9

Anterior Cervical Diskectomy and Fusion

Stephen M. Papadopoulos

◆ Patient Selection

Since its introduction in the 1950s, anterior cervical diskectomy with fusion (ACDF) has gained widespread acceptance and represents a significant component of the typical neurosurgeon's practice. Recent literature suggests that use of anterior cervical plating may increase the fusion rate, improve maintenance of cervical lordosis and interbody height, decrease the length of recovery, and obviate the need for a cervical orthosis.

In determining surgical candidates for ACDF, several criteria must be considered, including radiculopathy and/or myelopathy, axial neck pain, sagittal alignment, and proper correlation between clinical findings and radiological images. The following is a list of criteria for which cervical fusion may be indicated:

1. Axial pain accompanied by disk herniation
2. Radiculopathy with abnormal cervical lordosis (with or without axial neck pain)
3. Radiculopathy with disk herniation (with or without axial neck pain and cervical lordosis)
4. Myelopathy where imaging studies demonstrate greater disk compression anteriorly (greater posterior compression may suggest a posterior approach)
5. Constant axial neck pain (rarely)

Although radiculopathic patients without neck pain and with normal lordosis are candidates for ACDF, if the disk herniation is lateral rather than central, laminoforaminotomy is an option. In patients with multilevel disease, several additional factors must be considered to ensure that multilevel ACDF, as opposed to corpectomy, is appropriate. First, the use of multiple grafts with a plate will allow either or both restoration and maintenance of the lordosis. Second, because the vertebral end plates are minimally resected, there is better end plate loading, less subsidence, and quicker healing.

◆ Preoperative Preparation and Patient Positioning

The patient is placed in the supine position with the neck in slight extension. The posterior cervical spine is supported to establish and maintain normal lordosis. Significant extension is avoided, particularly if the patient has myelopathic symptoms. A 1 L IV fluid bag or a rolled towel can be used for the posterior cervical support. The surgeon must then choose a right- or left-sided approach to the cervical vertebral column. After the approach is selected, the head may be rotated to allow for adequate exposure of the upper cervical spine **(Fig. 9–1).** Some surgeons prefer the left-sided approach because of the more consistent anatomical location of the recurrent laryngeal nerve **(Fig. 9–2).** Interestingly, however, the literature does not support one side or the other in regard to the incidence of recurrent laryngeal nerve palsy. Other surgeons prefer the approach as dictated by the orientation of the pathology (i.e., a right-sided approach for the treatment of left foraminal stenosis and vice versa.

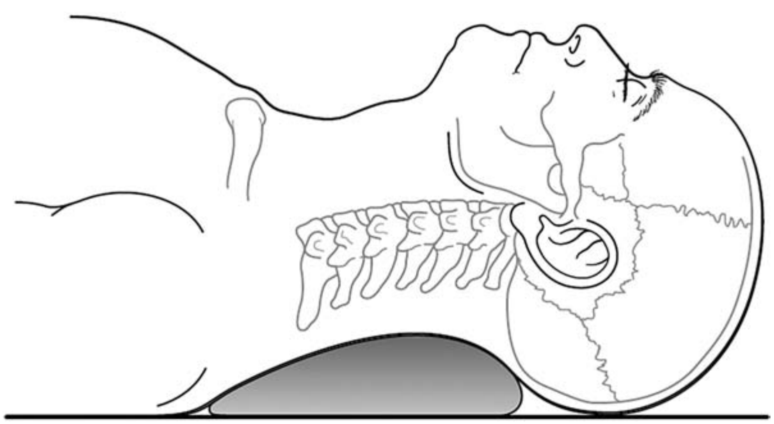

Figure 9–1 The patient is placed in the supine position with the neck in slight extension. A 1 L IV fluid bag or a rolled towel is used for posterior cervical support.

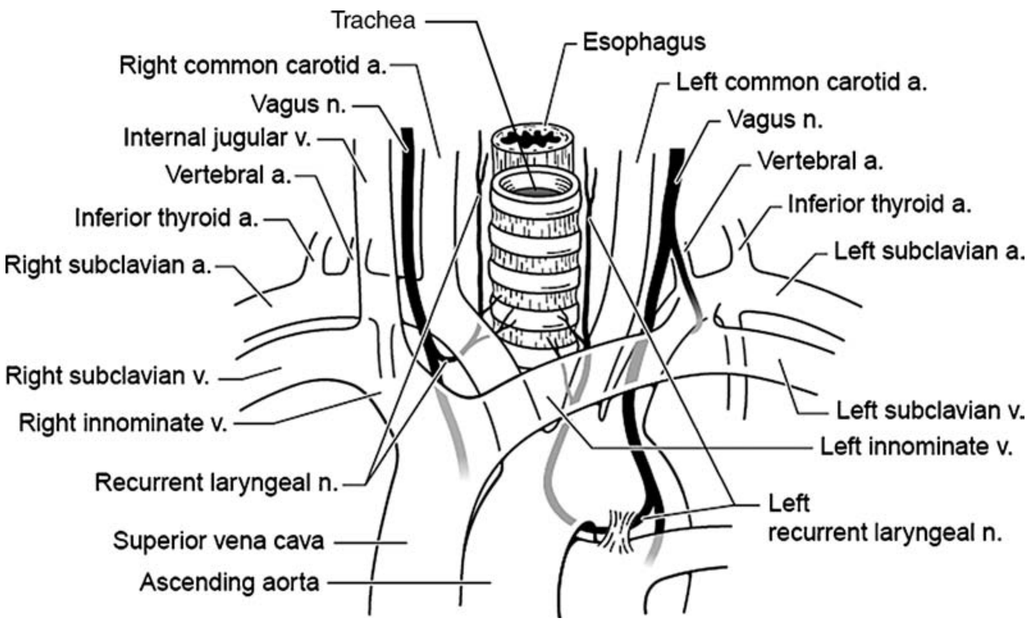

Figure 9–2 Anatomy: trachea, esophagus, carotid arteries, blood vessels, and nerves. a., artery; n., nerve; v., vein.

◆ Operative Procedure

Anatomy and Exposure

Typically a transverse skin incision is made. Adequate longitudinal exposure at this level is critical. The incision level can be accurately localized with fluoroscopy. Preferably, palpable external landmarks may be used. The hyoid bone is a landmark for C3–4, the thyroid cartilage usually overlies C5, and the cricoid cartilage marks the C5–6 space. The most reliable landmark is the C6 lateral tubercle, which is usually palpable **(Fig. 9–3).** The transverse incision begins just lateral to the midline and extends to the anterior border of the sternocleidomastoid. The platysma muscle is

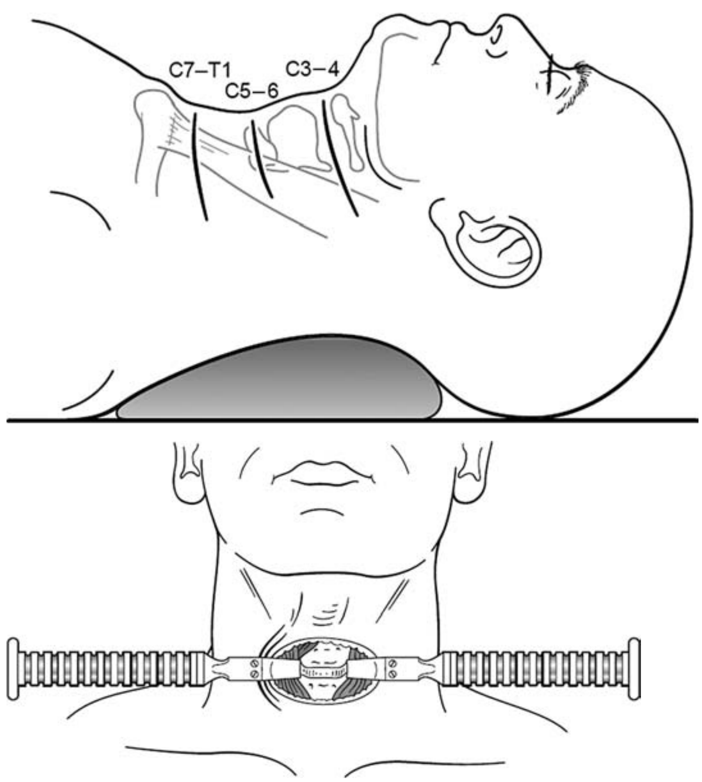

Figure 9–3 **(A)** Anterior cervical landmarks: hyoid bone (C3–4), thyroid cartilage (C5), cricoid cartilage (C5–6), (C7–T1) superior border of the clavicle. **(B)** Typical anterior exposure of the C5–6 disk space.

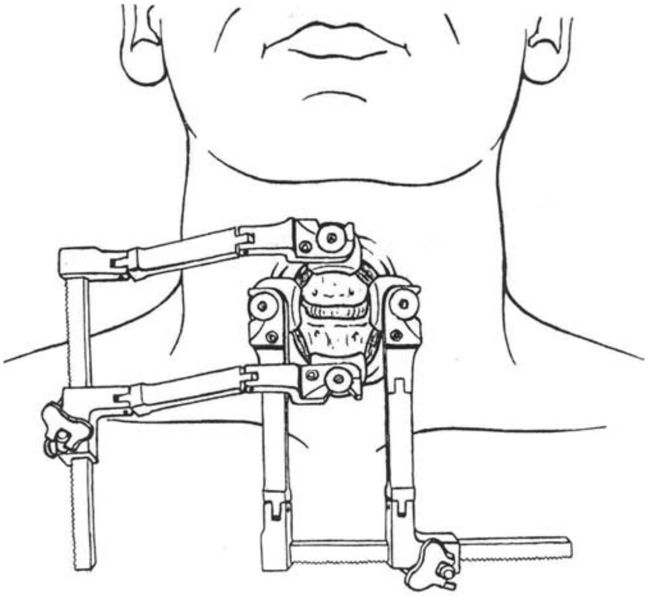

Figure 9–4 Retractors are used for optimal visualization. For single-level procedures a medial-lateral retractor alone may be sufficient. Additionally rostral-caudal retractors are also applied.

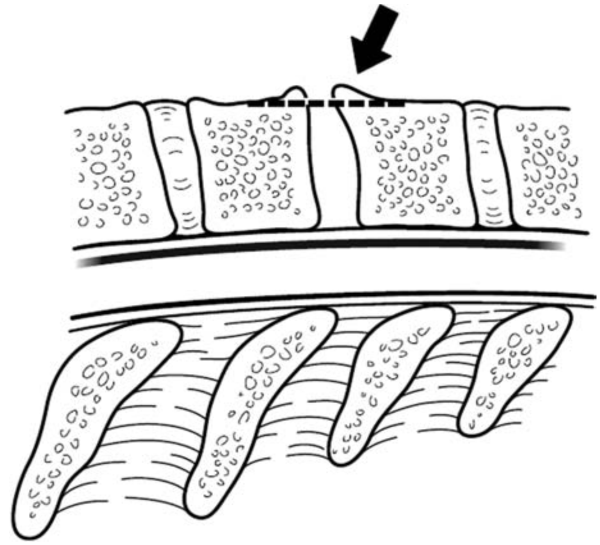

Figure 9–5 Remove anterior osteophytes and soft tissue so that the plate sits evenly on the anterior cortex.

identified and dissected in a superior-inferior orientation to facilitate exposure. The platysma is then elevated and incised with a vertical, muscle splitting incision. An avascular dissection plane is developed between the trachea and esophagus medially and the carotid sheath laterally. A kittner or peanut dissector can be quite useful in the initial blunt dissection of the midline plane directly overlying the anterior vertebral bodies. Handheld retractors are utilized to provide initial exposure of the anterior vertebral column and the adjacent longus colli muscles. The prevertebral fascial layer is opened sharply to expose the anterior longitudinal ligament.

After the anterior vertebral column has been exposed, the medial attachment of the longus colli muscles is elevated with Bovie cautery (Bovie Medical Corporation, St. Petersburg, Florida) and medial-lateral self-retaining retractor blades are securely positioned beneath them. It is important to make sure the retractor blades are under the residual cuffs of the longus colli muscles. This not only stabilizes the retraction system and facilitates exposure but also protects important structures such as the esophagus and carotid artery from the teeth on the retractor blades. A slotted blade may be used if an anterior osteophyte prevents proper positioning. For optimal visualization a longitudinal self-retaining retractor may be placed **(Fig. 9–4).** The anterior spine should be “gardened” to allow disk space visualization and an optimal bone–plate interface. This is best accomplished with a Cushing rongeur to remove the anterior osteophytes **(Fig. 9–5).**

Anterior Diskectomy

The initial diskectomy or diskectomies should be performed widely to the uncovertebral joints to allow proper “anterior release” prior to placement of the distraction pins. This is particularly important for the correction of cervical kyphosis. If a vertebral body distractor is used, distractor pins are positioned at the midline of the vertebral bodies adjacent to the diskectomies **(Fig. 9–6),** and the distractor is placed over the pins. An appropriate amount of distraction is applied to achieve adequate disk height. Graft preload should be considered when determining the amount of distraction. Distractor pins may also be utilized to restore segmental lordosis at a kyphotic segment. To achieve lordosis, pins should be placed in a convergent orientation at the level of

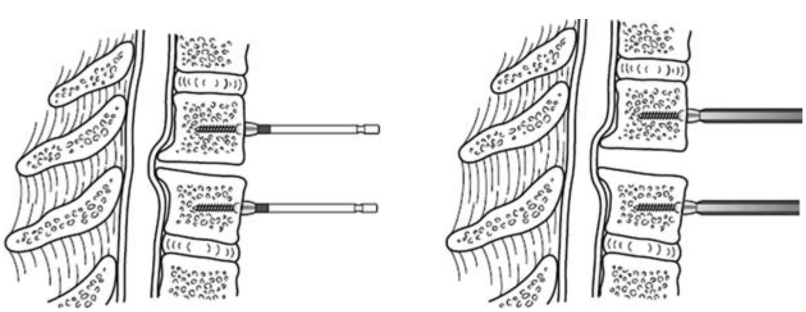

Figure 9–6 Distractor pins are positioned at the midline of the vertebral bodies adjacent to the diskectomy.

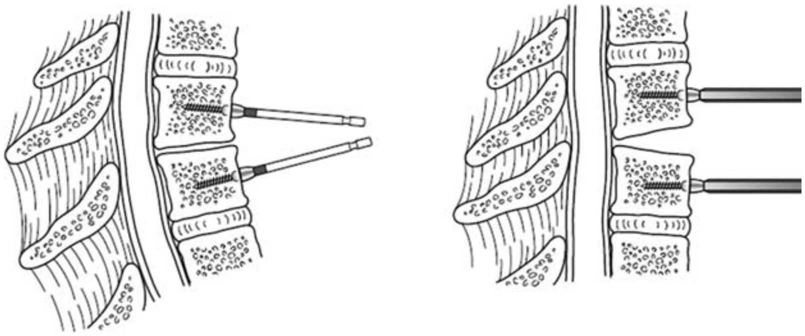

Figure 9–7 Pins placed in a convergent orientation at the level of kyphosis allow the vertebral bodies to be rotated to a lordotic orientation.

kyphosis so that once the distractor is attached and distraction force applied the vertebral bodies are rotated to a lordotic orientation **(Fig. 9–7).** The medial-lateral and superior-inferior retractors provide excellent protection of the surrounding soft tissue, and the pin distractor provides stable sagittal alignment of the cervical spine **(Fig. 9–8).**

Once the anterior portion of the disk is incised, the remainder of the disk is completely removed using pituitary rongeurs, curets, and Kerrisons. The lateral border of disk resection is defined by the gentle upward curve of the inferior uncovertebral joint complex. Proper exposure of the uncus bilaterally will provide a good guide to identifying the midline of the vertebral body and also the border of the lateral neural foramen. It is easier to remove the disk with angled curets in several large pieces. Initially the inferior lip of the superior vertebral body is removed to gain access to the disk space and to allow creation of parallel end plates. The posterior edge of the inferior vertebral body is then removed by a drill. This removes the uncovertebral joint and starts the initial decompression. Remove any posterior osteophytes by first thinning them with a high-speed drill and resecting with a fine-angled curet or 2 mm Kerrison **(Fig. 9–9A,B).** Incise and remove the posterior longitudinal ligament. When removing the posterior longitudinal ligament, the dura is identified and differentiated from the ligament by its white glistening appearance, clean epidural plane, and change in texture on gentle palpation. A 4–0 forward or back-angled curet is ideal for "cutting" the ligament from the vertebral body edge. The extent of lateral root decompression can be determined by the extent of uncovertebral joint removal, bleeding from the epidural venous plexus, which overlies the root, and direct visualization of the medial aspect of the root. The surgeon should be mindful of the anatomical location of the vertebral artery, which should be routinely reviewed on the preoperative studies.

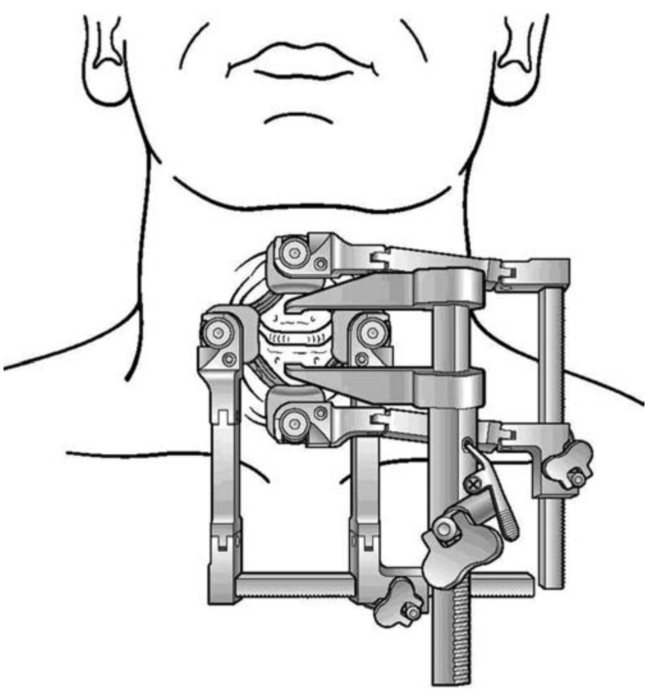

Figure 9–8 Medial-lateral and superior-inferior retractors provide excellent protection of the surrounding soft tissue.

End Plate Preparation and Arthrodesis

Once complete decompression is accomplished, end plate preparation is performed. This step is important for a successful fusion. Proper decortication ensures adequate vascular supply, availability of osteoprogenitor cells, maximum surface contact between grafts and implant sites, and preservation of structural integrity for load bearing. Prepare the graft site by decorticating the vertebral end plates using a high-speed cutting bur to create a precisely matched mortise with the bone graft to optimize the bone–graft interface. While maintaining normal lordosis, finish removing the anterior inferior edge of the superior vertebra and remove the posterior superior edge of the inferior vertebra. This allows for better visualization and parallel end plates. Thus, in concept, there is both cortical bone (dense woven bone) for strength and to resist subsidence and cancellous bone for bony ingrowth. Alternatively, end plate decortication can be performed parallel to the disk space **(Fig. 9–10).** In this technique, limit bone removal to a depth of 1.5 mm to preserve the functional integrity of the end plate and avoid excess subsidence. Some surgeons elect to leave a small ledge of bone posteriorly to prevent dorsal graft migration.

Although freehand preparation of the end plates is widely used, alternative methods are available that will decorticate the end plates with minimal bone removal.

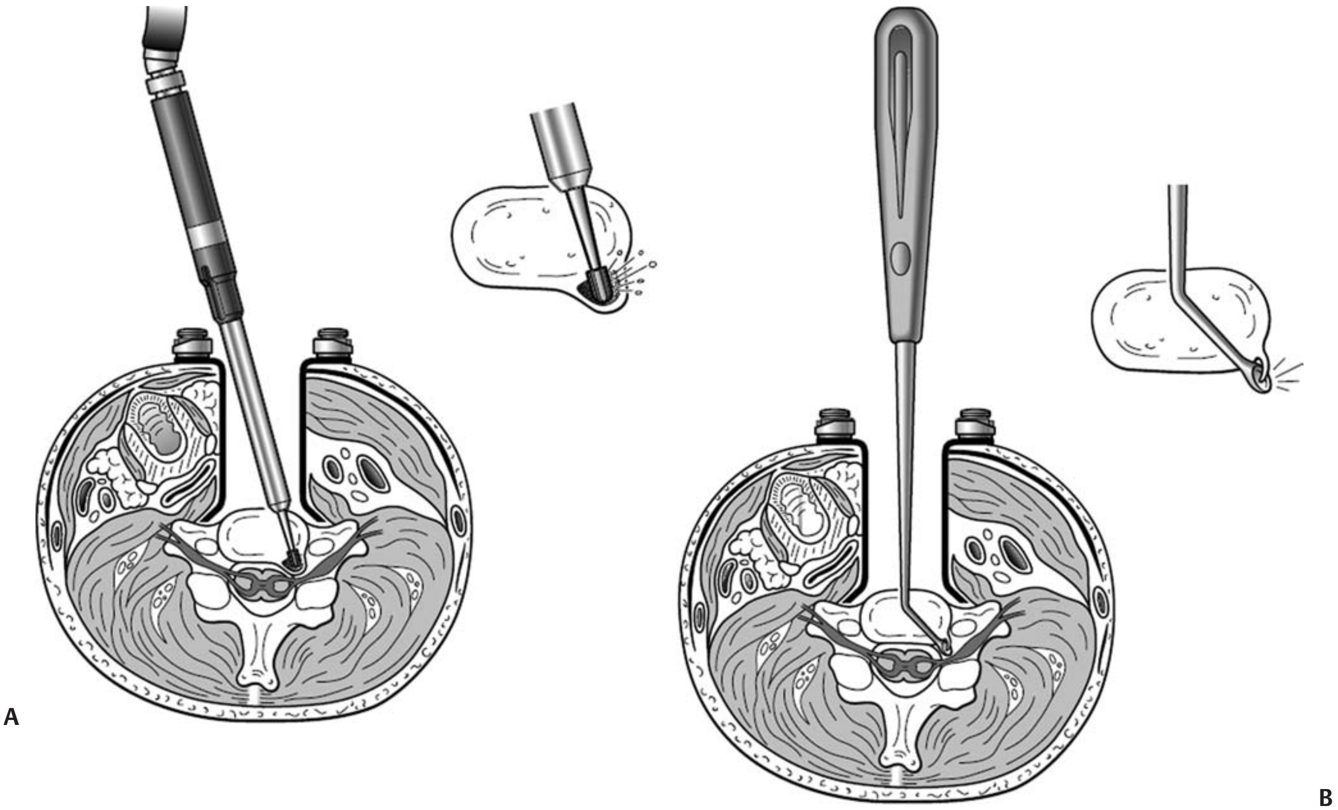

Figure 9–9 Posterior osteophytes removal. **(A)** Thin posterior osteophytes using a high-speed drill and **(B)** resect the posterior osteophytes with a fine-angled curet.

With the introduction of machined allografts, techniques have been developed using cylindrical burs (cutters) that prepare both inferior and superior end plates and create a posterior ledge with a single pass **(Fig. 9–11).** Such devices offer precise, repeatable end plate preparation. End plates are prepared in a parallel fashion, with bone removal limited to 1.0 mm per end plate.

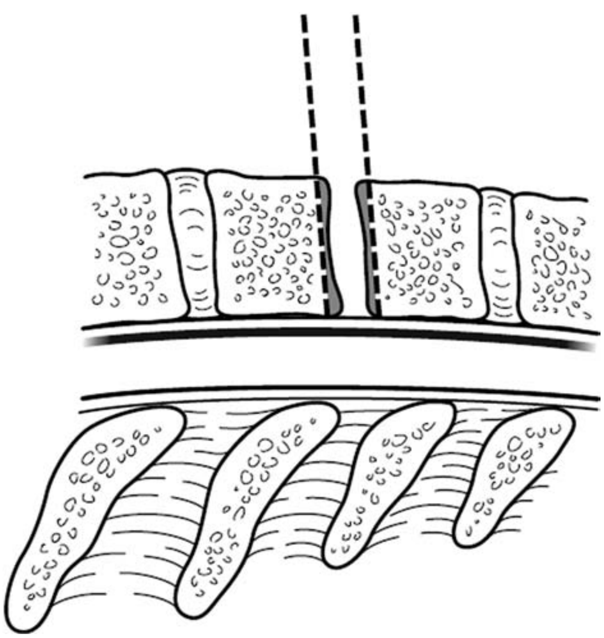

Figure 9–10 End plate preparation involves minimal resection of the end plate to assure parallel orientation for proper bone–graft interface.

Determine the final degree of distraction prior to determining graft size. It is important to measure the interbody space prior to cutting the graft to ensure adequate fit. The graft should be slightly larger than the interbody space to achieve a tight interference fit and good graft–vertebral body interface. Slight overdistraction of the pins allows for a tight graft fit with the bone under compression. If premachined allograft is used, graft sizing may be facilitated with the use of trials. Select the trial corresponding to the anticipated allograft size. Tamp the trial completely into the interspace to confirm adequate graft size and end plate preparation. If the trial does not fit flush and produce a tight interference fit, reevaluate the graft size or the end plate preparation or both.

Once an appropriate graft size is determined, gently tap the graft into place **(Fig. 9–12).** To ensure security of the graft in the interspace, an attempt should be made to manipulate the graft with an angled curet after insertion. Palpate the posterior aspect of the graft to ensure that an adequate space exists anterior to the spinal cord and that the graft is not directly impinging on the dura. Remove distraction and recheck for a secure graft fit.

Anterior Cervical Plate Fixation

Removal of the soft tissue and anterior osteophytes from the adjacent vertebral bodies so the plate sits evenly on

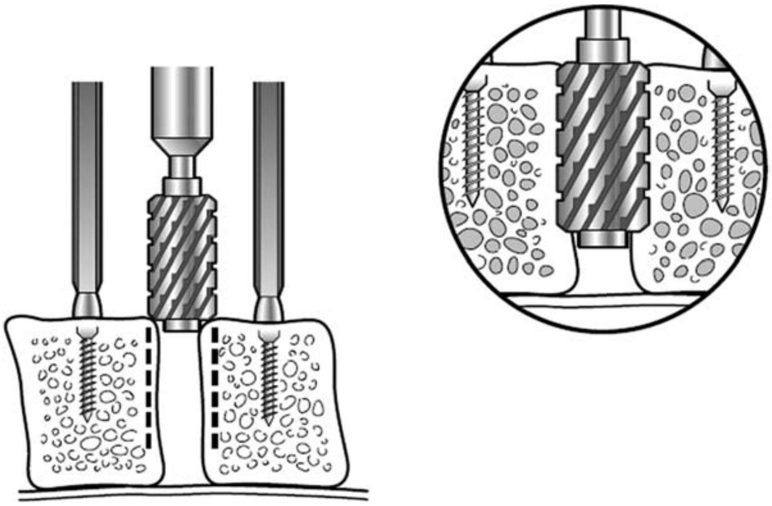

Figure 9–11 Cylindrical burs can prepare both inferior and superior end plates and create a posterior ledge with a single pass.

the anterior cortex should have already been accomplished (i.e., "gardening"). Select a plate length that will allow for either placement of fixed-angle bone screws or variable-angle bone screws adjacent to the stronger, subchondral bone. The edge of the plate should not interfere with the adjacent unfused disk spaces **(Fig. 9–13).** It is important to maintain cervical lordosis. Many anterior cervical plates are provided with a premachined lordotic curve; however, the plate may be further contoured to precisely match the lordotic curvature of the anterior cervical spine **(Fig. 9–14).** If required, increase or decrease the amount of lordotic curvature by using a double-sided plate bender. A gradual bend should be made over the entire length of the plate. Abrupt changes in curvature should be avoided.

Review landmarks to center the plate medially/laterally on the spine and hold the plate in position using plate holding pins or a plate holder. Lateral and anteroposterior (AP) fluoroscopy can be used to verify the position of the plate after the holding pins are placed.

Determine screw lengths and trajectories by measuring the vertebral body on axial computed tomographic (CT)

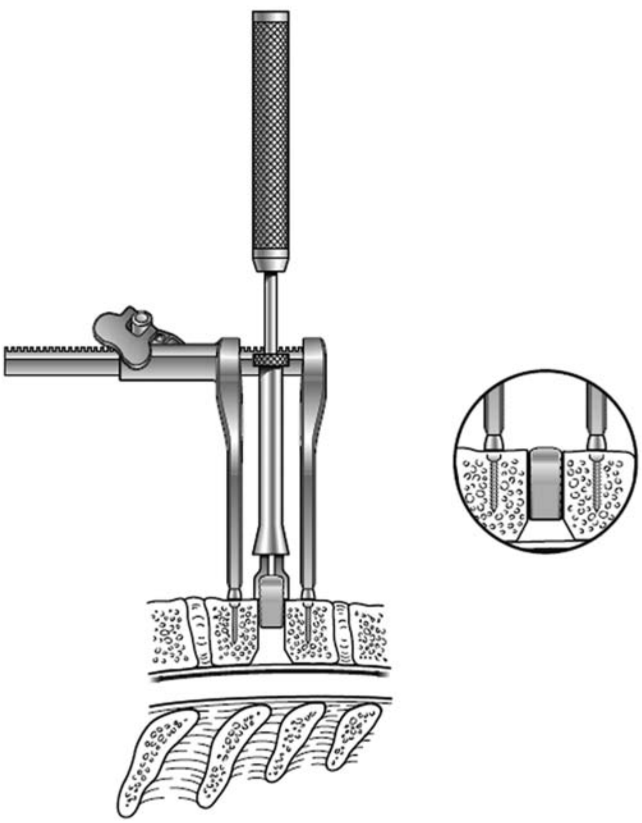

Figure 9–12 Proper graft placement should be confirmed by testing the security of the graft with an angled curet and ensuring that the graft does not impinge on the dura and that adequate space exists anterior to the spinal cord.

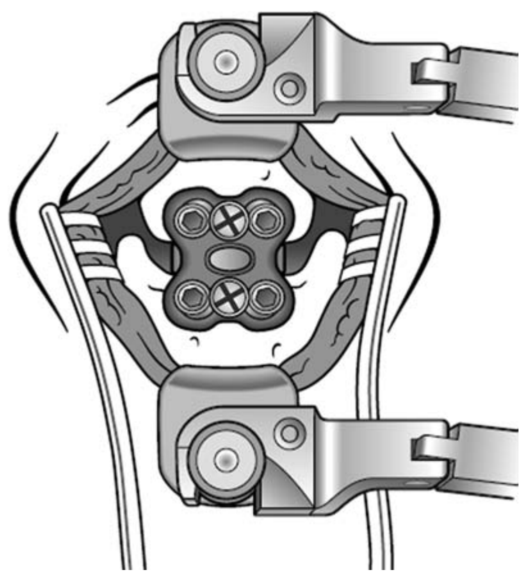

Figure 9–13 Position the plate so the superior and inferior screw holes are at the midportion of the vertebral bodies and the edge of the plate does not interfere with the adjacent unfused disk spaces.

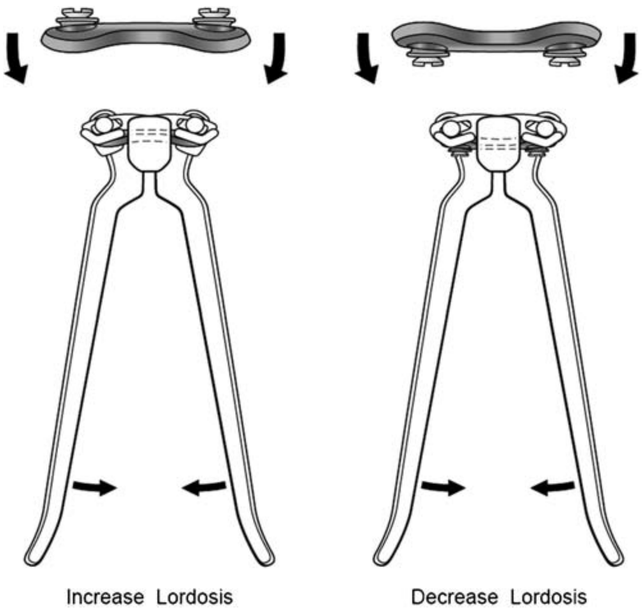

Figure 9–14 Increase or decrease the amount of lordotic curvature by using a double-sided plate bender.

scan or magnetic resonance imaging (MRI). Additionally, a depth gauge may be used to confirm depth of a pilot hole for proper screw length. In general, unicortical screw purchase is used; however, bicortical purchase may be employed if clinically indicated. Screw trajectories should employ divergent rostral-caudal angles and a convergent medial angle to produce a "toenailing" effect to prevent caudal pullout **(Fig. 9–15).** Screw trajectories should be chosen that will not violate the end plates of adjacent disk spaces.

Screw fixation is achieved by selecting the appropriate angle, drilling, tapping, and inserting the first screw through the plate. The initial screw should be placed and tightened. A second screw hole is drilled and tapped and the screw is inserted on the opposite side of the plate, diagonally from the first screw. Remove the plate holder or plate holding pin if appropriate. Drill, tap, and then insert the remaining screws. Final tightening is done sequentially so that the plate is evenly and firmly applied to the anterior cortical surface of the spine. Once all screws are completely tightened, lock the screws to the plate using the available lock mechanism to prevent screw backout.

A variety of screw designs are now available that can influence the surgical technique. Self-tapping and newer self-drilling screws allow the surgeon to omit the drilling and tapping steps. These "self-drilling" screws insert by gently tapping the screws with a mallet, then inserting in the standard fashion. In addition, fixed-angle and variable-angle screws are available that offer the surgeon greater versatility in choosing screw trajectory and construct dynamics.

For fixed-angle screws, the fixed-angle drill guide is selected and seated within the bone screw hole in the plate. The fixed-angle drill guide should be securely engaged into the plate, making sure to align the drill guide in the correct rostral-caudal divergent angle (12 to 15 degrees) and medial convergent angle (6 degrees) **(Fig. 9–15).** For variable-angle screws, the drill guide is seated within the bone screw hole in the plate and the surgeon has the flexibility to determine the screw angle.

It is important to consider the various device and system features in planning surgical approaches and needs. Construct dynamics, constrained, rotational, or translational, must be reviewed, especially in the case of multilevel procedures. Constrained constructs with their fixed-angle screws offer the greatest rigidity and can offer excellent results in cases of trauma. However, these systems may be too rigid in other applications and may contribute to reported rates of pseudarthrosis as high as 12% in cases of single-level ACDF. Constrained constructs decrease the amount of

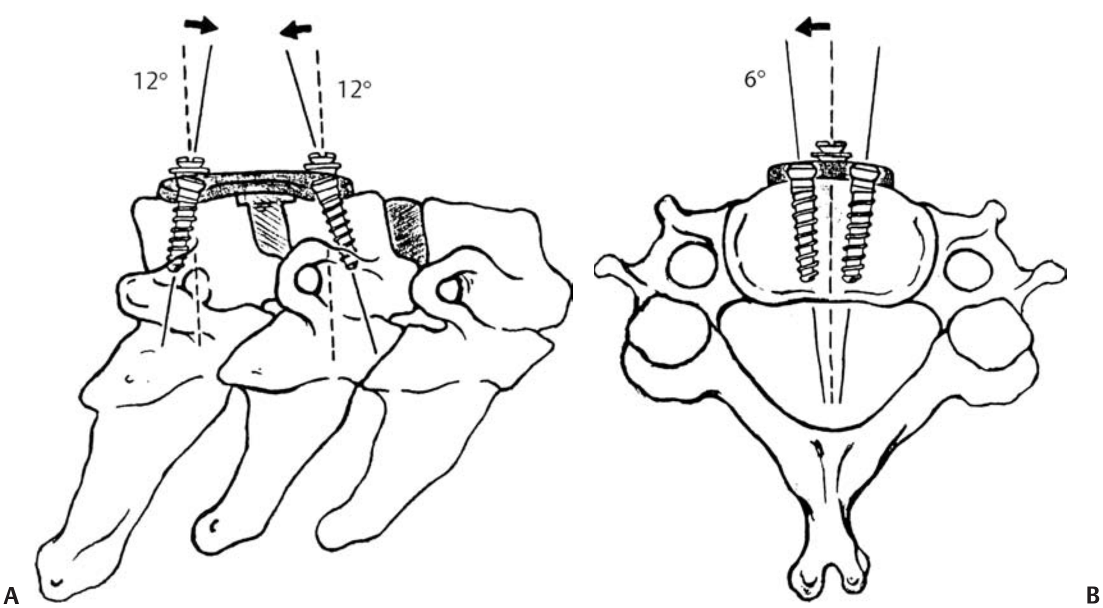

Figure 9–15 Screw trajectories should employ divergent rostral-caudal angles **(A)** and a convergent medial angle **(B)** to prevent caudal pullout.

compressive force on the graft and, as Wolff's law dictates, may inhibit fusion. Rotational constructs utilizing variable-angle screws, and hybrid constructs with fixed-angle screws inferiorly and variable-angle screws superiorly, allow increasing load on the graft and controlled subsidence for improved fusion rates. Further, variable-angle screws can more readily accommodate patient anatomy.

The concept of load sharing has been further advanced with the development of translational plate systems that allow axial settling with either fixed- or variable-angle screws. These dynamic constructs accommodate subsidence at each vertebral level to permit the greatest amount of graft loading. For some of these systems, precompression of the graft may be obtained during implantation to secure the graft in an optimal position and, potentially, accelerate healing. Prior to closure, absolute hemostasis is assured and an intraoperative radiograph obtained to document good position of the graft and instrumentation.

◆ Postoperative Management

Patients are usually watched overnight in the hospital, although some centers send patients home on the same day. No collar immobilization is necessary on single- and two-level cases, unless there is evidence of instability or posterior-element dysfunction preoperatively. Activity restrictions are tailored to the individual patient's vocation and comfort level.

10

Anterior Cervical Corpectomy

John Sandin and Josh Medow

Surgical intervention is generally reserved for those patients that have intractable pain or progressive neurological symptoms in the presence of documented compression of the cervical cord, nerve roots, or both. Pain relief and resolution or reduction of neurological deficits can be expected in the vast majority of patients if judiciously selected. The prognosis for patients with myelopathy is the most variable. Some studies suggest that increased preoperative disability, increased number of involved levels, myelopathic symptoms > 1 year in duration, bilateral motor deficit, spinal canal area < 30 mm^2, absence of Lhermitte's sign, and possibly advanced age adversely impact outcome. Therefore, halting the progression of disease before incapacitation occurs is often the goal of the surgery. The criteria for selecting an appropriate surgical procedure should be based on both the patient's symptoms and adjunctive study findings. Emphasis should be placed on treating the symptomatic cervical levels rather than the levels corresponding to the most abnormal anatomy on the imaging studies. In general we reserve the cervical corpectomy for patients with multilevel disease with stenosis, severe anterior osteophytes, and vertebral body deformities that are either traumatic or degenerative.

◆ Patient Selection

The purpose of operative intervention is to decompress the neural and vascular elements by removing the offending osteophytes, ligament, and disk material, stabilizing the spine against hyper mobility and reestablishing spinal balance. Because most spondylotic disease is located anteriorly an anterior approach is most often indicated. Anterior approaches afford the benefits of superior decompression of the ventral spinal cord. Anterior approaches allow for safe, reliable access from C2–3 to T1–2, with operation at each extreme a bit more technically challenging. Given that most root and cord compressions occur as a result of herniated disk fragments, anterior cervical diskectomy and fusion (ACDF) is typically the procedure of choice. Cervical corpectomy is a more extensive approach for the treatment of cervical myelopathy and radiculopathy and is indicated in cases of multilevel stenosis secondary to anterior pathology. It is most often the procedure of choice in patients with cervical kyphosis because the spinal cord becomes draped over osteophytic bars anteriorly, resulting in myelopathy **(Fig. 10–1).** The authors perform multilevel diskectomies instead of corpectomies for cervical disk disease when stenosis is limited to the disk spaces and is not confluent behind the adjacent vertebral bodies. Diskectomy and corpectomy may be performed in the same patient if the disease process is not confluent at the affected segments **(Fig. 10–2).**

A combined anteroposterior (AP) approach to the cervical spine may be appropriate if both anterior and posterior pathologies coexist and are severe, or occasionally if an anterior fusion is to be performed at three or more levels **(Fig. 10–3).** The prolonged operative time and complications associated with multiple wounds may preclude some patients from these procedures.

Internal fixation of the cervical spine is thought to prevent the AP translation of the vertebrae and graft material, thereby obviating the need for the patient to wear the rigid collar necessary in noninstrumented grafted fusions. Patients

Figure 10–1 T2-weighted magnetic resonance imaging demonstrating confluent stenosis of the cervical spine.

Figure 10–2 Lateral postoperative cervical anterior cervical diskectomy and fusion and corpectomy spine x-ray.

undergoing cervical diskectomy and fusion with instrumentation may receive a soft collar to help with pain relief, but it is not necessary for stabilization in most situations. Fusion can be expected to occur under normal circumstances within 6 weeks to 3 months for any fusion regardless of instrumentation or graft placement; however, it is thought to occur more quickly if instrumentation is present.

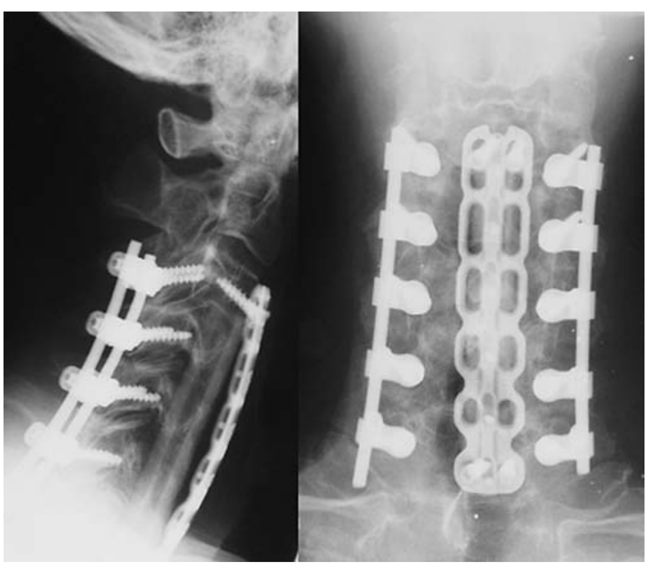

Figure 10–3 Anteroposterior and lateral postoperative multilevel cervical corpectomy and posterior cervical fusion x-rays.

◆ Preoperative Preparation and Patient Positioning

Patient positioning, as with all surgical approaches, is critical when performing surgery on the cervical spine. The use of tongs for traction and somatosensory evoked potentials (SEPs) should be considered if the patient's spine is unstable or if there is evidence of position-dependent neurological compromise. A small bolster roll should be placed behind the superior scapulae transversely to help expose the neck, and another beneath the iliac crest to aid with autograft harvesting from the hip if planned. The shoulders may be retracted inferiorly, if necessary, with wide tape to help expose the neck on both sides. It is exceptionally important not to pull the shoulders down to the limits of their range of motion because this may cause traction injury to the superior roots of the brachial plexus. A rolled towel or support may be used beneath the neck to help maintain a normal cervical lordosis.

Prior to incision, the bony landmarks of the neck should be identified. The angle of the mandible is lateral to C2–3, the hyoid bone traverses anterior to the cervical spine at C3, as do the thyroid cartilage at C4 and the cricoid cartilage at C6. The carotid tubercle can be used to help identify the C5–6 interspace. These landmarks become especially important for transverse incisions where the exposure offers a limited view of the structures within the operative field.

The cervical spine may be approached anteriorly from the right or left side. Although many surgeons are right handed and prefer to operate on the patient's right side, some surgeons prefer a left-sided approach. This is because of the predictability of the left recurrent laryngeal nerve as it tracks through the carotid sheath and enters the thorax, looping under the aorta before ascending back into the neck adjacent to the trachea and esophagus. The right recurrent laryngeal nerve has a more inconsistent course. It passes beneath the subclavian artery and enters the tracheoesophageal groove at a more rostral level than on the left side. Consequently, it can be readily injured, especially during an approach to C6–7.

The incision for a single- or two-level anterior approach to the cervical spine is best performed for cosmetic purposes by a transverse incision, preferably in a natural skin crease. Multilevel fusions or corpectomies at three or more levels or patients with a long thin neck may require a more extensive exposure that is best performed through a longitudinal incision. The patient should be prepped in an appropriate sterile fashion, and the choice of incision should be marked on the neck prior to draping.

◆ Operative Procedure

The incision is made with a scalpel down to the platysma and is followed by electrocautery for hemostasis. The platysma is then incised longitudinally in line with its fibers. Blunt dissection is then used to identify the parasagittal plane between the sternocleidomastoid and the carotid sheath laterally and the trachea, esophagus, and strap muscles medially.

The carotid artery is identified during the approach to ensure its integrity. The thyroid vasculature may be visualized anterior to the cervical spine and can be ligated during the exposure. The omohyoid, although a useful landmark, may obstruct the operative field rostrally if exposing the C2–4 levels and can be retracted or divided if necessary. Care is taken to protect the esophagus, which is retracted to the side opposite the exposure. The loose, middle cervical fascia layer that bridges the sternocleidomastoid and the strap muscles of the larynx is then dissected to reveal the anterior portion of the cervical spine **(Fig. 10–4).**

The prevertebral fascia is opened using electrocautery and blunt dissection, revealing the anterior aspect of the vertebral bodies. The longus colli muscle is then dissected with either or both electrocautery and a Key periosteal elevator to facilitate the placement of retractors. Care is taken to avoid the sympathetic chain located at the lateral surface of this muscle. Adequate retraction is attained when the uncovertebral joints are visualized. Adjustable retractors are then placed in transverse and cranial-caudal directions. Again care is taken to protect the esophagus and carotid sheath against trauma from the retractor devices.

One or two spinal needles can be inserted into the disk spaces suspected to be the levels that need repair, and a cross-table, lateral c-spine radiograph is obtained to confirm position. The film is then examined, and if the location is correct, the needle is removed while it is marked with electrocautery. If the patient is obese or has large shoulders and the inferior cervical vertebrae cannot be visualized, the second spinal needle can be placed into a rostral disk space that is not in need of repair. Its location can be confirmed radiographically, and the disk spaces between the rostral and caudal spinal needles can be carefully counted to determine the location of the caudal needle.

After the approach is complete, the disk spaces above and below the corpectomy level are identified for removal. The anulus and nucleus are incised with a scalpel. Curets and rongeurs are then used to perform a complete diskectomy to the level of the posterior longitudinal ligament and the uncovertebral joints. The rostral and caudal end plates of the interval vertebral bodies should be denuded of any ligament or cartilage, revealing the underlying cortical bone.

Attention is then directed toward performing the corpectomy. It may be useful to apply 10 to 20 lb of traction to distract and stabilize the cervical spine. A high-speed cylindrical bur is used to remove the vertebral body to the extent that only a thin cortical mantle remains. This must be performed symmetrically with respect to the midline and wide enough to permit adequate decompression of the spinal cord. The exact dimensions will vary based on information

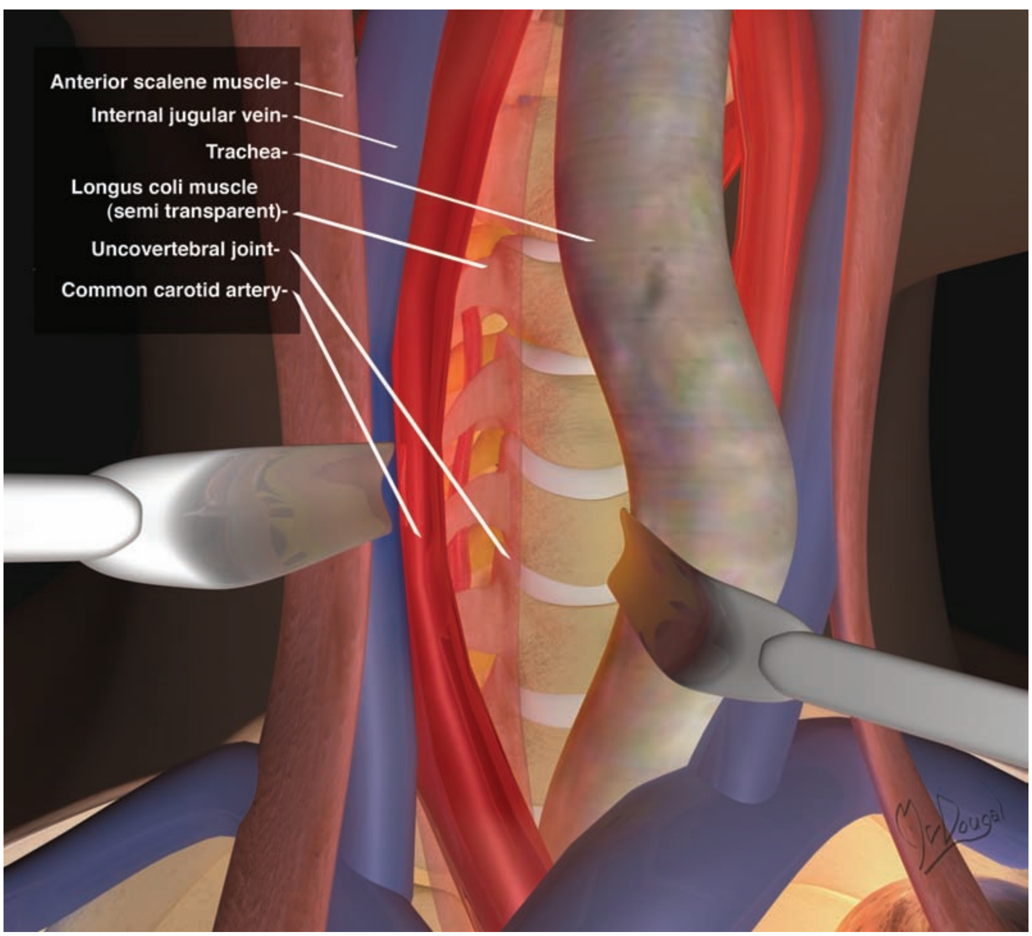

Figure 10–4 Schematic view of relevant anatomy during exposure.

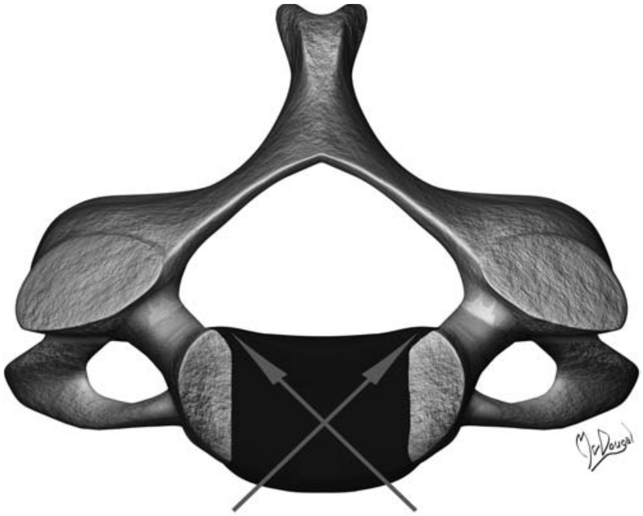

Figure 10–5 Schematic view of ideal "Erlenmeyer flask" corpectomy defect.

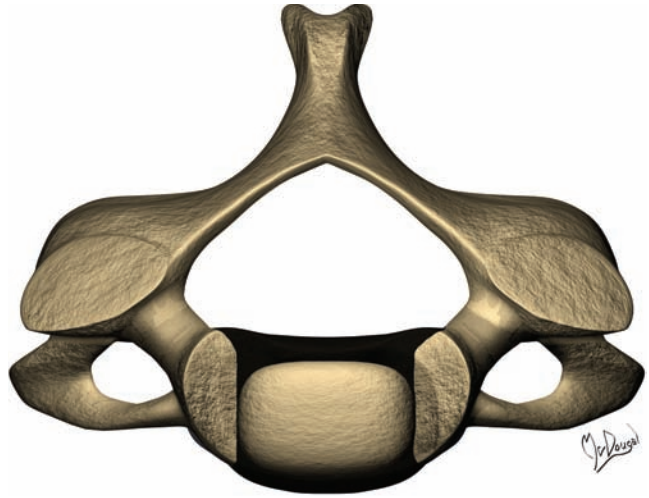

Figure 10–6 Schematic view of ideal graft placement.

gathered from preoperative imaging studies but the width is typically greater than 16 mm and is often 18 to 20 mm. An excessively wide corpectomy will put the vertebral artery at risk with disastrous complications. Thus dissection should not exceed the space between the uncovertebral joints at any level. The bony removal may be done in an "Erlenmeyer flask" configuration, being wider posteriorly (**Fig. 10–5).**

Once the posterior cortex is identified a 1 or 2 mm Kerrison punch is used to remove the posterior longitudinal ligament (PLL) and bone. The punch is used around the margins of the bony decompression, and the remaining ligament and bone may be removed as a single piece. An ossified PLL can be quite difficult to separate from the dura. In such patients, a cerebrospinal fluid (CSF) leak may be encountered. Management of this complication may involve a primary repair of the dura, attempts at patching the dura, and lumbar drainage.

Once the corpectomy has been completed and the spinal cord is adequately decompressed calipers are used to measure the dimensions of the corpectomy channel and a graft is fashioned to fit the defect (**Fig. 10–6).** Options for bone graft include iliac crest for corpectomies that are two levels or less in height, or fibula for corpectomies of any size. Several other options for grafting exist, including titanium mesh cages, PEEK, and resorbable devices in the future. If an iliac crest autograft is used, the iliac crest can be rendered in a manner similar to the harvest in a Smith-Robinson ACDF. The end plates can be mortised to accept the graft. Mortises that are too extensive can lead to pistoning of the bone graft. A 2 to 3 mm bony ledge should be left posteriorly in the rostral and caudal vertebrae to help prevent extrusion of the graft into the spinal canal. The graft is then carefully tapped into place. If necessary, additional traction may be gently provided by the anesthesiologist or through the use of distraction pins placed in the adjacent vertebral bodies. Once the graft is situated, traction and distraction are removed and the region is inspected for adequate decompression and stability.

A cross-table x-ray of the cervical spine should be performed to evaluate graft position. The radiograph can be delayed until the instrumentation is situated if it is to be employed.

For extensive multilevel corpectomies, it may be optimal to leave the patient intubated for 24 to 48 hours. Prophylactic steroids can be given to reduce vocal cord swelling, which subsequently may decrease the chance of postoperative respiratory failure. It is reasonable to check for an air leak around the endotracheal tube prior to extubation to help ensure that an adequate airway is maintained after the endotracheal tube is removed.

The indications for the use of anterior cervical instrumentation have expanded over the past several years. The theoretical advantages of instrumentation in the anterior cervical spine include increased fusion rate, decreased time to fusion, diminished use of postoperative bracing, faster return to premorbid activities, and restored cervical sagittal balance. The most recent cervical fixation devices have incorporated the principle of load sharing into their design. These devices allow a greater portion of the load to be borne by the bone graft as opposed to the instrumentation. Stress shielding is theoretically decreased and the optimal environment for fusion is present.

Cervical plates can be used following corpectomy, and single or multilevel diskectomy. The plate selection should be based upon the clinical situation. The surgeon may prefer to use a rigid plate for cases in which significant instability exists, such as trauma. A dynamic plate may be more appropriate for degenerative conditions, where instability is less of a consideration.

Certain principles are necessary for successful plate application. The surgeon should spend time "gardening" the spine prior to plate application. This process removes osteophytes and other abnormalities, which would prevent the plate from fitting the contour of the spine. Furthermore, it may be necessary to bend the plate to optimize the fit of the plate to the spine. The screws can be placed in a unicortical or bicortical fashion, although the indications for bicortical fixation are relatively few. The screws should be within the bone and not violate the disk space rostrally or caudally. If a dynamic plate is used, the instrumentation must not impinge upon the disk space rostrally or caudally when subsidence has completed.

Bony hemostasis is accomplished with thrombin-soaked Gelfoam (Pfizer, Inc., New York, New York), or bone wax if the Gelfoam is ineffective. Meticulous hemostasis is imperative prior to closure of the wound. If the wound continues to ooze excessively despite reasonable measures, a drain should be placed to help avoid the sequelae attendant to the formation of a large hematoma. The middle cervical fascia is closed with 3–0 Vicryl (Ethicon, Inc., Somerville, New Jersey) or other absorbable suture, thereby approximating the sternocleidomastoid and strap muscles over the carotid sheath. The platysma and subcutaneous regions are then closed independently with 3–0 absorbable sutures. The skin is approximated with a running stitch. A dressing is then applied over the wound and a hard cervical collar is fitted if indicated.

◆ Postoperative Management

Lateral x-rays of the cervical spine should be obtained in the first 2 weeks after surgery and then again 6 to 12 weeks after surgery to assess for fusion **(Fig. 10–7).**

Figure 10–7 Lateral postoperative single-level cervical corpectomy x-ray proper graft position and hardware placement utilizing a dynamic plate.

◆ Conclusion

Cervical corpectomy is effective and relatively safe for the treatment of a variety of diseases of the cervical spine when conservative therapies have not been effective or are not indicated. Advances in instrumentation have made cervical corpectomy a more successful operation; however, technological gains alone are not enough to ensure good patient outcomes. It is essential for surgeons to have a thorough comprehension of the anatomy of the neck and appropriately select cervical corpectomy as the procedure of choice before embarking on this reconstructive procedure. Meticulous operative technique is necessary to limit the chances for complications to occur. Additionally, careful patient selection and patient education are imperative ingredients for success. As with many medical issues, it is dependent on the physician to adequately evaluate each patient and execute a well-designed plan to ensure optimal results.