Lumbar Retrodiscal Transforaminal Steroid Injection

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Summary

Objective: To assess the therapeutic efficacy of lumbar retrodiscal transforaminal corticosteroid injection in sciatica. Also to compare with surgery in terms of patients satisfaction.

Methods: 43 patients with sciatica were treated with lumbar retrodiscal transforaminal steroid injection. The patients were invited for control assessments using visual analogue scale at 1, 3, 6 and 12 months after the procedure. After completing prospective case series study; 29 of the patients were compared with a series of 29 patients who undergone laminotomy and discectomy for sciatica in the same time period, in terms of patients' satisfaction.

Results: The success rates of the procedure at immediate post-procedure period, and 1, 3, 6, 12 months after the procedure were 81,4%, 65,1%, 60,5%, 58,1% and 57,1% respectively. Patients' satisfaction levels were higher in the surgery group at their last controls.

Conclusions: Lumbar Retrodiscal Transforaminal Steroid Injection is effective in relieving sciatic pain from herniated disks in more than half of the cases. Though surgery seems more effective in terms of patient satisfaction, injection therapy can be tried as an intermediate step after conservative, before surgical treatment modalities.

Key words: Corticosteroid, injection, retrodiscal, spinal, transforaminal

Özet

Amaç: Siyataljide lomber retrodiskal transforaminal kortikosteroid enjeksiyonunun iyileştirici etkisini belirlemek.


Bulgular: İşlemin başarı orani hemen işlem sonrası ve işlemden 1; 3; 6; 12 ay sonra sırasıyla %81,4; %65,1; %60,5; %58,1 ve %57,1 idi. Cerrahi grupta son kontrollerdeki hasta memnuniyeti açısından seviyeleri daha yüksekti.

Sonuç: Lomber Retrodiskal Transforaminal Steroid Enjeksiyonu vakaların yarısından fazlasında disk herniasyonundan kaynaklanan siyatik ağrısının rahatlatılmasına etkilidir. Cerrahi hasta memnuniyeti açısından daha etkili görünmekle birlikte, enjeksiyon tedavisi konservatif tedaviden sonra, cerrahi tedaviden önce bir ara basamak olarak denenebilir.

Anahtar Kelimeler: Kortikosteroid, enjeksiyon, retrodiskal, spinal, transforaminal
INTRODUCTION

Sciatica is a common problem having lifetime prevalence rate of approximately 40-60% (22,27). Lumbar intervertebral disc herniations are the most common cause of Sciatica, and 10-15% of patients with these herniations will eventually require surgery (4). The efficacy of conventional transforaminal epidural steroid injections (TFESI) as an alternative treatment of sciatica have been demonstrated in several studies (3,20,25,26).

In the case of TFESI with using the conventional (ganglionic) approach, which described by Derby et al (6), the spinal needle is positioned within the "safe triangle". The safe triangle was defined by the outer margin of the spinal nerve medially, the lateral border of the vertebral body laterally, and by the pedicle superiorly (Figure 1).

However, in cases of lumbar intervertebral disc herniations the site of impingement lies at the level of the supra-adjacent intervertebral disc, which is rostral to the conventional lumbar TFESI needle position. Recently preganglionic approach has been described by Lew (17) for transforaminal epidural steroid injection (Figure 1). The final needle position is at the inferior aspect of the supraadjacent neural foramen, with the tip of the needle immediately dorsal to the annulus and/or posterior longitudinal ligament in preganglionic approach (17).

Lee et al (16) modified this method and compared with the conventional TFESI. The landmark they used for needle insertion is just lateral to the pars interarticularis on the oblique view and superior to the supraadjacent disk level that is impingement site of the nerve root.

Jasper described the Lumbar Retrodiscal Transforaminal Injection that is almost identical to the Lew’s Preganglionic Approach. He concluded that the retrodiscal technique achieves superior placement of therapeutic injections such as corticosteroids when the target of the injection is the pathologic disc-nerve interface (11).

We aimed to assess the therapeutic efficacy and to find out if there is any factor influencing the success rate of lumbar retrodiscal transforaminal corticosteroid injection in sciatica. We also aimed to compare the injection therapy with surgery in terms of patients' satisfaction.

![Figure 1: Schematic of a posteroanterior view of the left side of a lumbar spine. The gray colored area represents the safe triangle for conventional (ganglionic) transforaminal injection and the oblique lined area represents for retrodiscal (preganglionic) transforaminal injection site for affected left L5 nerve root.](image)
MATERIAL AND METHODS

Between June 2005 and June 2008, 43 lumbar retrodiscal transforaminal steroid injection procedures were performed in 43 patients. There were 26 male and 17 female patients, ranging in age from 22 to 84 years (mean 45.5 years).

The inclusion criteria were as follows: (a) presence of sciatica, and the leg pain more than back pain if any (b) VAS pain score for leg pain was more than 40 (by using a VAS that ranged from 0 to 100) (c) no neurological deficit (d) clear documentation of nerve root compression with paramedian disk herniation at the supraadjacent intervertebral disk level (e.g., L5 nerve root compressed at L4-5 disk) by using computed tomography (CT) or magnetic resonance (MR) imaging (e) no more than one level needs to be injected (f) no lumbar stenosis (g) no prior therapeutic TFESI, (h) no prior surgery.

The data regarding the patients including their pre-procedure VAS scores, details of the procedures, type and size of the needles were prospectively recorded.

All procedures were performed under CT guidance. We never used any premedication or local anesthetic infiltration or prophylactic antibiotic. We used either one needle approach using 22 gauge Chiba needle (Chiba needle, Gallini, Mantova, Italy) or two needle approach (coaxial technique) using an outer 21-gauge 10-cm straight needle and an inner 25-gauge, 15-cm curved needle (Pakter Curved Needle Set, Cook, Bloomington, IN) (Figure 2).

The patient is placed prone on the CT table. The back is prepared with povidone iodine and draped. The puncture point and the needle trajectory were planned on both lateral CT scout scan and axial scans. This trajectory passes through the caudal half of the intervertebral foramen to avoid penetrating its exiting nerve root (e.g., to avoid L4 nerve root penetration, when the target was the L5 nerve root and herniated L4-L5 disc interface) and should intersect the posterior border of the targeted disc on lateral CT scout scan. This line can be parallel to anteroposterior axis of the disc making a right angle with its posterior border (Figure 3a), especially for L3-L4 and L4-L5 disc herniations.

The needle trajectory terminates beneath the superior articular process of the infraadjacent vertebral body (e.g., superior articular process of the L5 vertebra for L4-L5 disc herniation) just posterior to annulus on axial scans (Figure 3b). The final location of the tip of the needle needs to be medial to the lateral pedicular line to ease the spread of injectate into the spinal canal but not to the medial pedicular line because the risk of penetrating the dural sac (Figure 1). Such localisation ensures the anterior spread of injectate, between the herniated disc and nerve root, but one should avoid penetration of the disc. When the one needle approach was used, the trajectory of the needle was typically 40-45 degrees off the anteroposterior axis and the distance from the needle’s entry point to the midline was 8-10 centimeters on axial scans (Figure 3b). If the coaxial technique was used (Figure 4), the trajectory of the needle can be more perpendicular being about 20-30 degrees off the anteroposterior axis, and the distance from the needle’s entry point to the midline was shorter being about 4.5-6 centimeters on axial scans.

Because locating the tip of the straight needle medially to the lateral pedicular line were often obstructed by iliac crest, in the L5-S1 disc herniations mostly coaxial technique was chosen. Because of the high crest of the pelvis this was especially true in male patients. In some female patients obstruction of the iliac crest can be avoided by directing the needle from a superior to inferior direction making an acute angle with posterior border of the L5-S1 disc.
After insertion, the needle is advanced 4-5 centimeters along the desiring trajectory to stand still without hand support. The needle position is checked on both lateral CT scout scan and axial scan then is repositioned, if necessary. Minor adjustments can be made in the one needle technique using beveled Chiba needle, by partially withdrawing the needle, turning the bevel to face 180 degrees opposite of the intended trajectory, and advancing the needle while gently pressing the head of the needle to the bevel side. Because the needle tip tends to move away from the bevel, the needle can be redirected to its intended path. In coaxial technique redirecting of the outer needle cannot be made easily because it isn’t beveled. However, an adjustment of the tip of the curved inner needle is achievable by turning it before emerging from the outer needle. After being certain of the position of the needle tip, just posterior to annulus between the lateral and medial pedicular lines, small amount of water soluble contrast medium (about 1.0 cc Omnipaque-300) was injected to make sure that there is no vascular or dural puncture. It is desirable the contrast medium to spread into the anterior spinal canal especially to interface between the affected nerve root and the herniated disc. But because disc herniation compressed dura and nerve root, the dura-disc interface is too tight so the contrast medium usually cannot be seen between the dura and discs itself (Figure 5a). Instead the contrast medium can be seen in the anterior spinal canal just cranial and/or caudal to the intervertebral disc (Figure 5b).

After confirming the position of the needle tip by injecting contrast medium, 1 cc bethamethason (Celestone) was injected. We preferred fractional injection in two or three parts, waiting 1-2 minutes between them. The goal of this fractioning was to let the injectate spread between the nerve root and the disc and to observe the patient if there is any discomfort or pain or complication such as developing weakness etc. After finishing the injection the needle was withdrawn and the procedure was terminated. VAS levels assessed again immediately after the procedure. The patients were observed about 2 hours, and discharged.

Steroid injection performed only once and we never repeated the procedure within a year. After discharge, the patients were invited for control assessments at 1, 3, 6 and 12 months after the procedure. All controls were made face to face, and no telephone interviews or mailing were used for assessment of the VAS levels. Follow-up assessments were performed by the authors who had carried out the operations.

The patients with a reduction in the VAS of at least 2.5-point or a final raw score of <3.5 points were classified as receiving effective treatment, and the patients with less than 2.5 point net improvement and a final raw score of ≥3.5 points were classified as having ineffective treatment according to Glassman et al (9).

The patients who undergone lumbar disc operations in the follow-up period were considered as failed cases and their controls were discontinued.

Generally, chi-square tests were used in statistical analyses. T-test was used for comparing the mean ages and mean duration of symptoms of successful and unsuccessful groups. \( P < 0.05 \) was considered statistically significant.

After completing the first part of the study, during month of August, 2010 we called all the patients to evaluate patients' satisfaction levels. Patients were asked on the telephone whether they would recommend the procedure to a friend or family member with the same symptoms, whether they would have the surgery again under the same circumstances, and whether they considered themselves "better," "the same," or "worse." Eventually 29 patients (67%) were contacted by telephone, and 14 patients (33%) were not located (Patients no: 6, 11, 14, 15, 20, 25, 27, 30, 32, 33, 35,
J.Neurol.Sci.[Turk] 36, 39, 43). Then we chose 29 patients among 94 patients without neurological deficit, which undergone one level disc surgery for sciatica in the same time period to form a similar group with the first 29 patients. Both groups were similar in terms of age (mean age was 44.7±12.9 SD in transforaminal group, was 44.4±10.1 SD in the operation group, P =0.919, Independent Samples t-test), gender (12 female/17 male in transforaminal group, 14 female/15 male in the operation group, P =0.597, chi-square), disc levels the groups (20 L4-L5/9 L5-S1 disc levels in transforaminal group, 13 L4-L5/16 L5-S1 disc levels in the operation group, P =0.063, chi-square) and side (12 right/17 left side in transforaminal group, 18 right/11 left side in the operation group, P=0.115, chi-square). None of the patients had any neurodeficit in discectomy group like as transforaminal steroid group. Each patient had undergone discectomy only for one level. The patients in the discectomy group also were called for the assessment the patients' satisfaction levels. The mean follow up period was 46.8 months for the transforaminal injection group (25.7-62.4 months), was 41.4 months (25.2-61.8 months) for the discectomy group when the phone calls were completed. These two groups were not different in term of follow up periods (P=0.051; Independent Samples t-test.).

![Figure 2](image1.png)

**Figure 2:** Curved needle set for coaxial technique. The stylet of the outer needle had been withdrawn and curved inner needle was inserted into the outer needle. The curved distal part of the inner needle has emerged from the tip of the outer needle.

![Figure 3](image2.png)

**Figure 3:** Chiba needle before injecting the contrast medium. a: On lateral CT scout scan, needle line intersects the posterior border of the L4-L5 disc like a perpendicular bisector b: On axial CT scan, tip of the needle touching the L4-L5 annulus just beneath the right superior articular process.
Lumbar retrodiscal transforaminal steroid injection

The patients' data was summarized in Table 1. All procedures completed without any kind of complications. The success rates of the procedure at immediate post-procedure period, and 1, 3, 6, 12 months after the procedure were 81.4%, 65.1%, 60.5%, 58.1% and 57.1% respectively. Six patients underwent to lumbar disc surgery within one year after Retrodiscal Transforaminal Steroid Injection accepting as unsuccessful procedure. We couldn't get contact with a patient at the end of the first year.

There were 26 male and 17 female patients, and we did not find any significant difference between the male’s success rate and female’s success rate in any control period.

The mean age of our group was 45.5 years. The mean age of the successful group was older than unsuccessful group in every control periods except the immediate post procedure period, and these differences

**RESULTS**

*Lumbar retrodiscal transforaminal steroid injection*

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The mean age of our group was 45.5 years. The mean age of the successful group was older than unsuccessful group in every control periods except the immediate post procedure period, and these differences

**Figure 4:** Double coaxial needle before injecting the contrast medium. *a:* On axial CT scan passing through inferior rim of the L4 corpus, the outer and the inner needle can be seen. *b:* Axial CT scan passing through L4-L5 disc shows the curved inner needle just beneath the right L5 superior articular process.

**Figure 5:** After injection; *a:* Axial CT scan passing through L4-L5 disc shows contrast medium spreading to the posterior side of the dura mater. *b:* Just rostral of the disc space, the contrast medium can be seen in typical horizontal "y" shape spreading on both anterior and posterior surfaces of the dura mater.
were statistically significant at the end of the 3rd, 6nd and 12nd months (Table 2).

There were 26 L4-L5 and 17 L5-S1 disc herniations. Herniation sides were at the right side in 17 cases and left side in 26 cases. We couldn’t find relation between the success rate and the localization of the disc herniation in any control period.

The mean duration of symptoms was 2.7 months, ranging from 0.1 to 12 months. We couldn’t find any significant difference between the mean duration of symptoms of the successful group and unsuccessful group at the immediate post-procedure period but there were significant differences at the 1, 3, 6, 12 months after the procedure. The mean duration of symptoms of the unsuccessful group was longer than four months while succesful group’s was shorter than two months in all these periods (Table 3).

One needle technique was used 26 times and coaxial technique was used 17 times. There was no significant difference between their success rates in any control period.

Comparing the lumbar retrodisical transforaminal steroid injection with surgery

Patients’ satisfaction levels were higher in the surgery group at their last controls (Minimum two years follow up). 41.4% of the patients in the transforaminal group were describing themselves as worse though this proportion was 17.2% for the surgery group (Table 4) (P=0.043; Pearson Chi-Square).

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Table 2: Mean ages of the successful and unsuccessful groups

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m: month

Table 3: Mean duration of symptoms of the successful and unsuccessful groups as months

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<tbody>
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<td>Successful group</td>
<td>2,3</td>
<td>1,8</td>
<td>1,8</td>
<td>1,5</td>
<td>1,4</td>
</tr>
<tr>
<td>Unsuccessful group</td>
<td>4,1</td>
<td>4,3</td>
<td>4,0</td>
<td>4,3</td>
<td>4,2</td>
</tr>
<tr>
<td><em>P</em> (Independent Samples t-test)</td>
<td>0,086</td>
<td>0,013</td>
<td>0,006</td>
<td>0,001</td>
<td>0,002</td>
</tr>
</tbody>
</table>

m: month

Table 4: Patients satisfaction levels for the injection and surgery groups at their last control

<table>
<thead>
<tr>
<th></th>
<th>Better/Same</th>
<th>Worse.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection</td>
<td>17 (58,6%)</td>
<td>12 (41,4%)</td>
<td>29 (100,0%)</td>
</tr>
<tr>
<td>Surgery</td>
<td>24 (82,8%)</td>
<td>5 (17,2%)</td>
<td>29 (100,0%)</td>
</tr>
<tr>
<td>Total</td>
<td>41 (70,7%)</td>
<td>17 (29,3%)</td>
<td>58 (100,0%)</td>
</tr>
</tbody>
</table>

DoS: Duration of symptoms (months), Pre.: Pre-procedure, Post.: Post-procedure, V.: VAS, m.: Month, Op.: at that time the patient had undergone lumbar disc operation, NA: Non available
DISCUSSION

Epidural corticosteroid injections (ESI) can be used to treat lumbar radiculopathy due to disc pathology\(^{(1)}\). The mechanism is attributed to relieving the inflammation secondary to mechanical and/or chemical nerve root irritation\(^{(10)}\). Studies have shown that phospholipase A\(_2\) (PLA\(_2\)), cytokines, and other inflammatory mediators are released from an intact disc following injury\(^{(23)}\). PLA\(_2\), which itself is highly inflammatory and Epidural corticosteroids act by blocking PLA\(_2\) activity and can exert an anesthetic-like action by blocking nociceptive C-fiber conduction\(^{(13)}\). Epidural corticosteroids also exert a membrane-stabilizing effect, which may help decrease ectopic neuronal discharges and reduce radicular pain\(^{(7)}\).

The conventional lumbar transforaminal technique was described by Derby et al\(^{(6)}\). When the conventional lumbar transforaminal epidural steroid injection technique is employed, a spinal needle is positioned within the "safe triangle" below the inferior aspect of the pedicle. In most cases of lumbosacral radiculopathy that are secondary to spinal stenosis or disc herniation, the site of impingement can lie at the level of the supraadjacent intervertebral disc, which is rostral to the conventional lumbar TFESI bevel position. Ideally, the injectate may spread rostrally to the epidural portion of the preganglionic nerve root as well\(^{(17)}\).

Lew et al\(^{(17)}\) suggested that a preganglionic approach at the level of the supra-adjacent intervertebral disc would be useful as a supplementary injection technique to the conventional TFESI. Lew et al\(^{(17)}\) inserted the needle into the inferior and anterior neural foramen for performing preganglionic TFESI. The final needle position is at the inferior aspect of the supra-adjacent neural foramen, with the bevel immediately dorsal to the annulus/posterior longitudinal ligament.

Seigel et al. reported CT guidance and two needle technique in the percutaneous transforaminal steroid injections\(^{(24)}\). His technique was preganglionic and immediately dorsal to the annulus/posterior longitudinal ligament like as Lew’s modification.

In the study of Lee et al. it has been concluded that that the preganglionic TFESI alone is more effective in managing radiculopathy than was the conventional TFESI. But in the pictures in the article the tip of the needle is seen below the inferior aspect of the pedicle (in the superior half of neural foramen) like as conventional TFESI rather than was in Lew’s modification. In that picture the contrast medium had spread along the ganglionic-postganglionic portion of the L5 nerve root rather than targeted preganglionic portion of the S1 nerve root\(^{(16)}\).

Later Jasper described the lumbar retrodiscal transforaminal injection technique which is almost same as Lew’s modification\(^{(11)}\). Jasper notes that, there may be an advantage to deliver injections to the disc-nerve interface, rather than more distal sites.

Concern has been raised with transforaminal epidural corticosteroid injection regarding the risk of arterial injection and resultant paralysis\(^{(10)}\). Jasper also emphasized arterial supply tends to enter in the cranial foramen rather than inferior; thus, retrodiscal injection in the inferior foramen may have lower risk of radicular arterial injection. Our complication free series seems to support Jasper’s opinion about complications. In conclusion he claimed that the retrodiscal technique achieves superior placement of therapeutic injections such as corticosteroids when the target of the injection is the pathologic disc-nerve interface\(^{(11)}\).

Jeong et al. proposed that, they compared pre and postganglionic approach in a...
prospective randomized study but their preganglionic approach probably was not identical with "Lumbar Retrodiscal Transforaminal Injection" which we used. In their paper, the figures show the needle localized behind the L5 vertebral body, closer to the L5 pedicle rather than L5-S1 disc space. The tip of the needle pointed just below the L5 pedicle near the exit of the L5-S1 foramen. Such approach should be considered as "postganglionic conventional TFESI" for L5 root rather than "preganglionic approach" for S1 root even if the contrast material has spread to L5-S1 disk through the epidural space(12).

Jeong at al. found that shorter symptom duration favors a better outcome than does longer symptom duration at midterm follow-up. He concluded that, this may mean that the patients with longer symptom duration have a tendency toward experiencing recurrent pain attacks(12). We also found that shorter symptom duration favors a better outcome than does longer symptom duration, not only at midterm follow-up but also at short and long term periods.

One criticism of epidural steroid injections is that their benefit lasts only for a short duration(2,14,15,21). Opposite of this claim, Lutz et al(18) and Jeong at al(12) found positive long term relief. The overall success rate of our series also didn't change much by time after first month.

Comparing the series using conventional (ganglionic) transforaminal injection with our series

Cyteval et al(5) performed conventional (ganglionic) transforaminal injection in 229 consecutive patients with lumbar radiculopathy and followed for a minimal follow-up period of 1 year. Their patient group was not homogenous and including disk herniation in 172 cases, degenerative stenosis in 41 cases, and a combination of both in 16 cases. They classified pain relief percentages as "excellent " when the pain had diminished by 75% or more, "good " for a diminution of 50% to 74%, "fair " for a diminution of 25% to 49%, or "poor " for a diminution of less than 25% or an increase in pain. They reported detailed follow-up information 2 weeks after the procedure only. Two weeks after the procedure, pain relief was graded as excellent in 45 patients (19.7%), good in 48 patients (21%), fair in 45 patients (19.7%), and poor in 91 patients (39.7%). We calculated pain relief same day and one month after the procedure. In our group, immediate and one month after the procedure the pains reliefs -according to Cyteval- were as; excellent: 25.6%-25.6%; good: 46.5%-30.2%; fair: 14.0%-11.6%; poor: 14.0%-32.6% respectively. In any case, the percentage of good and excellent pain relief in our study was more than in Cyteval's study was. They couldn't find any relation between the conflict location and pain relief. Similarly localization of the disc herniation was not correlated with the success rate in our series. The symptom duration before the procedure was highly correlated with the pain relief outcome. Patients with excellent results 2 weeks after the procedure had a mean duration of symptoms of 3.04 months versus 7.96 months in the group with poor pain relief. Also the mean duration of symptoms of was longer than 4 months in the unsuccessful group in all control periods whereas shorter than 2 months in the successful group in all, except the immediate post procedure period in our series. The age of the patients was not a predictive factor of radicular pain relief in their study(5), whereas we found that the mean age of the successful group was older than of the unsuccessful group was.

In 2010 Ghahreman et al(8) published a five-arm placebo controlled RCT (randomized controlled trial) of transforaminal steroid injection using conventional (ganglionic) approach. This study compared the outcomes of transforaminal injection of steroid and local anesthetic, local anesthetic alone, or normal saline, and intramuscular injection of steroid or normal saline. The primary
outcome measure was the proportion of patients who achieved at least 50% relief, at 1 month after treatment. Their groups were homogenous like ours consisting of the cases with a disc herniation demonstrated by computerized tomography (CT) or magnetic resonance imaging (MRI) at a segmental level consistent with the clinical features. Transforaminal injection of steroids group included 28 patients. 54% of the group achieved success at 1 month, and 25% sustained relief for over 12 months. They concluded that transforaminal injection of steroids is effective only in a proportion of patients (8).

Our success rates were higher than theirs in the end of the first month (55.8% vs. 54%) and especially in the end of the first year (50.0% vs. 25.0%) when we use 50% pain relief criteria. These success differences may be originated from choosing the method of preganglionic retrodiscal transforaminal injection.

Comparing the surgery with our series

We found surgery is more effective than injection in terms of patients’ satisfaction in long term but it must be noticed that we performed lumbar retrodiscal transforaminal steroid injection only once. There may be some benefits of repeat injections.

Our study indicates that use of lumber retrodiscal transforaminal steroid injection is effective in relieving sciatic pain from herniated disks in more than half of the cases. It has better outcome when the symptom duration is short. Its effect doesn’t seem change by time. Age certainly is not a negative factor on pain relief. If the injection be performed within two months of the symptoms chance of success is high. Though surgery seems more effective than lumber retrodiscal transforaminal steroid injection in terms of patient satisfaction, injection therapy can be tried as an intermediate step after conservative, before surgical treatment modalities.

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Received by: 11 October 2012
Accepted: 20 August 2016

The Online Journal of Neurological Sciences (Turkish) 1984-2016
This e-journal is run by Ege University Faculty of Medicine, Dept. of Neurological Surgery, Bornova, Izmir-35100TR as part of the Ege Neurological Surgery World Wide Web service.

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