

MODULE BIOMECHANICS OF SPINE

Didactic Unit D: INSTRUMENTED ANALYSIS OF THE SPINE

D.4. How is a normal biomechanical assessment of the lumbar spine?

ACTIVITY:

Activity Assessment of the range of motion in lumbar flexion-extension using dual inclinometry



50-year old man

Profession: builder

UL dominance: right

History: no previous history of interest for the process

The man reports moderately severe low back pain for several months after a traffic accident. On examination, his condition is medically stable, and the X-ray shows degenerative changes in L4 and L5. He goes to the doctor to report his main problem: limitation of spinal mobility due to pain.

In the doctor's consulting room, there is a tool to measure spinal mobility and perform a biomechanical analysis, so he decides to assess the lumbar mobility in order to objectively control the degree of deficiency in his patient.

To do this, he uses two inclinometers. With the patient in a standing position, he locates the T12 spinous process and places one of the inclinometers on that point. He puts the other inclinometer in the centre of the sacrum. **NOTE: You can review the measuring protocol in didactic unit D.2.**

After measuring the flexion-extension mobility of the lumbar spine, the results shown in figure 1 were obtained for each repetition. Answer the following questions by calculating the missing data in the tables.





Figure 1

1. Can you determine the real flexion of the lumbar spine?

Using the calculation of the results of the first repetition included below as **help**, determine the real flexion of the lumbar spine in the 2nd and 3rd repetitions.

HELP: The **real flexion of the lumbar spine in the first repetition** is 25°. This result is obtained from the following data recorded by each inclinometer:

$$73.7^\circ - (-8.3) = 82^\circ \text{ of flexion by the inclinometer on D12}$$

$$71^\circ - 14.1^\circ = 56.9^\circ \text{ of flexion by the inclinometer on the sacrum}$$

Therefore, the real lumbar flexion is $82^\circ - 56.9^\circ$, which is approximately 25°

NOTE: You can also use what you learnt in didactic unit D.3 about range assessment using inclinometers.

Calculate the real lumbar flexion and the real lumbar extension of the 2nd and 3rd repetitions.

	Lumbar flexion	Lumbar extension
1st repetition	25°	
2nd repetition		
3rd repetition		

Solution:

	Pos. Neutra (D12/SACRO)	Pos. Flexión (D12/SACRO)	Pos. Extensión (D12/SACRO)	Flexión	Extensión
1ª	-8,3° / 14,1°	73,7° / 71,0°	-24,7° / 3,3°	25,0°	5,0°
2ª	-6,6° / 14,1°	73,4° / 71,4°	-22,8° / -1,5°	22,0°	0,0°
3ª	-6,0° / 14,1°	74,2° / 70,7°	-23,8° / -1,1°	23,0°	2,0°

2. Do these measurements meet the repeatability criteria established by the American Medical Association (AMA)?

HELP: We help you with the first repetition of the real lumbar flexion.

The values determined for each repetition were 25°, 22°, and 23°. The average of the three repetitions is 23.34°. As this value (23.34°) is less than 50°, the value of the three consecutive repetitions of the flexion must fall within 5° from the mean. Consequently:

$$23.34 + 5^\circ = 28.34^\circ$$

$$23.34 - 5^\circ = 18.34^\circ$$

Therefore, the values obtained for the real lumbar flexion (25°, 22° and 23°) fall within 5° from the mean that is considered to be normal (18.34° - 28.34°). We can conclude that the result obtained is valid since it meets the repeatability criteria.

Solution:

	Pos. Neutra (D12/SACRO)	Pos. Flexión (D12/SACRO)	Pos. Extensión (D12/SACRO)	Flexión	Criterio AMA	Extensión	Criterio AMA
1ª	-8,3° / 14,1°	73,7° / 71,0°	-24,7° / 3,3°	25,0°	OK	5,0°	OK
2ª	-6,6° / 14,1°	73,4° / 71,4°	-22,8° / -1,5°	22,0°	OK	0,0°	OK
3ª	-6,0° / 14,1°	74,2° / 70,7°	-23,8° / -1,1°	23,0°	OK	2,0°	OK

Yes, the results of the assessment meet the repeatability criteria, both for lumbar flexion and extension.

3. Is it necessary to apply a straight leg raising validity test for this patient?

HELP: We help you with the first repetition.

To confirm whether it is necessary or not, look at the results obtained by the inclinometer located on the sacrum for each repetition.

	Pos. Neutra (D12/SACRO)	Pos. Flexión (D12/SACRO)	Pos. Extensión (D12/SACRO)
1ª	-8,3° / 14,1°	73,7° / 71,0°	-24,7° / 3,3°
2ª	-6,6° / 14,1°	73,4° / 71,4°	-22,8° / -1,5°
3ª	-6,0° / 14,1°	74,2° / 70,7°	-23,8° / -1,1°

Figure 2

The values determined in the sacrum for the first repetition are:

71° (in flexion) and 3.3° (in extension); therefore, the flexion-extension range is:

$$71^{\circ} - 3.3^{\circ} = 67.7^{\circ}$$

NOTE: Remember that the validity test is used if the flexion-extension movement of the sacrum inclinometer is less than 55° in men or less than 65° in women.

Solution:

The ranges of the sacral flexion-extension in the second and third repetitions are:

$$2^{\circ} \text{ repetition: } 71.4^{\circ} - 1.5^{\circ} = 72.9^{\circ}$$

$$3^{\circ} \text{ repetition: } 70.7^{\circ} - 1.1^{\circ} = 71.8^{\circ}$$

A validity test is NOT necessary because such test is only requested in those cases in which the sacral flexion-extension mobility measured with the inclinometer placed on the sacrum is very small. Specifically, when the sacral flexion/extension range (sacral or hip movement) is less than 65° in women and 55° in men. In our case, the sacral flexion/extension angle is greater than 55°; therefore, the test is not necessary.

4. Interpretation of the clinical case

To complete the case assessed, the results obtained in the lateral flexions are as follows:

	Pos. Neutra (D12/SACRO)	Pos. Izquierda (D12/SACRO)	Pos. Derecha (D12/SACRO)	Flexión Lateral Izquierda	Criterio AMA	Flexión Lateral Derecha	Criterio AMA
1ª	5,8° / -2,4°	-20,4° / -5,5°	31,2° / 2,6°	23,0°	OK	20,0°	OK
2ª	5,6° / -1,9°	-21,9° / -6,1°	34,3° / 3,4°	23,0°	OK	23,0°	OK
3ª	5,7° / -1,3°	-23,5° / -5,7°	36,8° / 5,8°	24,0°	OK	23,0°	OK

Figure 3. Results recorded by each inclinometer (dual inclinometer technique) placed on T12 and the sacrum to assess the lateral flexion range of the lumbar spine. The measurement repeatability criterion is met (AMA criterion).

Therefore, the final result is as follows:

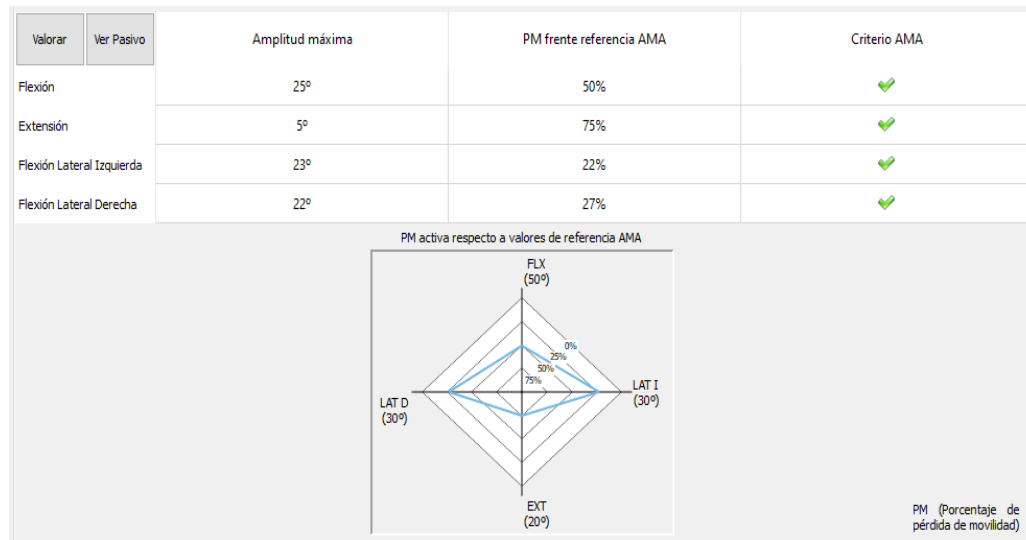


Figure 4. **Top:** Results of the maximum range of active motion of the lumbar spine and percentage of mobility loss or deficit (ML) in each test with respect to the reference values of the American Medical Association (AMA). **Bottom:** Comparison of the percentage of loss of active lumbar mobility with respect to the reference values of the American Medical Association (AMA) in each axis of movement assessed. The percentage of mobility loss is represented by the blue line.

Guided by the following questions, finish the interpretation of the results you obtained for the lumbar mobility assessment of this patient.

1. Were the records obtained valid in terms of repeatability?
2. Was a validity straight leg raising test necessary?
3. What was the maximum range recorded for each movement?
4. Is the mobility recorded for each axis considered as normal?
5. What values were taken as a reference for normality?
6. What is the most limited movement or with the greatest loss of mobility? And the least limited movement?
7. Is the loss of mobility recorded significant?
8. Were important asymmetries found in the laterality of the movements?

Solution:

1. Were the records obtained valid in terms of repeatability?
Yes, they meet the validity criteria of the AMA; three consecutive repetitions are obtained whose maximum flexion and extension value falls within 5° from the mean.
2. Was a validity straight leg raising test necessary?
No, because the flexion-extension mobility recorded in the sacrum with the inclinometers was greater than 55°.
3. What was the maximum range recorded for each movement?
Flexion: 25°
Extension: 5°
Left lateral flexion: 23°
Right lateral flexion: 22°

4. Is the mobility recorded for each axis considered as normal?
No, because there is a significant loss of mobility with respect to the values that were taken as reference. For example, there is a loss of mobility of 75% for extension and 50% for flexion.
5. What values were taken as a reference for normality?
The mobility values of the American Medical Association
6. What is the most limited movement or with the greatest loss of mobility? And the least limited movement?
Extension was the most limited movement, with 75% of mobility loss. The least limited movement was left lateral flexion, with 22% of mobility loss.
7. Is the loss of mobility recorded significant?
It was in the case of flexion/extension.
8. Were important asymmetries found in the laterality of the movements?
No. Asymmetry in laterality can only be observed in lateral flexions, and there is only 1° of difference.

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