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Clinical analysis of fenestration technique for the treatment of lumbar disc prolapse

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Abstract

Background: Major part of human population suffer from lumbago. It constitutes significant proportion of orthopaedic outpatient department clinic. Lumbar disc prolapse is important cause of back pain. This constitutes to sciatica in number of patients causing agonising disease due to radiculopathic leg pain. Wide range of treatment and techniques are present and have being devised to treat this disorder non-operatively and operatively. Operative techniques also vary a lot in the field of spine surgery depending on the centre, surgeon, diagnosis, symptoms, and cost factors. We present simple, cost effective operative technique with scientific basis in this paper.

Methods: On the basis of inclusion and exclusion criteria 26 patients were operated by our fenestration technique. All the patients were followed up at the interval of 1 month, 3 months and 6 months. At the end of 1 month and 6 months, assessment was done of subjective and objective findings with Japanese Orthopaedic Association (JOA) score and Rate of improvement (RI) was calculated. Out of 26 patients 18 were men and 8 were women. Age ranges from 28 years to 72 years. Mean age being 47.8 years.

Results: Out of 26 patients at the time of discharge, 20 patients (87.5%) could walk independently without any aid and without any radicular pain. In most of the patients 19(73.07%) sciatica improved immediately. The pre-operative mean \pm SD (SE) JOA score was $8.346 \pm 0.85(0.169)$ which improved to $11.807 \pm 0.694(0.136)$ after 1 month and $13.19 \pm 0.895(0.175)$ after 6 months.

Conclusion: Excellent to good results and improvement can be achieved surgically and economically by fenestration technique in the spine lumbar disc prolapse patients an many orthopaedic and spine centres easily with simple learning curve of the operating surgeon.

Keywords: Prolapse, fenestration, lumbar, spine

Introduction

In today's modern world with the hectic lifestyle we lead an estimated 80-85% of people of all age group especially of the working age suffer from some form of back pain. In India we have a large percentage of people using motorcycle's for daily commuting for work and other activities leading to mechanical loading of the back muscles and vertebrae which is further compounded by the deplorable conditions of Indian roadway's. This leads to loss of work, time and money.

In patients presenting with some form of back pain to a clinician the incidence of sciatica is more than 40%. Clinically radiculopathy is seen only in 4-6% cases [1, 2]. Lumbago is the second most common medical cause for absence from work. The pain is due to the irritation of the dural covering of the nerve root by the protruded part of intervertebral disc. Pressure on the nerve root itself causes parasthesia and numbness in the corresponding dermatome as well as weakness and diminished reflexes in the corresponding myotomes [3, 4]. It is common to get patients with lumbosacral disc disease presenting with lower back pain and radiculopathy. The first disc prolapse operation was conducted by Oppenheim and Krause in Berlin but they interpreted it as an enchondroma of spinal disc [5-7]. It was Mixter and Barr's first paper "Rupture of intervertebral disc with involvement of spinal canal" for diagnosis and operative treatment of lumbar disc prolapse [5]. They described extensive laminectomy. Then hemilaminectomy becoming a routine for unilateral signs and symptoms. Loew described extradural removal of herniated disc and devised interlaminar fenestration for treatment of lumbar disc prolapse. More minimally invasive techniques were devised for decompression of disc [6-9]. Fenestration technique was described by Williams who coined the term

“Conservative surgical approach to the virgin herniated disc” and he used the operating microscope to facilitate better visualization of dural sac, nerve roots and other interspinal structures including disc [10]. The advantages of fenestration and interlaminar approach has been demonstrated [11, 12, 13]. Mishra *et al.* compared laminectomy and fenestration for disc excision and came to the conclusion that fenestration was better overall in respect to early postoperative mobilization, early return to work and low incidence of postoperative backache as it is less extensive [14]. It is very safe, effective and reliable surgical technique for treating properly selected patients with herniated disc. This approach is free from spinal instability and membrane formation resulting from laminectomy [15]. Endoscopic and microscopic techniques need infrastructure, cost, skill, high learning curves and experience [16, 17]. Hence disc excision through fenestration is the procedure which can be performed by majority of orthopaedic surgeons even in small peripheral centers and with excellent results.

Materials and Methods

Study area and study population

This is a prospective study, conducted in the each of the author's working places with diagnosis of single level or two level lumbar disc prolapse from October 2013-August 2015.

Inclusion Criteria

1. Patient aged 18 years and above.
2. Single level or two level lumbar disc prolapse.
3. Failure to respond to non-operative treatment.
4. Patients willing for surgery.

Exclusion Criteria

1. Patients below the age of 18 years.
2. Multiple level disc herniation
3. Vertebral fractures.
4. Disc prolapse with bowel and bladder symptoms (cauda equina syndrome).
5. Patient with scoliosis or kyphosis.
6. Patients with spinal infection.

Sampling

Time period of study-October 2013-August 2015

With the incidence rate of lumbar disc prolapse cases undergoing surgery 0.07% [70/100000] at 95% confidence interval and ± 1 margin of error the sample size is $n = 26$.

$$n = \frac{(Z_{\alpha})^2 \times p \times q}{d^2}$$

Hence a minimum number of 26 patients were included in this study.

Statistical Analysis

Diagrammatic presentation

Mean \pm S.D.

Chi- Square Test or Mc Nemers Chi- Square Test.

Paired 'T' test or suitable non parametric test in case of skewed data (if necessary).

The study was approved by local ethics committee.

Methods

Pre-operative evaluation

A detailed history was obtained at the time of admission and all the patients were subjected to thorough clinical examination. All patients were subjected MRI.

The findings obtained therein were noted in a standard Proforma.

All the cases were assessed preoperatively and postoperatively with the Japanese Orthopaedic Association low back ache score. The results of surgery are evaluated using Mac Nab's criteria.

After detailed clinical evaluation, the patients had undergone relevant investigations like:

1. X-ray Lumbo-Sacral spine both anteroposterior (AP)/Lateral Views.
2. X-Ray Lumbo-Sacral Spine Lateral view in Flexion and Extension.
3. Blood routine-Hb%, BT, CT, FBS, PPBS, Blood urea, Sr. Creatinine.
4. Chest X-ray.
5. ECG for fitness for anaesthesia.
6. Consent of the patient for the surgery.

Technique of Surgery: All the patients were operated in prone position. Some patients in knee chest position and some patients on bolsters. The surgical procedure carried out was conventional standard discectomy by fenestration technique. Only fenestration through Ligamentum flavum was required in patients with disc prolapse at L5-S1 spaces (9 patients). A small amount of inferior lamina was removed in patients with L4-5 level prolapse to approach the disc. In patients with disc herniation at two levels L4-5 and L5-S1, simultaneous fenestration and discectomy was done at two levels. In all cases only prolapsed or extruded disc was removed and no disc space curettage was done. Nerve root was cleared of compression in all cases. Average duration of surgery was 75 min with a range of 45-100 min and average loss of blood was 200 ml with a range of 70 ml-350 ml. Blood transfusion was required in two patients who had double level intervertebral disc prolapse who required two level fenestration simultaneously. One patient with dural tear required suturing of dura with absorbable suture (No. 4.0 vicryl) and a fat graft. Epidural bleeding was controlled by bipolar cautery and packing. One case of superficial wound infection required wound dressing and 3 days of antibiotics. All patients were catheterised for 24 hrs post-surgery. Fortunately none of the above complications affected the final outcome.

Post-Operative Management

Pain was controlled with injectable and oral NSAIDS and intravenous antibiotics for 48 hours post-operative. In bed mobilisation of patient within 24 hours of surgery and bedside sitting was done on the second day post operatively. Sutures were removed on 14th post-operative day.

Lumbar Core stabilisation exercises was done by physiotherapist. Stooping and flexing the spine excessively were avoided by patients on advice. At discharge patient were advised not to strain the back or lift weights. Patients were instructed to minimize sitting and riding in a vehicle 6 months post-operatively and not to indulge in heavy weight lifting activity for nine months.

Japanese Orthopaedic Association

(JOA) rating scale was used to determine the outcome apart from Mac Nabs's criteria. The total score represents the sum of subjective symptoms and objective findings. The rate of improvement (RI %) was calculated by dividing the post-operative score minus the pre-operative score by 15 minus the pre-operative score, and multiplying by hundred [18, 19].

**Japanese orthopaedic association’s
Low back ache score**

| 1 | Subjective symptoms: | Score |
|----------|--|--------------|
| A | Low Back pain (3 points) | |
| a) | No Low Back pain | 3 |
| b) | Occasional mild low back | 2 |
| c) | Low back pain always present/Severe low back pain occurs occasionally | 1 |
| d) | Severe low back pain always present | 0 |
| B | Leg pain and/or tingling (3 points) | |
| a) | No lower extremity pain or numbness | 3 |
| b) | Occasional mild lower extremity pain and numbness | 2 |
| c) | Lower extremities pain and numbness always present/Severe lower extremities pain and numbness occur occasionally | 1 |
| d) | Severe lower extremities pain and numbness always present | 0 |
| C | Ability to walk (3 points) | |
| a) | Normal walking | 3 |
| b) | Walking at least 500m is possible, but pain, numbness & weakness are felt | 2 |
| c) | In walking 500m or less, pain, numbness and weakness occur, and Walking becomes impossible. | 1 |
| d) | In walking at most 100m, pain, numbness and weakness occur, and Walking becomes impossible. | 0 |
| 2 | Objective findings: | Score |
| D | straight leg raising test (SLRT): | |
| a) | Normal | 2 |
| b) | 30 degree-70 degree | 1 |
| c) | Less than 30 degree | 0 |
| E | Sensory Abnormality: | |
| a) | Normal | 2 |
| b) | Mild sensory disturbance (Hypoesthesia) | 1 |
| c) | Distinct sensory symptoms (Anesthesia) | 0 |
| F | Motor Abnormality: | |
| a) | Normal | 2 |
| b) | Slightly decreased muscle strength | 1 |
| c) | Markedly decreased muscle strength | 0 |
| | Total score | 15 |

$$\text{Rate of Improvement} = \frac{\text{postoperative score} - \text{preoperative score}}{15 - \text{preoperative score}} \times 100$$

Observations and Results

Observations

Total 26 patients were included in the study. All 26 patients were available for follow up by visits. All the patients were followed up at the interval of 1 month, 3 months and 6 months. At the end of 1 month and 6 months assessment was done of subjective and objective findings with Japanese Orthopaedic Association (JOA) score and Rate of improvement (RI) was calculated. Out of 26 patients 18 were men and 8 were women. Age ranges from 28 years to 72 years. Mean age being 47.8 years. In males age ranged from 28-72 years with mean 46.6 years. In females’ age ranged between 35-70 years with a mean age of 50.5 years. All of the patients had both back pain and leg pain. In almost all the cases back pain preceded leg pain (sciatica) except in one case who had complained leg pain to start with. 9 patients had (Rt) sided radiculopathy and 13 patients had (Lt) sided radiculopathy. 4 patients had bilateral leg pain. 53.84% of patients had L4-L5 disc space involvement.



Fig 1

Table 2: Involvement of disc spaces

| Level of disk | No. | % |
|---------------|-----|--------|
| L3 L4 | 1 | 3.85% |
| L4 L5 | 14 | 53.85% |
| L4L5,L5S1 | 2 | 7.69% |
| L5 S1 | 9 | 34.62% |

Table 3: Position of herniation

| location of herniation | Patients | % |
|------------------------|----------|-------|
| Central | 12 | 46.15 |
| Lateral | 1 | 3.85 |
| Paracentral | 8 | 30.77 |
| Posterior lateral | 5 | 19.23 |

Table 4: Neurological Symptoms

| Symptoms | No of cases (n=26) | Percentage |
|--|--------------------|------------|
| Back pain | 26 | 100 |
| Radicular pain | 26 | 100 |
| Parasthesia | 21 | 80.76 |
| Muscular weakness | 17 | 65.38 |
| Sensory symptoms (hypoesthesia/anesthesia) | 7 | 26.92 |
| Visceral involvement (bowel/bladder) | 0 | 0 |

All 26 patients had undergone conservative therapy in the form of Bed rest, traction, analgesics or physiotherapy.

Table 5: Neurological Deficits

| Defecit | Mild | Moderate | Severe |
|-----------------|------|----------|--------|
| Sensory deficit | 5 | 1 | 1 |
| Motor deficit | 11 | 4 | 2 |

Table 6: Immediate complications of surgery

| Complications | Frequency |
|-------------------------------|-----------|
| Dural tear | 1 |
| CSF leak | 0 |
| Significant epidural bleeding | 5 |
| Wound infection | 1 |
| Discitis | 0 |
| Neural damage | 0 |

Surgical outcome

For analysing the clinical outcome of fenestration-discectomy, we have used following criteria Japanese Orthopaedic Association score for pre-operative and post-operative objective and subjective symptoms and rate of improvement at 1 month and 6 months. Mac Nab’s criteria of outcome.

1. Excellent No pain; no restriction of mobility return to normal work & level of activity
2. Good Occasional nonradicular pain relief of presenting symptoms; return to modified work
3. Fair Some improved functional capacity still handicapped and unemployed
4. Poor Continued objective symptoms of root involvement; additional operative intervention needed at the index level irrespective of length of postoperative follow-up

Out of 26 patients at the time of discharge, 20 patients (87.5%) could walk independently without any aid and without any radicular pain. 6 patients with little radicular pain and with support.

In most of the patients 19 (73.07%) sciatica improved immediately. The clinical outcome of 26 patients after a mean follow up of 6 months is as follows:

Table 7: JOA score and Rate of improvement Mean score.

| JOA | MEAN |
|-----------------|--------|
| PRE OPER | 8.346 |
| AFTER 1 MONTH | 11.807 |
| AFTER 6 MONTH | 13.19 |
| Rate of IMP.1 M | 51.635 |
| Rate of IMP.6 M | 72.191 |

Table 8: Mac Nab's criteria

| Mac Nab's criteria | Frequency | Percentage |
|--------------------|-----------|------------|
| Excellent | 10 | 38.46 |
| Good | 12 | 46.15 |
| Fair | 2 | 7.69 |

Discussion

We observed 26 patients with follow up at 1 month, 3 months, 6 months.

I. Age distribution

Majority of the patients in our study were in the age group between 35-45 yrs (38.5%) and age ranges were from 28 years to 72 years. Mean age being 47.8 years. In SS Sangwan *et al.* the average age was 38.22 years ranging from 25-50 years.⁴

II. Sex distribution of patients

In our present study 18(69.23%) patients were male and 08(30.77%) were female. In SS Sangwan *et al.* the 18 patients were male and 08 were female. 46.15% of the patients were involved in significant occupations namely as daily wage workers or agriculturists.

III. Pre-operative pain

Among 26 patients all patients back pain with radiculopathy with 13(50%) patients with Lt sided radiculopathy. In SS Sangwan *et al.* 15(57.63) patients had Left sided radiculopathy.

IV. Duration of symptoms

The duration of symptoms was between 18-20 months in 7 patients (26.92%); between 14-16 months in 5 patients (19.23%).

V. Side

Symptoms were left sided in 13 patients (50%) and right sided in 9 patients (34.61%) and 4 patients (15.38) had bilateral in

our study.

VI. Pre-operative Sensory symptoms

7 patients had sensory deficit with 5 having mild, 1 moderate and 1 severe.

VII. Pre-operative Motor weakness

17 patients had motor weakness 11 having mild, 4 moderate, and 2 severe.

VIII. Epidural steroid

18 patients had epidural steroid prior to surgery and had relief for 3-4 months.

IX. Investigations

Magnetic resonance imaging studies was done in all the patients.

L4/L5 was affected in 14 patients (53.84%); L5/S1 in 9 patients (34.61%); L3/L4 in 1 patients (3.84%) and L4/L5-L5/S1 in 2 patients (7.69) in our study.

X. JOA score

The pre-operative mean \pm SD (SE) JOA score was $8.346 \pm 0.85(0.169)$ which improved to $11.807 \pm 0.694(0.136)$ after 1 month and $13.19 \pm 0.895(0.175)$ after 6 months.

A Wilcoxon paired signed rank test. Showed that the above changes were statically significant ($P < 0.0001$ HS). The 1 month mean \pm SD (SE) Rate of improvement (RI) was $51.635 \pm 10.09(1.797)$ and after 6 months was $72.191 \pm 12.8(2.511)$. A Wilcoxon paired signed rank test. Showed that the above changes were statically significant ($P < 0.0001$ HS).

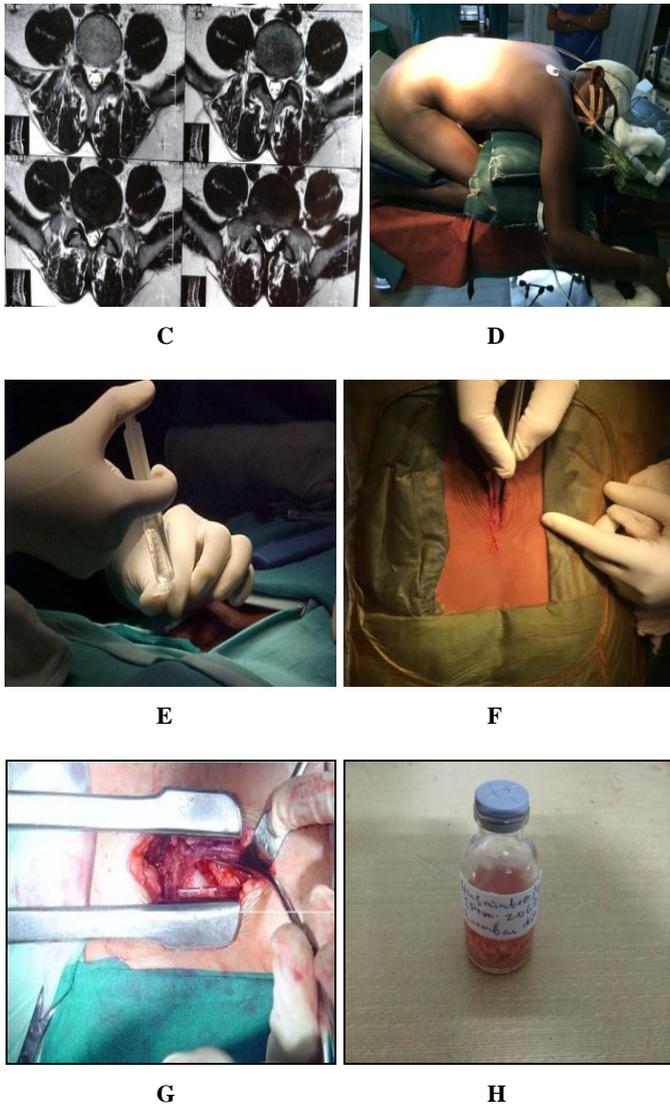
XI. Mac Nab's criteria

According to Mac Nab's criteria we had excellent outcome in 10(38.46%) patients and good in 12(46.15%) patients. In SS Sangwan *et al.* based on modified Macnab criteria 17 patients had excellent, 6 good and 2 fair results. In Babu MKV *et al.* according to Mac Nab's criteria they had good outcome in 29(90.6%) of patients^[6].

Cochrane review has shown better results of surgery for acute disc prolapse rather than chemonucleolysis. Getting back to work for young patients after surgery is more cost effective then conservative techniques for the treatment of lumbar disc prolapse. Surgery for lumbar disc prolapse has evolved from wider dissection and decompression techniques to lesser removal of bone i. e from wide laminectomies to hemilaminectomy to fenestration techniques and the micro-endoscopic techniques to prevent destabilisation of the spine, give minimally invasive approach, be cost effective and cosmetic.

Results of this study, state that the lumbar discectomy performed by fenestration is a safe, effective and reliable method for treating selected patients with herniated lumbar discs.





A, B, C: preoperative MRI showing extruded disc
 D: knee chest position ensures opening of interlaminar space and better access for fenestration.
 E: infiltration of epinephrine to aid hemostasis
 F: central midline incision
 G: exposure showing extruded disc
 H: disc fragment (to be sent for histopathology exam)

Conclusion

Interlaminar discectomy by Fenestration technique is a safe and reliable method for treating patients with lumbar disc prolapse who have been closely scrutinized for surgery. We have excellent outcome in 10(38.46%) patients and 12(46.15%) patients had good outcome and this result can be credited to careful selection of candidates for surgery. It is a safe procedure compared to extensive laminectomy and discectomy, which destabilizes the spine. Change in the outcome score gives better idea of the recovery compared to preoperative state in addition to total postoperative JOA scale. Rate of improvement is a good indicator of post-operative improvement in subjective symptoms and objective findings

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