Author's response to reviews

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

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Author's response to reviews: see over
Reviewer’s report

Title: Biomechanical Analysis and Modeling of Different Vertebral Growth Patterns in Adolescent Idiopathic Scoliosis and Healthy Subjects
Version: 2 Date: 4 April 2011
Reviewer: Xavier Banse

Reviewer’s report:

‘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

Reply: In the revised version, we defined “growth profile” as “(i.e., the growth rate of the vertebral body during the growth period)” in the “background” of the abstract, and changed “AIS growth profile” to “growth profile of AIS”; “normal growth profile” to “growth profile of normal subjects”.

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

Reply: In order to avoid confusion, we changed Fig. 3 to show 2 year growth speed interval.

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.

Reply: Thank you for having brought this important point to our attention. Results of the sensitivity analyses were reported in the new manuscript as advised. Since results from this form of analysis are very heavy, specific details were excluded and averages were summarized in the text as opposed to using a chart as proposed – authors maintain that they are more legible and understandable this way.

Below, you will find the new results concerning the sensitivity analysis.

The sensitivity analysis of β (0.4 to 0.6 MPa-1) magnified spinal Cobb angle amplitudes as β was increased. The final angle measures (after 10 years of simulated growth) were roughly doubled under a β of 0.6 compared to 0.4.
However, relative differences between final measures of AIS and healthy growth rates remained as described above. That is, the relative increase in coronal Cobb (Cobb\textsubscript{AIS growth}/Cobb\textsubscript{normal growth} after 10 years of simulated growth), for cases 3 to 6, varied lightly between 1.85 to 2.61 and 1.79 to 2.86 when using a beta of 0.4 and 0.6 respectively. Therefore, it was consistently maintained that the AIS growth rate significantly encouraged additional scoliotic progression. Analysis of spinal loading (gravity force or sagittal plane follower load) also proved not to significantly alter the tendency of AIS growth to promote progression. To elaborate, the average Cobb angle increase initiated by the use of the AIS growth profile was between 1.85 to 2.61 and 1.50 to 1.88 when adopting gravity and sagittal follower loads respectively. Analysis of growth velocities (G\textsubscript{m}= ±15%) altered magnitude of measured Cobb angles, to a lesser extent than factor β, and again, the relative comparisons were not significantly changed. More specifically, even when a 15% decrease in AIS growth rates was coupled with a 15% increase in normal growth velocities, final coronal Cobb angle related to AIS growth remained 1.8 times larger than that of the normal growth.

Figure layout should be improved (especially figure 5).

Reply: The legend of Fig 5 was changed from “AIS vs H” to “AIS vs Normal”. Besides, the label of the axis was enlarged.

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 1.5cm in control subjects?

Reply: The growth profile of the normal and AIS comes from Fig. 4 in [15]. In that figure, the growth rate was shown in percentage. By taking initial spine length at age 8 being 36cm [33], we converted those data into centimeters.

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.

Reply: The literature [9, 10, 14, 15] all supported that the relatively earlier growth spurt in normal compared to AIS. In [15], exact data at every pubertal age were reported.

In [9], it was observed that “There were differences between the prescoliotic girls and other girls in both mean age (11.8 vs 12.1 years, P = 0.02) and value (5.5 cm vs 6.1 cm/yr, P = 0.08) of peak sitting height velocity.”

In [10], it was found that “In girls the pubertal growth-spurt of the spine was found to start about 1 year earlier than in the controls and the growth of the spine seemed to cease later in the scoliotics.”
In [14], the author stated that "The scoliotic girls had an above-average height 2 years before the onset of the pubertal growth spurt."

The growth profile of the normal and AIS comes from Fig. 4 in [15]. In that figure, the growth rate was shown in percentage. By taking initial spine length at age 8 being 36cm [33], we converted those data into centimeters.

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).

**Reply:** With the growth rate, listed in Fig. 3, actually, given the initial spine length at age 8 being 36 cm [33], the total spine length at age 18 is 51.67 cm for AIS, and 45.76 cm for normal, which does not differ much, i.e., 5.91cm.

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**Reviewer's report**

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

**Version:** 2  **Date:** 4 April 2011

**Reviewer:** Keith Bagnall

**Reviewer’s report:**

Major compulsory revisions

none

Minor essential revisions

- the whole manuscript lacks an english ‘flow’. The authors might be encouraged to allow somebody whose first language is english to read the manuscript and make suggestions.

**Reply:** Our manuscript has been revised by a native English speaker in the updated version. The language modifications can be found under “track changes” in the file Anterior_overgrowth_manuscript_revised_with_track_changes.doc.

- Background

1st para - ....during the adolescent growth spurt ....

**Reply:** That sentence has been changed to “during the adolescent growth spurt”.

3rd para - .... and contributes ....

**Reply:** Revision has been made as suggested.

- Methods

2nd para - ...was built ...

**Reply:** Revision has been made as suggested.

simulation of different ....; ....in centimeters per year

**Reply:** Revision has been made as suggested.
sensitivity analyses ......; ...undertaken to ensure ...

**Reply:** Revision has been made as suggested.

- Discussion
2nd para - .....reported in the literature ..... 

**Reply:** Revision has been made as suggested.

there are more 'mistakes' and overall constrction of some phrases and sentences could be better.

**Reply:** We carefully checked the language in the revised version. The language was thoroughly reviewed by an English speaking person.

Overall this is a very good paper. This type of work is to be encouraged and supported because of the potential it holds for the future. The steps that need to be taken to improve and perfect this methodology are being taken and this paper represents the latest work in this area.

Discretionary revisions

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

**Quality of written English:** Needs some language corrections before being published

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