Introduction
Currently, the spinal fusion still represents the gold standard in the treatment of most degenerative disc disease of the cervical spine, by which a cage is usually applied. However, long term clinical studies have shown evidence of an increased incidence of pathologies in the adjacent levels [1,2,3]. Furthermore biomechanical studies have verified increased mobility and increased intradiscal pressure (IDP) in the adjacent segments after a cervical fusion [4,5,6,7]. For these reasons, more motion-preserving intervertebral disc-prostheses that act as placeholders have been developed to permit the mobility in all three planes of motion. More recently, so called dynamic implants, which provide stability while still allowing some motions have appeared. One such device was tested biomechanically in this study.

Materials/Methods
Seven adult sheep multisegmental C2-C5 specimens were tested in flexion/extension, lateral bending and axial rotation [8]. These motions were initiated by applying pure moments (± 2 Nm), which is the standard for spine motion-segment testing. In addition, the specimens were loaded with a constant follower load of 120 N. Initially, the physiological intact state of the specimens was investigated, followed by surgically implanted dynamic DCI™ implant (Paradigm Spine) placed at the C3/C4 level (Fig. 1 a).

The testing device consisted of a force and moment controlled serial robot KUKA KR15 and seven force controlled servo hydraulic actuators (Fig. 1 b). To determine the influence of the implant on the adjacent segments, the analysis was performed according to the Hybrid Test Method [9].

Results
In the treated C3/C4 segment, the percentage of intersegmental Range of Motion (iRoM) to the total Range of Motion (tRoM) decreased in flexion/extension from 38 to 27% compared to the intact physiological state (Fig. 2). In lateral bending, the iRoM decreased significantly (Wilcoxon, p = 0.028) from 36 to 11%. No change in the RoM was observed in axial rotation.

In the adjacent segments, no significant change of the iRoM was observed in flexion/extension and lateral bending. The IDP in flexion increased significantly by 148% in the cranial disc (Wilcoxon, p = 0.028). In extension and lateral bending, no significant change of the IDPs was observed.

Conclusion
In the flexion and extension the DCI™ implant shows a tendency to stabilize the segment while allowing some degree of residual mobility. In lateral bending, the implant significantly reduced movement, and thus stabilizes the affected segment. In the adjacent segments, the kinematics was not observed to be significantly affected in the three directions tested. The only significant change observed was an increase of IDPs of the cranial disc in flexion.

Based on these biomechanical findings, we conclude that from biomechanical perspective, the DCI™ implant could indeed provide an alternative to cage supported fusions, or total disc replacement in the cervical spine.

Acknowledgements
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Literature


Abbildung 1


Abbildung 2

Abb. 2: Bar charts of the percent distribution of the range of motion in flexion/extension and lateral bending with and without dynamic DCI™ implant in the level C3/C4. 100% represents 40% of the RoM of the intact specimens.