2019 Encore-Uhler Sports Medicine Symposium

Total Shoulder Rehabilitation/ Current Evidence and Outcomes

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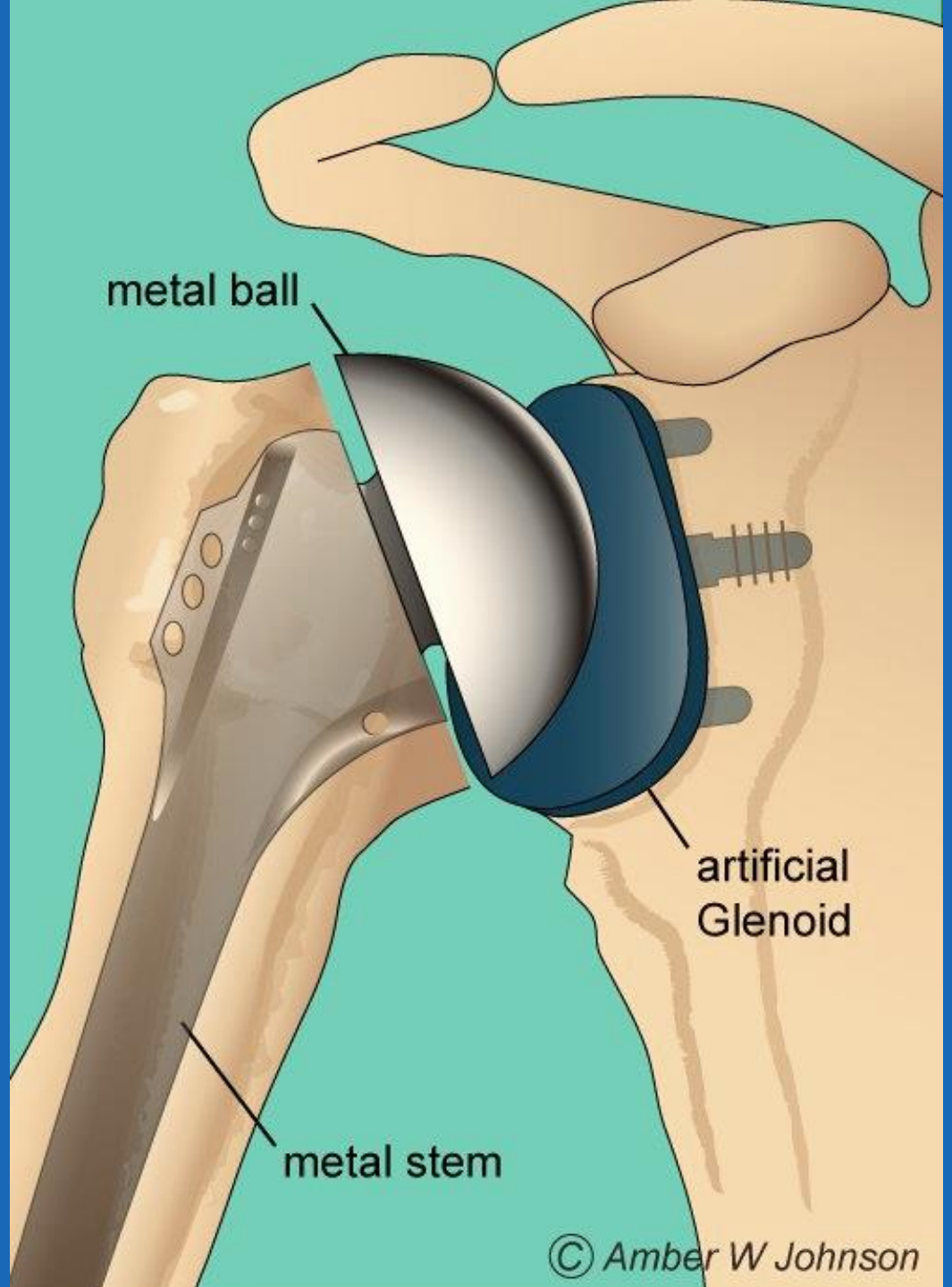
metal ball
artificial
Glenoid
metal stem
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What diagnosis are most common with joint replacement?

- Arthritis (OA is 85%)
- Fracture
- RA
- Osteonecrosis
- Injury to the joint (fracture, torn rotator cuff, etc.)
- Bone tumor breaking down the joint

National Data from 2011 (published in 2014) American Academy of Orthopedic Surgeons

1. TSA's have increased 243% in the last decade
2. Costs range between $7,000 and $21,000
3. 2006 was the first year TSA > Partial Shoulder Replacement and is now nearly double
4. According to Day, et al (2010) TSA incidents will be equal or greater than THA and TKA

Total Shoulder Verse Hemiarthroplasty

- 2,111 procedures: TSR: 1,642; HA: 316
- Revision rate for Ha was (13%) higher than TSR group (7%)

Conclusion: TSR results in less need for revision surgery.

Reference: Int. J. Shoulder Surg, 2013.

Pattern of Recovery:

TSA verse Humeral Head Replacement – 2 Year Follow-up

- Total Patients: 134; TSA: (81%); HAR: (19%)
- Both surgeries statistically showed improvement in range of motion and strength.
- Greatest change in outcomes were in the first 6 months.
- HAR Improvement in symptoms leveled off at 6 months.
- TSA Improvement in symptoms continued up to 12 months.
- Both groups showed strength improvements up to 24 months.

Reference: BMC Musculoskeletal Discord, 2014

Three Phases of Rehabilitation

- Pre-functional – Mobility
- Return to Function – Recruitment
- Return to Activity – Tri-Plane Stabilization

References: T.L. Trundle. 2011, 2016

Concepts of the Three P's

- Pivoters – scapular stabilizers i.e. rhomboids, trapezius, pectoralis minor and serratus anterior
- Protectors – rotator cuff
- Positioners – deltoids, latissimus dorsi, pectoralis major

Reference: Ellen M, Rogers DP, Gilhoal JJ

Total Shoulder Arthroplasty Protective Protocol Concepts

- Subscapularis Protection
  - Limits on external rotation – scapular plane
    - 30 degrees – 4 weeks
    - 45 degrees – 6 weeks
    - 60 degrees – 10 weeks
    - > 60 degrees – return to activity
  - No internal rotation combined with extension behind the back (hip) – 4 weeks
    - “Tucking in one’s shirt may be limited up to 12 weeks”

Total Shoulder Arthroplasty Protective Protocol Concepts

- Limits on Elevation
  - 75 – 100 degrees: pre-functional phase
  - 125 – 140 degrees: return to function phase
  - Rotator cuff and deltoid function

- Dynamic decompression of the humeral head by providing balance of the upper pull of the deltoids and not allowing the scapula to overcome the G-H joint
- Result = smooth rotational movement to allow shoulder elevation primarily in the transverse plane

Rotator cuff dysfunction = Elevation hike:

1. Rotator cuff weakness
2. Loss of transverse plane motion

- Scapulo-thoracic articulation – Not a true joint
    - Mobile structure stabilized by muscle
    - Scapula functions as a sesamoid reaction
    - True core of the Upper Kinetic Chain (T. Trundle/2016)
- Scapular positional movement
    - Normal position of the scapula is to be symmetrical mounted on the ribcage
    - Alteration of normal position or motion directly affect the glenohumeral joint and shoulder positioning is referred to as Scapular Dyskinesis

Clinical Examination Review

Scapula-thoracic – Static examination

- Anterior tilting – Inferior angle
  - Kibler Type I – seen in primary impingement
- Internal rotation – Medial border
  - Kibler Type II – commonly found in throwing athletes (pitchers)
- Elevation – Superior glide
  - Kibler Type III – present in hypomobile pathology – abhesive capsulitis

Reference: McQuade KJ, Burstad J, Siriani de Oliveira A, 2016 (PT)

Plummer HA et. Al. JOSPT 2017

Scapular Dyskinesis

- Does this play a role as an indicator of instability?
- What does it really mean in the symptomatic shoulder?
- Scapular Dyskinesis may not be supported in current research as it is linked to pathology
- Systematic review of 10 studies linking scapular kinematics and impingement indicates there is no ideal scapular position that causes or contributes to impingement

References: Thomas et al. J. Sports Rehab 2013

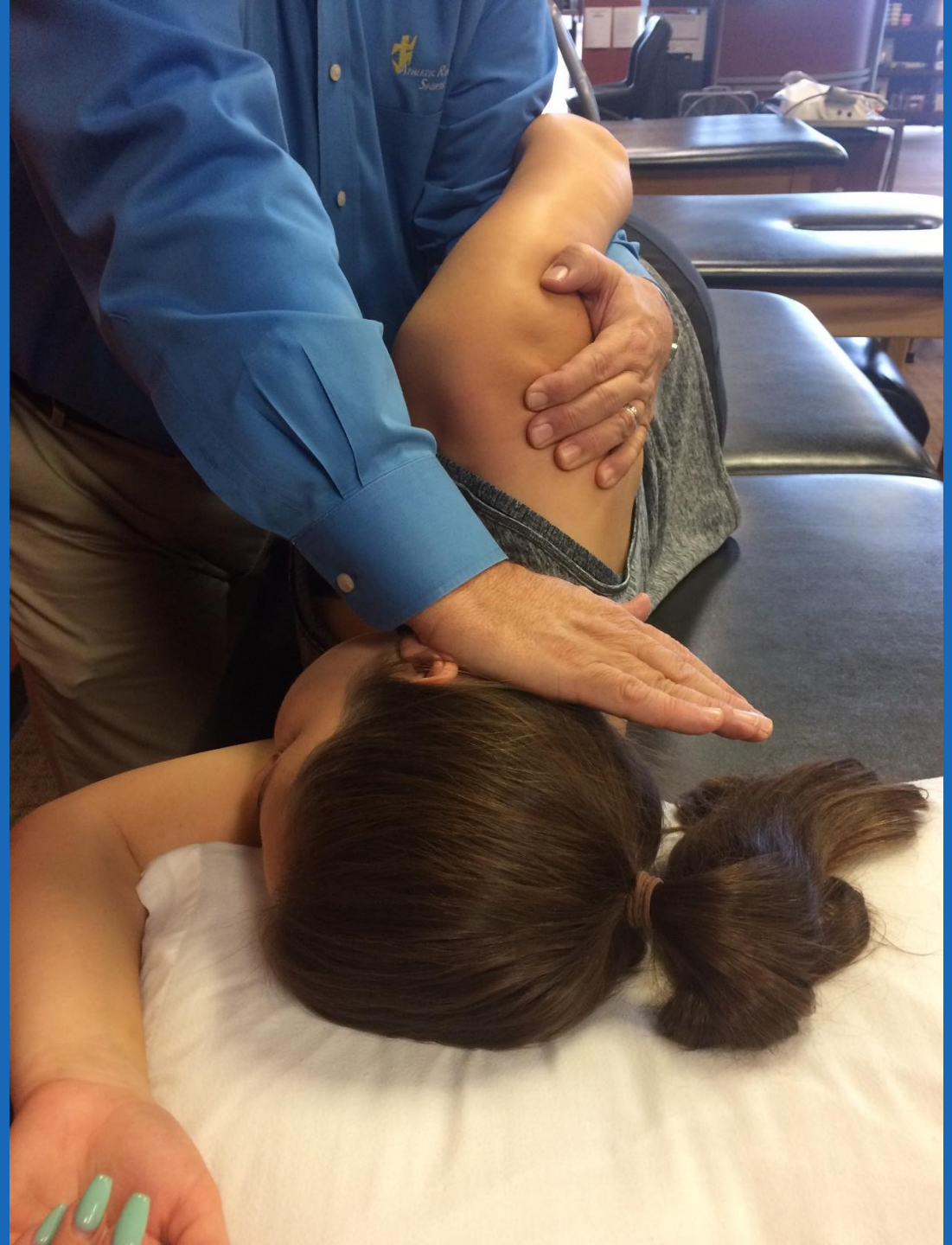
Ratcliffe et al. Br J Sports Med 2014

Michener LA et al. JOSPT 2017 – Presentation at CSM

Total Shoulder Arthroplasty:
Pre-functional Phase

- Immobilization device
- Scapula mobility
- UER glides
- Protective external rotation (subscap) – Goal: 30-45 degrees
- Active elbow and hand exercises
- Manual exercises: elevation in scaption – Goal: 90 degrees
- Counter-contraction decompression

Reference: Bullock GS, Garriques GE, Ledbetter L, Kennesaw J. JOSPT. 2019




Athletic Rehab Institute
Sports Medicine

Level 1 EMG Based Exercises for the Shoulder

- “Passive motion concept should be reconsidered”

- Level One – Low EMG
  - Clinician Assisted Forward Elevation
  - Pendulum (Codman) if performed correctly

  --Gravity Eliminated Forward Elevation
    - UE Ranger™ - seated glides
  - Scapular retraction sets

“The Vital Three Motion Patterns” Assessment

Mobility:

- Short lever arm rotation
  - External rotation in modified scaption (1)
  - Internal rotation – positional IR/to low spine level
- Long lever arm movement
  - Elevation – transverse plane (2) – distal marker: thumb up
  - Horizontal abduction above 90° (3) – slowly with TSF - RTSR
  - Abduction – modified scaption
- Clinical Concerns of Early Motion

1. Gravity point concept
2. Manual motion should begin in a scaption angle
   - - “Rotation before Elevation” – not as true for TSR
3. Counter contraction decompression

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Total Shoulder Arthroplasty:
Pre-functional Phase

- Scapula retraction with resistance
- Gravity point arm control
- Light isometric exercise w/o internal rotation but include the deltoids and external rotation
- Anodyne – Infrared


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Total Shoulder Arthroplasty:
Return to Function Phase

- Manual mobility: Glenohumeral as needed
- Progressive retraction
- Protraction at the gravity point
- Closed kinetic chain exercises
  - Wall push-up
- Rhythmic stabilization – shoulder sphere – static protocol – position 1-2
- Light strengthening – rotator cuff and deltoids
  - Seated scaption
  - Placement eccentrics

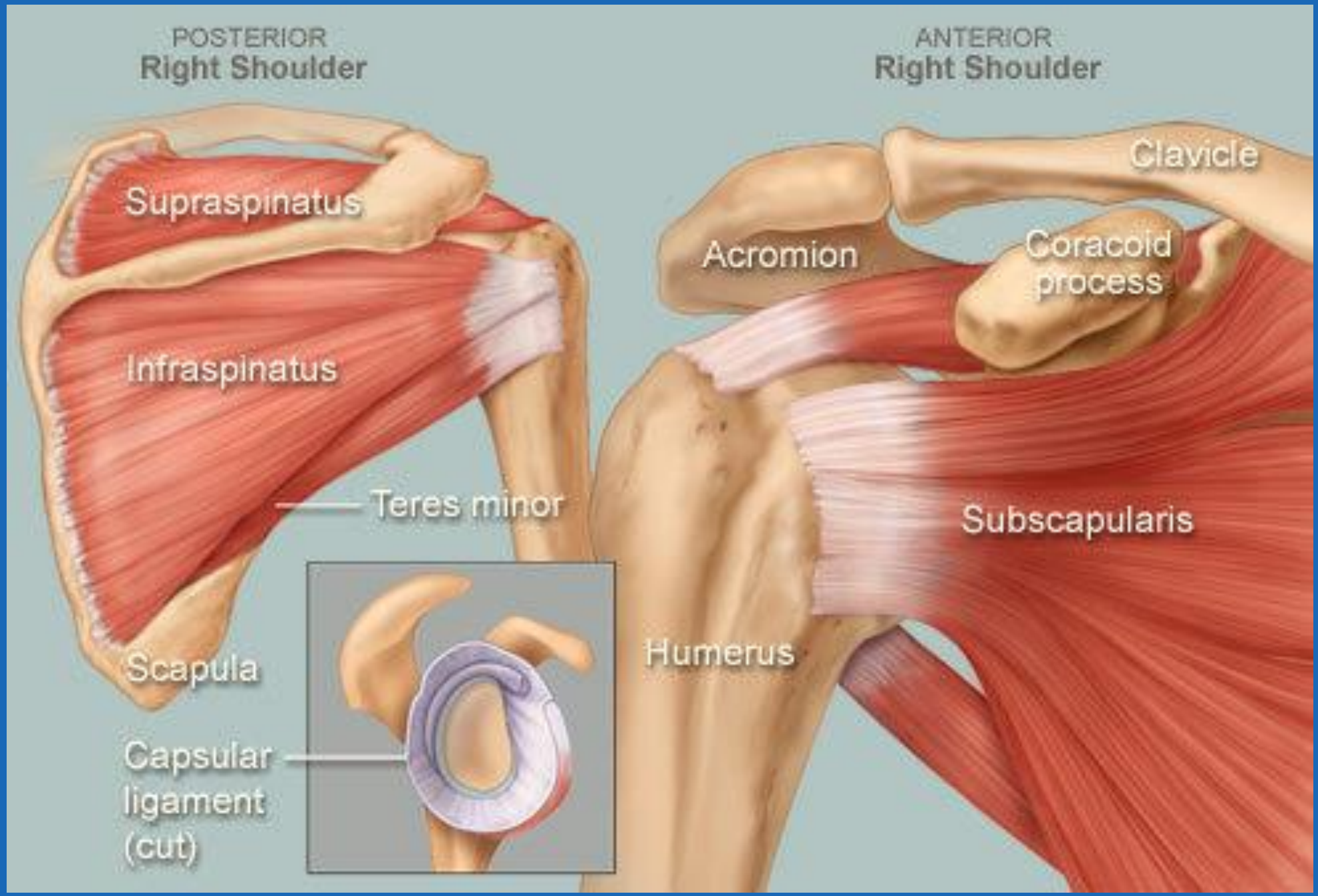
ROM Goals

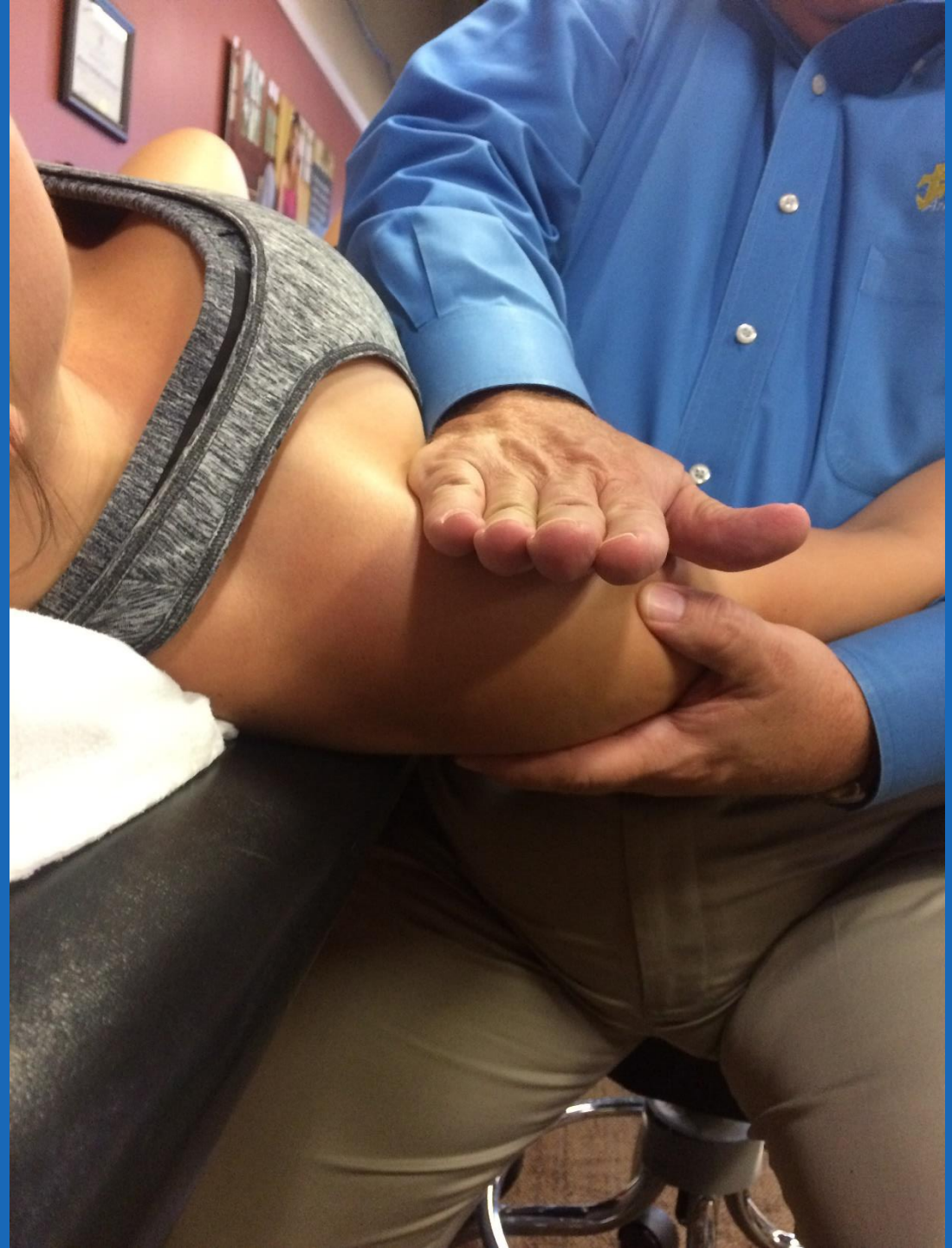
- Elevatoin 120-140 degrees
- External Rotation 60 degrees – scapular plane
- Internal Rotation 60-70 degrees – scapular plane
- Horizontal abduction toward the table
- Have you ever heard of the statement “Physical function vs Social function”

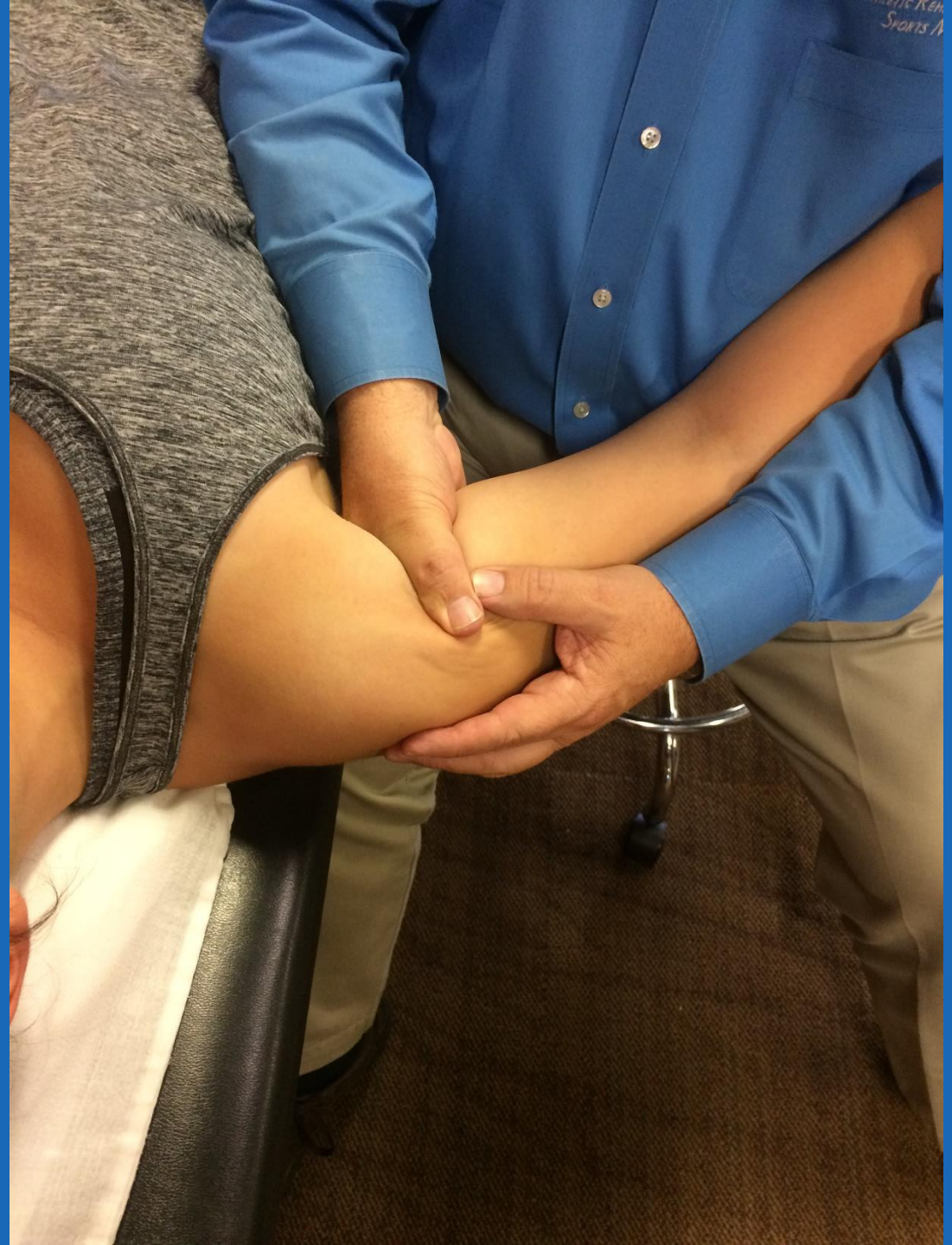
Glenohumeral Preparation Glides

- Inferior Glide
- Rotational Glide
- Posterior glide
- Lateral glide

Reference: Trundle, T.L., 2011, 2016.


POSTERIOR
Right Shoulder
ANTERIOR
Right Shoulder
Supraspinatus
Infraspinatus
Teres minor
Scapula
Capsular ligament (cut)
Humerus
Clavicle
Acromion
Coracoid process
Subscapularis





Gentle joint manual glides (mobilization) is always based on pain and the goal of improving elevation in the transverse plane. Mild posterior glide could be helpful.

Total Shoulder Arthroplasty - Documentation

Pt. increased active shoulder elevation from 80 to 95 degrees during today's session

Clinician completed manual posterior glenoid capsular mobilization to increase shoulder elevation in the scapular plane. ROM was then performed in this same plane. Manual elevation was performed by clinician to achieve 100 degrees in the transverse plane. Carry over natural scaption elevation was performed actively with minimal substitution of the scapula.


The path to physical recovery starts here.
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CLOSED KINETIC CHAIN RECRUITMENT

- Clinical Application
  - Promotes co-activation that leads to tri-plane stabilization

- Wall push-ups-double to single for TSA
  - Sagittal plane – weaker patient
  - Transverse plane – scaption angle
  - Modified frontal plane-single arm
- Wall push-up plus add resistance


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Four Levels – EMG Activity Based on Maximum Voluntary Isometric Contraction (MVIC)

- Level One: 20% of MVIC – low
- Level Two: 21% to 40% of MVIC – Moderate
- Level Three: 41% to 60% of MVIC – High
- Level Four: More than 60% of MVIC – Very High

- Precaution Concerning Rehabilitation
- Therapeutic value of EMG Based Recruitment Pattern is a Dynamic Activity Level and Not a Measurement of Tendon Stress.

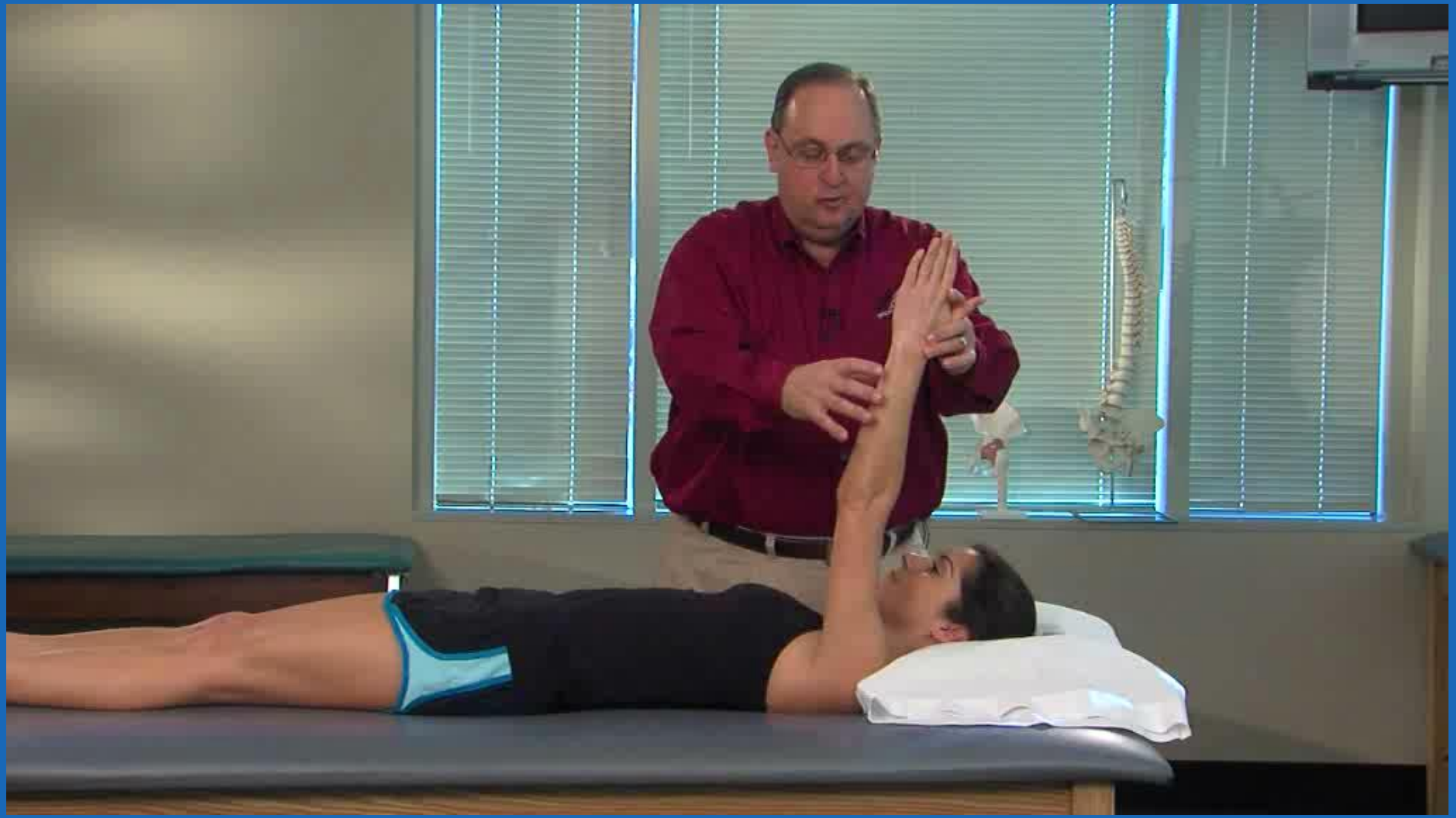
- Reference: Uhl, TL; 2009.

Protraction – Serratus Anterior Clinical Application Preparation for Elevation

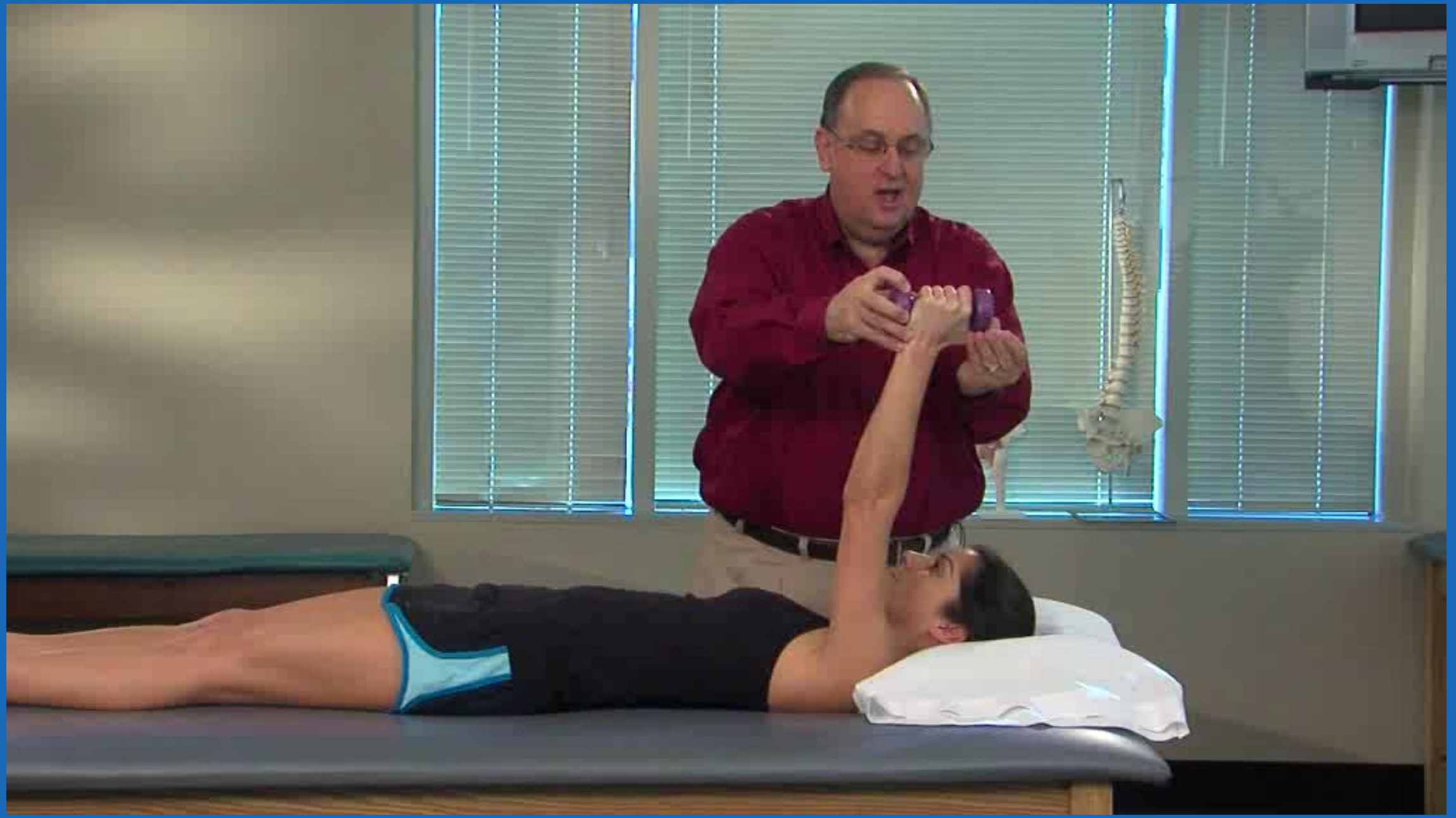
- Press-up plus – ceiling punch – Level 3
- Standing scaption to 120° - Level 4 – advanced elevation
- Wall push-ups plus – Level 2
- Dynamic hug – Level 3

Highest activity of the serratus anterior occurred at 55 degrees of elbow extension during the concentric phase of traditional push-up and not at the plus phase of the exercise.

Reference: San Juan JG, Suprak DN, Roach SM: BMC Musculoskeletal Disord, 2015.




The path to physical recovery starts h

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H Z C K O
N O R H O
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"My BenchMark therapist was as committed to my recovery as I was."
-Brett J.
The path to physical recovery starts here.
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committed to my
recovery as I was."
Exercise is medicine.

Placement Eccentrics

- Scaption
- Sidelying External Rotation

Recommended exercise progression

Progressive Protocol

- 2 sets of 5
- 3 sets of 5
- 2 sets of 10

Guard against eccentric overload

Reference: Trundle, TL 2016


orite ride again."
ohn H.

Muscle Recruitment

- Placement Eccentric
  - Isometric to eccentric isotonic activity is more likely to create functional carryover (improved recruitment)
  - Holding isometric to muscle lengthening (Eccentric) leads to controlled mobility (closing the gap)
  - The goal for the patient is to develop automatic controlled mobility during functional performance (elevation control)

Reference: Trundle TL 2011, 2016

Total Shoulder Arthroplasty - Documentation

Patient demonstrated protective guarding of right shoulder elevation. Clinician applied manual placement eccentric technique in scaption plane. Treatment results showed reduced shoulder elevation hike dysfunction in the transverse plane.

Total Shoulder Arthroplasty:
Return to Function Phase

- Active rotator cuff strengthening – elastic resistive exercises
  - Retraction
  - External rotation – short arc
  - Internal rotation – short arc
  - Standing extension
- Closed kinetic chain - wall push-ups: single arm
- Advanced scapula strengthening
- Scaption elevation with progressive resistance (3)
- Side lying external rotation
- Selective prone series exercises if tolerated
  - Prone extension toward hip (3)
  - Prone scaption (3)
- Seated rows
- Shoulder sphere – dynamic protocol

The Missing Link of Shoulder Rehabilitation

Modes of Contraction:

- Isometric – static
- Concentric – shortening/acceleration
- Eccentric – lengthening/deceleration

$$W = F \times D$$

Muscle Work = recruitment x (+/-) ROM

Eccentric exercise - negative training:

↓O_2 – oxygen debt

↓ATP – energy challenges

↓EMG Activity – less active fibers to dissipate load

- DOMS = Delayed Onset of Muscle Soreness
- Progressive Repetitive Protocol Needed
  - 2-3 sets of 5
  - 2 sets of 10
  - 3 set of 10


The path
Dynatronics


Dynatronics

Muscle Type Composition of Rotator Cuff Muscles

- Type I – slow-twitch: resistant to fatigue
- Type II – fast-twitch: type II A, type II X

- Muscles disuse is associated with a type I to type II shift.
- Endurance exercise protocols may result in an increase of type I fibers.
- Losing muscle mass, strength, injured or post-operative muscles are likely to be more fatigable due to fiber changes with disuse atrophy.

Clinical Concept: Missing link is eccentric strengthening of external rotation.

Reference: Lovering, Russ. JOSPT 2008


The path to physical
Dynatronics

- Prone extension: teres minor and deltoid (post) > 60% MVIC

Ref: Evans NA, Dressler EV, Uhl T, JOSPT (CSM 2017)


Dynatronics

Prone Scaption Series

1. Scaption at 100°
2. Scaption at 120°
   - Short-arc ROM for rotator cuff recruitment
3. Long-arc ROM for advanced scapular stabilization with increase of activation of the lower trapezius, used in advanced stages of exercises
   - EMG Level 4


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Average Force (pounds) for Thera-band Elastic band®

% Elongation	Yellow	Red	Green
50%	2	2.5	3
100%	3	4	5
150%	4	5	6.5
200%	5	6	8

Reference Page, et al JOSPT 2000


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Geriatric Big Four

1. Standing extension to hip
2. Seated scaption
    - Option with scapular retraction
    - Placement eccentrics
3. Side-lying external rotation with trunk support
4. Elastic Band Exercises

What does research say about outcomes with the TSA patient?

1. The average TSA client does not use full achieved ROM
    1. Research demonstrates clients will achieve 75-80% of their maximum ROM when completing ADL's
    2. Patient often use compensatory scapular and clavicular motions to achieve full flexion and abduction
    3. Conclusion can be drawn that patients retain old pathological motion patterns and have reduced proprioception
2. No positive affect on proprioception pre/post TSA

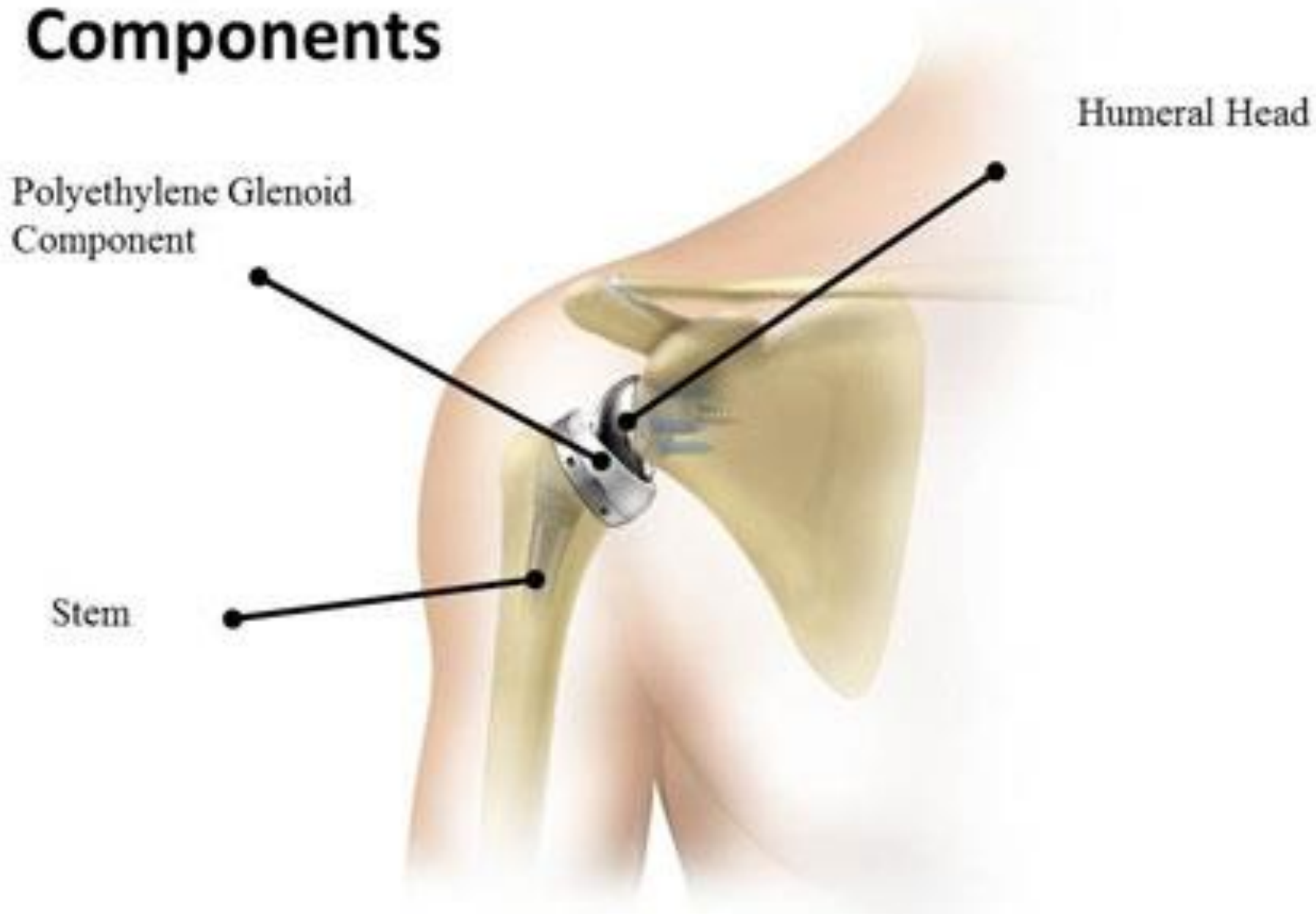
Return to Activity Phase

- Selective exercises and functional movement as needed
- Scapula-cuff stabilization using the three “p’s”
  - Pivotors – scapular stabilizers, i.e., rhomboids & trapezius – serratus anterior
  - Protectors – rotator cuff → decompression
  - Positionors – deltoids, latissimus dorsi, pectoralis major → controlled elevation - end product of function

Reverse Total Shoulder Prosthesis

- OA & RA with massive rotator cuff tear
- Proximal humerus fx with tuberosity malposition and nonunion
- Revision of failed arthroplasty with cuff tear
- Failed RCR with instability
- Proximal humeral tumors

Comprehensive Reverse Shoulder Components



Reverse TSA Prosthesis

Humeral head replaced with socket implant, glenoid now is the artificial ball

- Designed to increase the deltoids movement in arm and tension
- Results: deltoids begins the primary elevation of the arm in patient who previously could not raise their arm
- Function depends upon the deltoids and periscapular musculature

Rehab concerns and precautions

- If the shoulder dislocates it is normally into internal rotation/adduction/hyperextension
- No glenohumeral joint extension beyond neutral
- No heavy lifting. All heavy lifting should be done in transverse plane
- Remember, most of the rotator cuff is not usable

R-TSA Rehabilitation: Pre-functional

- Post-op support device, 4-6 weeks: use at night for sleep.
- Manual control ROM – no adduction or internal rotation. Stay in scaption
- Elevation manual range of motion: ROM to 90 degrees
- Active elbow, wrist, and hand ROM
- UER seated glides
- Manual scapula glides
- Retraction setting
- ROM progression: Elevation 110-120 degrees – Scapular plane 6 weeks and beyond
- Progressive external rotation 30 – 45 degrees, internal rotation limited to 50 degrees (no behind the back IR)
- Go slowly with horizontal abduction
- Short lever sub-max deltoids exercise if ready

R-TSA Rehabilitation: Return to Function Phase

- Mobility as needed – joint glides for elevation
  - Capsular mobility – modified sleeper stretch
  - Anterior capsular mobility is delayed and will be based on need and tolerance – posterior glide in neutral position
- Scapula stabilization and residual rotator cuff (Teres minor)
- Selective strengthening for elevation
- Eccentric scaption elevation – placement eccentrics
- Prone exercises as tolerated
  - Prone extension toward hip
  - Prone scaption – short arc
- Goal: Active ROM –
  - Elevation 100 – 120 degrees
  - External Rotation – 60 degrees
- Shoulder Sphere – static protocol – position 1-2 progress to 3

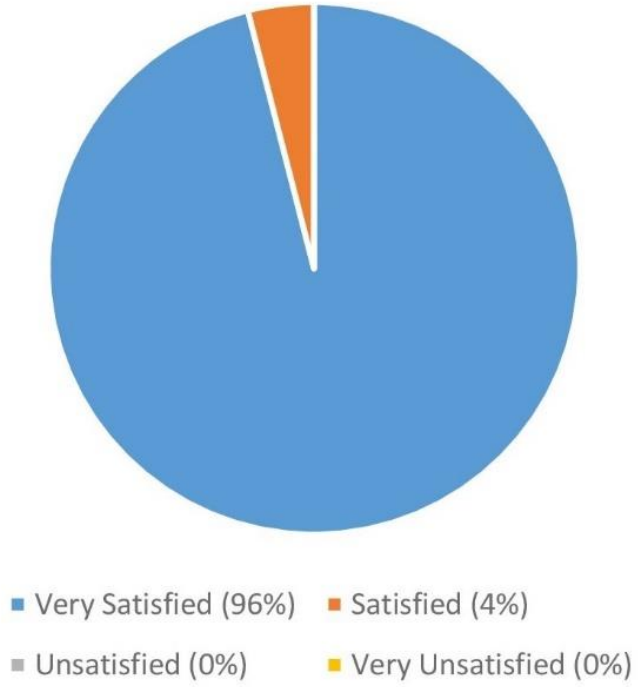
Research: Journal of Bone and Joint Surgery

- 60 patients avg. age 71 follow-up of 2 years
- 41 of the 60 rated their satisfaction as good excellent
- 17% had complications
  - Infection
  - Instability
  - Nerve Injury
  - Hematoma/blood clots
- Pain scores went from a 6/11 to 2/11
- Forward elevation 55 to 105 degrees
  - Abduction 41 to 101 degrees

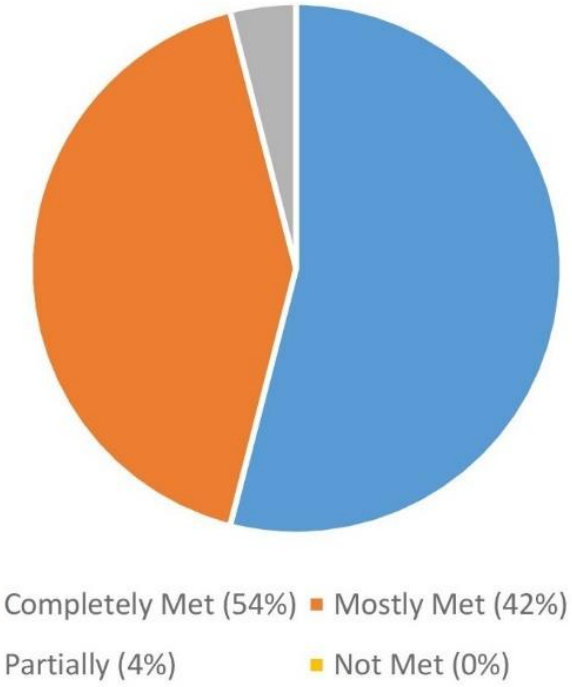
Clinical Dashboard

Aftercare Joint replacement of the Knee and Shoulder for Date Range: 02/11/13 - 10/01/15

Patient Satisfaction



Goals Met



	Initial	Complettion of Care	Diff	Diff %
DASH	49.3	9.3	40.0	81.1
LEFS	21.7	54.1	32.4	149.7

Questions