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"Correlation of Facet Joint Tropism and Degenerative Disc Disease in Lumbar Spine of General Population of Age Less Than 35 Years"

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ABSTRACT: Background: Facet tropism, defined as asymmetry between the left and right facet joints, is postulated as a possible cause of lumbar degenerative diseases,

Objectives of the study:

1. To study the Facet joint tropism on MRI at multiple lumbar intervertebral disc spaces in individuals less than or equal to 35 years of age, presenting with lower back ache.
2. Correlation of facet joint tropism with disc dessication as an early indicator of degenerative disc disease.

Materials and Methodology: All the measurements and observations are done on a SIEMENS 1.5 TESLA MRI Machine.Angle is calculated in the axial sections of MRI with the angle is measured between lines drawn along the posterior border of the vertebral body and bisecting the superior and inferior tips of the facet joint. The resultant angle calculated is taken as the facet joint angle the difference in the angulation of either facet joint at the same level if observed to be 8° or greater, it is considered as facet joint Tropism[7]

Results: Data entry will be done using Microsoft Excel. Data will be analysed using Statistical package for social sciences (SPSS). Descriptive statistics will be applied and data will be presented using ranges, mean values, standard deviation, frequencies and percentages. Student's t test and Pearson's correlation coefficient will be used to find out the correlation between different parameters studied. Statistical significance is set at 0.05 level of significance ($p < 0.05$)

Conclusion: Our study showed association between facet joint tropism and radiological signs of degenerative disc disease.Thus indicating the possible role of facet joint tropism in the evaluation of degenerative disc disease.

Keywords: Facet joint ,degenerative discintervertebral disc signal intensity

I. INTRODUCTION:

The lumbar facet joints are principal stabilizers of the dynamic motion thus preventing translation and excessive amounts of rotation and flexion[1].Approximately 33 % of the dynamic compressive load and 35 % of the static load are handled by the facet joints[1]

Degenerative changes in the spine can be a potential cause of back pain, and therefore an understanding of the relationship between pathoanatomic abnormality and advanced degeneration is of importance from a clinical and public health perspective[2]

Studies have suggested a decrease in gagCEST values of the nucleus pulposis and annulus fibrosus in participants with facet joint tropism and increased sagittal orientation of the facet joint, indicating that both characteristics are risk factors for the early development of biochemical intervertebral disc alterations[5].

Facet joint tropism is difference in the orientation and angle of facet joints with respect to each other in the sagittal plane. Angle is calculated in the axial sections of MRI/Computed tomography with the angle is measured between lines drawn along the posterior border of the vertebral body and bisecting the superior and inferior tips of the facet joint. The resultant angle calculated is taken as the facet joint angle the difference in the angulation of either facet joint at the same level if observed to be 8° or greater, it is considered as facet joint Tropism[7]

This can lead to unequal biomechanical forces on the facet joints and intervertebral disc during rotation and other physiological movements.

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Hence it was decided to initiate a study evaluating facet joint tropism by measurement of angle of facet joints and correlate it with disc dessication as a sign of early degenerative disc changes to look for statistical significant correlation between facet joint tropism and Disc dessication as a marker of early degenerative changes.

Materials and Methodology:

The ethical clearance for this study was approved by the Srinivas Institute of Ethics Committee (SIEC) with the ethical approval number :SIEC/SIMS & RC/57/06/2024 (IRB number)

Study type: Hospital based Retrospective study.
Sample size: 96

$$N = \frac{z\alpha^2 pq}{d^2}$$

where,
$z\alpha = 1.96$ for 95% confidence interval
$p = 46.3\%$(Had Total facet joint tropism)[3]
$q=1-p$
d= margin of error = 10%
∴ Estimated sample size (n)= 96

- Inclusion Criteria:

Patients of age less than or equal to 35 years of age with MRI of Lumbo-sacral Spine.

- Exclusion criteria:

Nil.

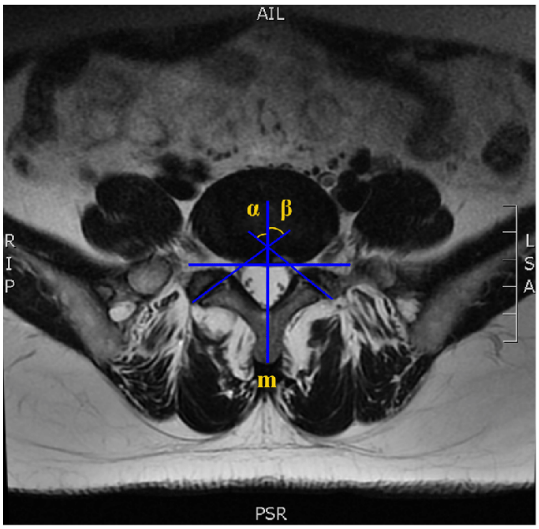
- Sampling technique:

Patients of age less than or equal to 35 years of age presenting with lower back ache for their MRI of Lumbo-sacral Spine.

- Data Collection tools:

All the measurements and observations are done on a SIEMENS 1.5 TESLA MRI Machine.

Angle is calculated in the axial sections of MRI with the angle is measured between lines drawn along the posterior border of the vertebral body and bisecting the superior and inferior tips of the facet joint. The resultant angle calculated is taken as the facet joint angle the difference in the angulation of either facet joint at the same level if observed to be 8° or greater, it is considered as facet joint Tropism[7]



MRI measurement of facet joint orientation. m: middle line, a reference line bisecting the base of the spinous process; α: the angle between the middle line and the left facet line connecting the margins of the superior articular process;β: the right facet joint orientation

Statistical analysis:

Data entry will be done using Microsoft Excel. Data will be analysed using Statistical package for social sciences (SPSS). Descriptive statistics will be applied and data will be presented using ranges, mean values, standard deviation, frequencies and percentages. Student's t test and Pearson's correlation coefficient will be used to find out the correlation between different parameters studied. Statistical significance is set at 0.05 level of significance ($p< 0.05$)

Statistics analysis report:

Gender	Frequency	Percent
Female	36	37.5

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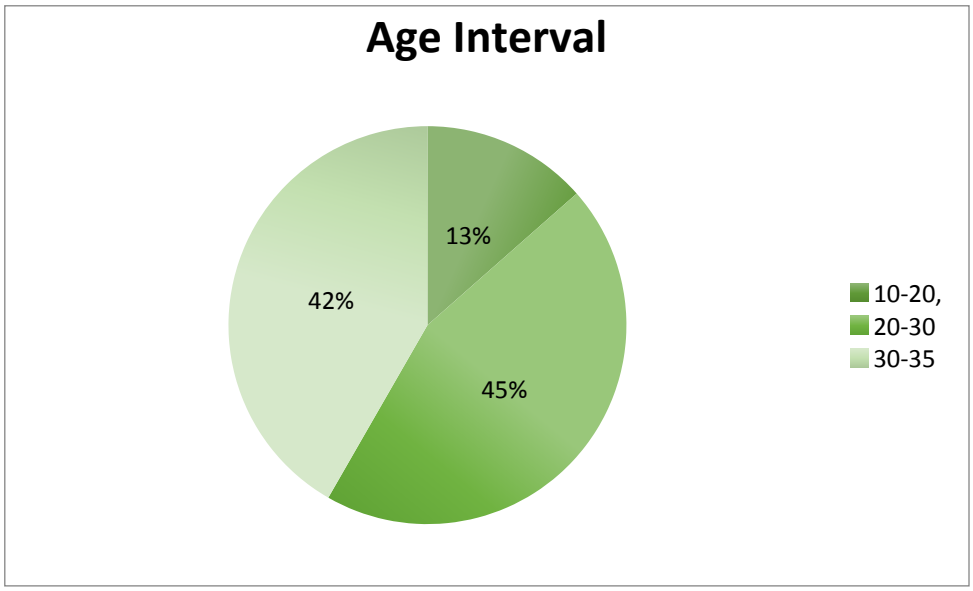
Male	60	62.5
Total	96	100.0
Age Interval	Frequency	Percent
10-20	13	13.5
20-30	43	44.8
30-35	40	41.7
Total	96	100.0

Table No.: 01. The following table provides the age and gender distribution of the study participants.



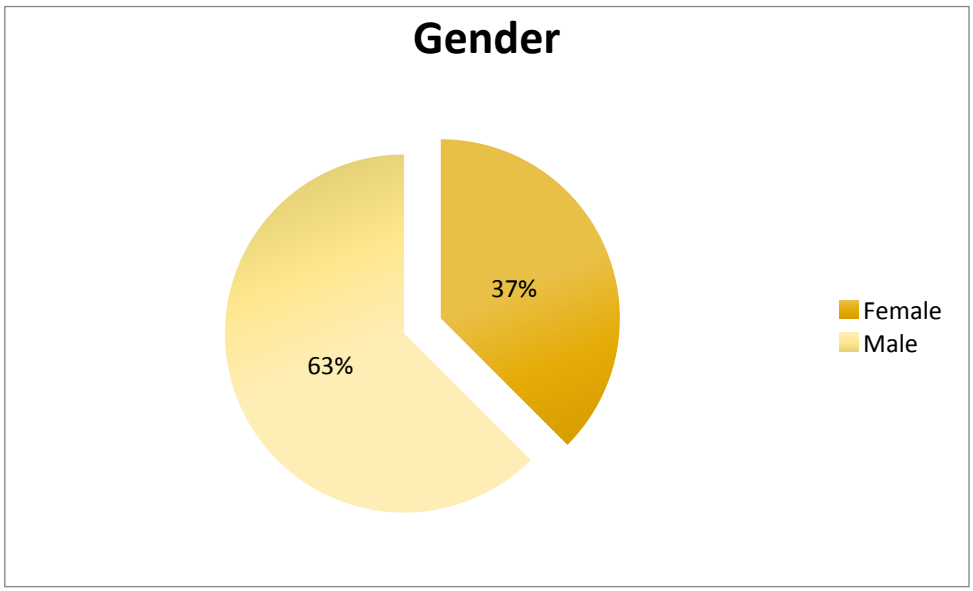


Table No.: 02. The following table shows the facet jointtropism .

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Facet Joint Tropism	Frequency	Percent
Absent	63	50.4
Present	62	49.6
Total	125	100.0

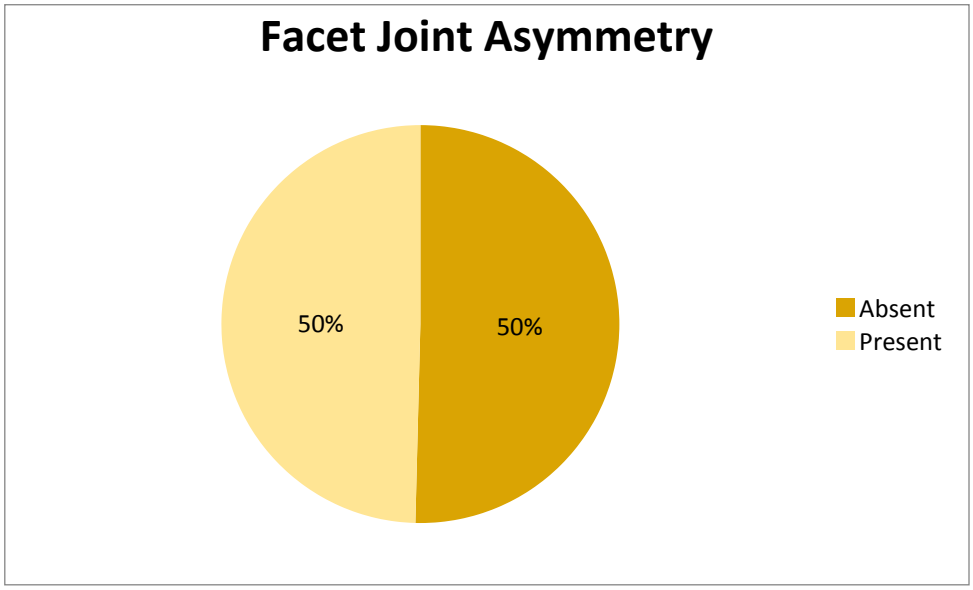

Table No.: 03. The inter-vertebral disc signal intensity observed among the study samples.

Intervertebral disc signal intensity	Frequency	Percent
Grade-I	47	37.6
Grade-II	57	45.6
Grade-III	21	16.8
Total	125	100.0

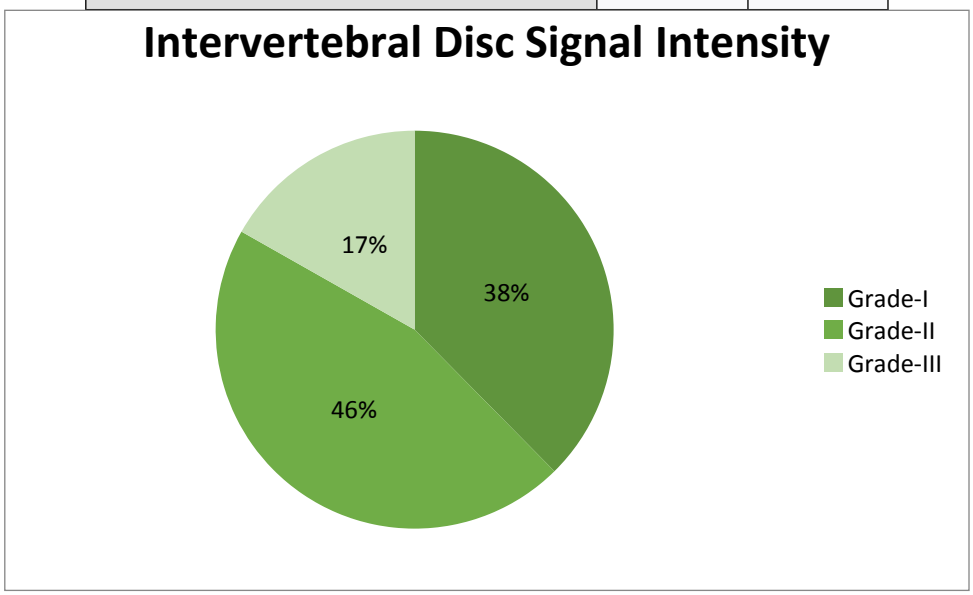

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Table No.: 04. The table shows the degenerative disc diseases observed among study samples.

Degenerative Disc diseases	Frequency	Percent
Bulge	73	58.4
Bulge with posterior annular tear	8	6.4
Disc extrusion	15	12.0
Protrusion	29	23.2
Total	125	100.0

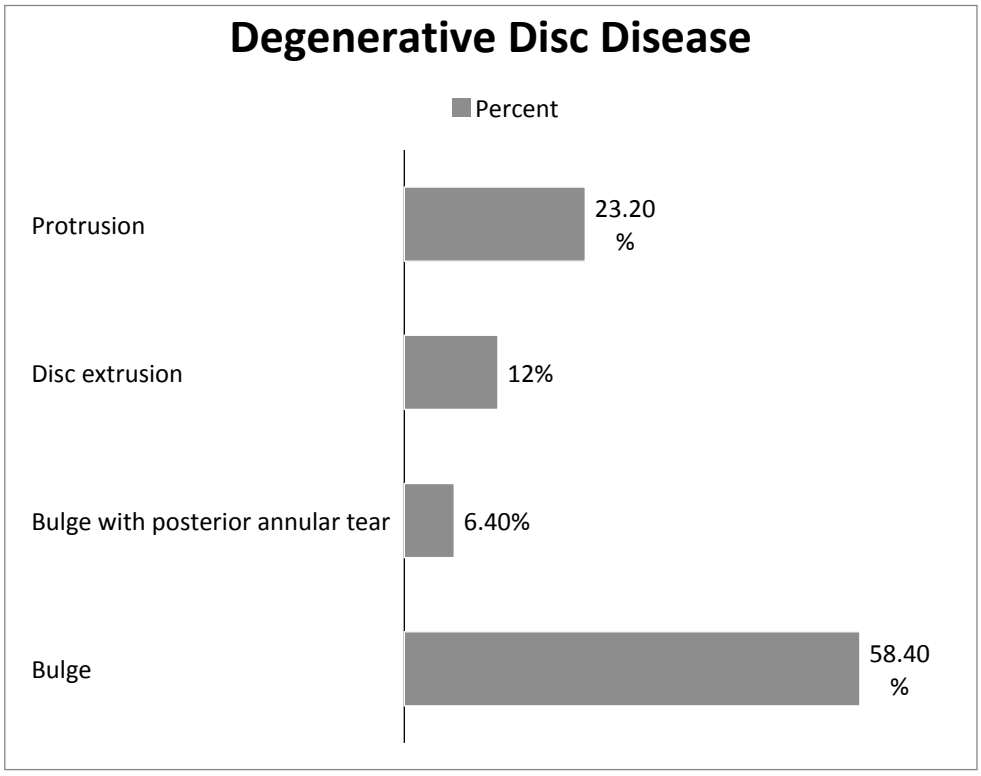

Table No.: 05. The table provides the involvement of inter-vertebral disc among study participants.

Involved intervertebral disc	Frequency	Percent
L2-L3	2	1.6
L3-L4	5	4.0
L4-L5	38	30.4
L5-S1	80	64.0
Total	125	100.0

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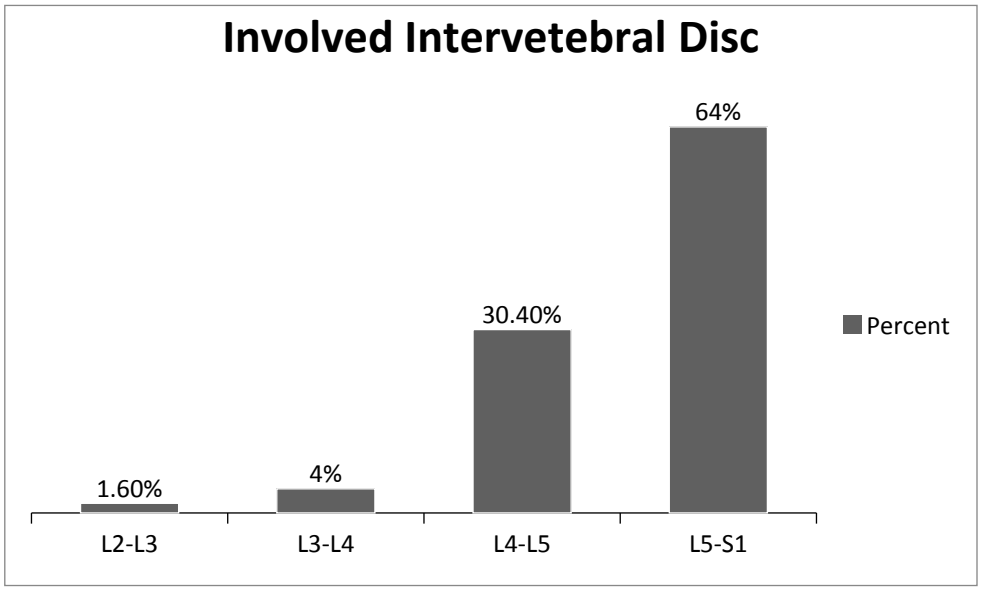

Table No.: 06. The following table provides the facet joint tropism observed among different inter-vertebral disc signal intensity.

Intervertebral disc signal intensity	Facet Joint Tropism		
	Absent	Present	Total
Grade-I	39	8	47
	83.0%	17.0%	100.0%
Grade-II	18	39	57
	31.6%	68.4%	100.0%
Grade-III	6	15	21
	28.6%	71.4%	100.0%
Total	63	62	125
	50.4%	49.6%	100.0%

*chi-square statistic = 32.035, p-value<0.001 (significant association)

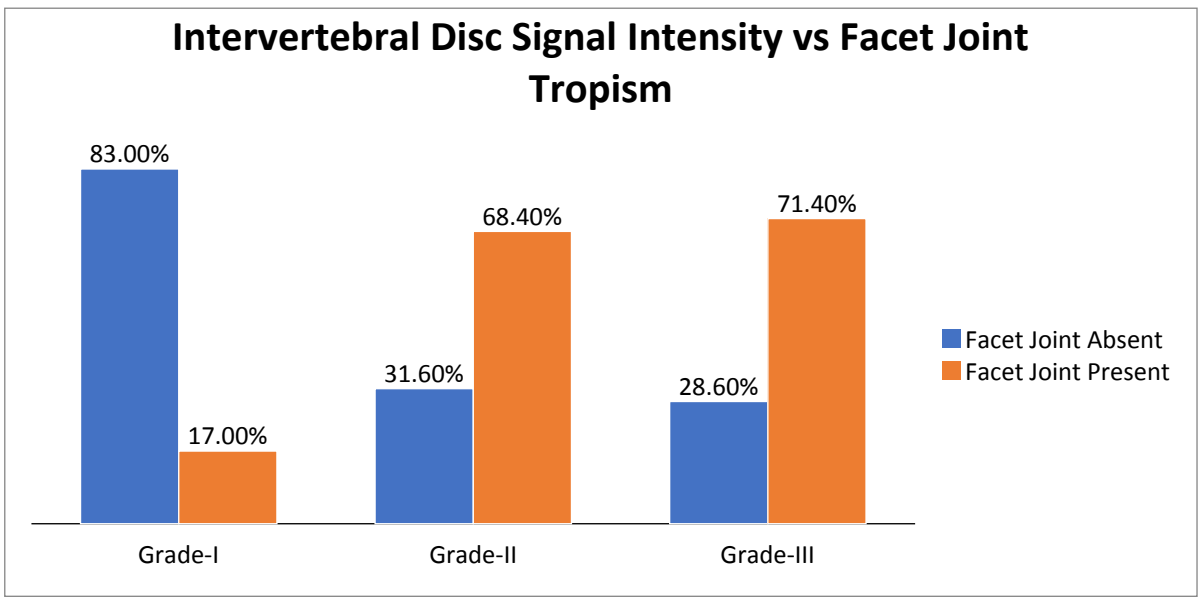

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Table No.: 07. The following table provides the facet joint observed among different degenerative disc diseases.

Degenerative Disc diseases	Facet Joint Tropism		Total
	Absent	Present	
Bulge	37	36	73
	50.7%	49.3%	100.0%
Bulge with posterior annular tear	5	3	8
	62.5%	37.5%	100.0%
Disc extrusion	6	9	15
	40.0%	60.0%	100.0%
Protrusion	15	14	29
	51.7%	48.3%	100.0%
Total	63	62	125
	50.4%	49.6%	100.0%

*chi-square statistic = 11.140, p-value<0.031 (significant association)

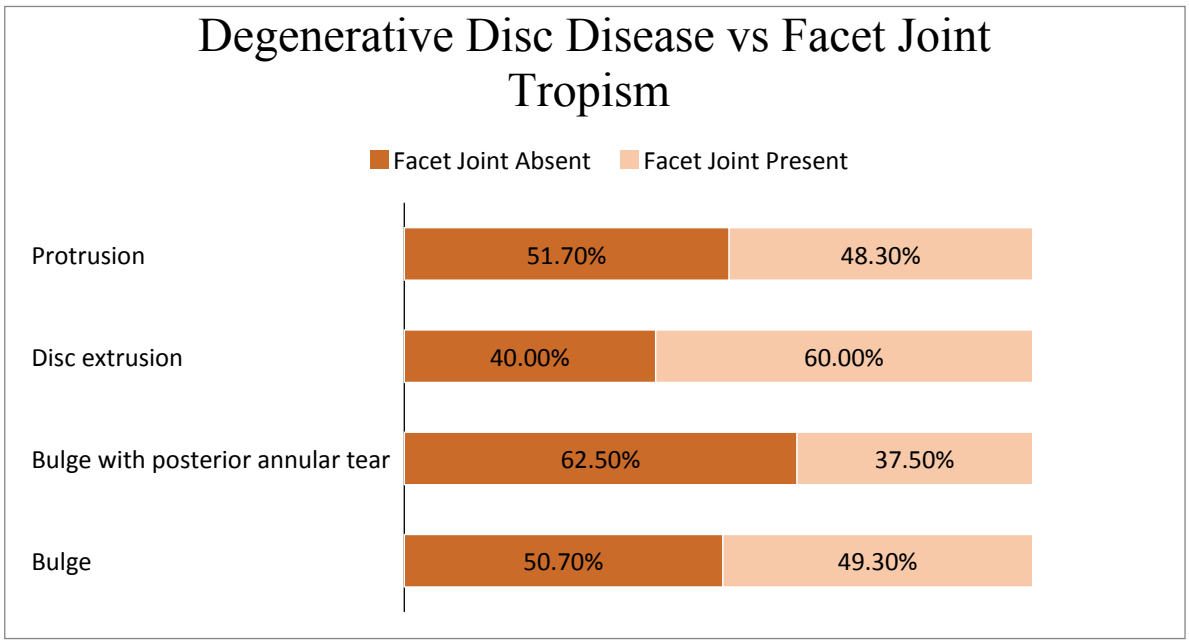

Table No.: 08. The following table provides the mean facet asymmetry observed among various degenerative disc diseases.

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Bulge	73	7.8203	5.12994	6.6234	9.0172	.90	31.00
Bulge with posterior annular tear	8	5.6875	6.21391	.4925	10.8825	.40	16.00
Disc extrusion	15	11.5933	4.80840	8.9305	14.2561	6.50	20.20
Protrusion	29	8.6710	4.97121	6.7801	10.5620	1.00	20.40
Total	125	8.3339	5.25069	7.4044	9.2635	.40	31.00

*One-way ANOVA, F = 237.940, p-value<0.033 (significant mean difference of Facet Asymmetry)

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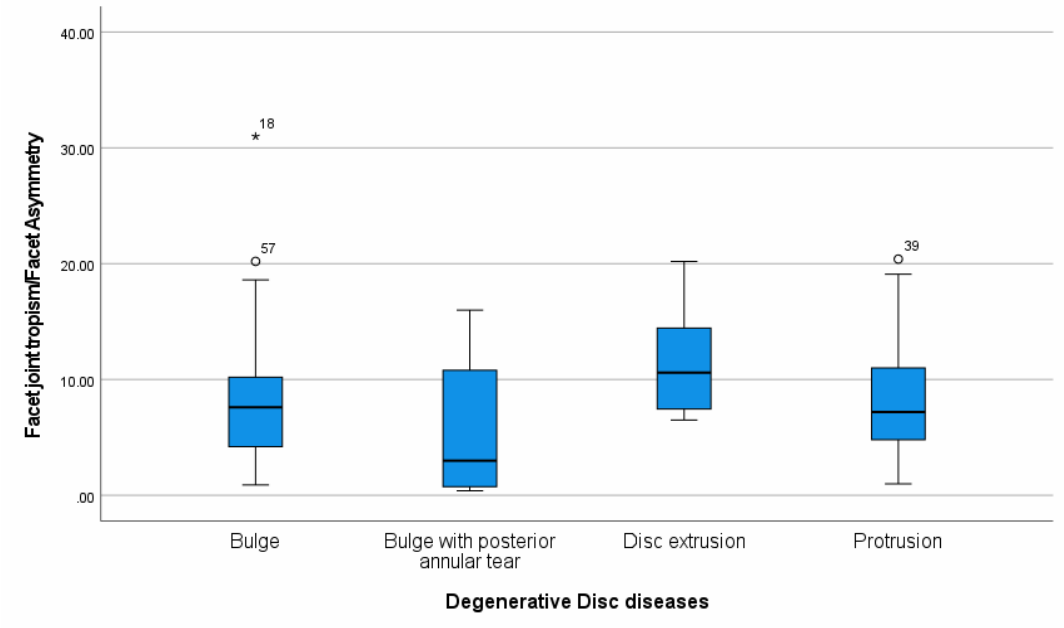

Table No.: 09. The following table provides the mean facet asymmetry observed among cases with grade 1, 2, and 3 of the signal intensity.

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Grade-I	47	5.0021	3.21515	4.0581	5.9461	.70	15.00
Grade-II	57	8.7979	3.45094	7.8822	9.7136	.40	15.90
Grade-III	21	14.5314	6.83973	11.4180	17.6448	2.00	31.00
Total	125	8.3339	5.25069	7.4044	9.2635	.40	31.00

*One-way ANOVA, F = 1340.601, p-value<0.000 (significant mean difference of Facet Asymmetry)

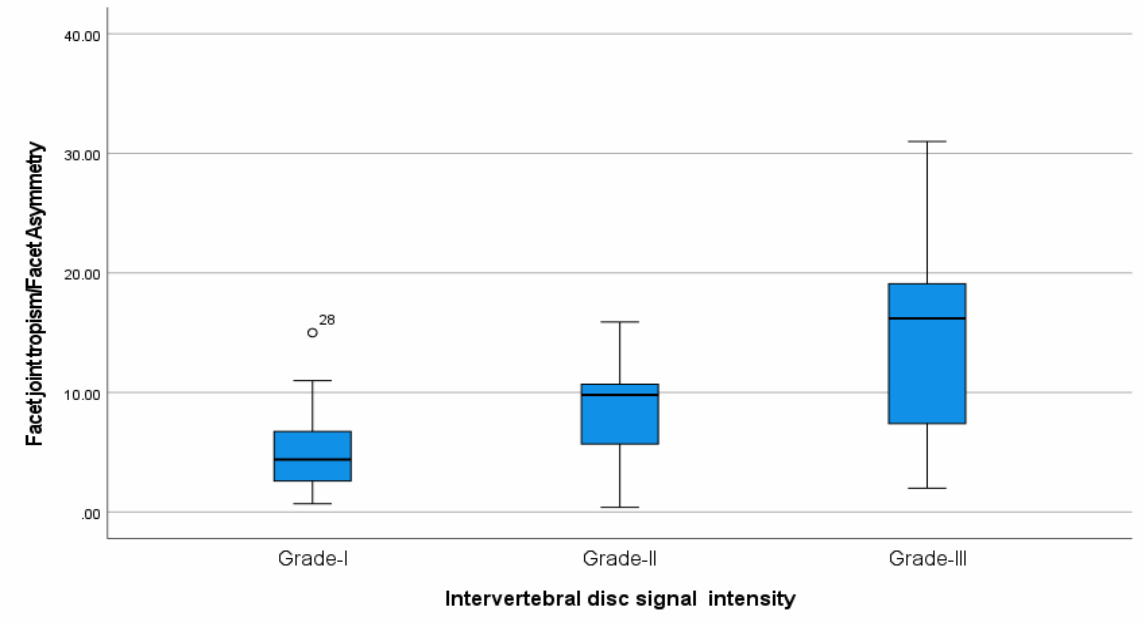

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Table No.: 10. The following table provides the facet joint tropismobserved in various degenerative disc diseases for disc signal intensity of grade-I.

Intervertebral disc signal intensity	Degenerative Disc diseases	Facet Joint		
		Absent	Present	Total
Grade-I	Bulge	27	6	33
		81.8%	18.2%	100.0%
	Bulge with posterior annular tear	3	0	3
		100.0%	0.0%	100.0%
	Disc extrusion	2	0	2
		100.0%	0.0%	100.0%
	Protrusion	7	2	9
		77.8%	22.2%	100.0%
	Total	39	8	47
		83.0%	17.0%	100.0%

*chi-square statistic = 12.229, p-value<0.029 (significant association)

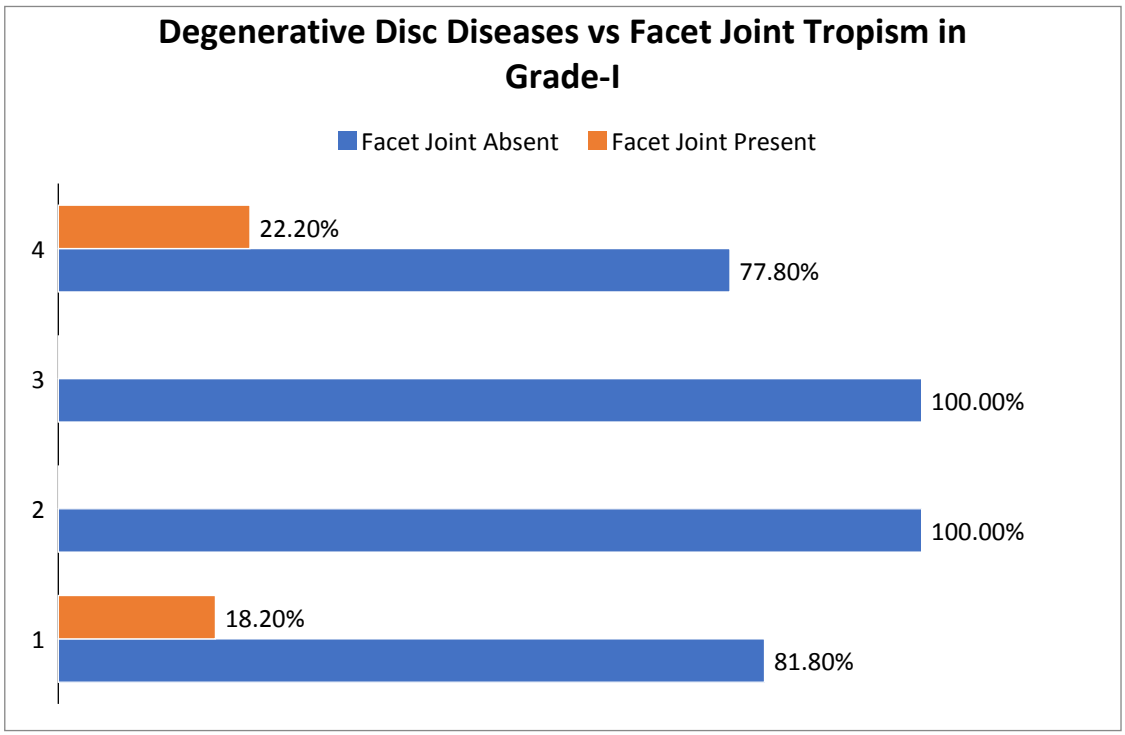

Table No.: 11. The following table provides the facet joint tropism observed in various degenerative disc diseases for disc signal intensity of grade-II.

Intervertebral disc signal intensity	Degenerative Disc diseases	Facet Joint		
		Absent	Present	Total
Grade-II	Bulge	10	24	34
		29.4%	70.6%	100.0%
	Bulge with posterior annular tear	2	2	4
		50.0%	50.0%	100.0%
	Disc extrusion	1	5	6
		16.7%	83.3%	100.0%
	Protrusion	5	8	13
		38.5%	61.5%	100.0%
	Total	18	39	57
		31.6%	68.4%	100.0%

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*chi-square statistic = 16.605, p-value<0.048 (significant association)

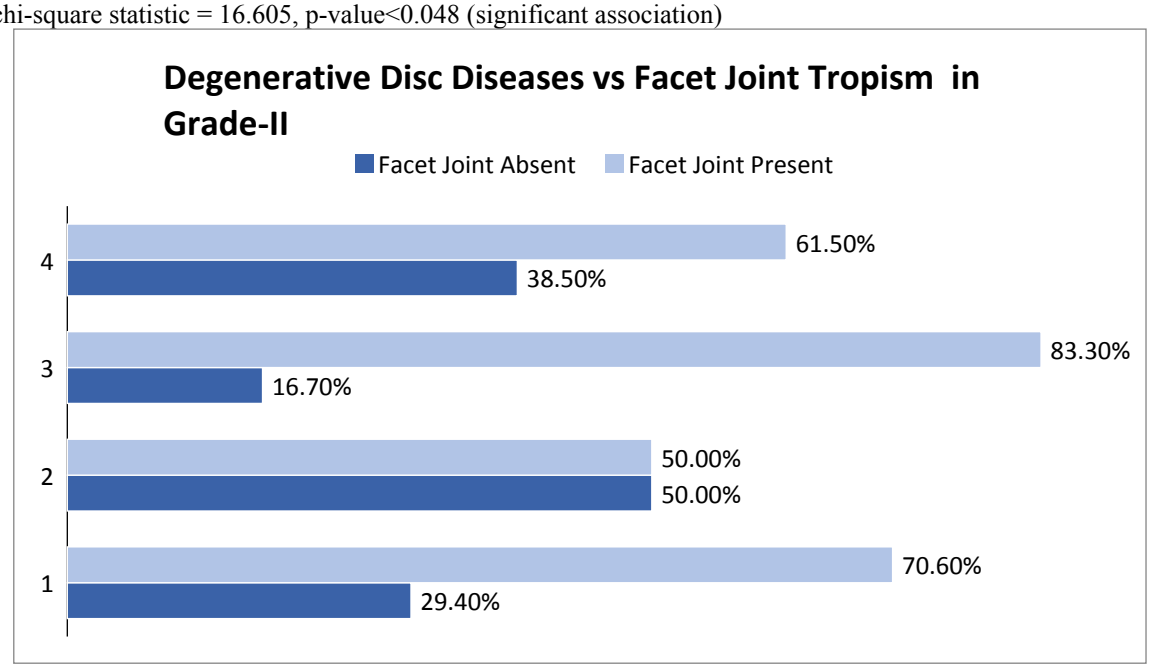

Table No.: 15. The following table provides the degenerative disc diseases observed among different age group.

Age Interval	Degenerative Disc diseases				Total
	Bulge	Bulge with posterior annular tear	Disc extrusion	Protrusion	
10-20	7	0	3	3	13
	53.8%	0.0%	23.1%	23.1%	100.0%
20-30	34	1	3	5	43
	79.1%	2.3%	7.0%	11.6%	100.0%
30-35	19	4	5	12	40
	47.5%	10.0%	12.5%	30.0%	100.0%
Total	60	5	11	20	96
	62.5%	5.2%	11.5%	20.8%	100.0%

*chi-square statistic = 12.328, p-value = 0.050 (significant association)

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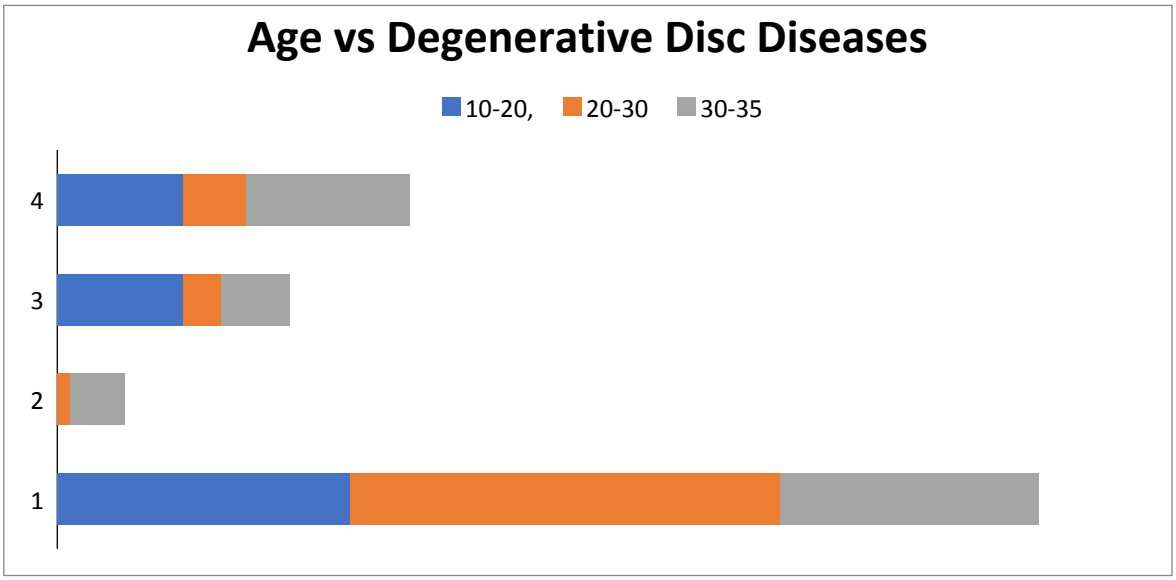

Table No.: 16. The following table provides the facet joint tropism observed among male and female.

Gender	Facet Joint		Total
	Absent	Present	
Male	15	21	36
	41.7%	58.3%	100.0%
Female	28	32	60
	46.7%	53.3%	100.0%
Total	43	53	96
	44.8%	55.2%	100.0%

*chi-square statistic = 0.227, p-value = 0.633 (significant association)

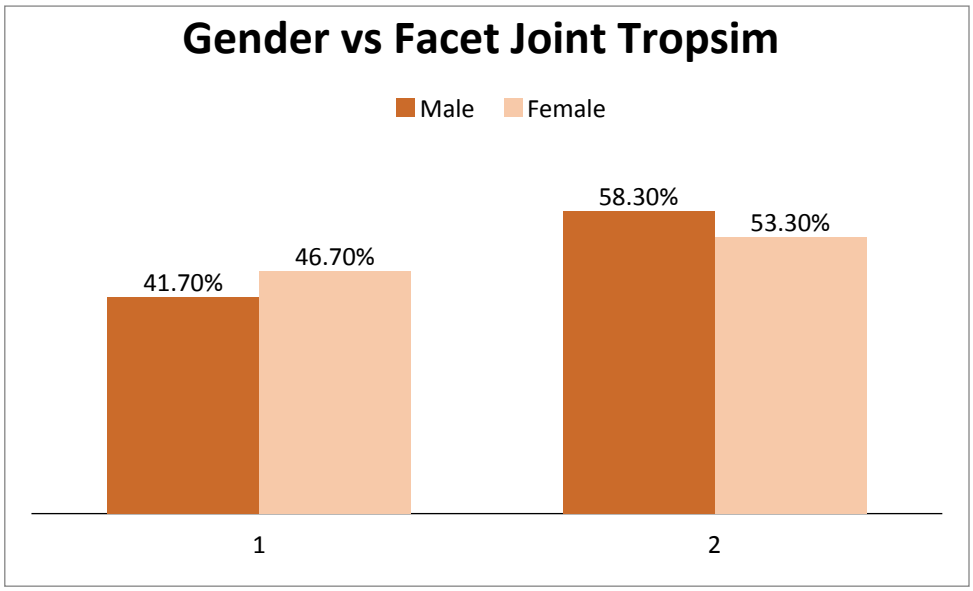

Table No.: 17. The following table provides the degenerative disc diseases observed among male and female.

Gender	Degenerative Disc diseases	Total

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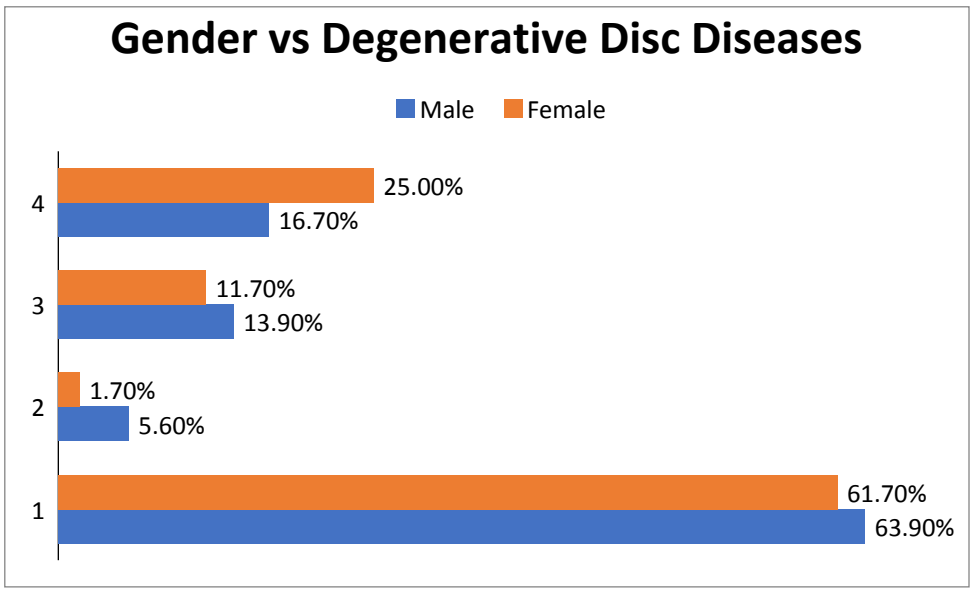
	Bulge	Bulge with posterior annular tear	Disc extrusion	Protrusion	
Male	23	2	5	6	36
	63.9%	5.6%	13.9%	16.7%	100.0%
Female	37	1	7	15	60
	61.7%	1.7%	11.7%	25.0%	100.0%
Total	60	3	12	21	96
	62.5%	3.1%	12.5%	21.9%	100.0%

*chi-square statistic = 1.910, p-value = 0.591 (significant association)



II.

III. DISCUSSION:

Our study showed:

1. There is significant association between inter-vertebral disc intensity and facet joint tropism (refer table no. 6).
2. Significant association is observed between degenerative disc diseases and facet joint tropism (refer table no. 7).
3. It is observed that there is significant mean difference of facet joint asymmetry found in various disc diseases (refer table no. 8).
4. It is observed that there is significant mean difference of facet joint asymmetry found in different inter-vertebral disc signal intensity (refer table no. 9).
5. Among cases with disc signal intensity of grade –I, it is observed that there is significant relation found between disc diseases and facet joint tropism (refer table no. 10).
6. Among cases with disc signal intensity of grade –II, it is observed that there is significant relation found between disc diseases and facet joint tropism (refer table no. 11).
7. There is a significant association observed between age group and degenerative disc diseases (refer table no. 15)

IV. CONCLUSION

Our study showed association between facet joint tropism and radiological signs of degenerative disc disease. Thusindicating the possible role of facet joint tropism in the evaluation of degenerative disc disease.

Ethical Approval:

The ethical clearance for this study was approved by the Srinivas Institute of Ethics Committee (SIEC) with the ethical approval number:SIEC/SIMS & RC/57/06/2024 (IRB number)

Informed Consent:

An informed consent could not be obtained as this is a retrospective study.

Conflicts of interest: The authors declare that we have no conflicts of interest.
Acknowledgements:None

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