Fracture Dislocation of the Cervical Spine

Value of Anterior Approach With Bovine Bone Interbody Fusion

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Twenty surgically treated cases of fracture dislocation of the cervical spine are presented. All patients had hyperflexion injuries with associated rupture of the intervertebral disc. All patients were operated on through an anterior surgical approach. Ten consecutive patients had interbody fusion with autogenous bone and ten consecutive patients were fused anteriorly with bovine (Kiel) bone. All patients injuries fused satisfactorily. There was no significant difference between the use of autogenous bone and bovine bone. [Key words: cervical spine fracture, bovine bone, autogenous bone, anterior interbody fusion]

The introduction of the anterior approach to disorders of the cervical spine by Cloward, and by Smith and Robinson has greatly increased the surgical options available to patients with fracture dislocation of the cervical spine.

In 1961 Cloward demonstrated the adaptability of this procedure for patients with fracture dislocation of the cervical spine. Other reports have followed which attest to the value of this procedure, especially in patients with acute flexion injuries of the cervical spine and associated herniated disc.

Taheri and Gueramy reported in 1972 on the use of bovine bone (Kiel bone) in 200 cases of anterior cervical interbody fusion employing the Cloward technique. The patients in that series had a variety of symptoms secondary to cervical spondylosis, and the outcome of fusion performed with Kiel bone compared favorably with the group in whom autogenous bone had been used.

To our knowledge no series has yet been reported documenting the efficacy of Kiel-bone fusion in patients with fracture dislocation of the cervical spine.

MATERIALS AND METHOD

The clinical courses of 10 consecutive patients with fracture dislocation of the cervical spine who underwent anterior interbody fusion with Kiel bone were reviewed. This group was compared with a control group of 10 consecutive patients with fracture dislocations of the cervical spine who underwent anterior interbody fusion with autogenous bone. Levels of injury, age and sex distribution, and mode of injury of all patients studied are shown in Tables 1, 2, and 3.

The method of ganding is essentially as outlined by Schaeerers.

Table 1. Level of Injury in 20 Patients Studied

<table>
<thead>
<tr>
<th>Level of injury</th>
<th>No. of patients</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3-4</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>C4-5</td>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td>C5-6</td>
<td>3</td>
<td>15</td>
</tr>
</tbody>
</table>
Table 2. Age/Sex Distribution of 20 Patients Studied

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-19</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>20-29</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>30-39</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>40-49</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>50-59</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>60-69</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14</td>
<td>6</td>
<td>20</td>
</tr>
</tbody>
</table>

**Clinical Grading**

Excellent: No residual complaints.
Good: Residual complaints were minor, occasional, and not incapacitating.
Fair: The patient was improved over his preoperative condition but still had some complaints and was partly incapacitated.
Poor: The patient showed no improvement over his preoperative condition.

**Roentgenogram Grading**

Excellent: Good fusion and no angulation.
Good: Good fusion and minimal angulation.
Fair: Moderate angulation, moderate absorption, or moderate fragmentation.
Poor: Complete collapse, marked absorption, marked fragmentation, marked protrusion, or marked angulation.

All patients were subjected to comprehensive blood and urine examinations, including antihuman titers.

Kiel bone (Kiel Surgibone) is available in the form of cylindrical dowels 12, 12.5, 14 and 14.5 mm in diameter and 19 mm in length. The smaller dowels are frequently used in the treatment of cervical spondylosis when more than one space is fused. The dowel is prepared according to the method described by Maatz and Bauermester.

In its processed form, kiel bone is an ivory-colored, densely hard, uniform cylinder of spongiosa. The inner package containing the bone is sterile and no further sterilization of the graft is necessary.

Kiel bone was extensively used in Europe prior to its introduction in this country and no adverse effects have been reported. Indications are that the substance is immunologically inert.

**TECHNIQUE**

The shape and form of the processed product make Kiel bone uniquely suited to the standard Cloward technique for anterior interbody fusion.
All patients except one were operated on in skeletal traction. The exception was a patient with normal alignment in the neutral position who demonstrated subluxation in flexion.

Intubation is usually accomplished via the nasal route without movement of the patient’s head. Immediately after transfer to the operating room table, a lateral cervical spine roentgenogram is performed using standard technique. This serves to document the status of the cervical reduction after movement of the patient from a circle electric bed to the operating room table. The film also serves as a guide to the depth of the interspace. A 20% reduction is made in the depth measurement to compensate for roentgenogram magnification. Nineteen millimeters ± 1 mm has been found to be the average depth of an adult male cervical intervertebral space. The corresponding measurement for females is about 16 mm ± 1 mm. Accordingly, the Kiel bone is usually shortened in females by 3 mm. During the drilling the depth is checked with a depth gauge. The final millimeter of bone is removed with a curette.

Mobilization of the patient postoperatively is mitigated by the extent of the preoperative cervical instability and neurologic deficit.

Patients whose spines are considered to be highly unstable because of comminution of the vertebral body or associated facet and predicle fracture may be kept at bedrest up to 6 weeks of until there is early evidence of fusion. These patients wear a cervical brace until there is roentgenogram evidence of solid bony union.

**DISCUSSION**

Our 3-year experience with Kiel bone has been gratifying. In no instance were any untoward results attributable to the use of kiel bone. All patients were free of infection and immunologic response. All grafts fused primarily without the need for further surgery.

The use of Kiel bone assures the surgeon of a uniform, sterile, structurally hard material. In patients with osteoporosis or extremely thin iliac crests, Kiel bone is superior to autogenous bone.

**Table 3. Mode of Injury Among 20 Patients with Cervical Spine Fracture Dislocation**

<table>
<thead>
<tr>
<th>Mode of Injury</th>
<th>No. of Patients</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Auto</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>Diving</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Trampoline</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Industrial</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>20</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Other advantages afforded by the use of Kiel bone are decrease in operating time, elimination of a painful hip incision, and elimination of all the possible complications associated with a second operative site.
Patients with extensive comminution of a vertebral body with herniation of the disc above and below the vertebral body are not suitable candidates for Kiel bone interbody fusion because of the dimensions and shape of the current material. Such patients should have stabilization with iliac crest (or tibial) strut grafts and overlying metal plate and screws. Availability of Kiel bone in block form which could be trimmed to fit the individual osseous defect would be desirable for these cases.

In other respects, analysis of the data has revealed some interesting findings considering all patients as a single group.

In this small series of 20 cases the following points were noted:
1). Examination of the data revealed that the need for tracheostomy or prolonged endotracheal intubation was indicative of a bleak prognosis. In this group of 4 patients, 1 died on the ninth postoperative day, 1 died on the 60th postoperative day, and 2 remained severely quadriparetic.
2). Both patients with long-strut grafts required reoperation for extrusion of graft. One patient required reinsertion of a strut graft and overlying fixation with a metal plate (Figure 1). This situation might be avoided by overlaying all strut grafts with a metal plate and screws as a primary procedure.
3). The c4-5 level was the most common site for fracture dislocation in this series of hyperflexion injuries. This is in contradistinction to the frequency of site level in cervical spondylosis where c5-6 is by far the most common with c6-7 second. This may be due to the fact that the C4-5 level is closer to the anatomic midpoint of the cervical spine and is more susceptible to forces transmitted from the back of the head.
4). Patients with acute complete motor/sensory paralysis of more than a few hours’ duration still have a poor prognosis. No significant recovery has occurred in any patient in this group.
5). The potential for substantial, even full, recovery is great in patients who present with partial neurologic deficit (Figure 2). Comparison of the immediate preoperative status and long-term followup tends to indicate that open decompressive procedures followed by fusion offer a substantial advantage over treatment with skeletal traction alone.
6). Steroids and mannitol have been used almost routinely over the past 2 years. Our data, however, are insufficient to draw any conclusions regarding the outcome of their use. We have had no experience with the use of epsilon amino caproic acid.
7). All patients were considered excellent regarding roentgenogram evidence of fusion and lack of angulation (Figures 3, 4, 5 and 6).
8). Automobile accidents remain the leading cause of severe cervical injury. None of the patients in this series was protected by lap belt, chest restraint, or head rest.

Table 4. Comparisons of Clinical Courses of 20 Patients Whose Fracture Dislocations Were Fused With Kiel Bone or Autogenous Bone

<table>
<thead>
<tr>
<th>Fusion</th>
<th>Patient</th>
<th>Cervical</th>
<th>Cause of</th>
<th>Neurologic</th>
<th>Skeletal</th>
<th>Steroid</th>
</tr>
</thead>
</table>

REFERENCES