RESEARCH PROJECT ON THE PERFORMANCE OF ENDOPROSTHETIC REPLACEMENTS IN LIMB SALVAGE SURGERY FOR BONE TUMOURS.

Dermot O'Rourke is a Research Associate biomedical engineer at Flinders University, Adelaide who completed his PhD in 2017 which focused on developing computer-based tools to assess the performance of joint replacements for patients with osteoarthritis. However, next year he is looking to apply for research funding for a new project in bone cancer. The concept is to develop similar tools to assess the performance of endoprosthetic replacements in limb salvage surgery for bone tumours. This is part of an application for a Young Investigator grant (Category B) for Cure Cancer Australia. (https://www.curecancerresearchers.com.au/our-grant-process/)

Dermot is seeking input from individuals from the Sock it to Sarcoma! community who have previously undergone limb salvage surgery in order to ensure the research will meet the needs and interests of those affected by speaking about their experiences with their endoprosthetic replacement.

The supervisor will be Prof. Mark Taylor, Professor of Biomedical Engineering at Flinders University. Clinicians on the research team are Dr Luke Johnson, from Flinders Medical Centre, and Dr Jakub Jagiello, from the Royal Adelaide Hospital. The team are also collaborating with Dr Richard Boyle and Dr Paul Stalley from the Royal Prince Alfred Hospital, Sydney.

The research will primarily take place at Flinders University but will be using medical images and patient information from patients treated at the Royal Prince Alfred Hospital and Flinders Medical Centre. Therefore, the team will be applying for ethics at the Royal Prince Alfred Hospital and the South Adelaide Local Health Network.

Please read below summary of the project for more detail.

If you are interested in assisting with the project please contact Dermot O'Rourke on dermot.orourke@flinders.edu.au

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PROJECT SUMMARY

Limb-salvage surgery is performed to remove a bone tumour in a patient's lower limb, negating the need for amputation. The procedure aims to remove the tumour while preserving enough nearby bone so that a prosthesis can maintain function of the affected limb. Massive endoprosthetic replacement is the most common method of reconstruction and allows patients early weight-bearing and a faster return to daily activities.

However, failure rates are high, with the most common cause being the mechanical failure of the supporting bone or the bone-prosthesis interface. Approximately 15% of patients require a revision surgery to replace a failed endoprosthesis within five years because of mechanical failure.

In this project, we propose to develop tools with a computer simulation method called finite element (FE) modelling to predict the mechanical failure of these endoprosthetic replacements before the surgery taking place. The finite element modelling process involves rendering a 3D model of the patient's lower limb and then simulate the forces of daily activities (walking, climbing stairs, squatting) on the virtually implanted endoprosthetic replacement (Fig. 1). Using a range of techniques in finite element modelling, we can make predictions on its risk of mechanical failure using the model.
In the future, we hope to use our developed tools as part of surgery planning to predict 'vulnerable' regions in the prosthesis that are likely to fail. If our predictions indicate a region at risk of failure, the surgeons can alter their plan in order to minimise the risk of mechanical failure and improve the longevity of the prosthesis in patients living with cancer.

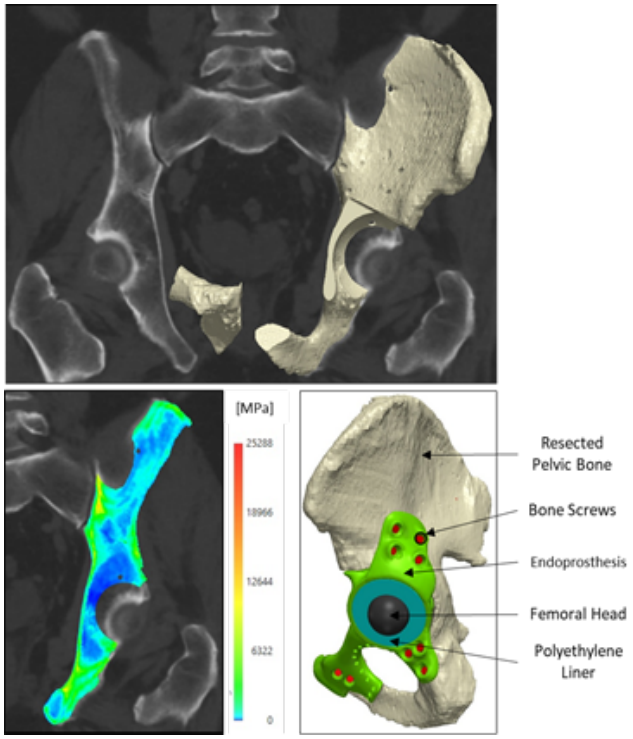

Fig. 1: Finite element model generation: 3D model of resected pelvic bone on a CT scan (top). The distribution of the material properties of the bone derived from the CT scan (left bottom). An implanted massive custom-made pelvic endoprosthesis (right bottom).