Anterior Cervical Fusion
Solution of a Particular Problem

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Upon contemplating operative fusion of the cervical spine, one becomes aware that neither the anterior nor posterior approach alone suffices for the treatment of all problems. Each has its advantages and faults, which must be weighed before application to the given patient. We propose to discuss the more obvious factors to be considered, and to report a case in which we were able to add an advantage to the anterior operation.

Several historical papers are outstanding in their contribution to our present treatment of injuries to the cervical spine. They include the report by Hadra in 1891 describing internal fixation of dislocation of the cervical spine with wire sutures. Operations for fusion of the cervical spine were described by De Quervain and Hoessly in 1917, and by Hibbs in 1922. In 1942 Rogers reported combining fixation with wire and bone grafting. In 1950 Smith and Robinson outlined a method of anterior cervical fusion. Independently, in the same year, Badger described a similar type of operation in which he adapted the dowel technique of Wilber to the cervical spine. This procedure utilizes a large drill opening spanning the diskal space, and permits exposure of the anterior portion of the spinal canal. A "precision-fit" dowel graft is inserted to effect the fusion.

Rogers defined succinctly the tenets of treatment of injuries of the cervical spine as follows:

1. The cord must be protected at all times.
2. Reduction of the fracture should be complete.
3. Stabilization must be adequate.

In complying with these principles he performed open reduction, wired the spinous processes of the fractured vertebrae in normal position, and applied subperiosteal bone grafts to the laminae to obtain a fusion. The benefits of this operation were attested to in his later report. Bailey and Badger stated that such a procedure, in their experience, was the only consistent and successful method of preventing recurrence of a dislocation.

In the main, communications regarding anterior interbody fusion have dealt with its use in disease of the cervical disk. Several authors, however, have demonstrated its use in acute trauma of the cervical spine. Coward has published the histories of 11 patients treated in this manner. Bailey and Badger expressed a preference for the ventral approach under certain circumstances and gave the following reasons:

1. It permits the neurosurgeon greater latitude in the extent of laminectomy without regard for structures that might be needed for posterior fusion.
2. The supine position is preferable for patients suffering with associated maxillofacial injuries.
3. It is superior for stabilization of old fracture-dislocation associated with quadriplegia. The fusion avoids further damage to the cord, and protects nerve roots needed for rehabilitation.
4. In fracture-dislocations associated with cervical spondylosis it permits stabilization without invasion of a route that might be needed for future decompressive laminectomy.

To these we would add a fifth reason. It is a safer and more direct route for removal of retro-pulsed fragments of disk producing an anterior spinal-cord syndrome.

In 1957 Schneider described the case of a patient with an acute cervical spinal-cord injury in which the posterior columns were spared. He recognized the acute phase of a syndrome described previously by Kahn. A posteriorly extruded intervertebral disk was removed subsequently by laminectomy. In a later report he showed that this same syndrome could be caused by other injuries, including a "tear-drop" fracture. The posterior inferior vertebral fragment is forced posteriorly to compress the spinal cord. He stressed the unreliability of Queckenstedt's test, and indicated the hazards of myelography in this condition. He advised expeditious decompression at the clinically established level. Coward has shown the efficacy and safety of diskography in demonstrating herniations of disks in these cases.

The posterior approach of the cervical spine still has some advantages. One may perform fusions above the 3rd or below the 7th cervical vertebrae, which cannot be accomplished readily by the anterior route. Decompressive laminectomy and spinal fusion may be executed in a single stage. Locked facets can be released with more facility under direct vision. We believe that decompressive laminectomy is a safer method of dealing with spinal-cord compression caused by posterior dislocation of fractured fragments of the vertebral body. Drilling out the diskal space from
the anterior aspect may force the loose bone fragments further into the spinal canal. Lastly, one of the most important features for consideration here is the immediate fixation by posterior wiring. Stability is not dependent on muscular or ligamentous resistancy. When there has been extensive tearing of these structures, compressive forces may be insufficient to lock the bone dowel tightly into place, so that the vertebral alignment is maintained precariously. Paradoxically, this is likely to be the patient for whom anterior operation would be indicated: specifically, the patient suffering an acute, extruded intervertebral disk. This dilemma is described in the present case, as well as a solution to the problem.

Case Report

A 22-year-old white male was pinned under an overturned fork-lift and rendered unconscious. As far as could be determined he was quadriplegic from the outset.

Examination. He was found to be disoriented and could relate none of the details of the accident. There was paralysis of both lower extremities, but he could extend weakly at the elbows and move both hands. Deep sensation was perceived throughout, but a bilateral sensory level to pain and temperature could be outlined to C7. The biceps reflexes were normal, but the triceps and radioperiosteal reflexes, as well as those in the lower extremities, were absent. There were no plantar responses. Marked tenderness could be elicited over the mid-cervical region, and the anterior prevertebral soft tissues were swollen markedly.

Roentgenograms disclosed fractures of the left 1st and 4th ribs, the right 2nd rib, the right clavicle, and the transverse process of T1. After repeated tries satisfactory roentgenograms of the cervical spine were obtained, which showed a mild posterior dislocation of C6 on C7, and fracture of the spinous process of C6. Pantopaque myelography was attempted in the supine position but was unsuccessful because of epidural injection. The diskogram suggested anterior and posterior herniation of the intervertebral disk between C6 and C7 (Fig. 1).

Operation. Halter traction of the neck was maintained until operation was performed through the left anterior cervical region some 30 hours after the injury. A large liquid hematoma was evacuated from the prevertebral tissues. When the vertebral body of C6 was exposed it was found to be freely movable and dislocated poste-

Fig. 1 (left). Diskogram performed prior to operation. The arrows indicate dye escaping from the intervertebral diskal space.

Fig. 2 (right). Roentgenogram made 22 months after operation demonstrating the position of the bone plate and alignment of the fused vertebrae.
riorly. There was a tear in the anterior longitudinal ligament through which diskal material protruded. The free diskal material was removed, and an endeavor was made to start the drill opening through the diskal space. When the drill was pressed against the vertebral body C6 became further dislocated posteriorly. Accordingly, a drill hole was made into the midportion of the body of C6 and into this a bone screw was threaded. This was held with a Kocher clamp as the diskal space was drilled out. The annulus and posterior longitudinal ligament were removed to widely expose and decompress the dura mater. A bone plug then was obtained from the right iliac crest and inserted into the opening. When the screw was released C6 again dislocated posteriorly. A 2-inch Sherman bone plate therefore was fixed to the anterior surface of the vertebra by means of one screw each into C6, C7, and T1; C6 was drawn into alignment, and could not be moved readily.

**Course.** In the early postoperative period the neck was immobilized with sand bags, and he was turned 45 degrees to each side. He was delirious and had considerable respiratory distress, so that a tracheotomy was required on the 2nd postoperative day. Agitation and confusion gradually improved after 10 days. The tracheotomy tube was removed 3 weeks after operation, and approximately 6 weeks after the injury he was transferred to another hospital for rehabilitation. The neurological findings at that time were unchanged from those found previously, except that deep sensation was now absent in the lower limbs.

Upon examination 22 months later there was found to be approximately 25 per cent limitation in flexion and rotation of the neck, but extension could be carried out to a full range. Transplants of tendon had improved the use of the hands. There was a bilateral motor loss to C7, with enhanced deep tendon reflexes in the lower extremities, and absent radioperiosteal and triceps reflexes, but the biceps reflexes were normal. Senses of touch and position had returned on the right side, but remained diminished on the left to the level of T9. Sensations of pain and temperature were perceived at C8 on the right side, and T12 on the left.

Roentgenograms revealed a solid fusion in good alignment (Fig. 2).

**Discussion.** The temporary loss of posterior-column function was thought to be the result of further dislocation of C6 when the drill was first applied. It was by then obvious that the operation could not be completed safely unless the upper vertebra could be stabilized in some manner. The screw threaded into the drill hole allowed the vertebra to be held with a Kocher clamp as the diskal space was drilled away. We found that a Raney drill inserted into the Cloward foot-piece aids in starting the drill opening through the cortical bone. The Cloward drill is substituted as soon as the anterior cortex has been well perforated.

When it was found that the bone plug would not maintain the anatomical alignment, some method of traction to hold the upper vertebra in position was considered, but no satisfactory arrangement could be devised. A three-point fixation of the bone plate was required to maintain adequate alignment. No problems were encountered in its application but more latitude in positioning the screws would have been desirable.

Obviously, definite conclusions cannot be drawn from 1 case, but several questions might be posed. Would internal fixation by this method prevent the anterior angulation, which occurred in 50 per cent of Cloward's patients who were treated for fracture-dislocation? Would a larger series yield complications from loosened screws? A danger of erosion of the esophagus must be considered.

**Summary.** When a patient has received a recent injury to the cervical spine, operative fusion may be indicated. If the extreme upper or lower cervical vertebrae must be exposed, the spinal cord decompressed, or locked facets released, the posterior approach appears to be more advantageous. Decompressive laminectomy would be a safer treatment for anterior spinal-cord compression by fragments of the vertebral body. Anterior spinal fusion is a more direct approach for removal of herniated diskal material compressing the cord. Unfortunately, there may be destruction of the restraining ligaments which make a dowel fusion insecure. In this situation, application of a bone plate across the site of the dislocation in our patient furnished stability, comparable to that obtained by posterior wiring. Alignment was maintained without external fixation. Fusion without angulation followed subsequently.

**References.**


