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Introduction: The research landscape on regional lumbar alignments has evolved rapidly with a specific focus on loss of lordosis. However, few studies have attempted to characterize how and where lumbar lordosis (LL) is lost. Therefore, the purpose of this study is to quantify how much LL is lost in the proximal and distal lumbar spine in patients with degenerative spine disease, and how this may relate to muscle health.

Materials and Methods: After describing the classic parameters, the cohort's normative L1PA, L4PA, global and regional lordosis were calculated using age-and PI-adjusted formulas. PI-LL offsets from norm were used to create 3 alignment groups: 74 pts with Mild (Mld), 55 pts with Moderate (Mod), and 26 pts with Severe (Sev) mismatch. The range of motion (ROM) of L1-S1, L1-L4, L4-S1 were calculated from flexion/extension films. The 3 alignment groups were then analyzed and compared. **Results:** 155 pts were included (age 56 ± 16 , BMI 29.26 ± 5 kg/m², 57% F) with the following sagittal alignment: PI = $55.4 \pm 10^\circ$, PI-LL = $8.35 \pm 11^\circ$, PT = $20.62 \pm 8^\circ$, L4-S1 = $30.6 \pm 9^\circ$, L1PA = $11.17 \pm 7^\circ$, and L4PA = $11.44 \pm 4^\circ$. Compared to age-and-PI adjusted values, our cohort had a loss of LL (Δ PI-LL: $12.0 \pm 9^\circ$) due to both proximal and distal segments (Δ L1-L4: $-7.1 \pm 8^\circ$; Δ L4-S1: $-4.5 \pm 9^\circ$) leading to a more anterior spine (Δ L1PA: $1.0 \pm 5^\circ$; Δ L4PA: $0.4 \pm 2^\circ$) (all $p < 0.01$). The 3 alignment groups had no differences in sex ($p = 0.14$), age ($p = 0.667$), and PI ($p = 0.658$). Compared to the Norm, patients in "Mld" (PI-LL offset from norm = $4.1 \pm 3^\circ$) had a significant loss of LL in the proximal segments (L1L4: 20.2° vs 23.9° $p < 0.01$) but none distally (L4S1: 35.3 vs 35.2 $p = 0.9$); they also had a slight anterior translation of L1 (L1PA: 8.2° vs 7.8° $p = 0.041$). Patients in "Mod" (PI-LL offset from norm = $14.4 \pm 3^\circ$) had 8.5° loss in the proximal segments (L1L4: 14.6° vs 23.1° $p < 0.001$) and 3.8° in the distal segments (L4S1: 29.1° vs 34.8° $p < 0.001$); L1 vertebra translated anteriorly (L1PA: 11.6° vs 7.8 $p < 0.001$) but not L4 (L4PA: 11.3° vs 10.7° $p = 0.06$). Finally, patients in "Sev" (PI-LL offset from norm = $29.4 \pm 6^\circ$) had a 14° loss of lumbar lordosis both in the proximal (L1L4: 9.8° vs 23.8°) and distal segments (L4S1: 20.4° vs 35.2°); the lumbar spine translated anteriorly as showed by L1PA (17.9° vs 7.8° , $p < 0.001$) and L4PA (13.2 vs 11.1 , $p < 0.001$). The "Sev" patients also had a smaller L4-L5 disc height (9.03 vs 11.05 mm $p < 0.01$), less ROM at L4S1 ($6.3 \pm 5^\circ$ vs $10.0 \pm 6^\circ$ vs $11.0 \pm 7^\circ$ $p < 0.001$), without significant difference in L1S1 ROM. There were no significant differences across groups in muscle CSA (4332 vs 4051 vs 4396 , $p = 0.332$) or Goutallier classification ($p = 0.412$), but there was a significant difference in Lumbar Indentation between "Mld" and "Mod" (14 vs 10 , $p = 0.02$). **Conclusion:** Our study showed that in a degenerative population the loss of lumbar lordosis begins proximally and progresses to affect the distal portion of the curve.

Furthermore, we noticed that the loss in curvature distally is characterized by the spine translating anteriorly, a reduction in disc space and a loss in distal range of motion.

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A21 I: Patterns and preferences of fusion selections in the treatment of lumbar spondylolisthesis among spine surgeons

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Introduction: Lumbar degenerative spondylolisthesis is a common clinical condition that spine surgeons across the globe treat routinely. Patients with symptomatic lumbar spondylolisthesis may present with significant variations of clinical presentation and radiographic findings that impact surgeons' treatment decisions. Age-related and other medical and anatomical considerations may alter surgeons' surgical strategies. The current study aims to understand how often surgeons decide to fuse in lumbar spondylolisthesis based on differences in clinical, radiographical, and patient factors. Additionally, the study aims to reveal patterns and preferences of various fusion types from surgeons worldwide. **Material and Methods:** Three lumbar spondylolisthesis cases were electronically presented to AOSpine international members to study surgeons' preferences for treatment considerations. Case 1 included an elderly patient with mainly radiculopathy and severe central stenosis without dynamic instability, case 2 included a younger patient with mechanical back pain and radiculopathy with severe central and neuroforaminal stenosis and significant instability on dynamic x-rays, and case 3 had an older patient with back pain and radiculopathy with instability on dynamic x-rays without severe central stenosis. Data collected includes demographics, training background, years of experience, and treatment decisions based on various radiographical findings, including segmental measures

and global and spinopelvic parameters. The survey was distributed online to over 6000 AO Spine members between July 27 – September 8, 2023. 943 responded, and 479 completed the survey. Responses to questions about decision-making parameters and surgical technique preferences in treating grade 1 L4-5 spondylolisthesis were collected and analyzed. Comparative analysis was performed using the Pearson Chi-Squared Test. **Results:** In all cases, fusion was the preferred treatment among all surveyed surgeons. Even without dynamic instability and mainly radiculopathy, 75.2% responded that they would fuse. Selection of fusion methods were distributed widely across all cases, ranging from 0.3% to 20.2% in case 1 with radiculopathy without dynamic instability, 0.5% to 17% in case 2 with back pain, and radiculopathy associated with dynamic instability with severe central and neuroforaminal stenosis, and 0.2% to 21.8% in case 3 with back pain and radiculopathy associated with dynamic instability without central or neuroforaminal stenosis. Overall, posterolateral fusion with direct decompression was the most common procedure among surveyed surgeons in patients with severe central stenosis without dynamic instability, followed by MIS transforaminal interbody fusion and posterior lumbar interbody fusion (PLIF). On the other hand, anterior and lateral approaches for fusion are less commonly chosen across all three cases. Dynamic instability was associated with increased utilization of anterior lumbar interbody fusion and lateral transpsoas or pre-psoas interbody fusions. There were no significant differences between orthopedics vs. neurosurgery, fellowship vs. no fellowship, academic/university practices vs. private practices, or < 15 years experience vs. > 15 years experience in selecting their surgical approaches. **Conclusion:** Fusion remains the most preferred procedure for treating lumbar degenerative spondylolisthesis by spine surgeons around the globe, and most surgeons favor posterolateral fusion with direct decompression in spondylolisthesis, followed by MIS TLIF and PLIF. There were no significant differences in the selection of fusion methods by subspecialty, fellowship status, practice setting, and years of experience.

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A212: A comparative study of superior facet joint violation with pedicle screw in minimally invasive percutaneous fluoroscopy guided vs robotic assistance in transforaminal lumbar interbody fusion: a short term prospective study

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Introduction: Superior facet joint violation during pedicle screw insertion will lead to adjacent segment degeneration.

Previous studies had compared facet joint violation in open & MIS technique. No study available in literature comparing facet joint violation in Robotic (Excelsius GPS) & MIS in Lumbar TLIF. **Material & Methods:** We studied 63 patients (33 Robotic & 30 MIS) prospectively and analysed facet joint violation & pedicle breach using a CT based grading system (Yson & Gertzbein Robbins). Demographic details & clinical outcome compared among these two groups. radiation exposure of patient & health care staff is also compared. **Results:** The overall incidence of facet joint violation in robotic group is 16.6% & MIS group is 13.33%. (p = 0.601) All the facet joint violation were Grade 1 in both the groups. In our study we found the accuracy with respect to mediolateral breach (Grade 0, 1) to be higher with Robotic group (98.09%) than MIS group (83.56%) (p value = 0.00078). The rate of radiologically significant pedicle breach (grade 2, 3) was more in MIS than robotic group (16.42% (23/140) vs 2.52% (4/158)). The mean total radiation exposure (preoperative & intra operative) to the patient in robotic TLIF is more than MIS group 10.57 >> 3.13 (mSv), whereas the mean intraoperative radiation exposure to the health care staff is more in MIS group 2.93 > 1.356 (mSv). **Conclusion:** This study demonstrates no major difference in facet joint violation in Robotic & MIS groups. Robotic assisted navigation effectively increases pedicle screw accuracy, safety & less radiation exposure to the health care staff than MIS group.

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A213: Nationwide trends in operative management of low-grade, stable degenerative lumbar spondylolisthesis

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Introduction: Operative management strategies for low-grade, stable degenerative lumbar spondylolisthesis remain disparate across spine surgeons, with dichotomous practices pertaining to the use of decompression alone versus decompression with fusion. Decompression with fusion is currently the gold standard, but recent literature suggests equivalent outcomes for patients treated with decompression alone with significant reductions in healthcare expenditures. The purpose of this study is to describe the recent utilization, demographics, complications, and revisions for patients with DLS undergoing decompression or decompression with fusion in the USA (US). **Material and Methods:** Patients who underwent lumbar decompression and fusion (n = 82,287) or lumbar decompression alone (n = 89,409) between 2010-2022 for DLS were queried from the PearlDiver National database.