Radiographic outcome and complication rate of 34 graduates from treatment with vertical expandable prosthetic titanium rib – a single centre report

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Conflict of Interest Disclosure

- Daniel Studer  
  no conflict of interest

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  no conflict of interest

- Carol Hasler  
  Consultant DePuy Synthes
Background

«The heritage of enthusiasm for titanium rib prosthesis»

- congenital EOS / TIS
- widen the spectrum of indications
- indirectly control spinal deformities
Retrospective analysis of the treatment strategy and outcome for graduates from growth-friendly sparing surgery with titanium rib prosthesis
Methods

- IRB approval
- Database screened for EOS patients who have completed growth-friendly treatment with titanium rib prosthesis

«Final» treatment

- fusion
  - r/o implant w/ PISF
    - w/ halo-gravity traction
  - w/o halo-gravity traction

- non-fusion
  - r/o implant
  - implant in situ
Methods

- Radiographic parameters
  - main coronal and sagittal plane deformity
    - pre/ post index surgery
    - at the end of lengthening
    - after final fusion (if applicable)
    - at latest f/u

- Complications
  - in case of final fusion surgery
Results

55 patients treated with titanium rib prosthesis

- 11 under ongoing treatment
- 5/11 converted to MCGR

44 patients

- 10 incomplete medical records
- 3 died
- 6 further treatment abroad
- 1 salvage procedure

34 graduates
Results

treatment at the end of lengthening

- **5/34 (15%)**  
r/o implant w/o final spondylodesis  
mean f/u 39 months  
[all congenital]

- **12/34 (35%)**  
implant in situ  
mean f/u 43 months  
[2 patients w/ recommendation for final fusion inoperable due to comorbidities]  
[9 congenital, 3 neuromuscular]

- **17/34 (50%)**  
r/o implant w/ final spondylodesis  
mean f/u 25 months  
age @ final fusion 14.6y  
[8/17 w/ preop Halo-Gravity Traction]  
[6 congenital EOS, 6 neuromuscular, 4 syndromic, 1 idiopathic]

82% congenital EOS

65% non-congenital EOS
## Results

<table>
<thead>
<tr>
<th></th>
<th>fusion</th>
<th>r/o implant (n=5)</th>
<th>Implant in situ (n=12)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>17</td>
<td></td>
<td></td>
<td>34</td>
</tr>
<tr>
<td><strong>avg Age at implantation (years)</strong></td>
<td>6.0</td>
<td></td>
<td>10.2</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>avg Duration of treatment (years)</strong></td>
<td>7.0</td>
<td>5.5</td>
<td>6.5</td>
<td>6.7</td>
</tr>
<tr>
<td><strong>avg Number of lengthenings</strong></td>
<td>11</td>
<td>9</td>
<td>10</td>
<td>10</td>
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</tbody>
</table>

**Aetiology**

- **Congenital**: 6
- **Neuromuscular**: 6
- **Syndromic**: 4
- **idiopathic**: 1

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**Image**: Box plot showing age at VEPtr implantation (months) for fusion and no-fusion groups. The plot indicates a statistically significant difference (indicated by ***) between the two groups.
Results
Evolution of the deformity

**Major Curve**

- Before index surgery
- After index surgery
- At end of lengthening
- After final fusion

**Main Kyphosis**

- Before index surgery
- After index surgery
- At end of lengthening
- After final fusion

The graphs illustrate the changes in Cobb angle and main kyphosis at different stages of treatment (before index surgery, after index surgery, at end of lengthening, after final fusion). The plots show the trend of Cobb angle and main kyphosis over time, with specific focus on the effects of VEPTR® treatment with and without fusion.
Results

Preop halo-gravity traction (8/17)

[27 ± 11 days, range, 14-43 days]

**Major Curve**

- Cobb at the end of VEPTR treatment
- Cobb at the end of HG traction
- Cobb after final fusion
- Cobb at latest f/u

**Main kyphosis**

- Kyphosis at the end of VEPTR treatment
- Kyphosis at the end of HG traction
- Kyphosis after final fusion
- Kyphosis at latest f/u
Results / Discussion
Complications after «final» fusion

- **7/17 (41% complication rate)**
  - 2x SSI
  - 2x PJK
  - 1x loss of sagittal balance
  - 1x disfunction of ventriculo-peritoneal shunt system
  - 1x superficial wound healing

- 6 unplanned returns to the OR
  - **35% re-operation rate!**

**Sawyer et al. _Spine Deformity_2016**
- n=37 (32 w/ rib-based fixation); 25 PSF
- complications: 15/25 (60%)
- re-operation rate: 24%

**Poe-Kochert et al. _JBJS_2016**
- n=100 (tGR; min. 2-y f/u after final fusion)
- complications: 20/100 (20%)
- 57 unplanned returns to the OR in 20 patients
Results / Discussion
Correction with final fusion

<table>
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<tr>
<td>Growing-Rod Graduates: Lessons Learned from Ninety-nine Patients Who Completed Lengthening</td>
<td>Complications and Radiographic Outcomes of Posterior Spinal Fusion and Observation in Patients Who Have Undergone Distraction-Based Treatment for Early Onset Scoliosis</td>
</tr>
</tbody>
</table>

- **percent of correction after final fusion**
  - ≤ 20% in 18% 65%
  - 21-50% in 48% 35%
  - > 50% in 15% 0%

- **spine flexibility @ final fusion**
  - 19% mobile
  - 19% decreased flexibility
  - 62% completely stiff

- «...no significant curve correction or gains in spine height and length with PSF...»

- «...high degree of rigidity...»
- «...spontaneous autofusion...»
- «...final fusion longer than intended...»

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**Extraspinal ossifications after implantation of vertical expandable prosthetic titanium ribs (VEPTRs)**

Vanja Zivkovic · Philippe Büchler · Dror Ovadia · Rolf Rüise · Ralf Stuecker · Carol Hasler
Conclusion

- High complication rate during treatment with titanium rib prosthesis and with final fusion surgery
- High re-operation rate [«final» fusion ≠ last surgery]
- Stiff spine and thorax allowing for little correction with final fusion
- Reluctant use of halo-gravity traction
- Adapt expectations [patient/family & surgeon] at the beginning of growth-sparing surgical treatment
Thank you for your attention

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