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Retrospective Study

The Efficacy of Transforaminal Epidural Steroid Injection by the Conventional Technique in Far-Lateral Herniation of Lumbar Disc

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Background: Owing to the anatomical difference between the far lateral herniation of the lumbar disc (FHLD) and the intraspinal herniation of lumbar disc (iHLD), the outcome of transforaminal epidural steroid injections (TFESI) in patients with FHLD seems to be different from that in patients with iHLD. However, few studies have evaluated the efficacy of TFESI in FHLD.

Objective: To evaluate and compare the efficacy of TFESI in FHLD and iHLD patients.

Study Design: A retrospective design.

Methods: There were 15 and 70 patients in the FHLD and iHLD groups, respectively. Patients received a fluoroscopically guided TFESI. Failure rates of TFESI were recorded, and questionnaires, including a visual analog scale (VAS) for leg pain and Oswestry Disability Index (ODI) were administered before the initial injection, at 2 weeks, 6 weeks, and 12 weeks after the injections.

Results: There was no failure for TFESI in the iHLD group, while 9 patients had to undergo alternative blocks in the FHLD group due to lancinating leg pain when the needle was advanced for TFESI. In the iHLD group, there was a statistically significant improvement in the VAS and ODI score 12 weeks after injection. Considering only successful cases of the FHLD group, significant improvement in the VAS and ODI score was also demonstrated in the FHLD group 12 weeks after injection. Moreover, there was no statistically significant difference of the VAS and ODI between the both groups.

Limitations: A relatively small numbers of cases were included in the FHLD group.

Conclusion: The current study suggests that an alternative needle placement technique for TFESI appears to be necessary for FHLD patients.

Key words: Far lateral herniation of lumbar disc, intraspinal herniation of lumbar disc, transforaminal epidural steroid injection, safe triangle, herniated lumbar disc, visual analog pain scale, Oswestry disability index, radiculopathy

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Far lateral herniation of lumbar disc (FHLD), or extraforaminal lumbar disc herniation, is characterized by several specific clinical features, including anterior thigh and leg pain, appropriate sensory loss, absence of back pain, absence of knee jerk response, and no reduction in straight leg raise (SLR) (1). In particular, severe radicular pain is often worse in FHLD patients than in patients with intraspinal herniation of lumbar disc (iHLD) including central or posterolateral herniation of the lumbar disc primarily because of compression on the nerve root ganglion (1-3).

The surgical treatment of this condition has evolved from a conventional interlaminar approach to an intertransverse transmuscular approach, and the surgical results have been reported to be excellent (3-5). However, in general, lumbar disc herniation can be treated by non-surgical methods (6,7), among which transforaminal epidural steroid injection (TFESI) has been reported to be a very effective treatment in radiculopathy or stenotic lesion of the lumbar spine (8-10). However, few studies have determined the efficacy of TFESI in FHLD. Since this type of herniation could alter the anatomical configuration of the nerve root in the extraforaminal area, we hypothesized that the outcome of TFESI for patients with FHLD would be different from that for patients with iHLD. Therefore, the purpose of this study was to evaluate and compare the efficacy of TFESI in FHLD and iHLD patients.

Methods

The clinical responses were evaluated and reviewed using a retrospective approach after obtaining approval of the Institutional Review Board (IRB). We identified 85 patients who received TFESI due to radiculopathy caused by FHLD or iHLD. There were 15 and 70 patients in the FHLD and iHLD groups, respectively. Before fluoroscopically guided TFESI was administered, all patients had undergone conservative treatments for at least 2 weeks, including a combination of analgesics, anti-inflammatory drugs, or physical therapy. Patients were included in the retrospective study if they met the inclusion criteria, which were unilateral radiculopathy and tension sign due to herniated disc before epidural injection despite conservative treatments for 2 weeks, and herniated disc at one level in the lumbar spine confirmed by magnetic resonance imaging (MRI). Patients were excluded from this study if they had undergone prior lumbar surgery, had disc herniation over 2 levels in the lumbar spine on MRI, had progressive neurologic deficits or cauda equina syndrome, had undergone prior epidural steroid injection, and had spinal deformities such as spondylolisthesis and scoliosis.

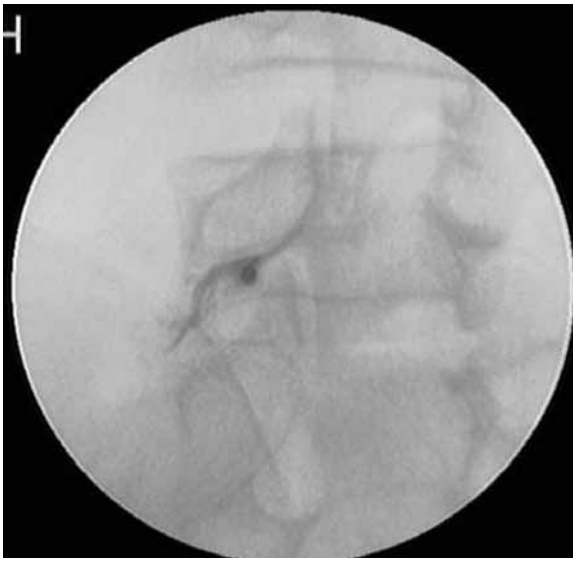

Fig. 1. *Fluoroscopic oblique view after administering the left L5 transforaminal epidural steroid injection with contrast medium showing the L5 nerve root sleeve.*

A single qualified anesthesiologist performed all the epidural injections. The technique was standardized in all procedures. With fluoroscopic imaging, an oblique view was obtained, with the final position of the pedicle of the superior vertebra aligned with the superior articular process of the inferior vertebra. The intended target is the 6 o'clock position of the pedicle (Fig. 1). The skin over this site was marked, prepped with povidone-iodine, and draped in the standard sterile fashion. The skin and subcutaneous tissues were anesthetized with 1% lidocaine. The tip of a 22-gauge, 3.5-inch spinal needle was slowly advanced toward the 6 o'clock position of the pedicle under intermittent fluoroscopic guidance into the so-called "safe-triangle" (11). The safe triangle is composed of a roof made up by the pedicle, a tangential base that corresponds to the exiting nerve root, and the lateral border of the vertebral body (Fig. 2). Both anteroposterior and lateral fluoroscopic projections confirmed proper needle placement. In the lateral view, the needle was positioned just below the pedicle along the ventral aspect of the intervertebral foramen. After negative aspiration of blood and cerebrospinal fluid, 1 mL of contrast medium (iohexol) was injected and the results of the epidurogram and pain response were recorded. If there was no flow to the corresponding nerve root and the disc space was level, the needle was repositioned. Once adequate flow of contrast to the target area was recorded, a 3 ml solution containing 40 mg triamcinolone and 1% preservative-free lidocaine was injected.

During this procedure, the pain response was monitored. In cases where the patient had very severe leg pain and was unable to maintain the prone position for proper needle placement or drug injection, an alternative approach, such as a caudal or posterior interlaminar epidural block was used. However, we considered

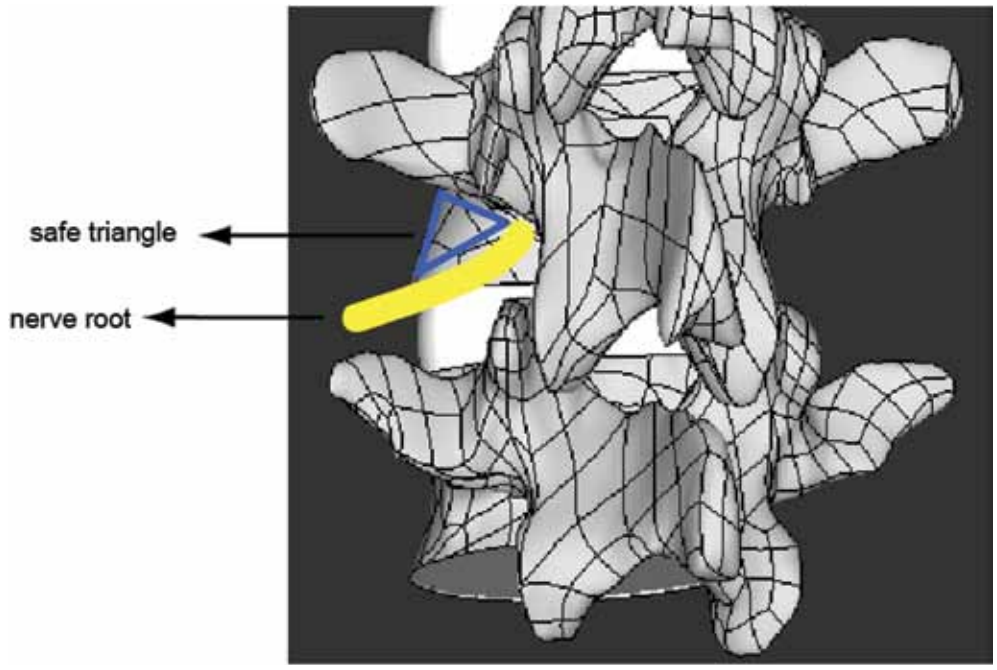

Fig. 2. *Normal anatomy of the lumbar spine. See the "safe triangle," which indicates the safe area of needle placement which was targeted in the transforaminal epidural steroid injection.*

such cases as technical failures of TFESI. Patients were evaluated by an independent observer and received questionnaires before the initial injection, at 2 weeks, 6 weeks, and 12 weeks after the injections. Questionnaires included a visual analog scale (VAS) for leg pain and Oswestry Disability Index (ODI). At the last follow-up (12 weeks), the patients who had underwent spine surgery due to leg pain were considered as treatment failure cases.

Statistical Analysis

The success rate of TFESI in both the groups was compared by using Fisher's exact test. The Mann-Whitney test was used for comparing age, symptom duration, VAS, and ODI between both groups. Moreover, to compare VAS and ODI between the pre-injection state and the post-injection state for each group, the Wilcoxon signed rank test was used. All data were analyzed using the SPSS 12.0.1 statistics package (SPSS, Inc., Chicago, IL). A value of $P < 0.05$ was accepted as significant.

Results

Demographic Data of Patients

Even though the number of patients (n=15) in the FHLD group was less than that in the iHLD group (n=70), there was no significant difference in the demographic data between the FHLD and iHLD groups. The mean age was 42.6 and 40.9 years in the FHLD and iHLD groups, respectively, and the mean symptom duration was 2.4 and 3.3 weeks in the FHLD and iHLD groups, respectively. In both groups, HLD most often occurred at the L4-5 level (Table 1), and there was no significant difference between the VAS/ODI and the level of HLD.

Table 1. *Comparison of the demographic data between the both group. Values are mean values (SD).*

	FHLD	iHLD	P
N	15	70	
Age (years)	42.6 (3.2)	40.9 (2.9)	0.105
Symptom duration (months)	2.4 (1.6)	3.3 (0.9)	0.262
M : F	7 : 8	24 :46	
Level (N) L3-4 L4-5 L5-S1	2 10 3	6 48 16	

FHLD; far lateral herniation of lumbar disc
iHLD; intraspinal herniation of lumbar disc

The Assessment of TFESI Outcome in Both Groups

In the iHLD group, there was no case of technical failure. However, among the iHLD patients, there were 15 cases (21%) of treatment failure, and they underwent surgery because leg pain was not relieved after the epidural steroid injection. In the iHLD patients (n = 70), the mean ODI decreased from 28.7 to 16.8 (57%) and the mean VAS decreased from 78.4 to 27.5 (65%) at 3 months after injection. These improvement rates in the ODI and VAS were statistically significant (P < 0.05) (Table 2).

In the FHLD group, 60% of cases were technical failures; 9 patients (60%) could not undergo the TFESI procedure because of the lancinating leg pain during the needle insertion process, and they received caudal blocks or interlaminar epidural steroid injections. In the FHLD group, 5 patients underwent discectomy after injection. Thus, 33.3% of cases were considered as treatment failures. In the technically successful cases in the FHLD group (n = 6), the mean ODI decreased from 35.8 to 18.2 (49%) and the mean VAS decreased from 92.2 to 30.7 (67%) at 3 months after injection. These improvement rates in the ODI and VAS were also statistically significant (*P* < 0.05) (Table 2).

Between the 2 groups, the pre-injection VAS was not statistically different even though it was higher in the FHLD group than in iHLD. At 3 month after injection, there also was no statistically significant difference in both VAS and ODI scores between the 2 groups (Table 2).

Table 2. *Comparison of the result of TFESI betweeen the FHLD and the iHLD group. Values are mean values (SD) (* ; P < 0.05)*

	FHLD	iHLD	P
Failure cases/total cases	9 / 15	0 / 70	0.020
VAS (0 – 100) for leg pain	6 cases	70 cases	
Pre-injection	92.2 (11.3)	78.4 (10.8)	0.062
3 months after injection	30.7 (8.5)*	27.5 (7.1)*	0.073
ODI (remaining cases)	6	55	
Pre-injection	35.8 (4.7)	28.7 (5.4)	0.145
3 months after injection	18.2 (3.8)*	16.8 (4.2)*	0.330

TFESI; transforaminal epidural steroid injection, FHLD; far lateral herniation of lumbar disc, iHLD; intraspinal herniation of lumbar disc, VAS; visual analog pain scale, ODI; Oswestry Disability Index *; statistically significant 3 months after injection, compared with pre-injection

Discussion

It has been a generally held opinion that transforaminal epidural steroid blocks appears to be beneficial for radiculopathy due to herniated nucleus pulposus in the lumbar spine even for short-term relief (9,12), thereby avoiding more invasive treatment. However, it should be acknowledged that previous well-designed outcome studies dealt with iHLD which accounts for the majority of herniated nucleus pulposus in the lumbar spine (6,8,12), and the clinical, anatomical patho-mechanisms of FHLD are different from those of iHLD (13).

FHLD or extraforaminal disc herniation was described in 1971 by Macnab after a failed exploration at the L4/L5 level (14). Abdullah et al were the first to describe the clinical syndrome of FHLD (13). They also reported that the SLR test result was positive in 35% of patients with such herniation. While the SLR test result is often negative, the femoral stretch test often yields positive results, because of the frequent involvement of nerve roots cranial to L4. Moreover, the clinical presentation often involves lancinating leg pain, whereas low back pain is often mild to moderate because the exiting root is compressed by the dorsal ganglion (1,5). Even MRI can be used to diagnose this herniation; however, Osborn et al misdiagnosed one-third of the cases of far lateral herniation with the initial interpretation (15). In general, while most radiologists and clinicians rarely miss posterolateral disk herniation with spinal MRI, FHLD is often overlooked and has remained elusive because of the atypical clinical presentation and inconsistent radiographic findings.

Because of severe radiating leg pain in this herniation, medication usually does not work for alleviation of pain and conservative measures are often unsuccessful, so early surgery is often performed. However, there has been only a single report on conservative injection therapy in FHLD (16), in which transforaminal injection for the compressed nerve root was shown to be effective for herniation. There have been no other studies since then. We assumed that transforaminal epidural injection for FHLD due to the anatomical alteration of the nerve root position required a different technique.

As expected, the FHLD patients had significantly higher failure rates (9/15, 60%) than iHLD patients (0/70, 0%). This result showed a statistically significant difference between the 2 groups (*P* = 0.02). The reason for failure of TFESI (n = 9) in the FHLD group was that the insertion of the epidural needle in TFESI was not tolerated by patients with FHLD because the needle in-

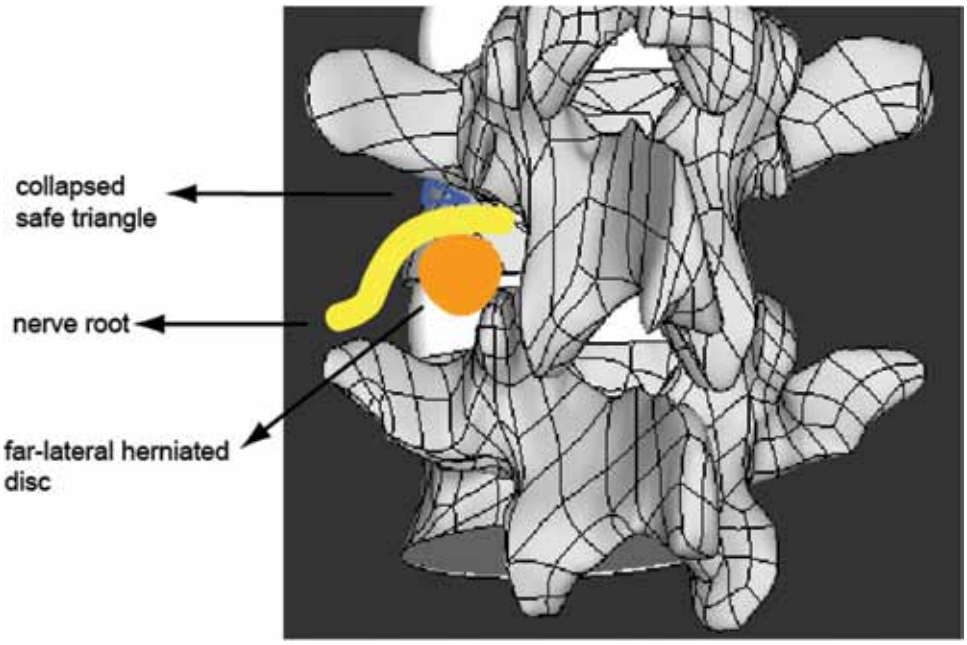

Fig. 3. *Collapsed "safe triangle" due to the displaced nerve root, caused by a migrated disc in FHLD.*

sertion aggravated the radiating leg pain. However, the successful cases of needle insertion showed a statistically significant decrease in ODI and VAS in both groups, and there was no significant difference of VAS and ODI 12 weeks after injection between the 2 groups. That is, in the case of successful needle placement in the safe triangle, both groups attained similarly significant reduction in ODI and VAS. Therefore, the alleviation of severe radiculopathy averted the need for surgery. This result is in line with the findings of previous reports regarding the outcome of TFESI (9,12).

Nonetheless, FHLD showed high failure rates with TFESI. This can be explained by the fact that the anatomical relation of the lumbar nerve root with the surrounding structures would be different, which could lead to technical difficulty in epidural needle placement. In transforaminal epidural injection under fluoroscopic guidance, the safe triangle is the landmark of the proper position of needle tip as described by Bogduk et al (11). The corresponding sides of this inverted triangle are as follows: the base is the inferior border of the pedicle; the medial side is the exiting spinal nerve root; and the lateral side is the lateral border of the vertebral body (Fig. 2). Fluoroscopic imaging in multiple planes will ensure that the needle tip is within the safe triangle. In FHLD, the nerve root is usually displaced upward and laterally by herniation because the herniated disc usually migrates laterally and cephalad (2). Therefore, the so called safe triangle is collapsed, and the compressed and displaced nerve root appears to block needle insertion of transforaminal epidural injection because the needle is inserted into the epidural space through the extraforaminal area (Fig. 3). Furthermore, because an inflammatory nerve root due to herniated disc is very sensitive to external mechanical stimuli, the patients would suddenly experience very severe and lancinating leg pain during the injection procedure when advancing the needle adjacent to the inflammatory nerve root or when injecting drugs through the needle.

Accordingly, the current results indicate the necessity to develop an alternative technique to TFESI for FHLD. Lew et al (17) introduced a preganglionic approach to TFESI, which has been reported to have a better therapeutic effect than conventional TFESI (18). Similarly, Jasper (19) reported an alternative method to TFESI; retrodiscal contrast medium injection resulted in reliable coverage of the retrodiscal region, the exiting nerve at that foraminal level, and the proximal portion of the transiting segmental neural sleeve. In

addition, retrodiscal TFESIs may flow centrally toward the midline or reach the first segment of the retrodiscal radicular canal and may flow caudally across the disc below (19). Furthermore, recently, Zhu et al (20) described a technique to place the tip of the needle immediately dorsal to the dorsal root ganglion to avoid the radicular artery injection and minimize nerve root penetrations. Theoretically, the above methods can prevent or minimize the irritation of the inflamed nerve root during TFESI in FHLD as compared to that by the conventional method. Therefore, we plan to compare the outcome of these alternative techniques with the conventional method in FHLD. Furthermore, regarding the favorable outcome of TFESI in patients with FHLD reported by Weiner and Fraser (16) we can presume that this result was influenced by the inclusion criteria, which included extra- and intraforminal herniation of the lumbar disc. As a matter of fact, they reported that of the 6 failed cases, 5 had lumbar disc herniations in the extraforaminal zone (FHLD). This finding also corroborates the opinion of the current study.

Conclusion

The current study has a crucial shortcoming. The small number of cases included in the FHLD group, compared to iHLD group, which hampered the thorough investigation of the efficacy of TFESI for the patients with FHLD. However, a valid outcome assessment could be completed in the current study, and the definite high failure rate of TFESI using the conventional method appeared to render the current results valid despite a small number of patients. In conclusion, FHLD leads to a different anatomical configuration of the lumbar nerve root and surrounding structures. For this reason, the present clinical series showed a higher failure rate of TFESI in the patients with FHLD. Therefore, the current study suggests that an alternative needle placement technique for TFESI appears to be necessary in cases of FHLD.

References

1. Ohmori K, Kanamori M, Kawaguchi Y, Ishihara H, Kimura T. Clinical features of extraforaminal lumbar disc herniation based on the radiographic location of the dorsal root ganglion. *Spine* 2001; 26:662-666.
2. Lejeune JP, Hladky JP, Cotten A, Vinchon M, Christiaens JL. Foraminal lumbar disc herniation. Experience with 83 patients. *Spine* 1994; 19:1905-1908.
3. O'Hara LJ, Marshall RW. Far lateral lumbar disc herniation. The key to the intertransverse approach. *J Bone Joint Surg Br* 1997; 79:943-947.
4. Melvill RL, Baxter BL. The intertransverse approach to extraforaminal disc protrusion in the lumbar spine. *Spine* 1994; 19:2707-2714.
5. Tessitore E, de Tribolet N. Far-lateral lumbar disc herniation: The microsurgical transmuscular approach. *Neurosurgery* 2004; 54:939-942; discussion 942.
6. Andersson GB, Brown MD, Dvorak J, Herzog RJ, Kambin P, Malter A, McCulloch JA, Saal JA, Spratt KF, Weinstein JN. Consensus summary of the diagnosis and treatment of lumbar disc herniation. *Spine* 1996; 21:75S-78S.
7. Weinstein JN, Lurie JD, Tosteson TD, Tosteson AN, Blood EA, Abdu WA, Herkowitz H, Hilibrand A, Albert T, Fischgrund J. Surgical versus nonoperative treatment for lumbar disc herniation: Four-year results for the Spine Patient Outcomes Research Trial (SPORT). *Spine* 2008; 33:2789-2800.
8. Botwin KP, Gruber RD, Bouchlas CG, Torres-Ramos FM, Sanelli JT, Freeman ED, Slaten WK, Rao S. Fluoroscopically guided lumbar transformational epidural steroid injections in degenerative lumbar stenosis: an outcome study. *Am J Phys Med Rehabil* 2002; 81:898-905.
9. Buenaventura RM, Datta S, Abdi S, Smith HS. Systematic review of therapeutic lumbar transforaminal epidural steroid injections. *Pain Physician* 2009; 12:233-251.
10. Vad VB, Bhat AL, Lutz GE, Cammisa F. Transforaminal epidural steroid injections in lumbosacral radiculopathy: A prospective randomized study. *Spine* 2002; 27:11-16.
11. Bogduk N, Aprill C, Derby R. Epidural steroid injection. In: AH W, J S (eds). *Spinal Care Diagnosis and Treatment*, CV Mosby, St. Louis, 1995, pp. 322-344.
12. Joshua H L. Prospective, double-blind, randomized placebo-controlled trials in interventional spine: what the highest quality literature tells us. *Spine J* 2009; 9:690-703.
13. Abdullah AF, Ditto EW, Byrd EB, Williams R. Extreme-lateral lumbar disc herniations. Clinical syndrome and special problems of diagnosis. *J Neurosurg* 1974; 41:229-234.
14. Macnab I. Negative disc exploration. An analysis of the causes of nerve-root involvement in sixty-eight patients. *J Bone Joint Surg Am* 1971; 53:891-903.
15. Osborn AG, Hood RS, Sherry RG, Smoker WR, Harnsberger HR. CT/MR spectrum of far lateral and anterior lumbosacral disk herniations. *AJNR Am J Neuroradiol* 1988; 9:775-778.
16. Weiner BK, Fraser RD. Foraminal injection for lateral lumbar disc herniation. *J Bone Joint Surg Br* 1997; 79:804-807.
17. Lew HL, Coelho P, Chou LH. Preganglionic approach to transforaminal epidural steroid injections. *Am J Phys Med Rehabil* 2004; 83:378.
18. Lee JW, Kim SH, Choi JY, Yeom JS, Kim KJ, Chung SK, Kim HJ, Kim C, Kwack KS, Kwon JW, Moon SG, Jun WS, Kang HS. Transforaminal epidural steroid injection for lumbosacral radiculopathy: Preganglionic versus conventional approach. *Korean J Radiol* 2006; 7:139-144.
19. Jasper JF. Lumbar retrodiscal transforaminal injection. *Pain Physician* 2007; 10:501-510.
20. Zhu J, Falco FJE, Formoso F, Onyewu O, Irwin F. Alternative approach for lumbar transforaminal epidural steroid injections. *Pain Physician* 2011; 14:331-341.