Posterior cervical foraminotomy for cervical radiculopathy has traditionally been performed using a long incision, which caused unnecessary bleeding and scarring. A new technology called the METRx Microdiscectomy Surgical Technique (Medtronic Sofamor Danek, Memphis, Tenn.) allows for a less invasive procedure that produces excellent results without the trauma of open surgery.

The METRx system is an innovative technique for performing microdiscectomy in a minimally invasive fashion. The system consists of assorted instruments, including muscle dilators and retractors, for use with a variety of patients, procedures, and surgeon preferences. The METRx technique uses a series of dilators to subcutaneously split muscle, avoiding excess bleeding and pain.

**Operative technique**

Ensuring precision by using fluoroscopy is vital. The first step in the METRx technique is to insert a spinal needle 1.0 cm to 1.5 cm from the midline and make an incision through the subcutaneous tissue at the puncture location. The incision length and the tubular retractor width must be the same.

The guidewire is inserted and the first dilator is placed over the guidewire. To begin dilation of the muscle, a twisting motion is used. The guidewire is removed when the fascia is penetrated with the dilator. The dilator may then be moved forward the lamina.

The subsequent dilators are placed on top of one another, while pressure on the initial dilator is maintained. The tubular retractor is then inserted over the dilators and the endoscope is attached (Figures 1-4). Direct incision of the superficial fascia makes passing the dilators easier. It is essential that all soft tissue be removed with cautery so that there is a clear operative area.

Once the bone is seen, a small hemi-laminotomy and foraminotomy can be performed (Figure 5). The ligamentum flavum is separated from the lamina with a curette. It is important to refer to lateral fluoroscopy to ensure correct instrument placement. The ligamentum flavum may now be removed from the foramina (Figure 6).

The nerve root is located, retracted with a dissector or retractor so that the located disc herniation can be removed, then carefully decompressed (Figure 7).

The operative area is irrigated for hemostasis and a piece
Insertion of a spinal needle aids in localizing the incision site. Figures 1-6 courtesy of Medtronic Sofamor Danek and Kevin T. Foley, M.D.

The initial dilator is inserted down to the level of the lamina.

Bilateral METRx tubular retractors have been positioned.

The traversing nerve root is retracted to expose the disc.

Minimally invasive posterior lumbar interbody fusion

Kevin T. Foley, MD

Spinal instability and disc-related back pain may interfere with a patient’s quality of life, making procedures such as posterior lumbar interbody fusion (PLIF) necessary. The PLIF procedure is often performed in conjunction with pedicle screw fixation, which has been recommended as safe and efficacious for many spinal conditions. Standard spinal stabilization surgery requires a 3-in to 6-in incision and stripping of the paraspinous muscles away from their attachments to the spinous processes, laminae, facets and transverse processes. In contrast, use of the METRx and Sextant techniques allows the surgeon to perform PLIF and pedicle fixation in a muscle-sparing, minimally invasive fashion through two paramedian, 1-in incisions.

METRx and Tangent technique

The patient is positioned prone on the operating table.

Kevin T. Foley, MD

My colleagues and I have found that patients who undergo minimally invasive foraminotomy are likely to experience little postoperative pain, decreasing the need for postoperative medications. Additionally, while the results of this procedure have been shown to be comparable with a standard open-foraminotomy, patients who undergo the minimally invasive procedure are discharged earlier. Other surgeons have found that patients were able to recover quickly with minimal to no pain. Finally, posterior cervical foraminotomy with the METRx technique decreases tissue trauma because the muscles are dilated during the procedure and return to their original state easily after surgery.

References

with chest rolls in place. C-arm fluoroscopy is used to guide instrument placement. The level of the operative interspace is determined with the fluoroscope and a 22-gauge spinal needle (Figure 1). Two 1-in incisions are made at this level, approximately 25 mm to either side of the midline, and carried only into the subcutaneous tissue. The METRx Microdiscectomy Surgical Technique (Medtronic Sofamor Danek, Memphis, Tenn.) instruments are used. A guidewire is inserted through the small incision and penetrates the underlying fascia. A cannulated soft-tissue dilator is passed over the guide wire, directed toward the inferior aspect of the superior lamina (Figure 2).

Once the dilator penetrates the fascia, the guidewire is removed. The dilator is advanced to the lamina. Sequentially larger dilators are passed over the first dilator down to the lamina. Markings on the sides of the dilators indicate the depth from the skin surface. A 22-mm tubular retractor of appropriate length is chosen and advanced over the final dilator. After it has been locked in position using the articulated, table-mounted retractor arm, the dilators are removed. The underlying anatomy is visualized with the operating microscope, an endoscope, or with surgical loupes. Residual soft tissue is cleared from the laminar surface, exposing the lamina and the ligamentum flavum. A second tubular retractor is placed in identical fashion through the contralateral incision (Figure 3).

Laminotomies are performed bilaterally through the tubular retractors, using rongeurs and/or a highspeed drill. The ligamentum flavum is removed, exposing the dural sac and the traversing nerve root (Figure 4). Bilateral discectomies are then carried out. Using the Tangent Posterior Impacted Instrument Set (Medtronic Sofamor Danek), cartilage is removed from the adjacent endplates. Interspace height is restored using sequentially larger interbody distractors inserted via the tubular retractors. The final distractor is left in place on the contralateral side. The appropriate-sized box chisel is then used to mortise the endplates on the ipsilateral side (Figure 5). The box chisel is removed, the interspace is packed with morselized autograft bone, and a Tangent machined allograft is impacted into the interspace. On the contralateral side, the distractor is removed, the interspace is mortised, and a second Tangent allograft is inserted along with additional autograft bone (Figure 6). This is all carried out under fluoroscopic control. The tubular retractors are then removed and segmental fixation with the Sextant pedicle screw and rod system is performed.

**Sextant screw and rod placement**

The Sextant screws are inserted through the same one-in incisions that were used for the tubular retractors. The pedicles are localized with anterior posterior and lateral fluoroscopy. Alternatively, the FluoroNav Virtual Fluoroscopy System (Medtronic Sofamor Danek) can be utilized. Using a technique similar to that for vertebroplasty, a needle is advanced through the pedicle until it enters the vertebral body. A K-wire is inserted through the needle and the needle is withdrawn. A second needle is then inserted into the adjacent pedicle and a second K-wire is left in position. Cannulated soft tissue dilators (similar to the METRx dilators) are inserted over the K-wires to dilate the...
fascia.

The pedicles are tapped through the final dilator using a cannulated tap of appropriate diameter (5.5mm, 6.5mm, or 7.5mm). The Sextant pedicle screws are then inserted over the K-wires and the K-wires are withdrawn. The Sextant pedicle screws are cannulated screws and come in 5.5mm, 6.5mm, and 7.5mm diameters and multiple lengths. They are first attached to screw extenders; the combined screw and screw extender are inserted as a unit.

The screw extender serves two functions. It allows for percutaneous manipulation of the multi-axial saddle of the Sextant screw and it allows the lock screw to be inserted. The screw extenders are made up of an outer sleeve and an inner sleeve (the lock screw retaining sleeve). A lock screw is inserted into the distal end of the inner sleeve, the inner sleeve is inserted into the outer sleeve, and the extender assembly is attached to the chosen Sextant pedicle screw with the first few threads of the lock screw. The assembled screw-extender unit has an opening in the saddle to receive a percutaneous rod. Once both screws have been inserted, the proximal ends of the screw extenders are aligned. This external (visible) alignment of the screw extenders automatically aligns both screw saddles so that they can be connected by a rod. The Sextant rod inserter is then attached to both extenders. This arc-shaped device geometrically constrains the screw saddles so that their openings lie along a curvilinear pathway, which the arc intersects. A trochar tip is attached to the rod inserter and a percutaneous pathway is created down to the first screw by advancing the arc along its constrained pathway. The trochar is removed.

A Sextant rod of appropriate length is chosen (a rod templating device exists for this purpose) and attached to the inserter. It is then percutaneously advanced with the inserter arc until the rod intersects both pedicle screw saddles (Figure 7). It is important to obtain fluoroscopic views of the assembly at several angles to verify that the rod has been correctly placed. The lock screw retaining sleeves are lowered into their second position within the outer extender sleeves and one of the lock screws is tightened using a hex driver. Compression and/or distraction forces can now be applied to the construct prior to tightening the second lock screw.

The lock screws have a torque-limiting break-off feature. As they firmly secure the rod within the saddle, their upper portion breaks off and releases the extender from the screw (the top portion of the lock plug is retained within the inner sleeve). After both lock plugs have been engaged, the Sextant rod is remotely released from the rod inserter and the detached screw extender-rod inserter assembly is removed from the field. The final pedicle screw-rod construct can be viewed fluoroscopically. The procedure is then repeated for the contralateral side. Lastly, the small wounds are closed with subcutaneous and subcuticular absorbable sutures.

**Benefits of METRx PLIF with the Sextant**

Posterior lumbar interbody fusion and pedicle screw fixation performed with the METRx and Sextant systems is minimally invasive, avoiding the need for large incisions, muscle stripping, and significant soft tissue retraction. Tissue trauma and blood loss are thus minimized. In my experience, patients treated with the Sextant system have had less postoperative pain than those treated with comparable open procedures. While achieving the same long-term goals as patients undergoing open lumbar fusion and fixation, these patients have had shorter hospital stays and have been able to resume normal activities sooner. This makes sense, as the bone grafting and pedicle screw-rod fixation are essentially the same as for the open procedure, but are performed with less approach-related trauma. Therefore, minimally invasive PLIF with percutaneous pedicle screw fixation appears to be a safe and effective alternative to traditional open approaches to lumbar fusion.

**References**