

Comparison of Efficacy of Lateral Branch Radiofrequency Denervation and Intra-articular Depot Methylprednisolone Injection for Sacroiliac Joint Pain

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BACKGROUND: The sacroiliac joint (SIJ) has drawn a lot of attention lately as a potential cause of low back pain (LBP), both chronic and acute. Sacroiliac joint lateral branch radiofrequency denervation is regarded as a better long-lasting alternative to steroid injection in the treatment of SIJ pain in patients with no improvement with conservative management or local steroid injection.

OBJECTIVE: The aim of the study is to compare pain relief following intra-articular steroid injection or radiofrequency denervation of lateral branches, as well as to compare patients' enhanced daily activities, general satisfaction with their treatment, and their ability to do daily tasks following both intervention methods.

METHODS: This prospective study enrolled 30 patients with clinically proven sacroiliac joint discomfort and who experienced greater than 50% pain alleviation following intra-articular diagnostic block injection. Patients were randomly assigned to one of two groups: group A received intra-articular methylprednisolone injections, while group B had standard radiofrequency denervation of the L4 L5 dorsal rami and S1-3 lateral branches. Numeric Rating Scale (NRS) before the procedure and at 2 weeks, one month and three months after the procedure, Oswestry Disability Index (ODI) before the procedure and at one and three months after the procedure and Global Perceived Effect (GPE) after three months, were used as outcome parameters to compare between both groups.

RESULTS: In group A (intra-articular methylprednisolone injection), the NRS outcome with >50% pain relief after two weeks, one month, and three months was 60%, 46% and 40%, respectively, with only 6 patients reporting improvement in daily activities and recommending the procedure to other patients (which is considered as a positive response for the GPE). Regarding group B (conventional radiofrequency), the NRS outcome with >50% pain relief at 2 weeks, 1 month, and 3 months was 60% unchanged all over the follow up period, with 9 out of 15 patients reporting improvement in pain and in daily activities after 3 months.

CONCLUSION: Radiofrequency denervation of the L4 L5 dorsal rami and S1-3 lateral branch provided significantly more prolonged pain relief and improved function than intra-articular methylprednisolone injection, yet our study's small sample size and short duration of follow-up posed significant limitations.

KEYWORDS: Lateral branches denervation of sacroiliac joint, Numeric rating scale, Radiofrequency denervation, Sacroiliac joint injection, Sacroiliac joint pain.

INTRODUCTION

The SIJ provides the upper body with strong (but flexible) support. Because of the SIJ's unique design and the fibrous apparatus tightness, movement is severely restricted in this joint.¹ As a result of its unusual structure, it is known as a diarthrodial/synovial joint.² Typically, the SIJ is made up of sacral segments S1, S2, and S3, however females are less likely to include the whole S3 segment in their SIJ.³ Within the second decade, the sacral vertebrae begin to fuse.² Anatomically, this joint space has a rather thin ventral SIJ capsule, which is frequently prone to leakage of joint-

space fluids onto nearby tissues. A fluoroscopic guided injection study revealed leakage of injected contrast in 76 joints, or 61% of all joints analysed.⁴ Grob et al. found posterior rami of S1–S4 innervating the joint.⁵ Willard et al. and McGrath and Zhang were able to trace minor branches out of L5, as well as out of S1 and S2, into the joint, respectively.^{6,7}

Diagnosis usually relies on physical examination and/or radiological imaging modalities to identify SIJ pain. There was a 22.5% prevalence rate in 1293 adult patients with LBP in Bernard and Kirkaldy-Willis' largest retrospective study. The major diagnostic tool used in this series was the physical examination.⁸ A trial by Schwarzer et al. used fluoroscopy guided SIJ injections on 43 patients with chronic low back pain, with the majority of patients having LBP below the L5-S1 level.

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Thirteen patients (30%) exhibited significant pain relief.⁹

Theories regarding etiology of sacroiliac joint dysfunction include external compression, shear pressure, and hypo or hypermobility. Intra-articular causes of SIJ pain include osteoarthritis, joint damage and entheses/ligamentous injury and enthesopathy. The SIJ discomfort may be caused after lumbar fusion surgery by either of the following mechanisms; the SIJ dysfunction was incorrectly underdiagnosed preoperatively, harvesting bone grafts near to the joint and an inaccurate diagnosis was made before fusion (i.e., the lumbar spine is mistakenly assessed to be fused).¹⁰ Several clinical and experimental studies on adjacent segment disease after lumbar fusion surgeries have shown greater mobility and stress on the facet and/or disc of surrounding movable segments in the adjacent cephalad and/or caudal segments.¹¹ Leg length disparity,¹² gait abnormalities,¹³ prolonged, vigorous activity,¹⁴ spinal lumbosacral fusion,¹⁵ and pregnancy,¹⁶ are all risk factors that increase the load on the SIJ. Sacral degenerative changes often take 10 to 20 years longer than those on the iliac surface to begin to occur. Joint mobility can be severely limited in the sixth decade when the capsule thickens and fibrous ankylosis develops. As we approach our eighth decade, we should expect to see erosions and plaque formation.¹⁷

Numerous experts agree that one of the most difficult issues in medicine today is treating pain in the SIJ. Using shoe inserts or physical therapy in treating the underlying problem is the primary goal of conservative therapies.¹⁸ Exercising and manipulating the SIJ can decrease discomfort and increase mobility in patients with postural and gait problems.¹⁹ Injections of methylprednisolone and local anesthetic into the SIJ may provide good pain relief for periods of up to 1 year.²⁰⁻²¹ It is assumed that intra-articular injections would produce better results than peri-articular infiltrations.¹⁹ There are significant extra-articular causes of pain in the sacroiliac area, and intra-articular diagnostic blocks may underestimate their incidence, according to Borowsky and Fagen study.²² The radiofrequency (RF) denervation techniques are another potential intervention to be explored further in the near future, with several researches showing its efficacy. There has been a broad variation in the selection criteria, definition of success, and RF parameters (e.g., temperature, time, and site of RF therapy) in the clinical studies.^{23,24} The RF denervation procedures that use fluoroscopic guidance have been documented.²⁵

The aim of the study is to compare pain relief following intra-articular steroid injection or radiofrequency denervation of lateral branches, as well as to compare patients' enhanced daily activities, general satisfaction with their treatment, and their ability to do daily tasks following both intervention methods.

PATIENTS AND METHODS

In this prospective study, 30 patients with sacroiliac joint discomfort were included from June 2020 to the end of

the follow-up period in February 2021. All patients were managed at Cairo University hospitals and Beni-Suef University hospital. Ethical approval was obtained by the institutional review board (IRB). The study conformed to the provisions of the Declaration of Helsinki. All participants signed an informed consent form. Patients had to have sacroiliac discomfort, between the ages of 18 and 70 years, with a history of low back pain lasting more than three months and unresponsive to conservative treatment, with a positive response to three provocative clinical tests at least, and positive result to the diagnostic block with more than 50% pain relief. Provocative clinical tests include Gaenslen's test, Flexion, ABduction, External Rotation (FABER) test, Gillet test, thigh thrust test, compression and distraction tests. Patients who refused to be included in the study, patients with history of focal neurological symptoms, bleeding diathesis, or persistent physical or mental disease were ruled out of the study.

Examining for motor weakness, sphincteric dysfunction and other neurological deficits as well as assessment of the location of the pain and whether it was spontaneous or preceded by trauma or previous lumbar surgery, were performed in all patients. In order to confirm the diagnosis and rule out other possible causes, all patients underwent imaging tests such as x-rays and magnetic resonance imaging (MRI). The diagnosis of sacroiliac joint pain was confirmed by intra-articular diagnostic block injection with local anesthetic (2ml lidocaine 2%) under fluoroscopic guidance in patients with positive response to three or more clinical provocative tests. Patients who showed a 50% or more improvement in their NRS were randomly divided into two groups and managed by intra-articular methylprednisolone injections (Group A) or radiofrequency lateral branch denervation of the sacroiliac joint (Group B) in a 1:1 ratio.

A fluoroscopically guided intra-articular injection of 2ml methylprednisolone and 1ml lidocaine 2% was performed on the first group of patients. The second group had radiofrequency denervation of the L4 L5 dorsal rami and the S1 to S3 lateral branch under fluoroscopic imaging utilizing the Stockert Neuro N50 device (manufactured by inomed Medizintechnik, Germany). Patients were given a very modest sedative. The C arm was used in either an oblique, anterior, or posterior projection. The S1 posterior foramen could be better seen with a small amount of ipsilateral oblique angulation. A 22 gauge cannula with a 5mm active tip was inserted until it makes contact with the bone at the level of the target nerve. Electro-stimulation at 50 Hertz was used to validate the right needle location, and paresthesia should be felt in the painful region with thresholds less than 0.5 volt at this stage. Multiple lesions might be required because of the tiny lesion size formed by traditional electrodes and the significant diversity in the position and number of nerves converging on each foramen. The lack of leg or sphincter contraction should be confirmed with motor stimulation prior to receiving the RF therapy. It is necessary to readjust

the needle if it was present. The RF probe was implanted, and a 90-second RF treatment at 80°C was performed after the electrode had been correctly positioned.

To analyze the clinical outcome parameters of pain improvement, we have employed the evaluation techniques used by earlier studies including NRS and ODI used by Cohen,¹⁷ and GPE used by Dutta et al.²⁶ Primary outcome parameter was assessed after two weeks using NRS and secondary outcome parameters were assessed after one month using NRS and ODI and after three months using NRS, ODI, and GPE.

The NRS evaluation technique for quantifying sacroiliac joint pain was utilized to examine the result of subjective symptoms and clinical signs. We determined NRS before the intervention and after 2 weeks, 1 month, and 3 months following the intervention. An improvement rate of above 90% was considered excellent, while improvements of 75%–89% were deemed good, and improvements of 50%–74% were deemed poor.

The ODI was used for assessment of sacroiliac joint pain before the procedure and after 1 and 3 months post intervention. A score from 0 to 100 constitutes the ODI questionnaire. A score from 0-20 reflects minimal disability, from 21-40 moderate disability, from 41-60 severe disability, from 61-80 crippled and from 81-100 bed bound or patients exaggerating their symptoms.

The following three questions were used to determine whether or not a GPE was positive; Since my previous appointment my pain has improved/worsened/remained the same, I am pleased/not satisfied with the management I had, and I would suggest it to others.

Statistical analysis

The data was coded and entered using the statistical package for social sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA). Categorical data was summarized using frequency (count) and relative frequency (percentage), whereas quantitative data was reported using the mean and standard deviation. Comparisons between the groups were made using an unpaired t-test. Repeated-measures Analysis of Variance (ANOVA) was used to compare serial measurements within each group. Categorical data was compared using the Chi-square test. When the expected frequency was less than 5, an exact test was used instead. A p-value of less than or equal to 0.05 was considered as statistically significant.

RESULTS

The data was collected from 30 patients with sacroiliac

joint pain who were randomized into 2 groups; group A for intra-articular methylprednisolone injection and group B for lateral branch radiofrequency denervation. Both groups were analyzed with no complications reported among both groups. Patients in group A were aged between 28 -56 years (mean age: 44 years), while in group B patients were aged between 25-58 years (mean age: 45.07 years). Out of the 15 patients in group A, 8 patients (53.3%) were females while 7 patients (46.7%) were males, while in group B 10 patients (66.7%) were females and 5 patients (33.3%) were males. In group A, the duration of sacroiliac joint pain ranged between 4 months to 2 years (mean: 10.6 months) with failed conservative management. In group B, the duration of sacroiliac joint pain ranged between 6 months to 1.5 years (mean: 8.67 months) with failed conservative management.

At 2 weeks post procedure, the mean NRS in both groups were significantly lower (<50 %) than at baseline. The mean NRS and ODI were significantly lower at 1 month and 3 months post-procedure in both groups (**Table 1**). In group A (intra-articular methylprednisolone injection), the NRS outcome with >50% pain relief after two weeks, one month, and three months was 60% (9 of 15 patients), 46% (7 of 15 patients), and 40% (6 of 15 patients), respectively. In comparison to group B (conventional radiofrequency denervation of the L4 L5 dorsal rami and S1-3 lateral branches), the NRS outcome with >50% pain relief at 2 weeks, 1 month, and 3 months was 60% unchanged all over the follow up period (**Table 2**).

In our study, the ODI was assessed before and after intervention in both groups at 1 month and 3 months intervals and summarized. The baseline for ODI scores before interventions for group A (mean= 23.40) and group B (mean =23.47) were comparable. At 1-month post-procedure, the mean ODI for group A (mean=16.27) and group B (mean= 14.73) had diverged. At 3 months post-procedure, the mean ODI scores in group A remained the same (mean= 16.87), while in group B the mean ODI was lower (mean=13.73), but remained statistically insignificant (**Table 3**).

The GPE was assessed after intervention (either positive response or negative response) in both groups at 3 months and summarized (**Table 4**). Six out of 15 patients (40.0%) in group A had positive response to intra-articular methylprednisolone injection, while in group B, 9 out of 15 patients (60%) had a positive response to lateral branch radiofrequency denervation. The difference between the 2 groups was not statistically significant (p value=0.273).

Table 1: Comparison of pre-intervention and post-intervention NRS and ODI over 3 months

	p value for comparison of pre-intervention & post-intervention NRS	p value for comparison of pre-intervention & post-intervention ODI
Pre procedure	----	----
2 weeks post procedure	< 0.001	----
1 month post procedure	< 0.001	< 0.001
3 months post procedure	< 0.001	< 0.001

NRS: Numeric Rating Scale, ODI: Oswestry Disability Index.

Table 2: Comparison of NRS between groups A and B over 3 months

	Group A (Steroids)		Group B (RF)		p value
	Mean	SD	Mean	SD	
NRS pre procedure	6.97	0.83	7.03	0.64	0.808
NRS 2 weeks post procedure	3.30	0.41	3.17	0.24	0.294
NRS 1 month post procedure	3.30	0.41	3.07	0.32	0.095
NRS 3 3 months post procedure	4.40	0.47	3.13	0.35	< 0.001

NRS: Numeric Rating Scale, SD: Standard deviation, RF: Radiofrequency.

Table 3: Comparison of ODI between groups A and B over 3 months

	Group A (steroids)		Group B (RF)		p value
	Mean	SD	Mean	SD	
ODI pre procedure	23.40	4.42	23.47	3.66	0.964
ODI 1 month post procedure	16.27	4.08	14.73	3.81	0.296
ODI 3 months post procedure	16.87	4.32	13.73	4.32	0.057

ODI: Oswestry Disability Index, SD: Standard deviation, RF: Radiofrequency.

Table 4: Comparison of GPE between groups A and B after 3 months

		Group A (steroids)		Group B (RF)		p value
		Count	%	Count	%	
GPE 3 months post procedure	+ve	6	40.0%	9	60.0%	0.273
	-ve	9	60.0%	6	40.0%	0.273

GPE: Global Perceived Effect, RF: Radiofrequency.

DISCUSSION

Within the context of sacroiliac joint pain diagnosed with three or more clinically provocative tests and diagnostic block injection of local anesthetic after failed conservative measures, this study aims to compare the effectiveness of intra-articular injection of methylprednisolone with radiofrequency denervation of S1-S3 lateral branches and L4 L5 dorsal rami. We here describe the results of 30 patients randomized into 2 groups for intra-articular injection of methylprednisolone and radiofrequency denervation of S1-3 lateral branches and L4 L5 dorsal rami and managed at Cairo university hospitals and Beni-Suef University hospital. In the current study, the mean age for patients presented with sacroiliac joint pain was 44 years and 45.07 years in groups A and B, respectively. This was similar to the study by Dutta et al. who reported mean age of 48 years,²⁶ but lower than the study by Liliang et al. who reported mean age of 63 years.²⁷ This may be related to the selection criteria of the patients enrolled in the study. Regarding gender distribution in

our study, out of a total of 30 patients included, 18 were females (60%); 8 in group A (53.3%) and 10 in group B (66.7%). This finding was similar to a previous study that reported that sacroiliac joint pain was more common in women than in men, where 134 out of 198 patients with sacroiliac joint pain were females (67.7%).²⁸

The NRS, ODI, and GPE were used in the current study to evaluate patients following the procedures whether steroid injections or radiofrequency denervation. The GPE assessment at 3 months post-procedure was considered a positive response if the patient reports pain relief, improved ability to perform daily activities, and if the patient would recommend the treatment for other patients.

Following intra-articular steroid injection in our study group A, the NRS outcome with >50% pain relief after two weeks, one month, and three months was 60%, 46% and 40%, respectively, with only 40% of the patients having positive GPE at 3 months. A randomized controlled trial by Murgars et al. enrolled 10 patients

with 13 SIJs dysfunction where six SIJs received intra-articular corticosteroids while seven other joints received physiological saline solution injections. Following corticosteroid injection, 86% of the patients reported a reduction in pain of 70% or more at one month. Their results were still significant at 3 months (62%) and 6 months (58%).²⁹ Their findings were different from ours where we had a limited time of pain alleviation following intra-articular steroid injection. On the other hand, another study found that only 26 of the 150 patients (17.3%) who got intra-articular injections of local anesthetic and triamcinolone acetate after receiving a positive response to dual sacroiliac diagnostic block injection achieved considerable pain relief for at least six weeks.³⁰ Another double-blind study on 24 patients, where 13 patients were injected with intra-articular methylprednisolone and lidocaine while 11 patients were injected with sodium chloride, showed that the patients in the steroid group exhibited substantial pain relief after one month compared to the placebo group.³¹ For short term pain relief, peri-articular injection with steroids demonstrated substantial improvements in pain alleviation and function, according to a systematic review of randomized controlled trials with follow up period of three months.³²

In our study group B where patients had conventional radiofrequency denervation of the dorsal rami of L4 and L5 as well as the lateral branches of S1-S3 at 80°C for 90 seconds, 60% of the patients were satisfied with the pain relief achieved after three months following treatment. Variable outcomes have been reported in the literature following radiofrequency for SIJ dysfunction. A retrospective study of lateral branch denervation on 33 patients (50 SIJs) using multiple 90°C lesions for 90 seconds at interval 1 cm but only on the posteroinferior ligament, reported more than 50% improvement of pain in only 36% of the patients at 6 months.³³ On the other hand, another retrospective study examined 18 individuals who reported more than 50% pain relief after diagnostic block injection, 9 of the patients received L4 L5 dorsal rami and S1-S3 lateral branch denervation with lesions at 80°C for 90 seconds, with 8 out of 9 patients (88.8%) reporting more than 50% pain relief after 9 months.³⁴ Another retrospective study including 14 patients having SIJ pain with more than 70% pain relief following two separate sacroiliac joint deep interosseous ligament injections, who underwent L5 dorsal ramus and S1-3 lateral branch radiofrequency denervation with lesioning at 80°C for 60 seconds, reported that around 64% of the patients reported more than 50% pain relief after 6 months, with 36% of the patients experiencing complete pain alleviation.³⁵ Similarly, a large retrospective study of 77 patients who reported greater than 70% pain relief following intra-articular sacroiliac joint block injection and underwent L4 L5 dorsal rami and S1-S3 lateral branch denervation with lesions performed at 80°C for 90 seconds using a variety of techniques (conventional and cooled radiofrequency), showed that 52% of the patients reported greater than 50% pain relief at 6 months.³⁶

Numerous other studies have shown a preference for radiofrequency methods over alternative therapies.³⁷⁻⁴¹

Comparison between clinical outcomes in both our study groups showed that radiofrequency denervation of L4 L5 dorsal rami and S1-S3 lateral branch has achieved more prolonged pain relief than traditional intra-articular corticosteroid injection with more patients' satisfaction at 3 months post-intervention.

CONCLUSION

Radiofrequency denervation of the L4 L5 dorsal rami and S1-S3 lateral branch provided significantly more prolonged pain relief and improved function than intra-articular methylprednisolone injection. Yet our study's small sample size and short duration of follow-up posed significant limitations.

List of abbreviations

ANOVA: Analysis Of Variance.
 FABER: Flexion ABduction External Rotation.
 GPE: Global Perceived Effect.
 IRB: Institutional review board.
 LBP: Low back pain.
 MRI: Magnetic resonance imaging.
 NRS: Numeric Rating Scale.
 ODI: Oswestry Disability Index.
 RF: Radiofrequency.
 SIJ: Sacroiliac joint.
 SPSS: Statistical package for social sciences.

Disclosure

The authors report no conflict of interest in the materials or methods used in this study or the findings specified in this paper.

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