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B-Lab

Advanced Robotic Testing of Surgical Devices

Pilot project

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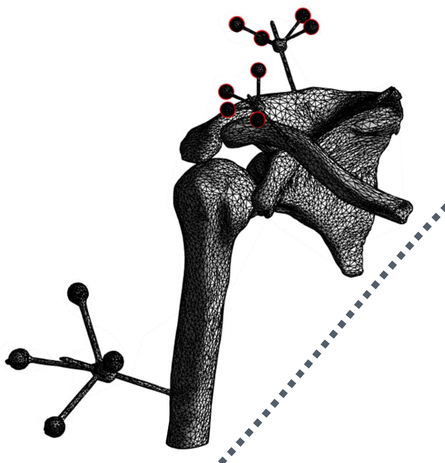
Context

The present B-Lab project is a **new research facility** developed as a **multidisciplinary collaboration** between 1) the Division of Orthopedic Surgery and Muskuloskeletal Traumatology of the Department of Surgery of the Geneva University Hospitals (Dr Holzer) 2) the Unit of Teaching in Anatomy of the Geneva Faculty of Medicine (Dr Beaulieu) and 3) the Kinesiology Laboratory of the University of Geneva (Dr Armand). The scope of the research program is the creation of a **unique platform for assessment of surgical devices performances** using advances in the fields of 1) robotised biomechanical testing 2) motion capture and 3) imaging and three-dimensional image reconstruction. The goal is the **development of pre-clinical models of human joints closely reproducing in vivo conditions and complexity of motion**. Outputs will include **gain in knowledge for efficent and safe use of surgical devices in patients**.

The pilot study is focused on acromioclavicular traumatic injuries. The primary objective is the validation of a first model of the complete shoulder girdle by comparison with unique data acquired in vivo. Secondary objective is the assessment of safety and efficacy of a new surgical procedures for acromioclavicular stabilization of traumatic injuries.

Innovation

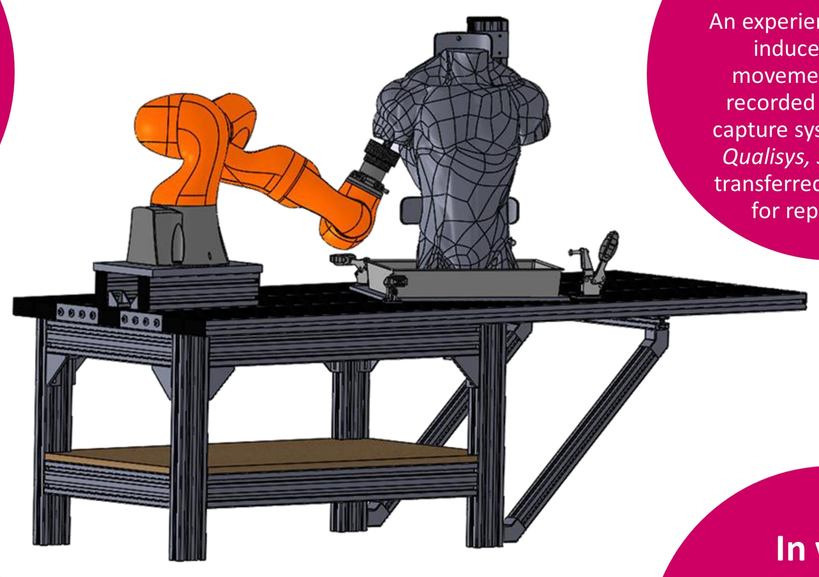
The innovation of the whole research program is to **establish a unique platform for multimodal biomechanical evaluation of orthopedic surgical devices** using latest advances in robotised testing associated with motion capture and three-dimensional image reconstruction.



Repeatable procedure
A robotic manipulator (*KUKA iiwa, Kuka GmbH, Germany*) moves the humerus of the specimen

Versatile protocol
The whole protocol has been designed so as to be adaptable to other surgical devices evaluation and other joints

Physiologic motions
An experienced operator induces analytic movements that are recorded by a motion capture system (*MIQUS, Qualisys, Sweden*) and transferred to the robot for reproduction



Surgery evaluation
Bone kinematics and joint congruence are assessed in native, rupture and 5 reconstruction conditions based on Ziptight devices (*Zimmer Gmbh, Switzerland*)

In vitro conditions
The kinematics of bony structures is recorded on 5 specimens (*from the body donation program*) while reproducing surgery conditions

Precise bone kinematics
Reflective markers installed on intracortical pins allow to know in real time the position and orientation of the bony structures based on CT-scan measurements

Advantages

1) **Experimental surgical facility setting.** Reproduction of a clinical environment for the use of surgical devices by medical specialists in realistic conditions.

2) **Simultaneous multiple body segments monitoring**. Comprehensive assessment of all relevant body structure affected by the use ofsurgical devices.

3) **Robotised complex motion assessments.** Reproduction of physiological motions & stresses encountered during clinical use of surgical devices.

Preliminary results

The first tests of the pilot project have taken place.

Planned outcomes are:

1) Validation of a complete robotised model for assessment of surgical devices performances during complex motion of the shoulder.

2) Comparative assessment of a first set of shoulder surgical procedures considering efficacy and safety of surgical devices use.

Collaborations

HUG
Université Savoie Mont Blanc
Université Gustave Eiffel
Université de Montréal
hepia – Haute école du paysage, d'ingénierie et d'architecture de Genève

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