RESULTS

Table (1): Sites of cervical spine instability among the studied patients according to their type.

Type / Site	Traumatic		Non traumatic		Total	
	No.	%	No.	%	No.	%
Upper	16	32.0	11	55.0	27	38.6
Lower	34	68.0	9	45.0	43	61.4
Total	50	100.0	20	100.0	70	100.0

$X^2 = 3.189$ $P > 0.05$

Table (1) demonstrates the types and sites of instability in the studied cases. Traumatic cases were 50 (71.4%) and non traumatic cases were 20 (28.6%) (Figure 1). The unstable segment was in the upper cervical spine (C0-C2) in 27 cases (38.6%) and in the lower cervical spine (C3-C7) in 43 cases (61.4%).

Fig.(1): Types of cervical instability among the studied patients

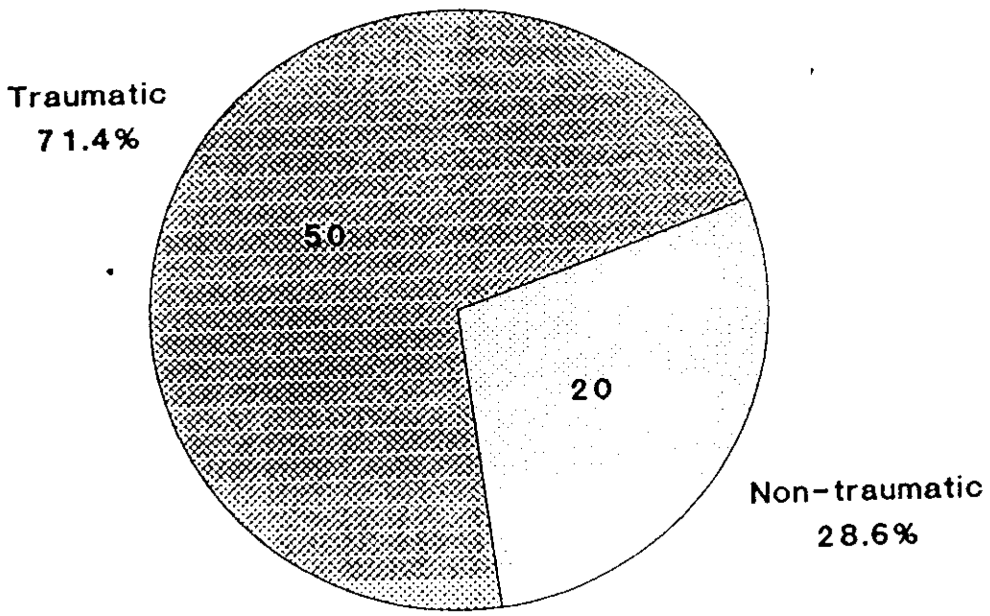


Table (2): Diagnosis of cases of traumatic cervical instability.

Diagnosis \ Distribution	No.	% of subtotal	% of total
(I) Cases of upper traumatic cervical instability:			
• Atlanto-axial subluxation	2	12.5	4.0
• Rupture of transverse ligament	1	6.2	2.0
• Jefferson's fracture	2	12.5	4.0
• Unstable dens fracture	6	37.5	12.0
• Unstable Hangman's fracture	3	18.8	6.0
• Atypical spondylolisthesis of the axis	2	12.5	4.0
Subtotal	16	100.0	32.0
(II) Cases of lower traumatic cervical instability:			
• Flexion tear drop fracture	4	11.8	8.0
• Bilateral interfacetal dislocation	5	14.7	10.0
• Fracture dislocation	8	23.5	16.0
• Fracture of middle & posterior neural elements.	5	14.7	10.0
• Ligamentous instability	4	11.8	8.0
• Significant diminished vertebral vertical height	3	8.8	6.0
• Comminuted fractures	2	5.9	4.0
• More than one cause	3	8.8	6.0
Subtotal	34	100.0	68.0
Total	50		100.0

Table (2) demonstrates the diagnosis of cases of traumatic instability. In post-traumatic upper cervical spine instability, unstable dens fracture was the most common cause representing 37.5% of cases, while in cases of post-traumatic lower cervical spine instability, fracture dislocation was the commonest cause accounting for 23.5% of cases. Among the all studied cases, 64 patients (91.4%) showed instability at the time of presentation. Delayed instability was only found in 6 cases (8.6%).

Table (4): Causative trauma in cases of traumatic instability.

Causative trauma \ Distribution	No.	%
* Motor vehicle accident	34	68.0
* Falling from height	10	20.0
* Sports injuries	2	4.0
* Gun shot injuries	2	4.0
* Occuptional injuries	2	4.0
	50	100.0

Table (5): Nature of trauma in patients with traumatic cervical instability.

Nature of trauma \ Distribution	No.	%
* Hyperflexion	16	32.0
* Hyperextension	9	18.0
* Flexion and rotation	3	6.0
* Extension and rotation	3	6.0
* Vertical compression	4	8.0
* Lateral flexion	4	8.0
* Indeterminate injury	9	18.0
* Combined injuries	2	4.0
Total	50	100.0

Fig.(2): Nature of trauma in patients with traumatic cervical instability.

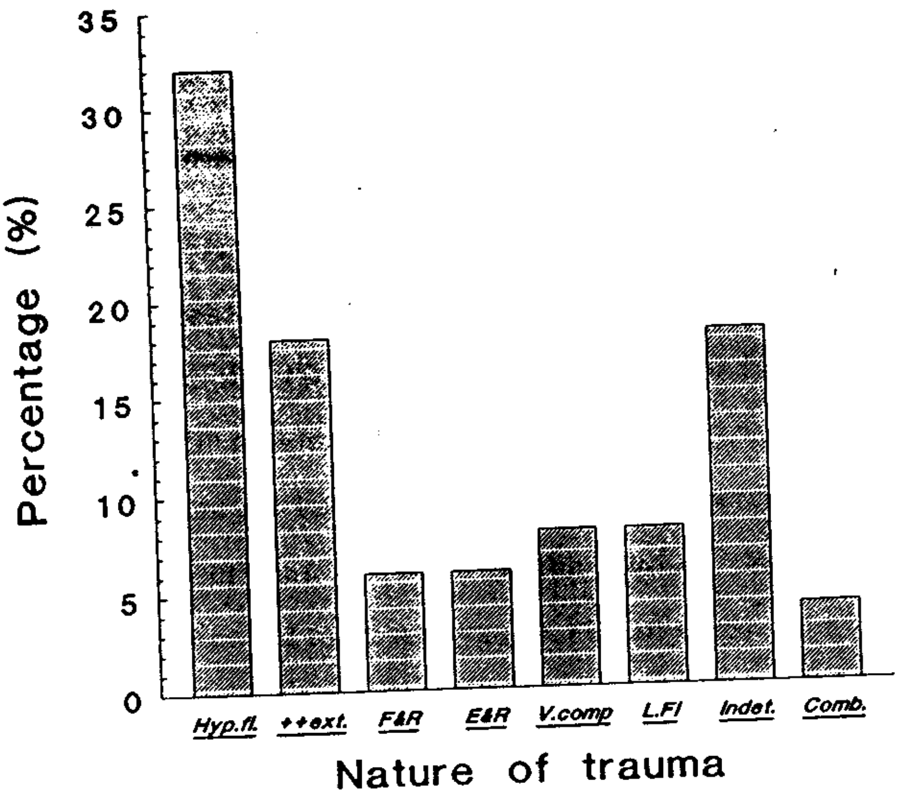


Table (7): Distribution of patients with post traumatic abnormal facetal mobility.

Pattern of post-traumatic abnormal facetal mobility / Distribution	No.	%
* Bilateral intefacetal dislocation	5	20.8
* Unilateral facetal dislocation	2	8.3
* Bilateral facetal subluxation	7	29.2
* Unilateral facetal subluxation	4	16.7
* Bilateral facetal disruption	2	8.3
* Unilateral facetal disruption	4	16.7
Total	24	100.0

Table (7) demonstrates the distribution of cases of post-traumatic facetal motions (instabilities). Post-traumatic abnormal facetal motions were positive in 24 cases (48.0%) and negative in the remaining 26 cases (52.0%) of traumatic cervical instability. Bilateral facetal subluxation (Perching) was the commonest form of abnormal motion. It was found in 7 cases (29.2%).

Table (8): Sensitivity of different imaging modalities in diagnosis of post-traumatic facetal instability in comparison to the results of combined CT and MRI.

Post-traumatic facetal instability	Sensitivity
* Plain radiographs	62.5
* CT	70.8
* MRI	95.8
* Plain radiographs and CT	83.3
* Plain radiographs and MRI	95.8
* CT and MRI	100.0

Table (9): Sensitivity of radiological modalities for detection of fractures.

Radiological modality / Distribution	No.	%*
* Plain radiographs	32	82.0
* Conventional axial CT	36	92.3
* CT with reconstruction	39	100.0
* MRI	34	87.2
* Plain radiographs with CT	38	97.4
* Plain radiographs with CT & MRI	37	94.9
* CT combined with MRI	39	100.0

* The percentage was calculated from the total cases showing fracture lines (n = 39).

Table (9) and Figure (4) demonstrate the sensitivity of imaging modalities in detection of fractures. Fracture lines were detected in (78.0%) of cases of traumatic instability. The combination of CT and MRI was the most sensitive method for detection of fractures with sensitivity of 100.0%. Similar sensitivity was also obtained by CT when supplemented by sagittal and coronal reconstruction. Fractures missed by plain radiography, conventional CT alone, MRI alone, x-ray combined with CT, and x-ray combined with MRI were found in 18.0%, 7.7%, 12.8%, 2.6% and 5.1% of cases respectively.

In cases of traumatic instability, facetal fractures (in particular) were found in 19 cases (38.0%) and absent in the remaining 31 cases (62.0%). Diagnosis of facetal fractures was obtained by plain radiography in 13 cases (68.4%) and by MRI in 15 cases (78.9%), while all cases (100.0%) was diagnosed by CT.

Fig.(4): Ability of imaging modalities in detection of fractures

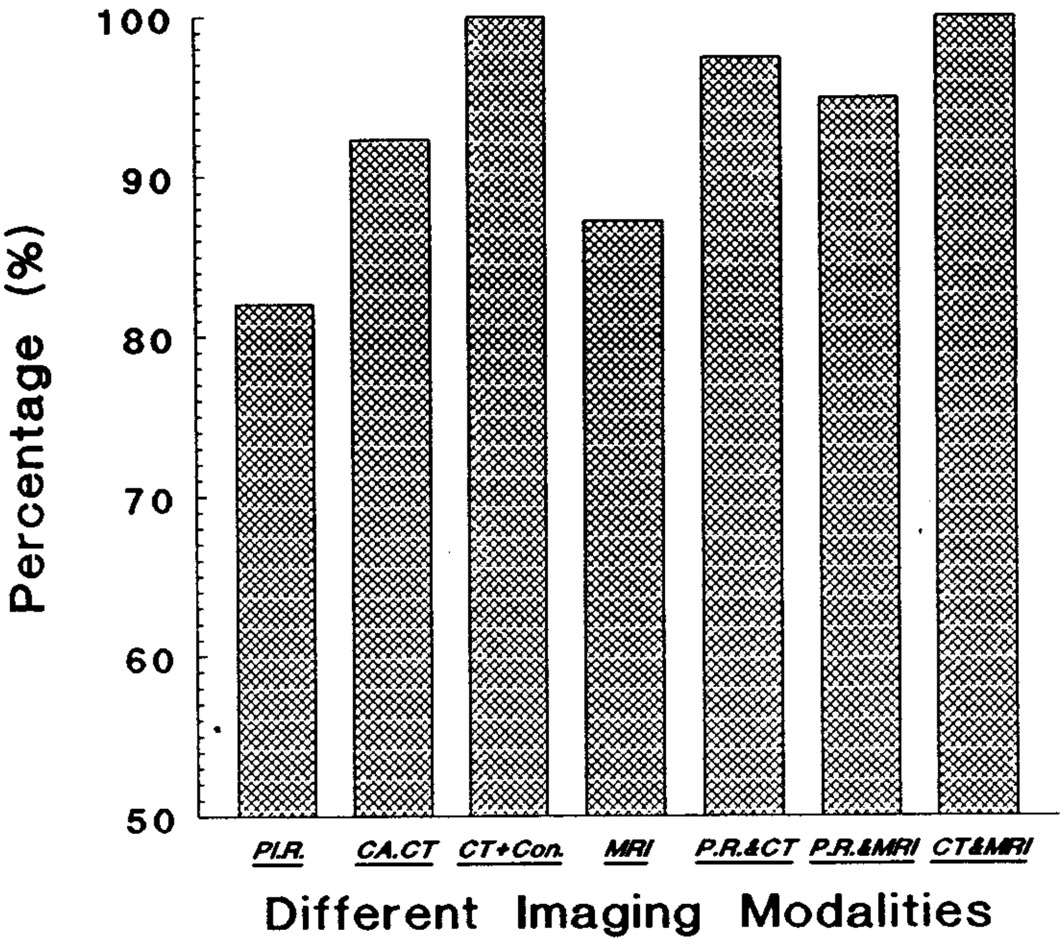


Table (10): Sensitivity of radiological modalities in detection of atlanto-axial abnormal motions.

Detection of atlanto axial abnormal movements / Distribution	No.	%*
* Plain radiographs	16	76.2
* Dynamic radiographs	19	90.5
* Conventional CT	17	80.9
* CT with reconstruction	19	90.5
* Static MRI	20	95.2
* Kinematic MRI	21	100.0
* Plain radiographs combined with CT	20	95.2
* Plain radiographs combined with MRI	21	100.0
* CT combined with MRI	21	100.0

* The percentage was calculated from cases showed abnormal atlanto-axial motions (n = 21).

Table (10) and Figure (5) demonstrate the sensitivity of different imaging modalities in diagnosis of atlanto-axial abnormal motions (instabilities). Atlanto-axial abnormal motions were found in 21 cases (30.0% of all studied cases and 77.8% of cases of upper cervical instability). Kinematic MRI was found to be the best imaging modality in diagnosis of such cases with sensitivity accounting for 100%.

Fig.(5): Ability of imaging modalities in detection of atl.-axial abn.motions

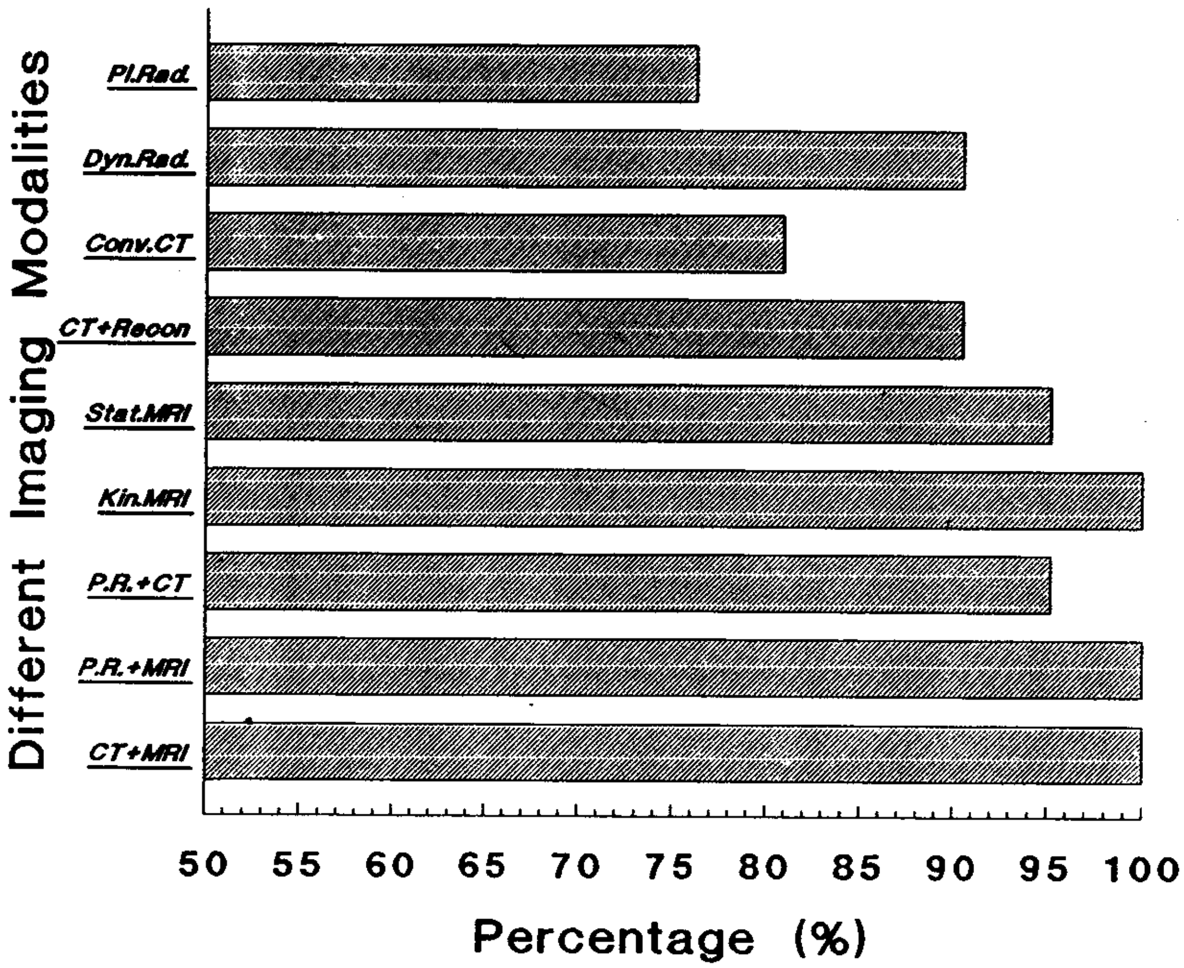


Table (11): Ability of different imaging modalities in diagnosis of posterior disc bulge or herniation, intraspinal loose bone fragments, soft tissue injuries and ligamentous disruption or incompetence.

Modality	Posterior disc bulge or herniation		Intraspinal loose bone fragments		Soft tissues injuries		Ligamentous injury or incompetence	
	No.	%	No.	%	No.	%	No.	%
Plain x-ray	0	00.0	7	70	16	57.1	14	51.8
CT	14	77.8	10	100.0	21	75.0	10	37.0
MRI	18	100.0	8	80.0	28	100.0	27	100.0

Table (11) demonstrates the ability and sensitivity of different imaging modalities in diagnosis of some abnormalities that may or may not be associated with cases of cervical instability. Posterior disc bulges or herniations were found in 18 cases (42.9%) of patients with lower C-instability (n = 42). Intraspinal loose bone fragments were detected in 10 cases (20.0%) among patients of traumatic instability (n = 50). Soft tissue injuries were also found in 28 cases (56.0%) among the same group. Ligamentous injury, disruption or incompetence among the whole studied patients (n = 70) were detected in 27 patients (38.6%). 27 patients (38.6% of the all studied cases) (not included in the table) showed abnormal cervical cord changes by MRI in the form of cord swelling (12.8%) cord oedema (12.9%), cord haematoma (2.9%), cord malacia (5.7%), cord transection (1.4%) and syringomyelia (2.9%).

Table (12): Data obtained by the three standard cervical radiographic views (A/P, lateral and open mouth) missed by the cross-table lateral x-ray view alone.

Data added by the three views / Distribution	No.	%*
(1) Negative	35	61.4
(2) Positive	22	38.6
• Detection of hidden fractures	7	12.3
• Detection of hidden subluxations	7	12.3
• Detection of atlanto-axial abnormal motions	3	5.3
• Detection of soft tissue shadows	5	8.7
Total of subsample	57	100.0

* The percentage was calculated from subsample of patients examined by the above mentioned radiographic views (n = 57).

Table (12) demonstrates the value of the three standard plain radiographic series over the cross-lateral x-ray view alone. A subsample of cases (57 patients) were examined by cross-table lateral x-ray view and by the three standard cervical views (A/P, open mouth and lateral views) simultaneously. Positive findings were obtained in 22 cases (38.6%). The main obtained positive findings were in the form of detection of hidden fractures and hidden subluxations. Both were found in 7 cases (12.3%).

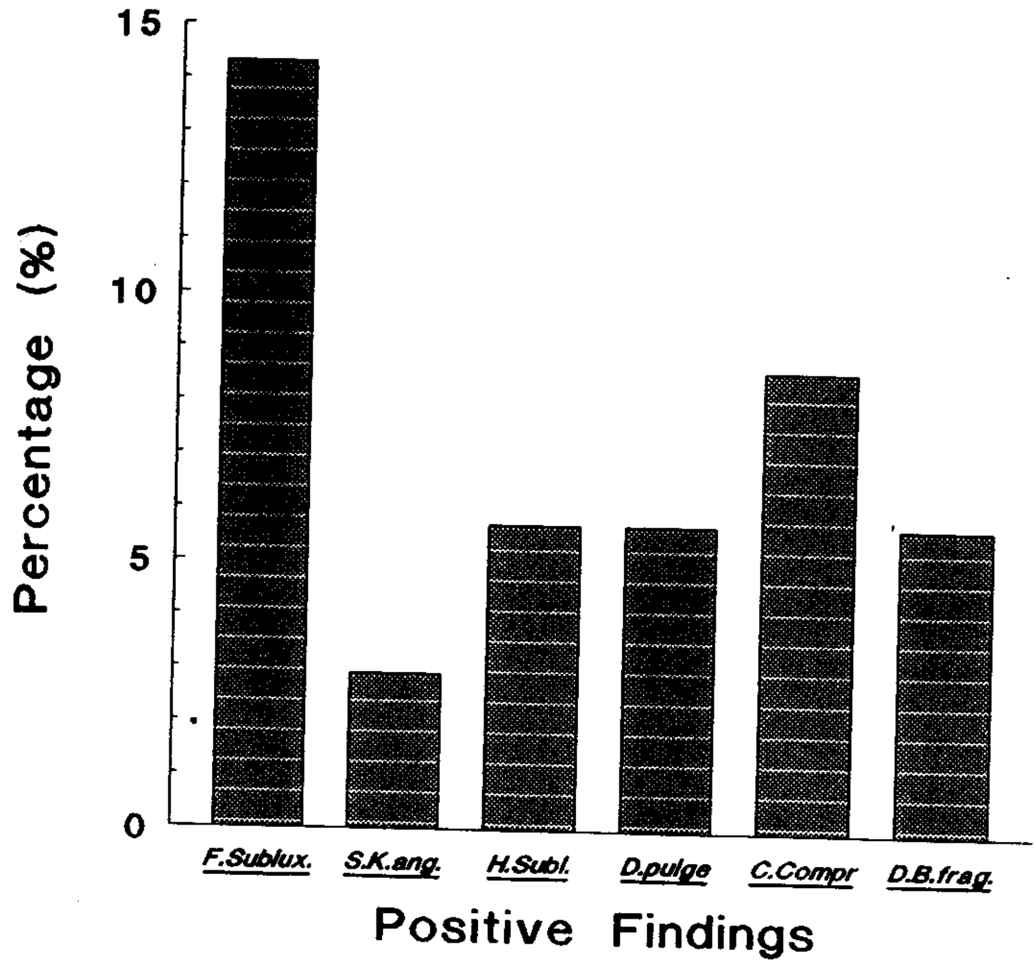
Table (13): Findings obtained by using dynamic radiographic examinations compared to the static techniques.

Findings obtained by dynamic Radiographic examinations \ Distribution	No		%*	
(I) Negative		20		57.1
(II) Positive		15		42.9
(1) Further subluxation	5		14.3	
(2) Significant kyphotic angulation	1		2.9	
(3) Detection of hidden subluxations	2		5.7	
(4) Detection of new posterior disc bulge or herniation or further increase of the degree of a pre-existing one	2		5.7	
(5) Appearance of new cord compression	3		8.6	
(6) Further displacement of bone fragments	2		5.7	
Total		35		100.0

* The percentage was calculated among the patients examined by dynamic and static radiographic examinations (n =35).

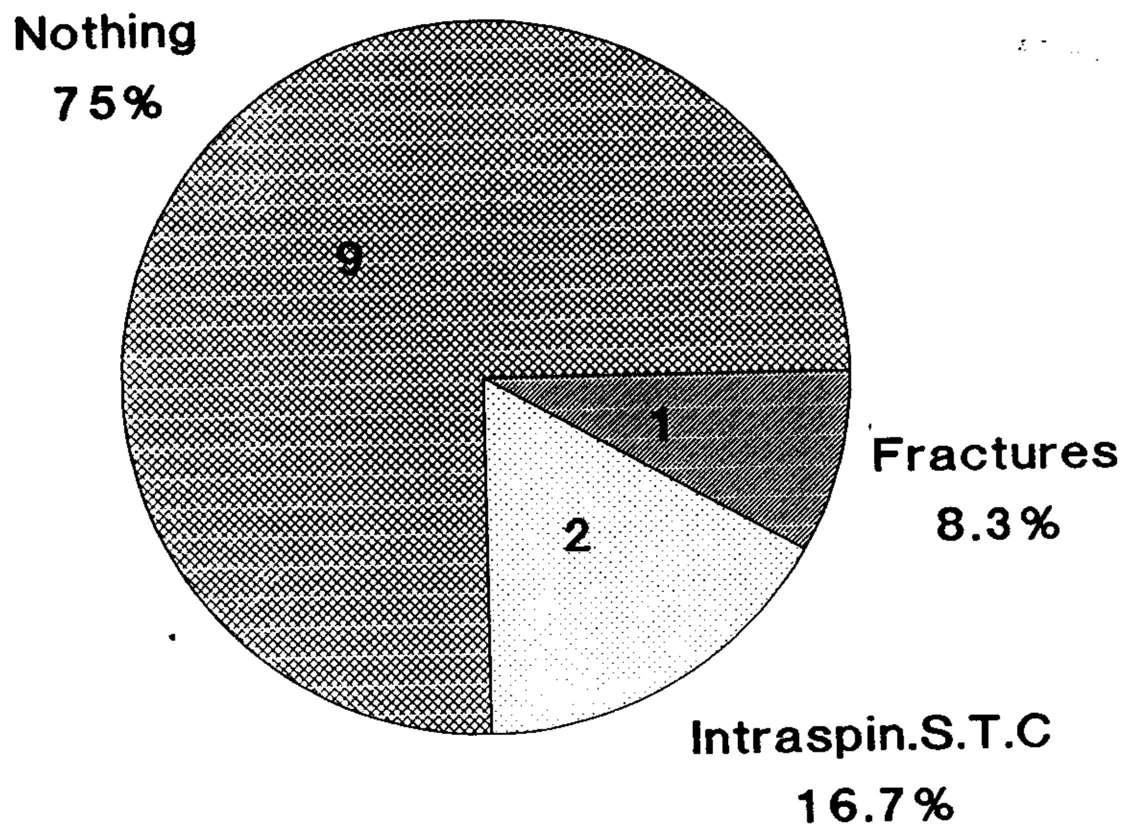
Table (13) and figure (6) demonstrate the value of dynamic radiographic techniques (dynamic x-rays, kinematic CT and/or kinematic MRI) over the static techniques. A group of patients (n = 35) were examined by static and dynamic radiographic techniques. Positive findings were obtained in 15 cases (42.9%), mainly in the form of further subluxation of unstable segments (n =5 = 14.3%).

Fig.(6): Positive findings obtained by dynamic radiographic examinations.



A group of patients (n = 12) were also examined by both conventional & Hellical CT. Positive findings were obtained in 3 cases (25.0%), in the form of detection of missed fractures in one case (8.3%) and detection of small hidden intraspinal soft tissue components in 2 cases (16.7%) (Figure 7).

Fig.(7): Data obtained by Hellical CT while missed by conventional CT.



Conventional axial CT was compared in another group of patients (n =25) with CT supplemented by 2D sagittal and coronal reformation and/or 3D reconstruction. Nothing was furtherly obtained in 20 cases (80.0%). Positive findings were obtained in 5 cases (20.0%) in the form of detection of missed fractures in 2 cases (8.0%), detection of intraspinal loose bone fragment in one case (4.0%), detection of calcification of the longitudinal ligament in one case (4.0%) and better detection of a relation of posterior osteoptytes to the spinal canal on the last case (4.0%) (Figure 8).

Fig.(8): Positive findings obtained by 2D or 3D reconstructed CT.