

# The Spine

## Objectives:

After completing this lab, you should be able to:

- Identify major bony landmarks and muscles of the spine,
- Measure and identify normal and abnormal spinal range of motion,
- Perform tests to identify normal and abnormal strength and length of the muscles around the spine
- Identify the relationship of the hip, pelvis, spine and head
- Identify the location and function of the supporting structures of the spine

## Equipment:

- Goniometer
- Marking pencil
- Tape measure

## Reading Material:

1. Kendall, F. P., E. K. McCreary, P. G. Provance, M. M. Rodgers, and W. A. Romani, 5<sup>th</sup> Ed. 2005. *Muscles, Testing and Function With Posture and Pain*. Williams & Wilkins, Baltimore.  
**Chapter 4: Neck (pg. 141-163)**  
**Chapter 5: Trunk and Respiratory Muscles (pg. 165-232, 242-243)**

## Procedures:

1. While your subject is in a sitting or standing position, find and mark the following bony landmarks:
  - **Occipital protuberance**: the bony prominence in the middle of the base of the skull
  - **Mastoid process**: the most lateral bony prominence at the base of the skull
  - Spinous process of cervical spine 7 (**C7**): the most prominent cervical spine process when you fully flex your neck
  - Spinous process of thoracic spine 3 (**T3**): located at the midline of the back at the same level as the root of the spine of the scapula
  - Spinous process of thoracic spine 7 (**T7**): located at the same level as the inferior angle of the scapula
  - **ASIS, iliac crest, PSIS** and **sacral bone** in standing
  - Spinous process of lumbar spine 4 (**L4**): located in the midline at the same level as the iliac crest
  - From the landmarks above, mark **all the spinous processes** between them
2. Identify the location and attachments of the following extrinsic muscles of the cervical spine on your subject

Neck Flexors:

- Sternocleidomastoid
- Scalenes (Anterior, Medial, and Posterior parts)

Neck Extensors:

- Levator Scapulae
- Trapezius (Upper, Middle, and Lower portions)

3. Identify and review the origins, insertions and actions of the following muscles:

- Paraspinal muscles
- Quadratus Lumborum
- Lumbar Multifidus
- Rectus Abdominis (RA)
- External Abdominal Oblique (EO)
- Internal Abdominal Oblique (IO)
- Transverse Abdominis (TA)

4. Observe and compare the size of the paraspinal muscles of the right and left sides. If the size of one side is bigger than the other by ½ inch, it is a significant difference between the two sides. The bigger side may limit lateral flexion to the opposite side.

5. Observe and record lumbar, thoracic, shoulder, and head & neck posture for: (Summary on pages 90-94)

- Kyphosis and Lordosis (Kendall, pg 66)
- Lordosis (Kendall, pg 67)
- Flat-back (Kendall, pg. 68)
- Sway-back (Kendall, pg. 72)
- Head anterior/posterior tilt and forward head (Kendall, pg. 152-153)
- Rotation of the lumbar and cervical spine
- Measure the height of the iliac crest and shoulder from the ground (both left and right side)

**Table 1. Posture of the spine, ribcage, pelvis, and shoulder in standing**

Segment	Sagittal plane	Coronal plane	Transverse plane
Head			
Cervical			
Thoracic			
Ribcage			
Lumbar			
Pelvis			

6. Observe and measure the **infrasternal angle**, which is the angle from by the right and left rib cage with the apex at the xiphoid process. Normal infrasternal angle should be 90°. Weakness or tightness of the abdominal muscle will result in different infrasternal angle.
7. Range of motion of the *lumbar spine*
- Flexion: Have your subject assume a standing position and then slowly curl the spine forward without tilting the pelvis. Keep the knees straight and minimize shifting of the hips. The end of motion is achieved when the lumbar spine is flat. Make sure that there is no tilting of the pelvis. Lumbar spine flexion is measured by the angle of the lumbar spine relative to the vertical line with the axis at the S1 level. The normal spine should measure 20°. During forward bending, observe the movement of both lumbar and thoracic spine and rib cage.
  - Lateral Flexion: In standing position, have your subject slowly bend the spine to the side without rotating or tilting the pelvis. Observe the movement of the lumbar spine and measure the angle of the lumbar spine relative to the vertical with the axis at the S1 level. Normal lateral flexion range should measure 30°.
  - Extension: Have your subject assume a prone position on a table, resting on the forearms. If the subject can extend his lumbar spine with the pelvis flat on the table, the range of extension is good. Measure the height of the ASIS from the table as an indicator of lumbar extension.

**Table 2. Range of Motion of Lumbar spine**

Movement	Measurement
Lumbar Flexion	
Lumbar Lateral Flexion to the right	
Lumbar Lateral Flexion to the Left	
Lumbar Extension	

8. Range of motion of the *cervical spine*
- Flexion/Extension: Measure the range of motion of the cervical spine while your subject is sitting in a chair with his/her back against the back rest to stabilize the thoracic and lumbar spine. Align the stationary arm of a goniometer with the lateral side, pointing upward vertically with the axis over the external auditory meatus. Align the moveable arm with the base of the nares. Have the subject move his/her chin toward the sternal notch to measure cervical flexion and then look up toward the ceiling to measure cervical extension. Record the angle between the moveable arm and the line perpendicular to the floor. Normal flexion and extension range of the cervical spine should measure 45°.

- Lateral Flexion: Have the subject assume a sitting position. Align the stationary arm of the goniometer on the posterior side, pointing downward vertically with the axis at the C7 spinous process. Point the moveable arm upward in the same line as the occipital protuberance. Subject moves his/her head toward the shoulder. Cervical lateral flexion range is the angle between the moveable arm relative to the vertical line. Normal lateral flexion range of the cervical spine should measure 45°.
- Rotation: Put the axis of the goniometer at the vertex with the end of the stationary arm pointing toward the acromion process. The end of the moveable arm is parallel to the nose. Have the subject rotates his/her neck to the side. Cervical rotation range is the angle between the moveable arm at the starting position and at the end. Normal rotation range of the cervical spine should measure 60°

**Table 3. Range Motion of Cervical spine**

<b>Movement</b>	<b>Starting Position</b>	<b>End Position</b>	<b>Range of Motion</b>
Flexion			
Extension			
Left Lateral Flexion			
Right Lateral Flexion			
Left Rotation			
Right Rotation			

### 9. Muscle Testing

- Anterior neck flexors (Kendall, pg. 154-155)
- Anterolateral neck flexors (Kendall, pg. 156)
- Posterolateral neck extensors (Kendall, pg. 157)
- Upper Trapezius (Kendall, pg. 158)
- Upper abdominals (IO and RA): trunk curl / sit-up (Kendall, pg. 200-203)
- Lower abdominals (EO and RA): Lower abdominal progression (Kendall, pg. 212-214)
- Combined IO and EO (Kendall, pg. 195-196):
  - Active hip and knee flexion in supine position: monitor the ASISs while the subject performs active hip and knee flexion. Poor control is indicated if one ASIS rotates more than ½ inch.
  - Active hip abduction and external rotation with hip and knee in flexion and foot on the supporting surface: Monitor the ASISs while the subject performs the movement.
  - Supine diagonal trunk curls (Kendall, pg. 186)
- Back extensors (Kendall, pg. 181)
- Quadratus Lumborum (Kendall, pg. 183)
- Lateral trunk flexors (Kendall, pg. 185)

### Questions:

1. Does your subject have limited ROM of the cervical spine? If yes, what are the ranges?
2. If your subject has limited left lateral flexion, what muscle(s) may be too short?
3. If your subject has limited neck flexion, what muscle (s) may be too short?
4. Design an appropriate exercise to stretch the levator scapulae muscle.
5. Design an appropriate exercise to correct a forward head posture.
6. What is your subject's posture of the cervical, thoracic, and lumbar spine?
7. Does your subject have scoliosis? If yes, describe the curve. (C or S curve)
8. Does your subject have an asymmetrical paraspinal muscle?
9. Assume that your subject has a shortened RA muscle, what would be the posture of the chest wall?
10. If the EO muscles are short, what would the infrasternal angle be ( $>$  or  $<$  than  $90^\circ$ )?
11. If the IO muscles are short, what would the infrasternal angle be ( $<$  or  $>$  than  $90^\circ$ )?
12. Describe the posture of the lumbar spine, pelvis, and chest wall in the case that all abdominal muscles are too short.
13. Describe the posture of the lumbar spine, pelvis, and chest wall in the case that all abdominal muscles are too long?
14. Does your subject have limited ROM of the lumbar spine? If yes, what are the ranges?
15. Which supportive structure(s) may be responsible for limited trunk flexion?
16. Which ligaments of the spine may cause limited trunk extension?
17. What movement of the hip and pelvis should you limit or monitor when performing a trunk curl/sit up?
18. If your subject's ASISs move more than  $\frac{1}{2}$  inch during active hip and knee flexion in supine, what does it tell you?
19. What would you recommend your subject do to limit the ASISs from moving during active hip and knee flexion in supine?
20. In sitting position, anterior pelvic tilt will cause the lumbar spine to increase or decrease lordosis, and why?
21. During lateral arm rise in standing (deltoid exercise), your trainer suggests you to keep the knee slightly flexed. What are the benefits of doing just that? Is there any others methods or techniques, which will allow you to get the same benefit?

### References:

- Hoppenfeld, S. 1976. Physical Examination of The Spine and Extremities. Appleton-Century-Crofts, East Norwalk.
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- Norkin, C. C., and D. J. White. 1985. Measurement of Joint Motion: A Guide to Goniometry. F.A. Davis Company, Philadelphia.
- Sahrmann, S. A. 2002. Diagnosis and Treatment of Movement Impairment Syndromes. Mosby, Inc., St. Louis.