PERCUTANEOUS PROCEDURES

Section
1. Introduction:

Percutaneous vertebroplasty is a popular and emerging minimally invasive technique. Polymethyl methacrylate (PMMA) is injected into the vertebral body under radiological guidance to maintain the stability and strength of the spinal column and to decrease patient pain. Galibert et al. (1) reported the first case in a patient with a painful vertebral hemangioma in 1987. In recent years, the indication was widened to include other painful osteolytic lesions of the vertebral body (2). Approximately, 700,000 people have vertebral body fractures secondary to osteoporosis, and this results in a decrease in patient quality of life (3).

Today, vertebroplasty is used generally for two primary indications: the treatment of metastatic vertebral tumors and symptomatic osteoporotic vertebral compression fractures (VCF).

2. Indications:

The suitable patient selection is very critical for obtaining good clinical results. Although the indications of vertebroplasty have widened in the recent years, the primary indications are noted here:

1. The most suitable cases for vertebroplasty are painful osteoporotic vertebral fractures which are not clinically improved after 4-6 weeks of conservative management (external bracing, analgesics, narcotic agent).
2. Vertebroplasty can be performed for aggressive and symptomatic vertebral body hemangiomas which lead to fracture of the body, metastatic tumors, vertebra osteonecrosis, osteogenesis imperfecta and acute vertebral body fractures.
3. Vertebroplasty can be performed for the treatment of chronic, traumatic vertebral fractures which are not fused following trauma.
4. Vertebroplasty can be chosen to decrease the symptoms of vertebral tumors which are multifocal and inoperable.

3. Contraindications:

Appreciation of the contraindications of vertebroplasty and important in avoiding complications. Generally, the main contraindications of vertebroplasty are noted below:

1. Unstable fractures of the vertebra, retropulsation of the fractured fragment into the spinal canal with compression of the cord or nerve root, and loss of vertebral body height more than 70%.
2. Allergic allergy to the vertebroplasty cement
3. Low technical capacity with the radiological tools used in the procedure and difficulties with detection of the landmarks of the operation.
4. Systemic and/or local infections, known difficulties with general and/or local anesthesia, and bleeding and coagulation disorders.
5. Asymptomatic VCF and prophylactic management of osteoporotic fractures at other levels.

4. Surgical Procedures

4.a. Surgical Equipment

The standard sterilization equipment for spinal surgery such as betadine, alcohol solution, drape and sterile towels are prepared. After the sterilization equipment is prepared, uniquely sized 22-25 gauge
spinal pins and 11-13 gauge bone biopsy pins are prepared. Additionally, PMMA cement, sterile barium sulfate, screw-down injector reservoir syringes are also prepared prior to initiation of the operation (Figure 1a, b).

4.b. Operating room set up
A proper operation table for standard spinal surgery is prepared and high quality single and/or biplanar fluoroscopy unit is positioned according to the choice of the surgeon. The monitors used for the fluoroscopy unit and surgical tools are localized just opposite to the surgeon to obtain the views of anatomical landmarks during the percutaneous procedure. This should be established prior to beginning the operation (Figure 2).

4.c. Patient positioning:
The patient placed on the operating room table in the prone position. Then, prone and semi-flexion position is chosen for the patient and the body is supported with silicon pillows for the vertebroplasty procedure of the thoracal and lumbar vertebrae. Both arms are located above the shoulders at flexion position to enable the use of lateral fluoroscopy scans.

4.d. Surgical Technique:
The percutaneous transpedicular vertebroplasty can be performed under general anesthesia, local anesthesia, or conscious sedation. After the placement of the patient in the prone position, antero-posterior and lateral fluoroscopic images of the affected vertebral body and pedicle are taken (Figure 3a). The lateral projection of the pedicle is localized with a Jamshidi needle under AP fluoroscopy and a 1 cm skin incision is made. After the incision, the upper and lateral wall of the pedicle is targeted and the Jamshidi needle is inserted through the muscle (Figure 3b). It optimal to have the Jamshidi needle is closer to the medial wall of the pedicle as one guides down the length of the pedicle during cannulation. The cranio-caudal position of the Jamshidi needle inside the pedicle is also monitored closely with lateral fluoroscopy. If the vertebroplasty procedure is to be bilateral, the same procedure is performed to the opposite side (Figure 3c, 3d). Frequent fluoroscopy control is critical for safe placement and guidance of the needle. (Figure 3e, 3f). The Jamshidi needle is stopped at the anterior wall of the vertebral body. The anterior wall of the body should remain intact during the entire procedure. The thorocar is stabilized and position at the anterior wall and a canal is maintained within the body with a hand drill.

The bone cement PMMA is prepared and put inside the syringe of the system and maintained until a “toothpaste-like” consistency (Figure 4a). Then, a connection established between the system and the trocar (Figure 4b, 4c). After this process, the cement is inserted into the vertebral body using a volume of 0.5 ml under low pressure with continuous AP and lateral fluoroscopy control. The processes is continued until the cement reaches the posterior one-third of the vertebral body (Figure 4d). The same procedure can be completed on the opposite side, as shown (Figure 4e, 4f). The process is then done at this time. We believe that the use of 2-4 cc of cement for thoracic and 4-6 cc cement for the lumbar spine is adequate for maintaining the strength adn stability of the vertebral body and to improve clinical pain (4). The system is removed after the bone cement has solidified and the skin is closed (5,6). The vertebroplasty must be stopped if the cement extends to the anterior or posterior portion of the vertebra body.
The transpedicular approach is the gold standard for percutaneous vertebroplasty. However, an extrapedicular approach is chosen for the higher thoracic spine and inadequately sized pedicles. The cranio-lateral point of the pedicule is the ideal insertion point for the extrapedicular approach. Additionally, fluoroscopy and computed tomography may be essential at the upper thoracic vertebra (Th1-4) because of the shoulder joints (7). Although the unipedicular approach is adequate, the bilateral approach can be performed for vertebroplasty.

Figure 3:
a) Targetting the upper and lateral wall of the pedicle antero-posterior fluoroscopic images 
b) Jamshidi needle is inserted through the muscle, targetting the upper and lateral wall of the pedicle 
c,d) Same procedure is performed to the opposite side nad cranio-caudal position of Jamshidi needle is controlled under lateral fluoroscopy 
e,f) AP and lateral fluoroscopic images of the Jamshidi needle is shown.
Microsurgical interlaminar vertebroplasty can be performed in cases of neural tissue compression (lumbar disc hernia, ligamentum flavum hypertrophy, lumbar stenosis, etc.) at the level of the compression fracture. The laminae, ligamentum flavum and the medial facet are excised by this process to decompress the thecal sac and segmental nerve root. The vertebroplasty canule is inserted into the vertebra body lateral to the thecal sac and cement is injected after the insertion of trocar under lateral fluoroscopy.

Figure 4:

a) The prepared bone cement PMMA put inside the syringe of system b,c) Connection is done between system and thorocar and cement is inserted into the vertebral corpus d) lateral fluoroscopic images of the bone cement insertion e,f) opposite side bone cement insertion and its lateral fluoroscopic images is shown.
5. Postoperative Care:

Neurological examination must be performed immediately after the operation. The patients are discharged after 2-3 hours of bed rest. We advise to use of a thorocolumbar corset for 1-2 weeks following the procedure.

6. Complications and Avoidance:

This percutaneous vertebroplasty procedure can be done with a low rate of complication in the hands of experienced surgeons (9). However, rare complications include dural tears, root injuries, spinal cord injury, arterial injury, pneumothorax, haemothorax, rib, and fractures to the pedicle and adjacent vertebra can be seen during the procedure (10). Spinal canal stenosis and/or spinal cord compression due to cement leakage through the posterior wall of vertebra corpus may cause neurological deficits. Leakage into the spinal neural foramen may cause nerve root compression and related complications. The heating capacity of the cement during the chemical solidification process also has been shown to potentially contribute to neural injury (9,11). The cement leakage into the paraspinous venous structures adjacent to anterior wall of the vertebral body has also been shown to result in pulmonary and cerebral emboli. Other notable, but rare complications include infection and anaphilaxic reaction to the components of the cement (12,13).

We believe that the first, and most important step, to avoid complication is intensive education with cadavers and the development of surgeon understanding of the associated minimally invasive anatomy. Additionally, the surgeon must have exposure to surgeons who are experienced in the technique. Attention to preoperative patient preparation, equipment sterilization and proper patient selection may also help to decrease complications. Visualization of adequate cement opacification on fluoroscopy may also help the surgeon to detect the landmarks of surgery and decrease the complications.

7. Case illustrations:

Case 1:

A 60 year-old female patient was admitted to the neurosurgery department with complaints of back pain and difficulty with walking after a fall down her stairs one month ago. The patient’s neurological exam was normal, however she had severe difficulty with
walking because of severe back pain. The thorocral and lumbar direct radiographs revealed a L1 vertebra compression fracture and associated kyphosis (Figure 5a, 5b). There was no compression of the thecal sack when evaluated by lumbar CT and MRI and the posterior wall of the vertebra body was intact. The bone density of the patient revealed osteoporosis (T-Score: -3.4). Percutaneous vertebroplasty was performed for the L1 vertebral body under general anesthesia and fluoroscopy (Figure 5c, 5d). The patient was mobilized the same day of the operation and discharged on post-operative day #1. The patient continued to do well at last follow-up (12 months) at which point her pain continued to be improved.

8. References:


1. Introduction:

Kyphoplasty is a minimally invasive technique that allows for percutaneous stabilization and the reduction of thoracic and lumbar vertebral compression fractures (VCF). The term kyphoplasty is designated with reference to established vertebroplasty and balloon angioplasty techniques. The first kyphoplasty technique was performed by Reiley in 1998 in a patient with an osteoporotic compression fracture associated with severe back pain. The percutaneous balloon kyphoplasty procedure is similar to percutaneous vertebroplasty. The primary and sole difference between kyphoplasty and vertebroplasty is that inflation of a balloon allows for mechanical restoration of the vertebral body height prior to placement of bone cement (methyl methacrylate) with the fractured vertebral body.

The common classification of VCF is based on a macroscopic view of the fractured vertebra with designation types including wedge, biconcave, and crush types. Wedge type fractures are commonly seen in the middle thoracic and thoracolumbar region as crush injuries. Additionally, biconcave VCFs are generally seen in the lumbar vertebra. Ismail et al. reported that more than 50% of VCF is wedge type, 17% is biconcave type and 13% is crush type.

The ideal candidates for kyphoplasty are patients with recent VCF and who have associated back pain. The evaluation of these patients must be documented carefully with a complete neurological examination. The vertebral body and pedicles must be evaluated with plain X-rays of the spine at the time of evaluation. Magnetic resonance imaging (MRI) and computerized tomography (CT) findings must also be evaluated carefully. The posterior part of the fractured vertebral body must be intact on the vertebral CT. If this portion of the VB is not intact, the surgeon must be concerned with introduction of material into the canal during the procedure. CT and MRI also may help to distinguish the new fracture from the older ones. This is especially important for the multiple level VCF’s. The edema in the vertebral body of new VCF of is hyperintense on T2 weighted MRI. Spinal cord compression of any nature on either the MRI images or CT is a relative contraindication to kyphoplasty, regardless of the presence or absence of neurological deficits.

Percutaneous kyphoplasty is an important minimally invasive procedure that can be used to treat VCFs. The benefits of this procedure, namely early patient mobilization post-procedure and the safe and technically non-demanding nature of the technique continue to increase the popularity of this technique.

2. Indications:

Kyphoplasty can be performed from Th5 down, including the thoracic and lumbar vertebrae under this level. The indications of kyphoplasty have been defined as the following three indications:

a) To restore the loss of height and correct kyphosis after VCF.
b) To decrease lumbar pain after VCF when secondary to osteoporosis.
c) To treat the VCF secondary to VB fracture related to multiple myelom and other osteolytic metastatic lesions.
3. Contraindications:

General contraindications are the recent use of anti-coagulant medications (including Warfarin, aspirin, and Plavix), platelets less than 100,000, active local infection (osteomyelitis) and/or sepsis. Specific contrindications are cervical and upper thoracic vertebra fractures and fracture inclusive of the posterior part of the vertebra and/or pedicles. Bone cement has been documented to leak into the spinal canal and/or neural foramen, rarely resulting in neurological deficits.

4. Surgical Procedures:

4.a. Surgical Equipment

Several items of equipment are needed to perform the kyphoplasty. First, a draped C-arm fluoroscopy and monitor are essential for verification of the position and localization of the patient during surgery. The kyphoplasty set is also necessary to perform the operation.

4.b. Operating room set up

A standard set up for spine surgery is used with the spine surgeon standing on the left or right side of the patient depending upon the location of the operative technician and surgical assistant. The monitor of the C-arm is placed with relation to the operative surgeon as shown (Figure 2).

4.c. Patient positioning:

The patient is placed in the prone position on a radiolucent spinal frame under local or general anesthesia. The fluoroscopy is located in a position that allows the operator to obtain both anteroposterior (A-P) and lateral images.

4.d. Surgical Technique:

A three millimeter incision is performed parallel to the fractured vertebra level and pedicles under A-P fluoroscopy. The Jamshidi needle is inserted to the lateral and upper part of pedicle under A-P fluoroscopy. After this is done, the C-arm is converted to the lateral position and the Jamshidi needle is moved through the pedicle and stopped after 2 mm insertion into the posterior wall of vertebra body. At that moment, the Jamshidi needle must be located near the medial wall...
Figure 3:
The patient positioning is seen.

Figure 4 a-c:
a) Three mm incision is performed parallel to the fractured vertebra level and pedicules under A-P fluoroscopy b, c) The Jamshidi needle is inserted to the lateral and upper part of pedicle under A-P fluoroscopy,
Figure 4 d-j:
d,e) The thoracar is slided through the guide-wire and put at the 2 mm deep of the posterior wall of the vertebra body under fluoroscopy.
f,g,h) The thoracar is taken out omitting the Jamshidi canule at the last position. Drilling process is performed after it is slided through the canule. The vertebra endplates must be cared during the drilling process.
i) The cement canule is inserted to the vertebral body and bone cement is injected to the vertebral body with pressure.
j) The bone cement canule is stopped inside the vertebra body until the bone cement become hard.
of pedicle as guided under A-P fluoroscopy (Figure 4c). The stylet is taken out from the canal of Jamshidi needle and guide-wire is inserted under lateral fluoroscopy. Now the Jamshidi needle is taken out while leaving the guide-wire in place. The trocar is now slid over the guide-wire and positioned 2 mm below the posterior wall of the vertebra body under fluoroscopy (Figure 4d, 4e).

The trocar is taken out leaving the Jamshidi canule at the last position. The drilling process is completed after it is slid through the canule. The vertebra endplates must be preserved during the drilling process (Figure 4f, 4g, 4h). After the drill is taken out, an inflatable bone tamp (IBT) is inserted into the body of fractured vertebra through the canule. The proximal and distal marking points of the IBT must be located inside the vertebra body. The IBT is inflated until the maximum restoration of disk height is obtained under fluoroscopy. The upper and lower endplates of the fractured vertebra must be observed and protected from developing a new structural defect in the VB. The IBT is taken out after its deflation. The bone cement (PMM) is prepared and put in the cement canule after it has become a toothpaste-like consistency. The cement canule is inserted into the vertebral body and the bone cement is injected into the vertebral body with pressure control under A-P and lateral fluoroscopy (Figure 4i). The injection process is terminated when the bone cement arrives at the posterior 1/3rd of the vertebra body. The bone cement canule is kept inside the vertebra body until the bone cement has hardened (Figure 4j). After these steps, the bone cement canule is taken out and the skin incision is closed.

5. Postoperative care:

Postoperative care of the kyphoplasty performed in a similar fashion to vertebroplasty as mentioned in chapter 6a.

6. Complications and Avoidance:

Although complications of kyphoplasty are rarely seen, spine surgeons must keep the 1% of patients who have complications in their mind. The bone cement may leak into the spinal canal and neural foramen via the posterior wall of vertebra body and pedicle. When this occurs, neurological deficits may develop. Cerebrospinal fluid may leak via the damage to the thecal sac. Epidural fibrosis, urine infections, premature ejaculation, and infection are rare complications, but may be seen after kyphoplasty. Pulmonary and cerebral emboli may develop via the cement leakage to the paraspinal venous plexus. Rupture of the balloon, additional vertebral body fracture, pedicle fracture, local pain, fat emboli and epidural and subdural hematomas of the spinal canal may develop after kyphoplasty procedures.

7. References:

1. Introduction:

The majority of adult population cause to lumbar backache at the any period of their lives. Although admission to the health center due to lumbar back pain is at the second level after upper breathing problems, it is at the first level about the loss of productive effort (1,2). While the symptoms of 60-80% of the patients improve with conservative treatment after 1-3 months, the rest of them may goes to chronic low back pain (3). One of the major and important ethiopathology of the lumbar back pain is lumbar disc herniation. Mixter and Barr (4) reported the relation between the lumbar disc herniation and siatalgia. Green et al. (5) declared that innervation of disc may cause to lumbar back pain without lumbar disc herniation.

Besides the conservative treatments and open surgery procedures for the management of intervertebral disc injury related back pain, percutaneous minimally invasive surgical procedures became popular nowadays. Percutaneous laser disc decompression (PLDD) is one of them so-called “minimally invasive” treatment modalities for lumbar disc herniation (6). The use of laser energy to vaporize the nuclear material was introduced in 1986 by Peter Ascher and Daniel Choy (7). Choy et al. (8) performed the first PLDD after invitro experimental studies. Recently, the popularity of PLDD increased because of decreasing the improvement time duration, early mobilization after surgery and decrease the time duration to return the job.

2. Indications:

The suitable patient selection is very important for the results of PLDD. The main indications of PLDD were written below.

- No response to 6 weeks conservative treatment.
- The neurological findings are the result of single nerve root irritation and lower extremity ache is more than back ache.
- Radicular symptoms concordance with radiological images of contained herniation.

3. Contrindications:

Contrindications are important to avoid the complications of this procedure. The main contrindications of PLDD were written.

- Systemic and local infections, difficulties for local anesthesia, coagulopathy.
- Large, secestration, extrusion and non-contained disc herniation.
- Lumbar disc herniated cases with severe neurological symptoms such as cauda equina syndrome.
- Severe disc degeneration and loose of disc height.
- Cases which necessitate acute surgery for lumbar disc herniation.
- Cases with moderate and/or severe spinal stenosis, spondylolysis, vertebral malignancy or fracture.
4. Treatment Principle of PLDD

The radicular symptoms of lumbar disc herniation is based on compression of herniated part of nucleus pulposus to the nerve root. The treatment principle of PLDD depends on the closed hydrolic system of intervertebral disc. This closed system consist of the nucleus pulposus, containing a large amount of water. Nucleus pulposus is surrounded by the inelastic annulus fibrosus. An increase in water content of the nucleus pulposus causes to the increase of intradiscal pressure\(^{(6)}\). PLDD leads to evaporation of water in nucleus pulposus and changes the structure of nucleus pulposus with laser energy. The decrease of pressure in nucleus pulposus leads to removement of herniated part and cause to decrease and/or improvement of the symptoms\(^{(6,7)}\).

5. Surgical Procedures

5.a. Vertebroplasty Equipment

The sterilization equipment for spinal surgery such as betadine, alchole solution, drape and sterile towel are prepared. Biplanar C-arm and PLDD equipment is the main part of this surgical procedure. The neuromonitoring systems are set up before operation.

5.b. Operating room set up

The C-arm and monitor is placed according to the localization of the surgeon. The spine surgeon, surgical assistant and operation technician are located according to the left or right side of the surgical area. It will be better if the monitors of neuromonitoring systems and C-arm are located opposite to the spine surgeon.

5.c. Patient positioning:

The prone position and a radiolucent spine operative table is suitable for PLDD surgical procedure. It will be better to prepare the fluoroscopic C-arm into the surgical field to provide for real-time lateral and A-P imaging. The operation area is then washed and draped in the usual sterile fashion.

5.d. Surgical Technique:

The procedure is conducted under local anesthesia of the skin and underlying muscles. After assessment of the correct disk level by using fluoroscopy, a hollow needle is inserted 10 cm away from the midline, pointing toward the center of the disk. When the 18-gauge needle is in place, its correct position is verified by using biplanar fluoroscopy, sometimes in combination with CT imaging.

The position of the needle must be changed if there is any new developing extremity pain after the insertion of needle. It will be better to be in dialogue with patient during the insertion of the needle. And then, a laser fiber (0.4 mm) is inserted through the needle into the center of the nucleus pulposus. Once the correct position has been reached, laser treatment can begin at 15 W, with pulses of 0.5 to 1s and pauses of 4 to 10s. The recommended doses are 1200 -1500 J for L1-L2, L2-L3, L3-L4, and L5-S1 levels, and 1500 - 2000 J for L4-L5 level\(^{(11)}\). Laser energy is then delivered into the nucleus pulposus to vaporize its content and reduce intradiscal pressure. The laser discectomy procedure is stopped after 30 minutes. The laser fiber and needle is taken out and the wound is closed.

Schenk et al.\(^{(6)}\) declared that different laser types and parameters with different radiological tools are used for laser discectomy. Additionally, CT and/or MRI imaging can be used during the procedure beside the fluoroscopy\(^{(9,10)}\).

6. Postoperative Care:

The patient is rotated to the supine position after closing the wound and taken to the recover room. The patient can be discharged after a few hours resting. A few days bed resting at home are suggested with aneligic, antiinflamatuary and antibiotics. It will be better to restrict physical exercise and to avoid hyperkyphosis position for 2 weeks. Physical therapy and rehabilitation is suggested 3 weeks later than the laser discectomy procedure.

7. Complications and Avoidance:

Septic and aseptic spondilodiscitis are the most encountered complications of laser discectomy. To care on the surgical sterilization procedures and infection at the patient and/or operation side may decrease the septic discitis. Injury of disc and surrounding structures via laser energy may cause to aseptic discitis. To use fluoroscopy and mark the localization of laser fiber may help to avoid from aseptic spondilodiscitis.
Thermal damage to the nerve root may cause to transient and/or continuous extremity pain. Epidural hematoma, abdominal perforation, parsiel cauda equina syndrome, free-fragment migration, phlebitis etc. are the rare complications of percutaneous laser discectomy (12).

8. References

1. Introduction:

Epiduroscopy, a new, minimally invasive diagnostic and therapeutic technique, may be useful for pain relief in such patients. Epiduroscopy is a procedure mainly used for the visualisation of the spinal epidural space with an endoscope, although optional interventions such as mechanical or laser mobilisation of spinal adhesions, or application of steroids to inflamed tissues, may also be performed. It allows visualization of normal anatomical structures, such as the dura mater, blood vessels, connective tissue, nerves and fatty tissue, as well as of pathological structures, such as adhesions, sequestration, inflammatory processes, fibrosis and stenotic changes (1).

Epiduroscopic technology with flexible optics has been used in clinical application on patients since the early 1990s (2). In 1991, Heavner et al. reported on endoscopic examinations of the epidural and spinal space of rabbits, dogs and human cadavers using a flexible endoscope (3). In 1996, Schutze published the first report on epiduroscopically assisted SCS electrode implantation (4). Ruetten et al. reported on clinical application of epiduroscopically assisted laser therapy for postnucleotomy syndrome (5). In 2000, Ovassapian wrote that the role of epiduroscopy for chronic back pain is explored (6). In 2004, Schutze described over 500 epiduroscopies in chronic pain patients. This publication described endoscopically assisted epidural analgesic therapy as well as the treatment of painful epidural fibrosis and adhesions with laser technology (7).

Among chronic pain disorders, low back pain arising from various structures of the spine constitutes the majority of problems. The lifetime prevalence of chronic low back pain has been reported as high as 80% with an annual prevalence ranging from 15% to 45%, with a point prevalence of 30% (6,7). Studies of the prevalence of low back pain (8) and its impact on general health showed 25% of patients reporting Grade II to IV low back pain with high pain intensity with disability. The human intervertebral disc in the lumbar spine has been known to cause low back and lower extremity pain secondary to disc disruption, disc herniation, and nerve root compression (8). Nerve root compression may be caused by disc herniation, spinal stenosis, and osteoarthritis. Chemical radiculitis and residual pain after surgical interventions, also known as post surgery syndrome, are also common factors in the causation of low back and lower extremity pain related to the disc (8).

Epiduroscopy is a new technique for treatment of chronic low back pain (8). At the present time, only a few prospective studies have been conducted to establish the benefits of epiduroscopy (9,10) although retrospective studies have described the clinical effectiveness and cost-effectiveness of epiduroscopy in patients with herniated disks or severe low back pain after back surgery (9,10).

2. Indications:

The suitable patient selection is very important for the results of Epiduroscopy. Epiduroscopy offers a technique for diagnosing and treating spinal pain syndromes. The main indications of Epiduroscopy were written below.

- This may involve distinguishing pathological and anatomical structures and circumstances, such as...
epidural fibrosis following invasive procedures and radiculopathies.

- Postlaminectomy syndrome, not elsewhere classified
- Lumbar spinal stenosis
- Cervical disc disorder with radiculopathy
- Lumbar pain, radiculopathy
- Postoperative epidural adhesions
- Chronic refractory back pain or failed back surgery

3. Contraindications:
Contrindications are important to avoid the complications of this procedure. The main contrindications of Epiduroscopy were written.

- Systemic and local infections, Bleeding tendency, coagulopathy disorders.
- Large, secestation, extrusion and non-contained disc herniation.
- Lumbar disc herniated cases with severe neurological symptoms such as cauda equina syndrome.
- Congenital anomalies, presence of or increase in intracranial pressure, pregnancy
- Cerebrovascular disease, renal or liver insufficiency, inflammatory or dystrophic skin lesions in the area of the sacral canal, meningeal cysts, meningoceles, meningomyeloceles, severe respiratory insufficiency
- Patient’s refusal to undergo the procedure

4. Treatment Principle of Epiduroscopy
For epiduroscopically assisted interventions, such as biopsy, adhesiolysis, resection of scar tissue, removal of irrigation fluid or lipoma removal, cauterization, extirpation of foreign bodies and abscess drainage, flexible surgical instruments, surgical lasers and catheters are available for use via the working channel of the epiduroscope(1).

Epiduroscopic epidural catheter placement for procedures such as epidural analgesic therapy for chronic pain is frequently indicated when sufficient analgesia cannot be brought about despite the use of systemic analgesics or if adverse effects occur that are intolerable for the patient.

The use of epiduroscopy allows directed and targeted spinal dorsal and ventral epidural pharmacologic treatment and epidural analgesic therapy (EAT). With the use of our epiduroscopy management, the epidural analgesic therapy can substantially contribute to optimizing the treatment strategy for problems such as failed back surgery syndromes, epidural fibroses and lumbar radiculopathy(1).

The use of laser (LASER = light amplification by stimulated emission of radiation) technology expands the options for epiduroscopic surgery. The-bundled light has a number of medical applications, such as coagulation for bleeding, rechanneling stenoses caused by tumors and destroying plaques in vessel walls(1). Ruetten et al. reported on a study in which 47 patients in whom epidural adhesions had been detected by epiduroscopy were treated with a Holmium:YAG laser(4).

Schütze et al. reported on patients who underwent epiduroscopally assisted SCS electrode implantation for neuromodulation for the first time to treat their failed back surgery syndrome(3). Epiduroscopy also allows this extraneous fibrous tissue or scarring near the implanted SCS electrode tip to be removed through microsurgery, in order to restore the efficacy of neuromodulation after long-term use without having to replace the electrode(1).

Radio frequency therapy (RFT) is a further invasive option for relieving chronic back pain. The original method of radio frequency thermolesion heated up the surrounding tissue to high temperatures during the application of electrical current. Epiduroscopically assisted SCS electrode implantation and adhesiolysis of the electrode tip, we have the impression that using endoscopy substantially lowers the risks associated with SCS pain management.

5. Surgical Procedures
5.a. Epiduroscopic Equipments
The sterilization equipment for spinal surgery such as betadine, alcohol solution, drape and sterile towel are prepared. Digital endo-camera system, which consists of the epiduroscope, light guide and camera with a cable, carrying out epiduroscopy and endoscopic
surgery requires that the proper sterile instruments are laid out on an instrument tray (Figure 1).

5.b. Operating room set up
Anesthesiological standards for preparing the operating room and carrying out the invasive procedure must be maintained at all times. When performing epiduroscopy, stringent safety standards for hygiene must be maintained. Absolute sterile techniques must be adhered to in the operating room when performing epiduroscopy. Our operating room is equipped with a number of highly developed specialized devices for epiduroscopy. Controlling the various devices and computers can be complicated, and adds to the stress on the part of the surgeon and the operating room technicians. In addition to controlling the high-quality endoscopy equipment, the assistants often have to operate the C-arm, saline irrigation system and laser and ultrasound technology simultaneously.

5.c. Preoperative management
When performing elective invasive EDS procedures, certain standards for preoperative management must be observed. Because clinical pain symptoms and radiological findings are also used to explain spinal pain syndromes, assessing diagnostic examinations can be difficult. The diagnostic method is selected based on the patient's previous course of disease and the current clinical findings. The multidisciplinary findings (e.g., radiological, neurological and psychiatric, orthopedic and neurosurgical findings, as well as the results of internal medicine and lab tests) and an informed consent discussion with the patient outlining the risks of the procedure are all integral parts of preoperative management for epiduroscopy.

5.d. Patient positioning
Because of the sacral approach to the epidural space, the patient is positioned prone on the operating table. While epiduroscopy can also be performed in the lateral position, it is much easier and safer for both patient and surgeon when epiduroscopy is performed with the patient in the prone position. The operation area is then washed and draped in the usual sterile fashion.

5.e. Surgical Technique
After sterile preparation of the surgical field, an 18-gauge Tuohy needle is introduced into the sacral hiatus, and its tip was confirmed to be in the caudal epidural space by lateral X-ray or by injection of a contrast medium (iopromide 10 ml, Isovist 240; Schering, Osaka, Japan) through the needle. A 0.8-mm guide wire is then inserted through the needle under fluoroscopic guidance. Using the Seldinger technique, the 4-mm (8.5 F) introducer (4005; Mylotec, Ruswell, GA, USA) with a dilator was advanced over the guide wire into the sacral epidural space. After removal of the dilator and the guide wire, a 0.9-mm endoscope (3000E; Mylotec) covered with a video-guided catheter (2000; Mylotec) is introduced into the epidural space through the introducer.

The endoscope is gently steered and advanced in a cephalad direction under direct vision in the epidural space. And also, fluoroscopy is used to determine the vertebral level of the endoscope tip. The epidural space was irrigated and distended by infusion of saline during the procedure to obtain a good visual field.

6. Postoperative Care:
The patient is rotated to the supine position after closing the wound and taken to the recovery room. The patient can be discharged after a few hours resting. A few days bed resting at home are suggested with analgesic, antiinflammatory and antibiotics. It will be better to restrict physical exercise and to avoid hyperkyphosis position for 2 weeks. Physical therapy and rehabilitation is suggested 3 weeks later than the epiduroscopy procedure.
7. Complications and Avoidance:

Complications that may arise during epiduroscopic procedures are generally caused by puncture trauma, accidental dural injury, puncture of an epidural blood vessel or epidural bleeding. The symptoms associated with these complications may include headache, general back complaints, vomiting, meningitis, radicular radiating pain, bladder and rectal disorders and even confusion. Although the available contrast agents are water soluble and are completely resorbed, adverse reactions such as headache, neck stiffness, fever, orthostatic dysregulation, spinal functional disorders, psycho-organic syndromes or contrast agent allergy may occur. Mizuno et al. described a case in which encephalopathy and rhabdomyolysis was induced by the administration of the contrast agent iotrolan during epiduroscopy. A dural tear during epiduroscopy allowed the contrast agent to enter the subarachnoid space. A potential complication of EDS is increased pressure in the epidural space due to the epidural infusion. In 2000 the journal Archives of Ophthalmology published a report on an acute incident of bilateral blindness associated with preretinal, retinal and subretinal hemorrhages following epiduroscopy. Epidural bleeding and epidural hematoma during or after epiduroscopy constitute extremely rare and extremely dangerous complications.

Epidural injuries may be caused by the epiduroscope itself or by microsurgical instruments or a catheter, for instance, when optimal endoscopic vision is not ensured during surgical procedures. In order to achieve the epidural target position, the epiduroscope may not be advanced blindly or with brute force. Permanent optimal endoscopic vision prevents avoidable complications.

8. References: