High-resolution peripheral quantitative computed tomography imaging in patients with a clinically suspected scaphoid fracture

Scaphoid fractures are the most common carpal fractures, and they are associated with serious complications when treated with delay. Early and accurate diagnosis is therefore important, but this remains challenging with current imaging modalities. The new high-resolution peripheral quantitative computed tomography (HR-pQCT) may be a potential alternative modality due its high resolution, but application to the scaphoid bone is new. Furthermore, the high resolution of HR-pQCT implies inspection of more than five hundred slices for fracture diagnosis.

This graduation project explored the applicability of HR-pQCT to the scaphoid bone in patients with a suspected scaphoid fracture. It was found that good-quality HR-pQCT scans of the scaphoid bone could be acquired when a cast was used during scan acquisition that immobilizes the wrist and thumb. The development of a both sensitive and specific automatic fracture detection algorithm to facilitate diagnosis-making appeared difficult but may have potential when further investigated. Additionally, the shape of scaphoid bone, quantified by a statistical shape model constructed from the HR-pQCT scans, appeared to be associated with fracture presence. Finally, automatic contouring of the scaphoid bone was possible, which allows for in vivo microarchitectural evaluations of the bone and conceivably also for research into scaphoid fracture healing.

A cast with removable thumb part was used during acquisition of the HR-pQCT scans; B. Example of a correctly automatic contouring of the scaphoid bone on the HR-pQCT scans; C. Example of a correct detection of a scaphoid fracture with the developed automatic fracture detection algorithm; D. A statistical shape model, constructed from the HR-pQCT scans, quantified the mean shape of the scaphoid bones as well as shape variance. In a regression model, two or five shape modes explaining shape variance could well classify scaphoid bones as fractured or non-fractured.