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Research Article

A CROSS-SECTIONAL PREVALENCE STUDY OF DISC DEGENERATION IN A RURAL POPULATION AND ITS RELATION WITH AGE, BODY MASS INDEX AND BACK PAIN

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ABSTRACT

The prevalence of degenerative discs (DD) in 59 male; 41 female patients belong to rural population of Anand district having mean age of 48.29 years; mean BMI (Body Mass Index) 22.196 kg/ m^2 associated with pain, radiculopathies and neurological deficit presenting to the various in & out patient departments of Shree Krishna Hospital & Pramukh Swami Medical College, Karamsad, Gujarat. Magnetic resonance imaging (MRI) performed with a sagittal T2 image of the lumbar spine using *closed type Superconductive 1.5 Tesla Magnetom Symphony Maestro (Manufactured by Siemens AG, Erlangen Company).* Patients with sedentary life style had maximum number of degenerative disc pathologies; while had ambulatory life style had maximum percentage of infective/inflammatory disc pathologies. 98.3 % male patients had degenerative lesions while 92.5 % of female patient had degenerative changes. Age group 61-70 years to be maximum involved. In the lumbar region maximum changes were seen at L5-S1 level (25.7 %); cervical region at C5-C6 level (12.2 %) and at thoracic region at D12-L1 level (24.2 %). B.M.I. group II (18-25 kg/m^2) to have maximum number of disco genic pathologies. All Congenital / developmental disc anomalies cases were associated with degenerative disc. It can be concluded that MRI is a highly sensitive imaging modality, which closely reflects histological changes. Grade III changes are mostly present in sedentary life style patient with high Body Mass Index.

KEYWORDS: MRI Spine, Intervertebral Disc, Herniation, Bulge

INTRODUCTION

The spinal column is a complex anatomical structure which is composed of vertebrae, intervertebral discs and ligaments. All these components undergo degenerative changes and morphologic alterations during life [1]. The intervertebral discs constitute the principal connections between the vertebrae and have two main functions: to serve as shock absorbers and to allow movement of the spinal column [2]. Movement at a single disc level is limited, but all of the vertebrae and discs combined allow for a significant range of motion [3].

There are many imaging modalities for assessing intervertebral discs. On plain X-ray films, soft tissues of the intervertebral discs are not differentiated. Plain X-ray has a limited role in the assessment of disc degeneration, since early degenerative changes within the disc cannot be detected (unless it contains foci of calcifications or ossifications) [4].

The first myelographic findings in intervertebral disc herniation were described in 1936 by Hampton & Robinson [5]. Myelography and *Discography* is an invasive procedure and causes excessive exposure to radiation, spinal headaches, and leakage of cerebrospinal fluid from the puncture site.

The importance of CT as a diagnostic tool in visualizing intervertebral discs has been further enhanced by the recent development of multi-detector row CT (MDCT) scanning MDCT allows physicians to complement their clinical diagnosis of low back pain with a detailed in vivo image of the structure and soft tissues of the spine.

But the important drawbacks of this method are the relatively high dose of ionizing radiation and intrinsically limited soft tissue contrast resolution between different soft tissues.

Intradiscal structure can only be grossly evaluated and its sensitivity at the early phases of disc degeneration is poor [6].

MRI is the most sensitive imaging method for evaluating the intervertebral disc and has become the primary imaging modality for investigation of the spine[7]. In addition to the noninvasive nature of this modality, MRI provides excellent anatomic detail of the spine, superb soft tissue contrast discrimination and multiplanar imaging capability [7].

Dynamic imagings of the spine further increase the sensitivity of MRI [8].

The reports of the above authors have inspired me to take up this study and to performed cross-sectional prevalence study of disc degeneration in a rural working population and it's relation with age, body mass index and back pain and compare them with other studies as well as evaluate the sensitivity and specificity of MRI scan with other imaging modalities.

MATERIALS AND METHODOLOGY

100 patients (mean age 48.49 years. age range 13-85 years; 59 male 41 female) presenting to the various in & out patient departments of Shree Krishna Hospital & Pramukh Swami Medical College, with symptoms of disco genic pathologies were taken up for study from September 2008 and October 2010.

Exclusion Criteria

i. Patients having non-discogenic spinal pathologies as well as from non-rural background were excluded from my study.

Methodology

i. Each patient's name, age, sex, occupation, habits, height & weight, medication history (corticosteroids/ opoids etc) and hospital number were documented.

ii. History of spinal cord trauma, weight bearing/lifting during sports, malignancy and any other diseases were documented.

iii. Clinical symptoms (including pain) and signs were noted down together with their clinical diagnosis from the case papers.

iv. Informed written consent was taken on consent form, including permission to utilized data for research purpose.

v. Body mass index (BMI) was calculated from patient height and weight

vi. Non-contrast enhance MRI Scan were performed as mentioned below.

Examination Technique

MRI Scan

Standard room exclusion criteria were followed, Items such as jewelry, watches, credit cards, hearing aids, Pins, hairpins, metal zippers, similar metallic items can distort the images and removable dental work should be taken out just prior to the scan.

The patient must be given disposable earplugs to attenuate the gradient switching noise, unless either of these adds significantly to claustrophobia. Consent form stating that patient do not have any of these items under mention in body will be taken

No additional charges were taken from patient when additional sequence or study was performed for research purpose.

MRI Procedures

Non-Contrast MRI examination were performed by using closed type Superconductive 1.5 Tesla Magnetom Symphony Maestro (Manufactured by Siemens AG, Erlangen Company) on every patient. Head coil and neck coil was used for cervical region imaging; while body coil was used for imaging of the thoracic and lumbar regions, with the study subjects in the supine position.

The following sequences were used:

i. A localizer sequence of three images, 24/6/30 degrees (TR/TE/flip angle) consisting of two coronal and one sagittal images in orthogonal planes in all patients.

ii. Sagittal T1 weighted spin echo, 551/13 (TR/TE), 320 x 256 matrix, 320 mm field of view, and 3 cervical to 4 mm section thickness in cervical/ dorsal / lumbar region.

iii. Sagittal T2 weighted turbo spin echo 4000/115 (TR/effective TE), 320 x 256 matrix, 320 mm field of view & 4 mm section thickness in cervical/dorsal/lumbar region.

iv. Axial T1 weighted turbo spin echo 525/15 (TR/ TE), 200 x 256 matrix, 200 mm field of view, and 3 to 4 mm section thickness in cervical/ dorsal / lumbar region.

v. Axial T2 weighted turbo spin echo 2390/103 (TR/effective TE), 200 x 256 matrix, 200 mm field of view & 3-4 mm section thickness in cervical/ dorsal / lumbar region.

vi. Coronal T1 weighted turbo spin echo 525/15 (TR/ TE), 200 x 256 matrix, 320 mm field of view, and 3 to 4 mm section thickness in cervical/ dorsal / lumbar

region.

vii. STIR coronal spin echo 4000/52 (TR/ TE), 200 x 256 matrix, 320 mm field of view, and 3 to 4 mm section thickness in cervical/ dorsal / lumbar region..

viii. *T2 Haste myelographic sequence 8000/1200 (TR/TE)sagital & coronal images.*

Additional sequences will be taken whenever necessary.

Definitions and Validity of MRI Variables

The definitions of findings and grading were adapted from the literature, discussed with experts within the field, and followed the generally accepted guidelines of radiological nomenclature. The MRI readings used in this study were those performed by the radiologist, who also had the overall responsibility for MRI procedures, definitions and ratings.

Analyses and Data Reporting

Prevalence rates of MRI findings were reported for each spinal level for discs: signal intensity, integrity of the annulus pulposus , disc height, High intensity in peripheral zone, disc contour abnormalities (bulging, protrusion, extrusion, disc herniation, sequestration, migration, end plate irregularities (upper and/or lower end-plate irregularies), modic type end plate degenerative changes , disc inflammation and disc infiltration. (Table 1)

Grading of degenerative changes were done into three type depending of number of disc lesions.(Table 6)

Histopathological Examination from Surgically Removed Specimen

Materials obtained from the pathological site were obtained after spinal operation and the histopathological assessment reports finding were recorded in written. However in most of cases micro discectomy was performed by operating surgeon and specimen was not send for histopathological examination.

RESULTS

i. In my study, commonest age group presenting with disco genic pathologies were in 31 to 40 years (23 %) with female preponderance; while that in 11 to 20 years and 21 to 30 years had male preponderance. In my study male: female ratio was 1.43:1. Degenerative lesion was present in 98.3 % male, 92.5 % female.(Table 5)

ii. Degeneration in discs was maximum in 60-70 years age (100%) group followed by 31 to 40 years age group (95 % and while no degenerative changes were seen in below 10 years age group. (Table 5)

iii. Patients with sedentary life style (55 patients) had maximum number of degenerative disc pathologies; while had ambulatory life style (45 patients) had maximum percentage of infective/inflammatory disc pathologies. In my study patients in BMI group 18-25 had maximum number of disc pathologies; while all obese patients (BMI > 25) had degenerative disc pathologies. Grade III changes were predominately occurs in mean BMI of 26.5.(Table 3)

iv. Out of 100 patients only 55 patients had to undergo operative treatment. Rest of the patients needed conservative management. Out of 55 only 5 patient's discs were sent for histopathology. MRI diagnosis conformed 100 % accurate on histopathologies in all such patient's.

DISCUSSION

My study cross-sectional prevalence study of disc degeneration in a rural working population and it's relation with age, body mass index and back pain in 100 patients makes an attempt to show efficacy of MRI in diagnosing Disc pathologies.

Symptomatology

In my study, the commonest presenting complain of patients were low back pain. Radiculopathies 56% and neurological deficit 14 %. Whereas, **P. Kjaer et al** study had shown low back pain to be 66 % [9] and **Takatalo et al** had shown 52 % in their studies[9].(Table 2)

Age & Sex

P. Kjaer et al in their study of 100 positive patients found male: female ratio to be 48:52, mean age 40, mean height 5.6 feet, mean weight 76.45 kg, and mean BMI was 25.1. [10].

Takatalo et al in their study male: female ratio was 1.38:1, mean weight 60 kg, mean height 5.5 feet and mean BMI was 22(Table 3). The prevalence of 2 or more disc pathologies in same patient was significantly higher in men than women[10]. Whereas in my study ratio of male : female ratio deferred from **P. Kjaer et al while** it tallied with T**akatalo et al**.

D Weishaupt et al study had shown in 40 -50 years age group maximum number of disc pathologies (39 %) occurred[11]. **Takatalo et al** revealed in 11-20 years age group discogenic pathologies were predominant in female patients in their study [11]. My results were contradictory with those of the above mentioned authors.

In obese patients (BMI > 25 kg/m^2) degenerative changes were common and occurred predominately at L4-L5 disc level. All my patients were symptomatic.

Morio Matsumoto et al in their study concluded that degenerative changes were observed in approximately half of the asymptomatic subjects. They observed that patients with BMI > 25 had more number of degenerative disc pathologies as compared to those with BMI < 25[12].

My study also showed that in young age group (47 %) had increased number of discogenic pathologies as compared to middle age (21 %) and older people (32 %) (Table 3).

M. Liuke et al in their study showed that BMI above 25 kg/m^2 increases the risk of disc degeneration, with a stronger effect of high BMI at young age than in middle age [13].

Degenerative Lesion (Table 1 & Table 4)

Degenerative lesion constituted 100 % of the total discogenic pathologies, where involvement of lumbar

intervertebral disc was 59.49%, cervical disc 25.4 % and dorsal I.V. disc 15.01 %. In the cervical region C5-C6 I.V. disc had maximum pathologies 30.7 %, C6-C7 had 22.8 % and C2-C3 had 6.2 % involvement. At dorsal region D12 – L1 disc had maximum number of pathologies16.9 %, D11-D12 12.6 % involvement and D1-D2 disc 4.9 %. In lumbar region L4-L5 disc were predominately involved 31.2 %, at L5-S1 disc level 24.8 % and at L1-L2 disc level there was 6.7 % involvement.

1. **Annular tear (6.0% of Discogenic Pathologies)**

Annular tears had occurred predominately in lumbar region out of which L4-L5 disc level involvement was 36.3 % and at L3-L4 & L5-S1 levels there was 25 % involvement in each level in my study (Table 4).

Stadnik, T.W et al in their study showed annular tears to be 56%, L5-S1 disc were predominately involved 39 %, and L4-L5 disc 32% in their study. There was a fairly marked increase in prevalence with age; in patients older than 60 years (96%)[14].

Jeffrey J. Jarvik et al in a prospective cohort study showed, annular tear predominately occurred at L5-S1 level (20 %)[15]. ; while in **Per Kjaer et al** in their study showed 39 % annular tear in 40-50 years age group which occurred at L4-L5 disc level predominantly (19 %). In 10-20 years age group annular tear was 7.3 %, which occurred at L5-S1 disc level predominately (37.5 %) [9]. MRI observations of above authors were similar as to those of mine.

2.

A. **Herniation (9.0% of disco genic pathologies) (Figure 2)**

Lumbar disc were predominately involved and L4-L5 disc had maximum number of disc herniations (39.2 %) while L5-S1 disc had 25.0 % and predominately involved in 61 to 70 years group(30.2 %).

Posterior herniations were present in 59.4 % cases maximum at L4-L5 disc level.

Para central herniation was 30.2 % maximum at L5-S1 disc level and foraminal herniation was 3.4 % which was frequent at L4-L5.

At L5-S1 extraforaminal disc herniation together with subarticular herniation was also present 4.6 % and 2.4 % respectively.

Modic et al in their study showed 60 % of disc herniation was associated with degenerative disc and only disc herniation without disc degeneration in 8 % of cases [16].

Per Kjaer et al showed in their study that in 40-50 years age herniation was 25 %.

Dong Hwa Heo, et al in their study showed extraforaminal disc herniation occurred maximum at L4–L5 intervertebral disc [17].

MRI observations of above authors were similar as to those of mine

B. **Protrusion (15.2 % of discogenic pathologies) (Figure 2)**

Disc protrusion was noted in the lumbo-sacral region (At L4-L5- 31.8 % and at L5-S1-29.5 %) and were maximum in 60-70 years age group .

Posterior protrusion was 52.1 % and occurred predominately at L5-S1 maximum in 60-70 years age group.

Para central disc protrusion was 25.2 % and occurred predominately at L5-S1maximum in 50-60 years age group.

Postero-lateral disc protrusion was 11.6 % and maximum at L4-L5 maximum in 60-70 years age group and broad base disc protrusion was 11.1 % and occurred maximum at L2-L3 level maximum in the same age group (60-70 years).

Estanislao Arana et al in their study showed disc protrusion to be 13.4 % (at L5-S1- 49.5 % & at L4-L5- 32.3 %) [18].

Stadnik T.W et al in their study showed 33% of volunteers had at least one protrusion. They observed that frequency of protrusions to be 80% in patients older than 60 years and 11% in patients in 30 years or younger age [14].

MRI observations of above authors were similar as to those of mine.

C. **Extrusion (1. 1% of disco genic pathologies) (Figure 2 & Figure 3)**

Disc extrusion was observed maximum at L4-L5 & L5-S1 levels in the age group 30-40 years.

Jeffrey J. Jarvik et al showed extrusion to be maximum at L5-S1 (3%). [15]

Per Kjaer et al in their study showed disc extrusion to be 1.2 % in 40-50 years age group. [9]

Dominik WeiShaupt, Marco Zanetti, Juerg Hodler, & Norbert Boos found only 3.7 % of disc extrusions in their study. They observed that in 40-50 years age group extrusion were common and predominately occurred at L5-S1 level [11]

MRI observations of above authors were similar as to those of mine.

D. **Sequestration (0.1 % of disco genic pathologies)(Figure 4)**

In my study herniated sequestrated disc had occurred only in 1 case at L5-S1 level. This was a 30 years old student with sedentary habits.

MRI observations: The sequested disc appeared isointense to parent disc on T1W images. On T2 Weighted Images, it appeared hyperintense to parent disc. T1 Contrast showed subtle enhancement.

Per Kjaer et al study showed sequestrated disc 0.2 % of cases in 40-50 years age group. [9]

3. **Intravertebral herniation (2.7 % of disco genic pathologies) (Figure 4)**

Intravertebral disc herniation was common at L2-L3 level (35 %) and least at D10-D11, D12-L1 and L4-L5 disc level (3 % each) and predominately occurred in 31-40 years age group.

Estanislao Arana et al in their study reported intra vertebral herniation at L1-L2 and L2-L3 levels [18].

4. **Bulge (21% of discogenic pathologies) (Figure 2 & Figure 3)**

Disc bulge was observed at L4-L5 disc 34.2 % & at L3-L4 27.7 %.

Posterior disc bulge were 41.6 % and were common at C6-C7.

Diffused disc bulge were 35.3 % and common at L4-L5 disc.

Paracentral disc bulge were 23.1 % and common at L5-S1

Disc bulge was found to be 33.3 % in the age group 61- 70 and in 41-50 years age group it was 7 %.

In the study of **Stadnik T.W et al,** total prevalence of disc bulge in asymptomatic volunteers was 81%. Their study showed 56 % bulge in 45 years group with involvement of L4-L5 disc (57%) and in L5-S1 26% [14].

Jeffrey Jarvik et al in their study showed disc bulge to be 47 % at L4-L5 level, which was found to be 83 % in patients above 65 years. [15].

Per Kjaer et al in their study showed in 13.7 % disc bulge in 10-20 years age group [9].

MRI observations of all the above authors were similar as to those of mine.

5. **Disc degeneration with vertebral degeneration: (37.9 % of disco genic pathologies)**(Figure 1)

Disc signal intensity suggesting degenerative changes were commonest at L4-L5 level (27.1 %; L5-S1 disc (25.7 %) (Figure 1) while in cervical region commonest at C5-C6.

In 61-70 age group maximum number of degenerative disc pathology was observed (23.3 %) with maximum involvement of L5-S1.

Jeffrey J. Jarvik et al showed in their study that disc degeneration had occurred 73 % at L5-S1 level. 100 % in patients above 65 years [15].

Minna Tertti et al showed 10% were degenerate disc changes in the age group of 10-15 years which occurred at the L4-L5 and L5-S1 levels [19].

Per Kjaer et al showed in their study in 40-50 years age group degenerative disc to be 53 %, maximum at L5-S1 (30 %). They observed that in 10-20 years age group degenerative disc to be 2.3% and occurred predominately at L5-S1 [9].

My observations were similar to those of **Per Kjaer et al** in 10-20 years age group and differed from those of **Minna Tertti et al.**

MANAGEMENT

In my study out of 100 patients only 55 patients had to undergo operative treatment. Rest of the patients needed conservative management. Out of 55 only 5 patient's discs were sent for histopathology.

MRI diagnosis proved to be 100 % accurate with histopathological diagnosis in all such patient's.

F aichner et al study concluded that magnetic resonance imaging may become the method of choice in the diagnosis of structural spinal cord diseases [20].

In 2 (3.6 %) cases surgeon had disagreement at the level of discectomy as there was a gap of 3 months between the MRI and surgery.

K. Halldin et al in their study showed that in 15% of the patients, the surgeon and radiologist's diagnosis differed.

The difference could probably be explained by shrinking or absorption of the disc herniation during the time between radiological examination and operation [21].

CLINICAL IMPLICATIONS

The study findings suggest that disc degeneration is determined BMI, age as well as life style. It can be concluded that MRI is an accurate, noninvasive means of evaluating disc, which can be performed on an outpatient basis. Normal and degenerated discs can be well differentiated by the different MRI signals. It is a highly sensitive imaging modality, which closely reflects histological changes.

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Table 1: *degenerative and/ or traumatic lesion*

I. Annular tear
   i. Radial
   ii. Concentric
   iii. Transverse

II. Herniation
   i. Axial position
      a) Central (posterior/ anterior)
      b) Para central (right / left)
      c) Right/left subarticular(lateral recess)
      d) Foraminal (right/ left)
      e) Extra foraminal(right / left)
   ii.
      a) Disc contour protrusion
      b) Extrusion
      c) Migration
      d) Sequestration
   iii. Intravertebral extention (schromol's)

III. Disc bulge
   1. Paracentral
   2. Central
   3. Diffused disc bulge

IV. Disc rupture

V. Degeneration

Table 2: *SYMPTOMATOLOGY*

S.NO	SYMPTOMS		TOTAL NO. OF PATIENTS
1.	Pain (Back pain + neck pain)		100
A.	Back pain		100
	Not radiating		19
	Back pain radiating to	Both lower limb	42
		To right limb	28
		To left limb	11

2.	Neurological deficit		14
	Paresthesia		3
	Paraparesis		2
	Paraplegia		5
	Quardriparesis		2
	Quadriplegia		2
3.	Radiculopathies		56
	Both limb		28
	Right limb		15
	Left limb		13

Table 3: *Intervertebral disc level comparison of degenerative and or traumatic disc lesion according to body mass index*

BMI	NO OF PATIFNTS	C2-C3	C3-C4	C4-C5	C5-C6	C6-C7	C7-D1	D1-D2	D2-D3	D3-D4	D4-D5	D5-D6	D6-D7	D7-D8	D8-D9	D9-D10	D10-D11	D11-D12	D12-L1	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	S1-S2
</18	9	1	0	0	0	0	0	1	1	0	2	0	1	1	0	1	1	0	1	1	4	4	15	13	0
18-19.9	16	1	8	2	6	4	0	0	2	1	0	1	1	2	1	0	0	0	3	3	13	14	24	21	1
20-21.9	26	1	5	13	10	12	4	2	2	1	1	2	2	2	2	0	0	1	2	4	12	22	35	32	0
22-23.9	19	6	9	15	23	13	6	2	0	1	1	2	1	2	1	2	3	1	2	6	25	28	31	22	1
24-25.9	16	2	5	11	22	14	4	1	0	1	2	2	0	4	3	1	2	6	9	11	21	25	39	24	1
26-27.9	10	1	8	6	9	8	0	0	0	2	1	2	2	0	0	2	4	9	4	8	17	18	26	16	0
> 28	3	0	0	0	3	1	0	0	0	0	0	0	0	0	0	1	0	0	1	2	2	2	2	2	1
TOTAL	100	12	35	47	73	52	14	6	5	6	7	9	7	11	7	7	10	17	22	35	94	113	172	130	4

BMI group 24-26 had maximum number of disc pathologies (30 %) while 22-24 had 22.8 % degenerative disc pathologies

Table 4: *Classification of degenerative pathologies according to intervertebral disc level*

GROUP	DISC PATHOLOGIES		C2-C3	C3-C4	C4-C5	C5-C6	C6-C7	C7-D1	D1-D2	D2-D3	D3-D4	D4-D5	D5-D6	D6-D7	D7-D8	D8-D9	D9- D10	D10-D11	D11-D12	D12-L1	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	S1-S2	TOTAL
A	**HERNIATION**																										
		SUBARTICULAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2
		EXTRAFORAMINAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	4
		FORAMINAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	3
		POSTERIOR	0	2	2	5	2	1	0	0	0	0	1	0	2	1	1	2	2	2	3	4	5	12	4	0	51
		PARACENTRAL	0	0	0	2	1	1	0	0	0	0	2	0	0	0	0	0	0	1	1	3	3	7	5	0	26
B	**PROTRUSION**																										
		PARACENTRAL	0	2	1	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	9	11	0	36
		POSTERIOR	0	3	5	11	8	2	0	1	0	0	1	0	1	2	1	1	3	1	0	7	6	11	10	1	75
		POSTEROLATERAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	4	4	5	2	0	17
		BROAD BASE	1	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	3	3	0	16
C	**BULGE**																										
		PARACENTRAL	0	1	2	4	2	0	0	0	0	0	0	0	0	0	0	1	1	1	1	5	10	9	9		46
		POSTERIOR	0	6	10	13	14	1	0	0	2	0	0	2	0	0	0	0	1	2	2	5	9	12	4	0	83
		DIFFUSED	0	2	5	10	1	0	0	0	0	2	1	1	0	1	1	0	1	1	2	8	11	16	5	2	70
D	**ANNULAR TEAR**																										
		RADIAL	0	1	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	2	7	10	5		35
		TRANSVERSE	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2	4	3		13
		CONCENTRIC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	3		9
E	**RUPTURE**		0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	1	2	0	1	0	1	0	0	8
F	**INTRA VERTEBRAL HERNIATION (SCHROMOL'S NODE)**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	3	7	3	6	1		26
G	**DEGENERATIVE VERTEBRAL CHANGES**		11	15	17	20	16	9	6	4	4	5	4	4	5	3	3	5	4	9	19	39	43	58	55	1	359
H	**MIGRATION**		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	4
I	**SEQUESTRATION**		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
J	**EXTRUSION**		0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	3	3	0	11
	TOTAL DISC PATHOLOGIES		12	35	46	73	52	15	6	5	6	7	9	7	11	7	7	10	17	22	35	94	113	172	130	4	895

Table 5: *Comparison of degenerative pathologies according to intervertebral*

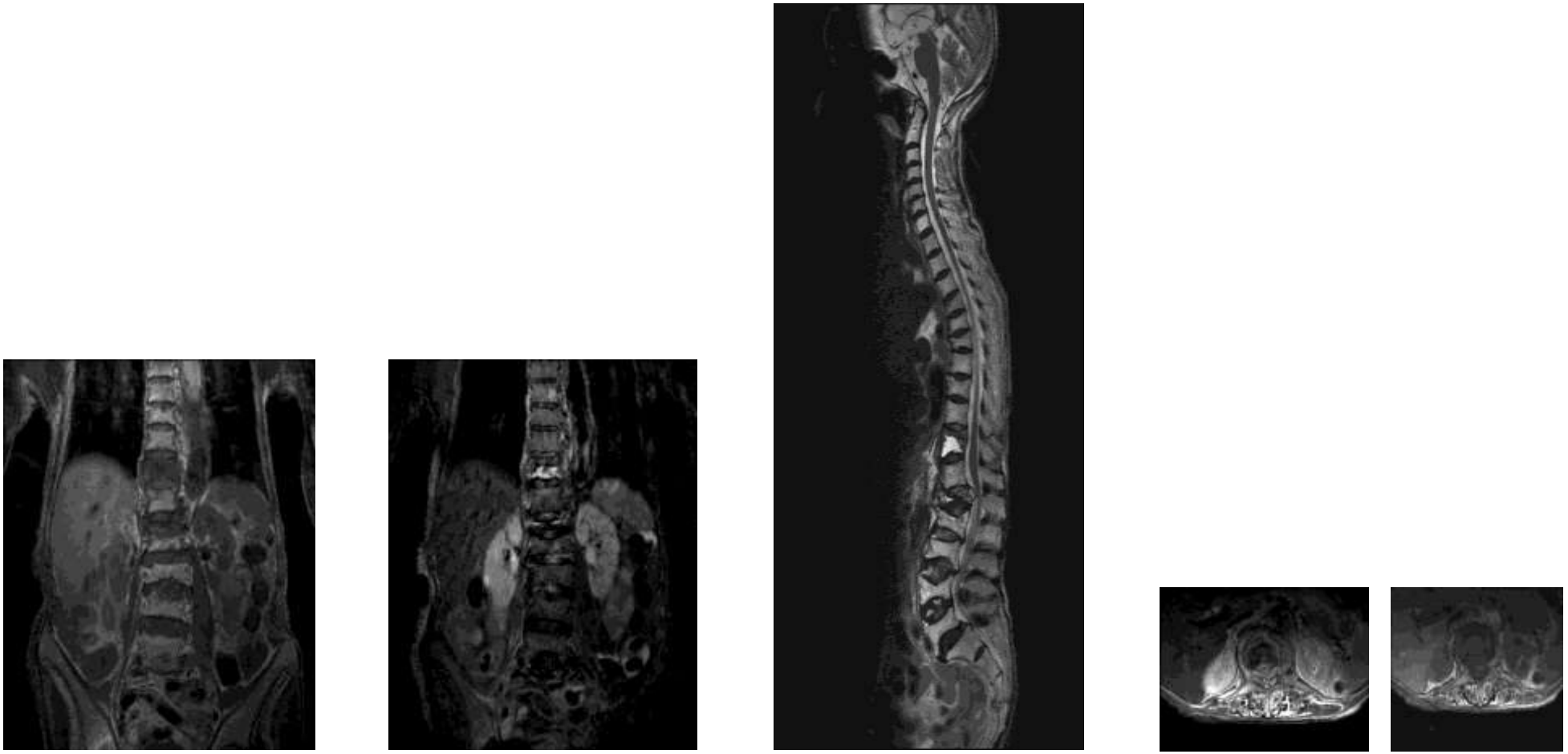
	DEGENERATIVE LESION

AGE GROUP (YEARS)	C2-C3	C3-C4	C4-C5	C5-C6	C6-C7	C7-D1	D1-D2	D2-D3	D3-D4	D4-D5	D5-D6	D6-D7	D7-D8	D8-D9	D9-D10	D10-D11	D11-D12	D12-L1	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	S1-S2
11- 20													2	1		2	2	4				14	9	
21- 30	1			6	2			1	1	1	1	1	1					1		3	4	13	6	
31-40	1	5	8	15	11		2	1	1	1	1	1	1			2	2	4	7	19	25	38	26	
41 - 50		2	3	5				1		1					1	1	2	1	4	10	17	15	14	1
51 -60	5	10	14	13	14	8	2		2	2	2	1	1			1	3	2	7	15	18	24	23	1
61 - 70	4	11	12	21	14	4	1	1	1	1	3	2	4	3	4	3	6	4	9	28	29	35	30	1
71-80	1	7	9	13	11	3	1	1	1	1	2	2	2	3	2	1	2	6	7	18	19	31	21	1
81-90																			1	1	1	2	1	
TOTAL	12	35	46	73	52	15	6	5	6	7	9	7	11	7	7	10	17	22	35	94	113	172	130	4

Table 6: *Grade of disk degeneration*

	Grade I	**Grade II**	**Grade III**
	Herniation/protrusion, bulge/ annular tear/ rupture/intra vertebral herniation/ migration/sequestration/extrusion	Multiple disc pathologies (more than 5)	Grade II + multiple degenerative change in vertebra
No of Patients	24	45	31
Mean B.M.I.	22.6	24.6	26.5

Figure 1: *In a case of degenerative chnages in spine:- a & b T2 & FLAIR coronal image shows scoliosis with endplates changes (arrow) in lower dorsal and upper lumbar vertebra; c T2 whole spine Sagittal image central wedging(osetoprotic) L1, L4, & L5 vertebrae (arrow); d & e:- T1 & T2 axial images suggetive of degenerative changes in I.V. disc with diffused herniaiton.*



A B C D E

Figure 2: 3-D illustration of grading of disc contour (from top left to bottom right): *Normal disc (no disc material beyond the margins of the adjacent vertebral bodies); bulging disc (disc extension around the vertebral margins at more than 50% (180 degrees) of the circumference of the disc); focal protrusion and broad-based protrusion (extension of the disc material beyond the disc space, with the base broader than any other dimension of the protrusion and localized to less than 25% (90 degrees) or less than 50% (180 degrees) of the*

circumference of the disc, respectively); extrusion (disc material beyond the vertebral margins with the base narrower than the diameter of the extruded disc material); sequestrated disc (a free disc fragment with no connection to the disc of origin).

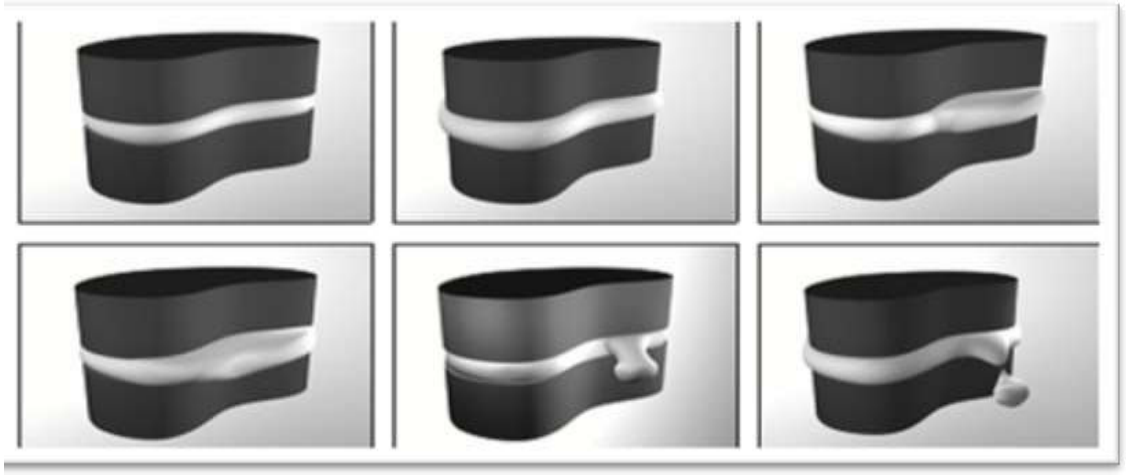
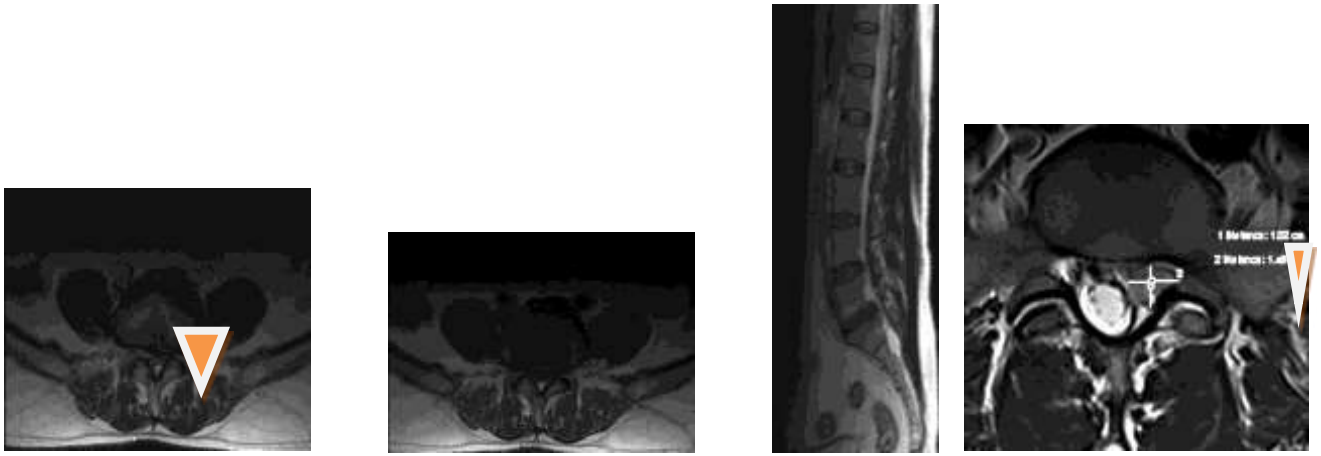
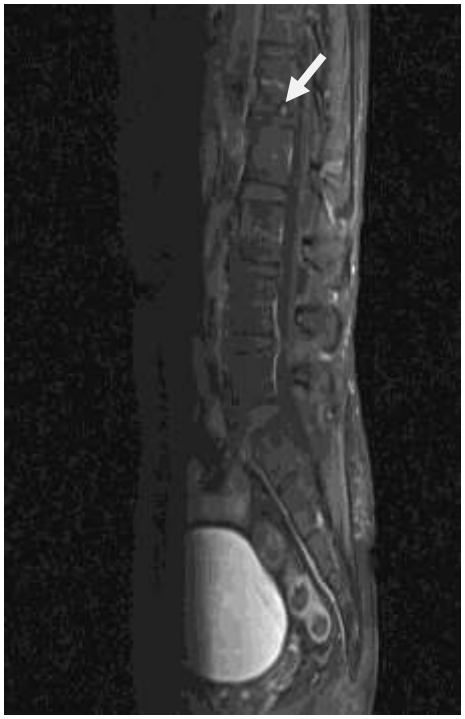


Figure 3:*a &b T1 & T2 Axial images suggestive of left para-central herniation (arrow head)of L4-L5 Intervertebral disc; c & d T2 sagittal image and T2 axial image of another patient suggestive of extrusion of L5-S1 intervertebral disc (arrow head).*

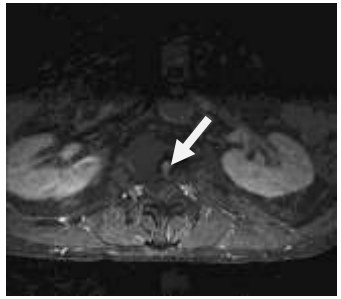


A B C D

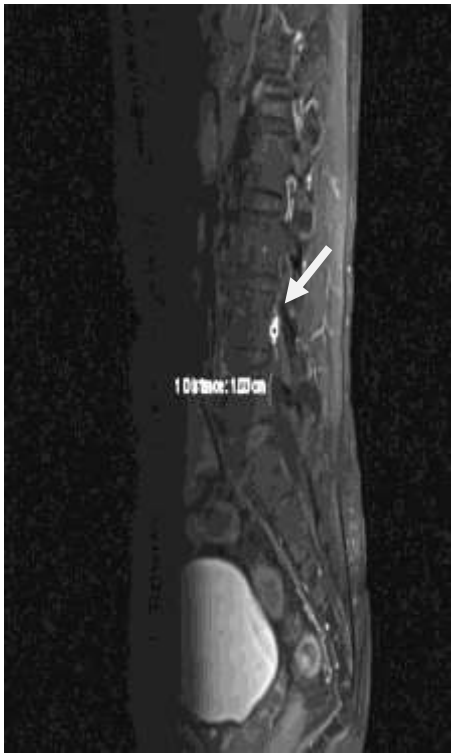
Figure 4: *T1 contrast sagittal & axial images suggestive of superior intra-vertebral herniaton of L1-L2 Intervertebral disc (a & b); in other patient T1 contrast sagittal & T1 axial images shows left infero-lateral sequestration of L3-L4 Intervertebral disc disc(c & d).*



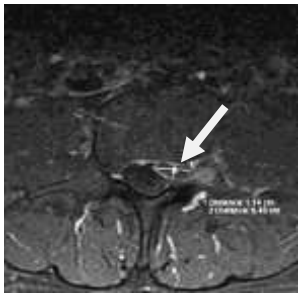
A



B



C



D