A new concept of a multiple-use screw-based shape-fitting plate in Total Knee Arthroplasty

Haselbacher M, Sekyra K, Mayr E, Thaler M, Nogler M

Experimental Orthopaedics, Medical University Innsbruck, Austria

Contact: matthias.haselbacher@i-med.ac.at

INTRODUCTION

In recent years new technologies using custom-fit cutting guides in combination with magnetic resonance imaging (MRI) were applied by orthopedic surgeons in total knee arthroplasty (TKA). The digital 3D reconstruction from MRI images is used to construct a negative mold, called jig. This jig can be used to transfer the surgical planning exact to the bone. In this technique one has to accept that the jigs are designed for single use and have to be purpose-built by a service contractor, which takes this step out of the hands of the surgeon. In addition intraoperative adjustments of the preoperatively planned implant size and position are not possible.

The purpose of this project was to construct an image based jig that can be adjusted in the actual surgical situation with the surgeon being in control of the whole process. Therefore we developed a grid plate with threaded holes und compared our technique with existing methods of navigation.

METHODOLOGY

1. Construction of grid plates with 443 threaded holes and 50 mm positioning screws.
2. Software programming: Shape Fit Proto (Stryker Leibinger, 2008) for 3D reconstruction and jig simulation.
3. Computer tomography (CT) images production of macerated human femora and tibiae.
4. 3 femora, 5 investigators, 150 measurements: Reproducibility of a CT planned plate position. Position measurement by MicroScribe (Version 4.0, Immersion Corporation, 2002). Measuring of rotation, extension and flexion and of the proximal-distal shift.
5. Statistical analysis with SPSS Version 17 (IBM, USA 2008).
6. Evaluation by comparison of angular deviations in TKA in literature.

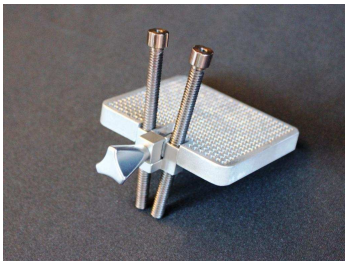

Figure 1: Grid plate with instrument interface

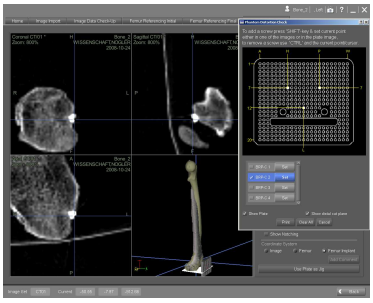

Figure 2: Software "Shape Fit Proto"

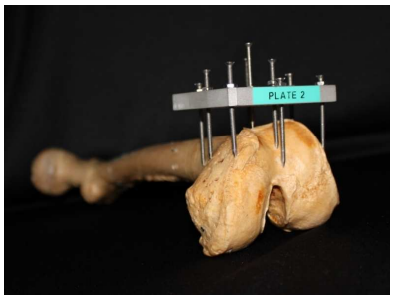

Figure 3: Grid plate set on distal femur

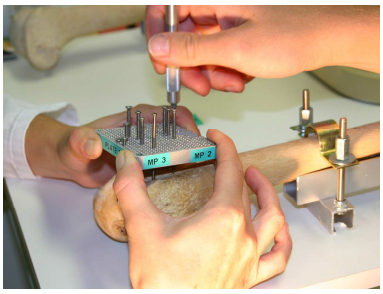

Figure 4: Grid plate position measurement by MicroScribe

RESULTS

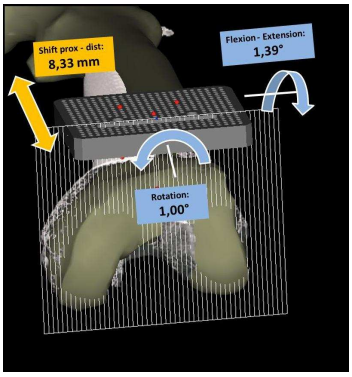

Figure 5: Rotation, flexion – extension and proximal - distal shift in degrees and millimeters

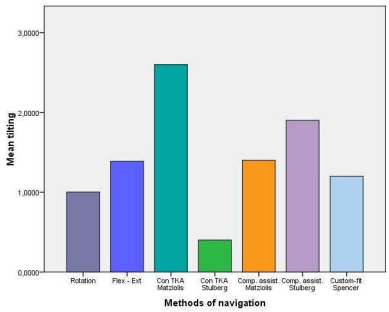

Figure 6: Comparison of different methods of navigation in degrees

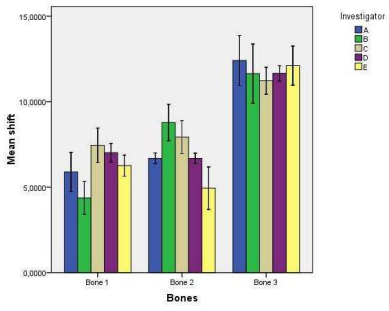

Figure 7: Mean shift at different bones by investigators in millimeters

	Shift prox - dist	Rotation:	Flexion – Extension:	Comparison to other methods of navigation:	
Bone 1:	6,20 mm	0,48 °	0,99 °	Conventional TKA Matziolis et al.	2,6 °
Bone 2:	7,00 mm	1,44 °	1,48 °	Conventional TKA Stulberg et al.	0,4 °
Bone 3:	11,81 mm	1,12 °	2,55 °	Computer assisted TKA Matziolis et al.	1,4 °
All Bones:	8,33 mm	1,00 °	1,39 °	Computer assisted TKA Stulberg et al.	1,9 °
				Custom-fit TKA (Shape-Fitting) Spencer et al	1,2 °

CONCLUSION

Construction and first use of our jig prototype were successful. The jig's rotation of 1.00° and flexion and extension of 1.39° agree well with the findings from other methods of navigation. Mean proximal-distal shifting of 8.33 mm seems to be very high. These results are encouraging but further studies are required to improve the fitting especially in proximal-distal.