Reviewer's report

Title: Biomechanical Analysis and Modeling of Different Vertebral Growth Patterns in Adolescent Idiopathic Scoliosis and Healthy Subjects

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Reviewer: Xavier Banse

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'Biomechanical Analysis and Modeling of Different Vertebral Growth Patterns in Adolescent Idiopathic Scoliosis and Healthy Subjects' Shi Lin, Defeng Wang, Mark Driscoll, Isabelle Villemure, Winnie Chu, Jack Cheng and Carl-Eric Aubin

Submitted to Scoliosis

General comment:
This paper explores the effect of two growth patterns on the AIS curve progression. The FEM method is appropriate to explore this issue. Authors refer to previous studies for method description. The data collection and interpretation require some clarifications (see later). Conclusions are correctly supported by the data. Writing is acceptable.

Minor revisions

Page 2, li 13: “AIS growth profile”, term should be defined in the abstract

Page 8 , li 15: 2 years interval of growth are chosen while figure 3 shows 1 year growth speed intervals

Page 10, li 11-19: reporting the sensitivity analysis results, authors should provide data. In example, using a second table with measured values. ‘not significant’ differences are mentioned. This should be supported by data.

Figure layout should be improved (especially figure 5).

Major revision

I have a problem with the AIS growth pattern reported in figure 3.

a) is it realistic to have a 3cm growth rate (for AIS patient aged 8) instead of 1.5 cm in control subjects?

b) is there any clinical data reporting constant decrease in growth speed (with no growth spurt) in AIS patient. I cannot find any reference to such observation in refs 9, 10, 14 and 15 mentioned on page 4.

c) comparing normal and AIS curves (fig 3) the surface under the curve is bigger in AIS pattern. Data from the literature and clinical practice support the idea that AIS patient are taller than controls. However with such difference in growth speed, final height should be significantly affected (more than reality).
I have a second problem with validation model (page 7 and 9)

a) page 8, li 4, authors report Gm values (0.8 for thoracic and 0.11 mm/year) for the 3 validation cases. What type of growth pattern (AIS or normal) did they use?

b) looking at figure 4, curves progression is roughly 30° over 2 years (probably during adolescence and growth spurt). In the 4 scoliosis models in figure 5 curve progression is maximal for AIS pattern, but barely reaches 10° over 2 year period. How could the authors explain such difference (parameters like growth profile, Gm, beta…)?

c) when describing methods for validation model on page 7 and 8 authors should give some more details

Third problem regarding the problem is the lack of acceleration of Cobb’s angle value during growth spurt (in the normal model). In addition to the lack of rotation simulation (commented on page 11, li 12-17) this should be commented.

Finally the conclusion should be adapted. Especially the sentence ‘The results suggests that the overall amplified growth velocity in AIS could indeed lead to supplementary progression of scoliosis…”, page 13,li 17. AIS growth pattern vs normal growth pattern do not differ only as ‘overall amplified growth velocity.

Those four points should be addressed by the author either modifying the manuscript or answering to the questions / issue raised here.

**Level of interest:** An article of importance in its field

**Quality of written English:** Acceptable

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

I declare that I have no competing interests