Quantitative Topographic Anatomy of the Femoral ACL Footprint – A Micro-CT Analysis

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INTRODUCTION

Anterior Cruciate Ligament (ACL) Reconstruction surgery is the sixth most common orthopaedic surgery in the USA and as a result has become the most studied musculoskeletal system. Despite this, full recovery after surgery is unsatisfactory with only ≈70% of patients regaining full knee mobility. Attempting to solve this, clinicians have investigated surgical methods that reconstruct the knee’s original anatomy after ACL reconstruction. However, further work must be done to determine whether these landmarks can be dependably used to guide correct femoral tunnel placement. Seven cadaveric knees were micro-CT scanned to understand the development of the femoral footprint, and to investigate the existence of any landmarks which could be used to guide surgical placement. These models developed from micro-CT data were found to be accurate to ±70μm even though the data size was reduced to 400μm. Various statistical methods were used to calculate the agreement between our participants and to determine whether these landmarks also show a range of responses indicating little agreement. Surgeons didn’t agree on the presence of the osseous landmarks in this sample indicating that they can’t be used reliably to guide tunnel placement.

METHODOLOGY

Validation of the surface extraction method was done using scanning sample femur (baseline scan) and then micro-CT scanning the same femur. The micro-CT scanned femur then underwent the developed surface extraction method. The two scanned surfaces were then compared using a deviation analysis which gives a colour representation of the differences between the ‘actual’ and ‘predicted’ surface. This allows us to quantify the error of the developed method.

RESULTS

The presence of the osseous landmarks in this sample was identified from both the relief maps and our surgeons’ descriptions, and compared with previous findings in the literature. Our results disfavour the current consensus.

CONCLUSIONS

This present study has described a technique for quantitatively analysing the femoral ACL footprint anatomy, utilising micro-CT imaging. This method has been shown to be accurate and could be used to investigate anatomical features of many regions of interest of the musculoskeletal system. Quantitative assessment was possible due to the consistent variability of the presence and orientation of osseous landmarks within the subjects in this study. These models could now be used to extract a closed surface. Finally, the two surfaces are optimised and merged together to create the finished surface model.

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REFERENCES