

Oral Presentation  
Track 4: Implants for Trauma and Orthopedics - Joint ESB Track  
4.3. Knee Endoprosthesis  
4.3.2. In Vivo Assessment of Performance

**Abstract: 4750**

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**Accuracy and precision of a model-based RSA technique for measuring implant migration**

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**Introduction:** Roentgen stereophotogrammetric analysis (RSA) allows the accurate measurement of implant migration [1], which correlates well with later aseptic loosening [3]. A disadvantage of the conventional RSA technique is the necessity of attaching tantalum markers to the prostheses, which results in significant additional cost. Model based RSA (MBRSA) is an approach by which pose-estimation of geometric surface models of the prosthesis is used to measure migration without prosthesis markers [2,4]. The goal of this study was thus to evaluate the accuracy and precision of the MBRSA method compared to the conventional RSA method.

**Methods:** A phantom-model manipulator (accuracy characterized by laser-interferometry) was used to generate motions whereby only the prosthesis (RM), or both the prosthesis and bone-model (ZRM) were moved relative to a reference position. Ten repetitions were performed for each axis measured. Reverse-engineered (RE) models of knee tibia- and femur-components were obtained using a fringe-projection digitizing system (GOM, mbH, Braunschweig, D). Migration was analyzed from the same images by RSA (RSA-CMS 4.3, Medis Medical Imaging Systems, Leiden, NL) and by MBRSA (2.0 beta, Leiden University Medical Center).

**Results:** The mean difference (bias) of the measured migration using RSA was less than 0.006mm (SD  $\leq$  0.048 mm) for ZRM, and less than 0.027 mm (SD  $\leq$  0.047 mm) for RM. Bias measured for MBRSA was less than 0.009 mm (SD  $\leq$  0.049 mm) for ZRM, and less than 0.048 mm (SD  $\leq$  0.037 mm) for RM. Bias for rotation was less than 0.220° (SD  $\leq$  0.187°) for both methods for RM and ZRM, with the maximum occurring for ZRM rotation about the long in-plane axis of the tibia-component using MBRSA.

**Discussion:** The results of this phantom study indicate exceptional accuracy and precision of both the RSA and the MBRSA methods when employed with RE surface-models. The MBRSA technique functions without prosthesis markers, which presents new opportunities for measuring implant migration where financial or geometric considerations preventing marker placement have been a prohibitive factor.

- Reference:
1. Kaptein B.L., et al. *J. Biomech.* 2003; 36: 873-882.
  2. Ryd L., et al. *J Bone Joint Surg* 1995; 77B: 377-383.
  3. Valstar ER, et al., *J Biomech* 2001; 34: 715-722.