Mismatch between rod bending and actual post-operative lordosis in short lumbar arthrodesis with poly axial screws

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1. Introduction

restoring sagittal balance is a common goal in modern spine surgery (Le Huec et al 2011), the question of rod bending is essential during posterior lumbar fusion. The role of posterior instrumentation during spinal surgery remains to be defined. In degenerative spine surgery, screws with poly axial head are used. It helps the surgeon to connect every screw head to the rod. But, with an appropriate bending, two situations can occur: a perfect match or a total mismatch between rod lordosis and lumbar lordosis. There is no study on the link between rod bending and lordosis.

The purpose of this study was to evaluate parameters that explain the mismatch between lumbar lordosis and rod bending in short lumbar surgery using poly-axial screws.

2. Methods

This study was monocentric, retrospective, descriptive and analytic. All patients with posterior L3L5 fusion in an university-affiliated hospital in 2017 were included. Patients with past surgical history of anterior fusion on the levels L3L5, Coronal malalignment with a Cobb angle superior to 5°, the use of dynamic fixation systems were excluded.

We measured on immediate post-operative standing profile x-ray sagittal parameters known to be important to minimise adjacent strain due to bad sagittal balance restauration (Barrey et al 2013): pelvic incidency, lumbar lordosis, lordosis of the instrumented segment.

Then we analysed three parameters yet not described that seem to have an important role (figure 1):

- the standard deviation of the distances between posterior wall and rod (EcarT) which reflects how homogeneously screws are put in depth,

- the angle between the screw body and rod (thetaMA) which reflect the poly axiality allowed by the head screw,

- the angle between screw and superior endplate (lambdaMA).

Figure 1: three new parameters studied: Theta MA, LambdaMA, EcarT

Univariate and multivariate analysis were conducted to see if there was a link between all those parameters and the mismatch: vertebral lordosis-rod lordosis (diffL).

3. Results and discussion

74 patients were included, mean age was 67. 18 were 360° fusion and 56 were postero-lateral fusions Demographic variables had no statistically significant effect on the difference between the rod and the vertebral lordosis. Lumbar Roussouly classification, pelvic parameters and the lordosis severity did not show any significant correlation with the outcome.

Statistically significant correlation was found between the fact that screws are put with a homogeneous depth (EcarT) and the diffL (R=0.47 [0.27, 0.63] p<0.0001)). Similarly, the diffL is correlated with the positioning of the screws parallel to the superior vertebral endplate (Lambda MA) The correlation between ThetaMA and the diffL was also significantly and negatively correlated with the diff L (R=-0.46 [0.26, 0.62] p<0, 0001).

We integrated these three indices in a multivariate regression model summarized in table 1, to create the MAI index. ThetaMA, LambdaMA and EcarT are used as explanatory variables while the dependent variable is the DiffL. We get the following index:

MAI = 40.1 - 0.46* ThetaMA + 0.71*LambdaMA + 1.16*EcarT

Variables	**Coefficient [CI95%]**	**P-value**
Intercept		
	40.1 [7.88;72.27]	
		0.02
TetaMA		

-0.46 [-0.82;-0.09]

0.01

LambdaMA

0.71 [0.11;1.31

0.02

EcarT

1.16 [0.31;1.99]

0.008

Table 1 Multivariate regression model with DiffL as dependent variable and lambdaMA,TetaMA, EcarT as explanatory variables

MAI index gives an improvement on the prognostic of the severity of the diffL. MAI index yields to an AUC of 0.84 [0.75, 0.93] for predicting a diffL greater than 5°. The estimated diagnosis cut point of the MAI index for predicting a diffL greater than 5 is 6.

4. Conclusions

Our study is the first on the link between rod bending and lumbar lordosis. Three new radiologic factors were highlighted and are involved in not obtaining the planned lordosis in short lumbar fusion with polyaxial screws (figure 2). These three factors explain the difference between rod lordosis and lumbar lordosis.

Figure 2: Illustration case with a wide mismatch in a) and a proper TetaMA, lambraMA, EcarT, to obtain a perfect match in b)

Two factors depend on the way the surgeon positions screw:

- parallel to the superior vertebral endplate(lambdaMA),
- with a homogeneous depth (EcarT).

And the last factor: ThetaMA is depending on the surgical technique (compression on screws, osteotomies, monoaxial screws, use of interbody devices) (Barrey et al).

The aim of the study is not to show any superiority of mono vs polyaxial screws nor to give the only way arthrodesis should be performed, but it gives a better understanding of the link between screw positioning, rod contouring, osteotomies and sagittal curves.

References

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