

4D CT AS A TOOL TO MEASURE DYNAMIC SCAPHOLUNATE DISTANCE: A RELIABILITY STUDY

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Introduction

Scapholunate (SL) instability is the most common form of posttraumatic carpal instability. Despite its crucial role in guiding therapeutic options, early diagnosis and classification remain challenging (1).

Four-dimensional computed tomography (4D CT) emerged as a novel imaging modality producing dynamic 3D image volumes over time, with a good temporal and spatial resolution. 4D CT has already been used to assess scapholunate (SL) instability (2), but no consensus on a gold-standard assessment for diagnosis has been reached. We present a technique to measure 3D scapholunate distance (SLD) based on 4D CT and its intra-observer reproducibility and interobserver reliability through a repeated-measures study in a representative patient cohort.

Methods

A 4D CT scan (Aquilion one, Canon, (voxel size: 0,468x0,468x0,5 mm)) of 7 patients suspected of SL lesion (positive Watson test and/or pain with palpation to the dorsal SL interval upon clinical examination and normal or inconclusive diagnosis based on plain radiographs) with video guidance was made after acquainting them with performing flexion-extension in the gantry. A 3D surface model of the wrist was created using Mimics (Materialise, Belgium). After identifying a dorsal, proximal and volar point on both the scaphoid and lunate (3), SLD was calculated at each interval. All 4D CT datasets were evaluated 3 times by 2 observers. Standard deviation (SD) of the differences between 2 measurements, Interclass Correlation Coefficient (ICC), Standard Error of Measurement (SEM) and Minimal Detectable Change (MDC) were calculated to evaluate intra- and interobserver variability.

Results

Results of the intra-observer evaluation for the first observer and second observer as well as inter-observer variability are given in Table 1.

Reproducibility Observer 1	SLD Dorsal	SLD Proximal	SLD Volar
SD (mm)	0,37	0,64	0,58
ICC	0,98	0,97	0,95
SEM (mm)	0,052	0,11	0,13
MDC (mm)	0,15	0,31	0,36

Reproducibility Observer 2	SLD Dorsal	SLD Proximal	SLD Volar
SD (mm)	0,43	1,29	0,35
ICC	0,98	0,88	0,77
SEM (mm)	0,07	0,45	0,17
MDC (mm)	0,17	1,24	0,47

Interobserver reliability	SLD Dorsal	SLD Proximal	SLD Volar
SD (mm)	1,44	1,19	0,99
ICC	0,86	0,94	0,85
SEM (mm)	0,54	0,29	0,38
MDC (mm)	1,51	0,81	1,04

Discussion

Comparing MDC to the resolution of the scan and the minimal clinically important difference (an average dorsal SLD of 7,47mm was measured), MDC was low, indicates that 4D CT offers a sufficiently precise and clinically applicable measurement technique.

Also ICC values were high for both intra- and inter-observer variability, demonstrating a relatively small error variance. We conclude using the proposed points and 3D assessment to measure SLD based on 4D CT acquired images is a reproducible and reliable method.

We acknowledge the lack of correlation to wrist arthroscopy in this study, making it impossible to already conclude on the clinical relevance of these findings. Therefore, future work will focus on how the SLD changes during wrist motion, and correlate this to wrist arthroscopy.

References

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