Deep Paraspinal Muscles In Idiopathic Scoliosis: An Electrophysiological And Histochemical Study

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The pathogenesis of AIS remains poorly understood.

- To date, little is known about potentially involved local changes in deep paraspinal muscles in IS.
- **Dysfunction of sensorimotor integration** has been proposed as being causative factor, too.

**Objectives:**

- To characterize the *electrophysiological and histological findings* in deep paraspinal muscles (on the concave and the convex side of the curve) in patients with idiopathic scoliosis.
- To compare the *morphological and functional changes* of paraspinal muscles on both sides of the main scoliotic curve.
Material:

• **18 patients with AIS** - 15 female / 3 male
• Mean age - 17.2 ± 5.5 years (range 11 – 31 years).
• **Lower thoracic curves** were focused.
• Cobb angle measurements of 50.5° ± 8.7° (range 31°– 70°). All but one subject had thoracic convexity to the right.

Methods:

• **Needle EMG of the paraspinal muscles** at convexity and concavity of the maine curve
• **Cutaneous silent period (CSP)** induced by noxious digit II stimulation in thenar muscles was recorded in IS patients and in healthy volunteers.
• **56 biopsy samples** from different depth paraspinal muscles obtained from all the patients during corrective spinal surgery.
Needle EMG of deep paraspinal muscles

- **Main thoracic curves** were focused. Needle EMG of the paraspinal muscles at the *top of convexity and concavity* was performed 1 day before corrective surgery.

- All patients examined by needle EMG showed increased amplitude of motor unit action potentials (MUP) on the convex side of the curve.

- One subject presented double curve and had higher amplitude of MUP on the left side. 14 subjects have increased MUP amplitude on this side (range 10-62%).
Cutaneous silent period (CSP)

- Cutaneous silent period (CSP) induced by noxious digit II stimulation in thenar muscles was recorded in IS patients and in healthy volunteers.
CUTANEOUS SILENT PERIODS

in AIS at convexity and concavity of the curve in comparison to healthy subjects

<table>
<thead>
<tr>
<th></th>
<th>Convexity of IS</th>
<th>Concavity of IS</th>
<th>Healthy Subjects</th>
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</thead>
<tbody>
<tr>
<td>CSP Onset</td>
<td>74,3 ± 5,6</td>
<td>77,0 ± 6,9</td>
<td>71,4 ± 12,8</td>
</tr>
<tr>
<td>CSP Duration</td>
<td>48,2 ± 14,2</td>
<td>42,6 ± 12,7</td>
<td>53,3 ± 14,8</td>
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<tr>
<td>CSP End</td>
<td>122,8 ± 13,0</td>
<td>123,2 ± 10,8</td>
<td>124,7 ± 10,0</td>
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Note: Averaged values are in ms. ANOVA testing, non-significant changes.

- **CSP did not significantly differ** between concavity and convexity but shortening of CSP duration was observed in more pronounced scoliotic curve.
Paravertebral muscle biopsy

4 muscle biopsies were taken bilaterally during surgery from the superficial and deep multifidus muscle at the apex of the scoliotic curve between the 9th and 12th thoracic vertebral levels.

The muscle tissue samples were frozen in isopentane pre-cooled in liquid nitrogen and histologically analyzed.

No distinguishable changes were observed in the routine hematoxylin-eosin stain.
PARAVERTEBRAL MUSCLE BIOPSY

• Here, the type I fibers are seen as light blue fibers, the type II fibers are brown.
• Predominance of type I fiber in the convexity can be observed in this figure.
• Besides the predominance, occasional focal neurogenic fiber type grouping was observed in convexity.
The exact quantification of type I fibers percentage gave statistically significant difference between the convexity and the concavity.

<table>
<thead>
<tr>
<th>% fiber type I</th>
<th>CONVEXITY</th>
<th>CONCAVITY</th>
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<tbody>
<tr>
<td>Superficial multifidus m.</td>
<td>68.0 ± 6.4</td>
<td>50.2 ± 3.4</td>
</tr>
<tr>
<td>Deep multifidus m.</td>
<td>68.5 ± 4.8</td>
<td>49.1 ± 4.4</td>
</tr>
<tr>
<td></td>
<td>68.3 ± 5.4*</td>
<td>49.7 ± 3.5*</td>
</tr>
<tr>
<td>p &lt; 0.05</td>
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Conclusions:

- **Significant asymmetry in fiber type distribution** corresponding with an altered function in paraspinal muscles with predominance on the convexity of the curve.

- **Correlation EMG** with increased amplitude of motor unit action potentials (MUP) on the convex side of the curve.

- **Spinal inhibitory reflex is preserved**; however, it could be modulated in more progressive IS.

- **Thus, local neurogenic changes in the paraspinal muscles might play an important role in the development of idiopathic scoliosis.**
Conflict of interest statement

- The authors have no conflicts of interest to declare in relation to the presented study.

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