

Radiofrequency Ablation of the Medial Branch Nerves for Posterior Element Pain in Chronic Vertebral Compression Fractures: An Anatomical Review and Retrospective Case Series

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Purpose: Vertebral compression fractures (VCFs) cause significant pain and disability, particularly in the elderly and those with osteoporosis, trauma, or malignancy. Medial branch nerve radiofrequency ablation (RFA-MBN) offers a minimally invasive intervention for facetogenic pain in patients with VCFs. This retrospective case study explores the efficacy and clinical outcomes of RFA-MBN in managing VCF-associated pain.

Patients and Methods: A retrospective chart review of 61 patients with confirmed chronic thoracic or lumbar VCFs who underwent RFA-MBN between 2014 and 2022 at a single academic pain center was conducted. Primary outcomes were self-reported percentage and duration of pain relief. Secondary outcomes included changes in disability index scores. Covariates such as age, gender, number, location, and cause of VCFs, PHQ-9 scores, history of prior vertebroplasty, laterality of RFA-MBN, and time to repeat ablation were evaluated. Statistical analysis was performed using linear mixed-effect models.

Results: The average pain relief was 56.6% over 36.1 weeks. 67% percent of patients experienced at least 50% pain relief for three months, with 47.5% of those patients maintaining relief for six months. A higher pre-disability index was significantly associated with increased pain relief ($p=0.007$) while none of the other covariates above showed significant associations with the primary outcomes.

Conclusion: RFA-MBN appears to provide meaningful pain relief for patients with VCFs, especially those with higher baseline disability.

Keywords: vertebral compression fracture, radiofrequency ablation, osteoporosis, back pain

Introduction

Vertebral compression fractures (VCFs) represent a significant healthcare challenge, regardless of whether they occur from traumatic incidents, osteoporosis-induced bone weakening, or pathological etiologies. VCFs are associated with substantial morbidity and mortality and impose considerable financial burdens on individuals and healthcare systems due to costs associated with diagnosis, treatment, rehabilitation, and potential long-term care. This is so staggering that in the United States, the cost of osteoporotic vertebral fractures is an estimated 746 million US Dollars (USD) yearly with projections to 25 billion USD in 2025.¹ Annually, the United States reports approximately 700,000 VCF cases,² and with an aging demographic, this incidence is only anticipated to escalate.³ VCFs can have a profound lifestyle impact on affected individuals. These fractures frequently cause severe, debilitating pain that is exacerbated by any movement or weight-bearing activities. Osteoporosis places patients at a heightened risk of VCFs, often from minimal trauma or even

routine activities. Even after the fracture heals, chronic pain can persist, leading to functional limitations and a notable reduction in quality of life.⁴ The long-term disability from chronic pain often exacerbates psychological distress, such as depression, further diminishing overall well-being.⁵

Current treatment for VCFs includes conservative measures such as physical therapy, non-steroidal anti-inflammatory medications (NSAIDs), and medications that increase bone mass (bisphosphonates, calcitonin, teriparatide, raloxifene, etc). More invasive approaches, namely percutaneous vertebroplasty or kyphoplasty, are available for acute and symptomatic VCFs though their efficacy has been questioned. While numerous studies have demonstrated their benefits when compared to conservative treatment,^{6–8} two studies published in the *New England Journal of Medicine* in 2009 showed no beneficial effects of vertebroplasty compared to sham procedure.^{9,10} Furthermore, vertebroplasty and kyphoplasty are often not indicated in or a covered benefit for insurance reimbursement in patients with subacute or chronic vertebral compression fractures.

Amid ongoing debates regarding the efficacy of existing treatments, a novel strategy for VCFs was proposed by Kim et al in 2005¹¹ where facet joint blocking was utilized prior to vertebral augmentation for patient comfort during the vertebroplasty and to identify the appropriate levels for augmentation in those with multiple VCFs. Of the 500 study patients, while 60% who underwent a prior facet joint block experienced a pain recurrence at follow-up, 50% of these patients that received radiofrequency ablation did not report a pain recurrence within 6 months. This study identified facet joint blocks as an adjunct with vertebroplasty for the treatment of posterior element pain due to VCFs.

To better understand the anatomy and biomechanics relevant to these findings, it is essential to consider the structure of the posterior arch elements of the vertebrae. These are composed of bilateral pedicles, an overriding lamina which gives rise to a superior articular process (SAP) cephalad and an inferior articular process (IAP) caudad, and a posteriorly positioned spinous process that arises from the middle of the lamina. The SAP of a given vertebra interdigitates with IAP from the vertebra above by forming a facet joint (see [Figure 1](#)). Each joint is surrounded by a dense connective tissue capsule that is innervated by the articular offshoots emanating from the medial branch of the dorsal ramus. The joint capsules are composed of horizontally oriented collagen bundles that facilitate a cephalocaudal rocking motion but resist rotation and separation.¹²

To elucidate the pain generators related to the vertebral body, a biomechanical model by Bogduck et al implicating the posterior elements has emerged as a subject of interest.¹³ Vertebral body height changes from a compression fracture is postulated to stress the facet joint. For instance, asymmetrical anterior wedging of the vertebral body will displace the adjacent superior vertebral body in an anterior and inferior direction causing traction of the IAP of the superior vertebrae against the SAP of the fractured vertebra ([Figures 2C and 3A](#)). Joint capsule deformity or pseudo-articulations between the articular processes may occur and could become a significant source of joint pain. On the other hand, in a symmetrical vertebral body collapse, where the entire vertebral body decreases in height without affecting the height of the posterior arch elements, the distance between the pedicle of the damaged vertebra and the pedicle of the vertebra below will decrease. This movement will force the IAP of the damaged vertebra into the SAP of the vertebra below ([Figures 2B and 3B](#)). As with the previous example, joint capsule deformity or frank bony contusions would be expected. Regardless of the exact mechanisms of origin, radiographic evidence also suggests that the facet joint shows signs of inflammation (increased signal intensity T2-weighted imaging) in patients with VCFs.¹⁴

Preliminary studies suggest that facet-targeted interventions may be effective for managing VCF-associated pain. A retrospective study by Park et al of 53 patients that underwent a therapeutic medial branch nerve block with local anesthetic and steroid reported 78.9% had notable pain relief (>40%), functional improvement (>20%), and rated their satisfaction level as “excellent” or “good” at 12 months.¹⁵ Two key limitations of this nerve block approach were the need to perform repeated blocks containing corticosteroid per year (on average 3.26/year) in an already osteoporotic population and the short-term average duration of pain relief limited to 13.26 weeks only. In another retrospective study by Im et al, of the 26 patients with VCFs that underwent intra-articular facet joint injection prior to percutaneous vertebroplasty, about 25% canceled the vertebroplasty due to reduced pain and overall, about 50% experienced notable pain relief.¹⁶ Despite its small sample size and lack of length of relief or disability outcome measures, this study reinforced that facet joint treatments have a role in the algorithm for the pain relief from VCFs. Wang et al provided further insight with a prospective randomized trial comparing vertebroplasty to facet blockade, finding better short-term

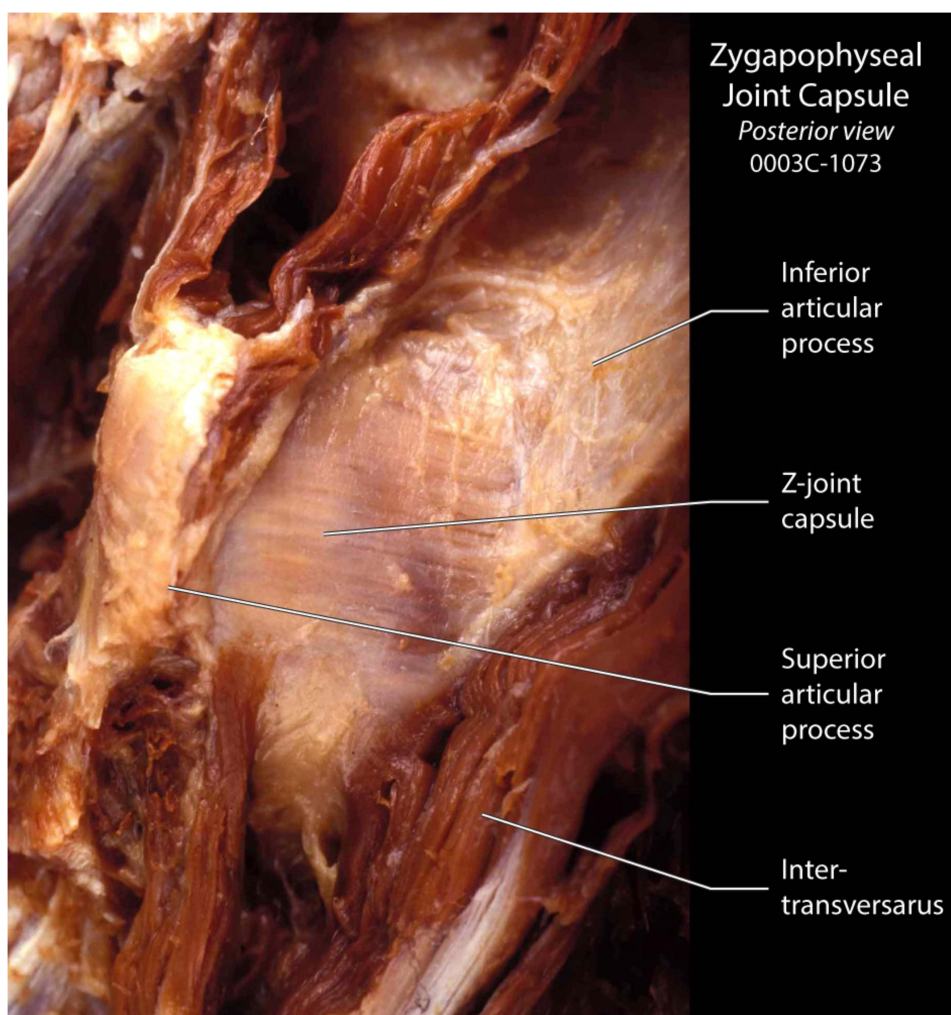


Figure 1 Posterior view of a facet joint capsule. The inferior articular process (IAP) approaches the joint from above and medially, while the superior articular process (SAP) enters from below and laterally. The joint capsule primarily consists of horizontal collagen fiber bundles. (Image reproduced with permission from the Carreiro/Willard collection.).

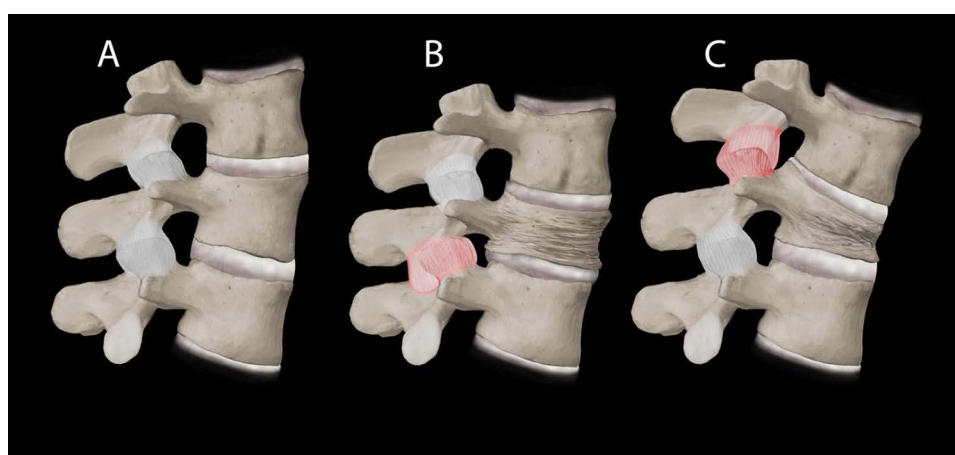


Figure 2 Illustration of stress and injury to posterior arch elements following vertebral body collapse. (A) Stylized lateral view of three lumbar vertebrae, with pale gray shading representing the normal contour of the facet joint capsule. (B) Depiction of a middle vertebral body collapse with symmetric vertical fracture, causing downward displacement of the IAP and lamina onto the SAP of the subjacent vertebra. This displacement stretches and inflames the joint capsule (indicated in pale red), with potential pseudoarthrosis formation between the SAP and lamina of the compressed vertebra. (C) Illustration of a wedge fracture of the middle vertebral body, characterized by anterior border collapse exceeding posterior border collapse. The resulting kyphotic angulation drives the IAP of the superior vertebra forward onto the SAP of the collapsed vertebra, leading to facet joint capsule inflammation (indicated in pale red) and/or pseudoarthrosis formation.

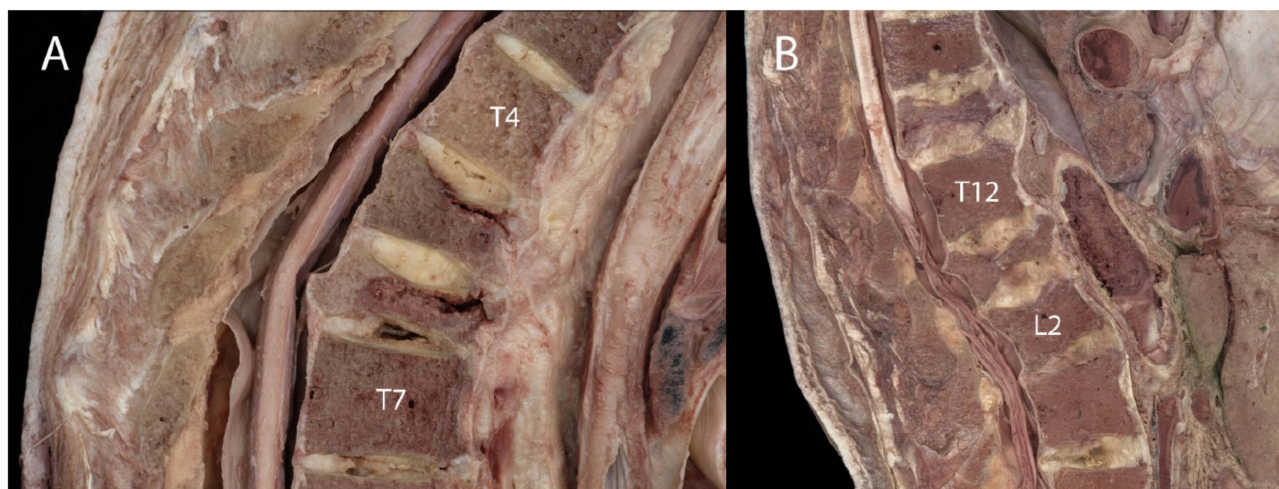


Figure 3 Vertebral body fractures. **(A)** Sagittal section of the vertebral column in an 84-year-old female, showing two adjacent wedge fractures of the T5 and T6 vertebral bodies. The anterior wall of the vertebral body collapses downward, tipping the vertebral column forward on the lower vertebrae creating a kyphotic configuration. **(B)** Sagittal section of the vertebral column of an 83-year-old male demonstrating collapsed vertebral bodies at L1 and T11. The entire body collapses downward on a vertical axis, decreasing the distance between the surrounding vertebrae.

(less than 1 week) pain relief and functionality than vertebroplasty but no significant differences at one month and 12 months for pain, disability, and quality of life.¹⁷ Dang et al prospectively studied 198 patients randomized to either vertebroplasty alone or combined with a facet block and showed that patients who had the combined therapy had better results for pain and disability up to 1 month later.¹⁸ These studies identified possibilities in using facet blocks for VCF related pain in conjunction with vertebroplasty. In a recent 2022 meta-analysis, seven out of ten studies combining facet blocks with vertebral augmentation showed benefits for pain relief and disability up to three months and when the procedures were compared to each other, there was little difference between the two interventions.¹⁹

An alternative to intraarticular facet blocks is radiofrequency ablation of the lumbar medial branch nerves, which supply the zygapophysial joint and posterior elements as described earlier. In the setting of the limited efficacy and invasiveness of kyphoplasty/vertebroplasty, thermal radiofrequency ablation of the medial branch nerves (RFA-MBN) emerges as a possible long-term therapeutic avenue for pain related to VCFs. A 2024 systematic review and meta-analysis of combination therapy using vertebroplasty and RFA-MBN for metastatic spinal tumors analyzed 947 cases and demonstrated significant short-term pain reduction with a complication rate of less than 1%.²⁰

Multispecialty experts have reviewed the RFA-MBN procedure and recommended these for well selected patients with axial back pain from a variety of causes who fail 3 months of conservative management and respond to diagnostic blocks. The procedure is performed under fluoroscopy guidance with the electrode placement parallel to the medial branch nerve.²¹ RFA-MBN is a safe procedure that provides lasting relief for facet-mediated pain, in up to 60% of patients for up to 12 months.²² Ablation is generally viewed as being superior to intra-articular facet injections and medial branch blocks in providing sustained relief, as it ablates the nerves, rather than anesthetizing the nerves that innervate the facet joint or applying steroids that may offer only short term relief.

In the treatment of VCFs, intra-articular facet blocks, often combined with bone cement vertebral augmentation interventions and typically used in patients with more acute pain, have been evaluated in the medical literature. However, there is limited information regarding single facet therapy, particularly RFA-MBN, as a standalone treatment for VCFs despite being a low-risk procedure with long-term benefits. While RFA-MBN has shown to be beneficial for chronic axial back pain, this has not been extrapolated to those suffering from chronic VCF pain. Furthermore, there remains a paucity of large and long-term studies that have examined the efficacy of RFA-MBN in relieving VCF-associated pain. To address this gap, this study presents our robust 8-year experience in treating chronic VCF pain with RFA-MBN, aiming to determine its effectiveness in providing significant, sustained relief.

Materials and Methods

The 8-year retrospective chart review study was conducted at a tertiary care academic pain center, University of California, Davis, between August 2014 to June 2022. This study was reviewed by the UC Davis Institutional Review Board and considered exempt (IRBNet ID 1908470–1); patient consent was waived due to the retrospective nature of this study. All data were anonymized, and patient confidentiality was maintained in accordance with institutional policy and the Declaration of Helsinki. The electronic medical records of 2420 patients that underwent RFA-MBN at the pain center were reviewed for the following inclusion criteria: patients with at least one level chronic VCF with axial back pain AND who underwent thermal RFA-MBN after previously achieving greater than 80% pain relief with two diagnostic MBN blocks. We excluded patients based on the following criteria: (1) not receiving at least 2 MBN blocks prior to RFA, (2) patients under the age of 18, (3) patients with cervical compression fractures, (4) RFA-MBN performed for back pain not associated with the compression fracture(s), and (5) lost to follow-up after RFA-MBN. Informed consent form was completed by all patients for the procedure after discussion of the proposed procedure, risks, alternatives (consent not required for the study itself given IRB exemption and retrospective nature of the study). These procedures were performed under the supervision of 5 faculty providers during the study period by faculty or fellows in an

Accreditation Council for Graduate Medical Education (ACGME) pain medicine training program. Needle probe position was verified by faculty providers prior to the ablation procedure. The time between repeat ablation procedures were noted, if applicable.

Procedure Details

The patients were positioned in prone position in the fluoroscopy procedure suite, where the VCFs and corresponding facet joints were identified. The medial branches innervating the facet joints above and below the compression fracture was surmised using bony landmarks such as the confluence of the pedicle and transverse process. The injection site(s) were prepped aseptically, and the skin and subcutaneous tissue were anesthetized using 1% lidocaine or mepivacaine local anesthetic. Thermal radiofrequency needle probes with ablating tip (20 gauge, 10 or 15 cm) were advanced to each target under fluoroscopic guidance utilizing either a coaxial approach to the anterior-posterior fluoroscopy view or placed using the Spine Intervention Society approach when applicable, which requires a parallel placement. Needles rested on the periosteum, with anterior-posterior, oblique and lateral views confirming appropriate needle placement. Motor stimulation at 3 volts and 2 Hz was performed at each level to ensure the absence of lower extremity motor fasciculations. Before ablation, a 2% lidocaine or mepivacaine solution was injected at each nerve. After a 3-minute delay, monopolar ablation lesions were performed at 80°C for 90 seconds at each probe location. After ablation, a dexamethasone and saline solution was injected at each nerve for post-ablation neuritis prophylaxis for most patients. The needles were sequentially removed, and patients were discharged home after meeting discharge criteria.

Study Outcomes and Data Collection

The primary outcome measure was patient self-reported percentage and length of pain relief post RFA-MBN as documented in post procedure notes within the electronic medical record (EMR). The secondary outcomes measured were pre-disability index, post-disability index, and difference disability index (post-disability index minus pre-disability index) as documented in clinic notes within the EMR. The primary covariates for the study included age, gender, number of VCFs, location of VCF, cause of VCF, Patient Health Questionnaire (PHQ-9) scores, history of prior vertebroplasty, laterality of RFA-MBN, and time to repeat ablation. Statistical analysis was conducted using R Version 4.1.3. Univariate linear mixed effect models were employed to evaluate the association between level and duration of pain relief to all relevant covariates. The random-effects component of the model accounted for patients undergoing repeated procedures in this study. All tests were two sided with a significance level set at 0.05.

Results

Out of 2420 patients identified through the EMR that received RFA-MBN, 68 patients underwent the procedure for axial back pain secondary to thoracic and/or lumbar compression fractures. Seven out of 68 patients with confirmed VCFs were excluded due to missing evaluation information about pain relief. The study cohort of 61 patients with confirmed thoracic and/or lumbar VCFs who underwent RFA between August 2014 and June 2022 were included in the study.

Table 1 summarizes the demographic information and baseline characteristics of the study participants. The average age of this group was 72.1 ± 11.5 years with the majority being female (44 patients or 72.1%). Regarding the number of

Table 1 Demographic Information and Baseline Characteristics

	Overall (N=61)
Age	
Median (Q1, Q3)	73.0 (66.0, 80.0)
Mean (SD)	72.1 (11.5)
Range	43.0–92.0
Gender	
Male	17 (27.9%)
Female	44 (72.1%)
Pre-Disability Index	
N-Missing	5
Median (Q1, Q3)	39.0 (28.8, 49.2)
Mean (SD)	39.9 (15.1)
Range	6.0–75.0
Post-Disability Index	
N-Missing	20
Median (Q1, Q3)	39.0 (28.0, 51.0)
Mean (SD)	39.2 (15.0)
Range	7.0–62.0
Difference Disability Index	
N-Missing	24
Median (Q1, Q3)	0.0 (–10.0, 8.0)
Mean (SD)	1.2 (16.0)
Range	–37.0–59.0
Number of VCF	
Single	33 (54.1%)
Multiple	28 (45.9%)

(Continued)

Table 1 (Continued).

	Overall (N=61)
VCF Location	
Lower Lumbar	18 (29.5%)
Both	12 (19.7%)
Lower Thoracic	13 (21.3%)
Upper Lumbar	18 (29.5%)
Upper Thoracic	0 (0.0%)
Laterality of RFA	
Bilateral	51 (83.6%)
Unilateral	10 (16.4%)
Cause of VCF	
Osteoporosis	21 (34.4%)
Cancer	8 (13.1%)
Osteopenia	5 (8.2%)
Trauma	18 (29.5%)
Unknown	9 (14.8%)
History of Vertebroplasty	
No	48 (78.7%)
Yes	13 (21.3%)
PHQ9	
N-Missing	22
Median (Q1, Q3)	7.0 (2.0, 11.0)
Mean (SD)	7.9 (6.5)
Range	0.0–22.0

Notes: Continuous variables are reported as follows: median (Q1, Q3), mean (SD), and range. Q1 and Q3 represent the first and third quartiles, respectively. SD = standard deviation. Categorical variables are summarized as frequency (percentage). N-missing indicates the number of participants without available data for that measure.

Abbreviations: VCF, vertebral compression fracture; RFA, radio-frequency ablation; PHQ9, Patient Health Questionnaire-9.

VCFs, 33 participants (54.1%) had a single fracture, while 28 participants (45.9%) had multiple fractures. Of these, 18 participants (29.5%) had fractures in the lower lumbar region, 12 (19.7%) in both the lower and upper lumbar regions, 13 (21.3%) in the lower thoracic region, 18 (29.5%) in the upper lumbar region, and none in the upper thoracic region. The main causes of VCFs in this cohort were osteoporosis in 21 patients (34.4%), followed by trauma in 18 (29.5%), cancer in 8 (13.1%), unknown causes in 9 (14.8%), and osteopenia in 5 (8.2%). The majority of patients underwent bilateral RFA-MBN based on their pain location (51 patients or 83.6%). Additionally, this analysis did include 13 participants

(21.3%) that had undergone vertebroplasty in the past and subsequently underwent RFA-MBN at the corresponding vertebral levels for persistent pain. The average pre- and post-disability index scores did not reveal a notable variation, that is, 39.9 ± 15.1 and 39.2 ± 15 , respectively. The PHQ-9 scores, used for depression assessment, were available for 39 participants with a mean score of 7.9 ± 6.5 .

The average pain relief percentage and duration were 56.6% (SD = 28.4) and 36.1 weeks (SD = 35.3), respectively. There were 41 (67.2%) patients who experienced at least 50% pain relief for at least three months; within this group, 29 (47.5%) maintained at least 50% pain relief for at least six months. There were 7 (11.48%) patients who reported that the procedure was not effective (Figure 4). When analyzing the relationship between percentage of pain relief and pre-disability index, there was a general positive trend indicated by the locally estimated scatterplot smoothing (LOESS) fit line in a scatter plot evaluating this association (Figure 5).

In order to analyze the associations between the primary outcomes and all relevant covariates, a univariate mixed-effects model was utilized (Table 2). The model examining pain relief percentage revealed that the Pre-Disability Index Score was a significant predictor ($p=0.007$), showing each increase in the pre-DI score was associated with a 0.64% increase in pain relief percentage after the procedure. Gender approached significance ($p=0.097$), with females experiencing 13.28% more pain relief than males. In addition, each higher PHQ9 score was associated with a 1.19% increase in pain relief percentage ($p=0.12$). Other variables such as age, number of VCF, VCF location, cause of VCF, history of vertebroplasty, laterality, and PHQ9 scores did not show significant associations. In the pain relief duration model, none of the covariates (including study repeat, gender, age, number of VCF, VCF location, cause of VCF, history of vertebroplasty, laterality, Pre-Disability Index Score, and PHQ9 scores) revealed statistically significant associations.

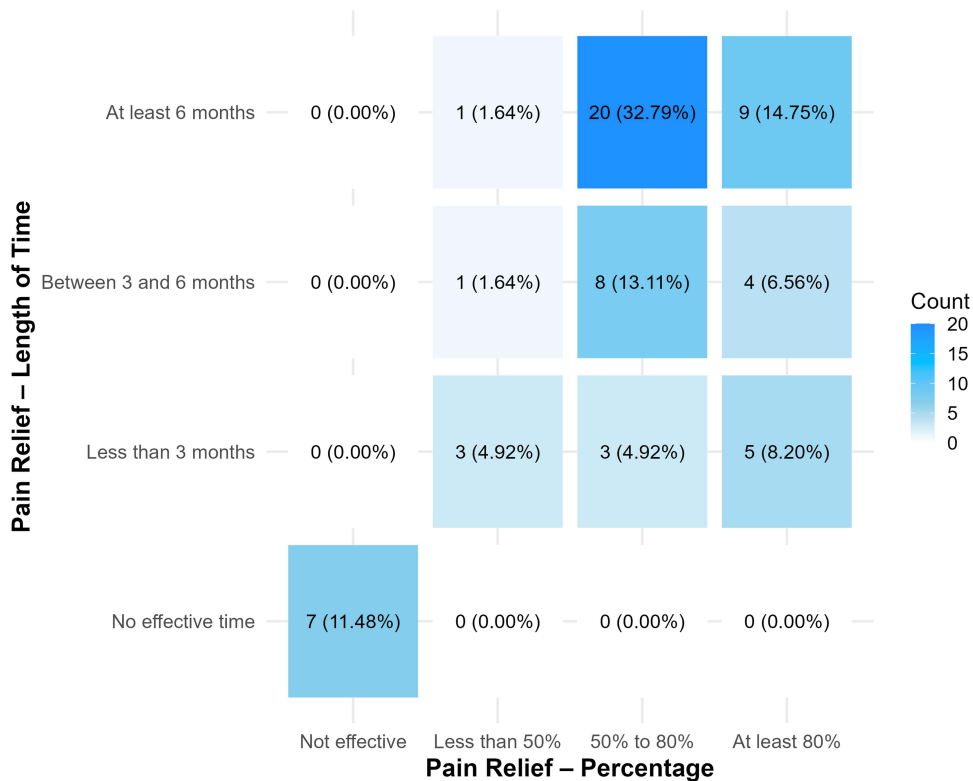


Figure 4 Heatmap of Percent of Pain Relief by Duration of Pain Relief.

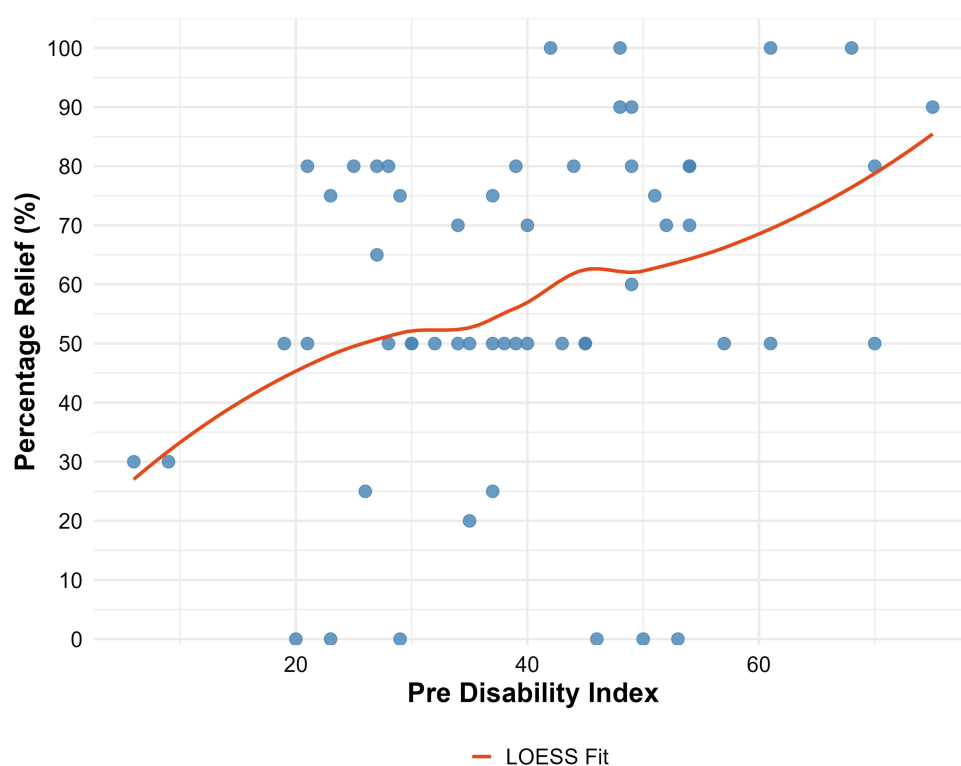


Figure 5 Scatter Plot of Pre-Disability Index versus Percentage of Pain Relief.

Discussion

In this study, we investigated the efficacy of RFA-MBN for managing axial back pain secondary to thoracic and lumbar VCFs. Our retrospective chart review at a tertiary care academic pain center included 61 patients who underwent RFA-

Table 2 Univariate Models for Pain Relief Percentage and Duration of Pain Relief

Variable	Pain Relief Percentage Model		Pain Relief Duration Model	
	Estimate (SE)	P-value	Estimate (SE)	P-value
Study Repeat				
No	Reference	0.41	Reference	0.7
Yes	8.5 (10.29)		5.07 (12.96)	
Gender				
Male	Reference	0.097	Reference	0.6
Female	13.28 (8)		-5.35 (10.22)	
Age				
Year	-0.35 (0.33)	0.29	-0.41 (0.4)	0.31
Number of VCF				
Single	Reference	0.26	Reference	0.5
Multiple	-8.21 (7.34)		-6.19 (9.15)	
VCF Location				
Lower Lumbar	Reference	0.81	Reference	0.66
Both	-3.85 (11.03)		11.58 (13.46)	
Lower Thoracic	-10.62 (11.04)		13.38 (13.14)	
Upper Lumbar	-5.35 (9.95)		12.89 (11.88)	

(Continued)

Table 2 (Continued).

Variable	Pain Relief Percentage Model		Pain Relief Duration Model	
	Estimate (SE)	P-value	Estimate (SE)	P-value
Cause of VCF				
Osteoporosis	Reference	0.36	Reference	0.32
Cancer	1.1 (11.77)		5.1 (14.75)	
Osteopenia	-15.52 (14.1)		-3.9 (17.66)	
Trauma	2.7 (9.1)		11.87 (11.4)	
Unknown	-17.3 (11.29)		26.7 (13.64)	
History of Vertebroplasty				
No	Reference	0.56	Reference	0.33
Yes	-5.39 (9.25)		-10.8 (11.14)	
Laterality				
Bilateral	Reference	0.28	Reference	0.39
Unilateral	10.6 (9.82)		10.61 (12.35)	
Pre-Disability Index Score	0.64 (0.24)	0.007	-0.16 (0.33)	0.63
PHQ9	1.19 (0.77)	0.12	0.34 (0.96)	0.73

Notes: Estimates are presented with standard errors (SE) and corresponding P-values. Reference indicates the comparison group in categorical variables.

Abbreviation: VCF, vertebral compression fracture; PHQ-9, Patient Health Questionnaire-9.

MBN over an 8-year window period - one of the largest reported cohorts to date. The procedure provided an average pain relief of 56.6% lasting 36.1 weeks, with 67.2% of patients experiencing $\geq 50\%$ pain relief for ≥ 3 months. Analysis identified a higher pre-disability index as a significant predictor of therapeutic efficacy, correlating with better post-RFA percentage of pain relief. Despite this overall trend, the data exhibits variability and outliers, suggesting that while higher Pre-Disability Index values are generally associated with greater relief, other factors likely influence this relationship. Multiple covariates such as age, number of VCFs, VCF location, cause of VCF, history of vertebroplasty, and laterality of RFA had no effect on the percentage and length of pain relief. These findings underscore the potential of RFA-MBN as a viable long-term therapeutic option amidst ongoing debates on avenues for managing pain in VCFs.

The clinical relevance of this work is highlighted by the rising incidence of VCFs in aging populations and the controversies surrounding vertebral augmentation procedures. While RFA-MBN is an established treatment for facet-mediated pain in degenerative spondylosis, its role in posterior element pain after VCFs has remained underexplored. Our results provide evidence for RFA-MBN as a preferred modality for pain relief over more invasive procedures and procedural extension for application towards patients with posterior element-related VCF pain. RFA-MBN reduces posterior element pain by interrupting nociceptive signaling from the medial branch nerves that innervate the facet joints and surrounding structures, which may also mitigate local inflammation. In some of the study participants, pain relief was temporary potentially due to nerve regeneration, highlighting the need for repeat procedures.

This study also demonstrates novelty by reporting one of the largest series to date of patients with compression fractures from osteoporosis, trauma, and malignancy across both thoracic and lumbar levels. From a broader perspective, this work fills an important gap in literature. Few large-scale studies have explored RFA-MBN specifically in the VCF population. The scarcity of recent publications makes our findings particularly relevant by offering timely data that is directly relevant to clinical practice in spine and pain medicine.^{21,23} A further advantage of RFA-MBN is its minimally invasive profile. The procedure utilizes small gauge electrode needles that stay posterior to the spinal column as compared to bone cement procedures that require violation of the osseous part of the vertebral body with larger gauge needle sizes (at times two via a transpedicular approach). Both kyphoplasty and vertebroplasty have been associated with significant potential complications, usually due to the bone cement material extravasating, such as pulmonary emboli, vascular injury, and neurological damage.²⁴ These risks may increase the higher up the vertebral level is treated and

usually cervical and upper thoracic levels are not recommended for bone cement procedures. Additionally, there is inconsistent evidence that these procedures may cause subsequent compression fractures.²⁴ Bone cement application may require either significant sedation or general anesthesia while RFA-MBN procedures can be completed with only local anesthetic or minimal sedation. Alternatively, the risk of radiofrequency ablation is low and includes mostly vascular, neurological, or muscular complications and longer-term degeneration of spinal musculature.²¹ This procedure can also be repeated if the pain returns or the medial branch nerves regenerate which is another potential benefit over injections of bone cement.^{21,25} Those requiring RFA-MBN procedures also do not need to discontinue any of their anticoagulants since the risk of bleeding is low as opposed to vertebroplasty/kyphoplasty. This is particularly beneficial in those with cancer who may be highly dependent on anticoagulation therapy. Additionally, the ablation procedure benefits from a diagnostic process in which patients must get pain relief from lumbar medial branch blocks prior to proceeding with the final RFA procedure.²¹ This is in contrast to kyphoplasty and vertebroplasty in which there is no opportunity for diagnostic mapping of the painful facet joints. In addition, success with these diagnostic blocks is predictive of benefit from the ablation itself.²³ Lastly, RFA is a covered benefit by most insurance products after conservative therapies fail.

Our study demonstrated benefits of RFA-MBN in those with VCFs due to a variety of causes and at multiple possible locations of the spine. The VCF patients had the same chance of success as published reports of patients who do not have that particular condition and present only with axial back pain worsened with facet loading.^{26–28} In other studies, RFA procedures have been shown to decrease medication use (including opioids) and lower disability with useful long-term results.^{25,29} Compared to other facet procedures, RFA-MBN is thought to be more efficacious than intra-articular steroid administration.³⁰ Some individuals in the study with a positive result from the initial RFA-MBN wished to have repeat ablation procedures and had similar positive results. Even those with a cancer diagnosis, who can be notoriously difficult to treat, benefited from this procedure as a minimally invasive alternative to vertebroplasty or kyphoplasty.

Comorbid status may further preclude bone cement therapies to treat pain that arises from posterior elements damaged by VCFs. For example, in the setting of progressive cancer with metastatic lesions (ie multiple myeloma and prostate cancer with osteolytic and osteoblastic lesions, respectively), patients may have compression fractures with retropulsed fragments. Retropulsed fragments have been considered a contraindication to vertebral augmentation. Moreover, patients afflicted with cancer are often in a hypercoagulable state which may require the need for anticoagulation as mentioned above. The integrity of the bone itself in these patients is often poor. Next, chemotherapeutics may alter liver enzymes and induce changes in renal function. These clinical circumstances often serve as obstacles, precluding vertebral augmentation and surgical stabilization. Treating the posterior elements by rendering them insensate with radiofrequency ablation offers a low-risk, high yield, alternative that spares medication management in some instances. It is often these complex patients with substantive comorbid disease burden that display a high degree of disability, dysfunction, and concomitant depression. It is not surprising that with escalating measures of depression, as measured by the PHQ9, and heightened disability, the clinically complex patient begins to stratify and demonstrate even greater improvement from treatment of the posterior elements as seen in our study. The comorbid laden patient presents in a more vulnerable and precarious position with substantive dysfunction from their pain. Many times, there are few other safe and effective treatment alternatives for their pain but RFA-MBN offers a greater degree of clinical benefit for the complex patient considering their profound clinical disability at baseline.^{11,17,31}

This study has several limitations, including its retrospective nature, which carries inherent risks of selection bias and incomplete data collection, as well as variable follow-up times documented in the medical record. Reliance on patient-reported percentage improvements in pain rather than standardized measures (eg, VAS, ODI) may have introduced measurement bias, and PHQ-9 scores were available for only a subset of patients, limiting assessment of the impact of depression on outcomes. Although statistical measures were used to mitigate missing data, the absence of a control group precludes direct comparison of RFA-MBN with vertebroplasty, kyphoplasty, or conservative options such as steroid injections, and therefore superiority cannot be inferred. Additionally, our study only included monopolar thermal ablation, while cooled or bipolar RFA-MBN is another possibility. The average duration of relief observed here provides useful but limited information about long-term efficacy; future prospective studies should include follow-up extending to 12–24 months to better capture recurrence rates and functional outcomes, as well as a tally of post-procedure analgesic use. A randomized controlled trial with prospective design, standardized outcome measures, and direct comparisons to

established interventions would provide stronger evidence to clarify the role of RFA-MBN in managing posterior element pain after VCFs. Nevertheless, this study offers important preliminary data supporting RFA-MBN as a potentially effective treatment, which should be validated in larger populations to facilitate eventual inclusion in clinical guidelines.

Conclusions

Our group describes a nearly 10-year experience with offering RFA-MBN procedures for those with VCFs due to a variety of causes, including metastatic cancer and osteoporosis. RFA-MBN could be a low-risk intervention in the treatment algorithm for posterior element pain in patients with VCFs, especially compared to more invasive treatment options such as vertebroplasty or kyphoplasty. The study shows promising pain relief, with many patients benefiting from sustained improvement, especially those with higher pre-disability levels. This makes it a valuable option, particularly for patients with complex medical conditions such as cancer. While further research is needed to directly compare RFA-MBN with cement-based interventions, this study supports its use as a safe and effective treatment alternative for managing VCF-related pain.

Disclosure

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