Improvement of Functional Outcome Using 6-minute walk in Patients with Congenital Scoliosis Treated by Growth Friendly Surgery: Five Years Follow-up Study

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## Disclosure

<table>
<thead>
<tr>
<th>Name</th>
<th>Relationships</th>
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<tbody>
<tr>
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No relevant financial relationships for this presentation

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**Note:**
- a. Grants/Research Support
- b. Consultant
- c. Stock/Shareholder
- d. Speakers’ Bureau
- e. Other Financial Support
6 Minute-Walk Test (6MW)

• To assess function in several cardiopulmonary and neuromuscular conditions
• Influenced by muscle strength, balance, nutritional status, cardiac and lung function
• Standardized with norms for children ≥ 5 years of age
• Easy to do in the outpatient setting
6-minute Walk Test in EOS

● Pre-op 6MW test in congenital scoliosis with rib anomalies
  ◆ ICEOS 2017, San Diego (Kawakami, Matsumoto, Redding)
    • Reduced in all patients compared to norm (10-30%)
    • Absolute 6MW values correlated with age, FVC and major curve

● 6MW test has not been widely used for EOS.

● No report of changes during surgical treatment in EOS
Purpose

- To investigate changes in 6-minute walk test before and after serial surgical treatment for congenital scoliosis
  - Hypothesis: Growth friendly surgery improves functional outcome measured by 6-minute walk

- To examine correlations between 6-minutes walk test and BMI and lung function forced vital capacity (FVC)
  - Hypothesis: Longer walking distance in 6MW test is associated with higher BMI and FVC

- To compare the results to changes reported in normal children
  - Hypothesis: EOS patients have less changes in function compared to norm
Design and Setting:

- A retrospective cohort study
- Consecutive patients 2004-2012 from a single center

Study Participants:

- Congenital scoliosis with rib anomalies (fused/defect, or severe deformed)
- Rib-based growth-friendly surgery
- Follow-up period: five years
Methods

Endpoints:

- 6 minutes walk test at 1-year, 2-year and 5-year
  - Absolute distance (m)
  - Standardized (height, age)

- BMI %tile at 1-year, 2-year and 5-year
  - Calculated by arm span
  - %tile by Japanese age specific norms

- FVC %tile at 1-year, 2-year and 5-year
  - Calculated by arm span
Study Participants

- **44 patients** (Male 14, Female 30)
- Age at primary surg.: **5.8±1.8 ys.**
- Pre-op BMI: **53±30 %tile**
- Number of procedures: **9.8±1.4** within 5 years
- 14 of 44 (32%) underwent spine fusion, implant removal, or termination of expansion by the end of the study
Involvement of Rib Anomalies in Thoracic Cage

**Laterality**
- None: 80%
- Bilateral: 1/3 of the unilateral thoracic cage
- Unilateral: 9%

**Area**
- None: 9%
- ≤1/3: 9%
- 1/3 ~ 2/3: 50%
- 2/3 ≤: 32%

80% of patients: unilateral involvement

>1/3 of the unilateral thoracic cage
Changes of Walking Distance: Standardized 6MW was compromised at preop but did not worsen postoperatively.

6 MW %tile using Swiss Age Norms

Preop 1 Yr Postop 2 Yr Postop 5 Yr Postop

0-9.9 10-19.9 20-29.9 30-39.9 40-49.9
## Results:

<table>
<thead>
<tr>
<th></th>
<th>Preop.</th>
<th>Immediate Postop.</th>
<th>1-year Postop.</th>
<th>2-year Postop.</th>
<th>5-year Postop.</th>
</tr>
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<tbody>
<tr>
<td>Major curve (°)</td>
<td>72 ± 28</td>
<td>53 ± 23</td>
<td>56 ± 22</td>
<td>56 ± 22</td>
<td>52 ± 23</td>
</tr>
<tr>
<td>BMI (%tile)</td>
<td>53 ± 30</td>
<td>---</td>
<td>51 ± 29</td>
<td>43 ± 31</td>
<td>34 ± 27</td>
</tr>
<tr>
<td>FVC % Predicted (%)</td>
<td>58 ± 17</td>
<td>---</td>
<td>57 ± 15</td>
<td>57 ± 15</td>
<td>54 ± 16</td>
</tr>
<tr>
<td>6-minute Walk (m)</td>
<td>344 ± 86</td>
<td>---</td>
<td>374 ± 74</td>
<td>390 ± 78</td>
<td>434 ± 80</td>
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</table>
Results:

• Over the 5-year period of study, 6-minute walk increased by 86±97m (17.2m/year)
  • Normal children increase distance of 16-25m per year

• The change in FVC did not correlate with the change in 6-minute walk as a % of incremental change over 5 years (p=0.30)

• No correlation between BMI and 6-minutes walk
Conclusions

● Over 5 yrs. of surgical Tx. for congenital scoliosis:
  ✓ Major coronal curve was reduced
  ✓ BMI decreased
  ✓ Lung function did not change as FVC % of predicted
  ✓ 6-minute walk distance increased in absolute terms at a rate seen in normal children over time

● Improvement in 6 minute walk occurs despite persistently reduced lung function, suggesting improvements in balance, strength, and stride length may be more important determinants of performance by rib-based growth-friendly surgery.
References


Thank you for your attention.
Standardized 6MW was compromised at preop but did not worsen postoperatively.