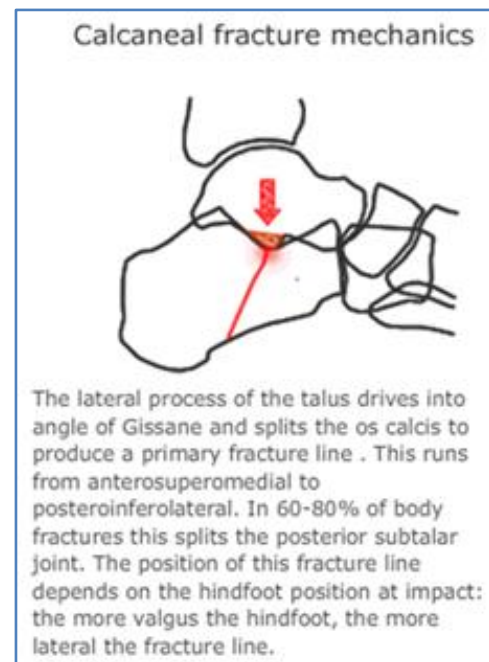
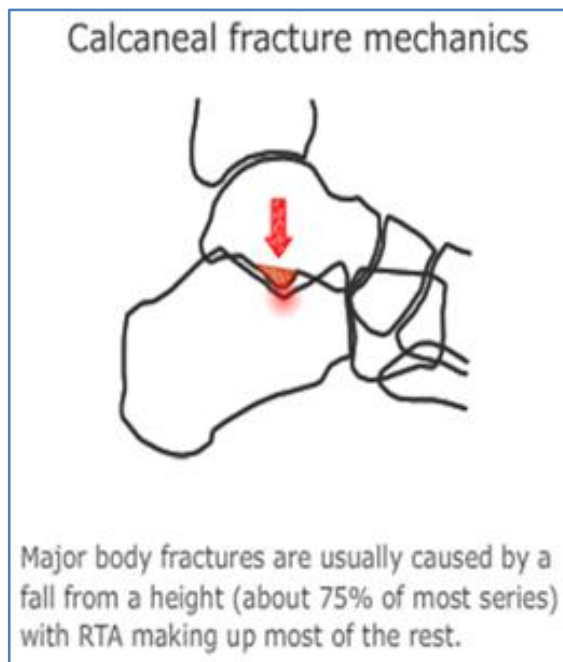
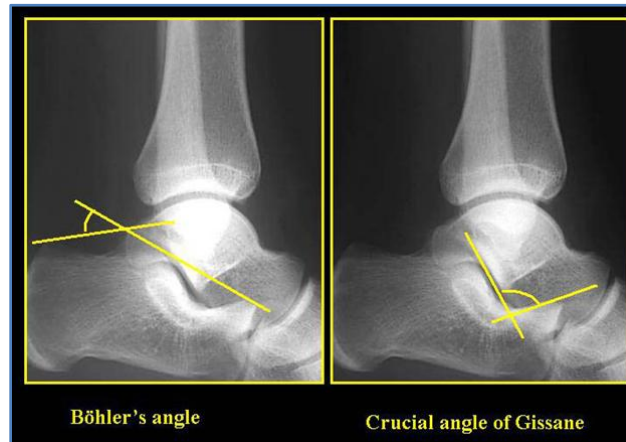
12. Displaced Intraarticular Calcaneal Fractures. Prognostic Factors for Poor Outcome. AO Journal Club/Evidence from the Literature. Orthop Trauma Dir 2004; 06: 9-16.
13. Bajammal S, Tornetta P 3rd, Sanders D, Bhandari M. Displaced intra-articular calcaneal fractures. J Orthop Trauma 2005; 19: 360-4.
14. Buckley R. Letters to the Editor. J Orthop Trauma 2002; 16: 210-1.
15. Tufescu TV, Buckley R. Age, gender, work capability, and worker's compensation in patients with displaced intraarticular calcaneal fractures. J Orthop Trauma 2001; 15: 275-9.
16. Herscovici D Jr, Widmaier J, Scaduto JM, Sanders RW, Walling A. Operative treatment of calcaneal fractures in elderly patients. J Bone Joint Surg Am 2005; 87: 1260-4.
17. Zwipp H, Rammelt S, Barthel S. Calcaneal fractures-open reduction and internal fixation (ORIF). Injury 2004; 35: SB46-54.
18. Hart AJ, Eastwood DM. Displaced intra-articular fractures of the calcaneus: What is New? Trauma 2003; 5: 9-21.
19. Loucks C, Buckley R. Bohler's angle: correlation with outcome in displaced intra-articular calcaneal fractures. J Orthop Trauma 1999; 13: 554-8.
20. Carr JB, Hansen ST, Benirschke SK. Subtalar distraction bone block fusion for late complications of calcaneus fractures. Foot Ankle 1988; 9: 81-6.
21. Rak V, Matonoha P, Otahal M, Masek M. Vascularization of the lateral heel in relation to extensive skin incision in osteosyntheses of calcaneal fractures. RozhlChir 2007; 86: 483-8.
22. Andermahr J, Helling HJ, Landwehr P, Fischbach R, Koebke J, Rehm KE. The lateral calcaneal artery. SurgRadiolAnat 1998; 20: 419-23.
23. Andermahr J, Helling HJ, Rehm KE, Koebke J. The vascularization of the calcaneum and the clinical consequences. ClinOrthopRel Res 1999; 363: 212-8.
24. Borrelli J Jr, Lashgari C. Vascularity of the lateral calcaneal flap: a cadaveric injection study. J Orthop Trauma 1999; 13: 73-7.

Table 1: Classification of patients according to pre-operative Bohler's angle:

	Excellent	Good	Fair	Poor
Pre-op Bohler $\geq 20^\circ$	2	1	0	0
Pre-op Bohler $< 20^\circ$	10	6	12	4

Table 2: Comparison of Allmacher grade in respect of preoperative Bohler's angle:

	0	1	2	3	4
Pre-op Bohler $\geq 20^\circ$	2	1	0	0	0
Postop Bohler $< 20^\circ$	8	17	4	2	1

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