Chapter 5: Trunk Range of motion:
Flexion and Extension
Anterosuperior iliac spine
Scapular instability and, specifically, serratus anterior weakness can interfere with the back extension test, as seen in the accompanying photograph.

Note: *Push-ups should not be done by individuals who exhibit this type of weakness.*
Movements of The Vertebral Column
Movements of The Vertebral Column
Movements of The Vertebral Column

Less-than-average back extension range of motion but normal muscle strength.
Average back extension range of motion, with anterosuperior-iliac spines in contact with the table.
Excessive range of motion in back extension plus hip joint extension that raises the anterosuperior-iliac spines from the table. This subject is a diver and also has excessive flexion of the back. (See p. 175.)
Movements of The Spine and Pelvis
 Movements of The Spine and Pelvis
The pelvis is in the neutral position, and the lumbar spine is in a normal anterior curve.

The pelvis is in a posterior tilt of 10°, and the lower back is flat (i.e., normal flexion).
Forward-Bending Test For Length of Posterior Muscles

Normal length of back, hamstring, and gastroc-soleus muscles.
Variations In Length of Posterior Muscles
Back And Hip Extensors
Back Extensors: Testing And Grading
Strong Back Extensors, Misdiagnosed
Quadratus Lumborum
Lateral Trunk Flexor And Hip Abductors

STRONG LATERAL TRUNK MUSCLES AND STRONG HIP ABDUCTOR MUSCLES

Lateral trunk flexion through the subject’s full range of motion.

Hip abduction through the subject’s full range of motion.
STRONG LATERAL TRUNK MUSCLES AND PARALYZED HIP ABDUCTOR MUSCLES

The subject can laterally flex the trunk, but the underneat shoulder will scarcely be raised from the table. The pelvis will be drawn upward as the head is raised laterally, and the iliac crest and costal margin will be approximated.

In attempting to raise the extremity in abduction, the movement that occurs is elevation of the pelvis by the lateral trunk muscles. The extremity may be drawn upward into the position as illustrated, but the hip joint is not abducted. In fact, the thigh has dropped into a position of adduction and is held there by the joint structure rather than by action of the hip muscles.
WEAK LATERAL TRUNK MUSCLES AND STRONG HIP ABDUCTOR MUSCLES

The subject cannot raise the trunk in true lateral flexion. Under certain circumstances, the patient may be able to raise the trunk from the table laterally even though the lateral trunk muscles are quite weak. If the trunk can be held rigid, the hip abductor muscles may raise the trunk in abduction on the thigh. The rib cage and iliac crest will not be approximated laterally as they are when the lateral trunk muscles are strong. By decreasing the pressure providing fixation for the hip abductors, the examiner can make it necessary for the lateral abdominals to attempt initiation of the movement.

The extremity can be lifted in hip abduction, but without fixation by the lateral abdominal muscles, it cannot be raised high off the table. Because of the weakness of the lateral trunk muscles, the weight of the extremity tilts the pelvis downward.
Oblique Trunk Flexors” Testing and Grading
Movements During Curled-Trunk Sit-Ups With Legs Extended

<table>
<thead>
<tr>
<th>SPINE</th>
<th>PELVIS</th>
<th>HIP JOINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical (Neck)</td>
<td></td>
<td>Anatomical</td>
</tr>
<tr>
<td>Thoracic (Upper Back)</td>
<td></td>
<td>degrees</td>
</tr>
<tr>
<td>Lumbar (Low Back)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Position: Supine, hands clasped behind head

<table>
<thead>
<tr>
<th></th>
<th>Pelvis</th>
<th>Femur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero</td>
<td>(Normal anterior curve)</td>
<td>(Normal posterior curve)</td>
</tr>
<tr>
<td>Neutral position</td>
<td>(Normal anterior curve)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zero 180°</td>
</tr>
</tbody>
</table>
Movement: Posterior pelvic tilt, lumbar spine flexion, and hip joint extension.

<table>
<thead>
<tr>
<th></th>
<th>Zero</th>
<th>Zero</th>
<th>Flexed (straight)</th>
<th>10° posterior tilt</th>
<th>10° extension</th>
<th>180°</th>
</tr>
</thead>
</table>
Movement: Cervical and thoracic spine flexion. Figure C represents completion of spine flexion phase and beginning of hip flexion phase.
**Movement:** Hip joint flexion. The hip joint has moved from a 190° angle of flexion to a 150° angle by pelvis flexing toward femur.

<table>
<thead>
<tr>
<th>Flexed (straight)</th>
<th>Flexed (curled)</th>
<th>Flexed (straight)</th>
<th>Posterior tilt in relation to trunk</th>
<th>Flexed 30°</th>
</tr>
</thead>
<tbody>
<tr>
<td>150°</td>
<td></td>
<td></td>
<td>Anterior tilt toward thigh</td>
<td></td>
</tr>
<tr>
<td>90°</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The diagram shows a comparison of the angles in flexion and shows the movement of the hip joint.
**Movement:** Hip joint flexion, and return toward zero position of cervical and thoracic spines.

<table>
<thead>
<tr>
<th>Toward zero</th>
<th>Toward zero</th>
<th>Flexed (straight)</th>
<th>Posterior tilt in relation to trunk</th>
<th>Anterior tilt toward thigh</th>
<th>Flexed so*</th>
<th>100°</th>
</tr>
</thead>
</table>
Movements During Curled-Trunk Sit-Ups With Hips And Knees Flexed

<table>
<thead>
<tr>
<th>SPINE</th>
<th>PELVIS</th>
<th>HIP JOINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical (Neck)</td>
<td></td>
<td>Anatomical degrees</td>
</tr>
<tr>
<td>Thoracic (Upper Back)</td>
<td></td>
<td>Geometric degrees</td>
</tr>
<tr>
<td>Lumbar (Low Back)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position: Supine, hands elapsed behind head, knees bent.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero (Normal anterior curve)</td>
<td>Zero (Normal posterior curve)</td>
<td>Neutral position</td>
</tr>
<tr>
<td>130°</td>
<td>50°</td>
<td>130°</td>
</tr>
</tbody>
</table>
Movement. Lumbar spine flexion and 10° decrease in hip joint flexion by virtue of posterior pelvic tilt.
Movement: Cervical and thoracic spine flexion. Figure C represents completion of spine flexion and the beginning of the flexion of the pelvis toward flexed thigh.
Movement: Hip joint flexion. The hip joint has moved from a 140° angle of flexion to a 100° angle by the pelvis flexing toward the femur.
Movement: Hip joint flexion, and a return toward zero position of the cervical and thoracic spines. On the basis of 125° being complete flexion, hip joint has reached the position of complete flexion.

<table>
<thead>
<tr>
<th>Toward zero</th>
<th>Toward zero</th>
<th>Flexed (straight)</th>
<th>Posterior tilt in relation to trunk</th>
<th>Anterior tilt toward thigh</th>
<th>125° (50° thigh + 75° pelvis)</th>
<th>55°</th>
</tr>
</thead>
</table>
Abdominal And Hip Flexor Muscles During Curled-Trunk Sit-Ups
POSTERIOR PELVIC TILT, LUMBAR SPINE FLEXION, AND HIP JOINT EXTENSION

POSTERIOR PELVIC TILT, LUMBAR SPINE FLEXION, AND HIP JOINT FLEXION
SPINE FLEXION PHASE (TRUNK-CURL) COMPLETED
HIP FLEXION PHASE (SIT-UP) INITIATED
HIP FLEXION PHASE (SIT-UP) CONTINUED
HIP FLEXION PHASE (SIT-UP) COMPLETED
Definitions And Descriptions of Trunk Movements
Rectus Abdominis
Anterior view of abdomen showing division of right external oblique into a, b, c, and d parts and left internal oblique into a', b', and c' parts.
Anterior view showing left and right portions (L. R. and R. R.) of rectus abdominis, and left and right portions (L. T. and R. T.) of transversus abdominis.
Posterior view showing posterior fibers of transversus abdominis.
Posterior view showing posterior fibers of left internal oblique, *a.* and right external oblique, *c.*
Lateral view of left external oblique showing a, b, and c portions.
Lateral view of left internal oblique showing a', b', c', and d' portions.
Differentiating Action of The Upper And Lowe Abdominals

![Diagram showing differentiating actions of upper and lower abdominals](image)
Differentiating Action of The Upper and Lower Abdominals
Upper Abdominal Muscles: Testing And Grading
Abdominal Muscle Weakness Trunk Raising
Abdominal And Hip Flexor Imbalance
Strong Hip Flexors, Weak Abdominals
Sit-Up Exercises
Therapeutic Exercises: Trunk Curl
Abdominal Muscle During Leg Lowering
Lower Abdominal Muscles Testing And Grading
Therapeutic Exercises:

Posterior Pelvic Tilt
Therapeutic Exercises: Trunk Rotation
Marked Abdominal Muscle Weakness: Testing And Grading

Diagram showing:
- Trunk Raising
- Leg Lowering
Low Back Pain
Anterior Pelvic Tilt

A
Kyphotic-lordotic posture.

B
Hip flexion with the trunk inclined forward.
Back Support
Posterior Pelvic Tilt

Flat-back posture.

Sway-back posture.