The clinical significance of common radiographic parameters of intraarticular calcaneal fractures in terms of pain duration after non-operative management

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Aims and objectives

Introduction:

The os calcis is the most commonly fractured tarsal bone of the foot and around three quarters of them are intra-articular fractures. The management of calcaneal fractures, conservative or operative, is controversial as the evidence for the outcomes of both groups is conflicting. There is also no strong predicting factor on the clinical outcome for those patients. Sander’s classification is most commonly used with some prognostic implication with higher grades. Traditionally, the initial assessment of calcaneal fracture was by means of radiographs. This has been replaced gradually replaced by computed tomographic scans for better delineation of the fracture extent. However radiographs are still in use today because they are readily available and are useful for follow up. There have also been many studies in assessing the significance of radiographic parameters of calcaneal fractures but have returned non-conclusive results. In our study we have selected parameters which are more easily measured at identifiable fixed points on a radiograph. These include Bohler’s angle, Gissane’s angle, length of calcaneum, calcaneal facet height, absolute foot height, posterior facet inclination angle and width of calcaneum. The clinical outcome which we defined is reported pain at follow up at different time points after the fracture. This simple clinical outcome may have better resemblance of daily clinical practice in contrast to formal pain scores.

Objective:

The purpose of this study is to investigate the significance of common radiographic parameters of intraarticular calcaneal fractures in its association with clinical outcomes in terms of pain duration after non-operative management.

Methods and materials

Methods and materials:

Our study adopted a retrospective cohort design. A total of 69 patients with intraarticular calcaneal fractures who were treated non-operatively were included over a 5-year period (2006-2010). Patients with extra-articular fractures that did not involve the posterior facet were excluded.

Non-operative management included leg elevation, administration of ice packs during hospitalization for about 1 week. Thereafter the patients had non-weight bearing for 6-8 weeks and subsequent gradual weight bearing.
The radiographs of these patients at the time of fracture were reviewed. The images were reviewed on the PACS station (Impax, Agfa Healthcare NV, Belgium). Measurements of selected parameters were made including Bohler’s angle, Gissane’s angle, length of calcaneum, calcaneal facet height, absolute foot height, facet inclination angle and width of calcaneum. The images were reviewed by two radiologists with 5 years and 3 years of experience in general radiology.

Thirty cases were assessed by both radiologists to test the reproducibility of the measurements.

Radiographic measurements Fig 1-7:

Bohler’s angle (A) is measured using the highest points of the calcaneal tuberosity, the subtalar joint and the anterior process.

The angle of Gissane (B) is formed by the posterior facet and the line from the calcaneal sulcus to the tip of the anterior process of the calcaneum.

The length of the calcaneum (C) is measured from the most posterior point of the tuberosity to the calcaneocuboid joint.

The calcaneal facet height (D) is measured as the perpendicular distance from the most superior point of the posterior facet to a line jointing the inferior aspect of the calcaneocuboid joint and the inferior aspect of the calcaneal tuberosity.

The absolute foot height (E) is measured from the plane of support to the upper point of the talus. The plane of support is taken as the line joining the inferior aspect of the calcaneum to the inferior aspect of the 5th metatarsal base.

The posterior facet inclination angle (F) is measured as the angle between the two intersecting lines drawn along the surface of the posterior facet and the upper surface of the calcaneal tuberosity.

The width of the calcaneum (G) is measured on the axial view excluding the sustenaculum.
The subsequent clinical notes of these patients were reviewed to evaluate for the presence of pain symptoms at selected time points (30, 60, 90, 180, 270, 365 days) up to 1 year. Those that reported pain and those without at these time points were compared in terms of the radiographic measurements.

Statistical analysis was performed by using the Statistical Package for the Social Sciences (version 20.0 for Mac.; SPSS Inc., Chicago, IL, USA) and any statistical significant difference in the mean values of the various radiographic parameters was determined by ANOVA test.

Reproducibility of the measurements between the observer was tested using the Pearson Correlation Coefficient.

Images for this section:
Fig. 1: Bohler's Angle
Fig. 2: Angle of Gissane
**Fig. 3:** Length of calcaneum
Fig. 4: Calcaneal facet height
Fig. 5: Absolute foot height
Fig. 6: Posterior facet angle
Fig. 7: Width of calcaneum
Results

A total of 69 patients were included for assessment. It consisted of 56 men and 13 women. The age ranged from 20-85 with a mean age of 52 years old. The mean follow up period was 210 days.

Comparison of calcaneal heights for various clinical outcomes is shown in Table 1.

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<th>Pain at 30 days (n=57)</th>
<th>No Pain at 60 days (n=19)</th>
<th>Pain at 60 days (n=50)</th>
<th>No pain at 90 days (n=24)</th>
<th>Pain at 90 days (n=45)</th>
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<th>Pain at 180 days (n=26)</th>
<th>No pain at 270 days (n=58)</th>
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<td>Calcaneal facet height (mm)</td>
<td>Absolut e foot height (mm)</td>
<td>Face t inclination angle (mm)</td>
<td>Width of calcaneum (mm)</td>
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Table 1: Comparison of calcaneal heights with various clinical parameters.

References: Dr WCS Chan

Results revealed that those with pain at 365 days (6 patients) after the fracture had a smaller absolute foot height compared with those without pain (63.8 vs 70.1, p<0.05).

There was no statistically significant difference between the parameters and the presence of pain at the other selected time points.

Test of reproducibility of the measurements of the parameters is shown in Table 2.
Table 2: Reproducibility of parameter measurements

References: Dr WCS Chan

Conclusion

Discussion:

The os calcis is the most commonly fractured tarsal bone of the foot. Around 75% of this is intra-articular with fracture involving the posterior facet joint. The management of calcaneal fractures, whether conservative or operative is controversial as the evidence for the outcomes of both groups is conflicting.\(^1,2\) There is no strong predicting factor on the clinical outcome for those patients.

With the advent of CT, cross-sectional imaging is now the choice of fracture delineation particularly true in that of the calcaneum where anatomy and fracture pattern is complex. However the use of radiographs still has its role given it being readily available at low costs and its lower radiation dose.

There have been many studies in assessing the significance of radiographic parameters of calcaneal fractures. Schepers et al\(^3\) had a comprehensive assessment of the known parameters of the calcaneum. Of the many parameters that they investigated, the
absolute foot height correlated with subsequent arthrodesis. This is somewhat in keeping with what our results revealed. They also found the tibiotalar angle to be associated with patient satisfaction score. However we did not include this parameter in our study because we found these angles difficult to measure with no fixed points as reference.

Regarding the correlation of Bohler’s angle and outcomes several studies found a correlation 4-7 while others failed to demonstrate this correlation 8-11. A 15 year follow up of patients after fracture also showed no correlation 13. Our results also show no correlation. No correlations have been demonstrated between the angle of Gissane and outcomes 9,11,12 in previous studies and likewise in our study.

Furthermore, a test of reproducibility of the measurements showed that the interobserver correlation coefficient was highest for the absolute foot height. The length of calcaneum and calcaneal facet height also had good correlation between the observers.

A limitation of this study is that the clinical outcome of pain was based on clinical records only without formal scoring system. However, this fact may also be advantageous as it may reflect pain deemed only to be clinically significant and thus affecting their management.

Our results suggest the absolute foot height measured on the radiographs may have clinical value in predicting clinical outcome for patients with intra-articular fractures managed non-operatively. Further studies are required to strengthen this postulation. The clinical value of the same measurement made on CT scan would also be of interest.

Conclusion:

Out of the many radiographic parameters described in calcaneal fractures, a smaller absolute foot height was found to be associated with more complaints of pain at 365 days amongst patients with intraarticular fractures with non-operative management. Other parameters were not associated with pain outcomes.

Personal information

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References


