Original Article

Post ejection CT / MRI spine: an appraisal

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ABSTRACT

A total of 25 post ejection cases between the age group 22-49 years were evaluated with CT / MRI at IAM, Bangalore from Jan 99 to Aug 2000, as per the policy of mandatory post ejection CT / MRI which came into effect from Jan 1999.

Apart from detecting compression fractures of the vertebral bodies, these high resolution imaging modalities can easily detect intervertebral disc bulge, prolapse and herniations along with associated soft tissue and ligamentous injuries. In 16 cases (64%) incidental and non-traumatic abnormalities like canal stenosis, facet joint arthropathies and disc degeneration have been revealed by these investigations.

The aim of this paper is three fold, one to highlight the advantages of CT / MRI in evaluating post ejection spinal injuries especially immediately after the accident, to facilitate early detection and treatment of the injuries. The second aim is to bring forth the incidental / non-traumatic abnormalities detected on post CR / MRI and the dilemma faced in the disposal of such cases. The paper also proposes to include MRI of the spine as a screening procedure for potential pilot candidates to detect bony as well as soft tissue abnormalities which may be incompatible with fighter flying and ejection, thereby limiting post ejection injuries.

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The chances of ejection in fighter flying are fairly high due to a variety of reasons and with it are associated injuries to the spine. The present day modern fighter aircrafts are fitted with seats, which impart ejection forces well within the tolerance limit of the human spine. Despite this, various studies in the IAF have shown that 27-35% of all ejections led to spinal injuries [1]. To obviate the possibility of pre existing spinal abnormalities, which may contribute to spinal injury in ejections, screening of potential pilot candidates with X-ray of the whole spine at the initial medical examination was started in 1977. Further X-ray examination of the whole spine was done immediately following ejection to detect any

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spinal injury, also a repeat X-ray examination was carried out after 4 weeks to detect any injury which could have been missed or was not apparent immediately after the ejection. Inspite of these X-ray examinations there were many instances when the pilots continued to be symptomatic even with a normal spine radiograph. This was thought to be due to paraspinal soft tissue injuries, IV disc and ligament injuries, which could not be picked up by conventional radiographs. With the advent of newer imaging modalities like CT and MRI a need was felt to incorporate these in the evaluation of post ejection cases and hence provide more objectivity in their assessment. Accordingly amendment no. 35 to IAP 4303 was made in Jan 99 making CT or MRI of the spine mandatory after 4 weeks in all ejectees. Further revision by amendment no. 40 to IAP 4303 in Oct 99 was affected which required that all cases of ejection be reviewed and disposed at IAM irrespective of symptoms / injuries, following six weeks of medical category A4G4 being awarded locally [2].

The policy of mandatory post ejection CT / MRI has certainly helped to bring out even the minute injuries of both bone and soft tissues following ejection, but at the same time it also reveals incidental and non-traumatic abnormalities of the spine which are also seen in the normal asymptomatic population.

Material and methods

A total of 25 post ejection cases were evaluated by CT / MRI at the Dept. of Human Engg. IAM, IAF, Bangalore from Jan 99 to Aug 2000. Some of these pilots were symptomatic with previously detected spinal injuries on initial X-ray examination following ejection. Others were asymptomatic with no evidence of spinal injuries on initial X-ray examination but CT / MRI done 4 weeks later revealed spinal injuries.

The nature of incidental / non-trau abnormalities not directly related to ejectio also analyzed with respect to the age of th and number of flying hours done.

Results

Out of the total of 25 post ejection c 13 (52%) were symptomatic with either trau persistent backache, 12 (48%) were asympto although they had spinal abnormalities bo initial X-ray and subsequent CT / MRI. Th wise distribution of cases with normal initial X findings are shown in Table-1.

Table-1

Age in Years	No. of cases with normal initial X-Ray	No. of ca
20-25	6	04
26-30	12	04
31-35	03	Nil
36-40	03	Nil
41-45	Nil	Nil
46-50	01	Nil

Out of these 8 cases with initial normal s radiographs, CT / MRI done after 4 weeks reve abnormalities in 6 (75%), with only 2 ca remaining normal on both Xray examination MRI. Also out of the total of 25 cases, 16 (64 revealed additional findings on CT / MRI w were not picked on routine radiograph. T included compression fractures of the vert bodies, Schmorl's nodes, fracture of p interarticularis, soft tissue injuries like subd haematoma, ligament tear and IV disc prolapse herniations. These additional findings are depic in Table-2.

Table-2

Age in years	Flying hours	Additional findings on CT/MRI
22	200	Fracture Pars Interarticularis LV3
24	400	Compression Fracture L2 & L3
25	453	Schmorl's Nodes at D12, L1 & L2
26	1300	PIVD L5 - S1 with nerve root compression
28	1200	Compression Fracture L1, L2 & L3
28	900	PIVD L5 – S1 with nerve root compression
28	1600	PIVD L1 – L2 with subdural haematoma
29	1200	Compression Fracture D12
29	1800	PIVD L2 – L3 with radial tear
30	960	Schmorl's Nodes at T12, L1 & L2
30	1500	Collapse of D6, D8 & D10
32	1550	Fracture L2 with pre and para vertebral swelling
33	2700	PIVD C5 - C6 with Cord and Nerve root compression
36	3000	PIVD C3 - 4, C4 –5 and D11 –12 with nerve root compression at D12
39	2600	PIVD L3 - L4 & L4 - L5
49	4200	PIVD C3 – C4

Incidental / non-traumatic abnormalities were detected on CT / MRI in 18 cases (72%) and are depicted in Table-3.

Table-3

INCIDENTAL FINDINGS	NO. OF CASES
Disc degenerative changes	11
Facet Joint Arthropathies	2
Canal stenosis	3
Spondylotic changes	2

A further analysis of the observed incidental findings brought out on CT / MRI reveals that disc

Table-4

Flying hours	No. of cases with incidental findings
< 500	4
501-1000	4
1001-1500	4
1501-2000	3
> 2000	3

degenerative changes were the commonest (61%) and were also seen in younger age group and those with relatively less flying hours. These findings are shown in Table-4 and Table-5.

Table-5

Age	No. of cases with incidental findings
20-25	3
26-30	8
31-35	3
36-40	3
> 40	1

Discussion

Out of the 25 ejection cases evaluated it is seen that additional findings on CT / MRI were revealed in 16 (64%), thus clearly reinforcing the fact that CT / MRI are superior imaging modalities than plain radiographs especially in detecting subtle bony and soft tissue injuries [3, 4].

A total of 18 cases (72%) showed incidental findings not directly related to ejection and out of these, degenerative disc disease was the most common (61%). It is well documented that almost 35% of the normal population in the age group of 20-39 years have disc bulge [5].

Facet joint degeneration begins in the first two decades of life and arthropathies are seen in almost 100% of the population over the age of 60 years and proportionately less in the younger age groups [6].

The precise incidence of spinal stenosis in the general population is not known b 4-28% of CT / MRI scans in asymptom show changes of lumbar canal stenos

Spondylotic changes are com advancing age and are seen in 60-80% more than 50 years of age, those involv physical labour and activities causing st spine get these changes at an early a

It is now established that CT and M superior imaging modalities reveal a m findings in both symptomatic and asym pilots which could have a direct bearing flying. Till date no study has been carri the IAF to find out the changes in the spi asymptomatic fighter aircrew hence i absolutely clear whether these incidental can be ascribed to repeated high ' G ' a and related stress of flying. Studies don USAF on F-15 and F-16 aircrew and thos Swedish Air Force on their aircrew have fo the incidence of disc degenerative and a changes are more in pilots as compared normal population [9,10]. Whether abnormalities will have an adverse effec flying career of the pilots and how they a to withstand the impact of subsequent e needs careful consideration in the disposal cases. Presently asymptomatic pilots with m bulge not compressing the thecal sac, tho Schmorl's nodes less than 1/3 of the v body are being awarded ejection seat su other parameters being normal. Those pil are symptomatic are being observed in low category and reviewed periodically. How clear cut policy on this exists thus making of the pilots in such cases rather arbitra

Conclusion

Introduction of post ejection CT / M

the evaluation of ejectees has greatly helped in diagnosing accurately the spinal injuries and at the same time helped in disposal of these cases with objectivity and precision. The problem of incidental findings not directly related to ejection which are revealed on CT / MRI has to be addressed, and a firm and clear policy needs to be formulated. It is proposed that MRI be used as a screening procedure at entry level for pilots so that disc prolapse, herniation of nucleus pulposus, Schmorl's nodes and other subtle abnormalities which are not apparent on conventional radiographs will be detected. Further, MRI at entry would serve as a baseline for further prospective studies to establish the long term effects of stress of flying on the spine. It can also be used for comparative analysis in post ejection evaluation.

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