Movement Impairment Syndromes of the Shoulder and Shoulder Girdle

Presented by:
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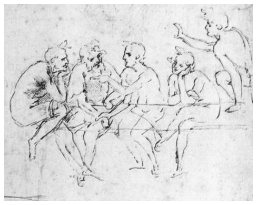
Based upon:
Diagnosis and Treatment of Movement Impairment Syndromes

Shirley A. Sahrmann, PT, PhD



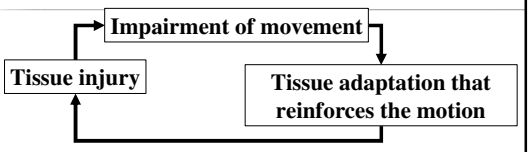
Movement System

- A physiological system that functions to produce motion of the whole body or of its element parts
- These elements are:
  - Musculoskeletal system
  - Neurological system
  - Cardiopulmonary system
  - Metabolic system

Movement System Balance

- Approach used by PT to assess physical performance and to design intervention programs
- Precise or balanced movement influences health of the movement system and its components
  - Optimal function of all contributing element
  - resulting in precise arthrokinematics and osteokinematics
- **Imbalance or impairment of movements causes pain syndromes**

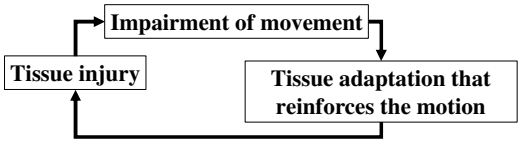
Movement Impairment Syndromes



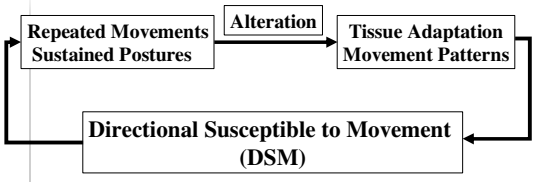
- **Named for the movement direction that is believed to be the cause of the pain**
  - Lumbar spine rotation/extension
  - Femoral anterior glide
  - Scapular abduction

Movement Impairment Syndromes

- **Treatment is directed at correcting the movement and the tissue adaptations that are contributing to the vicious cycle of:**



Key Concepts



- **The DSM is the cause of the pain because of the microtrauma produced by stress or movement in the specific direction**

Operational Definitions

- **Cause**
  - **The mechanical factor causing tissue irritation**
  - **e.g. humeral anterior glide**
- **Source**
  - **The issue or pathoanatomical structure that is believed to cause symptoms**
  - **e.g. supraspinatus tendinitis**

Key Concepts

- The focus of the examination is to **identify the DSM** and **the contributing factors**
- Maintaining or restoring precise movement of specific segments is the key to preventing or correcting musculoskeletal pain
- Ideal alignment facilitates optimal movements.
  - Faulty alignment must be corrected
  - Corrected alignment must be retained throughout the movement

Key Concepts

- **Impairments**
  - Muscle Performance
  - Motor Control
  - Biomechanics
- **Examination**
  - Standardized
  - Qualitative and Quantitative
  - Alignment
  - Movement

TRUNK supports for the limbs and their muscular attachments

Interaction between segments and TRUNK!!!!

Key Concepts

Contributing factors

- **Muscular**
  - Weakness
  - Length
  - Stiffness
- **Motor control**
  - Recruitment Patterns
  - De-recruitment Patterns
- **Biomechanical**

Key Concepts

- **Corrective Exercises - Specific**
  - **Examination provides the basis for determining corrective exercise**

Failed items/their modifications = corrective exercises

To improve neuromuscular control of a specific muscle and movement

  - **The treatment program includes:**
    - Instruction to maintain optimal postures
    - Using correct movement patterns for daily activities

Key Concepts

Correction of Impairments

- **Correct muscle length/strength**
  - Shorten the long & Lengthen the short
  - Strengthen the weak & support the strained
  - Reduce load on long & weak muscles
- **Reduce relative stiffness**
- **Train for specificity - neuromuscular**
- **Correct alignment**

Concepts and Principles of Movement

BASE Musculoskeletal System | MODULATOR Nervous System | BIOMECHANICAL Statics Dynamics | SUPPORT Cardiopulmoary Metabolic

- Variety in Specific Joint Movements And Postures → Precise Movement → Good Musculosketal Health
- Abnormality Injury (eg. RA) → Impairments in Components → Movement Impairment → Functional Limitation → Disability
- Repeated Specific Joint Movement Sustained Postures → Impairments of Components & The Interaction → Movement Impairments → Movement Impairment Syndrome → Abnormalities | Functional Limitations

Concepts and Principles of Movement

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Useful Criteria to assess precise or balanced movement

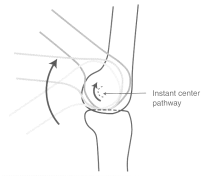

Figure 2–3
As the knee moves from flexion to extension, successive instantaneous centers can be mapped, which is known as the instant center pathway. In the normal knee, the pathway is semicircular and located in the femoral condyle. (Modified from Rosenberg A, Mikosz RP, Mohler CG: Basic knee biomechanics. In Scott WN, editor: *The knee*, St Louis, 1994, Mosby.)

- Repeated Specific Joint Movement Sustained Postures → Impairments of Components & The Interaction → Movement Impairments → Movement Impairment Syndrome → Abnormalities | Functional Limitations

Concepts and Principles of Movement

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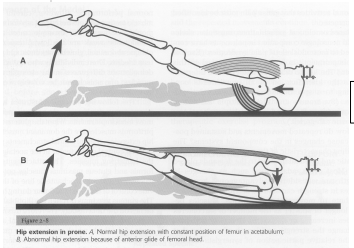


Figure 2–8
Hip extension in prone. *A*, Normal hip extension with constant position of femur in acetabulum; *B*, Abnormal hip extension because of anterior glide of femoral head.

- Repeated Specific Joint Movement Sustained Postures → Impairments of Components & The Interaction → Movement Impairments → Movement Impairment Syndrome → Abnormalities | Functional Limitations

Base Element Impairments Musculoskeletal System

- **Muscle Strength**
  - **Decreased muscle strength caused by Atrophy**
    - **Weak, but No pain reported during MMT**
  - **Decreased muscle strength caused by Strain**
    - **Pain upon palpated or contracting**
  - **Increased muscle strength caused by Hypertrophy**
    - **Increased muscle force**
    - **Increase passive tension of the muscle and connective tissues**

Base Element Impairments Musculoskeletal System

- **Muscle Length - Lengthened**
  - **Prolonged elongated position**
    - **Bed rest or inactivity**
  - **Injurious strain**
    - **Disruption of the cross-bridges**
  - **Sustained stretching**
    - **Prolonged stretch will add sacromeres in series**

Base Element Impairments Musculoskeletal System

- **Muscle Length - Lengthened**
  - **Prolonged elongated position**
    - **Bed rest or inactivity**
    - **Poor Alignment and posture**
    - **MMT - weak throughout the range**
    - **Example: Side-lying stretches posterior GMed and Lower Trapezius, and glides the humeral head relative to the glenoid**

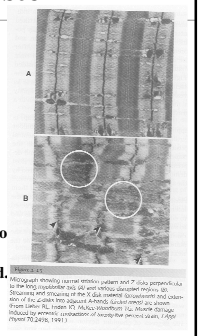
Base Element Impairments Musculoskeletal System

- **Muscle Length - Lengthened**
  - **Strengthening exercise**
    - **Approximately 4 weeks are required to verify the morphological changes**
    - **After the first 2 weeks,**
      - **80% changes in tension is from enhanced neural activation**
      - **20% from contractile capacity**

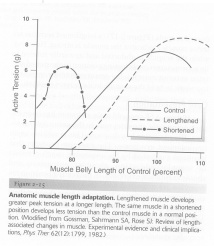
Moritani & Devries, Am J Phys Med, 1979

Base Element Impairments Musculoskeletal System

- **Muscle Length - Lengthened**
  - **Injurious strain**
    - **Disruption of the cross-bridges**
    - **Pain upon palpated and contracting**
    - **Healing process is more readily if the muscle is not subjected to contraction or constant tension**
    - **Example: Strained Upper Trapezius, weight of the shoulder/shoulder girdle is too heavy, pain increases with contraction of UT but subsides when the arm is supported.**



Base Element Impairments Musculoskeletal System



Anatomic muscle length adaptation. Lengthened muscle develops greater peak tension at a longer length. The same muscle in a shortened position develops less tension than the control muscle in a normal position. (Modified from Gossman, Sahrmann SA, Rose SJ: Review of length-associated changes in muscle. Experimental evidence and clinical implications, *Phys Ther* 62(12):1799, 1982.)

- **Muscle Length - Lengthened**
  - **Sustained stretching – added sacromeres**
    - **Elongated muscles tested weak at a shortened length**
    - **MMT – gives initially then able to hold**
    - **Example, abducted scapular posture – weak middle, lower trap at shortened length, but strong at a longer length**

Base Element Impairments Musculoskeletal System

- **Muscle Length - Shortened**
  - **Rapid loss of sacromeres in series (2-4 weeks)***
    - **How much shortness is clinically important?**
      - **RELATIVE to the TOTAL EXCURSION!!!**
    - **For example: 10 degrees of Hamstrings vs 10 degrees of Gluteus Maximus**

Tabary et al., J Physiol, 1972
Williams & Goldspink, J Anat, 1978
Williams & Goldspink, J Anat, 1973

Base Element Impairments Musculoskeletal System

- **Muscle Length - Shortened**
  - **Prolonged Stretch with low magnitude**
    - **Immobilization**
    - **Dynamic Splint**
    - **Low load**
  - **Shorten the elongated muscles**
  - **Prevent compensatory movements**

Base Element Impairments Musculoskeletal System

- **Dissociated Length Changes in Synergistic Muscles**
  - **Examples:**
    - **Uniarticular hip flexors vs Biarticular hip flexors**
    - **Pectoralis major vs Subscapularis**

Base Element Impairments Musculoskeletal System

- **Muscle and Soft-tissue stiffness**
  - **Active and Passive tension developed in the soft tissue, mainly muscles**
  - **Non contractile elements such as titin**
  - **Contractile elements – actin, myosin**
  - **Hypertrophy increases both active and passive elements of muscles, therefore, increases stiffness throughout the range***

Chleboun et al., Clin Biomech, 1997

Compensatory Relative Flexibility between Joints

P1: Balance of muscles stiffness

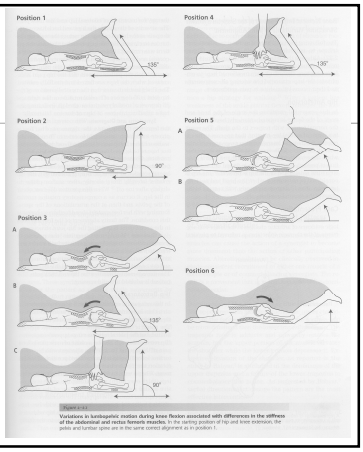
P2: Shortness of RF with counterbalancing of trunk

P3: Shortness of RF with compensatory lumbo-pelvic motion

P4: Compensatory motion without shortness of RF

P5: Compensatory motion with passive flexion controlled by active muscle contraction

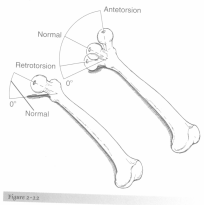
P6: Exaggerated posterior pelvic tilt



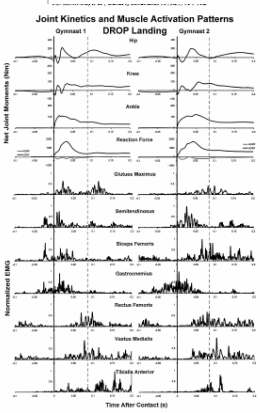
Variations in lumbopelvic motion during knee flexion associated with differences in the stiffness of the abdominal and rectus femoris muscles. In the starting position of hip and knee extension, the pelvis and lumbar spine are in the same correct alignment as in position 1.

Base Element Impairments Musculoskeletal System

- **Altered Recruitment Patterns**
  - **Anteversion and Retroversion**
  - **Genu varum and valgum**
  - **Tibial torsion and varum**
  - **Supinated rigid foot**
  - **Short trunk and long extremities**
  - **Long trunk and short extremities**
  - **Narrow upper body and wide lower body**
  - **Wide shoulders**



A representation of retrotorsion and anteversion of the femoral neck. (from Malone TR, McPoil TG, Nitz AJ: *Orthopedic and sports physical therapy*, 3e, St Louis, 1997, Mosby.)



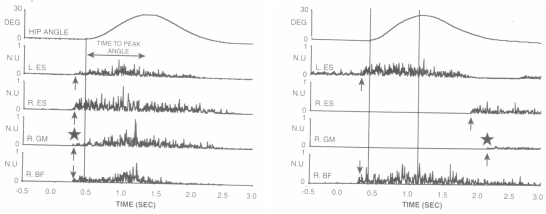
Base Element Impairments Nervous System

- Altered Recruitment Patterns of Synergists

McNitt-Gray et al., J Biomech, 2001

Base Element Impairments Nervous System

- Altered Recruitment Patterns of Stabilizing Muscles



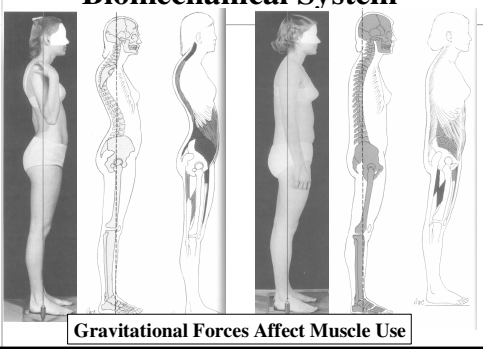
Subject 1 **Subject 2**

Pierce & Lee, JOSPT, 1990

Base Element Impairments Nervous System

- Alteration in cessation of activity
  - Normal scapular movement pattern observed during arm elevation
  - Scapular wining is observed during arm lowering

Base Element Impairments Biomechanical System



Gravitational Forces Affect Muscle Use

Base Element Impairments Biomechanical System

Gravitational Forces Acting on Bone and Joints

Base Element Impairments Biomechanical System

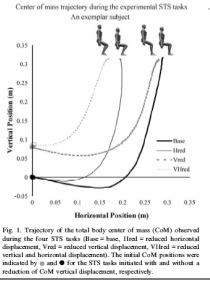


Fig. 1. Trajectory of the total body center of mass (CoM) observed during the four STS tasks (Base = base, Hred = reduced horizontal displacement, Vred = reduced vertical displacement, VHred = reduced vertical and horizontal displacement). The initial CoM positions were indicated by ○ and ● for the STS tasks initiated with and without a reduction of CoM vertical displacement, respectively.

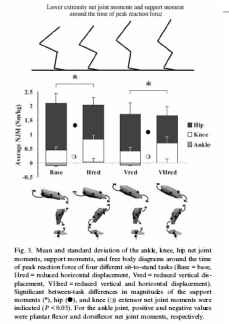
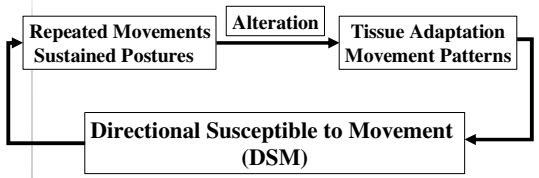


Fig. 3. Mean and standard deviation of the ankle, knee, hip net joint moments, support moments, and free body diagrams around the time of peak reaction force of four different sit-to-stand tasks (Base = base, Hred = reduced horizontal displacement, Vred = reduced vertical displacement, VHred = reduced vertical and horizontal displacement). Significant between-task differences in magnitudes of the support moments (*), hip (●), and knee (○) extensor net joint moments were indicated ($P < 0.05$). For the ankle joint, positive and negative values were plantar flexor and dorsiflexor net joint moments, respectively.

Modification in Movement Pattern Alters Load Imposed on the Lower Limbs

Summary



- **Identifying and correcting the mechanical cause of movement impairment!!!!**