

Retrospective Evaluation

Retrospective Review of the Efficacy of Lumbar Radiofrequency Ablation for Lumbar Facet Arthropathy: The Influence of Gender and Obesity

Sam Searcy, MD¹, Juan Mora, MD¹, Matthew Meroney, MD¹, Amir Jafari, DO¹, Chris Henson, MD¹, Keith Jenkins, MD¹, Bill Mallett, MD¹, Vyshak Shibu, MD¹, Blessing Ogbemudia, MD¹, Terrie Vasilopoulos, PhD^{1,2}, Alan D. Kaye, MD, PhD³, and Rene Przkora, MD, PhD¹

From: ¹Department of Anesthesiology, University of Florida College of Medicine, Gainesville, FL; ²Department of Orthopaedic Surgery and Sports Medicine, University of Florida College of Medicine, Gainesville, FL; ³Department of Anesthesiology, Louisiana State University Health Sciences Center, Shreveport, LA

Address Correspondence:
Rene Przkora, MD, PhD
Department of Anesthesiology
University of Florida
College of Medicine
1600 SW Archer Road
P.O. Box 100254
Gainesville, FL 32610
E-mail: rprzkora@anest.ufl.edu

Disclaimer: Support was provided solely from institutional and/or departmental sources.

Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

Manuscript received: 11-21-2022
Revised manuscript received: 05-24-2023
Accepted for publication: 06-23-2023

Free full manuscript:
www.painphysicianjournal.com

Background: Lumbar facet arthropathy is one of the leading causes of back pain. Lumbar radiofrequency lesioning is a therapy for lumbar facet arthropathy that uses heat to ablate the transmission of nerve signals from the medial branches of the spinal nerves associated with the corresponding painful lumbar joints.

Objectives: The present investigation evaluated the outcomes of patients undergoing lumbar radiofrequency ablation at an academic pain program with a special focus on the influence of gender and obesity.

Study Design: Retrospective chart review.

Setting: Academic tertiary care center.

Methods: We reviewed the charts of 232 patients for age, body mass index, gender, other procedures, and complications, in addition to the primary outcome measurements of Visual Analog Scale pain scores, pain relief percentages, pain relief duration, and functional status improvement per patient report. Associations with outcomes were evaluated with correlations, t tests/analysis of variance, and χ^2 test. Influences on a change in Visual Analog Scale pain scores before and after treatment were assessed with linear regression.

Results: Patients had an average pain reduction of 76.6% (SD = 24.5) from the initial treatment and an average of 30.7 weeks (SD = 21.2) of pain relief from the initial treatment. A total of 83% of the patients reported an improvement in functional status from the initial treatment. Women (mean = 79.8%, SD = 21.4) had a slightly higher pain relief percentage than men (mean = 71.6%, SD = 28.1; $P = 0.046$). A higher body mass index was associated with less improvement in Visual Analog Scale maximum pain scores from before and after the procedure ($\beta = 0.04$; SE = 0.02; $P = 0.042$).

Limitations: Our study is not a randomized controlled trial; however, based on the number of patients reviewed, our data provide important information regarding lumbar radiofrequency ablations.

Conclusions: This study highlights significant effectiveness for patients undergoing lumbar radiofrequency ablations for lumbar facet joint pain. A variation in effectiveness appears to be influenced by gender and obesity, and therefore additional studies are warranted to further investigate these differences.

Key words: Low back pain, gender, lumbar radiofrequency ablation, obesity, facet joint

Ethics approval: University of Florida Institutional Review Board (IRB#201901280).

Pain Physician 2023; 26:E695-E701

Chronic low back pain is described as pain that has persisted for 12 weeks or longer or as persistent pain after an initial treatment of acute low back pain (1). Low back pain can be an unbearable condition for most adults and occurs in more than 80% of the population at some point in their lives (1). It can be caused by myriad reasons, including congenital conditions, degenerative causes, trauma, nerve and spinal cord conditions, and nonspine etiologies. Furthermore, low back pain can originate from different joints in the spine, such as the lumbar facet joints, the intervertebral discs, the sacroiliac joint, and the coccyx (2). Specifically, lumbar facet arthropathy, a degenerative condition in the lumbar facet joints, has been recognized as a common source of pain and is often misdiagnosed and not properly treated. It has been estimated that lumbar facet joints are the source of chronic pain in 15% to 45% of patients with chronic low back pain (3).

Initial treatment options commonly include a pharmaceutical approach, physical therapy, massage, and/or behavioral therapy. Once these conservative measures fail, more invasive methods, such as steroid injections, nerve blocks, and radiofrequency ablations are typically utilized (2). Facet joint blocks can be performed initially to test the hypothesis that target joints are the source of a patient's pain (4). These joints can be anesthetized using local anesthetics or by anesthetizing the medial branches of the dorsal rami that innervate the facet joints. If the pain is not relieved, the joints cannot be considered as the pain source. However, if pain is relieved, a second block is performed to ensure a true positive result, confirming the initial positive response was not related to the placebo effect (4).

In the setting of 2 positive lumbar medial branch blocks, lumbar radiofrequency ablation can be performed, which involves placing an insulated needle with fluoroscopic guidance near or at the target medial bundle branch nerve. A high-frequency electric current is applied through the needle, which produces thermal energy. The heat produced from the needle tip of the radiofrequency ablation device destroys the target nerves, disrupting their ability to send pain signals (4). Some studies in which a select patient population was used demonstrated improvements in pain and functional limitations with lumbar radiofrequency ablation for chronic low back pain (5).

OBJECTIVES

In this study, therefore, our aim was to examine the effects of lumbar radiofrequency ablation as a therapy for lumbar facet arthropathy including decreases in pain, length of pain relief, and improvement of functional status with this procedure, as well as to explore the relationship between various patient characteristics, including gender, age, and body mass index (BMI [kg/m²]), with patient outcomes.

STUDY DESIGN

Retrospective chart review.

SETTING

Academic tertiary care center.

METHODS

This study was approved by the University of Florida Institutional Review Board (IRB #201901280). We retrospectively analyzed the charts of 232 patients whose average pain duration was nearly 8 months and who were treated from January 2015 through December 2019. The patients were selected based on whether they had undergone lumbar radiofrequency ablation. Data collection was performed by a team of physicians who were interested in extrapolating the results of the procedure but who were not participating in the clinical care of the patients. We documented patient characteristics, including gender, BMI, age, and history of previous interventional pain procedures. Primary outcome measurements included patient-reported pain relief percentage following the procedures, Visual Analog Scale (VAS) pain score (maximum pain) before and after procedures, functional status improvement per patient report, and pain relief duration.

The lumbar radiofrequency ablation procedure was performed only in patients who first underwent a medial branch "test block" with a local anesthetic. If the patient reported successful pain relief from this procedure, they were offered radiofrequency ablation (after insurance approval). The lumbar radiofrequency procedure was performed using the same technique for all patients. The procedure was performed by first identifying the correct spinal levels under fluoroscopy. An 18G curved radiofrequency needle with a 10-mm active tip was then guided to the target point at the medial border of the transverse process or sacral ala and the junction with the superior articular process under anteroposterior, oblique, and lateral fluoroscopic projections.

Motor stimulation was then performed at < 2 Hz to ensure contraction of the multifidus muscle and confirmation of the medial branch nerve; stimulation up to 2 Hz was then performed to ensure there was no evidence of distal muscle contraction at each level. Prior to lesioning, 0.5 mL of 2% lidocaine was injected at each level for patient comfort.

A final lateral fluoroscopic image was obtained to confirm final needle positioning before lesioning. The patient then received lesioning cycles at 80°C at each level. The needles were rotated 180° and the lesioning cycle was repeated after fluoroscopy revealed no other change in position besides the rotation. They were then allowed to cool down before being removed. The patients were discharged home with activity as tolerated.

Statistical Analysis

All analyses were performed in JMP Pro 16 (SAS Institute, Inc.). Continuous measures were summarized as mean ± SD and categorical measures were summarized as percentages. Associations between patient characteristics and outcomes were assessed using χ^2 tests, t tests, and Pearson correlation coefficients. Linear regression was used to assess the influence of patient characteristics (run separately) on the change in VAS pain scores (reported maximum) before and after treatment.

Pain before the procedure was included as an independent variable and pain after the procedure as the dependent variable, which created a “residual change score” for pain. This also adjusted analyses for patient differences in pain before treatment. Effects from regression analyses were quantified by using regression coefficients (β) with standard error. $P < 0.05$ was considered statistically significant.

RESULTS

Table 1 reports the characteristics of the total patient sample ($n = 232$). Patients were mostly women (60%) with an average age of 57.8 ± 15.2 years. The average BMI for patients was 32.2 ± 7.3 . More than one-half of patients had one or more previous procedures.

On average, the patients reported a substantial amount of pain relief after the procedure (Table 2). A majority of patients (83%, Table 2) reported functional status improvement. The average change in VAS maximum pain from before and after the procedure was -0.5 (95% CI, -0.8 to -0.2). There was a strong association between improvement in VAS maximum pain and pain levels before the procedure ($F[4,190] = 7.1$; $P < 0.001$). Patients with severe maximum pain showed

Table 1. Characteristics of patient sample ($n = 232$).

	n	%
Gender		
Male	92/232	40%
Female	140/232	60%
Previous procedures (number)		
None	97/226	43%
One	81/226	36%
Multiple	48/226	21%
Previous procedures (type)		
RFL	81/226	36%
ESI	53/226	24%
Facet joint	16/226	7%
SIJ	42/226	19%
Location of injection		
Left	78/193	40%
Right	100/193	52%
Bilateral	15/193	8%
Site		
L1	6/232	3%
L2	49/232	21%
L3	224/232	97%
L4	225/232	97%
L5	188/232	81%
S1	4/232	2%
S2	1/232	1%

ESI, epidural steroid injection; RFL, radiofrequency lesioning; SIJ, sacroiliac joint injection.

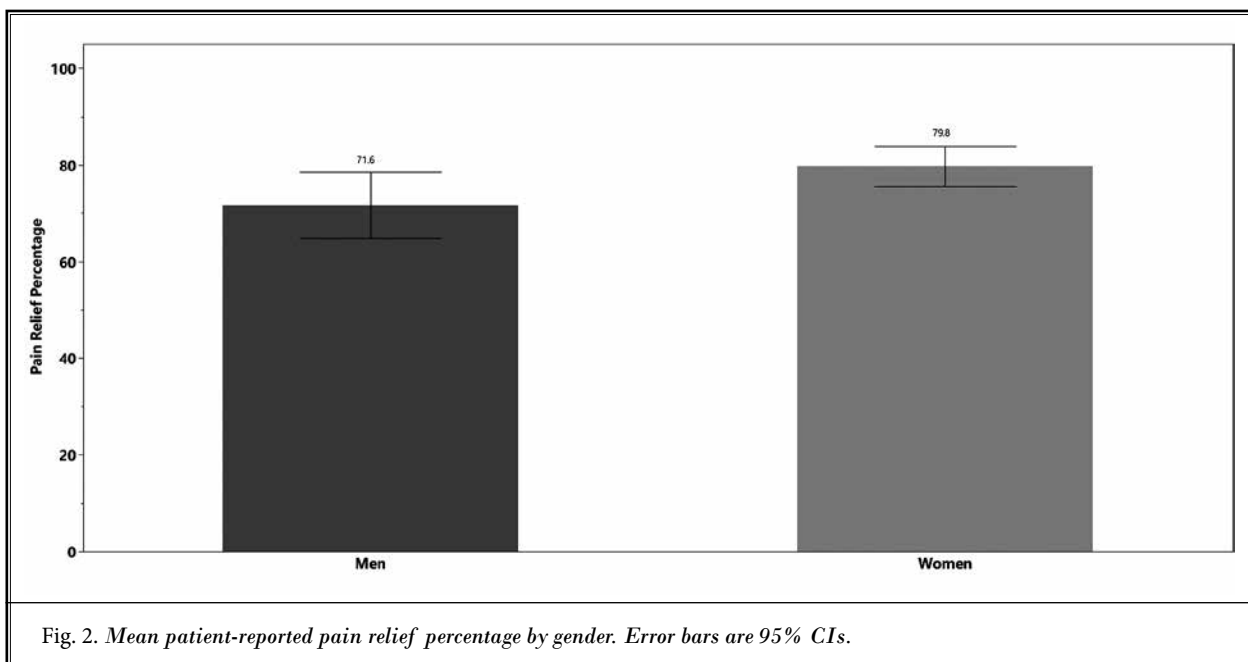
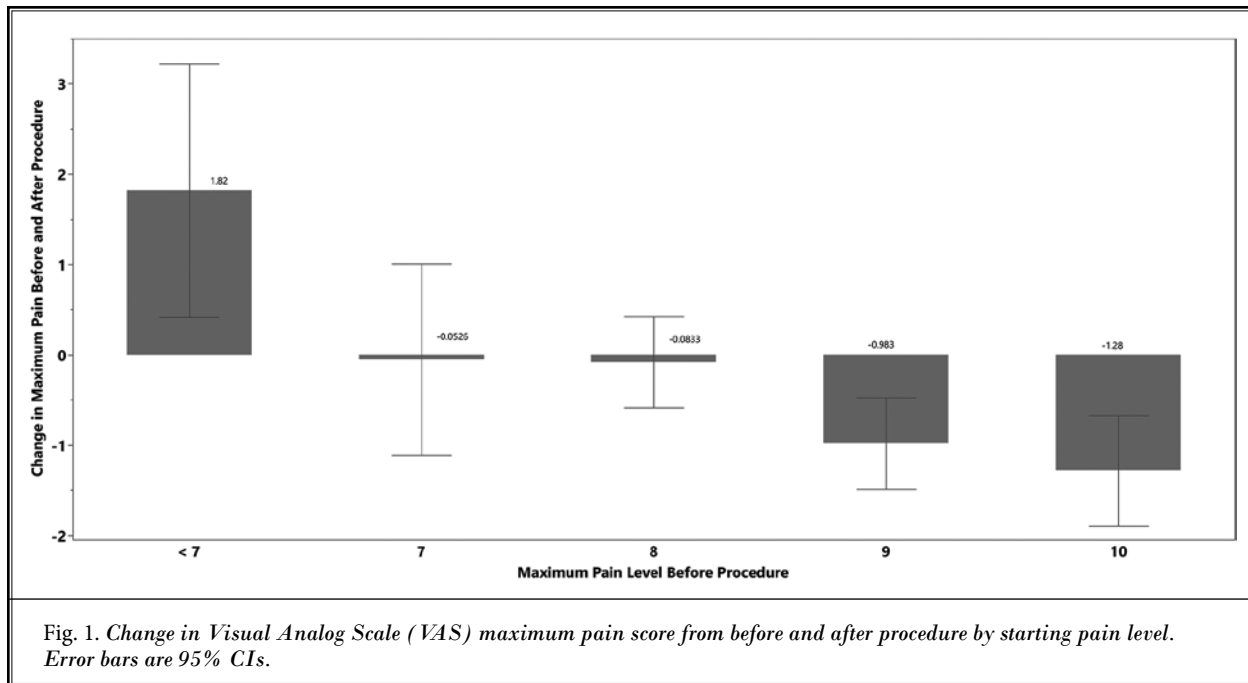
Table 2. Patient Outcomes Following Radiofrequency Ablation[†]

Outcome	Mean (SD) or n (%)
Pain relief (mean %, 95% CI)	76.6% 72.9% to 80.3%
Functional status improvement (n, %)	175/210 83%
Change in maximum VAS pain (mean change, 95% CI)	-0.5 -0.8 to -0.2
Change in average VAS pain (mean change, 95% CI)	-0.3 -0.8 to 0.2

[†]Pain relief is patient-reported percent relief following treatment. VAS, Visual Analog Scale.

the greatest improvements following the procedure, whereas those with more moderate starting pain had less or negligible improvement, and in some cases, worsening pain (Fig. 1).

There were statistically significant gender differences in pain relief, with women reporting more pain relief than men ($t[170] = 2.14$; $P = 0.034$; Fig. 2). There



were no statistically significant associations between pain relief and age ($r = -0.12$; $P = 0.104$), BMI ($r = -0.02$; $P = 0.845$) or previous procedures ($t[165] = 1.02$; $P = 0.308$). There were no statistically significant associations between functional status improvement and gender ($\chi^2 = 0.14$; $df = 1$; $P = 0.707$), age ($t[208] = -0.61$; $P = 0.543$), BMI ($t[206] = 0.66$; $P = 0.510$), or previous proce-

dures ($\chi^2 = 0.10$; $df = 1$; $P = 0.751$). There were also no statistically significant associations between pain relief duration and gender ($t[137] = -0.13$; $P = 0.897$), age ($r = -0.15$; $P = 0.789$), BMI ($r = -0.14$; $P = 0.737$), or previous procedures ($t[132] = 1.29$; $P = 0.201$).

BMI was associated with a change in VAS maximum pain before and after the procedure ($\beta = 0.04$; SE

= 0.02; $P = 0.042$). Specifically, patients with a higher BMI showed less improvement following the procedure than those with a lower BMI (Fig. 3). There were no statistically significant associations between the change in VAS maximum pain and gender ($\beta = -0.17$; SE = 0.15; $P = 0.239$), age ($\beta = -0.02$; SE = 0.01; $P = 0.055$), or previous procedures ($\beta = 0.01$; SE = 0.14; $P = 0.919$).

There were no complications reported regarding permanent neurological damage, postoperative admission, or surgical intervention.

DISCUSSION

The results of the present investigation demonstrate significant effectiveness for lumbar radiofrequency ablation, but with differences based on gender and obesity. In recent years, the use of lumbar radiofrequency ablation has more than doubled, jumping from 49 to 113 interventions per 100,000 persons from 2007 to 2016, an increase of nearly 10% annually (5). During this same time frame, the health care dollars dedicated to this procedure increased nearly 12% each year, from just under \$95,000 to more than \$260,000 per 100,000 patients (5).

Given the increasing use of this approach and the significant resources devoted to it, it is crucial to have evidence of the effectiveness of lumbar radiofrequency ablation in providing lasting pain relief and functional improvement. Studies have indicated that between 6

and 12 months of relief is typical with lumbar medial branch rhizotomy (6). Dreyfuss, et al (7) studied the efficacy of lumbar radiofrequency rhizotomy performed under ideal conditions and found that 60% of patients obtained 90% relief and 87% of patients obtained at least 60% relief at 12 months. Of note, Dreyfuss, et al (7) also reported that the results were not significantly different at their follow-up intervals, namely at 6 weeks, and 3, 6, and 12 months (7). Additionally, the patients in the study all responded to prior medial branch blocks before proceeding to radiofrequency ablation, which is also standard at our institution (7).

Our patient review showed excellent pain relief similar to the Dreyfuss, et al study (7), with an average 76.6% reduction in pain. The average pain relief duration was 30.7 weeks, which fits within the anticipated range of 6 to 12 months of relief. A total of 83% of our patients reported improved functional status. It is interesting to note that we found a statistically significant greater overall effectiveness in women than men. This is important because women usually have less favorable medical and surgical intervention outcomes (8).

Previous studies focusing on lumbar facet interventions have not identified the possibility that gender can affect outcomes of lumbar radiofrequency ablations. For example, Cohen, et al (9) compared 89 men to 103 women without finding a statistical association. Although we used 2 lesioning cycles with needle rota-

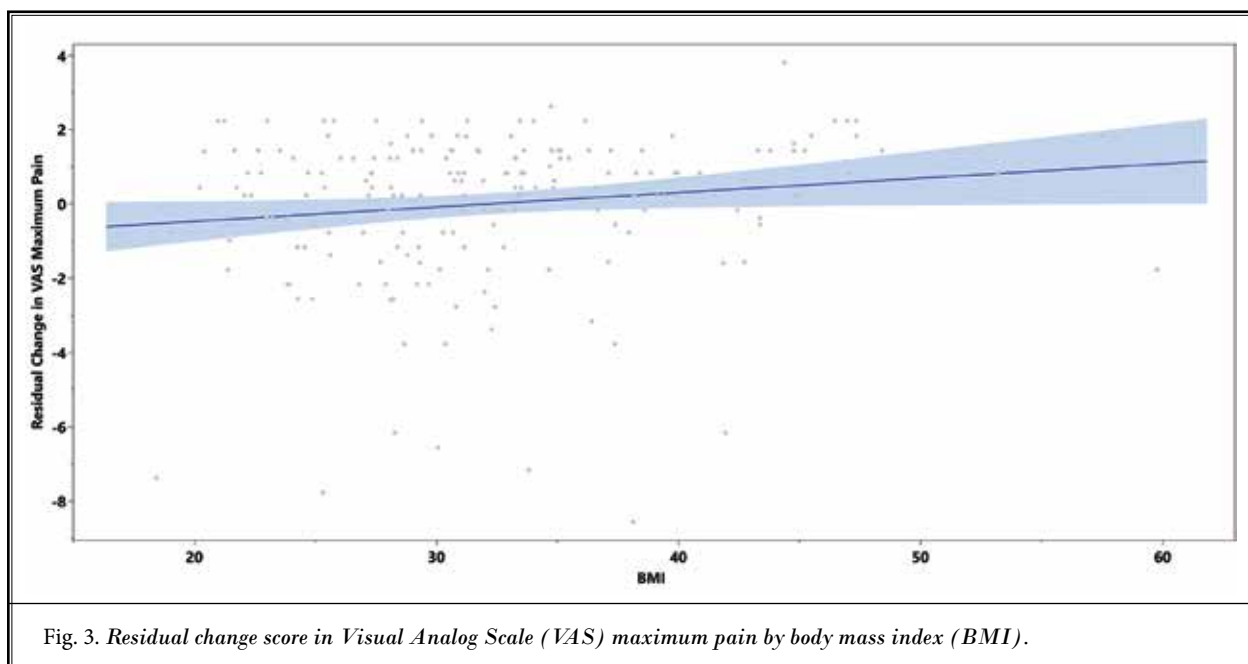


Fig. 3. Residual change score in Visual Analog Scale (VAS) maximum pain by body mass index (BMI).

tion versus only one cycle as in the study by Cohen, et al (9), this should not explain the difference observed between genders (8). Overall our finding is reassuring and further investigations should be considered.

Another finding of interest is that as detailed above, patients with severe preoperative pain scores found greater relief with this therapy compared to patients with less severe pain scores. These are findings that have not been well documented in the available literature. There is literature available investigating the question of radiofrequency ablation's effectiveness; our study helps to stratify patient populations and can be used for insight as to which patients may find this procedure most effective, such as women and patients with severe preprocedure pain. These findings could spark interest in future studies specifically analyzing these differences in results.

Considering that lumbar facet joint pain in part is related to mechanical stress, our results re-confirm that obesity negatively affects outcomes (10,11). This problem will continue to increase with the rising obesity epidemic (12). Studies reviewing the effects of obesity on the outcomes of lumbar facet joint procedures confirm our findings (13). Obesity negatively affects lumbar medial branch blocks and radiofrequency ablations (14-16). Our findings and other studies demonstrate the need to further study interventions such as weight loss to improve outcomes in this growing patient population for which alternative interventions such as opioids are less than ideal (17,18).

There were no statistically significant differences

based on age or history of prior pain procedures. Overall, our findings suggest that lumbar radiofrequency ablation performed at our academic pain program can provide strong relief for patients. This is consistent with numerous recent studies, including those on select populations of patients and with different probes (19-22).

Limitations

Limitations of our retrospective review include its nonrandomized design and lack of a consistent follow-up time. Despite implementation of a recommended follow-up interval, recurrence of discomfort can be the impetus for presentation after an intervention. This could theoretically introduce recall bias, but whether this would overstate or underestimate the effects of the intervention remains unclear.

CONCLUSION

Our results indicate that the pain relief and patient-reported improvement in functional status derived from lumbar radiofrequency ablation reiterate the effectiveness, safety, and reproducibility of pain relief and functional improvement of patients suffering from lumbar facet joint pain. The optimal interval between lumbar radiofrequency ablation treatments remains to be determined, and further research regarding the correlation of pain relief to functional improvement could prove beneficial. Variation in the effectiveness of lumbar radiofrequency ablation appears to be influenced by gender and obesity, and therefore additional studies are warranted to further investigate these differences.

REFERENCES

- Violante FS, Mattioli S, Bonfiglioli R. Low-back pain. *Handb Clin Neurol* 2015; 131:397-410.
- Leggett LE, Soril LJ, Lorenzetti DL, et al. Radiofrequency ablation for chronic low back pain: A systematic review of randomized controlled trials. *Pain Res Manag* 2014; 19:e146-e153.
- Manchikanti L, Hirsch JA, Pampati V. Chronic low back pain of facet (zygapophysial) joint origin: Is there a difference based on involvement of single or multiple spinal regions? *Pain Physician* 2003; 6:399-405.
- Bogduk N. International Spinal Injection Society guidelines for the performance of spinal injection procedures. Part 1: zygapophysial joint blocks. *Clin J Pain* 1997; 13:285-302.
- Starr JB, Gold L, McCormick Z, Suri P, Friedly J. Trends in lumbar radiofrequency ablation utilization from 2007 to 2016. *Spine J* 2019; 19:1019-1028.
- Binder DS, Nampiaparampil DE. The provocative lumbar facet joint. *Curr Rev Musculoskelet Med* 2009; 2:15-24.
- Dreyfuss P, Halbrook B, Pauza K, Joshi A, McLarty J, Bogduk N. Efficacy and validity of radiofrequency neurotomy for chronic lumbar zygapophysial joint pain. *Spine (Phila Pa 1976)* 2000; 25:1270-1277.
- Kozlov N, Benzon HT. Role of gender and race in patient-reported outcomes and satisfaction. *Anesthesiol Clin* 2020; 38:417-431.
- Cohen SP, Hurley RW, Christo PJ, et al. Clinical predictors of success and failure for lumbar facet radiofrequency denervation. *Clin J Pain* 2007; 23:45-52.
- Cohen SP, Raja SN. Pathogenesis, diagnosis, and treatment of lumbar zygapophysial (facet) joint pain. *Anesthesiology* 2007; 106:591-614.
- Cohen SP, Huang JHY, Brummett C. Facet joint pain—advances in patient selection and treatment. *Nat Rev Rheumatol* 2013; 9:101-116.
- Lindsey T, Dydyk AM. Spinal osteoarthritis. In: *StatPearls [Internet]*. Treasure Island, FL: StatPearls Publishing; 2023. www.ncbi.nlm.nih.gov/books/NBK553190/
- Javed S, Chen J, Huh B. Predictors of response to medial branch block, radiofrequency ablation or facet joint injections: A retrospective study. *Pain*

- Manag* 2021; 11:145-149.
14. Cohen SP, Doshi TL, Constantinescu OC, et al. Effectiveness of lumbar facet joint blocks and predictive value before radiofrequency denervation: The Facet Treatment Study (FACTS), a randomized, controlled clinical trial. *Anesthesiology* 2018; 129:517-535.
15. Boswell MV, Colson JD, Sehgal N, Dunbar EE, Epter R. A systematic review of therapeutic facet joint interventions in chronic spinal pain. *Pain Physician* 2007; 10:229-253.
16. Falco FJE, Manchikanti L, Datta S, et al. An update on the effectiveness of therapeutic lumbar facet joint interventions. *Pain Physician* 2012; 15:E909-E953.
17. Chin SH, Huang WL, Akter S, Binks M. Obesity and pain: A systematic review. *Int J Obes (Lond)* 2020; 44:969-979.
18. Archibald P, Subramoney K, Beydoun HA, Harris CM. The impact of obesity in patients hospitalized with opioid/opiate overdose. *Subst Abus* 2020; 43:253-259.
19. Chen YS, Liu B, Gu F, Sima L. Radiofrequency denervation on lumbar facet joint pain in the elderly: A randomized controlled prospective trial. *Pain Physician* 2022; 25:569-576.
20. Deng G, Smith A, Burnham R. Prospective within subject comparison of fluoroscopically guided lumbosacral facet joint radiofrequency ablation using a multi-tined (trident) versus conventional monopolar cannula. *Pain Physician* 2022; 25:391-399.
21. Manchikanti L, Kosanovic R, Pampati V, et al. Equivalent outcomes of lumbar therapeutic facet joint nerve blocks and radiofrequency neurotomy: Comparative evaluation of clinical outcomes and cost utility. *Pain Physician* 2022; 25:179-192.
22. Manchikanti L, Kaye AD, Soin A, et al. Comprehensive evidence-based guidelines for facet joint interventions in the management of chronic spinal pain: American Society of Interventional Pain Physicians (ASIPP) guidelines facet joint interventions 2020 guidelines. *Pain Physician* 2020; 23:S1-S127.

