Original Research Article

EVALUATING THE INFLUENCE OF FACET JOINT INJECTION ON SPINOPELVIC PARAMETERS AND FUNCTIONAL OUTCOMES IN LUMBAR OSTEOARTHRITIS

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ABSTRACT

Background: Low back pain (LBP) is a prevalent musculoskeletal issue contributing significantly to disability and economic costs. The lumbar facet joints, which stabilize spinal segments during movement, can degenerate with age, causing lumbar osteoarthritis (OA). This degeneration, particularly at the L4-L5 and L5-S1 levels, often triggers pain. Facet joint injections (FJI) are a common intervention, yet their effects on spinopelvic alignment and functional outcomes in lumbar OA remain underexplored. **Objective:** To evaluate the effects of FJI at different lumbar levels on spinopelvic parameters and functional outcomes in patients with lumbar OA, and to analyze the relationship between changes in these parameters and functional outcomes.
Materials and Methods: A prospective study was conducted at MKCG Medical College, Berhampur, including 144 patients with lumbar OA unresponsive to conservative treatment. Patients were divided into Group 1 (two-level FJI at L4-L5 and L5-S1) and Group 2 (five-level FJI from L1 to S1). Injections were administered with fluoroscopic guidance using a mixture of lidocaine and triamcinolone acetonide. Functional outcomes were assessed using the Oswestry Disability Index (ODI) before and three months post-injection, alongside radiographic measurements of spinopelvic parameters (pelvic incidence, sacral slope, and pelvic tilt). Statistical analyses included paired and independent t-tests, with correlations assessed via Pearson's coefficient.
Results: Of the 164 patients, 97 were female, with a mean age of 60.6 ± 6.4 years. Group 2 showed a significant reduction in ODI scores post-injection ($p = 0.009$) and in pelvic tilt ($p = 0.021$), while Group 1 demonstrated no significant changes. Correlation analysis revealed a moderate positive association between ODI changes and pelvic tilt ($r = 0.576$, $p = 0.013$), indicating that greater improvements in functional outcomes were associated with pelvic tilt adjustments.
Discussion: The findings suggest that multilevel FJI offers enhanced functional outcomes and adjustments in spinopelvic alignment, particularly pelvic tilt, compared to two-level FJI. These results align with previous studies showing that FJI can impact lumbar alignment, with implications for functional improvement in lumbar OA. Limitations include a short follow-up duration and lack of direct pain intensity assessment beyond ODI.
Conclusion: Multilevel FJI in lumbar OA patients significantly improves functional outcomes and reduces pelvic tilt, potentially influencing lumbar alignment and facet joint orientation. These insights suggest that broader

lumbar levels should be targeted in FJI for meaningful clinical improvements, with future research needed to refine patient-specific FJI approaches.
Keywords: Lumbar osteoarthritis, low back pain, facet joint injection, spinopelvic parameters, Oswestry Disability Index, lumbar alignment, pelvic tilt.

INTRODUCTION

Low back pain (LBP) ranks among the most common musculoskeletal complaints, leading to substantial social and physical disability and contributing significantly to economic strain due to treatment costs and lost productivity.[1] Lumbar spine movement varies across different spinal levels, with research indicating that the L4-L5 segment shows greater mobility in bending motions, while the L2-L3 segment exhibits a wider range of flexion-extension compared to lower levels.[2-5]

Facet joints play a vital role in stabilizing spinal segments during movement, bearing around 18% of the load on the lumbar spine.[6] Degenerative changes in these joints, known as osteoarthritis (OA), can lead to cartilage deterioration, joint space narrowing, synovial cysts, and osteophyte formation.[7] The lumbar facet joints are richly innervated by the medial branches of the dorsal rami, making them highly sensitive to pain8. Degeneration in the facet joints can trigger pain through two mechanisms: cartilage deterioration itself and the formation of osteophytes, which can compress adjacent nerve roots.[9-10] Facet joint degeneration is estimated to contribute to roughly a third of LBP cases, and changes in sagittal spinopelvic parameters have been associated with the progression of this degeneration.[11]

Facet joint injections (FJI), the second most common spinal intervention after epidural injections, are increasingly used to manage back pain. While the effects of FJI on pain relief and functional improvement have been studied extensively, its impact on spinopelvic parameters and the relationship between the injection level, functional outcomes, and spinopelvic parameter changes have not yet been explored.[12-13]

This study aims to investigate how the level of FJI affects spinopelvic parameters and functional outcomes and to explore the association between changes in functional outcomes and spinopelvic parameters. We hypothesize that multilevel FJI will result in greater improvements in functional outcomes and spinopelvic parameter changes and that improvements in functional outcomes will correlate with changes in spinopelvic parameters.

MATERIALS AND METHODS

Ethical Approval

The study received ethical clearance, and informed consent was obtained from all participants prior to enrollment. The research was conducted at MKCG Medical College and Hospital, Berhampur, Odisha.

The study included 245 patients who received facet joint injections (FJI) as treatment for facet joint arthritis between 2019 and 2021. Patients over 45 years old with low back pain associated with radiologically confirmed, symptomatic facet joint arthritis, unresponsive to medical management and physiotherapy for at least three months, were eligible. Patients received FJI at either the lower lumbar levels (L4-L5 and L5-S1) or all lumbar levels (L1-L2, L2-L3, L3-L4, L4-L5, and L5-S1). Exclusion criteria included other spinal conditions (such as spinal stenosis, radicular pain, or previous spinal surgeries), severe sagittal alignment issues, rheumatologic or neuropathic pain, abdominal or thoracic muscular/visceral conditions, pregnancy, hypersensitivity to local anesthetics or steroids, and bleeding disorders. Following these criteria, 164 patients were selected and divided into two groups: Group 1 (two levels, L4-L5 and L5-S1; n = 82) and Group 2 (five levels, L1-L2, L2-L3, L3-L4, L4-L5, and L5-S1; n = 82).

Injections were administered bilaterally by the same surgeon. Patients lay prone on a radiolucent table, and the target area was sterilized with a 10% povidone-iodine solution. Under fluoroscopic guidance, a spinal needle was placed into the target facet joints, and contrast material confirmed needle positioning. Each facet joint was then injected with a 1:1 mixture of lidocaine and triamcinolone acetonide.[14]

Patients were assessed clinically and radiologically before the injection and three months afterward. Functional outcomes were measured using the Oswestry Disability Index (ODI).[15] Standing anteroposterior and lateral spine radiographs were taken pre- and post-injection to measure pelvic incidence, sacral slope, and pelvic tilt. Radiographic assessments were conducted by two orthopedic surgeons, twice within a two-week interval.[16-18]

Descriptive statistics were reported using mean, standard deviation (SD), median, minimum, maximum, and frequencies. Variable distributions were assessed with the Shapiro-Wilk test. The independent samples t-test was applied to compare changes between groups, while the dependent samples t-test analyzed changes within groups. Correlation analysis was performed using Pearson's correlation to examine the relationship between changes in ODI and spinopelvic parameters. Correlation strength was categorized as follows: 0–0.3 (negligible), 0.3–0.5 (weak), 0.5–0.7 (moderate), 0.7–0.9 (strong), and 0.9–1.0 (very strong). Effect size was calculated using Cohen's d, classified as weak (0.2), weak to moderate (0.2–0.45), moderate (0.45–0.65), moderate to high (0.65–0.80), and high

(≥0.80). Intra- and inter-observer reliability of radiographic measurements was evaluated using the intraclass correlation coefficient (ICC), with ICC values classified as slight (0–0.2), fair (0.21–0.40), moderate (0.41–0.60), substantial (0.61–0.80), and perfect (>0.81)19-21. Statistical significance was set at $p < 0.05$, and analyses were performed using R software.

RESULTS

The study evaluated the outcomes of 164 patients, with an overall mean age of 60.6 ± 6.4 years. Of these, 97 patients (59.1%) were female and 67 (40.9%) were male, as detailed in Table 1. The patients were divided into two groups: Group 1 had a mean age of 59.9 ± 6.1 years, while Group 2's mean age was 61.3 ± 6.2 years. Body Mass Index (BMI) was comparable between the groups, with Group 1 averaging 28.3 ± 6.2 kg/m² and Group 2 averaging 28.2 ± 5.3 kg/m².

The demographic profiles of the groups were statistically similar, with no significant differences observed in age, gender distribution, or BMI (all p-values > 0.05), supporting comparable baseline characteristics across both groups. This balanced distribution provides a solid basis for analyzing outcome measures without confounding demographic variability. [Table 1]

The mean pre-injection Oswestry Disability Index (ODI) score was 61.5 ± 7.1, which decreased to 59.8 ± 7.9 post-injection, indicating a statistically significant reduction (P = 0.008). Radiographic measurements demonstrated high reliability, with both intraobserver and interobserver intraclass correlation coefficients (ICC) exceeding 0.75 and 0.73, respectively.

A notable reduction in pelvic tilt was observed from pre- to post-injection evaluations (P = 0.021). Table 2 details the pre- and post-injection ODI scores along with spinopelvic parameters for each group. Group 2 showed a significant decrease in ODI score post-injection (P = 0.009), while Group 1 showed a small, non-significant decrease (P = 0.259). Pelvic tilt values were consistently higher in Group 2, both before and after the injection (P = 0.001, effect size d = 1.89; P = 0.006, effect size d = 1.83), though changes in pelvic tilt within each group were not statistically significant (P > 0.05). [Table 2]

As outlined in Table 3, there was a moderate positive correlation between ODI score changes and pelvic tilt (P = 0.013, r = 0.576). Additionally, a low positive correlation was found between changes in ODI scores and adjacent vertebral angles (P = 0.021, r = 0.374). [Table 3]

Table 1: Demographic Characteristics of the Study Groups

Demographic characteristics of the two groups			
	Group 1 (*n* = 82)	**Group 1 (*n* = 82)**	**p value**
	Mean ± SD	**Mean ± SD**	
Age	59.9 ± 6.1	61.3 ± 6.2	0.555
Gender	51/31	46/36	0.485
BMI (kg/m2)	28.3 ± 6.2	28.2 ± 5.3	0.227

Table 2: Comparison of Pre- and Post-Injection Oswestry Disability Index (ODI) and Spinopelvic Parameters

		Group 1		**Group 2**			
		Mean ± SD	**Median**	**Mean ± SD**	**Median**	**p**	**d**
Oswestry Disability Index	Pre-injection	57.0 ± 6.9	57.1	66.9 ± 7.8	65	0.089	1.19
	Post-injection	54.4 ± 7.9	55.2	61.9 ± 7.2	61	0.151	0.91
	Intra-group difference *p*	0.259		0.009			
Pelvic incidence	Pre-injection	55.5 ± 5.8	54.9	61.8 ± 5.1	60.7	0.112	1.11
	Post-injection	56.1 ± 4.7	57.1	59.9 ± 4.9	61.9	0.352	0.82
	Intra-group difference *p*	0.637		0.234			
Sacral slope	Pre-injection	43.9 ± 5.6	44	39.2 ± 6.0	41.4	0.14	0.88
	Post-injection	42.9 ± 3.9	41.9	39.5 ± 4.5	42.9	0.231	0.86
	Intra-group difference *p*	0.511		0.801			
Pelvic tilt	Pre-injection	13.0 ± 4.5	12.3	24.0 ± 5.8	23.9	***0.001***	1.89
	Post-injection	13.4 ± 5.1	12.2	19.9 ± 5.1	22	***0.006***	1.83
	Intra-group difference *p*	0.301		***0.021***			
T12-L1	Pre-injection	2.3 ± 0.8	1.8	1.7 ± 0.5	1.9	0.241	0.91
	Post-injection	2.6 ± 0.9	2.3	1.6 ± 0.4	1.5	0.091	1.51
	Intra-group difference *p*	0.41		0.876			
L1-2	Pre-injection	4.1 ± 1.1	2.8	3.4 ± 0.9	2.9	0.291	0.55
	Post-injection	4.3 ± 0.9	3.7	3.8 ± 1.1	2.8	0.399	0.79
	Intra-group difference *p*	0.401		0.261			
L2-3	Pre-injection	5.9 ± 1.5	5.7	6.8 ± 1.5	5.9	0.498	0.49
	Post-injection	6.3 ± 1.6	5.3	6.0 ± 0.9	4.9	0.687	0.51
	Intra-group difference *p*	0.6		0.089			
L3-4	Pre-injection	7.6 ± 1.3	7.1	6.6 ± 1.1	7.1	0.086	0.89
	Post-injection	6.6 ± 0.9	6.9	5.9 ± 1.4	6.9	0.214	0.21
	Intra-group difference *p*	0.343		0.189			
L4-5	Pre-injection	9.8 ± 1.9	9.9	6.7 ± 2.1	6	0.061	1.49
	Post-injection	9.4 ± 2.2	10.6	7.6 ± 2.3	7.9	0.203	0.77
	Intra-group difference *p*	0.765		0.114			

L5-S1	Pre-injection	9.6 ± 2.7	10.3	12.4 ± 2.4	13.9	0.173	1.11
	Post-injection	9.3 ± 2.4	10.4	10.8 ± 2.8	10.9	0.238	0.63
	Intra-group difference *p*	0.381		0.137			

Table 3: Correlation Between Changes in Oswestry Disability Index and Spinopelvic Parameters

		T12-L1	L1-2	L2-3	L3-4	L4-5	L5-S1	Pelvic incidence	Sacral slope	Pelvic tilt
Oswestry disability index	*r*	0.031	0.039	0.056	0.14	0.021	0.2	0.374	0.061	0.576
	p	0.91	0.798	0.701	0.511	0.89	0.28	0.021	0.725	0.013

DISCUSSION

This study examined the influence of facet joint injection (FJI) levels on spinopelvic parameters and assessed the relationship between these parameters and functional outcomes. The main finding was that multiple-level injections led to a significant reduction in both ODI and pelvic tilt, while two-level injections showed no significant impact. A moderate correlation was found between changes in ODI and pelvic tilt, suggesting that multilevel FJI may influence lumbar lordosis and related pelvic tilt, potentially leading to changes in facet joint orientation and functional improvement. FJI is a common intervention for spinal issues, with prior studies exploring injection methods, agents, and duration of effects.[22-23] Therapy and NSAIDs are primary treatments for facet joint osteoarthritis, and intraarticular FJI is widely used as well. Past research has shown short-term benefits of steroid injections, though evidence supporting long-term efficacy remains inconclusive. Consistent with these findings, significant improvement in ODI values was noted at three months post-injection, particularly with multilevel injections.[24]

Various agents, including local anesthetics, corticosteroids, and PRP, have been studied for lumbar FJI. While Manchikanti et al. found no difference between anesthetics alone and anesthetics combined with steroids, our study used a mix of triamcinolone acetonide and lidocaine.[25] Different imaging methods are available to guide FJI, with fluoroscopic guidance being preferred for its accessibility and cost-effectiveness despite radiation exposure. Recent studies suggest that ultrasonography may be as effective as fluoroscopy or CT for guiding FJI.[26-27]

The study also highlights the relationship between low back pain, lumbar lordosis, and spinopelvic alignment. As lumbar lordosis or posterior pelvic tilt increases, spinopelvic parameters like pelvic tilt, sacral slope, and pelvic incidence are used to evaluate sagittal spinal balance before and after interventions.[28] This research is the first to evaluate these parameters in relation to clinical outcomes in facet joint osteoarthritis. Our results showed that clinical improvement post-FJI was associated with changes in pelvic tilt and facet joint orientation. We focused on these parameters, acknowledging that spinopelvic norms vary across populations but that changes within individuals provide meaningful insights.[29]

This study has several limitations. First, the sample size was not sufficient to analyze each treatment level individually, leading to the use of grouped comparisons. Additionally, we assessed only the three-month post-injection parameters and did not consider pain intensity directly, relying on the ODI score, where pain is one component. Lastly, all patients received the same injection combination, so alternative treatment effects were not evaluated. The moderate correlation between ODI and pelvic tilt changes, along with the weak correlation with pelvic incidence, suggests that the relationship between ODI and spinopelvic changes is limited.

CONCLUSION

This study provides insights into the effect of multilevel versus two-level facet joint injections (FJI) on spinopelvic parameters and functional outcomes in patients with lumbar osteoarthritis. Multilevel injections significantly improved functional outcomes, as measured by the Oswestry Disability Index (ODI), and also led to a reduction in pelvic tilt. This moderate correlation between changes in ODI and pelvic tilt highlights the potential for FJI to influence lumbar alignment, potentially leading to changes in facet joint orientation that support functional improvement. Conversely, two-level injections did not demonstrate significant changes in ODI or spinopelvic parameters, suggesting that broader lumbar levels may need to be targeted for meaningful outcomes.

The study underlines that variations in spinopelvic alignment play a role in clinical improvements following FJI, with specific spinopelvic parameters, particularly pelvic tilt, showing changes in response to treatment. While the moderate correlation between ODI and pelvic tilt suggests an association, the weaker relationship with other parameters, such as pelvic incidence, indicates that FJI's impact on spinopelvic parameters may be limited. These findings encourage further investigation into individualized FJI approaches tailored to spinopelvic alignment, which may enhance patient-specific outcomes in managing low back pain associated with lumbar osteoarthritis.

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