Evaluation and Treatment of the Shoulder Girdle of Aerial Artists

From a Movement Systems Perspective

THE ACADEMY OF HAND & UPPER EXTREMITY PHYSICAL THERAPY

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THE ACADEMY OF HAND & UPPER EXTREMITY PHYSICAL THERAPY

2020 is the **35th** anniversary

Academy of Hand and Upper Extremity Physical Therapy

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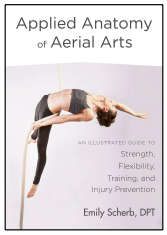
Disclosures:

Author of Applied Anatomy of Aerial Arts
Published by North Atlantic Books 2018



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Objectives

- Identify why learning about circus artists is important now.
- Discover the concepts of the Movement System Impairment (MSI) Syndromes through a brief overview of the upper quarter with a focus on the scapula and humerus.
- Recognize and assess common movements in aerial in relationship to the shoulder
- Illustrate MSI Syndromes using patient cases of aerial artists for evaluation and treatment

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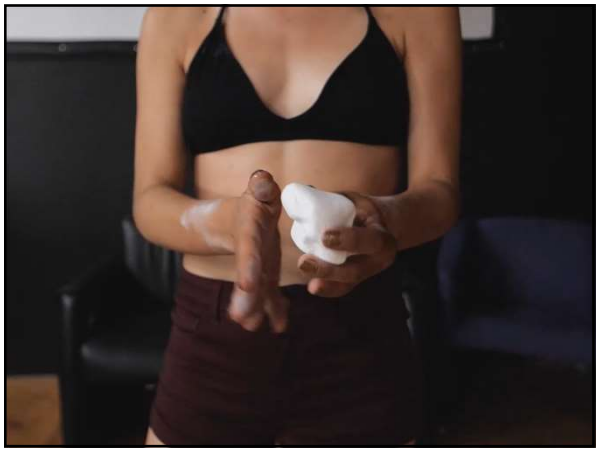

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Aerial Arts in the United States

- Professional Performers
- Professional Vocational Training
- Pre-professional Programs
- Competitions and Festivals
- Social circus / Accessible circus
- Recreational
- National Organizations

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PROFESSIONAL PERFORMERS

- **Traditional**
- **Contemporary**
- **Event / Corporate / Nightclub**

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VOCATIONAL AND PRE-PROFESSIONAL PROGRAMS

Vocational Schools
- Circadium

Pre-Professional Programs
- 23 schools around the country
- 1-2 year programs

College Circuses
- FSU
- University of Illinois
- Many others have classes in aerial dance, or circus arts related studies

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PRE-PROFESSIONAL TRAINING

- Youth Circus Companies
- Young adult/ adult programs
- Self-guided part-time programs
- Full time set curricula

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COMPETITIONS AND FESTIVALS

- Opportunity to showcase new work and performers
- Workshops and knowledge sharing
- Community building

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Recreational Circus

Number of schools in the US have exploded in the last fifteen years and formalized

As of 2007 there were ~ 8 circus schools in the US
(Aerial Dance Smith and Bernasconi 2008)

Today >800 circus/aerial schools in the U.S. (ACE and Circus Now)

Aerial apparatus are found in yoga studios, dance studios, gymnastics gyms, traditional gyms, and pole studios

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AMERICAN CIRCUS EDUCATORS SURVEY

Founded Before 2000

- More varied apparatus
- More students
- More Performances
- Larger Budget
- More likely to be a non-profit and have Social Circus Programing

Founded After 2000

- More Aerial Focused (or only!)
- Older age of students
- Smaller budget
- Smaller Staff (many with 0 full time)

165 schools responded which was estimated to be a 20% response rate

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CURRENT ISSUES IN RECREATIONAL CIRCUS

- Rapid Growth
- Instructor training
- Rigging
- Learning from social media
- Community support and awareness
- Lack of research

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ACCESSIBLE / SOCIAL CIRCUS

- Community engagement
- Building relationships, trust
- Circus for physical literacy
- Reaching marginalized populations
- Adaptations for cognitive and physical disabilities
- Circus as occupational therapy, social work, physical therapy and with psychotherapy

(Stevens 2019) (Spiegel 2017) (Fournier 2014)

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NATIONAL ORGANIZATIONS

American Youth Circus Organization (AYCO)
- Encourages youth participation and community across the country regional and national meetings

American Circus Educators (ACE)
- Instructors meet at national meetings to educate each other and set standards for circus education and safety

Circus Now
- Increase the visibility of circus and public education
- Interest in funding for circus arts

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What is a circus injury?

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Circus Injury Literature

Definition
- Time loss (Sheir 2009)
- Medical attention (Munroe 2014, Sheir 2009)
- Self report of injury via questionnaire (Stubbe 2018)

Cohorts
- Mostly Professional Artists
  - Generally divide into acrobat/non-acrobatic
  - Injury Rate 7.27 – 9.37 (Wolfenden 2017)
- Few studies on Students
  - Only one discussed the effect of apparatus (Munroe 2014)
  - Lower injury reporting in circus than basketball in a high school (Long 2011)

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Heterogenous Population Sudden Load / Acrobat

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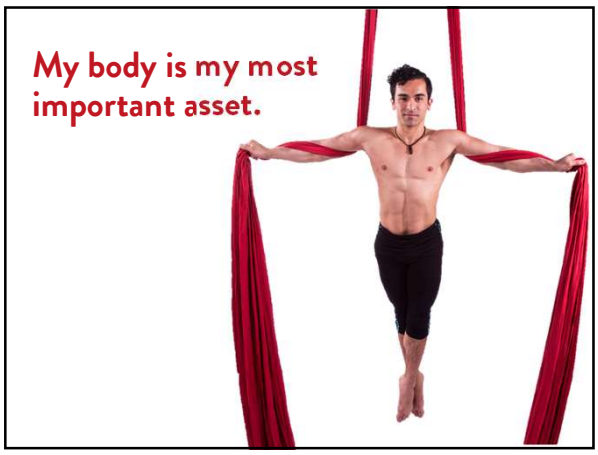

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Objectives

- Provide brief overview of Movement System Impairment Syndromes concepts
- Briefly describe movement system-based examination, diagnosis, and intervention emphasizing the scapula and glenohumeral joint
- Apply Movement System Impairment examination and diagnoses to patient cases

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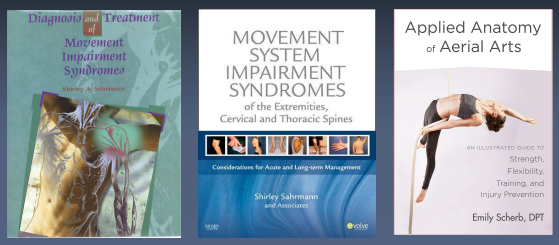
Resources:
Applied Anatomy of Aerial Arts
Movement System Impairment Syndromes
Texts: Vol 1 (2002) and Vol 2 (2010)



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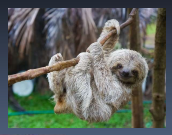
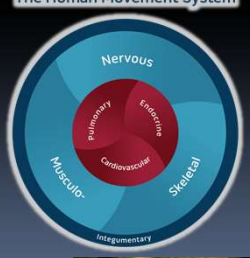
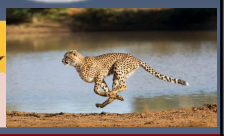
- Movement is an essential function of life at all levels of living organisms.







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The way everyday activities are performed is the critical issue to be assessed during your examination and provide an intervention including aerial movements.

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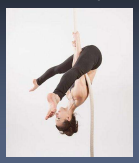
Aerial class and practice time spent

- Number of hours spent doing aerial:
  - Recreational compared to professional:
    - 4-10 hrs per week compared to 30-40 hrs per week



- What is this population doing the rest of 120-150 hrs of that week?

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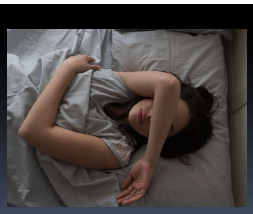
Sleeping positions

- 50-70 hrs per week



What is this population doing the rest of 70-120 hrs of that week?

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Every day activities and their adaptations to our bodies

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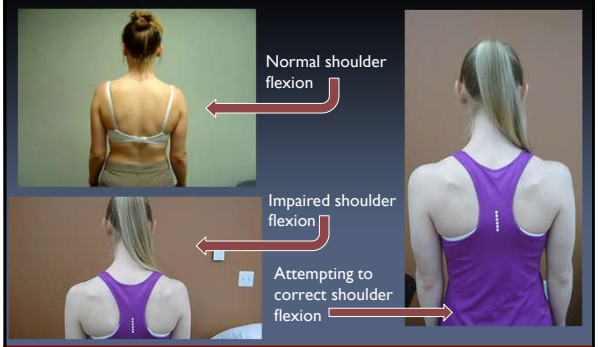
Ideal compared to faulty movement



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Why Does Movement Become Impaired?

- The body follows the law of physics and follows the ***path of least resistance*** for motion which contributes to subtle hypermobility.
- The way everyday activities are performed reinforces this hypermobility and the movement pattern.

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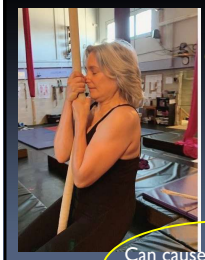
Why Does Movement Become Impaired?



Muscle performance is determined by the pattern of movement

Altered movement patterns impair proper muscle performance

Can cause tissue injury and symptoms

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Movement System Key Concepts

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Key Concepts

- Relative stiffness/flexibility of muscles
- Path of Least Resistance for Motion
- Hypermobility causes degeneration and pain (accessory/arthrokinematic motion)
- Joint moves more readily in a specific direction than other joints and then you develop a movement pattern
- Subtle deviation in precision of movement are cause of injury
- Examining functional daily and work, and recreational activities are key to this system

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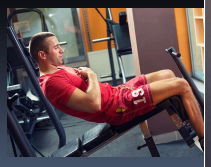
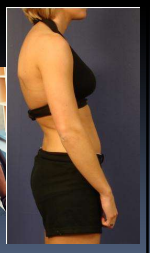
Key Concepts

- You get what you train
- Presence of a muscle does not mean appropriate use
- No magic in an exercise except if the desired motion is evident





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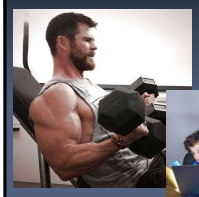
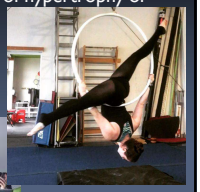
Relative Muscle Stiffness

- Passive tension of muscle and connective tissue
- Hypertrophy of muscle increases the passive stiffness
- Daily activities can induce different degrees of hypertrophy of muscles on either side of a joint





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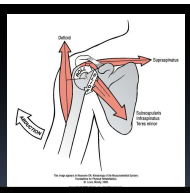
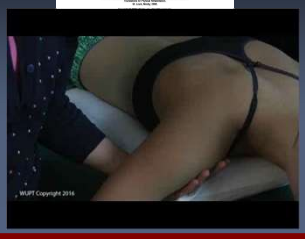
Relative flexibility

- Can occur in both accessory and physiological ROM

Example:
Excessive glenohumeral joint motion while testing middle traps muscle strength





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Relative Stiffness vs. Relative Flexibility

Latissimus length test:

- Stiffness can promote scapular depression or humeral medial rotation
- Glenohumeral joint more flexible than latissimus: excessive anterior-inferior glide of humerus

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Path of least resistance for motion

- Contributes to hypermobility of a joint can cause pain
  - Excessive GHJ due to lack of scapular elevation and upward rotation

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Movement System Impairment Approach

- Systematic examination used to evaluate, diagnose and treat neuromusculoskeletal pain problems
  - Based on anatomy and kinesiology
  - Exam is based on symptom alleviation, not just provocation
- Consists of tests of alignment and movement performed in several positions
- Analysis of functional activities (daily, work, fitness, leisure, and recreational)

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Movement System Examination: List of tests

- Standing
  - Alignment
  - Thoracic movements
  - Shoulder flexion
  - Shoulder abduction
  - Shoulder lateral rotation
  - Cervical range of motion
    - shoulder girdle elevation test
- Supine
  - Alignment
  - Length tests: latissimus, scapulohumeral, posterior deltoid/capsule/shoulder, pec major (sternal and clavicular), pec minor, biceps
  - Shoulder medial and lateral rotation
  - Cervical flexion
  - Lower abdominals muscle performance

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Movement System Examination: List of tests

- Prone
  - Shoulder medial and lateral rotation motion and muscle performance
  - Middle and lower trapezius muscle performance
- Quadruped
  - Alignment
  - Cervical range of motion
  - Rocking backward
  - Shoulder flexion
- Sitting
  - Muscle performance of serratus anterior
- Activities
  - Daily self care and household chores
  - Work or school
  - Fitness/leisure/recreational

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Movement System Examination

- During the systematic exam:
  - Patient's ***preferred*** alignment and movements are analyzed while monitoring symptoms

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Movement System Examination

- Determine the pattern of movement which most consistently elicits symptoms
- Modify the preferred/impaired pattern immediately to determine the effect on the symptoms

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Movement System Examination

Identify the site that is moves more readily in a specific direction and make corrections to decrease symptoms

- MMT/muscle performance:
  - Assess recruitment timing and avoid substitution
    - Example: lower trapezius
      - Scapular depression and humeral medial rotation due to dominance of latissimus muscle

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Movement System Examination

Middle trapezius MMT:
- attempting to correct impairments

Middle trapezius MMT:
Scapular depression and humeral extension due to over-recruitment of latissimus and posterior deltoids

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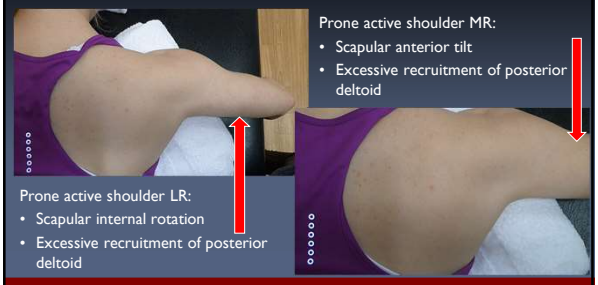
Movement System Examination

Identify the contributing factors of tissue and/or motor control impairments



Prone active shoulder MR:
- Scapular anterior tilt
- Excessive recruitment of posterior deltoid

Prone active shoulder LR:
- Scapular internal rotation
- Excessive recruitment of posterior deltoid

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Movement System Examination

- Muscle length test:
  - Not just overall length but amount of stiffness through the range and compare to uninvolved side
  - Example: Scapulohumeral muscle length test

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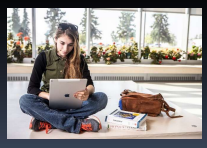
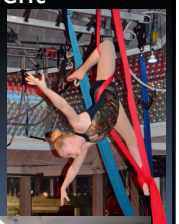
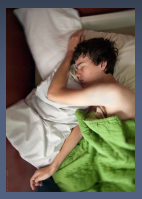
Activities evaluation/assessment

- Need to obtain information about all activities:
  - Work/school
  - Fitness/leisure
  - Sleeping positions
- Need to assess these activities when possible and make appropriate modifications







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Movement Examination to Diagnosis

- PTs must establish a diagnosis of the condition they are treating to ensure most effective treatment (APTA House of Delegates 1994, 1995)
- Diagnosis named according to the impairment(s) observed
  - Frequency
  - Magnitude
  - Production of symptoms
  - Response to modification of movement
- Diagnosis helps to direct treatment

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Movement System Impairment Syndromes

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Movement System Impairment Syndromes

- Named for movement direction that causes symptoms and that is impaired.
- Correction of the movement usually decreases the symptoms.
- Identify the **cause** of the dysfunction & contributing factors
  - Tissue & neuromuscular impairments
- Organize & cluster specific tissue and movement impairments
- Provide a direction for treatment
- Based on anatomy and kinesiology

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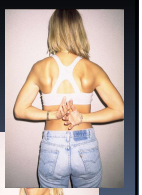
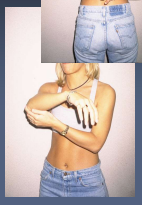
Movement System Impairment Syndromes

Across the full systematic exam:

- Perform the test and assess impaired motion and symptoms
- Identify the *cause* of the dysfunction
  - Shoulder pain due to stiffer posterior capsule/shoulder muscle than rhomboids/trapezius leading to scapular internal rotation or abduction





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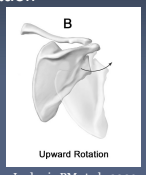
Cause versus source operational definitions

- Cause
  - Mechanical factor (movement) that results in tissue irritation
  - Example: Insufficient upward rotation



Ludewig PM et al. 2009

- Source
  - The tissue or pathoanatomical structure that is symptomatic
  - Example: supraspinatus tendinopathy

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Movement System Impairment Syndromes

If symptomatic, correct impaired movement.

If it decreases or eliminates symptoms with correction, then working toward a diagnosis:

- Shoulder flexion with scapular depression and insufficient upward rotation

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Movement System Impairment Syndromes

- Organize specific tissue or movement impairments based on anatomy and kinesiology

Patient with shoulder pain with an MSI syndrome of scapular depression with insufficient upward rotation:

- Active shoulder flexion
- Weak or poor muscle performance for serratus anterior and/or trapezius
- Short or stiff latissimus, rhomboids, levator scapulae

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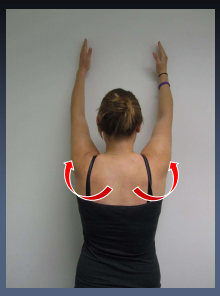
Movement System Impairment Syndromes



- Provide a direction for intervention
  - Do not require identification of a specific pathoanatomical structure (source)
  - Correct the ***cause*** of impaired motion for precision to alleviate or reduce tissue irritation and thus symptomatic conditions
    - Example: Improve scapular upward rotation during shoulder flexion

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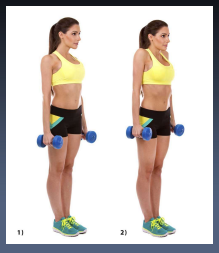
Movement System Impairment Syndromes



- Not as effective if treating isolated muscles:
  - Example:
    - Isolating upper traps and levator with shoulder shrugs with arms at side does not mean it will translate to elevation and/or upward rotation of the scapula with shoulder flexion

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Movement System Impairment Syndromes for the Upper Quarter

- Scapular
  - Depression with insufficient upward rotation
  - Internal rotation: with insufficient anterior tilt, upward rotation, or abduction
  - Adduction with insufficient upward rotation
  - Elevation
  - Winging
- Humeral
  - Anterior glide
  - Medial rotation
  - Multidirectional hypermobility
  - Superior glide
  - Hypomobility
- Cervical, thoracic, elbow, wrist and hand

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Movement System Treatment Principles

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General principles of treatment

- Patient education is key part of treatment
- Redistribute movement to appropriate joints
- *Correct the movement pattern* that is causing the tissue to become painful rather than direct treatment to the affected tissue

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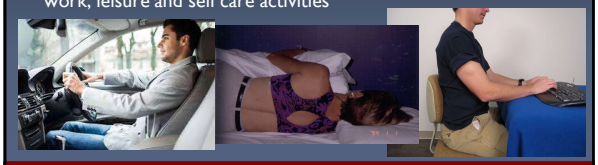
General principles of treatment

- Because treatment is addressing ***cause*** of symptoms, pain reduces as tissue stresses are reduced
  - Recurrence less likely if cause of pain is addressed
  - Source of pain indirectly addressed

KEY:

Modify direction-specific movement and alignment during daily work, leisure and self care activities



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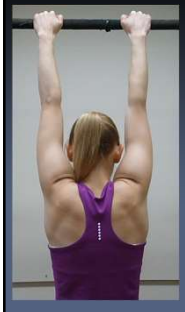
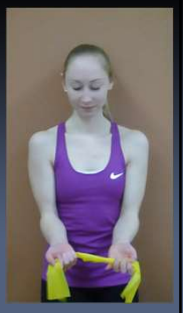
General principles of treatment



- Train proper movement patterns to induce appropriate muscular (strength, length) and biomechanical adaptations to reinforce the development of optimal neuromuscular action
  - Example: Improving shoulder lateral rotators to stabilize glenohumeral joint while flexing shoulder



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General principles of treatment

- Critical to prescribe corrective exercise program:
  - Emphasizes precise motion
  - Individualized to the patient
- Practice performing all movements using the corrected or modified strategy

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Summary

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Summary: Muscular Impairments Contributing to Altered Movement

- Tissues like muscle are highly adaptable
- Adaptability is function of type of demands placed upon the muscle
  - The way we do all every day activities
- The adaptations alter how you move leading to movement impairment and loss of precision of motion of joints

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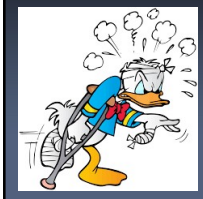
Summary: Muscular Impairments Contributing to Altered Movement

- Tissue injury and pain with resulting tissue impairments



- Muscle
  - Weakness, strain, length adaptation, stiffness, dissociated length of synergists
- Motor control
  - Altered recruitment and de-recruitment
- Biomechanics
  - Variations in stresses on bone, joint, tissues
  - Muscle loading by gravity

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Summary of Movement System Impairment Theory

- Movement impairments of the scapula and the humerus are causes of shoulder pain
- The impairments are the results of muscle and motor control adaptations that must be specifically identified because the treatment is specific to the muscle/motor control problem

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Aerial Fundamentals and Case Studies

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Objectives

- Recognize and assess common movements in aerial arts in relationship to the shoulder
- Illustrate MSI Syndromes using patient cases of aerial artists for evaluation and treatment

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Aerial Movement Basics

- Hollow Body
- Hanging
- Climbing – Vertical Apparatus
- Inversions
- Skin the Cat
- Beats

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Hanging

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Bent Arm Hanging

Applied Anatomy of Aerial Arts

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The Shoulder in Long Hanging

Gravity now pulling the body downward

How does that effect the shoulder?

- Increased recruitment of lower trapezius to support the body up and maintain a connection with the scapula
- Increased recruitment of the rotator cuff to stabilize the humeral head at the glenoid

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Common Cues for "Engaged Shoulders"

Old Cues:

"Pull your shoulders away from your ears"

"Move your shoulder blades down your back"

"Put your shoulder blades in your back pockets"

Better Cues:

"Break the bar behind you"

"Rotate your elbows forward, keep the rotation and push the bar back"

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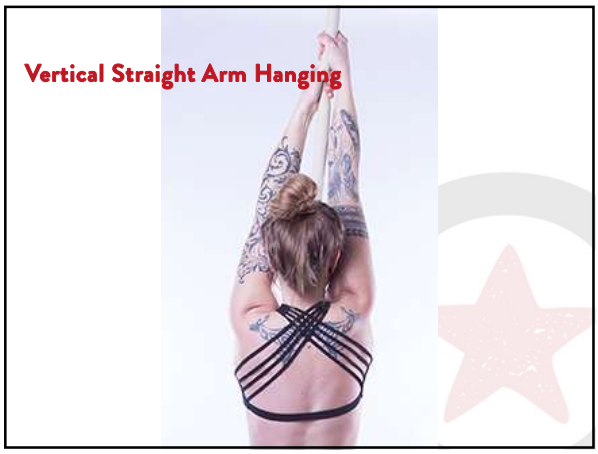

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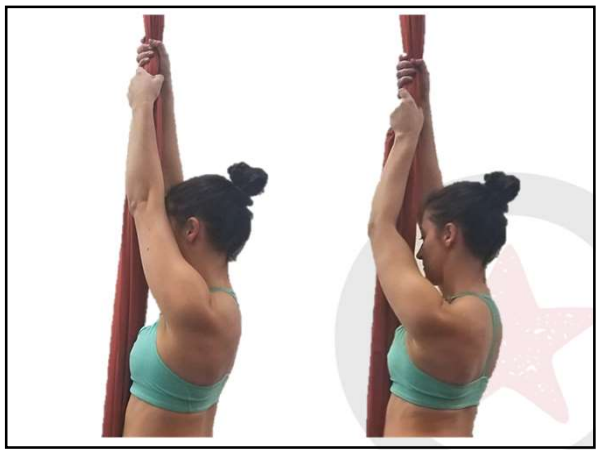

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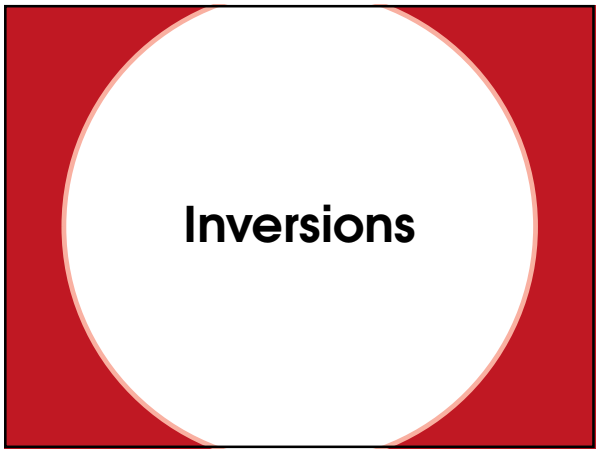

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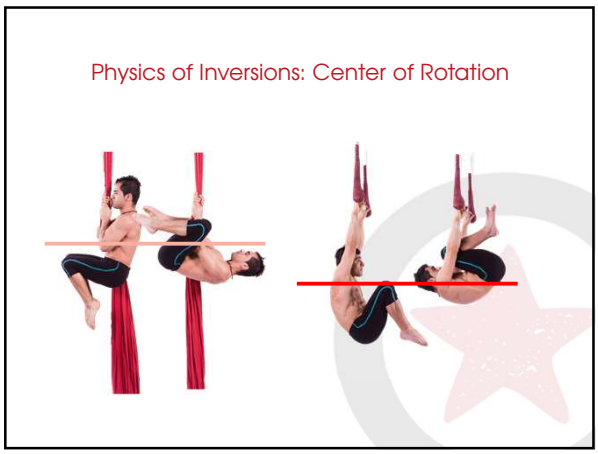

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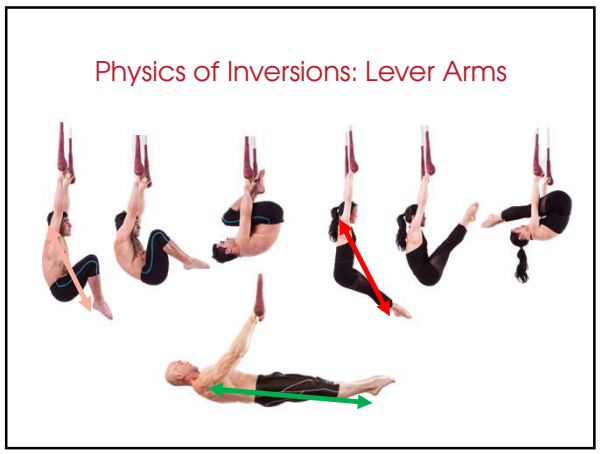

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Stabilization -> Compression

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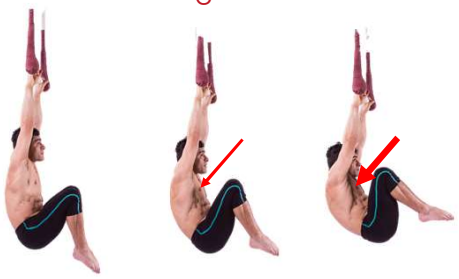
Initiating Rotation



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Rotation

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Stabilization

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Early shoulder extension

Shoulders "closing" early
- Increased load on shoulder joint due to longer lever arm of the body

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BEATS

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BEATS

Applied Anatomy of Aerial Arts

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Case Studies of Aerial Artists

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Common Injury Patterns

Patterns of Movement Dysfunction of the Shoulder

- Scapular Anterior Tilt and Internal Rotation
- Scapular Deprewith Insufficient Upward Rotation
- Glenohumeral Directional Instability or Multidirectional Hypermobility

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Scapular IR with Anterior Tilt

Clinical Presentation

- 25 yo professional double trapeze "flyer"
- 9 months s/p Left index finger amputation at the MP joint

Primary Complaint

- Left shoulder feels "crooked" with inversions since returning to training ~6 months ago
- In the last 3 months left shoulder pain is developing with leg lifting and inversion

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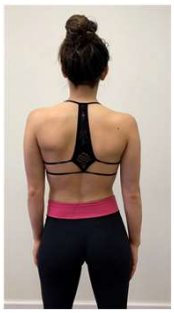
Scapular IR with Anterior Tilt



Measures and Findings

Standing posture: Left scapula anterior tilt with prominent inferior angle

Shoulder Flexion: L limited with decreased scapular posterior tilt at end range, and humeral IR

Shoulder Abduction: scapular IR and anterior tilt on return

External Rotation: B scapular anterior tilt, Left also with scapular abduction

Quadruped: L scapular anterior tilt IR with unilateral weightbearing

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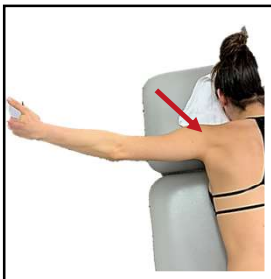

Manual Muscle Testing

SA R 5/5 L 4/5 with pec major dominance

Middle Trapezius R 5/5 L 3+/5 with deltoid and upper trap over recruitment with place and hold increased humeral extension

Lower Trapezius R 5/5 L 5-/5 with upper trap recruitment

Rhomboid 5/5 B

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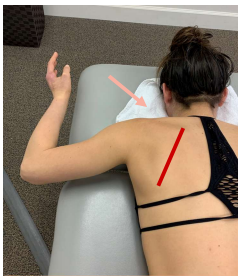

Manual Muscle Testing

ER R w/ mild anterior glide L w/ scapular abduction and elevation

IR B 5/5

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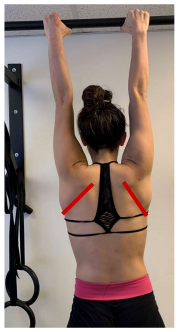

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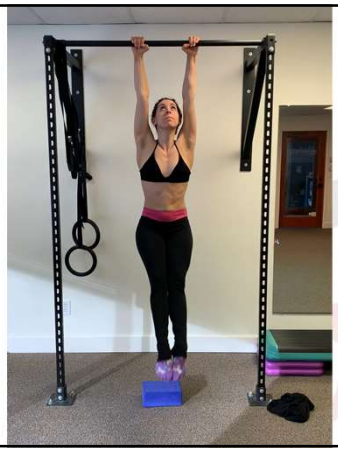

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Scapular IR with Anterior Tilt

Long/Weak
- Serratus Anterior
- Lower Trapezius
- Middle Trapezius

Short/Stiff
- Posterior Deltoid
- Posterior capsule
- Pectoralis minor and major
- Latissimus dorsi

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Scapular IR with Anterior Tilt

More Common Presentation

- Beginning artists especially vertical
- Adult onset aerial
- Repeated Shoulder extension from full flexion

- Pec dominant bent arm hang "Shoulder Snuggle"
- Bent arm Inversion issues

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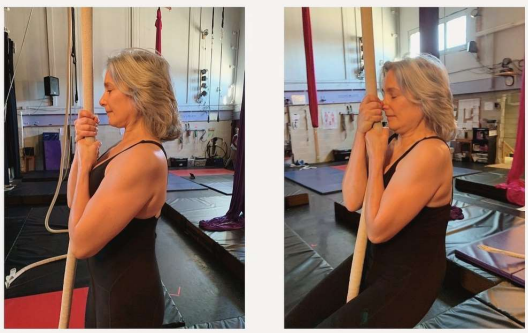

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Shoulder "snuggle" inversion

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Scapular Depression with Insufficient Upward Rotation

Clinical Presentation

- 29 yo female
- Recreational aerial silks artist
- Right shoulder pain
  - Pain began with increasing training time after changing jobs
  - Pain was a dull ache at rest 2/10 pain at the lateral shoulder
  - Sharp pain with overhead movement and lifting arm in front or to the side
  - No pain once warmed up while training, but pain worse afterwards

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Scapular Depression with Insufficient Upward Rotation

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Movement/Functional Findings

Shoulder flexion limited

- Right scapula significant depression with lack of upward rotation and excessive abduction
- With manual correction pain 80% decreased

Shoulder abduction

- Scapular depression and downward rotation increases until about 90 degrees of shoulder flexion

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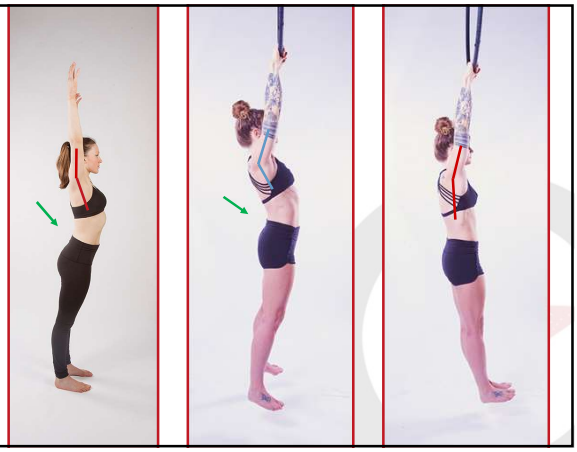

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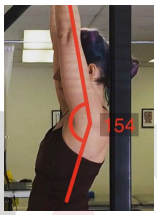
Scapular Depression with Insufficient Upward Rotation – cont.

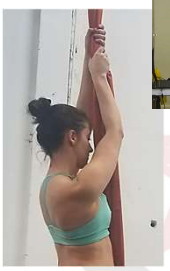
Hanging position Bar

- Shoulders "closed"
- Lumbar extension

Hanging Vertical

- **right hand high** shoulders are level
- **left hand high** right elbow bent





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PROM

- Latissimus Dorsi Stiffness
- Scapulohumeral muscles stiffer than scapulothoracic muscles

Strength findings

- Serratus Anterior
  - 4+/5 R 5/5 L
- **Lower Trapezius**
  - **3+/5 R 4+/5 L**
- Middle Trapezius
  - 4/5 R 5/5 L
- Upper Trapezius
  - 5/5 B
- Rhomboid
  - 5/5 B
- ER Shoulder
  - 4+/5 R 5/5 L
- IR Shoulder
  - 5/5 B

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Scapular Depression with Insufficient Upward Rotation

Long/Weak
- Lower Trapezius
- Serratus Anterior

Short/Stiff
- Rhomboids
- Latissimus dorsi

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Wall Slides

Wall slides
- Cues to press into wall and band with verbal cues to elevate scapula

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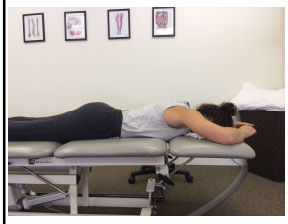
Prone O



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Prone O and Y

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Backwards Crawling

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Shoulder Flexion with Back to Wall

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Activity Specific Progression

- Vertical bent arm hanging
  - Cues for scapular stability and work from back
- Long hanging re-ed on bar
- Vertical long hanging
- Progress to slow controlled movement on vertical
  - climbing
- To dynamic on vertical
  - Beats
  - Inversions

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Straddle Up Modification

Progression

Goal

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Humeral Anterior Glide w/ Medial Rotation

Clinical Presentation

- 27 yo female
- Professional straps artist
- Right shoulder pain
  - Pain during and after training with burning at the posterior glenohumeral joint
  - Feeling of lack of mobility into external rotation with warm up exercises
  - Feeling of weakness with daily activities including pouring

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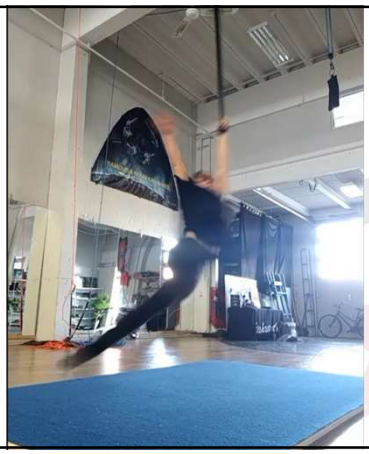

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Humeral Anterior Glide – cont.

Measures and Findings

Standing alignment: anterior humeral head, humeral internal rotation

Movement/Functional Findings

- Shoulder flexion w/ excessive scapular elevation and humeral IR
- Hanging lack of R humeral ER, excessive scapular abduction
- ER R w/ scapular anterior tilt, humeral anterior glide, and humeral extension

Strength findings

Lower Trapezius
- 4+ R 5- L

Middle Trapezius
- 4+ R 4+ L

Rhomboid
- 5- R 5- L

ER Shoulder
- **3- R 5- L**

IR Shoulder
- 5 R 5 L

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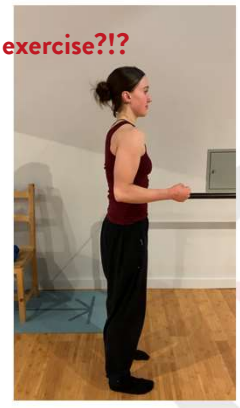
ER warm up exercise?!?



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Humeral Anterior Glide – cont.

Treatment

- External rotation at 90^0 Scaption
  - Cues to "spin" at humerus without trunk rotation or humeral anterior glide
- Wall Slide – with looped band
  - Cues for maintaining external rotation throughout movement
- Shoulder Flexion w/ Band and back to wall
  - Cues for rotation

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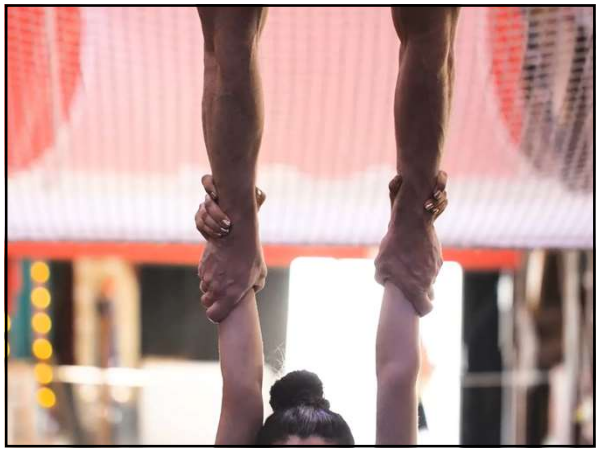

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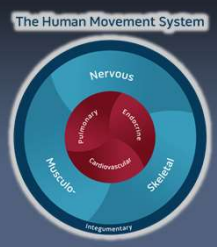

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THANK YOU

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