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Biomechanical Multibody Model with Refined Kinematics of the Elbow

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The overall aim of the study is to develop a new external fixator for the elbow, which maps the native kinematics of the elbow closer in order to decrease the joint forces associated with shortened rehabilitation time and reduced pain.
An experimental setup was designed for determining the native kinematics of the elbow during flexion of cadaveric arms. This includes a robot, an optical motion tracking system, and a force torque sensor. In 2000, Bottlang *et al*. [1] showed in kinematic measurements that the elbow is not a hinge joint but performs a complex motion during flexion. They used a mobile roller for the flexion of cadaveric arms. The motion was measured with an electromagnetic tracking system and a translational accuracy of 0.5 mm.
In our experiment, the arm is flexed by the robot and the motion tracking system Optotrak Certus (Northern Digital Inc., Waterloo, Ontario, Canada) has an accuracy of 0.15 mm.
Measured data will be used to modify the existing multibody model from Holzbaur *et al.* [2]. In particular, the flexion axis of the elbow moves translationally and rotationally during flexion (closer to the native kinematics), which was not considered in the existing model [2]. Computed joint forces of both models were compared and a substantial difference in the force-flexion-angle course was found. We conclude that the consideration of a more native kinematics for the development of a new external fixator has a significant impact on the outcome.

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