The surgical technique of anterior cervical fusion using bone grafts obtained from cervical vertebral bodies

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The authors describe the surgical technique of anterior cervical fusion using bone grafts obtained from cervical vertebral bodies. This series consisted of 90 patients with cervical intervertebral disc disease suffering from cervical spondylotic myelopathy. Thirty-five patients were operated on at one level, 33 at two levels, and 22 at three levels. Postoperative x-ray films showed solid bone fusion in all patients at a mean follow-up time of 24 months (range 1 year to 3 years 6 months). Anterior angulation was found in four (4.4%) of the 90 patients. This surgical procedure has two major advantages: 1) there are no complications related to the iliac donor site, allowing early patient mobilization; and 2) the extensive posterior spur can be removed safely and easily under a wide operative field without damaging the spinal cord and nerve roots.

Key Words • anterior cervical fusion • bone graft • cervical disc disease

Anterior interbody fusion of the cervical spine is a widely used surgical procedure for the treatment of cervical intervertebral disc disease. In general, autogenous bone from the iliac crest is used for interbody fusion. In order to avoid the complications associated with the iliac donor site, such as pain, hematoma, or infection, we attempted anterior cervical fusion using bone grafts obtained from cervical vertebral bodies (RC Williams, personal communication, 1990). The purpose of this report is to describe our surgical technique.

Clinical Material and Methods

Patient Population

This series consisted of 90 patients with cervical disc disease who underwent anterior cervical fusion using bone grafts obtained from cervical vertebral bodies. There were 64 men and 26 women, ranging in age from 23 to 73 years (mean age 51 years). Individual patients exhibited varying degrees of cervical spondylotic myelopathy.

Cervical disc disease was diagnosed by magnetic resonance imaging and computerized tomographic myelography. Cervical disc disease of up to three disc levels was treated by this anterior cervical fusion, regardless of canal diameter. Thirty-five patients were operated on at one level, 33 at two levels, and 22 at three levels. A total of 176 discectomies were performed. The C3–4 interspace was operated on in 25 cases, C4–5 in 46, C5–6 in 77, C6–7 in 27, and C7–T1 in one.

Operative Procedure

The patient was placed in the supine position with the neck slightly extended and rotated to the contralateral side. The anterior approach from the right side was used. A transverse skin incision at the appropriate level was preferred for a single or double fusion. An oblique skin incision was employed for a three-level operation and was made along the anteromedial border of the right sternocleidomastoid muscle. After the appropriate spinal level was confirmed on intraoperative x-ray films, limited discectomies were performed. With the use of a spinal saw* (Fig. 1), two bone grafts were removed from the cervical vertebral bodies above and below the incision (Fig. 2). Each bone graft was 4 to 6 mm thick, 13 to 15 mm wide, and 15 to 17 mm long. The posterior osteophytes and disc protrusions were then completely removed under a surgical microscope. A single bone graft, created using three interrupted sutures of 3–0 Dexon (Fig. 3), was inserted into the in-

* Williams microsurgical saw manufactured by Acc Medical Co., Los Angeles, California.
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Fig. 1. Photograph showing the right-angled saw blade for undercutting (upper) and the straight-cutting saw blade (lower).

Fig. 2. Diagrams, anterior (left) and lateral (right) views, illustrating bone graft margins in the cervical vertebral bodies above and below the incision.

Clinical Results

The average postoperative follow-up period was 24 months and ranged from 1 year to 3 years 6 months. The patients were generally allowed out of bed wearing a soft collar within 1 day postoperatively. The collar was used for 3 months after surgery. The postoperative course of all patients was uneventful and neurological symptoms improved in all cases.

Postoperatively, patients were evaluated according to the Neurosurgical Cervical Spine Scale designed by the Scale Committee of the Japanese Society of Spinal Surgery: Grade A, total disability; Grade B, unable to work and can perform only limited daily activities; Grade C, able to work part-time and perform normal daily activities; Grade D, able to work, but unable to engage in previous work; and Grade E, able to engage

Fig. 3. Diagrams illustrating the use of a microsurgical saw to obtain a bone graft from cervical vertebrae. Upper Left: Prior to the use of the saw, an air drill with a steel bar 1 to 2 mm in diameter is used to create a groove in the vertebral body. Upper Right: The right-angled saw blade is used to make a horizontal undercut. Lower Left: Next, a safety-stop straight-cutting saw blade is used to make the vertical and transverse incisions. Lower Right: The two bone grafts thus removed are sutured together, cancellous surfaces meeting, to create a single bone graft.
in previous work. Based on this scale, 71 patients were classified as Grade E, nine as Grade D, six as Grade C, and four as Grade B.

Postoperative x-ray films showed solid bone fusion in all patients (Fig. 6). No graft extrusion and no pseudoarthrosis occurred. Postoperative anterior angulation was found in four (4.4%) cases and was unrelated to the operative results. Thirty-five patients with single-level fusion experienced no anterior angulation. On the other hand, anterior angulation was found in two (6%) of the 33 patients with two-level fusion and in two (9%) of the 22 patients with three-level fusion. The graft bones were small in the four patients showing anterior angulation.

Discussion

Anterior interbody fusion of the cervical spine has been described by Robinson and Smith (1955)\(^2\) and by Cloward (1958). In their surgical techniques, autogenous bone from the iliac crest is used for interbody fusion. The complications associated with the iliac donor site are inevitable. These complications\(^7\) include persistent graft-site pain, lateral femoral cutaneous nerve injury, and hematoma formation. In order to avoid such complications, various types of grafts have been utilized, including calf bone,\(^6\) cadaver bone,\(^1\) and Apaceram.\(^4\) However, we believe that autogenous bone is superior to other grafts. Therefore, we attempted anterior cervical fusion using bone grafts obtained from cervical vertebral bodies (RC Williams, personal communication, 1990). This procedure eliminates donor site complications and allows early mobilization of patients, who are generally allowed out of bed with a soft collar within 1 day postoperatively. The procedure described here has another advantage. In the Robinson-Smith technique,\(^2\) in which the operative field is small, there is always the risk of damaging the spinal cord or nerve root when complete removal of the osteophyte is attempted. Our procedure, on the other hand, provides more extensive exposure of the osteophyte and the herniated disc, which can be safely and easily removed without damage to the spinal cord. It permits full anterior decompression.

The technical problems are that bone grafts of an inappropriate size are occasionally obtained and anterior angulation can occur. In our experience, four (4.4%) of 90 patients developed postoperative anterior angulation. The bone grafts in these cases were small. If too small bone grafts are inserted into the intervertebral space, the anterior intervertebral space may be narrowed and the bone grafts may fracture, resulting in anterior angulation. To prevent anterior angulation, it is important to insert bone grafts of the appropriate size (4 to 6 mm thick, 13 to 15 mm wide, 13 to 17 mm long) into the intervertebral space. To allow the grafting of appropriately sized bone pieces, it is essential to mark the incision line on the cervical vertebral body after the anterior longitudinal ligaments are excised. Bone grafting from a vertebral body should not be performed until the vertebral body is completely incised; otherwise, it may break and adequate bone graft material will not be obtained. In recent cases in which we exercised sufficient care with regard to these points, no postoperative anterior angulation occurred.

Our findings indicate that bone grafts obtained from cervical vertebral bodies can be used successfully to achieve cervical spine fusion. We propose that anterior

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Fig. 4. Diagrams, anterior (left) and lateral (right) views, illustrating the insertion of the sutured bone graft into the intervertebral space.

Fig. 5. Intraoperative photograph showing the sutured bone graft in the intervertebral space.
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**Fig. 6. Left:** Preoperative T2-weighted spin-echo (TR 2306 msec, TE 90 msec) magnetic resonance image demonstrating disc protrusion at the C5–6 level in a 46-year-old man with a 1-year history of numbness and clumsiness of an upper extremity and gait disturbance. **Center:** Postoperative cervical x-ray film taken 1 week after surgery. **Right:** Postoperative cervical x-ray film taken 14 months after surgery showing solid bone fusion.

cervical fusion utilizing bone grafts obtained from cervical vertebral bodies is useful in the surgical treatment of cervical disc disease.

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**References**


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