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Original Article

Risk of injury to vascular-nerve bundle after calcaneal fracture: comparison among three techniques

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ARTICLE INFO

Article history:
Received 2 May 2015
Accepted 15 June 2015
Available online 16 February 2016

Keywords:
Calcaneus/injuries
Orthopedic pins
Bone screws
Operative surgical procedures/methods

ABSTRACT

Objective: To ascertain whether the number of screws or pins placed in the calcaneus might increase the risk of injury when three different techniques for treating calcaneal fractures.
Method: 126 radiographs of patients who suffered displaced calcaneal fractures were retrospectively analyzed. Three surgical techniques were analyzed on an interobserver basis: 31 radiographs of patients treated using plates that were not specific for the calcaneus, 48 using specific plates and 47 using an external fixator. The risk of injury to the anatomical structures in relation to each Kirschner wire or screw was determined using a graded system in accordance with the Licht classification. The total risk of injury to the anatomical structures through placement of more than one wire/screw was quantified using the additive law of probabilities for the product, for independent events.
Results: All of the models presented high explanatory power for the risk evaluated, since the coefficient of determination values (R^2) were greater than 98.6 for all the models. Therefore, the set of variables studied explained more than 98.6% of the variations in the risks of injury to arteries, veins or nerves and can be classified as excellent models for prevention of injuries.
Conclusion: The risk of injury to arteries, veins or nerves is not defined by the total number of pins/screws. The region and the number of pins/screws in each region define and determine the best distribution of the risk.

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http://dx.doi.org/10.1016/j.rboe.2016.02.002

Risco de lesão do feixe vasculonervoso após fratura do calcâneo: comparação entre três técnicas

Palavras-chave:
Calcâneo/lesões
Pinos ortopédicos
Parafusos ósseos
Procedimentos cirúrgicos operatórios/métodos

RESUMO

Objetivo: Verificar se o número de parafusos ou pinos colocados no calcanhar aumentaria o risco de lesão quando usamos três técnicas diferentes para o tratamento das fraturas.
Método: Foram analisadas retrospectivamente 126 radiografias de pacientes que sofreram fratura desviada do calcanhar. Foram analisadas três técnicas cirúrgicas sob a forma inter-observador: 31 radiografias de pacientes tratados com placa não específica para o calcanhar, 48 com placa específica e 47 com fixador externo. O risco de lesão das estruturas anatômicas em relação a cada fio de Kirschner ou parafuso foi determinado pelo sistema de graduação segundo a classificação de Licht. A quantificação do risco total de lesão das estruturas anatômicas na colocação de mais de um fio/parafuso foi calculada pela lei aditiva das probabilidades do produto para eventos independentes.
Resultados: Todos os modelos apresentaram um alto poder de explicação do risco avaliado, uma vez que os valores do coeficiente de determinação R^2 são maiores do que 98,6 para todos os modelos. Portanto, o conjunto de variáveis estudado explica mais de 98,6% das variações dos riscos de lesão das artérias, veias ou dos nervos e podem ser classificados como excelentes modelos para prevenção de lesões.
Conclusão: O risco de lesão das artérias, veias ou dos nervos não é definido pelo total de pinos/parafusos. A região e a quantidade de pinos/parafusos em cada região definem e determinam melhor a distribuição do risco.

Introduction

Fractures of the calcaneus account for 60% of the fractures of the tarsus.[1,2] Although calcaneal fractures account for only 1–2% of all fractures in all parts of the skeleton, they are still a major challenge for orthopedists.[2–6] In young patients, they are frequently caused by high-energy trauma. Approximately 75% of these fractures are intra-articular.[4,7,8] Calcaneal fractures present a high rate of unsatisfactory results, with great morbidity for the patients.

The ideal treatment for intra-articular fractures of the calcaneus remains a matter of controversy, despite the advances in imaging diagnostics and surgical techniques.[9] Several surgical techniques for treating displaced intra-articular fractures exist, and these include: open reduction with internal fixation,[5,9] minimally invasive techniques,[10] percutaneous techniques,[11] percutaneous calcaneoplasty[4] and external fixation.[12] Independent of the technique used, various anatomical structures in the medial region of the heel may be at risk of iatrogenic injuries caused by the tips of screws, drill bits, external fixator pins or Kirschner wires.[13–15]

The objective of this study was to investigate whether the number of screws or pins placed in the heel would increase the risk of injury, in using three different techniques for treating calcaneal fractures.

Material

A retrospective analysis was conducted on 126 radiographs on patients who suffered displaced fractures of the heel in 2013 and 2014. Cases of fractures without displacement and fractures treated conservatively, and patients for whom no postoperative radiographic control was available, were excluded. Three surgical techniques were analyzed in inter-observer form: 31 radiographs from patients who were treated using a plate that was not specific for the calcaneus, 48 with a specific plate and 47 with an external fixator. These patients were treated at four institutions.

To calculate the risk of injury to nerves, arteries and veins, the heels were divided into six different zones, as illustrated in Fig. 1. Zones IA and IB were located in the anterior tuberosity of the calcaneus, from the calcaneocuboid joint line to a line in the region of Gisane's angle. Zones IIA and IIB were located in the region of the calcaneal body, from the line of Gisane's angle

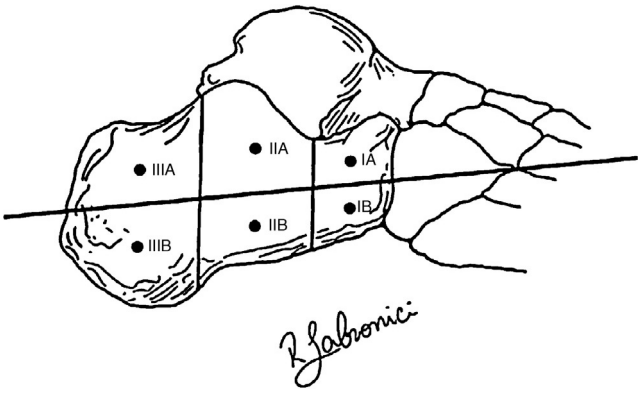

Fig. 1 – Diagram showing the six zones of the calcaneus for calculating the risk of injury to nerves, arteries and veins.