DERMOT O'ROURKE

POSTDOCTORAL FELLOW | PROGRAM 1
ARC TRAINING CENTRE FOR JOINT BIOMECHANICS

Appointment duration: March 2022 - March 2023

PhD (Flinders Uni) **MSc** (University College Dublin), **BE** (University College Dublin)

Research Interests: Joint replacement, joint mechanics, in silico trials, statistical shape modelling, bone tracking

Collaborators: Stryker, QUASR, Herston Biofabrication Institute

RESEARCH SUMMARY

In-vitro testing of orthopaedic devices and assessment of novel surgical techniques. Precision tracking of the shoulder joint for rehabilitation and the comprehensive assessment of clinical intervention.

PROJECT LIST

Inlay and onlay glenoid implantation techniques in total shoulder arthroplasty.

- Aim: Compare the loosening of inlay and onlay glenoid implant techniques in total shoulder arthroplasty.
- Background: The most common long-term complication of total shoulder arthroplasty is glenoid loosening. A major cause of loosening is due to the 'rocking-horse' mechanism, which can result in opposite edge lift-off.
- Hypothesis: preserving a peripheral ring of cortical bone when implanting the glenoid with inlay technique provides greater stability during the rocking-horse motion.
- Expected Outcome: The inlay implantation technique will improve stability during the rocking-horse motion. This represents a first step in translating the implantation into clinical practise. Decreased glenoid loosening increases longevity of the implant thereby reducing the rate of revision surgery and cost for the management of this condition.

Precision tracking of the shoulder joint using ultrasound tomography.

- Aim: Quantify the accuracy of ultrasound tomography in determining humerus and scapular positions.
- Background: Assessing shoulder function under dynamic conditions is important for surgery planning, rehabilitation, and prosthesis design. Dynamic in vivo imaging provides valuable information to assess joint function under dynamic conditions and select optimal treatment strategies. However, existing state-of-the-art motion joint tracking techniques present limitations & challenges for implementation into clinical assessment.
- Hypothesis: ultrasound tomography will track the humerus and scapula bones within one millimetre and one degree rotation.
- Expected Outcome: The study will determine the number and location of ultrasound probes to accurately track the humerus and scapula positions. A ultrasound tomographic tracking technique will recontextualise existing ultrasound technology to deliver cheaper, accurate, non-ionising radiation, and marker-less assessment of joint that will enhance routine clinical assessment, post-operative rehabilitation, and experimental shoulder biomechanics

Inlay and onlay-Grammont humeral stem failure in reverse shoulder arthroplasty

- Aim: Compare the strength and failure of the implant-bone construct of inlay and onlay Grammont-style humeral stem using micro-CT
- Background: The Grammont-style reverse shoulder arthroplasty (RSA) is a treatment that covers a variety of indications including revision shoulder arthroplasty, proximal humeral fractures, and pathologies associated with rotator cuff deficiency. Grammont-style RSA systems typically use an inlay humeral tray which establishes bony contact, but the additional removal of metaphyseal bone may compromise the strength of the implant-bone construct.
- Hypothesis: by preserving bone in the onlay-Grammont humeral stem there is greater strength of implant-bone construct.
- Expected Outcome: the onlay-Grammont humeral stem will have increased strength, a first step in translating the technique into clinical practise to reduce implant failure.

GRANTS

- ESB Travel Award (2022); ARC ITTC Joint Biomechanics – Seed Grant (2023)

SELECTED PUBLICATIONS

Articles

- O'Rourke, D., Bucci, F., Burton, W. W., Al-Dirini, R., Taylor, M., & Martelli, S. (2023). Determining the relationship between tibiofemoral geometry and passive motion with partial least squares regression. Journal of Orthopaedic Research, Accepted
- O'Rourke, D., Beck, B. R., Harding, A. T., Watson, S. L., Pivonka, P., & Martelli, S. (2022). Geometry and bone mineral density determinants of femoral neck strength changes following exercise. Biomechanics and Modeling in Mechanobiology.

Conferences

- O'Rourke, D., Beck, B. R., Harding, A. T., Watson, S. L., Pivonka, P., Martelli, S. (Aug, 2022) Geometry and bone mineral density determinants of femoral neck strength changes following exercise, ANZBMS-MEPSAANZORS Scientific Meeting, Gold Coast, Australia.

SUPERVISION

- Arun Jolly, Natali Uribe Acosta, Natalia Muhl Castoldi

ORCID HTTPS://ORCID.ORG/0000-0002-4496-929X
dermot.orourke@qut.edu.au
@dermoto'rourke

Joint Biomechanics Training Centre