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Original Article

Sacroiliac tuberculosis – A neglected differential in refractory low back pain – Our series of 35 patients

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ABSTRACT

Introduction: Osteo-articular tuberculosis accounts for 1–3% of which 5–8% involves sacro-iliac joint. Isolated sacroiliac involvement is very rare. It usually presents as vague back pain. Plain radiographs are often inconclusive. Due to rarity of lesion, vague symptoms and non-conclusive X-rays the diagnosis is further delayed. We present a series of 35 patients presented with sacroiliac tuberculosis.

Methods: 35 patients were diagnosed of sacroiliac tuberculosis from January 2008 to December 2011. After a thorough history and clinical examination, patients were taken up for X-rays and MRI scans. Ultrasound guided needle aspiration was done from suspected area. After histological confirmation of the diagnosis, patients were treated with anti tubercular therapy.

Results: Persistent low back pain and difficulty with walking were noted in all patients. There were 21 males (60%) and 14 females and the age ranged from 22 to 55 years (mean: 27 years). Most of the patients (91.4%) had unilateral disease (32 patients). Results of conservative management were good. 21 (60%) of our patients achieved bony ankylosis at the end of study. 9 patients did not respond to conservative management where surgical debridement was done. 4 of these cases had MDR tuberculosis.

Conclusion: Sacroiliac tuberculosis must be kept as a differential in all refractory low back pain particularly in endemic areas. MRI is very helpful in early diagnosis of disease. In the early stages of the infection aspiration using a closed needle biopsy is recommended. An open biopsy is essential when the aspirate yields no growth. Open debridement should be done in those not responding to conservative management.

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1. Introduction

Tuberculous bacilli have lived in symbiosis with mankind since time immemorial. In spite improved standard of living and extremely effective anti tubercular therapy today, there

are still 30 million people suffering from tuberculosis around the globe.¹ Osteo-articular tuberculosis accounts for 1–3% of which 5–8% involves sacro-iliac joint.^{1,2} Prior to the introduction of anti-TB treatment, Seddon and Strange and Sohlt reported over 200 cases with a high morbidity and mortality.^{2,3}

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The incidences have since declined and Kim et al reported 16 cases, which were treated over a 20-year period.⁴ Sacro-iliac joint is mostly involved in conjunction with spine or hip. Isolated sacroiliac involvement is further rare. It usually presents as vague back pain. Plain radiographs are often inconclusive. Due to rarity of lesion, vague symptoms and non-conclusive X-rays, the diagnosis is often delayed and it is not unusual to see that patients are being treated with physiotherapy and anti-inflammatory drugs for long time. The natural history of sacroiliac tuberculosis is bony ankylosis.^{2,3} We here present a series of 35 patients of isolated sacro-iliac tuberculosis.

2. Materials and methods

A prospective study of sacroiliac joint tuberculosis was performed from January 2008 to December 2011. 42 cases were diagnosed of isolated sacroiliac tuberculosis during this period. Patients with confirmed active tuberculosis of any other musculoskeletal site were excluded from the series. Seven patients were excluded as they had been followed up for less than 2 years.

A thorough clinical examination was done in all patients with a chronic back pain for over 6 weeks including back, hip joint, stress test for sacroiliac joint and neurological examination. Patients with morning stiffness and polyarthralgia were not included in the study. Tests for sacroiliac joint includes tenderness over sacroiliac joint and stress tests namely the pelvic compression test, the FABER (flexion, abduction and external rotation) test and the Gaenslen's test. Blood and radiological investigations were done for patients suspected with sacroiliac involvement. Complete blood count with ESR, C-reactive protein, baseline liver and renal function and mantoux were initial laboratory investigations. These were followed up by AP and Oblique X-rays of pelvis and bilateral hip. We used the classification given by Kim et al to classify our lesions.⁴ Type 1 involved widening of sacroiliac joint with blurring of margins, Type 2 had erosions of sacroiliac joint, Type 3 had severe destruction and Type 4 had an associated gluteal or spinal abscess and/or spinal tuberculosis. MRI of lumbosacral spine with bilateral sacroiliac joints was also done in all these cases.

Cases which showed lesions in sacroiliac area in radiological investigation were subjected to ultrasound guided needle biopsy from the lesion. Of those who showed inconclusive results, a formal open biopsy from posterior approach was done. The material was sent for histopathology, pus culture and sensitivity, gram stain, acid fast stain and culture on Lowenstein–Jensen medium.

Patients with histopathological or culture proven tuberculosis were started on anti tubercular therapy for 18 months.⁵ Four drugs – Isoniazid 5 mg/kg, Rifampicin 10 mg/kg, Ethambutol 25 mg/kg and Pyrazinamide 15 mg/kg were given for initial 2–3 months. Depending on response, decrease in pain and decline in ESR, Pyrazinamide was stopped after 2–3 months and the other 3 drugs were continued for 6–9 months. Once pain was relieved and ESR approached near normal Ethambutol was also stopped and 2 drug therapy was continued. Total duration of anti tubercular therapy was kept

for 18 months. Patients were kept on complete bed rest for initial 3 months. With relief in pain crutch assisted mobilisation was allowed with lumbosacral corset. Corset was used till healing of disease. Follow up X-rays were done at 3, 6, 12 and 18 months. Patients were evaluated on the Barthel index of activities of daily living and on Majeed pelvic scores.⁶ Minimum follow up in our series is of 2 years (range 2–6 years).

All those patients who were not relieved with ATT after 6–12 weeks with no improvement in pain and pelvis score were taken up for debridement and fusion of sacroiliac joint using posterior approach. With patient prone, semilunar incision was made along posterior third of crest. Origin of gluteus Maximus from ilium and sacrospinalis from sacrum were elevated. Sacroiliac joint was exposed and tuberculous debris was removed. Any remaining synovium or capsule was removed, surfaces were freshened, and bone block harvested from ilium was countersunk in prepared sacral bed. Post operatively patient was kept on bed rest for 10–12 weeks, after which limited ambulation with moulded brace was permitted.

3. Results

During January 2008–December 2011, 35 patients were diagnosed with sacroiliac tuberculosis. Results are summarised in Table 1. 9 of these patients had past history of pulmonary tuberculosis and 3 of these had not completed their DOTS treatment regimen. 2 patients had history of Potts spine in the past for which both of them had taken full course ATT and disease was healed clinically and radiologically. 3 patients had history of abdominal Koch's and 4 had history of tuberculosis in other region. All had taken full course of ATT. For rest of 17 patients, it was first episode of diagnosed tuberculosis. 13 patients had history of tubercular contact in our series.

27 patients in our series belonged to lower socio-economic status. The nutritional status of these patients was calculated using Rainey-McDonald nutritional index and we found 23 patients to be malnourished.⁷ 3 patients had uncontrolled diabetes and 7 patients were alcoholics.

Most of the patients (91.4%) had unilateral disease (32 patients). There were 21 males (60%) and 14 females (40%) and the age ranged from 16 to 55 years (mean: 27 years). The duration of symptoms ranged from 7 weeks to 22 weeks (mean: 10 weeks). Most of these patients were misdiagnosed as chronic low back pain, sciatica or postural pain.

Persistent low back pain and difficulty with walking were noted in all patients. Two patients presented with an abscess over the gluteal region. 22 patients had constitutional symptoms involving loss of weight, poor appetite and night sweats. 13 patients did not report any constitutional symptoms. In our study nearly 37% of our patients did not have any constitutional symptoms.

Clinical examination revealed tenderness along the affected sacroiliac joint in all patients. Stress tests of the sacroiliac joint, namely the pelvic compression test, the FABER (flexion, abduction and external rotation) test and the Gaenslen's test were positive. Ranges of motion at the hips were only painful at the extreme of flexion and extension. The straight leg raising test was negative in 28 patients (80%).

Table 1 – Results of patients in our series.

S. no	Sex	Laterality	No. of weeks from symptoms to presentation	Presentation	X-ray feature (Kim type)	Site of involvement	Diagnosis	Treatment	Final result	MDR
1	M	U/L	7	LBA	N	Upper third	Open biopsy	ATT	B	–
2	M	U/L	8	LBA + CS	1	Middle third	Needle biopsy	ATT	F	–
3	F	U/L	11	LBA + CS	2	Upper third	Open biopsy	ATT	B	–
4	M	U/L	8	LBA	1	Upper third	Needle biopsy	ATT	F	–
5	M	U/L	7	LBA + CS RAD	2	Middle third	Needle biopsy	ATT + Surgery	B	–
6	F	U/L	9	LBA + CS	N	Upper third	Open biopsy	ATT + Surgery	B	+
7	F	B/L	9	LBA + RAD	1	b/l Upper third	Open biopsy	ATT	F	–
8	M	U/L	12	LBA	N	Lower third	Needle biopsy	ATT	F	–
9	M	U/L	13	LBA + CS + ABSCESS	4	Middle third	Needle biopsy	ATT	F	–
10	M	U/L	22	LBA	1	Lower third	Open biopsy	ATT + Surgery	B	–
11	M	U/L	8	LBA + CS	1	Upper third	Open biopsy	ATT	B	–
12	M	U/L	9	LBA	2	Upper third	Needle biopsy	ATT	F	–
13	F	U/L	10	LBA + RAD	N	Lower third	Needle biopsy	ATT + Surgery	B	+
14	M	B/L	12	LBA + CS	3	b/l Upper third	Open biopsy	ATT	F	–
15	F	U/L	13	LBA + CS	2	Lower third	Open biopsy	ATT	B	–
16	M	U/L	15	LBA	N	Middle third	Needle biopsy	ATT	F	–
17	M	U/L	7	LBA + CS + ABSCESS	4	Middle third	Needle biopsy	ATT	F	–
18	F	U/L	11	LBA	N	Upper third	Open biopsy	ATT + Surgery	B	–
19	F	U/L	7	LBA + CS	N	Upper third	Needle biopsy	ATT + Surgery	B	+
20	M	U/L	10	LBA + RAD	2	Lower third	Needle biopsy	ATT	F	–
21	F	U/L	10	LBA + CS	3	Middle third	Needle biopsy	ATT	F	–
22	F	U/L	13	LBA + CS	N	Middle third	Needle biopsy	ATT	F	–
23	M	U/L	14	LBA + CS	N	Upper third	Needle biopsy	ATT	F	–
24	M	U/L	11	LBA + CS	2	Upper third	Needle biopsy	ATT	B	–
25	M	U/L	10	LBA + CS	1	Lower third	Needle biopsy	ATT	B	–
26	M	B/L	9	LBA + CS	3	Lower third	Needle biopsy	ATT + Surgery	B	+
27	F	U/L	7	LBA + CS	N	Middle third	Needle biopsy	ATT	F	–
28	F	U/L	10	LBA	3	Upper third	Needle biopsy	ATT	B	–
29	F	U/L	9	LBA + CS	2	Upper third	Open biopsy	ATT	B	–
30	F	U/L	9	LBA + CS	3	Upper third	Needle biopsy	ATT	B	–
31	M	U/L	7	LBA + CS	3	Middle third	Needle biopsy	ATT + Surgery	B	–
32	M	U/L	7	LBA	2	Lower third	Open biopsy	ATT + Surgery	B	–
33	M	U/L	8	LBA + CS	N	Lower third	Open biopsy	ATT	B	–
34	F	U/L	8	LBA + CS	N	Middle third	Open biopsy	ATT	B	–
35	M	U/L	0	LBA	3	Upper third	Needle biopsy	ATT	B	–

U/L – unilateral B/L – bilateral.

LBA – low back pain.

CS – constitutional symptoms.

RAD – radiation.

ATT – anti tubercular therapy.

B – bony ankylosis.

F – sound fibrous union.

The erythrocyte sedimentation rate (ESR) was elevated (mean: 68 mm/h) in most patients (range: 23–98 mm/h) whereas the complete blood count (CBC) revealed a normocytic, normochromic anaemia in most (range: 7.9–11.3 gm/dl, mean: 10.1 gm/dl).

AP and oblique pelvic radiographs were ordered for all patients. The features seen on X-rays included joint space widening, sclerosis of the joint margins and periarticular osteopenia (Fig. 1). Oblique X-rays were particularly important; lesions not seen clearly on AP X-rays became evident on oblique X-rays (Fig. 2a and b). According to Kim classification, we had 6 type 1 cases (26%), 8 type 2 cases (34.7%), 7 type 3 (30.4%) and 2 type 4 cases (8.6%) in our series.⁴ Radiographs were however not always helpful. 12 patients did not have any obvious bony changes and were reported as normal by two different radiologists. CT can establish the degree of bone destruction or rarely sequestrum. Most studies have used CT scan as the radiological modality in sacroiliac tuberculosis. CT definitely gives a better picture of bony destruction but soft tissue evaluation and abscess formation were relatively less defined. Further pelvis CT has high radiation dose. MRI was very useful in such cases as it not only showed bony involvement but also the associated soft tissue abscess without any risk of radiation (Fig. 3a and b). An early MRI in patients suspected with tuberculosis along with ultrasound guided biopsy helped us to reach diagnosis early with average time of diagnosis from presentation to commencement of ATT being 2.3 weeks.⁸ Most common site in our series was upper part of sacroiliac joint.

Disease was confirmed on basis of histological and microbiological evaluation. All patients were undertaken ultrasound guided needle biopsy from suspected area. Needle biopsy gave positive results in 22 of 35 patients (62%) which avoided the risk of formal biopsy under general anaesthesia. Open biopsy was done in remaining 13 patients (38%) in whom needle biopsy results were inconclusive.

All patients showed histopathological features suggested of tuberculosis. The biopsy material revealed areas of central caseous necrosis numerous epithelioid cells with pale pink cytoplasm and indistinct boundaries with oval or elongated

nucleolus. There was presence of Langhans type giant cells with large mass of cytoplasm containing multiple small nuclei arranged peripherally. Stains for acid fast bacilli were positive in only 14 patients (40%) (Fig. 4) and 3 patients (8%) showed growth on Lowenstein–Jensen medium.

Results of sacroiliac tuberculosis treated with anti tubercular therapy were good (Fig. 5a and b) (Fig. 6a and b). No treatment other than ATT was required in 26 of 35 patients. In these patients, the mean Barthel index of activities of daily living was 55 pre-treatment which increased to 85 post treatment. The Majeed pelvic score was 43 (poor) in pre-treatment time which became 86 after treatment. Pain decreased by 2–3 months. ESR was reduced and came to near normal level by 6–9 months. Only one patient required incision and drainage for a gluteal abscess which failed to resolve on conservative management. 21 (60%) of our patients achieved bony ankylosis while rest did not show radiological ankylosis. Radiological healing in our series did not correlate well with clinical healing. Patients were symptomatically better on anti tubercular therapy much before radiological signs of healing could be demonstrated. Moreover both, radiologically ankylosed and radiologically non ankylosed patients, had similar pain and functional scores at 2 years showing that these cases have sound fibrous healing. No case of limb length discrepancy was seen in our series. Patients in whom anti tubercular therapy was started early responded well to treatment, however when treatment was started late in course of disease, patient complained of some residual pain at the end of study. We observed that a delay of over 14–16 weeks in starting of ATT after starting of pain was a poor prognostic sign.

The 9 patients who did not respond to conservative management were taken up for surgical debridement through posterior approach followed by fusion of joint. Fusion was performed through posterior approach using autogenous bone graft. The infected material, synovium and cartilage were removed and raw surfaces were filled with bone grafts. No implant was used. Cultures were sent intra-operatively. 4 of these patients showed multi drug resistance. These patients were started on second line ATT depending on the sensitivity reports. No growth was seen in rest of the patients. However all these patients responded favourably after debridement and bony ankylosis was achieved in 2 years' time. At end of 2 years, all patients had healed disease, with minimal or no discomfort, full weight bearing without support, no significant limb length discrepancy. The final fate of sacroiliac tuberculosis in our series was either spontaneous bony fusion or sound fibrous healing.

Fig. 1 – Plain AP radiograph of pelvis showing joint widening and sclerosis of the margins on left side.

4. Discussion

Tubercular sacroiliitis is rare, represented only by sporadic case reports in the literature.^{9,10} In recent literature after year 2000, this is one of the largest series of pathologically proven sacroiliac tuberculosis. Table 2 provides the comparison of various published data in literature. Sacroiliac joint is a true synovial joint and is subject to infection as any other joint. The disease may start from lateral mass of sacrum, ilium or synovial membrane. Children are less commonly affected and in

Fig. 2 – a and b: AP and oblique X-rays of the patient. It is important to note that joint space widening is more obvious on oblique X-rays than on AP Films.

Fig. 3 – a: Coronal T2 weighted MRI image showing signal intensity changes in upper part of sacroiliac joint. b: Coronal T2 weighted image on sagittal cut showing increased intensity on left sacroiliac joint.

Fig. 4 – Pus sample from sacroiliac joint lesion showing acid fast bacillus. Arrow marked shows the clump of acid fact bacillus.

patients with poor nutritional status, bilateral involvement is not uncommon.¹ The presenting symptoms of sacroiliitis are vague and the distribution of pain varies considerably due to close relationship between the joint, the lumbosacral plexus and the ability of the abscess to track in any direction.^{3–5} All patients in our series presented with vague low back pain and only about 63% reported any constitutional symptoms. The infection in the early stages is often misleading and may mimic pathology in the lower back as well as of the ilium. In bilateral sacroiliac disease particularly in younger males early ankylosing spondylitis also needs to be ruled out. There were 3 patients in our series with bilateral disease.

FABER test and direct tenderness over sacroiliac area in our study were most reliable clinical tests for evaluating SI joint. Active straight leg raise gave a very high false positive result. Similar results are also seen elsewhere in literature.¹¹

In the early stages of the disease, capsular distension is evident on magnetic resonance imaging (MRI). Associated

Fig. 5 – a and b: Pre-treatment and follow up AP X-ray at 2 years showing ankylosis of joint space.

bone oedema and destruction are also noted.⁸ X-rays reveal haziness initially, but this is replaced by joint widening, sclerosis of the margins and possible sequestrae in the joint in the more advanced stages.^{2,3} Oblique views of the pelvis were particularly important and these clearly demonstrated the lesions when AP views failed to do so.

There are wide array of differential diagnosis of sacroiliac pain. These can be divided broadly as rheumatic and non-rheumatic conditions. Rheumatic conditions mostly involve most commonly ankylosing spondylitis followed by other spondylo-arthropathy. Non rheumatic conditions usually involve infections, osteomalacia, neoplasms and osteitis condensus ilii.¹² Tuberculosis may mimic such pathologies and it may be difficult to diagnose especially in bilateral cases. However classical history of waxing and waning symptoms, morning stiffness, occasional positive family history, restriction of lumbar flexion generally is features in ankylosing spondylitis. HLA B-27 in bilateral cases when positive, though not diagnostic, helps to shift the favour more towards ankylosing spondylitis. On the other hand constitutional

symptoms, positive mantoux, elevated ESR and previous history of tuberculosis or tubercular contact were in favour of tuberculosis. However in most occasions further radiological investigations in form of CT scan and MRI may be warranted. We used MRI in our study which showed hyper intense T1 and hypo intense T2 images due to presence of blood degradation products, inflammation, necrosis and fibrosis which is seldomly seen in other proliferative arthropathies. Para-articular abscesses have thin, smooth and enhancing walls in MRI. In contrast, ankylosing spondylitis show synovial enhancements correlating with disease activity, inter-spinous ligament enhancement showing enthesopathy and increased T2 signal correlating with oedema or vascularized fibrous tissue. Diagnosis in our series was however confirmed by biopsy.

A diagnostic aspiration or closed needle biopsy of the sacroiliac joint is appropriate when the disease is in its early stages with minimal joint destruction.^{3–5,13} The method is less invasive, can easily be done under local anaesthesia and gave good results when done under ultrasound guidance. In our series 62% patient were diagnosed on needle biopsy and

Fig. 6 – a and b: Pre-treatment and follow up AP X-ray at 2 years showing ankylosis of joint space.

Table 2 – Comparison of published series in pubmed in post tubercular chemotherapy era with atleast more than 10 patients.

Study	No. of patients	Result	No. of patients requiring surgery	Complications	Treatment followed	MDR TB	Diagnosis
Kim et al ⁴	16	Bony arthrodesis in all	12	None mentioned	Type 1 & 2 – ATT	Not mentioned	12 pathologically proven, 4 clinically suspected
R.J.S. Ramlakan et al ⁵	15	Bone healing at 2 years	All	Mild pain/discomfort in all	Type 3 & 4 – surgery	Not mentioned	Open biopsy in 12
Present series	37	21 bony ankylosis and 16 sound fibrous healing	9	No major complication	Curettage and ATT ATT in all. surgery in 9 Patients not responding	4	Histopathologically by open biopsy Ultrasound guide aspiration/open biopsy. All histopathologically proven or AFB positive

formal open biopsy under anaesthesia was not required. Kim et al performed an open biopsy in 12 of 16 patients.⁴ They found that fusion occurred earlier in patients who had an open biopsy when compared to the four patients treated conservatively with anti tuberculous medication only.⁴ Soholt showed that bony ankylosis occurred in both the operative and non-operative groups, and the advantage of open biopsy was that the process of healing might be faster.³ We also observed similar results. Open biopsy was done in 13 patients, 11 of which had bony ankylosis in 2 years. 2 patients of biopsy group had fibrous healing. On the other hand, only 10 of 22 patients in needle biopsy group had spontaneous bony fusion.

Both needle biopsy and open biopsy have given high yields in literature.^{2,4} In this study, the yield was 100%, but acid fast bacilli were only isolated in 40% of cases. This may be attributed to the paucibacillary nature of musculoskeletal tuberculosis. In the absence of TB elsewhere (pulmonary, spinal), a tissue diagnosis is essential especially when the aspirates are negative.

None of the reports mention the presence of multi drug resistance in their series of sacroiliac joint tuberculosis. However we found that 4 of our 35 patients were MDR. A through debridement with second line ATT helped to control the infection. Possibility of MDR should be kept in mind in patients not responding to ATT.

5. Conclusion

A clinical diagnosis of sacroiliac joint infection includes a thorough history and a meticulous examination of the lower back and the sacroiliac joint. Most of the patients present with chronic back pain. Sacroiliac tuberculosis must be kept as a differential in all refractory low back pain particularly in endemic areas. MRI is very helpful in early diagnosis of disease. In the early stages of the infection aspiration using a closed needle biopsy is recommended. An open biopsy is essential when the aspirate yields no growth. Possibility of MDR tuberculosis should be kept in mind in patients not responding to first line ATT. Final fate of sacroiliac tuberculosis in most cases is bony ankylosis or sound fibrous healing.

Consent of patient

A full and free consent were taken by patients regarding the study to be published for which patients did not have any objection.

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES

1. Tuli SM. *Tuberculosis of the Skeletal System (Bones, Joints, Spine and Bursal Sheaths)*. New Delhi: Jaypee Brothers Publication; 2010:3–15.
2. Seddon HJ, Strange FG. Sacroiliac tuberculosis. *Br J Surg*. 1940;193–221.
3. Soholt ST. Tuberculosis of the sacroiliac joint. *J Bone Joint Surg Am*. 1951;33:119–129.
4. Kim NH, Lee HM, Yoo JD, Suh JS. Sacroiliac joint tuberculosis—classification and treatment. *Clin Orthop Relat Res*. 1999 Jan;358:215–222.
5. Ramlakan RJS, Govender S. Sacroiliac joint tuberculosis. *Int Orthop*. Feb 2007;31(1):121–124.
6. Majeed Sa. Grading the outcome of pelvic fractures. *J Bone Joint Surg Br*. 1989;71-B:304–306.
7. Rainey-McDonald CG, Holliday RL, Wells GA, et al. Validity of a two-variable nutritional index for use in selecting candidates for nutritional support. *J Parenter Enteral Nutr*. 1983;7:15.
8. Kim NH, Lee HM, Suh JS. Magnetic resonance imaging for the diagnosis of tuberculous spondylitis. *Spine*. 1994;19:2451–2455.
9. Attarian DE. Septic sacroiliitis: the overlooked diagnosis. *J South Orthop Assoc*. 2001;10:57–60.
10. Chen WS. Chronic sciatica caused by tuberculous sacroiliitis—a case report. *Spine*. 1995;20:1194–1196.
11. Laeslett M, Williams M. The reliability of selected pain provocation tests for sacroiliac joint pathology. *Spine*. 1994;19:1243–1248.
12. Gupta AD. Sacroiliac joint pathologies in low back pain. *J Back Musculoskelet Rehabil*. 2009;22(2):91–97.
13. Hendrix RW, Lin PJ, Kane WJ. Simplified aspiration or injection technique for the sacroiliac joint. *J Bone Joint Surg Am*. 1982;64:1249–1252.