

Radiological evaluation of the lumbar lordosis in spine operated patients: is plain film still mandatory?

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Aims and objectives

Sagittal malalignment often wrongly coined sagittal imbalance refers to the loss of normal alignment in the sagittal plane and is associated with recruitment of compensatory mechanism.

Sagittal malalignment by itself is not an indication for surgery but it must be seen as a factor of great relevance when evaluating any patient referred for problems at the vertebral level.

Although there is no consensus on whether it is necessary to perform radiological tests in the postoperative period of asymptomatic patients undergoing spinal fusion arthrodesis, in our Hospital, the protocol includes the performance of a conventional radiological study in the immediate postoperative period as well as a MDCT before hospital discharge.

There are different radiological methods when exploring the **regional curvature of the lumbar lordosis. The most accepted are: the Cobb, TRALL**, vertebral centroid and the posterior tangent method of the vertebral body. In our study we opted for the Cobb method to be the best known and accepted in the medical community.

The main purpose of the poster is to determine if **there are significant differences in the value of lumbar lordosis in the post-operative of patients undergoing lumbar vertebral fusion measured by radiography and through CT o RM.**

It was also assessed if there were differences in the values of the lordosis measured in CT and MRI

Images for this section:

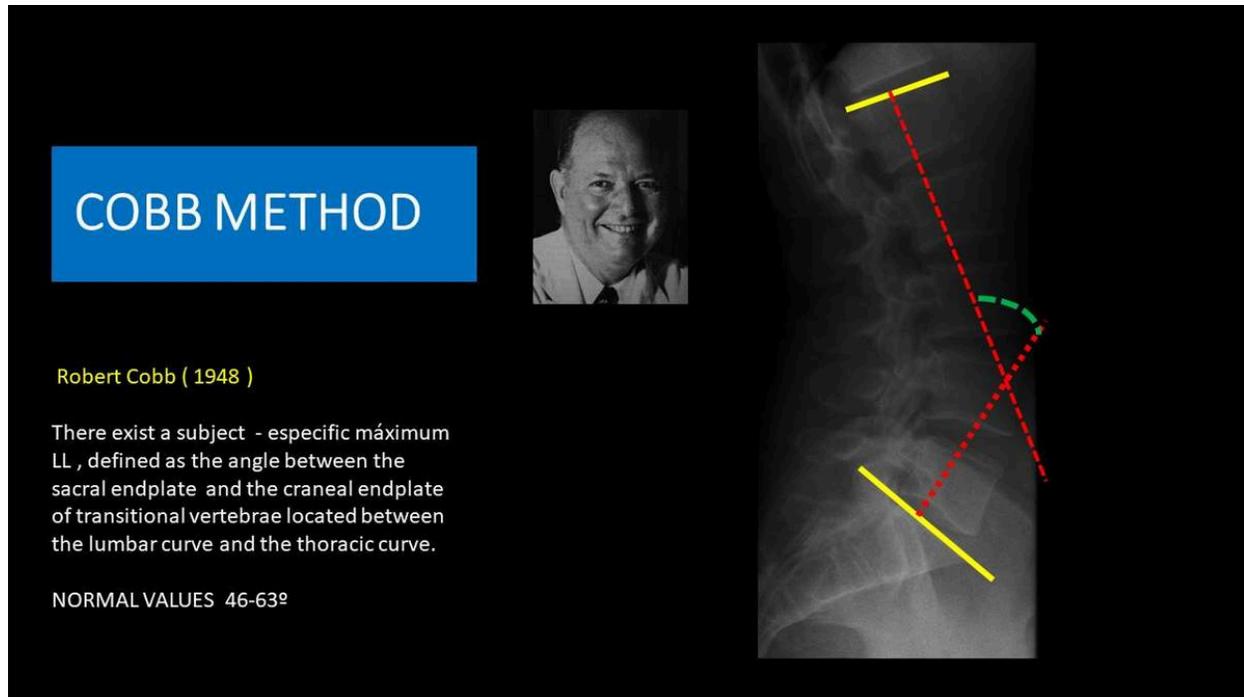


Fig. 1

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Methods and materials

A retrospective study of patients operated in our Hospital Center between 2012 and 2017 was carried out.

The impossibility of performing an adequate measurement of the lumbar lordosis in any of the radiological techniques used in the study was established as an **absolute exclusion criterion**, regardless of the cause that generated it.

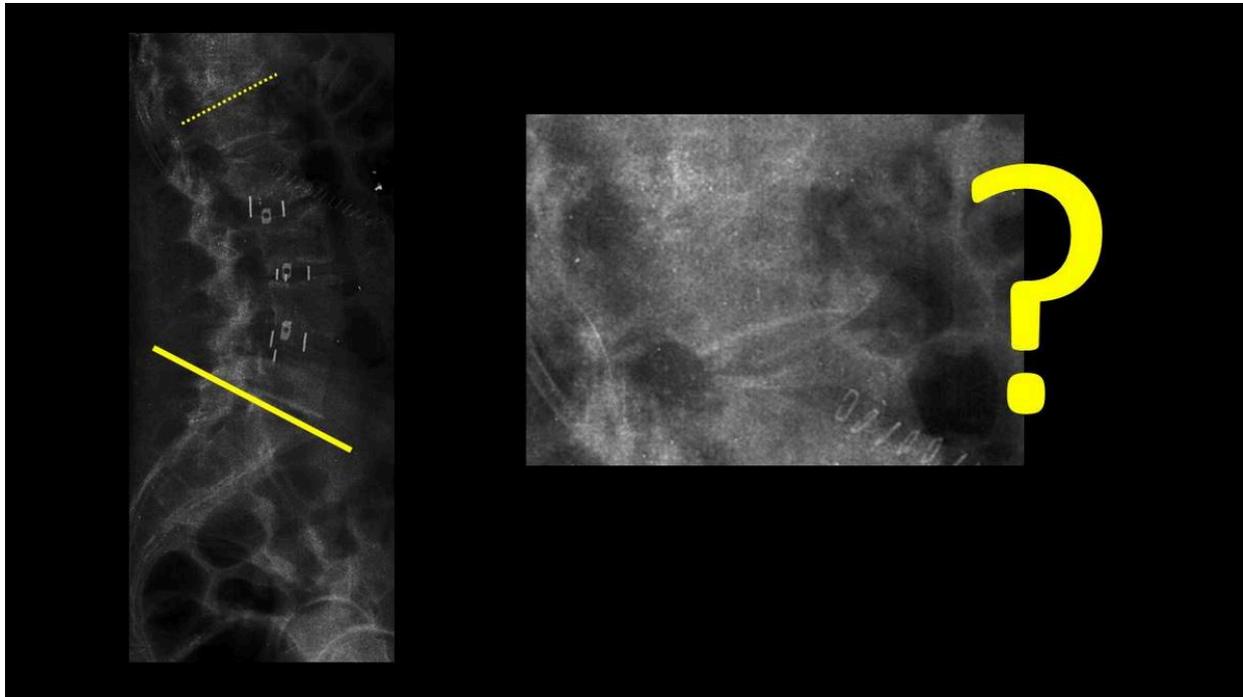


Fig. 2

References: Radiology, Hospital del Mar - Barcelona/ES

The **criteria for inclusion in the study** were:

To be operated on an instrumented arthrodesis of the lumbar spine regardless of the number of levels and the cause of the intervention

Have a post-surgical radiological control by radiography and CT or MRI. Arbitrarily, it was defined that no more than 1 month should elapse between the radiograph and the other imaging tests.

The patient had to comply with the requirement to be operated in our Hospital and that the imaging tests were also performed in our center.

The study recruited a total of 240 patients (the first 40 patients who met the inclusion criteria each year). The mean age was 64.9 (max 94 min 19) years and the distribution was 56.6 percent of men and 43.4 of women.

83 patients had the three imaging techniques.

The measurement of lordosis in the lumbar curvature was performed according to the criteria defined by Robert Cobb in 1948, establishing the angle between the sacral endplate and the cranial endplate of the vertebral transitional located between the lumbar curve and the thoracic curve. It was defined that the transitional vertebra was always L1 in order to avoid dispersion in the values obtained. The values of normality were established between the ages of 43 and 63.

The measurements made in the CT were obtained in the oriented MPR reconstructions. The measurements made in the MRI were obtained from T1WI or T2W2 images in the sagittal plane

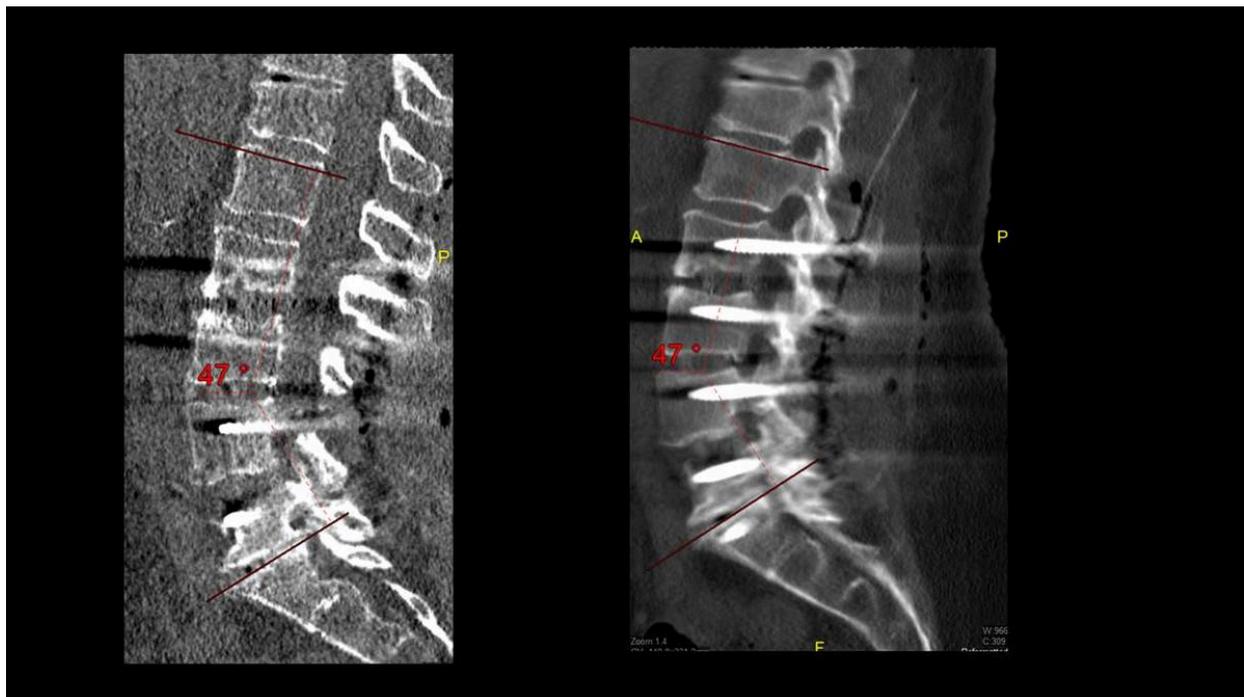


Fig. 3

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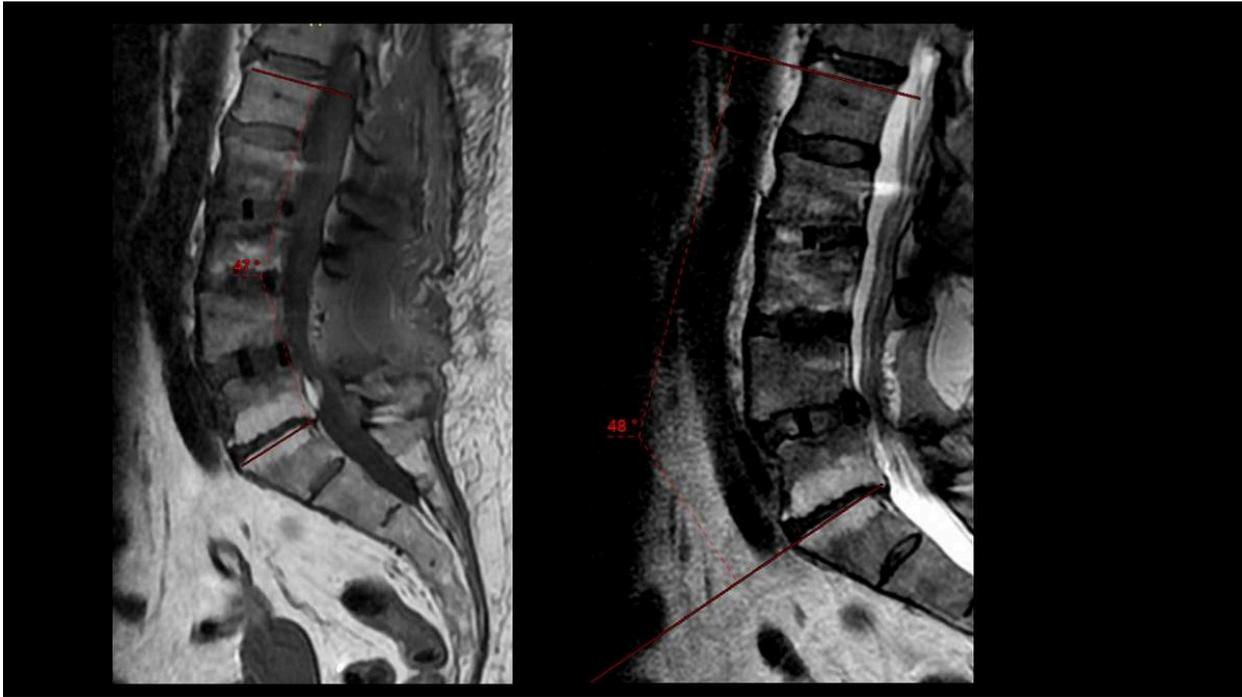


Fig. 4

References: Radiology, Hospital del Mar - Barcelona/ES

All measurements were made in the PACS-IW centricity system as shown in the following image

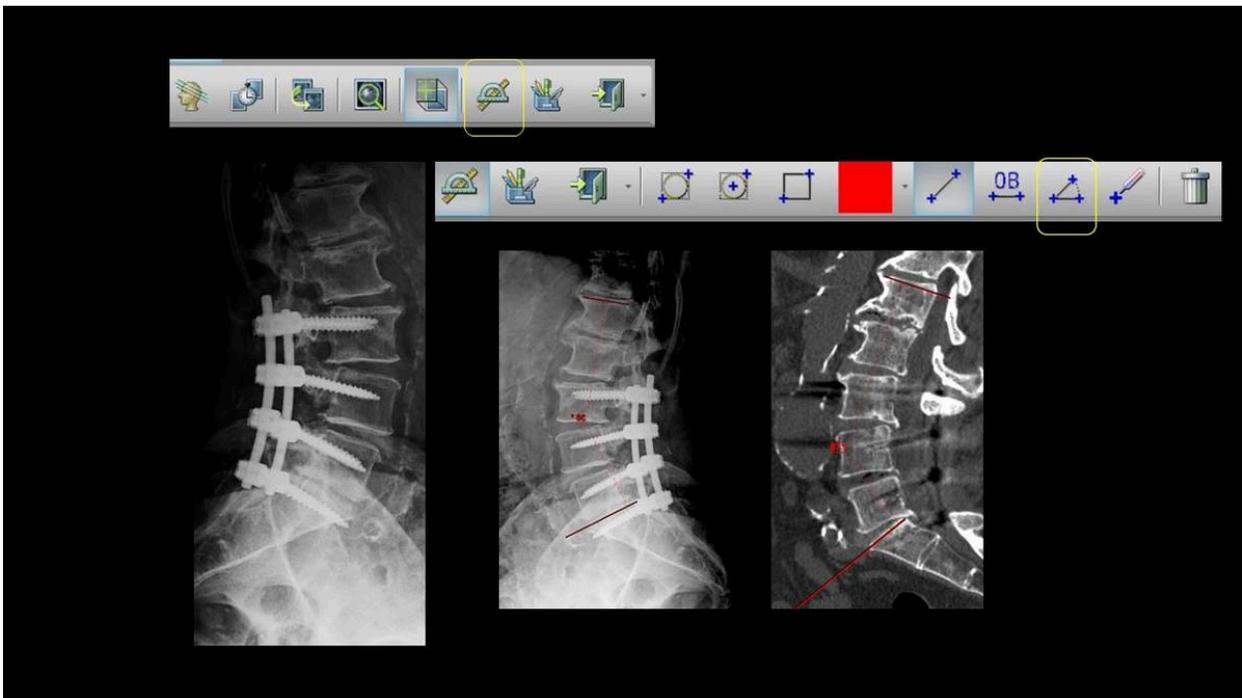


Fig. 5

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Two experienced members of our unit performed the measurement of the Cobb angle according to the technique described above. Previously, the two readers jointly measured three series of 10 patients.

Two measurements were made for each of the imaging techniques. The measurements in each of the techniques should not exceed 3 weeks

The person did not know the previous value of the angle obtained or the value of the angle obtained by the other reader. The numerical value of the measurement was obtained and established if it was within the range of normality or not.

Statistical analysis

To determine if any difference between measurement means was statistically significant, calculated differences between means were statistically compared against the hypothetical value of zero.

The means, standard deviations, interclass and intraclass correlation coefficient and Kappa coefficient between the two readers and between the three measurements of each reader were calculated. The statistical management of the data included the coefficient of kappa with a p- value of 5%.

Images for this section:

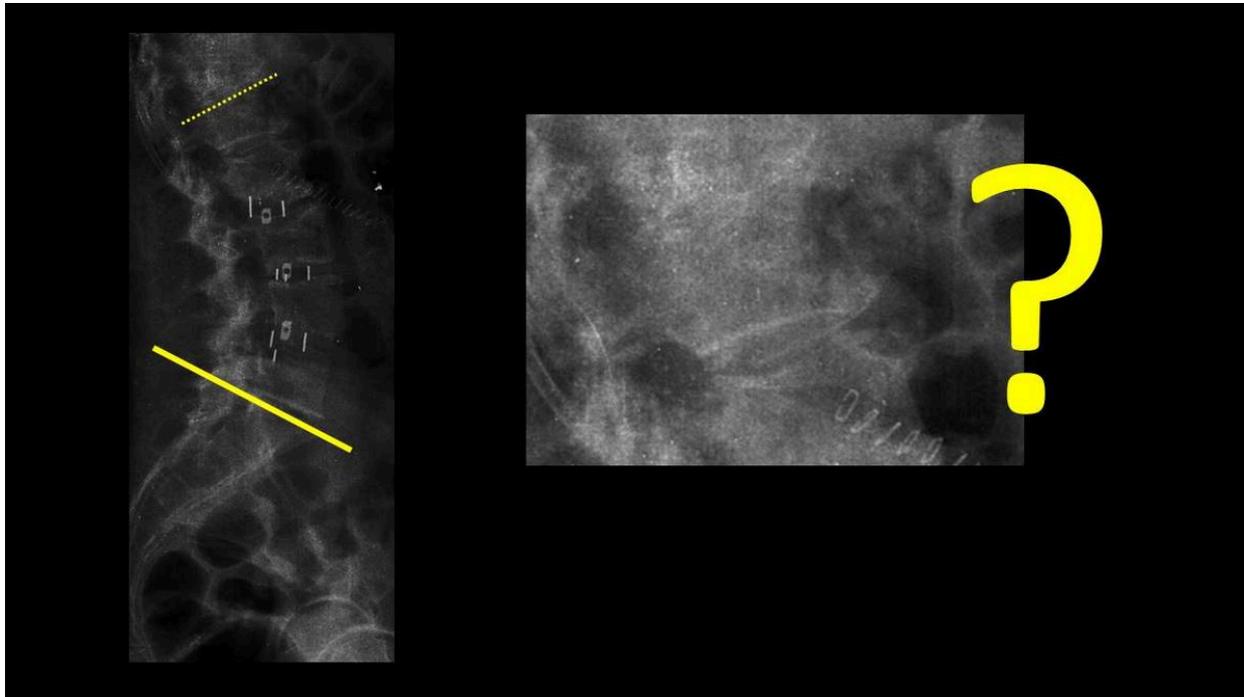


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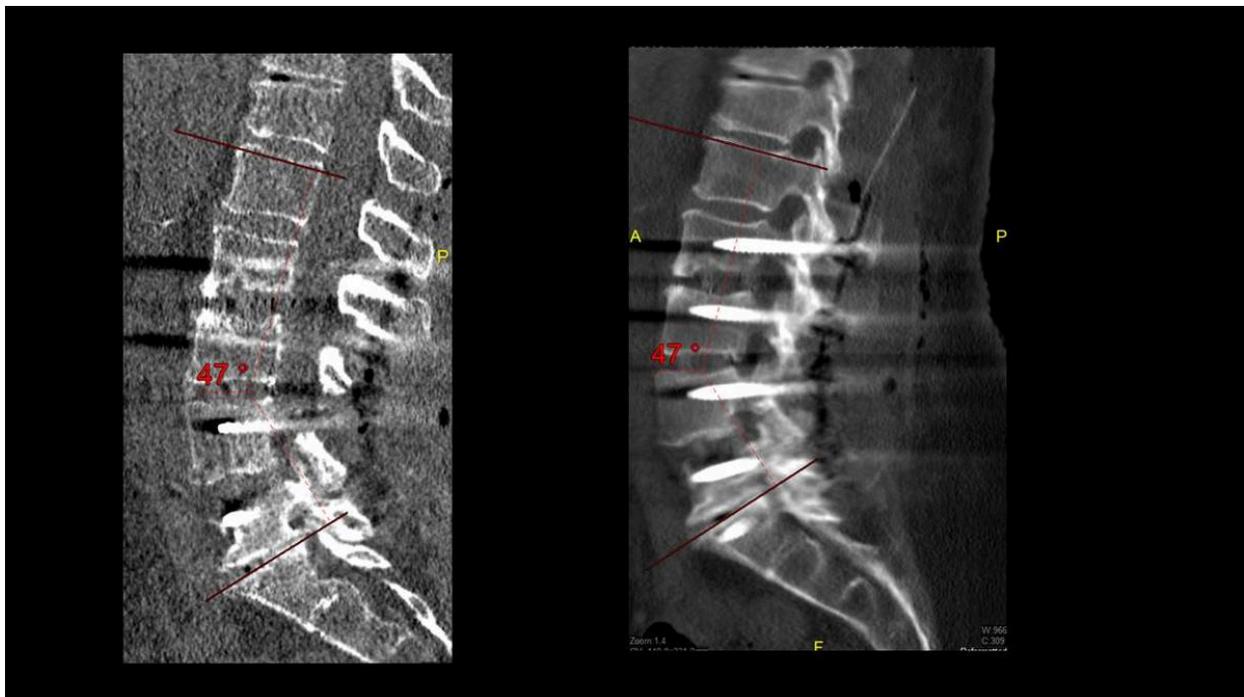


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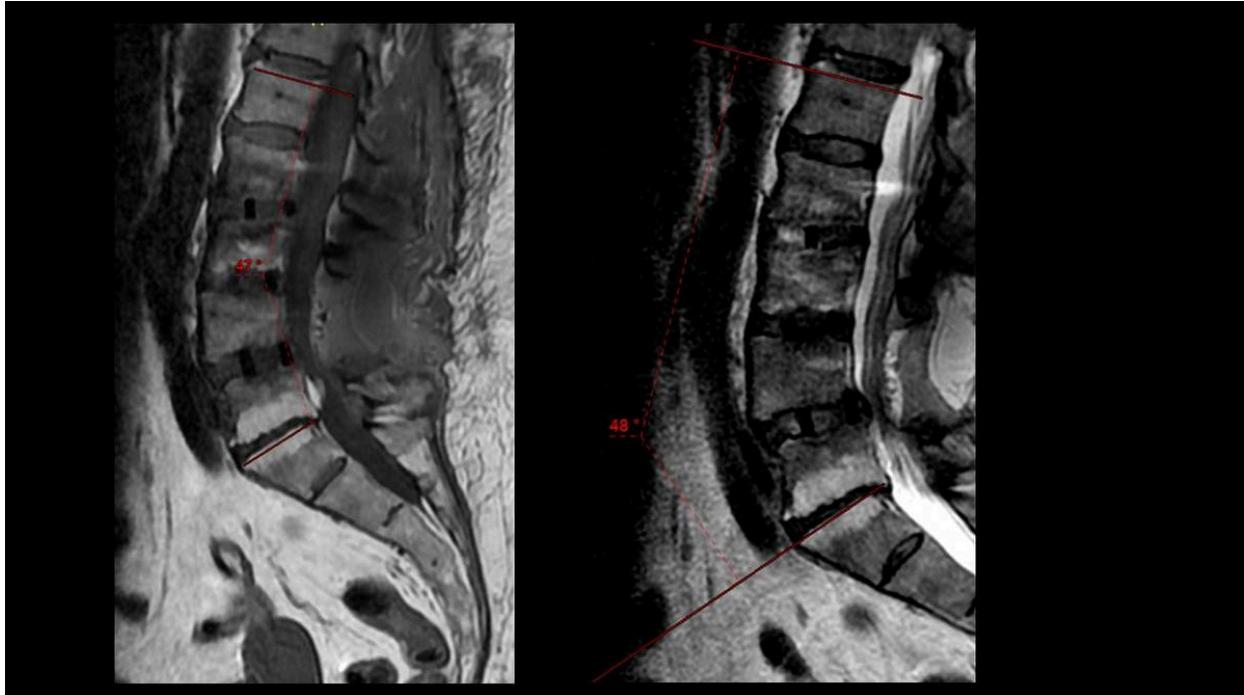


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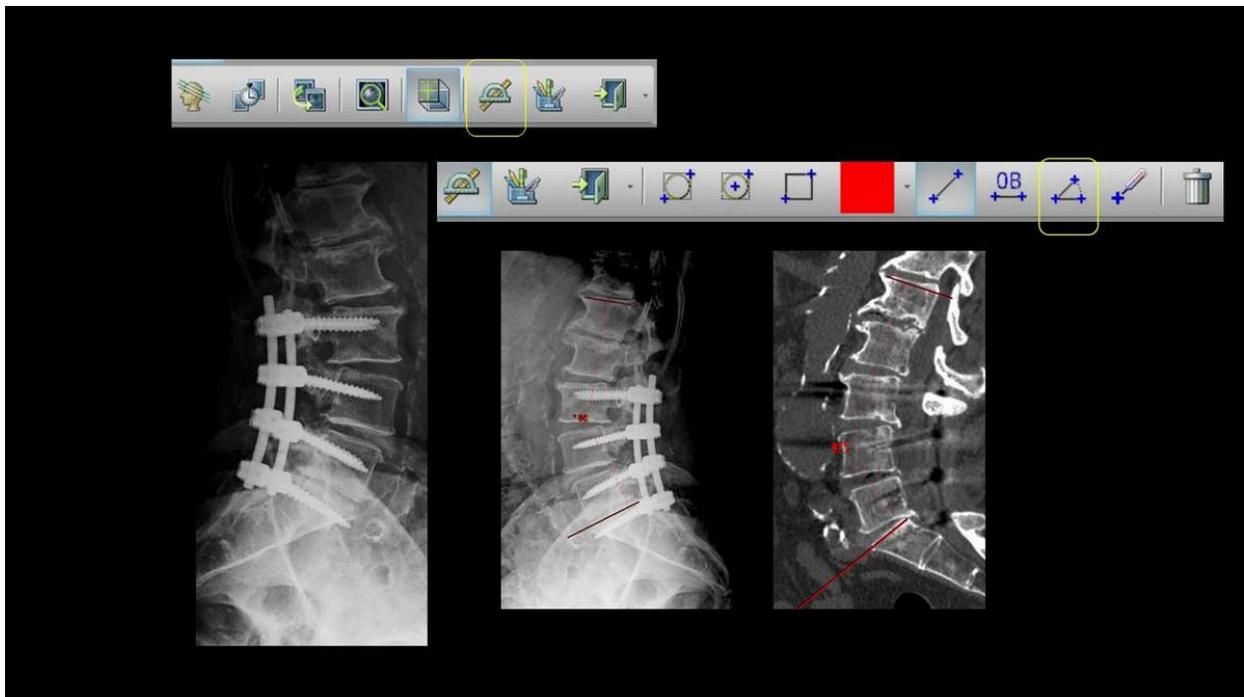


Fig. 5

Results

It was necessary to review the imagen tests of more than 509 patients in order to be able to recruit the 240 study patients. This can be explained by two reasons; the lower quality of the radiography in the immediate postoperative period and also the complexity of the treated pathology. Unlike the article by Jae Young Hong, in our study the number of patients with severe scoliosis was low due to the inability to clearly establish the points of measurement of the angle of Cobb.

Our results are in agreement with the studies of Polly and Mok and in disagreement with Ruhinda's studies.

The figure displays two tables of Intraclass Correlation Coefficient (ICC) values. The first table, titled 'ICC INTRA OBSERVER', compares two readers (READER 1 and READER 2) across four techniques: RX, CT, MR, and GENERAL. The second table, titled 'ICC INTEROBSERVER', shows the ICC for the same four techniques. The values are color-coded: blue for RX, CT, and MR, and yellow for GENERAL.

ICC INTRA OBSERVER				
	RX	CT	MR	GENERAL
READER 1	0,79	0,92	0,93	0,87
READER 2	0,82	0,95	0,93	0,89

ICC INTEROBSERVER				
	RX	CT	MR	GENERAL
	0,76	0,92	0,92	0,87

Fig. 6

References: Radiology, Hospital del Mar - Barcelona/ES

The mean lordosis measured by RX was 39°, by TC 43.8° and by MRI of 40.49°. There are statistically non-significant differences by gender being the average higher in men than in women for all techniques.

	READER 1 Mean ± SD	READER 2 Mean ± SD
RX	38,6 ± 9,6 °	39,4 ± 6,97 °
CT	43,2 ± 2,4°	44,4 ± 2,9 °
MR	40,4 ± 5,6 °	41,5 ± 95 6 °

Fig. 7

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CT and MRI underestimated the values of hipolordosis and hyperlordosis in relation to radiography. Our results are very different from those mentioned by Andreasen et al (2007) or Bendirz et al (2017) who compared the value of lordosis between the radiography and the MRI and found no significant difference (<3°).. Our results differ in a very important way from those expressed by Greimel et al (2017). The number of patients and the patient's position being different (decubitus prone)

The kappa coefficient was only acceptable between the RX-CT and the RX-MR.

KAPPA COEFFICIENT		
	READER 1	READER 2
RX- CT	0,48	0,51
RX- MR	0,51	0,53
CT- MR	0,77	0,75

NORMAL VALUES = 43- 63 °

Fig. 8

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Conclusion

- In the medical literature, multiple methods of radiological measurement of lordosis have been described. **The Cobb method (L5-S1) is not considered the most accurate..**
- The **correction of the loss of lordosis** is considered one of the essential factors in the post-surgical result. Currently multiple centers use computer-assisted procedures in the evaluation of the regional or global curvature of the column Measurement of post-surgical lordosis is not performed under the same conditions as pre-surgical planning, so the **result is not comparable.**
- **Post-surgical radiology does not allow a linear estimation of the real value of the lordosis.**
- **CT and MR overestimate the value of lordosis in patients with hipolordosis and underestimate it in patients with hyperlordosis.**
- ***Standardized studies should be carried out, under similar conditions, with a high number of patients and with the same measurement system so that the results can be assessed.***

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