- If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.
- This handout is for reference only. Non-essential images have been removed for your convenience. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.

Technical issues with the Recording?

- Clear browser cache using these instructions
- Switch to another browser
- Use a hardwired Internet connection
- Restart your computer/device

Still having issues?

- Call 866-782-9924 (M-F, 8 AM-8 PM ET)
- Email customerservice@OccupationalTherapy.com

Elbow Stiffness: Biological and Neurological Considerations

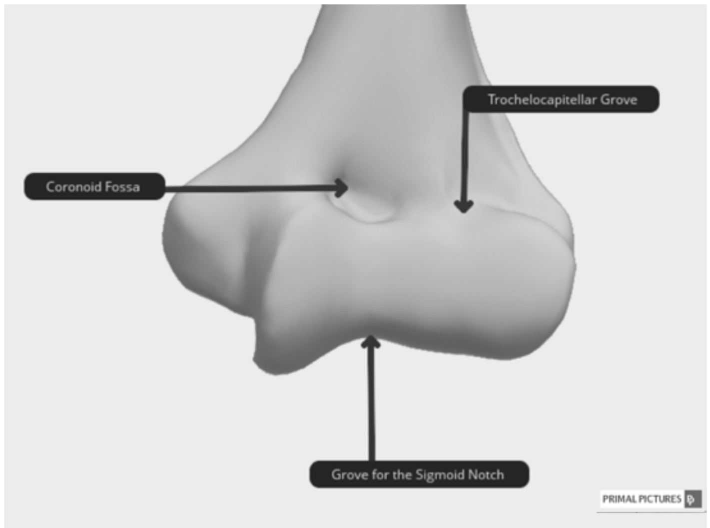
Paul J. Bonzani MHS, OTR/L, CHT
Assistant Clinical Professor
Department of Occupational Therapy
University of New Hampshire

1

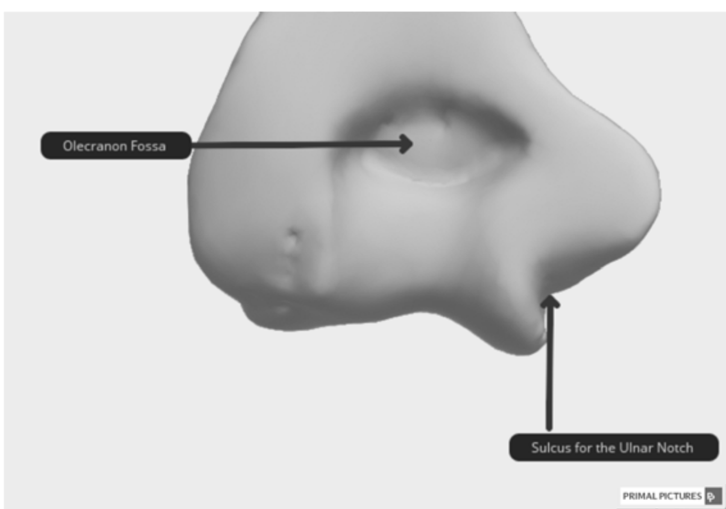
3 Learning Outcomes

- After this course, participants will be able to describe the physiological timing of contracture development.
- After this course, participants will be able to list neurophysiological/occupation-based phenomena associated with the development of elbow stiffness.
- After this course, participants will be able to describe preventative strategies designed to reduce occupational performance deficits with elbow stiffness.

2


Trochelocapitellar Grove
Coronoid Fossa
Grove for the Sigmoid Notch
PRIMAL PICTURES

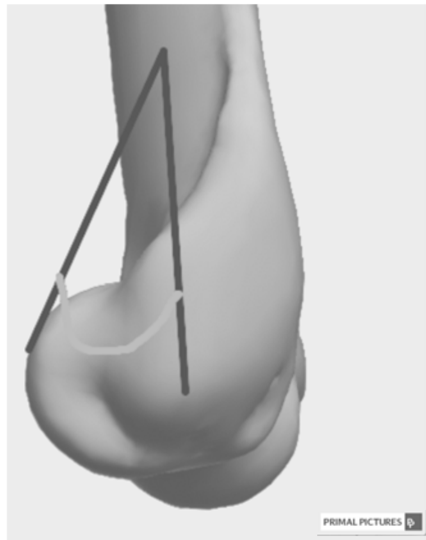
3


Olecranon Fossa
Sulcus for the Ulnar Notch
PRIMAL PICTURES

4

Elbows are built to flex!

30-degree anteversion angle

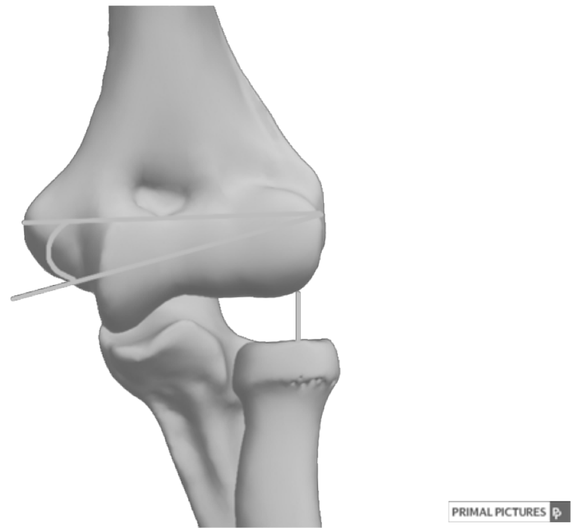


(*Q1)

The carrying angle

- The angle formed by the long axis of the humerus and the long axis of the ulna.
- The anatomic arrangement of the distal humerus causes to orientation toward valgus.
- The laxity of the radio-humeral joint contributes to an orientation to valgus.
- Males: 11-14 degrees, Females: 13-16 degrees.

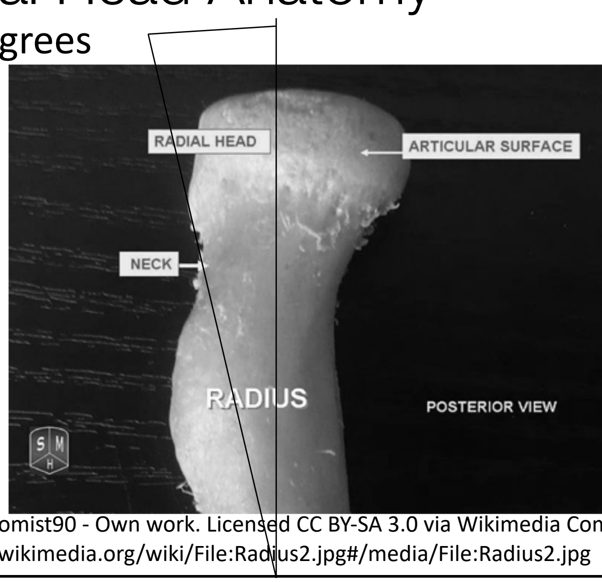
(*Q2)



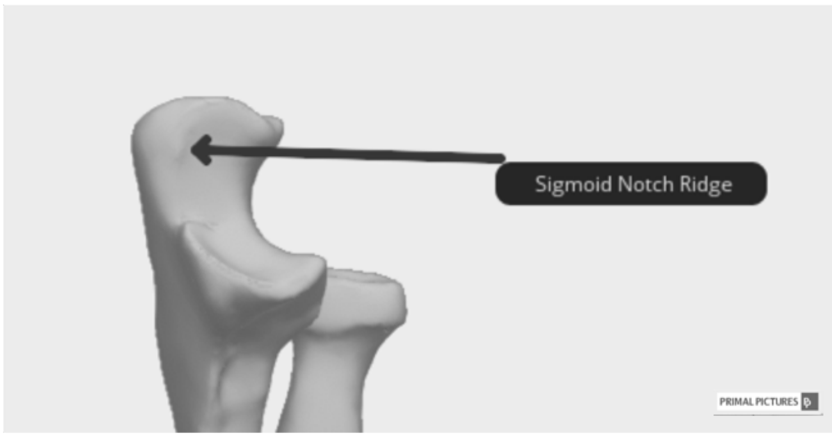
7

Radial Head Anatomy

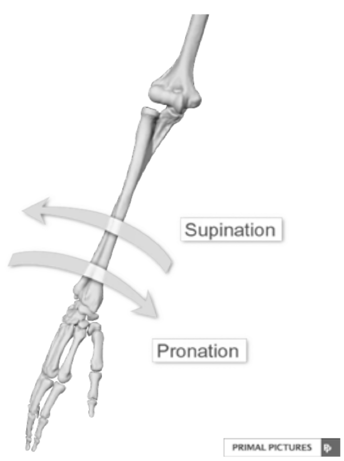
15 degrees



8



Forearm Axis of Rotation



Video of the Mechanics of Flexion/Extension

(*Q8)

Video of the Mechanics of Supination and Pronation

(*Q8)

Osteokinematic Vs. Functional Movement of the Elbow

- Extension/Flexion (0-145)
- Supination/Pronation (85/80)
- Functional extension/flexion (30-130)
- Functional pronation/supination (50/50)

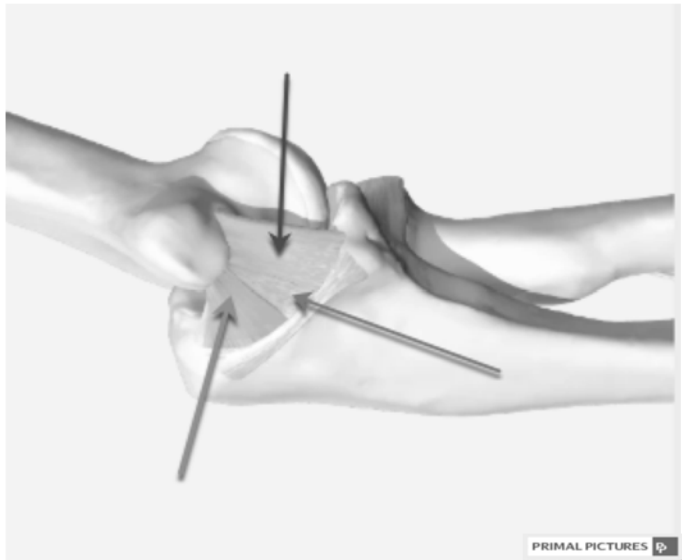
13

The Medial Ligaments: The Main Source of Stability to Valgus Forces.

- Anterior bundle: 3 functional regions
  - Anterior fibers: taut in full extension.
  - Middle fibers: taut in mid range flexion.
  - Posterior fibers: taut with the posterior bundle at end range flexion.
- Posterior bundle: Taut in flexion past 90 degrees. Strengthened by the transverse fibers of cooper's ligament.

(*Q4)

14



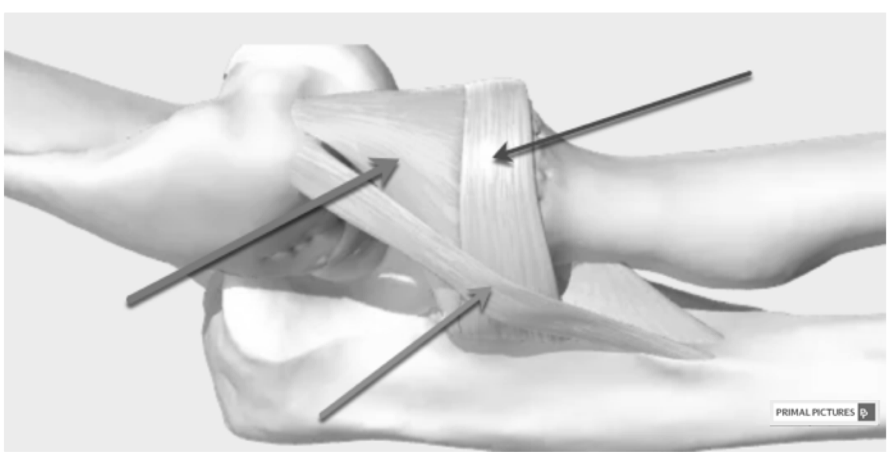
15

16

The Lateral Ligaments

- The radial collateral ligament.
- The accessory collateral ligament.
- The lateral ulnar collateral ligament.
- The annular ligament.

(*Q5)



19

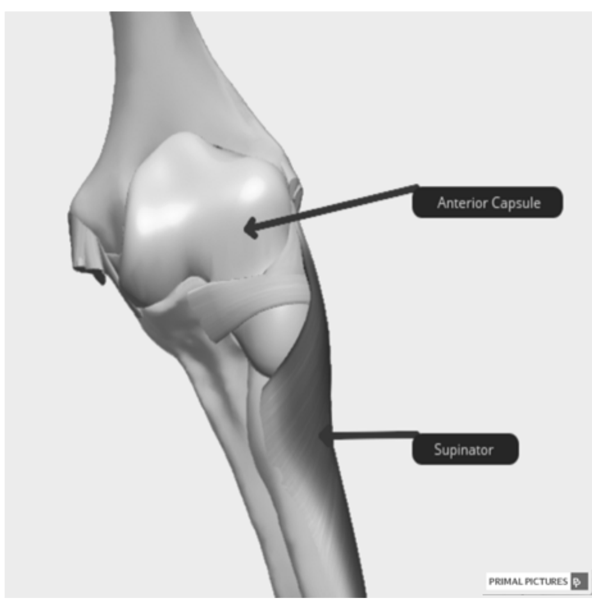
Collateral Ligament Function

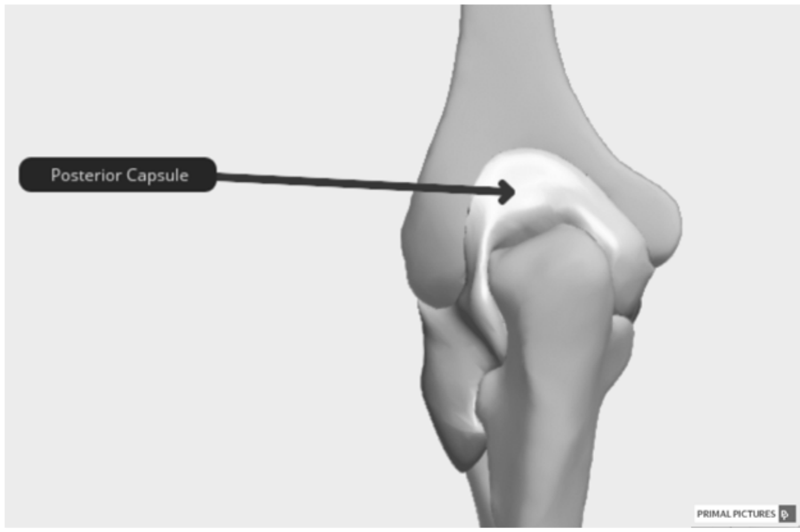
- Varus-Valgus stability.
- Limitation of internal-external rotation of the ulna on the humerus
- Norms: 5 degrees of medial rotation and 10 degrees of lateral rotation.
- Loss of LUCL is associated with increased ulna external rotation: posterior-lateral rotary instability (PLRI).

20

Soft Tissue Structures: Joint Capsule

- The anterior capsule lends some stability to the joint.
- Thin, transparent structure.
- Lax in flexion-most capacity at 60-80 degrees.
- Main cause of flexion contracture following injury.





23

Forearm Rotation

- Integration of the superior and inferior radio-ulnar joints.
- The interosseous membrane binds the forearm bones and maintains alignment.
- Parallel relationship in supination.
- Radius moves on the ulna during pronation.

(*Q6)

24

Contracture Development

The physiology of stiffness

Contracture Development

Intrinsic Contracture

- Loose bodies
- Joint derangement

Extrinsic Contracture

- Soft tissue contracture
- Exostosis

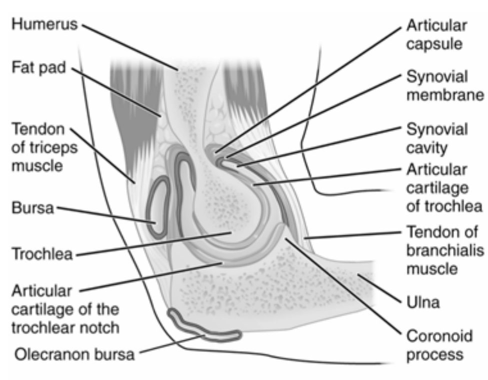
(*Q7)

27

Intrinsic Contracture

- Loose body excision
- Plica excision

Typically a high force repetitive motion injury



(a) Medial sagittal section through right elbow (lateral view)
Tehttps://openstax.org/books/anatomy-and-physiology/pages/9-6-anatomy-of-selected-synovial-jointsxt

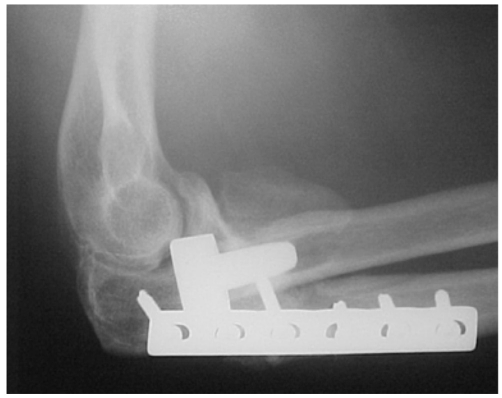
https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

28

continuED

Extrinsic contracture

- Heterotrophic bone formation
  - By production of the highly vascularized nature of the anterior elbow



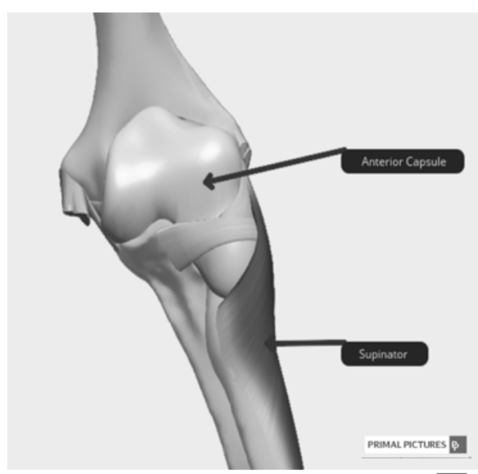
(*Q8)

29

continuED

Elbow: Predisposition to Pericapsular Stiffness

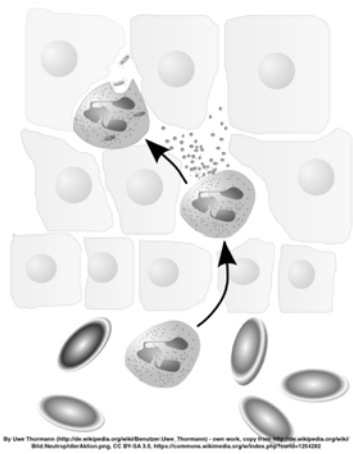
- Anterior capsule has a high concentration of fibroblasts
- Rapid conversion to myofibroblasts
- Mechanical redundancy
- Confluence to other soft tissue structures

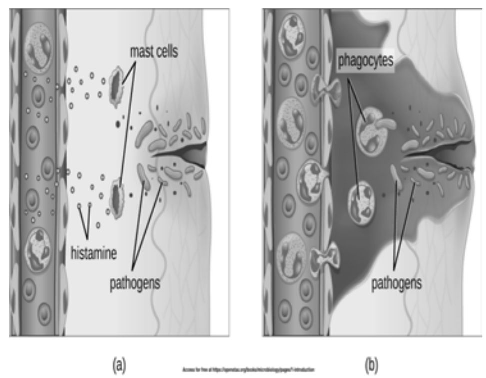


(*Q9)

30

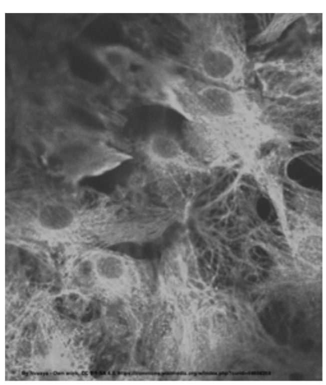
Cellular processes

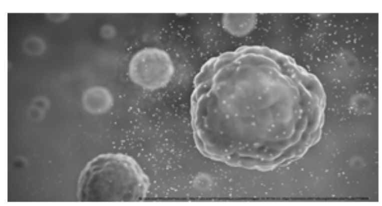


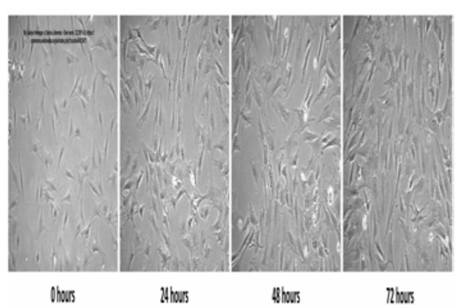


31

Cellular processes (cont.)

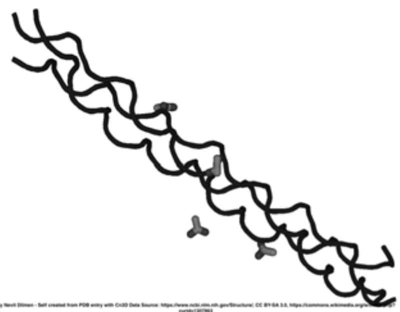


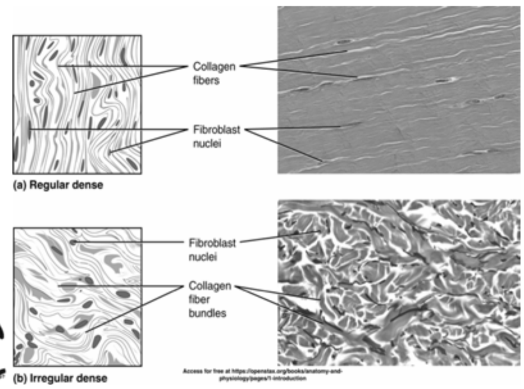




32

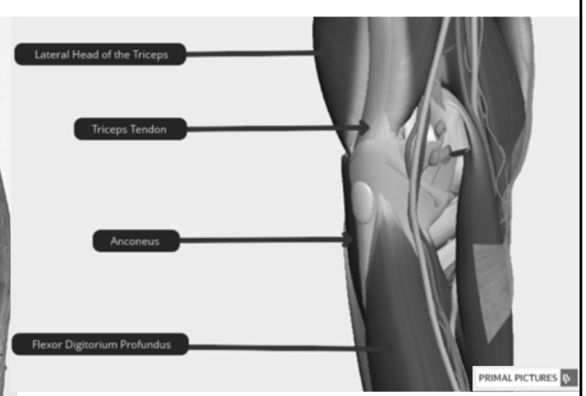
Capsular Changes





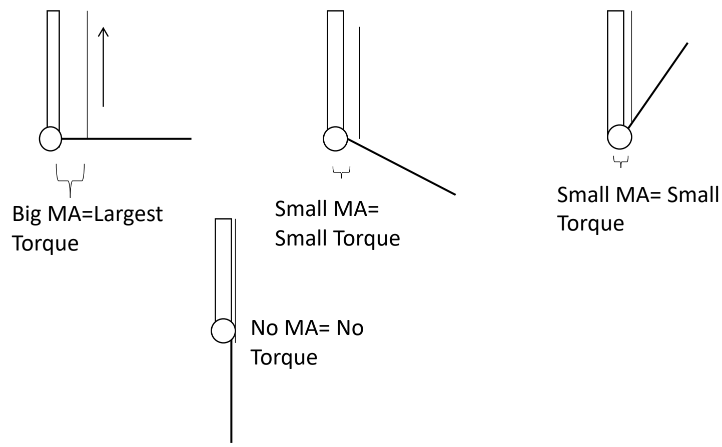
33

Muscle/Neurological Considerations

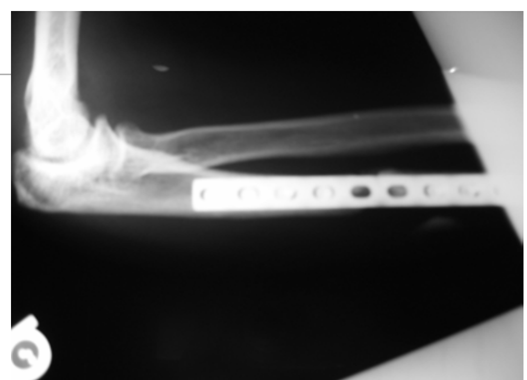


34

Understanding Torque



35



36

Postural Considerations

37

Co-Contraction Phenomena

38

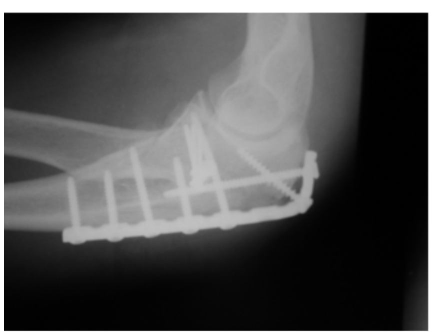
Co-contraction Phenomena

(*Q5)

(*Q10)

39

Grade 3 Monteggia



40

41

References:

- Charalambos, P., & Morrey, M.E. (2018). Elbow stiffness: Basic science and overview. In Morrey, Sanchez-Sotelo, & Morrey (Eds), *The elbow and its disorders* (pp 529-536). Philadelphia, Pa: Elsevier
- Dunham, C.L., Chamberlain, A.M., Meyer, G.A. (2018). Muscle does not drive persistent posttraumatic elbow contracture in a rat model. *Muscle & Nerve, 58,* 843-851.

42

References:

- Dunham, C.L., Castile, R.M., Havlioglu, N., Chamberlain, A.M., Lake, S.P. (2018). Temporal patterns of motion in flexion-extension and pronation-supination in a rat model of posttraumatic elbow contracture. *Clinical orthopedics and Related Research, 476,* 1878-1889.

- Rafijah, G. (2014). Posttraumatic elbow contracture. *Current Orthopedic Practice, 25*(3), 213-216.
- Zhang, D, Nazarain, A., Rodriguez, E.K. (2020). Post-traumatic elbow stiffness: Pathogenesis and current treatments. *Shoulder & Elbow,12*(1) 38-45.

Questions?

- Email: Paul.Bonzani@unh.edu