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3D CT Modelling for Kinematic Analysis of Lateral Ulnar Collateral Ligament Reconstruction

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Summary:

Isometric reconstruction for double strand LUCL is achieved with vertical tunnel configuration.

Abstract:

Background. Lateral ulnar collateral ligament (LUCL) has been the most reconstructed structure in posterolateral rotatory instability despite other dynamic stabilizer structures. There are numerous surgical techniques described for LUCL reconstruction. However, the study for LUCL reconstruction is limited to static analysis on single-strand reconstruction. We aim to analyse the kinematics of a double-strand LUCL reconstruction with three different configurations of graft placement in a dynamic analysis.

Methods. Five healthy elbow joints were scanned by computed tomography. Images were converted into three-dimensional models. The humeral origin and ulnar insertions of 2 ligament strands were registered in 3-matics software. There were 3 different configurations of graft placement which are horizontal, vertical and triangle configurations. A dynamic elbow joint was simulated at 1-degree increments throughout the motion arc. Each ligament strand length and the discrepancy were measured.

Results. The ligament length for each strand were respectively reported as (1) 30.95 ± 4.57 mm and 34.25 ± 5.01 mm, for horizontal graft configuration, (2) 32.54 ± 3.59 mm and 35.35 ± 4.16 mm for vertical graft configuration, and (3) 31.96 ± 4.00 mm and 33.70 ± 3.11 mm for triangle graft configuration. The minimum discrepancy in each graft strand throughout the motion arc was 1.12, 0.01, and 1.03 mm for the horizontal, vertical, and triangle graft configurations, respectively.

Conclusions. The study showed no isometric reconstruction for double strand LUCL reconstruction with dynamic analyses of three-dimensional elbow model. However, the vertical double-strand configuration may serve as a coequal option for its nearly isometric reconstruction.