Dynamic Stability of the Thumb

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Conservative Management of the Painful Thumb is a CHALLENGE!
Teamwork is Important
Person - Therapist - Doctor - Family

Why is the human thumb at risk for pain?
Is it because there is only a 35 year warranty on the 1st CMC joint?

What is the mystery of dynamic stability for the CMC joint?
Can something be done about it? YES!

Effects of Exercise, Orthoses & Joint Protection Education

- Reduction in Pain & Improvement in Function
- No consensus for which orthosis is best
- No consensus (YET) for which exercises are best
- Little is known about dosage of exercise for the small muscles of the hand (ACSM 2011)
- EULAR and ACR recommend Exercises, Orthoses & JPE
- 1st Dorsal Interosseous & the Opponens are emerging as key muscles for thumb stability

Evidence Based/Informed Practice

History of Dynamic Thumb Stability

- Brand & Hollister: 1st DI as a lateral thenar, has a stabilizing effect on CMC (1993)
- Use of thumb muscles during function to stabilize and prevent suluxating forces at the CMC, with web space restoration and orthotic support (Taylor, 2000)
- Promote stability and functional strength about the CMC with resistive thumb exercises (Neuman & Biefefield, 2003)
- Dynamic Stability: known rehab strategies for other joints for injuries and OA: i.e. Knee, Shoulder (Braun, Hurd, Meister, Wilks, Chmielewski, Zen, Eltenbrecher)
- Lack of Neuromuscular coordination of motion seen often in those with CMC OA, thumb pain. (Van Heest & Kallemeier, 2008)

What is Dynamic Stability of the Thumb?

- Restore Functional ROM; at joint & soft tissues
- Re-education of specific muscles to improve the strength of the hand and thumb
- Reduce pain and disability: May not change the course of the disease (if present)
- Self-management of pain during function
- Stabilizing orthosis, as needed & a plan to wean out of orthosis or to wear only as needed for heavy tasks
**3 Important Points for a Stable Thumb…**

1. Widen Thumb Webspace: Keep it **SUPPLE**
2. Use of All Thumb Motors to **Stabilize** and **Centralize** the 1st metacarpal as it moves on the trapezium.
3. **Educate** the Person to stabilize own thumbs for a lifetime.

**Including Therapists and Surgeons…**

"Effects of a Dynamic Stability Approach in Conservative Intervention of the Carpometacarpal Joint of the Thumb: A Retrospective Study"

**Primary Purpose:**
- to investigate change of pain and disability from using a DYNAMIC STABILITY modeled approach

**Secondary Purpose:**
- Ave.# visits
- Average "date-range" of visits

"Effects of Selective Activation of the 1stDI & OP on Thumb CMC Kinematics: A Synopsis of 2 Cadaver Studies"

**Hypotheses:**
- **Study #1:** increased loads in the FDI and OP will result in effects to the joint kinematics and kinetics of the 1st CMC
- **Study #2:** that a more uniform distribution of loads and reduced subluxation ratio will be realized across the surface of the thumb CMC joint.

**Cadaveric Study #1 Results**

**Positional**
- OP alone changes metacarpal proximally & volarly, exacerbating subluxation
- FDI greatest effect is distal and dorsal pull.

**Rotational**
- OP tends to over-rotate MC volarly & ulnarly.
- FDI pulls Trapezium dorsally, attenuates MC translation.
- FDI & OP act to help center MC on Trapezium.

**Effects of Selective Activation of the 1stDI & OP on Thumb CMC Subluxation: A Cadaver Study**

**Hypothesis & Purpose**
- The FDI and OP work concomitantly to decrease subluxation in the CMC joint
- Investigation of effect of load application to the FDI, OP, and FDI+OP on cadaver model

**Methods:** (Capsulotomy of CMC)
- Loading the FDI from 0 to 30N
- Loading the OP from 0 to 40N
- Simultaneously loading the FDI and OP from 0 to 30N & 0 to 40N, respectively.
Results #2: In a Dose Dependent Manner...

- OP improved Subluxation Ratio (SR)
- FDI minimal effect on SR
- OP + FDI improved SR in all loading states
- In 75% or greater, significantly improved SR (p<.014)
- FDI in combination with OP may reduce subluxation, reduce pain and symptoms

Conclusions for Both Cadaveric Studies:

- These biomechanical data support use of FDI and OP in conservative exercise programs. thumb CMC joint pain

Activation of the First Dorsal Interosseous Muscle Results in Radiographic Reduction of the Thumb CMC Joint (Fluoroscopic Study)

- Hypothesis: Activation of the 1st directly reduces subluxation of the 1st metacarpal to trapezium
- Methods: 17 healthy subjects
  - (5M, 12F)
  - Mean age: 26, no CMC OA
  - Measured Max. Voluntary Contraction 1st DI strength

Results

- Subluxation with Stress, Reduction with FDI Activation (27)
- No subluxation (3)
- Subluxation at Rest, No Further Subluxation with Stress (2)

Stout deltoid-like CMC dorsoradial ligament structure

- Dynamic proprioceptive function of the joint is subject of continuing studies

Carpometacarpal (CMC) joint

- Loose capsule
- Joint surfaces are not congruent
- Stability from soft tissues
- Ligamentous support
- Muscular support
The anatomy and biomechanics of the thumb CMC is similar (in many ways) to that of the shoulder. 

Doesn’t the thumb deserve the same amount of attention we have given to shoulder problems?

Muscles that influence the Thumb

9 muscles influence the thumb

Thumb is 70% of the dominant hand, 60% of the non-dominant hand (Disability ratings)

We have a big job to help our patients with their thumbs!!!!

Accessed at: militarydisabilitymadeeasy.com

Know and USE Your Extrinsic Thumb Muscles:

- Extensor Pollicis Longus
- Extensor Pollicis Brevis
- Abductor Pollicis Longus
- Flexor Pollicis Longus

Know and USE your Thumb Intrinsics Muscles

- Abductor Pollicis Brevis
- Flexor Pollicis Brevis – deep and superficial heads
- Opponens Pollicis (Deep) • AFO-acronym to remember the Thenars
- Adductor Pollicis

• First Dorsal Interosseous!

The multidirectional pull of these muscles:

Range of Motion of the Thumb

FLEXION @ MP & IP • RADIAL ABD • PALMAR ABD • RETROGLOVUSION • OPPOSITION

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Potential De-Stabilizers

Dynamic Stabilizers

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Manual Release

- **Adductor**: One of the strongest muscle per square measure in the body.
- Manual release of this muscle increases the potential ROM of the thumb lost due to web space contracture.
- Helps to “set the stage” to gain congruency of joint surfaces for the next portions of the exercise program.

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Elongate Soft Tissues in the Web Space

1) Web to web: press in to relax tissues, 2) Extend Thumb and Index to stretch tissues, 3) Hold each 15-30 seconds. Repeat 3-5 times

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**Intervention to Restore Dynamic Thumb Stability**

- Manual release of the adductor and any over-active, dominant muscle
- Joint mobilization to reduce / realign the CMC
- Muscle re-education / strengthening
- Use of adaptive tools and joint protection techniques
- Orthosis/Orthoses as needed
- Strategy to wean from orthosis

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Joint Mobilization

Initiated after Manual Release: adductor release and soft tissue elongation ...

**AND before Muscle Re-education**

- **To Reduce Pain**
- **To Approximate Joint Surfaces**: centralize the MC on Trapezium to improve motion and production of nutritional substances in the joint.
- **To Restore Stable Thumb Biomechanics**

*Must be done pain free!*

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With respect for pain at each step
Distraction is the first level (grade I) of joint mobilization:
- Opens joint spaces, relieves pain & increases nutrition.
- Grasp the base of involved thumb, hold arms behind back. The weight of the arms provides distraction.
- If this position causes pain in shoulders, bring arms in front of body, relax, and bring elbows back to distract the CMC.

In both photos, the subject's RIGHT CMC is being distracted.

Self-Joint Mobilization

Must be PAIN-FREE: restores Retropulsion, improves CMC/STT glide.

Muscle Re-education first: Before Strengthening

Re-education of the thumb muscles to restore stable balance IN PAIN FREE CONTEXT.

Focus: Retrain in Kinetic Chain
- Abductor Pollicis Brevis
- Opponens Pollicis
- 1st Dorsal Interosseous
- Extensor Pollicis Brevis
- Abductor Pollicis Longus
- Flexor Pollicis Brevis

Isometric and Isotonic Muscle Re-education of palmar abduction.

The CMC joint is most stable in the “C” position.
Note the rubber band placement on the metacarpal.

This exercise is done pain free.

Isolate the Abductor and Opponens

Make the thumb puppet sing

Closed Chain Exercise
Strengthen the 1st Dorsal Interosseous

1st DI has a distal and ulnar-ward pull on 1st Metacarpal:
**NOT A COMPRESSION FORCE**

Mobargha, 2016

1st Dorsal Interosseous Exercise

Rubber Band Exercise:
Abduct the Index away from the Middle Finger

NEW GOAL: 100 repetitions per day??

Thumb Stability Exercises: Using a Rubber Band

Start with a thinner rubber band at P1 IF. Lift IF up and down slowly and smoothly.
ISOKINETIC: Concentric/eccentric

To progress, advance RB distally on IF toward P2 and P3: PAIN-FREE ONLY.

Advance to thicker RB, and repeat the same progression.

DOSE: 10 reps 2-3 sets/session
GOAL: 100 x / day !?!!?!!

1st Dorsal Interosseous with Instability

- For the patient who has a very unstable CMC, performing 1st DI strengthening may be painful initially.
- External support may be needed
  - with co-contraction of the “C” position
  - manual support of the metacarpal
  - OR performing exercise with orthotic support at the CMC.

If the program is unsuccessful in stabilizing the CMC and relieving pain, reconstruction may be a consideration.

Functional Muscle re-education with strengthening: EPB APL APB OP & FDI

"Piano playing" or Other Functional tasks
(Active to isometric to isotonic)
- Extensor Pollicis Brevis
- Abductor Pollicis Longus
- Abductor Pollicis Brevis
- Opponens Pollicis
- AND the 1st Dorsal Interosseous

Train to Abduct and Extend without losing the MP flexion posture

3 Important Points for a Stable Thumb...

1. The thumb webspace: Keep it SUPPLE
2. Use of ALL thumb motors to Stabilize and Centralize the 1st metacarpal as it moves on the trapezium.
3. Educate the person to stabilize their own thumbs for a lifetime.

Are Your Thumbs Stable?
Recap: Intervention to Restore Dynamic Thumb Stability

- Manual release of the adductor and any over-active dominant muscle
- Joint mobilization to reduce / realign the CMC
- Muscle re-education / strengthening
- Use of adaptive tools and joint protection techniques
- Orthosis/Orthoses as needed; Wean out as able

More Research...For Thumb Stability

- Which are the key exercises?
- What is the least optimal number of exercises?
- What is the dosage of exercises which effect change?
- For which DX, which OA grades is dynamic stability optimal? Effective?
- Will you contribute to Evidence for Thumb Stability?

In Remembrance: Jan Albrecht (1935-2016) OT & Hand Therapist Extraordinaire

- Jan Albrecht, OTR, CHT (1981-2011)
- She discovered the power of dynamic thumb stability for her own painful thumb
- Used her passion and commitment to teach others: patients, therapists, and physicians

Thank you

Questions?

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