Research article

A study of efficacy between interlaminar vs transforaminal approaches in symptomatic intervertebral disc herniations when treated with triamcinolone acetate

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ABSTRACT

Introduction and Aim: With lumbar disc herniations occurring in the population at a rate of 2-3%, low back pain is one of the most common chronic pain syndromes. Since 1952, patients with failed medical and conservative therapy for lumbar radiculopathy in presence or absence of discogenic back pain have been treated using epidural corticosteroid injections. Triamcinolone acetate, a local steroid, limits the inflammatory response. Interlaminar, transforaminal and caudal routes are various approaches for steroid injections. This study compared the effectiveness of triamcinolone acetate injections administered via an interlaminar vs. transforaminal method. The aim was to contrast the transforaminal technique and interlaminar approach to triamcinolone acetate's effectiveness in relieving pain.

Materials and Methods: In this study, 60 patients with low back pain are divided into two groups of 30 patients each and randomly allocated to receive care. Triamcinolone acetate solution, 40 mg, is used in each group. Interlaminar approach was chosen to inject the drug into the epidural space blindly, whereas through the transforaminal approach, the drug was delivered using dye with the help of fluoroscopic guidance. The outcome comprises evaluating pain reduction at the second and fourth weeks following the injection using a numerical scale and a verbal evaluation scale. Data was gathered after 15 minutes, at the 2nd and 4th week post injection.

Results: Patients who received triamcinolone acetate via transforaminal route experienced greater pain reduction in terms of NRS and VAS at the second week.

Conclusion: When comparing the NRS and VAS scores for pain alleviation, transforaminal is preferable to interlaminar because it delivers triamcinolone acetate to specific targets and is more successful than ILESI.

Keywords: Disc prolapse; interlaminar; transforaminal; epidural steroid infiltration; IVDP.

INTRODUCTION

The nucleus pulposus found in the lumbar disk's nucleus is displaced in lumbar disc herniation intervertebral disc via the fibrous annulus ring (1). The pain associated with this dislocation is clinically characterised by discomfort originating due to irritation of nerve roots from the lumbar region known as sciatica (2). Sciatica has a complex aetiology. It can be brought on by the nucleus pulposus releasing inflammatory and pain-relieving mediators, as well as by mechanical compression by the intervertebral disc (3-8). According to estimates, 2.5% to 3% of people over the age of 35 years have lumbar disc hernias, compared to 4.8% of males and 2.5% of women overall. Additionally, it is the most frequent diagnosis among lumbar degenerative changes and the major reason for surgery in the older age group. Most often, conservative therapy is used as the first course of action for disc hernia. Surgery is a rather infrequent kind of care that ought to only be employed after exhaustion of other minimalistic approaches, or if a patient is suffering from progressive motor sensory deficits or features of cauda equina compression (9). Back pain, hamstring stiffness, lumbar spondylosis and radicular pain are treated with steroid injections into epidural space and sacroiliac joints. Epidural steroid injection is a good option for lumbar disc hernia treatment among minimally invasive techniques. As a result, the majority of people can lower their inflammatory response, experience less pain, use fewer analgesics, continue their daily activities, and avoid surgery (10-13). Patients who are unresponsive to suitable conservative treatment may benefit from epidural steroid injections in an effort to delay or perhaps avoid surgery. Both Dexamethasone and Triamcinolone acetate have been evaluated for epidural steroid injections, although transforaminal injections have been shown to be beneficial for treating lumbar radiculopathy temporarily (14). Interlaminar and transforaminal approaches, as well as caudally (through the sacral hiatus), can be used for this (15,16). This study aims to assess the effectiveness of intraforaminal and translaminar injections of triamcinolone acetate.

MATERIALS AND METHODS

Between 2019 and 2021, the current investigation was conducted at the AJ hospital in Mangalore. Patients from the orthopaedic department were included in the study data collection method:

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Inclusion norms

Patients of both sexes aged between 18 and 60 years having low back discomfort lasting longer than three months and accompanied by unilateral or bilateral lumbar radicular pain as well as patients whose MRI results pointed to protrusions or bulges in the intervertebral disk.

Exclusion norms

Patients who were reluctant to surgery, who had many levels of disc protrusion or bulging. Patients with disc extrusion and sequestration, according to MRI results, people on anticoagulants and having serious coagulopathies, patient having history of allergies to steroids, local anaesthetics, and contrast media, Previous epidural steroid injections or lumbar spine operations, patients with degenerative spine disease at multiple levels, vertebral compression fractures, arachnoiditis, instability of the spine, cauda equina syndrome, and spondylolisthesis, Patients identified as having active malignancy, congestive heart failure, history of substance abuse, type 2 diabetes, current psychiatric comorbidity, Critical health care patients, Patients with chronic hepatic disease and acute febrile illness, Pregnant women were excluded from the study.

Sample size

The GPower programme version 3.1.9.2 was used to estimate the sample size. Based on the projected 77% effect size, 80% research power, and 5% margin of error, 40 samples are required in total. Therefore, the total number of units seized will be divided into two groups of 20, each. Due to the significant non-response rate during the pandemic, an additional 12 participants in each group were taken into account, and 30 participants in each group remained until the study’s conclusion. Consequently, there were 30 samples in each group. 60 individuals were involved, of which 20 had herniations of disk at L5-S1 and 40 with herniations of disk at L4-L5. At random, the patients were split into two groups of 30 each based on a different approach. Group 1 was approached through the interlaminar region, while Group 2 through the transforaminal region.

Patients were informed about the operation and given the opportunity to provide written consent. Standard NPO procedures were followed for 3 hours following that 20G cannula was used to secure the intravenous line. NIBP, SpO2, and ECG monitors were all connected. A qualified anaesthetist administered a mixture of 1 ml triamcinolone acetate and 3 ml 0.5% levo-anawin by inserting an 18 gauge needle in the spine at L3-L4 epidural region in the interlaminar area while patient is in lateral position. An orthopaedic spine surgeon administered a mixture of 0.5% of 3 ml of levo-anawin and 1 ml of triamcinolone into the foraminal region of group TF patients while they are lying on their backs and under fluoroscopic guidance at transforaminal region (Fig 1 and 2). Patient was observed for any immediate negative effects for 15 minutes in the operating room and for an hour in the recovery area.

Outcomes

Primary result - Visual Analogue Scale (VAS) and Numerical Rating Scale (NRS) measurements of pain reduction were taken at the end of the 2nd and 4th week following triamcinolone acetate injection. VAS is a subjective tool, whereas NRS is an objective tool.

Secondary result - Using NRS and VAS, the immediate pain alleviation following the injection of triamcinolone acetate is evaluated. After the injection of triamcinolone acetate, data on the reduction in analgesic demand was gathered after 15 minutes, at the end of the second week, and at the end of the fourth week.

Statistical analysis

Statistical analysis of the data was performed using the programme SPSS 23.0. Analyses of descriptive statistics were computed consisting of frequency, percentage, mean, and standard deviation. In the current investigation, inferential statistics were used. Unpaired t tests were used for comparison between groups while paired t tests were used for pre-post comparison. Chi square test used to search associations. A 0.05% level of significance was used.

Fig 1: TFESI at right L5. A: Spinal needle placement in right L5 transforaminal area is confirmed by an anterior-posterior image on an image intensifier. B: Spinal needle in the L5 transforaminal area is confirmed by a laterally focused image on an image intensifier. C: Right L5 nerve root leaving following dye injection, as seen on an image intensifier.

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RESULTS

Data analysis and interpretation

In the interlaminar approach group the average age was 33.833±8.522 years, while the average age in the transforaminal approach group was 34.843±8.179 years. The groups' ages did not significantly differ from one another. 24 members (80%) in the interlaminar group were men, and 6 members (20%) women. The majority of the transforaminal group consists of 23 men (76.7%) and 7 women (23.3%). There was no apparent relationship between the group and sex.

Only 5(16.7%) of the interlaminar group had only pain, and 4(13.3%) had both pain and tingling sensation, whereas 21(70%) of them displayed all three symptoms (pain, tingling feeling and weakness). The majority of the 17 patients in the transforaminal group (56.7%) experienced all three symptoms (pain, tingling and weakness), compared to only 6 (20%) who only had pain, 3(10%) had pain and tingling sensation, and 4(13.3%) had only pain and weakness (Table 1). The association between symptoms and group had a chi square value of 4.655 and a p-value of 0.05, there was no statistically significant correlation between the two.

At the 2nd and 4th weeks post the procedure, the interlaminar group's NRS of pain was much lower than the other group. Patients who underwent treatment using the interlaminar technique had an average NRS reduction of 2.9 from the time of their initial presentation to the second week, with a p-value of 0.05. This showed that there was a considerable decrease in discomfort two weeks after the treatment. Average NRS score reduction from the second to the fourth week was 0.933 with a 0.05 p-value, and average pain reduction from the baseline to the fourth week was 3.833 with a 0.05 p-value (Table 2).

Table 1: Cross tabulation of symptoms and group

<table>
<thead>
<tr>
<th>Variables</th>
<th>Interlaminar Approach</th>
<th>Transforaminal Approach</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain, Tingling, Weakness</td>
<td>21 70.0%</td>
<td>17 56.7%</td>
<td>38 63.3%</td>
</tr>
<tr>
<td>Pain</td>
<td>5 16.7%</td>
<td>6 20.0%</td>
<td>11 18.3%</td>
</tr>
<tr>
<td>Pain, Tingling</td>
<td>4 13.3%</td>
<td>3 10.0%</td>
<td>7 11.7%</td>
</tr>
<tr>
<td>Pain and Weakness</td>
<td>0</td>
<td>4 13.3%</td>
<td>4 6.7%</td>
</tr>
<tr>
<td>Total</td>
<td>30 100%</td>
<td>30 100%</td>
<td>60 100%</td>
</tr>
</tbody>
</table>

Table 2: Interlaminar technique for displaying pre and post comparisons in NRS and VAS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean difference</th>
<th>T Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRS</td>
<td>VAS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At presentation – week 2</td>
<td>2.900</td>
<td>15.438</td>
<td>5.117</td>
</tr>
<tr>
<td>Week 2 – week 4</td>
<td>0.933</td>
<td>20.149</td>
<td>6.277</td>
</tr>
<tr>
<td>Baseline – week 4</td>
<td>3.833</td>
<td>21.304</td>
<td>7.740</td>
</tr>
</tbody>
</table>

NRS: Numeric pain rating scale  VAS: Visual analog scale
Initial visual analogue scale score was 4.1±0.8440, which decreased to 3.366±0.85 in the 2nd week and to 1.933±0.284 in the fourth week using an interlaminar method.

In the interlaminar approach, the average VAS reduction was 0.733 with $p<0.05$ at the second post-procedure week. This shows that the discomfort of pain has significantly decreased by the second week. The average VAS score decreased from the second to the fourth week was 1.433 with $p$ value <0.05. Average pain decrease from the time of presentation to fourth week is 2.166, with a 0.05 significance level (Table 2).

The average numeric pain score for the transforaminal group was 7.733±0.691 at baseline; this decreased to 4.566±0.727 in the second week; and subsequently, to 2.9±1.37 in the fourth week.

Average NRS reduction post-procedure through transforaminal at the second week is 3.166 with $p<0.05$. This shows that the pain has significantly decreased by the second week. The average VAS score drops from the second to the fourth week is 1.633 with $p<0.05$. Average pain reduction from the time of presentation to 4th week is 3.1 with $p<0.05$. Statistical analysis showed the VAS score significantly decreased from the baseline to the fourth week (Table 3).

### Table 3: Pre and post comparison in NRS and VAS through transforaminal approach

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean-difference</th>
<th>T-value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NRS</td>
<td>VAS</td>
<td>NRS</td>
</tr>
<tr>
<td>Baseline – week 2</td>
<td>3.165</td>
<td>1.466</td>
<td>32.684</td>
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<tr>
<td>Week 2 – week 4</td>
<td>1.666</td>
<td>1.633</td>
<td>6.312</td>
</tr>
<tr>
<td>Baseline – week 4</td>
<td>4.832</td>
<td>3.1</td>
<td>5.362</td>
</tr>
</tbody>
</table>

Fig. 3: Comparison of NRS between the two groups

Fig. 4: Comparison of VAS between the two groups
Interlaminar and transforaminal groups in NRS were compared post-procedure. In the second week, the interlaminar group exhibits a NRS of 2.7667 with improvement in pain, while the transforaminal group has a NRS of 3.4 with improvement. Interlaminar group improvement from the second to the fourth week in NRS is 1.0, while transforaminal group improvement is 1.6667. With p values 0.05 in each instance, the improvement from baseline to the fourth week in the interlaminar group with NRS of 3.766 and in the transforaminal group it is 5.066 (Fig. 3).

In a VAS post-procedure comparison of the interlaminar approach and the transforaminal, the improvement in pain in the second week was 0.733 in the interlaminar group and 1.466 in the transforaminal group. Interlaminar group improvement was seen from the second to the fourth week (VAS = 1.433), while in transforaminal group improvement was 1.633. With p values 0.05 in each case, the improvement from baseline to the fourth week in the interlaminar group with VAS of 2.166, and in the transforaminal group it is 3.1(Fig. 4).

**DISCUSSION**

The most prevalent issue among acute and chronic pain problems is lower back pain, either alone or in conjunction with lower limb pain. There are numerous potential etiologies for chronic lower back pain, making it a complex illness. According to reports, the lower back experiences back discomfort between 65% and 80% of the time. The intervertebral discs, ligaments, facet joints, muscles and fascia were identified by Kuslich et al., (17) as the tissues that can convey pain in the lower back.

Park et al., (14) used Dexamethasone and Triamcinolone acetate to demonstrate the effectiveness of non-particulate and particulate steroid injection in treating radiculopathy of the lumbar origin. Mean pain scores were considerably lower in the group that received triamcinolone acetate injection through transforaminal route in comparison to the group that received dexamethasone injection one month after the therapy (p=0.000). When compared to the dexamethasone group, which had a 40% drop in pain score, the triamcinolone group’s reduction was 71%. Hence, it can be concluded that triamcinolone acetate transforaminal injection is preferable for the alleviation of radicular pain originating from the lumbar region for a short period.

According to the study, 46% of the ILESI group and 68% of the TFESI group experienced very effective pain alleviation right away. At the conclusion of the research period, 54% of the transforaminal group and 34% of the interlaminar group still had a considerable degree of relief. It demonstrates that triamcinolone acetate causes pain alleviation that begins extremely early and lasts longer than an improvement in impairment.

In 30 instances of the ILESI group, the assessment of pain using a numeric rating scale revealed that, on average, 35.5% of the pain was relieved during the first week, and 48.1% of the pain was relieved during the second week. The ILESI group’s pain was reduced by 48.1% between the baseline and second week, according to the comparison. According to assessment results, there was a 44% decrease in pain during the first week, a 65.4% decrease from the first to the second week, and a 65.4% decrease from baseline to the second week in the TFESI group.

In both the ILESI and TFESI groups, it was demonstrated how the triamcinolone acetate impact worsens over time in the majority of patients. In the current trial, approximately 6.7 percent of patients in the TFESI group experienced 100 percent pain reduction, compared to 0% in the ILESI group. ILESI group consists of patients who are in the age of 20 to 65 years. Patients under the age of 35 experienced an average pain relief of 57.15%, and patients over the age of 35 years experienced an average pain relief of 57.92%.

The study group comprised 47 men and 13 women. 13 female patients had an average pain alleviation of approximately 53.7%, and 17 male patients had an average pain alleviation of approximately 57.59%. Male and female NRS scores for pain alleviation were compared, and there was no statistically significant difference between the two groups.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Study</th>
<th>Group</th>
<th>Sample Size</th>
<th>Baseline of pain score (average)</th>
<th>First follow up (average)</th>
<th>Second follow up (average)</th>
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<tr>
<td>1</td>
<td>Current study</td>
<td>ILESI</td>
<td>30</td>
<td>7.866</td>
<td>4.966</td>
<td>4.033</td>
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<td></td>
<td></td>
<td>TFESI</td>
<td>30</td>
<td>4.1</td>
<td>3.366</td>
<td>1.933</td>
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<td>2</td>
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<td>7.3</td>
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<td>5.9</td>
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<tr>
<td></td>
<td></td>
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<td>5.9</td>
<td>2.9</td>
<td>3.2</td>
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<tr>
<td>3</td>
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<td>ILESI</td>
<td>19</td>
<td>7.57</td>
<td>2.05</td>
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<td></td>
<td></td>
<td>TFESI</td>
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<td>6.73</td>
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<td>Beyaz(16)</td>
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<td></td>
<td></td>
<td>TFESI</td>
<td>126</td>
<td>7.6</td>
<td>3.5</td>
<td>3.2</td>
</tr>
</tbody>
</table>

ILESI: Interlaminar epidural steroid injection   TFESI: Transforaminal epidural steroid injection

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Patients under the age of 35 years had a mean relief rate of 67.1%, and those over 35 years had a mean relief rate of 63.21%. The study consists of patients whose age lie between 20 to 56 years in the transforaminal group. 7 females and 23 males, on average, reported experiencing pain relief. Average pain alleviation for seven female patients was 56.46%, whereas average pain alleviation for seven male patients was 68.14%. There was no discernible difference between male and female NRS pain relief according to the t value = 1.633 and p = 0.114 comparison of the two sexes.

In 30 instances assessed using the VAS in the ILESI group, the average 1st week pain relief was 16.9%, while the 2nd week pain relief was 50.9%. The comparison between baseline and second week revealed that the ILESI group had seen a 50.9% reduction in pain. The TFESI group demonstrated pain alleviation of 35.1% in the 1st week, 66.7% from the 1st to the 2nd week, and 76.7% from the baseline to the second week.

According to this study, 57.9% of the ILESI participants below the age of 35 years, exhibited an average improvement of 50% or higher. In the ILESI group of people under 35 years, 42.1% had an average improvement of 50%. In the ILESI group of people over the age of 35 years, 45.5% demonstrated an improvement of about 50% on average. In the TFESI group of females aged under 35 years, 33.3% had an average improvement of 50%, and 66.7% demonstrated an average improvement of 50%. In the TFESI group of people over the age of 35 years, 92.3% demonstrated an improvement of less than 50% on average. In the TFESI group of people who were over 35 years old, 7.7% had an average improvement of 50%. In females, 100% showed improvement on an average of 50%. 8.7% and 91.3% of males, respectively, exhibited an average improvement of 50%.

According to Table 4, TFESI group has seen greater pain relief than the ILESI group. According to North American Spine Society (NASS) a favourable response should be sought for with no more than two injections. Once the effect has been attained, up to three injections can be taken over the course of six months to maintain it.

According to the study of Gharibo et al., (18) the TFESI group’s pain decreased by 73.4% and the ILESI groups by 44.3%. But he only kept track of patients for three weeks. However, the study by Kolsi et al., (19) found no distinction between the two groups’ levels of pain alleviation. Similar pain alleviation was experienced by both groups (62.8% and 63%). He studied for 28 days likewise (Table 5).

The efficiency of transforaminal, interlaminar, and caudal procedures with modest and high volumes of injectate in the treatment of lumbosacral disc herniations or spinal stenosis was evaluated in a retrospective comparative study by Lee et al., (20). 54 of the study’s subjects underwent caudal injections, 64 underwent ILESI, and 115 underwent TFESI. Using the VAS (Visual Analogue Pain Scale), Patient Satisfaction Index (PSI), and Roland Five Point Pain Scale, outcomes were evaluated after two weeks, one month, and two months. Translaminar and TFESI procedures had higher success rates when compared to caudal techniques in VAS in the HIVD group and in VAS and PSI in the stenosis group.

The current and the previous studies indicate that: from baseline to the second week, there is a significant reduction in pain in the ILESI and TFESI groups on both the NRS and VAS. Patients who received steroid injections using TFESI, however, saw superior therapeutic results than those who received them using the interlaminar method.

The current study results are supported by various other research studies. In a study comparing the two methods of epidural steroid injections on 20 patients, Schaufele et al., (13) came to the conclusion that the transforaminal was more efficient. However, their study had important limitations, including a fairly small population (n = 20) and a large range in patient ages. In a similar study, 90 patients were studied by Ackerman and Ahmad who evaluated the interlaminar and transforaminal approaches and concluded that the transforaminal approach was the most effective (21).

Two randomised controlled studies (21, 22) provide support for these findings. Numerous research on TFESI and ILESI have been published as a result, and they show either favourable or negative outcomes with an efficacy of more than six months. Although interlaminar steroid injection studies were carried out as randomised controlled studies which are approached blindly for specific one level injection, transforaminal steroid injection studies were recently shown to produce more effective outcomes. Hopwood

Table 5: Comparison of NRS - transforaminal versus interlaminar in different studies

<table>
<thead>
<tr>
<th>Study by various authors</th>
<th>Transforaminal group (n)</th>
<th>Interlaminar group (n)</th>
<th>Improvement in Interlaminar vs Transforaminal</th>
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</thead>
<tbody>
<tr>
<td>Current study</td>
<td>30</td>
<td>30</td>
<td>48.1% vs 65.4%</td>
</tr>
<tr>
<td>Schaufele et al., (10)</td>
<td>20</td>
<td>20</td>
<td>19.2% vs 45.8%</td>
</tr>
<tr>
<td>Smith et al., (15)</td>
<td>19</td>
<td>19</td>
<td>39.5% vs 30.5%</td>
</tr>
<tr>
<td>Gharibo et al., (17)</td>
<td>20</td>
<td>20</td>
<td>44.3% vs 73.5%</td>
</tr>
<tr>
<td>Rados et al., (18)</td>
<td>32</td>
<td>32</td>
<td>43.5% vs 45.6%</td>
</tr>
<tr>
<td>Kolsi et al., (19)</td>
<td>17</td>
<td>13</td>
<td>63.5% vs 62.8%</td>
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</tbody>
</table>

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Biomedicine- Vol. 43 No. 4: 2023
and Abram listed 33 characteristics that were linked to lumbar epidural steroid injection success rates and recommended that all 33 parameters be taken into account when prescribing epidural steroids to patients with chronic lumbar pain (23). But the proficiency of the person doing the process still has a significant role in success/satisfaction rates.

CONCLUSION

This study concludes that epidural steroid injections are safe and do not cause any significant side effects. Patients presenting with radiculopathy from disc herniation or lumbar canal stenosis report significant pain alleviation regardless of their age, gender, the duration of their symptoms, or the severity of their pain. As it provides target specific administration, compared to interlaminar root, triamcinolone acetate given through transforaminal root are superior. Interlaminar steroids are administered blindly, increasing the possibility of needle insertion errors and lowering success rates. The study’s variables included the fact that TFESI was carried out by an orthopaedic spine surgeon whereas interlaminar steroid injections were carried out by a single skilled anaesthetist.

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CONFLICT OF INTEREST

The authors state that they have no conflicts of interest.

REFERENCES


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Biomedicine- Vol. 43 No. 4: 2023

1280