

# Cervical Fracture Complicating Ankylosing Spondylitis

## A Report of Eight Cases and Review of the Literature

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Fracture of the cervical spine is a serious and often fatal complication of ankylosing spondylitis. An evaluation of eight patients and a review of 75 additional cases from the literature are presented. Although this complication is relatively uncommon, it is clear that people with advanced disease and complete ankylosis of the cervical spine are at increased risk of sustaining cervical fracture. When fracture occurs it usually stems from minor trauma resulting most commonly in disruption of the lower cervical segments (fifth through the seventh cervical vertebrae). Fracture is most likely the result of a hyperextension type injury, occurs through what was formerly an intervertebral space, and is unstable. Severe neurologic sequelae occur in 57 percent of the cases and the mortality rate (35 percent) is twice that observed with similar fracture involving normal spines. The majority of patients are best treated with closed reduction with halo traction together with body cast or jacket. Laminectomy is rarely indicated except in the event of an advancing neurologic deficit. With appropriate understanding and execution of management principles, the outcome in these patients can be favorable. Unfortunately, recognition of cervical fracture in patients with ankylosing spondylitis is often needlessly delayed. Distortion of normal anatomy in spondylitics, predominant fracture location in lower cervical spine segments and lack of obvious displacement make identification difficult. Thus, management is often inappropriate resulting in excessive neurologic injury and mortality.

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Fracture of the cervical spine is a serious and potentially fatal complication of ankylosing spondylitis. It is associated with the development of severe neurologic deficits in 57 percent of the cases and results in a 35 percent mortality rate, twice that seen with fractures involving normal spines [1]. In over half the cases the precipitating trauma is of a minor nature, unlikely to result in fracture of a normal spine; in 7 percent no history of trauma is obtained. For this reason, and because neck pain is a common complaint of patients with ankylosing spondylitis, detection of these fractures is often delayed or overlooked, usually to the detriment of the patient.

This complication was considered to be uncommon. In an analysis of 2,500 cases of traumatic spinal injuries, only seven cases of ankylosing spondylitis were found [2]. Wilkinson and Bywaters [3] reported three cases of spinal fracture resulting in one death in their review of 212 patients with ankylosing spondylitis followed for as long as 20 years. Of 146 deaths among 836 patients with ankylosing spondylitis reported by Radford et al. [4], only three were attributable to vertebral fracture. From these data and from others in which long-term

follow-up was reported [5-7], it would appear that fracture of the ankylosed vertebral column is a rare event and is a minor contributor to mortality in ankylosing spondylitis.

Our experience has made us wary of this conclusion for we have had the opportunity to evaluate eight cases of cervical fracture complicating ankylosing spondylitis over the past five years. The diagnosis and management of cervical fracture in these patients presented unique and difficult problems, and the clinical course resulted in death or the development of severe neurologic sequelae in half the cases. We present here our experience with these eight patients together with a review of 75 additional cases reported in the literature [1,2,8-38].

## PATIENTS AND METHODS

Five patients with ankylosing spondylitis and cervical fracture were hospitalized at the Teaching Hospitals of the University of Texas Health Science Center at San Antonio between June 1973 and December 1978. Each patient was evaluated by one of the members of the Division of Rheumatology. In addition, we evaluated the medical records and roentgenograms in three other previously unreported cases, two from community hospitals in San Antonio (Cases 6 and 7) and one from the University Hospital in San Diego (Case 8).

## REPRESENTATIVE CASES

**Case 1.** A 48 year old man with a 20 year history of ankylosing spondylitis was involved in a motor vehicle accident and sustained a fracture of the left tibia. While being evaluated in the emergency room, he complained of neck pain and an electric shock-like sensation radiating down his spine and into his extremities whenever he moved his head. Neurologic examination reportedly disclosed no abnormalities. Films of the spine revealed complete ankylosis of the cervical segments associated with severe osteopenia. No fracture or dislocation was seen; however, the vertebral segments below the sixth cervical vertebra were not well visualized. The left leg was placed in a cast and the patient was admitted for further observation. Repeat films of the entire spine were obtained. No fractures were detected, but again the lower cervical segments were not well seen. After transfer from a stretcher to a bed, the patient complained of increased neck pain and experienced the sudden onset of numbness and weakness in his legs. Neurologic evaluation revealed partial motor and sensory dysfunction in the lower extremities associated with absent reflexes. Over the next 12 hours an inability to urinate and progressive motor and sensory deficits to a sixth cervical vertebral level developed. Tomography of the cervical spine showed a fracture through the seventh cervical vertebra-first thoracic vertebra interspace with 90 percent anterior displacement of seventh cervical vertebra on the first thoracic vertebra.

The patient was placed in cervical traction, using Crutchfield tongs, and decompression laminectomy was performed. At surgery the dura appeared to pulsate normally, and no lacerations or gross derangements of the spinal cord were seen. Because of the patient's marked thoracic kyphosis and forward angulation of the head, proper alignment was difficult to maintain postoperatively. Six days postoperatively, an episode

of bradycardia and respiratory insufficiency developed when the patient turned to a prone position. Bradycardia and respiratory insufficiency again developed with repositioning on postoperative days 9 and 10. Cervical fusion was considered; however, pneumonia and progressive respiratory insufficiency developed and the patient died on the 17th hospital day.

**Comment:** Failure to adequately evaluate the lower cervical region roentgenographically and to appropriately analyze the symptoms of neurologic involvement resulted in quadriplegia and ultimately death in this case. The development of bradycardia and respiratory insufficiency when the patient turned to a prone position probably resulted from loss of alignment of the fracture segments and associated spinal cord compression [39].

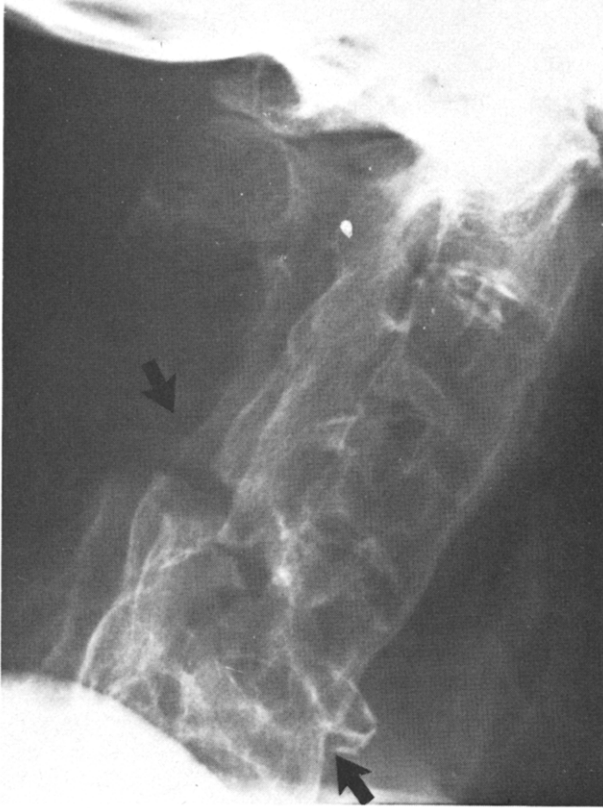
**Case 2.** A 66 year old man with a 40 year history of ankylosing spondylitis fell at night while walking to his bathroom. He struck the posterior aspect of his head and neck, and experienced the immediate onset of neck pain. He was unable to move his extremities for approximately 15 minutes. Subsequently, he was able to ambulate but experienced what he described as electrical shocks down his spine and into his extremities with head movement. Because of persistent neck pain, he was taken by automobile 250 miles to a Veterans' Administration facility for hospitalization.

On examination he was noted to sit with a very rigid posture. The fifth and sixth cervical vertebrae region was tender posteriorly; palpation of the area caused radiation of pain into both upper extremities. Neurologic examination was otherwise within normal limits. Films of the cervical spine revealed complete ankylosis of the entire cervical region with advanced osteopenia. A compression fracture of the superior portion of the sixth cervical vertebral body was noted (**Figure 1**). The fracture line extended through the posterior elements at the fifth cervical vertebral level, and slight anterior displacement of the superior fracture segment was present.

Crutchfield tongs were placed, and the patient was treated with 20 pounds of cervical traction. Because of slow healing, the amount of traction was gradually reduced. The patient did well with maintenance of good alignment. By the 10th hospital week skeletal traction was discontinued and a four-poster brace was applied. The follow-up films demonstrated excellent alignment with good healing of the fracture site 15 weeks after the injury (**Figure 2**). The findings on neurologic examination remained within normal limits.

**Comment:** The presence of marked osteopenia and the application of excessive cervical traction may have retarded healing in this case. In retrospect, this patient was ideally suited for the application of halo traction using a body cast or jacket. This device would have provided stabilization of the fracture while allowing the patient to remain comfortable, to ambulate and to care for his own activities of daily living.

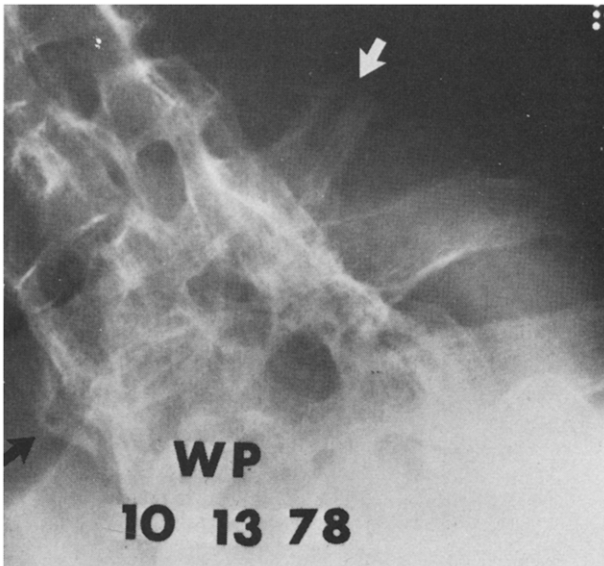
**Case 3.** A 60 year old man with a history of ankylosing spondylitis since the age of 20 presented with a five week history of sharp, intense, persistent pain in the region of the medial, superior border of the right scapula associated with numbness and weakness of the right hand and arm. No history of trauma was obtained; however, he admitted to being intoxicated the



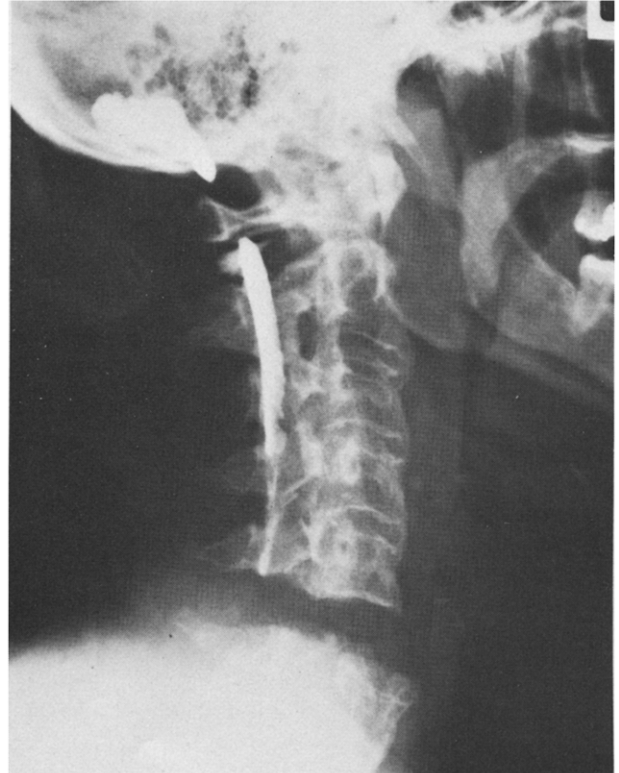
**Figure 1.** Case 2. Lateral roentgenogram of the cervical spine demonstrating extensive ankylosis and osteopenia. A compression fracture of the superior portion of the sixth cervical vertebral body is apparent with the fracture line extending through the posterior elements.



**Figure 2.** Case 2. Roentgenogram taken 15 weeks after fracture. Restoration of alignment and fracture healing are demonstrated.



**Figure 3.** Case 3. Cervical roentgenogram demonstrating a fracture through the sixth and seventh cervical vertebrae interspace extending through the posterior elements and bisecting the sixth cervical vertebra spinous process (white arrow). Callus formation is noted anterior to the fracture region (black arrow).



**Figure 4.** Case 8. Lateral roentgenogram of the cervical spine following myelography and the application of excessive cervical traction using Gardner-Wells tongs.

night before the onset of his symptoms. On examination he had the typical posture of advanced ankylosing spondylitis with a prominent thoracic kyphosis and forward angulation of the head. No tenderness was elicited over the cervical or thoracic spine, or over the right scapula. Reduced perception to pinprick and light touch was noted over digits three, four and five of the right hand. Marked atrophy and weakness were noted in the intrinsic hand muscles of the involved hand. Weakness of the right deltoid and triceps was also observed. Electromyography and nerve conduction studies showed evidence of denervation of the muscles supplied by the sixth, seventh, and eighth cervical vertebra nerve roots. Cervical films demonstrated a fracture through the sixth and seventh cervical vertebra interspace extending through the posterior elements and bisecting the sixth cervical vertebra spinous process (Figure 3). Callus formation was noted anterior to the sixth and seventh cervical vertebra interspace.

The patient was placed in halo traction using a body jacket. After six weeks of immobilization, the scapular pain resolved and marked improvement in motor function was observed. By the 16th week after injury the halo device was removed, and tomography of the fracture site demonstrated satisfactory healing. Only minimal weakness remained in the right hand and arm.

**Comment:** This case is of interest for two reasons. Although it is quite likely that some form of trauma was incurred while the patient was intoxicated, the history was negative. Secondly, this case illustrates that signs of nerve root injury may be the presenting manifestation of cervical fracture in patients with ankylosing spondylitis. Immobilization of the fracture segments can result in neurologic recovery.

**Case 8.** A 49 year old man with a 15 year history of ankylosing spondylitis received a blow to the head while intoxicated. He fell to the floor striking his head and experienced the immediate onset of quadriplegia. Examination shortly after the injury revealed total absence of motor and sensory function below the sixth cervical vertebral level. Tenderness was elicited over the lower cervical region, and reflexes were absent in both upper and lower extremities. Roentgenograms of the cervical spine demonstrated a fracture through the fifth and sixth cervical vertebra interspace extending through the posterior elements with posterior displacement of the superior fracture segment (Figure 4).

Gardner-Wells tongs were attached to the skull, and cervical traction was applied. Utilizing more than 100 pounds of traction, the fracture segments could not be reduced satisfactorily to reconstitute the cervical canal. A myelogram demonstrated a complete block of the subarachnoid space at the fourth cervical vertebra level. In an effort to recover spinal cord function, a decompression laminectomy was performed. At the time of surgery, the spinal cord was noted to be markedly edematous at the fifth cervical level. Following incision of the dura the spinal cord was found to be severely contused with necrotic, liquified material extruding from the dorsal surface of the cord from fifth to sixth cervical vertebra.

Postoperatively the neurologic deficit ascended to a fifth cervical vertebral level which was attributed to manipulation of the spinal cord at the time of operation. The patient's hospital course was complicated, and he was finally discharged

15 months after initial injury, quadriplegic, to custodial care.

**Comment:** The amount of cervical traction used to attempt reduction of the fracture segments was excessive in this case and resulted in dangerous separation at the fracture site (Figure 4). The progression of the neurologic lesion could have occurred at the time cervical traction was applied. Spinal cord and nerve root injury are established complications of excessive cervical traction [1,21].

## COMMENTS AND REVIEW OF THE LITERATURE

**General Observations.** The clinical characteristics of the eight patients comprising the present study are summarized in Table I. All patients were male with a mean age of 55 years at the time of fracture and had advanced disease with an average duration of 25 years. Roentgenographically every patient had complete obliteration of the sacroiliac joints and ankylosis of the entire spine with advanced osteopenia. These cases combined with the 75 previously reported cases show a male predominance with mean age at the time of injury in the sixth decade and a history of long-standing ankylosing spondylitis averaging 22 years (Table II).

A finding of interest is the association of alcohol intoxication at the time of fracture in 14 percent of the cases, including four in the present study. Since many cases in the literature are not reported in detail, this figure may be an underestimation.

**Incidence.** Using the most recent epidemiologic figures [40], there are probably between 30,000 and 45,000 people in the United States with ankylosing spondylitis. Several large series in which morbidity and mortality in these patients were evaluated [3-7] suggest that cervical fracture is an uncommon complication of this disease. The true incidence of this occurrence, however, cannot be ascertained since many of these fractures probably go unreported. In addition, there is some evidence that this complication, when unassociated with major neurologic injury, may go unrecognized. In three of the five cases reported by Storig and Schilling [24], the patients sustained cervical fractures six to 18 months prior to diagnosis. Grisolia et al. [27] reported finding evidence of old vertebral fractures in five of six patients with ankylosing spondylitis uncovered during a survey of 1,646 hospitalized patients.

Based on our experience and the present review, it appears likely that the occurrence of vertebral fracture in patients with ankylosing spondylitis is not a rare event. Since cervical ankylosis develops in 75 percent of the patients with ankylosing spondylitis in whom the duration of disease is 16 years or greater [3,5], cervical fracture presents a very real threat to a substantial number of people.

**Etiology of Fracture.** It is clear that the forces necessary to fracture an ankylosed spine are of a much smaller magnitude than those required to fracture a normal spine. The underlying disease process in ankylosing

**TABLE I Clinical Characteristics of Eight Patients with Ankylosing Spondylitis and Cervical Fracture**

Case No.	Age (yr) and Sex	Duration of AS	Type of Injury	Roentgenographic Appearance	Initial Neurologic Deficit	Type of Treatment	Final Outcome	Comment
1	48, M	20 yr	Motor vehicle accident	C7-T1 IS fx with 90% ant displacement of C7 on T1	No neurologic deficit initially; quadripareisis later developed	Cervical traction with Crutchfield tongs; laminectomy 1 day after injury	Death from respiratory failure 17 days after injury	Intoxicated at time of injury
2	66, M	40 yr	Fall in bedroom	C6 vert body compression fx extending through C5 post elements with 0.5 cm ant displacement of sup fx segment	Transient quadripareisis	Cervical traction with Crutchfield tongs; four-poster brace	No neurologic deficit	Excessive cervical traction may have retarded healing
3	60, M	40 yr	No history of trauma	C6-7 IS fx extending through post elements at C6	Sensory and motor deficits in right upper extremity in C6-7 distribution	Halo traction and body jacket	Minimal residual weakness	Intoxicated night prior to onset of symptoms
4	56, M	23 yr	Motor vehicle accident	Nondisplaced fx through C7 vert body extending obliquely through C5-6 post elements	Quadripareisis below C6 cord level	Cervical traction with Crutchfield tongs; four-poster brace	Minimal neurologic improvement	Difficulty maintaining alignment may have retarded healing
5	45, M	23 yr	Fall in bedroom	C6 vert body fx extending through C5 post elements; 30% post angulation of sup fx segment; fx of C3, 4, 5 spinous processes	Quadripareisis below C5 cord level	Cervical traction with Gardner-Wells tongs	Death from pneumonia and sepsis 15 wk after injury	Intoxicated at time of injury
6	49, M	25 yr	Fall to ground from bulldozer	C6-7 IS fx extending through post elements with 3 mm ant displacement of sup fx segment	Weakness in the right upper extremity	Halo traction and body cast	Complete neurologic recovery	3 wk delay in fracture recognition
7	65, M	18 yr	Fall on sidewalk	C6 vert body compression fx extending through C5-6 post elements with 40% forward angulation of sup fx segment	None	Halo traction and body cast; anterior fusion with strut graft 4 mo after injury	No neurologic deficit	Pseudoarthrosis developed requiring anterior fusion
8	49, M	15 yr	Blow to head and fall to floor	C5-6 IS fx extending through post elements with 1 cm post displacement of sup fx segment	Quadripareisis below C5 cord level	Cervical traction with Gardner-Wells tongs; laminectomy; halo traction and body cast; posterior cervical fusion; cervical collar	Quadripareisis below C4 cord level	Intoxicated at time of injury

NOTE: C7 = seventh cervical vertebrae, T1 = first thoracic vertebrae, etc.; IS = interspace; fx = fracture; ant = anterior; vert = vertebral; sup = superior; post = posterior.

**TABLE II Clinical Features of 83 Patients with Ankylosing Spondylitis and Cervical Fracture**

Feature	No.
Sex	
Male	77
Female	5
Unspecified	1
Age (yr)*	
Mean	53
Range	33-77
Duration of spondylitis† (yr)	
Mean	22
Range	6-45
Intoxication	12

\* Determined from 77 cases.

† Determined from 46 cases.

spondylitis transforms the vertebral column and its ligamentous attachments into a solid column of tubular bone through which the spinal cord passes. This transformation, together with the development of osteopenia as the disease progresses, results in a brittle, rigid structure poorly suited to withstand stress and thus susceptible to fracture. It is not surprising that the majority of fractures in these patients occurred following minor trauma. In only three of the eight cases reported here (Cases 1, 4 and 6) was the trauma considered severe enough to have resulted in fracture of a normal spine (Table I).

Considering these cases together with those in the literature (Table III), minor trauma accounted for 46 percent of all cervical fractures associated with ankylosing spondylitis. In another 7 percent, no history of trauma was obtained. Falling out of bed [18] or from a wheelchair [29], driving a motor vehicle over rough terrain [18], simple falls to the floor [2,25] and chiropractic manipulation of the neck [31,37] have been reported to result in cervical fracture in patients with ankylosing spondylitis. The minor nature of the trauma and the frequent symptoms of spinal pain associated with this disease can result in costly delays in recognition and appropriate management of cervical fracture in these patients [41,42]. Distortion of vertebral architecture and osteopenia make roentgenographic identification of a fracture line difficult. Furthermore, the characteristic posture of these patients makes it difficult to remove the shoulders from view so that the lower cervical segments can be properly evaluated. Oblique views and tomography may be necessary. If these measures fail, radionuclide imaging may be useful [43].

**Location and Mechanism of Fracture.** The cervical spine is the most common site of spinal fracture in patients with ankylosing spondylitis. According to a recent review [44], 75 percent of all fractures occurring in these

**TABLE III Etiology of Cervical Fracture in 83 Patients with Ankylosing Spondylitis**

Etiology	No.	%
Minor fall	38	46
Major fall	14	17
Motor vehicle accident	19	23
Trauma—extent unspecified	6	7
No history of trauma	6	7
Total	83	100

**TABLE IV Location of Cervical Fracture in 83 Patients with Ankylosing Spondylitis**

Cervical Level	No.	%
<b>Predominantly interspace fracture</b>		
C1-C2	0	0
C2-C3	1	1
C3-C4	2	2
C4-C5	6	7
C5-C6	21	25
C6-C7	16	19
C7-T1	4	5
<b>Predominantly vertebral body fracture</b>		
C1	0	0
C2	1	1
C3	2	2
C4	3	4
C5	3	4
C6	16	19
C7	6	7
Undetermined	3	4
Total	84*	100

\* Cervical fracture at two levels occurred in one patient [20].

patients involves the cervical region or the cervicothoracic junction; 14 percent and 5 percent involve the thoracic and lumbar regions, respectively. Although fractures at almost every cervical level have been reported, the lower cervical segments (fifth through the seventh cervical vertebrae) are most susceptible to injury (Table IV).

Hyperextension is the most common mechanism of fracture in patients with ankylosing spondylitis due to the rigidity of the spine and the position of the head and neck in relationship to the thoracic spine [2,10,13,29]. With advancing disease the ankylosed cervical spine becomes angulated forward in a fixed position of extension in relation to the kyphotic thoracic spine. In the event of a forward fall, the neck cannot be forwardly flexed in the normal defensive manner and the head strikes the surface in a position that forces the neck into hyperextension. On the other hand, if the patient falls in the opposite direction the head is propelled backward and, because of the thoracic kyphosis, the neck is once again forced into hyperextension. Although less frequent, flexion injuries do occur in these patients and

**TABLE V** Comparison of Initial and Final Neurologic Status and Mortality Rates Following Cervical Fracture of Ankylosed and Normal Spines

	Cervical Spine			
	Ankylosed		Normal [1]	
	No.	%	No.	%
Initial neurologic deficit				
None	25	30	27	35
Minor*	12	15	34	45
Major†	46	55	15	20
Total	83	100	76	100
Final outcome				
Return to work‡	36	43	54	71
Neurologic deficit§	18	22	8	11
Death¶	29	35	14	18
Total	83	100	76	100

\* Mild sensory or motor dysfunction or abnormal reflexes or symptoms of nerve root pressure.

† Complete or incomplete spinal cord interruption.

‡ Those who actually did return to work or had the neurologic potential.

§ Paraparesis, quadriparesis or residual neurologic deficit preventing return to work.

¶ Within 13 months of injury.

**TABLE VII** Type of Management in 83 Patients with Ankylosing Spondylitis and Cervical Fracture

Type	No.	%	Deaths	
			No.	%*
Conservative†	48	58	14	29
Surgical	20	24	9	45
Laminectomy alone	9	...	...	...
Cervical fusion alone	5	...	4	...
Both	6	...	1	...
Unspecified	15	18	6	40
Total	83	100	29	35

\* Refers to mortality rate within each treatment group.

† Cervical traction with Crutchfield tongs, Gardner-Wells tongs, Vinke tongs, halo apparatus, Sayre halter, maxillary hooks; immobilization with Minerva jacket, cervical collar, four-poster brace; or bedrest alone.

generally result from forces directed anteriorly against the posterior aspect of the head or neck.

Most cervical fractures (70 percent) in these patients occur through what was formerly the intervertebral disc space. However, contrary to earlier reports [11,15,22], fractures involving the vertebral bodies are not rare (Table IV). Some investigators have observed that hyperextension injuries result in interspace fractures, whereas flexion trauma leads to fracture of the vertebral body [21,35].

**Neurologic Sequelae and Mortality Rate.** In the ankylosed spine, fractures invariably extend through the entire width of the spine including the calcified liga-

**TABLE VI** Cause of Death in 29 Patients with Ankylosing Spondylitis and Cervical Fracture

Cause	No.	%
Respiratory failure	10	35
Pulmonary infection	5	17
Perforated duodenal ulcer	2	7
Gastrointestinal hemorrhage	1	3
Pulmonary embolism	2	7
Unspecified	9	31
Total	29	100

mentous supporting structures. This was true in every case comprising the present series. Consequently, this type of fracture is extremely unstable and results in a high frequency of spinal cord and nerve root injury. Of our eight patients, cervical fracture resulted in the development of a neurologic deficit in seven. In one, quadriplegia was only transient and in two others the injury resulted in nerve root deficits which later resolved. In the remaining four, however, severe permanent quadriplegia developed, culminating in death in two.

If the experience with cervical fractures of ankylosed spines is compared with a large series of similar fractures involving normal spines [1], some striking differences become apparent. As shown in Table V, fracture of ankylosed cervical spines results in a higher frequency of neurologic deficits; severe neurologic sequelae (paraparesis or quadriparesis) occur nearly three times more frequently. Death occurred nearly twice as often in patients with ankylosing spondylitis (35 versus 18 percent). In general, delay in seeking medical attention [2,2], failure in fracture recognition [22], instability of the fracture site, inappropriate treatment [31] and the reduced general state of health of patients with ankylosing spondylitis [4] resulted in a poorer outcome.

The causes of death complicating cervical fracture in 29 patients are listed in Table VI. Respiratory failure and pulmonary infection accounted for at least 52 percent of these deaths. The restrictive ventilatory defect from chest wall rigidity increases the risk of death from respiratory complications. In three cases death was due to either duodenal perforation or gastrointestinal hemorrhage [2,25,36]. In none of these cases was the therapeutic use of corticosteroids mentioned. Two patients died following pulmonary embolization [27,36], and in nine the cause of death was not specified [9,12,18,25,26,29,32].

**Management.** The majority of patients in this review (58 percent) were managed conservatively, most commonly with skeletal traction (Table VII). Owing to the extremely unstable nature of these fractures and the presence of distorted vertebral architecture, the application of skeletal traction and the maintenance of sat-

isfactory reduction was difficult. Care must be taken to prevent hyperextension of the superior fracture segment which can occur when traction is applied in the usual neutral position. Application of traction with the cervical spine in slight flexion is usually required. Loss of reduction after attainment of satisfactory alignment resulted in progressive neurologic injury and/or sudden death in several cases [18,21,25]. This occurred following slight movements of the head, as with coughing or patient repositioning during routine nursing care. In our experience the halo apparatus mounted on a body cast or jacket is the preferred method of immobilization since it provides rigid stabilization in all three planes and results in less patient discomfort [45,46].

Twenty patients were treated surgically; nine with laminectomy alone, five with cervical fusion and six with both. Nine patients in this group died (45 percent) as compared to 14 (29 percent) in the conservatively managed group. The reason for the higher mortality rate in this group is unclear; the surgically treated patients may have had more severe initial neurologic injuries. The role of laminectomy in the management of cervical fractures is controversial [47]. However, one indication for this procedure appears clear—progression of a neurologic lesion or development of a neurologic deficit in a patient previously normal neurologically. Several instances of epidural hemorrhage and associated spinal

cord compression responding to laminectomy have been reported [19,32].

The time required for healing does not appear excessive in patients with ankylosing spondylitis. In fact, some investigators believe healing may be facilitated by the tendency toward bony ankylosis inherent in the underlying disease process [11]. Prolongation in the healing process may result from excessive traction or inadequate immobilization. Pseudoarthrosis can occur [48, Case 7].

The principle objectives in the management of those who have incurred cervical fracture remain clear. These include reduction of the fracture and realignment of the spine to relieve or forestall spinal cord compression, immobilization of the fracture segments to prevent further neurologic injury and to facilitate healing, and anticipation and treatment of such complications as respiratory insufficiency and infection. The ultimate outcome is determined by the success or failure with which these objectives are met. Unfortunately, a recent critique of the early management of fracture-dislocation of the cervical spine by U.S. physicians was not favorable [49].

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