



Thumb carpometacarpal joint stability: the importance of the dorsal ligaments

Educational article - English edition

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Source article: Lin JD et al. Trapeziometacarpal joint stability: the evolving importance of the dorsal ligaments. Clin Orthop Relat Res. 2014;472(4):1138-1145.

This systematic review examines thumb trapeziometacarpal (TMC) joint stability and addresses three questions: which ligaments are the main stabilisers; what evidence supports ligament reconstruction or plication for instability and early osteoarthritis; and what evidence supports first-metacarpal extension osteotomy?

The issue is both pathophysiological and therapeutic: instability might reduce congruence, concentrate loading on particular cartilage areas and contribute to TMC osteoarthritis onset or progression.

Methods

The authors searched MEDLINE and EMBASE through November 2012, supplemented by manual searching and reference lists. Of 2,112 initial records, 1,334 remained after deduplication. Fifty-two studies were included: 24 anatomical, histological or biomechanical studies; 16 on ligament reconstruction; and 12 on first-metacarpal osteotomy.

Studies of reconstructions combined with arthroplasty, fractures, trapezial osteotomies, reviews and conference communications were excluded.

Ligament anatomy and stability

Six ligaments are regularly identified: dorsoradial; superficial anterior oblique; deep anterior oblique; intermetacarpal; ulnar collateral; and posterior oblique. Additional dorsal structures vary by classification: dorsocentral ligament, dorsal TMC ligament and dorsal intermetacarpal bundles.

Evolution of the biomechanical model

The historical model, largely derived from Eaton and Littler and Pellegrini, assigned the anterior oblique ligament-particularly its deep portion or beak ligament-a central role in stability and osteoarthritis pathogenesis.

More recent anatomy and biomechanics challenge this view. Most studies published in the two decades before the review identify the dorsoradial ligament as the principal restraint to dorsal or dorsoradial translation of the first metacarpal.

Convergent findings include markedly increased dorsal displacement after division; substantial anatomical thickness; high mechanical strength and stiffness; rich innervation suggesting a



proprioceptive role; and membership of an organised dorsal complex sometimes termed the “dorsal deltoid ligament”.

However, it is not an isolated stabiliser. TMC stability probably results from coordinated action of dorsal, volar and intermetacarpal ligaments whose tension varies with thumb position.

Instability and TMC osteoarthritis

The proposed pathway is ligament laxity → subluxation and incongruence → reduced contact area → locally increased loading → cartilage degeneration.

Some studies associate deep anterior oblique ligament degeneration with cartilage damage. This does not establish whether ligament injury causes osteoarthritis, results from it or is associated with it. The review cannot formally identify one ligament as responsible for TMC osteoarthritis.

Ligament reconstruction

The 16 articles describe highly heterogeneous techniques using flexor carpi radialis, palmaris longus, abductor pollicis longus, extensor pollicis brevis, extensor carpi radialis longus or fascia lata.

Eaton-Littler technique

This is the most studied reconstruction. A flexor carpi radialis tendon strip passes through an extra-articular tunnel at the first-metacarpal base and is attached to the remaining tendon. Although historically presented as anterior oblique ligament reconstruction, its path restores function of both the anterior oblique and dorsoradial ligaments.

Series generally report less pain, greater grip strength, better function and reduced clinical laxity. Favourable medium- and sometimes long-term findings mainly concern painful instability and early osteoarthritis.

All clinical evidence, however, consists of level IV case series. It cannot rigorously compare techniques or distinguish treatment effects from natural history, patient selection or associated treatments.

The initial search identified no clinical study specifically assessing simple dorsoradial ligament plication or retensioning. A technical description of dorsoradial capsulodesis appeared after submission, without changing the evidence level.

First-metacarpal extension osteotomy

Osteotomy is performed at the first-metacarpal base, usually with approximately 30° of extension. Two mechanisms are proposed: shift contact towards less damaged volar cartilage, and increase dorsal ligament tension during key pinch to reduce laxity.

A biomechanical study found that 15° osteotomy could reduce laxity as effectively as 30°. This experimental finding does not establish clinical equivalence.

Published series generally report reduced pain, improved strength and function, high satisfaction and maintenance of results over two to twelve years, depending on the study. Again, evidence consists



exclusively of level IV clinical studies with heterogeneous indications, techniques and outcomes.

Review limitations

Although the search was systematic, overall evidence quality remained low: English-language publications only; exclusion of non-indexed literature; no meta-analysis; heterogeneous ligament definitions and biomechanical protocols; mixed cadaveric, histological, biomechanical and clinical studies; no controlled or randomised trials; no direct comparison of reconstruction and osteotomy; often dated and non-standardised functional outcomes; and possible bias in qualitative synthesis.

Convergent anatomical findings strengthen conclusions about the dorsoradial ligament. Conversely, weak clinical methods substantially limit treatment conclusions.

Clinical conclusion

The review formalises an anatomical paradigm shift: the anterior oblique ligament is probably not the sole decisive structure. The dorsoradial ligament and broader dorsal complex appear to be the principal TMC stabilisers, particularly against dorsal first-metacarpal translation.

Ligament reconstruction and extension osteotomy offer encouraging symptomatic outcomes in painful instability and early osteoarthritis. Nevertheless, no evidence demonstrates that surgical stabilisation prevents or slows TMC osteoarthritis progression.

These interventions should therefore be regarded as treatments for pain, instability and functional impairment in selected patients, rather than preventive procedures with an established structural effect.