INTRODUCTION:
Two common approaches to address multi-level cervical sub-axial (C3-C7) disc degeneration are posterior laminectomy and fusion (PLF) and combined anterior and posterior decompression and fusion (A&P). Both approaches aim at ensuring spinal stability after fusion (PLF) and combined anterior and posterior decompression and sub-axial (C3-C7) disc degeneration are posterior laminectomy and fusion (A&P). A closer look at that rotational motions revealed that the location of HAM was similar relative to the torso and head. This indicated that across groups, there was no change in global axis of head rotation and a detailed analysis of the intersegmental motions is required to address any possible difference due to direction of motion. The center of the HAM was similar across control, 4-level and 5-level groups with slight shift in the superior and anterior directions for the treated groups. This shift was not statistically significant. Finally, according to the NDI survey, all surgical groups were categorized with mild disability except 5-level AP had a moderate disability. In addition, 5-level fusions scored higher than 4-level fusions on all questions except “Personal Care” and “Headaches”. Moreover, “Lifting” and “Recreation” had the highest score among the questions for all groups.

METHODS:
A dynamic, six degree of freedom virtual reality-assisted cervical motion tracking device (Next of Birds - Ascension Technology Corporation) was used to record the ROM of 82 subjects (Table 1) between the age of 38 and 79. Subjects were divided into 5 groups: non-operative control (N=18), 4-level PLF (N=30), 5-level PLF (N=16), 4-level A&P (N=14), and 5-level A&P (N=4). All operative subjects were diagnosed with multilevel cervical disc degeneration. The experimental design was a prospective cohort study in which different subjects were grouped and compared independently. Subjects performed three to five continuous cycles of primary motions (Flexion/Extension: FE, Axial Rotation: AR, and Lateral Bending: LB) while minimizing the other two rotational motions to reduce motion coupling. The ROM was considered to be the averaged peak to peak movement amplitude to avoid uncertainties about the location of the neutral position. Moreover, significant differences in ROM were further investigated by analyzing movement kinematic properties by calculating the location of the helical axis of motion (HAM). HAM was determined after normalizing the distance between the subject’s torso and initial head position. Data was collected and analyzed in MATLAB, and the MATLAB kinematic toolbox was used to calculate HAM. NDI was collected from all surgical subjects prior to kinematic testing. An ANOVA statistical test with Bonferroni correction was used to determine statistical significance.

RESULTS:
The ROM of all operated subjects was significantly lower than controls (Fig. 1). Subjects with 4- or 5-level PLF had comparable ROM to subjects with 4- or 5-level A&P, respectively. Meanwhile, there was a large difference in ROM between 4- and 5-level PLF and between 4- and 5-level A&P. Since there was no difference according to surgical operation, 4-level PLF and A&P subjects were combined under one group (4-level, N=44). Similarly, 5-level subjects were considered as one group (5-level, N=20). The HAM was calculated for flexion and extension motion separately to address any possible difference due to direction of motion. The center of the HAM was similar across control, 4-level and 5-level groups with slight shift in the superior and anterior directions for the treated groups. This shift was not statistically significant. Finally, according to the NDI survey, all surgical groups were categorized with mild disability except 5-level AP had a moderate disability. In addition, 5-level fusions scored higher than 4-level fusions on all questions except “Personal Care” and “Headaches”. Moreover, “Lifting” and “Recreation” had the highest score among the questions for all groups.

DISCUSSION:
To our knowledge, this is a novel study addressing the ROM of patients with 5-level cervical fusion. Both PLF and A&P groups showed similar trends in their ROM relative to asymptomatic controls. The fusions created a significant loss of motion relative to controls. Extending the fusion segment from C3-C7 to C3-T1 introduced a significant additional loss of about 23° during FE. A closer look at that motion revealed that the location of HAM was similar relative to the torso and head. This indicated that across groups, there was no change in global axis of head rotation and a detailed analysis of the intersegmental motions is required to address the difference between 4- and 5-level ROM. Finally there was no significant difference in the level of subject’s disability according to NDI survey across the various groups.

REFERENCES:

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