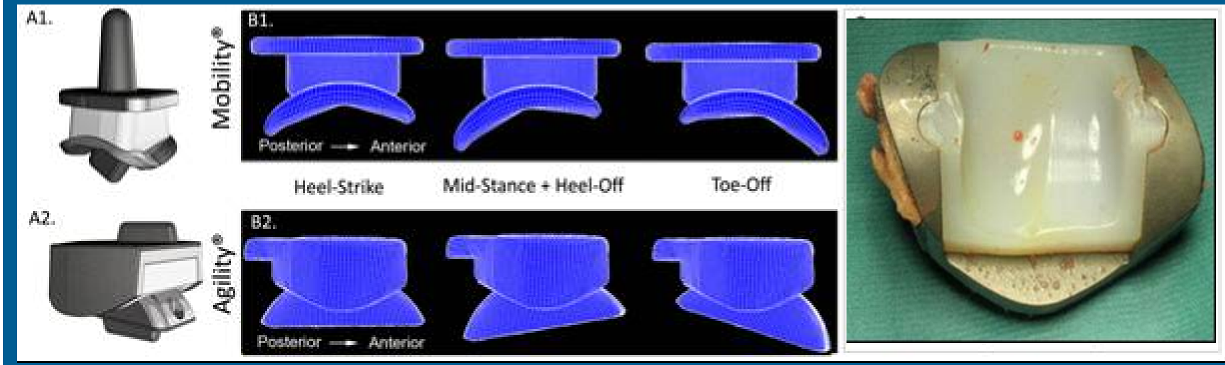
STUDENT RESEARCH PROJECT



Left: Creation of a finite-element model; Right: Premature wear of the polythyelene insert due to misalignment of total ankle replacement

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Biomechanical behaviour of different designs of total ankle replacement

Master Project

A previous comparative experimental and finite-element-model study (performed at our laboratory) has shown that a two-component total ankle replacement design with fixed bearing behaves inferior when compared with a three-component design in terms of joint contact pressure distribution. In this study a computational model was established to parametrically explore the hypothesis that inter-component positioning deviating from manufacturer recommendations could result in abnormal pressure distributions on the polyethylene insert. This is of relevance when considering premature wear of the polyethylene as a possible causative factor leading to early implant failure. Because in that setting only two designs have been investigated no generalization could be made to other total ankle replacement designs. It would be of major clinical interest to investigate the biomechanical behaviour of other two-component and three-component designs. With the wide variety of total ankle replacement designs available on the market this work would have a serious impact on selection of implants and help to improve designs in the future.

A finite-element model is created to quantify peak and average contact pressures on the polyethylene surfaces. The validation of the FE model is done according to our previously established experimental protocol.

Project Tasks:
1. Review of literature.
2. Further refinement of previous developed finite-element model.
3. Experimental testing of different two-and three component total ankle replacement designs.
4. Create finite-element model and validate it by the experimental data.
5. Submission of a final report.

30% Theoretical work 60% Experiments and computational analysis and 10% statistical analysis.
Basic knowledge of finite-element analysis is recommended.

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