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Thoracic Outlet Syndrome: A Physical Therapy Perspective.

Presented to: 20th Annual NM Sports Medicine Conference

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2026 Conference NM Sports Med Conference

Disclosers and Objectives

- **Disclosers:**
  - I'm a Physical Therapist employed by Northwestern Medicine.
  - I have no other financial conflicts or disclosers.

- **Objectives:**
  - Understand the Patho-mechanics of TOS.
  - Define the clinical presentation of TOS.
  - Review tests and measures that will assist in determining if a pt has TOS.
  - Understand differential diagnosis between TOS and similar conditions.
  - Brief review of surgical options
  - Review possible treatment approaches for pt's with TOS

Thoracic Outlet Syndrome

Introduction

- **Compression of the neurovascular bundle formed by the brachial plexus (C5-T1), the subclavian artery and the subclavian vein as the exit the axial skeleton (12).**
- **TOS can be:**
  - Neurological: Compression of the brachial plexus. Present in 90% of cases (4, 12). The lower brachial plexus is normally more effected causing more issues in Ulnar nerve distribution (12).
  - Vascular: Compression of the artery or vein. Less common. (4)

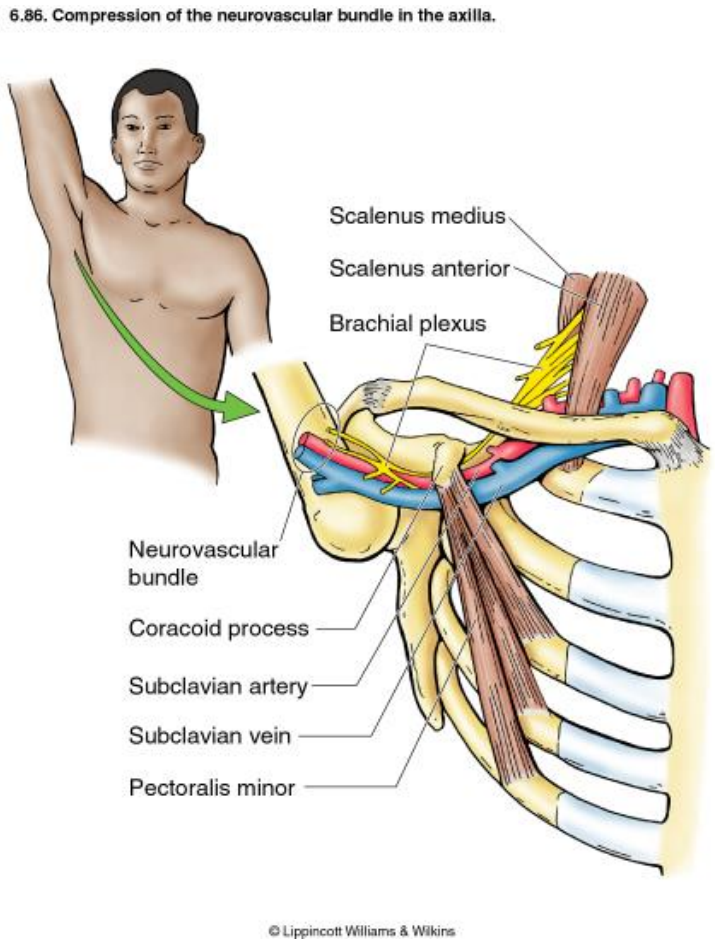
Thoracic Outlet Syndrome

Intro/Epidemiology

- True diagnosis can be difficult estimated to effect 3-80/1000 (3, 12).
  - Female > Male 3:1 to 4:1- Likely due to narrower thoracic outlets, less-developed musculature, greater breast tissue leading to shoulder depression, and a lower anatomical position of the sternum (1).
  - The condition is most often diagnosed between the ages of 20 and 50 and is rarely seen in children. (1, 12)
- Athletes who participate in repetitive overhead sports; volleyball, baseball, swimming exposes the neurovascular bundle to repetitive stress increasing likelihood of TOS. (5)
- Also people that engaging in repeated overhead tasks for work: Electrician, Carpenter.
- No single test definitive test more of a diagnosis of exclusion. Important to look at the whole case. (6)

Anatomy

- **The thoracic outlets consists of 3 main passageways. Compression in any of the 3 can lead to symptoms.**
  - 1. Interscalene Triangle
    - Ant: Anterior scalene
    - Post: Middle scalene
    - Inferior: 1st rib
    - Subclavian vein is anterior
  - 2. Costoclavicular space
    - Superior: Middle 1/3 of the clavicle
    - Inferiorly: 1st rib
    - Medial and posterior: costoclavicular ligaments
  - 3. Subcoracoid space
    - Superior: Coracoid process
    - Anterior: Pec minor
    - Posterior: 2nd -4th ribs



Possible causes

- **Interscalene**
  - Muscular tightness, altered muscle attachments, presents of scalene minimums, long C7 transverse process, Most likely place of compression for Neurogenic TOS (12)
- **Costoclavicular space**
  - Trauma to the clavicle or 1st rib, elevated 1st rib, presents of a cervical rib (4), hyper mobile clavicle, scapular posture/positioning
- **Sub-coracoid space**
  - Tightness in pec minor, fx to coracoid process, scapular posture/positioning
- **General causes**
  - Poor posture (fwd head, Rounded shoulder), scapular weakness, poor scapular control, scoliosis.
  - Malignancy induced compression (Pancoast).
  - Trauma: whiplash, neck injury, fractured clavicle, fractured 1st rib
  - Hypercoagulability

Clinical presentation

- Typically increased with overhead postures/activities and motions.
  - This can lead to scarring do to repeated micro trauma to the vessels and muscular adaptions leading to further compression.
- Especially with sustained motions overhead and positions of abd/ER
- Increase with talking on phones or working at desk.
- N+T may increase at night with certain sleeping postures.

Clinical Presentation

- **Neurogenic (nTOS)**
  - Pain and or N/T- in neck/arm/hand in non-dermatomal pattern. Typically, more medial
  - Possible weakness
  - Occipital HA
  - Chest pain
  - Loss of fine motor
  - Cold intolerance
  - Hypersensitivity to touch/clothing
  - Positive ULNT tests
  - Heaviness in arms and hands
- **Venous (VTOS)**
  - Cyanosis
  - Feeling of heaviness
  - Paresthesia
  - Arm swelling
  - More common on dominate side and with repeated motions
  - Signs of dilated collateral veins, more on effected side.
- **Arterial (ATOS)**
  - Pain in the hand
  - Claudication
  - Pallor
  - Cold intolerance
  - Paresthesia
  - Reduced pulse
  - Least common

Assessment

- **Important subjective questions**
  - Injury history
  - Overuse history: Electrician, throwers, etc.
  - Onset
  - Location of S+S
  - Worsens: Arm elevated positions, throwing, being on phone, turning head, sensitive to cold, sensitivity to clothing.
  - Alleviates: Resting arms, shoulder shrugs, heat, hot showers

Tests

No one test rules in or out.

- **Additional outside tests may be helpful (2)**
  - EMG, X-ray, MRI, Duplex ultrasonography, venography, arteriography, anesthetic injection
- I always start by ruling out cervical radiculopathy and peripheral nerve compression 1st. Pt may have some S+S with these tests, but it won't by a typical presentation.
  - Posture: pay close attention to head and scapular posture
  - Palpation: Pay attention to scalene, clavicle, pec's
  - Cervical ROM with over pressure > Cervical quadrants > Spurling's test > Arm abduction test
  - Dermatomal/myotomes and possible reflexes (good to rule out other possible neurologic conditions like MS). If odd presentation may need to do Babinski and cranial nerve tests.
  - Tinel's: Carpal tunnel, Cubital fossa, Cubital tunnel, Distal lateral forearm, Brachial plexus.
  - Phalen's tests: Palm together elbows out. Doral side of hands together elbows out.
  - ULNT tests: from my experience Ulnar is most provocative with TOS. Median seems to be most provocative with cervical issues.
  - UE ROM/MMT: assess mobility of Pec's, Lat's Ability to get arms flat in supine/snow angles
  - Scapular MMT: SA, MT, LT, UT are all very important in motor control with arm elevation.
  - BP differences in arms.

TOS tests

Roos: (7)

- The patient has both arms in the 90° abduction-external rotation position shoulders and elbows are in the frontal plane of the chest. Open and close hands for up to 3 min.
- Normal test is just fatigue.
- Possible TOS: Reproduction of primary S+S, Pain/N+T in arms/neck/shoulder.
  - If arterial: Pallor and reduced pulse with arm elevated and reactive hyperemia when arm is lower.
  - If venous: Cyanosis and swelling
- If carpal tunnel pain will be in medial hand
- If shoulder issues pain will be isolated to the shoulder
- Sensativity 84% Specifcity 30%

TOS tests

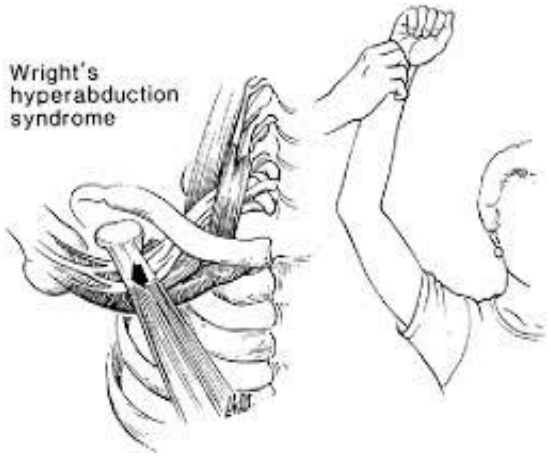
- **Cyriax release test (10)**
  - Pt in sitting with elbows bent to 90 resting in scaption.
  - Therapist than elevates the shoulder girdle at the elbows. Hold for 1-3 minutes.
  - Positive test: Is noted as a reproduction of N+T that will peak and than reduced. This is do to releasing pressure and the release phenomenon. Think coming back in from the cold. I've personally seen a reduction in S+S if the have resting S+S.
  - Specificity: 88% 3 min/97% 1 min (10)

TOS test

- **Adsons Test (8)**
  - A provocative test to increased or bring on symptoms of TOS caused by possible compression of the subclavian artery by a 1st rib or tight scalene.
  - Arm abd to 30 and maximal extension. Support trunk. Palpate for radial pulse. Have pt turn head toward extended arm and hold a deep breath. Hold for 30 seconds. Reduced pulse compared to opposite side is positive for vascular TOS. Neuro TOS might have increased N+T.
  - Sensitivity 79% specificity 74-100%. Other studies show high false +
  - With head turned away it is called Halstead.

TOS tests

- **Wright or Hyperabduction test**
  - Performed in sitting or supine. Arm is abducted to 90 with ER. Elbow is flexed no more than 45 degrees. Head in neutral
  - Hold for 1 min and monitor radial pulse.
  - Test is repeated at end range abduction.
  - Positive test is reduced radial pulse and/or reproduction of S+S.
  - Limited evidence to be used in isolation. (9)



TOS tests

- **Supraclavicular compression test**
  - Apply pressure over the scalene triangle at the superclavicular fossa compressing the brachial plexus and neurovascular bundle for 30 seconds.
  - Positive test would be reproduction in S+S. Not just tenderness in the area of compression.
  - Be mindful of the presents of a palpable mass.
  - May be positive with TOS and cervical radiculopathy.
  - I also squeeze the scalene muscles.

TOS tests

- **Clavicular depression test**
  - Place downward pressure at the mid point of the clavicle and hold for 30 seconds.
  - This reduces the space between the clavicle and 1st rib.
  - Positive test would be reproduction of S+S. Most notability distal S+S.
  - This test has not been studied.

TOS tests

- **Costoclavicular Test/Military Brace test**
  - Palpate radial pulse and draw shoulders/arms down and back into depression, extension and retraction as pt lifts crest. Performed in sitting or standing. Hold for 30-60 seconds.
  - Positive test is reduced radial pulse and or reproduction of S+S.
  - This will compress the neurovascular bundle between the 1st rib and clavicle.
  - Can be done unilaterally or bilaterally.
  - I like to do a similar test that involves scapular retraction and elevation to test pec minor interval.

TOS tests

- **Cervical rotation lateral flexion test**
  - To test for the presents of the 1st rib.
  - Head is rotated away from the side being tested to end range. Then laterally flexed to end range slowly.
  - Test is positive if lateral flexion is block or reduced on one side.
  - Might also reproduced S+S.

Differential Diagonsis

TOS has many conditions with overlapping symptoms. Pt may have 2 conditions that are feeding off one another. TOS+Neck pain and TOS+RTC pathologies are both common.

- **Neurological**
  - Cervical radiculopathy: Normally more related to neck positions, tends to have myotome/dermatomal distribution. Spurling's positive. Arm abduction test likely to reduce symptoms instead of increase.
  - Peripheral nerve entrapments: More provocative by specific ULNT tests, Follows myotome/dermatomal distribution. Test: Tinels +, Phalens +
  - Complex Regional Pain Syndrome: Tends to be more random and present even at rest. May follow surgery or trauma to nerves
  - Parsonage-Turner: Rare condition. More sudden onset of weakness in the arm followed by pain.
  - Early MS: sometimes starts as odd N+T with heaviness.
  - Raynaud's Syndrome: Raynaud's tends to be B and has a direct relation to cold exposure.
  - Double Crush injury: Pt's with peripheral nerve entrapments like carpal tunnel have 89% had cervical arthritis (12)

Differential Diagonsis

TOS has many conditions with overlapping symptoms. Pt may have 2 conditions that are feeding off one another. TOS+Neck pain and TOS+RTC pathologies are both common.

- **Musculoskeletal**
  - Shoulder pathology
    - RTC- more pain dominant and brough on with AROM and MMT
    - Impingement- more pain dominant and brought on by motion
  - Epicondalgia
    - More isolated to elbow and increased with resistance to wrist.
- **Vascular**
    - DVT
    - Paget-schrotter syndrome: Effort induce compression and thrombosis of subclavian vein due to repeated strenuous movement.
- **Red flags**
  - Cardiac issues (look for increase S+S with activity unrelated to involved UE)
  - Pancoast tumor or other space occupying lesion.

Treatments

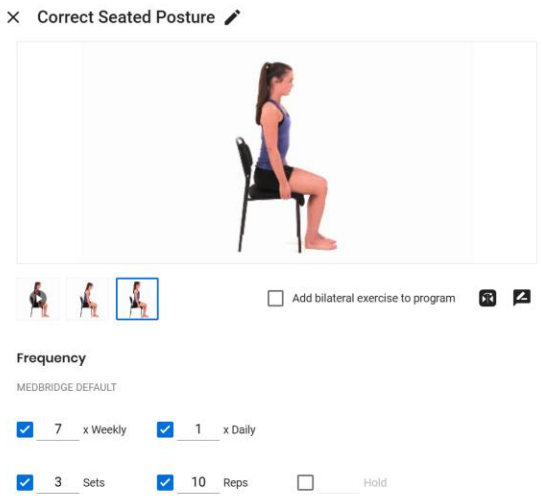
Medical treatments available

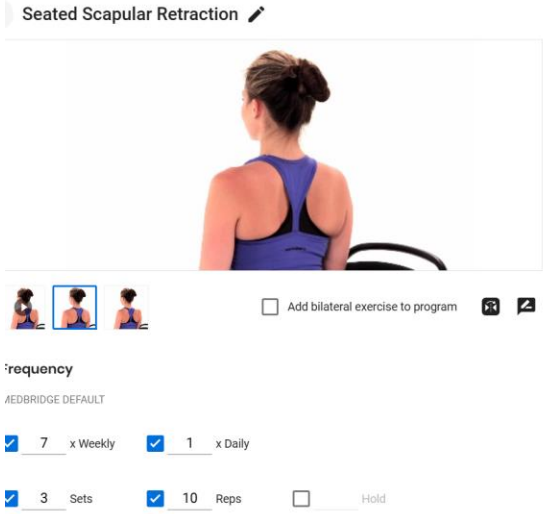
- **NSAID, cortisone injections, Botox, Neurontin.**
- **Surgical management:** Normally for pt that have failed conservative management for at least 6 months or for vascular TOS with clear cause of compression (12, 13)
  - 1st rib decompression: transaxillary, supraclavicular and infraclavicular have all shown success. (12)
  - Scalenectomy
  - Pec Minor release
  - Overall success rates are listed as high as 95%.
- **Spinal cord stimulator:** an implanted medical device that uses low-level electrical currents to interrupt pain signals before they reach the brain. It treats chronic, neuropathic pain in the back, legs, or arms, often reducing pain by 50% or more.

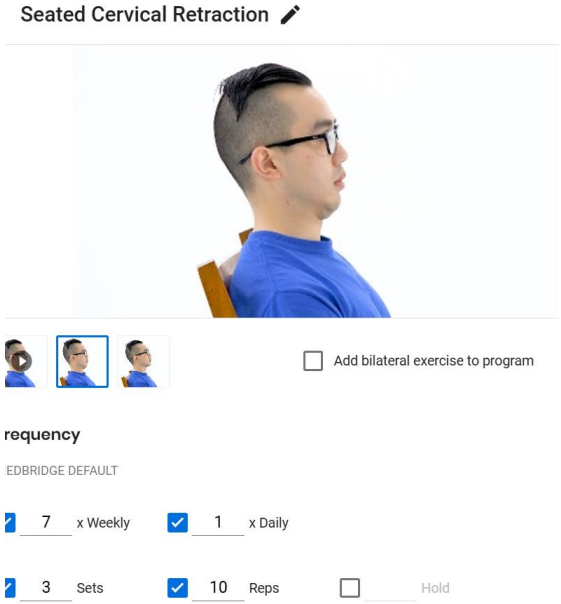
Treatments- Treat all 3 regions

- **Manual therapy:**
  - STM- focused on scalene, UT, Pec, SCM, Anterior neck musculature.
  - Joint mobilization- Cervical up glides, possible cervical manipulation, 1st rib mobilizations, thoracic mobilizations/manipulations.
- **Dry needling:** Scalenes, UT, LS, parascapular muscles
- **Nerve Glides:** Ulnar, median, radial
- **Stretching:**
  - Lats, pecs, scalenes, UT, STM
- **Therapeutic Exercises:** Focusing on maintaining scapular control.
  - MT, UT, LT, SA, cervical stabilizer muscles, RTC
- **Breathing and postural exercises/awareness.**
  - Working on reducing accessory breathing strategies.
  - Work on diaphragmatic breathing.
- **Taping and bracing.**

Treatments- Posture







Treatments- Breathing

Supine Diaphragmatic Breathing

Add bilateral exercise to program

Frequency

MEDBRIDGE DEFAULT

7 x Weekly 1 x Daily

3 Sets 10 Reps Hold

Add bilateral exercise to program

Frequency

MEDBRIDGE DEFAULT

7 x Weekly 1 x Daily

3 Sets 10 Reps Hold

Supine Deep Neck Flexor Training - Repetitions

Add bilateral exercise to program

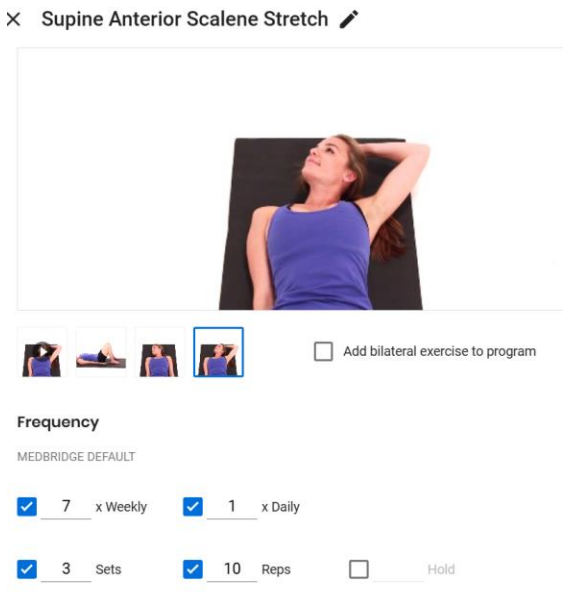
Frequency

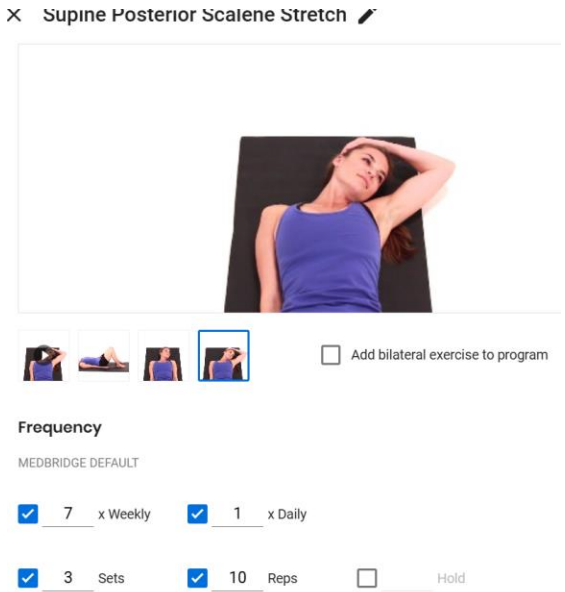
MEDBRIDGE DEFAULT

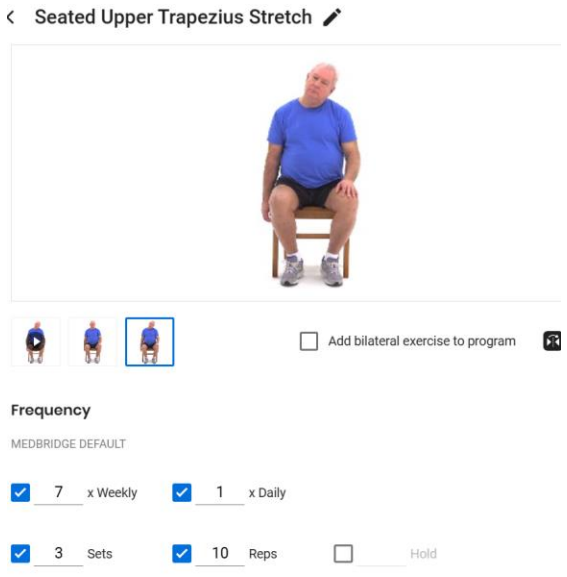
7 x Weekly 1 x Daily

3 Sets 10 Reps Hold

Treatments- Stretching







Treatments- Stretching

Doorway Pec Stretch at 90 Degrees Abduction

Add bilateral exercise to prograr

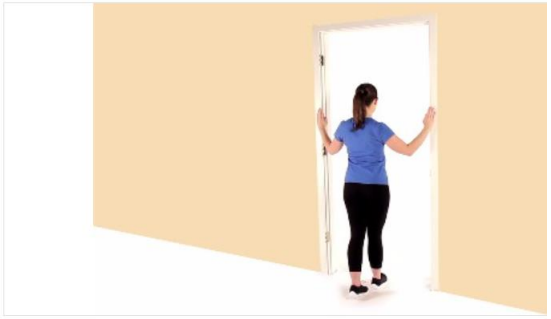
Frequency

MEDBRIDGE DEFAULT

7 x Weekly 1 x Daily

3 Sets 10 Reps Hold

Doorway Pec Stretch at 60 Elevation



Add bilateral exercise t

Frequency

MEDBRIDGE DEFAULT

7 x Weekly 1 x Daily

3 Sets 10 Reps Hold

Supine Thoracic Mobilization Towel Roll Vertical with Arm Stretch

Add bilateral exercise to program

Frequency

MEDBRIDGE DEFAULT

7 x Weekly 1 x Daily

3 Sets 10 Reps Hold

Treatments- Thoracic/cervical mobility

Supine Thoracic Mobilization Foam Roll Horizontal with Arm Stretch

Add bilateral exercise to program

Frequency

MEDBRIDGE DEFAULT

7 x Weekly 1 x Daily

3 Sets 10 Reps Hold

Supine Thoracic Mobilization Foam Roll Horizontal with Arm Stretch

Add bilateral exercise to program

Frequency

MEDBRIDGE DEFAULT

7 x Weekly 1 x Daily

3 Sets 10 Reps Hold

Seated Assisted Cervical Rotation with Towel

Add bilateral exercise to program

Frequency

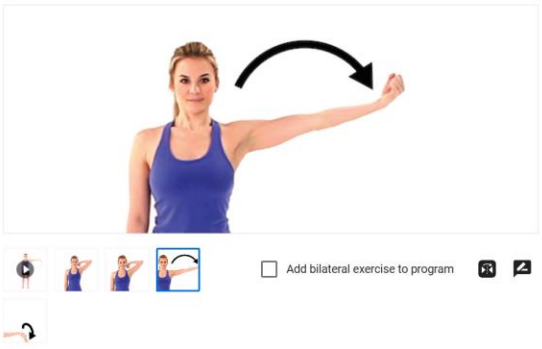
MEDBRIDGE DEFAULT

7 x Weekly 1 x Daily

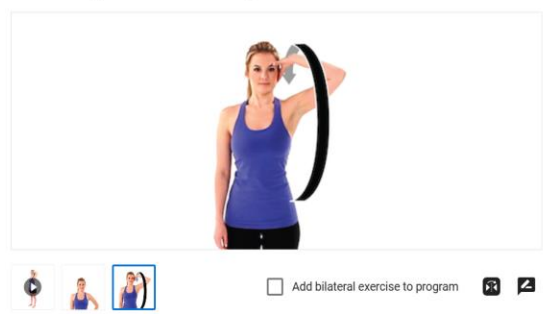
3 Sets 10 Reps Hold

Treatments- Nerve Mobility

Standing Median Nerve Glide

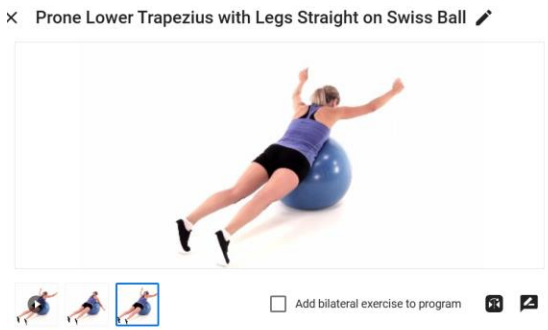


Standing Ulnar Nerve Glide

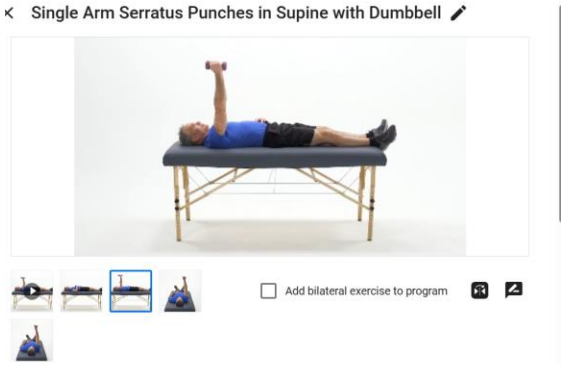


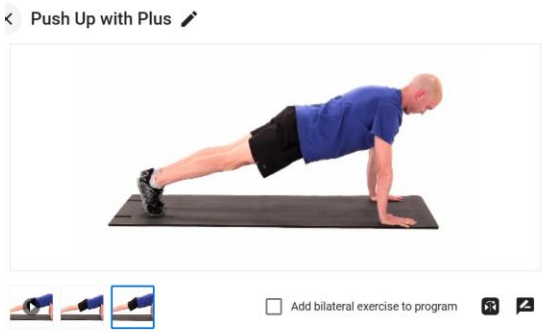
Standing Radial Nerve Glide

Treatments- Scapular/GH control

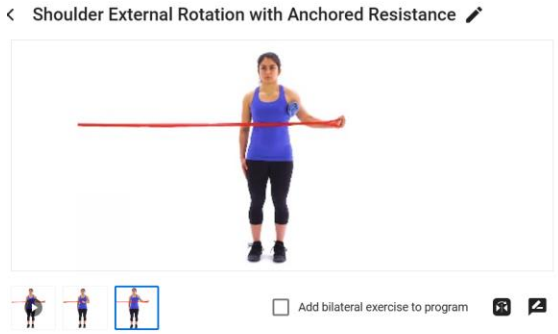


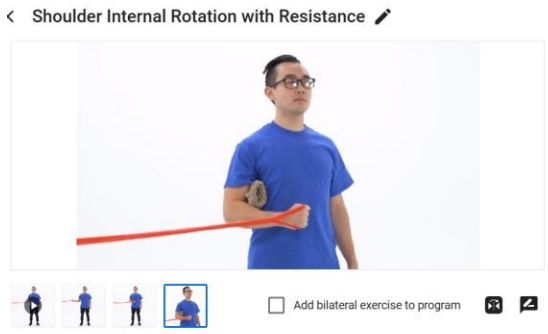
Treatments- Scapular/GH control



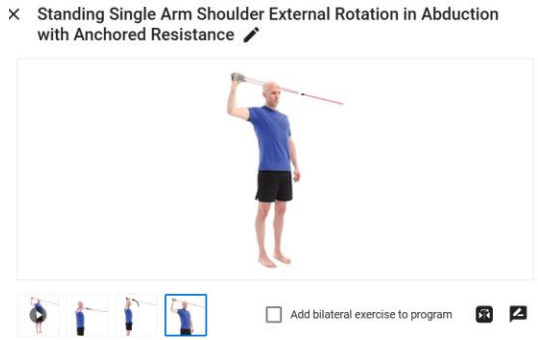


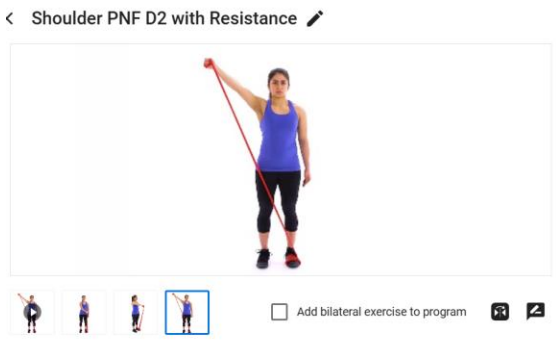
Treatments- Scapular/GH control





Treatments- Scapular/GH control





- Eventually progress to overhead lifting/reaching/throwing activities.

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Thank you

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