

Evaluation von konventionellen CT, CT Traumascan und Iso-C-3D Datensätzen bei der Pedikelschraubenplatzierung

Evaluation of conventional CT, CT traumascan and Iso-C-3D datasets for pedicle screw placement

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Introduction

CT based navigation dependent on the registration process performed with registration. For surface registration landmarks are not necessary. Due to multi slice CT scanner this investigation become quickly and in polytrauma patients a „traumascan“ is possible within minutes using higher slice distances. The question is if these CT data are as precise for navigation as conventional CT data, also compared with the accuracy of Iso-C-3D navigation. One advantage of this technique is that no registration process is necessary. The aim of this study was to evaluate: 1. the influence of the CT scan protocol. 2. the influence of different surface registration points to the accuracy within CT based navigation. 3. Comparison of CT vs. Iso-C-3D based navigation within the spine.

Methods

The Surgigate system (Medvision, Switzerland) was used. A spine model (Synbone, Switzerland) were marked at different levels with titanium markers. Furthermore pedicle screw canals were prepared. A CT scan (Volume Zoom, Siemens, Germany) of the spine using: 1. a normal spine protocol (1.25/1/5.5/0.6); 2. a traumascan protocol (3/2.5/15/2) was performed.

After Pair-Point-registration surface registration was performed using symmetric and asymmetric protocols: 1. six points symmetric bilaterally to the posterior process, 2. eight vs. four points, 3. six points symmetric within cranial third, 4. twelve points ipsilateral of the posterior process, 5. six points asymmetric bilaterally to the posterior process.

A „reversed verification“ was used. An advice allows a three dimensional manipulation until the displayed pointer hit a selected point on the navigation monitor. The holder was fixed and the distance in reality was measured with a calliper, accuracy 0.1 mm (Mitutoyo Inc, USA). As landmarks the titanium marked points were used.

Trajectories were planned within the pedicle screw holes and the awl was placed into the canal. A screen shot was taken and a print out was performed.

The difference of the planned trajectory and the visualisation of the instrument were measured. The deviation to the side and the difference in angle were measured.

Results

Deviation:	markers (mm)	mediolateral (mm)	mediolateral	(degree)	
	kraniokaudal (mm)	kraniokaudal (degree)			
Conventional	0.9 [0 - 4.9]	0.3 [0 - 5]	0.3 [0 - 7]	0.6 [0 - 5]	0.5 [0 - 6]
Traumascan	1.2 [0 - 8.2]	0.3 [0 - 4]	0.2 [0 - 5]	0.7 [0 - 7]	0.8 [0 - 10]
Iso-C-3D	0.5 [0 - 1.9]	0.3 [0 - 4]	0.1 [0 - 1]	0.2 [0 - 3]	0.4 [0 - 3]

The different registration methods did not have an influence to the accuracy.

Discussion

Pedicle screws should be placed within the axis of the pedicle. Pitfalls during navigation might occur during registration. The surface of the vertebra might be calculated incorrect due to osteoporotic bone or artifacts. Within this study a spine model was used so this can be excluded.

Navigated pedicle screw placement is more precise than the placement in conventional manner, however, Iso-C-3D navigation is more accurate than CT based. The reason therefore might be that no registration is needed.

Further clinical studies have to prove the supposed benefit of the intraoperative three-dimensional navigation with ISO-C-3D in spinal pedicle screw placement.