Improving safety and predictability of complex musculoskeletal surgery

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As the average lifespan increases, the percentage of aged individuals in populations across developed countries is also growing. This means healthcare systems are presented with a higher incidence of complex musculoskeletal pathologies, such as joint deformation and misalignment or bone and soft-tissue cancer, thus the demand for reconstructive orthopaedic operations is correspondingly rising.

Musculoskeletal surgical procedures are usually reliant on the ample experience of orthopaedic surgeons. Unfortunately, major interventions such as joint reconstruction, prosthesis implantation and muscle transfer have unpredictable outcomes, as well as a high risk of complications and revision surgery, due to the complexity of the musculoskeletal system.

The TLEMsafe Project, funded by the Seventh Framework Programme (FP7) of the European Union and coordinated by Professor Nico Verdonschot at University of Twente, is addressing this issue, making significant strides towards developing a personalised surgical method that can help reduce complications and improve the patient's quality of life after surgery.

TLEMsafe patient workflow

At the core of TLEMsafe project is the Twente Lower Extremity Model (TLEM), a mathematical tool used to simulate everyday movement (such as walking, getting up from a chair, stair climbing) and predict muscle

and joint reaction forces necessary to reproduce such activities.

Starting from MRI scans of patients hospitalised at the Radboud University Medical Center, essential individual details of the patient's musculoskeletal system are extracted, using innovative algorithms purposely developed by Materialise NV. All these data are then integrated by researchers at the University of Twente into the TLEM model and implemented into the modelling system provided by AnyBody Technology A/S, in order to build a patient-specific musculoskeletal model.

The innovative SPE3D pre-planning system developed by the Warsaw University of Technology allows the surgeon to virtually operate on the patient-specific model, in order to simulate the functional effect of different operative scenarios and select the optimal plan. The surgeon can then use a 3D surgical navigation system, developed by Brainlab AG, and exactly reproduce the pre-selected optimal plan, resulting in the best functional outcome for the patient.

Towards the future of surgery

Coming to the end of this fruitful international collaboration, TLEMsafe provides a basis for further work in surgical navigation, as well as pushing surgery further towards the personalised approaches that the field must take in order to improve. The additional patient information provided by the system will also allow for the use of more advanced robotic tools during operations, and open up routes to less invasive, more precise surgery.

More information: www.tlemsafe.eu/