Comprehensive Evaluation of Degenerative Changes following Adolescent Idiopathic Scoliosis Surgery: A Five-Year Follow-Up Study

Takaaki Uto[1], Satoru Demura[2], Satoshi Kato, Noriaki Yokogawa[1], Satoshi Nagatani[3], Masafumi Kawai
[1]Kanazawa University, [2]Department of Orthopaedic Surgery, Kanazawa University, [3]Kanazawa Univercity

INTRODUCTION:
Surgical treatment for idiopathic scoliosis aims to halt curve progression and achieve stable fusion. However, fusion may accelerate degeneration and result in symptoms in the remaining mobile segments. Although some studies have examined the impact of fusion level on spinal mobility and pain, a comprehensive evaluation of disc, facet joint, and paraspinal muscle degeneration in these segments is lacking. This study aims to provide a thorough assessment of degenerative changes and evaluate clinical outcomes at a five-year follow up.
METHODS:
Patient Population: A retrospective review was conducted on scoliosis cases undergoing surgery at our institution between 2006 and 2015. Inclusion criteria encompassed idiopathic scoliosis patients aged ten years or older with progressive curves requiring surgery, preoperative MRI, fusion between T12 and L4 as the lowest instrumented vertebra (LIV), a minimum five-year follow up, and postoperative lumbar MRI at the five-year mark. Exclusion criteria included non-idiopathic scoliosis, prior spine surgeries, revision surgery, neurologic deficits, or less than five years of follow up. Forty eligible patients with complete clinical evaluations were included.
Outcome Measures: The patients were divided into selective fusion (LIV L2 and above) and non-selective fusion (LIV L3 and below) groups. Disc degeneration, facet degeneration, and paraspinal muscle degeneration were assessed using pre- and postoperative MRIs. Degeneration grading was done using established scoring systems. Clinical outcomes were measured using the SRS-22 Patient Outcome Questionnaire, assessing function, pain, self-image, mental health, and satisfaction.
RESULTS:
Patient Characteristics: Among the 40 patients, 21 underwent selective fusion (LIV L2 and above), while 19 underwent non-selective fusion (LIV L3 and below). There were no significant demographic differences between the groups. The average BMI was 19.47 ± 2.09 kg/m2, and the average fusion length was 9.13 ± 2.80 levels.
Degenerative Changes:
Disc Degeneration: After five years of follow up, 15% of patients exhibited disc degeneration in the remaining mobile segments, primarily in the lower lumbar regions. However, there were no statistically significant differences in disc degeneration based on Pfirrmann's score before and after surgery or between the selective and non-selective fusion groups.
Facet Degeneration: Six patients showed no facet joint degeneration at any level during the follow up. In the selective fusion group, significant facet joint degeneration occurred at the three levels below the fusion mass (T12-L1 $p = 0.025$, L1-2 $p = 0.002$, L2-3 $p = 0.004$). In the non-selective fusion group, significant degeneration occurred at the two levels below the fusion mass (L3-4 $p = 0.016$, L4-5 $p = 0.010$). The non-selective fusion group exhibited significantly greater facet degeneration than the selective fusion group at all levels (L3-4 $p = 0.003$, L4-5 $p = 0.003$, L5-S1 $p = 0.029$).
Muscle Degeneration: Paraspinal muscle degeneration was observed in 47.5% of patients at the five-year follow up. The postoperative Goutallier score was significantly higher in both the selective and non-selective fusion groups ($p = 0.025$ and $p < 0.001$, respectively). The non-selective fusion group had a significantly higher Goutallier score compared to the selective fusion group ($p < 0.001$). Muscle degenerative changes occurred in 23.8% of patients in the selective fusion group and 73.7% of patients in the non-selective fusion group.
Clinical Outcomes: There were no significant differences in clinical outcomes between the selective and non-selective fusion groups at the five-year follow up. All patients had relatively satisfactory clinical outcomes, with a mean SRS-22 subtotal score of 4.24 ± 0.34. Neurologic examinations were normal, incisions were fully healed, and sagittal and coronal balance was achieved. No complaints were reported regarding lumbar range of motion after five years.
DISCUSSION AND CONCLUSION:
This five-year follow-up study provides insights into degenerative changes following surgical treatment for adolescent idiopathic scoliosis. Selective fusion surgery with the LIV at L2 and above showed advantages, with lower incidences of facet joint and muscle degeneration compared to non-selective fusion. Facet degeneration extended up to three levels below the fusion mass. Importantly, these degenerative changes did not correlate with clinical symptoms at the five-year follow up. However, longer follow-up studies are necessary to fully understand the potential symptomatic impact.