Effects of dividing the transverse carpal ligament on the mechanical behavior of the carpal bones under axial compressive load: A finite element study.

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Transecting the transverse carpal ligament (TCL) is a routine procedure to surgically treat carpal tunnel syndrome; yet, its mechanical consequences on carpal bones are unclear. In this study, our intent was to perform a computational analysis of carpal biomechanics resulting from TCL release. A three-dimensional finite element model of the wrist was constructed, which included all the carpal bones, the distal ulna and radius, the proximal metacarpals and the interosseous ligaments. Cartilage layers of each bone were modeled manually according to anatomic visualization software. The TCL was also modeled in three dimensions and added to the bone model. A 100-Newton axial load was applied to the upper section of the second and third metacarpals. The effects of dividing the TCL on the displacements of the carpal bones and the contact stress distribution in the midcarpal joints were studied using a finite element analysis method. When the TCL was divided, the axial compressive load resulted in the carpal bones deviating more radially. More specifically, the carpal bones on the radial side of the capitate and lunate (i.e. the trapezium, trapezoid, and scaphoid) moved further toward the radius, and the carpal bones on the ulnar side of the capitate and lunate (i.e. hamate, triquetrum, and pisiform) moved further toward the metacarpals. The contact stresses and contact locations in the midcarpal joints changed as a result of dividing the TCL. The changes in displacements of carpal bones and the contact stress distributions in the midcarpal joints due to TCL release may be implicated for some of the postoperative complications associated with carpal tunnel release.