INFLUENCE OF CERVICAL TOTAL DISC REPLACEMENT ON MOTION IN THE TARGET SEGMENTS AND ADJACENT SEGMENTS

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Introduction

In contrast to cervical discectomy and fusion, total disc replacement (TDR) aims at preserving the motion at the treated vertebral level, thereby sparing the adjacent segments. Two-level TDR in particular is not sufficiently investigated yet.
Therefore, the aim of this in-vitro study was to investigate the range of motion (ROM) of the cervical spine after one-level and two-level TDR in the target segments as well as the adjacent segments.

Methods

TDR was performed on seven fresh frozen human cervical spine specimens (C4-T1, mean age 40 ± 17 years) first one-level at C5-6 and then extended one level further caudal (C5-7). In the intact state and after each implantation the ROM of the specimens was evaluated.
Each specimen was quasistatically loaded with pure moments up to 1.5 Nm in flexion/extension (FE), lateral bending (LB) and axial rotation (AR) in a universal spine tester for 3.5 cycles at 1 °/s. Motion tracking was performed for each vertebral body individually to determine the ROM of each spinal level. Statistical analysis was performed using a Friedman-test and post-hoc correction with Dunn-Bonferroni-tests ($p < 0.05$).

Results

In FE, one-level TDR (C5-6) moderately increased the ROM in all four segments, but only significantly at the cranially adjacent segment C4-5 (Fig. 1 A). Additional TDR at C6-7 further increased the ROM at the target segment ($p = 0.054$) but did not influence the other segments.
In LB, one-level TDR decreased the ROM at the target segment C5-6 significantly, without influencing the other segments (Fig. 1 B). Extending TDR to C6-7 decreased ROM in the target segment again but did not affect the adjacent segments.
In AR, one-level TDR at C5-6 decreased the ROM at the target segment ($p > 0.05$) while ROM at the caudally adjacent segment C6-7 was increased (Fig. 1 C). Additional TDR at C6-7 did not further affect the ROM. At both segments C4-5 and C7-T1, the ROM was not affected by TDR at all.

Discussion

The motion preservation capabilities in FE as well as the reduction of motion in LB and AR are in line with previous studies of the adjacent segments is not regularly reported. In FE, even one-level TDR results in increased motion not only in the target segment but also the adjacent segments. During the ventral approach and the decompression of the spinal canal the anterior longitudinal ligament, major parts of the ventral annulus and the posterior longitudinal ligament at the target level are dissected. This seems to have a motion increasing effect spanning several segments during FE loading but does not show a clear influence in LB and AR.

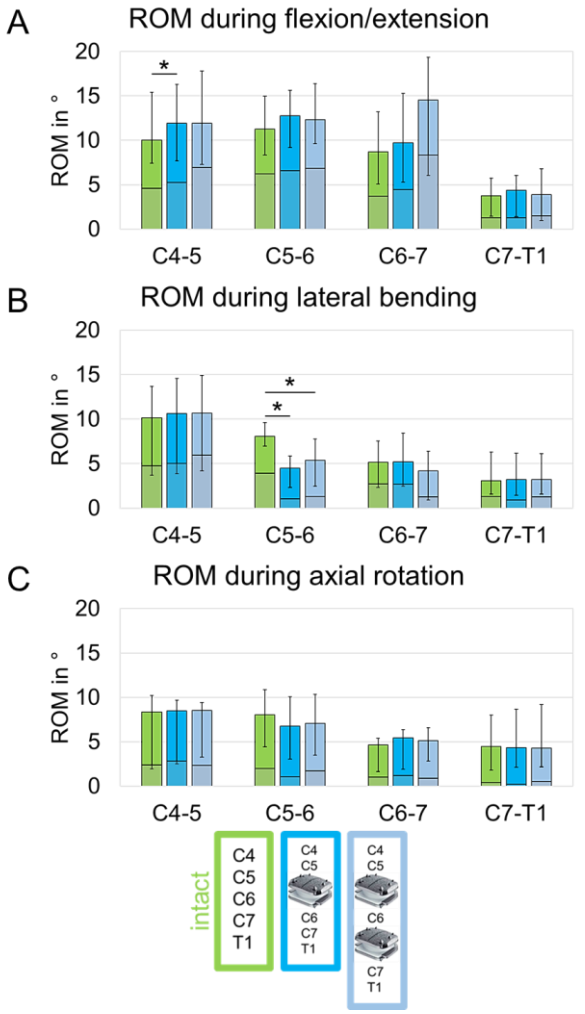

Figure 1: Median range of motion (ROM) and neutral zone of each motion segment during FE (A), LB (B) and AR (C). Errors bars represent range of ROM. Significant differences ($p < 0.05$) in ROM are denoted with an asterisk.

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