5b TRANSFORAMINAL ENDOSCOPIC DISCECTOMY

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1. Introduction:

Percutaneous endoscopic discectomy (PED) is a minimally invasive technique for the treatment of lumbar foraminal or extraforaminal and foraminal disc herniations that represent up to 11% of all lumbar herniated discs [1-4] Another study defined that farlateral disc herniations, constituting 7% to 12% of all disc herniations, typically migrate cranially as they extended laterally, foraminally, and farlaterally [5]

In 1934 Mixter and Barr were the first authors who treated lumbar disc herniation surgically [6] In 1950 Hult L described the anterior transperitoneal approach [7] Hijikata S was the first author who performed the percutaneous discectomy technique in 1975 using fluoroscopy [8] During this time, long follow up results were obtained by others. Kambin described the uniportal arthroscopic discectomy in 1983 [9] Indications to use endoscopic discectomy technique have since changed. Kambin and Gellman have played major roles in forming the indications used today.

Various minimal invasive intradiscal techniques have been described. Intradiscal techniques like percutaneous nucleotomy and laser decompression without chemonucleolysis revealed poor results in prospective randomized and controlled studies [6] Numerous surgical accesses, such as midline approaches involving partial or complete facetectomy, intramuscular extra foraminal and paramedian approaches have been described [10-14] These approaches are often associated with partial bone removal therefore the risk of spinal instability can develop [15-19] Percutaneous endoscopic technique is optional approach for disc removal through the foramen and this technique has gradually developed. The benefits of percutaneous endoscopic discectomy are less postoperative pain [20-22], less adhering and scarring [23-25] Direct and clear visualization is obtained by the irrigation of surgery space, increased efficacy of the intervention and avoided instabilization [26-28]

1.a. Historical prospective and background:

Looking at history the principal changes in concept of PED up to now. Percutaneous endoscopic nucleotomy using scopy was first described by Hijikata in 1975 [8] This method is advanced by Parviz Kambin [6,9,26] and today is extensively used. In 1985 Onik described automated nucleotomy to remove nucleus pulposus and then laser nucleotomy was developed [29] Percutaneous nucleotomy became popular all around the world. However the outcomes were not satisfactory. In 1993, Revel reported a 44% success rate with percutaneous nucleotomy and a 66% with chemonucleosis [30] Today percutaneous nucleotomy is not used, so PED indications are totally changed [26]

2. Indications:

The morphologie of disc herniation and clinical findings are two factors that have major role to choice of endoscopic surgery for treatment of farlateral disc herniations. Many authors believe that the treatment procedures to noncontained disc herniations and contained disc herniations are different. The arthroscopic and percutaneous endoscopic techniques are suited for patients with contained disc herniations [5,31] on the other hand noncontained disk herniations maybe removed using the transforaminal technique or microendoscopic discectomy the criteria's for performing endoscopic transforaminal discectomy were gradually changed with development

of endoscopy technology and advanced in personal practice experience.

Recently, Kambin [6,9,32] defined the criteria's for performing of endoscopic extraforaminal approach:

- Positive sign of straight leg response
- Radiologic examination findings describe the clinical symptoms and signs
- Radiating pain with or without neurologic deficits
- If radiating leg pain severity is more than lower back pain
- Insufficient conservative (non-surgical) treatment during 8 weeks

The advantages of endoscopic posterolateral approache:

The use of posterolateral route to approache for farlateral disc herniations supply many advantages with comparison of middle approach with senior total facetectomy. Besides, use of endoscopic techniques supply extreme minimally invasive surgery to reach extraforaminal field.

- In endoscopic posterolateral approache, the entrance route is transmuscle, in result epidural and neural ven is prevented, neural edema does not arise from venal congestion.
- Epidural bleeding in result establish of epidural scar tissue is protected.
- Connective tissues and ligaments such as ligamentum flavum, posterior longitudinal ligaments are protected.
- Paravertebral muscle retraction is not performed in posterolateral approaches, on the contrary of middle line approache.
- Protect of facet joint prevent long-term instabilization complications such as spondilolisthesis
- The risk of disc herniation recurrence is less than middle approach, because supportive and connective tissues are preserved in posterolateral approach.
- The superiority of endoscopic posterolateral approach is protection of facet joint.
- In case of recurrence disc herniation, middle approache is fresh, because in the first operation, epidural and epidural anatomic structures are preserved.

3. Contraindications and Disadvantages:

Endoscopic extraforaminal discectomy have more benefits. Therefore these techniques become popular near spine surgeons. Despite useful characters, this technique has many limitations in practice and indications.

Some disadvantages of endoscopic surgery:

- A long time to master this technique and gain experience in endoscopic surgery
- Technical difficulties are adapting to endoscopic equipments
- Paravertebral intramuscle extensive scarring

Contraindications:

- Extensive immigrated disc fragment (far disc fragment imigration)
- To L5-S1 level (particularly in male patient, the patient with long iliac wings)
- More than one level
- Spine canal and foramen stenosis
- Spondilolisthesis
- Recurrence disc herniations (reoperation)
- Nerve root anomalies such as conjugant root.

4. Surgical Procedures:

Endoscopic approach for farlateral disc herniations is usually performed using by one port. A bipolar approaches used for the removal of large central or paramedian subligamentous, the uniportal approache is used for the removal of extraforaminal, foraminal herniations [32]

4.a. Surgical Equipments:

Initially, the endoscopic system for discectomy of farlateral disc was designed without irrigation. Then for the best exposure, the endoscopic instrument was modified which irrigation endoscopic system. The instruments and equipments which are used in percutaneous extra foraminal discectomy are showed (Figure 1).

4.b. Operating room set up:

A spacious room is used to performing endoscopic procedure. The fluoroscopy is positioned appropriately after patients were given prone position. The layout of the operating room is presented in (Figure 2)

4.c. Patient positioning:

The procedure is usually performed in an operation room, using epidural anesthesia. General anesthesia is also used to do endoscopic farlateral discectomy by many surgeons. We also believe that perform of general anesthesia supply comfort ambience for both patient and surgeon. The patient is positioned prone position same classic position for performing discectomy, but the femur and knee angels are little more than classic prone positions (Figure 3)

Figure 1:
All equipments that use in percutaneous endoscopic discectomy.

4.d. Surgical Technique:

The entry point 8-10 cm laterally to the midpoint is done on the effected side using fluoroscopy. The guide wire is inserted through the triangular working zone into the intervertebral disc with approximately a 45 º angle (Figure 4) As depicted in (Figure 5) the triangular working zone is basically defined by Kambin and Gellman [9] The zone is formed medially by the superior facet joint, inferiorly by the transverse process and superiorly and inferiorly by the nerve root exiting the neural foramen. The guide wire location should be on the interpediculer line and controlled with fluoroscopy in AP position. The working channel is placed in order from thin to wide dilatators. The end working channel was fixed on working triangle very carefully. In this way, the root nerve was quitted superior-anterior side out of working channel, in result wall of trocar was retracted root nerve. We used a 0 º angle optic with 15 cm length and 3 mm diameter. The irrigation system was set up and Saline irrigation was used to aid visualization. The special tools which were designed for this technique such as dissector, grasping forceps were adapted to PED procedure. Normally, working channel is positioned superior-anteriorly for visualization of root nerve. But in some patient's nerve roots have only been in half of working area, the root nerve was mobilized by a nerve hook and then the working channel was repositioned. After clear exposure of the extruded disc material, it was removed (Figure 6) and at the end of the operation the foraminal area was looked over.

5. Post operative care:

The patient is followed-up in recovery postoperatively after neurological examination transfer to ward. Perfusion of analgesia via patient control analgesics (PCA) equipment can be applying a comfort ambiance for patient postoperatively. Patients are usually discharged one day after surgical treatment.

6. Complications and Avoidance:

Complications of endoscopic extraforaminal discectomy usually occur during operation or early postoperatively. The complications in our series (66 patients) were postoperatively dysesthesias with partial root damage in 6% of patients, 3% were operated after PED at the same sessions, 4.5% late recurrence disc herniation [33]

Complication of endoscopic extraforaminal discectomy usually occurs during operation or early postoperatively. Preoperatively more malposition of working port or other endoscopic instruments cause nerve root damage. In result depend to nerve root injury, dysesthesias, paresia, paresthesia and neuralgia can be occurred. Insufficient or unsuccessful discectomy is other reason of early postoperative pain.

As other surgical procedure, infections such as discitis, wound infection, extensive hematoma are complications after endoscopic surgery. In late term recurrence of disc herniation is common complication. Instability and spondilolisthesis is occurred less than classic open surgery.

7. Discussion and Summary:

The PED technique is a minimal invasive surgical procedure in foraminal or extraforaminal disc herniations. In open surgery, due to partial facetectomy it always has a risk for potential instability [16,18,19] PED provides enough observations of all foraminal anat-

omy with a 45º angle, so that it is not necessary to remove facets for visualization and partial facetectomy is not even performed [27,34-36]

Kambin [6] reported the indications which are accepted today. These indications are: 1) with or without neurologic deficit, 2) Intractable pain after conservative treatment for 8 weeks, 3) The pain shows radicular character. That means, the basic criteria's of classic lumbar disc surgery are also available with PED.

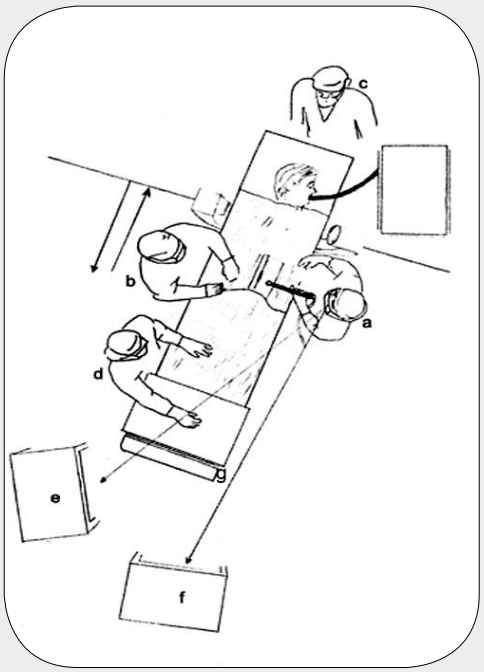

Figure 2:
Situation of operating room
a) Surgeon
b) Assistant
c) Anesthesiologist
d) Nurse
e) Endoscopic monitor
f) Scopy monitor
g) C-arm scopy

PED is an alternative method to open surgery. As discussed above in midline approach to foraminal or extraforaminal disc herniation, medial or lateral facetectomy is necessary [12,37] Removal of disc and facet joint results in a risk to develop segmental instability [16,19] An alternative open surgery technique is to approach laterally through muscles and laterally to facet joint [38] This is an invasive technique because passing through muscles might causes bleeding during the operation so that there is no clear visualization during the operation. Extensive scarring can be seen to both muscles and foraminal area in the long term. In addition the distance is too long from the skin to the extraforaminal space. The PED technique offers an easy way to reach extraforaminal space and Saline irrigation provides good vision and no need to remove facet joint. Although PED is a minimal invasive method and offers many benefits to the patient, it takes a long time to master this procedure and to gain experience in endoscopic surgery requires working with experienced surgeons for sometime. Technical difficulties are adapting to an endoscope monitor, endoscope tools and endoscopic anatomy of the surgical area. All these factors restrict PED practice in lumbar surgery.

The hospitalization period is only 1 day and 63% of our cases returned to work in 3-4 days similar to literature data [28] The injury to paraspinal muscles due to traction and denervation are common in open surgery [23-25] There is no retraction in PED and it is not necessary to remove excessive bone and facet joint, does not cause probable instability. There is always a chance of a midline approach for reoperation.

Postoperative evaluation is critical to understand the success of the procedure. Onik and Allen [29] de-

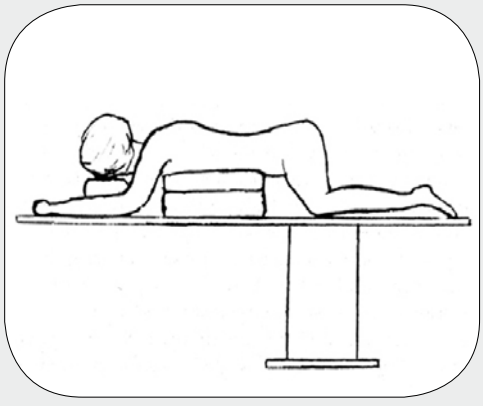

Figure 3:
Patient prone position for transforaminal endoscopic discectomy

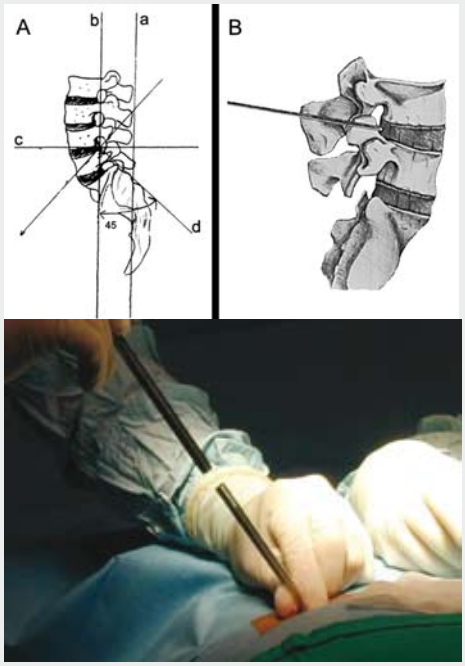

Figure 4:

A. ***a)*** Middle line

b) Foraminal longitudinal line

c) Foraminal transverse line

d) Endoscope apparatus line

B. Working channel usually inserted with 45º angle. The correct insert angle has to be confirmed using fluoroscopy.

C. The working channel is placed in order from thin to wide.

scribe the satisfactory outcome criteria; total or partial reduction in radicular pain, the return of postop functions, no need for narcotic analgesics, also the surgeon and patient both being relaxed. These criteria are also valid in open surgery. Our experience showed following PED procedure the significant reduction in pain is an important criteria. Particularly, in extruded extraforaminal disc herniations there is a dramatic improvement following PED. In these cases, the general outcome can only be obtained with removal of fragmented disc material. The removal of fragmented disc material offers pain free status; we know some points of view in literature show that removal of the free fragment is enough in lumbar disc surgery. We share this opinion because our practice is the same [33]

The data shows that PED procedure can be applied both under general or local anesthesia [6,39-41], we did all procedures under general anesthesia. Literal reviews show that general anesthesia is important in regard to the patient's psychology [42-44] Patients still might experience pain during the procedure under local anesthesia. Moreover, the operating room condition may also have a negative effect on the patient's psychology [45] Finally, if the PED procedure fails to remove fragmented material, we can do the open surgery during the same session under general anesthesia.

As discussed above, a minimal invasive method offers many advantages to the patient. Less anatomic injury offers the patient to return to normal daily life in a short period. Thus, the least amount of time out of work offers economic and social advantage to the patient. The major disadvantages of this method is the difficulty to reach extraforaminal disc herniations at L5-S1 level due to iliac bone wings and the disc herniations located in the spinal canal. Additionally, in the presence of pathologies such as spinal stenosis, degenerative spondylosis, facet hypertrophy, short pedicle and spondilolisthesis the decompression can not be achieved.

In summary, PED technique in appropriate cases can be an optional surgical procedure which can achieve a favorable outcome with pain free status, and need a competent team with adequate endoscopic technology.

8. Case illustrations

Illustrations of some patients who underwent percutan arthroscopic discectomy procedure. Sagittal an axial view of these patients was showed (Figure 7)

9. References:

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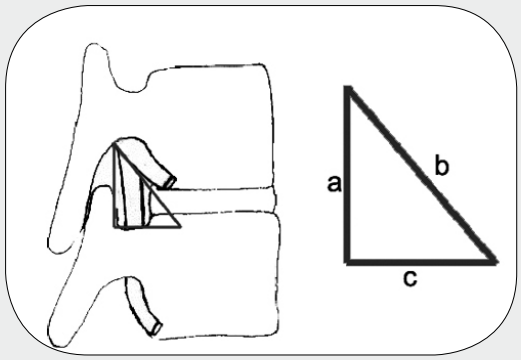

Figure 5:
Triangular working zone.

a. Medial is superior edge facet joint, triangular zone

b. Superior , anterior edge is the nerve root exiting the adjacent neural foramen

c. Inferior edge is transverse process.

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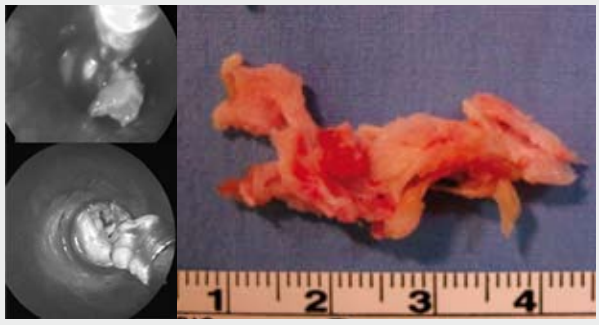

Figure 6:
Demonstrating a disc fragment removed using the endoscopic apparatus.

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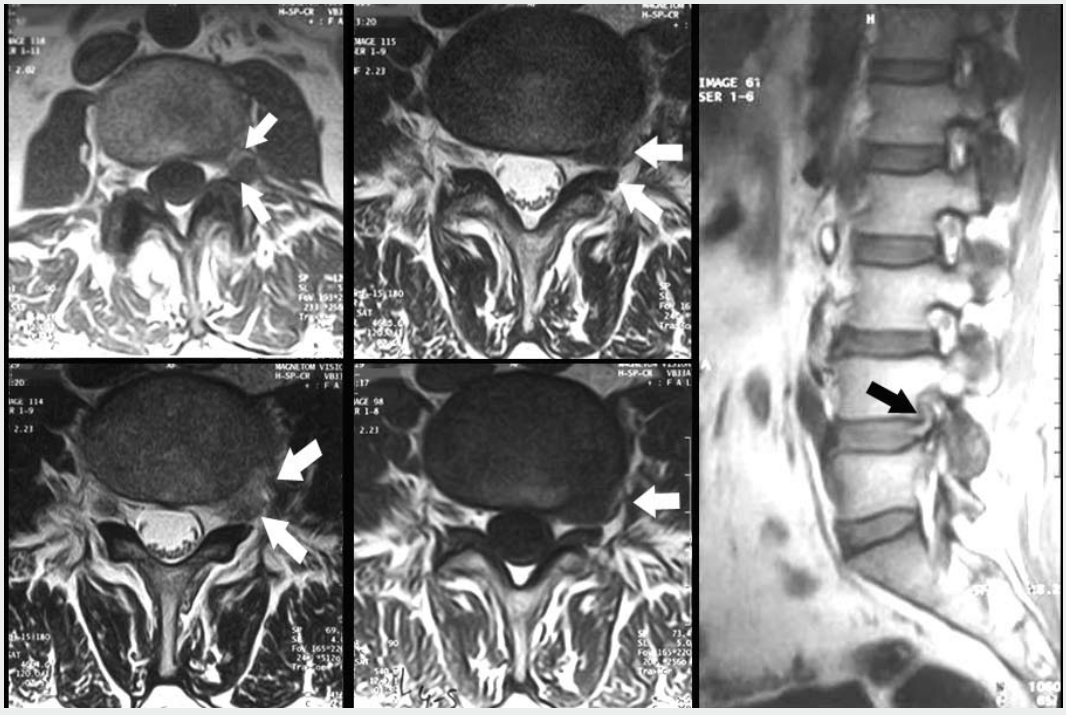

Figure 7:
MRI scans of some cases that have been operated (sagittal and axial view).

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