The ligaments of the trapeziometacarpal joint: detailed anatomy and material properties.

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The basal thumb joint, or trapeziometacarpal (TMC) joint, is a highly mobile joint, reinforced by a joint capsule and several ligaments. The ligaments play an important role in joint stability, but to date it remains unclear whether the dorsal or volar ligaments are the main joint stabilizers. Earlier publications (Eaton et al. 1973; Pelligrini et al. 1991; Imaeda et al. 1992; Najima et al. 1997; a.o.) have pointed to the volar ligaments as key stabilising structures, and surgical treatment of thumb osteoarthritis (OA) or fractures of the first metacarpal (MC1) are based on these findings. This means that a dorsal approach will often be chosen in favour of an anterior approach to expose the TMC joint during surgery in order to spare the volar ligaments and thenar musculature. However, the stabilizing role of the volar ligaments has been contested in more recent publications (Bettinger et al. 1999, 2000; Comtet et al. 2006; Colman et al. 2007; a.o.), which have put forward the dorsoradial ligament as main stabilizer of the TMC joint. To shed light on this debate, we executed a detailed anatomical study of the dorsoradial (DRL) and anterior oblique (AOL) ligament, including detailed dissection and material testing.

Nine fresh-frozen cadaveric thumbs (male: n=6; female: n=3) from seven specimens with a mean age of 74 years were used for this study. Cadavers were obtained via the human body donation programme of the University of Leuven. Detailed dissections were executed on thawed specimens, reflecting all muscle layers to expose the TMC joint ligaments. Length, width and thickness of the AOL and DRL were measured *in situ* on each specimen. Next, the first metacarpal (MC1) and trapezium (Trap) were isolated together with both ligaments and the MC1 and Trap were cut sagitally to isolate a MC1-AOL-Trap and MC1-DRL-Trap complex from each specimen. These samples were mounted in a material testing rig (Bose LM1 Test Bench) and cyclic, displacement-controlled tests (2Hz; 40 cycles; pre-conditioning at 0.5N) were executed on each sample until a maximal loading of 150 N or until ligament/bone rupture. The obtained force-displacement curves were used to calculate stiffness and hysteresis of each sample.

Our results show that the DRL is significantly shorter and thicker than the AOL, which is thin and ill-defined. This supports a recent histological study by Ladd et al. (2012) which described the AOL as a thin, capsular-like structure and makes a stabilizing function of this ligament unlikely. Our results also indicate that the DRL has a higher stiffness than the AOL, making it a more likely candidate to provide joint stability. These findings are highly relevant for clinical practice, as they indicate that an anterior approach might be preferred in surgery and/or that the dorsoradial ligament should be repaired or reconstructed to regain full functionality of the thumb and to decrease the TMC dislocation risk.