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Occupational Health Clinics for Ontario Workers Inc.
Centres de santé des travailleurs (ses) de l'Ontario Inc.

Osteoarthritis (OA) of the First Carpometacarpal (CMC) Joint

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Case Study – Medical History

- 53-year-old Male
- Sheet Metal Journeyman with 32 years of experience
- Presented with severe thumb and wrist pain, difficulty with fine movement
- Orthopedic Surgeon diagnosed 1st CMC joint OA
- X-ray and Ultrasound confirmed the diagnosis
- He underwent a 1st CMC joint steroid injection and experienced relief for 9 months
- Repeat injections had shorter duration of relief. He is currently waiting surgery.

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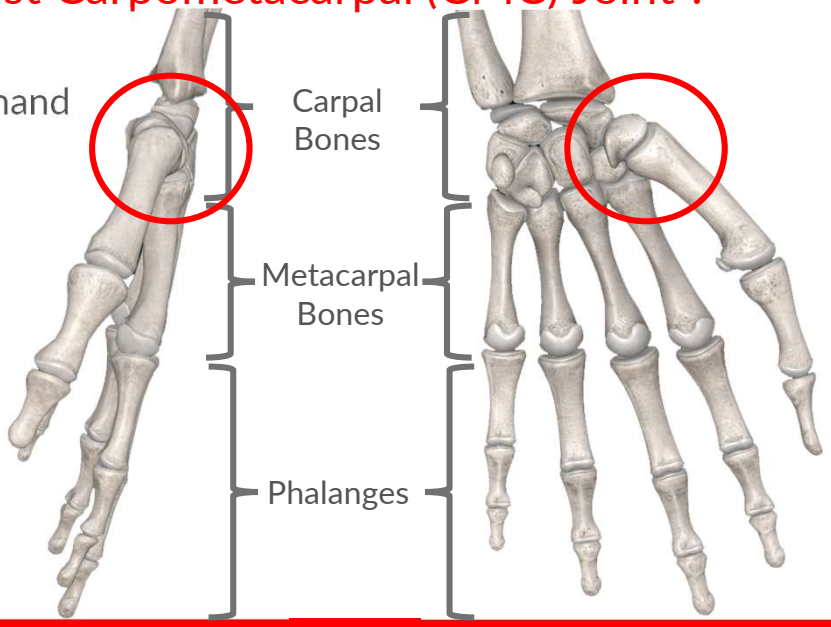
What is the 1st Carpometacarpal (CMC) Joint ?

- Anatomy
- Bones of the hand



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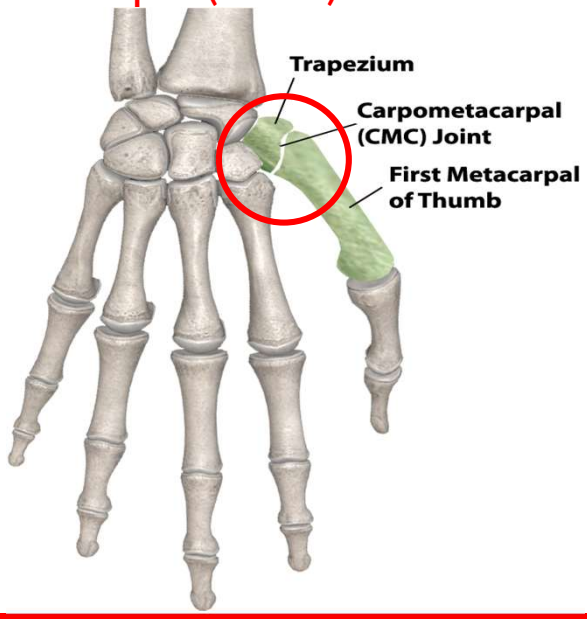
What is the Carpometacarpal (CMC) Joint ?

- Anatomy
- 1st CMC Joint



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What is the Carpometacarpal (CMC) Joint ?

- Anatomy
- 1st CMC Joint
- Articular Cartilage

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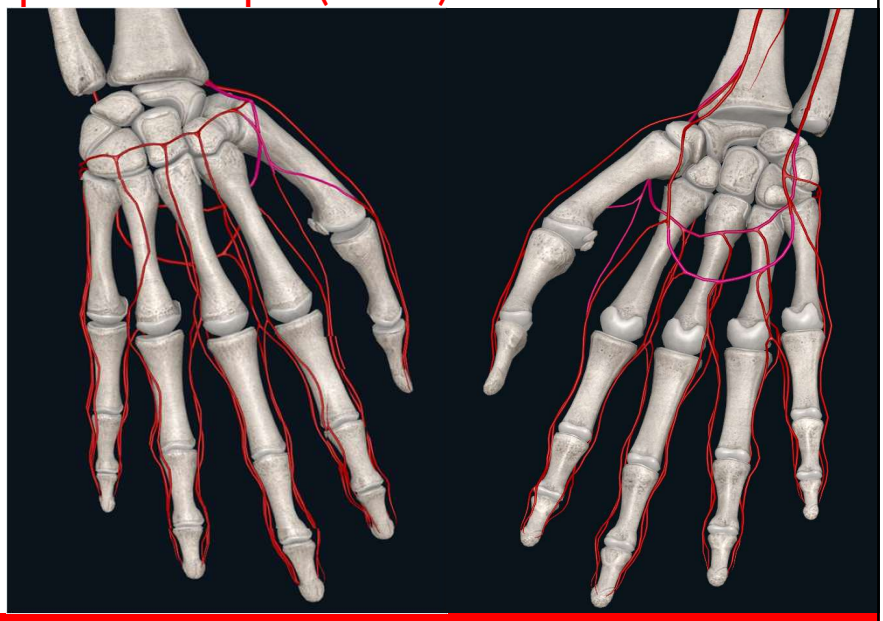
What is the Carpometacarpal (CMC) Joint ?

- Anatomy
- 1st CMC Joint
- Blood Supply



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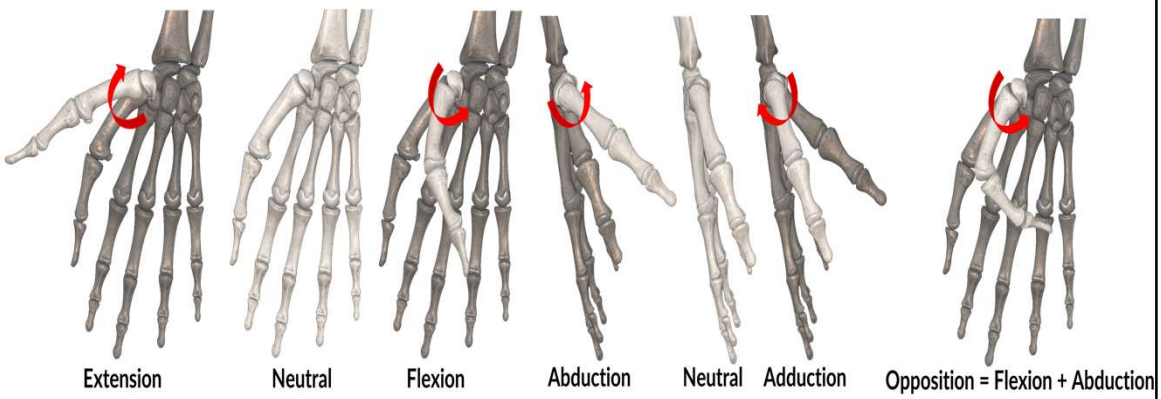
What is the Carpometacarpal (CMC) Joint ?

- 1st CMC Joint Function
- Wide ROM



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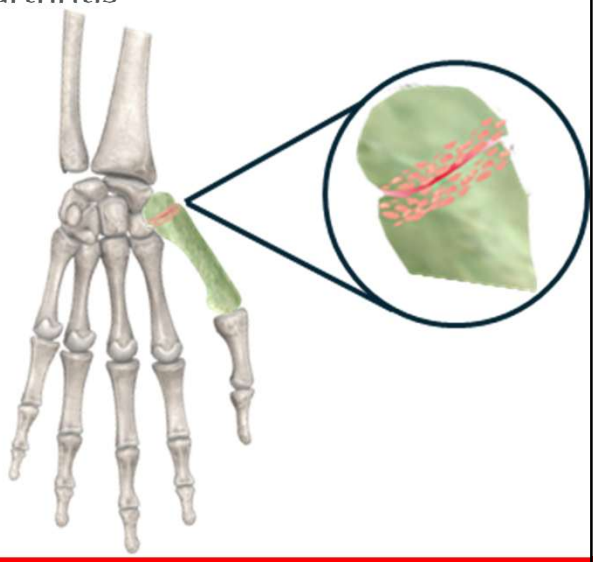
Osteoarthritis (OA)

- OA is the most common form of arthritis
- 15% of the population has OA
- Narrowing of joint space
- Loss of articular cartilage
- Changes to bones, ligaments



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1st CMC OA

- 12% of the UK population over the age of 50 have pain from OA in their hands.(Marshall et al, 2014)
- Hand OA is one of the most common sites for OA
- 1st CMC OA is the second most common site in the hand
- 1st CMC OA accounts for more pain and disability than other hand OA (Kwok et al, 2014).

Kwok WY, Kloppenburg M, Marshal M, et al. The prevalence of erosive osteoarthritis in carpometacarpal joints and its clinical burden in symptomatic community-swelling adults. Osteoarthritis and Cartilage 2014;22: 756-763.

Marshall M, Watt F, Vincent T et al. Hand Osteoarthritis : clinical phenotypes, molecular mechanisms and disease management. Nature Review Rheumatology 2018; 14: 641 –656.

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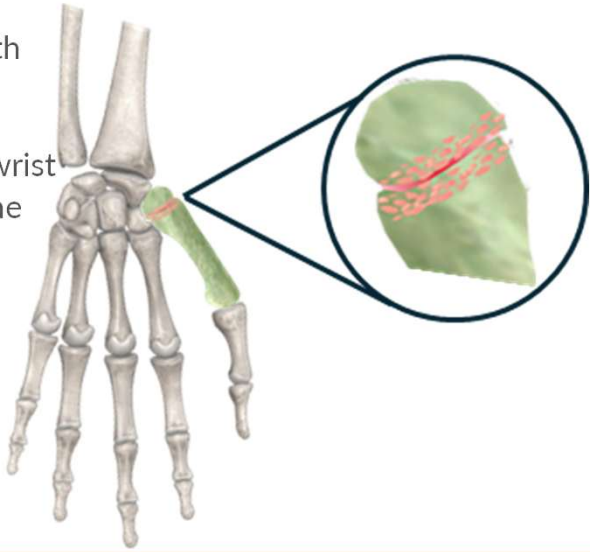
CMC Joint Osteoarthritis (OA)

- Symptoms
  - Thumb pain that may get worse with pinching or gripping
  - Thumb weakness
  - Loss of strength in the thumb and wrist
  - Loss or difficulty in movement of the thumb and wrist



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CMC Joint Osteoarthritis (OA) Diagnosis

History

- Physical Exam
- X-rays
  - 1st CMC joint OA on x-ray has a higher association with hand pain and decrease grip strength than other sites (Kwok et al, 2014).
  - 21% of the USA population has radiographic evidence of OA of the hand without symptoms
  - 16% are symptomatic (Marshall et al, 2014).
  - Subluxation is common in 1st CMC joint OA

Kwok W, Kloppenburg N, Marshall M, et all. The prevalence of erosive osteoarthrosis joints and its clinical burden in symptomatic community-swelling adults. Osteoarthritis and Cartilage 2014; 756 -763
Marshall M, Watt F, Vincent T et al. Hand osteoarthritis : clinical phenotypes, molecular mechanisms and disease management. Nature Review Rheumatology 2018; 14: 641 –656.
O'Neill T, McCabe P, McBeth J. Update on the epidemiology, risk factors and disease outcomes of osteoarthritis. Best Practice and Research Clinical Rheumatology 2018;32: 312- 326.

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Treatment

- Non-Surgical
  - Anti-inflammatory medication, oral or topical can be used
  - Supportive splint
  - Steroid Injection especially in older individuals and patients with co-morbidities in order to avoid surgery
  - Adapting Movements
  - Exercise -Physiotherapy

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Treatment

- Surgical
  - Arthrodesis (Bone Fusion)
  - Arthroplasty-all procedures involve partial or complete trapeziectomy with other procedures to maintain the joint space
  - Ligament reconstruction
  - Ligament reconstruction and tendon interposition (LRTI)
  - Hematoma and distraction arthroplasty
  - 93% of USA surgeons perform Trapeziectomy with LRTI (Cohen-Shohet et al, 2022)

Cohen-Shohet R, Morgan A. Surgical Treatment of Advanced CMA Arthritis Trapeziectomy with Hamatoma Arthroplasty. Hand Clinic 2022; 38: 199- 205

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Risk Factors – Non-Occupational

- The current evidence in the scientific literature opines that it is the interaction of the individual's risk factors that results in the development of OA (Johnson, Hunter, 2014).
- Age
- Sex – females are at higher risk of Hand OA
  - Peaking after menopause with a maximum 4-fold increase compared to males between 50-55 (Prieto Alhambra, 2014).
  - Age adjusted prevalence is 7% of men and 15% of women (Raj et al, 2022).
  - Estrogen role versus bone strength, alignment, ligament laxity, pregnancy

Johnson V, Hunter D. The epidemiology of osteoarthritis. Best Practice and Research Clinical Rheumatology 2014;28: 5 –15.

Prieto-Alhambra D, et al. "Incidence and risk factors for clinically diagnosed knee, hip and hand osteoarthritis: influences of age, gender, and osteoarthritis affecting other joints" Annual of Rheumatic Diseases 2015 Mar 1;73(9): 1659 – 1664.

Raj S, Reece C, Ramji S. Traeziectomy bersus joint replacement for first carpometacarpal (CMC1)joint osteoarthritis:a systematic review and meta-analysis. European Journal of Orthopedica Surgery and Traumatology 2022;32; 1001 – 1021.

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Risk Factors – Non-Occupational

- Obesity – controversial
- Genetics - 60% of hand OA are secondary to genetics
- Previous Trauma
  - Previous fracture

Fontana L , Neel S, Claise J et al. Osteoarthritis of the Thumb Carpometacarpal Joint in Women and Occupational Risk Factors: A Case – Control Study. The Journal of Hand Surgery2007 Apr; 32A(4): 459 – 469.

Wigley R< Walls C, Brougham D et al. What does degeneration mean? The use and abuse of an ambiguous word. NZMJ 2011 May 24;124(1335): 73 – 79.

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Risk Factors – Non-Occupational

- Summary
- Fontana et al, 2007 stated
  - "Moreover, interactions between constitution and environment such as changes of lifestyle (e.g., in work life) and in predisposed people (e.g., women, those with genetic predisposition) may have a strong effect."
- Risk factors such as sex, age, genetics can predispose to injury, but an accident or environmental change is necessary to cause the injury (Wigley et al, 2011)

Fontana L , Neel S, Claise J et al. Osteoarthritis of the Thumb Carpometacarpal Joint in Women and Occupational Risk Factors: A Case – Control Study. The Journal of Hand Surgery2007 Apr; 32A(4): 459 – 469.

Wigley R< Walls C, Brougham D et al. What does degeneration mean? The use and abuse of an ambiguous word. NZMJ 2011 May 24;124(1335): 73 – 79.

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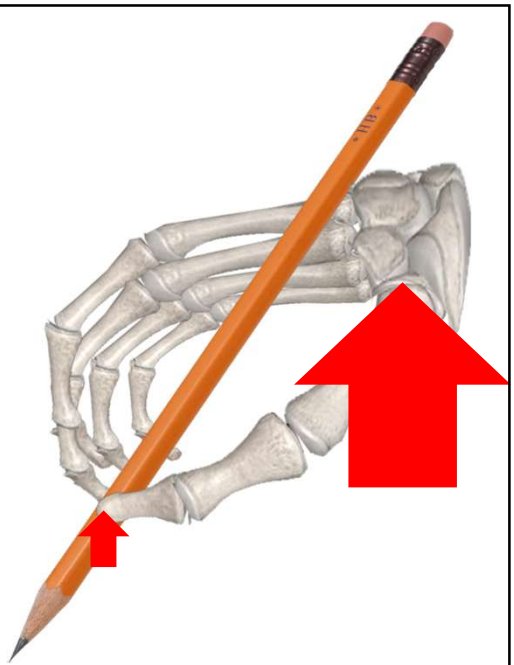
Causes - Occupational

- Force - Pinch Gripping
  - Grasping an object between index finger and thumb
  - Reactive force from pinch grip is 12 X greater at CMC than tip of thumb
  - Force generated with a pinch grip is significantly less than a gross (power) grip.



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Causes - Occupational

- Gilbertson at al. (1994) sought to establish normative data for adults aged 19 to 92 years comparing power and pinch grips.
  - Regardless of which hand was being used, power grip was 4.26 (men) and 3.71 (women) times larger than a lateral pinch grip.
  - Using a pinch grip allows for only about 25% of maximal grip strength compared to a power grip.

	Men			Women		
	Average Minimum	Average Mean	Average Maximum	Average Minimum	Average Mean	Average Maximum
Power Grip (R)	33.42	44.66	55.35	19.91	27.64	35.77
Lateral Pinch Grip (R)	7.61	10.46	13.34	5.39	7.4	9.67
Power/Pinch (R)	4.39	4.27	4.15	3.69	3.74	3.70
Average Power/Pinch (R)	**4.27**			**3.71**		
Power Grip (L)	33.4	44.58	55.02	19.8	27.59	35.75
Lateral Pinch Grip (L)	7.63	10.47	13.27	5.35	7.39	9.67
Power/Pinch (L)	4.38	4.26	4.15	3.70	3.73	3.70
Average Power/Pinch (R)	**4.26**			**3.71**		

Gilbertson L, Barber-Lomax S. Power and Pinch Grip Strength Recorded Using the Hand-Held Jamar Dynamometer and B+L Hydraulic Pinch Gauge: British Normative Data for Adults. *British Journal of Occupational Therapy*. 1994;57(12):483-488.

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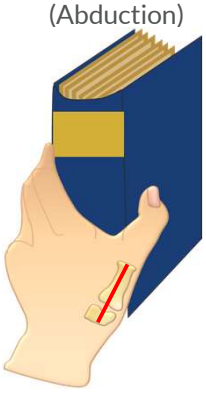
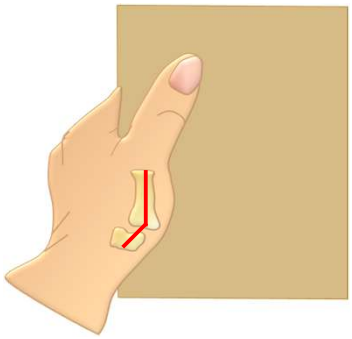
Causes - Occupational

- Awkward Posture
  - With Adduction (thumb close to palm), the bones do not fit together well and there is strain on the surrounding ligaments resulting in instability.

Stable Position (Abduction)



Unstable Position (Adduction)



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Causes - Occupational

- Inadequate Recovery (Formerly Repetitive Motion)
  - Winzeler, S. & Rosenstein, B. (1996).
  - "The thumb provides a stable post about which the rest of the hand may perform activities of pinch and grasp. The special functions of the thumb account for up to 50% of overall hand use. Exposure to twisting, jamming, and contusing forces, as well as repetitive stress is an everyday occurrence in the workplace."
- Overall, repeated, forceful, manual tasks will diminish a worker's ability to produce a required force (like gripping). It also increases their subsequent risk of fatigue and injury.

Winzeler, S. & Rosenstein, B. D. (1996). Occupational injury and illness of the thumb. Association of American Occupational Health Nurses, 44 (10), 487-492.

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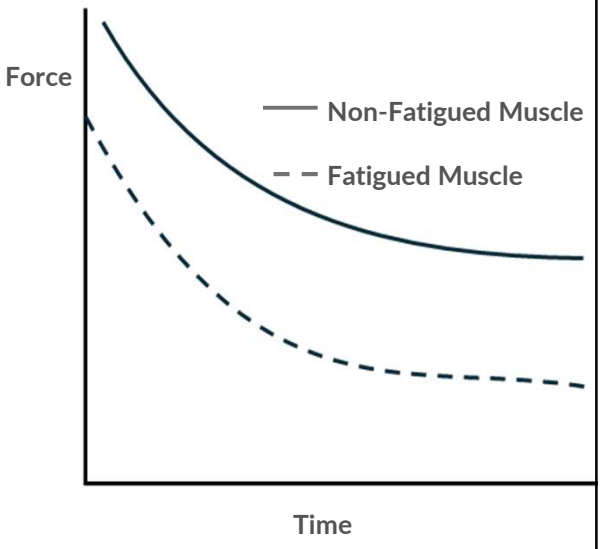
Causes - Occupational

Inadequate Recovery (Repetitive Motion)

- Continuous use of the hands and wrists results in fatigue of the muscles.
- Reduces muscle's ability to generate maximal force



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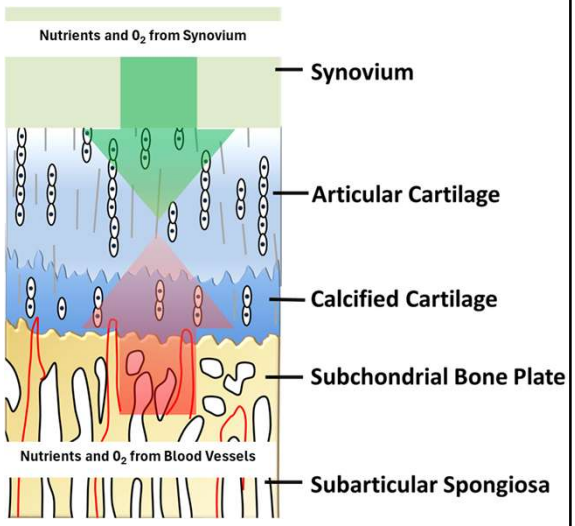
Causes - Occupational

- Static Posture
  - CMC area of low blood flow
  - Static postures result in reduction of blood flow
  - ↓ penetration of cartilage by solutes
  - Tissue discomfort and fatigue



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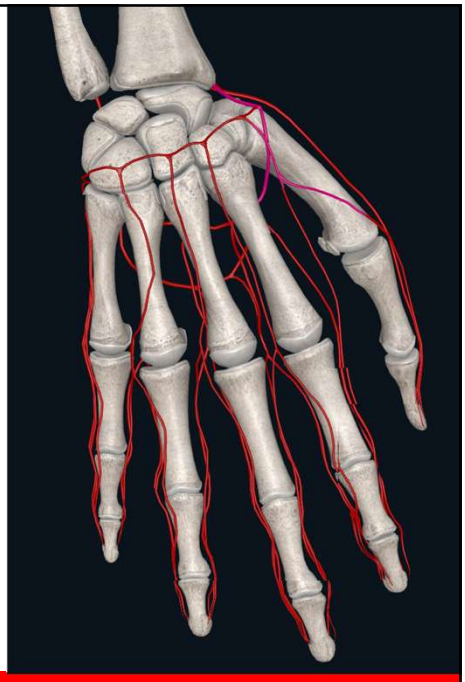
Causes - Occupational

- Cartilage does not have capillaries
- Receive nutrients from the synovial membrane.
- Transfer of nutrients occurs when pressure is being placed on the joints and during normal movements such as flexion and extension.
- Occurs under pressure – like a sponge
- Static postures prolongs the duration of pressure
  - No nutrient delivery with prolonged pressure period
  - No cellular repair can occur



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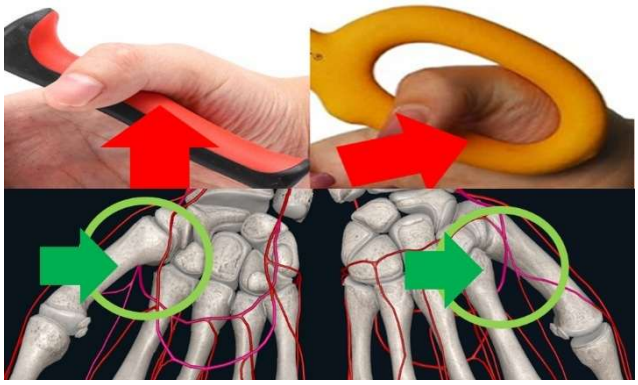
Causes - Occupational

- Contact Stress
  - When gripping tools point of application of force occurs directly on the CMC joint.
  - Applies pressure directly onto the joint and blood vessels
  - Results in continued trauma to the joint



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Causes - Occupational

- Gloves
  - Loss of tactile sensation
  - If too small can reduce blood flow
  - If too large will grip harder
  - ↓ Maximum grip strength (70% of max)
  - ↑ Muscle activation

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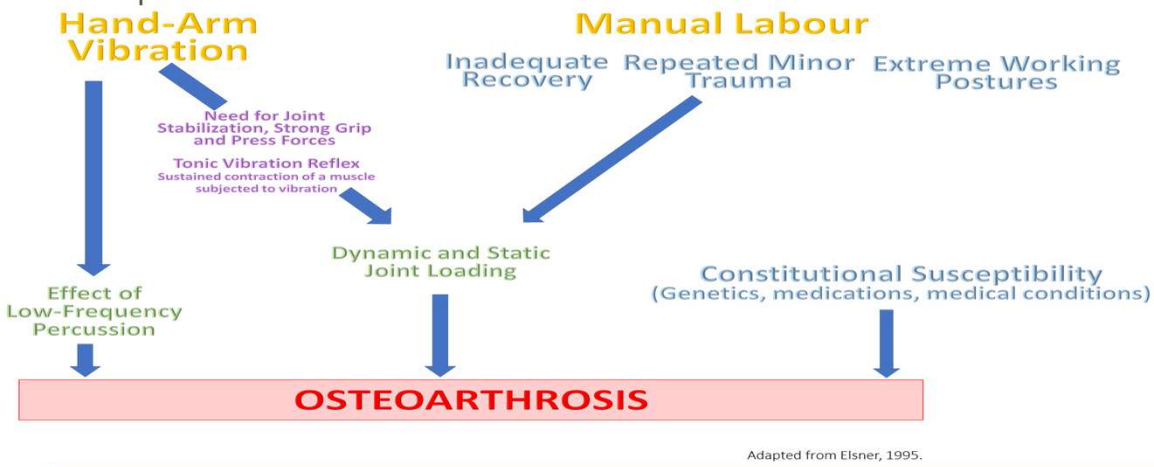
Causes - Occupational

- Vibration
  - Increase muscle fatigue
  - Disruption of blood flow



Adapted from Elsner, 1995.

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Prevention

- Think when pain occurs
- Using a Pinch grip (for example writing)
  - Keep the top joint of the thumb bent and the wrist extended.
- Activities that involve turning or twisting
  - Avoid fully straightening the top joint of the thumb and the thumb crossing in front of the palm.
- Spread the load over several joints
- Use larger stronger joints
- Use less effort

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Prevention

- Examples of Joint Protection
- Carrying a Coffee Mug
  - Instead of carrying the mug with your thumb
  - Hold the mug with one hand and supporting the base with the other.

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Prevention

- Examples of Joint Protection
- Holding Items
  - Instead of holding a pile of papers or other bulky item with one hand.
  - Hold it with two hands or hug the item to your chest.

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Prevention

- Assistive Devices - Writing
  - Large diameter pens
  - Pen grips
  - Felt tip or gel pens vs. ball point pens

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Prevention

- Assistive Devices
  - Electric Toothbrush
  - Wider utensils or foam to increase diameter
  - Button hook
  - Jar and bottle openers

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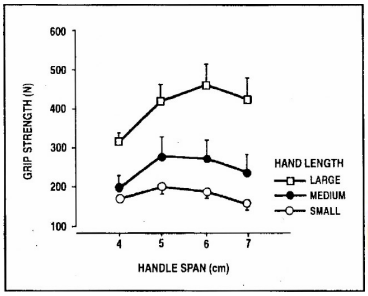
Prevention

- Tool Design
  - Purchase tools with a wider handle diameter to avoid pinch gripping
  - Spring loaded tools to reduce force
  - Rubber handles to avoid pressure points
  - Handle Span



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Case Study – Medical History

- 53-year-old Male
- Sheet Metal Journeyman with 32 years of experience
- WSIB denied claim
  - "After reviewing your file, I have determined that there is no evidence of ongoing impairment related to your workplace injury. The ongoing diagnosis of osteoarthritis is degenerative in nature and therefore not compatible with your workplace injury. Any work-related sprain/strain would have recovered in the given time period. As such, there is no further entitlement on your claim, effective July 16th, 2020 when the non-compensable diagnosis was determined to be the ongoing cause of impairment."

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Case Study

- Tools

Shears	Snips
• Longer smooth cutting blade	• Shorter often serrated blade
• Longer length for large cuts	• Shorter length for smaller cuts
• Used for thicker or longer pieces of metal	• Used for fine, short or curved cuts and on thinner metal
	• Leaves jagged edges that must be smoothed with a grinder
	• Multiple designs for straight, left and rights cuts

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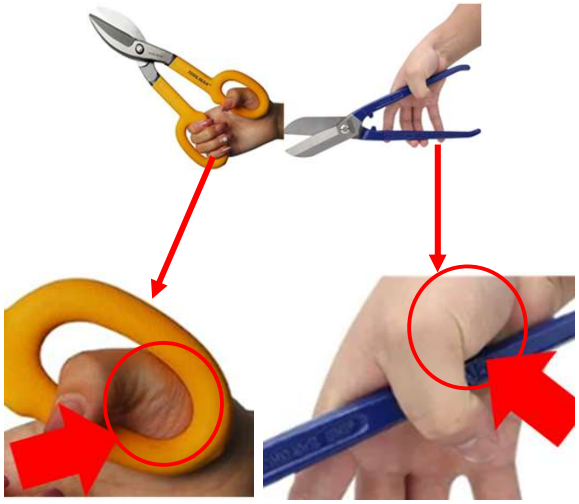
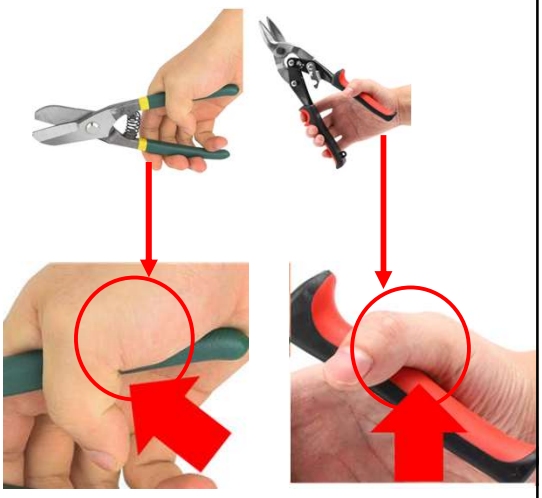
Case Study

- Tools





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Case Study

- Physical Demands

Job Demand	Averaged Frequency	Frequency Defined
Dynamic Pushing/Pulling (Force)	34.75%	Frequently - 34%-66% (2 hours 41 min to 5 hours 17 min/day)
Hand Gripping	83.50%	Constantly - 67%-100% (5 hours 18 min to 8 hours/day)
Pinch Gripping	39.83%	Frequently - 34%-66% (2 hours 41 min to 5 hours 17 min/day)
Upper Extremity Coordination	83.50%	Constantly - 67%-100% (5 hours 18 min to 8 hours/day)
Vibration	50%	Frequently - 34%-66% (2 hours 41 min to 5 hours 17 min/day)
Glove Use	100%	Constantly - 67%-100% (5 hours 18 min to 8 hours/day)

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Case Study

- Risk Factor Summary

Non-Occupational Risk Factors		Occupational Risk Factors		
Age	✗	Force - Pinch Grip	✓	39.83%
Gender	✗	Force - Gross Grip	✓	83.5%
Obesity	✗	Awkward Posture	✓	62%
Genetics	✗	Inadequate Recovery	✓	83.5%
Previous Trauma	✗	Contact Stress	✓	83.5%
		Vibration	✓	50%
		Glove Use	✓	100%

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SUMMARY

- JOHNSON, HUNTER, 2014
- "OA appears to be the result of a complex interplay between mechanical, cellular and biochemical factors leading to common end-stage pathology, as such a different set of risk factors acting together may cause OA onset in any given individual."

Johnson V, Hunter D. The epidemiology of osteoarthritis. Best Practice and Research Clinical Rheumatology 2014;28: 5 –15.

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Contact us:

OHCOW
Occupational Health Clinics for Ontario Workers Inc.
Centres de santé des travailleurs (ses) de l'Ontario Inc.

Phone toll free: 1-877-0336
Email: ask@ohcow.on.ca

General Ergo Email: ergo@ohcow.on.ca

www.ohcow.on.ca

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