DESSOS

Decision Support Software for Orthopaedic Surgery

The objective of the DESSOS is to develop decision support software for orthopaedic surgery so as to reduce variability in surgical outcome and maximise the longevity of orthopaedic devices and in particular, total knee replacements.

Objectives of the project

Across the EU25 there are approximately 540,000 knee replacement operations per year. Between one in 10 and one in 20 knees will require re-operation after 10 years. A significant proportion of implanted knees have abnormal kinematics and this may accelerate the failure process. Variability in patient outcome is highly dependant upon the experience and skill of the individual surgeon, and there are at present no knowledge based systems available to assist during the planning of an operation that take patient specific data into account.

The main objective of **DESSOS** is to develop both knowledge, and the software tools that encapsulate that knowledge, in order to provide orthopaedic surgeons with appropriate information to make informed choices related to implant orientation and placement.

"There are at present no knowledge based systems available to assist during the planning of an operation that take patient specific data into account"

Specifically, **DESSOS** aims to:

- Develop rapid methods for generating patient specific models of the lower limb
- Develop rapid musculo-skeletal models capable of predicting forces for everyday activities
- Develop rapid numerical models capable of predicting the kinematics and stresses experienced by the knee replacement.
- Determine the likely envelop of performance for a particular patient.
- Develop optimisation strategies to identify the implant orientation which would maximise the longevity of the device.

Project Description

The project combines both fundamental and applied research to support the development of knowledge based software capable of providing the surgeon with recommendations for both the appropriate size, and orientation, of prosthetic implants within the joint, based on patient specific anatomical data provided either pre- or intra-operatively, in order to achieve desirable, pre-determined kinematics of the replaced joint. The recommendations will be based on predictions using advanced modelling and optimisation techniques.

In order to achieve this goal, there are a number of significant technological challenges that need to be addressed:

- to develop methodologies through which key metrics and parameters associated with patient data can be extracted automatically from disparate data sources (CT Scans, MRI scans and IGS systems);
- to develop methodologies by which patient specific data (ankle centre, knee flexion axis etc.) can be integrated with, and used to modify ("morph") musculo-skeletal and finite element models of the human lower limb so as to predict the forces and kinematics respectively;
- to develop methods through which point cloud information pertaining to soft tissues such as ligaments can be automatically converted to meshed structures, appropriate for deployment within finite element modelling tools (so-called "meshless" FEA) with the aim of enhancing the fidelity of the lower limb model;

- to develop mechanisms and systems through which the likely performance of the replaced knee can be supplied automatically to the surgeon in a time frame suitable for use both within the pre-operative and intra-operative phases;
- Develop appropriate optimisation tools that will determine the size and orientation of the prosthetic components in a time frame suitable for pre- and intra-operative use.

"With DESSOS, patients can expect longer implant life times, reducing the risk of revision surgery"

Expected Results & Impacts

By developing these models, techniques and methodologies, and applying them through a suite of software tools, we aim to deliver a surgical planning tool that is appropriate for use in knee replacement procedures, of which there are currently an average of 540 000/annum, expected to rise to 750000/annum by 2010 within the European Union.

The beneficiaries of DESSOS will be the health providers and patients. Optimising the placement of the artificial joint will lead to better function and reduced risk of failure, in both the short and long term. Hence, patients can expect longer implant life times, reducing the risk of revision surgery. This benefit will be passed on to the health service as revision rates will be lower thus producing significant savings.

D E S S O S

Decision support software for orthopaedic surgery

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- Leiden University Medical Centre (NL)
- University of Zaragoza (ES)
- ESI (FR)
- Finsbury Orthopeadics (UK)
- PERA (UK)
- DePuy International (UK)
- Zuse Institute Berlin (DE)

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