SUBSPECIALTY PROCEDURES

SINGLE-LEVEL CERVICAL DISC ARTHROPLASTY WITH A BRYAN DEVICE

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Introduction

The anterior cervical approach for discectomy with modified distraction and milling tools (Video 1) provides an ideal method for surgical treatment of symptomatic discogenic disease and subsequent placement of an arthroplasty device.

The cervical spine is positioned in neutral on a surgical table that allows for anteroposterior and lateral imaging. The procedure is accomplished through a standard anterior Smith-Robinson-type approach. The index disc space is identified anatomically and radiographically. It is helpful to identify the center of the vertebral body above and below the target level and mark this with electrocautery. Modified Caspar-type pins (Medtronic Sofamor Danek) are placed in a parallel fashion well above and below the disc space to allow for discectomy, sizing, and use of a biconvex electric milling device. Tools to confirm that the pins have been placed far enough from the disc space are available. It is important to minimize intrinsic distraction through the Caspar pins and instead use the intradiscal distraction tool to further open the native target disc space. A complete discectomy is performed with care taken to completely resect the entire posterior longitudinal ligament. Bilateral decompression of the neuroforaminal regions addressing any uncovertebral degenerative change that is present is completed.

The disc space is measured with a sizing tool to identify the appropriate footprint of the arthroplasty device. The biconvex milling tool is then placed within the disc space, and appropriate placement is confirmed with fluoroscopy. At the initiation of milling, distraction through the Caspar pins is slowly removed, with subsequent gentle compression during the milling process. Irrigation is helpful to minimize heat generation. Following the

Video 1 Surgical technique. Techniques notes: A standard transverse incision consistent with the typical Smith-Robinson technique is used. One of several anterior skin folds may be chosen for postoperative cosmesis if the incision also allows appropriate exposure of the index surgical level.

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milling process, convex end-plate preparation is inspected, and hemostasis is obtained prior to placement of the arthroplasty device. Final radiographs are obtained to ensure appropriate placement of the device. Wound closure is consistent with that typical for the Smith-Robinson technique.

Indications & Contraindications

Indications

- Single-level, symptomatic, discogenic cervical radiculopathy or myelopathy that cannot be treated satisfactorily with nonsurgical means.

Contraindications

- Severe stenosis
- Spinal cord injury
- Severe facet degenerative change (spondylosis)
- Cervical kyphosis
- Primary bone pathological condition (metabolic, infectious, etc.)
- Multilevel symptomatic or nonadjacent pathological involvement

Step 1: Patient Positioning

Position the patient supine on a radiolucent table that allows for anteroposterior and lateral fluoroscopic imaging.

- Place the neck in neutral, avoiding kyphosis and hyperlordosis.
- Identify an appropriate surgical incision for the transverse incision of a Smith-Robinson approach to the cervical spine. Typically, one of several anterior skin folds will be appropriate from a cosmetic perspective. Use fluoroscopy to confirm that the incision is appropriate.
- We prefer to make the surgical approach contralateral to the side of the most notable symptoms (e.g., a right-sided approach for a patient with left-sided radiculopathy).

Step 2: Surgical Approach

Use a standard Smith-Robinson approach to the anterior cervical spine at the index level of pathological involvement.

- Make a standard 3 to 4-cm incision with good hemostasis.
- Split the platysma longitudinally and mobilize it for later closure.
- Expose the interval between the medial strap muscles and the sternocleidomastoid muscle.
- Take down the prevertebral space and fascia.
- Identify and fluoroscopically confirm the anterior longitudinal ligament and the target disc.
- Mark the midline of the vertebral bodies with electrocautery above and below the target level.
- Place modified Caspar-type pins well above and below the target disc level in a parallel fashion that is also parallel to the disc space and confirm the placement fluoroscopically. An intradiscal measuring tool is available to confirm that the pins were placed at least 7 mm above and below the end plates of the target disc.

Step 3: Discectomy, Distraction, and Initial End-Plate Preparation

Perform the initial discectomy with a modified distraction technique; then perform the index neurological decompression followed by bilateral neuroforaminal decompression.

- Proceed with an incision of the anterior anulus and perform the initial discectomy with microsurgical curets and pituitary rongeurs to the level of the posterior anulus and the posterior longitudinal ligament.
- Perform intradiscal distraction with the designated tool and retain the distraction with the Caspar system. We prefer not to perform the primary distraction using the Caspar system and instead use the Caspar locking mechanism to retain the distraction obtained primarily with the intradiscal distractor, thereby avoiding inadvertent loosening of the pins.
- Resect the posterior anulus and posterior longitudinal ligament under magnification. Loupe magnification or an operating microscope is recommended.
- Complete neurologic decompression ensues with removal of end-plate spurs, bilateral uncovertebral spurs, and herniated discogenic material. We recommend bilateral decompression and complete removal of the posterior longitudinal ligament even in patients with unilateral pathological involvement.
- Achieve end-plate flatness with use of a barrel-type burr.

Step 4: End-Plate Preparation

Size the end plates and eventual arthroplasty device, and mill the end plates.

- Assess the intradiscal decompression visually.
- Judge the appropriate size of the arthroplasty device with a tool designed specifically to measure the anteroposterior length of the disc space. Make sure that the sizing tool fully covers the anteroposterior diameter of the index disc space to determine the appropriate size of the arthroplasty device.
- Confirm the sizing fluoroscopically, and consider the additional use of the burr to allow initial sizing. We prefer a side-cutting, barrel-type burr to flatten the medial aspects of the uncovertebral joints evenly.
- Place the biconvex electric milling tool in the distracted disc space, and confirm its placement fluoroscopically. Confirm the ability to perform on-demand fluoroscopy with the radiology technician in the room.
- Irrigate the wound with a small amount of saline solution, and start the milling tool.
- Slowly remove the distraction through the Caspar device.
- Carefully apply compression to the end plates via the Caspar pins with the milling device continuously engaged.
- Stop the milling device and remove it.
- Irrigate the wound to remove bone and other debris and achieve hemostasis. We prefer to use Gelfoam patties (Pfizer) or powder with thrombin, as bone wax could prevent later incorporation of the arthroplasty device to the end plates.
- Remove excess hemostatic agent.
- Inspect the end plates to confirm appropriate milling.
- Confirm the integrity of the neurological decompression.

Step 5: Insertion of Arthroplasty Device

Prepare the arthroplasty device and insert it.

- Open and prepare an arthroplasty device of appropriate size.
- Under slight distraction, carefully place the device with the insertion tool.
- Remove the insertion tool.
- Obtain final radiographs prior to wound closure.

Step 6: Imaging and Wound Closure

Close the wound and incision in a fashion typical for a Smith-Robinson-type approach.

- Perform the final irrigation of the wound.
- Remove the Caspar pins.
- Apply bone wax to the former Caspar pin sites, and confirm hemostasis.
- Obtain final anteroposterior and lateral radiographs to confirm proper device placement. Typically, it is properly placed if 1 of the 2 anterior device flanges is 1 mm anterior to its respective disc space.
- Approximate the platysma with resorbable suture, close the dermis with subcuticular resorbable suture, and use Steri-Strips (3M) for the final skin closure.

Step 7: Postoperative Care

- The timing of patient discharge to home is consistent with an outpatient surgical procedure and at the surgeon's discretion—routinely at 4 hours postoperatively.
- No surgical immobilization is recommended, and activities as tolerated are appropriate.
- Typically, routine surgeon-driven recommendations for postoperative wound care, pain control, and postoperative follow-up are followed. Narcotic-type medications are used for a minimal period (1 to 7 postoperative days), and nonsteroidal anti-inflammatory drugs are used for 14 postoperative days for pain control and prevention of heterotopic bone formation.
- Follow-up for wound-healing is at the surgeon's discretion. Radiographic follow-up is performed at intervals employed by the specific surgeon.

Results

Pain, neurological, and functional outcomes in the immediate perioperative period are at least similar, if not superior, to those achieved with arthrodesis, as are the outcomes over the ensuing months and years.

Pitfalls & Challenges

- Patients should provide consent for both arthroplasty and potential arthrodesis.
- Centering of the Caspar pins and parallel placement of these pins away from the disc space are keys to end-plate preparation and placement of the arthroplasty device.
- Bilateral decompression is critical to the success of an arthroplasty in contrast to an arthrodesis because, if it is inadequate at the time of the index procedure, continued target-level motion could lead to new symptoms.

- The entire posterior longitudinal ligament should be removed.
- Successful arthroplasty relies on excellent visual AND radiographic assessments. If both cannot be ensured during the procedure, conversion to arthrodesis at the time of the index procedure should be considered.
- Kyphosis should be avoided with positioning and device placement.

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