Int Surg 2015;**100:**320–327
DOI: 10.9738/INTSURG-D-13-00194.1

A Cadaveric Study on Sacroiliac Joint Injection

Yu-Cong Zou[1], Yi-Kai Li[1], Cheng-Fu Yu[2], Xian-Wen Yang[1], Run-Qi Chen[1]

[1]*Department of Orthopedics, Academy of Traditional Chinese Medicine, Southern Medical University, Guang Zhou, People's Republic of China*

[2]*Department of Radiology, SinoWest Medical Hospital, Guang Zhou, People's Republic of China*

The scope of this study was to explore the possibility as well as the feasibility of sacroiliac joint injection following simple X-ray clip location. For the cadaveric study, 10 fixed sacroiliac joint (SIJ) sectional specimens, 4 dried cadaveric pelvises and 21 embalmed adult cadaveric pelvises were dissected, followed by an injection of contrast agent into the joint. The irrigation of the agent was observed through CT scanning. For the radiologic study, 188 CT scans of ankylosing spondylitis patients (143 male, 45 female) were collected from 2010 to 2012, in Nanfang Hospital. What was measured was (1) Distance between the posterior midline and sagittal synovium; (2) Length of the sagittal synovium; (3) Distance between the midpoint of the sagittal synovium and posterior superior iliac spine; and (4) Distance between the superficial skin vertical to the sagittal synovium point were measured. For the practice-based study: 20 patients (17 males and 3 females) with early ankylosing spondylitis, from Nanfang Hospital affiliated with Southern Medical University were recruited, and sacroiliac joint unguided injections were done on the basis of the cadaveric and radiologic study. Only the inferior 1/3rd portion parallel to the posterior midline could be injected into since the superior 2/3rd portion were filled with interosseous ligaments. Thirteen of the 20 patients received successful injections as identified by CT scan using the contrast agent. Sacroiliac joint injection following simple X-ray clip location is possible and feasible if the operation is performed by trained physicians familiar with the sacroiliac joint and its surrounding anatomic structures.

Key words: Synovium lining at the SI joint – Synovial injection – Clip localization

Corresponding author: Yi-Kai Li, MD, and Xian-Wen Yang, MD, Department of Orthopedics, Academy of Traditional Chinese Medicine Southern Medical University, 1838 North Guang Zhou Avenue Guang Zhou 510515, People's Republic of China.
Tel.: +86 020 61648255; F: +86 020 61648254; E-mail: gzliyikai@126.com; yangxw999@163.com

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-07 via free access

Ankylosing spondylitis (AS) is a chronic inflammatory disease involving the sacroiliac joint (SIJ) and spine, which is mainly characterized by sacroiliitis.[1] This disease is twice as common in men as in women.[2] AS leads to fatigue and functional impairment, which leads to a diminished quality of life and also proves to be a socioeconomic burden.[3–6] Besides infection, injury and tumor also contribute to sacroiliitis.[7,8] According to statistics, 16%–30% of cases with low back pain are a result of sacroiliac joint lesion.[9] Treatment of AS is difficult due to the progressive nature of the disease. Currently available conventional therapies are palliative at best. Nonsteroidal anti-inflammatory drugs (NSAIDS) are the first line of treatment; however, they prove ineffective in the long term as the disease becomes refractory to this treatment modality. Disease-modifying anti-rheumatic drugs (DMARDS) is the second line and proves to be more clinically beneficial. In recent years, the injection technique has been proven to be an effective treatment to relieve the pain originating from sacroiliac joint.[10] Several investigators have reported that image-guided injections of the SIJ provide long-term pain relief and improve the mobility as well as tolerability of physical therapy. Almost all reported injection cases were performed under the guidance of imaging techniques such as C-arm, X-ray, CT, MRI, ultrasound, and many scholars reported that unguided injection for sacroiliac joint was almost impossible because of its complicated structure.[11] Fluoroscopy-guided corticosteroid injections of the joint improved sacroiliac pain in about 50%–64% of cases.[12,13] Other studies report good to excellent clinical response in about 50%–70% of patients after sacroiliac injection guided by computed tomography (CT).[14–16] Although the accuracy and success rate could be increased using image-guided technique, it is a complicated and cumbersome process in addition to the danger of being exposed to potential radiation. CT and fluoroscopy are both time-consuming interventions that involve the risk of allergy to contrast products and exposure to ionizing radiation for both physicians and patients.[17,18] X-ray exposure is also dangerous for women of childbearing age.[19] MRI is advantageous over other imaging techniques as there is no ionizing radiation; however, it is very expensive and also contraindicated in patients who are overweight, have claustrophobia or cardiac pacemaker.[20–22] Although ultrasound guided puncture could increase the accuracy and success rate in recent years, the technique is still not prevalent in many countries. Therefore, in areas where ultrasound is not available, sacroiliac joint injection just following X-ray clip location could provide a better alternate for both physicians and patients exposed to least radiation injury while keeping accuracy and success rate. In this study, we combined cadaveric and radiologic study of sacroiliac joint and conducted injection based on the measurements obtained from these examinations.

Materials and Methods

Cadaveric study

10 fixed sectional sacroiliac joint specimens, 4 dried cadaveric pelvises and 21 embalmed adult cadaveric pelvises, from the department of Anatomy of Southern Medical University, were studied. All the cadaveric pelvises were dissected from the sacroiliac joint to examine the inner portion, including the shape, composition of the SIJ joint in order to ascertain the injection target.

Radiologic study

The radiologic study was aimed to ensure the approximate puncture point. CT scans of 188 male and female pelvises were obtained and the length of the sagittal synovium, distance between the posterior midline and sagittal synovium, and the distance

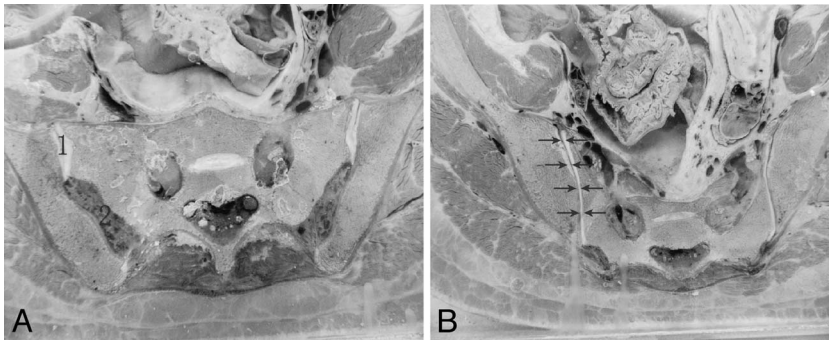

Fig. 1 (A) Photograph showing medial section of sacroiliac joint (parallel to the second sacral vertebrae), (1) synovium; (2) interosseous ligament. (B) Photograph showing the synovium of sacroiliac joint (parallel to the third sacral vertebrae). The arrows indicate the entire synovium (the target puncture section).

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-07 via free access

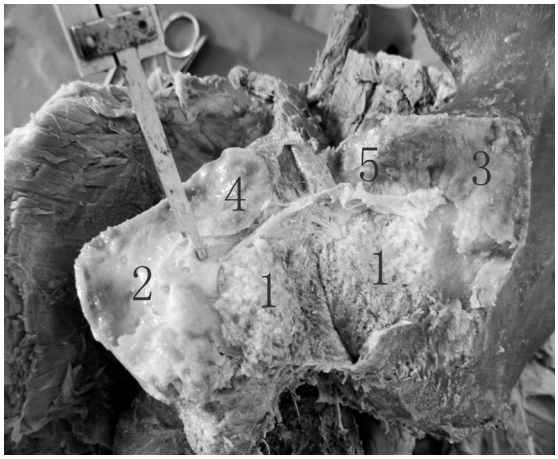

Fig. 2 Photograph of dissected sacroiliac joint showing the inner portion of the sacroiliac joint: (1) interosseous ligament; (2) facies auricularis ossis sacri; (3) facies auricularis ossis ilii; (4), (5) sagittal synovium.

between the midpoint and posterior superior iliac spine were measured. We were then able to make an average for these measurements for the male and female pelvises to determine the location of the intra-articular injection.

Practice-based study

A total of 20 patients (17 male and 3 female) were suspected to have ankylosing spondylitis (according to their complaints, symptoms, and clinical signs). The physician used his thumb to identify the posterior superior iliac spine. Then the posterior midline was confirmed through spine palpation, following which the clip was located about 41 mm away, parallel to the posterior midline and 27.6 mm below the posterior superior iliac spine, according to the previous cadaveric and radiological imaging. The pelvis was then X-rayed to confirm the location of clip and if any deviation from the injection site existed, the physician moved the clip, and another X-ray was performed to check the placement, to identify whether the clip was in the right location. The clip location and X-ray filming were done no more than 2 times in each case. The puncture point was then marked. The patient was placed in the prone position, and then a pillow was located under the abdomen to straighten the lumbar lordosis. The skin within the gluteal area was disinfected with antiseptic solution. After confirmation of clip position, the steroid mixed with the contrast agent was injected at the puncture point with a 22-gauge, 8-cm long needle, The angle was all 90° at the beginning, for the synovium part of SIJ is almost parallel to the posterior midline. There was resistance felt as the needle passed through the ligaments into the joint, and slight angle adjustment could be done after the first resistance of SIJ posterior ligament according to the factual X-ray results of patients. After twice feeling

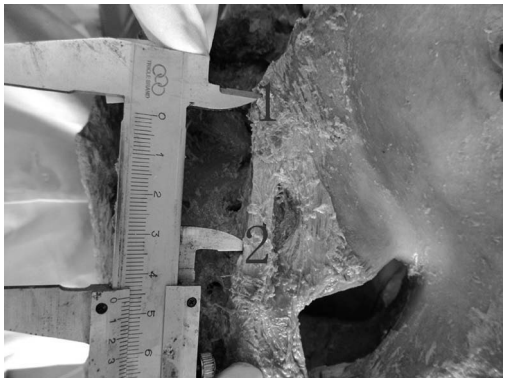

Fig. 3 Photograph of a dissected sacroiliac joint showing the distance between the sagittal synovium and peak of the posterior superior iliac spine (1) posterior superior iliac spine; (2) sagittal synovium.

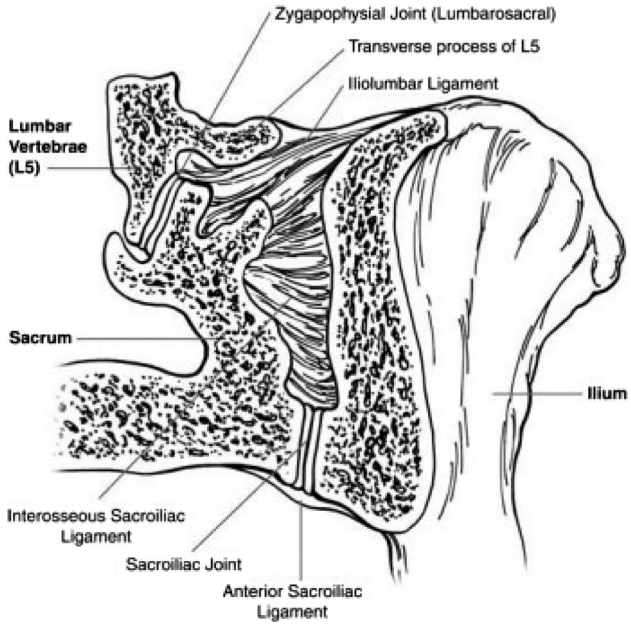

Fig. 4 Drawing of the sacroiliac joint in cross-section shows the true synovial-lined joint space within the inferior one-third of the joint. Cited from Stallmeyer.[30]

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-07 via free access

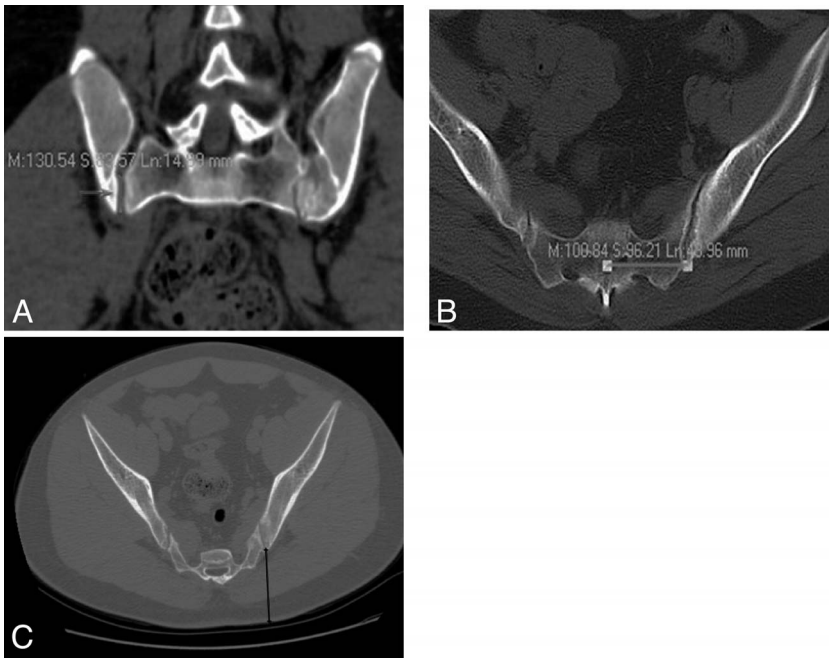

Fig. 5 CT scan of patients sacroiliac joint. (A) The length of sagittal synovium in coronary section. (B) Distance between the sagittal synovium and posterior midline in horizontal plane. (C) Distance between the superficial skin vertical to the sagittal synovium point.

at first hollowness, then the mixed drugs and contrast agent could be injected. In the injecting process, the resistance is tough; however, the drugs could still be injected into the joint space. The syringe and needle was left in place and rapid CT scanning was done to verify if the contrast agent had been injected into the inferior one-third of the joint space.

Results

Cadaveric study

The SIJ has both a fibrous component and a true joint space, located inferiorly, within the capsule (Fig. 2). The lower third portion of the true joint space is targeted for entry. Since the superior two-thirds portion of the SIJ is composed of interosseous ligaments, the inferior one-third was targeted for the unguided injection parallel to S3–S4 levels.

Radiologic study

The radiologic study was aimed to ensure the approximate puncture point. The average length of the sagittal synovium was 18.40 ± 3.40 mm in males and 17.32 ± 3.60 mm in females ($P > 0.05$); the average distance between the posterior midline and sagittal synovium was 41.00 ± 3.30 mm in males and 42.74 ± 4.00 mm in females ($P < 0.05$). We determined that there was a significant difference between male and female pelvises in the average distance between the midpoint and posterior superior iliac spine, which was 27.66 ± 3.10 mm in males and 28.76 ± 3.50 mm in females ($P > 0.05$; Fig. 5A; Fig 5B; Fig 5C; Table 1). The contrast agent was then injected into the joint (Fig. 6).

Practice-based study

In the whole process, no patients were allergenic to the drugs and contrast agent. The whole process

Table 1 Measurement results of the sagittal synovium (Mean ± SD) mm

Sex	D1	D2	D3	D4 (median)
Males	41.00 ± 3.30	18.40 ± 3.40	27.66 ± 3.10	36.2
Females	42.74 ± 4.00	17.32 ± 3.60	28.76 ± 3.50	38.6

D1: Distance between the posterior midline and sagittal synovium ($P < 0.05$).

D2: Length of sagittal synovium ($P > 0.05$).

D3: Distance between the midpoint and posterior superior iliac spine ($P > 0.05$).

D4: Distance between the superficial skin vertical to the sagittal synovium point ($P > 0.05$).

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-07 via free access

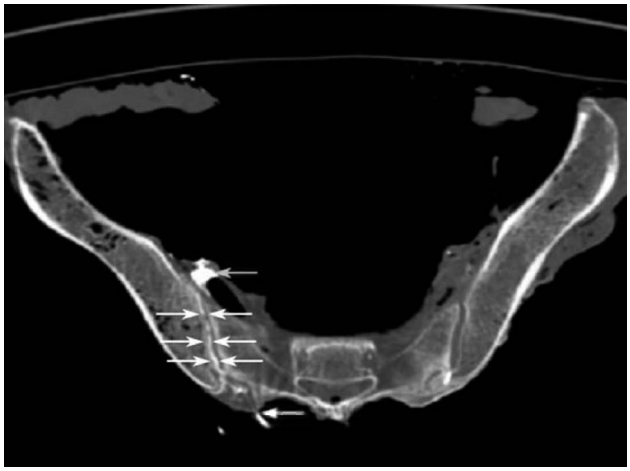

Fig. 6 CT scan of sacroiliac joint injection in embalmed cadavers. Arrow pointing to the dorsal side, indicating the needle; arrow pointing to the SI joint, indicating contrast agent showing the inner the sacroiliac joint, arrow pointing to the abdominal side, showing the extravasation of the contrast agent.

cost average only 13.6 minutes from the clip location to the CT identification. The contrast agent was irrigated successfully in 13 male patients, 11 males and 2 females failed to be injected (Fig. 7). Among 13 successfully-injected patients, 11 patients were located by clip only once.

Discussion

The progressive process of spondyloarthropathies renders their management tough. Thus far, no available treatment definitively alters the underlying mechanism of inflammation. The conventional interventions currently available, like usage of NSAIDs and DMARDs etc., are palliative rather than curative and often fail to control its progression or structural destruction in the long run. The sacroiliac joint is the leading joint that suffers from ankylosing spondylitis and is perhaps also involved in other spondyloarthropathies. In recent years, SIJ injection has been validated to diagnose SIJ pain and be therapeutically beneficial.[23,24] Inhibition of ankylosis of the sacroiliac joint plays a pivotal role in maintaining functional mobility and its prognosis. The efficacy of injection management under fluoroscopic,[25] CT,[26] or MRI[27] guidance has been validated.

The SIJ lies at an inferior location in the spine and the best approach often overlies the buttocks. Therefore, locating the target and optimum trajectory to the SIJ is crucial. The SIJ space is also small, with only 2–3-mm width and even narrower in AS patients or elderly individuals. The average length of sagittal synovium was 18.40 ± 3.40 mm in males and 17.32 ± 3.60 mm in females ($P > 0.05$); the average distance between the posterior midline and sagittal synovium was 41.00 ± 3.30 mm in males and 42.74 ± 4.00 mm in females ($P < 0.05$). Significant difference existed between males and females and the average distance between the midpoint and posterior superior iliac spine was 27.66 ± 3.10 mm in male and 28.76 ± 3.50 mm in females ($P > 0.05$). The median value of distance between the superficial skin vertical to the sagittal synovium point was 36.2 mm in males and 38.6 mm in females. These statistics are in correspondence with a previous study.[28]

In early ankylosing spondylitis patients when they complain mainly about pain before the bone turnover taking place, the space of synovium part of sacroiliac joint is wide enough (2–3 mm, compared with a common person) to permit a needle to enter in, this could be verified by our radiologic study (Fig. 6). In earlier studies some scholars reported that the sacroiliac joint space is small and that intra-articular injection of drugs cannot be successful without image assisted guidance.[29] However, in our study, we successfully injected 13 out of 20 patients using just X-ray clip location without any other image guidance. Sacroiliitis was confirmed by experienced radiologist and physician based on pelvic anteroposterior (AP) radiography.

In the process of unguided SIJ injection, the feeling of resistance will be felt twice followed by first a feeling of entering into a hollow space and then a narrow space. The first resistance is the needle passing through the SIJ posterior ligament and second resistance is felt when the needle enters the joint, followed by a sense of hollowness once the needle is in the joint space. Physicians tend to misjudge and ignore the feeling when entering the joint space. According to our findings in this study, the feeling of ligamentous resistance and joint resistance followed by a sense of hollowness is crucial. Another key point is that when pushing the drugs, the resistance is very tough but the process could still go on. If the power of resistance is either very mild or extremely huge to pushing the syringe, maybe the needle was out of joint space or has been pricked into the bone cortex, these 2 feelings were obtained in accordance with our cadaveric and radiologic study. Furthermore, the injections seem more tremendous than in patients, likely attributing to the tighter SI joint in embalmed cadaveric specimen than in patient.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-07 via free access

Fig. 7 (A) X-ray showing clip location, injection (the clip had been removed) in a patient.

Fig. 8 Photograph of a dissected pelvis showing the posterior sacroiliac joint ligament.

Conclusion

In fact, unlike many block or puncture techniques, sacroiliac joint injection is a very safe operation process if we are familiar with its structure. In our conclusion, unguided sacroiliac joint injection is possible and feasible after simple X-ray clip location for suspected sacroilitis patients including AS. Therefore, injection can be performed by a trained physician under aseptic conditions as an outpatient procedure especially in country or areas where fluoroscopy is not available. For the long term this study paves the way for unguided sacroiliac joint injection and makes it possible.

Limitations

In this study, only 20 patients were collected to attend our study, for some patients their symptoms

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-07 via free access

could be resolved by using drugs or other treatment, and another of them were afraid of the puncture process despite our detailed safety informs. And just 3 females were included in that AS male patients tend to be more common in clinics and often have severe symptoms. Six male patients and 1 female patient failed to enter the SIJ joint, for we did not sense in them what we mentioned above. Last is that all measured statistics from cadavers and patients were all Han Chinese people without other country or race; however, no matter what country or race, the research method is in the same way. Further study and more samples and patients are needed to investigate whether unguided sacroiliac joint injection is possible and feasible.

Acknowledgments

There is no source of support. As for competing interests, all authors have no interests to declare.

There was no funding for this study. For this article, Yucong Zou, Yikai Li, Xianwen Yang, and Runqi Chen researched literature and conceived the study. Chengfu Yu and Xianwen Yang were involved in protocol development, gaining ethical approval, patient recruitment, and data analysis. Yucong Zou and Yikai Li wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

References

1. Van Der Linden S, Valkenburg HA, Cats A. Evaluation of diagnostic criteria for ankylosing spondylitis. A proposal for modification of the New York criteria. *Arthritis Rheum* 1984; **27**(4):361–368
2. Feldtkeller E, Khan MA, van der Heijde D, van der Linden S, Braun J. Age at disease onset and diagnosis delay in HLA-B27 negative vs. positive patients with ankylosing spondylitis. *Rheumatol Int* 2003;**23**(2):61–66
3. Gran JT, Skomsvoll JF. The outcome of ankylosing spondylitis: a study of 100 patients. *Br J Rheumatol* 1997;**36**(7):766–771
4. Ward MM. Health-related quality of life in ankylosing spondylitis: a survey of 175 patients. *Arthritis Care Res* 1999; **12**(4):247–255
5. Dagfinrud H, Vollestad NK, Loge JH, Kvien TK, Mengshoel AM. Fatigue in patients with ankylosing spondylitis: a comparison with the general population and associations with clinical and self-reported measures. *Arthritis Rheum* 2005; **53**(1):5–11
6. Ward MM. Functional disability predicts total costs in patients with ankylosing spondylitis. *Arthritis Rheum* 2002;**46**(1):223–231
7. Dreyfuss P, Dreyer S, Cole A, Mayo K. Sacroiliac joint pain. *Am Acad Orthop Surg* 2004;**12**(4):55–65
8. Cohen S. Sacroiliac joint pain: A comprehensive review of anatomy, diagnosis, and treatment. *Anesth Analg* 2005;**13**(1): 40–53
9. Schwarzer AC, Aprill CN, Bogduk N. The sacroiliac joint in chronic low back pain. *Spine* 1995;**20**(1):31–37
10. Boswell MV, Trescot AM, Datta S, Schultz DM, Hansen HC, Abdi S *et al*. Interventional techniques in the management of chronic spinal pain: evidence-based practice guidelines. *Pain Physician* 2005;**8**(1):1–47
11. Forst SL, PA-C, Michael T, Vilensky JA. The sacroiliac joint: anatomy, physiology and clinical significance. *Pain Physician* 2006;**9**(1):61–68
12. Karabacakoglu A., Karaköse S., Özerbil Ö.M. Fluoroscopy-guided intraarticular corticosteroid injection into the sacroiliac joints in patients with ankylosing spondylitis. *Acta Radiol* 2002; **43**(4):425–427
13. Dussault RG, Kaplan PA, Anderson MW. Fluoroscopy-guided sacroiliac joint injections. *Radiology* 2000;**214**(1):273–277
14. Fischer T, Biedermann T, Hermann KG, Diekmann F, Braun J, Hamm B *et al*. Sacroiliitis in children with spondyloarthropathy: therapeutic effect of CT-guided intra-articular corticosteroid injection. *Rofo* 2003;**175**(6):814–821
15. Liu Y, Wang Q, Xiao Z, Chen S, Zeng Q. CT-guided percutaneous needle biopsy and intra-articular injection of sacroiliac joint. *ZhonghuaYi Xue Za Zhi* 2002;**82**(10):692–695
16. Ziran B.H., Heckman D., Smith W.R. CT-guided stabilization for chronic sacroiliac pain: a preliminary report. *J Trauma* 2007; **63**(1):90–96
17. Manchikanti L, Cash KA, Moss TL, Pampati V. Radiation exposure to the physician in interventional pain management. *Pain Physician* 2002;**5**(4):385–393
18. Mettler FA, Wiest PW, Locken JA, Kelsey CA. CT scanning: patterns of use and dose. *J Radiol Prot* 2000;**20**(4):353–359
19. Frush DP, Donnelly LF, Rosen NS. Computed tomography and radiation risks: what pediatric health care providers should know. *Pediatrics* 2003;**112**(4):951–957
20. Uppot RN, Dushyant VS, Hahn PF, Gervais D, Mueller PR. Impact of obesity on medical imaging and image-guided. *Intervention AJR* 2007;**188**(2):433–440
21. Kilborn LC, Labbe EE. Magnetic resonance imaging scanning procedures: development of phobic response during scan and at one-month follow-up. *J Behav Med* 1990;**13**(4):391–401
22. Ho HS. Safety of metallic implants in magnetic resonance imaging. *J Magn Reson Imaging* 2001;**14**(4):472–477
23. Fortin JD, Dwyer AP, West S, Pier J. Sacroiliac joint: pain referral maps upon applying a new injection/arthrography

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-07 via free access

technique. Part 1: Asymptomatic volunteers. *Spine* 1994;**19**(13): 1475–1482

24. Fortin JD, Dwyer AP, West S, Pier J. Sacroiliac joint: pain referral maps upon applying a new injection/arthrography technique. Part 2: Clinical evaluation. *Spine* 1994;**19**(13):1483–1489
25. Dussault RG, Kaplan PA, Anderson MW. Fluoroscopy-guided sacroiliac joint injections. *Radiology* 2000;**214**(1):273–277
26. Braun J, Bollow M, Seyrekbasan F, Häberle HJ, Eggens U, Mertz A *et al*. Computed tomography guided corticosteroid injection of the sacroiliac joint in patients with spondylarthropathy with sacroiliitis: clinical outcome and follow-up by dynamic magnetic resonance imaging. *J Rheumatol* 1996;**23**(4): 659–664
27. Fritz J, König CW, Günaydin I, Clasen S, Kastler B, Kötter I *et al*. Magnetic resonance imaging guided corticosteroid-infiltration of the sacroiliac joints: pain therapy of sacroiliitis in patients with ankylosing spondylitis. *Rofo* 2005;**177**(4):555–563
28. Sadreddini S, Noshad H, Molaeefard M, Ardalan MR, Ghojazadeh M, Shakouri SK. Unguided sacroiliac injection: effect on refractory buttock pain in patients with spondyloarthropathies. *Presse Med* 2009;**38**(5):710–716
29. Rosenberg JM, Quint TJ, de Rosayro AM. Computerized tomographic localization of clinically-guided sacroiliac joint injections. *Clin J Pain* 2000;**16**(1):18–21
30. Stallmeyer MJB. Facet blocks and sacroiliac joint injections. *Techniques in Vascular and Interventional Radiology* 2002;**5**(4): 201–206

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-07-07 via free access