Case Study

Fluoroscopy-Guided Sacroiliac Joint Injection: Description of a Modified Technique

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Sacroiliac joint (SIJ) pathology is a common etiologic cause for 10 – 27% of cases of mechanical low back pain (LBP) below the L5 level. In the absence of definite clinical or radiologic diagnostic criteria, controlled blocks of the SIJ have become the choice assessment method for making the diagnosis of SIJ pain. The SI joint is most often characterized as a large, auricular-shaped, diarthrodial synovial joint. In reality, its synovial characteristic is limited only to the distal third and anterior third. In SIJ interventions, the lateral view has been underutilized. In our technique, we used the lateral view to create a three-dimensional view of the SIJ to aid in gauging the accurateness of the contrast spread and to obtain a precise block. After obtaining appropriate fluoroscopic images, a curved tip spinal needle was directed into the inferior aspect of the SIJ using a posterior approach. As the needle contacts firm tissues on the posterior aspect of the joint, position of the needle tip is checked using lateral fluoroscopy. In the lateral view, the needle tip position is manipulated to keep it in the anterior third of the SIJ and contrast is injected. Our criteria for accurate SIJ block, in posteroanterior (PA) view, is the injection of the contrast medium should outline the joint space and the contrast medium should be seen to travel cephalad along the joint line. In the lateral view, the contrast medium most densely outlines the parameter of the joint. We have utilized this method with good effect in approximately 30 cases over one year. Out of 30 cases, needle position and contrast spread was satisfactory in 28 and 27 cases, respectively. So satisfactory needle placement and contrast spread was in 93% and 87% cases. Pain relief of 80% or more after intra-articular injection of local anaesthetic was seen in 50% (15 of 30) patients; pain relief of 50 – 79% was witnessed in 30% (9 of 30) patients. Thus, pain decreased 50% or more in 80% (24 of 30) of the joints. Out of 24 joints where we got satisfactory needle position and contrast spread, 23 joints got more than 50% relief. Thus, if needle position and contrast spread is satisfactory as per the criteria, pain relief of 50% or more was in 96% (23 of 24) of joints. There are few possible limitations with this study like difficulty to go up to the anterior third of the SIJ, it may be more painful as a narrow joint line has to be travelled in depth, sciatic numbness due to drug leak, or injuring the pelvic structure. Advantages of this method are that depth and level of the needle tip for a SIJ block is described for the more precise block. This will reduce false positive and false negative results, i.e., sensitivity and specificity of SIJ blocks and results for diagnostic blocks become more reliable. It will also reduce the chances of a case getting abandoned due to inappropriate contrast spread obscuring the fluoroscopic landmarks. As we know the depth of the needle, the chances of injuring pelvic structures become less and safety improves.

Key words: Sacroiliac joint, low back pain, contrast dye, fluoroscopy, lateral view, pain management, SI joint block, modified technique

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Sacroiliac joint (SIJ) pathology is a common etiologic cause of low back pain (LBP), accounting for 10 – 27% of cases of mechanical LBP below L5 level (1,2). In the absence of definite clinical or radiologic diagnostic criteria, controlled blocks of the SIJ have become the choice assessment method for making the diagnosis of SIJ pain. There is good evidence for diagnostic SIJ injections using controlled local anesthetic or placebo blocks and 75 – 100% pain relief as the diagnostic criterion (3). Systematic reviews have found that the evidence for therapeutic SIJ injections is limited, but several investigators have

reported good pain relief with the technique (4-14). Diagnostic and therapeutic SIJ injections are frequently performed interventions in pain management settings.

The anatomical structure, innervations, presence of sinusoids around the joint, and inter-individual variations in structure make SIJ injections difficult to accomplish without any guidance (e.g., fluoroscopy, computerized tomography (CT), ultrasound) (Fig. 1). Clinically-guided SIJ injections without radiographic guidance have been reported to result in low rates of intra-articular injections, spread into sacral foramina, extension into the epidural space, and vascular uptake (15). Fluoroscopically guided intra-articular SIJ injections are widely performed in clinical practice. Previous authors have described fluoroscopically guided single needle techniques and a double needle technique (16-24).

In the conventional single needle technique, even with dynamic fluoroscopic guidance, the contrast spread may not be satisfactory. If the result after contrast injection is not appropriate, then further visualization of the SIJ becomes difficult and the procedure needs to be postponed. In the double needle technique, we consider that either of the 2 needles placed must have been placed in the correct position in the SIJ (24). However, it can be possible that both the needles are not in the SIJ.

In most fluoroscopically guided interventions in pain management practice, it is common for posterior-anterior (PA), oblique, and lateral views to be obtained using the C-arm to create a three-dimensional image. In SIJ interventions, the lateral view has been underutilized. Here, we have described a modified fluoroscopically guided injection technique that uses the lateral view to create a three-dimensional view of the SIJ to aid in gauging the accurateness of the contrast spread and to obtain a precise block. Criteria for an accurate or precise block, in the PA view, is the injection of a contrast medium should outline the joint space and contrast medium should be seen to travel cephalad along the joint line. In the lateral view, the contrast medium most densely outlines the parameter of the joint.

We have utilized the method detailed here for SIJ injections with good effect in approximately 30 cases over the last year.

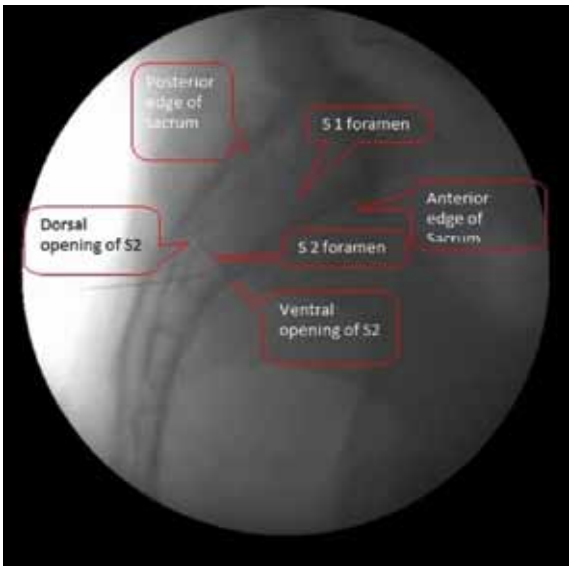

Fig.1. *On dynamic fluoroscopy in lateral view, fluoroscopic anatomy of SIJ.*

Methods

The technique described herein was performed over a period of one year, between March 2013 and February 2014. We performed this technique on selected patients who presented with SIJ pain and were in the age range of 18 – 60 years, had no diabetes or hypertension, had a positive Patrick's test (FABERE test) or Gaenslen's test, and had no pain above the posterior superior iliac spine (PSIS) level. We excluded those patients with local infection, sepsis, coagulopathy, allergy to local anaesthetics, and those on anticoagulants. We assessed percentage pain relief using a visual analogue scale (VAS) after the procedure. We retrospectively analyzed data of SIJ injection success and pain relief from hospital records of the 30 patients who underwent this technique during this one year period.

After explaining the procedure and obtaining informed consent, the patients were positioned prone on the fluoroscopic table. The injection site was prepared and draped using sterile technique.

The fluoroscopy tube is started in the PA view, angled cephalad to focus the beam downward on the lower part of the SIJ, and rotated toward the contralateral oblique view (0 – 30˚) until a clear view of the SIJ is obtained, such as to visualize the widest space at the most inferior aspect of the SIJ.

The C-arm is angled in such a way that the silhouettes of the posterior and the anterior aspects of the SIJ are seen to overlap and the hyper lucent area noted between the joint lines (Fig. 2). The target area for the SIJ is the inferior third lucent area. If the anterior (lateral silhouette) and posterior (medial silhouette) lines

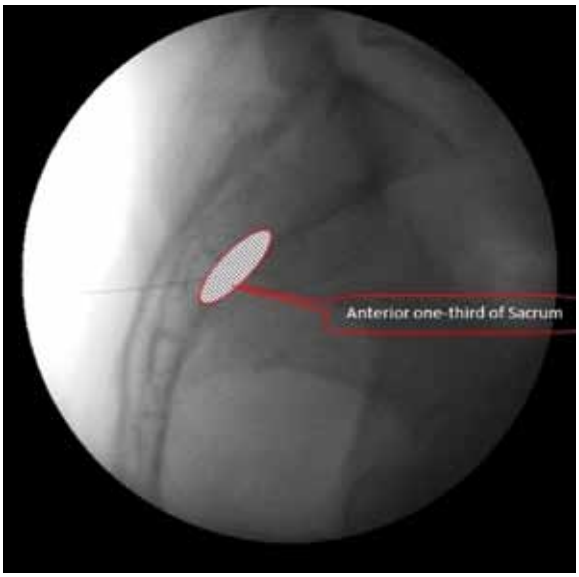

Fig. 2. *On dynamic fluoroscopy in lateral view, target position for the tip of the needle, ie, in anterior one-third of SIJ.*

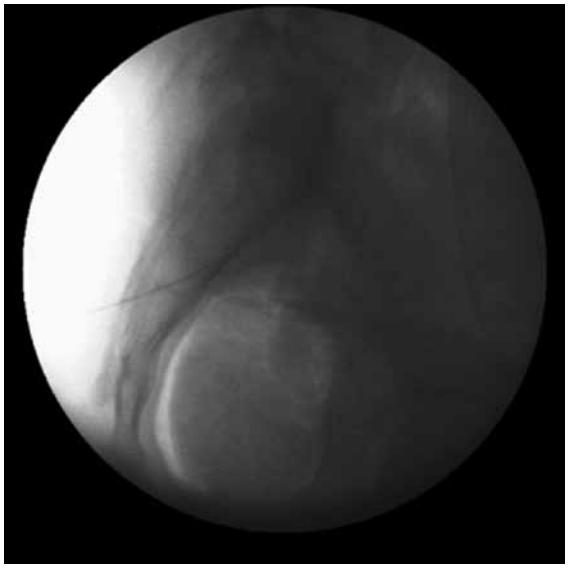

Fig. 3. *On dynamic fluoroscopy in lateral view, the tip of the needle appears in anterior one-third of SIJ.*

of the joint appear divergent, the posterior border is selected for cannulation.

After obtaining appropriate fluoroscopic images, the injection site was marked and anesthetized using local anaesthesia. A 23-gauge, 3.5-inch long, curved tip spinal needle was directed into the inferior aspect of the SIJ using a posterior approach. As the needle contacts firm tissues on the posterior aspect of the joint, it should be maneuvered through the ligaments and capsule into the joint which gives a subtle tactile sensation of a "giving away" or loss of resistance. Then a needle is advanced by about 5 mm, usually by angling the needle tip slightly laterally and cephalad to follow the natural curve of the joint.

After the tip of the needle has reached the target zone, the oblique views (ipsilateral and contra lateral) are used to ensure that the needle is placed within the joint space and this is visible in different views. The tip of the needle should appear between the joint lines in the joint space and not seem to be on the bone. Then the position of the needle tip is checked using lateral fluoroscopy.

In the lateral view, the needle tip position is checked and manipulated to keep it at or above the S2 foramen ventral opening and in the anterior one-third of the SIJ. If the needle tip is below the S2 level, the needle is withdrawn 5 – 10 mm, angled cephalad, and advanced again to reach the S2 level or above. Once the needle is in place, contrast (ultravist 300, 0.3 to 0.5 mL) is injected through the needle (Fig. 3). In a PA view, the contrast travels cephalad along the joint line and spreads throughout the SIJ in an inferior to superior fashion (Fig. 4). In the lateral view, the contrast spread will be flask shaped as shown in Fig. 5 and densely outlines the SIJ's anterior, posterior, inferior, and sometimes superior border.

Results

Out of 30 cases, needle position was satisfactory in 28 cases and contrast spread was satisfactory in 27 cases (Table 1). Satisfactory needle placement was almost in 93% cases and satisfactory contrast spread was in 87% cases (Table 2). There was not much difference in successful contrast spread between men (83%) and women (87%) (Table 3). Pain relief of 80% or more after intra-articular injection of local anaesthetic was seen in 50% (15 of 30) of patients; pain relief of 50 – 79% was witnessed in 30% (9 of 30) of patients. Thus, pain decreased 50% or more in 80% (24 of 30) of the joints. Out of 24 joints where we got satisfactory needle position and contrast spread, 23 joints got more than 50% relief and out of 6 joints where needle position and contrast spread was not satisfactory, 5 joints got less than 50% relief. Thus if needle position and contrast spread is satisfactory as per the criteria (here in our study 24 joints), pain relief of 50% or more was

seen in 96% (23 of 24) of joints. This technique has been used in my practice with high accuracy and has made the procedure less complicated.

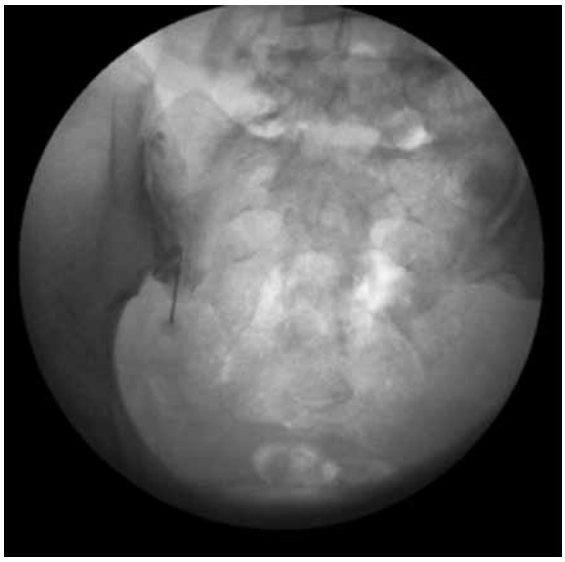

Fig. 4. *On dynamic fluoroscopy in AP view showing the contrast spread in SIJ.*

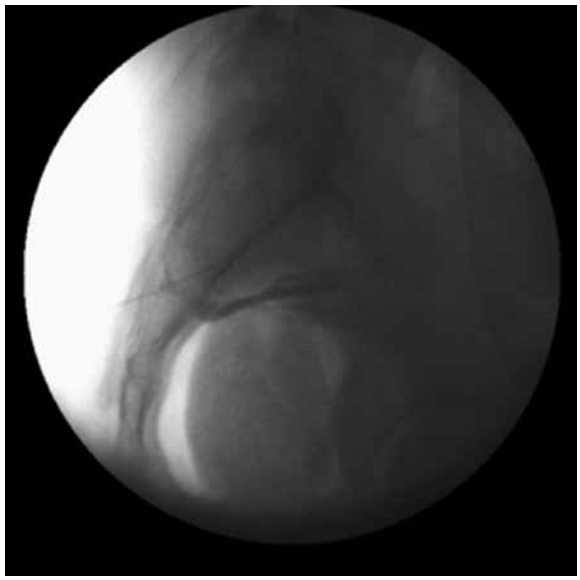

Fig. 5. *On dynamic fluoroscopy in lateral view showing the contrast spread in SIJ.*

Discussion

The SIJ is the largest axial joint in the body, with an average surface area of 17.5 cm^2 (25). There is wide variability in the adult SIJ, encompassing size, shape, and surface contour. Large disparities may even exist within the same individual (26,27). The SIJ is anatomically complex and comprised of a fibrous part where the joint surfaces are held together by interosseus ligaments and a cartilaginous part that has some features of a synovial joint. This synovial characteristic is limited only to the distal one-third of the SIJ, where the iliac joint facet resembles a synovial joint with the presence of an inner capsule that has synovial cells (28-30). Stability to the joint is provided by the ligaments (interosseus ligament and the sacroiliac ligaments) and fibrous expansions of adjacent muscles that reinforce the joint capsule (31). The SIJ is most often characterized as a large, auricular-shaped, diarthrodial synovial joint. In reality, only the anterior third of the interface between the sacrum and ilium is a true synovial joint; the rest of the junction is comprised of an intricate set of ligamentous connections. Because of an absent or rudimentary posterior capsule, the SI ligamentous structure is more extensive dorsally, functioning as a connecting band between the sacrum and ilium (32).

A cadaveric study showed that the joint is innervated anteriorly from the ventral rami of L5 to S2 and via branches of the sacral plexus, and posteriorly from the lateral branches of the S1 to S4 dorsal rami (33). Recent studies have shown predominant dorsal innervations of the SIJ in humans with sensory fibres from the L5 dorsal ramus and the S1 to S4 dorsal rami (34-36). Another anatomic study on cadavers demonstrated that the number and location of lateral branches from each sacral dorsal ramus level traceable to the SIJ complex displayed marked variation. The lateral branches were seen to exit from the 2 o'clock to 6 o'clock position on the right and from the 6 o'clock to the 10 o'clock position on the left at the S1-S3 foramen dorsally (37). These studies indicate that the nerve supply to the SIJ does not follow a particular pathway, thus making it difficult to block and hence the need for intra-articular injection (24).

The complexity of the SIJ structure and anatomic variations make intra-articular injections clinically difficult to accomplish without any guidance (38-40). A double-blind study demonstrated that clinically guided technique could achieve successful intra-articular injection in only 22% of patients (15). In another study, blind clinically guided SIJ injections by an experienced

Table 1. *Results of needle position and contrast spread.*

No	Age	Gender	Needle position	Contrast spread	Probable cause of unsatisfactory needle position/ contrast spread	% of pain relief
1	36	Female	Satisfactory	Satisfactory		80
2	58	Female	Satisfactory	Satisfactory		90
3	55	Female	Satisfactory	Satisfactory		75
4	42	Female	Satisfactory	Satisfactory		100
5	47	Male	Satisfactory	Satisfactory		80
6	23	Female	Satisfactory	Satisfactory		100
7	50	Female	Satisfactory	Satisfactory		70
8	52	Female	Tip in middle third	Satisfactory	Not able to move ahead due to bone/ narrow joint space	40
9	38	Female	Satisfactory	Satisfactory		60
10	44	Female	Satisfactory	Satisfactory		90
11	45	Female	Satisfactory	Satisfactory		80
12	20	Male	Satisfactory	Satisfactory		75
13	35	Female	Satisfactory	Satisfactory		80
14	47	Female	Satisfactory	Satisfactory		100
15	55	Male	Satisfactory	Satisfactory		60
16	49	Female	Satisfactory	Partly in & partly out	capsule leak	40
17	43	Female	Satisfactory	Satisfactory		40
18	32	Female	Satisfactory	Satisfactory		70
19	56	Female	Unable to enter	Not Satisfactory	Calcified capsule/narrowing of joint space	0
20	28	Female	Satisfactory	Satisfactory		100
21	59	Male	Satisfactory	Unable to inject	Too tight joint space	0
22	29	Female	Satisfactory	Satisfactory		60
23	47	Female	Satisfactory	Satisfactory		90
24	36	Male	Satisfactory	Satisfactory		100
25	23	Female	Satisfactory	Satisfactory		85
26	30	Female	Satisfactory	Satisfactory		90
27	52	Male	Satisfactory	Satisfactory		100
28	50	Female	Satisfactory	Not satisfactory (irregular contrast spread)	Due to irregular joint	30
29	44	Female	Satisfactory	Satisfactory		70
30	56	Female	Satisfactory	Satisfactory		60

Table 2. *Percentage of satisfactory needle position and contrast spread.*

	Satisfactory	Percentage	Not Satisfactory	Partial
Needle position (30)	28	93.33%	2	
Contrast spread (30)	26	87%	3	1

Table 3. Satisfactory contrast spread in male and female patients.

	Satisfactory contrast	Percentage
Male (6)	5	83.33%
Female (24)	21	87.50%

spinal injectionist had only around a 12% success rate for intra-articular injections (41). These results indicate that SIJ injections have to be performed only under radiographic or ultrasonographic guidance. Fluoroscopically guided techniques allow more precise localization of the SIJ during injection and high success rates for intra-articular injection of up to 97 – 98% have been reported with it (21,42).

A direct posterior approach is favored to target the accessible postero-inferior portion of the SIJ (19). Due to the curvature of the SIJ, the posterior aspect of the SIJ is situated medially and the anterior aspect of the joint is located laterally (39). As it is difficult to get a complete view of the SIJ under fluoroscopic guidance, maneuvring of the C-arm to different angles is needed to visualize the target area. The C-arm is rotated 25 – 35° caudally from the axial plane to make the accessible postero-inferior aspect of the SIJ clearly differentiated from the anterior aspect. Oblique positioning on the contra lateral side between 0 – 30° helps avoid interference from the ipsilateral iliac crest (43).

Different authors have described techniques to delineate the target region for the needle. These include getting a radiographic separation between anterior (medial silhouette) and posterior (lateral silhouette) joint aspects and targeting the medial silhouette. The other technique is based on getting a hyper lucent area when the caudal portions of medial and lateral joint silhouettes cross while orbiting the C-arm and targeting the inferior one-third of the SIJ (20-23).

The double needle technique described by Gupta (24) uses the C-arm left and right oblique positions in dynamic fluoroscopy to confirm that the needle tip is within the joint line and not over the bone. If the first needle is seen to be on the bone, then a new joint line is identified to pass a second needle and its position confirmed by dynamic fluoroscopy. The contrast agent is first injected into the needle most likely to be in the SIJ and if proper contrast spread is not seen, contrast is then injected into the second needle. This method provides 2 opportunities to confirm that optimal needle positioning is achieved (24).

The lateral view has more commonly been used to check for contrast spread. Under fluoroscopy, the AP view shows the inferior recess of the SIJ, the contrast within the joint margins, and any subligamentous or inferior recess extension. The oblique (en-face orauricular) view is used to delineate the contrast in relation to the joint borders and to reveal any diverticula and ventral capsular tears. The lateral view is utilized to demonstrate any posterior ligamentous extravasation, diverticula, and ventral tears (44). The lateral view has also been recommended as the safe view to guarantee that the needle has not been advanced too far ahead such that it can impinge on the pelvic viscera such as bladder and bowel (45).

In our technique, the lateral view has been used to check proper positioning of the needle. As only the anterior third and distal third of the SIJ is a true synovial joint, the lateral view is taken into consideration for appropriate needle positioning (28,30,32). Here, we have described a modified fluoroscopically guided injection technique that uses the lateral view to create a three-dimensional view of the SIJ to aid in gauging the accurateness of the contrast spread and to obtain a precise block. Criteria for an accurate block, in the PA view, are the injection of the contrast medium should outline the joint space and contrast medium should be seen to travel cephalad along the joint line. In the lateral view, the contrast medium most densely outlines the parameter of the joint.

We noticed that if in the lateral view the needle tip is kept at or above the S2 foramen ventral opening, contrast spread is usually correct. If we see the flask-shaped contrast spread in all cases in the lateral view, the inferior border usually lies at or above the midpoint of the S2 and S3 foramen. So we recommend keeping the needle angled laterally and cephalad after the loss of resistance in the PA view so that the needle tip remains at or above the S2 foramen ventral opening. But this needs more detailed study to decide the level of the needle tip.

In this technique, we have tried to add a third dimension to a fluoroscopically guided SIJ block so that we can confirm whether we are in the joint. We have used this technique with great success. In a single or double needle technique, even with a PA view showing we are in the joint, we may not get the appropriate contrast spread. The lateral view helps to confirm the needle position. It is best to get the needle tip within the joint line in the PA view. But if you are not getting it exactly and are still able to move the needle without much force within safe limits, you can do a successful SIJ

block. So we think this technique may help to increase the chances of successful SIJ intra-articular injection.

We have utilized the method detailed here for SIJ injections with good effect in approximately 30 cases over the last year. In our study 6 men and 24 women were included, aged between 18 and 65 years. The needle position and contrast spread is considered satisfactory if they are as per the criteria. Out of 30 cases, needle position was satisfactory in 28 cases and contrast spread was satisfactory in 27 cases (Table 1). In one case, contrast spread was partial in and partial out; this case we have considered as not satisfactory. So satisfactory needle placement was seen in almost 93% of cases and satisfactory contrast spread was seen in 87% of cases (Table 2). There was not much difference in successful contrast spread between men (83%) and women (87%) (Table 3). Pain relief of 80% or more after intra-articular injection of local anaesthetic was seen in 50% (15 of 30) of patients; pain relief of 50 – 79% was witnessed in 30% (9 of 30) of patients. Thus pain decreased 50% or more in 80% (24 of 30) of the joints. Out of 24 joints where we got satisfactory needle position and contrast spread, 23 joints got more than 50% relief and out of 6 joints where needle position and contrast spread was not satisfactory, 5 joints got less than 50% relief. Thus if needle position and contrast spread is satisfactory as per the criteria (here in our study in 24 joints), pain relief of 50% or more was in 96% (23 of 24) of joints. In one study by Dussault et al (21) after injection, pain decreased by 80% or more in 7 of the 28 joints (27%), by 50 – 70% in 11 joints (39%), and by less than 50% in 10 joints (36%). Pain relief of 50% or more after intra-articular injection of local anaesthetic was obtained in 64% (18 of 28) of the joints.

There are few possible risks or problems with this study. In one case, in the PA view, the tip of the needle was not exactly within the joint line but we were able to proceed without much resistance and force in the lateral view to the desired anterior third position. Then contrast spread noted which was satisfactory in both the PA and lateral view. In another case though fluoroscopically we were in the correct position in the PA and lateral view, contrast spread was partly in joint and partly outside. This could be a capsule leak. In one more case, the needle tip was fluoroscopically correct but we were not able to inject the contrast even with moderate force. In one patient, we were not able to enter in the joint and in another case we were not able to go beyond the middle third, even though contrast spread was satisfactory in the latter case. In such cases, whether CT guided SIJ intra-articular needle placement will be more helpful needs to be evaluated. As we are using the lateral view and still are unable to reach the true synovial joint, i.e., anterior third of SIJ, we can plan for alternative methods like CT guided blocks, rather than giving inadvertent, inappropriate, incorrect SIJ blocks. We are able to dictate these problems as we have used the lateral view. In most of the cases we noticed that though we are in the correct position in the PA view, the contrast spread is not satisfactory. When we checked it in the lateral fluoroscopic view, we were in the posterior third or posterior to the SIJ.

If the needle position is too inferior or too much depth is given, then there is a chance of injuring the pelvic structure. In the previous single or double needle technique, we don't know the exact depth of the needle. But as we are using a lateral fluoroscopic view, we can avoid such injuries. The three dimensional view created by using the lateral view will definitely improve the safety of the block. If the drug leaks out, then there are chances of sciatic numbness. Sometimes it may be difficult to go up to the anterior third region of the joint. It may be more painful as a narrow joint line has to be travelled in depth. It requires more detailed study to decide at which level to keep the needle tip for a more precise block.

Conclusion

The advantages of this method are that depth and level of the needle tip for SIJ blocks are described for more accurate/precise blocks. So this will reduce the chances of inappropriate contrast spread and improve the preciseness. This will reduce false positive and false negative results, i.e., sensitivity and specificity of SIJ blocks, and results for diagnostic blocks will become more reliable. We observed overall pain relief of 50% or more in 80% (24 of 30) of the joints. But if the needle position and contrast spread is satisfactory as per the criteria (here in our study in 24 joints), pain relief of 50% or more was seen in 96% (23 of 24) of the joints. This technique will also reduce the chances of a case getting abandoned or postponed due to inappropriate contrast spread obscuring the fluoroscopic landmarks. As we know the depth of the needle, the chance of injuring the pelvic structure becomes less and safety improves.

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