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Cervical Spine Injuries: Radiodiagnostic Importance

Jaturat Kanpittaya[†]
Sombat Rojviroj[††]
Shavengsak Suibnugarn[††]
Jitjaroen Chaiyakhum[†]

[†]*Department of Radiology and*
[††]*Department of Orthopedics and Rehabilitation,*
Faculty of Medicine, Khon Kaen University

ภยันตรายต่อกระดูกสันหลังส่วนคอ: ความสำคัญของรังสีวินิจฉัย

จตุรัตน์ กันต์พิทยา† พ.บ., สมบัติ โรจน์วิโรจน์†† พ.บ.,
เชวงศักดิ์ สืบนุการณ์†† พ.บ., จิตเจริญ ไชยาคำ† พ.บ.
†ภาควิชารังสีวิทยา ††ภาควิชาออร์โทปิดิกส์และเวชศาสตร์ฟื้นฟู คณะแพทยศาสตร์ มหาวิทยาลัยขอนแก่น

การศึกษาย้อนหลังของผู้ป่วยที่ได้รับภยันตรายบริเวณกระดูกสันหลังส่วนคอ จำนวน 86 ราย ซึ่งมารับการรักษาที่โรงพยาบาลศรีนครินทร์ตั้งแต่เดือนมกราคม 2525 ถึง มกราคม 2531 พบว่าระดับของกระดูกสันหลังส่วนคอที่ได้รับภยันตรายอันที่ 1 ถึง 2 จำนวน 28 ราย ระดับที่ 3 ถึง 7 จำนวน 58 ราย ครึ่งหนึ่งเกิดจากอุบัติเหตุบนท้องถนน การแบ่งประเภทของภยันตรายได้ยึดถือเอากลไกการบาดเจ็บเป็นพื้นฐาน ซึ่งการตรวจวินิจฉัยทางเอกซเรย์มีประโยชน์มากในการบอกถึงความรุนแรงของภยันตรายและความมั่นคงของกระดูกโดยประกอบกับอาการทางคลินิก ช่วยให้สามารถวางแผนการรักษาผู้ป่วยทั้งในระยะแรกและระยะยาวได้เป็นอย่างดี

ผู้ป่วยเพียง 23 ราย ได้รับการรักษาโดยการผ่าตัด มีผู้ป่วยถึงแก่กรรมจำนวน 4 ราย จากโรคแทรกซ้อน

At Srinagarind Hospital from January 1982 to January 1988, 86 cases of cervical spine injuries were studied retrospectively. The level of involvement were at atlantoaxial in 28 patients, and between third and seventh cervical vertebrae in 58 patients. Half of injuries were by road traffic accident. Classification were base on mechanism of injuries. Roentgenographic examination were very important in evaluation of extent and stability of injuries, correlated with neurological syndrome, for furthur treatment planning.

Only 23 cases were treated by spinal fusion. There were 4 cases died, due to associated complications.

INTRODUCTION

Cervical spine injuries are among the most common causes of severe disability and death following trauma[1]. A practial classification are based on mechanism of injuries and radiological appearances[2]. Recognization of the injuries, proper roentgenographic investigation are helpful in evaluation the extent and stability of injuries.

In present study is undertaken in an attempt to correlate the roentgenological findings, neurological syndrome and outcome of the patients.

MATERIALS AND METHODS

From January 1982 to January 1988, 86 cases of cervical spine injuries were collected at Srinagarind Hospital. These cases were reviewed admission card, radiological findings, operative notes and also follow up information.

A plain film study is the basic examination of these patients. A minimum of two views, include anteroposterior and horizon tal-beam lateral view to preclude the patient motion. The examination try to cover the area from base of skull through the seventh cervical segment, which depends on the patient's clinical condition and neurological status. In some cases additional open-mouh examination were obtained in order to visualize the atlantoaxial articulation in frontal projection.

RESULTS

Of the 86 cases, 66 cases were males and 20 females. The patient ages ranged from 8 to 72 years, with average ages 33 years.

The injuries were due to motor vehicle accidents in 43 cases, 23 cases to falls, trauma in 6 cases, minor trauma in 12 cases and gun shot wound in 2 cases.

Associated condition and injuries are shown in table I

Table I Associated condition and injuries

Associated condition and injuries	Number of cases
Head injury	10
Facial injury	7
Alcoholic	5
Chest injury	6
Extremity and spinal injury (thoracic level)	12

The level of involvements were shown in Table II, III

Table II Injury to C 1-2 level (28 cases)

Type	Number of cases	Neurological deficit	Unstable	Spinal fusion
1. Rotatory subluxation	9	0	0	0
2. Fracture dens	7	2	3	2
3. Old subluxation C1-2	5	3	5	4
c̄ fracture	3			
s̄ fracture	2			
4. Flexion injury c̄ fracture spinous process	2	0	0	0
5. Vertical compression c̄ Jefferson fracture	1	1	0	0
6. Extension injury c̄ fracture pedicle (Hangman's fracture)	4	1	0	0
Total	28	7	8	6

Table III Injury to C3-7 level (58 cases)

Type	Number of cases	Neurological deficit	Unstable	Spinal fusion
A. Flexion				
1. Anterior subluxation	12	8	4	3
2. Bilateral interfacetal dislocation	3	3	3	2
3. Wedge compression fracture	5	3	1	1
4. Clay-shoveler fracture	9	4	1	1
5. Flexion tear drop fracture	1	1	1	1
B. Flexion-rotation				
1. Unilateral interfacetal dislocation	7	6	7	5
C. Vertical compression				
1. Bursting fracture	2	2	0	0
D. Hyperextension				
1. Dislocation	2	1	0	0
2. Extension teardrop fracture	1	1	0	0
3. Laminar fracture	5	3	4	4
4. Traumatic spondylolisthesis	1	0	0	0
E. Miscellaneous				
1. No fracture	4	4	0	0
2. Gun shot wound	2	2	0	0
3. unclassify	4	3	-	-
Total	58	41	21	17

Neurological deficit were presented in 48 cases with complete cord lesion in 13 cases. Unstable injuries were suspected in 29 cases. Only 23 cases were treated by spinal fusion.

Follow up period was about 1 month up to 2 years. There were 4 cases died. Cause of death were due to brain injury, respiratory failure and sepsis.

DISCUSSION

Head and neck injuries are found about 61 percent of persons who have a fatal accident. Huelke[1] estimate that about 6000 occupants of passengers cars die annually in the unitate states as a result of a broken neck. From 500 to 650 people per year become quadriplegic from vehicle crashes. The cervical spine has a high degree of mobility and consequent high susceptibility to injury[3].

The horizontal-beam lateral roentgenogram of the cervical spine is the most important in diagnostic work up of the patient with suspected cervical fracture dislocation. Prevertebral soft tissue might indicate the level of cervical spine injury[4].

Base on clinical biomechanics of the spine,[5-8] we try to predict clinical instability from radiographic appearance of three column (anterior, middle, posterior) of the spine, for evidence of bony fracture or ligamentous rupture, correlated with neurological syndrome.

Injuries to C1-2 level,[9,10] horizontal-beam lateral and open-mouth views are most helpful. There are 7 cases with fracture dens. (Fig 1, 2)

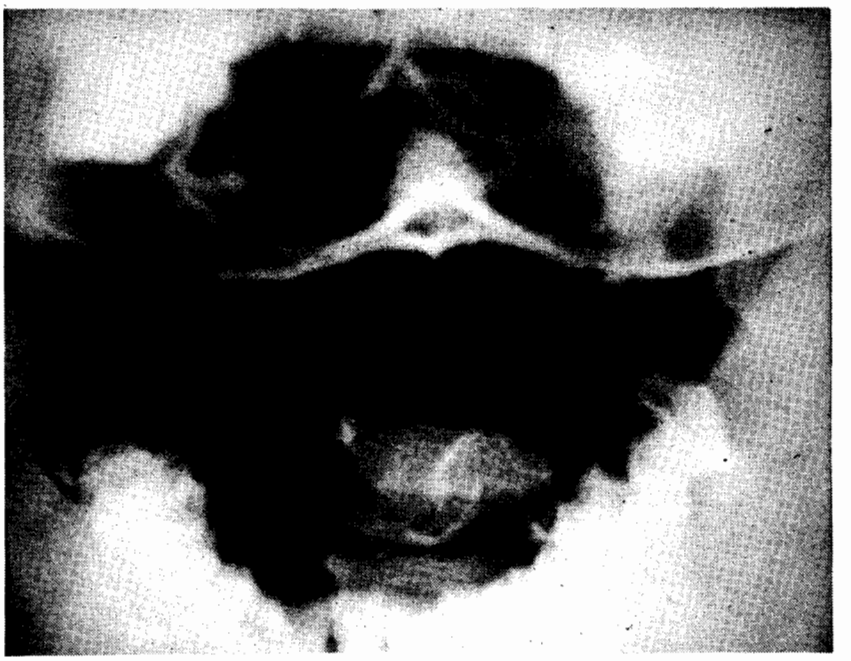


Fig. 1 High dens (type II) fracture (arrowhead) in lateral and open mouth views.

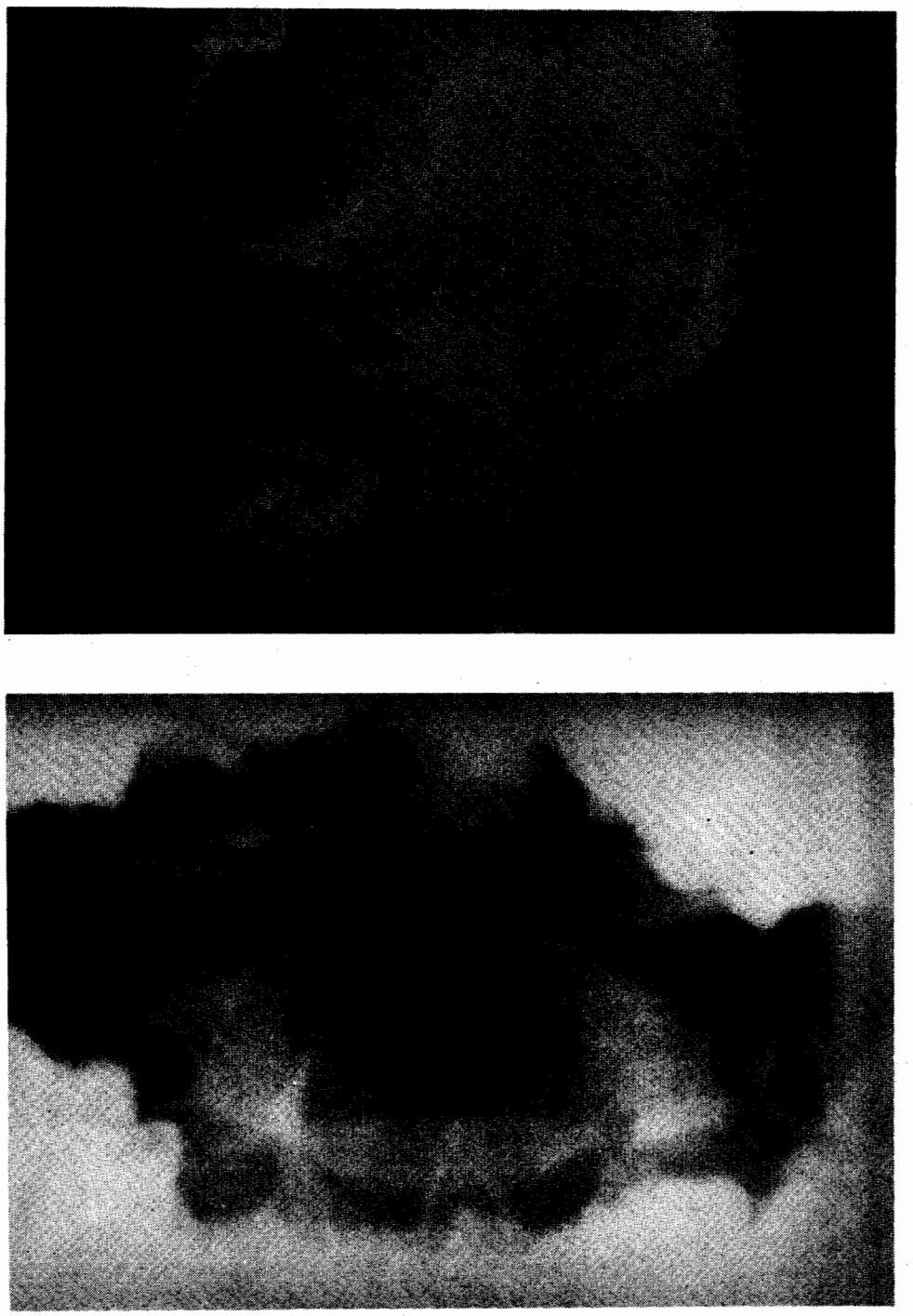


Fig. 2 Low dens (type III) fracture (arrowhead) in lateral and open mouth views. The axis ring is disrupted in lateral projection.

All rotatory subluxation or spasmodic torticollis are stable type (Fig.3). The key to diagnosis is radiologic.[11] Most of cases (6 in 9) are children (8-12 years). These include one case of rheumatoid arthritis with spontaneous subluxation.

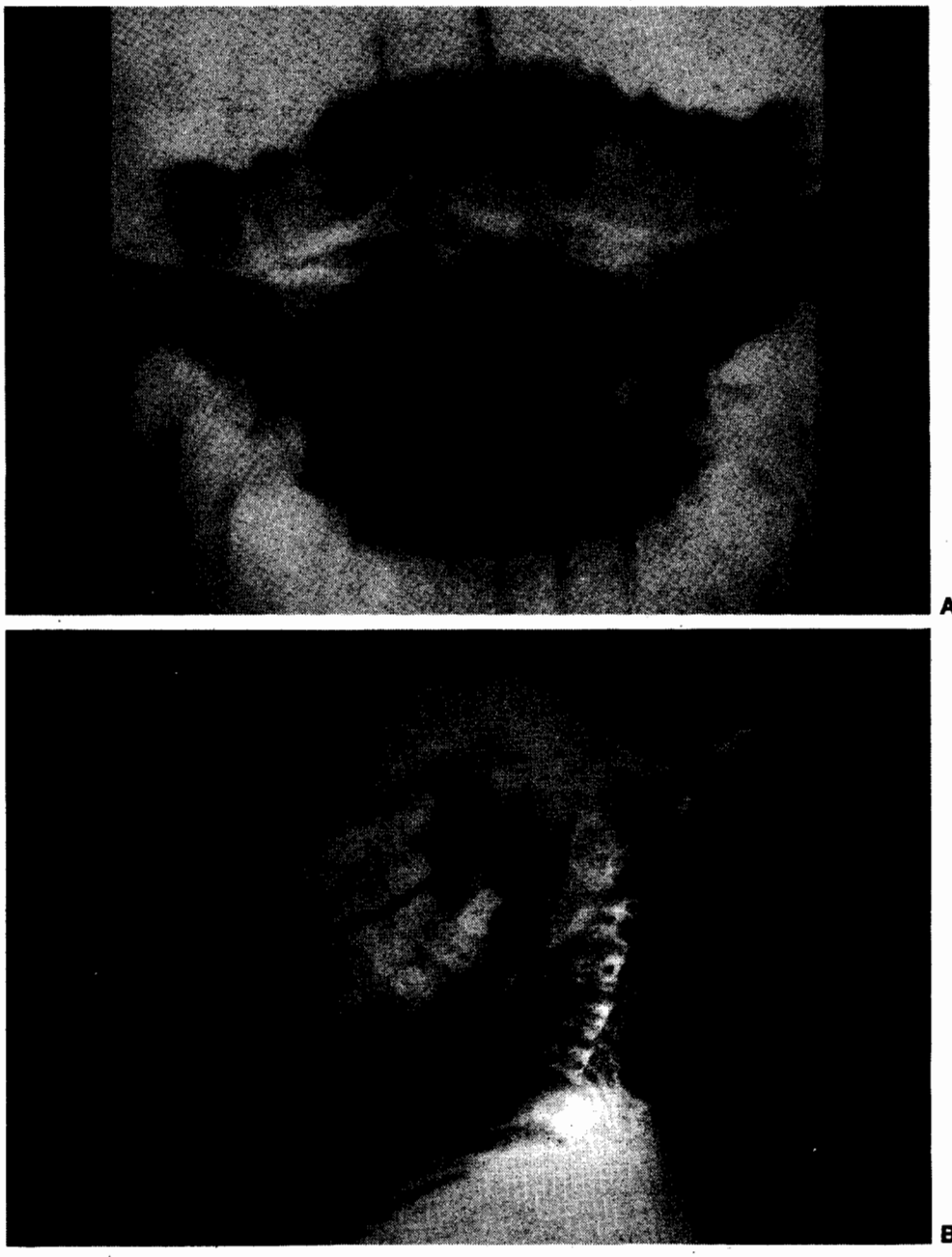


Fig. 3 A rotatory dislocation of C1 on C2
(A) An open mouth view shows asymmetry of space between dens and lateral mass of C1.
(B) On lateral view notes abnormal anterior displacement of the ring of C1 in relation to the dens. (Greater than 3 mm. in children)

Cases of old subluxation at C1-2 level, all 5 cases are unstable as seen from flexion and extension radiographs (Fig.4).

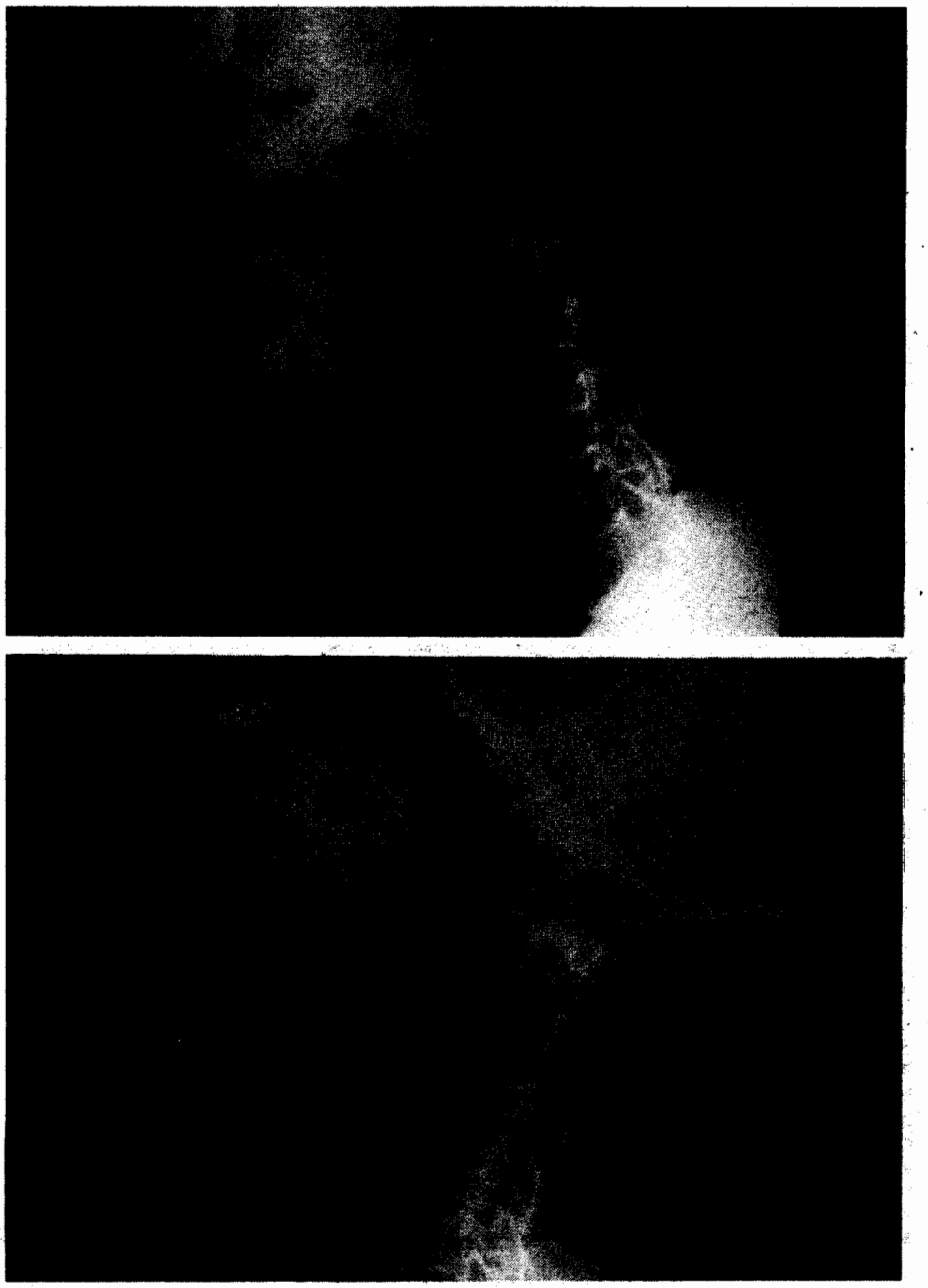


Fig. 4 Flexion-extension lateral radiographs made 4 months after injury, show kyphotic deformity and subluxation of C1 on C2. (Old fracture dens).

One case of Jefferson fracture is stable as predict by radiological criteria[13] (Fig. 5).

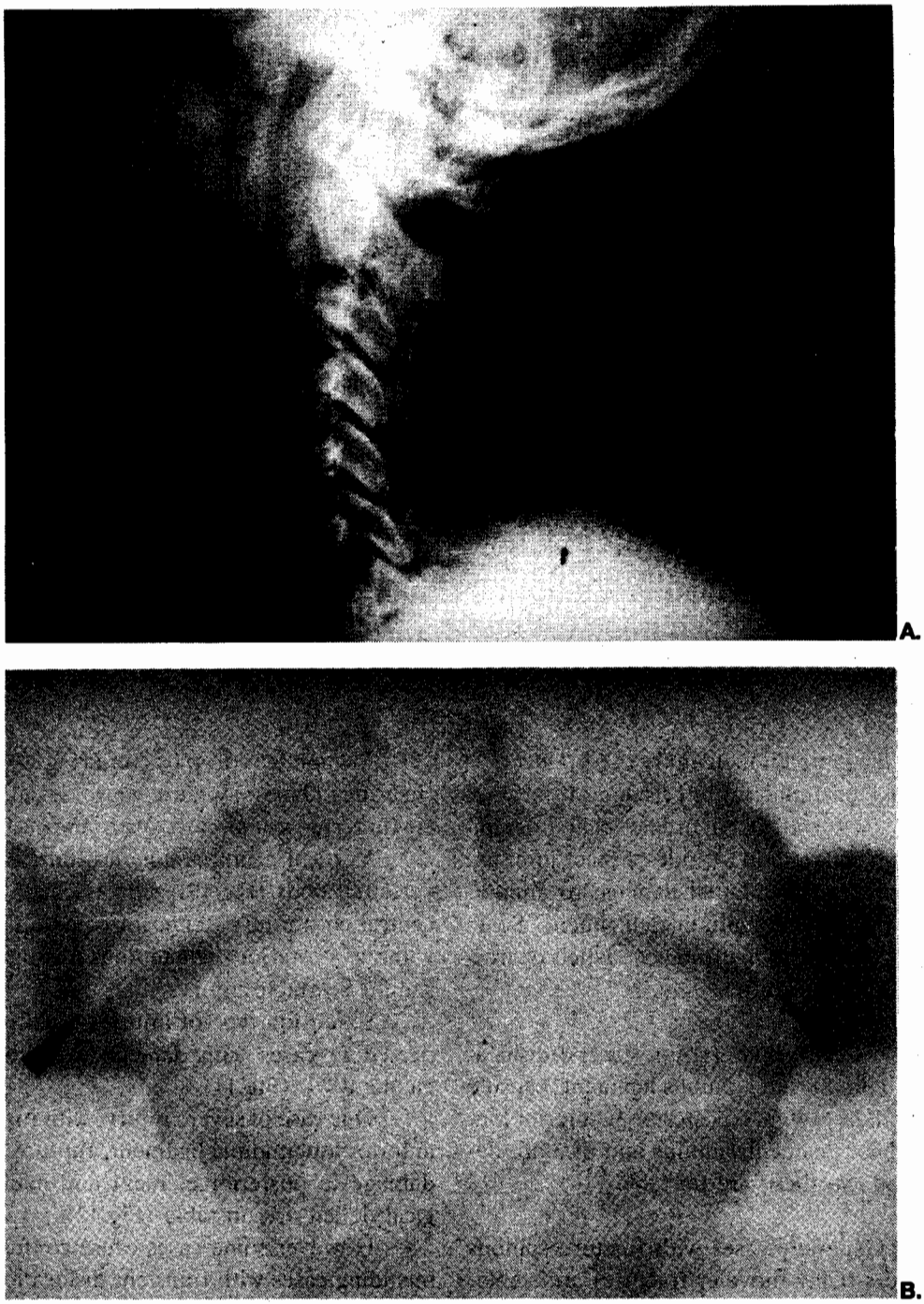


Fig. 5 A Jefferson fracture.
(A) Lateral view shows prevertebral soft tissue swelling at C1, 2 level (arrowhead).
(B) Open mouth view reveals splaying of lateral mass of C1.

Four cases of hangman's fracture are stable (Fig. 6). Clinical experience has shown that the defect of C2 pedicle fracture usually heals with effective immobilization.[14]

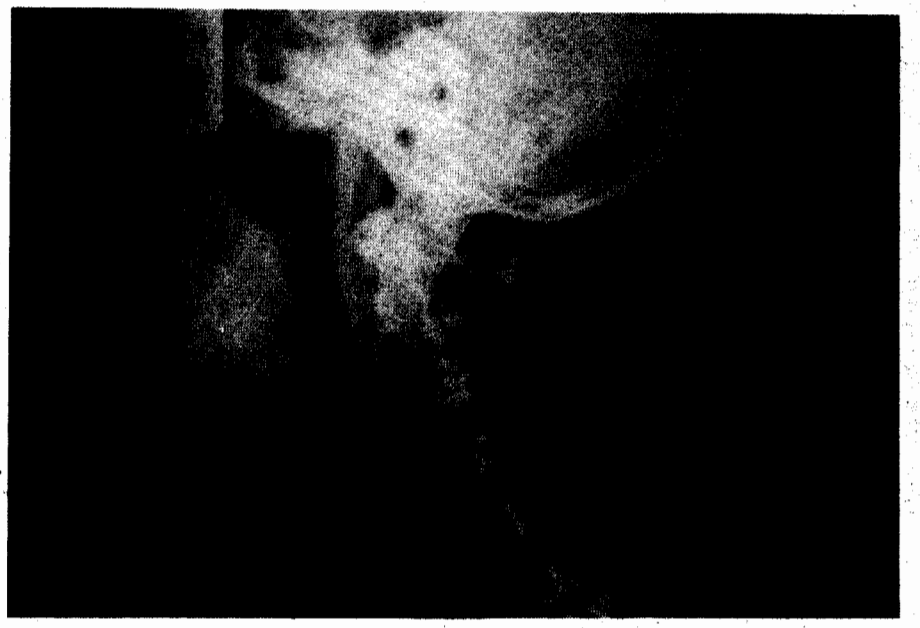


Fig. 6 A hyperextension injury, result in a traumatic spondylolisthesis of C2.(Hangman's fracture).

Pay attension on injury to C3-7 level,[15] in case of unilateral interfacetal dislocation (Fig. 7a,b), Beatson predict that interspinous ligament and capsule of facet joint are ruptured with minimal damage to annulus and posterior longitudinal ligament. So in these cases with neurological deficit or fracture of facet are unstable.

Cases of bilateral interfacetal dislocation. (Fig.8), interspinous ligament, capsule of both facet joints, posterior & anterior longitudinal ligament, annulus and disc are damaged. So these are unstable.

Generally cases with fracture spinous process (Clay-shoveler fracture) are stable, because posterior longitudinal ligament are intact, except in severe injuries. Fracture of vertebral body without posterior element fracture or ligamentous disruption is stable (simple wedge fracture)

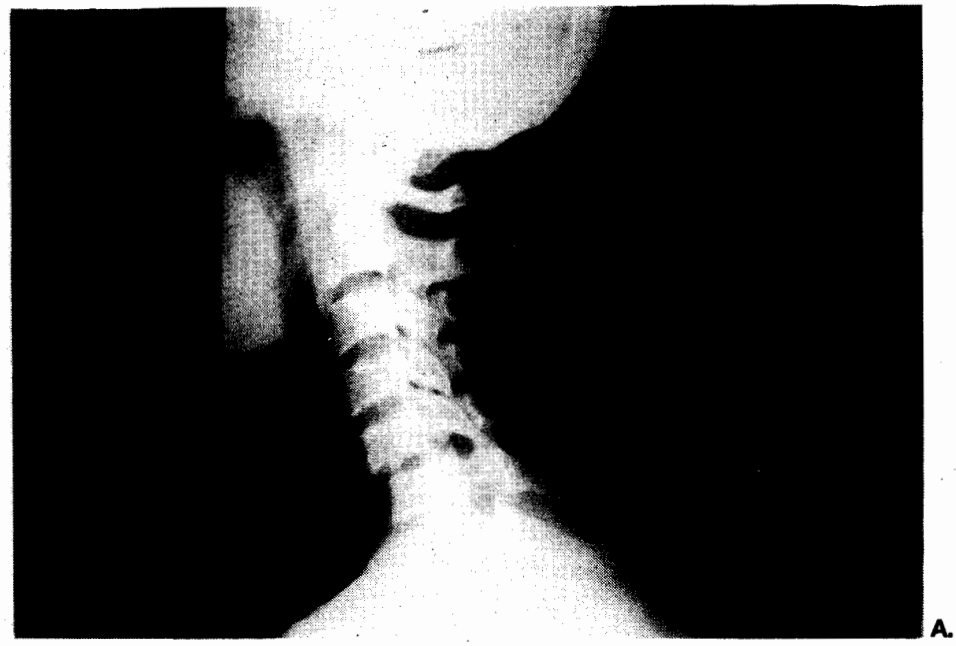
Flexion tear drop fracture (Fig. 9) with shearing failure may cause neurological deficit (anterior spinal cord syndrome).

Vertical compression with bursting of vertebral body (Fig.10), may associate with central cord injury. Anterior column injury without posterior ligamentous disruption, should be stable injury.

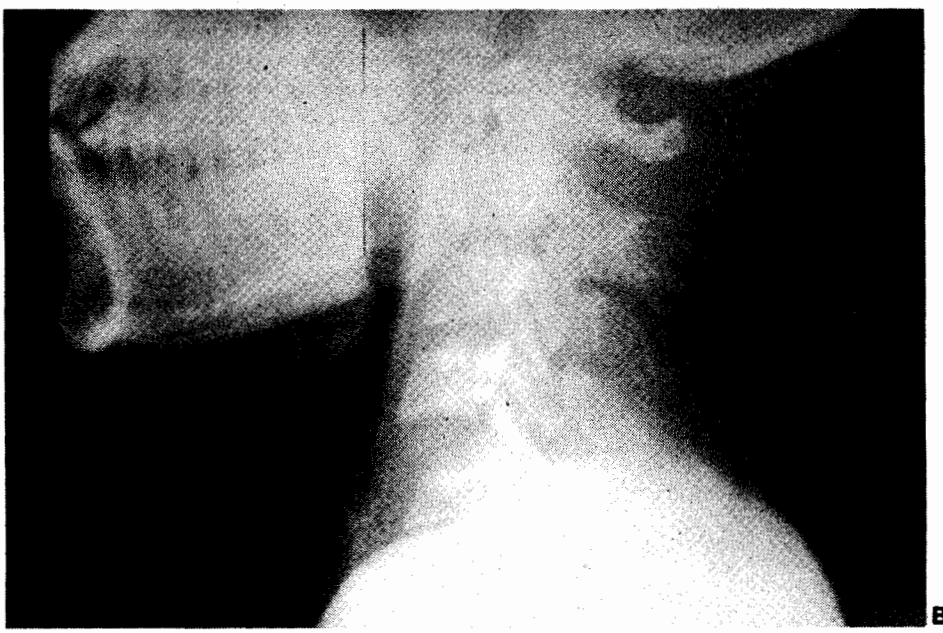
Extension type of injuries usually suspected in cases with damage to posterior element[16,17](Fig.11)

One case of severe injury, with rupture anterior longitudinal ligament, rupture disc, damage to posterior element and neurological deficit are unstable (Fig.12).

However some cases cause confusion, including cases with transient dislocation or spinal cord injury without evidence of fracture or dislocation. These may be due to complexity mechanism of injuries, depend on major injury vector (MIV) of traumatic forces.[5]



A.



B.

Fig. 7 (A) Lateral radiograph of unilateral facet dislocation cause minimal anterior displacement of C5 on C6. Also note fracture spinous process of C6.

(B) Another case of unilateral left facet dislocation with abnormal anterior translation of C4 on C5. This is an unstable injury due to associated fracture facet right side and both lamina of C4.

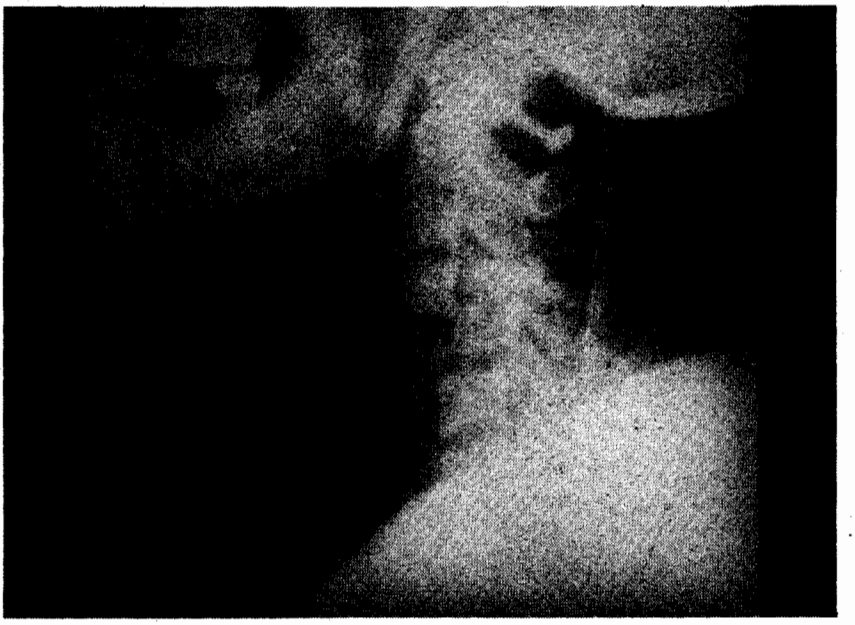


Fig. 8 Lateral view shows anterior displacement of C4 on C5 for a distance greater than 1/2 of AP depth of vertebral body, a severe and unstable injury with complete cord lesion. Severe damage to posterior element. Also notes triangular fragment of bone at anteroinferior aspect of C5, probably due to shearing failure.

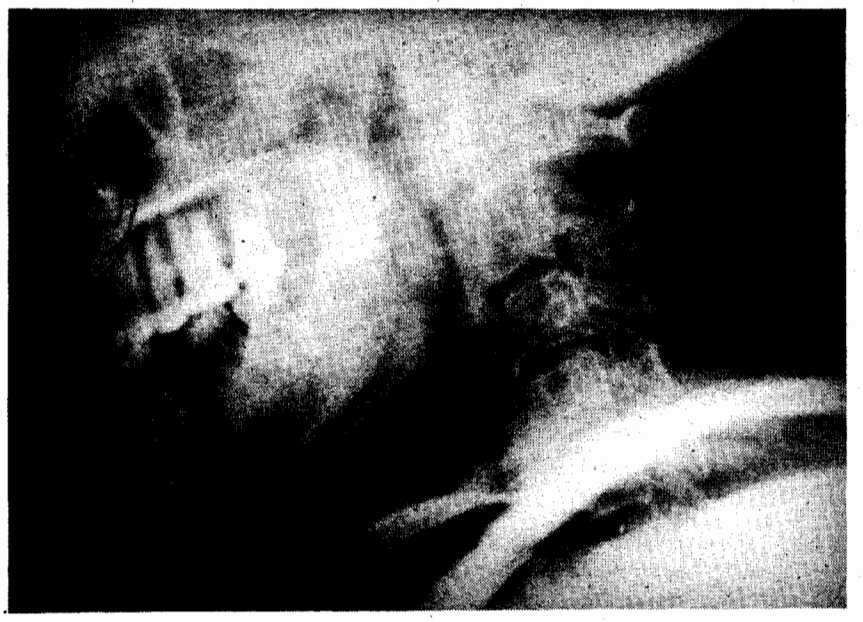


Fig 9. The triangular fragment off the anteroinferior of body of C3, classical tear drop fracture.

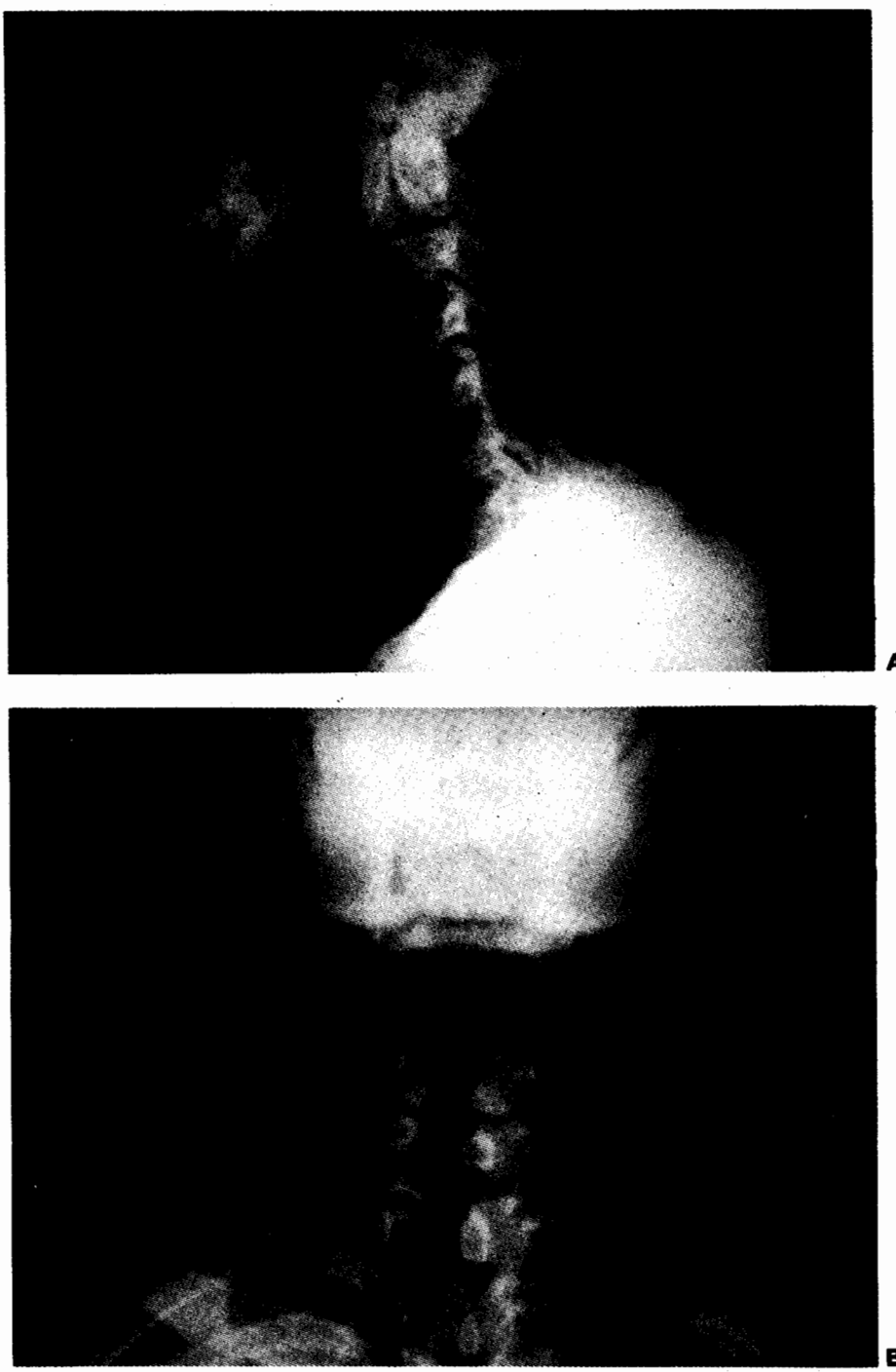


Fig 10. (A) Lateral view shows comminuted fracture of C6 centrum.
(B) Frontal view reveals vertical compression fracture through the vertebral body of C6.

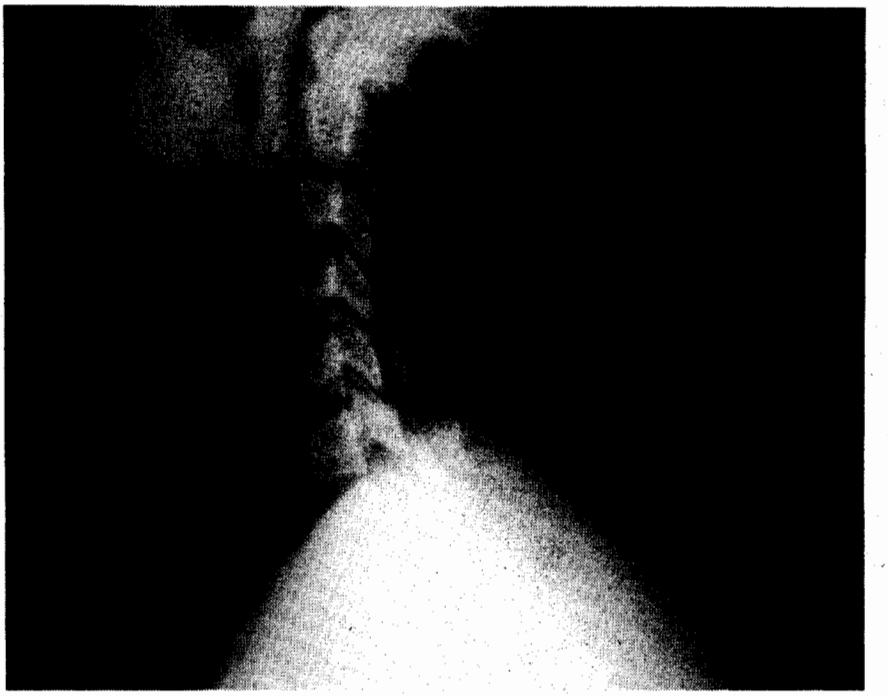


Fig 11. Laminar fracture of C6 level, seen in lateral projection

Fig 12. A case of rupture anterior longitudinal ligament and disc shows wide separation of C6, 7 level. Also note fracture spinous process of C5, 6.

CONCLUSION

We are living in a new age of medicine. Road traffic accident account for half of the serious cervical injuries and cause morbidity and mortality. So we must aware of cervical spine and cord injuries, especially in patients which presence of head injury with decrease in level of conciousness, alcoholic intoxication and associated multiple injuries. The adequate roentgenogram include lower part of the cervical spine should be obtained. The radiological role for recognization of extent and stability of cervical spine injuries are helpful in evaluation of the patients, for further proper managements. These may result in decrease morbidity and mortality of the patients.

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REFERENCES

1. Bohlman H.H., Acute fractures and dislocations of the cervical spine: An analysis of three hundred hospitalized patients and review of the literature. J Bone Joint surg. (Am) 1979; 61: 1119-42.
2. Harris J.H., Monroe B.E., and Kopaniky D.R.: A practical classification of acute cervical spine injuries. Orthop Clin. North Am. 1986; 17: 15-28.
3. Harris J.H.The radiology of acute cervical spine trauma, Baltimore, William & wilkins, 1978.
4. Paakkala T. Prevertebral soft tissue changes in cevical spine injury. CRC Crit Rev Diagn. Imaging 1985; 24: 201-36.
5. White A.A., III, and Panjabi M.M. clinical biomechanics of the spine. Philadelphia, J.B. Lippincott, 1978.
6. Harris J.H., Radiographic evaluation of spinal trauma. Orthop Clin North Am. 1986; 17: 75-85.
7. Roaf R. A study of the mechanics of spinal injuries. J. Bone Joint surg (Br), 1960; 42: 810-23.
8. Bloch R.F., Basbaum M., management of spinal cord injuries. Baltimore: William & Wilkins 1986; 41-57.
9. Levine A.M. Edwards C.C. Treatment of injuries in the C1-C2 complex. Orthop Clin North Am. 1986; 17: 31-42.
10. Anderson L.D., and D'Alonzo R.T. Fractures of the odontoid process of the axis. J Bone Joint surg (Am). 1974; 56: 1663-74.
11. Fielding J.W. Hawkins R.J., Hensinger R.N., et al. Atlantoaxial rotatory deformities. Orthop Clin North Am. 1978; 9: 955.
12. Johnell I.R., Subaxial caudal dislocation of the cervical spine in rheumatoid arthritis. Neuroradiology. 1984; 26: 407-10.
13. Jefferson G.: Fracture of the atlas vertebrae. Br J. surg. 1920; 7: 407.
14. Elliott J.M., Rogers L.F., Wessinger J.P., et al. The hangman's fracture. Radiology. 1972; 104: 303-07.
15. Stauffer E.S., Management of spine fracture C3 to C7. Orthop Clin. North Am. 1986; 17: 45-8.
16. Burke D.C.: Hyperextension injuries of the spine. J. bone Joint Surg. 1971; 53: 3-12.
17. Scher A.T.: Cervical laminar fractures radiological identification. S Afr. Med. J. 1981; 59: 76-8.
18. Soderstrom C.A., Brumback R.J. Early care of the patient with cervical spine injury. Orthop Clin. North Am. 1986; 17: 3-13.
19. Alker G.J., Oh Y.S., Leslie E.V., et al. Postmortem radiology of head and neck injuries in fatal traffic accidents. Radiology. 1975; 114: 611.
20. Kim K.S., Rogers L.F., Regenbogen V. Pitfalls in plain film diagnosis of cervical spine injuries: False positive interpretation, Surg Neurol. 1986; 25: 381-92.