The "topping-off" technique is a new concept applying dynamic or less rigid fixation such as a hybrid stabilization device (HSD) or interspinous process device (IPD) for the purpose of avoiding adjacent segment disease (ASD) proximal to the fusion construct. A systematic review of the literature was performed on the effect of topping-off techniques to prevent or decrease the occurrence of ASD after lumbar fusion surgery. We searched through major online databases, PubMed, and MEDLINE, using keywords related to the "topping-off" technique. We reviewed the surgical results of "topping-off" techniques with either HSD or IPD, including the incidence of ASD at two proximal adjacent levels (index and supra-adjacent level) as compared to the fusion alone group. The results showed that the fusion alone group had a statistically higher incidence (8.1%) of revision surgery. Besides, the HSD (10.5%) and fusion groups (24.7%) had statistically higher incidences of radiographic ASD at the supra-adjacent level than the IPD (1%). The findings suggest that the "topping-off" technique may potentially decrease the occurrence of ASD at the proximal motion segments. However, higher-quality prospective randomized trials are required prior to wide clinical application ¹⁾.

To determine whether 'topping-off' lumbar fusions, using Posterior Dynamic Stabilization Systems with specific biomechanical parameters, reduces the risk of adjacent segment disease (ASD).

Methods: Survival analysis of two non-randomized cohorts, with or without 'topping-off' (T/O or NoT/O), compared the risk of further surgery for ASD following multi-level posterior lumbar interbody fusion (PLIF). The study sample comprised consecutive patients, aged 55 + years, with degenerative pathology at 2, 3 or 4 levels. The NoT/O cohort underwent surgery between August 1993 and September 2019 (n = 425) and the T/O cohort between September 2011 and September 2019 (n = 146). Comparison of ASD risk between cohorts used Cox proportional hazards (CPH) modeling and Kaplan-Meier survivorship analysis.

Results: Analysis was completed on 571 operations across 507 patients. Median follow-up was 63 months (range 0.3-196) and 37 months (range 1.7-98) for the NoT/O and T/O cohorts, respectively. Of 423 patients, 125 (29.6%) patients in the NoT/O cohort underwent further surgery for ASD and 16/145 (11.03%) in the T/O cohort. The hazard ratio (T/O: NoT/O) from the CPH model was 0.42 (95% CL: 0.24-0.74, P = 0.003). The mean annual incidence across the first 5 years was 5.0% in the NoT/O cohort compared with 2.8% in the T/O cohort (P = 0.029). No patient required surgery or developed ASD at a 'topped-off' level. Two patients developed asymptomatic pedicle screw loosening at the level of the PDS device. PROMs were similar between cohorts.

Conclusion: This large, non-randomized, observational study found an approximately 60% reduction in further surgery for ASD with the use of the PDS to 'top-off' PLIF fusions. PDS device-related complications were very low $^{2)}$.

1)

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