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# MULTIPLE NON-CONTIGUOUS INJURIES TO THE SPINE

LAXMAN S. KEWALRAMANI & ROBERT G. TAYLOR

UCD-Sacramento Medical Center and University of California School of Medicine, Davis, California, U.S.A.

Over a period of 4 years, 120 patients with an identified neurologic defect secondary to spinal cord injury were admitted to the UCD-Sacramento Medical Center. Of these cases five (4.2 per cent) were found to have multiple non-contiguous injuries to the spine which would have been capable of producing complete neurologic loss at either level. Proper treatment is dependent on diagnosis, and correct diagnosis is dependent on the awareness that multiple non-contiguous injuries to the vertebral column can occur in victims of severe motor vehicle accidents.

*Key words:* spinal injury; spinal cord injury; paralysis

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In high speed automobile accidents the injuries that the patient may receive are almost always multiple and the examining physician must be alert to the possibility of multiple organ system involvement. The neurologic injury which is perhaps the easiest to overlook is the presence of spinal cord damage in an unconscious patient, and this may remain untreated until the patient regains consciousness. Another combination in which one neurological injury can be concealed by another is the presence of multiple non-contiguous injuries to the spine, with either or both lesions being capable of producing the paralysis.

Multiple non-contiguous injuries to the spine, as used in this text, are defined as injuries to the vertebral column at more than one site, with these sites being separated by an area of normal spine. A review of the literature revealed a paucity of references on this subject. The purpose of this paper is to report five patients with such a problem who represent 4.2 per cent of the patients with spinal injury admitted to the UCD-Sacramento Medical Center during the period January 1970 to December 1973. Clinically the level of neurological deficit was assessed by repeated motor and sensory examination. Osteoarticular injury to the vertebral column was evaluated by radiographs. Evidence of injury to the vertebral column found at the time of operation is also included where appropriate. Awareness that such multiple injuries to the spine can occur will lead to more adequate evaluation and permit early recognition and treatment of these disorders so as to avoid deterioration of neurologic function.

## CASE REPORTS

*Case 1.* H.D. A 51-year-old male was the driver of an automobile which rolled 100 feet down an embankment. Initially he was seen at another hospital and was found to be semicomatose without any focal localizing signs. Twenty-four hours later when he regained consciousness he was noted to be a $C_7$ tetraplegic with some sacral sparing. Radiographs of the spine showed a wedge compression fracture of the $T_6$ vertebral body (Figure 1 A) and cervical spine radiographs were interpreted to be normal. On myelography a complete block was noted at the $C_6$ intervertebral space. Decompression laminectomy ($C_5$–$T_1$) was done revealing fracture of the right lamina of $C_6$ and a hyperemic spinal cord without evidence of contusion. At 2 months following the initial injury the patient was allowed to sit up. Three weeks later subluxation of $C_6$ on $C_7$ (Figure 1 B) was detected and anterior fusion was performed.

*Comments.* In this patient the diagnosis of spinal cord injury was delayed because of unconsciousness. Twenty-four hours later when the patient regained consciousness, the level of paralysis indicated injury to the spinal cord, although the radiographs of the cervical spine appeared to be normal. Myelography revealed a block at $C_{6-7}$, and fracture of the right $C_6$ lamina was found during laminectomy.

*Case 2.* D.M. An 18-year-old female college student was a passenger in the rear seat of an automobile which was involved in a two-vehicle head-on collision, and the patient was thrown out of the car. There was no loss of consciousness and she noticed immediately loss of sensation in the lower half of her body and inability to move the lower limbs. On admission to hospital she was found to be paraplegic with complete sensory and motor loss below $T_5$. This patient also had a Horner's Syndrome on the right side. Radiographs of the spine showed fracture dislocation of $T_{5, 6 \& 7}$ with maximum compression-dislocation at $T_6$, and fractures of the spinous processes of $C_{6, 7}$ and $T_1$ (Figure 2). On decompression laminectomy ($T_4$–$T_8$) the spinal cord was reported to be macerated.

*Comments.* The severity of the initial trauma was obvious. Thoracic spine injury was the important injury for the paraplegia. In the absence of any evidence of bruising of the neck it is unlikely that the Horner's Syndrome was secondary to direct neck injury. The fractures of the spinous processes of $C_{6, 7}$ and $T_1$ with right Horner's Syndrome suggest the possibility of injury to the cervical spinal cord or intraspinal root injury.

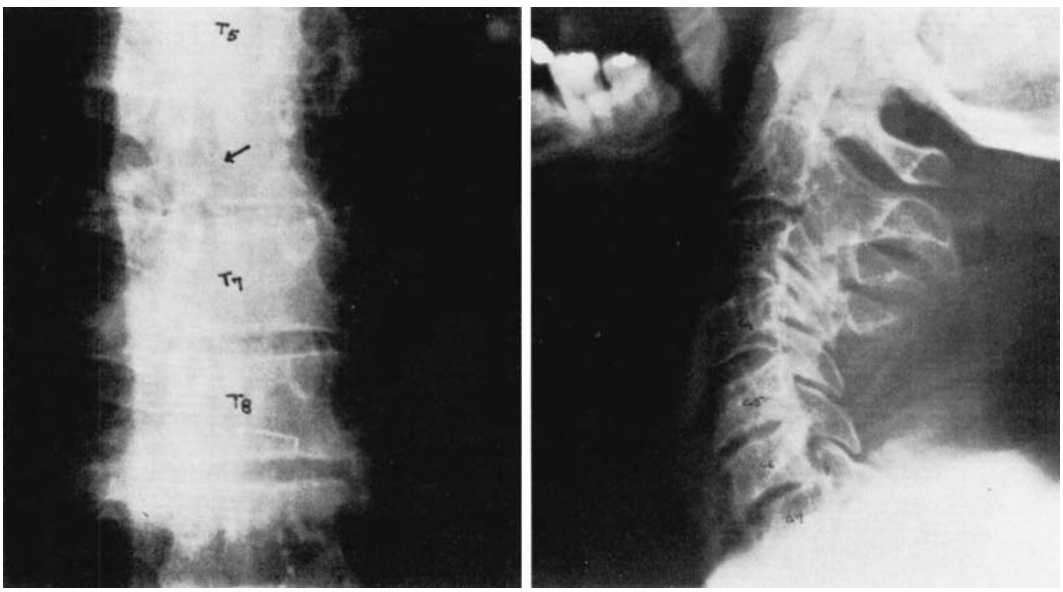


*Figure 1. (Case 1). A. Left—x-ray thoracic spine, approximately 1 month following injury, reveals compression fracture of $T_6$ vertebral body with splitting of the vertebral body. B. Right—x-ray of cervical spine 12 weeks following injury, and after sitting has been allowed, reveals subluxation of $C_6$ vertebral body on $C_7$.*

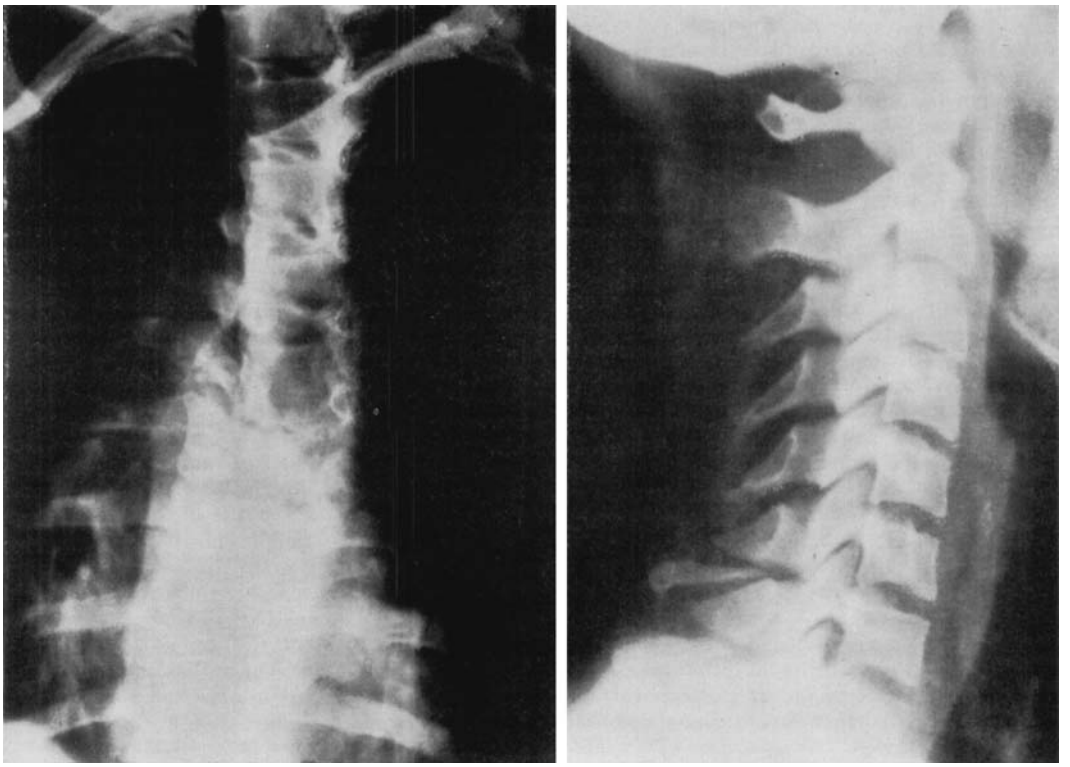

*Figure 2. (Case 2). Left—x-ray of thoracic spine, taken at time of admission, reveals fracture dislocation of $T_5$, $T_6$ & $T_7$ with maximum compression and displacement at $T_6$. Right—x-ray of cervical spine, taken at time of admission, reveals fractures of the spinous processes of $C_6$ and $C_7$. The spinous process of $T_1$ was also fractured but is not visible on this plate.*

*Case 3.* S.G. An 18-year-old male was the driver of an automobile which rolled over on relatively level ground. He noticed inability to move his upper and lower limbs immediately following the injury. Loss of sensation below $T_{10}$ and loss of motor power in both lower limbs was detected in the emergency room. One hour later he was noted to have sensory loss below $T_6$ and motor loss below $C_7$. X-rays of the thoracic spine revealed wedge compression of $T_{11}$ vertebral body (Figure 3 A). Since the level of paralysis rapidly ascended to $C_7$, radiographs of the cervical spine were obtained, which showed a fracture dislocation of $C_7$ on $T_1$ (Figure 3 B). Two years following the injury, the patient is still a tetraplegic below the $C_7$ level.

*Comments.* At the time of the initial examination in the emergency room, with sensory and motor loss below $T_{10}$ and radiographic evidence of a wedge compression fracture of $T_{11}$, the examining physician was satisfied with the diagnosis. Since there were no symptoms or signs referable to the cervical lesion at that time, it was overlooked until an hour later because of the ascending motor level to $C_7$; radiographs of cervical spine were obtained showing fracture dislocation of $C_7$ on $T_1$.

*Case 4.* E.W. A 23-year-old, slightly obese male, was a passenger in the front seat of a pickup truck which was forced from the road and hit a fence. The patient was thrown out of the vehicle. At the time of admission to hospital the patient was found to be paraplegic with motor and sensory loss below $T_5$. There was patchy sparing of sensation in the lower limbs. In the upper limbs there was hypoesthesia below $C_5$ dermatome and asymmetric weakness of wrist flexors and extensors. Deep tendon reflexes were hyperactive in the lower limbs. The Babinski sign was positive bilaterally. Radiographs of the spine showed fracture dislocation of $T_5$ on $T_6$; subluxation of $C_4$ on $C_5$ and a wedge compression fracture of $C_5$ vertebral body (Figure 4 A & B). Following placement of Crutchfield tongs for cervical traction, decompression laminectomy $T_5$–$T_7$ was done. The lamina of $T_6$ was found to

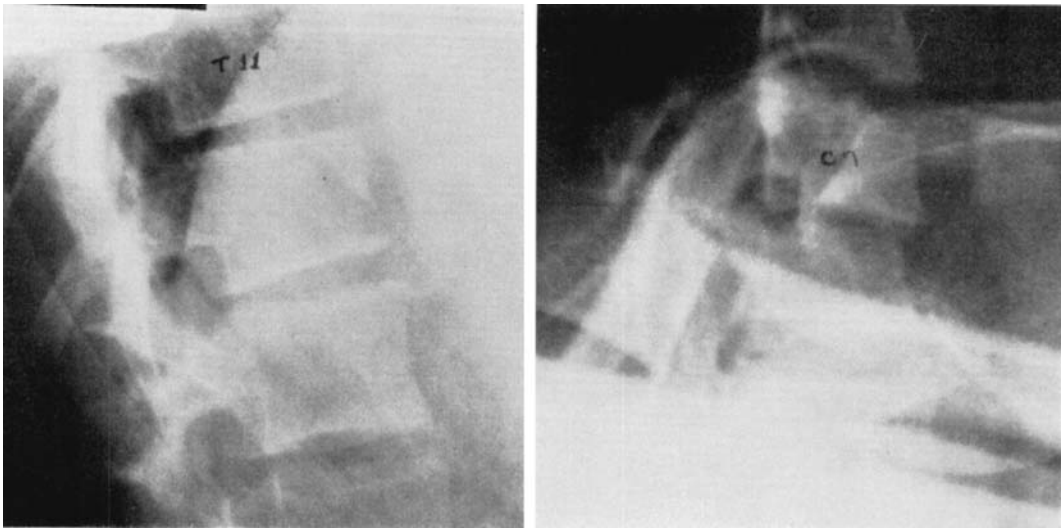


*Figure 3. (Case 3). A. Left—x-ray of thoracic spine, taken at time of admission, reveals compression fracture of $T_{11}$ vertebral body. B. Right—x-ray of cervical spine, taken at time of admission, reveals fracture dislocation of $C_7$ vertebral body on $T_1$.*

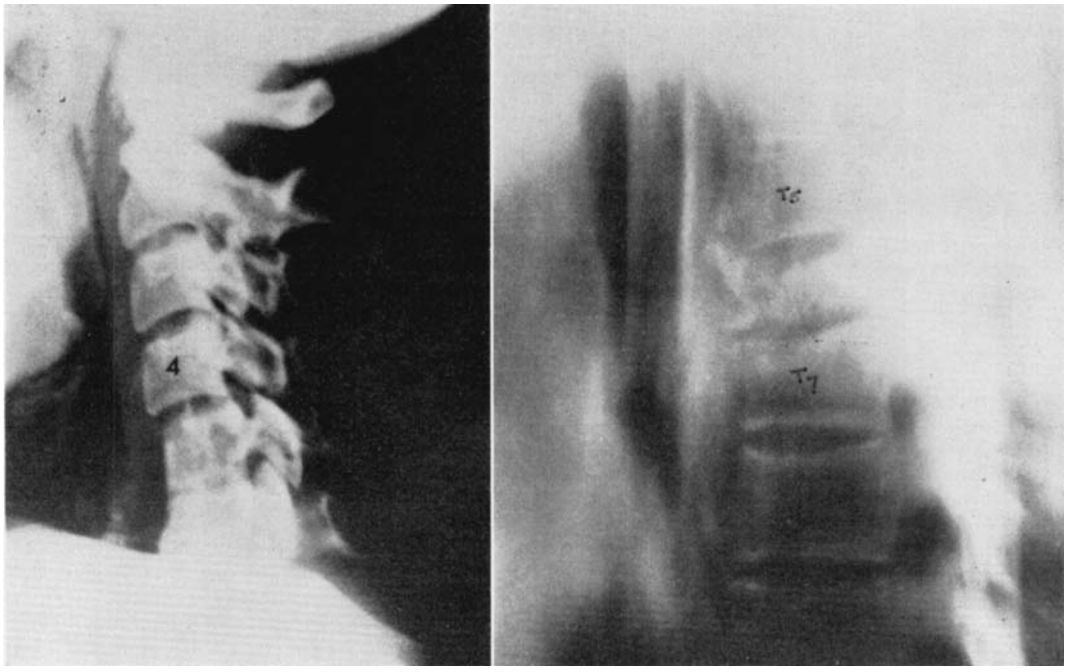


*Figure 4. (Case 4). A. Right—x-ray (tomogram) of thoracic spine taken 4 weeks following injury. This tomogram adequately demonstrates comminuted fracture of $T_6$ vertebral body plus fracture of the inferior angle of $T_5$ and wedging of the body of $T_7$. Dislocation of $T_5$ vertebral body on $T_6$ was more evident on the plain films. B. Left—x-ray of cervical spine, taken 4 weeks following injury, reveals compression fracture of $C_5$ with subluxation of $C_4$ vertebral body on $C_5$.*

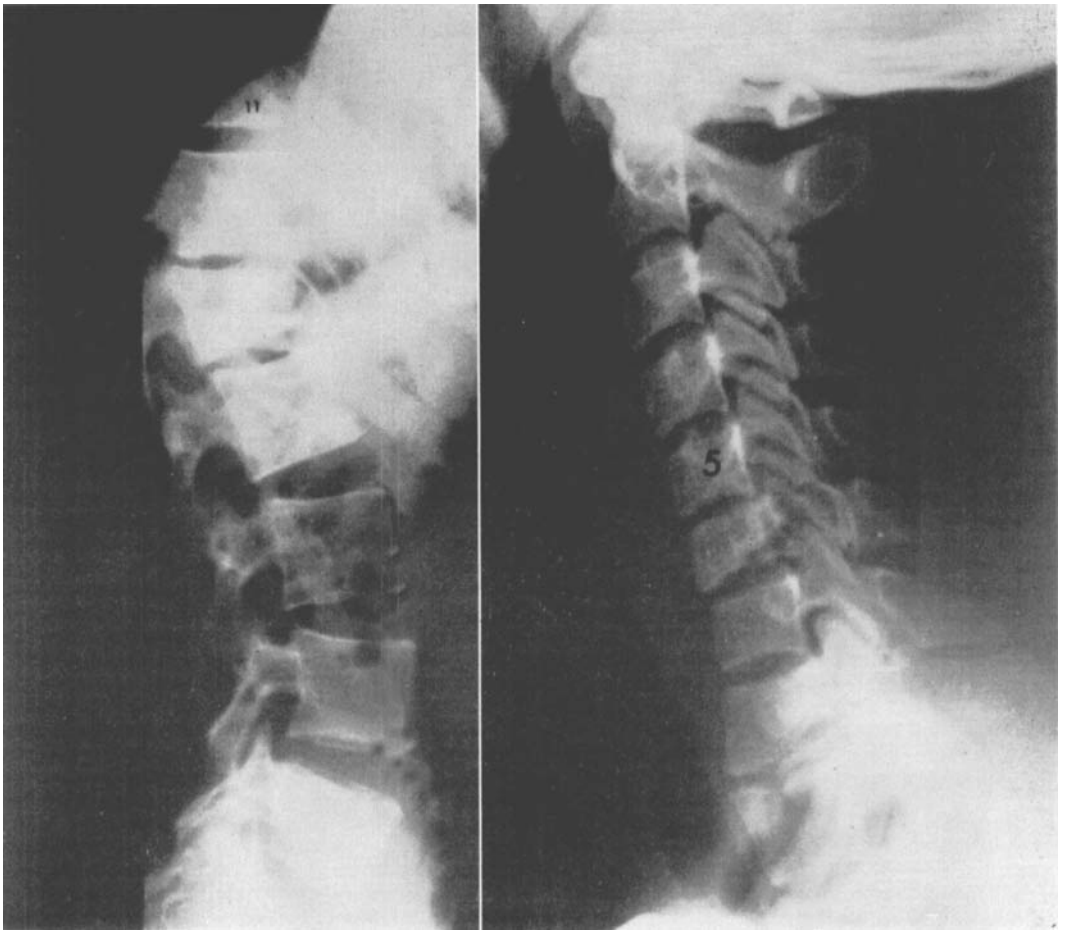

*Figure 5. (Case 4). A. Left—x-ray of thoracic spine at the time of admission revealed wedge compression fracture of $L_1$ vertebral body. B. Right —x-ray of cervical spine showing wedge fracture of $C_6$ and subluxation of $C_6$ on $C_7$.*

be fractured and the spinal cord was reported to be normal. Two years following the injury, the patient has normal motor power in all four extremities and actively participates in sports.

*Comments.* The initial neurological findings could easily have been explained by the flexion rotation injury to the thoracic spine. Had the subtle evidence of the cervical lesion been overlooked, or explained away as peripheral nerve injury, the patient might easily have become a permanent tetraplegic from the cervical spine injury.

*Case 5.* D.H. An 18-year-old male was involved in a motorcycle versus automobile accident. Two hours later in the emergency room he complained of pain in the lower part of his back. There was no detectable neurological deficit. Radiographs of the spine showed wedge fracture of $L_1$ vertebral body and fracture subluxation of $C_6$ on $C_7$ (Figure 5 A & B). The patient was hospitalized for one week and was immobilized in a sternal occipital mandibular immobilization device.

*Comments.* In this patient the severity of the vertebral injury was obvious (Figure 5 A & B) but there was no neurological injury. By early diagnosis and appropriate treatment any deterioration in functional status was avoided.

## DISCUSSION

The incidence of multiple non-contiguous injuries to the spine is probably very low.

*Table 1. Injuries observed.*

| Case # | Cervical spine | | Thoracic and lumbar spine | | Associated injuries |
|---|---|---|---|---|---|
| | Vertebral | Neurological | Vertebral | Neurological | |
| 1. | Fracture Rt. lamina $C_6$ (found during operation) | Tetraplegia | Wedge fracture $T_6$ | | Multiple bruises, closed head injury, unconscious 24 hours. |
| 2. | Fracture spinous processes $C_{6-7}$, $T_1$ | Horner's Syndrome right side | Fracture-dislocation $T_{5-6-7}$ | Paraplegia $T_5$ | Fracture left radius, fracture pelvis, sacro-iliac separation, pulmonary contusion. |
| 3. | Fracture subluxation $C_7$–$T_1$ | Tetraplegia $C_7$ | Wedge fracture $T_{11}$ | Sensory loss below $T_6$ | Multiple bruises, cerebral concussion. |
| 4. | Fracture subluxation $C_{4-5}$ | Sensory loss below $C_5$ with sparing, asymmetric upper limb weakness | Fracture-dislocation $T_{5-6}$ | Paraplegia $T_5$ | Fracture clavicle (Rt.), fracture 4th rib (Rt.), pulmonary contusion, rupture spleen. |
| 5. | Wedge fracture of $C_6$ | Normal | Wedge fracture $L_1$ | Normal | |

Griffith et al. (1966) in a series of 250 cases with spinal injuries, reported only five cases (2 per cent) with injury to the dorsal and lumbar regions. Bentley & McSweeney (1968) reported four cases of co-existing injuries to the cervical and thoracic spine. They were able to identify only one case with injury to the cervical and lumbar spine in the report published by Kosven (1965). It is probable that there are many other cases of non-contiguous injuries to the spine as yet unreported. There is a paucity of references on this subject in the medical literature. In this study five cases out of 120 (4.2 per cent) were found to have multiple non-contiguous injuries to the spine: cervical and upper thoracic, 3; and cervical and lower thoracic or lumbar, 2. The four victims of automobile accidents were not wearing seat belts and all had other associated injuries (Table 1).

Early diagnosis of the specific type and severity of the injury to the vertebral column is of critical importance, as treatment and prognosis depend on accurate assessment of the degree of damage to the spine. In patients with complete tetraplegia associated with fracture, dislocation, or fracture-dislocation of the cervical spine, a separate injury to the spine at a lower level would be concealed. If the cephalad lesion is complete the patient's problem would probably not be significantly worsened if the lower lesion was overlooked, unless there was a severe structural instability. But this is not true in the patient where the caudal lesion is neurologically symptomatic and the cephalad lesion is missed. Thus it is obvious that in a patient with clinical evidence of paraplegia and radiographic evidence of injury to the thoracic or lumbar spine, a missed injury to the cervical region could convert the patient into a tetraplegic. If the initial thoracic

or lumbar lesion was incomplete and could possibly show neurological improvement, the results would be even more disastrous if this patient were allowed to become tetraplegic because of the negligence and inadequate treatment of the missed injury to the cervical region.

The comatose patient poses special problems in diagnosis for the possibility of injury to the spinal cord. Loss of voluntary movement and absence of sensation may either be overlooked due to the reduced level of consciousness, or might even be interpreted to be due to intracranial injuries. Since the conventional neurological examination cannot be adequately carried out in unconscious patients, the examining physician is forced to rely on his suspicion and place greater than usual emphasis on radiologic examination. In comatose patients radiographic examination of the entire spine is essential, with particular attention to the more vulnerable, mobile cervical spine, and the cervicothoracic and thoracolumbar junctions. In cases where simple radiographs are inconclusive or suspicious, special views of the areas in question should be obtained. All patients with a suspected injury to the cervical spine must be immobilized until affirmative or negative proof can be obtained.

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Correspondence to: L. S. Kewalramani, M.D., M.S. Orth., UCD-Sacramento Medical Center, Sacramento, Ca. 95817, U.S.A.