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A comparative study on outcome of maintaining Bohler angle & Gissane angle in the treatment of calcaneum fracture: A retrospective analysis

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Abstract

Background: Calcaneum fracture is the most frequently injured tarsal bone of human body. It consists of 2% of all fractures, out of them 70% are intra-articular fracture. 10% injuries are bilateral and 5% are open fractures which leads to high potential for disability. Best treatment option is always controversial. The aim of our study was the management and outcome of these fractures by maintaining angles like Bohler's angle and Gissane's angle by either conservative or surgical method.

Objective: To compare and evaluate the outcome of calcaneum fracture by maintaining Bohler's angle and Gissane's angle of calcaneum by conservative or surgical procedure, taking into account, the post management outcome, complications, and the AOFAS questionnaire.

Material & Methods: This is a Retrospective study design, where a retrospective study was carried out on 60 patients at SCB Medical College from 2015 to 2017 of which 20 patients were referred to SCB OPD from peripheral centres with old calcaneum fracture & who did not received any treatment for the same. Rest 40 patients with calcaneum fracture were intervened of which 10 had bilateral calcaneum fracture. For statistical method: Chi-square test was used. P value was calculated to determine the level of significance.

Results: We have achieved good functional outcome with AOFAS score of 78 as compared to 62 of control group by trying to restore the angles of calcaneum by interventions. (Conservatively or Surgical)

Conclusion: Surgical or conservative management of calcaneum fractures according to types of fractures by maintaining angles like Bohler's angle and Gissane's angle gives good functional results.

Keywords: Calcaneum, fractures, boehler, gissane, angle

Introduction

Calcaneum fracture is the most frequently injured tarsal bone of human body & it is one of the most challenging fracture to deal with, which is most common in means working in industrial setup. It consists of 2% of all fractures. Out of them 75% are intra-articular fracture, 10% injuries are bilateral and 5% are open fractures which leads to high potential for disability. Extend and pattern of fracture depends upon severity of trauma, causing force, osteoporosis, position of foot during impact. Tongue fracture type are highly prone for overlying skin necrosis if left untreated. Skin blisters and oedema requires monitoring and delay in open reduction surgical fixation. Intra-articular incongruity in calcaneum fracture leads to arthritis of subtalar, calcaneo-cuboid joint and splaying of lateral wall leads to peroneal impingement. There may be disturbed gait due to varus mal-alignment of the heel and opening of gastro-soleus complex due to elevation of Tendo-achilis insertion. Therefore maintenance of boehler's angle and gissane angle during management of calcaneum fracture has its own importance to avoid such problems. Regardless of mode of treatment, chronic pain remains in some patients, limiting their capacity to carry daily activities. Late complication occurs like post traumatic arthrosis of the subtalar joint, anterior ankle impingement, tibial & sural nerve complications, fat pad atrophy, chronic regional pain syndrome, lateral subfibular impingement of peroneal tendon.

Aim of the study

The aim of our study was management of calcaneum fracture by maintaining angles like Bohler's

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angle and gissane's angle, either by closed manipulation & cast or surgical intervention. Bohler's Angle- Formed by line from highest point of anterior process to highest point of posterior facet and the line running along the superior portion of the calcaneal tuberosity. Also know as Tuber angle of Bohler.

Normal is 20 to 40 degrees.

Gissane's Angle- Formed by a line that runs along the lateral border of the posterior facet, and a line extending along the beak of the calcaneus. Normal angle is 120 to 140 Degrees.

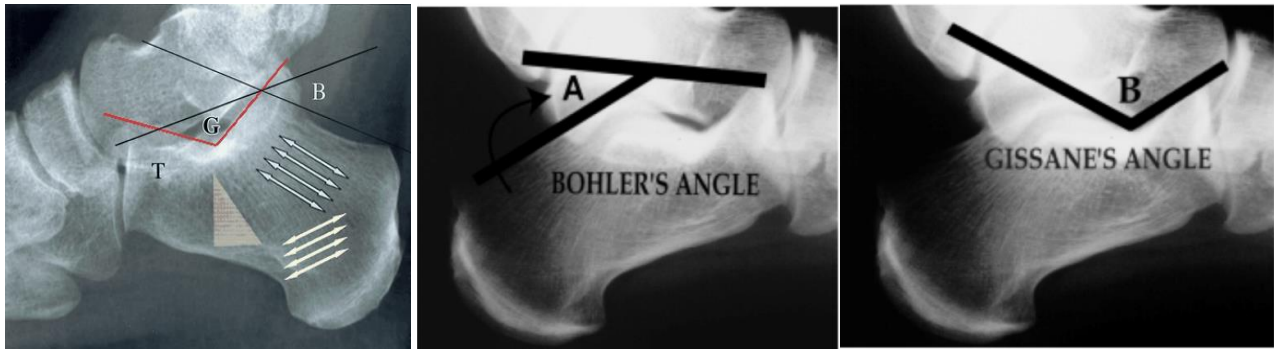


Fig 1: x-ray showing radiographic anatomy, Bohler's angle & Gissane's angle classification according to mechanism of injury: A. joint depression type B. tongue type

Sander's classification

Type I- Nondisplaced

Type II & III- Have two & three fragments respectively, which

are then subdivided depending on the medial or lateral position of the primary fracture line.

Type IV- Severely comminuted

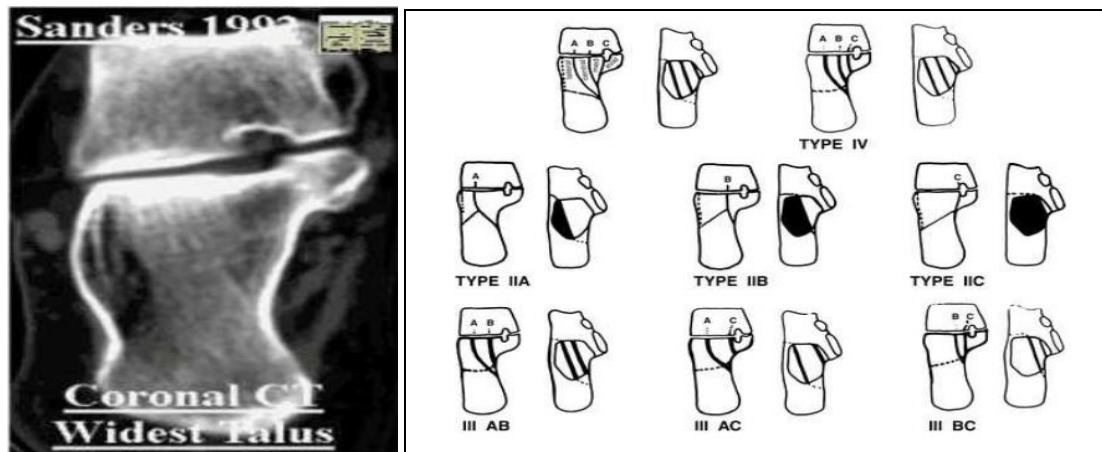


Fig 2: Classification calcaneum fracture

Materials and Methods

The total number of patients were 60. The sample size was decided according to convenience (Convenient sampling). Study was done from 2015 to 2017 in the Department of Orthopaedics, SCB Medical College. Out of them, 41 were males & 19 were female patients. Mode of injury was fall from height. Total calcaneum fracture 73 (Includes 13 bilateral cases). From 60 patients, 20 were referred from peripheral centres. They had old calcaneum fracture, and had received treatment from local rural quacks & bonesetters (3 had bilateral calcaneum fracture). These 20 patients were treated as controls for our study, since they did not receive medical treatment at the time of fracture. Rest 40 patients who sought immediate medical attention were intervened conservatively & surgically. And these cases formed the study group.

We have taken Sanders type-II/type-III cases with articular displacement more than 1 mm in our study. Sanders type- I calcaneum fracture were excluded from our study.

Conservative treatment done in 16 cases with below knee cast after closed manipulation. These includes- 1. Patients with comorbidities that preclude good surgical outcome, 2. anterior process fracture involving less than 25% of calcaneo-cuboid

joint, 3. articular displacement of less than 2mm of Sander's type-II.

Surgical treatment performed in 34 cases with lateral extensile approach, K-wire, Steinman pin, reconstruction plate & Screw fixation. These includes- 1. Sander's type- III, 2. Sander's type-II fracture with Gross displacement of >2mm.

Cases excluded were – 1. Extra Articular Fracture. 2. Compound injury. 3. Associated spinal or other injury. 4. Osteoporotic. 5. Peripheral vascular disease. 6. Skin infection. 7. Age < 18 years. 8. Age over 60 years.

Radiological evaluation

- Lateral X-Ray** = shows Tuber angle of Bohler & Crucial angle of Gissane.
- Antero Posterior view** = shows fracture extension to calcaneocuboid joint.
- Harris Axial view** = shows loss of height, increase in width, angulation in tuberosity.
- Broden's view** = shows articular process of posterior facet.
- Three Dimensional CT scan** = shows complete articular fracture pattern.

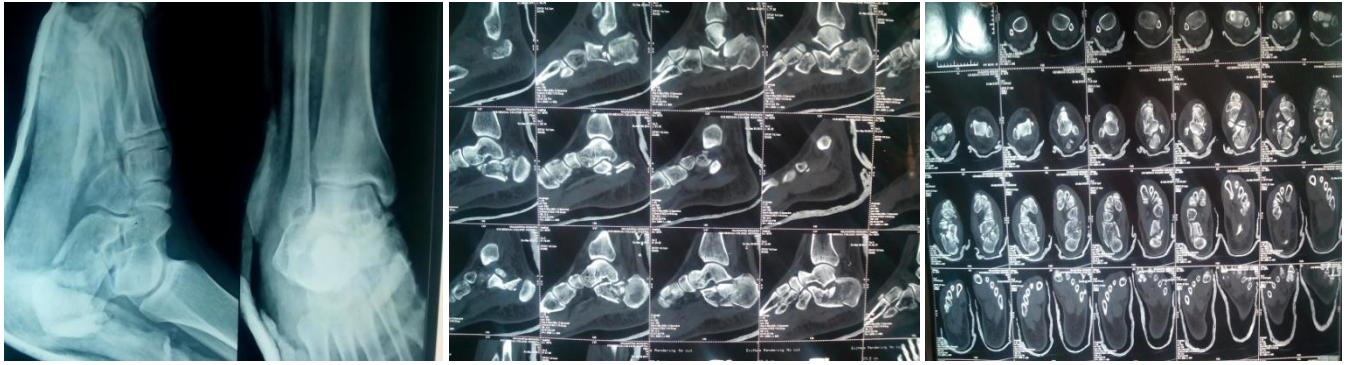


Fig 3: Pre-op X-ray & CT scan

Bilateral X-Rays of AP view, Axial view, Lateral views were taken preoperatively, immediate post operatively, and late post operatively. Angle of Gissane & Bohler's angle was measured. All the patients responded to questionnaire of American Orthopaedic Foot & Ankle Society (AOFAS). The AOFAS questionnaire measures the subjective scale of pain, foot function, and the alignment of the foot and ankle, with the following variables: level of activity (Basic or recreational), walked distance, ability to walk in different surfaces, gait abnormality, foot and hind foot motion (Flexion-extension and inversion-eversion), and ankle hind foot stability. In the scoring, total of 100 points: Pain [40 points], Function [50 points], Alignment [10 points]. Excellent results range from 90 to 100 points. Good results range from 80 to 89; Satisfactory, from 70 to 79; and Poor, below 69.

Conservative treatment

Conservative treatment was done with Below Knee plaster cast after closed manipulation, after subsiding of swelling, done in minimally displaced fractures <2mm (sander's type II), elderly patients, with comorbidities, anterior process fracture with less than 25% involvement of calcaneo-cuboid joint.

Surgical management

Done for displaced fractures. Sander's type III & Sander's type II with >2mm displacement. Percutaneous fixation with K-wires or Steinman pins done for sander's-IIc type fracture, beak fracture. Essex-Lopresti maneuver was used for reduction. Cortical lag screws and cannulated screw fixation done in two patients. While doing the procedure fluoroscopy imaging was used as guide to maintain Bohler's and Gissane angle as far as possible.

Seligson's lateral extensile approach for open reduction and

fixation with plate and screws was used in few patients with gross displaced and intra-articular fracture. Surgery was performed after 2 weeks of fracture, after wrinkling sign was positive, to avoid soft tissue complication & infection. This approach was preferred because it minimizes Peroneal tendinitis, reduces devascularisation of the anterior skin flap and preserves the sural nerve. Here patient lies in lateral decubitus position on the table, with scissoring manner where the normal limb lying down straight & affected limb lying up with knee bend. Calcaneum is exposed laterally & reduction of fragments is done by vision & also by help of image intensifier, provisional reduction is done through K-wires & Steinmann pins then definitive fixation is achieved by anatomical plate & screws. proper valgus alignment of tuberosity fragment is important, patient tolerates varus malalignment poorly. This is achieved by intra operative Harris view radiography. Sural nerve & Peroneal tendon injuries are more common with this approach. Sural nerve should be protected at both proximal & distal edge of incision line. Peroneal tendons are particularly vulnerable because the flap is elevated over a protruding lateral wall, especially if the tendons are dislocated by the wall. Then wound is closed with proper respect to flap to prevent flap necrosis & wound dehiscence. Allgower Donaghty suture is used. A closed suction drain given & compressive sterile dressing is applied.

Suction drain is used for 24 to 48 hours. Limb is elevated for 72 hours and icing is done to minimize swelling & pain. Stitch is removed after 2 to 3 weeks. If the flap heals uneventfully then active range of motion in ankle & subtalar joint is encouraged and posterior POP slab is used for support, in the mean while weight bearing is not allowed till 3 weeks of surgery. Gradual supportive weight bearing allowed after 3 weeks with walker.



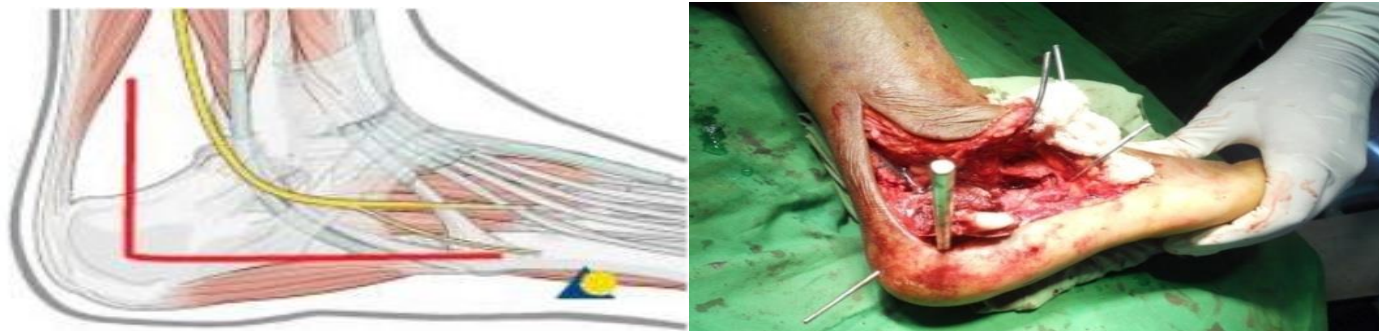


Fig 4: Lateral extensile approach & per- operative clinical photographs

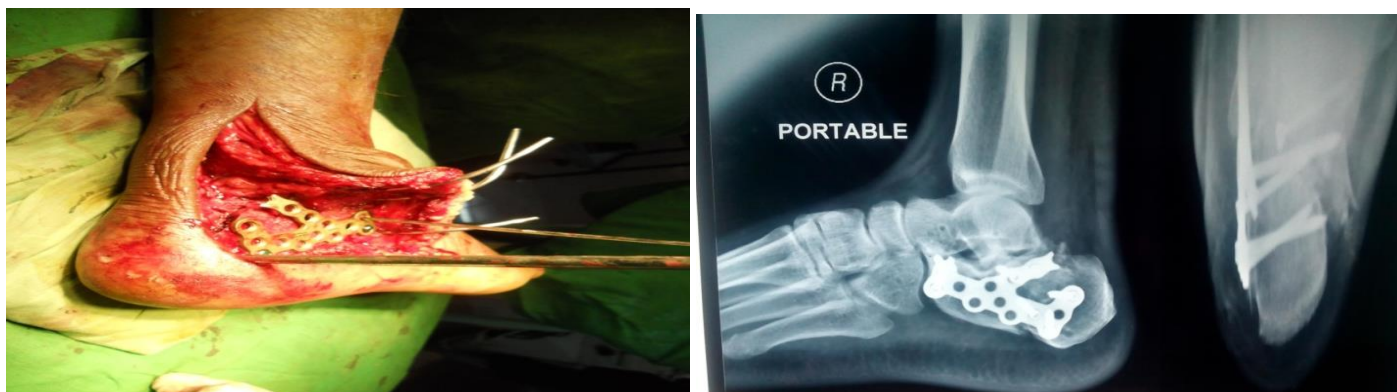


Fig 5: Final per-operative fixation & post operative X-ray



Fig 6: Post- op 9 months and after removal x-rays



Fig 7: Final clinical photographs of various movements.

Results

Out of total of 60 calcaneum fractures, 50 were intervened by us, they consisted the study group. Sander's Type-II= 30 cases & Type- III= 20 cases, rest 10 fractures were taken as control subjects. Operative group includes 34 cases (6 bilateral & 22 unilateral) and conservative group 16 cases (bilateral 4 cases & 8 unilateral). Out of which wound dehiscence in 2 cases, necrosis wound edges in 4 cases and early superficial infection in 2 cases were found. We observed AOFAS score= excellent in 13, good

in 14 cases, satisfactory in 5 cases & poor in 2 cases in the operative group & 9 good & 7 satisfactory seen in conservative group. Mean Post interventional Bohler's angle is 19 Degrees as compared to control group which has 9 Degrees. & mean Post interventional Gissane's angle is 124.75 Degrees as compared to control group, which has 162 Degrees. Mean AOFAS score for intervened cases was 78 as compared to 62 of control cases.

AOFAS score in study & control group

Table 1: Operative group

Sander's Type	Excellent	Good	Satisfactory	Poor
II	9	8	3	-
III	4	6	2	2

Table 2: Conservative group

Sander's Type	Excellent	Good	Satisfactory	Poor
II	-	6	4	-
III	-	3	3	-

Table 3: AOFAS score in study & control group

Results Of AOFAS Scale	Variance	Mean
Study cases	65 – 92	78
Control cases	58 – 64	62

In operative cases**Table 4.a:** Various angle in degree

Sander's type	Type II (20 cases)	Type III (14 cases)
Bohler's Angle:		
Pre-Op	10	8.6
Post-Op	25.4	22.6
After 1 Yr	22.4	21.3
Gissane's Angle:		
Pre-Op	146	160
Post-Op	114	122
After 1 Yr	112	121

In conservative cases**Table 4.b:** Various angle in degree

Sander's type	Type II (10 cases)	Type III (6 cases)
Bohler's Angle:		
Pre-CON	8	9
Post-CON	18.5	15.4
After 1 Yr	17.4	15.3
Gissane's Angle:		
Pre-CON	150	154
Post-CON	128	140
After 1 Yr	126	140

In control group**Table 5.a:** Various angle in degree

	Mean Angle
Bohler's Angle	9 degrees
Gissane's Angle	162 degrees

In study group**Table 5.b:** Various angle in degree

	Mean Angle
BOHLER'S Angle	19.1 degrees
GISSANE'S Angle	124.7degrees

Statistical Analysis: 2x2 Contingency Table**Table 6:** Various mean interventional angle in degree

	Bohler's angle	Gissane's angle
Study group	19	124
Control group	9	162

Chi-Squared equals 5.224 with 1 degrees of Freedom
The two-tailed P value equals 0.0223 which is <0.05

Discussion & Conclusion

Controversies still remain on operative versus nonoperative treatment for fracture calcaneum. Many researches still suggests that, there is no great difference between patients treated conservatively & operatively. Studies also suggest early mobilization improves long term outcome in conservatively treated fracture calcaneum. However displaced intra-articular fracture treated non-operatively do not give good functional outcome, results of operative treatment also vary from cases to cases. Newer studies suggest outcome depends upon quality of reduction of the posterior facet. Essex – Lopresti stated that 80% of patients younger than age 50 years who had “successful reduction “of posterior facet had satisfactory results, too early weight bearing before at least 8 weeks causes’ loss of reduction of major fragments & affects results of surgery.

Newer few small studies show better functional scores for operatively treated patients than those treated nonoperatively. Operative patients are able to return to there work & occupation early, specially when anatomical reduction is obtained by surgery. We found similar results in our study.

Since last decade ORIF of intra-articular fracture calcaneum has become a standard surgical method with low complication rate& better quality of life after surgery.

To minimise soft tissue complication, closed reduction & percutaneous fixation is preferred by many surgeons. But requires thorough knowledge of calcaneal anatomy and skills & expertise to reduce bony fragments. This method is not suitable for Sander's- III & IV type of fracture.

Reproducing the Crucial angle of Gissane & Bohler's angle to near its normal angle in calcaneum fracture improves the outcome of intervention as seen in this study by improved AOFAS score.

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Five multicentric studies comparing conservative vs operative favoured operative & similar results with excellent outcome in 8 patients compared to 19 satisfactory outcomes in conservative group of patients.

To conclude, Fracture calcaneum is a difficult fracture to manage, controversy still exists wheather we should deal it operatively or conservatively, but according to our study conservative or surgical management in fracture calcaneum by doing anatomical reduction of posterior facet & maintaining the Bohler's angle & Critical angle of Gissane, gives good results in term of long term functional outcome, painfree gait, return to their occupation & not spoiling their productivity, ability to wear normal footwear, less swelling on prolonged walking, less need for subsequent subtalar arthrodesis to relieve pain while walking and painfull ankle movement.

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