In-vitro analysis of elbow instability using 3D CT imaging

ABSTRACT TRAUMADAGEN 2025

M. Boeijenga

Posttraumatic elbow instability is difficult to diagnose due to the limited sensitivity of clinical examinations and static imaging. This in-vitro study evaluated the feasibility of 3D CT scanning under load as a diagnostic tool for detecting ligamentous instability. Three fresh-frozen cadaveric upper limbs were used to simulate valgus, varus, and posterolateral rotatory instability through sequential ligament injury. A custom loading device applied forces in clinically relevant directions, while 3D CT imaging quantified translations and rotations of the radius and ulna relative to the humerus. The results showed clear bone displacement under multidirectional loading with a measurement variability of less than 0.1 mm/°. These findings demonstrate that 3D CT under load can quantitatively detect elbow instability and may serve as a promising technique for assessing posttraumatic ligamentous injury.