A NOVEL CHARACTERISATION MODEL FOR MICROVASULATURE CHANGES FOLLOWING CLOSED SOFT TISSUE TRAUMA USING MICRO-CT IMAGING

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INTRODUCTION

There is evidence that the reduction of blood perfusion caused by closed soft tissue trauma (CSTT) delays the healing of the affected soft tissues and bone [1]. We hypothesise that the characterisation of vascular morphology changes (VMC) following injury allows us to determine the effect of the injury on tissue perfusion and thereby the severity of the injury. This research therefore aims to assess the VMC following CSTT in a rat model using contrast-enhanced micro-CT imaging.

METHODOLOGY

A reproducible CSTT was created on the left leg of anaesthetized rats (male, 12 weeks) with an impact device. After euthanizing the animals at 6 and 24 hours following trauma, the vasculature was perfused with a contrast agent (Microfil, Flowtech, USA). Both hind-limbs were dissected and imaged using micro-CT for qualitative comparison of the vascular morphology and quantification of the total vascular volume (VV). In addition, biopsy samples were taken from the CSTT region and scanned to compare morphological parameters of the vasculature between the injured and control limbs.

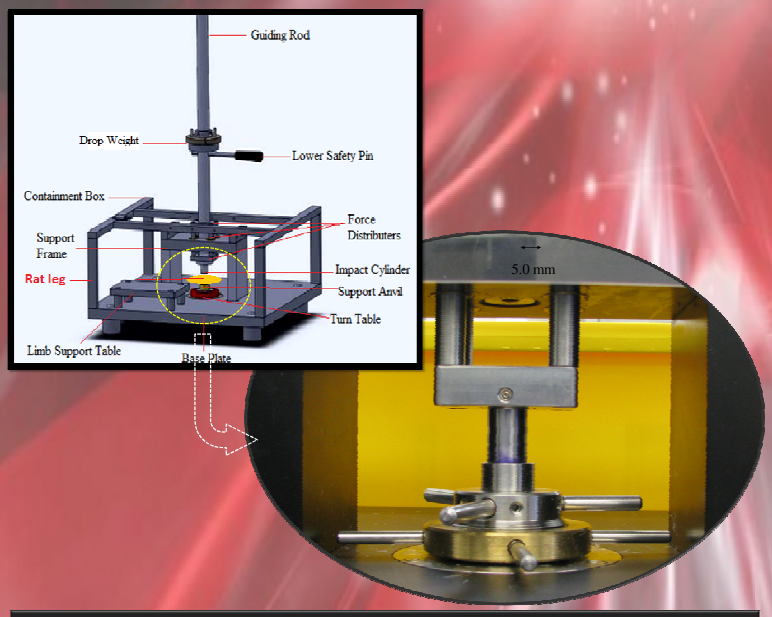

Figure 1: The impact device for creating the CSTT: The anaesthetised rat's leg is secured in the impact device between the impact cylinder and the support anvils, before the drop weight is dropped along the guiding rod to impact the leg.

RESULTS AND DISCUSSION

While the visual observation of the hindlimb scans showed consistent perfusion of the microvasculature with microfil, enabling the identification of all major blood vessels, no clear differences in the vascular architecture were observed between injured and control limbs. However, overall VV within the region of interest (ROI) was measured to be higher for the injured limbs after 24h. Also, scans of biopsy samples demonstrated that vessel diameter and density were higher in the injured legs 24h after impact.

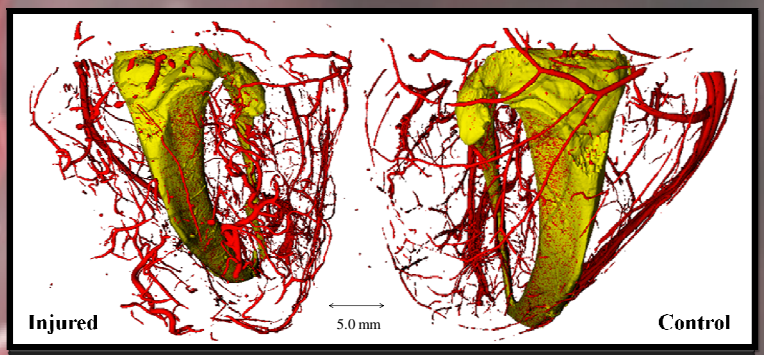

Figure 2: Three-dimensional visualisation of the vascular tree (red) surrounding the rat's tibia (yellow) obtained from micro-CT data. The quantification of correlated ROI's showed a higher VV in the injured legs, 24 hours after injury in comparison with the control legs.

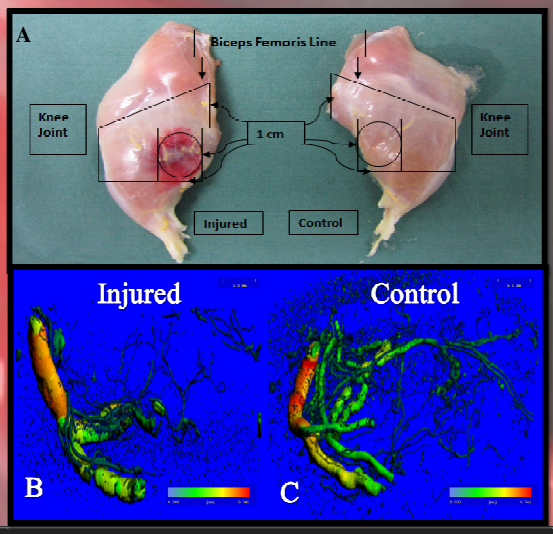

Figure 3: (A) Full thickness biopsies were taken from the region of impact of both control and injured legs. Three-dimensional reconstructions of the biopsy micro-CT scans from injured (B) and control limbs (C) visualising the measured vessel diameter between 0 -0.741 mm (blue-red).

CONCLUSION

We believe these results will contribute to the development of objective diagnostic methods for CSTT based on changes to the microvascular morphology as well as aiding in the validation of future non-invasive clinical assessment modalities.

ACKNOWLEDGEMENT

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REFERENCES

[1] L. Claes et al., Moderate Soft Tissue Trauma Delays New Bone Formation Only in the Early Phase of Fracture Healing. Journal of Orthopaedic Research, 2006: p. 1178-1185