

# Magnetic Resonance Imaging Correlation Of Facet Joint Morphology And Tropism With Degenerative Disease Of The Lumbar Spine

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**Abstract: Introduction:** The present study was planned to determine if there is associations of facet joint arthropathy with degenerative disc disease of the lumbar spine. Further we determined if there is associations of facet joint tropism with degenerative disc disease of the lumbar spine. In this study we also determined if there is association of facet joint tropism with facet joint arthropathy in lumbar spine. **Materials and methods:** It is a retrospective and prospective study conducted in Department of Radio diagnosis, Sri Venkateshwara Medical College Hospital and Research Centre (SVMCH&RC), a tertiary care teaching hospital located in Ariyur, Pondicherry with the sample size of 126. Facet joint arthropathy and facet joint tropism with degenerative disc disease of the lumbar spine was measured. **Results:** MRI Lumbar spine is good imaging modality to assess facet joints and lumbar disc disease. In our analysis, we found No significant association between facet tropism and facet joint osteoarthritis in confirmation with results from contemporary studies. No significant association between facet joint tropism and degenerative disc disease of the lumbar spine. No significant association between facet joint tropism and degenerative disc disease of the lumbar spine.

**Key words:** lumbar spine, facet joint tropism, facet joint arthropathy.

## INTRODUCTION

A synovial membrane and joint capsule cover the subchondral bone of the facet joints, which are the only synovial joints in the spine<sup>1</sup>. Degenerative changes in the spine may affect the morphology and orientation of the facet joints, either by causing the changes or by causing abnormal forces caused by those changes. Degenerative conditions like lumbar disc herniation, degenerative lumbar scoliosis and lumbar spondylolisthesis are common in orthopaedic medicine. If the lumbar facet joint is damaged, the vertebral column will move forward and the upper body weight will be transferred to the lower body<sup>2</sup>.

In severe cases of lumbar degenerative diseases, facet tropism, defined as asymmetry between the left and right facet joints, could also be a contributing factor<sup>3</sup>.

An asymmetry of the sagittal orientation between the left and right vertebral (apophyseal) facet joints was described by Brailsford in 1929 as FT<sup>4</sup>.

Some scholars state that lumbar facet joint structural asymmetry is associated with lumbar spine diseases<sup>5</sup>. As per Masharawi et al., most thoracic vertebrae have

asymmetric facet orientations; only lumbar vertebrae do not<sup>6</sup>.

First, Farfan and Sullivan hypothesized that facet tropism might lead to lumbar disc herniation. Cassidy reported that it is controversial whether disc herniation happens on the sagittal or coronal side of the spine as a result of facet asymmetry<sup>7</sup>.

According to Grogan et al., lumbar facet joint tropism is not linked to an increase in degenerative processes in the facet joints<sup>8</sup>. Disc degeneration and degenerative spondylolisthesis can be caused in part by the SAF joint, according to some studies<sup>9</sup>.

A lumbar facet joint may degenerate with age or exhibit alternate morphologic characteristics as a result of aging. By examining the pathoanatomical abnormalities in the region, we can understand the specific causes of low back pain. In this regard, lower lumbar degeneration should be known to link to developing degenerations<sup>10</sup>. Anatomical T2 weighted MRI images were used to measure the facet angle orientation.<sup>11</sup>

Each facet angle was measured as the angle between the sagittal plane and the oblique line. According to the method described by vanharanta et al., moderate tropism was defined as difference of 7 to 15 degrees and severe tropism as more than 15 degrees. A calculation was performed to determine the difference between the two angles (FT). As a result, an investigation of the association between facet joint tropism and morphology and degenerative spine disease was planned<sup>12</sup>.

**Materials and Methods**

**Type of study:** Retrospective and prospective study

**Place of study:** Department of Radio diagnosis, Sri Venkateshwara Medical College Hospital and Research Centre (SVMCH&RC), a tertiary care teaching hospital located in Ariyur, Pondicherry.

**Study Design:** Hospital based observational study

**Study Population:** patients referred to the Radiology Department for whom Magnetic Resonance Imaging Lumbar spine is successfully taken.

**Sample Size:** calculated using epi info version 7.3.1.2. Sample size was calculated using confidence interval 95% power 75% mean and margin of error 5% and a sample size of 126 was obtained.

**Sampling technique:** purposive sampling

**Inclusion Criteria**

Patients for whom Magnetic Resonance Imaging Lumbosacral spine is taken in the Department of radiodiagnosis.

**Exclusion Criteria**

- Patients with history of trauma/surgery
- Patients with history of infection in the spine and presence of neoplasm (except uncomplicating

small hemangiomas)/ kyphosis/ scoliosis in the spine

- Patients with neoplasm /infection in the paravertebral regions
- Patients with poliomyelitis /neurological reasons for positional abnormalities in the spine/muscular dystrophies.
- Paediatric populations are exempted.

**Data collection procedure**

Scientific Research committee clearance and Institutional Human Ethical committee will be obtained. MRI -MRI LUMBOSACRAL SPINE done with SIEMENS 1.5TESLA is analyzed.

**Grading for facet degeneration**

Any changes like disc bulge/protrusion/extrusion/annular tear if present the case was classified as degenerative disc change positive. Disc dehydration alone present without any of the above changes and normal discs are classified as degenerative disc change negative.

**Data Analysis**

Data will be entered in MS excel and analyzed by using SPSS version 23 software will be used for statistical analysis.

**Results**

Out of 126 cases involved in the study, age group below 50 years, 49 cases had normal facet morphology, 40 cases had normal facet morphology in 51-55 years age group. In the age group of 56-60, 1 case was reported to have normal facet morphology and 17 cases reported to have facet joint arthropathy changes. In the age group of 60 and above 1 (0.8%) case was reported to have normal facet morphology and 18 cases were reported to have facet joint arthropathic changes. Hence, there was increased prevalence in the age group above 60 showing facet joint arthropathy changes.

**Table 1-To estimate the association between facet joint arthropathy with degenerative disease of disc**

Including all levels (L1-L2, L2-L3, L3-L4, L4-L5, L5-S1)	Facet joint arthropathy Positive	Facet joint arthropathy Negative	Total
Degenerative changes in disc Positive	18 (14.2%)	55 (43.6%)	73 (57.9%)
Degenerative changes in disc Negative	17 (13.4%)	36 (28.5%)	53 (42%)
<b>Total</b>	35(27.7%)	91(72.3%)	126
Odds ratio :0.69		Chi-square p-value: 0.358	

**Table 2-To estimate the association between facet joint tropism withdegenerative disease of disc**

Including all levels (L1-L2, L2-L3, L3-L4, L4-L5, L5-S1)	Facet tropism Positive	Facet tropism Negative	Total
Degenerative changes indisc Positive	19 (15.1%)	54 (42.8%)	<b>73 (57.9%)</b>
Degenerative changes indisc Negative	16 (12.6%)	37 (29.3%)	<b>53(42%)</b>
<b>Total</b>	35(27.7%)	91(72.3%)	126
<b>Odds ratio :0.81</b>	Chi-square p-value: 0.6		

**Table 3: To estimate association of Facet tropism and Facet joint arthropathy**

	Facet tropism positive	Facet tropism Negative	Total
Facet joint arthropathy Positive	10 (7.9%)	25 (19.8%)	35 (27.7%)
Facet joint arthropathy Negative	25 (19.8%)	66(52.3%)	91(72.3%)
<b>Total</b>	35(27.7%)	91(72.3%)	126
<b>Odds ratio :1.05</b>	Chi-square p-value: 0.901		

**Table-4 Age distribution with Facet joint arthropathy changes**

Age distribution	Facet joint arthropathy	
	Absent	Present
≤ 50 yrs	49 (38.9%)	0 (0.0%)
51 – 55 yrs	40 (31.7%)	0 (0.0%)
56 – 60 yrs	1 (0.8%)	17 (13.5%)
>60 yrs	1 (0.8%)	18 (14.3%)
<b>Total</b>	<b>91</b>	<b>35</b>

## Discussion

While estimating the association between facet joint arthropathy with degenerative disease of disc we observed the following: Total studies having degenerative changes in disc and facet joint arthropathy =18(14.2%) patients. Total studies having Degenerative changes in disc Positive and facet joint arthropathy negative = 55 (43.6 %) patients. Total studies having Degenerative changes in disc negative and facet joint arthropathy Positive was =17 (13.4%). Total studies having degenerative changes in disc and facet joint arthropathy negative =36 (28.5%) patients. The odds ratio observed was 0.69. This is a weak negative ratio.

Our next objective was to estimate the association between facet joint tropism with degenerative disease of disc we observed the following: Total studies having Degenerative changes in disc and Facet tropism positive = 19 (15.1%) patients. Total studies having degenerative changes in disc Positive and Facet tropism negative = 54 (42.8 %) patients. Total studies having degenerative changes in disc negative and Facet tropism positive =16 (12.6%) patients.

Total studies having Degenerative changes in disc and Facet tropism negative = 37 (29.3%) patients. The odds ratio observed was 0.81 which is weak negative odds ratio. Chi-square test yielded a p- value of 0.60, suggesting the ratio observed is very likely to be insignificant/very likely to be due to chance rather than significant association. + This result of our study is in disagreement with results from those conducted by Devanand Degulmadi et al.<sup>13</sup>, Manish Chadha et al.<sup>14</sup>, and in agreement with results of the study conducted by Kunakornsawat<sup>15</sup>. Their observations and results are provided here with.

Devanand Degulmadi et al studied 500 patients and found that L4-L5 level demonstrated significant association with sagittally aligned facet and facet tropism in lumbar disc herniation and degenerative spine. Our study did not show any positive correlation between these two variables. Manish Chadha et al., conducted study in 60 patients (18-40 years) stated that there was a significant tropism associated with herniated disc at L5-S1 level. In a cross-sectional study by Kunakornsawat using MRI as the modality to measure the association, no statistically significant correlation was found between facet tropism and lumbar disc herniation. Total studies having Facet tropism negative and facet joint arthropathy Positive =25 (19.8%). Total studies having Facet joint arthropathy and Facet tropism Negative = 66 (52.3%). The odds ratio recorded to be 1.05, implying there is no significant association between presence of facet joint arthropathy and facet joint tropism. Our study is in agreement with Study done by Kalichman et al<sup>16</sup>, where they found that Facet tropism did not show an association with facet joint OA at any spinal level in their study population. Fujiwara et al., reported that higher grades of facet joint osteoarthritis showed more sagittal orientation of the facet joints at the L3-L4 and L4-L5 levels, but found little association between facet joint osteoarthritis and tropism of the lumbar spine. This confirms to our study where

there is no significant amount of association between facet tropisms and facet joint arthropathy.

Comparison with respect to age distribution and its association with facet joint arthropathy was evaluated and results evaluated as, Out of 126 cases involved in the study, age group below 50 years, 49 cases had normal facet morphology, 40 cases had normal facet morphology in 51-55 years age group. In the age group of 56- 60, 1 case was reported to have normal facet morphology and 17 cases reported to have facet joint arthropathy changes. In the age group of 60 and above 1(0.8%) case was reported to have normal facet morphology and 18 cases were reported to have facet joint arthropathy changes. Hence, there was increased prevalence in the age group above 60 showing facet joint arthropathy changes.

Comparison with respect to age distribution and its association with facet tropism was evaluated and results evaluated as, Out of 126 cases involved in the study, 36 (28.5%) cases had no facet tropism in the age group of 50 and below, in 51-55 years age group 28 (22.2%) cases had no facet joint tropism and 9 (7.1%) had moderate facet tropism and 3 (2.3%) had severe tropism. In the age group of 56-60, 12 (9.5%) cases had no facet joint tropism and 6 (4.7%) had moderate facet tropism and zero cases had severe tropism and in the age group of 60 and above 15 (11.9%) cases had no facet joint tropism and zero cases had moderate facet tropism and 4 (3.1%) cases had severe tropism. There is no significant association between any particular age group and facet tropism. Chi-square test yielded a p-value of 0.84, while comparing different age groups with presence/absence of facet tropism.

## Conclusion

MRI Lumbar spine is good imaging modality to assess facet joints and lumbar disc disease. In our analysis, we found No significant association between facet tropism and facet joint osteoarthritis in confirmation with results from contemporary studies. No significant association between facet joint osteoarthritis and degenerative disc disease of the lumbar spine. No significant association between facet joint tropism and degenerative disc disease of the lumbar spine.

## References

- [1]. Gellhorn AC, Katz JN, Suri P. Osteoarthritis of the spine: the facet joints. *Nature Reviews Rheumatology*. 2013 Apr;9(4):216-24.
- [2]. Hartmann H, Wirth K, Klusemann M. Analysis of the load on the knee joint and vertebral column with changes in squatting depth and weight load. *Sports medicine*. 2013 Oct;43(10):993-1008.
- [3]. Hangai M, Kaneoka K, Kuno S, Hinotsu S, Sakane M, Mamizuka N, Sakai S, Ochiai N. Factors associated with lumbar intervertebral disc degeneration in the elderly. *The spine journal*. 2008 Sep 1;8(5):732-40.
- [4]. Arzpeyma SF, Hajir P, Khorram PB. The relationship between facet tropism and lumbar disc herniation in patients with low back pain. *AIMS Medical Science*. 2019 Sep 1;6(3):181-90.
- [5]. Van Vlasselaer N, Van Roy P, Cattrysse E. Morphological Asymmetry of the Superior

- Cervical Facets from C3 through C7 due to Degeneration. *BioMed Research International*. 2017 Nov 22;2017.
- [6]. Masharawi YM, Kjaer P, Bendix T, Manniche C, May H, Mirovsky Y, Anekshtein Y, Jensen TS, Hershkovitz I. Lumbar facet and interfacet shape variation during growth in children from the general population: a three- year follow-up MRI study. *Spine*. 2009 Feb 15;34(4):408-12.
- [7]. Chadha M, Sharma G, Arora SS, Kochar V. Association of facet tropism with lumbar disc herniation. *European Spine Journal*. 2013 May;22(5):1045-52.
- [8]. Varlotta GP, Lefkowitz TR, Schweitzer M, Errico TJ, Spivak J, Bendo JA, Rybak L. The lumbar facet joint: a review of current knowledge: part 1: anatomy, biomechanics, and grading. *Skeletal radiology*. 2011 Jan;40(1):13-23.
- [9]. Sun K, Lin F, Jiang J, Sun J, Shi J. A Novel Capsule Lumbar Interbody Fusion (CLIF) in Treating Foot Drop due to Lumbar Degenerative Diseases: a Prospective, Observational Study. *Pain Research and Management*. 2021 Nov 12;2021.
- [10]. Uhrenholt L, Uhrenholt L. Morphology and Pathoanatomy of the Cervical Spine Facet Joints in Road Traffic Crash Fatalities with Emphasis on Whiplash: A Pathoanatomical and Diagnostic Imaging Study: PhD Thesis. Faculty of Health Sciences, University of Aarhus; 2007.
- [11]. Grogan J, Nowicki BH, Schmidt TA, Haughton VM. Lumbar facet joint tropism does not accelerate degeneration of the facet joints. *American journal of neuroradiology*. 1997 Aug 1;18(7):1325-9.
- [12]. Kleipool RP, Dahmen J, Vuurberg G, Oostra RJ, Blankevoort L, Knupp M, Stufkens SA. Study on the three-dimensional orientation of the posterior facet of the subtalar joint using simulated weight-bearing CT. *Journal of Orthopaedic Research®*. 2019 Jan;37(1):197-204.
- [13]. Degulmadi D, Dave BR, Krishnan A. Age-and sex-related changes in facet orientation and tropism in lower lumbar spine: an MRI study of 600 patients. *European Spine Journal*. 2019 May 1;28:961-6.
- [14]. Chadha M, Balain B, Maini L, Dhaon BK. Pedicle morphology of the lower thoracic, lumbar, and S1 vertebrae: an Indian perspective. *Spine*. 2003 Apr 15;28(8):744-9.
- [15]. Kunakornsawat S, Sirikajohnirun S, Piyaskulkaew C, Pruttikul P, Kittithamvongs P, Pongpinyopap W, Pluemvitayaporn T. Comparison between 1 g and 2 g of intrawound vancomycin powder application for prophylaxis in posterior instrumented thoracic or lumbosacral spine surgery: a preliminary report. *Asian journal of neurosurgery*. 2019 Sep;14(03):710-4.
- [16]. Kalichman L, Hunter DJ. Diagnosis and conservative management of degenerative lumbar spondylolisthesis. *European Spine Journal*. 2008 Mar;17:327-35.