Changes In The Vertebral Growth Plate After Surgical Correction Of Scoliosis In Animal Model.

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conflict of interest disclosure

There is no conflict of interest for any author
Mechanical stress affects bone growth

**Aim:**
What are the possibilities of reconstruction of the deformed vertebrae on the apex of the curvature after the correction?
Material and methods

49 day old rats weight 119-127 g (mean 125g)
24 animals

External fixator

Composite materials

Stainless steel wires Ø 0.5 mm


49 d.o.  
Day 0  

Stage I  
Springs  
load 0.2 MPa  

Wedge deformation of the vertebra  

4 animals  
His-pat  
Control (Group I)  

device implanted in the remaining 20 animals
49 d.o.
Day 0

4 animals  →  His-pat  →  Control (Group I)

device implanted in the remaining 20 animals

Stage I

Springs
load 0.2 MPa

Wedge deformation of the vertebra

73 d.o.
3 weeks

8 animals  →  His-pat  →  (Group II)
49 d.o. Day 0

4 animals $\xrightarrow{\text{His-pat}}$ Control (Group I)

Device implanted in the remaining 20 animals

Stage I

Springs
load 0,2 MPa

Wedge deformation of the vertebra

73 d.o. 3 weeks

8 animals $\xrightarrow{\text{His-pat}}$ (Group II)

Reversal of compressive forces
49 d.o.  
Day 0

4 animals  →  His-pat  →  Control (Group I)

device implanted in the remaining 20 animals

Springs
load 0.2 MPa

Wedge deformation of the vertebra

Stage I

73 d.o.
3 weeks

8 animals  →  His-pat  →  (Group II)

Reversal of compressive forces

Stage II

94 d.o.
6 weeks

7 animals  →  His-pat  →  (Group III)

End of experiment

The control group of each group - vertebrae without stabilizer
histological examination

Preparations were cut in the frontal plane

disc, fibrous ring
nucleus pulposus
Growth plate
vertebral body

centric center convex

Rest zone
proliferative zone
hypertrophic zone
zone of ossification
mature bone

thickness
end plate
hypertrophic zone
chondrocytes
Results

Histopathology: Group II (formed scoliosis) cartilage from the concave (a), and control group (b)

*Staining of H + E and Methyl blue 200x.*

- Irregular column layout of proliferative zone
- Growth plate is thin
- Hypertrophic layer is atrophic (a)

- Correct, the regular arrangement of the layers,
- Growth plate is wide
- Hypertrophic layer is fully active (b)
the height of the **growth plate**, **chondrocytes** and **hypertrophic zones** in all research groups (in microns)

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
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<tbody>
<tr>
<td><strong>thicknes</strong></td>
<td>Control day0</td>
<td>After 3 weeks- skoliozis =0+3weeks</td>
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<tr>
<td><strong>end plate</strong></td>
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<td>center</td>
<td>convex</td>
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<td><strong>SD</strong></td>
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<td>22.1</td>
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In the II'nd group was the most **reduced** height of hypertrophic zone and chondrocytes **on compression-side** (p < 0.001) compared with the control.
the height of the growth plate, chondrocytes and hypertrophic zones in different all groups (in microns)

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After 3 weeks of **correction** - increase the **activity** of the structures over the entire width of the growth plate - thickening. Hypertrophic chondrocyte layer and the concave side doubled its height (p <0.001).
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After the experiment, the height of chondrocytes on the entire width of the cartilage did not differ from those in the control group (p> 0.05). End plate thickness after correction corresponds to the control group.
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None of the evaluated elements was activated on the convex side of the curvature - distraction forces relative to the control group (p <0.001)
Conclusions

1. Starting early correction of scoliosis with strain relief of compressed end-plate allows the return of the physiological activity of the growth and rebuilding of deformed vertebral body.
Conclusions

2 Results may be an interesting starting point to consider the possibility to remove stabilization without SF after GGS treatment.

From Russian Ilizarov Scientific Centre
"Restorative Traumatology and Orthopaedics"

Nonfusion Treatment of Adolescent Idiopathic Scoliosis by Growth Modulation and Remodeling.
Aronsson, David; Stokes, Ian
DOI: 10.1097/BPO.0b013e318203b141
Thank you

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