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Role of computerised tomography in management of intra-articular fractures of the os calcis

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Abstract This study aimed to look at the role played by the CT scan in decision making in the management of intra-articular fractures of the calcaneum. Twenty-four patients with intra-articular fractures of the calcaneum were included. Their initial radiographs and CT films were blinded and assessed by three independent observers. Based on this they were selected for operative or non-operative management. The actual management was also recorded. The data were then subjected to statistical analysis to look at the association between the decision from radiograph, that from the CT scan and the actual management undertaken. Non-parametric tests for related samples were performed to look at the association between the actual management and the decisions made by assessing the radiographs and the CT scans. For all three observers, there was no significant difference between the actual management and decisions made by assessing the plain radiographs or the CT scan. There was also no significant difference between the radiograph-based and the CT-based decisions. However, the Cochran Q test showed that there was significant variation among the three observers for the CT-based assessment. Our results, show that the CT scan should only be done when a definite decision is made to operate on a patient, based on plain radiographs. Calcaneal fractures which are selected for non-operative management, based on X rays, should not have a CT scan as a routine as it provides no valuable additional information affecting the management decision.

Résumé Quel est le rôle joué par le scanner dans la décision concernant les indications du traitement des fractures articulaires du calcanéum? 24 patients avec une fracture articulaire du calcanéum ont été inclus dans cette étude. Les radios initiales et les films scanners ont été analysés par trois observateurs indépendants. A partir de ces données, les patients ont été sélectionnés pour un traitement orthopédique ou un traitement chirurgical avec une analyse statistique permettant de relier le traitement prévu et les décisions que l'on pourrait prendre en fonction de l'analyse des radiographies et du scanner. Il n'y a pas eu de différences significatives dans les décisions prises par les trois observateurs à l'examen des radiographies et du scanner rapportées aux traitements prévus. Il n'y a pas eu également de différences significatives sur la décision à partir de l'examen des radiographies ou de l'examen du scanner. Le test de Cochran a montré une différence significative entre les trois observateurs sur les analyses du scanner. A partir de l'analyse de ces résultats, nous pouvons dire que l'indication de scanner n'est indiquée que pour les patients chez lesquels une décision opératoire était prise à partir d'examens radiographiques. Les fractures articulaires du calcanéum pour lesquelles il n'est pas prévu de traitement opératoire et pour lesquelles il est prévu un traitement orthopédique, à partir de l'examen des radiographies simples, ne doivent pas bénéficier d'un scanner de routine. Celui-ci n'apporte pas d'informations supplémentaires quant à la décision thérapeutique

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Introduction

Fractures of the os calcis account for 1–2% of all fractures and represent the most common of the tarsal fractures [4, 8]. They are usually the result of a fall from a height. They are commonly bilateral and are associated with fractures of the spine. The fractures can be classified as those involving the talo-calcaneal joint, subtalar (intra-articular), and those that do not. The injury is found predominantly in young or middle-aged men and causes a very significant loss of economic activity, as it takes up to 18 months to regain

full weight bearing [2]. The injury also results in residual heel pain, deformity and swelling in many individuals. It is thus imperative to achieve a good pain- free functional outcome in these patients.

The management of calcaneal fractures is the subject of much debate and controversy [9–11, 15]. It may be operative or non-operative, and various studies in the literature have claimed similar results in both these groups. However, recently published randomised control trials, comparing operative and non-operative management, show slightly better outcomes in certain groups of patients treated surgically [3]. Non-operative interventions involve the use of ice, elevation, plaster splintage and early mobilisation. The operative methods involve closed reduction with pins, open reduction and internal fixation, and arthrodesis [8, 11]. The management decision to operate or not is based on assessment of the axial and lateral radiographs and a computerised tomography (CT) scan. Various classification systems have been proposed, based on radiographs [7, 14] and CT [5, 6, 12, 16]. The classification system suggested by Sanders [13] has been found useful in determining treatment and prognosis. However, this CT-based classification system has high degrees of variability and inconsistencies [1]. It has been suggested that the best method of assessing a calcaneal fracture is a CT scan. We set out to assess the role that a CT scan plays in the management of these fractures and to determine whether it makes any difference in the decision making process.

Methodology

This was a retrospective cohort study. Twenty-three individuals with 24 fractures of the calcaneum were included in the study. Only intra-articular fractures, involving the talo-calcaneal joint, were included. These fractures were investigated with lateral and axial radiographs and a CT scan. The actual management, in dichotomous groupings (operative or non-operative), was also documented. The films were then blinded as to patient's name and age, placed in random order and assessed by three individual observers separately. The observers were asked to assign the radiographs to operative or non-operative management. The CT scan films were then similarly assessed for operative or non-operative treatment. The observers were not told of their radiograph-based management decision before they graded the CT scans. The results were then analysed using statistics software (SPSS version 11).

Results

The agreement between the actual management and the management decision made from assessing the radiographs, and that between the actual management and the management decision assessing the CT scans, were analysed for each of the three observers. The data were non-parametric and related. The sign test was used to analyse whether the decisions made in each of the groups were

Table 1 Sign test: radiographs versus actual management

Observer	Significance (<i>P</i> value)	Number of agreements (out of 24)
Observer 1	0.75	14
Observer 2	0.06	13
Observer 3	0.72	16

significantly different from the actual management. The results are enumerated in Table 1 and 2.

The *P* value, for the sign test, was greater than 0.05 for all sets of observations. This means that there is no statistically significant difference at the 5% level, for any of the observers, between the management decision from the radiographs and the actual management (Table 1) or between the decision from the CT films and the actual management (Table 2). This implies that there is good agreement between the decisions and the actual management for both the CT scans and the radiographs.

The change in management that the CT scan brought about was also assessed for each of the observers using McNemar's test. This test is used to detect changes in responses in each case brought about by the CT scan. This was carried out as the data were non-parametric, related and the response dichotomous. There was no statistically significant difference ($P > 0.05$) in the decision made (i.e. non-operative or operative treatment), between the radiographs and the CT scan assessments, for any of the three observers. Thus, a CT scan did not make any significant difference to the decision based on the plain radiographs as to whether to operate or not.

A statistical analysis was also performed to assess the variability of the management decisions regarding the 24 fractures among the three observers. A Cochran Q test was used for the analysis, showing that there was no significant difference ($Q = 3.84$, $P = 0.14$) between the radiograph based assessments of the three observers. However, there was statistically significant difference ($Q = 9.50$, $P = 0.009$) among the CT-based assessments of the observers. This shows that there is more inter-observer variability in decision making using the CT-based assessment.

The results show that neither the radiograph-based nor the CT-based management decision differed significantly from the actual management. There was also no statistically significant difference between the decisions based on the two modalities. A CT scan, therefore, does not significantly change the management decision from that already decided from assessing the plain radiographs.

Table 2 Sign test: CT scan versus actual management

Observer	Significance (<i>P</i> value)	Number of agreements (out of 24)
Observer 1	0.75	14
Observer 2	0.05	10
Observer 3	0.29	16

Discussion

Typically, intra-articular fractures of the os calcis are assessed using lateral and axial plain radiographs, followed by a CT scan. There is a tendency routinely to request a scan to delineate the fracture fragments when the plain radiograph suggests an intra-articular fracture. It has been suggested that a CT scan is the best method of assessing an intra-articular fracture in order to decide management. It is thought that the scan may delineate the fracture fragments better than a plain radiograph and thus help in making the management decision. However, the best-known CT-based classification system, that of Sanders, has been shown to have high degrees of variability and inconsistencies [1]. The study reported here demonstrated that there was good correlation between the final actual management and both the plain radiograph-based and the CT scan-based assessments. There was no difference in the management decisions (operative or non-operative), between the plain radiographs and the CT scans. McNemar's test, performed to see whether the CT scan made any change to the management decision from that based on plain radiographs, showed that CT did not significantly alter the decision for any of the three observers. In fact, the decisions based on the CT scan showed a greater degree of variability between the observers, than the decisions based on plain radiographs. This was demonstrated by the Cochran Q test ($P < 0.01$). These tests suggest that the management decision on whether to operate or not can reliably be based solely on plain radiographs. Thus, there may be no need to obtain a CT scan as a routine in all intra-articular fractures of the os calcis. However, once the decision to operate has been made, the CT scan is useful in providing further detail of the fracture pattern.

Conclusion

We conclude that a CT scan should be requested only when a decision has been made to operate on the fracture, based on plain radiographs. This may help to delineate the fragments in a comminuted fracture and may assist the pre-operative planning of fracture fixation. A CT scan does not have to be obtained as a routine to assess all intra-articular fractures of the calcaneum.

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