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Oral presentation

Robotic cadaver testing of a new total ankle prosthesis model (GERMAN ANKLE SYSTEM)

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Introduction

An investigation should be carried out into possible increased forces, torques and altered motions during motion of a load-bearing ankle after implantation of two different total ankle prostheses. A robot-based cadaver test was developed for the study. We hypothesized that the parameters investigated would not differ in relation to the two implants compared.

Methods

We included two different ankle prostheses (Hintegra, Newdeal SA, Vienne, France; German Ankle System, Small Bone Innovations, Morrisville, PA, USA). The prostheses were implanted in seven paired cadaver specimens (sides and testing sequence randomized). The specimens were mounted on an industrial robot (RX 90, Stäubli Tec-Systems, Bayreuth, Germany, Figure 1).

The robot was guided by a navigation system (VectorVision™, BrainLAB Inc., Kirchheim-Heimstetten, Germany). The robot detected the load-bearing (30 kg) motion of the specimens without prostheses during 100 cycles and mimicked that exact motion after the prostheses were implanted for another 100 cycles. The resulting forces and torques were recorded by an integrated load cell (model FT Delta SI-660-60; Schunk, Lauffen, Germany). The spatial orientation of the tibia, fibula, and foot plate was recorded via an ultrasound measurement system (model CMS HS; Zebris Inc., Tuebingen, Germany). The differences of the measured parameters were compared between prosthesis types.

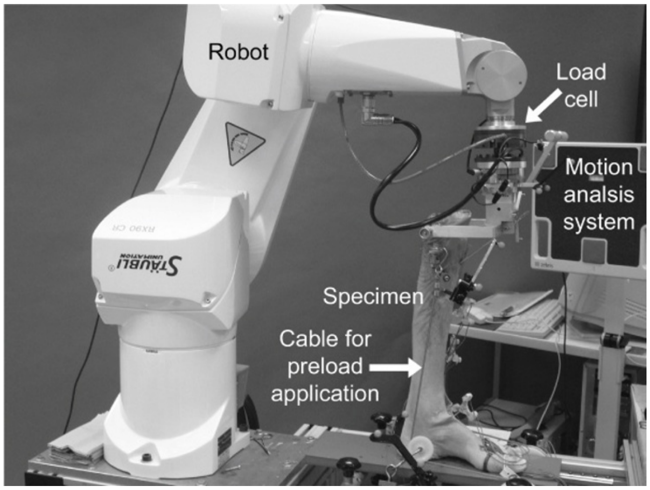

Figure 1
Setting with robot, specimen, and motion analysis system. Specimen mounted to the robot and footplate and equipped with ultrasound transducers.

Results

No shifting or dislocation of the tibial or talar components in relation to the specimen was observed after the testing by radiological assessment. No significant differences of forces, torques and motions (parameters as described below) occurred between the cycles 6–10 with the cycles 96–100 with prosthesis (paired-t-test for all parameters, $p > 0.05$).

The Hintegra and German Ankle System, significantly increased the forces and torques in relation to the specimen without prosthesis with one exception [One-sample-t-test, each $p \leq 0.01$ (exception, parameter lateral force measured with the German Ankle System, $p = 0.34$)]. The force, torque and motion differences between the specimens before and after implantation of the prostheses were lower with the German Ankle System than with the Hintegra (unpaired t-test, each $p \leq 0.05$).

Conclusion

In conclusion, the German Ankle System prosthesis had less of an affect on resulting forces and torques during partial-weight bearing ankle motion than the Hintegra prosthesis. This might improve function and minimize loosening during the clinical use.

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