ANTERIOR CERVICAL FUSION

Roger Mullis, CST

In the normal aging process, the water content in the nucleus of the spinal disc commonly decreases with time, leading to disc degeneration. In a study by Gore and colleagues, researchers discovered that by 60 to 65 years of age, 95% of men and 70% of women had at least one disc level with degeneration on the cervical spine.[1]

Statistics for the number of spinal surgeries performed annually are already high. According to the American Association of Neurological Surgeons' 1999 Procedural Statistics, total number of spinal procedures topped a half million that year. Of those, more than 111,000 were functional arthrodeses, and almost 78,600 were anterior discotomies.[2] A majority of both of these procedures were performed on the cervical spine. As the Baby Boom population continues to age, the number of surgeries and need for this expertise will continue to increase.

Overview

Anterior cervical fusions (ACFs) have been routinely performed since the late 1950s when the procedure was first introduced. A small incision is made on the anterior neck just lateral of midline. After meticulous dissection, the operative level of the cervical spine is identified and exposed. The cervical disc is removed, relieving pressure on the spinal cord and nerve roots. The disc is then replaced with either the patient's own bone graft from the iliac wing (autograft) or bank bone (allograft). Artificial grafts can also be utilized; however, this article will not address artificial grafts since they account for less than 1% of cases.

Anatomy

The cervical spine is composed of seven vertebral bodies, commonly referred to as C1 through C7. The cervical spine has a lordotic curve (a backward "C" shape). The major difference between the cervical spine and the rest of the spine are the transverse foramina, located in the vertebral bodies that allow passage of vertebral arteries and veins.

There are three distinct anatomic regions to the cervical spine: the atlas (C1), the axis (C2), and the remaining cervical vertebra (C3 through C7). The discs of the cervical spine are anatomically identical to the discs found in the rest of the spine. The disc is composed of the annulus fibrosis and the nucleus pulposus. The annulus is a fibrous ring-like structure, which serves to connect the vertebral bodies. In the center of the annulus is the nucleus. The nucleus, which has an almost "crab meat" type texture, acts along with the annulus as a shock absorber against loading on the spine. The annulus is weakest at the posterolateral margin. Ligaments provide less support in this area, making herniation of the nucleus much more common (Figure 1).

Patient indications

In a study by Kelaey and colleagues, researchers found that acute cervical disc herniations affected people in their fourth decade more than any other age group.[1] The male to female ratio was 1.4 to 1, and the vast majority of those had involvement at the C5-C6 and C6-C7 levels. They also found that factors such as frequent heavy lifting at work and direct trauma to the neck (eg whiplash-type injury) can lead to ACFs. In the aforementioned study, doctors found that, of 205 patients that were followed for a minimum of 10 years after the onset of their pain, 79% had a decrease in pain, while 43% were now pain free. Persistent moderate-to-severe pain was seen in 32% of patients.

The vast majority of possible ACF patients present with complaints of moderate-to-severe neck pain. Symptoms include arm pain (either bilateral or unilateral), shoulder pain, loss of motion, weakness, paresthesia, severe headaches, even the legs can be affected. Surgery is not usually indicated unless the patient does not respond to six weeks of conservative treatment, has major neurologic deficit, or non-improving significant deficit.

The symptoms that can lead to ACF are also associated with rotator cuff disease, shoulder pathology, impingement syndrome, or instability.

Room set-up and instrumentation

Beyond instrumentation, pay particular consideration to patient positioning equipment. After the patient is put under general anesthesia, he/she should be placed in the supine position. Every effort should be made to keep the patient comfortable and well padded. This is accomplished with the aid of egg crate foam placed on the bed, along with foam heel padding and pillows or bolsters under the knees keeping them slightly bent. These efforts are important to prevent decubitus ulcers. Antiembolism sleeves or stockings should be placed on the legs as well. The placement of a Foley catheter is recommended for cases that are estimated to last four hours or longer.

It is important to keep access to the hip available if the surgeon has indicated that autograft will be used. Many surgeons prefer to place a padded bump (either a sandbag or an IV bag) under the hip that will be used for harvesting the autograft. A second roll towel will be placed

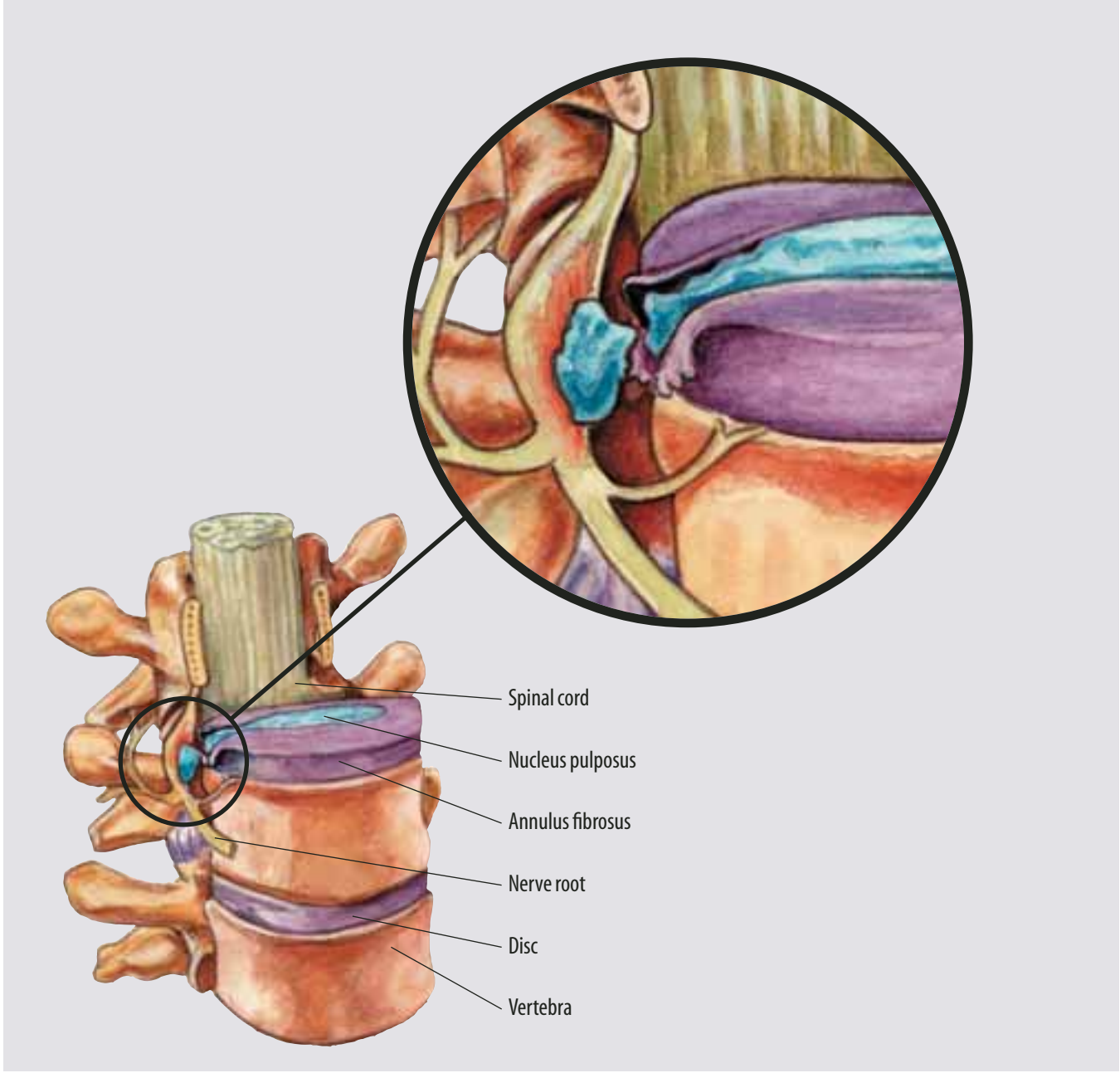


FIGURE 1

Herniated disc

under the patient's shoulder to aid in extending the neck. After positioning, the patent's entire anterior neck surface is prepped in the usual manner. A second prep kit is necessary for graft harvesting.

Many surgeons will place a Gardner Wells Tongs to the patient's skull, often with the aid of fiber optic endotracheal equipment so as not to endanger an already unstable neck, and add anywhere from 5-10 pounds of weight on the device. This technique accomplishes cervical distraction and avoids the need for placement of distraction pins in the vertebral bodies. Other miscellaneous equipment may include a fluid warmer, surgical microscope or loops, neuro-monitoring equipment, a patient warmer, or an AGF (autologous growth factor) blood machine.

Procedure

After draping, a 4 cm incision is made just lateral of midline. The anterior approach is very versatile and, while the vast majority of incisions are made on the patient's right side, either side is acceptable. The side chosen for incision is mostly a matter of surgeon's preference. The left side may be preferred because of the anatomy of the recurrent laryngeal nerve. On the left side, the nerve is in the carotid sheath, then loops under the aortic arch and ascends in the neck, where it is protected by the esophagus and trachea. On

FIGURE 2

Disc material being removed

ⓐ C4
ⓑ C5
ⓒ disc space

FIGURE 3

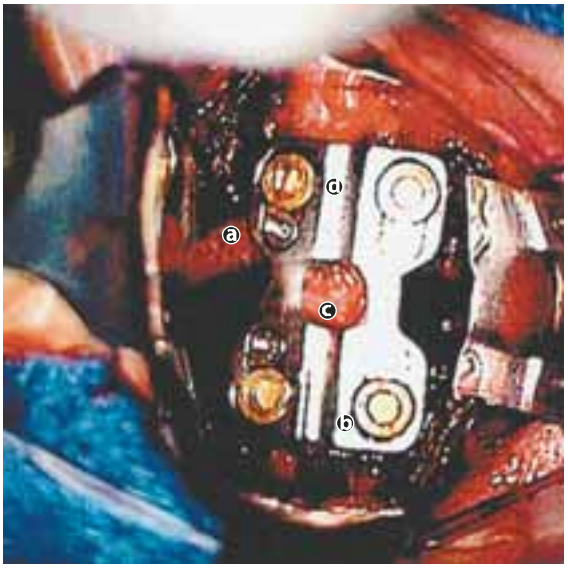
Graft in place (single level ACF)

ⓐ C4
ⓑ C5
ⓒ disc space

FIGURE 4

Final plate on graft

ⓐ C4
ⓑ C5
ⓒ interbody graft
ⓓ Codman plate



the right side, the nerve will exit the carotid sheath at a higher level and cross the surgical field. The nerve is more susceptible to injury with a right-sided approach, but injury can occur on either side.

Meticulous dissection and identification is vital to avoid injury. Hemostasis is accomplished while the carotid sheath and sternocleidomastoid muscles are moved laterally. The esophagus is moved and held medially with hand-held Cloward retractors. At this point, it is important to identify the affected disc space with X-ray. An 18 gauge spinal needle, bent in a "stair-step" style is placed directly in the disc. After X-ray, the self-retaining retractor is placed. Our facility uses both the Shadowline and Trimline style of ACF retractors. While the blades for the retractor that are being placed both medially and laterally can have teeth; the superior and inferior blades should have no teeth to protect the cartoid sheath and the esophagus.

Now that the proper cervical spine level has been identified and the retractor placed, removal of the disc can begin (Figure 2). A #15 blade is used to make a small stab wound in the annulus of the disc. The bulk of the disc is carefully removed with pituitary rongeurs. After removal, the surgeon may choose to place distraction pins into the vertebral bodies above and below the affected level. After the distracter is placed onto the pins and distraction is achieved, the disc space is opened approximately 1-2 mm more than its normal height. This will allow a more thorough removal of disc and easier placement of the replacement graft. After complete removal of the disc, any prominent bone spurs are removed to alleviate any impingement of either the nerve roots or the spinal cord itself. A caliper is then used to measure dimensions of the graft. After measurements are taken and recorded, the graft can be harvested from the patient's iliac wing or the allograft can be shaped for placement.

If the surgeon and patient have agreed on the use of allograft, it is very important to follow the set guidelines for sterile handling. Soak the graft in antibiotic solution per the manufacturer's instructions (usually 30 minutes). The graft can now be shaped precisely (following earlier measurements)

with a burr to fit the cleaned-out disc space. A precise fit is crucial, since a graft that is too large can lead to graft extrusion, and one too small can lead to intrusion. Intrusion of the graft could be disastrous, causing impingement of the spinal cord.

The graft size is consequential because a properly fitting graft will fuse with the adjoining vertebral bodies much sooner (Figure 3). The graft is then tapped into place using a precision bone tamp and small mallet. After placement, the graft is checked with a blunt nerve hook for impingement of the cord. If the surgeon is satisfied with the graft placement, the distraction pins can be removed and the screw holes sealed with bone wax to prevent bleeding. At this point, placement of a plate and screws would follow (Figure 4).

On a one-level fusion, the use of instrumentation is at the surgeon's discretion, as it is not always indicated. The use of plating on single-level fusions would depend on a number of factors: the patient has indicated the desire to return to work and a normal lifestyle quickly, or the patient wants to avoid wearing a cervical collar. On multiple-level ACFs, a cervical plating system is the standard of practice and is almost always indicated. These systems provide a higher fusion rate and better maintenance of cervical lordosis or curvature.

Disadvantages of ACF

Beyond the usual possible complications that are found with any surgery (eg infection, rejection of the graft, scarring), there are usually few, if any, real problems with a one- or two-level fusion. Problems that may occur include temporary sore throat and loss of voice. The greatest risk, of course, is for spinal cord damage; however, this is a very rare event. In a study by Flynn, of 82,000 cases, spinal cord injury occurred in 0.1% of cases.[1]

As the number of levels increases, so do the complications. With any fusion, patients experience some loss of motion. With the single- or two-level fusion, this loss is often not noticeable by the patient. As more levels are fused, loss of motion increases.

Another long-term consideration is the increased axial loading that is placed on the healthy disc spaces above and below the surgical site. As the number of levels increases, the axial loading on the adjacent healthy disc spaces is greatly increased, typically causing premature disc degeneration to occur over the next 15 to 20 years.

Summary

Anterior cervical fusion is an important procedure to the many patients who require it. The patient's life has often been "put on hold" until this procedure can be performed. For many patients, this procedure is a life-altering event. The knowledge, continuing education and skill of the surgical team is paramount to positive outcomes for the patients. As the technology for plating systems improves and advances, surgical technologists should anticipate being able to serve an aging and growing population even better.

About the author

Roger Mullis, CST, is co-coordinator for the neurosurgical team at Redding Medical Center in Redding, California. He received his training at the Academy of Health Sciences, Ft Sam Houston, Texas, and Walter Reed Medical Center, Washington, DC. He is also a site inspector for the Accreditation Review Committee on Education in Surgical Technology.

Acknowledgments

The author would like to thank Lisa Often, RN, John Bennet, RN, the operating room team at Redding Medical Center, Dr Afra Guity, Dr Gary Lam and Dr Kevin Lawson.

References

1. Rappoport and O'Leary, Cervical Disc Disease. *The textbook of Spinal Surgery.* 2nd edition. Philadelphia, Penn:Lippincott Raven; 1997.
2. National Neurosurgical Statistics, 1999 Procedural Statistics. Top Reported Spine Procedures Performed in 1999. American Association of Neurological Surgeons. ***www.neurosurgery.org/aans/membership/stats/spine.html*** Accessed 5/9/02
3. Cervical Herniated Disc ***spineuniverse.com/displayarticle.php/article265.htm*** Accessed 5/14/02