Management of Lumbar Spinal Stenosis with Lumbar Epidural Steroid Injections

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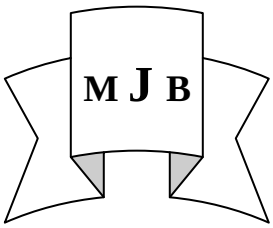

Abstract

Degenerative lumbar stenosis is a common source of pain and disability in middle age and elderly. It presents clinically with a variety of symptoms, though neurogenic claudication is the hallmark. There is a multifactorial pathogenesis to lumbar spinal stenosis and its symptoms. Epidural steroid injections are commonly utilized to help reduce radicular pain in lumbar spinal stenosis. It can be accomplished by one of three methods: caudal (C), interlaminar (IL), or transforaminal (TF).

In this study we sought to determine the efficacy of fluoroscopically guided caudal and transforaminal epidural steroid injections for the management of radicular pain associated with lumbar spinal stenosis. The outcome measures of this study are patient satisfaction, pain relief, improved function and walking tolerance.

Of 42 patients included in this study 71.4% of the patients had partial to complete pain relief at 1 month compared to 57.1% at 6 months and 45.2% at 12 months. 64.2% had full or improved function at 1 month compared to 50% at 6 months and 33.3% at 12 months. 66.6% of the patients were completely or somewhat satisfied at 1 month compared to 59.5% at 6 months and 38% at 12 months.

When weighing the surgical alternatives and associated risk, cost, and outcomes, lumbar epidural steroid injections are a reasonable nonsurgical option in select patients especially in those patients who are unwilling to do surgery or in whom surgery is contraindicated.

الخلاصة

يعتبر تضيق العمود الفقري القطني مصدرشائع للعجز والألم في الأشخاص متوسطي وكبار العمر.ويتمثل سريريا بمجموعه من الأعراض لكن العرج العصبي هو السمه المميزه. حقن الستيرويد في المتطفه فوق الجافية تستخدم للمساعدة على الحد من ألألم الجذري الناتج من التضيق في العمود الفقري القطني ويمكن تحقيق ذلك من خلال واحدة من ثلاث طرق: الحقن الذيلي ،الحقن بين الصفائح والحقن خلال فتحة جّذرالعصب.

في هذه الدراسه سعينا الى تحديد مدى فعالية الحقن الذيلي والحقن خلال فتحة جذز العصب مع أستخدام الصبغه والأشعه السينيه لمعالجة الألم الجذري الناتج من تضيق العمود الفقري القطني .المقاييس المعتمده في هذه الدراسه هي:قناعة المريض،تخفيف االأم،تحسن الوظائف وزيادة القدره على المشي.

أشتملت هذه الدراسه على ٤٢ مريضا وكانت النتائج كالاتي:٧١,٤% من المرضى يتمتعون بأختفاء كلي أو جزئي للألم بعد شهر واحد من حقن الستيرويد مفارنة ب57.1% من المرضى بعد ستة أشهر و٤٥،٢%من المرضى بعد سنه كامله من الحقن.٦٤,٢% من المرضى كانوا يتمتعون بتحسن كلي أو جزئي في أداء الوظائف بعد شهر من الحقن مقارنة ب٥٠% بعد ستة أشهر و ٣٣,٣% بعد سنه كامله من الحقن.أما على مستوى قناعة المريضكان هنالك ٦٦,٦% من المرضى مقتنعين بشكل كلي أو بعض الشيء مقتنعين بعد شهر واحد مقارنة ب ٥٩,٥% بعد ستة أشهر و ٣٨% بعد سنه.

عند أخذ الجراحه باللآعتبار وما يرافقها من خطوره وتكلفه ونتائج فأن الحقن الموضعي يعتبر خيار معقول في بعض المرضى الذين لايرغبون بأجراء العمليه الجراحيه أو المرضى الذين لديهم موانع لأجراء العمليه الجراحيه.

Introduction

Spinal stenosis is an abnormal narrowing of the central, lateral recess or the intervertebral foramena to the point where the neural elements are compromised**.** It is a frequent cause of functional impairment and disability in the middle aged and elderly population. The most common cause of the stenosis is degeneration of the intervertebral disc or the apophyseal joints with subsequent displacement or osteophyte formation. Neurogenic claudication is the hallmark for symptomatic lumbosacral stenosis (LSS). Classically described as lower limb or buttock pain brought on by prolonged standing or walking, the pain distribution may be unilateral or bilateral, monoradicular or polyradicular, and may include a component of parasthesia and weakness. Low back pain is common but is not always present. Activities involving lumbar extension such as prolonged overhead reaching or walking downhill are typical exacerbating factors. Lumbar flexion postures, such as bending forward, or sitting down typically relieves symptoms. Patients may complain of walking with a stooped-forward posture [1].

Many patients with severe symptoms are treated surgically, although studies have shown that these patients reported better outcome with surgery at 1 and 4 years [2,3] Conservative treatment of these individuals has been shown to be a viable initial treatment option [4-8]. For patients choosing nonsurgical care, there is evidence that neurologic deterioration does not occur over time. Furthermore, delaying surgery in those choosing initial conservative treatment does not adversely affect the postoperative outcome. Surgery also may be contraindicated in many patients with LSS because significant comorbidities, conservative treatment also remain necessary for those patients who do not want to undergo surgery.

The use of epidural space injections was first described by Evans in 1930 [9] Epidural steroid injections were used for the first time in the treatment of lumbar radicular pain syndromes by Robechi in 1952[10].

Pathogenesis:

The pathogenesis of LSS is multifactorial. If narrowing and compression were the sole pathologic entities of LSS, decompressive surgery would be a curative treatment. There are vascular, biochemical, and biomechanical factors that contribute to the symptoms of LSS.

The vascular factors include impaired epidural venous return resulting from an increase in cerebrospinal fluid pressure below the level of compression, leading to venous engorgement and arterial insufficiency of the radicular blood supply or disruption of nerve root microcirculation [11, 12, 13]. This process can result in the formation of nerve root edema (which can lead to an ischemic neuritis). [14].

Arterial insufficiency is another proposed source of the claudication symptoms of LSS. With lower limb exercise, the lumbar radicular arterioles dilate to provide nourishment to the spinal nerve roots. In patients with stenosis, however, this arterial dilation may be defective [15].

The discogenic inflammatory mediators are another component of this multifactorial pathogenesis. These include phospholipase A2, cytokines, leukotriene B4 and thromboxane B2 and immune cells [16]. These inflammatory mediators may enhance the excitability of

the dorsal root ganglion under a state of chronic compression from stenosis.

Treatment of LSS

Treatment for LSS includes conservative (activity modification, assistive devices for ambulation, medications, and exercise) and interventional (ESIs and surgery) approaches. Treatment decisions should be driven in part by patient preference.

Mechanism of action of ESI

Corticosteroids have been noted to have potent anti-inflammatory properties[17,18] These effects are a result of inhibition of specific leukocyte functions including inhibition of leukocyte migration, prevention of degranulation of granulocytes, mast cells, and macrophages, and stabilization of lysosomal membrane and other membranes[17,19] Corticosteroids have been shown to be able to block nociceptive C-fiber conduction [20] and also to inhibit prostaglandin synthesis[21] The mechanisms of pain relief of corticosteroid include the inhibition of nerve root edema which reduce ischemia, reduction in sensitivity of the prostaglandin-sensitized dorsal horn neurons by inhibiting inflammatory mediators, and by direct inhibition C-fiber conduction

Techniques for ESI

There are three main approaches to access the lumbar epidural space these are the interlaminar, caudal and transforaminal approaches (figure 1). These techniques are performed under the fluoroscopy and contrast enhancement to increase the accuracy of these techniques as there is 30-40% miss rates, even in experienced hand, without fluoroscopy [22,23] Also there is risk of possible inadvertent intravascular, intrathecal or soft tissue placement of the needle and the medication[22,24,25].

Interlaminar approach This procedure can be performed at any interlaminar level in the lumbar spine, though most commonly is performed at L4–5 or the L3-L4 interspaces.

Caudal approach The entry point for this approach is the sacral hiatus. Typically, a larger volume of injectant is administered. In 80% of the time 10 mL of injectate volume will reach the L4-5 interspace [19].

Transforaminal approach It is the most selective of the three. This approach requires fluoroscopic guidance .The transforaminal approach allows access to the ventral epidural space, Andrade and Eckman [26], where the disc lies,

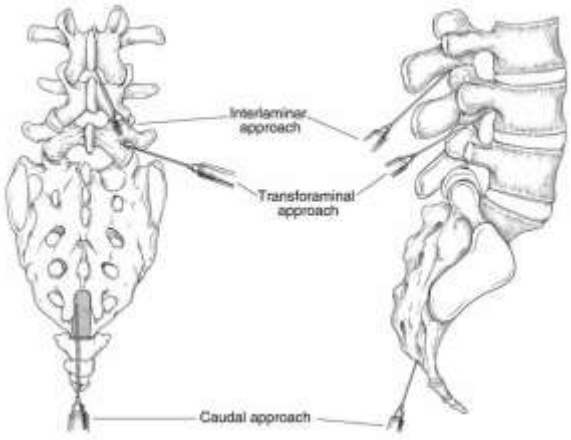

Figure 1 three approaches of epidural steroid injection [Journal of the American Academy of Orthopaedic Surgeons Volume 15, Number 4, April 2007 p 220]

Complications

The reported complications of ESI includes headache with an incidence of 1.4-6% in translaminar injection [27, 28] and up to 21% of the caudal approach [29]. Dural puncture is common with an incidence of 5% [30] to 17% [31. Exacerbation of radicular pain with an incidence of over 4% [32,33,34]. Other rare complications are meningitis [35], epidural abscess [36,37], cerebrospinal fluid–cutaneous fistula, epidural hematoma [38], allergy to steroids [39] and retinal hemorrhage [40]. Corticosteroids have several well known side effects, fluid retention, the development of Cushing's syndrome from excessive corticosteroids over short period [41], Serum cortisol levels depressed for 1 or 2 weeks after epidural injection [42], minor changes in serum glucose [43],. Also present are insomnia, facial erythema, nausea, rash and pruritis with betamethasone [44], Arachnoiditis has been reported after intrathecal injection of methylprednisolone acetate [45]. Psychogenic reactions are caused by fear and apprehension from the injection procedure [20, 46].

Indications and contraindications

Indications for ESI include low back pain associated with radicular symptoms, failure of other nonsurgical management, nerve root compression, and nerve root irritation. Contraindications are divided into absolute (e.g. coagulopathy, active local or systemic infection, uncontrolled diabetes or spinal malignancy) and relative (e.g., allergy to injectate, congestive heart failure) (Table 1)

Table 1 Indications and contraindications for LSI

Indications and Contraindications for Lumbar Epidural Steroid Injection
Indications
Low back pain associated with radicular symptoms
Failure of medications, physiotherapy, and rest, with persistence of functionally limiting back and leg pain beyond 6 weeks
Physical examination findings consistent with nerve root irritation (ie, positive dural tension signs and/or evidence of neurologic deficits)
Advanced imaging studies demonstrating nerve root compression with clinical correlation
Contraindications
Absolute
Anticoagulant usage, coagulopathy
Active local or systemic infection
Uncontrolled diabetes or spinal malignancy
Relative
Allergy to injectate
History of steroid psychosis
Congestive heart failure
Pregnancy
History of failed epidural steroid injection

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Methods

This a randomized prospective study which was held in AL-hilla teaching hospital over 3 years period from march 2008 to may 2011, in which 42 patients with lumbar spinal stenosis (LSS) in whom the diagnosis of LSS was based on the patient history of disabling back and leg pain consistent with nerve root entrapment or neurogenic claudication and the MRI (which reveals the level of the stenosis and the site whether it is central, lateral recess or root canal stenosis). All MRI were interpreted by a single board certified radiologist.

The inclusion criteria consist any patient with backache and bilateral leg pain or neurogenic claudication and they must filled out the questionnaire that include patient satisfaction, pain relief, walking tolerance and functional improvement. The exclusion criteria include any patient with contraindication for lumbar epidural steroid injection (table 1), cauda equina syndrome, acute disc prolapse, previous lumbar back surgery and peripheral vascular disease

Patients were given injections only if they had not improved after at least 3 months of treatment with a combination of analgesics, oral anti-inflammatory agents, and physical therapy.

All patients received at least 1 or 2 fluoroscopically guided transforaminal, caudal or combined injections, over all 56 injections (mean 1.3). The fluoroscopy and contrast used to increase the accuracy and decrease the miss rate [22, 23, 24, 25]. We used methylprednisolone acetate 2ml (80 mg) with 2 ml of 2% local anesthetic (xylocain) these diluted with normal saline to a volume of 10-20 ml depending on the level and technique of the injection; we used larger volume for multilevel stenosis and for caudal approach. The transforaminal approach used for those patients with unilateral symptoms at one or two levels (17 patients) and caudal approach for those with bilateral symptoms at the level of L4-L5 or L5-S1 (11 patients), for those patients with multilevel stenosis we used a combined approaches (14 patients).

The patients lie prone on radiolucent table; the skin prepared with iodine based antiseptic solution.

For the caudal approach the sacral hiatus is identified by palpation of the tip of the coccyx with middle finger of the dominant hand the hiatus will be at the level of the proximal interphalangeal joint, the skin then anesthetized will local anesthetic agent and 22-gauge spinal needle was guided into the hiatus and lateral fluoroscopic view was used to confirm that the needle in the caudal epidural space. Aspiration was performed, if the aspirate was negative for blood or cerebrospinal fluid the 2 ml of non ionic contrast was instilled to confirm epidural flow of the injectate and to rule out intravascular, intrathecal and/or soft tissue infiltrate (figure 1A), then the therapeutic solution was injected.

For the transforaminal approach a 22- or 25-gauge spinal needle is inserted under intermittent fluoroscopic guidance to the dorsal/ventral aspect of the neural foramen at the suspected symptomatic radicular levels. An A-P or slightly oblique fluoroscopic view is obtained to assure that the needle is directed to approximately at the 5:30 position on the right and the 6:30 position on the left, using the pedicle as a clock face, Aspiration is performed once in this location. If the aspirate is negative for blood, non-ionic contrast agent is injected to confirm epidural flow of the injectate and to rule out intravascular, intrathecal, or soft tissue infiltration (figure 1B), then

the therapeutic solution was injected. All patients had been monitored by pulse oximetry and blood pressure during and after the procedure, patients had been transferred to the recovery unit for 30 minutes, all patients remain in the ward for 5- 6 hours before discharge. All injections had been performed by a board certified anesthesiologist and orthopedic surgeon.

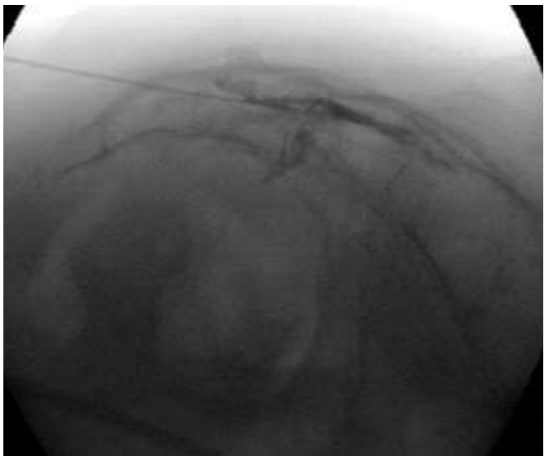

Figure 1A *Caudal ESI*

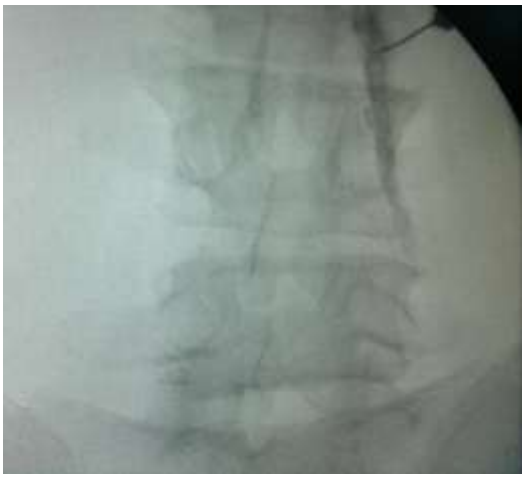

Figure 1B *Transforaminal ESI*

The outcome measures include, *patient satisfaction* (**A** Satisfied, **B** Somewhat satisfied and **C** Not satisfied), *pain relief* (**A** Full relief, **B** Partial relief and **C** No relief), *function score* (**A** Full function, **B** Improved function, **C** No changed) and *walking tolerance test* (**A**=4, **B**=2-3, **C**=Zero-1). (Table 2)

The patients were assessed before the injection for these outcome measures then one month after the injection then six months after the injection and finally 12 months after the injection.

Table 2 Outcome measures for epidural injections

	A	B	C
Patient satisfaction	**satisfied**	**Somewhat satisfied**	**Not satisfied**
Pain relief	**Full relief**	**Partial relief**	**No relief**
Function score	**Full function**	**Improved function**	**No change**
Walking tolerance	**4**	**2-3**	**Zero-1**

Walking tolerance test:
0=0-15 meters, **2**=16-60 meters, **3**=61-150meters, **4**=more than 150 meters

Results

The study was conducted at first on 48 patients of whom 2 patients underwent surgery 4-5 months after the first injection and 4 patients were lost the follow-up at the end of the study. Those 6 patients were excluded from the study, therefore 42 patients were included in this study those patients were between the ages of 35-83 years (mean age 62.4), 23

female (54.7%), 19 male (45.2%). One level involved in 27 patients (64.2%), two levels in 12 patients (28.5%) and three levels in 3 patients (7.1%) The mean duration of the symptoms 21.1 months, 29 patients (69 %) have bilateral leg symptoms, 13 patients (30.9%) have unilateral symptoms (7 on right side and 6 on left side), the total number of injections 56 injections, 8 patients (19%) have Hypertension, 5 patients (11.9%) have diabetes mellitus and 3 patients (7.1%) have both hypertension and diabetes and 16 patients (38%) are smokers, these demographic data are shown in table 3

Table 3 Baseline characteristic of the patients

Number of the patients at the beginning of study	48
Number of the patients at 12 months	42
Age	Range from 35-83 years with mean age 62.4
gender	23 female (54.7%), 19 male (45.2%)
Duration of the symptoms	Mean duration of the symptoms 21.1 months
Number of the stenosis levels	One level 27 (64.2%), two levels 12 (28.5%), Three levels 3 (7.1%)
Smoking	16 patients (38%)
Associated diseases	8 patients(19%) have Hypertension , 5 patients(11.9%) have diabetes mellitus and 3 patients (7.1%)have both hypertension and diabetes
Number of injections	56 injections (mean 1.3)
Localizations of the symptoms	29 patients (69 %) have bilateral leg symptoms, 13 patients (30.9%) have unilateral symptoms (7 on right side and 6 on left side)

All patients had moderate to bad pain, impaired function and walking tolerance grade zero-1 in the preinjection stage.

At one month after the injection there was improvement in all scores and in patient satisfaction. Regarding pain relief a 20 patients (47.6%) had full relief, 10 patients (23.8%) had partial pain relief and 12 patients (28.5%) showed no change in preinjection pain severity (figure 2). Regarding the function score 16 patients (38%) had full function, 11 patients (26.1%) had improved function and 15 patients (35.7%) had no changed in function score(figure 3). regarding the walking tolerance score 14 patients (33.3%) had a score 4, 12 patients (28.5%) had score 2-3 and 16 patients (38%) had a score of zero-1 (figure 4). For patient satisfaction at one month 19 patients (45.2%) were completely satisfied, 9 patients (21.4%) were somewhat satisfied and 14 patients (33.3%) were not satisfied (figure 5).

At 6 months there were some reductions in the positive scores. Regarding pain relief 11 patients (26.1%) had full relief, 13 patients (30.9%) had partial pain relief and 18 patients (42.8%) showed the same preinjection pain quality (figure 2). For

the function score 12 patients (28.5%) had full function, 9 patients (21.4%) had improved function and 21 patients (50%) had no changed in function score (figure 3). For walking tolerance 11 patients (26.1%) had a score of 4, 11 patients (26.1%) had a score of 2-3 and 20 patients (47.6%) had a score of zero-1 (figure 4). For patient satisfaction at 6 months 15 patients (35.7%) were completely satisfied, 10 patients (23.8%) were somewhat satisfied and 17 patients (40.4%) were not satisfied (figure 5).

At 12 months there were further reduction in all score, regarding pain relief 4 patients (9.5%) had full relief, 15 patients (35.7%) had partial pain relief and 23 patients (54.7%) showed the same preinjection pain quality (figure 2). For the function score 8 patients (19%) had full function, 6 patients (14.2%) had improved function and 28 patients (66.6%) had no changed in function score (figure 3). for walking tolerance 5 patients (11.9%) had a score of 4, 10 patients (23.8%) had a score of 2-3 and 27 patients (64.2%) had a score of zero-1 (figure 4). For patient satisfaction at 12 months 10 patients (23.8%) were completely satisfied, 6 patients (14.2%) were somewhat satisfied and 26 patients (61.9%) were not satisfied (figure 5). These results are shown in table 4

Table 4 Results at 1, 6 and 12 months

	1 Month			6 Months			12 months		
	A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Pain relief	20 47.6%	10 23.8%	12 28.5%	11 26.1%	13 30.9%	18 42.8%	4 9.5%	15 35.7%	23 54.7%
Function score	16 38%	11 26.1%	15 35.7%	12 28.5%	9 21.4%	21 50%	8 19%	6 14.2%	28 66.6%
Walking tolerance	14 33.3%	12 28.5%	16 38%	11 26.1%	11 26.1%	20 47.6%	5 11.9%	10 23.8%	27 64.2%
Patient satisfaction	19 45.2%	9 21.4%	14 33.3%	15 35.7%	10 23.8%	17 40.4%	10 23.8%	6 14.2%	26 61.9%

Our main objective was to see if there was an improvement in the patient condition after caudal or transforaminal epidural steroid injection, from the above results we can see that there are 71.4% of the patients had partial to complete pain relief at 1 month and 57.1% of the patients had partial to complete pain relief at 6 months and 45.2% had partial to complete pain relief at 12 months. 64.2% patients had full or improved function at 1 month, 50% had full or improved function at 6 months and 33.3% of the patients had full or improved function at 12 months. Also we can see that 66.6% of the patients were completely or somewhat satisfied at 1 month, 59.5% of the patients were completely or somewhat satisfied at 6 months and 38% were completely or somewhat satisfied at 12 months.

Only 2 patients (4.7%) develop headache after the injection and this resolved spontaneously within 24 hours. There were no specific baseline characteristics that affect the outcome from epidural

steroid injection in our study, the smoking, hypertension and diabetes mellitus did not predict response from epidural injection in this study and this may be related to small sample size.

It appears that epidural steroid injections are effective in patients with LSS in the short and intermediate term with some effectiveness in the long term.

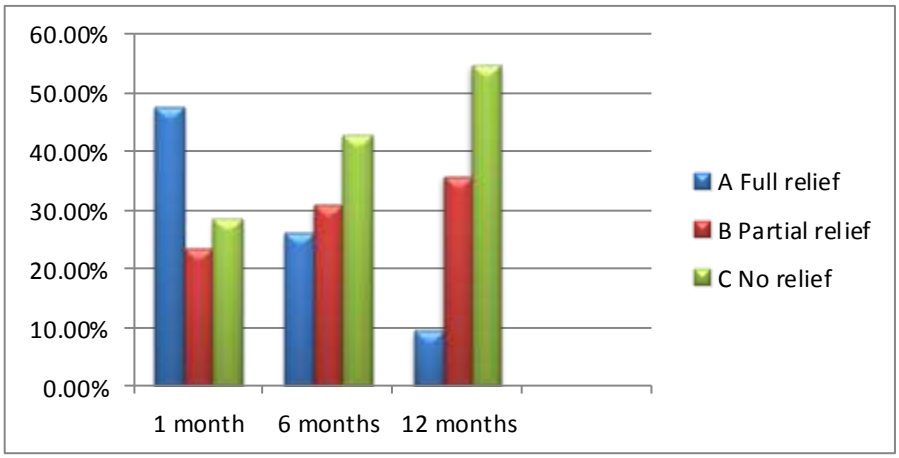

Figure 2 Pain relief score

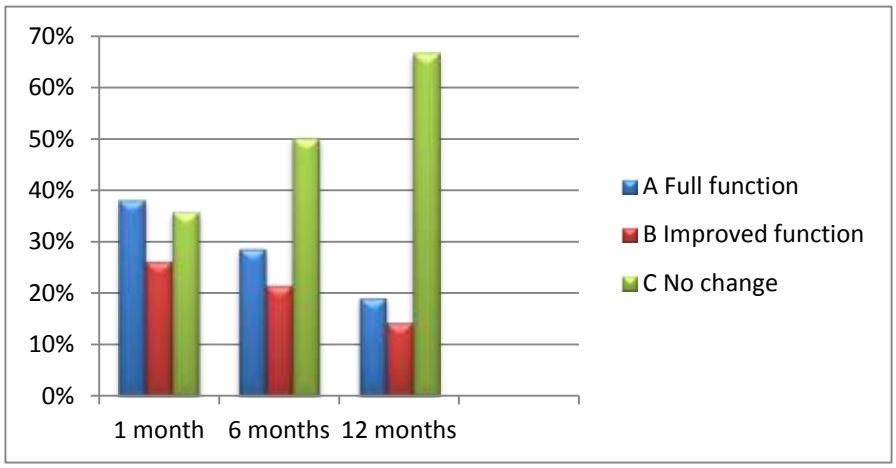

Figure 3 Function score

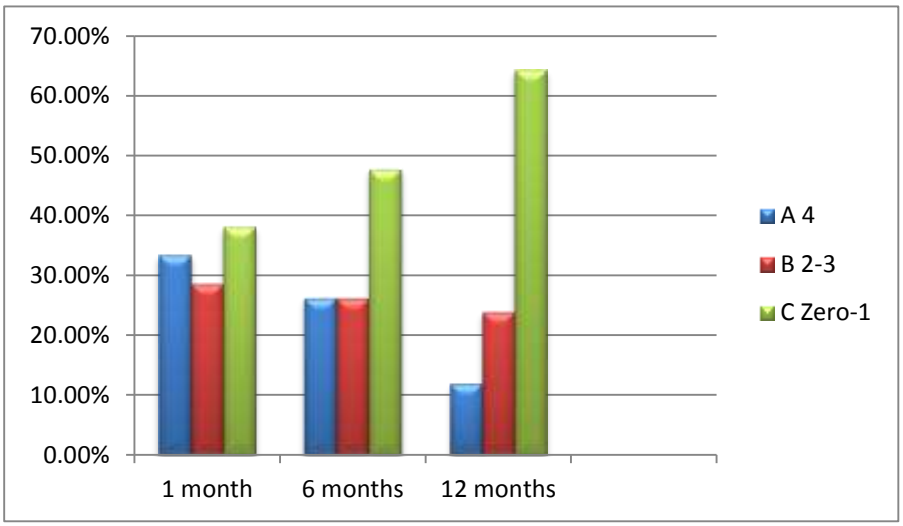

Figure 4 Walking tolerance

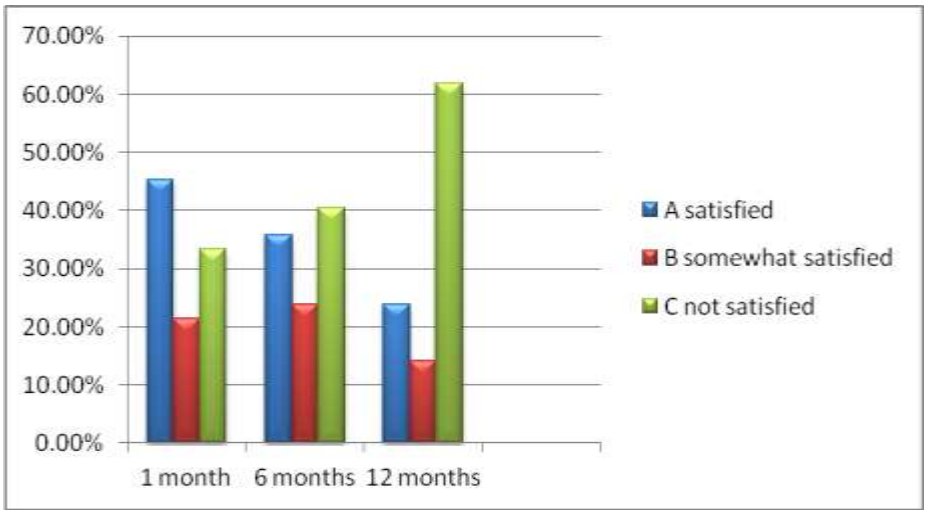

Figure 5 Patient satisfaction

Discussion

Our study sought to demonstrate the use of lumbar epidural steroid injection in the management of degenerative LSS, Atlas et al [3], Amundsen et al [47] and others [5, 48] have shown that the majority of patients with stenosis treated conservatively do not worsen over time. In addition, delayed surgery resulted in just as favorable outcome as immediate surgery. Atlas [3] found that conservatively managed patients remain the same or showed a trend towered improvement with time.

It appears that degenerative stenosis is a degenerative disorder with periods of remission and exacerbation and does not necessarily symptomatically worsen with time. Some patients with degenerative LSS found the epidural steroid injection helpful during the exacerbation of the symptoms; the epidural steroid injection is also a suitable treatment option for those patients who are unwilling to do

surgery or those in whom the surgery is contraindicated.

The relief of pain and improved function make the patients more tolerable for the physiotherapy which is an important part of the treatment of the spinal stenosis.

There are limited studies evaluating the efficacy of ESIs for degenerative lumbar spinal stenosis, as the majority of injection outcome studies are evaluating lumbosacral radiculopathy secondary to disk herniation. There are no studies comparing efficacy of injection techniques in patient with LSS. Most of the studies for the epidural steroid injections were done without the use of fluoroscopy and contrast and in these studies the benefit of the epidural steroid was underreported because poor result may occur as a result of the steroid not reaching the epidural space and the desired nerve root resulting in 30-40% miss rate [22, 23].

Delport et al [49] retrospectively evaluated 140 patients aged 55 years and older with central, lateral recess, or neuroforaminal stenosis, and disabling back and leg pain. A mean of 2.2 fluoroscopically guided caudal or transforaminal ESIs were administered, and one third of patients had >2 months of relief.

A useful comparison can be made with Botwin et al study [50] who prospectively followed elderly patients with spinal stenosis and unilateral radicular pain who underwent fluoroscopically guided transforaminal epidural injections (average, 1.9 injections). Outcomes at 2 and 12 months showed highly statistically significant improvements in pain, function and patient satisfaction scales. The patient satisfaction scale revealed that 62% of patients at 2 months compared with 66.6% of the patients in our study who fell satisfied or somewhat satisfied at 1 month and 64% of patients felt somewhat or completely satisfied at 12 months in Botwin study compared with 38% of the patient in our study who were completely or somewhat satisfied at 12 months.

The evidence suggests that patients achieve at least short-term symptom relief from transforaminal and caudal epidural steroid injections, which indicates that epidural steroids have a therapeutic use in managing spinal stenosis.

Conclusion

We conclude that epidural steroid injection is an important interventional therapeutic method in patient with spinal stenosis that can achieve a short and intermediate term relief in patient symptoms mainly during the flair up of the patient symptoms it also help to improve the patient function, satisfaction and their ability to withstand the physiotherapy.

It is better to do the epidural steroid injection by using the fluoroscopy and contrast to increase accuracy of the injections and improve their positive results.

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