Ten-Year Postoperative Magnetic Resonance Imaging Assessment of Nonfused Lumbar Disc and Facet Joint Degeneration in Adolescent Idiopathic Scoliosis

Takaaki Uto, Noriaki Yokogawa, Satoshi Kato, Takaki Shimizu, Yuji Ishino, Kazuhiro Nanpo, Megumu Kawai, Narimichi Takino, Satoru Demura

INTRODUCTION:
Surgical fusion for Adolescent Idiopathic Scoliosis (AIS) can lead to stress concentration in nonfused spinal segments, potentially accelerating adjacent segment degeneration. While intervertebral disc degeneration is known to be inversely related to the number of mobile segments, with factors like lowest instrumented vertebra (LIV) below L4 and abnormal sagittal alignment implicated in long-term studies, data on facet joint degeneration are less extensive. Facet joint changes have been linked to axial rotation, kyphosis, and pain, with some reports suggesting higher rates adjacent to the LIV. However, comparative long-term progression patterns between disc and facet joint degeneration remain inadequately defined. This study aimed to clarify the differences in ten-year postoperative degenerative progression patterns of nonfused lumbar intervertebral discs and facet joints in AIS patients using magnetic resonance imaging (MRI) and to assess any correlation with clinical outcomes.
METHODS:
We retrospectively reviewed 24 female patients who underwent AIS surgery at our institution between 2007 and 2014. All included patients had preoperative, 5-year, and 10-year postoperative lumbar MRIs. Mean age at surgery was 17.2 years. Mean preoperative Cobb angle was 56.2°. Lenke Type 1 was the most common curve (n=11), and Lumbar Modifier C was present in 15 patients. LIV distribution was T12 (n=5), L1 (n=4), L2 (n=2), and L3 (n=13); no patients had an LIV at L4. Degeneration of 97 intervertebral discs was assessed using Pfirrmann classification, and 97 facet joints using Fujiwara score. Progression was defined as ≥1 grade worsening. Scoliosis Research Society-22 (SRS-22) scores were obtained at the 10-year follow-up.
RESULTS:
At 10 years postoperatively, progression of disc degeneration (≥1 Pfirrmann grade) was observed in 15 of 24 patients (63%). Progression was most frequent at L3/4 (46%). Most discs showed stability in Pfirrmann grades 1 and 2; one severe case developed Modic changes.
Facet joint degeneration progressed in 21 of 24 patients (88%). This affected 57% of individual facet joints and was more frequent than disc degeneration. Progression rates were approximately 60% across all evaluated lumbar levels, without clear predilection for a specific level. The most common change was from Fujiwara grade 1 to grade 2, characterized by joint space narrowing.
There were no significant differences in SRS-22 scores at 10 years between patients with or without disc degeneration, or with or without facet joint degeneration.
DISCUSSION AND CONCLUSION: This study demonstrates that AIS patients experience progressive, time-dependent degeneration in both intervertebral discs and facet joints in nonfused lumbar segments over a ten-year postoperative period. The degeneration is influenced by both aging and the biomechanical consequences of spinal fusion. Facet joint degeneration (88% of patients) was notably more prevalent than disc degeneration (63% of patients) at 10 years, a finding consistent with some literature suggesting facet joints adjacent to LIV are susceptible, though our study did not find a clear association with LIV level or specific spinal level for facet changes. The predominant Fujiwara grade 1 to 2 shift suggests joint space narrowing may be an early indicator of facet degeneration.
Previous studies report disc degeneration in 42-63% of patients at long-term follow-up, often at L4/5 and L5/S1. Our disc degeneration rate aligns with this, though specific level predilection was less clear.
The lack of correlation between degenerative changes and SRS-22 scores at 10 years is likely because patients were relatively young (20s-30s), and age-related degenerative influences were minimal, making it difficult for differences to manifest clinically. These early degenerative changes appear to be largely asymptomatic.
Limitations include the retrospective single-center design, small sample size, potential selection bias from loss to follow-up, and possible influence of longitudinal variations in MRI acquisition parameters on grading.
In conclusion, at 10 years post-AIS surgery, 63% of patients showed disc degeneration progression, while 88% showed facet joint degeneration, most commonly characterized by facet joint space narrowing. These early degenerative changes did not impact clinical outcomes at this time point. However, continued long-term follow-up is crucial to monitor for potential symptom development as these patients enter middle age and aging effects become more prominent.

Feature	Disc Degeneration	Facet Joint Degeneration
Patients with progression (n, %)	15 (63 %)	21 (88 %)
Most common change	Pfirrmann G1→2	Fujiwara G1→2

Table 1. Progression of Lumbar Disc and Facet Joint Degeneration at 10 Years Post-operatively.