

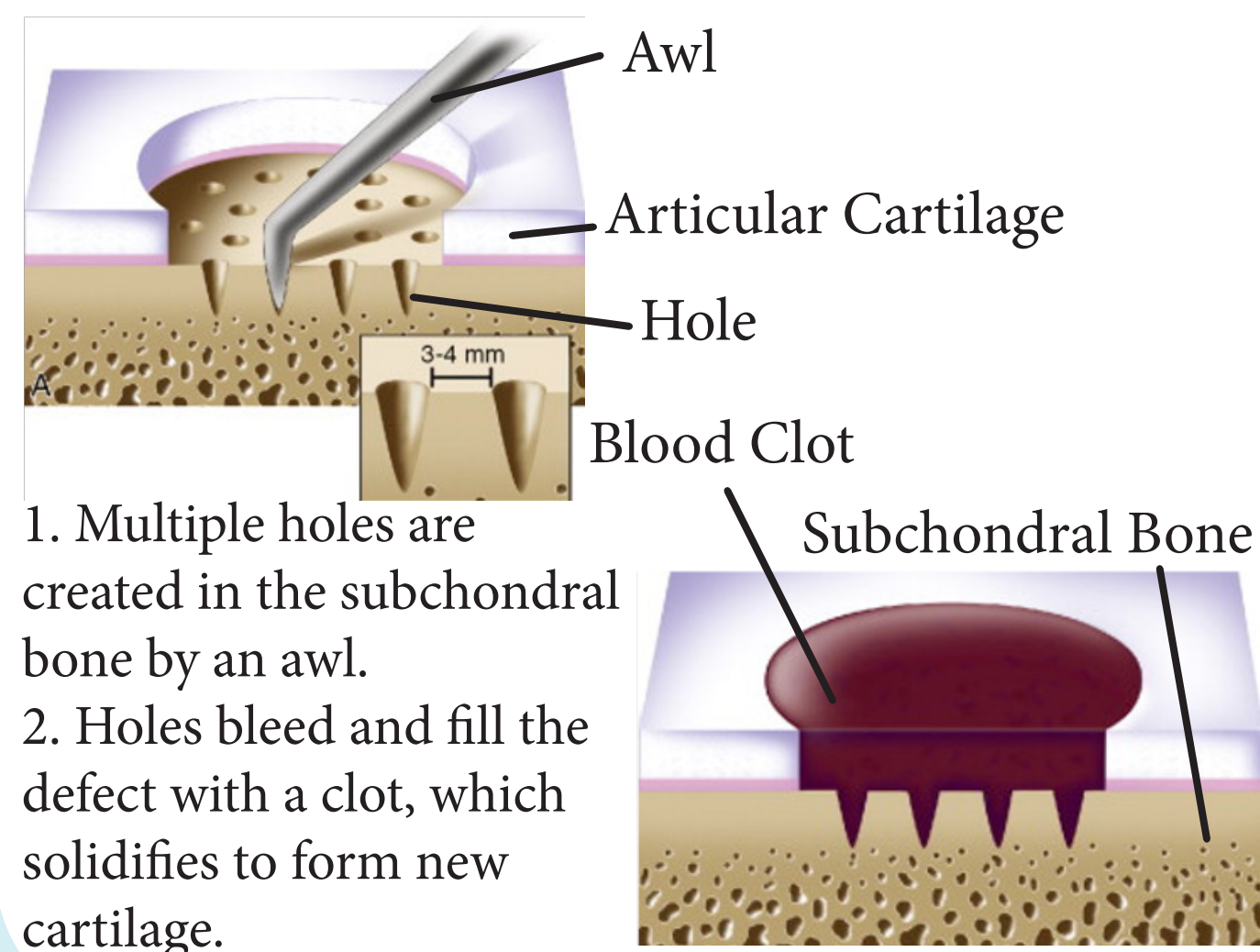
SURGICAL MICRODRILLING FOR OSTEOARTHRITIS TREATMENT

Tobia Sebastiano Nava¹, Anya Davidson¹, Francesca Beaton², Nan Li¹, Michael Sutcliffe¹, Mark Birch² Andrew McCaskie²

¹Biomechanics Group, Department of Engineering, University of Cambridge

²Division of Trauma and Orthopaedic Surgery, University of Cambridge

Introduction



Experimental

Microdrilling:

- Shows higher precisions depth
- Higher precision in diameter
- Less bone compaction
- Less debris left in hole
- Clear and open channels

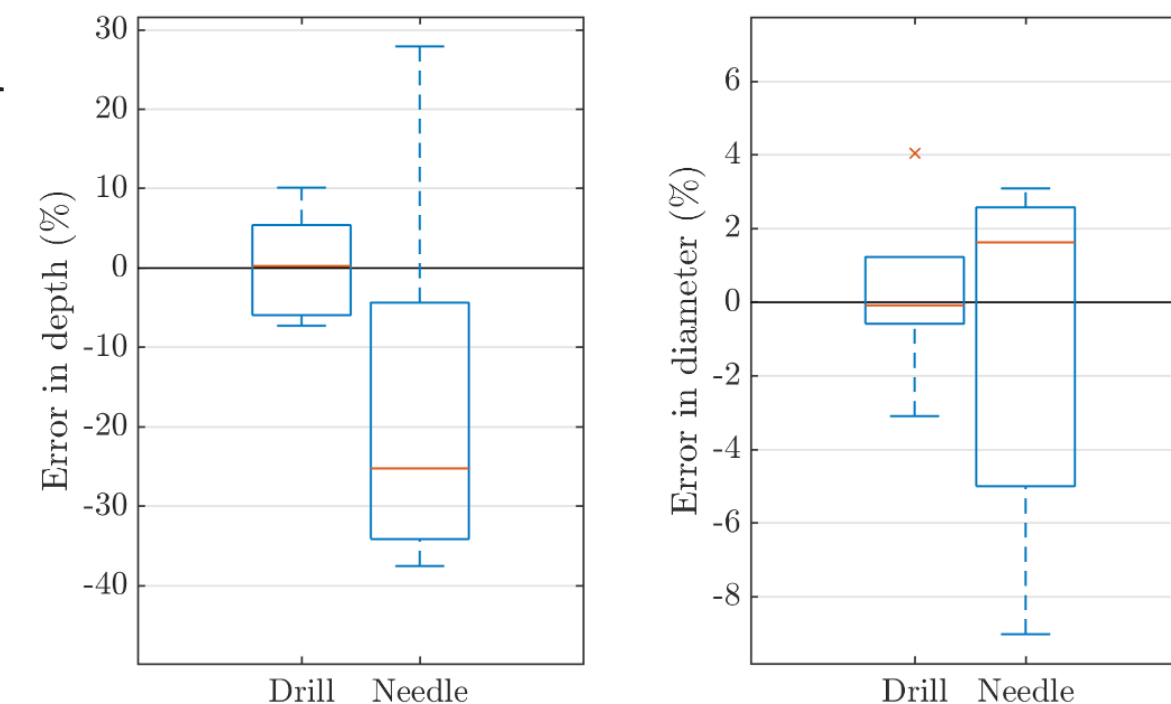


Figure 1: Comparison of accuracy in depth and diameter between drill and needle

Computational

Normalised Deflection

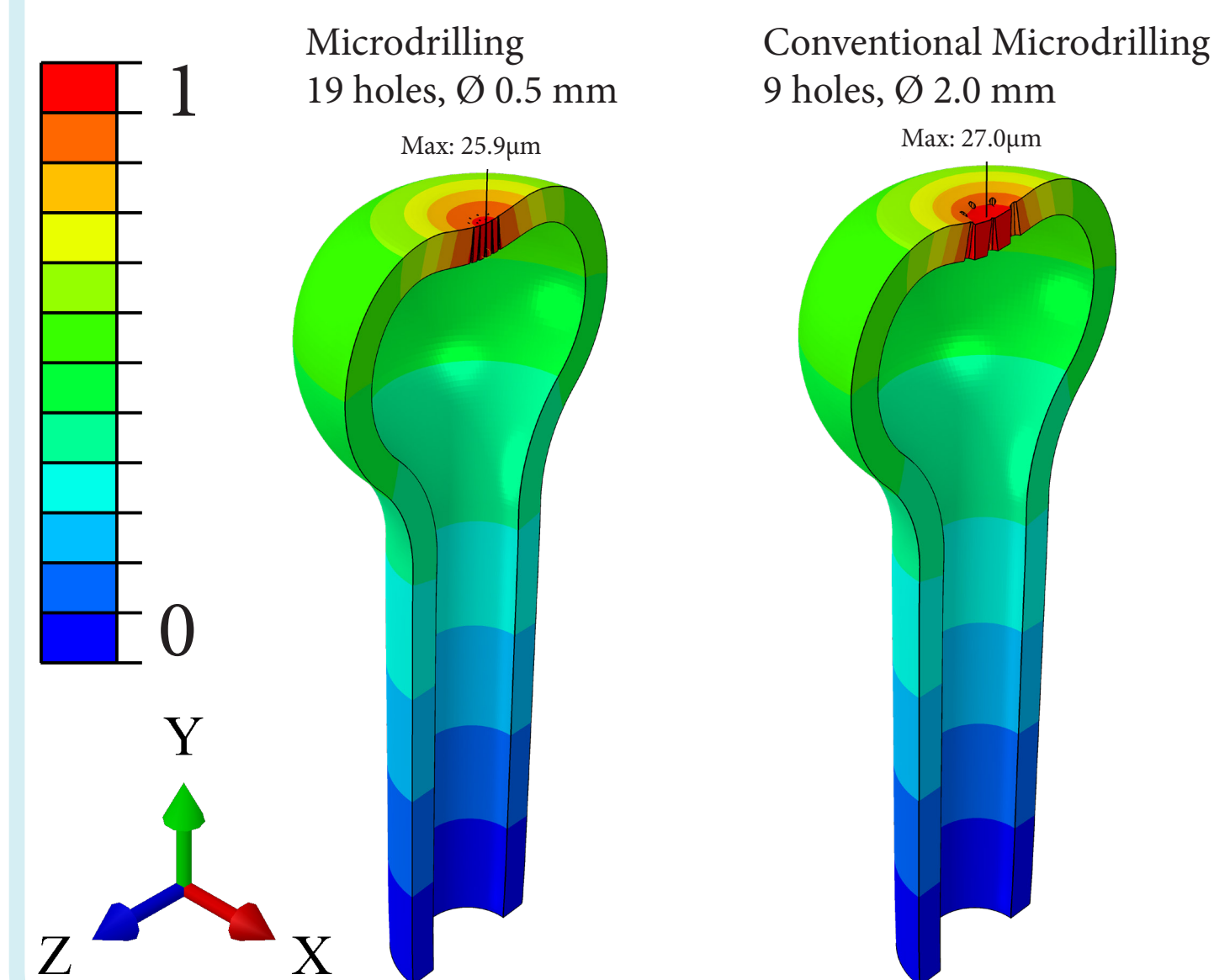
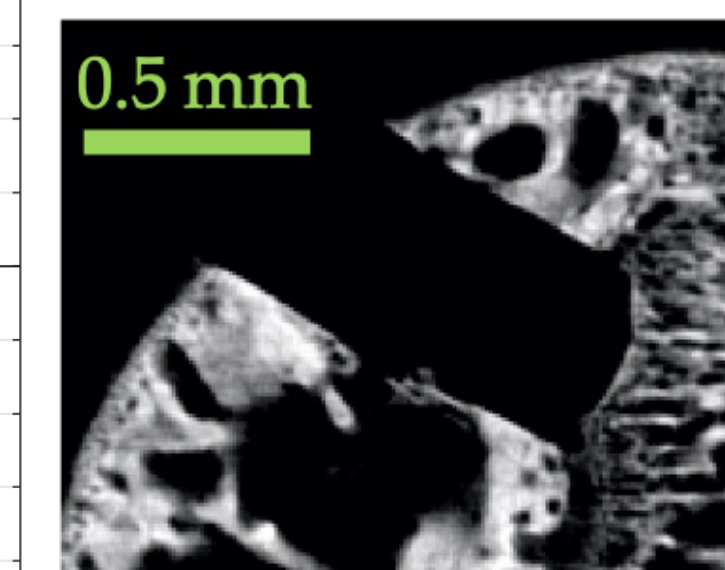


Figure 3: Computational results from FEM simulation, left with MD and right with conventional MD.

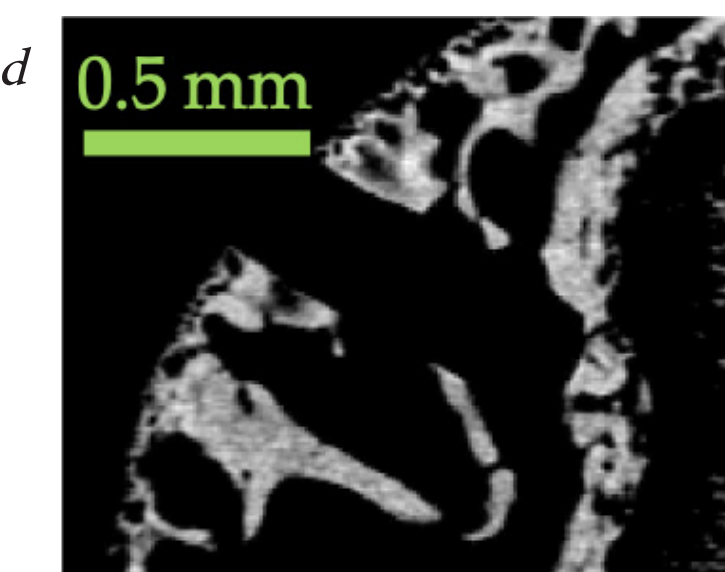
Structural Effects:

- Minor weakening due to microdrilling
- Deflection increases by +1.05% for 0.5mm diameter hole
- Deflection increases by +5.25% for 2mm diameter hole

a. 0.5 mm drill bit



b. 0.3 mm drill bit



c. 0.46 mm needle

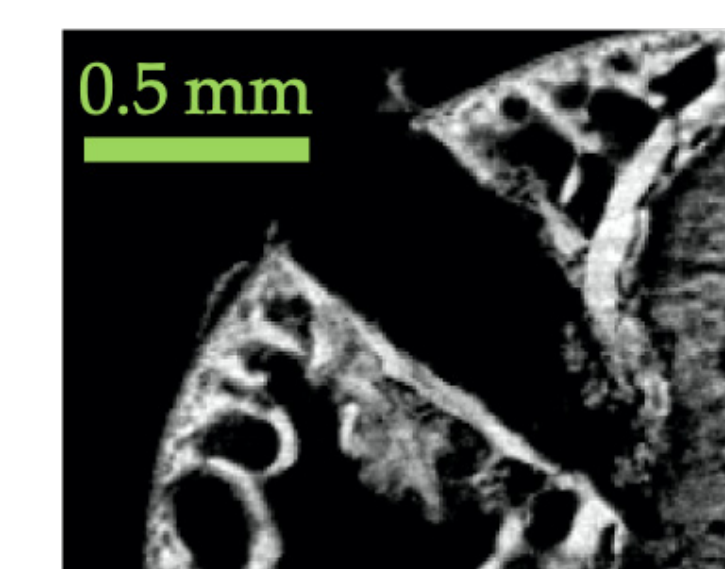


Figure 2: CT-scans from mice femur visualising bone compaction around the edge of the hole. Especially in c. bone compaction is visible by the clear border of bone, whereas otherwise porous appearance represents a normal state.

Conclusion

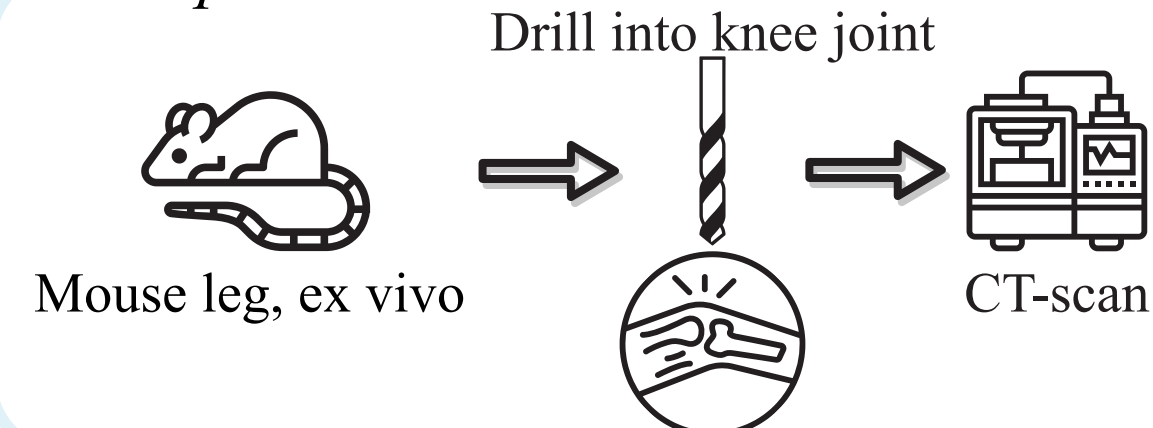
1. Microdrilling creates less bone compaction around the drilled holes
2. Gives surgeon more control over the process
3. Increases accuracy of surgery [1]
4. Created channels are expected to result in better healing response and improve the outcome of the treatment[2]
5. Effects on structural weakening are rather small.
6. Adaptive stress on bone is expected to be marginal

Further experimental research will be necessary to identify the long-term effects of MD onto the bone and surrounding cartilage. Additionally, the changes of contact stiffness will be investigated computationally to study the changes in the cartilage as a result of MD.

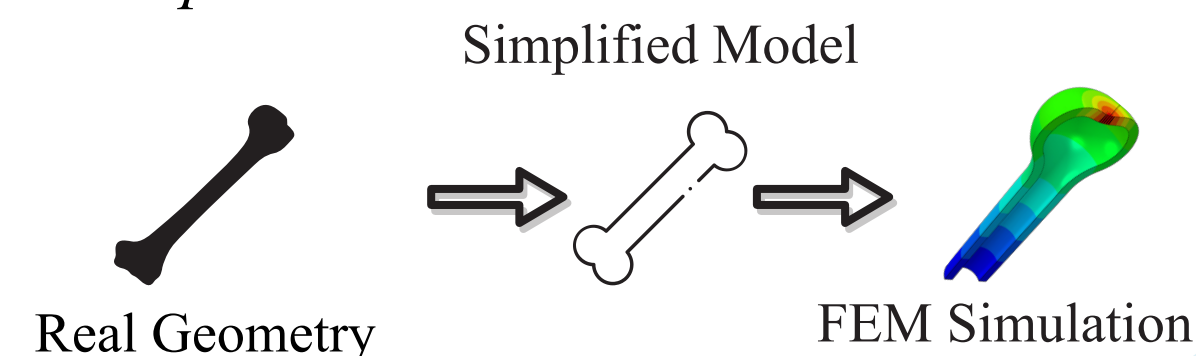
This should help to gain crucial information about microdrilling and its prospects to help people suffering from osteoarthritis.

Methods

Experimental



Computational



References

- [1] A. Davidson, Surgical microdrilling for arthritis treatment. Master's thesis, University of Cambridge. 2019
- [2] H. Chen et al. Drilling and Microfracture Lead to Different Bone Structure and Necrosis during Bone-Marrow Stimulation for Cartilage Repair, Journal of Orthopaedic Research. 2009

About the Project

T.S. Nava is an exchange student for Royal Institute of Technology KTH, Stockholm, doing his master's degree thesis at the University of Cambridge in biomechanics.