

Präzisionsvergleich zwischen der CT-, Fluoroscopy und Iso-C 3D Navigation bei der perkutanen SI Verschraubung.

Comparison of precision between CT-, Fluoroscopy - and Iso-C-3D navigated percutaneous SI screw fixation

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Introduction

In the treatment of instable pelvic injuries with disruption of the ileosacral joint, the osteosynthesis with ileosacral screws can be an elegant possibility to stabilise the posterior pelvic ring. Condition is a fixation of the anterior pelvic ring with plates or external fixation. By using conventional technique the drilling can only be performed in one projection, the position of screws must be followed and altered under radioscopy in inlet-outlet and a lateral projection afterwards. This can lead to a high radiation dose for the surgeon and the patient. Injuries of nerve roots and the gluteal vessels are described with the use of this method. This is among other things due to the reduced imaging. The aim of this study was to evaluate the precision and the special problematic of conventional navigation possibilities (CT-, fluoroscopy- und Iso-C-3D navigation).

Material and Methods

Set-up for the fluoroscopy-based navigated drillings: The module "C-arm" was used. Following, 4 projections (a.p., lateral, inlet and outlet) were acquired with the navigated C-arm (Exposkop 8000®, Ziehm, Nürnberg). The images were imported in the system and the trajectories defined corresponding to the course of S1 resp. S2 screw. Set-up for the CT-based navigated drillings: A spiral-CT of 5. generation was used. After the data set was loaded to the navigation system module "spine", the segmentation, anatomic-based landmarks and trajectories were planned in the preoperative mode. The drillings were performed with only a mean error of registration of ≤ 1 mm. Set-up for the ISO C 3D - based navigated drillings: The Iso-C3D Siremobil® was used. to plan the drillings. After the planning of the multiplane layers the navigated drilling was started. For every method

of navigation five pelvises were used, the drillings were performed on S1 and S2, any two right and left. Considering a postoperative CT, the evaluation was taken with a score: 0= no perforation, 1= minimal perforation, without clinical relevance, 2= obvious perforation.

Results

By using CT based navigation 14 screws (70%) could be placed without perforation., 4 screws (20%) perforated the cortex grade 1, and 2 screws (10%) grade 2. Concerning the distribution of S1 and S2 it yielded the result, that all S1 screw connections could be placed correctly, all incorrect placements were seen at S2. With all Iso-C-3D navigated drillings, no perforation was seen.

Discussion

Percutaneous screw fixation in the field of pelvic surgery is technical demanding. The treatment under fluoroscopic control demands partly a long radiation time, since drilling is only possible in one projection and the result must be controlled in the other projections. For other applications it was already shown that the use of navigation systems could reduce the radiation exposure. The results show that CT navigated drillings are in an inferior position to Iso-C-3D. An important source of error could be the registration. The intraoperative calibration of anatomic landmarks is even more difficult than on models as they must be dissected accessorially. The registration under fluoroscopy and Iso-C-3D navigation results self-acting, so the source of error of pair-point registration does not apply. A possible disadvantage of fluoroscopy could be the picture quality with obese patients. Additionally no real three-dimensionality is given. This does not apply with Iso-C-3D but there a disadvantage follows from the small volume, which is restricted to a cube of ca. 12cm length (119mm³). Furthermore the alignment of the isocentre is aggravated with obese patients. In following clinical studies the clinical precision of the three mentioned navigation systems should be evaluated.