Association of Lower Lumbar Facet Joint Osteoarthritis With Demographic Factors And Intervertebral Disc Degeneration In Patients With Low Back Pain

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Abstract— Background: Facet joint osteoarthritis (FJO) is an important element of lumbosacral degenerative disease. However, its association with other possible risk factors is still controversial. This study was conducted to investigate the association of FJO with risk factors and with presence of lumbar intervertebral disc degeneration (IVDD).

Patient and method: Lumbosacral magnetic resonance imaging (MRI) examinations of 100 patients (36 male and 64 female) with low back pain (LBP) were reviewed in this cross-sectional retrospective study for the presence of FJO. The overall prevalence of FJO as well as the number of levels affected was correlated with the age, gender, body weight, height, BMI, female parity. FJO was also correlated with presence of corresponding IVDD.

Results: Overall prevalence of FJO was 23%. The prevalence of FJO was significantly associated with advancing age ($p=0.018$). Females were more affected than males but without statistical significance (p value = 0.79). Similarly, FJO were more frequent in women with advanced multiparity but the association was statistically not significant (p value 0.1) there was statistically significant association between BMI and number of levels affected by FJO (p value 0.037). IVDD was significantly associated with higher prevalence of FJO especially at L3/4 and L4/5 levels (p values $P<0.0001$ and 0.04 respectively).

Conclusion: Age was the single most important factor significantly associated with both overall higher prevalence of FJO and higher number of involved levels. BMI was statistically associated with increasing number of level affected. IVDD was significantly associated with presence of FJO at L3/4 & L4/5 levels.

Index Terms—facet joints, osteoarthritis, magnetic resonance imaging.

I. INTRODUCTION

Low back pain (LBP) is considered as one of the commonest complains encountered in the primary care and majority of people will have some sort of LBP during their lives resulting in significant morbidity, disability and reduced productivity [1,2].

LBP have different causes, with lumbosacral spinal degenerative disease being amongst the common ones which is manifested in form of intervertebral disc degeneration (IVDD), ligamentum flavum (LF) thickening and facet joint osteoarthritis (FJO) in variable degrees of severity and combinations. Both computerized tomography (CT) and magnetic resonance imaging (MRI) can demonstrate variable features of FJO with good agreement between both

imaging modalities, although MRI has the advantage of being safe regarding radiation hazard rendering it as the first choice in evaluation such conditions [3, 4].

FJO has been blamed as a source of LBP for a long time, especially in old age patients [5, 6] because of the nature of facet joint innervation [7] and the contribution to the spinal canal stenosis and roots compression together with LF hypertrophy and disc herniation [8]. Despite that several studies were conducted, debate is still present on the exact correlation between the presence of LBP and the spinal degeneration, particularly FJO, documented on imaging modalities [9-17]

FJO, as part of more general spinal degeneration, is a multifactorial disease, however, there is a controversy on the nature of combination between facet joints hypertrophy and other forms of spinal degenerative changes and it is not well known which patient will have one or other form of degeneration. This study was conducted to assess some of possible risk factors (including age, gender, parity, weight, height, body mass index) that may predispose for development of FJO and to investigate the relationship between presence of FJO and lumbosacral IVDD in with LBP.

II. PATIENTS AND METHOD

This is cross-sectional study was conducted on conveniently selected 100 patients (36 male and 64 female) already referred to the MRI unit of the radiology department for evaluation of LBP. The study was approved by the Institutional Ethical Committee and no consent was taken from the patients because of the non-interventional nature of the study provided that the collected data are kept confidential and not disclosed to unauthorized personnel.

The population of the study included any patient with LBP who underwent lumbosacral MRI examination. Patients with spinal tumor, congenital deformity or trauma as well as those whose MRI examinations do not included all L3/4, L4/5 and L5/S1 levels were excluded from the study. Demographic and clinical information were taken from the record as well as directly from the patients themselves.

Imaging evaluation: Radiological evaluation of the included MRI studies was done by a board-certified radiologist (with more than 10 years experience in neuroradiology and spinal imaging). A general assessment of lumbosacral spine was done at first for any exclusion criteria and then a more dedicated evaluation of L3/4, L4/5 and L5/S1 intervertebral discs for the grade of IVD using Pfirrmann grading system [18]. Using axial T2 weighted

images (Figure 1 and 2), facet joints were assessed for the presence of FJO at each level according to Weishaupt D et al [3]. FJO was documented to be present when grade 2 and more was seen and when asymmetry is present, the higher side was assigned for that level.

MRI examination. All patients were examined by the same MRI device (Acheiva 1.5 Tesla, Philips Medical System, 2011), using the following sequences: sagittal T1 weighted TSE (TE=8ms, TR=500ms), sagittal T2 weighted TSE (TE=100ms, TR=4000ms) and axial T2 weighted TSE (TE=100ms, TR=4000ms). No intravenous contrast medium was administrated

Statistical analysis of the data was done using SPSS, version 2.4; IBM, USA. The cases were subdivided into two groups; those with FJO and those without FJO. Differences between the two groups regarding demographic characteristic age, gender, female parity, weight, height and body mass index (BMI) were calculated. Furthermore, prevalence and grades of DD amongst the two groups were assessed and correlated with presence of FJO at each level using Pearson correlation coefficient. P value of <0.05 was set as statistically significant.

Fig. 1. Axial T2-weighted MR image at L4-5 intervertebral disc showing normal bilateral facet joints evident by the normal joint space, normal high signal of the synovial fluid and normal thin lines of articular surfaces (white arrows).

Fig. 2. Axial T2-weighted MR image at L4-5 intervertebral disc showing bilateral facet joints osteoarthritis (FJO) evident by joint space narrowing, lost high signal of the synovial fluid and sclerotic hypertrophied articular surfaces (white arrows).

III. RESULTS

A total of 300 IVD of 100 patients (36 male and 64 female) were studied. Mean age was 46.62 ± 13.72 years, with mean BMI of 30.4 ± 5.9 . Out of 100 patients, 23 showed features of FJO (23%), of these 11 had single level (48%), and 6 with two and 6 with three levels (26% for each). L3-4 was the most frequently involved level by FJO (18%), followed by L4-5 914% & L5-S1 (9%), as shown in Table 1.

Age was significantly associated with the presence of FJO, while gender and female parity were not (table 2). On other hand, higher number of disc levels affected by FJO was seen in older age but with borderline significance (p value 0.07) while no statistically significant association was seen between neither the parity nor the gender of patents with the number of affected level (p values 0.44 and p=0.79 respectively).

TABLE I: OVERALL DESCRIPTIVE STATISTICS FOR THE DEMOGRAPHIC AND OBSERVATIONS OF STUDY PARAMETERS OF THE POPULATION OF THE STUDY

Parameter	Value
Age (year):	
Mean:	46.62 $\pm$ 13.72
Range:	20-90
Gender:	
No. (%) Males	36 (36%)
No. (%) Females	64 (64%)
Male: Female ratio	1: 1.77
BMI: Mean	30.4 $\pm$ 5.9
Parity (out of 64 women) Median	4 $\pm$ 3.5
No. (%) of women parity 0-3	26 (40.6%)
No. (%) of women parity 4-6	17 (26.56%)
No. (%) of women parity $\geq$ 7	21 (32.81%)
Weight (Kg) Mean	80.21 $\pm$ 3.5
Height (CM) Mean	163.4 $\pm$ SD 8.7
Disc degeneration score mean, (median)	
L3-4	2.8 $\pm$ 1.3, (3)
L4-5	3.1 $\pm$ 1.2, (3)
L5-S1	2.9 $\pm$ 1.5, (3)
No. (%) of patients with FJO Total (out of 100):	23 (23%)
Single level out of FJO positive (23):	11 (11%), 11/23 (48%)
Two levels out of FJO positive (23):	6 (6%), 6/23 (26%)
Three levels out of FJO positive (23):	6 (6%), 6/23 (26%)
No. (%) of patients with FJO according to the level: L3-4	18 (18%)
L4-5	14 (14%)
L5-S1	9 (9%)

TABLE II: ASSOCIATION OF AGE, GENDER AND FEMALE PARITY WITH PRESENCE OF FJO.

Parameter	FJO Yes, (%)	FJO No, (%)	Total	P values
Age				p=0.018 (Significant)
20-39	5 (15.63)	27 (84.38)	32	
40-59	8 (17.39)	38 (82.61)	46	
$\geq$ 60	10 (45.45)	12 (54.55)	22	
Gender				p=0.79 (not significant)
Males	6 (16.7)	30 (83.3)	36	
Females	17 (26.56)	47 (73.44)	64	
Parity				p=0.1 (not significant)
0-3	4 (15.38)	22 (84.62)	26	
4 to 6	4 (23.53)	13 (76.47)	17	
7= $\geq$	9 (42.86)	12 (57.14)	21	
Total	17	47	64	

The degree of DD was significantly associated with presence of FJO at L3/4 & L4/5 levels but with borderline

significance at L5/S1 (table 3). However, no statistically significant association was found between the number of levels affected by FJO (single, two or three) with the DD at any of L3-4, L4-5 and L5-S1 levels (p values 0.42, 0.64 and 0.64 respectively).

TABLE III: ASSOCIATION OF AGE, GENDER AND FEMALE PARITY WITH PRESENCE OF FJO.

Grades/Level	FJO		Total	P values
	Yes, (%)	No, (%)		
L3-4				P<0.0001 (Highly significant)
0-1	1 (5.56)	17 (94.44)	18	
2 to 3	6 (11.32)	47 (88.68)	53	
4 to 5	16 (55.17)	13 (44.83)	29	
Total	23	77	100	
L4-5				P=0.04 (Significant)
0-1	0 (0)	10 (100)	10	
2 to 3	8 (17.8)	37 (82.2)	45	
4 to 5	15 (33.3)	30 (66.7)	45	
Total	23	77	100	
L5-S1				P=0.057 (Borderline significant)
0-1	1 (5.26)	18 (94.74)	19	
2 to 3	12 (30.77)	27 (69.23)	39	
4 to 5	10 (17.24)	48 (82.76)	58	
Total	23	77	100	

Overall, there was no statistically significant difference between patients with and without FJO regarding weight, height or BMI (Table 4). However, among patients with FJO, BMI was significantly correlated with increasing number of levels affected by FJO (p value 0.037), while neither the weight, height nor age were significantly different (0.98, 0.39 and 0.54 respectively)

TABLE IV: MEAN WEIGHT, HEIGHT AND BMI DIFFERENCE BETWEEN PATIENTS WITH FJO VERSUS WITHOUT FJO

Parameter	Facet joint osteoarthritis		P values
	Yes	No	
Weight (kg)			p=0.88
Mean	79.83	80.29	
Standard deviation	10.41	14.39	
Height (CM)			p=0.6
Mean	162.52	163.60	
Standard deviation	9.32	8.57	
BMI			p=0.96
Mean	30.46	30.39	
Standard deviation	4.18	6.36	

IV. CONCLUSION

Understanding the factors associated with the one of important but underestimated elements of spinal degenerative disease, the FJO, is an essential step in management of patients with LBP.

The frequency of FJO in our population was 23% which falls within the reported ranges [12, 15].

Among the lower three lumbar levels and contrary to Kalinchman et al [19], FJO was slightly more common at L3-4 than L4-5 (18 vs 14% respectively) which can be attributed mainly to the hypermobility of these segments and sagittal orientation of their facet joints relative to more stable L5/S1 and more coronal orientation of facet joint at this level [20, 21].

Among the demographic factors that may be associated with presence of FJO, our current study showed that age was significantly associated with the overall prevalence of FJO. This is consistent with findings of other studies [7, 19 and 5]. Moreover, older patients have more levels affected by FJO than younger ones, consolidating the significance of age in the degeneration of facet joints.

BMI was also not significantly associated with prevalence of FJO; however, patients with higher BMI tend to have more levels affected by FJO.

Studies have addressed the role of estrogen-receptor in the process of joint degeneration [22, 23] which supports our finding that female were more frequent affected by FJO (16 vs 7) at all three levels studied in our study. This is in agreement with Kalinchman [19] only at L4/5 levels and in contrary to other studies, which found male predominance [24] or did not found sex difference [19] in the prevalence of FJO.

Importantly, the degree of IVD degeneration seems to have significant impact on the FJO, they may share underlying etiology or may be acting on each other [7,19]. This may also explain why the presence of FJO was associated with the degeneration of the corresponding level and not with number of the overall levels affected.

One of limitations of our study is that we used MRI for the diagnosis of FJO while CT scan is the optimal modality specially regarding the bony elements, however, MRI is the most common and routinely used modality in evaluation of LBP and it showed moderate agreement with CT in assessment of the FJO [3, 4].

In conclusion, age was significantly associated with both higher overall prevalence of FJO and higher number of involved levels. Female were more affected than males and women with advanced multiparity were more affected but without statistical significance. BMI was statistically associated with increasing number of level affected. These demographic factors should be addressed in the pathogenesis of FJO. Moreover, IVD degeneration was also significantly associated with presence of FJO (but not with number of levels), therefore, facet joints should be carefully evaluated by imaging when IVD degeneration is noted on lumbosacral spinal imaging. Finally, future case-control and long-term cohort studies to investigate the possible etiological role of these factors, are still worthy.

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