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Role of root block in lumbar spine radiculopathy

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Abstract
Introduction: Chronic lumbosacral pain is a common and challenging clinical entity problem in pain management centre. Since its first description by Mixter Barr in 1934, lumbar disc herniation is one of the few abnormality in the lumbar spine, were a clear relationship between the morphological alteration and pain seems to exist while pure mechanical compression was considered previously as a source of sciatica there is increasing evidence that chemical irritation of the nerve root plays an essential role perhaps even most important role.
Materials and Methods: Chronic spinal back pain due to prolapsed intervertebral disc and lumber canal stenosis was previously treated with lumbar epidural steroid injections which gives its effect via drugs into the epidural space, not at particular level and its effect was also short lasting. Selective nerve root block and radiofrequency ablation therapy block the pain pathway by blocking the ascending pain pathway at dorsal root ganglion at particular level.
Results: In this study, 100 patients were included. 82 patients were treated with selective nerve root block and 18 patients treated with pulse radiofrequency, were followed for average 6 months. Maximum number of patients are found in age group of 31 to 40 (41%). Mean age of our study is 41.7 years. In this study, total 51 % were male and 49 % were female so, male to female ratio is almost 1:1. Maximum number of patients having disc herniation at level of L4-L5(43%) and L5-S1(47%).
Discussion: In our study, majority of patients were between age group of 31-40 years. In patients older than 50 years a disc has developed some degree of inherent stability through fibrous changes that occurs with loss of water content. In our study, the disc herniation was found to be slight more common in males. A herniated disc occurs most often in the lower lumber region of the spine especially at the L4-L5 and L5-S1 levels (90% in this study). This is because the lower lumber discs bear much more of the body weight and comparatively more bending force which leads to more degeneration and ruptures.
Conclusion: The selective nerve root block combined with careful history, physical examination and quality radiographic studies, is an important tool in the diagnosis and treatment of patients with predominant lumber radicular symptoms and it is a less invasive procedure. It gives an acceptable results in form of pain relief if given in early course of disease.

Keywords: Root block, lumbar spine radiculopathy

Introduction
Humans have been plagued by back and leg pain since the beginning of recorded history. Low back pain is thought to occur in almost 80% of adults in some points in their life. Among chronic conditions, back problems are the most frequent cause of limitations of activity in persons less than 45 year [1]. Since its first description by Mixter Barr in 1934, lumbar disc herniation is one of the few abnormality in the lumbar spine, were a clear relationship between the morphological alteration and pain seems to exist while pure mechanical compression was considered previously as a source of sciatica there is increasing evidence that chemical irritation of the nerve root plays an essential role perhaps even most important role [2].
The natural history of sciatica is favorable and typically resolves with conservative care which includes activity modifications, physical therapy, progressive exercise, non- steroidal anti-inflammatory drugs, spinal injections, radiofrequency ablations therapy and surgical intervention.
Radiofrequency ablation theory of dorsal root ganglion has been suggested as a potential therapeutic option for chronic radicular pain. The premise for the use of pulsed radiofrequency lesioning (PRFL) is to produce a partial lesion in the DRG so as for preferentially disrupt nociception while avoiding significant sensory deficit. Because of the potential neurological complication of the continuous radiofrequency lesioning (CRFL); pulsed radiofrequency

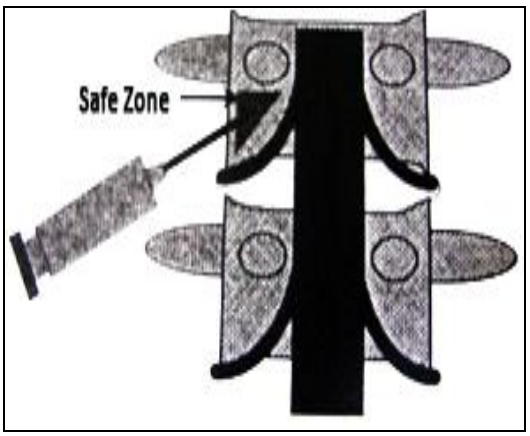
lesioning (PRFL), an isothermal radiofrequency treatment is used is used for the chronic lumbosacral radicular pain [3, 4].
The most commonly involved surgical indication are intractable leg or back pain and significant functional impairment that have been unresponsive to conservative measures. The absolute indication for lumber herniated disc decompression is major motor weakness and cauda equina syndrome [5]. Diagnostic image appearance of the disc herniation can pinpoint the pathology but the decision for surgery is primarily dependent on patients clinical course rather than the size of the disc herniation nor on the extruded disc material.
Imaging techniques such as Magnetic Response Imaging (MRI) have contributed to a better understanding of the physical characteristics an accuracy of disc herniation, lumber canal stenosis, etc.

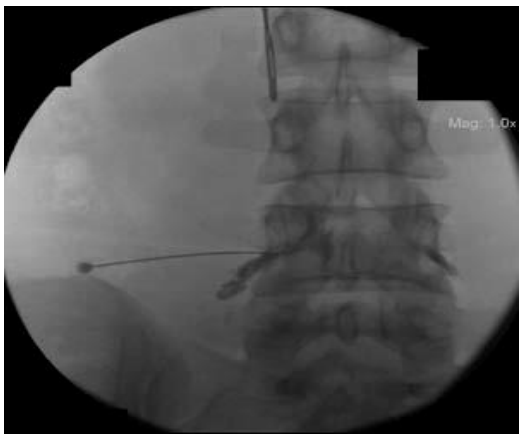
Aim
The aim of our study is to investigate whether a selective nerve root block with local application of bupivacaine and triamcinolone or pulsed radiofrequency ablation of dorsal root ganglion for safety and effectiveness in patients with radicular leg pain due to various pathology.

Methods and Materials
Study level: This is a therapeutic study – LEVEL II, prospective comparative study.

Methods
All patients (n=100) who were included for study had complained of unilateral or bilateral leg pain and all had positive nerve root tension signs and or neurological deficit
Each patients had symptoms were consistent with the level of disc herniation. All patients had received one of the following terms of treatment like analgesics, NSAIDs, physical therapy, selective nerve root block or pulse radiofrequency.
In this study selective nerve root block given every 20 days for 6 weeks or single dose pulse radiofrequency given for symptomatic radiculopathy with prolapsed intervertebral disc and they follow up for minimum six months with 85% follow up.
Conservative management continued for six weeks. The recommendation of surgery was based on clinical symptoms and failure to improve on conservative therapy.
Patients results were assessed with pre-procedure and post procedure pain scores like Oswestry Disability Index (ODI) [6] and Visual Analogue Score (VAS) [7]

Procedure
1. Selective nerve root block [8]
After taking informed consent, patient taken on operating table in prone position with proper exposure. Under IITV control spine is seen in oblique view, painting and draping done. Under IITV guidance anaesthetize the skin with 2% lignocaine. 22/25 gauge spinal needle is inserted paramedially through skin and muscles in cranio- medial direction till bony encounter occurred. This method allows advancing the needle in "safe triangle" without contact to the nerve root.





Safe triangle - above the exiting nerve root and below the corresponding pedicle.
After verification of needle and correct needle position under IITV control, iohexol dye is injected and confirming into the periradially along the spinal root.
Subsequently 2ml (80mg) triamcinolone acetate, 0.5 ml bupivacaine and 2 cc normal saline injected.
With this technique described by Bogduk for giving injection in L1 to L5.

To perform selective nerve root block in S1 is different technique is required as foramen direction is different
First IITV is made perpendicular to foramen.
Needle is inserted in foramen position checked in two planes and dose given.
Patient should be observed in ward for 30 minutes for side effects.
Successful nerve root block was defined as reduction of leg pain of more than 60 % within the first four days.

2. Pulse radiofrequency [3, 4]
Written consent of the procedure must be taken first. After taking consent patient is given injection midazolam 1mg iv stat as a mild sedative. Prone position given on table. Level is confirmed under the IITV control. Painting and drapping done. Local infiltration with injection lignocaine 2% 2cc with 24gauge hypodermic needle. Under IITV control 22gauge spinal needle with a curved 10 mm active tip with 1% lignocaine. Needle position must be confirmed in the intervertebral foramen anteroposterior and lateral view and the sensory and motor components are confirmed. Once the needle was appropriately positioned, the stylet is replaced by radiofrequency probe. After confirmation of sensory and motor components, thermocoagulation done.

Stimulation setting		Thermal lesion setting	
Sensory	motor	Pulse mode	
Pulse width	1ms	1ms	Temp. 60 degrees
Frequency	50hz	2hz	Pulse width 20 ms
Maximum voltage	3v	2v	Frequency 2 hz

Patient should be carefully watched for vitals in the ward for about 30 minutes and assess the pain relief.

Mechanism of action of selective nerve root block [8]

In selective nerve root block, a mixture of triamcinolone acetate and bupivacaine is injected at nerve root level, bupivacaine exibhits a long acting local anaesthetic action hence relieves pain for short term whereas triamcinolone by its anti-inflammatory action reduces nerve edema by decreasing level of the pain mediators from inflammatory process and is neuro-protective, thus reduces pain for long term.

Mechanism of Action of radiofrequency [3, 9]

Continuous radiofrequency (CRF) uses high-frequency alternating current to induce coagulative necrosis in the target.tissue. Tissue destruction occurs with probe temperatures between 60° and 80° C. Because tissue heating decreases rapidly with distance from the electrode tip, CRF lesions are well circumscribed, thus offering an advantage over chemical neurolysis. With CRF, the magnitude of tissue destruction is related to the temperature of the tissue, as well as the size of the electrode and duration of the procedure.

In contrast, Pulse radiofrequency (PRF) uses radiofrequency current in short (20 ms), high-voltage bursts; the “silent” phase (480 ms) of PRF allows time for heat elimination, generally keeping the target tissue below 42 °C.

Pulse radiofrequency (PRF), a technology related to continuous radiofrequency, is unique in that it provides pain relief without causing significant damage to nervous tissue. The mechanism by which PRF may involve a temperature-independent pathway mediated by a rapidly changing electrical field.

The notion that the electrical fields generated by PRF can affect neuronal membranes is supported by neurophysiologic studies that demonstrate PRF changes synaptic signaling and causes electroporation. A popular theory is that the rapidly changing electric fields produced by PRF alter the transmission of pain signals via a pathway involving c-Fos, a so-called immediate early gene. The results not only indicate a mechanism of c-Fos activation that is independent of temperature, but also hint at the inhibition of excitatory C-fibers and long-term depression as a viable therapeutic mechanism in PRF.

Results

In this study, 100 patients were included. 82 patients were treated with selective nerve root block and 18 patients treated with pulse radiofrequency, were followed for average 6 months. We have following observation and results according to

Table 1: Number of Patients According To Age Incidence

Age	Number of Patients		
	Root Block	Radio Frequency	Total
21-30	12 (12%)	03 (03%)	15(15%)
31-40	35(35%)	06 (6%)	41(41%)
41-50	14 (14%)	07 (7%)	21(21%)
51-60	13(13%)	02 (2%)	15 (15%)
61-70	06 (6%)	--	06 (6%)
71-80	02 (2%)	--	02 (2%)
Total	82 (82%)	18 (18%)	100 (100%)
Mean Age	42.08	39.94	41.70

Maximum number of patients are found in age group of 31 to 40 (41%). Mean age of our study is 41.7 years.

Table 2: Sex Incidence

Sex	Root Block	Radiofrequency	Total
Male	40(40%)	11(11%)	51(51%)
Female	42(42%)	7(7%)	49(49%)
Total	82(82%)	18(18%)	100(100%)

In this study, total 51% were male and 49% were female so, male to female ratio is almost 1:1.

Table 3: Number of Patients According To Level of Disc Herniation

Level	Root Block	Radiofrequency	Total
L1-L2	0(0%)	0(0%)	0(0%)
L2-L3	1(1%)	0(0%)	1(1%)
L3-L4	8(8%)	1(1%)	09(09%)
L4-L5	36(36%)	7(7%)	43(43%)
L5-S1	37(37%)	10(10%)	47(47%)
Total	82(82%)	18(18%)	100(100%)

Maximum number of patients having disc herniation at level of L4-L5(43%) and L5-S1(47%).

Table 4: Number of Patients According To Site and Type of Disc Prolapse

Disc Prolapse	Root Block	Radiofrequency	Total
Central			
-Contained	17(17%)	4(4%)	21(21%)
-Extruded	5(5%)	2(2%)	7(7%)
-Sequestrated	0(0%)	0(0%)	0(0%)
Parecentral			
-Contained	45(45%)	11(11%)	56(56%)
-Extruded	15(15%)	1(1%)	16(16%)
-Sequestrated	0(0%)	0(0%)	0(0%)
Total	82(82%)	18(18%)	100(100%)

Majority of patients having disc prolapsed is paracentral (72%). Among them 56% were contained disc and 16% were extruded disc.28% patients having central type of disc prolapsed, among them 21% contained and 7% extruded disc.

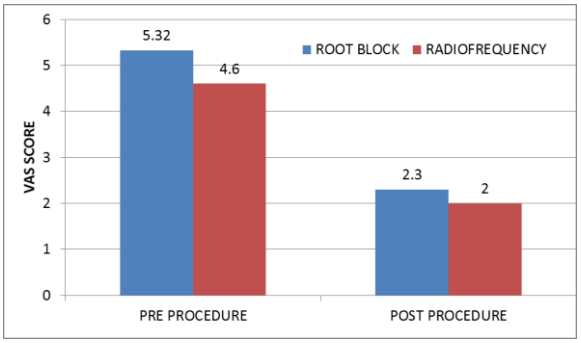


Chart 1: Pre and Post Procedure Vas Score

Here, there is significant difference in pre and post procedure VAS score for root block (p<0.05).But there is no significance difference in VAS score for radiofrequency (p>0.05).

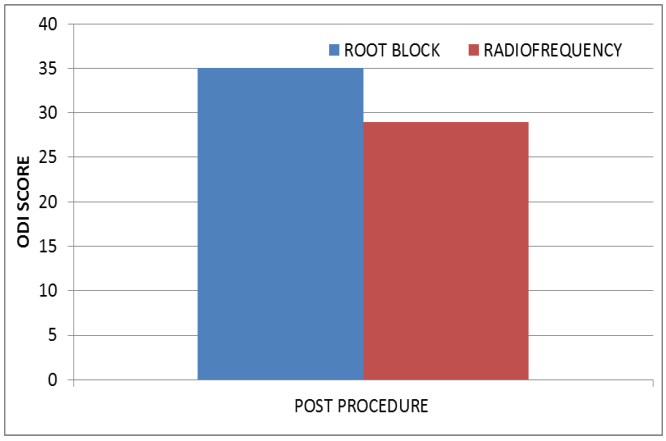


Chart 2: Post Procedure ODI Score Of Root Block and Radiofrquency

Here, there is significant difference in post procedure ODI score of root block and radiofrequency (p<0.05).

Table 6: Post Procedure Vas Score Of Root Block and Radiofrequency

	Root Block	Radio Frequency	P-VALUE
Vas Score	2.31	2	>0.05

Here, there is no significant difference in post procedure VAS score of root block and radiofrequency (p>0.05).

Table 7: Result of Root Block According To ODI Scoring

Result	ODI Score (%)	No of Patients	Percentage (%)
Excellent	0-20	15	18.30%
Good	21-40	41	50%
Fair	41-60	23	28.04%
Poor	>60	3	3.66%
Total		82	100%

Total, 18.3% patients present with excellent result, 50% patients present with good result, 28% patients present with fair results and only 3 patients present with poor result.

Table 8: Comparison of Result of Root Block of Our Study with Other Study [17].

Result	Our Study	Other Study
Excellect	15(18.30%)	21(16.03%)
Good	41(28.04%)	40(30.53%)
Fair	23(28.04)	37(28.24%)
Poor	3(3.66%)	33(25.19%)
Total	82(100%)	131(100%)

Here, excellent to good result in both the studies are same (p>0.05) but fair to poor result in our study is better than the other study (p<0.05).

Table 9: Results of Radiofrequency According To ODI Scoring

Result	ODI Score (%)	No of Patients	Percentage (%)
Excellent	0-20	4	22.22
Good	21-40	12	66.67
Fair	41-60	2	11.11
Poor	>60	0	0
Total		18	100

Here, 22.22% patients present with excellent result, 66.67% patients present with good results and only 2 patients present with fair result.

Table 10: Comparison of Result of Root Block and Radiofrequency According To Odi Score

Result	Root Block	Radiofrequency
Excellent	15(18.30%)	4(22.20%)
Good	41(50%)	12(66.67%)
Fair	23(28.04%)	2(11.11%)
Poor	3(3.66%)	0
Total	82	18

Here, According to ODI score, excellent to good score in root block is 68% and excellent to good score in radiofrequency is 89%. But overall there is no significant difference (p>0.05).

Discussion

In our study, majority of patients were between age group of 31-40 years. This because at this age the disc is on its way to degeneration. In younger patients, younger than age of 30 years, the resilience of the disc protects it from degeneration. In patients older than 50 years a disc has developed some degree of inherent stability through fibrous changes that occurs with loss of water content.

In our study, the disc herniation was found to be slight more common in males. The male:female ratio was 1.04. This because, the men are exposed to more physical stresses, especially twisting and lifting without the knowledge of using their muscles of back properly.

A herniated disc occurs most often in the lower lumber region of the spine especially at the L4-L5 and L5-S1 levels (90% in this study). This is because the lower lumber discs bear much more of the body weight and comparatively more bending force which leads to more degeneration and ruptures.

According to type and site of disc prolapse, patients are separated into central and paracentrally located herniation groups. The most common type of disc prolapse is paracentral (72%), among them 56% are contained disc and 16% are extruded disc. The other less common type of disc prolapse is central (28%), among them 21% are contained disc and 7% are extruded disc. In paracentral disc, patients presents with more radicular pain than with the central disc prolapsed. This may be expected anatomically because the laterally located nerve roots are more likely to be irritated by a paracentral herniation than central herniation because lateral recess is narrow than central canal for allowing relative displacement of root to avoid direct compression. The apex of the paracentral disc herniation is much closer to the traversing and exiting nerve roots as compared with a central herniation.

Regarding the type of the disc prolapsed, natural history of disease suggests that majority of patients with acute disc herniation improve spontaneously by 3 months. The patients who continue to be symptomatic beyond 3 months are a distinct subset in whom the sciatic pain is related more to compression of the nerve root by herniated disc material rather than injury from inflammation. This could potentially explain why epidural steroid and selective nerve root block were associated with worse outcome when administered at 12-18 weeks post onset of symptoms.

If selective nerve root block is given for acute disc herniation with root inflammation, it will be most effective particularly within 6 weeks of onset of symptom. In this situation nerve root blocking with steroid and local anaesthetic resulted in better pain score because of anti-inflammatory action of steroid.

According to ODI score, results of radiofrequency is better than root block (p<0.05). But there is no statistical significance in VAS score (p>0.05). In our study, ODI score of walking, standing travelling and self care improve more after

radiofrequency than root block because of long lasting effect of radiofrequency ablation of dorsal root ganglion.

In our study, patients with disc protrusion and foraminal stenosis were included. While a chemical irritation of the nerve root by disc material is well documented experimentally, mechanical compression of nerve root appears to be the major source of foraminal stenosis in elderly patients often persisted for a time before suddenly becoming symptomatic. In spinal stenosis, there is a fix compression on cord structures rather than chemical irritation. In spinal stenosis, cord compression is found in more than one level. So, root block is more effective in early course of disc herniation where the main pathology is nerve inflammation. Dorsal root ganglion is more sensitive for pain perception by compressive pathology so, radiofrequency ablation of dorsal root ganglion is more effective in patients in later course of disc prolapse with foraminal stenosis.

In lysthesis, patient with static stenosis treated with root block and radiofrequency presents with better result than patients with dynamic stenosis. In dynamic stenosis-lysthesis, main cause of pain is mechanical instability so, these patients should be treated with surgically rather than root block and radiofrequency.

In our study 68.30% patients treated with root block present with excellent to good results while 89% patient treated with radiofrequency present with excellent to good results which is statistically insignificant (P>0.05). So, both modalities of treatment are equally effective in reducing radicular pain.

Conclusion

The selective nerve root block combined with careful history, physical examination and quality radiographic studies, is an important tool in the diagnosis and treatment of patients with predominant lumber radicular symptoms and it is a less invasive procedure. It gives an acceptable results in form of pain relief if given in early course of disease.

Along with selective nerve root block, pulsed radiofrequency ablation of dorsal root ganglion is also less invasive and effective therapy in patients with lumber radiculopathy. As radiofrequency machine is not easily accessible and it is costlier than root block so, root block should be the first choice in treating patients with disc herniation. Patients compliance is better with radiofrequency than root block because one dose of radiofrequency will affect at least 6 months while in root block 3 -4 injections have to be taken every 3 weeks according to the response.

In our study, both treatment modalities, root block and radiofrequency are equally effective, as there is no significant difference in VAS score. Root block is more effective in patients with disc herniation rather than canal stenosis. Root block is more effective in early course of disease, within 6 weeks and less effective after 12 weeks of course of disease. While, radiofrequency is equally effective in patients with disc herniation as well as canal stenosis. In dynamic instability, root block and radiofrequency is temporarily effective so it requires surgical stabilization.

The patient's clinical course remains the most important determinant for treatment decision in disc herniation.

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