Global postural re-education in idiopathic scoliosis: immediate effect of self-correction posture on curve reduction

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Introduction

- Idiopathic scoliosis (IS) causes trunk posture impairments affecting self-image/appearance, activity performance and quality of life and generates more chronic back pain in adolescents with IS (50-78%) compared to healthy adolescents (28-48%).
- Early and personalized physiotherapy specific exercises are recommended to improve trunk posture and avoid scoliosis progression\(^1\).
- Global Postural Re-education (GPR) aims at improving posture, function and reduce back pain\(^2,3\). This approach consists of active stretching postures and motor control exercises to avoid scoliosis progression.
- Currently, there is a lack of evidence regarding the effect of GPR self-correction posture on scoliotic curve reduction.

Objectives

- To assess the immediate effect of GPR self-correction posture on scoliotic curves (Cobb angle)
- To develop a trunk stiffness index from simulations using a finite element modeling (FEM) approach.

1. Negrini et al., SOSORT guidelines, Scoliosis Spinal Disord, 2016
2. Bonetti et al., BMC Musculoskel Disord, 2010
Methods

**Participants:** 16 adolescents (15 ♀, 1 ♂), 13.5 ± 1.3 y.o. with right thoracic IS: 33° ± 9° (11° - 45°)

**Finite element modeling (FEM)**

**Reference posture**

[Image: Reference posture showing a patient's reference posture with a Cobb angle of 30°.

**Finite element modeling (FEM)**

Patient’s reference posture

**Simulation (FEM) of autocorrection (AutoC)**

**Preliminary step** (Apex & T1 selection)

**Simulation** (Apex & T1 displacement)

Result

**Statistical analyses:**

ANOVA with Tukey post-hoc test (95% CI, p < 0.05): Cobb angle in frontal and sagittal planes

Correlation between AutoC x-ray and AutoC simulation: Pearson coefficient (r), p < 0.05

**Trunk stiffness index =**

\[
\frac{\text{Reaction force}}{\Delta \text{Cobb angle}} \left[ \frac{N}{°} \right]
\]
Results

Correlation between AutoC (x-ray) and AutoC (simulation): \( r = 0.9 \)

Thoracic frontal Cobb angle: mean \( \downarrow 11^\circ \) * (\( \downarrow 33\% \))

Lumbar frontal Cobb angle: no significant difference

Thoracic kyphosis: mean \( \downarrow 6^\circ \) *

Lumbar lordosis: mean \( \downarrow 5^\circ \) *

Vertebral rotation: \( \downarrow \) from 11° to 7° on average

Mean reaction force at the thoracic apex: 45 N

\[
\text{Trunk stiffness index} = \frac{\text{Reaction force}}{\Delta \text{Cobb angle}} \left[ \frac{N}{^\circ} \right] : 0 - 21 \, N/^\circ
\]

For more details see open access article: Dupuis et al., BMC Musculoskel Disord, 2018, 19:200
Conclusion

- GPR self-correction posture is effective to momentary reduce the scoliotic curve indicating patient’s motor control ability for an immediate and momentary spine correction.
- Self-correction exercises should be added progressively to avoid negative posture compensations such as decrease of the thoracic kyphosis or coronal slit.
- Although simulation underestimated the correction, this study highlights the feasibility of using finite element modeling (FEM) to better understand the effect of self-correction exercises used in GPR.
- FEM allowed to quantify trunk stiffness index (the active resistance of the trunk) and may contribute to set personalized therapeutic objectives for posture correction.
- Further studies are required to determine long-term benefits of GPR on scoliosis.

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