

The Interventional Pain Management of Sacroiliac Joint Pain: A Brief Review

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Abstract: The sacroiliac joint accounts for approximately 10% to 25% of cases of chronic mechanical low back pain. Some pain provocation sacroiliac joint tests can be used in diagnosing sacroiliac joint pathology. However, none of the provocative sacroiliac tests alone were found to have positive predictive value for diagnosing sacroiliac joint pain. Diagnostic sacroiliac joint injections is considered to be the best diagnostic method. Intra-articular injections, periarticular injections, conventional radiofrequency, pulsed-radiofrequency and cooled-radiofrequency neuromodulations are the interventional pain management methods of sacroiliac joint. The evidence for cooled radiofrequency neurotomy treatment seems to be fair according to the treatment guidelines. The evidence for intraarticular steroid injections, periarticular injections with steroids, pulsed radiofrequency, and conventional radiofrequency neurotomy seem to be limited (or poor) for short-term and long-term pain relief.

Keywords: Low back pain, Injections, Intra-articular, Sacroiliac joint, Neurolysis.

INTRODUCTION

Low back pain (LBP) is associated with significant economic, societal, and health impact. Most of the LBP episodes (80%-90%) are resolving in about 6 weeks. However, 5% to 10% of the patients with acute LBP develop persistent LBP lasting more than 6 weeks [1]. To determine the specific etiology of the chronic LBP is not easy. The specific cause can only be determined in up to 15%-20% of the patients with chronic LBP. Schwarzer *et al.* [2-4] showed facet joint pain in 15% to 40% of the patients, discogenic pain in 39% of the patients, and sacroiliac joint mediated pain in 19% of the patients with chronic LBP.

The sacroiliac joint (SIJ) is a diarthrodial joint with unique characteristics not typically found in other diarthrodial joints. The distinctive feature is that the SIJ has fibrocartilage in addition to hyaline cartilage. Anterior surface of the SIJ shows a feature of synovial joints, while posterior surface of the joint has a syndesmotomic junction. The sacroiliac joint is well innervated. The SIJ is innervated mainly by the ventral rami of L4 and L5, the superior gluteal nerve, and the dorsal rami of L5, S1, and S2 [5]. Due to the wide distribution of innervation, clinical symptoms associated with SIJ pain is also very different. SIJ pain can occur following a traumatic event or cumulative shear events,

or can occur spontaneously. Several mechanisms of injury may be linked to the development of SIJ pain, including a direct fall onto the buttocks, motor vehicle accidents, and a step into an unexpected hole [6].

The most common pain-referral zones from the SIJ are the lower lumbar region and buttock. The other pain-referral zones are consisted of thigh, leg and groin [7]. Some pain provocation SIJ tests can be used in diagnosing SIJ pathology. However, none of the provocative sacroiliac tests alone were found to have positive predictive value for diagnosing SIJ pain [8]. Sensitivity and specificity for three or more of six positive SIJ tests (distraction test, thigh thrust test, Gaenslen's test, compression test, cranial shear test and sacral thrust test) were 94% and 78%, respectively. So that, composites of provocation SIJ tests are of value in clinical diagnosis of symptomatic SIJ. When all six provocation tests do not provoke familiar pain, the SIJ can be ruled out as a source of current LBP [9].

In the literature, the use of radiography, computed tomography (CT), single photon emission CT (SPECT), bone scans, magnetic resonans imaging (MRI), and other nuclear imaging techniques have been used to identify specific disorders of the SIJ. However, no pathognomonic findings supporting the cause of SIJ pain are found on medical imaging except those patients with "red flags" such as infection, inflammation and trauma [9, 10]. So that, medical imaging is indicated only to rule out "red flags" [11].

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Due to the inability to make the diagnosis of symptomatic SIJ with clinical examination and radiological imaging, sacroiliac joint blocks appear to be as a current acceptable method to provide appropriate diagnosis [12]. The International Association for the Study of Pain (IASP) criteria for making the diagnosis of symptomatic SIJ are: (1) pain is present in the region of the SIJ, (2) stressing the SIJ by clinical tests that are selective for the joint reproduces the patient's pain, (3) selectively infiltrating the symptomatic joint with local anaesthetic completely relieves SIJ pain of the patient [13].

DIAGNOSTIC SACROILIAC JOINT INJECTIONS

Based on present knowledge, a proper diagnosis can only be made using controlled diagnostic SIJ blocks. The false-positive rate was found more higher in those patient having a single block than in those having a double block [14]. The false-positive rate of a single block is estimated to range between 20% and 54% [15]. The use of double-blocks can reduce the high false-positive rate associated with uncontrolled SIJ injections. The evidence for the accuracy of SIJ diagnostic injections was found as good for the diagnosis of SIJ pain utilizing controlled diagnostic blocks [16].

The common indications for SIJ blocks are: 1) patients with chronic LBP below the level of L5 vertebra, 2) patients with or without somatic referred pain in the lower limb, in whom no other diagnosis is readily apparent, 3) lack of obvious evidence for disc-related or facet joint pain, 4) a diagnosis has been made or cannot be made using less invasive options, and 5) failure to respond to conservative management [16].

Controlled SIJ blocks with placebo or controlled comparative local anesthetic blocks are recommended when indications are satisfied. A positive response is considered $\geq 80\%$ pain relief with ability to perform previously painful movements [17].

The use of fluoroscopy or other imaging to guide needle placement during SI joint blocks is strongly recommended. Computerized tomography (CT) monitored injections are useful when the SI joint cannot be accessed using fluoroscopy [18]. In an observational study, 60 patients had blind SIJ injections with 2 ml of contrast. The authors found that only 12% of patients had intraarticular spread [19]. Rosenberg *et al.* [20] evaluated the accuracy of clinically guided SIJ injections using CT. Intraarticular injection was

accomplished in only 22% of the patients, though the injected contrast was noted to be within one cm of the joint in 68% of individuals. There is no evidence to support the use of ultrasound or landmark-guided injections for SIJ pain. These injections must be performed under fluoroscopic or radiologic guidance.

THERAPEUTIC SACROILIAC JOINT INJECTIONS

Interventional pain managements for SIJ include intra-articular injections, periarticular injections and radiofrequency (RF) neurolysis. RF neurolysis is becoming a more popular and accepted treatment for SIJ pain [21]. The treatment guidelines suggest RF neurolysis in the patients who had positive response to diagnostic block injection, and who had short-term pain relief after the intra-articular steroid injections [15]. However the effectiveness of RF neurolysis for SIJ pain remains unclear. RF neurolysis can be used in treating patients with SIJ pain who had no response to the conservative treatments [21].

RADIOFREQUENCY NEUROLYSIS

There are currently three different methods of RF neurolysis: a) Conventional RF: The nerve lesion occurs in 60-90 s with 70-80 °C. The lesion in proximal side of active electrode is larger than distal side. Therefore, it is recommended that the electrode must be positioning as parallel to the nerve tissue. b) Pulsed RF: The heat does not exceed 42 °C. RF current is applied two times per second, 20 ms during 120 s. Thus, no permanent damages were observed in the affected nerves. The most intense part of the electromagnetic field is the sharp end of electrode. Therefore, the electrode in the pulsed RF applications is placed perpendicular to the nerve tissue in contrast to conventional RF. c) Cooled-RF: Cooled-RF is a novel technique whereby internally cooled RF probed can lead to larger lesions. In this application; the circulatory water in the probe is cooling the area of nerve which is near the electrode while RF energy between two electrodes heats the tissue.

RF neurolysis is usually applied to the posterolateral branch of the nerve roots of L5-S3. The electrodes are placed to the treatment area with guidance of C-arm fluoroscopy. After the target nerve stimulation and impedance control are done for confirming the right place of the electrode tip, RF current application is started. The application of conventional RF can be painful if local anesthetic injection is not applied. The positive response criteria are to achieve 50% pain reduction at 2 weeks after the RF neurolysis [15]. In case of lack of response to treatment, the suggested

time for RF neurolysis would be 3 months or longer. It is suggested that the neurolysis can be repeated up to a maximum 3 times in the year [17].

The complications for RF include increasing in spinal pain, a dysesthetic sensation, a burning sensation, hypoesthesia localized at the joint and allodynia, temporary leg pain, insufficient muscle strength of lower extremity, sensory or motor deficits of the strained sciatic nerve-other spinal nerve, irreversible injury of nontarget nerves [23].

Level of Evidence

In the systematic review, the authors found that the conventional-RF for persistent SIJ pain had a low level of evidence [15]. Ferrante *et al.* [24] reported the use of RF denervation with bipolar electrode; and they showed that 36.4 % of the patients had 50 % pain reduction in period of at least six months. There are two randomized placebo-controlled studies including cooled-RF treatment. In the first study, Cohen *et al.* [25] found 50 % pain reduction in 64% of the patients at 3rd month after the management. But this rate reduced to 57 % at the 6th month. In the second study, Patel *et al.* [26] found 50 % pain reduction in 47 % of the patients at 3rd month while they reported this rate as 38 % at the 6th month after intervention. According to these results, the treatment efficacy of cooled-RF showed a moderate level of evidence [15].

PERIARTICULAR AND INTRAARTICULAR SIJ INJECTIONS

Periarticular and intraarticular SIJ injections are indicated in the patients who has chronic LBP unresponsive to conservative treatment, who has LBP at least 3 months, who has $\geq 80\%$ pain reduction after the diagnostic SIJ injection. In the injection technique; the patients are positioned in a prone position on the

fluoroscopy table. C- arm fluoroscopy is set up contralaterally in the anteroposterior position to view the SIJ. The fluoroscopy is set up into an approximate 10-15 degree midsagittal position to identify SIJ clearly. After the skin and subcutaneous region are anesthetized using 2 cc of 1 % lidocaine hydrochloride, a 22-gauge 3.5 inch spinal needle is inserted into the SIJ space under fluoroscopy control. 1-2 ml of contrast material (omnipaque 300) is injected to confirm a proper arthrogram pattern (Figure 1). When the right spread of the contrast pattern is achieved, a mixture of depo corticosteroid and local anaesthetic are injected into the SIJ. SIJ injections can be also performed with ultrasonography guidance. In a recent study, it was reported that the ultrasound guided SIJ injections has similar accuracy and efficacy to the fluoroscopy guided SIJ injections [27].

The positive response criteria is to achieve 50% pain reduction at 2 weeks after the injection [15]. If there is no response to the treatment, the next SIJ injection can be done 2 months or longer. The number of injections can be limited to a maximum of 4 to 6 times for steroid injection over a period of one year, per joint [17].

Complications

Local or systemic infection, hematoma formation, neural damage, trauma to the sciatic nerve, complications related to drug administration could be seen. It is indicated that the postprocedural complications are uncommon, but the risk of contamination and serious infections is very high [28].

Level of Evidence

There are good and quality studies which report short-term effect of corticosteroid and local anesthetic injection for SIJ. However, long-term effects are lacking



Figure 1: Normal Sacroiliac Joint Arthrogram Pattern after Contrast Injection.

[29]. Based on evidence-based guidelines and systemic reviews, the level of evidence for intra-articular injection is low [15, 17, 30]. However, in another an evidence-based clinical study, the evidence of intra-articular mixture of corticosteroid and local anesthetic injection into SIJ is high [12]. In a review, it was reported that the effectiveness of local steroid and local anesthetic injections are similar [28].

The authors evaluated the role of the periarticular injections in 2 randomized trials. Both of the studies showed that periarticular injections of local anesthetic with steroids are superior, though only in a short-term follow-up. However there were no significant difference between steroid and placebo groups in the long-term period. The major limitations for these studies are having small sample size and having injections without fluoroscopy guidance [31, 32]. Based on the review, there is low evidence for periarticular SIJ injections [15]. Borowksy *et al.* [33] investigated the combination of periarticular and intraarticular steroid injections. It was found that the response rate to treatment in patients who received the combination of injections was 31.25% while the response rate was 12.5% in the patients who receiving intraarticular injections only at 3 months. However there were not significant difference between the groups in the long-term period. In this study, the authors concluded that the significant part of SIJ pain could be extraarticular origin. So that the failure of the treatment for SIJ pain can be due to having only intra-articular injection. In another study, it was found the success rate 96% in periarticular injection of the SIJ pain while 62% success rate was found for intraarticular injection [34]. In a systematic review the periarticular, intraarticular steroid injections were evaluated, the authors could not have a definitive conclusion, which treatment was superior than others [15].

PROLOTHERAPY IN SACROILIAC JOINT PAIN

Prolotherapy is known as a regenerative injection technique. The mechanism of action is based on the regenerative healing process. It has three phases: inflammation, proliferative with granulation and remodelling with contraction [35]. The major application area of prolotherapy is SIJ pain. In a recent report, the effectiveness of prolotherapy in SIJ pain was studied. Three injections were performed under CT-guided into the dorsal interosseous ligaments. The improvement was achieved in clinical outcomes during 3 months [36]. In another study; the intraarticular prolotherapy was applied and significant relief of SIJ pain was achieved [37].

CONCLUSIONS

When we evaluated the effectiveness of interventional treatment methods of SIJ; the treatment efficacy of cooled-RF showed a moderate level of evidence while the other interventional treatment methods showed a low level of evidence. Although there are different results for the interventional treatment methods of SIJ, there is still ongoing debate about the effectiveness.

REFERENCES

- [1] Quittan M. Management of back pain. *Disabil Rehabil.* 2002; 24(8): 423-34.
<http://dx.doi.org/10.1080/09638280110108850>
- [2] Schwarzer AC, Aprill CN, Derby R, Fortin J, Kine G, Bogduk N. The prevalence and clinical features of internal disc disruption in patients with chronic low back pain. *Spine* 1995; 20(17): 1878-83.
<http://dx.doi.org/10.1097/00007632-199509000-00007>
- [3] Schwarzer AC, Wang SC, Bogduk N, McNaught PJ, Laurent R. Prevalence and clinical features of lumbar zygapophysial joint pain: a study in an Australian population with chronic low back pain. *Ann Rheum Dis.* 1995; 54(2): 100-6.
<http://dx.doi.org/10.1136/ard.54.2.100>
- [4] Schwarzer AC, Aprill CN, Bogduk N. The sacroiliac joint in chronic low backpain. *Spine* 1995; 20(1): 31-7.
<http://dx.doi.org/10.1097/00007632-199501000-00007>
- [5] Forst SL, Wheeler MT, Fortin JD, Vilensky JA. The sacroiliac joint: anatomy, physiology and clinical significance. *Pain Physician.* 2006; 9(1): 61-7.
- [6] Chou LH, Slipman CW, Bhagia SM, Tsaur L, Bhat AL, Isaac Z, et al. Inciting events initiating injection-proven sacroiliac joint syndrome. *Pain Med.* 2004; 5(1): 26-32.
<http://dx.doi.org/10.1111/j.1526-4637.2004.04009.x>
- [7] Slipman CW, Jackson HB, Lipetz JS, Chan KT, Lenrow D, Vresilovic EJ. Sacroiliac joint pain referral zones. *Arch Phys Med Rehabil.* 2000; 81(3): 334-8.
[http://dx.doi.org/10.1016/S0003-9993\(00\)90080-7](http://dx.doi.org/10.1016/S0003-9993(00)90080-7)
- [8] Maigne JY, Aivaliklis A, Pfefer F. Results of sacroiliac joint double block and value of sacroiliac pain provocation tests in 54 patients with low back pain. *Spine* 1996; 15; 21(16): 1889-92.
- [9] Laslett M, Aprill CN, McDonald B, Young SB. Diagnosis of sacroiliac joint pain: validity of individual provocation tests and composites of tests. *Man Ther.* 2005; 10(3): 207-18.
<http://dx.doi.org/10.1016/j.math.2005.01.003>
- [10] Madsen KB, Jurik AG. Magnetic resonance imaging grading system for active and chronic spondylarthritis changes in the sacroiliac joint. *Arthritis Care Res (Hoboken).* 2010; 62(1): 11-8.
<http://dx.doi.org/10.1002/acr.20008>
- [11] Lim R, Fahey FH, Drubach LA, Connolly LP, Treves ST. Early experience with fluorine-18 sodium fluoride bone PET in young patients with back pain. *J Pediatr Orthop.* 2007; 27(3): 277-82.
<http://dx.doi.org/10.1097/BPO.0b013e31803409ba>
- [12] Vanelderden P, Szadek K, Cohen SP, De Witte J, Lataster A, Patijn J, Mekhail N, van Kleef M, Van Zundert J. 13. Sacroiliac joint pain. *Pain Pract.* 2010; 10(5): 470-8.
<http://dx.doi.org/10.1111/j.1533-2500.2010.00394.x>
- [13] Laslett M. Evidence-based diagnosis and treatment of the painful sacroiliac joint. *J Man Manip Ther.* 2008; 16(3): 142-52.
<http://dx.doi.org/10.1179/jmt.2008.16.3.142>

- [14] Merskey H, Bogduk N. Classification of chronic pain: descriptions of chronic pain syndromes and definitions of pain terms. 2nd ed. Seattle: IASP Press; 1994.
- [15] Hansen H, Manchikanti L, Simopoulos TT, Christo PJ, Gupta S, Smith HS, et al. A systematic evaluation of the therapeutic effectiveness of sacroiliac joint interventions. *Pain Physician*. 2012; 15(3): E247-78.
- [16] van der Wurff P, Buijs EJ, Groen GJ. A multitest regimen of pain provocation tests as an aid to reduce unnecessary minimally invasive sacroiliac joint procedures. *Arch Phys Med Rehabil*. 2006; 87(1): 10-4. <http://dx.doi.org/10.1016/j.apmr.2005.09.023>
- [17] Manchikanti L, Boswell MV, Singh V, Benyamin RM, Fellows B, Abdi S, et al. ASIPP-IPM. Comprehensive evidence-based guidelines for interventional techniques in the management of chronic spinal pain. *Pain Physician*. 2009; 12(4): 699-802.
- [18] Simopoulos TT, Manchikanti L, Singh V, Gupta S, Hameed H, Diwan S, et al. A systematic evaluation of prevalence and diagnostic accuracy of sacroiliac joint interventions. *Pain Physician*. 2012; 15(3): E305-44.
- [19] Bollow M, Braun J, Taupitz M, Häberle J, Reibhauer BH, Paris S, et al. CT-guided intraarticular corticosteroid injection into the sacroiliac joints in patients with spondyloarthritis: indication and follow-up with contrast-enhanced MRI. *J Comput Assist Tomogr*. 1996; 20(4): 512-21. <http://dx.doi.org/10.1097/00004728-199607000-00002>
- [20] Hansen HC. Is fluoroscopy necessary for sacroiliac joint injections? *Pain Physician*. 2003; 6(2): 155-8.
- [21] Rosenberg JM, Quint TJ, de Rosayro AM. Computerized tomographic localization of clinically-guided sacroiliac joint injections. *Clin J Pain*. 2000; 16(1): 18-21. <http://dx.doi.org/10.1097/00002508-200003000-00004>
- [22] Aydin SM, Gharibo CG, Mehnert M, Stitik TP. The role of radiofrequency ablation for sacroiliac joint pain: a meta-analysis. *PM R*. 2010; 2(9): 842-51. <http://dx.doi.org/10.1016/j.pmrj.2010.03.035>
- [23] Kornick C, Kramarich SS, Lamer TJ, Todd Sitzman B. Complications of lumbar facet radiofrequency denervation. *Spine* 2004; 29(12): 1352-4. <http://dx.doi.org/10.1097/01.BRS.0000128263.67291.A0>
- [24] Ferrante FM, King LF, Roche EA, Kim PS, Aranda M, Delaney LR, et al. Radiofrequency sacroiliac joint denervation for sacroiliac syndrome. *Reg Anesth Pain Med*. 2001; 26(2): 137-42. <http://dx.doi.org/10.1097/00115550-200103000-00008>
- [25] Cohen SP, Hurley RW, Buckenmaier CC 3rd, Kurihara C, Morlando B, Dragovich A. Randomized placebo-controlled study evaluating lateral branch radiofrequency denervation for sacroiliac joint pain. *Anesthesiology*. 2008; 109(2): 279-88. <http://dx.doi.org/10.1097/ALN.0b013e31817f4c7c>
- [26] Patel N, Gross A, Brown L, Gekht G. A randomized, placebo-controlled study to assess the efficacy of lateral branch neurotomy for chronic sacroiliac joint pain. *Pain Med*. 2012; 13(3): 383-98. <http://dx.doi.org/10.1111/j.1526-4637.2012.01328.x>
- [27] Soneji N, Bhatia A, Seib R, Tumber P, Dissanayake M, Peng PW. Comparison of Fluoroscopy and Ultrasound Guidance for Sacroiliac Joint Injection in Patients with Chronic Low Back Pain. *Pain Pract*. 2015 May 19. doi: 10.1111/papr.12304. <http://dx.doi.org/10.1111/papr.12304>
- [28] Shamliyan TA, Staal JB, Goldmann D, Sands-Lincoln M. Epidural steroid injections for radicular lumbosacral pain: a systematic review. *Phys Med Rehabil Clin N Am*. 2014 ; 25(2): 471-89. <http://dx.doi.org/10.1016/j.pmr.2014.02.001>
- [29] Manchikanti L, Datta S, Gupta S, Munglani R, Bryce DA, Ward SP, et al. A critical review of the American Pain Society clinical practice guidelines for interventional techniques: part 2. Therapeutic interventions. *Pain Physician*. 2010; 13(4): E215-64.
- [30] Hansen HC, McKenzie-Brown AM, Cohen SP, Swicegood JR, Colson JD, Manchikanti L. Sacroiliac joint interventions: a systematic review. *Pain Physician*. 2007; 10(1): 165-84.
- [31] Luukkainen RK, Wennerstrand PV, Kautiainen HH, Sanila MT, Asikainen EL. Efficacy of periarticular corticosteroid treatment of the sacroiliac joint in non-spondylarthropathic patients with chronic low back pain in the region of the sacroiliac joint. *Clin Exp Rheumatol*. 2002; 20(1): 52-4.
- [32] Luukkainen R, Nissilä M, Asikainen E, Sanila M, Lehtinen K, Alanaatu A, et al. Periarticular corticosteroid treatment of the sacroiliac joint in patients with seronegative spondylarthropathy. *Clin Exp Rheumatol*. 1999; 17(1): 88-90.
- [33] Borowsky CD, Fagen G. Sources of sacroiliac region pain: insights gained from a study comparing standard intra-articular injection with a technique combining intra- and peri-articular injection. *Arch Phys Med Rehabil*. 2008; 89(11): 2048-56. <http://dx.doi.org/10.1016/j.apmr.2008.06.006>
- [34] Murakami E, Tanaka Y, Aizawa T, Ishizuka M, Kokubun S. Effect of periarticular and intraarticular lidocaine injections for sacroiliac joint pain: prospective comparative study. *J Orthop Sci*. 2007; 12(3): 274-80. <http://dx.doi.org/10.1007/s00776-007-1126-1>
- [35] Steilen D, Hauser R, Woldin B, Sawyer S. Chronic neck pain: making the connection between capsular ligament laxity and cervical instability. *Open Orthop J*. 2014; 8: 326-45. <http://dx.doi.org/10.2174/1874325001408010326>
- [36] Cusi M, Saunders J, Hungerford B, Wisbey-Roth T, Lucas P, Wilson S. The use of prolotherapy in the sacroiliac joint. *Br J Sports Med*. 2010; 44(2): 100-4. <http://dx.doi.org/10.1136/bjism.2007.042044>
- [37] Kim WM, Lee HG, Jeong CW, Kim CM, Yoon MH. A randomized controlled trial of intra-articular prolotherapy versus steroid injection for sacroiliac joint pain. *J Altern Complement Med*. 2010; 16(12): 1285-90. <http://dx.doi.org/10.1089/acm.2010.0031>

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