ACE Personal Trainer Manual, 4th edition

Chapter 7:

Functional Assessments: Posture, Movement, Core, Balance, and Flexibility

Learning Objectives

- This session, which is based on Chapter 7 of the *ACE Personal Trainer Manual* (4th ed.), explains the importance of various functional assessments and outlines how to properly perform each.
- After completing this session, you will have a better understanding of:
  - How to set up a plumb line to conduct a basic postural assessment.
  - How to identify five key postural deviations.
  - How to conduct various movement screens, including clearing tests.
  - How to conduct key flexibility (muscle-length) assessments.
  - How to evaluate balance and core function.

Introduction

- Sequencing a client's assessments involves consideration of protocol selection and timing of the assessments.
- The physiological assessments must be consistent with the client's goals and desires, and with the discoveries made during the needs assessment.
- One primary objective of all training programs should be to improve functionality (movement efficiency).

Movement Efficiency

- Movement efficiency is the ability to generate appropriate levels of force and movement at desired joints while stabilizing the entire kinetic chain against reactive and gravity-based forces.
  - All movement begins and ends from a static base, ideally a position where all body segments are optimally aligned.
  - Since movement originates from this base, a postural assessment should be conducted to evaluate body-segment alignment.
  - Additionally, movement screens that evaluate how posture impacts the ability to move should be incorporated.

Static Posture

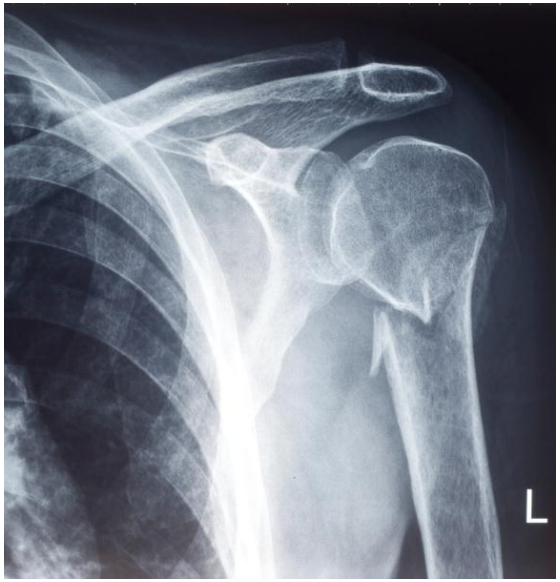
- Static posture represents the alignment of the body's segments.
  - Holding a proper postural position involves the actions of postural muscles.
- Good posture is a state of musculoskeletal alignment that allows muscles, joints, and nerves to function efficiently.
  - If a client exhibits poor static posture, this may reflect muscle-endurance issues in the postural muscles and/or potential imbalances at the joints.
- Since movement begins from a position of static posture, the presence of poor posture is an indicator that movement may be dysfunctional.

Static Postural Assessment

- A static postural assessment may offer valuable insight into:
  - Muscle imbalance at a joint and the working relationships of muscles around a joint
  - Altered neural action of the muscles moving and controlling the joint
  - Potentially dysfunctional movement
- Tight or shortened muscles are often overactive and dominate movement at the joint, potentially disrupting healthy joint mechanics.
  - Personal trainers should consider conducting a static postural assessment on their clients as an initial assessment.

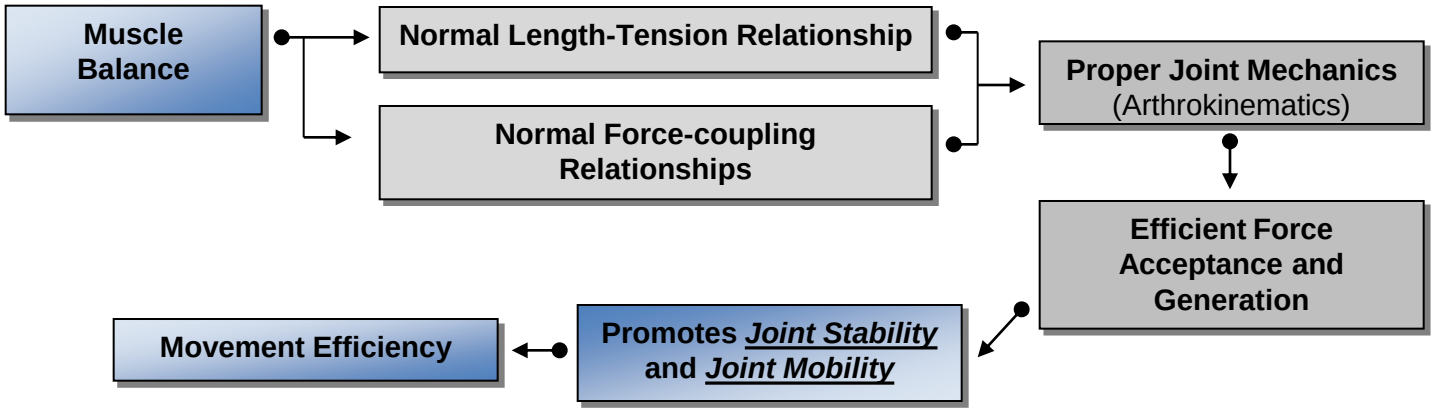
Muscle Imbalance and Postural Deviation Factors

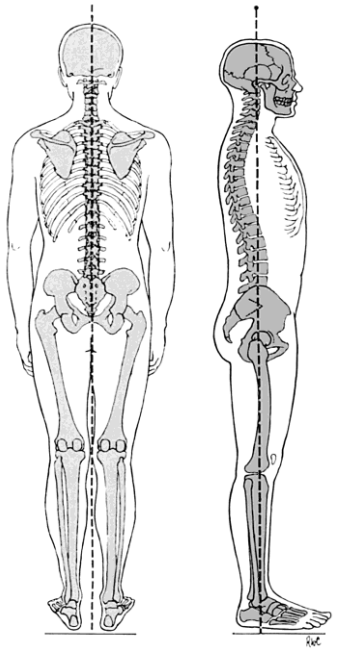
- Muscle imbalance and postural deviations can be attributed to many factors that are both correctible and non-correctible.
- Correctible factors:
  - Repetitive movements
  - Awkward positions and movements
  - Side dominance
  - Lack of joint stability or mobility
  - Imbalanced strength-training programs
- Non-correctible factors:
  - Congenital conditions
  - Some pathologies
  - Structural deviations
  - Certain types of trauma



Neural Activity

- Proper postural alignment promotes optimal neural activity of the muscles controlling a joint.
  - When joints are correctly aligned, the length-tension relationships and force-coupling relationships function efficiently.
  - Good posture facilitates proper joint mechanics.





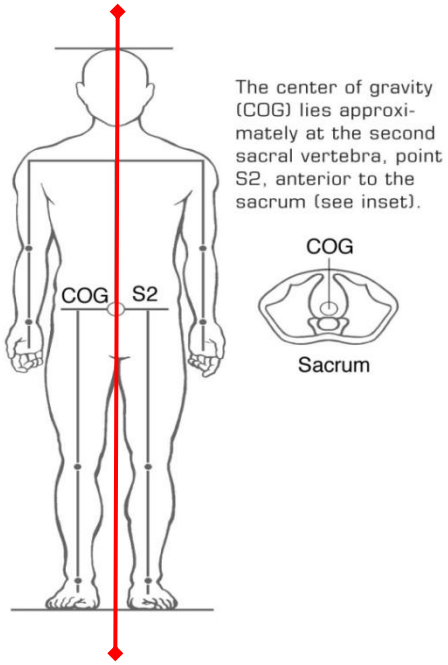
Right-angle Rule of the Body

- An initial training focus should be to restore stability and mobility and attempt to “straighten the body before strengthening it.”
  - The trainer should start by looking at a client’s static posture following the right-angle rule of the body.
  - This model portrays the human body in vertical alignment across the major joints.
- The right-angle rule allows the observer to look at the individual in all three planes to note specific “static” asymmetries at the joints, as illustrated on the following slide.

Right-angle Rule (Frontal and Sagittal Views)

Line of Gravity

- Good posture is observed when the body parts are symmetrically balanced around the body's line of gravity.
  - While the right-angle rule can identify potential muscle imbalances, there are limitations in using this model.



Line of Gravity

Plumb Line Instructions

- The objective of this assessment is to observe the client's symmetry against the plumb line.
  - Using a length of string and an inexpensive weight, trainers can create a plumb line that suspends from the ceiling to a height 0.5 to 1 inch (1.3 to 2.5 cm) above the floor.
  - A solid, plain backdrop or a grid pattern with vertical and horizontal lines that offer contrast against the client is recommended.
  - Clients should assume a normal, relaxed position.
  - Personal trainers should focus on the obvious, gross imbalances and avoid getting caught up in minor postural asymmetries.

Plumb Line Positions: Anterior View

- For the anterior view, position the client between the plumb line and a wall.
- With good posture, the plumb line will pass equidistant between the feet and ankles, and intersect the:
  - Pubis
  - Umbilicus
  - Sternum
  - Manubrium
  - Mandible (chin)
  - Maxilla (face)
  - Frontal bone (forehead)

Plumb Line Positions: Posterior View

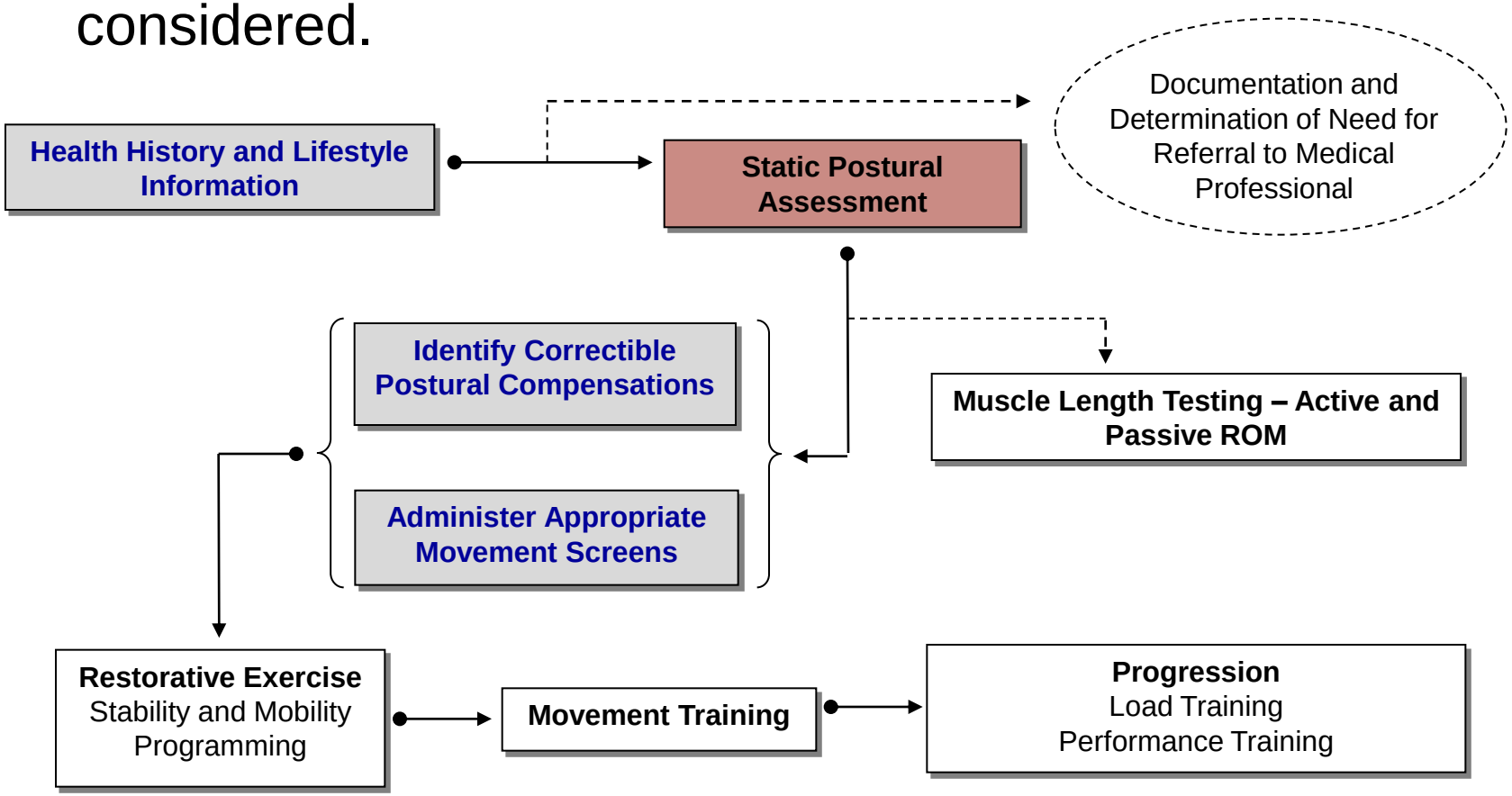
- For the posterior view, position the individual between the plumb line and a wall.
  - With good posture, the plumb line should ideally intersect the sacrum and overlap the spinous processes of the spine.

Plumb Line Positions: Sagittal/Transverse Views

- Position the individual between the plumb line and the wall, with the plumb line aligned immediately anterior to the lateral malleolus.
- With good posture, the plumb line should ideally pass through:
  - The anterior third of the knee
  - The greater trochanter of the femur
  - The acromioclavicular (A-C) joint
  - Slightly anterior to the mastoid process of the temporal bone of the skull
- All transverse views of the limbs and torso are performed from frontal- and sagittal-plane positions.

Chronological Plan for Conducting Assessments

- When conducting assessments of posture and movement, the following components should be considered.

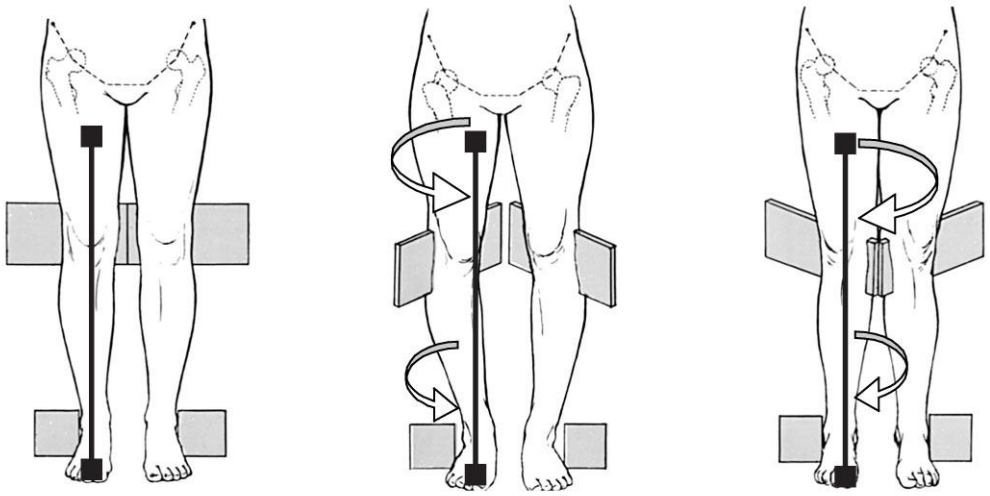


Deviation 1: Ankle Pronation/Supination

- Both feet should face forward in parallel or with slight (8 to 10 degrees) external rotation.
  - Toes pointing outward from the midline, as the ankle joint lies in an oblique plane with the medial malleolus slightly anterior to the lateral malleolus
- The toes should be aligned in the same direction as the feet.

Ankle Pronation and Tibial and Femoral Rotation

- The body is one continuous kinetic chain.
- Barring structural differences in the skeletal system, a pronated ankle typically forces internal rotation of the tibia and faster, greater internal rotation of the femur.



Neutral subtalar position with neutral knee alignment

Pronation with internal rotation of the knee

Supination with external rotation of the knee

Ankle Pronation/Supination: Lower Extremity Effects

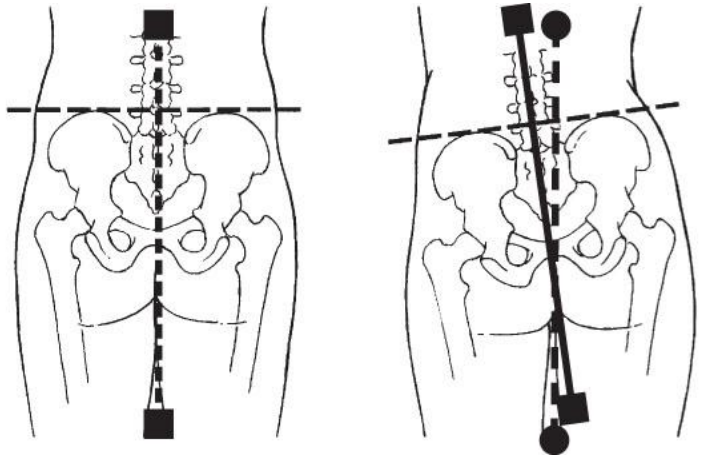
- Ankle pronation forces rotation at the knee and places additional stresses on the knee.
  - As pronation moves the calcaneus into eversion, this may actually lift the outside of the heel slightly off the ground.
  - In turn, this may tighten the calf muscles and potentially limit ankle dorsiflexion.
  - A tight gastrocnemius and soleus complex (triceps surae) may force calcaneal eversion in an otherwise neutral subtalar joint position.

Ankle Pronation/Supination and the Effect on the Feet, Tibia, and Femur

Ankle Movement	Foot Movement	Tibial (Knee) Movement	Femoral Movement	Plane of View
Ankle pronation	Eversion	Internal rotation	Internal rotation	View from front
Ankle supination	Inversion	External rotation	External rotation	View from front

Deviation 2: Hip Adduction

- Hip adduction is a lateral tilt of the pelvis that elevates one hip higher than the other.
  - If a person raises the right hip, the line of gravity following the spine tilts toward the left following the spine.
  - This position progressively lengthens and weakens the right hip abductors, which are unable to hold the hip level.
  - Sleeping on one's side can produce a similar effect, as the hip abductors of the upper hip fail to hold the hip level.



Alignment of the Pelvis Relative to the Plumb Line

- To evaluate the presence of hip adduction with a client, a personal trainer must identify the alignment of the pelvis relative to the plumb line.

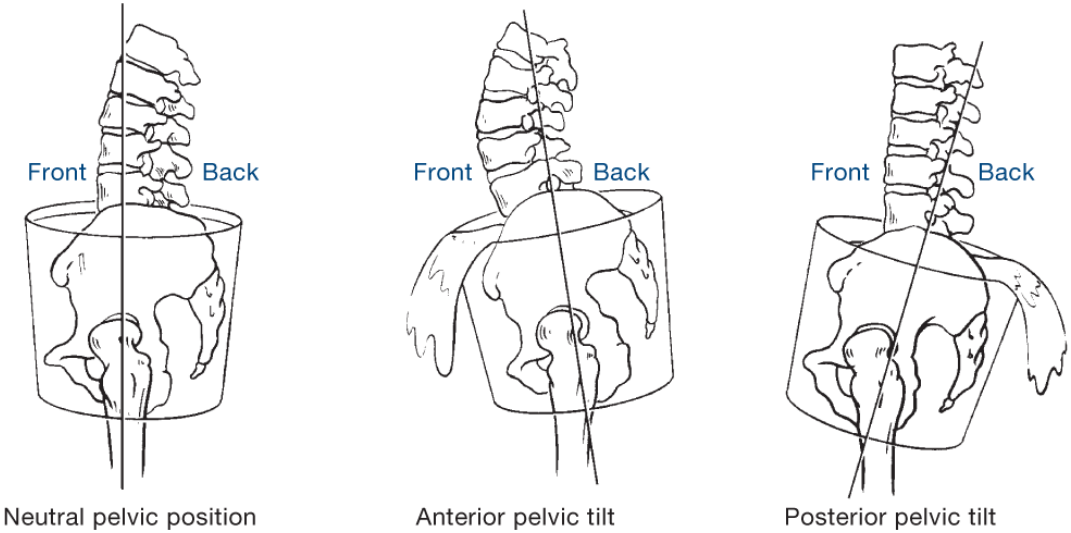
Hip Adduction			
Observation	**Position**	**Plumb Line Alignment**	**Plane of View**
Right hip adduction	Elevated (vs. left side)	Hips usually shifted right	View from front
Left hip adduction	Elevated (vs. right side)	Hips usually shifted left	View from front

Hip Adduction Screen

- The plumb line should pass through:
  - The pubis in the anterior view
  - The middle of the sacrum in the posterior view
- Positioning a dowel or lightly weighted bar across the iliac crests can help determine whether the iliac crests are parallel with the floor.

Deviation 3: Hip Tilting (Anterior or Posterior)

- Anterior tilting of the pelvis frequently occurs in individuals with tight hip flexors.
  - With standing, a shortened hip flexor pulls the pelvis into an anterior tilt.
  - An anterior pelvic tilt rotates the superior, anterior portion of the pelvis forward and downward.
  - A posterior tilt rotates the superior, posterior portion of the pelvis backward and downward.



Neutral pelvic position | Anterior pelvic tilt | Posterior pelvic tilt

Pelvic Rotation

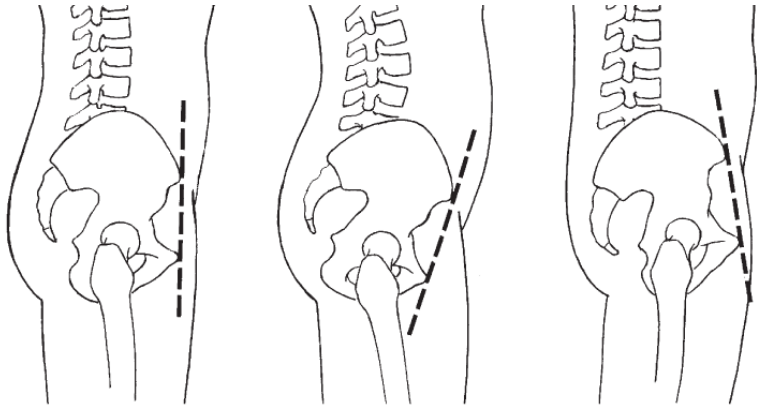
- An anterior pelvic tilt will increase lordosis in the lumbar spine, whereas a posterior pelvic tilt will reduce the amount of lordosis in the lumbar spine.
  - Tight hip flexors are generally coupled with tight erector spinae muscles, producing an anterior pelvic tilt.
  - Tight rectus abdominis muscles are generally coupled with tight hamstrings, producing a posterior pelvic tilt.
  - This coupling relationship between tight hip flexors and erector spinae is defined as the lower-cross syndrome.
  - With ankle pronation and accompanying internal femoral rotation, the pelvis may tilt anteriorly to better accommodate the head of the femur.

Pelvic Rotation			
Observation	**Rotation**	**Muscles Suspected to Be Tight**	**Plane of View**
Anterior tilt	ASIS tilts downward and forward	Hip flexors, erector spinae	Sagittal
Posterior tilt	ASIS tilts upward and backward	Rectus abdominis, hamstrings	Sagittal

Note: ASIS = Anterior superior iliac spine

Pelvic Tilt Screen: ASIS and PSIS

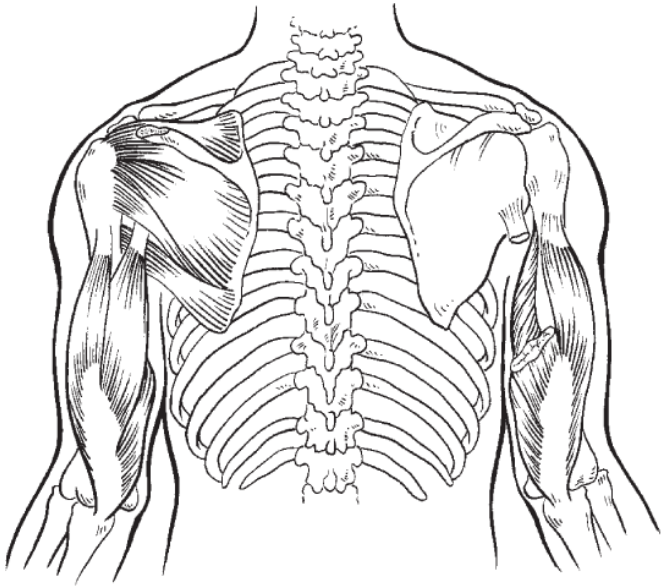
- To evaluate the presence of a pelvic tilt, a trainer can use a consensus of four techniques:
  - The relationship of the anterior superior iliac spine (ASIS) and the posterior superior iliac spine (PSIS) (two bony landmarks on the pelvis)
  - The appearance of lordosis in the lumbar spine
  - The alignment of the pubic bone to the ASIS
  - The degree of flexion or hyperextension in the knees



Alignment of the ASIS and pubic bone

Deviation 4: Shoulder Position and Thoracic Spine

- Limitations and compensations to movement at the shoulder occur frequently due to the complex nature of the shoulder girdle.
  - Observation of the scapulae in all three planes provides good insight into the quality of movement a client has at the shoulders.
  - Locate the normal “resting” position of the scapulae



Shoulder Screen: Level Shoulders

- Determine whether the shoulders are level.
  - If the shoulders are not level, trainers need to identify potential reasons.

Shoulders: Torso/Shoulders Relative to Line of Gravity

- Determine whether the torso and shoulders are symmetrical relative to the line of gravity.
  - A torso lean would shift the alignment of the sternum and spine away from the plumb line and create tightness on the flexed side of the trunk.
  - However, if the hips are level with the floor and the spine is aligned with the plumb line, but the shoulders are not level with the floor, this may represent muscle imbalance within the shoulder complex itself.
  - An elevated shoulder may present with an overdeveloped or tight upper trapezius muscle.
  - A depressed shoulder may present with more forward rounding of the scapula.
  - The shoulder on a person's dominant side may hang lower than the non-dominant side.

Shoulders: Rotation of the Scapulae and/or Arms

- Determine whether the scapulae and/or arms are internally rotated.
- Anterior view
  - If the knuckles or the backs of the client's hands are visible when the hands are positioned at the sides, this generally indicates internal rotation of the humerus or scapular protraction.
- Posterior view
  - If the vertebral/inferior angles of the scapulae protrude outward, it indicates an inability of the scapulae stabilizers to hold the scapulae in place.

a. Scapular protraction

b. Scapular winging

Shoulders: Normal Kyphosis

- Determine whether the spine exhibits normal kyphosis.
  - With the client's consent, the trainer can run one hand gently up the thoracic spine between the scapulae.
  - The spine should exhibit a smooth, small, outward curve.

Shoulder Position		
Observation	**Muscles Suspected to Be Tight**	**Plane of View**
Shoulders not level	Upper trapezius, levator scapula, rhomboids	Frontal
Asymmetry to midline	Lateral trunk flexors (flexed side)	Frontal
Protracted (forward, rounded)	Serratus anterior*, anterior scapulohumeral muscles, upper trapezius	Sagittal
Medially rotated humerus	Pectoralis major, latissimus dorsi, subscapularis	Frontal
Kyphosis and depressed chest	Shoulder adductors, pectoralis minor, rectus abdominis, internal oblique	Sagittal

*Serratus anterior is usually tight with scapular protraction and is usually weak with scapular winging.

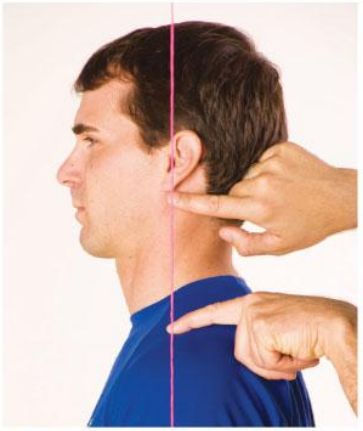
Deviation 5: Head Position

- With good posture, the earlobe should align approximately over the acromion process.
- A forward-head position is very common.
  - This altered position does not tilt the head downward, but simply shifts it forward.
  - The earlobe appears significantly forward of the acromioclavicular (AC) joint.

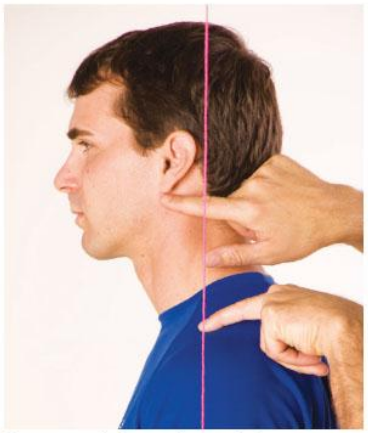
Head Position		
Observation	**Muscles Suspected to Be Tight**	**Plane of View**
Forward-head position	Cervical spine extensors, upper trapezius, levator scapulae	Sagittal

Forward-head Position Screen

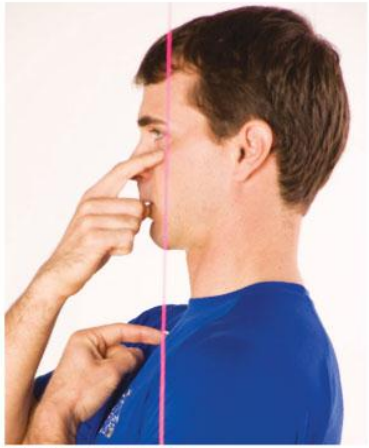
- In the sagittal view, align the plumb line with the AC joint, and observe its position relative to the ear.
- A forward-head position represents tightness in the cervical extensors and lengthening of the cervical flexors.
- With good posture, the cheek bone and the collarbone should almost be in vertical alignment with each other.



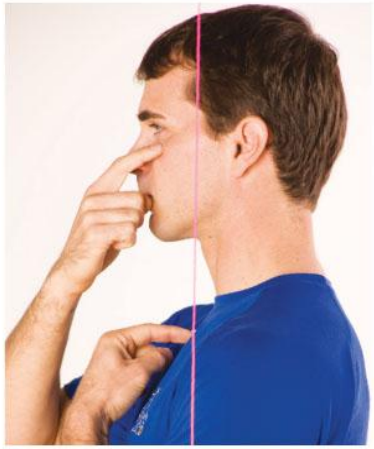
Good posture



Forward-head position



Good posture



Forward-head position

Movement Screens

- Observing active movement is an effective method to identify movement compensations.
- When compensations occur, it is indicative of altered neural action.
- These compensations normally manifest due to muscle tightness or an imbalance between muscles acting at the joint.

Five Primary Movements

- Movement can essentially be broken down and described by five primary movements that people perform during many daily activities:
  - Bending/raising and lifting/lowering movements (e.g., squatting)
  - Single-leg movements
  - Pushing movements
  - Pulling movements
  - Rotational movements
- ADL are essentially the integration of one or more of these primary movements.

Movement Screens and the Kinetic Chain

- Movement screens must be skill- and conditioning-level appropriate, and be specific to the client's needs.
  - Screens generally challenge clients with no recognized pathologies to perform basic movements.
  - This can help the personal trainer evaluate a client's stability and mobility throughout the entire kinetic chain.

Clearing Tests

- Prior to administering any movement screens, trainers should screen for pain by using basic clearing tests.
  - These tests may uncover issues that the individual did not know existed.
  - Trainers should select clearing tests according to the movements that require evaluation.
  - The objective when conducting clearing tests is to ensure that pain is not exacerbated by movement.
- Any client who exhibits pain during a clearing test should:
  - Be referred to his or her physician
  - Not perform additional assessments for that part of the body

Clearing Test: Cervical Spine

- The client performs the following movements in a seated position while the personal trainer monitors for any indication of pain:
  - Move the chin to touch the chest.
  - Tilt the head back until the face lies approximately parallel or near parallel to the floor.
  - Drop the chin left and right to rest on, or within 1 inch (2.5 cm) of, the shoulder or collarbone.

Clearing Test: Shoulder Impingement

- The client performs the following movement in a seated position while the personal trainer monitors for any indication of pain:
  - Reach one arm across the chest to rest upon the opposite shoulder and slowly elevate the elbow as high as possible.

Clearing Test: Low Back

- The client performs the following movements from a prone position while the personal trainer monitors for any indication of pain:
  - Slowly move into a trunk-extension position, producing lumbar extension and compression in the vertebrae and shoulder joint.
  - Move into a quadruped position and slowly sit back on the heels with outstretched arms, producing lumbar and hip flexion.

Bend and Lift Screen: Objective

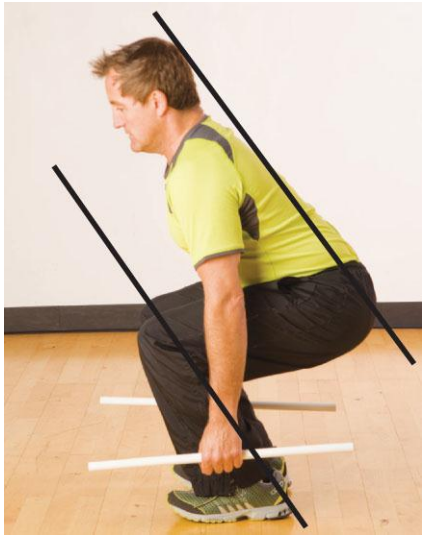
- To examine symmetrical lower-extremity mobility and stability, and upper-extremity stability during a bend-and-lift movement

Bend and Lift Screen: Frontal View Observations

- First repetition
  - Observe the stability of the foot.
- Second repetition
  - Observe the alignment of the knees over the second toe.
- Third repetition
  - Observe the overall symmetry of the entire body over the base of support.

Bend and Lift Screen: Sagittal View Observations

- First repetition
  - Observe whether the heels remain in contact with the floor.
- Second repetition
  - Determine whether the client exhibits “glute” or “knee” dominance.
- Third repetition
  - Observe whether the client achieves a parallel position between the tibia and torso in the lowered position, while controlling the descent phase.
- Fourth repetition
  - Observe the degree of lordosis in the lumbar/thoracic spine during lowering and in the lowered position.
- Fifth repetition
  - Observe any changes in head position.



Bend and Lift Screen: Potential Compensations

Bend and Lift Screen					
View		**Joint Location**	**Compensation**	**Key Suspected Compensations: Overactive (Tight)**	**Key Suspected Compensations: Underactive (Weak)**
☐	Anterior	Feet	Lack of foot stability: Ankles collapse inward/ feet turn outward	Soleus, lateral gastrocnemius, peroneals	Medial gastrocnemius, gracilis, sartorius, tibialis group
☐	Anterior	Knees	Move inward	Hip adductors, tensor fascia latae	Gluteus medius and maximus
☐	Anterior	Torso	Lateral shift to a side	Side dominance and muscle imbalance due to potential lack of stability in the lower extremity during joint loading	
☐	Sagittal	Feet	Unable to keep heels in contact with the floor	Plantarflexors	None
☐	Sagittal	Hip and knee	Initiation of movement	Movement initiated at knees may indicate quadriceps and hip flexor dominance, as well as insufficient activation of the gluteus group	
☐	Sagittal	Tibia and torso relationship Contact behind knee	Unable to achieve parallel between tibia and torso Hamstrings contact back of calves	Poor mechanics, lack of dorsiflexion due to tight plantarflexors (which normally allow the tibia to move forward) Muscle weakness and poor mechanics, resulting in an inability to stabilize and control the lowering phase	
☐	Sagittal	Lumbar and thoracic spine	Back excessively arches Back rounds forward	Hip flexors, back extensors, latissimus dorsi Latissimus dorsi, teres major, pectoralis major and minor	Core, rectus abdominis, gluteal group, hamstrings Upper back extensors
☐	Sagittal	Head	Downward Upward	Increased hip and trunk flexion Compression and tightness in the cervical extensor region	

Sources: Abelbeck, K.G. (2002). Biomechanical model and evaluation of a linear motion squat type exercise. *Journal of Strength and Conditioning Research*, 16, 516–524; Cook, G. (2003). *Athletic Body in Balance.* Champaign, Ill.: Human Kinetics; Donnelly, D.V. et al. (2006). The effect of directional gaze on kinematics during the squat exercise. *Journal of Strength and Conditioning Research,* 20, 145–150; Fry, A.C., Smith J.C., & Schilling, B.K. (2003). Effect of knee position on hip and knees torques during the barbell squat.*Journal of Strength and Conditioning Research,* 17, 629–633; Kendall, F.P. et al. (2005). *Muscles Testing and Function with Posture and Pain* (5th ed.). Baltimore, Md.: Lippincott Williams & Wilkins; Sahrmann, S.A. (2002). *Diagnosis and Treatment of Movement Impairment Syndromes.* St. Louis, Mo.: Mosby.

Hurdle Step Screen: Objective

- To examine simultaneous mobility of one limb and stability of the contralateral limb while maintaining both hip and torso stabilization under a balance challenge of standing on one leg

Hurdle Step Screen: Frontal View Observations

- First repetition
  - Observe the stability of the foot.
- Second repetition
  - Observe the alignment of the stance-leg knee over the foot.
- Third repetition
  - Watch for excessive hip adduction greater than 2 inches (5.1 cm) as measured by excessive stance-leg adduction or downward hip-tilting toward the opposite side.
- Fourth repetition
  - Observe the stability of the torso.
- Fifth repetition
  - Observe the alignment of the moving leg.

Hurdle Step Screen: Sagittal View Observations

- First repetition
  - Observe the stability of the torso and stance leg.
- Second repetition
  - Observe the mobility of the hip.

Hurdle Step Screen: Potential Compensations

Hurdle Step Screen					
View		**Joint Location**	**Compensation**	**Key Suspected Compensations: Overactive (Tight)**	**Key Suspected Compensations: Underactive (Weak)**
☐	Anterior	Feet	Lack of foot stability: Ankles collapse inward/feet turn outward	Soleus, lateral gastrocnemius, peroneals	Medial gastrocnemius, gracilis, sartorius, tibialis group, gluteus medius and maximus—inability to control internal rotation
☐	Anterior	Knees	Move inward	Hip adductors, tensor fascia latae	Gluteus medius and maximus
☐	Anterior	Hips	Hip adduction >2 inches (5.1 cm) Stance-leg hip rotation (inward)	Hip adductors, tensor fascia latae Stance-leg or raised-leg internal rotators	Gluteus medius and maximus Stance-leg or raised-leg external rotators
☐	Anterior	Torso	Lateral tilt, forward lean, rotation	Lack of core stability	
☐	Anterior	Raised-leg	Lack of ankle dorsiflexion Limb deviates from sagittal plane Hiking the raised hip	Ankle plantarflexors Raised-leg hip extensors Stance-leg hip flexors—limiting posterior hip rotation during raise	Ankle dorsiflexors Raised-leg hip flexors
☐	Sagittal	Pelvis and low back	Anterior tilt with forward torso lean Posterior tilt with hunched-over torso	Stance-leg hip flexors Rectus abdominis and hip extensors	Rectus abdominis and hip extensors Stance-leg hip flexors

Sources: Cook, G. (2003). *Athletic Body in Balance.* Champaign, Ill.: Human Kinetics; Kendall, F.P. et al. (2005). *Muscles Testing and Function with Posture and Pain* (5th ed.). Baltimore, Md.: Lippincott Williams & Wilkins; Sahrmann, S.A. (2002). *Diagnosis and Treatment of Movement Impairment Syndromes.* St. Louis, Mo.: Mosby.

Shoulder Push Stabilization Screen: Objective

- To examine stabilization of the scapulothoracic joint during closed-kinetic-chain pushing movements

Shoulder Push Stabilization Screen: Observations

- Observe any notable changes in the position of the scapulae relative to the ribcage at both end-ranges of motion.
- Observe for lumbar hyperextension in the press position.

Shoulder push stabilization screen with scapular winging

Should Push Screen: Potential Compensations

Shoulder Push Stabilization Screen				
View		**Joint Location**	**Compensation**	**Key Suspected Compensations**
☐	Sagittal	Scapulothoracic	Exhibits "winging" during the push-up movement	Inability of the parascapular muscles (i.e., serratus anterior, trapezius, levator scapula, rhomboids) to stabilize the scapulae against the ribcage. Can also be due to a flat thoracic spine.
☐	Sagittal	Trunk	Hyperextension or "collapsing" of the low back	Lack of core, abdominal, and low-back strength, resulting in instability

Sources: Sahrmann, S.A. (2002). *Diagnosis and Treatment of Movement Impairment Syndromes.* St. Louis, Mo.: Mosby; Kendall, F.P. et al. (2005). *Muscles Testing and Function with Posture and Pain* (5th ed.). Baltimore, Md.: Lippincott Williams & Wilkins.

Shoulder Pull Stabilization Screen: Objective

- To examine the client's ability to stabilize the scapulothoracic joint during closed-kinetic-chain pulling movements

Starting position

Test position

Shoulder Pull Stabilization Screen: Observations

- Observe any bilateral discrepancies between the pulls on each arm.
- Observe the ability to stabilize the trunk during the pull movement.
  - That is, the ability of the core to stiffen and lift the hips with the shoulders and resist trunk rotation during the lift.

Shoulder Pull Screen: Potential Compensations

Shoulder Pull Stabilization Screen				
View		**Joint Location**	**Compensation**	**Key Suspected Compensations**
☐	Sagittal	Scapulothoracic	Scapula moves into protraction during the pull	Inability of the parascapular muscles (i.e., serratus anterior, trapezius, levator scapula, rhomboids) to stabilize the scapulae against the ribcage
☐	Transverse	Trunk	Rotation during the pull	Lack of core stability

Source: Cook, G. (2003). *Athletic Body in Balance*. Champaign, Ill.: Human Kinetics.

Thoracic Spine Mobility Screen: Objective

- To examine bilateral mobility of the thoracic spine
- Lumbar spine rotation is considered insignificant, as it only offers approximately 15 degrees of rotation.

Starting position

End position

T-Spine Mobility Screen: General Interpretations

- Observe any bilateral discrepancies between the rotations in each direction.
  - Identify the origin(s) of movement limitation or compensation.
  - This screen evaluates trunk rotation in the transverse plane.
  - Evaluate the impact on the entire kinetic chain.
  - The lumbar spine generally exhibits limited rotation of approximately 15 degrees, with the balance of trunk rotation occurring through the thoracic spine.
  - If thoracic spine mobility is limited, the body strives to gain movement in alternative planes within the lumbar spine.

Thoracic Spine Screen: Potential Compensations

Thoracic Spine Mobility Screen				
View		**Joint Location**	**Compensation**	**Possible Biomechanical Problems**
☐	Transverse	Trunk	None if trunk rotation achieves 45 degrees in each direction	
☐	Transverse	Trunk	Bilateral discrepancy (Assuming no existing congenital issues in the spine)	Side-dominance Differences in paraspinal development Torso rotation, perhaps associated with some hip rotation *Note:* Lack of thoracic mobility will negatively impact glenohumeral mobility

Source: Sahrmann, S.A. (2002). *Diagnosis and Treatment of Movement Impairment Syndromes.* St. Louis, Mo.: Mosby.

Flexibility and Muscle-length Testing

- A personal trainer may opt to assess the flexibility of specific muscle groups.
- Specific muscle groups that frequently demonstrate tightness or limitations to movement are discussed in this section.
- The table on the following slide provides normal ranges of motion for healthy adults at each joint.

Average Ranges of Motion

Average Range of Motion for Healthy Adults			
Joint and Movement	**ROM (°)**	**Joint and Movement**	**ROM (°)**
Shoulder/Scapulae		*Thoraco-lumbar Spine*	
Flexion	150–180	Lumbar flexion	40–45
Extension	50–60	Thoracic flexion	30–40
Abduction	180	Lumbar extension	30–40
Internal/medial rotation	70–80	Thoracic extension	20–30
External/lateral rotation	90	Lumbar rotation	10–15
Shoulder horizontal adduction	90*	Thoracic rotation	35
Shoulder horizontal abduction	30–40*	Lumbar lateral flexion	20
		Thoracic lateral flexion	20–25
Elbow		*Hip*	
Flexion	145	Flexion	100–120
Extension	0	Extension	10–30
		Abduction	40–45
Radio-ulnar		Adduction	20–30
Pronation	90	Internal/medial rotation	35–45
Supination	90	External/lateral rotation	45–60
Wrist		*Knee*	
Flexion	80	Flexion	125–145
Extension	70	Extension	0–10
Radial deviation	20		
Ulnar deviation	45	*Ankle*	
		Dorsiflexion	20
Cervical Spine		Plantarflexion	45–50
Flexion	45–50		
Extension	45–75	*Subtalar*	
Lateral flexion	45	Inversion	30–35
Rotation	65–75	Eversion	15–20

*Zero point (0 degrees) is with the arms positioned in frontal-plane abduction at shoulder height.

Source: Adapted from Kendall, F.P. et al. (2005). *Muscles Testing and Function with Posture and Pain* (5th ed.). Baltimore, Md.: Lippincott Williams & Wilkins.

Thomas Test—Hip Flexion/Quad Length: Objective

- To assess the length of the muscles involved in hip flexion
  - This test should not be conducted on clients suffering from low-back pain, unless cleared by their physician.

Starting position

Test position

Thomas Test—Hip Flexion/Quad Length: Observations

- Observe whether the back of the lowered thigh touches the table (hips positioned in 10 degrees of extension).
- Observe whether the knee of the lowered leg achieves 80 degrees of flexion.
- Observe whether the knee remains aligned straight or falls into internal or external rotation.

Thomas Test: General Interpretations

Interpretation of the Thomas Test	
Movement/Limitation	**Suspected Muscle Tightness**
With the back and sacrum flat, the back of the lowered thigh does not touch the table and the knee cannot flex to 80 degrees.	Primary hip flexor muscles
With the back and sacrum flat, the back of the lowered thigh does not touch the table, but the knee does flex to 80 degrees.	The iliopsoas, which is preventing the hip from rotating posteriorly (this would allow the back of the thigh to touch the table)
With the back and sacrum flat, the back of the lowered thigh does touch the table, but the knee does not flex to 80 degrees.	The rectus femoris, which does not allow the knee to bend

Source: Adapted from Kendall, F.P. et al. (2005). *Muscles Testing and Function with Posture and Pain* (5th ed.). Baltimore, Md.: Lippincott Williams & Wilkins.

Passive Straight-leg (PSL) Raise: Objective

- To assess the length of the hamstrings

Trainer's hand position

Test position

Passive Straight-leg (PSL) Raise: Observations

- Note the degree of movement attained from the table or mat that is achieved before the spine compresses the hand under the low back or the opposite leg begins to show visible signs of lifting off the table or mat.
  - The mat or table represents 0 degrees.
  - The leg perpendicular to the mat or table represents 90 degrees.

Passive Straight-leg Raise: General Interpretations

Interpretation of the Passive Straight-leg Raise	
Movement/Limitation	**Hamstrings Length**
The raised leg achieves ≥80 degrees of movement before the pelvis rotates posteriorly.	Normal hamstrings length
The raised leg achieves <80 degrees of movement before the pelvis rotates posteriorly or there are any visible signs in the opposite leg lifting off the mat or table.	Tight hamstrings

Source: Kendall, F.P. et al. (2005). *Muscles Testing and Function with Posture and Pain* (5th ed.). Baltimore, Md.: Lippincott Williams & Wilkins.

Shoulder Mobility Assessment

- Apley's scratch test involves multiple and simultaneous movements of the scapulothoracic and glenohumeral joints in all three planes.
  - To identify the source of the limitation, trainers can first perform various isolated movements in single planes to locate potentially problematic movements.
- Consequently, the scratch test is completed in conjunction with:
  - The shoulder flexion-extension test
  - An internal-external rotation test of the humerus

Apley's Scratch Test—Shoulder Mobility: Objective

- To assess simultaneous movements of the shoulder girdle (primarily the scapulothoracic and glenohumeral joints)
- Movements include:
  - Shoulder extension and flexion
  - Internal and external rotation of the humerus at the shoulder
  - Scapular abduction and adduction

Apley's scratch test: Shoulder flexion, external rotation, and scapular abduction

Apley's scratch test: Shoulder extension, internal rotation, and scapular adduction

Apley's Scratch Test—Shoulder Mobility: Observations

- Note the client's ability to touch the medial border of the contralateral scapula or how far down the spine he or she can reach with shoulder flexion and external rotation.
- Note the client's ability to touch the opposite inferior angle of the scapula or how far up the spine he or she can reach with shoulder extension and internal rotation.
- Observe any bilateral differences between the left and right arms in performing both movements.

Apley's Scratch: General Interpretations

Interpretation of Apley's Scratch Test	
Movement/Limitation	**Shoulder Mobility***
Ability to touch specific landmarks	Good shoulder mobility
Inability to reach or touch the specific landmarks or discrepancies between the limbs	Requires further evaluation to determine the source of the limitation (i.e., which of the movements is problematic) • Shoulder flexion and extension • Internal and external rotation of the humerus • Scapula abduction and adduction

*Tightness of the joint capsules and ligaments may also contribute to limitations. It is common to see greater restriction on the dominant side due to increased muscle mass.

Source: Kendall, F.P. et al. (2005). *Muscles Testing and Function with Posture and Pain* (5th ed.). Baltimore, Md.: Lippincott Williams & Wilkins.

Shoulder Flexion Test: Objective

- To assess the degree of shoulder flexion
  - This test should be performed in conjunction with Apley's scratch test to determine if the limitation occurs with shoulder flexion or extension.

Shoulder Extension Test: Objective

- To assess the degree of shoulder extension
  - This test should be performed in conjunction with Apley's scratch test to determine if the limitation occurs with shoulder flexion or extension.

Shoulder Flexion/Extension Tests: Observations

- Measure the degree of movement in each direction.
- Note any bilateral differences between the left and right arms in performing both movements.

Shoulder Flexion/Extension: General Interpretations

Interpretation of the Shoulder Flexion and Extension Test	
Movement/Limitation—Flexion	**Shoulder Mobility**
Ability to flex the shoulders to 170–180 degrees (hands touching/ nearly touching floor)	Good shoulder mobility
Inability to flex the shoulders to 170 degrees or discrepancies between the limbs	Potential tightness in the pectoralis major and minor, latissimus dorsi, teres major, rhomboids, and subscapularis Tightness in the latissimus dorsi will force the low back to arch. Tightness of the pectoralis minor may tilt the scapulae forward (anterior tilt) and prevent the arms from touching the floor. Tight abdominals may depress the ribcage, tilting the scapulae forward (anterior tilt), and prevent the arms from touching the floor. Thoracic kyphosis may round the thoracic spine and prevent the arms from touching the floor.
Movement/Limitation—Extension	**Shoulder Mobility**
Ability to extend the shoulders to 50–60 degrees off the floor	Good shoulder mobility
Inability to extend the shoulders to 50 degrees or discrepancies between the limbs	Potential tightness in pectoralis major, abdominals, subscapularis, certain shoulder flexors (anterior deltoid), coracobrachialis, and biceps brachii Tightness in the abdominals may prevent normal extension of the thoracic spine and ribcage. Tightness in the biceps brachii may prevent adequate shoulder extension with an extended elbow (but may permit extension with a bent elbow).

Sources: Kendall, F.P. et al. (2005). *Muscles Testing and Function with Posture and Pain* (5th ed.). Baltimore, Md.: Lippincott Williams & Wilkins; Houglum, P.A. (2005). *Therapeutic Exercise for Musculoskeletal Injuries* (2nd ed). Champaign, Ill.: Human Kinetics.

External Rotation—Humerus (Shoulder): Objective

- To assess external rotation of the humerus at the shoulder joint to evaluate medial rotators
  - This test should be performed in conjunction with Apley's scratch test to determine if the limitation occurs with internal or external rotation of the humerus.

Internal Rotation—Humerus (Shoulder): Objective

- To assess internal rotation of the humerus at the shoulder joint to evaluate lateral rotators
  - This test should be performed in conjunction with Apley's scratch test to determine if the limitation occurs with internal or external rotation of the humerus.

Internal/External Rotation—Humerus: Observations

- Measure the degree of movement in each direction.
- Note any bilateral differences between the left and right arms in performing both movements.

Internal/External Rotation—Humerus: Interpretation

Interpretation of the External and Internal Rotation Test	
Movement/Limitation—External/Lateral Rotation	**Shoulder Mobility**
Ability to externally rotate the forearms 90 degrees to touch the mat	Good mobility in the internal (medial) rotators, allowing the joint to move through the full range
Inability to reach the floor or discrepancies between the limbs	Potential tightness in the medial rotators of the arm (i.e., subscapularis) The joint capsule and ligaments may also be tight and limit rotation.
Movement/Limitation—Internal/Medial Rotation	**Shoulder Mobility**
Ability to internally rotate the forearms 70 degrees toward the mat (i.e., forearms are 20 degrees off the mat)	Good mobility in the external (lateral) rotators, allowing the joint to move through the full range
Inability to internally rotate the forearm 70 degrees, or discrepancies between the limbs	Potential tightness in the lateral rotators of the arm (i.e., infraspinatus and teres minor) The joint capsule and ligaments may also be tight and limit rotation.

Sources: Kendall, F.P. et al. (2005). *Muscles Testing and Function with Posture and Pain* (5th ed.). Baltimore, Md.: Lippincott Williams & Wilkins; Houglum, P.A. (2005). *Therapeutic Exercise for Musculoskeletal Injuries* (2nd ed). Champaign, Ill.: Human Kinetics.

Balance and the Core

- Balance and core baseline assessments evaluate the need for comprehensive balance training and core conditioning.
- Dynamic balance tests are generally movement-specific and quite complex.
  - Trainers should aim to first evaluate the basic level of static balance that a client exhibits by using the sharpened Romberg test or the stork-stand test.

Sharpened Romberg Test: Objective

- To assess static balance by standing with a reduced base of support while removing visual sensory information

Sharpened Romberg Test: Observations

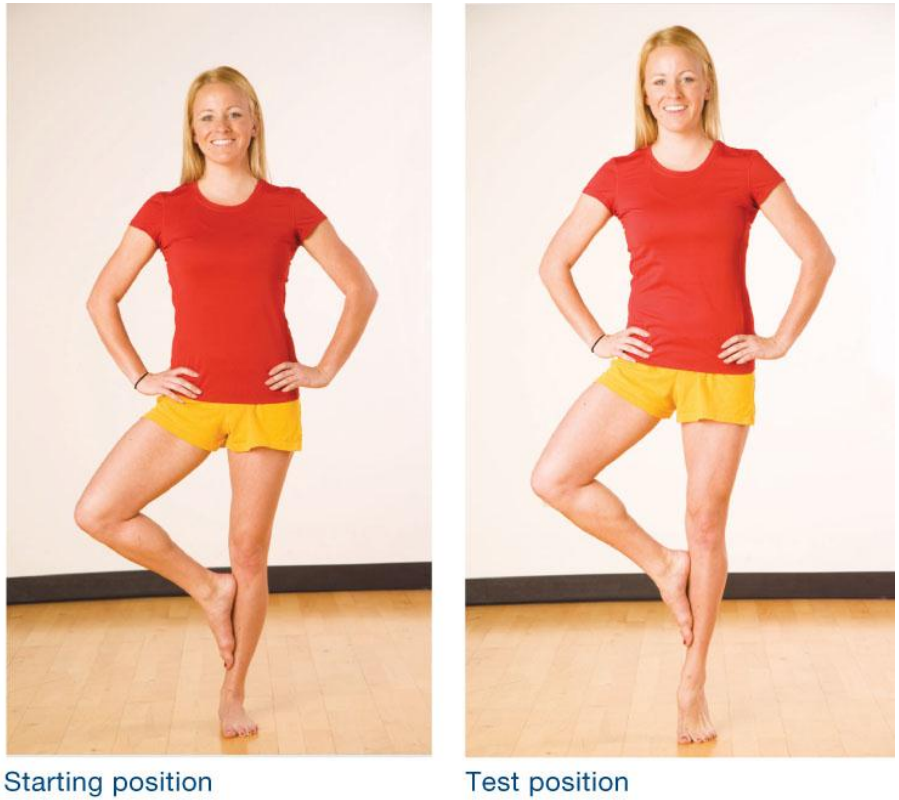
- Continue to time the client's performance until one of the following occurs:
  - The client loses postural control and balance
  - The client's feet move on the floor
  - The client's eyes open
  - The client's arms move from the folded position
  - The client exceeds 60 seconds with good postural control

Sharpened Romberg Test: General Interpretations

- The client needs to maintain his or her balance with good postural control (without excessive swaying) and not exhibit any of the test-termination criteria for 30 or more seconds.
- The inability to reach 30 seconds is indicative of inadequate static balance and postural control.

Stork-stand Balance Test: Objective

- To assess static balance by standing on one foot in a modified stork-stand position



Starting position

Test position

Stork-stand Balance Test: Observations

- Timing stops when any of the following occurs:
  - The hand(s) come off the hips
  - The stance or supporting foot inverts, everts, or moves in any direction
  - Any part of the elevated foot loses contact with the stance leg
  - The heel of the stance leg touches the floor
  - The client loses balance

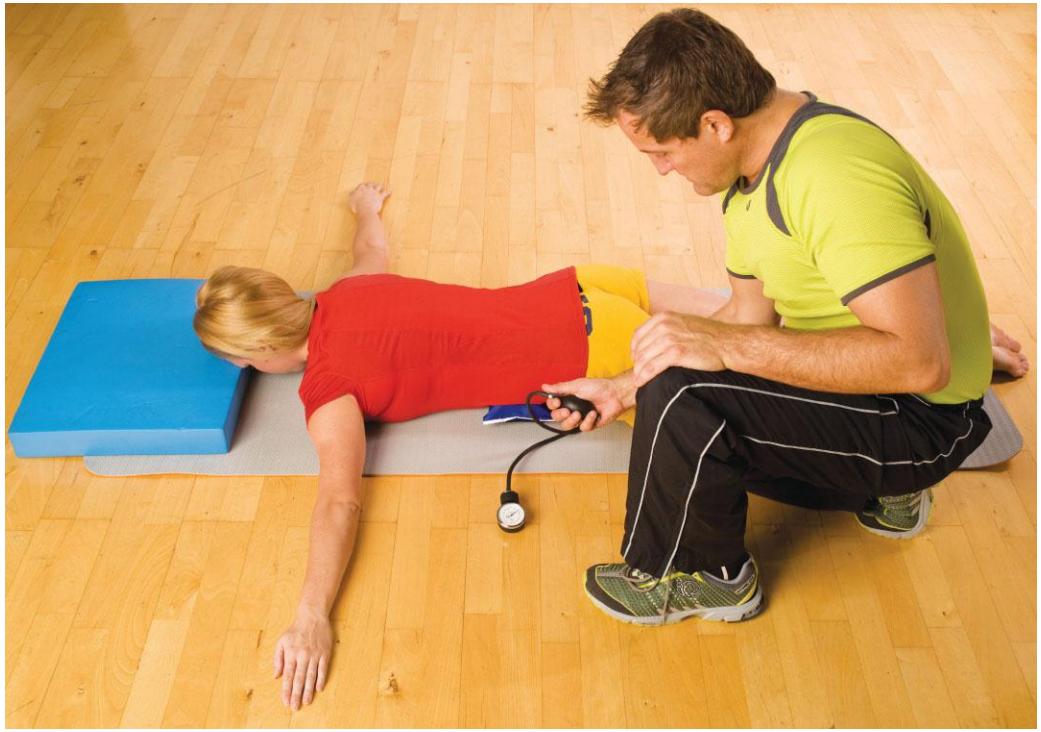
Stork-stand Balance Test: General Interpretation

The Stork-stand Balance Test					
Rating	**Excellent**	**Good**	**Average**	**Fair**	**Poor**
Males	>50 seconds	41–50 seconds	31–40 seconds	20–30 seconds	<20 seconds
Females	>30 seconds	25–30 seconds	16–24 seconds	10–15 seconds	<10 seconds

Source: Johnson B.L. & Nelson, J.K. (1986). *Practical Measurements for Evaluation in Physical Education* (4th ed.). Minneapolis, Minn.: Burgess.

Core Function—BP Cuff Test: Objective

- To assess core function, as demonstrated by the ability to draw the abdominal wall inward via the coordinated action of the transverse abdominis (TVA) and related core muscles without activation of the rectus abdominis



Core Function—BP Cuff Test: Observations

- While the client attempts the contraction, carefully monitor for any movement of the hips, ribcage, or shoulders.
- Clients must avoid any movement at the ankles (dorsiflexion) or pushing from the elbows that would be used as leverage to raise the torso.

Core Function—BP Cuff Test: General Interpretation

- A good indicator of TVA function is the ability to reduce the pressure in the cuff by 10 mmHg during the contraction.
  - If a client lacks effective core function, he or she usually recruits the rectus abdominis muscle instead to achieve the desired movement.
  - No change or a change <10 mmHg does not necessarily represent a lack of core function.

Summary

- Trainers should adhere to the principle of “straightening the body before strengthening it.”
- Trainers should consider performing the assessments in Chapter 7 of the *ACE Personal Trainer Manual* (4th ed.), in the sequence presented.
- This session covered:
  - Static postural assessment
  - Movement screens
  - Flexibility and muscle-length testing
  - Shoulder mobility assessment
  - Balance and the core