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 VCF’s 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 anticoagulant 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 to 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.

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 pedicles 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 slid through the guidewire 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 slid 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 canal 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 (3,4).

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 (3,4,6,7).

7. References: