

FAT SATURATED MAGNETIC RESONANCE IMAGING (FS-MRI) IN THE EVALUATION OF LUMBAR FACET ARTHROSIS IN ADULT PATIENTS WITH LOW BACK PAIN IN A TEACHING HOSPITAL OF EASTERN NEPAL

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ABSTRACT

Introduction

Facet joint arthropathy is one of the myriad of abnormalities for low back pain and since conventional Magnetic resonance Imaging detects the facet joint pathologies poorly when compared to fat suppressed MRI sequences, fat suppressed MRI promises to be contributory to proper diagnosis and management.

Objective

The objective of this study was to find the prevalence of lumbar facet joint arthrosis among patients with low back pain and comparing conventional versus fat saturated sequence in detecting the MRI findings of facet joint arthrosis.

Methodology

A cross sectional study was conducted at the Department of Radiodiagnosis and Department of Orthopedics at Birat Medical College Teaching Hospital from February 15, 2020 to May 15, 2020. Ethical clearance was taken and 100 participants having low back pain were enrolled for Magnetic Resonance imaging after informed consent. Data were

Results

57% study participants were found to have facet joint arthrosis (FJA) in their lumbar spine and on comparing the detection rate of the grades of arthrosis between the conventional and FS MRI, the difference in diagnosis of grade 2 and grade 3 changes of FJA were 87.9% and 42.9% respectively whereas no difference was found in diagnosing grade 4 changes in both the sequences. Data was entered in MS excel and analysed by SPSS.

Conclusion

This study showed that facet joint arthrosis is frequently seen in the patients presenting with low back pain and these changes are better diagnosed by fat saturated MRI sequence as compared to conventional sequence.

KEYWORDS

facet joint arthrosis (FJA), fat saturated MRI (FS MRI), low back pain (LBP), lumbar spine (LS)



INTRODUCTION

Low back pain (LBP) is a condition of global concern and is the most common cause of years lived with disability.¹ Globally, 60.1 million disability-adjusted life-years were due to low back pain in 2015, which increased by 54% since 1990.² According to Global Burden of Disease data, low back pain is the number one cause of disability in Nepal; since 2005 the number of years lived with disability due to low back pain in Nepal increased by 16.9%.³ Pathologies of the lumbar intervertebral discs, lumbar facet joints (LFJs) and the sacroiliac joints are potential sources of chronic LBP.^{4,5} Osteoarthritis of the LFJs due to degenerative change(s) is considered to be the main cause of facet joint-origin LBP.⁶ Degenerative changes in facet joints can lead to abnormal stress and strain, resulting in increased load on the facet joint with subsequent inflammation which activates nociceptors within and surrounding the joints, which further exacerbate facet joint-origin LBP.⁷ Computed tomography (CT) and (Magnetic Resonance Imaging) MRI are equally useful in demonstrating morphological changes in Facet joints, however MRI is the imaging modality of choice as there is no ionizing radiation and gives remarkable soft tissue description.⁸ Also, MRI clearly presents advantages of better assessing the immediate consequences of facet joint degeneration, such as surrounding neural structure impingement.⁹ A study indicates that T2 sequences with Fat Saturation helps to better visualize or disclose degenerative-inflammatory changes in the lumbar spine, showing the active-inflammatory phase and extension of these processes which may not be depicted during a standard MR examination.¹⁰ It was found that integrating MRI with T2-weighted images with fat saturation increases diagnostic sensitivity in patients with low back pain, particularly in those cases whose standard MR examination does not disclose a clear cause of pain. In such cases, Fat saturated MRI (FS MRI) enables a focused therapeutic regimen to be generated, and allows critical re-evaluation over time on specific therapy.¹¹ There is lack of evidence regarding prevalence of facet joint arthrosis in patients with low back pain in our setting. The objective of this study is therefore to find the prevalence of lumbar facet joint arthrosis among patients with low back pain and compare conventional versus fat saturated sequences in detecting the MRI findings of facet joint arthrosis.

METHODOLOGY

We conducted a cross sectional study at the Department of Radiodiagnosis and Department of Orthopedics at Birat Medical College Teaching Hospital from February 15, 2020 to May 15, 2020. We used consecutive sampling to enroll 100 study participants having low back pain who went for Magnetic Resonance imaging. Ethical clearance was taken

from the Institutional Review Committee [Ref:IRC-PA-044/2076-77] of Birat Medical College Teaching Hospital. Informed consent was taken from study participants. Data was entered in MS excel and analysed by SPSS. Univariate and bivariate tests were used for statistical analysis. Patients with general contraindications to MRI such as presence of prosthetic heart valves, metallic clips and implants, claustrophobia and those with past history of surgical procedures in the spine were excluded from the study. Standard clinical spine imaging protocols with images acquired in axial, sagittal and coronal plane using spin echo imaging sequences on 0.3 Tesla MRI scanner (Siemens Medical Systems). Images were obtained without and with fat-suppression technique using T2 STIR sequence in axial sections. Axial images were acquired in the lumbar spine using a 256 × 256 matrix and 5 mm slice thickness, with 1 mm interslice gap and an 18 cm field of view, using a conventional spin echo (CSE) (TR/TE = 600 msec/12 msec) sequence for T1-weighting or a turbo (fast) spin echo (TR/TE = 4500– 5000 msec/110–120 msec) sequence for T2-weighting. Those patients having MRI findings of acute spinal infection, recent trauma, previous lumbar spinal surgery, tumors, spinal dysraphism and metabolic conditions were excluded from the study. The MRI findings of facet joint arthrosis were observed for changes in the facet joints such as joint space narrowing, osteophytes, articular process hypertrophy, subarticular erosions and subchondral cysts. These changes have been identified and graded based upon Weishaupt proposed criteria adapted by Pathria to define the degree of facet degeneration (Table 1).¹²

Table 1. Criteria for grading of osteoarthritis of facet joints

Grades	Criteria
1	normal facet joint space (2–4 mm width)
2	narrowing of the facet joint space (<2 mm) and/or small osteophytes, and/or mild hypertrophy of the articular process
3	narrowing of the facet joint space and/or moderate osteophytes, and/or moderate hypertrophy of the articular process, and/or mild subarticular bone erosions
4	narrowing of the facet joint space and/or large osteophytes, and/or severe hypertrophy of the articular process, and/or severe subarticular bone erosions, and/or subchondral cysts

RESULTS

Based on FS-MRI, we found 57% study participants having facet joint arthrosis (FJA) in their lumbar spine. The majority 32(56.14%) were female and the commonest age group for FJA was 50-59 year (28%). It was most common in overweight (37%) followed by type I Obesity (26%) (Table 2).



Table 2: Socio demography of Facet Joint Arthrosis of study participants Based on FS-MRI (n=57)

Variable	Category	n (%)
Sex		
	Male	25(43.85%)
	Female	32 (56.14%)
Age group (Years)		
	Less Than 40	6(10%)
	40-49	9(15%)
	50-59	16(28%)
	60-69	14(24%)
	More Than 70	12(21%)
BMI		
	Normal/underweight	10(18%)
	Overweight	21(37%)
	Obesity I	15(26%)
	Obesity II/III	11(19%)

Table 3: Depiction of facet joint arthrosis changes with fat saturation MRI and Conventional MRI technique (n=57)

Grade	FS-MRI n(%)	Conventional MRI n (%)	Difference
Grade 2	33	4	29/33=87.9%
Grade 3	14	8	6/14=42.9%
Grade 4	10	10	0/0= 0%

We compared facet joint arthrosis changes findings between fat saturated MRI (FS-MRI) and conventional sequence MRI. FS-MRI and Conventional MRI showed variation in the depiction of facet joint changes. Further when the grades of facet joint arthrosis were compared between the FS and conventional MRI sequences, it was observed that there was difference in diagnosis of grade 2 changes (87.9%) and grade 3 changes (42.9%) whereas no difference was found in diagnosing grade 4 changes in both the sequences (Table 3).

Low back pain (LBP) is one of the most common pain syndromes and imparts an enormous burden to society. The high healthcare costs may be attributed to multiple factors, including lack of an accurate diagnosis imaging overuse, unwarranted surgery and work stoppages.¹⁴ Facet joint arthritis has been implicated in literatures as primary pain generator in 10–15% of young adult patients with chronic LBP and higher in older populations.¹⁵ In order to investigate the association of low back pain and Facet joint pathology, most studies successfully utilized Facet joint nerve blocks and its associated pain relief. Thus, there is convincing evidence that Facet joint arthritis pain plays an important role in low back pain and occurs in up to 45% of individuals.¹⁶ Because of their high level of mobility and the important forces influencing in the lumbar area, they can develop significant degenerative changes and be a potential source of pain. The capsule of the Facet joints, subchondral bone and synovium are richly innervated with nociceptive and autonomic nerve fibres. Substance P nerve fibres have been identified in subchondral bone in degenerative lumbar Facet joints. Inflammatory mediators such as prostaglandins and cytokines (IL6, TNF α) have been found in cases of degenerative innervated area that is subject to high stress and strain. The resulting tissue damage or inflammation is likely to cause release of chemicals irritating to the nerve endings in these joints, resulting in low back pain.¹⁷ Controlled diagnostic studies have shown a prevalence of lumbar facet joint pain of 27–40% in patients with chronic LBP.¹⁸

For the representative sample of 100 patients presenting to the department of radiology, Birat Medical College and Teaching Hospital for MRI evaluation for low back pain, the prevalence of facet joint arthrosis was found to be 57%. Eubanks et al found evidence that nearly 60% of all adults show some signs of degenerative changes by the time they reach age 30. It has been shown in previous studies that following the initiation of arthritic changes, subsequent degeneration appears to steadily increase until the seventh decade, by which time evidence of arthrosis becomes ubiquitous.¹⁹ Current study also shows that facet joint arthrosis is common in all age groups, with highest prevalence in the age group of 50-69 years. (Table 2). This is in agreement with Lewin's comprehensive anatomic review of lumbar synovial joints, which stated that the facet joints showed only minor cartilage changes before the age of 45. After age 45, advanced cartilage changes, subchondral sclerosis and osteophytes become common phenomena.²⁰

Our study shows that the highest prevalence of facet joint arthrosis was in females than in males (56.14% in females versus 43.85% in males) but this was not statistically significant (P value 0.353). This is in keeping with previous studies which show no statistically significant difference in prevalence of facet joint arthropathy based on gender.²¹ It was observed from our study that changes of facet arthrosis is more common in individuals who are overweight and obese. This finding corroborates with previous studies which reveal that facet joint degenerative changes linked



with higher BMI. Higher categories of BMI were associated with greater odds of moderate facet joint arthrosis for overweight and type I obesity.²²

When fat-suppression techniques are applied to the spine, the signal intensity of fat in normal bone marrow and in normal soft tissues adjacent to the facets is suppressed. On T2-weighted MR images, abnormal tissues will display T2 hyper intensity, which is rendered more conspicuous by applying a fat-saturation technique. Categorizing the patients on findings of joint space narrowing, osteophytes, articular process hypertrophy, subarticular erosions and subchondral cysts, it was found that these findings were better picked up by addition of fat saturated sequence than on conventional sequence alone. Our study revealed the facet joint arthritis changes in 57 individuals versus only 22 individuals showing these changes on conventional sequence alone. Further, grading facet joint arthrosis based on these changes as advocated by Weishaupt proposed criteria adapted by Pathria to define the degree of facet degeneration (Table 1).¹² It was observed that there was significant difference in diagnosis of grade 2 changes (89.9%) and grade 3 changes (42.9%) whereas grade 4 changes were equivocally picked up even without additional fat saturation sequence. This suggests that the earlier grades of facet joint arthrosis are better illustrated by addition of fat saturated sequence therefore is clinically useful in determining the course of action based upon these findings thereby facilitating better management outcomes. This finding corroborates with previous study which shows fat sequence better in depiction of degenerative changes in posterior stabilizing elements in patients in low back pain.²³

LIMITATION OF STUDY

The observer bias between radiologists may limit our study. This study is was a cross-sectional investigation without any longitudinal follow-up. In addition, we did not adjust for the bias such as occupation, which should be addressed in further analysis.

CONCLUSION

This study shows that facet joint arthrosis is frequently seen in the patients presenting with low back pain in our hospital and these changes are better diagnosed by fat saturated MRI sequence as compared to conventional MRI sequences.

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CONFLICT OF INTEREST

We declare no conflict of interest in our study.

FINANCIAL DISCLOSURE

We have no financial support to disclose.

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