**Results from an Expedited Spinal Nerve Root Block Clinic at a UK Tertiary Neurosurgical Centre**

**Abstract:**

**Study Design**

Retrospective Observational Study

**Introduction**

Lumbar radicular pain has a prevalence of 3-5%. Level 1 evidence has demonstrated equivalence between surgical and injection treatment. We assess the outcomes from a transforaminal epidural steroid injection clinic in a tertiary neuroscience referral centre.

**Methods**

We performed an analysis of data from consecutive patients entered into a new internal referral database between August 2018 to May 2021.Radicular pain was classified as one of “first presentation” or “recurrence”. Outcomes were obtained from follow up clinic letters and recorded in a binary manner of “positive result” or “negative result”. Spinal pathology was documented from radiology reports and MRI images.

**Results**

We analysed 208 patients referred to the clinic. Excluding those who improved to a point of not requiring treatment, and those who underwent surgical intervention, 119 patients undergoing injection were included, of which 14 were lost to follow-up. 68% of patients had a positive result from injection. Subgroup analysis demonstrated good outcomes for both hyperacute (<6 weeks) and chronic (>12 months). Contained disk pathologies had better outcomes than uncontained. There was no difference in outcomes across grades of compression, but previous same level surgery was associated with poorer response rates.

**Conclusions**

There is a high rate of natural resolution of symptoms in patients with LSRP. In those where pain persists, TFESI is a valuable first line treatment modality. This study suggests the efficacy of TFESI is potentially independent of grade of stenosis and chronicity of symptoms. Contained disc pathologies respond better than uncontained.

**Keywords:** Epidural injection; sciatica; lumbosacral radicular pain

**INTRODUCTION**

Lumbosacral radicular pain (LSRP), defined as pain arising from the lumbar spine and radiating to a lower limb, is one of the most common presentations to orthopaedic and neurosurgical outpatient clinics, with an estimated prevalence of 3-5% 1. The natural course is relatively benign – LSR pain naturally resolves partially or completely in 60% of patients within 12 weeks 2. Where pain-congruent mechanical compression of nerve roots is identified, the underlying pathology is thought to be a complex interplay of compression, local inflammatory and immune responses, as well as the neurophysiologic response of the dorsal root ganglion to these stressors 3. In these cases, treatment pathways to address these contributing factors have been developed, inclusive of oral analgesia, physiotherapy; injection treatment and surgery4.

Injection treatment has classically been delivered as image-guided interlaminar epidural corticosteroids injection (ILSI) however this has largely been replaced by targeted Transforaminal Epidural Steroid Injection (TFESI), allowing delivery in proximity to the dorsal root ganglion (DRG) 5,6, providing local control of the inflammatory component of the pain, with a potential mechanical washout effect of inflammatory mediators as a contributing therapeutic factor 7.

Wilby et al. (2021) performed a randomised control trial assessing responses to TFESI compared to those undergoing discectomy8. This found improvements in pain scores to be equivocal in both arms, with significant cost savings yielded from the implementation of TFESI as first line treatment for those presenting with LSRP.

We assess the outcomes for our clinical patient cohort undergoing TFESI, and correlate improvements in outcome scores to the size of the disc herniation. We assessed the rate of natural improvement of LSRP and the discharge rate for patients from tertiary care with a positive response to nerve root blocks.

**METHODS**

This service evaluation was registered with and approved by the hospital’s audit department (NS343aa).

*Patient pathway*

An expedited root block service (ERBS) commenced at our unit in August 2018. Patients referred to the unit with LSRP from either primary or secondary care were reviewed in a neurosurgical triage clinic. Where management with a root block was considered an appropriate option, the triaging clinician referred patients on to an ERBS clinic. A small number of patients were referred directly to the ERBS clinic from a nearby tertiary hospital by either a musculoskeletal clinical assessment service clinician (MCAS), or from that hospital’s Emergency Medicine Unit.

*Data acquisition*

All patients referred to the ERBS clinic, from August 2018 until May 2021 were included denoting the time from its inception to the point at which the database was reviewed.

Data were entered in real time into a database established at commencement of a new clinical pathway at our institution. Outcomes were extracted from recorded clinical assessment documented on the electronic healthcare record of the clinical notes of all patients entered in that database.

Initial referral criteria to the ERBS service were

1. Presence of acute/sub-acute (6 weeks up to approximately 12months duration), severe LSRP in patients with no previous same level surgery *and*
2. Nerve root impingement from disc prolapse or foraminal narrowing evident on an MRI that was consistent with the symptoms described.

These criteria were subsequently expanded in line with clinical need to also allow inclusion of

1. Patients after previous spinal nerve decompression procedures at the same level
2. Patients with other radicular spinal pathologies (e.g. epidural varices),
3. Patients with a pain duration of somewhat over >12 months or <6 weeks.

The target time from receipt of referral to TFESI was six weeks.

Upon receipt of the referral, it was triaged and where applicable allocated to the next available ERBS pain clinic. These were held twice weekly, with either telemedicine clinics or face-to-face appointments being offered to patients. Based on assessment in the ERBS clinic, the patient was then either consented and listed for the TFESI treatment, referred back to the neurosurgical team, or directed to another route of management including involvement of complex pain management teams and physiotherapy.

*Root Block Procedure*

The TFESI procedure was conducted following standard procedure outlined in Appendix A. As part of the procedure, patients were asked if they experienced pain during contrast injection. ‘*Concordant*’ pain was recognised as pain in a similar distribution to their typical radicular pain. At follow up, the patient’s response to the block was assessed in a binary fashion, defined as either having provided or not provided meaningful pain relief (for details see below).

*Outcome Data*

For the purpose of this retrospective study, at the time of referral we classified radicular pain as one of “first presentation”; “acute exacerbation” or “recurrence”. Patient demographics inclusive of age and sex were documented. Time from onset of symptoms and any prior symptoms were noted. Any previous spinal surgery was documented with spinal level(s).

We documented parameters of the TFESI procedure itself, including injectates, level and side of procedure, presence of concordant radicular pain during contrast injection, immediate complications, and any unplanned post-procedural admissions.

The main TFESI efficacy outcome was the presence or absence of meaningful pain relief in patients after the procedure, as reported at the first follow-up assessment and documented in the clinical notes. A report of pain relief that was reasonably attributable to the TFSI procedure was defined as a positive procedure, regardless of its duration. As there was significant variation in the documentation between different healthcare professionals, for the purpose of this study we defined meaningful pain relief post TFSI if clearly documented as such; pain relief documented as ‘with little impact’, ‘mild’, ‘not making any difference’, ‘uncertain’, ‘minor’, ‘minimal’ was considered unsuccessful. We considered terms such as ‘substantial’, ‘meaningful’, and ‘significant’ to reflect a positive binary outcome.

We analysed and recorded the spinal pathology (type of disc pathology, other compressing lesion) present at the level of the injection and related the type of pathology to the block outcome. We captured data regarding the patient’s most recent lumbosacral MRI, including the duration between the last MRI and TFESI, the presence and severity of lateral recess stenosis using Bartynski’s grading system 9, and the Lee grading system for foraminal stenosis10. These grading systems are both 4 point scales. Bartynski’s grade 0 is described as normal, with grade 1 having lateral stenosis evident but no direct root compression. Grades 2 and 3 are reflective of radiographic root compromise, with increasing severity. Lee’s system for foraminal stenosis relates to the obliteration of the fat demonstrated on the T1 sequence on parasagittal trans foraminal cut of the MRI, with grade 4 representing nerve root collapse/deformity. We categorised grades 0 and 1 as mild - moderate and 3 and 4 as severe, correlating outcomes on the basis of this binary measure.

*Statistics*

Summary statistics were computed to explore differential block outcomes in patient- and pathology subgroups. The rate of subsequent surgical intervention within the cohort was assessed using the Chi-square test. The relationship between the graded severity of stenosis and block outcome was assessed using the Fischer exact test using a 2x4 matrix of severity of stenosis and success of injection therapy. Prism®9 (GraphPad 01.23) was used for statistical analysis.

**RESULTS**

Between 3rd of August 2018 and 14th of May 2021, 208 referrals were received to the ERBS clinic. All but two patients were referred as outpatients. Patients had a mean age of 48(+/-12.8) years. The female to male ratio was 1.2:1.

The majority (58.6%) of these referrals were first presentations, with 59% of participants having symptoms between 6 weeks and 12 months (Figure 1a and 1b).

Analysis of the referral letters demonstrated that 60% of patients (n=125) were referred based on clinician preference to offer TFESI rather than surgery. In 38% (n=79) of patients the surgeon had offered patients a choice between surgery and TFESI with patient preference being an injection.

Thirty-four patients (16%) had a history of prior spinal surgery; of which thirty now had LSPR on the ipsilateral side corresponding to the same level.

At clinic attendance overall 55/208 patients were not offered TFESI (Figure 2). The most common reason for not offering TFESI was that the treating clinician considered the LSRP sufficiently improved to not warrant the TFESI procedure (15% of referred patients, n=31); this pain improvement was documented in the clinic letter. The ‘other’ category within this figure represents patients who had a change in pain pattern; had a motor deficit requiring a referral back to the neurology or neurosurgical services; had no evidence of the pain being consistent with a lumbar aetiology on MRI scans; or required referral to other specialties such as the complex pain management service or physiotherapy.

There was a dropout rate of 20% in the time between ERBS clinic appointment and injection. Of 30 patients consented who did not proceed with the injection, 11 patients felt their pain had resolved naturally; nine patients were not injected due to service disruption during Covid pandemic, with additional reasons consisting of patient change of mind (n=3), patient undergoing spinal surgery on an urgent basis due to worsening of symptoms (n=1), and unrelated illness resulting in an inability to perform injection(n=1). The remaining five TFESIs were performed by a Neuroradiologist to improve delivery time during a high volume period of referrals; these injections were excluded from further analysis in this study. This gave a total of 119 patients’ outcomes reviewed for this analysis.

The flow of these patients through the system, and their outcomes, is illustrated in Figure 3.

*TFESI procedure and outcomes*

There were no significant adverse events reported from the procedure. Two patients had a vasovagal event during the procedure with procedures completed in both cases.

Adaptation of the employed technique during the TFESI procedure was required in 7/119 patients (6%), due to anatomical variation, further described in Table 1.

During TFESIs procedures 71/119 (60%) patients reported concordant pain during injection of contrast or medications, ten did not, and the response was not recorded for the remaining 38 patients.

There were 63 left sided and 56 right sided TFESIs. The most commonly injected spinal nerve root was L5 (n=55, 46%). All TFESIs used both local anaesthetic and steroid. The majority of procedures were performed with 1 ml of 0.5% Levobupivacaine as local anaesthetic (n=74, 62.2%). Variations based on injecting clinicians’ preferences included 2 mls of 0.5% Levobupivacaine (n=2, 1.7%), 1 ml of 0.25% Levobupivacaine (n=4, 3.4%), and 2 mls of 0.25% Levobupivacaine (n=8, 6.7%). The most commonly used steroid was 11.4 mg Dexamethasone (n= 55, 46.3%), with Dexamethasone 3.3 mg (n=2, 1.7%), Dexamethasone 3.8 mg (n=9, 7.6%), Dexamethasone 7.6 mg (n=21, 17.6%), and Triamcinolone 40 mg (n=1, 0.8%) also used. In 31 of early cases the injected *volume* of LA was not documented due to a technical issue with the documentation system (0.5% levo-Bupivacaine was used in 27 of these cases, and 0.25% levo-Bupivacaine in 4). Of the same 31 cases, 15 had 3.8 mg Dexamethasone injected, 9 with 11.4 mg, 5 each with 7.6 mg, and 3.3 mg.

The median time to first follow up after TFESI in the neuro-surgical clinic was 57 (4-311) days, and 54 (6-396) days when pandemic related delays to appointment were excluded. This reflect a standard follow up between six and eight weeks that is standard at our unit.

*Spinal Pathology*

The most common spinal pathology identified from the available MRI reports was related to disc-herniation only, with no concomitant pathology. The overall positive rate for these injections was 68%. In those with an element of posterior compression (n=10), there was a 70% response, however the low numbers within this category should be noted.

*Block outcomes*

Outcome data were available for 105/119 patients: 68% (71/105) of these reported meaningful pain relief (Table 2). Of the 14 injected patients for which no outcome data were available, ten had been lost to follow up, with block outcomes not reported for four patients.

At the time of the last data entry at our centre pain remained improved in 47/71 (66%) of all patients after positive TFESIs. Meaningful pain improvement was also noted in 12/34 (35%) of all negative TFESIs at a subsequent follow up, considered to be a natural resolution of the symptoms.

Outcomes assessed in relation to anatomical pathologies, duration of symptoms and recurrent LSRP are presented in Table 3 for patients where these were clearly documented within the healthcare records. Block outcomes were not related to the type of presentation (first presentation or recurrence of symptoms), however those with previous spinal surgery at the same level had a significantly poorer outcome than first presentations (p<0.01, Fisher’s exact test). Within the group of 31 patients referred with contained disc-related pathology (protrusion or annual fissure), 87% (n=27) had a positive result, against 39% (7/18) of non contained (extruded or sequestered) discs (p<0.001, Fisher’s exact).

*MRI-confirmed degree of nerve root compression and correlation with TFESI result*

Complete information for eighty patients referred with lumbar radicular pain associated with lateral recess stenosis (LRS), and eight patients who were referred with foraminal stenosis was available. Table 4a outlines the responses to injection for the lateral recess stenosis group. The types and graded severity of the stenosis are outlined in Table 4a and Table 4b, with the binary outcomes of positive or negative response to the injection.

Using the Freeman-Halton extension of Fischer’s exact probability test for the 2x3 contingency table, no statistically significant correlation between response to TFESI and grade of lateral recess stenosis was found (p=0.22). Small numbers within the foraminal stenosis group limit significance of statistical analysis due to the risk of a Type II error.

**Discussion**

We audited outcomes of a TFESI pathway for acute/sub-acute LSRP relating to a pain-concordant spinal pathology in a tertiary neurosurgical centre. We found a high rate of spontaneous LSRP resolution in the time-period between referral to TFESI and date of scheduled procedure. Surgical management was required in a minority of patients entered onto this pathway (21/119, 18%). The *severity* of compressive pathology did not predict block outcome in our patients, although the *type* of pathology was predictive with disc extrusions/sequestrations being relatively poor prognostic factors when compared to contained disc pathologies. Those with previous surgical intervention (same level) had poorer outcomes than those who did not.

The use of TFESI for pain relief is well established. Equivalent outcomes with the more invasive option of surgical discectomy has been demonstrated in the NERVEs trial8. Several studies have confirmed that the success of transforaminal injection treatment for LSRP rests on the use of steroid injectate. Riew et al.’s RCT (2000) compared the effect of TFESI on the need for operative treatment of lumbar radicular pain to a local anaesthetic only injection. Post injection, 66% of the LA group proceeded to surgical discectomy against 36% in the TFESI group (p<0.0004) 11. A meta-analysis of seven randomised controlled trials of TFESI for LSRP in the presence of a pain-concordant herniated discs confirmed significant reduction in mean pain scores in patients receiving steroids compared with local anaesthetic/saline at a median duration of three months after the intervention12. Although these results elucidated the benefits to initial treatment with injection, predicting which subsets of patient will get an optimum response from TFESI is unclear.

Given the complex interplay between inflammatory and nociceptive local reactions and mechanical compression of the nerve root, the optimal treatment may require tailoring to the presentation and the appearance on MRI. The effect of prolonged compression and its effect on the local inflammatory milieu may play a role in the response to treatment 13. Patients within our cohort demonstrated good response to injection therapy even if over twelve months in duration (89%), although the numbers in this group were low. Our injection pathway catered to a heterogenous group of aetiologies, and we demonstrated a better response in the contained group than the uncontained.

One of the lesser investigated aspects of TFESI outcomes is the correlation between either structural pathology or severity of stenosis and improvement of symptoms post injection. Given the wide discrepancy of clinical symptoms between severity of stenosis and severity of radiculopathy14, clinicians should be cautious in their expectations of outcomes on basis of this alone, as the underlying pathology is dependent upon the interplay between mechanical and inflammatory stimuli15. Furthermore, most herniated lumbar discs resolve spontaneously, even those of a large canal occupancy16. Gupta et al. (2020) found no correlation over two years between need for surgical decompression and size of disc herniation17. Choi et al. (2007) demonstrated that high grade compression lesions were less likely to respond to injection therapy (17% responder vs 52% non-responder) than lower grade (32% vs 4%), with a likelihood ratio of response to injection for low vs high grade compression being 1.8. Midgrade compression was found to be equivocal (51% vs 41%)18. Ghahreman and Bogduk’s corresponding likelihood ratio was 2.6 with their cohort of 71 patients 19. Given that the injection is aimed at the inflammatory aspect of radicular pain through the effects of the steroid and with the washout theory of injections, this outcome is perhaps not unexpected.

Discrepancy also exists within published studies pertaining to the success of TFESI correlating with the chronicity of symptoms. A timeframe of six months was suggested by Roy et al., after which time success rates were lower20, although this can be regarded as a trend rather than a difference that could be considered statistically significant 19,21,22 with MacVicar et al’s meta-analysis reporting a likelihood ratio of a successful outcome for acute (<6 months) to chronic being 1.223. Our data would suggest a hyperacute treatment of less than six weeks has a 71% success rate. Injections for chronic symptoms of greater than twelve months had a similar success rate than as the hyperacute group (67%).

The retrospective nature of the outcome data collection is a limitation to our study. Incomplete documentation and loss to follow up limited the number of patients within our cohort. Follow up for patients was limited to standard follow up for injections, and further curtailed by the restrictions imposed upon the health service due to the Covid pandemic. Thus, long term outcomes for TFESI were not available from our dataset. Our initial follow up between six and eight weeks allowed us analyse the short-medium term efficacy of our treatment, however this approach does not allow us to assess the shorter term results from the injection.

One of the changes being implemented in our ERBS clinic as a result of this study is the introduction of VAS and other PROMs tools both at baseline and at follow up for inclusion within the patients electronic healthcare record.

**Conclusion**

There is a high rate of natural resolution of symptoms in patients with LSRP referred to a tertiary neurosurgical service. In those where this pain persists, TFESI is a valuable option in its treatment. This study suggests the efficacy of TFESI is potentially independent of grade of stenosis and chronicity of symptoms up to 14 months, in contrast to previous studies. Previous same level surgery was associated with poorer response rates with injection therapy. Contained disc pathologies respond better than non contained.

**References**

1. Tarulli AW, Raynor EM. Lumbosacral radiculopathy. *Neurologic clinics.* 2007;25(2):387-405.

2. Van Boxem K, Cheng J, Patijn J, et al. Lumbosacral radicular pain. *Evidence‐Based Interventional Pain Medicine: According to Clinical Diagnoses.* 2011:71-86.

3. Dower A, Davies MA, Ghahreman A. Pathologic basis of lumbar radicular pain. *World neurosurgery.* 2019;128:114-121.

4. Lee J, Gupta S, Price C, Baranowski A. Low back and radicular pain: a pathway for care developed by the British Pain Society. *British journal of anaesthesia.* 2013;111(1):112-120.

5. Choi E, Nahm F, Lee P-B. Comparison of contrast flow and clinical effectiveness between a modified paramedian interlaminar approach and transforaminal approach in cervical epidural steroid injection. *BJA: British Journal of Anaesthesia.* 2015;115(5):768-774.

6. Kraiwattanapong C, Wechmongkolgorn S, Chatriyanuyok B, et al. Outcomes of fluoroscopically guided lumbar transforaminal epidural steroid injections in degenerative lumbar spondylolisthesis patients. *Asian Spine Journal.* 2014;8(2):119.

7. Viswanathan VK, Kanna RM, Farhadi HF. Role of transforaminal epidural injections or selective nerve root blocks in the management of lumbar radicular syndrome-A narrative, evidence-based review. *Journal of Clinical Orthopaedics and Trauma.* 2020;11(5):802-809.

8. Wilby MJ, Best A, Wood E, et al. Surgical microdiscectomy versus transforaminal epidural steroid injection in patients with sciatica secondary to herniated lumbar disc (NERVES): a phase 3, multicentre, open-label, randomised controlled trial and economic evaluation. *The Lancet Rheumatology.* 2021;3(5):e347-e356.

9. Bartynski WS, Lin L. Lumbar root compression in the lateral recess: MR imaging, conventional myelography, and CT myelography comparison with surgical confirmation. *American Journal of Neuroradiology.* 2003;24(3):348-360.

10. Lee S, Lee JW, Yeom JS, et al. A practical MRI grading system for lumbar foraminal stenosis. *American Journal of Roentgenology.* 2010;194(4):1095-1098.

11. Riew KD, Yin Y, Gilula L, et al. The effect of nerve-root injections on the need for operative treatment of lumbar radicular pain: a prospective, randomized, controlled, double-blind study. *JBJS.* 2000;82(11):1589.

12. Bhatia A, Flamer D, Shah PS, Cohen SP. Transforaminal epidural steroid injections for treating lumbosacral radicular pain from herniated intervertebral discs: a systematic review and meta-analysis. *Anesthesia & Analgesia.* 2016;122(3):857-870.

13. Lutz GE, Vad VB, Wisneski RJ. Fluoroscopic transforaminal lumbar epidural steroids: an outcome study. *Archives of physical medicine and rehabilitation.* 1998;79(11):1362-1366.

14. Splettstößer A, Khan MF, Zimmermann B, et al. Correlation of lumbar lateral recess stenosis in magnetic resonance imaging and clinical symptoms. *World journal of radiology.* 2017;9(5):223.

15. Stafford M, Peng P, Hill D. Sciatica: a review of history, epidemiology, pathogenesis, and the role of epidural steroid injection in management. *British journal of anaesthesia.* 2007;99(4):461-473.

16. Cribb G, Jaffray D, Cassar-Pullicino V. Observations on the natural history of massive lumbar disc herniation. *The Journal of bone and joint surgery British volume.* 2007;89(6):782-784.

17. Gupta A, Upadhyaya S, Yeung CM, et al. Does size matter? An analysis of the effect of lumbar disc herniation size on the success of nonoperative treatment. *Global Spine Journal.* 2020;10(7):881-887.

18. Choi S-J, Song JS, Kim C, et al. The use of magnetic resonance imaging to predict the clinical outcome of non-surgical treatment for lumbar interverterbal disc herniation. *Korean journal of radiology.* 2007;8(2):156-163.

19. Ghahreman A, Bogduk N. Predictors of a favorable response to transforaminal injection of steroids in patients with lumbar radicular pain due to disc herniation. *Pain Medicine.* 2011;12(6):871-879.

20. Roy C, Chatterjee N, Patro SN, Chakraborty A, Kumar GV, Sengupta R. The efficacy of transforaminal epidural steroid injections in lumbosacral radiculopathy. *Neurology India.* 2011;59(5):685.

21. Jeong HS, Lee JW, Kim SH, Myung JS, Kim JH, Kang HS. Effectiveness of transforaminal epidural steroid injection by using a preganglionic approach: a prospective randomized controlled study. *Radiology.* 2007;245(2):584-590.

22. Lee JW, Kim SH, Choi J-Y, et al. Transforaminal epidural steroid injection for lumbosacral radiculopathy: preganglionic versus conventional approach. *Korean journal of radiology.* 2006;7(2):139-144.

23. MacVicar J, King W, Landers MH, Bogduk N. The effectiveness of lumbar transforaminal injection of steroids: a comprehensive review with systematic analysis of the published data. *Pain Medicine.* 2013;14(1):14-28.