Adjacent Level Ossification Development Following Anterior Cervical Fusion: How Does it Affect the Next Level Disc?

W.-K. Min¹, D.-H. Lee², J.-S. Yi³, J.M. Pahys⁴, C.R. Kennedy⁵, K.D. Riew⁵
¹Kyungpook National University, Orthopaedic Surgery, Daegu, Korea, Republic of, ²Asan Medical Center, University of Ulsan, Orthopaedic Surgery, Seoul, Korea, Republic of, ³Daejeon Catholic Hospital, Catholic University, Neurosurgery, Daejeon, Korea, Republic of, ⁴Albert Einstein Medical Center, Orthopaedic Surgery, Philadelphia, PA, United States, ⁵Washington University in St. Louis, Orthopaedic Surgery, St. Louis, MO, United States

Introduction: Anterior adjacent level ossification development (ALOD) is a form of heterotopic ossification that occurs commonly after anterior cervical arthrodesis. In severe form, it might lead to near or complete auto fusion, thus resulting in restriction of the range of motion (ROM) at the affected segment. However, to date, there have been no reports regarding its clinical significance. The purpose of this study was to investigate how ALOD influences the affected and the next level discs in terms of ROM and degenerative changes including disc height decrease, osteophyte formation, and anteroposterior displacement.

Methods: This is a retrospective, single institution, matched-pair study of anterior cervical fusions with minimum 2-year follow-up. The severity of ossification was classified as grade 0 (no ossification), grade 1 (< 50% of disc space), grade 2 (≥50% of disc space), and grade 3 (complete bridging). Twelve patients who presented with grade 3 ALOD were first selected. To these patients, 12 patients with grade 2 disease, 12 with grade 1, and 12 with grade 0 were matched using criteria of age, gender, and number of fusion levels.

Three lateral radiographic views of the cervical spine were taken in neutral, extension, and flexion preoperatively and at the final follow up. On the neutral films, disc height and the length of osteophytes were measured at the segments which were 1- (adjacent segment) and 2-level cranial (the next segment) to the uppermost fused disc. On the lateral films in extension/flexion position, the ROM of each segment and the degree of maximal listhesis (antero- or retro-) were investigated. The patients were classified into two groups according to the degree of ALOD: group 1 (grade 0-1, N=24) vs. group 2 (grade 2-3, N=24). The changes of all variables were compared between two groups.

Results: There were no significant differences between two groups based on age, gender, the number of fusion levels, and follow-up period (p>0.05). The mean ROM of adjacent segment increased by 3.6° in group 1; meanwhile, decreased by 2.8° in group 2 (p=0.002). The mean ROM of the next segment increased in both groups and the increasing amount was significantly greater in group 2 than in group 1 (4.5° vs. 1.2°, p=0.016). The osteophyte growth and the aggravation of listhesis at the next segment were significantly greater in group 2 (p< 0.05); however, at the adjacent segment, the degree of listhesis was not aggravated. Neither at the adjacent level nor at the next level, was the disc height changed significantly (p>0.05).

Conclusions: Moderate to severe ALOD (grade 2-3) following anterior cervical fusion significantly reduced ROM at the affected segment; meanwhile it increased the motion at the next segment. This suggests that ALOD affects not only the adjacent segment, but also 2 levels cranial to the fusion site by increasing osteophyte growth and the aggravation of listhesis. On the basis of these results, ALOD could be considered as a type of complication related with anterior cervical arthrodesis. Therefore, surgeons need to apply the possible techniques to avoid or mitigate this problem.