Does Sagittal Position of the CTDR Related Center of Rotation Influence Functional Outcome? Prospective 1 Year Follow-up Analysis

1Neurocenter Liberec, Neurosurgery, Liberec, Czech Republic, 2University Rostock, Neurosurgery, Rostock, Germany, 3University Helsinki, Neurosurgery, Helsinki, Finland, 4BG-Kliniken Bergmannstrost, Neurosurgery, Halle, Germany, 5University Hospital Motol, Spinal Surgery, Prague, Czech Republic, 6University Hospital Charité-Campus Virchow-Klinikum, Neurosurgery, Berlin, Germany, 7Warrington District General Hospital, Spinal Surgery, Warrington, United Kingdom, 8Zentrum für Endoskopische und Minimale Invasive Wirbelsäulenoperationen, Berlin, Germany, 9Katholisches Klinikum Koblenz, Spinal Surgery, Koblenz, Germany, 10Hospital Maz, Neurosurgery, Zaragoza, Spain, 11Istituti Fisioterapici Ospitalieri, Neurosurgery, Roma, Italy, 12Frictionless GmbH, Kiel, Germany

Aims: Segmental range of motion (ROM) and restoration of cervical spine balance in the sagittal profile are currently considered to be essential aspects for CTDR success, influencing the risk for future adjacent segment degenerations. But what is the role of implant related center of rotation positioning in this coherence?

Methods: We analyzed the interim results of 111 patients (47m, 64f), who were treated with single-level (2xC3/4, 7xC4/5, 56xC5/6, 46xC6/7) CTDR (activ C™) at 11 European sites. 81 of them received a standard and 30 a flat implant version. One major difference between both types is the sagittal position of the center of rotation, which is more anterior in flat components, depending on the implant size. Examinations took place pre-operatively, 6 weeks, 6 months and 1 year postoperatively. Computerized radiographic measures and statistical analysis were performed independently.

Results: Mean NDI changed from 40.1 preoperatively to 22.2 at 6 weeks, 19.8 at 6 months and 19.9 at 1 year follow-up, mean VAS for neck pain severity from 52.0 to 23.1, 22.6, and 24.0 and for arm pain severity from 53.6 to 18.8, 16.5, and 20.0 respectively. This substantial postoperative improvement was statistically significant (p< 0.001) for all outcome measures, but there were no significant differences by implant type apart from NDI after 6 weeks (p=0.037).

For standard components the mean preoperative segmental angle increased from -2.3° lordosis to -5.4° after 6 weeks and remained at -5.2 after 6 months and -5.3° after 1 year and for flat components from -1.0° lordosis to -5.9° after 6 weeks and remained at -6.1 after 6 months and -6.0° after 1 year (no significant differences by implant version). However, correction of disc angle achieved (preop vs. 1 year) differed between standard and flat implants (3° vs. 5° lordotic correction, p=0.008). Correlation analyses showed a medium effect (Pearson Rho -0.322, p< 0.001) between the COR of the implant relative to the midpoint of the inferior endplate (CORi) and correction achieved.

ROM was for standard components 9.6° preoperatively, 7.6° after 6 weeks and 7.8° after 6 months. For flat components these measures were 9.0°, 9.4° and 8.7°. Significant differences between both groups were detected after 6 weeks (p=0.049), but there was no statistically significant correlation between CORi and ROM after 6 months.

Lateral device placement was considered to be ideal for all cases (111/111) just as all devices (111/111) were intact. No device subsidence (>3mm), migration (>3mm) or expulsion occurred (0/111) and 3/111 cases showed signs of osteolysis.

Conclusions: Our results demonstrate a relationship between the sagittal position of the COR of cervical disc prostheses and mid-term correction of cervical lordosis: the more anterior the COR, the higher the lordotic correction achieved. As proper cervical sagittal profile seems to be essential for good rotational movement in the long term, future analysis should investigate the development of segmental motion. For clinical practice we suggest to consider COR positioning for specific CTDR devices accordingly.