European Review for Medical and Pharmacological Sciences 2023; 27: 10539-10546

Under what conditions is the intra-articular steroid injection superior to nonsteroidal anti-inflammatory drugs for treating sacroiliac joint pain?

H.S. CINE[1], E. UYSAL[2], M. DEMIRKOL[1], E. CETIN[3]

[1]Department of Neurosurgery, Istanbul Medeniyet University, Prof. Dr. Suleyman Yalcin City Hospital, Istanbul, Turkey
[2]Department of Neurosurgery, University of Health Sciences Turkey, Prof. Dr. Cemil Tascioglu City Hospital, Istanbul, Turkey
[3]Department of Neurosurgery, University of Health Sciences, Haydarpasa Numune Training and Research Hospital, Istanbul, Turkey

Abstract. – OBJECTIVE: The purpose of this prospective study was to determine the conditions under which intra-articular injection therapy may be superior to nonsteroidal anti-inflammatory drugs (NSAIDs) in patients with sacroiliac joint pain in the outpatient setting at our hospital.

PATIENTS AND METHODS: Patients with sacroiliac pain were divided into two groups: NSAID and the sacroiliac injection group. The NSAID group received 25 mg of indometacin orally once a day and 750 mg of naproxen orally once a day. In the sacroiliac injection group, 5 mg of betamethasone were injected into the sacroiliac joint. The patients' history of lumbar surgery, whether they had sacroiliitis, and the duration of pain were recorded. The patients' VAS (Visual analogue scale) scores at week 1 and month 1 were evaluated.

RESULTS: VAS scores were decreased after the first week and first month in the sacroiliac injection group compared to the NSAID group ($p<0.001$). Sacroiliac steroid injection was found to be superior to NSAIDs in reducing VAS scores in patients with sacroiliitis, a history of lumbar surgery, and pain lasting more than 30 days ($p<0.001$). In patients without sacroiliitis, without a history of lumbar surgery, and with less than 30 days of pain, no difference was observed between the groups in reducing VAS scores at the end of the first month.

CONCLUSIONS: In patients with sacroiliac joint pain, sacroiliac joint injection is superior to NSAIDs in pain relief in patients with pain for more than 30 days, those with MRI-diagnosed sacroiliitis, and those who have undergone lumbar surgery.

Key Words:
Sacroiliac joint, Pain, Visual analogue scale, Intraarticular injection, Nonsteroidal anti-inflammatory drugs.

Introduction

One of the most significant contributors to axial low back pain is the sacroiliac joint, which supports the entire spinal load[1]. The incidence of pain localized to the sacroiliac joint rises with age[2]. Tenderness in the sacroiliac joint has been documented[3] in 15-30% of outpatient cases of low back pain. Several factors may cause sacroiliac joint pain, such as infection, arthritis, spondyloarthropathies, malignancies, past surgeries, and trauma[4]. Since pain radiating to the leg may also be present in patients with a very similar character with lumbar disc hernia, it is important to distinguish it for proper treatment. Otherwise, patients may undergo unnecessary surgery for lumbar discs, and their pain may not disappear[5]. Patients experience pain that is particularly aggravated by movement of the sacroiliac joint and indicates a specific location upon palpation. It is a type of pain that stems from one or both sacroiliac joints and frequently radiates to the inguinal region. The pain constrains patients' daily routines and lowers their quality of life.

The diagnosis is typically apparent from the patient's medical history. A specific event from the past, like a previous injury or a recent change to a sedentary lifestyle, should raise the patient's suspicion. To diagnose sacroiliac joint damage, medical professionals can perform provocation tests such as the Gaenslen test, Patrick test, Yeoman test, side-lying iliac compression test, midline sacral push test, and applying pressure to the sacral sulcus in the prone position[6]. Immobility poses a significant threat to the sacroiliac joint;

Corresponding Author: Ece Uysal, MD; e-mail: ece.uysal1@saglik.gov.tr

therefore, long-term bed rest is not recommended, even in the presence of pain. Localized cold therapy may effectively alleviate discomfort. Non-steroidal anti-inflammatory drugs (NSAIDs) (such as indometacin and naproxen) can be utilized for persistent pain[7]. Moreover, steroids, which have recently been administered topically, are efficient in promptly reducing inflammation and relieving pain in patients[8]. The purpose of this prospective study was to determine the conditions under which intra-articular injection therapy may be superior to nonsteroidal drugs in patients with sacroiliac joint pain in the outpatient setting at our hospital.

Patients and Methods

A total of 60 patients who applied to our clinic between 2020 and 2022 with sacroiliac pain were included in this research. All procedures followed were in accordance with the Helsinki Declaration of 1975, as revised in 2008. Ethics approval was taken from Istanbul Medeniyet University Ethical Committee (approval No.: 509/2023).

Patients with localized sacroiliac pain were included in the study. Lumbar magnetic resonance imaging (MRI) and sacroiliac MRI were initially conducted on all patients. Patients with extruded disc herniation in the lumbar MRI and those with uncorrected spondylolisthesis were excluded from participation in this study. On the other hand, patients experiencing radicular pain, neurological deficits, immunosuppression, osteoporosis, prior sacral surgery, negative effects from NSAIDs or steroids, previous gastric surgery or gastric ulcer, gastritis, and patients with cancer were excluded from participation in this study. The patients were divided into two groups: the group administered with NSAIDs and the sacroiliac injection group. The NSAID group received 25 mg of indometacin orally once a day and 750 mg of naproxen orally once a day. In the sacroiliac injection group, 5 mg of betamethasone were injected into the sacroiliac joint under the guidance of fluoroscopy or ultrasound. Those who experienced stomach discomfort during the follow-up were unable to take medication, or expressed a desire to leave the study were excluded from our investigation.

Patients' pain durations were evaluated to distinguish between acute and chronic processes, with durations of less than 30 days and more than 30 days, respectively. Those who were identified to have sacroiliitis through sacroiliac MRI were noted. Furthermore, those who had undergone previous surgery in the lumbar region were also documented. The study followed patients for a duration of 1 month, assessing their pre-procedure VAS scores, 1-week VAS scores, and 1-month VAS scores and comparing them among the groups.

Study Groups

- Group 1: NSAID (n=30): 25 mg of indometacin + 750 mg of naproxen orally.
- Group 2: Sacroiliac injection (n=30): 5 mg of betamethasone intraarticulary.

Sacroiliac Injection Procedure

The patient was placed in a prone position under local anesthesia. The sacroiliac joint was detected under fluoroscopy or ultrosound. After cleaning the area to be injected, sterilization procedures were followed, and a total of 5 mg betamethasone injection was administered if no blood flow was detected by entering the intraarticular area.

Statistical Analysis

Data were analyzed using the Statistics Package for Social Science (SPSS 23.0, IBM Corp., Armonk, NY, USA). Characteristics of patients, as n (percent) or mean±standard deviation (SD) for categorical and continuous variables, were compared among treatment groups using Chi-square or Mann-Whitney U and Kruskal-Wallis H tests. The Wilcoxon signed-rank test was used to compare the median of two dependent groups. The *p*-value was set at <0.001 for statistical significance.

Results

A total of 60 patients participated in our study, divided equally between two groups: one group received NSAIDs, and the other group received sacroiliac injection. The ages of the patients ranged from 51 to 70, with a mean age of 60.9. Notably, there was no significant age difference observed between the groups (p=0.678). A total of 32 (53.4%) patients were women and 28 (46.6%) were men. Interestingly, no significant difference in gender was observed between the two groups (p=1.000). While 25 patients (41.7%) experienced pain for fewer than 30 days, 35 patients (58.3%) experienced pain for more than 30 days. MRI diagnosis showed sacroiliitis in 24 patients (40%). Additionally, 24 patients (40%) had a history of lumbar surgery. The patients' pre-treatment VAS scores ranged from 3 to 8, with no si-

Table I. Comparison of demographic characteristics in patients who developed SAIH and patients who did not.

		Total (n=60)	NSAID (Indometacin + Naproxen) (n=30)	Sacroiliac Injection (Betamethasone) (n=30)	
		n (%)/M±SD [min-max]	n (%)/M±SD [min-max]	n (%)/M±SD [min-max]	p
Gender	Female	32 (53.4%)	16 (26.7%)	16 (26.7%)	1.000
	Male	28 (46.6%)	14 (23.3%)	14 (23.3%)	
Age		60.9 [51-70]	59.9 [41-71]	60.5 [43-74]	0.678
Duration of pain	<30 days	25 (41.7%)	12 (20%)	13 (21.7%)	0.143
	>30 days	35 (58.3%)	18 (30.0%)	17 (28.3%)	
Sacroiliitis on MRI	Yes	24 (40%)	12 (20%)	12 (20%)	0.007
	No	36 (60%)	18 (30%)	18 (30%)	
Lumbar surgery	Yes	24 (40%)	14 (23.3%)	10 (16.7%)	0.022
	No	36 (60%)	16 (26.7%)	20 (33.3%)	
First VAS		6.88±0.92 [3-8]	7.07±0.82 [5-8]	6.70±0.98 [3-8]	0.131
1-week VAS		4.33±1.68 [1-8]	5.60±0.96 [4-7]	3.07±1.23 [1-8]	<0.001
1-month VAS		2.97±1.62 [1-6]	4.0±1.44 [1-6]	1.93±1.01 [1-5]	<0.001

VAS: Visual Analogue Scale, NSAID: Nonsteroidal anti-inflammatory drug, MRI: Magnetic resonance Imagining.

gnificant differences observed among the groups (p=0.131). A notable reduction in VAS scores during the first week was observed in the sacroiliac injection group (3.07±1.23) compared to the NSAID group (5.60±0.96; p<0.001). Similarly, a significant decrease in VAS scores during the first month was observed in the sacroiliac injection group (1.93±1.01) compared to the NSAID group (4.0±1.44; p<0.001) (Table I).

The patients were evaluated in terms of previous lumbar surgery, no significant difference was observed between the pre-treatment VAS scores of the patients (p=0.674, p=0.213). When the VAS scores at week 1 were examined, a significant decrease in VAS scores was observed in both the lumbar surgery group and the group without lumbar surgery in those who received sacroiliac injection (p<0.001). When looking at the VAS scores at the end of the first month, sacroiliac injection caused a significant decrease in those who underwent lumbar surgery (p<0.001), while no statistical difference was observed between the NSAID group and the sacroiliac injection group in those who did not undergo lumbar surgery (p=0.003) (Table II, Figure 1).

When patients were categorized based on the identification of sacroiliitis on MRI findings, no statistically significant difference was observed in their pretreatment VAS scores (p=0.070, p=0.653). When analyzing the VAS scores at week 1, both the sacroiliac injection group and the no sacroiliitis group showed a significant decrease in VAS scores compared to the NSAID group (p<0.001). Based on the VAS scores obtained at one month, sacroiliac injection resulted in a statistically significant reduction in individuals with sacroiliitis (p<0.001). However, no significant difference was observed between the NSAID group and the sacroiliac injection group in individuals without sacroiliitis (p=0.002) (Table III, Figure 2).

Patients were grouped according to the duration of their pain. There was no statistically significant difference in pre-treatment VAS scores between patients with more than 30 days of pain and those with less than 30 days of pain (p=0.785, p=0.028). When the VAS scores at week 1 were examined, a significant decrease was observed in both the sacroiliac injection group for those with pain for less than 30 days and those with pain for more than 30 days (p<0.001). According to the VAS scores obtained in the first month, there is no significant difference between the sacroiliac injection group and the NSAID group in those with pain for less than 30 days (p=0.003). However, a significant decrease in VAS scores compared to the NSAID group was observed when the sacroiliac injection was performed in patients with pain for more than 30 days (p<0.001) (Table IV).

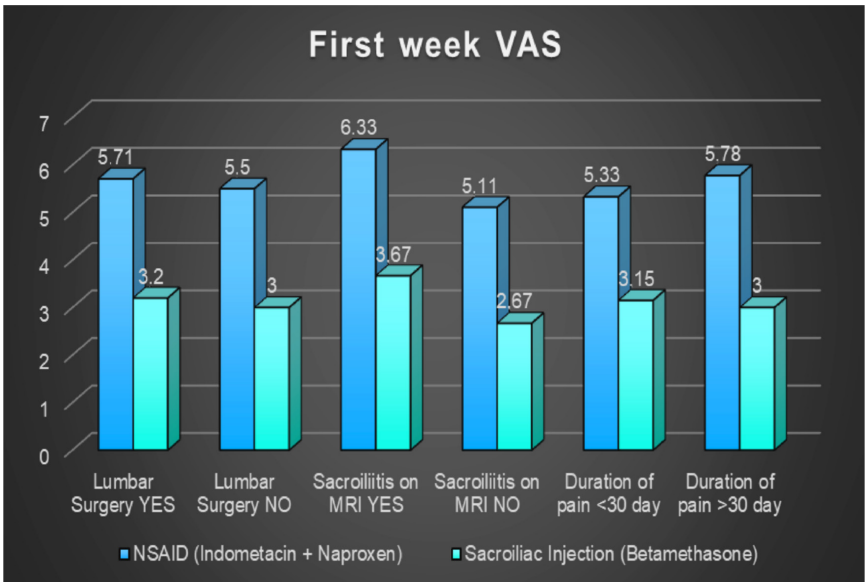

Figure 1. VAS scores at the first week after treatment are shown according to whether or not lumbar surgery was performed, whether there was sacroiliitis, and the duration of pain. VAS: Visual Analogue Scale, NSAID: Nonsteroidal anti-inflammatory drug, MRI: Magnetic resonance Imagining.

Discussion

Sacroiliac joint pain is a clinical condition that greatly impacts the quality of life for those affected, necessitating appropriate medical interventions. The occurrence of sacroiliac pain, especially among individuals in desk-based occupations, could impede the return-to-work process and potentially lower workforce efficiency[9]. There is a need for a comprehensive therapy approach that is tailored to specific parameters and has been proven effective.

The diagnosis of a patient's sacroiliac joint pain should be based solely on physical examination and provocative testing. Although MRI of the sacroiliac joint is sometimes found in patients with sacroiliitis, it may not be detected by MRI because chronic sacroiliitis is not the only cause of sacroiliac joint pain. For this reason, the Spine Intervention Association[10] has emphasized that it is not important to use MRI to perform an intervention. We did not use MRI to diagnose sacroiliac disease, but rather provocative testing and physical examination. Only 40% of patients with sacroiliac pain had MRI evidence of sacroiliitis, in our study. In patients with sacroiliitis, sacroiliac joint steroid injection was found to significantly reduce pain from the 1st week, but when the 1st-month results were examined in patients without sacroiliitis, no difference in pain reduction with

Table II. Comparison of treatment results according to whether patients had lumbar surgery or not.

	Lumbar Surgery Yes (n=24)			Lumbar Surgery No (n=36)		
	NSAID (Indometacin + Naproxen)	Sacroiliac Injection (Betamethasone)		NSAID (Indometacin + Naproxen)	Sacroiliac Injection (Betamethasone)	
	Mean±SD	Mean±SD	*p*	Mean±SD	Mean±SD	*p*
First VAS	7.21±0.70	7.10±0.57	0.674	6.94±0.93	6.50±1.10	0.213
1-week VAS	5.71±0.99	3.20±0.63	<0.001	5.50±0.97	3.00±1.45	<0.001
1-month VAS	4.50±0.94	2.20±1.22	<0.001	3.56±1.67	1.80±0.89	0.003

VAS: Visual Analogue Scale, NSAID: Nonsteroidal anti-inflammatory drug, MRI: Magnetic resonance Imagining.

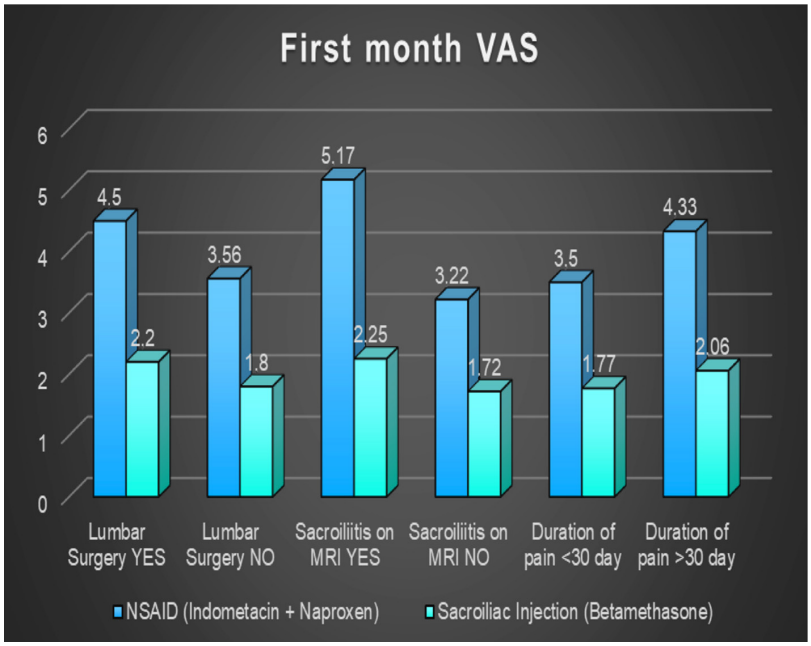

Figure 2. VAS scores at the first month after treatment are shown according to whether or not lumbar surgery was performed, whether there was sacroiliitis, and the duration of pain. VAS: Visual Analogue Scale, NSAID: Nonsteroidal anti-inflammatory drug, MRI: Magnetic resonance Imagining.

NSAIDs was observed. Similarly, in patients who had undergone lumbar surgery, sacroiliac joint steroid injection was found to significantly reduce pain starting at week 1, but in patients who had not undergone lumbar surgery, no difference in pain reduction with NSAIDs was observed when looking at the results at 1st month.

Studies conducted in patients with sacroiliitis have also shown[11,12] that steroid injection therapy is effective in relieving pain in a shorter period of time compared to oral therapy. In addition, mid-term results in patients with sacroiliitis have shown[13] that steroid injection into the sacroiliac joint results in a decrease in bone edema on the patients' MRI scans.

One significant factor in pain of the sacroiliac joint is elevated levels of cytokines that result from an inflammatory reaction[14]. The inflammatory condition may stem from traumatic incidents, iatrogenic factors after surgical procedures[15], or spondyloarthropathies[16], such as ankylosing spondylitis[17]. The main goal of the therapeutic intervention is to decrease inflammation and prevent the production of cytokines[18]. To achieve this, nonsteroidal anti-inflammatory drugs (NSAIDs) with strong anti-inflammatory properties can be used

Table III. Comparison of the pain of patients with and without sacroiliitis according to treatment results.

	Sacroiliitis on MRI Yes (n=24)			Sacroiliitis on MRI No (n=36)		
	NSAID (Indometacin + Naproxen)	Sacroiliac Injection (Betamethasone)		NSAID (Indometacin + Naproxen)	Sacroiliac Injection (Betamethasone)	
	Mean±SD	Mean±SD	*p*	Mean±SD	Mean±SD	*p*
First VAS	7.67±0.492	6.92±0.07	0.070	6.67±0.76	6.56±0.70	0.653
1-week VAS	6.33±3.67	3.67±1.50	<0.001	5.11±0.83	2.67±0.84	<0.001
1-month VAS	5.17±2.25	2.25±1.22	<0.001	3.22±1.31	1.72±0.83	0.002

VAS: Visual Analogue Scale, NSAID: Nonsteroidal anti-inflammatory drug, MRI: Magnetic resonance Imagining.

Table IV. Comparison of the pain of patients with and without sacroiliitis according to treatment results.

	Duration of pain <30 days (n=25)			Duration of pain >30 days (n=35)		
	NSAID (Indometacin + Naproxen)	Sacroiliac Injection (Betamethasone)		NSAID (Indometacin + Naproxen)	Sacroiliac Injection (Betamethasone)	
	Mean±SD	Mean±SD	p	Mean±SD	Mean±SD	p
First VAS	6.58±0.90	6.46±1.27	0.785	7.39±0.60	6.88±0.69	0.028
1-week VAS	5.33±1.07	3.15±1.72	<0.001	5.78±0.88	3.00±0.70	<0.001
1-month VAS	3.50±1.56	1.77±1.01	0.003	4.33±1.28	2.06±1.03	<0.001

VAS: Visual Analogue Scale, NSAID: Nonsteroidal anti-inflammatory drug, MRI: Magnetic resonance Imagining.

orally. Corticosteroids, on the other hand, work by antagonizing the immune response. However, the effects of this substance in the short term are limited to its anti-inflammatory activity. Over an extended period, these facilitate the upregulation of anti-inflammatory genes while downregulating pro-inflammatory genes, such as cytokines[18].

Conservative treatments such as multimodal medical pain management with NSAIDs, corticosteroid or local anesthetic injections[19,20], and radiofrequency ablation may be used to treat sacroiliac joint pain[14]. In rare cases where there is no response to these treatments, minimally invasive sacroiliac joint arthrodesis may be performed[21]. Among these treatment methods, we compared the post-procedure pain of patients who received the NSAID combination of indometacin and naproxen orally with the group receiving glucocorticoid (betamethasone) injection, an invasive method[22,23]. In our study, the efficacy rate of steroid injection was found to be superior to NSAIDs for sacroiliac pain control. Young et al[24] claimed that radiofrequency ablation therapy for sacroiliac joint pain provides longer-term pain control than intra-articular steroid injection therapy. However, it should be noted that the statistical significance of this finding is limited due to the relatively small sample size of patients who underwent radiofrequency ablation in their study[24].

There have also been studies in literature on where to inject for sacroiliac joint pain. Intra-articular injection methods have been found[25] to be more effective than those applied to the periarticular region. In our study, we administered intra-articular steroid injection to the patients. Controversially, Nacey et al[26] suggested that the utilization of mixed periarticular and intraarticular steroid injections achieves superior results[26]. Intra-articular steroid treatment alone may be sufficient to achieve the desired results, as we have shown in our study. In the study by Kokar et al[27], triamcilone injection was performed and it was found to be effective for pain relief from the 1st week compared to non-invasive treatments. They found that oral treatment provided equivalent pain control compared to injecting only at the end of the 6th month[27]. In our study, intra-articular injection of betamethasone was found to be superior to oral medical therapy from the 1st week.

Imaging techniques may be used during injection. This can be done by injecting into the sacroiliac joint using CT, ultrasound, or fluoroscopy[28]. Although it can be performed more easily by palpation or blindly than other injection methods, it has been shown[29] to be more effective when performed with imaging modalities to prevent potential side effects and ensure complete blockade of the joint. In our study, although we performed a sacroiliac injection with fluoroscopy and ultrasound, there is still no consensus on whether imaging is necessary to reduce pain in experienced hands[30].

Steroid treatments are avoided because of side effects such as Cushing's syndrome, weight gain, fluid retention, and immunosuppression[18]. However, because intra-articular steroid injections use low doses, long-term oral NSAIDs are more reliable methods compared to medical treatments. Sacroiliac injection is one of the injection methods with the fewest side effects in patients with low back pain[31]. In our study, we did not observe any side effects in any of the patients who received intra-articular betamethasone.

In our study, we also performed sacroiliac injections in cases of sacroiliac joint pain lasting less than 30 days. We observed a significant difference between the NSAID group and the non-NSAID group in the results of the first week in

those with pain less than 30 days, but no difference was observed at the end of the first month. Therefore, treatment recommendations can be made for patients who have had pain for less than 30 days, taking into account the advantages and disadvantages.

Limitations

This study has certain limitations. Although our data provide strong statistical results, comparison with larger numbers of patients is required. Comparisons can also be made with intraarticular injectable agents.

Conclusions

In patients with sacroiliac joint pain, sacroiliac joint injection is superior to NSAIDs for pain relief in those with pain for more than 30 days, those with MRI-diagnosed sacroiliitis, and those who have undergone lumbar surgery. While sacroiliac joint injection provides rapid pain relief in the early period for those with pain for less than 30 days, those without sacroiliitis, and those who have not undergone lumbar surgery, no difference was observed between it and NSAIDs in the medium and long-term.

Conflict of Interest

The authors declare that they have no conflict of interests.

Funding

None.

Informed Consent

Written informed consent was obtained from patients.

Ethics Approval

All procedures followed were in accordance with the Helsinki Declaration of 1975, as revised in 2008. Ethics approval was taken from Istanbul Medeniyet University (ethics approval No.: 509/2023).

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Authors' Contributions

Research concept and design: HSC, EU, EC.
Data analysis and interpretation: HSC, EU, EC, MD.
Collection and/or assembly of data: HSC, EU, EC.
Writing the article: HSC, EU, EC, MD.
Critical revision of the article: HSC, EU, EC.
Final approval of the article: HSC, EU, EC, MD.

ORCID ID

Hidayet Safak Cine: 0000-0002-0808-5921.
Ece Uysal: 0000-0002-2355-8395.
Mahmut Demirkol: 0009-0009-4286-6690.
Eyup Cetin: 0000-0002-2045-6721.

References

1) Forst SL, Wheeler MT, Fortin JD, Vilensky JA. The sacroiliac joint: anatomy, physiology and clinical significance. Pain Physician 2006; 9: 61-67.
2) DePalma MJ, Ketchum JM, Saullo TR. Multivariable analyses of the relationships between age, gender, and body mass index and the source of chronic low back pain. Pain Med 2012; 13: 498-506.
3) Cohen SP, Chen Y, Neufeld NJ. Sacroiliac joint pain: a comprehensive review of epidemiology, diagnosis and treatment. Expert Rev Neurother 2013; 13: 99-116.
4) Abdollahi S, Sheikhhoseini R, Rahimi M, Huddleston WE. The sacroiliac dysfunction and pain is associated with history of lower extremity sport related injuries. BMC Sports Sci Med Rehabil 2023; 15: 36.
5) DePalma MJ, Ketchum JM, Saullo TR, Laplante BL. Is the history of a surgical discectomy related to the source of chronic low back pain? Pain Physician 2012; 15: 53-58.
6) Lyu Z, Bai J, Zhang J, Hong Y, Liu J, Yu W. Novel Physical Examination Tests for the Diagnosis of Chronic Sacroiliac Joint Dysfunction and Differentiate It From Lumbar Disc Herniation. Pain Physician 2023; 26: 289-298.
7) Han CS, Hancock MJ, Sharma S, Sharma S, Harris IA, Cohen SP, Magnussen J, Maher CG, Traeger AC. Low back pain of disc, sacroiliac joint, or facet joint origin: a diagnostic accuracy systematic review. EClinicalMedicine 2023; 59: 101960.
8) Kennedy DJ, Engel A, Kreiner DS, Nampiaparampil D, Duszynski B, MacVicar J. Fluoroscopically Guided Diagnostic and Therapeutic Intra-Articular Sacroiliac Joint Injections: A Systematic Review. Pain Med 2015; 16: 1500-1518.
9) Medani K, Bvute K, Narayan N, Reis C, Sharip A. Treatment outcomes of peri-articular steroid injection for patients with work-related sacroiliac joint pain and lumbar para-spinal muscle strain. Int J Occup Med Environ Health 2021; 34: 111-120.

10) MacVicar J, Kreiner DS, Duszynski B, Kennedy DJ. Appropriate Use Criteria for Fluoroscopically Guided Diagnostic and Therapeutic Sacroiliac Interventions: Results from the Spine Intervention Society Convened Multispecialty Collaborative. Pain Med 2017; 18: 2081-2095.

11) Rajaei E, Bavieh K, Mowla K, Ghorbani A, Movaffagh N. The impact of intra-sacroiliac joint methylprednisolone injection in the recovery of patients with spondyloarthropathy: a randomized controlled trial. Reumatologia 2022; 60: 332-339.

12) Al Khayyat SG, Fogliame G, Barbagli S, Conticini E, Fabbroni M, D'Alessandro R, Vitale A, Gentileschi S, Bardelli M, Baldi C, Stella SM, Saponara A, Del Chiaro A, Falsetti P, Cantarini L, Frediani B. Ultrasound guided corticosteroids sacroiliac joint injections (SIJIs) in the management of active sacroiliitis: a real-life prospective experience. J Ultrasound 2023; 26: 479-486.

13) Ramírez Huaranga MA, Castro Corredor D, Plasencia Ezaine AE, Paulino Huertas M, Arenal Lopez R, Fernández JA, Ramos Rodríguez CC. First Spanish study on the effectiveness of ultrasound-guided sacroiliac joint injection in patients with spondyloarthritis. Rheumatol Adv Pract 2022; 6: rkac036.

14) Aranke M, McCrudy G, Rooney K, Patel K, Lee CA, Hasoon J, Kaye AD. Minimally Invasive and Conservative Interventions for the Treatment of Sacroiliac Joint Pain: A Review of Recent Literature. Orthop Rev (Pavia) 2022; 14: 31915.

15) Daneri-Allis GM, Violante-Mejía J, Villa-Benites A, Anaya-Prado R, Zepeda-Ochoa JD. Assisted dorso-lumbar instrumentation with O-arm neuronavegation and minimally invasive surgery: clinical-surgical outcome. Cir Cir 2021; 89: 595-602.

16) Giuffrida A, Di Bari A, Falzone E, Iacono F, Kon E, Marcacci M, Gatti R, Di Matteo B. Conservative vs surgical approach for degenerative meniscal injuries: a systematic review of clinical evidence. Eur Rev Med Pharmacol Sci 2020; 24: 2874-2885.

17) Karabacakoglu A, Karaköse S, Ozerbil OM, Odev K. Fluoroscopy-guided intraarticular corticosteroid injection into the sacroiliac joints in patients with ankylosing spondylitis. Acta Radiol 2002; 43: 425-427.

18) Schilling LS, Markman JD. Corticosteroids for Pain of Spinal Origin: Epidural and Intraarticular Administration. Rheum Dis Clin North Am 2016; 42: 137-ix.

19) Ab Aziz SNF, Zakaria Mohamad Z, Karupiah RK, Che Ahmad A, Omar AS. Efficacy of Sacroiliac Joint Injection With Anesthetic and Corticosteroid: A Prospective Observational Study. Cureus 2022; 14: e24039.

20) Osorio W, Ceballos C, Moyano J. Effectiveness of acute post-operative pain management by the acute pain service. Cir Cir 2022; 90: 197-201.

21) Kasapovic A, Ali T, Jaenisch M, Rommelspacher Y, Gathen M, Pflugmacher R, Schwetje D. Minimal-invasive Arthrodese des Iliosakralgelenks (ISG) [Minimally invasive arthrodesis of the sacroiliac joint (SIJ)]. Oper Orthop Traumatol 2022; 34: 98-108.

22) Manchikanti L, Cash KA, McManus CD, Pampati V, Benyamin R. Fluoroscopic lumbar interlaminar epidural injections in managing chronic lumbar axial or discogenic pain. J Pain Res 2012; 5: 301-311.

23) Anzillotti G, Conte P, Di Matteo B, Bertolino EM, Marcacci M, Kon E. Injection of biologic agents for treating severe knee osteoarthritis: is there a chance for a good outcome? A systematic review of clinical evidence Eur Rev Med Pharmacol Sci 2022; 26: 5447-5459.

24) Young AC, Deng H, Opalacz A, Roth S, Filatava EJ, Fisher CA, de Sousa K, Mogren G, Chen L. A Retrospective Analysis of Sacroiliac Joint Pain Interventions: Intraarticular Steroid Injection and Lateral Branch Radiofrequency Neurotomy. Pain Physician 2022; 25: E341-E347.

25) Althoff CE, Bollow M, Feist E, Marticorena-Garcia SR, Eshed I, Diekhoff T, Hamm B, Hermann KG. CT-guided corticosteroid injection of the sacroiliac joints: quality assurance and standardized prospective evaluation of long-term effectiveness over six months. Clin Rheumatol 2015; 34: 1079-1084.

26) Nacey NC, Patrie JT, Fox MG. Fluoroscopically Guided Sacroiliac Joint Injections: Comparison of the Effects of Intraarticular and Periarticular Injections on Immediate and Short-Term Pain Relief. AJR Am J Roentgenol 2016; 207: 1055-1061.

27) Kokar S, Kayhan Ö, Şencan S, Gündüz OH. The Role of Sacroiliac Joint Steroid Injections in the Treatment of Axial Spondyloarthritis. Arch Rheumatol 2021; 36: 80-88.

28) Bessar AAA, Arnaout MM, Basha MAA, Shaker SE, Elsayed AE, Bessar MA. Computed tomography versus fluoroscopic guided-sacroiliac joint injection: a prospective comparative study. Insights Imaging 2021; 12: 38.

29) Fouad AZ, Ayad AE, Tawfik KAW, Mohamed EA, Mansour MA. The Success Rate of Ultrasound-Guided Sacroiliac Joint Steroid Injections in Sacroiliitis: Are We Getting Better? Pain Pract 2021; 21: 404-410.

30) Bresnahan JJ, Ng AT. Review of Sacroiliac Joint Injection Techniques. Curr Pain Headache Rep 2022; 26: 385-390.

31) Voelker A, Pirlich M, Heyde CE. Complications of injections in conservative treatment of degenerative spine disease: a prospective unicentric study. BMC Musculoskelet Disord 2022; 23: 1002.