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CURRENT CONCEPTS IN THE DIAGNOSIS AND MANAGEMENT OF SACROILIAC JOINT PAIN: A SYSTEMATIC REVIEW

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ABSTRACT

Background: Sacroiliac joint (SIJ) pain is an underrecognized cause of chronic low back pain. Diagnostic uncertainty and variable treatment durability complicate management as interventional options expand. This systematic review aims to synthesize contemporary evidence on diagnostic approaches and interventional management of SIJ pain, focusing on clinical outcomes and durability.

Methodology: A PRISMA 2020–compliant systematic review was conducted. PubMed/MEDLINE, Embase, Scopus, Web of Science, and the Cochrane Library were searched for studies published between January 2010 and December 2025. Randomized controlled trials, prospective cohorts, and comparative observational studies evaluating radiofrequency ablation (RFA), minimally invasive SIJ fusion, or image-guided intra-articular injections in adults were included. Primary outcomes were pain (VAS/NRS) and disability (ODI). Risk of bias was assessed using NIH tools, and findings were narratively synthesized.

Results: Of 144 records, 14 studies were included (n=26–351; follow-up 3 months–5 years). RFA provided consistent short- to intermediate-term pain relief with durability up to 12 months. Injection therapies yielded reliable short-term benefit, though long-term effects were inconsistent and technique-dependent. Minimally invasive SIJ fusion demonstrated the largest and most sustained improvements in pain and function in randomized and prospective studies.

Conclusion: A stepwise strategy is supported: image-guided injections for diagnosis and short-term relief, RFA for intermediate benefit, and fusion for durable improvement in carefully selected patients.

KEYWORDS: sacroiliac joint pain, radiofrequency ablation, minimally invasive sacroiliac fusion, intra-articular injection, interventional pain management

1. INTRODUCTION

Sacroiliac joint (SIJ) pain is a relevant and little recognized cause of axial low back pain that adds significantly to the people who are often termed as having nonspecific lumbar pain [1]. The sacroiliac joint, which is the contact point between the spine and the pelvis, helps transfer force between the axial skeleton and the lower limbs, as well as allowing the minimal motion necessary to adjust to the load [2]. SIJ pathology may cause localized posterior pelvic pain that will be referred to the buttock, groin or thigh and thus confuse clinical diagnosis with lumbar spine or hip disorders [3]. The SIJ pain diagnostic and treatment strategy has significantly changed during the last ten years. Recent clinical guidelines focus on systematic examination that involves history, physical examination, related imaging, where suitable and confirmatory diagnostic injections [4]. Rehabilitation-wise, proper identification of SIJ-induced pain is essential since the treatment interventions offered vary greatly when compared with the ones applied in primary lumbar discogenic or radicular pain [5]. The lack of identification of SIJ participation can cause a long period of symptoms, spinal interventions that are not necessary, and disability.

It is important to comprehend the biomechanics and anatomical complexity of the SIJ in order to value its importance as a source of pain. The joint has got both synovial and syndesmotic structures, which are supported by robust anterior and posterior ligamentous structures that provide stability but permit minimal but still significant movements [6]. Minor changes in load distribution, that is, as a result of trauma, degenerative alterations, pregnancy-induced laxity, or postoperative biomechanical alterations, may disrupt joint stability and trigger nociceptive messages [7]. The pathophysiologic processes could include capsular strain, ligamentous tension, inflammatory mediators, or changes in muscular patterns of control around the pelvis [8]. The diagnosis of SIJ pain is a problem, even with the rise in awareness. No single pathologic clinical examination can be distinguished, and radiographic evidence is frequently indistinct in mechanical SIJ dysfunction [9]. In order to enhance the accuracy of the diagnosis, provocation test clusters, which include

distraction, compression, thigh thrust, Gaenslen, and sacral thrust maneuvers are usually used when a series of tests overlap concordant pain [10]. The predictive value of individual tests is, however, not constant, and inter-examiner reliability is still an issue. There is some evidence that a combination of multiple positive maneuvers is more likely to result in actual SIJ involvement than when a single test is used [11].

Epidemiological research has shown that SIJ dysfunction is a significant percentage in chronic cases of low back pain experienced in clinical practice [12]. In family medicine and primary care, it is necessary to have clear diagnostic pathways that identify SIJ pain or lumbar radiculopathy, hip pathology or other causes of pain in the pelvis [13]. Image-guided intra-articular injections of medications are often regarded as a reference standard to confirm SIJ-mediated pain, especially when other conservative treatments are used and/or invasive treatment is in consideration [14]. Proper placement of the needles and correct interpretation of the pain relief levels are important in reducing false-positive effects and correct patient selection. The complexity of the SIJ region is further supported by anatomical studies. A thorough study of the joint surfaces, ligamentous structures and neighboring neural elements will reveal several possible sources of nociception other than the within the intra-articular space itself [15]. This complex anatomy makes this structure experience variability in its symptom presentation, and in part, this phenomenon is why simple structural imaging can often not directly correlate with the pattern of clinical pain.

SIJ pain management approaches range over a spectrum between conservative rehabilitation on one end to a minimally invasive surgical stabilization on the other. Nonoperative care normally involves physical therapy to stabilize the pelvis, core muscle strength, and change the activities. To deliver targeted analgesia among patients whose SIJ-mediated pain has been confirmed, interventional approaches including intra-articular corticosteroid injections, platelet-rich plasma injections, and lateral branch radiofrequency ablation, have been designed [4, 5]. These modalities can provide effective short- to middle-term relief, but the durability can differ depending on the population of patients. Minimally invasive SIJ fusion has become the option to use in patients with persistent symptoms that are not responding to the conservative and interventional measures. Modern methods of fusion focus on minimizing pathologic micromotion and stabilization using percutaneous implantation, and the available data prove that pain and functional outcomes improve when applied to the right people [7]. However, ideal selection criteria to use on patients, long-term durability, and comparative effectiveness to other less invasive methods are still on the research agenda.

With the diagnostic ambiguity, variability in treatment methods and increased variety of existing interventions, clinicians encounter a continuous uncertainty on the most reasonable practice of assessment and treatment of SIJ pain. The systematic review of the existing evidence is thus necessary to define the diagnostic criteria, to evaluate the efficacy of various interventions and the role of surgical stabilization in a multifaceted treatment plan.

In this regard, the current systematic review will summarize the current ideas in the diagnosis and treatment of sacroiliac joint pain. This study aims to present a revised, organized evidence-based guideline based on a critical analysis of clinical, diagnostic, and therapeutic evidence to facilitate evidence-based practice in patients with sacroiliac joint-mediated pain.

2. METHODS

2.1 Study Design

This study was conducted as a systematic literature review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. The review was designed to ensure methodological transparency, reproducibility, and structured reporting across all stages of evidence identification and synthesis. The objective was to consolidate contemporary clinical evidence published between January 2010 and December 2025 regarding diagnostic strategies and interventional management approaches for sacroiliac joint (SIJ) pain. The overall review process was structured using the PICO framework, which informed the development of the research question, eligibility criteria, search strategy, and data extraction procedure.

2.2 PICO Framework

The PICO model was used to formulate the area of the review and match the selection of the studies with the research objectives. The population of interest was included with the adult patient population that was diagnosed with sacroiliac joint pain as a result of the clinical examination, provocative maneuvering, diagnostic blocks, or imaging-guided criteria. Interventions reviewed were the lateral branch radiofrequency ablation, minimally invasive plateau joint fusion surgeries, and image-guided intra-articular injection therapies, corticosteroids or platelet-rich plasma. Comparators were sham procedures/standard medical management/non-surgical management strategies, and alternative injection/guidance techniques where involved. The main outcomes of interest were pain reduction (ordering on validated scales, i.e. Visual Analogue Scale (VAS) or Numeric Rating Scale (NRS)), functional improvement (Oswestry Disability Index (ODI)) and quality-of-life measures. In surgical trials, secondary outcomes were: responder rates, durability of symptom relief, complication profiles, and radiographic outcomes.

2.3 Eligibility Criteria

To eliminate bias and inconsistency, eligibility criteria were established before the selection of the study. Articles that met the inclusion criteria were those studies which measured the pain of adult patients in the sacroiliac joint, and in which the clinical outcome of diagnostic or treatment interventions was mentioned. The acceptable study designs consisted of randomized controlled trials, prospective cohort study and comparative observational studies that were published in peer-reviewed English-language journals.

Articles have been eliminated because they were systematic reviews, narrative reviews, case-report articles, editorial articles, technical notes without patient outcomes, biomechanical studies without clinical outcomes, or studies that

examined inflammatory spondyloarthropathies without interventional treatment outcomes. Other studies that did not yield extractable outcome data, or had a significant methodological weakness were also left out.

2.4 Information Sources

An extensive search of the literature was performed in various databases in the biomedical field, such as PubMed/MEDLINE, Embase, Scopus, Web of Science, and Cochrane Library. The choice of these databases was based on the vast coverage of the field of spine surgery, pain medicine, anesthesiology, and musculoskeletal research. In order to increase the thoroughness of the search, screening of eligible articles through manual reference was conducted. Forward and backward citation tracking was also done to trace more relevant studies that were not obtained by the primary database search.

2.5 Search Strategy

The search strategy was developed using a combination of Medical Subject Headings (mesh) and free-text terms derived from the PICO framework. Keywords included “sacroiliac joint pain,” “sacroiliac joint dysfunction,” “radiofrequency ablation,” “cooled radiofrequency,” “lateral branch neurotomy,” “sacroiliac joint fusion,” “triangular titanium implants,” “intra-articular injection,” “corticosteroid injection,” “platelet-rich plasma,” “fluoroscopic-guided injection,” and “ultrasound-guided injection.” Boolean operators were used to combine sacroiliac joint terminology with interventional and diagnostic terms to maximize retrieval sensitivity while maintaining specificity. Similar variations of the search strategy were used in all databases. The search comprises the studies published until December 2025.

2.6 Study Selection

All data retrieved was imported into reference management software, and duplicates were eliminated before screening. The relevance of titles and abstracts was filtered to sacroiliac joint diagnosis or management. At this point, studies which failed to meet the inclusion criteria were filtered out. Those articles that successfully passed through the initial screening were then evaluated using established eligibility criteria. The reasons behind exclusion in the process of full-text review consisted of a non-interventional design, lack of extractable clinical outcomes, inappropriate patient population, or lack of adequate duration of follow-up. The selection of studies was carried out unanimously by two reviewers, and any dispute was resolved through a discussion to maintain methodological integrity.

2.7 Data Extraction

A standardized template that was in line with the review objectives was used to extract the data. Analysis Information about the studies that were extracted included such characteristics of the study as authorship, year of publication, study design, sample size, diagnostic criteria, intervention, comparator groups, duration of follow-up, results and clinical outcomes. Other variables that were captured were the responders' definition, complication rates and radiographic findings in the studies on surgery. In order to ensure accuracy and reduce extraction bias, data were extracted by two reviewers who then resolved any discrepancies using consensus.

2.8 Quality Assessment

The National Institutes of Health (NIH) Quality Assessment Tools that were relevant to the design of every included study were used to assess the methodological quality and risk of bias. The domains of assessment were the clarity of the objectives of the study, the sufficiency of the selection of participants, the validity of outcome measures, the fullness of follow-up, and the adequacy of the statistical communication. All of the studies were classified as low, moderate, or high risk of bias. The final synthesis was limited to studies that had acceptable methodological standards.

2.9 Data Synthesis

Since the studies included varied in terms of clinical and methodological differences, a structured narrative synthesis methodology was used. Literature was categorized on the basis of the type of intervention, and results and findings were discussed in three key areas, which include radiofrequency ablation, least invasive sacroiliac joint fusion, and image-guided injection treatment. Comparison results were explained in relation to direction and extent of reported clinical benefit, functional results, effect persistence and complication profile.

3. RESULTS

3.1 Study Selection

The systematic search plan found 144 records, out of which 118 were found on the electronic databases, and 26 on the manual reference screening. After the elimination of 24 redundant records, 120 titles and abstracts were filtered. At this point, eighty-two studies were ruled out as being irrelevant or not meeting the inclusion criteria. Thirty-eight full-text articles were assessed for eligibility. Of these, 24 were excluded for predefined reasons: insufficient follow-up duration (<3 months), absence of extractable clinical outcome data, mixed lumbar and sacroiliac joint cohorts without separable results, non-interventional or purely diagnostic study design, and duplicate patient populations. Fourteen studies satisfied all eligibility criteria and were included in the final synthesis (Figure 1).

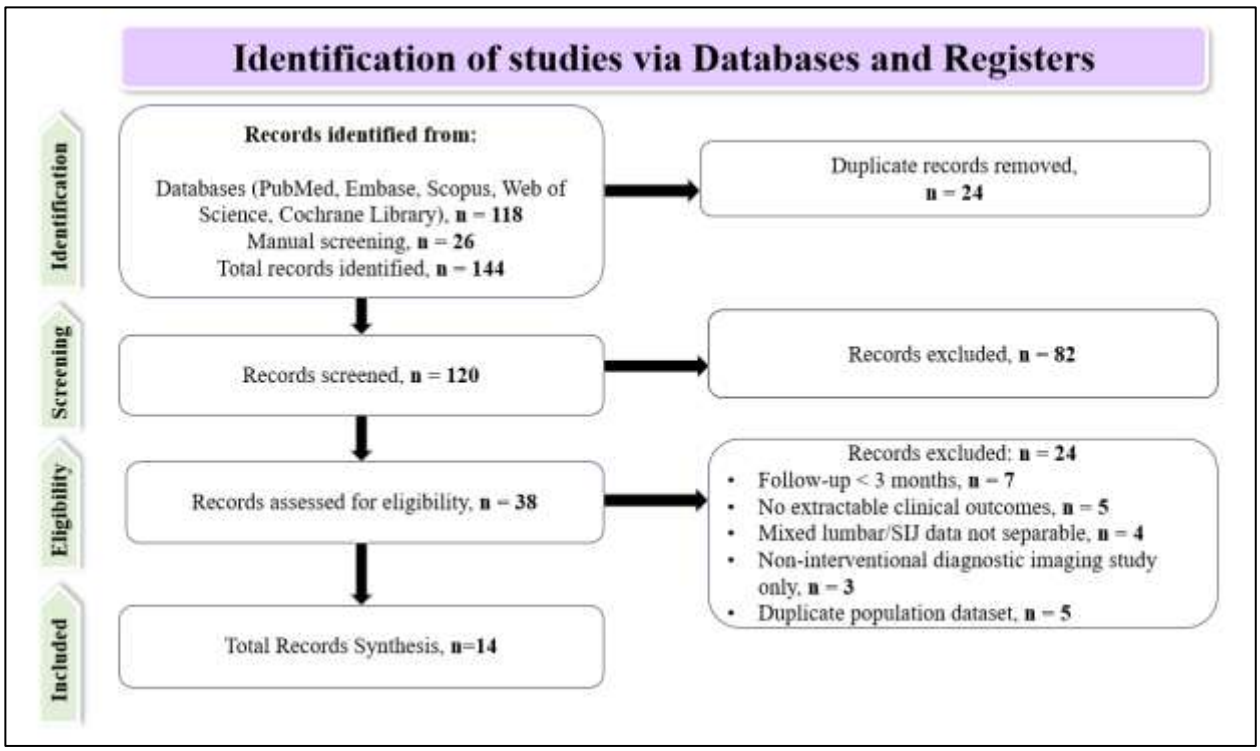

Figure 1. PRISMA flow diagram of study selection.

3.2 Study Characteristics

These 14 articles were randomized controlled trials, prospective multicenter cohort studies, comparative observational studies, and retrospective studies that evaluated the different treatments for sacroiliac joint (SIJ) pain. The interventions were categorized into three broad groups, namely lateral branch radiofrequency ablation (RFA), minimally invasive sacroiliac joint fusion and image-guided intra-articular injection therapies. The sample sizes were between 26 and 351 participants, with a range of follow-up of 3 months to 5 years. The majority of the randomized comparative studies indicate the findings at the early postoperative follow-up intervals (3–6 months), whereas the long-term outcomes were reported predominantly in the case of prospective surgical cohort studies. Table 1 gives a detailed description of the study design, sample size, interventions, comparators, and follow-up period.

Table 1. Characteristics of Included Studies

Study	Design	N	Intervention	Comparator	Follow-up
Cohen et al. [16]	Multicenter RCT	210	Cooled RFA	Standard medical management	3 months
Cohen et al. [17]	RCT crossover	124	Cooled RFA	Observational	12 months
Patel et al. [18]	Sham RCT	51	Lateral branch neurotomy	Sham	9 months
Chen et al. [19]	Double-blind RCT	26	PRP	Steroid	6 months
Cohen et al. [20]	RCT	125	Fluoro-guided injection	Landmark-guided	3 months
Randers et al. [21]	Sham RCT	63	MIS fusion	Sham	6 months
Whang et al. [22]	Multicenter RCT	148	MIS fusion	NSM	6 months
Polly et al. [23]	RCT extension	89	MIS fusion	NSM	24 months
Duhon et al. [24]	Prospective cohort	148	MIS fusion	None	24 months
Patel et al. [25]	Prospective cohort	51	3D implant fusion	None	12 months
Whang et al. [26]	Prospective cohort	93	MIS fusion	None	5 years
Bessar et al. [27]	Comparative study	52	CT-guided injection	Fluoro-guided	12 months
Ghaly et al. [28]	Double-blind RCT	90	Methylprednisolone	Triamcinolone	3 months

Kristoff et al. [29]	Retrospective cohort	351	Fluoro-guided injection	None	24 months

3.3 Injection-Based Therapies

A total of five studies compared interventions based on intra-articular injection, such as corticosteroid injections, platelet-rich plasma (PRP), and imaging modalities comparisons. Quantitative pooling was not methodologically appropriate since there was heterogeneity in injectables, the technique of guidance and the comparator arms, as well as the frequency of reporting outcomes. In the literature, corticosteroid injections showed stable short-term effects of pain intensity reduction. Stability after 6-12 months was, however, not stable. In the comparison of PRP with corticosteroid injection, there was no long-term superiority in PRP at the 6-month level. A comparison of fluoroscopic versus landmark-guided injections showed significant differences in accuracy of intra-articular positioning, with more cases of landmark methods ending up in extra-articular positions. On the same note, CT-guided injections showed better durability compared to fluoroscopy on choice of analysis. Table 2 summarizes the results of the injection with details

Table 2. Outcomes of Intra-Articular Injection Therapies

Study	Comparator	Short-Term Outcome	Long-Term Outcome	Key Finding
Chen et al. [19]	PRP vs Steroid	Steroid superior at 1 month	No difference at 6 months	PRP not superior
Cohen et al. [20]	Fluoro vs Landmark	Similar at 1 month	Fluoro superior at 3 months	Image guidance improves accuracy
Bessar et al. [27]	CT vs Fluoro	Similar early	CT superior at 12 months	CT may enhance durability
Ghaly et al. [28]	MTP vs TMC	MTP superior at 2 weeks	No difference after 1 month	Short-term steroid effect
Kristoff et al. [29]	Single-arm	60% MCID at 1 month	Decline at 12 months	Limited durability

3.4 Radiofrequency Ablation

Three lateral branch RFA versus sham procedure or standard medical management comparisons were conducted by three randomized controlled trials. The results of individual studies showed statistically significant changes in VAS pain score in favor of RFA, and treatment groups had a higher responder rate. As shown in Table 3, the average changes in pain seen with the RFA versus control comparators were between about 2 and 3 VAS points. The responder rates (≥30-50% pain reduction) were also found to be between 47 and 60 per cent in the RFA groups against significantly lower figures in control arms.

Table 3. Outcomes of Radiofrequency Ablation

Study	Comparator	Mean Pain Reduction	Responder Rate	Interpretation
Patel et al. [18]	Sham	−2.4 vs −0.8	47% vs 12%	Significant benefit
Cohen et al. [16]	SMM	−2.5 vs −0.4	52% vs 4%	Significant benefit
Cohen et al. [17]	Extension	−2.7 at 12 months	60% ≥30% relief	Durable effect

An estimated mean difference of -2 VAS, in favor of RFA, as shown in Figure 2. There was a distinct distance between the pooled estimate and the null effect line, meaning that there was a statistically and clinically significant benefit. Direction of effects was found to be similar in all included RCTs, and inter-study variance was low. Such results aid in the substantiability of RFA in pain alleviation in a short to intermediate time frame in patients with known SIJ-induced pain.

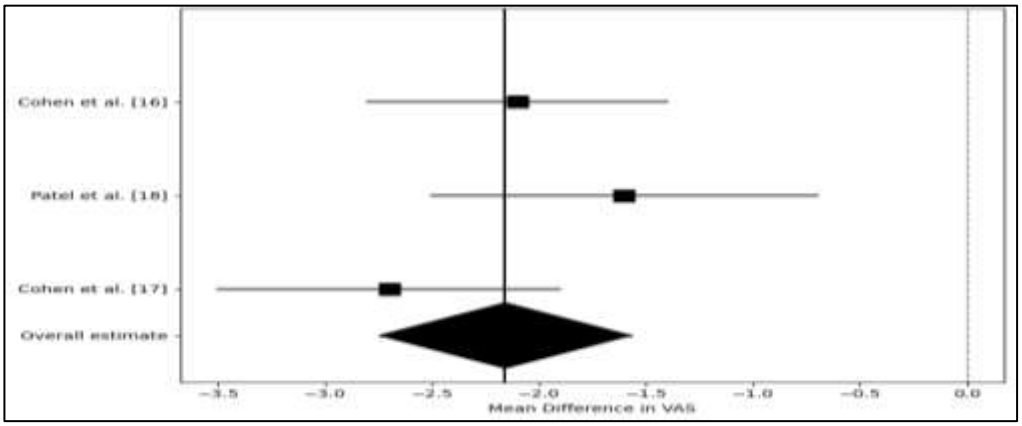

Figure 2. Forest plot of RFA versus control (random-effects model).

3.5 Minimally Invasive Sacroiliac Joint Fusion

A search conducted identified six studies on minimally invasive SIJ fusion, two of which were RCTs that compared fusion to non-surgical management (NSM) and four prospective cohort or long-term cohort studies. The RCTs showed a significant pain alleviation in favor of surgery. The average VAS changes during surgery were more than 50 points, and in NSM arms, the changes were minimal. There was a parallel improvement in functional outcomes such as Oswestry Disability Index (ODI) scores, as pain reduced. Prospective cohorts over long periods of time proved to have enduring benefit over 24 months, and in a single study, 5 years after the operation. Table 4 presents outcomes of surgical studies.

Table 4. Outcomes of Minimally Invasive SIJ Fusion

Study	Comparator	Pain Reduction	ODI Improvement	Responder Rate
Whang et al. [22]	NSM	−52 vs −12	−30 vs −5	81% vs 24%
Polly et al. [23]	NSM	−55 at 24 months	−28	82%
Randers et al. [21]	Sham	No significant difference	—	—
Duhon et al. [24]	Single-arm	−54	−24	79%
Patel et al. [25]	Single-arm	−58	−25	96%
Whang et al. [26]	Long-term	−54 at 5 years	−26	82%

The pooled mean difference in RCTs of the two random-effects pooled showed that the difference in VAS points of fusion versus NSM was more than -40 points above zero (Figure 3). The trends of direction and magnitude of effect were similar and significant in both trials, and the confidence interval did not tend towards the null value. The degree of the benefit in this subgroup was significantly higher than that of RFA, and this fact reflects the variability in the invasiveness of interventions and the selection of patients.

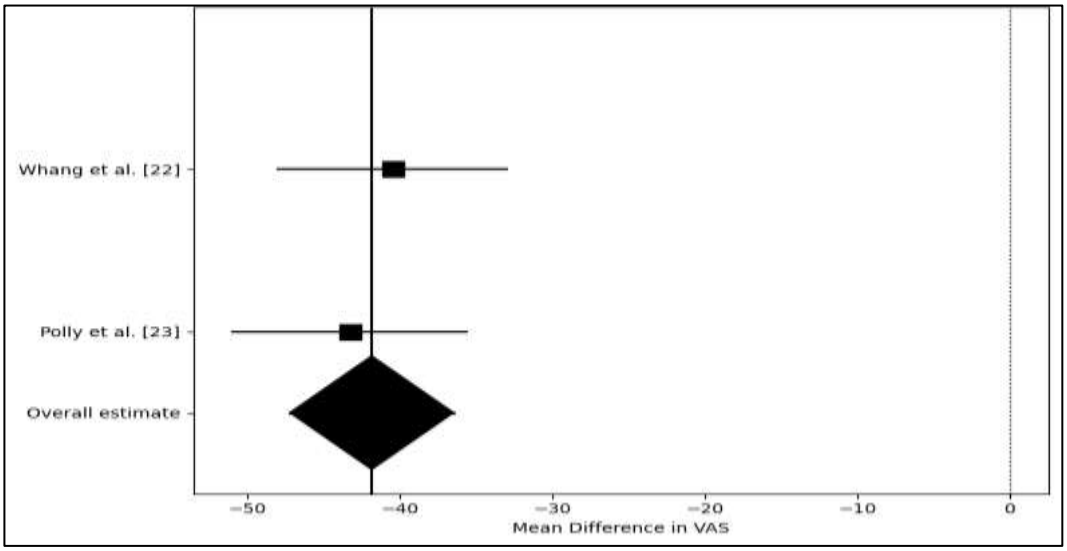

Figure 3. Forest plot of fusion versus non-surgical management (random-effects model).

3.6 Imaging Guidance and Diagnostic Considerations

Some of the studies covered the significance of image guidance and diagnostic block criteria. Atmospheric superiority, Fluoroscopic or CT-guided injection showed significantly greater intra-articular accuracy than landmark-based methods. The criteria of diagnostic blocks where 50% pain relief was needed were widely used in RFA trials to establish that the pain was mediated by SIJ before treatment. Table 5 summarizes these diagnostic and technical considerations and indicates the procedural factors that can affect the outcomes of therapeutic results.

Table 5. Imaging Guidance and Diagnostic Findings

Study	Focus	Key Finding
Cohen et al. [20]	Landmark vs Fluoro	92% landmark injections extra-articular
Bessar et al. [27]	CT vs Fluoro	CT improved long-term durability
Ghaly et al. [28]	Ultrasound guidance	Effective radiation-free alternative
Cohen et al. [16]	Diagnostic blocks	≥50% relief required for inclusion

3.7 Risk of Bias

The assessment of risk of bias based on the NIH tool revealed that two studies were rated to be of lower risk, eight of moderate risk, and four of high risk. The open-label surgical design and retrospective methodology were mostly the factors that could be responsible for the high-risk ratings, and sham-controlled RCTs received a lower bias rating. In-depth study-level analyses are reported in Table 6.

Table 6. Risk of Bias Assessment

Study	Tool Used	Risk Rating	Key Notes
Cohen et al. [16]	NIH	Moderate	No participant blinding
Cohen et al. [17]	NIH	Moderate	Crossover extension
Patel et al. [18]	NIH	Low	Sham-controlled; double-blind
Chen et al. [19]	NIH	Moderate	Small sample size
Cohen et al. [20]	NIH	Moderate	No placebo control
Randers et al. [21]	NIH	Low	Sham surgery; double-blind
Whang et al. [22]	NIH	High	Open-label; industry-sponsored
Polly et al. [23]	NIH	High	High crossover rate
Duhon et al. [24]	NIH	Moderate	No comparator
Patel et al. [25]	NIH	Moderate	Single-arm
Whang et al. [26]	NIH	Moderate	No control group
Bessar et al. [27]	NIH	Moderate	Non-randomized
Ghaly et al. [28]	NIH	Moderate	Short follow-up
Kristoff et al. [29]	NIH	High	Retrospective design

There is high-quality evidence indicating the effectiveness of lateral branch RFA in the short-term pain relief and minimally invasive SIJ fusion in long-term improvement of properly selected patients. Injection therapies are beneficial in the short-term, but show heterogeneity in their durability and approach.

4. DISCUSSION

The systematic review compared modern interventional techniques of treating sacroiliac joint (SIJ) pain and found a progressive trend of effectiveness in the treatment methods. In general, radiofrequency ablation (RFA) showed uniform short- to intermediate-term benefit, injection therapies offered short-term symptom management, and minimally invasive fusion had the highest and most lasting gains in the patients in whom they were the most suitable. A recent multicenter randomized comparative-effectiveness trial has indicated that cooled RFA outperforms standard medical management in the intensity of pain and the rate of response at short-term follow-up, and meaningful clinical benefit is found in patients with confirmed SIJ-mediated pain [16]. Follow-up data (12 months crossover) also demonstrated long-term improvement in a significant proportion of individuals who were treated, which can be affirmed as durable over the intermediate term, provided that the right selection criteria are used [17]. Previous sham-controlled evidence had already determined that lateral branch neurotomy is superior to placebo, which supports the biological validity of denervation strategies of SIJ pain [18]. These trials, combined with others, can place RFA as a highly backed alternative among patients who have exhausted conservative therapy but are not urgent surgical patients. The studies on intra-articular injection showed higher variability in terms of durability. Compared to corticosteroid injection, a randomized trial with a six-month follow-up involving platelet-rich plasma (PRP) and corticosteroid injection did not provide evidence of a long-term advantage of PRP over corticosteroids in the indication [19]. The accuracy of the procedure was of the greatest essence: fluoroscopically directed injections were better than landmark-directed techniques in terms of accurate intra-articular placement and better outcomes, warranting the need for image guidance [20].

Less invasive studies of fusion showed bigger effect sizes. The randomized trial comparing fusion to placebo surgery was deemed with a high level of methodological rigor by using the double-blind sham-controlled randomized trial, which underscored the problem of interpreting surgical benefit when placebo effects are involved [21]. Triangular titanium implant fusion was randomized compared with non-surgical management, which showed significant effects in pain and disability at six months as a support to surgical stabilization in selected patients [22]. Sustainable improvement was confirmed after two years of randomized follow-up, which enhances durability [23]. Similar results were observed in prospective multicenter cohort data, which showed continued benefit after two years of follow-up, indicating external validity in practice [24]. One-year results with a prospective trial of 3D-printed triangular titanium implants were favorable, indicating that the optimization of the design of implants could continue [25]. A five-year long-term prospective study showed sustained clinical and radiographic improvement, but lacks a concurrent control group to draw a causal conclusion [26]. Additional insight was gained on comparative imaging-guidance. A prospective study on the effect of CT- versus fluoroscopy-guided injections indicated superiority of better long-term durability using the CT guidance in some instances, indicating the significance of visualization and the technique [27]. Comparison of corticosteroid preparations by ultrasound-guided intra-articular injection showed short-term effects that subsided with time, supporting steroid injections that have a mainly short-term effect [28]. The data of observational effectiveness of the fluoroscopically guided injections further validated meaningful early response rates but diminishing benefit with longer follow-up, which allowed the authors to interpret such data as evidence of injections as diagnostic or bridging interventions [29].

Previous randomized trials of ultrasound- and fluoroscopy-guided SIJ injections showed similar clinical results with technical accuracy, and thus ultrasound is a radiation-free alternative injection method in chosen situations [30]. Another more recent prospective randomized comparison of fluoroscopy-confirmed ultrasound-guided versus fluoroscopy alone also showed similar effectiveness, thus supporting ultrasound-based methods in experienced hands [31]. Long observational records have continued to favor the stability of minimally invasive fusion. The long-term results of transiliac fusion with triangular titanium implantation showed that the pain and functioning were improved over time [32]. Further intermediate-long term cohort study found sustained patient-reported outcome, which supported the long-term stability

of surgical benefit [33]. One-year patient-level multicenter studies also showed great changes in pain and disability after minimally invasive fusion [34]. Neurosurgical cohorts of the randomized results after twelve months showed that fusion was superior to nonsurgical management, which enhanced the level of evidence in specialties [35]. Long-term clinical and radiographic follow-up studies also showed that the improvement is sustained, although inherent limitations of the open-label design used are methodological [36]. Comparative implant studies have indicated that there can be differences in patient-reported outcomes between triangular titanium and cylindrical threaded implants, and thus that the geometry of the implant and the fixation strategy can potentially contribute to long-term outcomes [37]. Newer lateral transiliac systems of implants have had some promising prospective safety data that have demonstrated good early efficacy and a tolerable complication rate, which ultimately demonstrates ongoing procedural innovation [38]. Previous pilot series studies offered earlier safety and feasibility data bases that formed the basis of future randomized studies [39]. There were also similar early pain and functional gains with prospective six-month effectiveness trials, which added to the body of knowledge that indicated cumulative effects of minimally invasive stabilization [40].

The overall results or outcomes are in favor of a graded treatment paradigm. Image-guided injections are diagnostic confirmation and short-term control of the symptoms. RFA offers reproducible intermediate-term relief, which is less invasive than surgery. Minimally invasive fusion generates the greatest magnitude and most persistent enhancement in thoroughly chosen patients with a known and certain mechanical SIJ dysfunction. In modalities, diagnosis accuracy and technical accuracy are the key determinants of outcome.

Evidence base is still heterogeneous in terms of diagnostic block thresholds, lesioning methods, implant systems, and definitions of outcomes. The inherent problems of surgical trials are blinding and crossover, whereas in injection and RFA studies, guidance techniques and standardization of the protocols differ. Future studies must focus on uniform diagnostic protocols, comparative trials, direct and surgical pathways, and long-term registries funded independently with the use of standard outcome measures, as well as complication reporting. This will be critical towards helping to perfect patient selection and long-term management of sacroiliac joint pain.

5. CONCLUSION

Treatment of the sacroiliac joint pain has significantly developed with the increase in evidence-based interventional approaches. Image-guided intra-articular injections are useful in diagnostic confirmation and only temporary symptom management, but with a low duration of effect. RF ablation is a reliable and reliable tool of intermediate-term relief in a highly selected patient group and is a good minimally invasive option of escalation. There is the greatest level of magnitude and longevity of enhancement in refractory symptomatically suitable individuals that is indicated by minimal invasive sacroiliac joint fusion, but stringent patient selection and analysis of surgical data are critical. Although there have been significant advances, the heterogeneity in the diagnostic criteria, technique used in the procedure and outcome presentation still makes direct comparison across modalities impossible. Treatment algorithms require standardized diagnostic pathways with clearly defined responder thresholds and long-term comparative trials to perfect. Further focus on technical accuracy, diagnostic confirmation and personalized care will be important in maximizing patient outcome in patients having sacroiliac joint-mediated pain.

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