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(G*) A Four-Dimensional Ultrasound System for Assessing Ligament Laxity in Basal Thumb Osteoarthritis

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Introduction: Joint laxity has been hypothesized to be a risk factor for thumb osteoarthritis (OA). Previous studies assessing thumb biomechanics have utilized various imaging modalities including radiography, magnetic resonance imaging, computed tomography imaging, and ultrasound (US). However, these imaging techniques provide limited information on joint laxity during motion. This work validates the use of a novel 4DUS imaging system to characterize the laxity of the thumb joint.

Methods: A 4DUS system consisting of a motorized semi-submerged transducer assembly was developed. A high frequency transducer was automatically translated laterally along the location of the thumb joint. 4DUS and 4DCT images of thumb abduction were collected from five healthy volunteers and five thumb OA patients. The distance between the bones of the thumb joint along with the length of the dorsoradial ligament in each image were measured to characterize ligament laxity. Intra- and inter-class correlation coefficients were calculated to determine the reproducibility of the measurements.

Results: The average maximum length of the dorsoradial ligament in the healthy cohort and patient cohort was 12.76 and 15.53 mm, respectively. Registration of the 4DCT images to the 4DUS images validated the 4DUS system's capability to detect bony landmarks, such as the base of the first metacarpal and the bony angulation of the trapezium. With intraclass and interclass correlation coefficients greater than 0.9, the ligament length measurements indicate excellent repeatability.

Conclusion: In this preliminary study, a 4DUS system for the assessment of ligament behavior during thumb motion was developed, and its reliability and reproducibility were tested. This system will be used in a cohort of thumb OA patients to evaluate the patterns of ligament laxity associated with various stages of disease progression. This imaging system will provide an explanation of the changes to the thumb's stabilizing ligaments that influence the onset and progression of thumb OA.

Keyword-1

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Keyword-2

ultrasonography

Keyword-3

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