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Review

Intraoperative 3D-imaging in foot and ankle trauma - clinical examples and study results

Intraoperative 3D-Bildgebung beim Fuß- und Sprunggelenkstrauma - klinische Beispiele und Studienergebnisse

Martinus Richter*

Department for Foot and Ankle Surgery Rummelsberg and Nuremberg, Germany

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SCHLÜSSELWÖRTER
3D-Röntgenbildgebung;
ISO-C-3D;
ARCADIS-3D;
Fraktur;
Korrektur

Summary

Background: Intraoperative 3D radiographic imaging in foot and ankle (trauma) surgery was introduced more than ten years ago. This review was performed to specify the potential benefit.
Methods: The previous literature dealing with intraoperative 3D-imaging was reviewed and summarized, and case reports were added.
Results: Imperfect reduction and/or implant position was detected in more than one third of operatively treated foot and ankle injuries through intraoperative visualization with 3D radiographic imaging. The second device generation allows for faster scanning and image interpretation time and halved radiation dose. 3D radiographic imaging leads to cost reduction through avoiding revision surgery.
Conclusions: Intraoperative 3D radiographic imaging improves the intraoperative visualization of fracture reduction and implant position in comparison with 2D-imaging.

Zusammenfassung

Hintergrund: Die intraoperative 3D Röntgenbildgebung für die Traumaversorgung an Fuß und Sprunggelenk wurde vor über 10 Jahren vorgestellt. Dieses Review soll den potentiellen Benefit spezifizieren.
Material und Methoden: Die bisherige Literatur, die sich mit der intraoperativer 3D Röntgenbildgebung bei der Traumaversorgung an Fuß und Sprunggelenk befasst wurde gesichtet und zusammengefasst und einige Fallbeschreibungen wurden angefügt.
Ergebnisse: Durch die verbesserte intraoperative Visualisierung mittels 3-D-Röntgenbildgebung wurde bei der Versorgung von Verletzungen an OSG/Fuß

* Corresponding author: Professor Martinus Richter, MD, PhD, Department for Foot and Ankle Surgery Rummelsberg and Nuremberg, Location Hospital Rummelsberg, Rummelsberg 71, 90592 Schwarzenbruck, Germany. Tel.: +49-9128-50-43450; Fax: +49-9128-50-43260.
E-Mail: martinus.richter@sana.de
URL: http://www.foot-surgery.eu.

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jeweils in mehr als einem Drittel der Fälle verbesserungsbedürftige Reposition/Korrektur und/oder Implantatlage erkannt. Die zweite Gerätegeneration erlaubt eine schnelleren Scan und Bildanalyse als die erste Generation bei halbierter Strahlenbelastung. Der Einsatz der intraoperativen 3D-Röntgenbildgebung führt zur Kostenersparnis durch Vermeidung von Revisionen.
Schlußfolgerungen: Die intraoperative 3D-Röntgenbildgebung verbessert die intraoperative Visualisierung von Knochen(-fragment-)positionen und Implatatlagen im Vergleich zur 2D-Röntgenbildgebung.

Introduction

When using intraoperative fluoroscopy in foot and ankle surgery, incorrect position of bones, bone fragments and/or implants frequently remains undiscovered, and is only recognized on postoperative computed tomography (CT) scans [1—4,10,11].

A mobile C-arm with three-dimensional imaging (ISO-C-3D Siemens, Erlangen, Germany) was developed to better enhance the intraoperative recognition of problems with fracture reduction and fixation [2—4,10]. The conclusions of the first clinical experience using this device was that the intraoperative three-dimensional visualization with

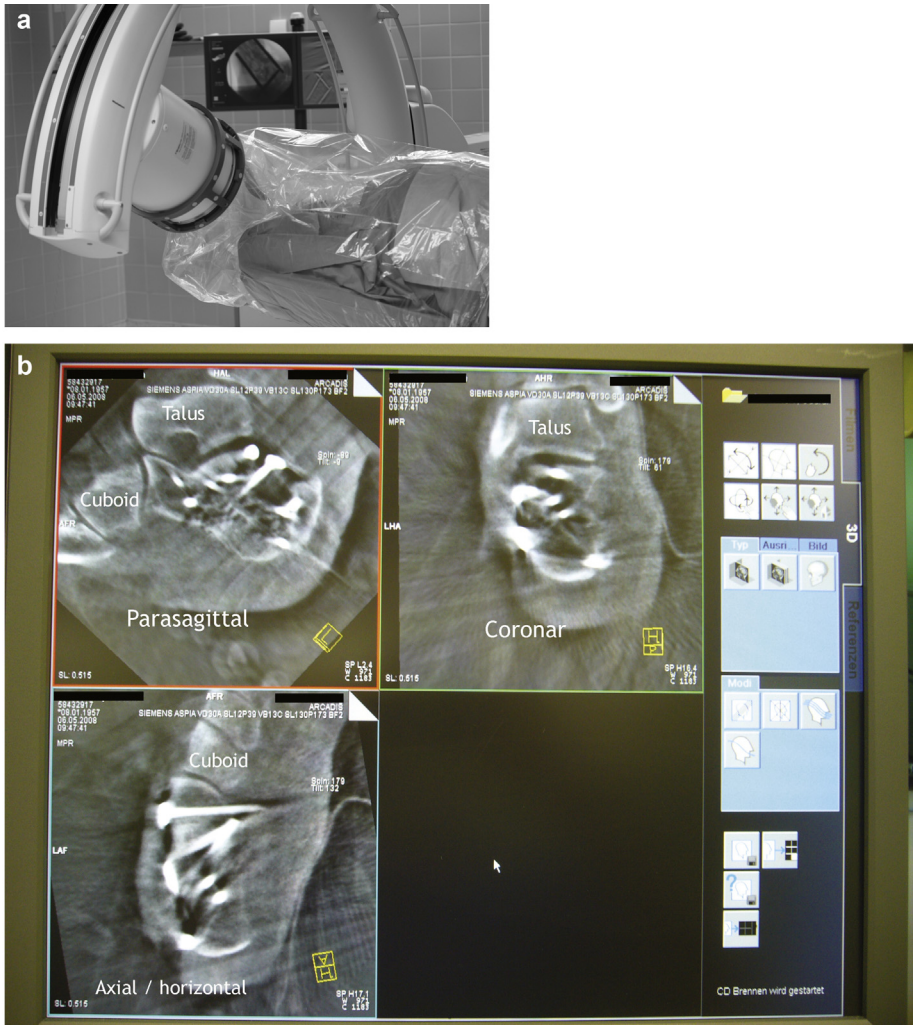

Figure 1a-b. Figure 1a shows the ARDACIS-3D during intraoperative scan. The lower leg, ankle and foot are placed on a splint which is covered by a sterile plastic bag to maintain a neutral foot and ankle position during the scan. Then, the entire table with lower legs, ankles and feet is covered with a second sterile plastic bag to maintain sterility. During the scan, the entire staff leaves the area of radiation contamination. Figure 1b shows a monitor view of ARCADIS-3D device showing multiplanar reformations of a calcaneus after open reduction and internal fixation with a plate and screws. The axial/horizontal reformation shows a screw which is too long in the distal part of the calcaneus close to the calcaneocuboid joint which was not visible with 2D radiographic imaging.