Surgical Technique Guide
INTRODUCTION

The fusion technique used in anterior cervical interbody fusion has gone through many transformations, from the use of a tricortical iliac crest graft as advocated by Smith and Robinson\(^1\), to Cloward’s bicortical dowel-shaped graft\(^2\). The BENGAL\(^{\text{®}}\) Cervical Interbody System represents further advancement by adopting the benefits of a mechanical device while facilitating conditions for fusion, which can be visualized due to the radiolucent property of the biocompatible cage material.

The BENGAL Cage is a carbon fiber reinforced polymer (CFRP) interbody fusion and VBR device. The cage distracts and maintains the intervertebral height, as well as providing restoration of cervical lordosis. The range of cages available is based on natural anatomical variation.
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**Positioning the Patient**

The patient is given general endotracheal anesthesia, then placed in the supine position with the neck extended. It is helpful to place rolled blankets under the scapulae and a rolled towel under the neck to provide extension of the cervical spine. Both arms are placed at the patient’s side so that X-rays can be taken with traction applied to the arms by an unscrubbed assistant at the foot of the table.

**STEP 1: EXPOSURE**

- The exposure can be made either on the left or right side according to surgeon preference. Although risk of retraction injury to the recurrent laryngeal nerve is higher from the right, a left-sided approach has the possibility of injuring the thoracic duct and is more likely to injure the esophagus. Most right-handed surgeons prefer to approach from the right side.

  A transverse “hemi-collar” incision is made parallel to the clavicle extending from the sternocleidomastoid muscle to the midline (Figure 1).

**STEP 2: MAKING THE INCISION**

- The crico-thyroid membrane is at the C5-6 disc level. The incision is usually two or three fingerbreadths above the clavicle, depending on vertebral level desired. The incision is taken through the subcutaneous fat to the surface of the platysma. Although some surgeons divide the platysma in line with the skin incision, it is more cosmetic to elevate the skin a distance of two to three centimeters on either side of the skin incision and divide the platysma in the direction of its fibers (Figure 2a).
• The layer of deep cervical fascia is incised along the anterior border of the sternocleidomastoid muscle (Figure 2b).

- Blunt dissection is used to develop the interval between the carotid sheath and the midline structures, staying close to the trachea. The fascia along the lateral edge of the superior belly of the omohyoid muscle is cut with a Metzenbaum (straight blunt scissors) until the edge of the esophagus is visible (Figure 2c).

• The surgeon can use either a “peanut sponge” or index finger to open the plane of cleavage between the carotid sheath laterally and the trachea and esophagus in the midline (Figure 2d), exposing the anterior cervical spine.

NOTE: The diagonal fibers of the muscle.
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STEP 3: REMOVAL OF THE DISC AND PREPARATION OF THE ENDPLATES

- Cautery is used in the midline over the cervical spine, followed by a "peanut sponge" to reflect the fascia and longus coli muscles (Figure 2e).

- If desired, self-retaining retractors may be placed. The blunt-tooth blades are placed medial-lateral, taking care that the teeth remain within the longus coli muscle fibers. The smooth blades are placed superior-inferior.

- A 22-gauge spinal needle is placed in the appropriate disc and a lateral X-ray taken to verify anatomic level. If the needle has been pre-bent to a 90° angle 1cm from its tip, excessive penetration will be prevented.

- Use of a Caspar or similar vertebral distractor is recommended to distract across the disc space. Long shank distraction screws are inserted in the vertebra above and below the affected disc, making sure that the screw shanks are parallel. The distractor is applied, stretching the disc space (Figure 3a).

- Anterior osteophytes overlying the disc space may need to be removed using a rongeur or osteotome. At times, these osteophytes add substantially to the anterior-posterior dimension of the vertebral body. The anterior annulus is incised and removed. The nucleus is removed with a pituitary rongeur or curette. The cartilaginous endplate is peeled from the vertebral bodies above and below using a small periosteal elevator or curette. Dissection should not be undertaken lateral to the upslope of the uncovertebral joint on either side to assure protection of the vertebral arteries. After the disc has been removed, greater distraction can usually be achieved using the distractor.
While some surgeons have recommended that posterior osteophytes not be removed due to increased risk of damage to the spinal cord, others have recommended that all posterior osteophytes be removed. A tiny up-angled curette or Kerrison rongeur can be used to remove the posterior osteophytes, if necessary. This dissection can be carried laterally until the neural foramen can be entered with a nerve hook to verify that the nerve root is free and that all nuclear material has been removed (Figure 3b). Vigorous probing into the foramen should be avoided to prevent penetration of the vertebral artery.

The cage’s specific rasps (Figure 4a) are used to flatten the endplate and ensure that all endplate cartilage has been removed. As recommended by Robinson, subchondral bone should be preserved as far as possible so that it can function as a bearing surface for the implant.

NOTE: The osteophytes have been removed on the patient’s left side and a nerve hook verifies that the foramen is free. On the right side, the osteophyte has not been removed and the access to the spinal canal is limited.
STEP 4: CHOOSING THE APPROPRIATE BENGAL CAGE

- The trials for the BENGAL Cage (Figure 4a) are used to gauge the selection of implant size.

- Figure 4b shows the use of a trial for gauging both the height and the size of the implant required, and to assure that each surface is flat and the space is equally tapered from front to back. Each trial is slightly smaller than the actual cage implant (0.75 mm) to allow the implant a snug fit.
STEP 5: HARVESTING, PREPARATION AND INSERTION OF GRAFT INTO BENGAL CAGE

- The BENGAL Cage may be filled with autologous cancellous bone.
- The selected cage is engaged with the threaded portion of the cage inserter (Figure 5) and placed in the filler block. Using the cage filler block, the cancellous bone is packed firmly into the hollow area of the cage.

STEP 6: INSERTION OF THE BENGAL CAGE

- The cage is then gently tapped into the prepared disc space (Figure 6) using the inserter designed to prevent driving the cage too far posteriorly. Under normal circumstances, the cage should be recessed 1 to 2 mm from the anterior cortex. A final X-ray is taken to verify position of the implant.
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STEP 7: CLOSURE OF THE WOUND

- Absolute hemostasis must be achieved prior to closure. The vertebral body distractor is removed along with the long shank distraction screws (Figure 7). Bone wax is placed in the screw holes. The anesthetist is asked to move the cervical spine through a range of flexion and extension positions, to ensure that stability has been achieved. An anterior cervical stabilization device, such as the SKYLINE® Anterior Cervical Plate, can be applied if less than optimum stability is observed. A small drain is placed deep in the wound. The self-retaining retractors are removed and the tissue layers closed. The platysma is usually the only layer requiring suture. Subcutaneous or subcuticular sutures are placed and steri-strips applied to the skin. A soft cervical collar may be applied.

STEP 8: POST-OPERATIVE CARE

- The patient is usually placed in the surgical intensive care unit overnight to observe for the unlikely but dangerous possibility of airway obstruction. The patient is allowed to ambulate 24 hours post-operatively. The drain is removed and the patient discharged when comfortable, usually on the second or third post-operative day. The patient is instructed to minimize motion of the cervical spine and wear the soft collar for one month post-operatively.
INDICATIONS:
The **BENGAL**® Cervical Interbody System** is indicated for use as an intervertebral body fusion device in skeletally mature patients with degenerative disc disease (defined as discogenic back pain with degeneration of the disc confirmed by patient history and radiographic studies) at one level of the cervical spine with accompanying radicular symptoms. Patients should have six weeks of non-operative treatment prior to surgery. BENGAL implants are used to facilitate fusion in the cervical spine (C2-T1) and are placed via an anterior approach using autogenous bone. When used as an interbody fusion device, DePuy Spine supplemental fixation may be used.

The **BENGAL Cervical Interbody System** is indicated for use in the thoracolumbar spine (i.e., T1-L5) to replace a diseased vertebral body resected or excised for the treatment of tumors, to achieve anterior decompression of the spinal cord and neural tissues, and to restore the height of a collapsed vertebral body. This system is also indicated for treating fractures of the thoracic and lumbar spine. This system is designed to restore the biomechanical integrity of the anterior, middle and posterior spinal column even in the absence of fusion for a prolonged period. When used as a vertebral body replacement device this system is intended for use with DePuy Spine supplemental internal fixation.

**Limited Warranty and Disclaimer:** DePuy Spine products are sold with a limited warranty to the original purchaser against defects in workmanship and materials. Any other express or implied warranties, including warranties of merchantability or fitness, are hereby disclaimed.

**WARNING:** In the USA, this product has labeling limitations. See package insert for complete information.

**CAUTION:** USA Law restricts these devices to sale by or on the order of a physician.

To order in the US, call DePuy Spine Customer Service (1-800-227-6633).

Not all products are currently available in all markets.

**REFERENCES**