

The Shoulder Girdle

A Review of Anatomy, Mechanics, Pathology,
Ergonomics and Treatment

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PROF. HISTORY

- 38+ years in out-patient orthopedic setting
- Focus of shoulder and combined spinal and shoulder pathology in adult populations

38 years of shoulders



Prof. History cont...

- Published

REHABILITATIVE OVERVIEW

- The joint of the 90's and beyond
- Unstable, abused/overused, poorly understood, mismanaged, complex
- Cervical and Neuro based complications with both assessment and treatment
- 20.9% of populous



REHABILITATIVE OVERVIEW...cont

- The most complex joint mechanically
- High rate of overuse and abuse in the USA
- Moderate patterns of compensatory motion
- Chronic pathology before Rx initiated
- Unrealistic perception of surg/rehab
- Patient education, diligence, MD/therapist cooperation crucial for success

Rehab Overview: Neer Progression....."THE WHAT"

- Neer CS II. Impingement Lesions. Clin Orthop 1983;173:70.

THE NEER PROGRESSION

- THE ABOVE STORY HAPPENS 95% OF THE TIME

SHORTFALLS OF THE PATHOANATOMICAL LABEL

- Per Ludewig Cont Ed The Aging Shldr

Shortfalls cont...

- A recent investigation of over 100 patients with unilateral shoulder pain demonstrated a nearly equivalent prevalence of tissue pathology on the asymptomatic versus the symptomatic side.
- Barreto RG, Braman JP. Etal. J Shoulder Elbow Surg. 2019;28(9):1699-1706

Ludewig concludes...

- While pathoanatomic diagnoses are common and traditional in orthopaedic practice, they often are limited with regard to directing best practice physical therapy intervention.
- Since 2017, there have been growing calls from varied perspectives **to move away from medicine's reliance on pathoanatomic labels.**
- Ludewig PM, Gaura S, et al. IJSPT . 22;17(1):7-17.

Further support for a pathomechanical mindset

- We agree with previous advocates that these non-specific labels may reduce unnecessary surgery or over reliance on expensive imaging modalities in cases where specific tissue pathologies are being labeled that do not relate to a patient's symptoms or function.
- Zadro JR, etal. J Orthop Sports Phys Ther. 2021;51(8):401-411.

REHABILITATIVE GOALS....think

Ben Kibler MD

- Restoration of optimal static and dynamic mechanical capabilities; specifically osteo/arthrokinematics, strength and neurologic function
- Create an environment for optimal healing and tissue preservation
- Instruction in short/long term goals, basic anatomy/mechanics, progressive home/club exercise, preventive care

Further Support for a Path Mech Model

- Ludewig: The Aging Shldr 2014

In Summation: Big 3 Movement Based Diagnoses

- HYPERMOBILITY

Primary Contributors Of Pathology

- Force (strength/power) Deficit
- Coordination/Control Deficit
- Endurance Deficit
- Soft Tissue Flexibility Deficit
 - As per Ludewig

“It’s Tune Up Time”

- There are usually 5 major components to this tune up.....”The WHYS”
- “Why is there a problem/impairment?”
 - Scapular control noting the importance of posterior tipping to clear subacromial structure
 - Post/Post-Inf>Ant capsular motion loss
 - Restoring humeral inferior migration with elevation (AT END RANGES; FRONTAL plane)
 - Mid range rotator cuff dysfunction: INFRA
 - Relative scapular vs humeral positioning through ROM
 - Neurogenic pain

IN CONCLUSION.....

- If you hear “The Story”

Quick Breather...

A Prior 1st World Problem



THE EVALUATION PROCESS

- THE APPROPRIATE REFERRAL TO PT

THE EXAMINATION PROCESS

....The 5 Point Progression

obj 2

- Progress in this relative order

REHAB CONCEPTS CONT.

- Progressive open and closed chain patterns on a stable scapular base, focusing on 3D rotator cuff control, with or through available/safe

IN SUMMARY

TO SUCCESSFULLY ADDRESS THE SHOULDER:

- Assess pathomechanics

The Obligatory Dog Photo

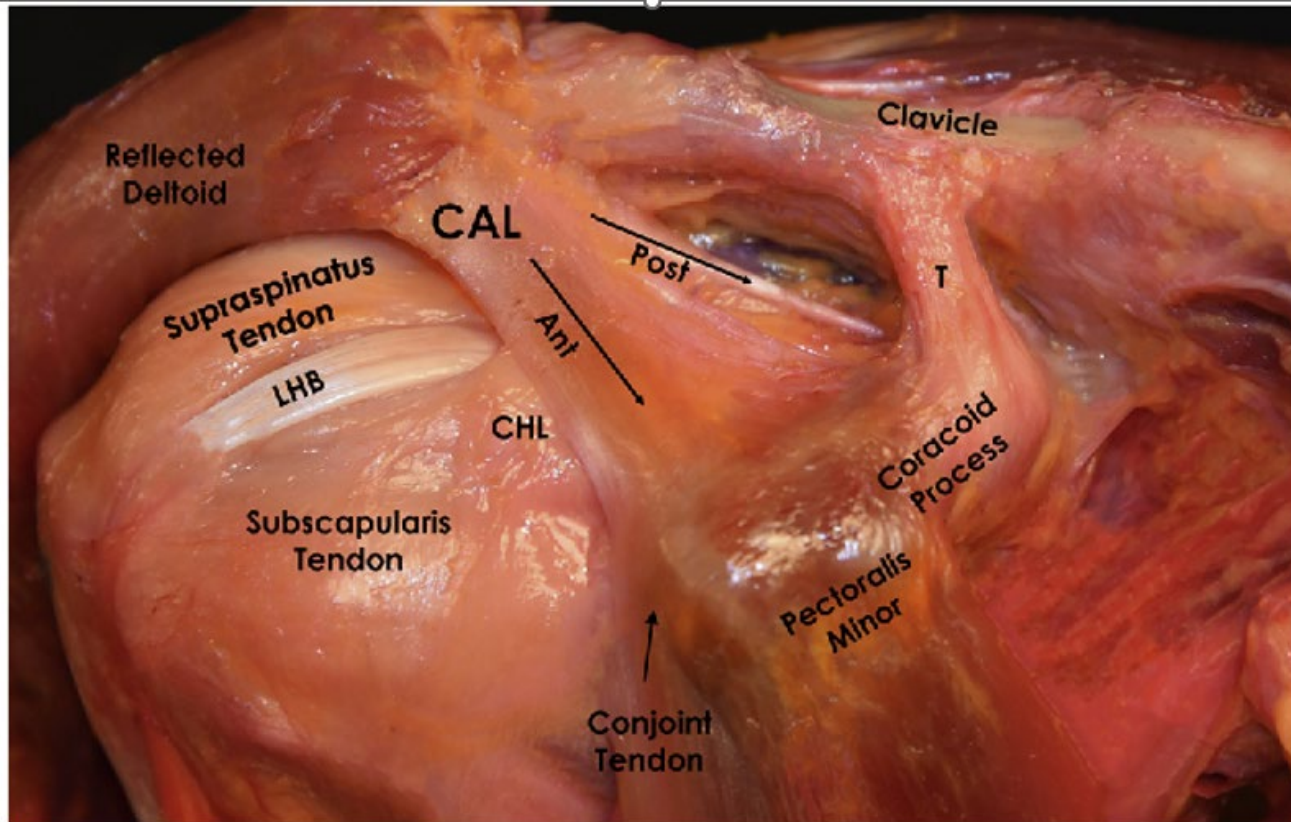


ANATOMY/BIOMECH

BONY STRUCTURE

- Clavicle
- Scapula
- Humerus
- 7-13 mm subacromial sp, to 1-5 mm w/ mid range motion
- Type I-III acrom

Coracoacromial arch



Pain Sensitive Subacromial Structures....Inhibition vs Weakness

- Per G. Davies

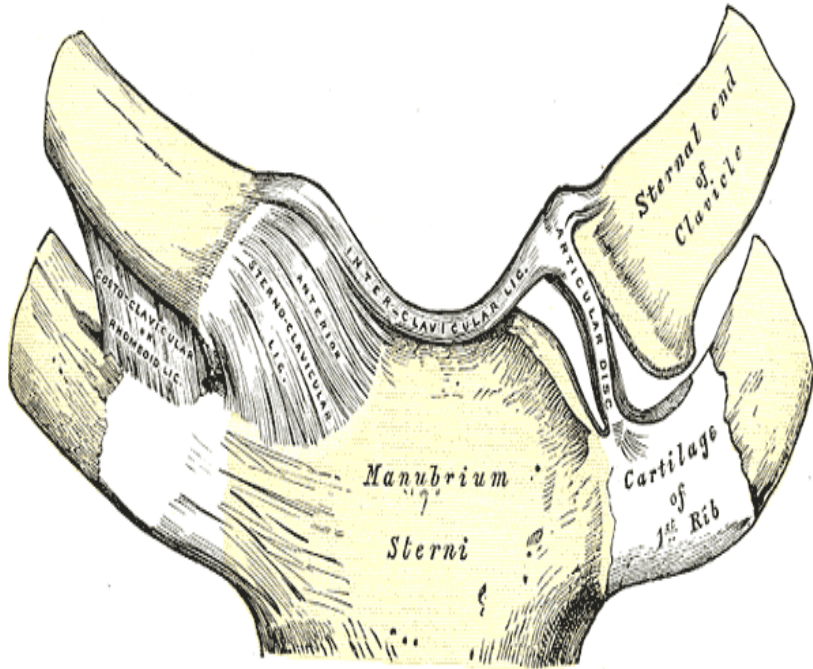
CASE STUDY

- 49 Y/O F; direct impact L shldr/hockey; 2/11'
- EXAM

CASE STUDY CONT..

- Rehab started

ANAT/BIOMECH CONT.

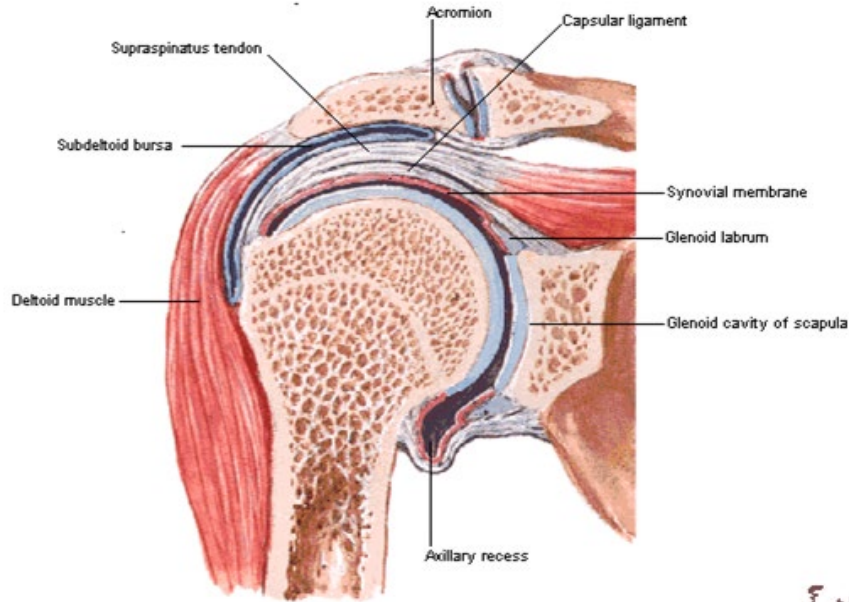


Sternoclavicular Joint

- Plane synovial
- Minimal bony contact
- 3 stabilizing lig; ant, inter, costoclav
- Elev 5 to 10, post rotation 25-30, retraction 10-15. Ludewig JBJS 09/2016 Notes
- Med supraclavicular, subclavius n (T1-3)

ANAT/BIOMECH CONT

Glenohumeral Joint
Coronal Section through Joint



Acromioclavicular Joint

- Plane synovial
- 2 major ligaments; conoid, trapazoid
- Allows more scapular post tipping; up rotation 10-15, post tipping 15, int rot 5-7. Ludewig JBJS 09/2016 notes
- Suprascap, lat pect, axillary, supraclav n's innervate



Type 1



Type 2



Type 3

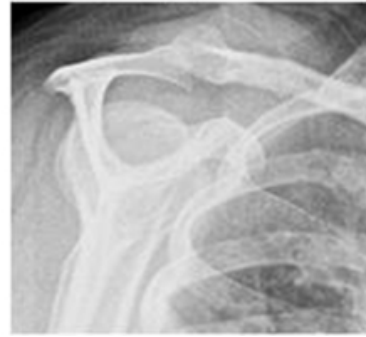
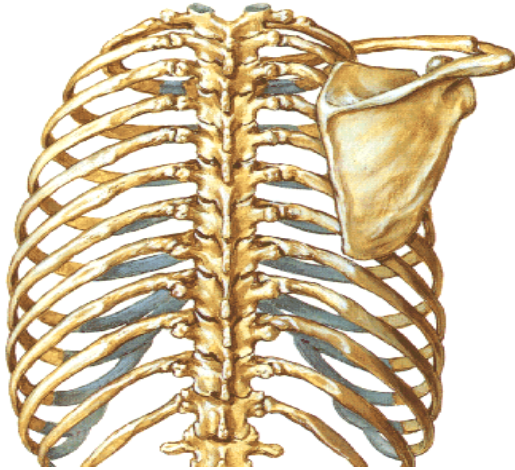


Fig. 3 Bigliani's classification of acromion undersurface with corresponding supraspinatus outlet view radiograph.

ANAT/BIOMECH CONT.

Bony Framework of Thorax
Posterior View



Scapulothoracic Joint

- Atmos. pressure holds to thorax
- Between T2-7, 2" from spinous process
- Orientate glenoid for optimal contact, needs AC/SC mobility
- Scap motion (deg) relative to thorax: 2 ER, 39 upward rotation, 21 post tipping (Ludewig JBJS 09')

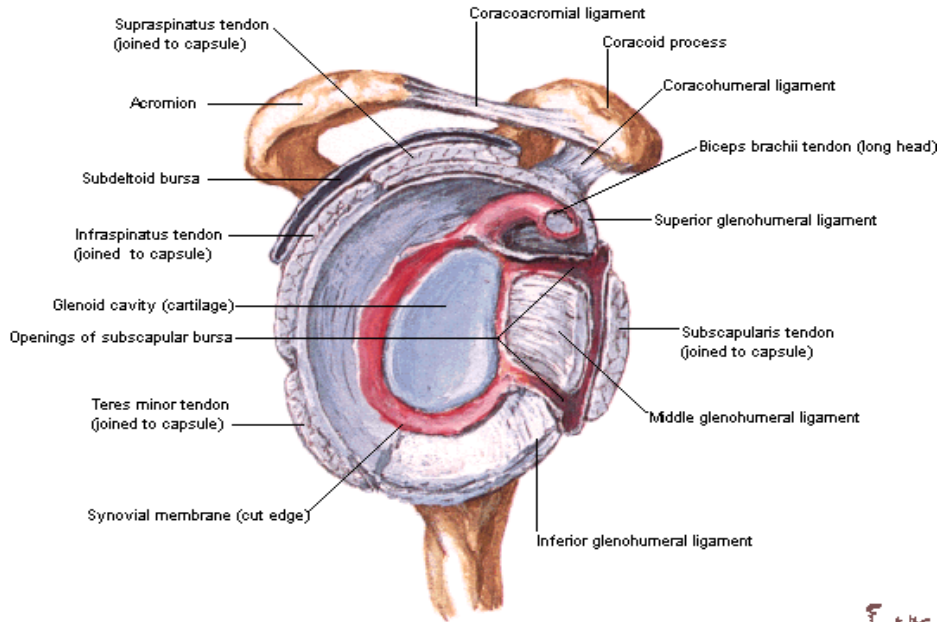
Scapular Function

- 1. Maintain a stable GH joint

ANAT/BIOMECH CONT.

Glenohumeral Joint [Opened]

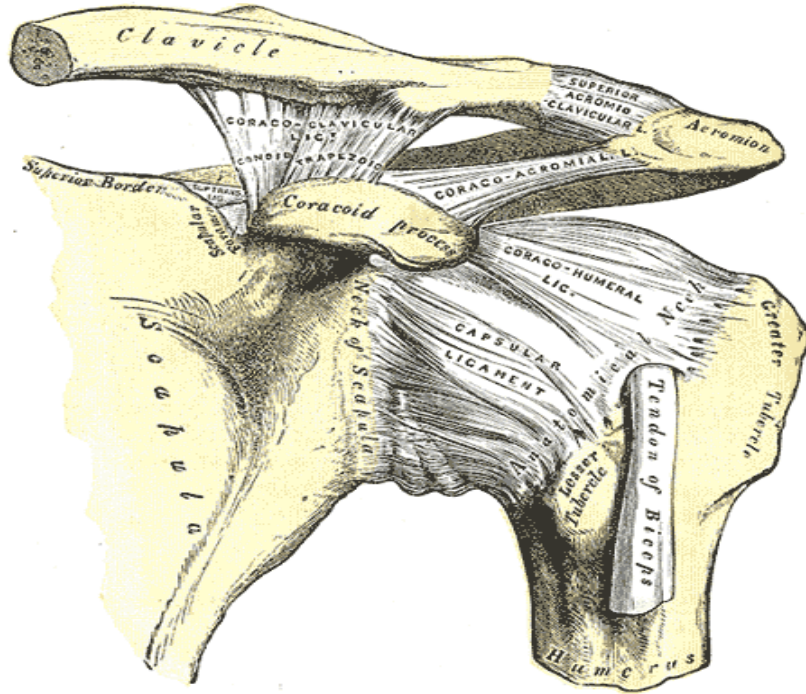
Lateral View



Glenohumeral Joint

- Pear shaped glenoid, facing ant, superior (5) and lat
- 4 lig; GHx3, CH (thickenings of capsule)
- Lax inferiorly, 1" distract
- Labrum; +75% area, 9mm depth, + 50%
- Supr/Subscap, axillary, lat pect, musculocut, n.
- Wilk et al JOSPT 97';25:6

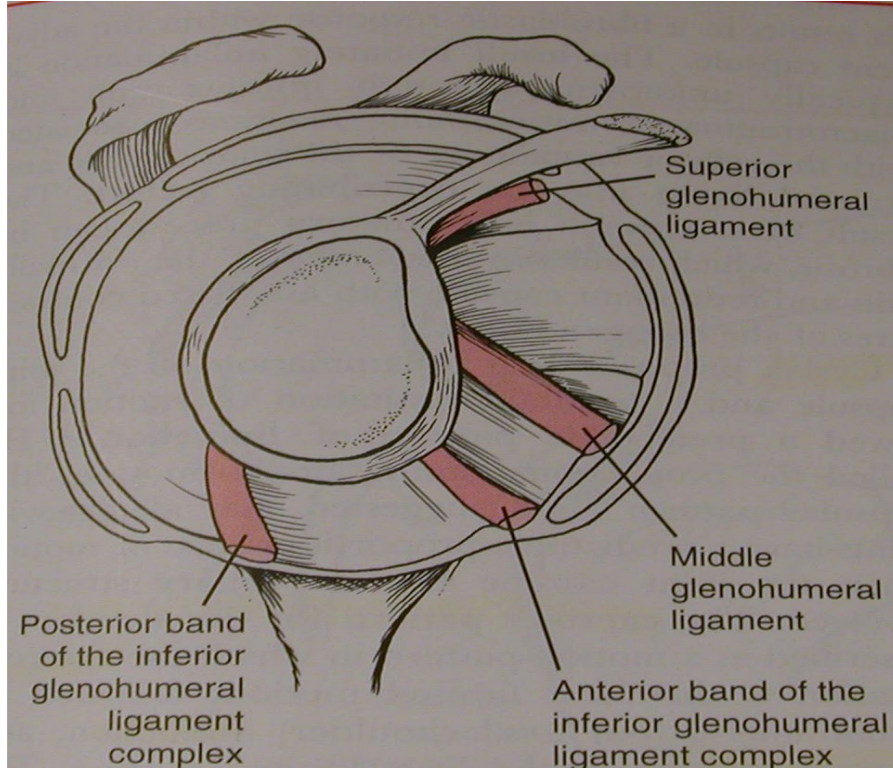
ANAT/BIOMECH CONT.



Joint Capsule

- Edges of glenoid to the humeral neck, encloses biceps
- Thin post, folds inf
- Thickenings are GH and CH lig
- “Rotator Interval”: between Supra & Subscap covered by CH
- Axillary n innervates lower capsule

ANAT/BIOMECH CONT.



Ligamentous

- CH: Lat coracoid to ant Gr tub (external to capsule, in the rot interval)
- S GH: Sup labrum (ant to biceps) to sup of less tub
- M GH: to med less tub and subscap
- I GH: A/P bands/pouch (3 to 8:00) to anat neck

THE ROTATOR CUFF

- Supraspinatus

More Muscles

- Upper Trapezius



Rehab Overview: Neer Progression....."THE WHAT"

- Neer CS II. Impingement Lesions. Clin Orthop 1983;173:70.

THE NEER PROGRESSION

- THE ABOVE STORY HAPPENS 95% OF THE TIME

Nope, wrong guy

The 5% club



Ya, this is the guy

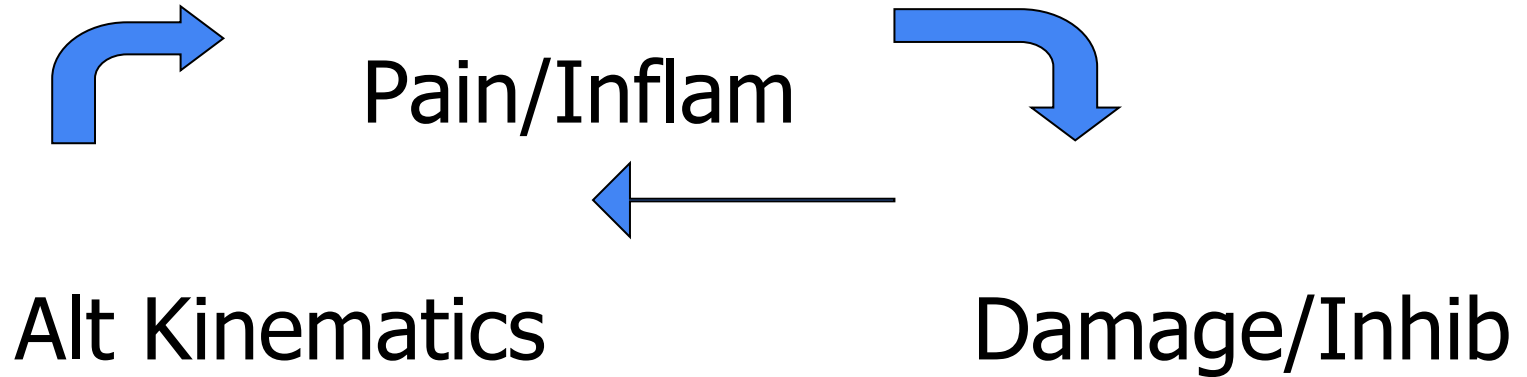
- The 95% club, **THIS IS OUR PATIENT**



SHOULDER IMPINGEMENT

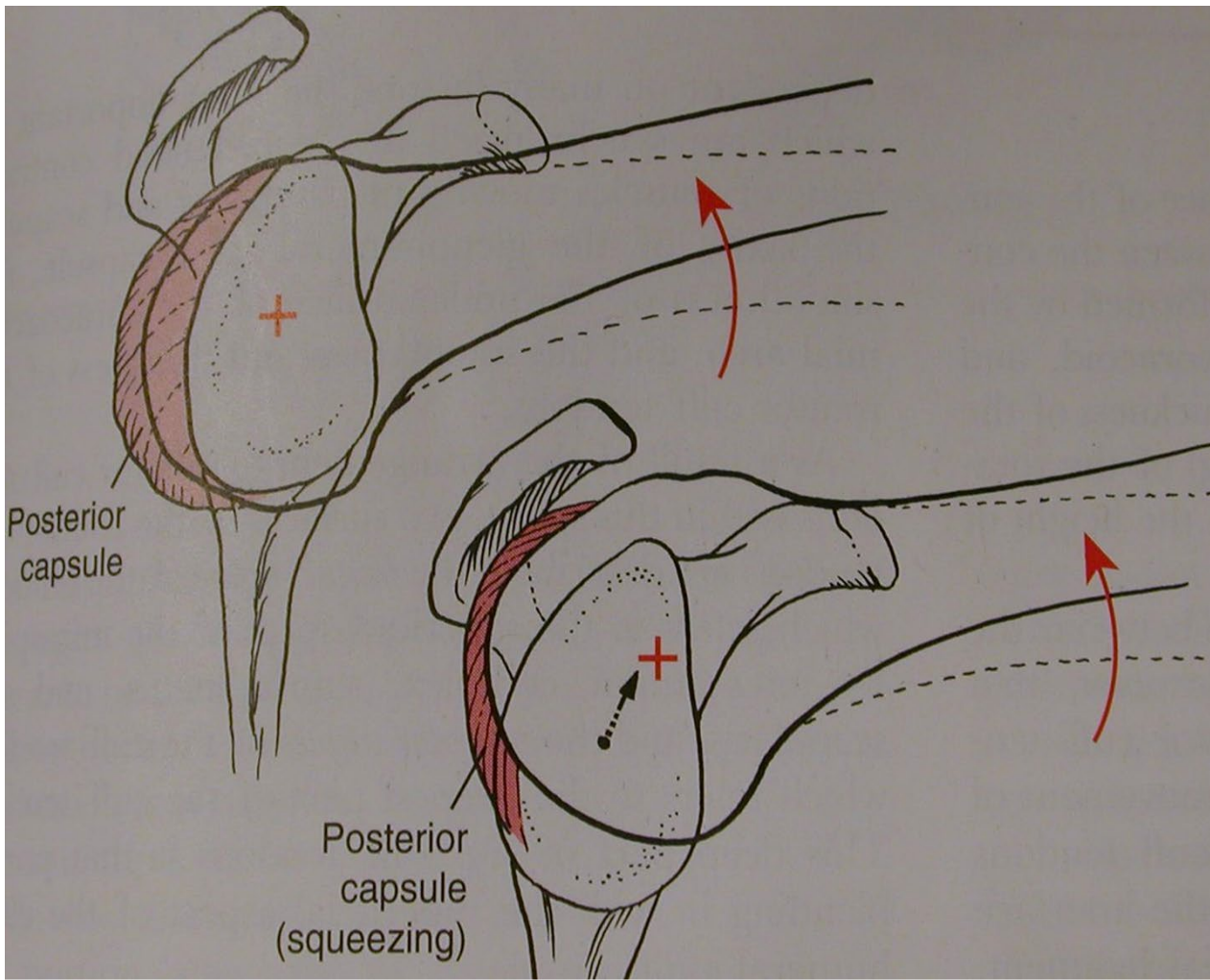
The **mechanical** entrapment and abrasion of the RC tendons or long head of the biceps tendon beneath the CA arch (superior, external or outlet) or the glenoid (internal or posterior)

The Downward Spiral



OF ERGONOMIC INTEREST

- Subacromial mech impinge occurs at lower ranges (30-70 degrees) then the classic “painful arc” (60-120 degrees)
- Classic mid range impingement tests do not coincide with greatest mechanical cuff contact risk positions
 - 2016, Staker J, Lawrence R, Ludewig P



Typical vs Atypical Impingement

Buss, Freehill, Marra

- Typical
 - Changes in acromial morph ie type I-III
- Atypical
 - Os Acromiale (acromial ossification site)
 - Subcoracoid disorder
 - AC undersurface hypertrophy
 - Deconditioned RC
 - Scapular dyskinesis
- Nonsurgical Rx is generally successful

To Inject...or Not

Therapists don't tell the doctor/PA to do this...of course

Just inquire whether analgesia is an option...for;

- Unrelenting moderately impaired sleep
- Distractive pain during the day
- Stagnation in therapy/HEP

Extremes thereof.....

“I’ve been injected monthly in my shoulder for 10 years”

. Iron range mine worker

Appropriate Injection Utilization

- Younger adult w/ cuff pathology
 - Only steroid inject 2x (ever)
 - 40% increase in additional cuff pathology if more
- Weekend warrior
 - Toradol
- >70 y/o w/ non-operable cuff pathology/pending TSA
 - Every 4 months, DC 3 months prior to surgery
 - Maybe combo of steroid and Toradol
- >80 y/o palliative care
 - Every 3 months

Steroid Injection...continued

- TSA with somewhat/generally intact cuff
 - Guided injection
 - Prevent infection
- RTSA (no cuff)
 - No inject for concern of infection
 - Oral options

Ketola et al JBJS Br 09'

- Arthroscopic **acromioplasty provides no clinically important effects over a structured and supervised exercise program alone** in terms of subjective outcome or cost effectiveness when measured at **24 months**. Structured exercise should be the basis for treatment of shoulder impingement with operative Rx offered judiciously.

THE IDEAL ACROMIOPLASTY PATIENT

- Failed 6 mo. conservative care
- Type III
- Bursal side RCT
- Pain with activity
- Not Work Comp
- Not too young (instab)
- Not too old (cuff integrity)

ROTATOR CUFF OVERVIEW

- ◆ Possibly the most abused, overused and unappreciated musculature in the body
- ◆ 50% of those over 60 and 80% over 80 have RC path, most are doing well
- ◆ “LUG NUTS”: Crucial dynamic stability function; compress, depress, maintain congruency (prevent translation)...With much needed help from the scap!
- ◆ Provides rotation and compression

PATHOLOGIC REGRESSION MECHANISM

- ◆ Eccentric overloading, ischemia, degeneration: tendinopathy
- ◆ Anatomical/acromial abnormalities
- ◆ Motion abnormalities
- ◆ A cyclical regression is created;
 - Pain inflammation
 - Altered kinematics
 - Inhibition

CHRONIC vs ACUTE

- ◆ Chronic highly predominate, especially in U.S. populations
- ◆ 2 types of chronic progressions (95% Neer)
 - 1. Secondary to chronic compression
 - Defined: **Primary/External** impinge; ie electrician/mechanic
 - Neers Progression Stage I-III, Jobe/Pink Group I, **bursal** side trauma
 - 2. Secondary to tensile overload
 - Defined: **Secondary/Internal** impinge; ie tennis/thrower
 - Jobe/Pink Progression Groups II-III, **humeral** side trauma
 - Hill-Sachs being the co-morbidity
- ◆ Acute tears post macro trauma (5% Neer)

ANATOMICAL vs EXTRINSIC FACTORS

- ◆ Anatomical: Acromial type, spur, cuff vascularity (smokers).....Surgeon
- ◆ Extrinsic: GH/ST muscle imbalance, scapular mechanical faults, postural change, capsular tightness, physical activities/overuse.....PT/PTA, OT/OTA

Muscle Forces

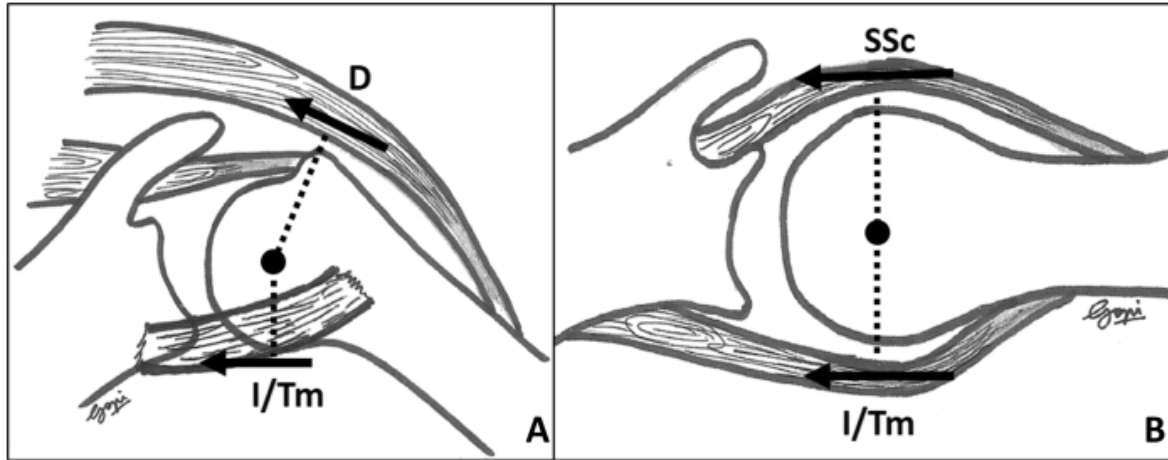


Fig. 1 (A) Coronal force couple. (B) Transverse force couple. D = deltoid muscle force; I/Tm = infraspinatus/teres minor muscle force; SSc = subscapularis muscle force.

TEAR TYPES

◆ Full thickness

- Top to bottom or vice versa
- Generally in the critical zone
- Can extend to the infra, t minor or subscap

◆ Partial

- Superior of undersurface as previously described

◆ Interstitial

- Tear between surfaces, shear is proposed origin

RX: POST REPAIR

◆ Initial Goals

- Reduce pain
- Reduce muscular, neuro inhibition
- Create a stable base in which to move
- Re-establish mechanically sound motion
- Restore functional strength through the mechanically sound motion

◆ Resource: Ellenbecker JOSPT 2006;36(5)

ADHESIVE CAPSULITIS

.....THE **ENIGMA**.....

In The Beginning.....

- In 1934, Codman stated, "This entity [FS] is difficult to define, difficult to treat, and difficult to explain from the point of view of pathology."
 - Codman EA. The shoulder. Rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa. Boston: Thomas Todd; 1934.

Wamsley: AS DEFINED IN 2009

- Primary
 - Idiopathic aka spontaneous
- Secondary
 - Known
 - Systemic; DM, Hypo/Hyperthyroid, Hypoadrenal
 - Extrinsic; Parkinsons, Cardiac, DDD, Humeral Fx
 - Intrinsic, shoulder joint disorder

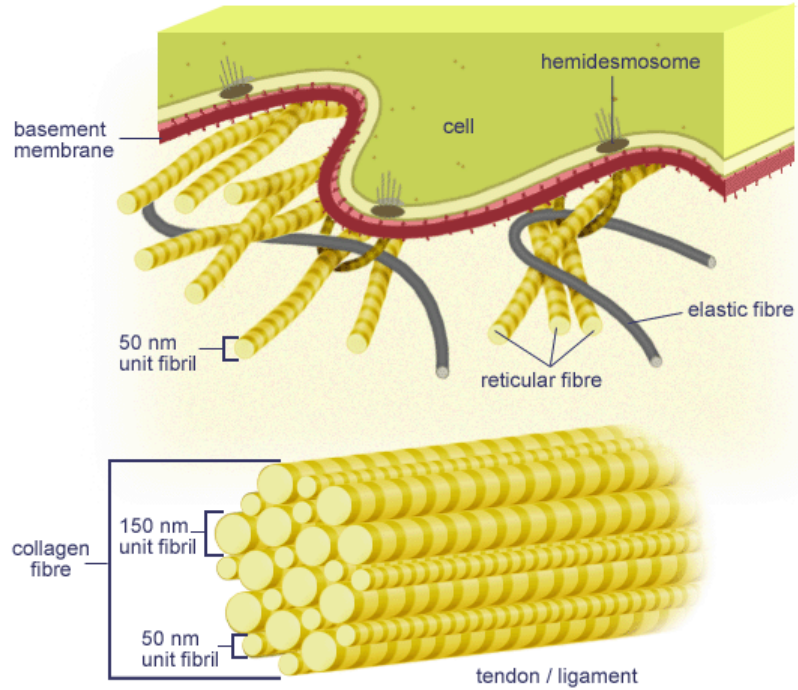
PRIMARY: HISTOLOGICAL ETIOLOGY

Bunker/Reilly 2000

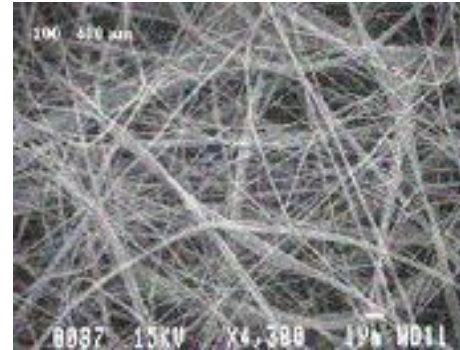
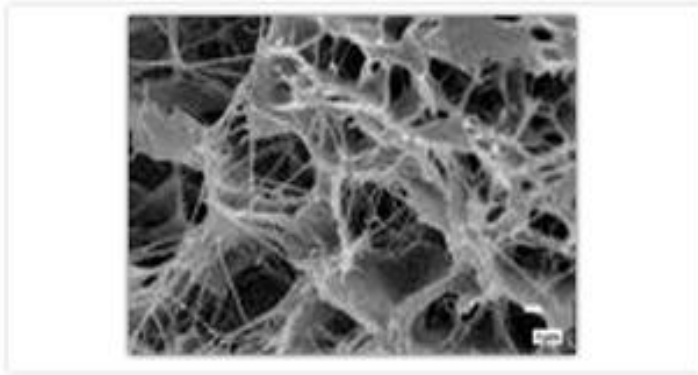
- Elevated cytokine levels
 - Growth factor; facilitates tissue repair
- Decreased matrix metalloproteinases (MMP)
- Stimulus unknown
 - Appear in cellular mechanisms of sustained inflammation and fibrosis
- Possibly....
 - Insult initiates an inflammation healing response and subsequent excess accumulation and propagation of **fibroblasts** releasing Type I and III collagen. Fibroblasts differentiate into **myofibroblasts** causing contraction of newly laid down type III collagen without normal remodeling capacities and subsequent scar tissue formation

Collagen/Elastin

Connective tissue



Type III Collagen



TREATMENT OVERVIEW

- Educate: Potentially long battle ahead
- Primary goal: Resolve pain
- Overall goal: Restoration of mechanically sound, three dimensional motion is the overall goal of treatment.
- No data to support modality use

Manipulation or intra-articular steroids

- Both groups reported decreased pain and improved function with treatment. However, there was **no significant statistical difference between the manipulation under anesthesia and steroid injection groups**. The authors recommend using steroid injection treatment rather than manipulation under anesthesia due to the ease and safety of the treatment. Jacobs LG, Smith MG, Khan SA, Smith K, Joshi M. J Shoulder Elbow Surg 2009; 18(3): 348-353

Shoulder pathology with concomitant neurovascular pathology; Identification and Treatment

Terry Buisman PT

FREQUENCY

- Visser CP, et al, Clin Neur & Nsurg, Jun 99
 - 215 pts s/p ant. Dislocation tested via needle EMG. 62% tested + for neuropathy. Testing MMT's, Sensation, DTR's was not reliable
- David Butler MAppSc, PT
 - "Mechanosensitivity of injured nerve is a more regular feature than conduction loss."

DIFFERENTIAL DX

ISOLATED SHOULDER PATH

- Local joint pain and dysfunction
- Increased local joint pain with motion
- C5 possibly C6 dermat., axillary, suprascapular/clavicular pain distribution
- Upper trap. may be sore but no other cervical based symptoms

DIFFERENTIAL DX SX WITH NEUROPATHY

- Diffuse pain pattern extends through the extremity with focal regions of pain including; wrist, lateral elbow, ant. Shoulder
- Symptoms can be modified by placing neurologic structure on tension; ie side bend away of head or placing shoulder in subluxed position
- Diffuse referred pattern created with extremity motion into end ranges
- Onset or heightened cervical/thoracic pain

TREATMENT CONT.

- Treatment Priorities:
 - Neurologic
 - Scapular Stability/Mobility
 - Capsular Mobility
 - Rotator Cuff 3D Stability
 - Prime Movers
- These are followed through a mobility progression; neutral to single planar to multi planar end ranges

SHOULDER INSTABILITY:

CREATING A 3 DIMENSIONAL STATIC AND
DYNAMIC BALANCE
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Differentiate

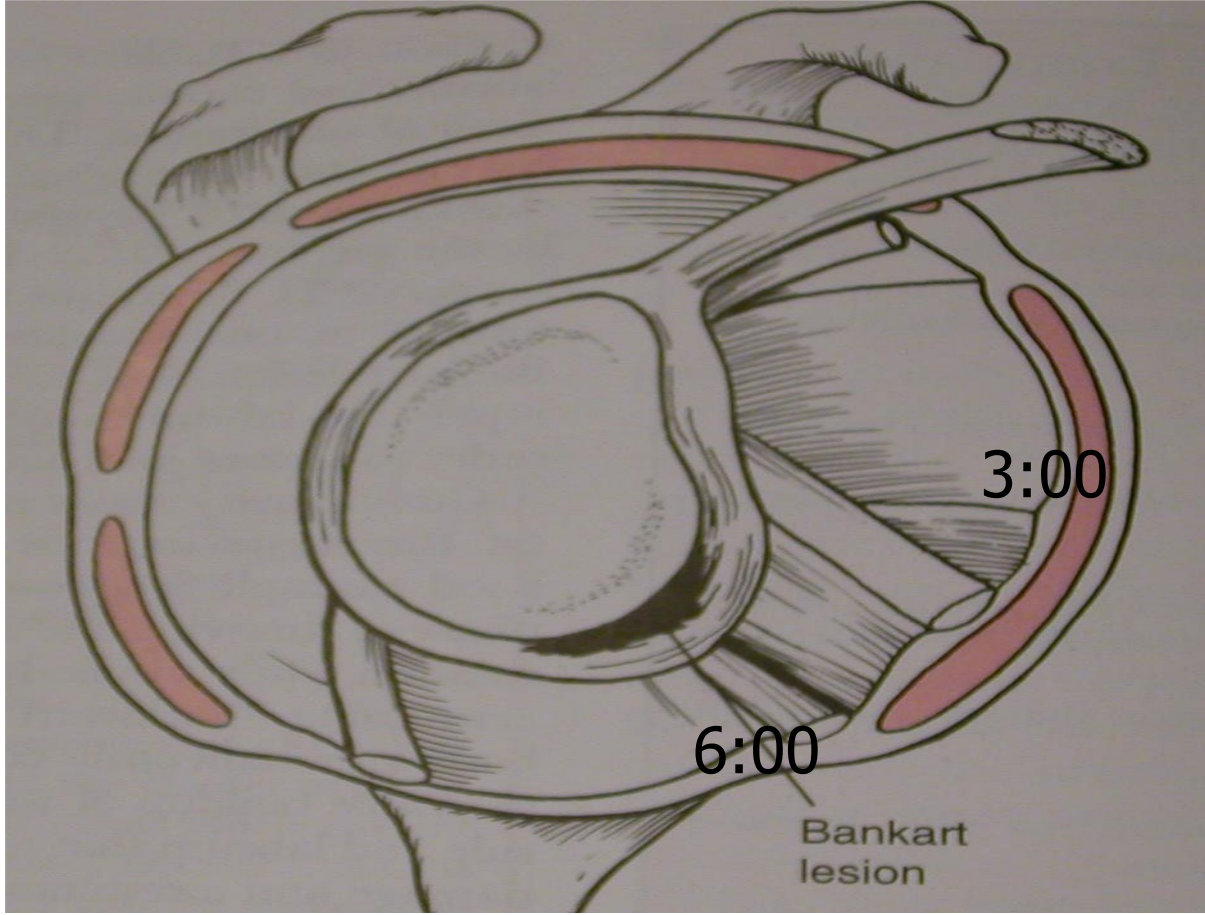
- Laxity
 - Congenital, multi joint, Female>male (ie gymnast) not pathologic, self limiting, "AMBRI-Born Loose"
- Instability
 - Excess motion in one or more planes that is pathologic, traumatic origin, "TUBS-Torn Loose"
- Resource: Shldr Instab; Mngmnt and Rehab JOSPT 2002;32(10) p497-509

LEVELS THEREOF

- Subluxation
 - Self reduce
- Dislocation
 - +/- self reduce
- Wilk "Silent subluxations"
 - Throwers, swimmers etc

DIAGNOSTIC TYPES

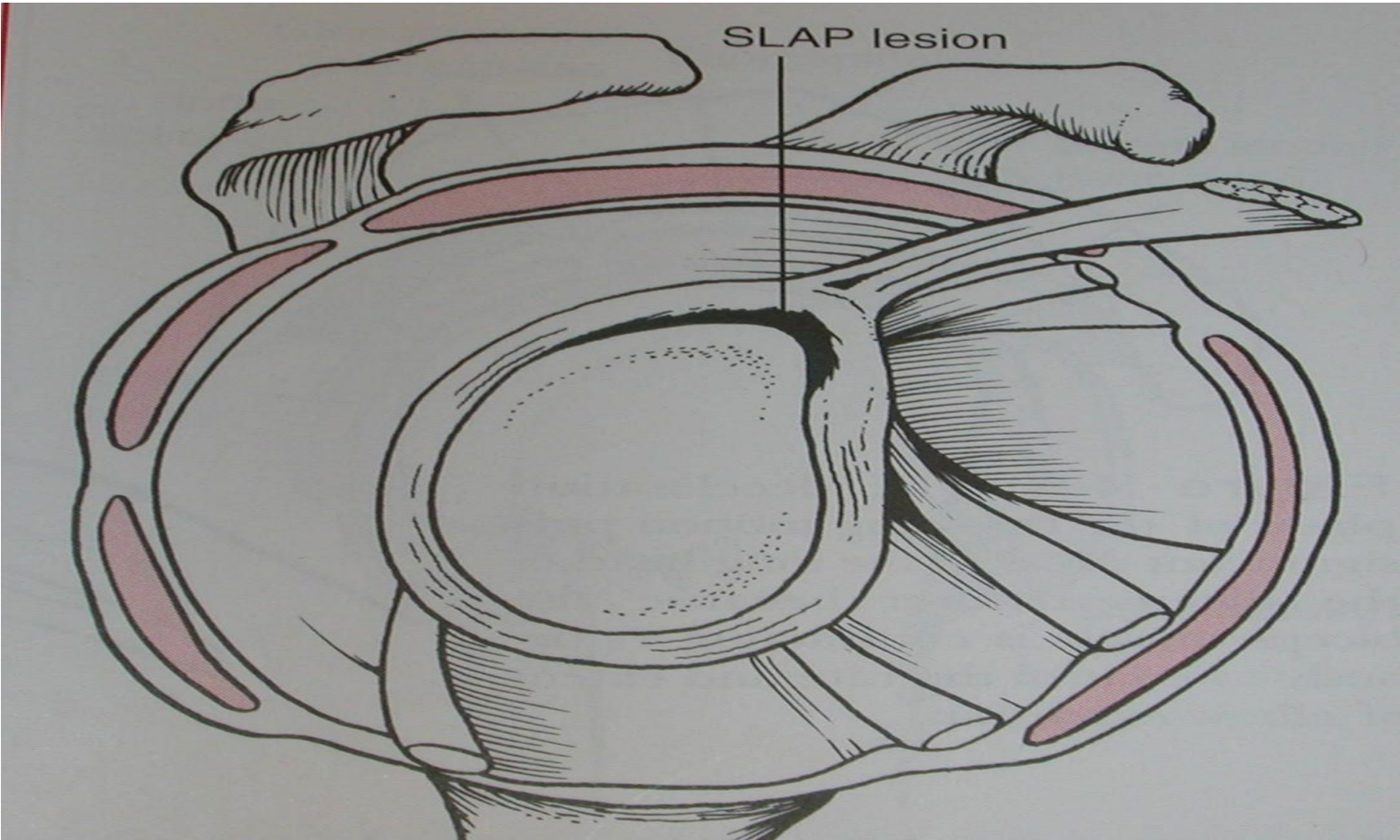
- Traumatic
 - SLAP: 10-2:00
 - Bankart:3-6:00
- Congenital
 - MDI
 - Bidirectional
- Acquired (subtle)
 - SLAP



3:00

6:00

Bankart
lesion



SLAP lesion

Hill-Sachs Lesion



SURGICAL PROCEDURES


- Bankart/SLAP repair
 - Suture, anchor or tac labrum
- Capsular shift
 - Subscap shift
- Thermal shrink
 - Laser or radio frequency heat probe

REHAB PROGRESSION

- Immobilization
 - If nec., control pain, tissue scarring
- Controlled Motion
 - Motion NOT stretching (PNF mindset)
 - Re-establish neuro sensory/motor
 - Re-establish static and dynamic stability through previously noted progression; scap through major movers

DYNAMIC STABILITY

- In mid range motion, the Supra and Subscap provided higher dynamic stability
- At end range motion, the Subscap, Infra and T Minor provided higher dynamic stability
- S.B Lee, et al. Dynamic GH Stability provided by the RC in mid/end range motion. JBJS Vol. 82-A, #6, 849-857.



RELAX AND BIG
BREATH,
YOU'VE
ALMOST MADE
IT THROUGH
THIS THING



[J Healthc Eng.](#) 2022; 2022: 5178333.

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PMCID: PMC8959976

PMID: [35356625](https://pubmed.ncbi.nlm.nih.gov/35356625/)

The Ergonomic Association between Shoulder, Neck/Head Disorders and Sedentary Activity: A Systematic Review

[Rama Krishna Reddy Guduru](#), [Aurelijus Domeika](#), [Linus Obcarskas](#), and [Berta Ylaite](#)