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Conservative Contracture Remediation for the Upper Extremity Series

Part 1 - Shoulder Complex

Ellie Pong DPT, MOTR/L

• This course series will explore conservative treatment combinations including modalities, Botulinum toxin injections, dynamic and static splinting, and hands-on soft tissue and joint mobilization for patients with soft tissue and joint contractures of the upper extremity. Neurological and orthopedic-caused contractures will be addressed separately.

• The series consists of three courses: The Shoulder Complex; The Elbow; and The Wrist and Hand.
Learner Outcomes

As a result of this course, participants will be able to:
1) ...identify the joint and soft tissue structures of the shoulder complex that are commonly problematic in neurological and orthopedic contractures
2) ...recognize in post-course testing, best combined use of conservative treatments including modalities, splinting, hands-on manual treatments, and Botulinum toxin injection guidance to treat patients with contractures of the shoulder complex.
3) ... discuss and later incorporate into the participant's daily practice, evidence-based conservative treatments as well as those pending clinical trials which have demonstrated successful use in the clinic for these impairments.

The Stiff Shoulder

- When considering treatments for a patient who has shoulder stiffness, a consideration of the tissue status is very important.
  - Normal tissue, non-fibrous or scarring, tightened from simple non-use.
  - Fibrous tissue from scar formed in normal healing process.
  - Fibrous tissue from burn scarring with superficial and deep tissue contracture.
  - Fibrous tissue from inflammatory and/or autoimmune/unknown tissue pathology.
  - Hypertonic contractile tissue with contracture of both muscle and tendon.
  - Hypotonic tissue with contracture due to gravity, muscle unable to maintain normal anatomical positioning.
The Stiff Shoulder

• Shoulder stiffness can be caused by pathologies requiring highly specialized treatments outside of the scope of this course, such as burn scarring, upper limb lymphedema, or pediatric upper limb dysfunction after brachial plexus birth injury.

• We will address more generalized causes today, with the additional specific inclusion of primary adhesive capsulitis.

The Stiff Shoulder

• Normal tissue, non-fibrous or scarring, tightened from simple non-use.
  – After breast reduction, the patient is not allowed to lift her arms above shoulder height or stretch out to the sides for weeks.
  – Many tissues are tightened as a result, especially the latissimus dorsi and pectoralis major.
  – The actual structures of the glenohumeral joint are not in a healing mode.
  – Stretching is not painful, although some discomfort may be present.
  – Joint mobilizations will be more general due to less-specific structural restrictions.
The Stiff Shoulder

- Fibrous tissue from scar formed in normal healing process.
  - After shoulder surgery such as rotator cuff repair, patient is restricted in active use of the shoulder.
  - Passive range is limited at first, gradually increasing.
  - Meanwhile, in the natural healing process, scar develops in the healing tissues.
  - Our stretching and mobilizations must not disrupt the repair, and they must avoid engendering an excessive scar healing response by their aggression. Specific techniques will address specific tissues.

The Stiff Shoulder

- Fibrous tissue from inflammatory and/or autoimmune/unknown tissue pathology.
  - In the shoulder, this occurs with idiopathic adhesive capsulitis.
  - Stages of pathology with resulting tissue differences must be considered.
  - We must avoid increasing the body’s reactivity and engendering a prolonged or exacerbated response to pain or tissue trauma.
The Stiff Shoulder

• Hypertonic contractile tissue with contracture of both muscle and tendon.
• Hypotonic tissue with contracture due to gravity, muscle unable to maintain normal anatomical positioning.
  – Now the situation is extremely complex. A myriad of relationships between hypertonic and hypotonic restrictions must be considered.
  – No matter what we do to the tissue, the tone will not permanently change to normal; therefore, there will always be likelihood of redevelopment of contracture.

Biomechanical Considerations

• Nearly thirty years ago, the factors necessary for normal shoulder complex movement were summarized, “The biomechanical analysis of the shoulder emphasizes the synchronized movement of four joints: glenohumeral, scapulothoracic, sternoclavicular, and acromioclavicular” (Donatelli & Greenfield, 1987, p. 118).
Biomechanical Considerations

• “As the humerus moves into elevation, movement must occur at all four joints. This joint movement has been described as the joint arthrokinematics, or the intricate movement of the joint surfaces” (Donatelli & Greenfield, 1987, p. 118).

Biomechanical Considerations

• “Normal arthrokinematic movements occur only in the presence of normal periarticular connective tissue, extensibility, and integrity and muscle function.
• A stiff shoulder has limited capsular flexibility and altered muscle function.
• In order to re-establish harmonious movement within the shoulder complex the therapist must rehabilitate the connective tissue by restoring its extensibility, and restore normal balance of muscles” (Donatelli & Greenfield, 1987, p. 118).
Biomechanical Considerations

• Indeed, in any contracture, there will be (at the very least) an imbalance of short, tight structures and lengthened, often weakened, structures.
• Pathological structures may be contractile and/or non-contractile.
• The very basics of the biomechanical alterations then lead us to a two part harmony of lengthening and strengthening to restore “normal” joint movement.

Biomechanical Considerations

• In contractures of the shoulder complex, we must consider alterations in all joints of the complex.
• At times it appears that treatments focus on the glenohumeral joint without regard for scapular movement alterations.
• Ludewig and Reynolds, 2009, identified scapular kinematics during arm elevation in healthy versus shoulder contracture states.
Biomechanical Considerations

| Scapular Kinematics During Arm Elevation in Healthy Versus Frozen Shoulder States |
|---------------------------------|---------------------------------|
| **Group**                       | **Healthy Shoulders**           | **Frozen Shoulders**          |
| Primary Scapular Motion         | Upward rotation                 | Greater upward rotation       |
| Secondary Scapular Motion       | Posterior tilting               | No consistent evidence for alteration |
| Accessory Scapular Motion       | Variable internal/external rotation | No consistent evidence for alteration |
| Possible Implications           | Maximize shoulder range of motion and available subacromial space | Presumed compensatory to minimize functional shoulder range-of-motion loss |

Table adapted from Ludewig and Reynolds (2009, p. 95)

Image adapted from Ludewig and Reynolds (2009, p. 91)
Biomechanical Considerations

• As we explore treatments for the stiff shoulder then, we must consider both the passive limitations (tightened tissue) and the dynamic limitations (muscle weakness, altered kinematics producing blocks to movement).
• Let us begin with a review of general shoulder contracture treatments.

General Shoulder Contracture Treatments

• Passive range of motion
• Joint Mobilizations
  – Glenohumeral, scapular, clavicular, and sternal
  – Including Mobilization with Movement
• Specific muscle stretching
  – Manual
  – Self, positional
• Soft tissue work
  – Myofascial release, cross-friction, massage
General Shoulder Contracture Treatments

- Strengthening of weak antagonists
  - May enhance with Functional Electric Stimulation
- Aquatic therapy for functional self-range
- Botulinum toxin focal injections to force relaxation, improving tolerance to splinting and stretching
- Dynamic and static splinting
  - Pros and cons, specific applications

General Shoulder Contracture Treatments

- At all times, remember that transfer of training is often poor.
- Remember human task motivation for functional activity versus lifting a free weight.
- Use functional activities and movements when possible.
General Shoulder Contracture Treatments

• A general order of treatment:
  – Physically warm the tissue
    • Exercise or moist heat
  – Long positional stretching
    • Relax tissues to full length potential
  – Soft tissue work, manual stretching
  – Joint mobilization
  – Functional activity, strengthening
  – Splinting at home, at rest

General Shoulder Contracture Treatments

• Physically warm the tissue
  – Exercise or moist heat
    • You want to avoid beginning the session with pain
    • If the patient is unable to perform a warming exercise, such as pulleys or UBE (arm bike) without pain, then moist heat is a better choice.
    • If using moist heat, position the patient comfortably
      – Supine, bolster under knees, pillow under head but not shoulders, towel pad under end of humerus, lower arm resting on stomach
      – If sitting, prop arm on a pillow, don’t just hang the hot pack from the shoulder with the arm dangling
General Shoulder Contracture Treatments

• Long positional stretching
  – Relax tissues to full length potential
  – These will of course depend upon the area of restriction and the patient’s position tolerance.
    • Prone, propped on elbows (posterior capsule)
    • Supine, propped on elbows (anterior capsule)
    • Sidelying on affected arm, arm at 90 degrees abduction, roll towards outstretched hand (use pillow under head)
    • Supine flat abduction stretch “reverse snow angel”

General Shoulder Contracture Treatments

• Soft tissue work, manual stretching
  – Many techniques are available, some can be very painful
  – Consider carefully the role that increased pain may play in increasing muscle tension, patient guarding, inability to reach true end range
  – A deep comfortable massage of the muscles that is not painful appears to engender both tissue and subjective relaxation.
General Shoulder Contracture Treatments

• Passive range of motion and stretch techniques
  – We learned them in therapy school, regardless of the specific program.
• In the clinic I frequently see three problems in passive GH range:
  – Impingement positioning for abduction
  – Lack of stabilization of the scapula during abduction
  – Lack of stabilization during internal rotation

General Shoulder Contracture Treatments

• Impingement positioning for abduction

Therapist elevates shoulder into abduction by pulling distal humerus with elbow flexed; meanwhile, forearm drops, pulling shoulder into internal rotation. Try it on yourself...ouch!
General Shoulder Contracture Treatments

- Lack of stabilization of the scapula during abduction

In this image, the therapist has his forearm scooped under the scapula as though using it to provide stabilization, but see the lateral edge of the scapula rotating with abduction of the glenohumeral joint; a better stabilization would be the palm or hand of the therapist alongside the lateral scapular border.

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General Shoulder Contracture Treatments

- Lack of stabilization during internal rotation

As the therapist moves the stiff shoulder into internal rotation, the glenoid/acromion/scapula will follow the humerus by projecting anteriorly. If the therapist wishes to use the same arm elbow to prevent this, the elbow cannot rest on the proximal humerus. It must rest against the acromion.
General Shoulder Contracture Treatments

- Common glenohumeral mobilizations (Hertling & Kessler, 2006)
  - Inferior glide
    - Facilitates abduction and flexion of the GH joint
  - Posterior glide
    - Facilitates IR, flexion, and horizontal adduction of the GH joint
  - Anterior glide
    - Facilitates ER, extension, and horizontal abduction of the GH joint
  - Distraction (lateral glide)
    - Reportedly facilitates all planes of movement of the GH joint.

General Shoulder Contracture Treatments

- Common scapular mobilizations (Hertling & Kessler, 2006)
  - Inferior glide
    - Facilitates depression and medial rotation of the scapula
  - Superior glide
    - Facilitates elevation and lateral rotation of the scapula
  - Medial glide
    - Facilitates retraction, depression, and medial rotation of the scapula
  - Lateral glide
    - Facilitates protraction, elevation, and lateral rotation of the scapula
General Shoulder Contracture Treatments

• Mobilization with Movement of the Shoulder Complex
  – Developed in the early 2000’s by Brian Mulligan (other MWM techniques were developed earlier)
  – As these techniques are numerous and fairly complex, I would like to provide resources for learning:

  Brian Mulligan, Shoulder Girdle Techniques 2013. YouTube Video: https://youtu.be/xsZvpiKwi3g


General Shoulder Contracture Treatments

• Mobilization with Movement of the Shoulder Complex
  – Additional resources for learning:


  Shoulder MWMS - Mulligan Technique. YouTube Video. https://youtu.be/1_5EKqJNimc

General Shoulder Contracture Treatments

• Mobilization with Movement of the Shoulder Complex
  – Specific shoulder MWM to treat shoulder contracture was described by Yang et al., 2007:
  – “With the subject in a relaxed sitting position, a belt was placed around the head of the humerus to glide the humerus head appropriately, as the therapist’s hand was used over the appropriate aspect of the head of the humerus. A counter pressure also was applied to the scapula with the therapist’s other hand. The glide was sustained during slow active shoulder movements to the end of the pain-free range and released after return to the starting position. Three sets of 10 repetitions were applied, with 1 minute between sets” (p. 1309).

General Shoulder Contracture Treatments

• Mobilization with Movement of the Shoulder Complex

This image varies from the previous movement description in the placement of the therapist’s right hand. In the previous movement, the hand was placed over the appropriate aspect of the head of the humerus. In this image, the hand is assisting the patient to perform elevation. The belt position and therapist’s stabilizing hand on the patient’s scapula are the same.

Image adapted from Hing, Miller & Fernández-de-las-Peñas, 2016, p. 354.
General Shoulder Contracture Treatments

- Mobilization with Movement of the Shoulder Complex Guidelines *(direct quotation)* (Mulligan, 2003, p. 140)
  - They must never produce pain.
  - They must produce an immediate beneficial effect (e.g. a painfree increase in range of movement).
  - With all ‘MWM’ techniques overpressure must be applied without pain to ensure their success.
  - Repetitions are considered necessary. For the extremities my suggestion is three sets of ten.
  - There must be some lasting improvement. If between visits the symptoms return, ‘MWM’ treatment may be discontinued. However the therapist should first ensure that the patient has followed advice including self-treat recommendations where applicable.

Specific Shoulder Contracture Treatments

- Now we will move from a more general discussion of shoulder contractures to one that is very unique and specific, primary adhesive capsulitis.
Idopathic Adhesive Capsulitis

• Also called “Frozen Shoulder”
• Primary or idiopathic is not the same as secondary, due to scar following shoulder surgery
• Pathology between the two varies
• Course of treatment varies due to disease process of idiopathic adhesive capsulitis (IAC)

Idopathic Adhesive Capsulitis

• Predisposing factors:
  – Age (increased)
  – Minor injuries with no observable damage to the glenohumeral joint
  – Non-shoulder surgery (ie. Cervical, thoracic, sternal)
  – Thyroid disorders
  – Diabetes mellitus
  – Cardiac and pulmonary disease
(Bron, de Gast & Franssen, 2016)
Idopathic Adhesive Capsulitis

• Is IAC inflammatory?
  – Even yet the pathological process is debated.
  – “Arthroscopy shows a hyperaemic and swollen synovial membrane. The recent discovery of several cytokines in the joint capsule...supports the inflammation theory” (Bron, de Gast & Franssen, 2016, p. 345).
  – “The synovial reaction...eventually leads to fibrosis of the underlying layer of the glenohumeral capsule (fibrous membrane)” (Bron, de Gast & Franssen, 2016, p. 345).

Idopathic Adhesive Capsulitis

• Is IAC inflammatory (cont)?
  Especially in the area of the coracohumeral ligament (CHL) and the rotator cuff interval, scar formation and contracture formation are initiated by the expression of vimentin (a cytocontractile protein that is usually seen in fibromyocytes), while in the entire joint capsule there is fibroplasia (thickening of the joint capsule) but without contraction.
  (Bron, de Gast & Franssen, 2016, p. 345).
Idopathic Adhesive Capsulitis

• Natural Stages
  – Freezing, synovitis
    • 3-9 months
  – Frozen
    • 4-12 months
  – Thawing
    • 12-42 months

(Bron, de Gast & Franssen, 2016, p. 346).

Idopathic Adhesive Capsulitis

• Treatment – Depends on the Stage
  – Pre-freezing/Freezing – alleviate patient’s pain
    • Corticosteroid injections, NSAIDs, trigger point dry needling
    • No exercises or glenohumeral mobilizations because they increase pain and are thought to increase or prolong the inflammatory phase and possibly resulting fibrosis.

(Bron, de Gast & Franssen, 2016).
Idopathic Adhesive Capsulitis

• Treatment – Depends on the Stage
  – Frozen – many different treatment options supported/not supported
    • Gentle mobilization glenohumeral posterior glide to increase external rotation (Noten, et al., 2015).
    • Positional stretching of the coracohumeral ligament (Ruiz, 2009).
    • Dynamic splinting at home (Gaspar & Willis, 2009).
Idopathic Adhesive Capsulitis

• Treatment – Depends on the Stage
• Frozen – Prediction Rule for posterior GH glides with scapular mobilization:
  – “End-range intensive grade IV anterior-posterior mobilization techniques combined with scapula superior/inferior and upward/downward mobilization techniques can be advocated in subjects with FSS who have less than 8 degrees of scapular posterior tipping, 97 degrees of humeral elevation, and 39 degrees of humeral external rotation during arm elevation” (Yang et al., 2012, p. 52).

Idopathic Adhesive Capsulitis

• Treatment – Frozen – Positional stretch of the coracohumeral ligament (Ruiz, 2009):
  • The patient lies on the unaffected side, with a pillow placed under the head to align it with the body.
  • The affected arm rests along the side of the body (this side is uppermost).

Image by Author
Idopathic Adhesive Capsulitis

• Treatment – Frozen – Positional stretch of the coracohumeral ligament (Ruiz, 2009):
  – The patient grasps a 2 foot dowel (can be sawed off straight cane) with the hand of the affected arm, keeping the arm in supination to ensure shoulder external rotation and a taut position of the coracohumeral ligament.
  – The patient will place one end of the dowel on the table/bed behind the body, placing the shoulder in about 10 degrees of hyperextension.

Idopathic Adhesive Capsulitis

• Treatment – Frozen – Positional stretch of the coracohumeral ligament (Ruiz, 2009):
  – By sliding his or her hand down the dowel, the shoulder will be placed into adduction to tolerance.
  – Compensatory posterior trunk rotation must be avoided.
  – Typically this position is held 15 minutes, with the patient working up to this from an initial 5 minutes at end range.
Idopathic Adhesive Capsulitis

• Treatment – Frozen – Dynamic Splinting
  – Gaspard and Willis (2009) reported that patients receiving physical therapy augmented with dynamic splint use at home demonstrated greatest improvement in AROM external rotation.
  • Comparison groups were control, dynamic splinting only, and physical therapy only.
  • The dynamic splinting consisted of 90 hours of end-range stretching over a period of 90 days.
Idopathic Adhesive Capsulitis

- Treatment – Frozen – Dynamic Splinting
- Let us discuss some common errors in utilization of dynamic splinting.
  - Contracture must be not due to bony block.
  - Relaxation of the tissue in a lengthened position must be present for “creep” to occur.
  - This cannot be achieved if the splint pressure is too great as to produce pain.
    - Tissue will simply become painful and reactive, so the patient will carry it in shortened position defensively.

Idopathic Adhesive Capsulitis

- Treatment – Thawing
  - This is a natural event in the course of recovery
  - Gentle mobilization may be used but is thought to offer little added benefit
  - Using the arm in functional, daily activities is recommended

(Bron, de Gast & Franssen, 2016)
Idopathic Adhesive Capsulitis

• Treatment – Not Waiting For Thawing
  – At times the patient and/or physician does not want to wait for the natural course of thawing, and may prefer these treatment options (Bron, de Gast & Franssen, 2016):
    • Manipulation under anesthesia
    • Hydrodilation
    • Arthroscopic capsular release
    • Interventional microadhesiolysis (Ahn et al., 2008)

• Treatment – Not Waiting For Thawing
  – Manipulation under anesthesia: “…a general anaesthetic is administered and the shoulder joint capsule is gently stretched by moving the humerus into flexion, abduction and finally (optionally) by moving the adducted humerus into external rotation” (Uppal, Evans & Smith, 2015, p. 265).
    • Risks of iatrogenic damage including humeral or glenoid fracture, rotator cuff tears, glenohumeral dislocation, brachial plexus injuries, labral tears and haematomas (Uppal, Evans & Smith, 2015).
Idopathic Adhesive Capsulitis

• Treatment – Not Waiting For Thawing
  – Manipulation under anesthesia: “It has been demonstrated in post manipulation arthroscopy[26] that the typical appearances are of haemarthrosis and capsular tearing but other lesions often seen include iatrogenic superior labral anterior posterior tears, partial subscapularis ruptures and rupture of the anterior labrum” (Uppal, Evans & Smith, 2015, p. 265).
  – What percentage of motion gained is maintained?

Idopathic Adhesive Capsulitis

• Treatment – Not Waiting For Thawing
  – Hydrodilation: “...the injection of local anaesthetic into the capsule at a pressure high enough to distend and stretch the joint capsule” (Uppal, Evans & Smith, 2015, p. 266).
    • Has also been performed with saline with or without corticosteroids (Bron, de Gast & Franssen, 2016).
    • Beneficial in the short term (Uppal, Evans & Smith, 2015).
    • Beneficial compared to manipulation under anesthesia (Quraishi et al., 2007).
    • Poorly tolerated due to pain with procedure (Bron, de Gast & Franssen, 2016).
Idopathic Adhesive Capsulitis

• Treatment – Not Waiting For Thawing
  • Arthroscopic capsular release: “Standard posterior and anterior portals are made, a diagnostic arthroscopy is performed to confirm the diagnosis and a synovectomy of the rotator interval is performed. The capsular release starts with excision of the rotator interval to the under surface of the conjoint tendon, the release is extended inferiorly posterior to the tendon of subscapularis down to the five o’clock position” (Uppal, Evans & Smith, 2015, p. 264).

Idopathic Adhesive Capsulitis

• Treatment – Not Waiting For Thawing
  • Arthroscopic capsular release (cont): “Some surgeons advocate release of the superior edge of subscapularis[15], though this is highly controversial. The superior release is then extended to reach the long head of biceps and is continued to release the coracohumeral ligament in the plane between the superior glenoid and supraspinatus. If internal rotation of the shoulder is significantly restricted then the camera portal can be reversed to facilitate a posterior capsular release” (Uppal, Evans & Smith, 2015, p. 264).
Idopathic Adhesive Capsulitis

• Treatment – Not Waiting For Thawing

  • Arthroscopic capsular release (cont): “Some surgeons complete the inferior release with a gentle manipulation but some surgeons advocate a full 360 degree capsulectomy under direct vision whilst accepting the higher risk of iatrogenic injury the axillary nerve[14]” (Uppal, Evans & Smith, 2015, p. 264).

  • Both early and long-term improvements are reported. “These improvements were maintained and/or enhanced at seven years. In contrast to results reported for nonoperative treatment, shoulder range of motion at seven years was equivalent to that in the contralateral shoulder” (Le Lievre & Murrell, 2012, p. 1208).

Idopathic Adhesive Capsulitis

• Treatment – Not Waiting For Thawing

  – Intervenotional microadhesiolysis: Special needles are used in three approaches to perform the following releases (Ahn et al, 2008):
    • subacromial release (the round needle)
    • posteroinferior capsule release (the flexed round needle)
    • subcoracoid release (Ahn’s needle)
Idopathic Adhesive Capsulitis

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NEEDLES USED: (Ahn et al., 2008, p. 3 of 8 in pdf)
Idopathic Adhesive Capsulitis

SUBACROMIAL RELEASE with round needle:
(Ahn et al, 2008, p. 3 of 8 in pdf)

*note: image cropped to omit ultrasound pictures

Idopathic Adhesive Capsulitis

POSTERO-INFERIOR CAPSULE RELEASE with flexed round needle:
(Ahn et al, 2008, p. 4 of 8 in pdf)
Idopathic Adhesive Capsulitis

SUBCORACOID RELEASE with Ahn’s needle:

(Ahn et al, 2008, p. 4 of 8 in pdf)

*note: additional images in this series are omitted

Idopathic Adhesive Capsulitis

- Treatment – Not Waiting For Thawing
- Interventional microadhesiolysis: Outcome measures of pain, range of motion, and joint effusion were reported as improved versus their original status.
  - A new treatment, long-term outcomes have not been assessed.
  - This study was a case report series, number of participants was 10.
Idopathic Adhesive Capsulitis

• Treatment – Not Waiting For Thawing
• In each of the invasive treatments we just discussed, therapy will have a follow-up role.
• In each case, our primary role is to maintain or even improve the gains achieved by the surgeon.
  — Not always possible.
• Now we have potential for both primary and secondary adhesive capsulitis due to trauma on top of pathology.

Idopathic Adhesive Capsulitis

• Treatment – Not Waiting For Thawing
• It is still the best choice to adhere to limitations based on stage of the pathology in regard to treatment choice and level of aggression.
• Additionally, even if the patient had reached the frozen stage, an invasive procedure will set off a healing response which could be affected poorly by increased pain and tissue trauma during therapy.
• Careful decisions here are critical.
Neurological Shoulder Contractures

• Now we will discuss treatment options for shoulder contractures caused by a neurological pathology.

Neurological Shoulder Contractures

• Problem:
  – Hypertonic muscles prevent effective stretching in a relaxed, fully lengthened position of the muscle fibers.
  – Interventions, whether surgical lengthening or sessions of botox, stretching of the hypertonic agonist and strengthening of the weak antagonists, yield temporary results.
  – The cause of the problem, in the brain, remains...and will continue to re-shorten the tissue.
Neurological Shoulder Contractures

• Does this mean that we should not try to intervene, because we know it will be only temporary?
  – No. But we do need to make it clear to the patient and/or caregivers that what we provide will most often be temporary improvement, and may be repeated.
  – Quality of life is the benefit here, whether for active use of the arm, or for ease to the caregiver and patient in dressing and other assisted or dependent activities of daily living (Lam et al., 2012).

Neurological Shoulder Contractures

• Distinguish between the function of the extremity and the function of the individual.
  – We think of active function and passive function of the extremity. These terms refer to the expected outcomes for a limb but do not indicate the outcome for the person as a whole. Surgical releases of an arm contracted in a flexed and internally rotated position in a hemiplegic patient often allows the person to become independent in dressing even though the arm itself remains nonfunctional” (Keenan & Mehta, 2004, p. 144).
Neurological Shoulder Contractures

• Treatment of patients with contractures of the shoulder complex due to neurological causes may include stretching and strengthening enhanced by dynamic splinting and botulinum toxin injection.

Neurological Shoulder Contractures

• Currently, large double-blind, randomised, placebo-controlled studies are focused on proving that the use of botox in the upper extremity for the neurologically impaired patient population is safe (Gracies et al., 2015).

• Studies have also explored the use of botulinum for pain reduction in painful shoulder syndromes (Singh & Fitzgerald, 2010; Wu et al., 2015).
Neurological Shoulder Contractures

• Studies have investigated combined rehabilitation therapies post-injection with botulinum toxin.
• There is a lack of studies featuring injections and therapies specific to the shoulder, especially regarding neurological contractures of the shoulder. (Kinnear et al., 2012)

Neurological Shoulder Contractures

• Reasons to consider:
  – As of 2013, the only upper extremity muscles approved in the United States (US) for onabotulinumtoxinA (one of four botulinum products approved for use in the US) injection were the biceps brachii and specific finger and wrist flexors.
  – Studies may report on only specific botulinum products.
### Neurological Shoulder Contractures

<table>
<thead>
<tr>
<th>Muscles</th>
<th>All studies (44 studies, 58 treatment arms)</th>
<th>Studies reporting number of patients injected (33 studies, 46 treatment arms)</th>
<th>Studies reporting mean dose (36 studies, 39 treatment arms)</th>
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<td>Dose range (U)</td>
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<td>Shoulder</td>
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</tr>
<tr>
<td>Triceps</td>
<td>2</td>
<td>2</td>
<td>60</td>
</tr>
<tr>
<td>Triceps brachii</td>
<td>5</td>
<td>6</td>
<td>50–400</td>
</tr>
</tbody>
</table>

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Citation: (Nalysnyk et al., 2013, p. 5 of 11 in pdf)
Neurological Shoulder Contractures

• Considerations:
  – For dynamic splinting and manual stretching to be effective, the tissues must be able to attain a fully lengthened position, or a true end range.
  – The muscle must be relaxed to achieve this.
  – Careful and selective use of botulinum toxin can assist to provide a temporarily relaxed muscle.

Neurological Shoulder Contractures

• In my clinical experience, the effects of botulinum toxin take a few days to a week to reveal themselves, and these effects will usually last up to three months.
• In some individuals whose bodies create antibodies to the toxin, effects may not last as long.
• Special care is taken with amount of toxin injected (mouse units) to prevent this.
Neurological Shoulder Contractures

• Caution: “In a neurologically impaired patient it is frequently difficult to distinguish between the many potential causes of limited joint motion” (Keenan & Mehta, 2004, p. 149).
  – “…increased muscle tone, a myostatic contracture, the presence of periarticular HO, an undetected fracture or dislocation, joint subluxation, pain, or the lack of patient cooperation secondary to diminished cognition” (Keenan & Mehta, 2004, p. 149).

Neurological Shoulder Contractures

• Consider this patient: neurological contracture of the shoulder due to stroke, at two years post-CVA.
  – Shoulder is pulled into internal rotation and adduction. Significant weakness of external rotators.
  – Careful palpation reveals sternal fibers of the pec major as the main contributor to this position, although other muscles are also tight and hypertonic.
    • Why palpation? Most patients with neurologically impaired shoulders cannot achieve the standard test position.
Neurological Shoulder Contractures

• The patient’s functional goals were considered.
  – He wanted to be able to abduct his shoulder to offer his daughter his arm as he escorted her down the aisle at her wedding.
  – Sternal fibers of affected side pectoralis major were injected with botulinum toxin.
  – After one week from injection, occupational therapy altered previous care to focus on his shoulder goals and botulinum treatment.

Neurological Shoulder Contractures

• Outline of therapy
  – Superficial heat to affected pectoralis major and shoulder.
    • Why superficial heat rather than an active muscle warm-up?
  – Positional stretch supine of shoulder complex internal rotators.
  – Manual clinical massage of pectoralis major and manual stretching.
  – Functional Electric Stimulation on dual channels of supraspinatus/middle deltoid and infraspinatus/posterior deltoid combined with functional reaching task exercises.
Neurological Shoulder Contractures

• Positional stretch supine of shoulder complex internal rotators.

  Image by Author

  • Arm relaxes and stays in place with bolster while feet and hips are moved to rest in opposite direction. Stretch is 10 minutes.

Neurological Shoulder Contractures

• Manual clinical massage of pectoralis major and manual stretching.
  – Why no glenohumeral joint mobilizations?
  – When the rotator cuff is imbalanced by a hypertonic and tight antagonist muscle(s), subluxation of the glenohumeral joint is often present. If we follow the logic that the patient who lacks glenohumeral external rotation will benefit from anterior and/or posterior glides and/or distraction, the results may be a worsened subluxation due to a stretched capsule lacking dynamic support.
Neurological Shoulder Contractures

• Manual clinical massage of pectoralis major and manual stretching.
  – What is clinical massage?
  – Myofascial release is included as a clinical massage technique.
  – Myofascial release has been defined to include: “...three techniques used in craniosacral therapy (compression – static, listening to and following the craniosacral rhythm, still point), in addition to cross-fiber friction, deep gliding, holding, J-stroke, manual stretching, traction, skin rolling, rocking, jostling, shaking and vibration” (Sherman et al., 2006, p. 4 of 7 in pdf).

Neurological Shoulder Contractures

• Manual clinical massage of pectoralis major and manual stretching.
  – As I do not perform craniosacral therapy (compression – static, listening to and following the craniosacral rhythm, still point), I limited my tissue work to cross-fiber friction, deep gliding, holding, and manual stretching...not strictly meeting the previous definition of myofascial release. This, I termed “clinical massage.”
Neurological Shoulder Contractures

• Considerations for clinical massage and manual stretching of hypertonic tissue:
  – Tissue response to pain is increased spasticity or shortening.
  – Tissue response to fast movement or abrupt stimulation is increased spasticity of shortening.
  – SLOW movements, NEVER to the point of pain.
  – In manual stretching, standard techniques may be inappropriate due to bony block/altered joint mechanics. More hands-on tissue work may be needed.

Neurological Shoulder Contractures

– Is there supporting evidence for massage or manual tissue myofascial release of muscles in the stiff shoulder?
– Although the study has significant limitations, and application is not specific to the neurological stiff shoulder, Yang and associates (2012) reported that “…massage was an effective treatment for patients with posterior shoulder tightness, but was less effective in patients with longer duration of symptoms, higher functional limitation, and less posterior deltoid tightness” (p. 1 of 8 in pdf).
Neurological Shoulder Contractures

– Functional Electric Stimulation (FES) on dual channels of supraspinatus/middle deltoid and infraspinatus/posterior deltoid combined with functional reaching task exercises.

– Exercise: Repetitive practice of patient offering his arm to his “daughter” (therapist).

– Movement initiated with abduction and external rotation, then refined with slight extension and external rotation.

Neurological Shoulder Contractures

– Approximate FES pad placement: note channel arrangement is different than what I used.

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Citation:
(Alon, 2013, p. 6 of 9 in pdf)
Neurological Shoulder Contractures

– Channel arrangement that I used:

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(Alon, 2013, p. 6 of 9 in pdf)

Note: Original image has been altered to show alternative channel settings.

Neurological Shoulder Contractures

– Movement:

• Initiated with abduction and external rotation, Channel 1 ON
• Then refined with slight extension and external rotation, Channel 2 ON
• Pause, then Channel 1 OFF with Channel 2 remaining ON
• Pause, then Channel 2 OFF
• RELAX ARM
• REST
Neurological Shoulder Contractures

• Considerations for FES with neurological muscle weakness:
  – Time needed for full contraction of muscle is longer
  – Time needed for full muscle relaxation is longer
  – Fatigue is earlier
  – Therefore, longer ramp times are needed with longer rest times in between and fewer repetitions before lengthy rest period.

Neurological Shoulder Contractures

• NOTE: Although the resting position of the arm would be at side, internal rotation, the patient required the ability to abduct, externally rotate and slightly extend the shoulder to initiate the “offering arm” movement.

Image by Author
Neurological Shoulder Contractures

– Is there supportive evidence for use of FES on the shoulder to treat neurological shoulder contractures?
– Meadmore and associates (2014) have demonstrated positive results in the application of FES to three muscle groups in the upper limb, including shoulder, to complete goal-oriented movements to facilitate functional motor recovery post-stroke.

Neurological Shoulder Contractures

– Supportive evidence for use of FES to treat neurological shoulder contractures?
– Maciejasz and associates (2014) reported in a review that “FES significantly reduces the weight of the device. From a therapeutic point of view, FES allows patients to exercise muscles, improving muscle bulk and strength and preventing muscular atrophy [161]” (p. 17 of 29 in pdf).
Neurological Shoulder Contractures

— Supportive evidence for use of FES to treat neurological shoulder contractures?
  • “However, FES may cause strong involuntary muscle contractions and can be painful for patient” (Maciejasz et al., 2014p. 17 of 29 in pdf).

Neurological Shoulder Contractures

— Supportive evidence for use of FES to treat neurological shoulder contractures?
  • “Furthermore, it is difficult to control movements using FES because of the non-linear force characteristic of contracting muscles, muscles fatigue and dependency of the achieved contraction on the quality of the contact between stimulating electrodes and the body tissue” (Maciejasz et al., 2014p. 17 of 29 in pdf).
Neurological Shoulder Contractures

• What about the dynamic splinting?
  – In the patient’s case I just discussed, dynamic splinting was not utilized.
  – My concern with using shoulder dynamic splints is that many other tissues in the arm will also be hypertonic or inhibited, and the splint encompasses most of the arm.
  – I find the use of dynamic splints more reasonable for neurological contractures of the wrist and hand, as less of the total arm is restrained by the device.

• When dynamic splinting is requested, I highly recommend initiating the device at least a week after botulinum toxin injection into the most hypertonic muscles.
• If the muscles being stretched by the splint continue to evidence increased tone, the stretch will resemble a wrestling event than the creep phenomena at work.
Neurological Shoulder Contractures

• What about other presentations? What about spastic shoulder abduction or other patterns?

• The strategy is the same:
  – Identify the major players restricting functional use of the shoulder and arm.
  – Target these muscles with your lengthening and relaxing treatments as we just discussed.
  – Strengthen the weak antagonists.
  – Be respectful of bony or painful joint limitations.
  – Recognize that function does not require a standardized “full” range of motion.

Summary

• We have more tools now than ever before to treat contractures of the shoulder, regardless of the cause or type.

• This course has explored general shoulder contracture treatment as well as treatment for contractures due to adhesive capsulitis and neurological pathology.

• In each case, important considerations are the state of the tissue, limitations imposed by the causative pathology, and each patient’s personal goals for functional use of his/her arm.
Learner Outcomes

As a result of this course, participants will be able to:
1) ...identify the joint and soft tissue structures of the shoulder complex that are commonly problematic in neurological and orthopedic contractures
2) ...recognize in post-course testing, best combined use of conservative treatments including modalities, splinting, hands-on manual treatments, and Botulinum toxin injection guidance to treat patients with contractures of the shoulder complex.
3) ... discuss and later incorporate into the participant's daily practice, evidence-based conservative treatments as well as those pending clinical trials which have demonstrated successful use in the clinic for these impairments.

References


References


References


Questions and Answers:

Point of Contact:
Please feel free to email me with any additional questions or discussion of this course. Thank you for your time and attention!

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