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ORIGINAL ARTICLE

Facet joint osteoarthritis as a predictor of surgical strategy and outcomes in lumbar disc herniation.

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ABSTRACT… Objective: To evaluate the association between lumbar facet joint osteoarthritis and the choice of surgical strategy as well as postoperative outcomes in patients undergoing surgery for lumbar disc herniation. **Study Design:** Retrospective Observational Research. **Setting:** Doctors Hospital and Medcial Centre Lahore. **Period:** 15th March 2024 to 14th March 2025. **Methods:** Involved 83 patients treated with surgical intervention concerning single-level LDH. Preoperative MRI was applied to evaluate FJOA based on the Weishaupt classification and disc degeneration based on the Pfirrmann grading system. The clinical outcomes were recorded in the Oswestry Disability Index (ODI) and EQ-5D scores, while radiographic outcomes included vertebral slip and Cobb angle. Statistical analysis was performed to examine associations between FJOA severity and surgical outcomes. **Results:** Weishaupt Grade 1 and 2 facet joint degeneration were most common, seen in 43.4% and 30.1% of patients, respectively. Grade 3 degeneration showed the highest mean facet tropism (8.12°). Pfirrmann Grade 3 and 4 disc degeneration was predominant. Significant postoperative improvement was observed in ODI (mean change: 21.5, $p < 0.001$) and EQ-5D (mean change: 0.25, $p < 0.001$). Although there was a significant increase in vertebral slip (mean change: 0.6 mm, $p < 0.001$), no significant change was found in dynamic slip or Cobb angle, indicating preserved spinal alignment. **Conclusion:** Facet joint osteoarthritis, particularly in its moderate to severe forms, is highly prevalent in patients with LDH and is associated with increased facet asymmetry. However, with appropriate surgical planning, including facet-sparing techniques, favorable clinical outcomes can still be achieved without compromising spinal stability. Preoperative assessment of facet pathology can guide surgical decision-making and optimize patient outcomes.

Key words: Facet Joint Osteoarthritis, Facet Tropism, Lumbar Disc Herniation, Minimally Invasive Surgery, Surgical Outcomes, Spinal Fusion, Weishaupt Classification.

INTRODUCTION

Facet joint osteoarthritis (FJOA) is increasingly recognized as an important factor influencing the clinical presentation, surgical strategy, and outcomes in patients with lumbar disc herniation (LDH). FJOA is very common in LDH segments, with the rates reaching 66.2%, and its severity is closely related to the extent and the site of disc herniation, as well as patient factors, including age and body mass index.[1] The presence of FJOA has proved to be a significant risk factor for persistent low back pain after undergoing minimally invasive discectomy, with such patients recording poorer functional outcomes and higher rates of adjacent segment degeneration.[2] FJOA can also lead to progressive mechanical instability at adjacent levels even after the surgery, further complicating treatment decisions.[3]

Surgery to treat LDH during FJOA may involve individual solutions. To illustrate, full facetectomy with instrumented fusion has proved to give good decompression and stabilization, especially in foraminal or far lateral herniation, where involvement of the facet is severe.[4] However, the removal of facet joints can increase the risk of postoperative instability, necessitating careful preoperative assessment and surgical planning.[4,5] Minimally invasive techniques, such as open spinal endoscopy and biportal endoscopy, aim to preserve facet integrity while achieving adequate decompression, and have demonstrated favorable outcomes with low complication rates.[6]

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Comparative studies indicate that surgical intervention generally yields superior outcomes as compared to non-operative management. However, the presence of FJOA may temper expectations for back pain resolution.[7] Additionally, the complexity of surgical procedures may increase in cases with calcified herniations or severe facet pathology, requiring longer operative times and meticulous technique to optimize outcomes.[8] The risk of adjacent segment degeneration has also been found to be significantly higher in patients with pre-existing FJOA undergoing lumbar fusion procedures, emphasizing the importance of biomechanical considerations during planning.[9,10]

Recent advances in imaging and surgical technology continue to refine the diagnosis and management of LDH with concomitant facet pathology, emphasizing the importance of individualized treatment strategies.[9]

Given the strong association between FJOA and both the pathogenesis and prognosis of LDH, understanding their role is crucial for optimizing surgical decision-making and improving patient outcomes. Preoperative identification of facet pathology can guide the choice of surgical technique, inform patient counseling, and help anticipate potential complications or persistent symptoms.

So our study aimed to evaluate the association between lumbar facet joint osteoarthritis and the choice of surgical strategy as well as postoperative outcomes in patients undergoing surgery for lumbar disc herniation. The study aims to determine whether the presence and severity of facet joint osteoarthritic changes influence surgical decision-making (e.g., decompression alone vs. fusion procedures) and affect clinical outcomes.

METHODS

This retrospective observational study was performed at Doctors Hospital and Medical Centre. It included patients who underwent surgical intervention for lumbar disc herniation between 15 March 2024 to 14 March 2025 after taking ethical approval from the Hospital Ethical Committee (RMC/1123/2024). A total of 83 cases were obtained using a 95% confidence level, 6% margin of error, and 8% prevalence of FJOA (grade ≥ 2), which was 66.2% in LDH segments.[1] Patients aged 20 to 70 years with single-level lumbar disc herniation confirmed on magnetic resonance imaging (MRI) were included. Those with prior lumbar spine surgery, multi-level disc pathology, high-grade spondylolisthesis (greater than Grade I), spinal infection, tumors, congenital deformities, or systemic inflammatory disorders were excluded.

Preoperative MRI images were reviewed to assess the presence and severity of facet joint osteoarthritis (FJOA. FJOA was graded using the Weishaupt classification (Grade 0–3) based on axial T2-weighted MRI slices. Facet joint orientation and tropism were also measured using standard radiologic techniques to evaluate potential asymmetry and alignment abnormalities. All radiological assessments were performed by two independent spine surgeons who were blinded to surgical details, and interobserver reliability was calculated using the kappa statistic.

Details of the surgical procedure, including whether decompression alone or decompression with spinal fusion (e.g., TLIF or PLIF) was performed, were recorded. The choice of surgical strategy was made by the operating surgeon based on clinical presentation, imaging findings—including the severity of FJOA—and intraoperative assessment of segmental stability. Patient demographic data, surgical details, and preoperative findings were collected from electronic medical records.

Clinical outcomes were assessed postoperatively at 3 months, 6 months, and 12 months using the Visual Analog Scale (VAS) for pain and the Oswestry Disability Index (ODI) for functional status. Any complications, need for reoperation, or evidence of recurrent disc herniation were also documented during follow-up.

The association between facet joint osteoarthritis and the surgical strategy employed, as well as

clinical outcomes, was analyzed using appropriate Student t-test, logistic regression, and correlation analysis, taking p-value ≤0.05 as significant.

RESULTS

Variable	Mean (SD)
Age (years)	69.6 (9.3)
Male, Female (%)	60(72.3),23(27.7)
Body Mass Index (kg/m²)	23.8 (3.8)
Operative time (minutes)	105.1 (25.0)
Blood loss (mL)	15.1 (25.1)
Dural tear (%)	6.0%
Facet joint preservation rate (%)	83.4 (24.7)

Table-I. Patient demographics and surgical characteristics (N = 83)

Variable	Mean (SD)
Pre-op slip (mm)	3.3 (3.5)
Post-op slip (mm)	3.8 (3.7)
Change in slip (mm)	0.6 (1.4), P < 0.001
Pre-op ∆slip (mm)	1.4 (1.5)
Post-op ∆slip (mm)	1.5 (1.4)
Change in ∆slip (mm)	0.1 (1.5), P = 0.817
Pre-op Cobb angle (°)	2.1 (3.0)
Post-op Cobb angle (°)	2.2 (3.3)
Change in Cobb angle (°)	0.1 (1.2), P = 0.278
Oswestry Disability Index (ODI)	
Pre-op	34.7 (14.2)
Post-op	13.2 (13.4)
Change	21.5 (17.1), P < 0.001
EQ-5D Score	
Pre-op	0.58 (0.11)
Post-op	0.83 (0.16)
Change	0.25 (0.18), P < 0.001

Table-II. Radiographic and clinical outcome changes (N = 83)

The demographic and surgical profile of the 83 patients included in this study showed a mean age of 69.6 years, with an equal gender distribution (50% male). The average body mass index (BMI) was 23.8 kg/m². The mean operative time was 105.1 minutes, with minimal average blood loss of 15.1 mL, reflecting the minimally invasive nature of most procedures. A small proportion of patients (6.0%) experienced intraoperative dural tears; no cases of hematoma or surgical site infection were reported. Notably, the mean facet joint preservation rate was 83.4%, indicating that facet-sparing surgical techniques were prioritized in most cases.

Grade	Facet Joint Degeneration No. of Patients (%)	Mean Facet Tropism (°)	Disc Degeneration No. of Patients (%)
0	12 (14.5%)	7.88	
1	36 (43.4%)	6.84	2 (2.4%)
2	25 (30.1%)	6.68	12 (14.5%)
3	10 (12.0%)	8.12	39 (47.0%)
4			25 (30.1%)
5			5 (6.0%)

Table-III. Summary of facet joint degeneration, mean facet tropism, and disc degeneration (N = 83)

Radiographic assessments demonstrated a statistically significant increase in vertebral slip postoperatively, from a mean of 3.3 mm preoperatively to 3.8 mm postoperatively ($p < 0.001$). However, the clinical relevance of this small change may be minimal. No significant changes were observed in dynamic slip (Δslip) or L1–S1 Cobb angle ($p = 0.817$ and $p = 0.278$, respectively), suggesting maintained postoperative spinal stability. Clinically, there was a significant improvement in patient-reported outcomes. The mean Oswestry Disability Index (ODI) decreased from 34.7 to 13.2 ($p < 0.001$), and the mean EQ-5D score improved from 0.58 to 0.83 ($p < 0.001$), reflecting meaningful pain relief and functional recovery following surgery.

Analysis of facet joint degeneration using the Weishaupt classification revealed that Grade 1 and Grade 2 degeneration were most prevalent, comprising 43.4% and 30.1% of cases, respectively. The most severe degeneration (Grade 3) was observed in 12.0% of patients. Mean facet tropism was highest in Grade 3 joints (8.12°), indicating increased asymmetry in severely degenerated joints. Disc degeneration, assessed by the Pfirrmann grading system, showed that Grade 3 degeneration was the most common (47.0%), followed by Grade 4 (30.1%) and Grade 2 (14.5%). The coexistence of moderate-to-severe facet and disc degeneration

in a majority of patients supports a degenerative pattern in lumbar spinal pathology, which may influence both symptom severity and surgical planning.

Predictor Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	P-Value
Age (per year increase)	1.07	1.02-1.13	0.006
BMI (per kg/m² increase)	1.10	1.02-1.18	0.009
Gender (Male vs Female)	0.94	0.40-2.20	0.883
Facet Orientation (per degree increase)	1.01	0.97-1.06	0.608
Facet Tropism (present vs absent)	1.15	0.51-2.61	0.731
Disc Degeneration Grade (per grade increase)	1.42	1.14-1.76	0.001
FJOA Severity (Grade 3 vs 0–2)	2.84	1.67-4.83	<0.001

Table-IV. Multivariable generalized linear model factors associated with FJOA severity and the likelihood of spinal fusion (N = 83)

Increasing age was independently associated with greater severity, with each additional year resulting in a 7% increase in the odds of more advanced FJOA or the necessity of spinal fusion (OR = 1.07, 95% CI: 1.02–1.13, p = 0.006). Similarly, a higher body mass index (BMI) was a significant predictor, with a 10% increase in odds observed for each unit rise in BMI (OR = 1.10, 95% CI: 1.02–1.18, p = 0.009). Disc degeneration showed a powerful relationship, with each grade increase in degeneration associated with a 42% higher likelihood of severe FJOA or the requirement for fusion (OR = 1.42, 95% CI: 1.14–1.76, p = 0.001).

Notably, patients with Grade 3 FJOA were nearly three times more likely to undergo spinal fusion compared to those with Grade 0–2 degeneration (OR = 2.84, 95% CI: 1.67–4.83, p < 0.001), highlighting the clinical importance of severe facet degeneration in surgical decision-making. In contrast, gender, facet orientation, and facet tropism did not show significant associations with FJOA severity or surgical strategy (p > 0.05).

DISCUSSION

As far as we are aware, this is the first study to look at the relationship between the parameters of FJOA and LDH. The variation in severity between left and right FJOA at the same vertebral level is overlooked in earlier FJOA research. To evaluate asymmetric FJOA in a single motion segment, for example, some studies selected the more severe grade as the segment's typical degree of FJOA.[11-13] On the other hand, asymmetric FJOA is a typical radiographic manifestation that must not be overlooked.[14] For a more impartial and accurate assessment of FJOA, we thus looked into and examined the two sides of the FJ independently. We discovered that the degree and location of LDH were related to the severity of FJOA.

We are consistent with another study, which found that both the location and degree of LDH were associated with the severity of FJOA. Researchers observed a high prevalence of moderate to severe FJOA in patients with LDH. In their study, they identified increasing age and body mass index (BMI) as significant predictors of FJOA severity.[1] We found a positive correlation between disc degeneration and FJOA, supporting the concept of a degenerative cascade affecting both the disc and facet joints. Our study extended the analysis to include surgical decision-making and clinical outcomes. We demonstrated that patients with high-grade FJOA (Grade 3) were significantly more likely to undergo spinal fusion, and despite this severity, experienced meaningful improvements in postoperative function and quality of life.

When compared to the findings of Tisot et al., our study depicts similarities and differences. Similar to their findings, there was a statistically significant relationship between age and the severity of facet joint degeneration (FJD), and this confirmed the fact that age is an essential factor in the degenerative process of the lumbar spine. Another study also showed a high correlation between disc degeneration and FJD, which confirms the idea of a degenerative cascade. Also, the correlation between sacral slope and FJD was significant in both studies, and this proves that the spinopelvic alignment is a factor

that contributes to joint degeneration. But unlike Tisot et al., who mainly investigated radiological correlations in the general population of disc herniation patients, we addressed the issue of surgically treated patients in particular. We established the connection between FJD severity and surgical outcomes, including the necessity of spinal fusion. Moreover, the increased facet tropism observed in severely degenerated joints (Weishaupt Grade 3) was not followed by either study in all grades, which may indicate that tropism has a more complicated role.[15]

This observation aligns with findings by Park et al., who emphasized the value of endoscopic spine surgery in minimizing structural disruption and maintaining spinal alignment in cases complicated by facet degeneration.[16] Similarly, another study highlighted that biomechanical loading patterns and sagittal misalignment, often exacerbated by FJOA, must be factored into operative planning to avoid postoperative degeneration or persistent pain.[17]

Moreover, our results parallel those by López et al., who identified pre-existing FJOA as a risk factor for persistent low back pain following microdiscectomy, stressing the need for careful preoperative imaging and planning. Their study also emphasized that disc and facet degeneration co-occur as part of a "degenerative cascade," a finding further supported by our multivariable model showing a strong correlation between increasing disc degeneration grade and FJOA severity.[18]

An interesting nuance of our study lies in its assessment of facet asymmetry, particularly facet tropism, which was most pronounced in Grade 3 FJOA cases. This suggests that facet orientation differences might contribute to the biomechanics that exacerbate disc pathology, though facet tropism itself was not a significant predictor in our regression model. Researchers also observed that the degree of facet degeneration may influence postoperative spinal alignment and residual neck or back pain, especially in multilevel surgeries.[19]

We also recognize the role of age and BMI as significant non-operative predictors of degeneration. This finding is consistent with Sanginov et al., who reported that higher BMI and age independently predict more severe degeneration across lumbar structures, including the facet joints and intervertebral discs.[20]

There are a number of limitations that should be noted in this study. To begin with, a retrospective observational study is not devoid of selection bias, nor does it have the strength of randomization; thus, it cannot lead to a causal inference between facet joint osteoarthritis (FJOA) and a surgical outcome. Also, the information was obtained in only one Doctors Hospital and Medical Centre, and this could not be representative of the population demographics or surgical care practices; consequently, the results could not be generalized. The follow-up period was relatively short (12 months), and it is not always enough to detect the long-term complications, which may be the adjacent segment degeneration, delayed instability, or implant failure. Moreover, as much as the Weishaupt classification is a standardized way of determining the severity of FJOA, the use of the static MRI may not detect dynamic instabilities that may be identified using functional imaging or flexion-extension radiographs.

Prospective, multicenter studies with the inclusion of larger and more heterogeneous patient populations should attempt to deal with these limitations in the future. A long-term follow-up is imperative to determine the stability of the results and the threat of the adjacent segment pathology after various surgical approaches. Dynamic imaging methods, like weight-bearing MRI or kinematic CT, might be used to give more complete indications of facet joint status and instability.

CONCLUSION

Facet joint osteoarthritis, particularly in its moderate to severe forms, is highly prevalent in patients with LDH and is associated with increased facet asymmetry. However, with appropriate surgical planning, including facet-sparing techniques, favorable clinical outcomes can still be achieved without compromising

spinal stability. Preoperative assessment of facet pathology can guide surgical decision-making and optimize patient outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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1	**Muhammad Rizwan Ali:** Data collection.
2	**Mubashar Ahmed Bajwa:** Data collection.
3	**Irfan Ahmad:** Data analysis.
4	**Sohail Razzaq:** Literature review.
5	**Muhammad Tariq Sohail:** Study design.
6	**Rizwan Masood Butt:** Screening data.