

Intraoperative 3-D Bildgebung bei Intraartikulären Frakturen - Analyse von 122 klinischen Fällen- Intraoperative 3-D Imaging at Intraarticular Fractures -Value and First Analysis of 122 Cases-

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Introduction

Identification and interpretation of articular steps and hardware misplacement remains a crucial step during joint reconstruction. Long term outcome correlates with initial reposition and adequate fixation. Twodimensional intraoperative imaging modalities, as c-arm, are not sufficient as threedimensional image modalities and limited in analyzing complex anatomic shapes of e.g. calcaneus, acetabulum, pilon tibiae or tibial plateau. Intraoperative computer tomography (CT) is rare and costly. Often postoperative CT became the standard method on decision making and postoperative analysis. Correctional reoperations are necessary if significant articular steps or misplacements are finally identified. A new mobile three dimensional c-arm (Iso-C3D, Siemens) provides multiplanar image reconstruction, enabling direct intraoperative control of articular steps and implant misplacement. Enabling immediate operative corrections in same procedure. We studied the value and the resulting intraoperative decisions based on the Iso-C3D imaging in 122 different joint fractures on different anatomic regions within the last year at our clinic.

Material and Methods

Between 1/2003 and 11/2003 122 different joint fractures were intraoperatively scanned with the Iso-C3D. Following fractures were analysed: (n= 19 ankle fractures; n= 13 forefoot, n=20 calcaneus; n=23 pilon tibiae; 19 tibia plateaus; n=11 wrists; n=9 spine; n=8 pelvis fractures). Positioning was done on full -carbon tables (VIWAS, Maquet). Multiplanar reconstructions were obtained from 100 fluoroscopic images the Iso-C-3D provides during one automatic scan protocol. The scans were performed intraoperatively directly after open reduction and internal fixation of articular joint lines was done. Before initial conventional c-arm imaging was done in all cases. Surgeons were able to analyze joint

reconstruction and screw misplacement in multiplanar reconstructions intraoperatively and compare with conventional the c-arm images. Decisions about remaining articular steps and implant misplacements were done and if necessary operative corrections performed.

Based on the surgeons decisions post operative CT scans were performed, Quality and congruently compared to Iso-C3D images was assessed by the specific surgeon. The data about intraoperative use, users, indications, set up time, preparing and resulting intraoperative decisions were analyzed.

Results

A total of 122 intraoperative Iso-C-3D scans were performed. Caused by artefacts 5 scans were not useable. 2 times the system crashed, 3 patients moved during the scan. Finally 112 cases could be analyzed. Scanning procedure time itself took 120 seconds (s). Radiation time was 20 s/case. Set up time including positioning of the system took 190s (150-840). Time for analyzing the multiplanar images on the Iso-C3D monitor took 240s (126-500). In 17 clinical cases (15%) a direct intraoperative correction resulted in implant change (8%) or correction of reduction (7 %), caused by articular steps → 2mm, screw or k-wire misplacement. In all those cases conventional c-arm images did not reveal the significant step or misplacement, correction decision were all based on the Iso-C3D imaging in those cases. In another 8 cases (7%) significant steps or misplacements were identified in c-arm images and confirmed in the Iso-C3D images. One subchondral k-wire seemed to be identified intrarticular on c-arm images, while the mutiplanar images revealed exact subchondral placement. Post operative CT scans were done in 47% of all cases, they confirmed the Iso-C3D results and were congruently. Quality was considered sufficient and good in all cases. No significant intraarticular step or hardware misplacement was missed with the Iso-C3D.

Discussion and Significance

Twodimensional intraoperative imaging does not allow precise identification of all articular joint steps and hardware misplacements. Especially minimal invasive procedures combined with closed reduction require exact anatomic reduction. Intraoperative visualisation remains problematic and conventional c-arm images are not always sufficient. A intraoperative CT is costly, not mobile and very rare. The Iso-C3D provides three dimensional intraoperative images regarding the detection of remaining intraarticular steps and implant misplacements. Direct intraoperative decisions and corrections become possible. Potentially in postoperative CT's identified steps and misplacements can be avoided. However necessary set up time including scanning and preparing of the multiplanar images as well as special trainend personel is still necessary

for the intraoperative use of the Iso-C3D. Extra costs for postoperative CT's and safed reoperation have to be compared by initial Iso-C3D costs.