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The clinical impact of lumbar epidural steroid injections prior to spine surgery for lumbar spinal stenosis

Kyle Wentz *, Yu-Chen Chung, Ankit Patel

UT Southwestern Medical Center, United States

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ABSTRACT

Introduction: Lumbar spinal stenosis is a common finding in the adult population. Lumbar Epidural Steroid Injections (ESIs) are often used in management of this condition, with conflicting evidence regarding their efficacy. Previous research has suggested a negative impact of ESIs on the postoperative outcomes when ESIs are administered preoperatively prior to spine surgery in this population. Our retrospective study was performed to gain greater insight into the impact of preoperative ESIs on postoperative outcomes following spine surgery in management of lumbar stenosis.

Objective: Our objective is to determine how preoperative ESIs impact postoperative outcomes following spine surgery in management of lumbar stenosis.

Design: Retrospective cohort involving 95 patients (39 patients who received ESI in the preoperative timeframe and 56 patients who did not) who underwent surgical management of lumbar stenosis. Data for patients with preoperative ESI was compared to those without preoperative ESI administration.

Setting: Institutional.

Interventions: Not Applicable.

Main outcome measures: PROMIS (Patient-Reported Outcomes Measurement Information System) scores, VAS (Visual Analog Scale) pain scores, ODI (Oswestry Disability Index), NDI (Neck Disability Index).

Results: At baseline (time of surgery), the ESI group had significantly higher ODI, PROMIS pain, PROMIS pain interference, VAS leg and lower PROMIS physical function, but no significant difference in PROMIS satisfaction, VAS back and NDI, compared to the Non-ESI group. At 3 months after surgery, both the ESI and Non-ESI groups demonstrated a significant decrease in VAS back, VAS leg, PROMIS pain and ODI from baseline scores. The improvement in PROMIS pain at 3 months after surgery was larger in the ESI group than the Non-ESI group.

Conclusions: Preoperative ESI administration did not lead to worsening of disability, function, or pain symptoms in the short-term postoperative period following surgical management of lumbar stenosis. Patients had short term improvements in radicular pain following surgical management of lumbar stenosis, regardless of preoperative ESI administration.

1. Introduction

Lumbar spinal stenosis is a common finding in the adult population [1,2], and involves crowding of the neurovascular components of the spine. Patients with lumbar spinal stenosis can present with neurogenic claudication symptoms including leg pain, fatigue, or weakness with standing or walking. Various non-operative treatments have been used in the management of symptomatic lumbar stenosis, including physical therapy, pain medication, and injection therapy. Epidural steroid injections (ESIs) are commonly administered to provide symptomatic relief in the non-operative management of patients with lumbar spinal stenosis.

There continues to be conflicting evidence with regard to the long term efficacy of ESIs in the management of lumbar stenosis [3–8] while significant cost is often incurred for patients receiving these injections [9–11]. A subgroup analysis of the SPORT trial noted that receiving an ESI prior to spine surgery resulted in a greater length of hospital stays [3]. However, this same study suggested lower pain scores (SF-36 BP) months to years after surgery in patients who had received an ESI compared to those who did not [3]. Our study was performed in an effort to further add clarification to limited literature on this topic as it relates to

* Corresponding author.
E-mail address: wentz.kyle@gmail.com (K. Wentz).

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understanding of surgical outcomes in those who receive ESIs prior to spine surgery. Further high quality research is needed on this topic. Such evidence could guide clinicians in determining when to offer ESIs to patients in the preoperative period prior to spine surgery.

2. Materials and methods

2.1. Study design

This study was conducted at a medical institution in North Texas utilizing the institution's spine center database. The UT Southwestern Medical Center institutional review board approved the standardized protocol for this retrospective analysis. The study was conducted according to the Declaration of Helsinki.

2.2. Patient population

Patient data for this retrospective cohort was retrieved solely from a patient database of a medical institution in North Texas. Patients were included in the study if they underwent surgical management of lumbar spinal stenosis between January 2016 and December 2020. The inclusion criteria required an active diagnosis of lumbar spinal stenosis. Patients who received an ESI within three months prior to the spine surgery were included in the "ESI" group, while those who did not receive a lumbar ESI within three months prior to the spine surgery were included in the "Non-ESI" group (Fig. 1). Operative interventions included in the study were laminectomy including minimally invasive laminectomy, posterior lateral interbody fusion, foraminotomy, medial facetectomy, transforaminal lumbar interbody fusion, discectomy, posterior spinal fusion, pedical subtraction osteotomy, synovial cyst removal with dural repair, microdiscectomy.

Exclusion criteria were patients who did not have a specific diagnosis of lumbar spinal stenosis, patients who did not undergo lumbar spine surgery between January 2016 and December 2020, and those who did not receive their ESI and spine surgery at this medical institution during the same time frame.

2.3. Study measures

Primary outcome measures were ODI (Oswestry Disability Index) back, NDI (Neck Disability Index) back, VAS (Visual Analog Scale) leg pain, VAS back pain, PROMIS (Patient-Reported Outcomes Measurement Information System) pain, PROMIS pain interference, PROMIS satisfaction, PROMIS physical function at time of spine surgery(baseline) and at three months after surgery.

All results were collated on a Microsoft Excel file as retrieved from a patient registry of a medical institution in North Texas based on exclusion and inclusion criteria above. Statistical analysis was performed using IBM

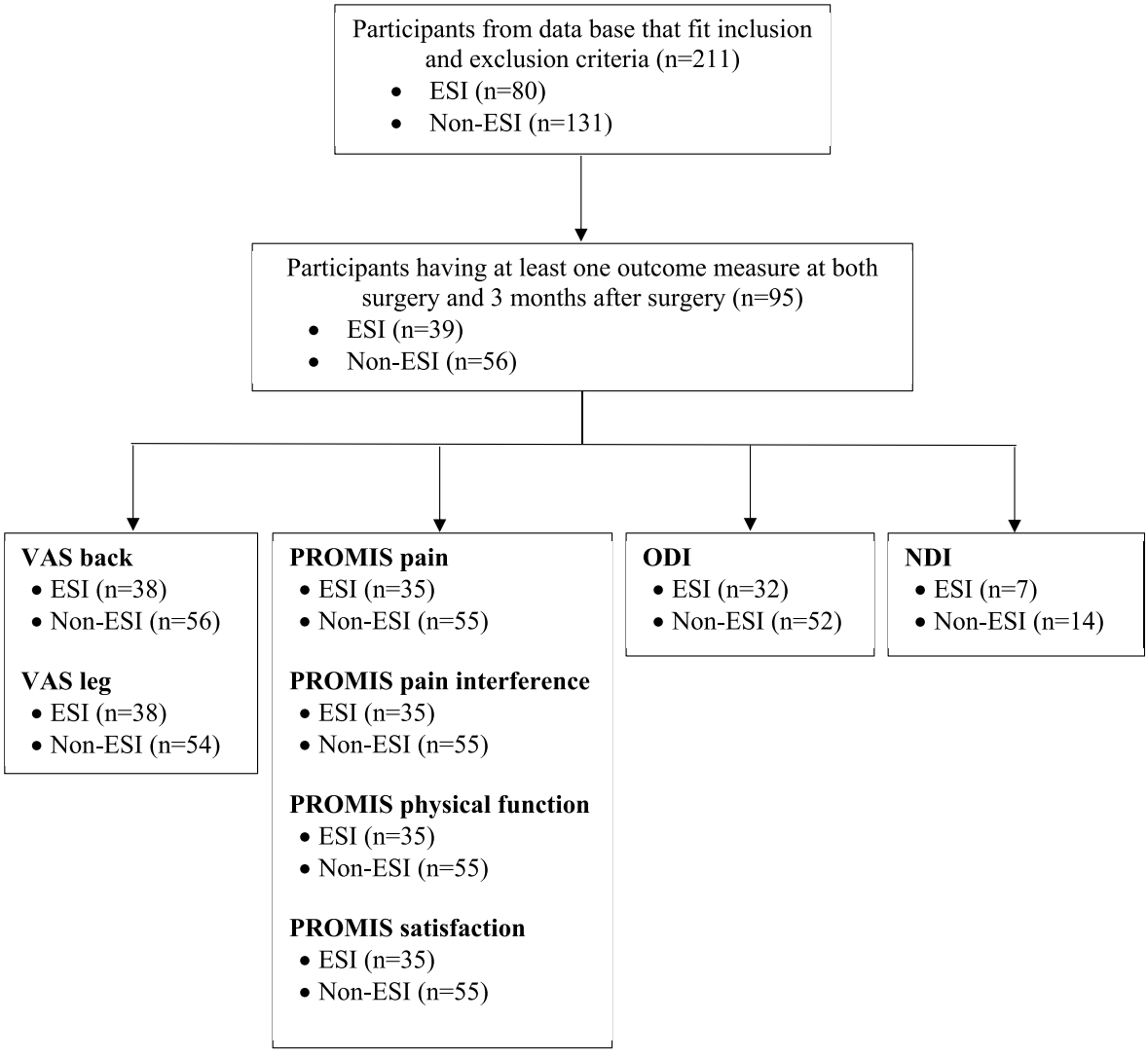

Fig. 1. Flow chart of study design and the number of participants included for each outcome measures.

SPSS software, with *t*-test and repeated-measures ANOVA used to determine significance. P-value less than 0.05 was considered statistically significant. In accordance with the policy by the Spine Section of Pain Medicine [12], the proportion of participants improving above the minimal clinically important difference (MCID) for each outcome measure was compared between the ESI and non-ESI participants, using chi-square tests. Based on the suggestion for the numeric rating pain scale [12], the MCID for VAS back, VAS leg and PROMIS pain was defined as a reduction of pain by 30%. The MCID for PROMIS pain interference, satisfaction and physical function was an improvement by 5.5, 6 and 5.5 [13,14]. The MCID for ODI and NDI was determined as a decrease by 12.8 and 7.5, respectively [15,16].

3. Results

3.1. Demographics

In the data base, there were 80 patients who received ESI ("ESI") within three months prior to spine surgery, and 131 patients who did not receive an ESI ("Non-ESI"). However, there were only 39 and 56 patients, respectively, who had at least one outcome measure at both baseline and at 3 months which were thus included in the analysis and results of this study. Based on this sample size, there were no significant demographic differences between groups in age, BMI, or ethnicity. The ESI group had significantly more females (63%) compared to the Non-ESI group (39%) ($p = .02$) (Table 1).

3.2. Baseline data

At baseline (time of surgery), the ESI group had significantly higher ODI (ESI vs. Non-ESI, 43.63 ± 13.79 vs. 36.50 ± 15.25; $p = .03$), PROMIS pain (ESI vs Non-ESI, 7.06 ± 2.34 vs. 5.71 ± 2.06; $p < .01$), PROMIS pain interference (ESI vs. Non-ESI, 16.57 ± 3.57 vs. 13.20 ± 5.64; $p < .01$), but no significant difference in PROMIS satisfaction (ESI vs. Non-ESI, 9.97 ± 4.11 vs. 11.20 ± 5.25; $p = .24$). PROMIS physical function measures were lower in the ESI group (ESI vs. Non-ESI, 8.91 ± 3.38 vs. 10.91 ± 4.28; $p = .02$) (Table 2). The ESI group also had higher VAS leg scores (ESI vs. Non-ESI, 7.63 ± 2.50 vs. 5.22 ± 2.88; $p < .001$) at time of surgery. There was no significant difference in VAS back between groups at baseline (ESI vs. Non-ESI, 5.71 ± 3.45 vs. 5.75 ± 2.44; $p = .66$).

Table 1
Participant demographics and clinical characteristics.

Group	Non-ESI	ESI	*p* value
N	56	39	–
Age[#]	65.61 ± 13.87	68.21 ± 11.33	0.45
Female (n)	22 (39%)	24 (62%)	0.03*
BMI[a]	29.98 ± 5.55	28.51 ± 6.04	0.23
Ethnicity (n)			
White	43 (77%)	27 (69%)	0.37
Black	8 (14%)	10 (26%)	
Hispanic	3 (5%)	2 (5%)	
Unidentified	2 (4%)	0 (0%)	
Comorbidity (n)			
Hypertension	30 (54%)	23 (59%)	0.60
Diabetes	10 (18%)	9 (23%)	0.53
Cancer	11 (20%)	6 (15%)	0.59
Hyperlipidemia	30 (54%)	21 (54%)	0.87
CHF	0 (0%)	1 (3%)	0.23
CVA	2 (4%)	1 (3%)	0.78
COPD	1 (2%)	0 (0%)	0.40
Depression	12 (21%)	10 (26%)	0.63
Anxiety	9 (16%)	7 (18%)	0.81
Fusion (n)			
No fusion	33 (59%)	32 (82%)	0.02*
Single-level	8 (14%)	5 (13%)	
Multi-level	15 (27%)	2 (5%)	

Value is reported as mean ± standard deviation.
* Significance group difference. Group differences tested by the Mann-Whitney *U* test are indicated by.
# . BMI, body mass index; CHF, congestive heart failure; CVA, cerebrovascular accident; COPD, chronic obstructive pulmonary disease.
[a] BMI data were missing in 3 non-ESI participants and 1 ESI participant.

3.3. Months postoperative follow-up

At three months after surgery, both groups demonstrated a significant decrease in VAS back ($p = .009$), VAS leg ($p = .001$), PROMIS pain ($p < .001$) and ODI ($p < .001$) measures from baseline scores (Fig. 2 and Table 3). PROMIS pain interference, PROMIS physical function, PROMIS satisfaction, and NDI measures improved for both groups over the three month timeframe after surgery, but these improvements did not reach statistical significance. The overall trend in the postoperative PROMIS pain scores for both groups was not statistically significant, the PROMIS pain scores did show significantly more improvement in the ESI group than in the non-ESI group (7.06 ± 2.34 at baseline to 4.06 ± 2.71 at 3-month post-surgery for the ESI group, 5.71 ± 2.06 at baseline to 3.75 ± 2.35 at 3-month post-surgery for the Non-ESI group; $p = .03$). The achieved power in the group × time interaction effect of PROMIS-pain found in this study was calculated post hoc and reached 1.0.

3.4. Proportion of participants improving above MCID

The proportion of participants showing an improvement above MCID at 3-month post-surgery did not differ significantly between the ESI and non-ESI groups for all outcome measures, including PROMIS pain (Table 4). Considering that a 30% reduction from the baseline value was used as the MCID for PROMIS pain, the larger improvement of PROMIS pain in the ESI group reported above may be attributed to the worsened PROMIS pain at baseline in the ESI group.

4. Discussion

There is mixed literature regarding the efficacy of lumbar epidural steroid injections for management of lumbar spinal stenosis [17,18]. Furthermore, there is limited research investigating the outcomes of patients who undergo spine surgery for lumbar spinal stenosis following the administration of lumbar epidural steroid injections. The results of this study demonstrate that regardless of ESI administration in the preoperative period, patients who undergo surgical management for lumbar stenosis have improved PROMIS pain and VAS leg scores in the short-term post operative period. Also, there was no significant worsening of ODI, VAS back, PROMIS Physical Function, PROMIS Satisfaction in patients who received ESIs in the preoperative period. This is not inconsistent with current literature which remains mixed with regards to the impact of ESIs on quality of life parameters [3,8,19–22]. Our results are contradictory to

Table 2
Group differences in baseline outcome measures.

Group	Non-ESI	ESI	*p* value
VAS back[†]	5.75 ± 2.44	5.71 ± 3.45	0.66
VAS leg[†]	5.22 ± 2.88	7.63 ± 2.50	<0.001*
PROMIS			
Pain[†]	5.71 ± 2.06	7.06 ± 2.34	<0.01*
Pain interference[†]	13.20 ± 5.64	16.57 ± 3.57	<0.01*
Physical function	10.91 ± 4.28	8.91 ± 3.38	0.02*
Satisfaction	11.20 ± 5.25	9.97 ± 4.11	0.24
ODI	36.50 ± 15.25	43.63 ± 13.79	0.03*
NDI	36.43 ± 26.04	37.14 ± 21.29	0.95

Value is reported as mean ± standard deviation.
* Significance group difference. Group differences tested by the Mann-Whitney *U* test are indicated by.
[†] VAS, Visual Analog Scale; PROMIS, Patient-Reported Outcomes Measurement Information System; ODI, Oswestry Disability Index; NDI, Neck Disability Index.

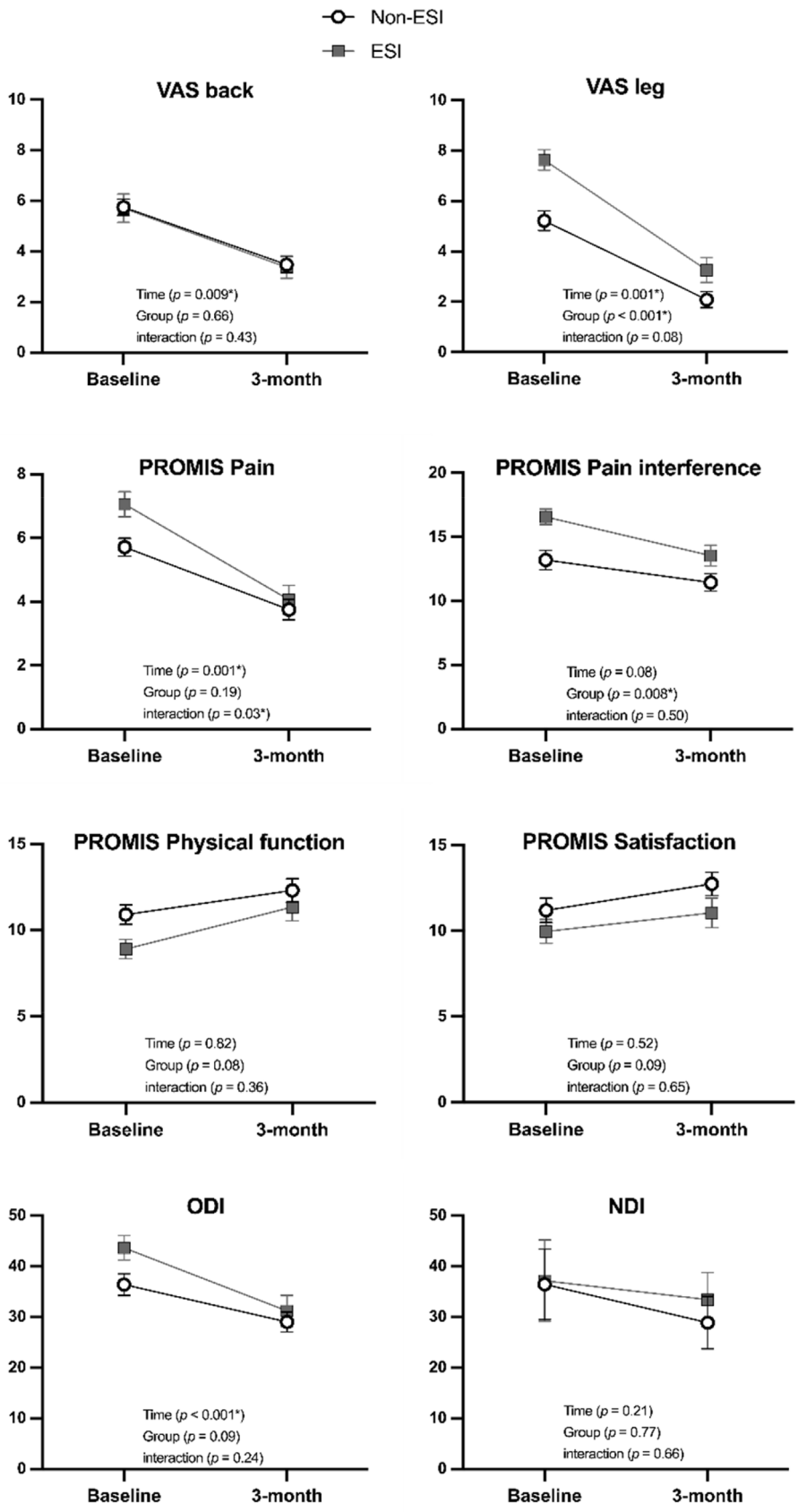

Fig. 2. Outcome measures at baseline and 3 months between the non-ESI and ESI groups. The 2 (Time, baseline vs. 3-month) x 2 (Group, Non-ESI vs. ESI) Repeated Measures ANOVAs for all outcome measures were adjusted with sex and fusion as co-variates, except for ODI and NDI.

Table 3
Outcome measures at baseline (time of surgery) and 3-month post-surgery between Non-ESI and ESI groups.

Outcome measure	Group	N	Baseline	3-month	Group	Time	Group x Time
VAS back	**Non-ESI**	56	5.75 ± 2.44	3.48 ± 2.40	0.66	0.009*	0.43
	ESI	38	5.71 ± 3.45	3.37 ± 2.69			
VAS leg	**Non-ESI**	54	5.22 ± 2.88	2.09 ± 2.38	<0.001*	0.001*	0.08
	ESI	38	7.63 ± 2.50	3.26 ± 3.06			
PROMIS							
Pain	**Non-ESI**	55	5.71 ± 2.06	3.75 ± 2.35	0.19	<0.001*	0.03*
	ESI	35	7.06 ± 2.34	4.06 ± 2.71			
Pain interference	**Non-ESI**	55	13.20 ± 5.64	11.44 ± 5.07	0.008*	0.08	0.50
	ESI	35	16.57 ± 3.57	13.54 ± 4.81			
Physical function	**Non-ESI**	55	10.91 ± 4.28	12.31 ± 4.70	0.08	0.82	0.36
	ESI	35	8.91 ± 3.38	11.34 ± 4.85			
Satisfaction	**Non-ESI**	55	11.20 ± 5.25	12.75 ± 5.07	0.09	0.52	0.65
	ESI	35	9.97 ± 4.11	11.06 ± 5.17			
ODI	**Non-ESI**	52	36.50 ± 15.25	29.04 ± 14.53	0.09	<0.001*	0.24
	ESI	32	43.63 ± 13.79	31.19 ± 17.52			
NDI	**Non-ESI**	14	36.43 ± 26.04	28.86 ± 19.37	0.77	0.21	0.66
	ESI	7	37.14 ± 21.29	33.43 ± 14.22			

Value is reported as mean ± standard deviation. The 2 (Time, baseline vs. 3-month) x 2 (Group, Non-ESI vs. ESI) Repeated Measures ANOVAs for all outcome measures were adjusted with sex and the number of patients receiving fusion as co-variates, except for ODI and NDI.
* Significance group difference. VAS, Visual Analog Scale; PROMIS, Patient-Reported Outcomes Measurement Information System; ODI, Oswestry Disability Index; NDI, Neck Disability Index.

Table 4
Proportion of participants improving above MCID in the Non-ESI and ESI groups.

Outcome measure	Non-ESI	ESI	Chi square test		
			df	X^2	p value
VAS back	63% (35/56)	47% (18/38)	1	2.11	0.15
VAS leg	70% (38/54)	68% (26/38)	1	0.04	0.84
PROMIS					
Pain	58% (32/55)	57% (20/35)	1	0.10	0.92
Pain interference	24% (13/55)	29% (10/35)	1	0.27	0.60
Physical function	16% (9/55)	29% (10/35)	1	1.91	0.17
Satisfaction	22% (12/55)	20% (7/35)	1	0,04	0.84
ODI	38% (20/52)	47% (15/32)	1	0.58	0.45
NDI	50% (7/14)	43% (3/7)	1	0.10	0.76

Value is reported as % (n/N).
*Significance group difference. VAS, Visual Analog Scale; PROMIS, Patient-Reported Outcomes Measurement Information System; ODI, Oswestry Disability Index; NDI, Neck Disability Index.

a prior study which showed increased levels of postoperative radicular pain in patients receiving ESIs prior to spine surgery [3].

It is notable that PROMIS pain scores showed significant improvement in both groups, and those who received ESIs in the preoperative timeframe demonstrated significantly more improvement in PROMIS pain than those who did not receive preoperative ESIs. It is reasonable to suggest that since the ESI group had higher baseline PROMIS pain scores, there would be greater potential for improvement seen in the postoperative period for the ESI group. Notably, both groups had roughly similar PROMIS pain scores at 3-month postoperative follow-up (ESI vs. Non-ESI, 4.06 ± 2.71 vs. 3.75 ± 2.35). Patients in the ESI group having worsened ODI and PROMIS Pain scores at time of surgery could potentially be related to refractory symptoms in this group in anticipation of possible surgery. This is certainly an assumption and impossible to prove. There is also a small chance that exposure to steroid may have worsened some patients' pain levels from conditions such as a steroid flare [23].

Our findings could lead to increased utility of ESI administration in the preoperative management of symptomatic lumbar stenosis in a patient population who would like greater pain control as they await surgery, with the understanding that the ESI administration is not likely to hinder pain improvement, worsen disability or function in the postoperative period. This information could also lead some to avoid ESI administration in the preoperative period for certain patients with the understanding that ESI administration in this period would also not lend to greater regained function following surgery.

Our study has several limitations worthy of discussion. First, all patients included were treated at one institution, with the inherent limitations of a single center study. The patient group included in this study was quite heterogenous in terms of the severity of lumbar stenosis, severity of symptoms, type of procedure performed, patient gender, comorbidities, and post operative physical activity. For example, some patients included in the study had severe spinal stenosis with neurogenic claudication, while others had more mild central stenosis or neuroforaminal stenosis without central canal narrowing. Second, this was a retrospective cohort study with inherent limitations as such compared to a randomized controlled trial. In this study, patient follow-up rates dramatically decreased after three months following surgery, which led to limited application of results with regards to long term impact. Although research is mixed with regards to postoperative infection rates among those receiving preoperative ESIs[24–26], this study did not specifically compare infection rates. This study also does not compare other noteworthy complications such as dural tears or perioperative bleeding. Prospective research is needed to establish a more complete clinical impact of preoperative ESI administration on postoperative outcomes following spine surgery for lumbar spinal stenosis [1,2]. Prospective data on this subject can lead to improved patient outcomes and guide clinicians in providing more cost-effective patient care.

5. Conclusion

Preoperative ESI administration did not lead to worsening of disability, function, or pain symptoms in the short-term postoperative period following surgical management of lumbar stenosis. Patients had short term improvements in radicular pain following surgical management of lumbar stenosis, regardless of preoperative ESI administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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