ROLE OF MUSCLES IN THE STABILIZATION OF LIGAMENT-DEFICIENT WRISTS

Alex Lluch
Institut Kaplan
Hospital Vall d'Hebron
(Barcelona, Spain)

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Disclosure: Potential or actual Conflicts of Interest

Alex Lluch
Head. Hand & Wrist Unit. Vall d'Hebron University Hospital. Barcelona, Spain.
Co-director. Institut Kaplan. Barcelona, Spain.
Elected treasurer. ExCom & Council member FESSH.

Speaker/consultor:
- Acumed

Speaker:
- Zimmerbiomet

Member:
- AO Hand Expert Group

No conflicts of interest in this topic

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- ✓ What's unstable and what is not?
- ✓ Carpal stabilization mechanisms
- ✓ Role of muscles in scapholunate dysfunction
- ✓ Role of muscles in other wrist dysfunctions
- ✓ Conclusions

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Three-Ligament Tenodesis for the Treatment of Scapholunate Dissociation: Indications and Surgical Technique

Marc Garcia-Elias, MD, PhD, Alberto L. Lluch, MD, PhD, John K. Stanley, FRCS, MChOrth, FRCS, FRCSE

J Hand Surg Am. 2006 Jan;31(1):125-34.

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	I	II	III	IV	V	VI	VII
Partial lesion	Yes	No	No	No	No	No	No
Reparable	Yes	Yes	No	No	No	No	No
Normal RL angle	Yes	Yes	Yes	No	No	No	No
Stable lunate	Yes	Yes	Yes	Yes	No	No	No
Reductible	Yes	Yes	Yes	Yes	Yes	No	No
Normal cartilage	Yes	Yes	Yes	Yes	Yes	Yes	No

This is NOT a SL instability classification!

Garcia-Elias M, Lluch AL, Stanley J. 3LT for the treatment of SLD: indications and surgical technique. J Hand Surg Am. 2006;31(1):125-34.

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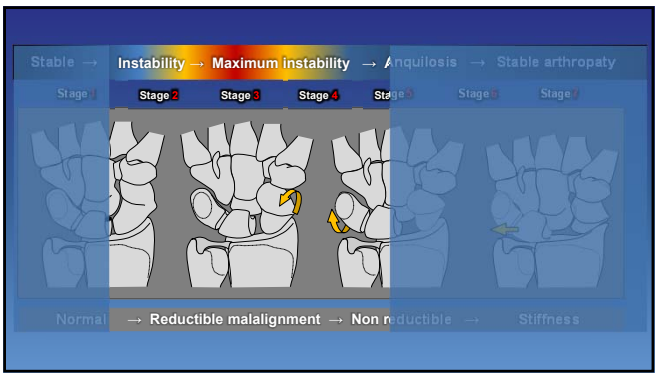

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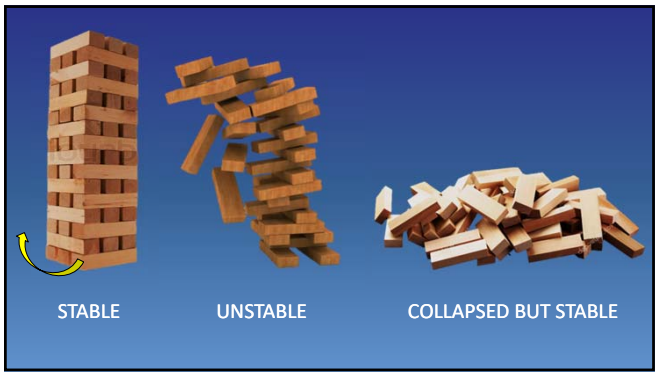

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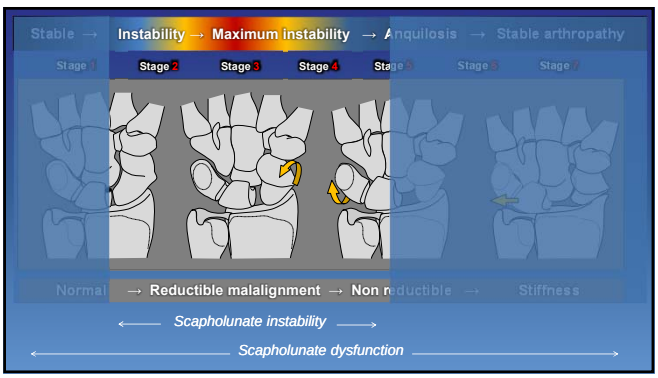

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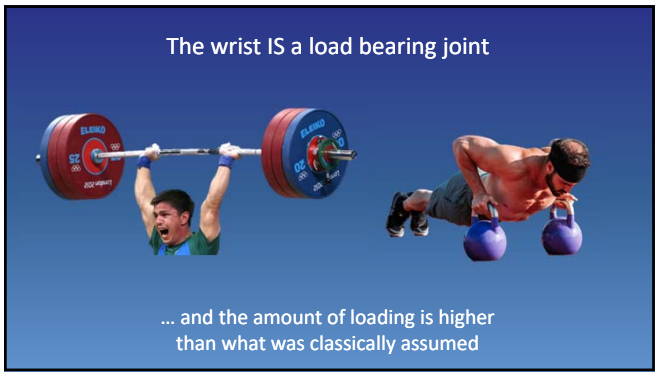

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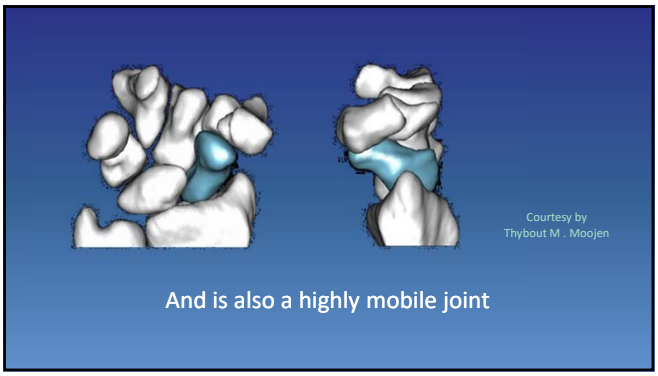

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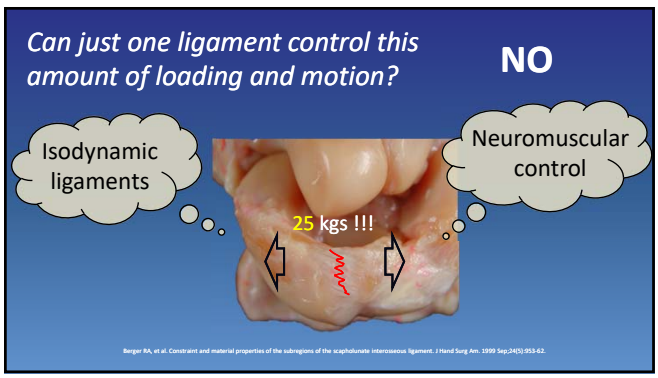

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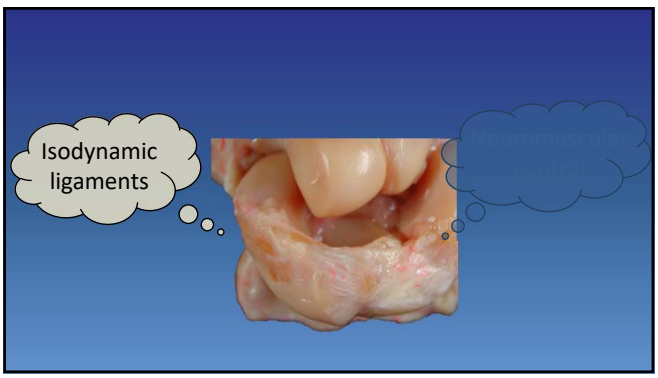

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Axial load in neutral position induces pronation of the distal row

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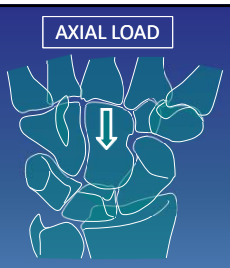

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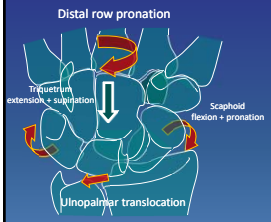

Who is guiding all these displacements?

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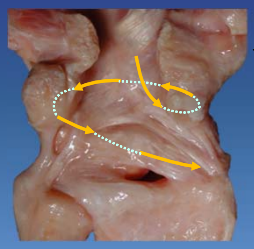
Isodynamic ligaments means a complex of ligaments that work together to constrain carpal displacements



AXIAL LOAD

Helical Antipronation Ligaments

Garcia-Elias, M., et al. Carpal Ligaments: A Functional Classification. Hand Clinics 2017;33(3): 511 - 520

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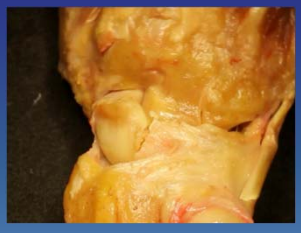

Volar & dorsal SLL + membrane. DIC intact

Volar & dorsal SLL + membrane + DIC

Much more than SL ligaments play a role in SL stability

Pérez AJ, Jethanandani RG, BSE, Emil S. Vutescu ES, et al. Role of ligament stabilizers of the proximal carpal row in preventi DISI instability. J Bone Joint Surg Am. 2019;101:1388-96

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Ligaments are the first line of defense in carpal stabilization

… but they cannot be the only stabilizers

Because even a complex of ligaments is not strong enough!!

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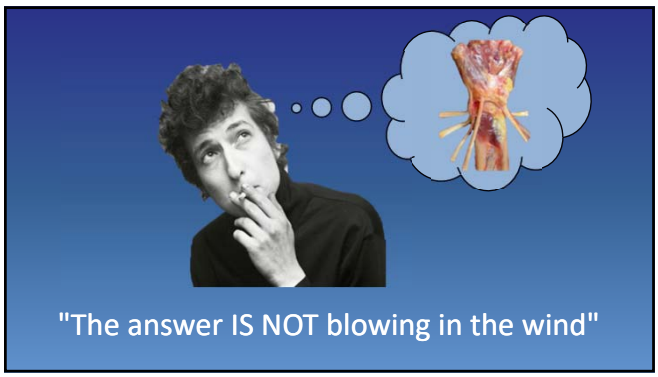

"The answer IS NOT blowing in the wind"

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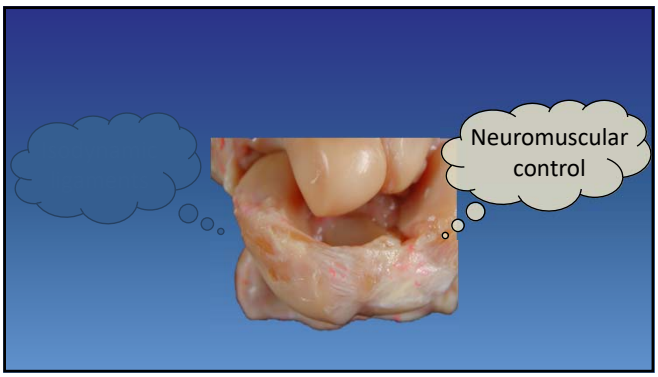

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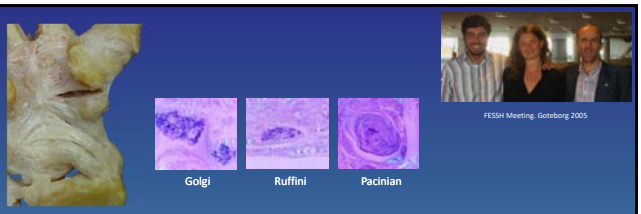

FESSH Meeting. Goteborg 2005

Golgi Ruffini Pacinian

Wrist ligaments are not just stiff cables aimed to resist tension, but complex structures containing nerve endings and mechanoreceptors

Hagert E, et al. Immunohistochemical analysis of wrist ligament innervation in relation to their structural composition. J Hand Surg 2007;32A: 30-36.

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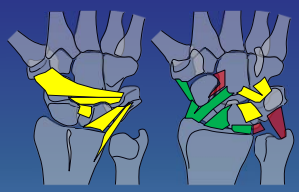

Richly innervated ligaments

Mechanoreceptors are not equally distributed in carpal ligaments

Hagert E, et al. Immunohistochemical analysis of wrist ligament innervation in relation to their structural composition. J Hand Surg 2007;32A: 30-36.

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- Only loading
- Hand blocked
- Wrist in neutral
- Forearm in neutral

INTRACARPAL ROTATION

Forearm muscle contraction has an effect in the position of the carpal bones

Salva-Coll G, et al. Effects of forearm muscles on carpal stability. J Hand Surg Eur Vol. 2011 Sep;36(7):553-9

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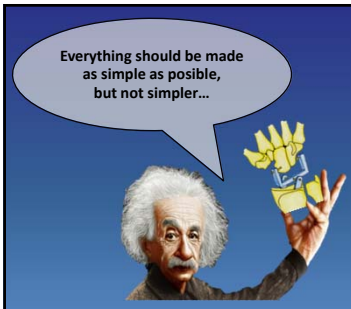
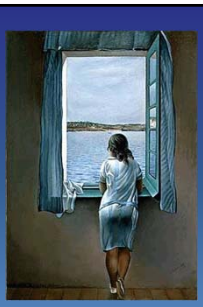


Simplification of reality



A door was opened

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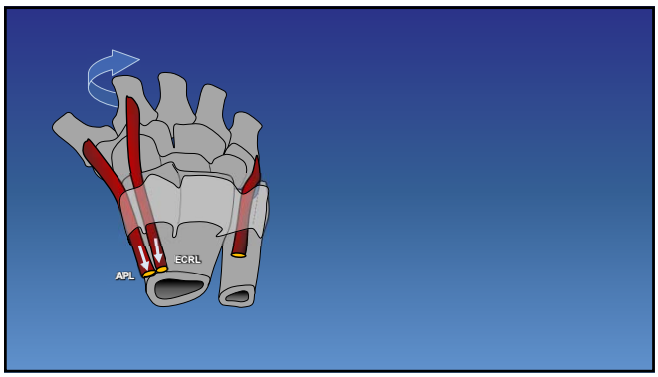

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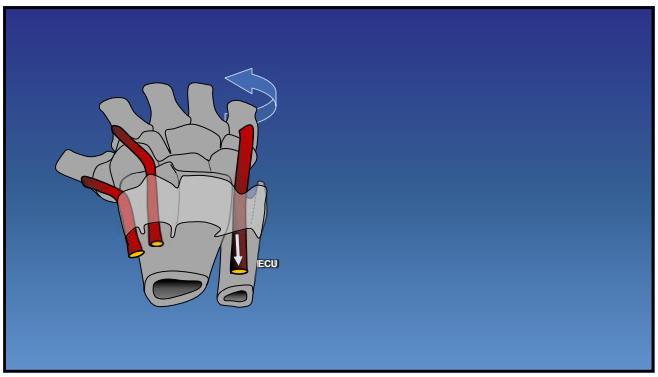

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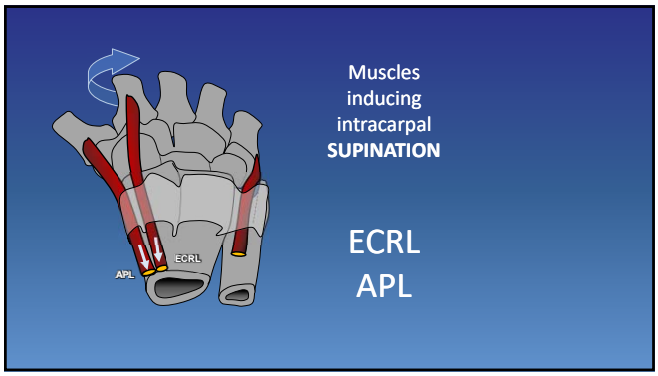

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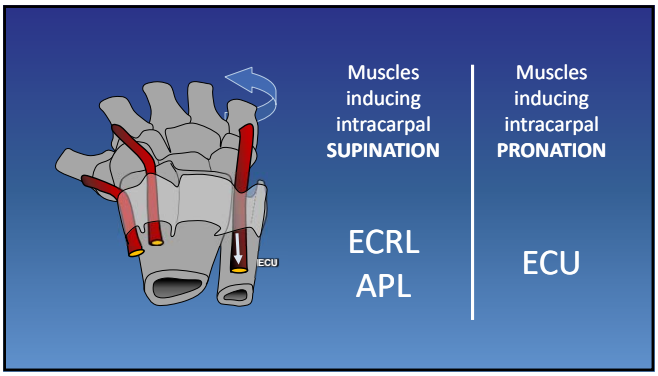

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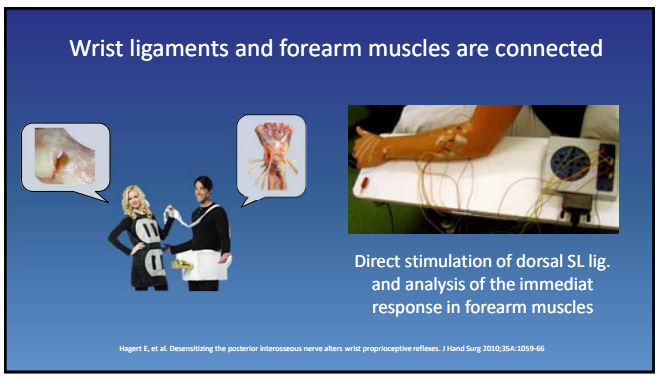

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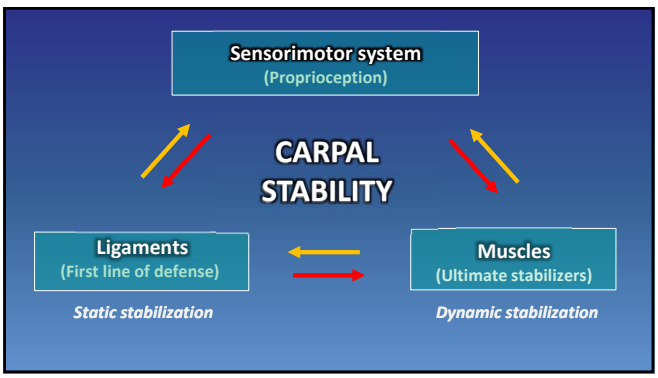

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How do the muscles know when to contract?

37

Lluch A, Salvà-Coll G, Esplugas M, et al. El papel de la propiocepción y el control neuroms en las IC. Rev Iberoam Cir Mano 2015;43(1):70-78.
Hagert E, Lluch A, Rein S. The role of proprioception and neuromuscular stability in carpal instabilities. J Hand Surg Eur 2016;41(1):94-101.
Esplugas M, Garcia-Elias M, Lluch A, et al. Role of muscles in the stabilization of ligament-deficient wrists. J Hand Ther. 2016 Apr-Jun;29(2):166-74.

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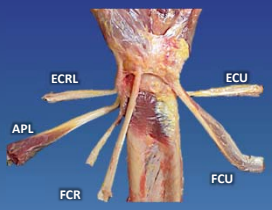

Gross SL instability

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Right wrist

ECRL
APL

ECU

Pronation of the scaphoid and the distal row increases the SL gap

Salvà-Coll G, Garcia-Elias M, Leon-Lopez MM et al. Role of the ECU and its sheath on dynamic carpal stability. J Hand Surg Eur Vol. 2012 Jul;37(6):544-8.
Salvà Coll G, Garcia-Elias M, Lluch Bergadà A et al. Carpal dynamic stability mechanisms. Experimental study. Rev Esp Cir Ortop Traumatol. 2013;57(2):129-34.

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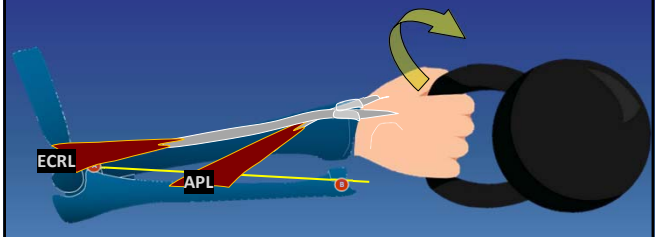

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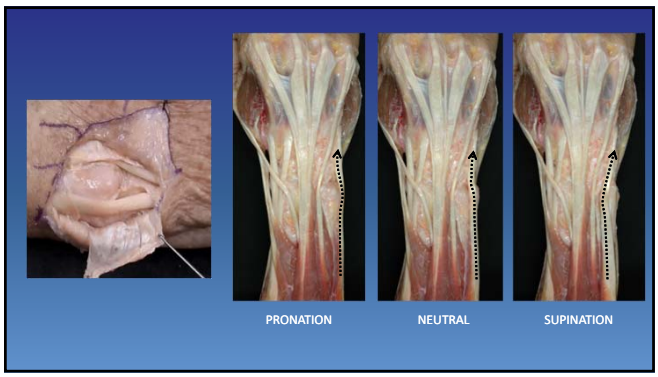

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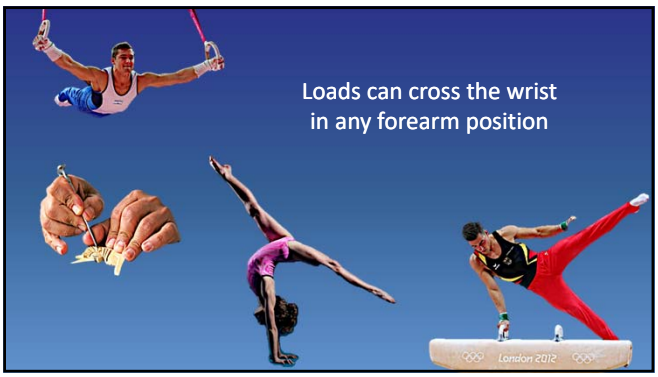

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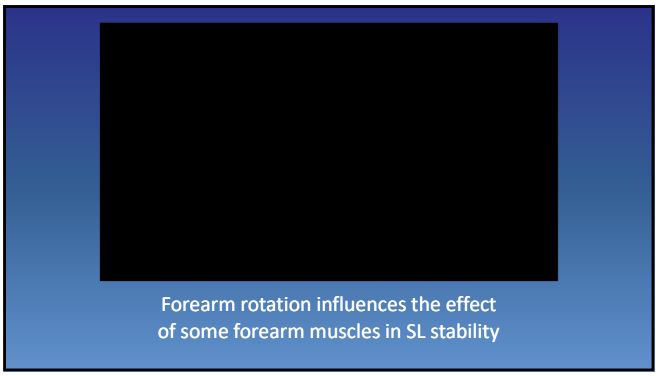

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- ECU has a destabilizing effect on the SL joint in ANY FOREARM ROTATION.
- SL "friendly muscles" were not effective in SUPINATION.
- Forearm SUPINATION is a position to be avoided for loading or strengthening in SL training programs.

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Left wrist

Gross LT instability

ECU ↓

↓ ECRL

Pronation of the distal row improves LT incongruity

Salva-Coll G, Garcia-Elias M, Leon-Lopez MM et al. Role of the ECU and its sheath on dynamic carpal stability. J Hand Surg Eur Vol. 2012 Jul;37(6):544-8.
León-López MM, Salvà-Coll G, Garcia-Elías M, Lluch-Bergadà A, Llusá-Pérez M. Role of the ECU in the stabilization of the lunotriquetral joint. An experimental study. J Hand Ther. 2013;26(4). doi:10.1016/j.jht.2013.07.003

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Palmar MC dysfunction or Palmar CIND

"Catch-up clunk"

Dr. Carlos Heras-Palou

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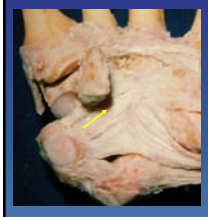
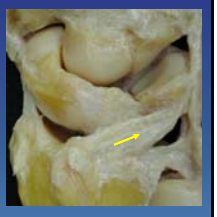


Triquetro-hamate & triquetro-capitate ligaments

SC & STT ligaments



Dorsal radiocarpal ligament !!!

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ECU ↓

Pronation of the distal row induced by the ECU improves the flexion of the proximal row in the model of CIND

Hagert E, Lluch A, Rein S. The role of proprioception and neuromuscular stability in carpal instabilities. J Hand Surg Eur 2016;41(1):94-101.
Lluch A. The role of neuromuscular control in carpal non-dissociative instabilities. ASSH Meeting. 2015 Seattle, USA.

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1. War against instability can't be won just with ligaments.

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2. Forearm muscles definitely play a role in carpal stabilisation.

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3. There is a connection between muscles and ligaments.

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4. Forearm rotation modifies the efficiency of protective muscles for the SL joint.

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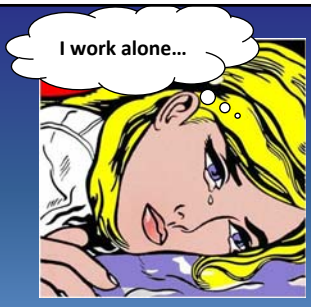

5. Stimulating team work is mandatory for learning

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THANK YOU !
dr.alexlluch