FRACTURE OF THE CERVICAL SPINE IN PATIENTS WITH RHEUMATOID ARTHRITIS

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(Received for publication March 17, 1958)

Fracture of the cervical spine in patients with rheumatoid arthritis has received only scant mention in the literature. Unlike the normal spine, the ankylosed spine when fractured breaks like a long bone and usually the fracture occurs through what had formerly been the interspace. These fractures present a difficult problem since they frequently occur in elderly people or chronically ill patients who are poor operative risks. We wish to present observations on patients who presented this type of problem, in which the sequence of events illustrates certain important principles in therapy. The experience cited in this report indicates that rapid bony healing at the site of the fracture may not take place in the cervical spine with minimal signs of rheumatoid arthritis. Complications resulting from skeletal traction on the Foster frame are illustrated.

CASE REPORTS

Case 1. A 51-year-old male 6 months previously fell backward from a truck, striking his shoulders. He had pain and soreness in the neck and later noticed that the neck did not “straighten out.” Three months later, one day after riding in a truck over rough ground, he awoke with weakness of the arms and legs. Motor power returned incompletely in 10 days. At the time of admission he complained of weakness in the arms and legs and difficulty in walking for any distance. At age 24 he had had the onset of typical ankylosing arthritis with generalized involvement except for temporomandibular joints.

Examination revealed spasm of the muscles of the neck. The head and neck were held in a forward-flexed or anterior position in relation to the trunk, with the head extended on the neck. There was an incomplete sensory level to C5 bilaterally. Gait was spastic. Breathing was abdominal in type. The grip in the hands was weak and atrophy of the intrinsic muscles was evident. Biceps reflexes were active, while triceps reflexes were reduced bilaterally. Patellar reflexes were hyperactive and Achilles reflexes were reduced. Hoffmann’s sign and abnormal plantar responses were present bilaterally.

Roentgenograms showed marked fracture-dislocation of C5 on C6 and cervical myelogram revealed a partial block at this level (Fig. 1A). Rheumatoid arthritic changes were evident between the vertebral bodies of C6 and C7 with typical bamboo appearance of the dorsal and lumbar spine.

The patient was placed on a Foster frame and traction with 20 pounds of weight

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was applied to Crutchfield tongs. Twelve hours later the patient was taken to the operating room and under general anesthesia blind intubation of the trachea was attempted. Considerable bleeding ensued; the patient became cyanotic and tracheotomy was performed.

Twelve hours postoperatively weakness in the left arm was evident and traction was reduced to 10 pounds. This was followed by a slowly progressive tetraplegia and urinary retention. Decompressive laminectomy, from C4 through C7, was per-

![Image](image_url)

**Fig. 1. Case 1.** (A) Myelogram demonstrating partial block at fracture-dislocation at C5–C6 level, which was locked at joints of facets. (B) Roentgenogram showing formation of callus at previous fracture-dislocation.

formed 4 days later. The fracture-dislocation was visualized and bony alignment was re-established with 50 pounds of weight applied to Crutchfield tongs. The dura mater at C5 level was compressed by bone and heavy granulation tissue. The spinal cord appeared normal grossly and the dentate ligaments were sectioned bilaterally at the C5 and C6 levels.

Motor strength in all but the left upper extremity improved markedly during the first 48 hours. Subsequently there was complete return of motor and sensory function except at the C5 and C6 dermatomes on the left. Roentgenographic studies showed satisfactory alignment of the dislocation with considerable formation of callus at the C5–C6 level 2 months following operation (Fig. 1B). Three months after opera-
tion acute respiratory difficulty developed and the patient expired suddenly.

At necropsy healing fracture in satisfactory bony alignment was evident. Sections of the spinal cord taken from the area of fracture showed in one locus almost complete loss of anterior horn cells in a glial scar and few anterior horn cells on the contralateral side. The attached peripheral nerve roots showed a striking loss of axis cylinders and the Schwann sheaths were vacuolated.

Case 2. A 63-year-old male was admitted with symptoms of urinary retention, acute alcoholism and mental confusion. During the next week there was development of abdominal distension, incontinence of feces and loss of motor power below the C5 level bilaterally. Sensation was intact, except that vibration was decreased at the ankles. The head and neck were flexed forward in relation to the trunk, and the head was slightly extended on the neck. Ecchymosis was present over the posterior part of the neck and upper dorsal spine. Deep tendon reflexes were active with no pathological responses.

Roentgenograms showed extensive rheumatoid spondylitis of cervical and dorsal spine. There was marked anterior dislocation of the C5 body in relationship to C6 (Fig. 2A).

The patient was placed on a Foster frame and traction with 4 pounds of weight was applied to the Crutchfield tongs. Roentgenograms of the cervical spine 24 hours later showed hyperextension of the neck with further anterior dislocation of the upper part of the cervical spine (Fig. 2B). The patient expired suddenly when turned from the face-down to the face-up position.

Necropsy revealed central hematomyelia of the spinal cord at the level of the fracture. The body of C5 was displaced forward on C6 with complete separation of the ligaments between these two bodies.

Case 3. A 60-year-old man fell out of bed and struck his head in the fall; he was not unconscious but severe pain in the neck developed. He had had a “frozen spine” for 27 years caused by ankylosing spondylitis. He noted no change in the relationship of the position of his head to his trunk following the injury.

The head and neck were flexed forward in relation to the trunk, with the head extended on the neck. The head remained elevated several inches from the bed after all support was withdrawn from under it. No neurological deficits could be demonstrated.

Comparison with pre-injury roentgenograms (Fig. 3A) revealed a fracture of the ankylosed cervical spine between C6 and C7 (Fig. 3B) which extended through the bodies and neural arches. The upper cervical spine was displaced anteriorly by the width of a cervical vertebral body. The neural arches were displaced and locked. The posterior joints of the facets were obliterated.

This patient was placed flat on his back with his head supported on a pillow in its usual position of forward flexion and later he was fitted with a padded cervical collar and an adjustable cervical collar. No signs of involvement of the spinal cord or cervical nerve root appeared during his treatment. Roentgenograms 10 weeks after trauma showed solid union of the cervical spine in its displaced position (Fig. 3C).

DISCUSSION

Individually reported cases of cervical spine fracture-dislocation with rheumatoid spondylitis collected from the literature are presented in Table 1.
A hyperextension type of injury occurred in the majority of these cases with varying degrees of fracture-dislocation. In this type of injury two mechanisms for locking in hyperextension occur, namely, locking of facets (Figs. 1A and 4A) and locking of the neural arches (Figs. 3B and 4B). Case 1 is illustrative of locking of the facets; here the cervical spine was minimally involved with rheumatoid spondylitis so that the joints of the facets remained intact, whereas in the other 2 cases the solid spine behaved in fracture like a long bone, fracture-dislocation occurring through the facets, and locking developing between the neural arches. Case 1 illustrated that limited rheumatoid spondylitis may be attended with minimal bony fusion at the site of the fracture since reduction could be obtained 6 months after trauma. This is in contrast with the experiences in collected cases of complete cervical ankylosis.
in which healing at the site of the fracture occurred 6 to 10 weeks after injury (Table 1).

Prognosis in fracture-dislocation of the ankylosed spine depends in part on the degree of vertebral displacement, concurrent spinal cord injury and general condition of the patient. These factors can also be related to modes of therapy. Paucity of neurological signs permits conservative and minimal therapy, although considerable vertebral displacement may be present, as illustrated in Case 3. In the acute phase the method advocated by Barnes, of slight flexion of the neck on a small pillow, may suffice, particularly since cervical collars and braces are poorly tolerated by many elderly patients. Should neurological signs develop on ambulation after conservative therapy, one has the advantage then of performing spinal cord decompression in a relatively stable spine, since solid fusion in the previously ankylosed spine generally occurs in 6 to 10 weeks. Extensive bone grafting would not seem indicated for stabilization of the spine after this period of time.

Neurological symptoms in fracture-dislocation of the ankylosed cervical

**TABLE 1**

*Reported cases of rheumatoid spondylitis with fracture-dislocation in the cervical spine*

<table>
<thead>
<tr>
<th>Author</th>
<th>Age of Patient</th>
<th>Nature of Injury</th>
<th>Radiographic Appearance</th>
<th>Type of Paraplegia</th>
<th>Treatment</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hathaway</td>
<td>37</td>
<td>Fell on floor</td>
<td>Fracture C4 on C5</td>
<td>None</td>
<td>None</td>
<td>Death 8 hrs, 45 mins. after fall</td>
</tr>
<tr>
<td>2. Stiasny</td>
<td>36</td>
<td>Fell with occi-put against window</td>
<td>Fracture between bodies C5 &amp; C6</td>
<td>None</td>
<td>Glisson head-halter traction</td>
<td>Rapid healing noted in 12 days</td>
</tr>
<tr>
<td>3. Bergmann</td>
<td>middle age</td>
<td>Fell in bath-tub</td>
<td>Fracture C5 &amp; C6, slight ant. displacement C5 on C6</td>
<td>None</td>
<td>Not described</td>
<td>Fracture healed, neck more extended</td>
</tr>
<tr>
<td>4. Bergmann</td>
<td>middle age</td>
<td>Fell on ground</td>
<td>Fracture C5 &amp; C6, slight post. displacement C5 on C6</td>
<td>Quadriplegia; any change from original degree of flexion of head caused cessation of respiration</td>
<td>Not described</td>
<td>Bony union within 6 wks.</td>
</tr>
<tr>
<td>5. Barnes</td>
<td>77</td>
<td>Knocked down by car</td>
<td>Advanced spondylitis, vertebral ankylosed below C4, fracture lower margin C3, post. displacement C3 on C4 by 5 cm.</td>
<td>Incomplete</td>
<td>Small pillow, neck slightly flexed</td>
<td>Death 4th day</td>
</tr>
<tr>
<td>6. Bergmann</td>
<td>middle age</td>
<td>Struck by taxi-cab</td>
<td>Fracture C5 &amp; C6 with side displacement C5 body post. &amp; minimal ant. or post. malalignment</td>
<td>None</td>
<td>Sayre halter</td>
<td>Firm bony consolidation, 6 wks.</td>
</tr>
<tr>
<td>7. Bergmann</td>
<td>middle age</td>
<td>Fell downstairs</td>
<td>Fracture C6 &amp; C7; no film of injury</td>
<td>Paresthesia of hand</td>
<td>Sayre halter</td>
<td>Healed in 7 wks.</td>
</tr>
<tr>
<td>8. Rogers</td>
<td>—</td>
<td>Fell face down</td>
<td>Fracture C4 &amp; C5, slight ant. displacement C4 on C5</td>
<td>None</td>
<td>Skull traction in extension</td>
<td>Refusion in 8-10 wks.</td>
</tr>
<tr>
<td>9. Jones &amp; Corn</td>
<td>33</td>
<td>Fell on stairs landing on head</td>
<td>Post. subluxation C6 on C7 with fracture through fused area of spondylitis</td>
<td>Transient</td>
<td>Skull traction in neutral position followed by Minerva jacket &amp; plaster collar</td>
<td>Improved</td>
</tr>
<tr>
<td>10. Schneider et al.</td>
<td>49</td>
<td>Fell downstairs</td>
<td>Locked in hyperextension, comminution and fracture-dislocation C4 ant. on C5</td>
<td>Complete</td>
<td>Crutchfield skeletal tongs</td>
<td>Death 3rd day</td>
</tr>
</tbody>
</table>

*Crutchfield, skeletal tongs*
spine are indication for reduction of the fracture by traction and in some instances operative therapy. Bergmann\(^2\) has emphasized that traction must be applied carefully in these cases, but he did not outline the principles he employed with head-halter traction. Rogers\(^6\) and others have advised strongly against head-halter traction, indicating that skeletal traction is much better tolerated in the elderly patient. Thus, he successfully corrected an extension fracture through the level of the fourth intervertebral disc by traction of the

![Fig. 3. Case 3. (A) Roentgenogram of ankylosed spine several years before injury. (B) Fracture between C6 and C7 locked at neural arches. (C) Healed fracture.](image)

![Fig. 4. Diagrams of cervical spine demonstrating locking of spine (A) at joints of facets and (B) at neural arches.](image)
skull in the extended position when a pre-existing flexion deformity had been present in the ankylosed cervical spine. The patient of Jones and Corn\textsuperscript{5} with fracture and posterior subluxation of C6 on C7 was treated with skeletal traction in the neutral position. The problem of fracture-dislocation locked in hyperextension was presented in the case of Schneider et al.\textsuperscript{7} and the cases cited in this report. Experience with locked facets or neural arches emphasizes that the conventional mode of skeletal traction produced hyperextension of the cervical spine on the Foster or Stryker frame, and was poorly adapted to reduction of this type of injury prior to unlocking of facets or neural arches. Jones and Corn\textsuperscript{5} previously advised that in this type of injury traction be applied initially in the neutral plane, followed by hyperextension, but only after the facets have been cleared. Furthermore, the reduction they found was now stable and only 3–4 pounds of traction was necessary for maintenance of alignment. The term "neutral," as applied to the cervical spine, is defined by Rogers\textsuperscript{6} as that position in which there is a slight amount of extension, that is, one of slight lordosis. The force of traction must be applied in the direction of the long axis of the neck in the neutral position. Failure to attain reduction of the facets or neural arches by traction in cases complicated by neurological deficits appears to be a definite indication for open operative reduction.

Neurological deficits resulting from skeletal traction in cervical spine fracture-dislocations have been observed to occur in cases of fractures with badly torn spinal ligaments, when traction widens the intervertebral space to such a serious degree that it results in injury to the spinal cord or cervical nerves.\textsuperscript{8} In hyperextension injuries of the cervical spine, voluntary extension of the neck by the confused patient during application of traction and extension of the neck during intratracheal intubation under general anesthesia produced similar injury.\textsuperscript{6} The sequence of events revealed that in our Cases 1 and 2 the spines were unstable in the hyperextended position. Twenty pounds of skeletal traction was permitted by the patient in Case 1 prior to anesthesia; however, relaxation of the cervical muscles with general anesthesia and the mode of cervical traction on the Foster frame (Fig. 5), rather than the attempted intratracheal intubation, were considered responsible for the development of increased neurological deficits. The factor of traction in cases of locking in hyperextension was revealed in the roentgenograms of Case 2, in which identical traction resulted in hyperextension of the cephalad portion of the ankylosed spine with resultant increase in the bony deformity at the site of fracture. Preliminary tracheotomy under local anesthesia will provide a satisfactory airway for general anesthesia during open reduction. Delay in applying skeletal traction to the ankylosed spine seems advisable until open exposure has been accomplished under general anesthesia, since relaxation of muscles and the likelihood of ossified ligaments being torn in the fracture-dislocation would permit minimal traction to effect separation of the two ends of the spine.
SUMMARY

Fracture-dislocation of the cervical spine locked in hyperextension by facets or neural arches was illustrated in patients with rheumatoid arthritis. Complete reduction occurred 6 months after trauma in a spine with limited cervical rheumatoid spondylitis in which locking was related to unfused joints of the facets, and this was compared with cases collected from the literature in which the fractures in the completely ankylosed cervical spine were found to be solidly fused in 6 to 10 weeks. Prognosis and modes of therapy depend in part on the degree of vertebral displacement, concurrent spinal cord injury and general condition of the patient. When conventional skeletal traction on the Foster frame was applied to a patient with fracture-dislocation of the ankylosed cervical spine locked in hyperextension at the neural arches, hyperextension and further forward dislocation of the cephalad portion of the spine developed. With this mode of traction, when general anesthesia was administered to a patient with cervical spine fracture-dislocation locked by facets in hyperextension, neurological deficits resulted.

REFERENCES