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ORIGINAL ARTICLE

MRI of knee: high signals in STIR sequences and its relation with anterior knee pain our population.

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ABSTRACT… Objective: To evaluate the significance of high signals in STIR sequences in MRI in patients presenting with non-traumatic knee pain. **Study Design:** Cross-sectional study. **Setting:** Department of Radiology, Liaquat National Hospital, Karachi, Pakistan. **Period:** March 2023 to August 2023. **Methods:** The patients presented for MRI of knee joint for knee pain unrelated to trauma were analyzed. Data were collected through a proforma based on 9 questions that included demographic data and questions related to the cause of pain. The total calculated sample size was 86 patients Data was analyzed through SPSS. Descriptive statistics were calculated. Association was determined using chi-square test considering p-value ≤0.05 as significant. **Results:** Our study showed no statistical correlation between knee pain and high STIR signals seen in pre-patellar bursa with 90.9% showing high signals with pain, while 85.3% showed high signals without pain. In our study this signal was found in about 20-30% that were mostly female household help and carpet layers. **Conclusion:** There is no statistical correlation between knee pain and high STIR signals seen in pre-patellar bursa.

Key words: High Signals, MRI, Non-traumatic Knee Pain, STIR Sequences.

INTRODUCTION

Most common presenting complaint related to knee in our population is non traumatic knee pain, more commonly in females. There are various causes of knee pain including bursitis, patellar chondromalacia, plica syndrome, quadriceps tendon abnormalities, patellar tendon abnormalities, Hoffa's disease, traction apophysitis syndrome and bony abnormalities.[1] MRI is the modality of choice for the diagnosis of Musculo-skeletal disorders.[2] Bursitis is one of the important causes of high signals in anterior subcutaneous adipose tissue on fat suppressed proton density weighted images on MRI. Clinical presentation of bursitis is similar to various muscular and joint abnormalities.[1] It is important to differentiate bursitis from normally presenting high signals on proton density weighted images due to subcutaneous fat in prepatellar and superficial infrapatellar bursae in order to provide adequate management to the patient.[1]

There are four bursae anterior to the knee joint including supra-patellar, subcutaneous prepatellar, subcutaneous infra-patellar, deep infra-patellar bursae. Two bursae laterally are fibular collateral ligament-biceps femoris tendon and one between lateral collateral ligament and popliteus muscle. Medially there is a bursa between medial collateral ligament and pes anserinus and between medial collateral ligament and semi membranous. Posteriorly there are four bursae. The fluid filled bursae help in reducing friction between moving structures in joints.[3] These pre-patellar bursae normally appear high on T2 weighted images, low on T1 weighted images and STIR. In some cases these may show high signals on STIR in normal asymptomatic individuals. According to one study pre-patellar high signals were seen in 82.7% patients of which 84.6% had knee pain however there was no relation between the knee pain and edema that was resulting in the high signals. However age, weight and micro-trauma were factors associated

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with anterior edema.[1] In another study 12% of the MRI's showed quadriceps fat pad causing mass effect over the supra-patellar recess resulting in intermediate to high signals on STIR.[4] One of the studies demonstrated that subcutaneous fluid around knee has an association with increased amount of fat in the subcutaneous tissue, due to shearing injury and continuous micro trauma to the fat resulting in reduction in its elasticity related to metabolic syndrome.[5]

This study was aimed to find out the prevalence of pre-patellar high signals in our population and find out their clinical significance of reporting these high signals in patients presenting to Liaquat National hospital with knee pain. Although previous studies have reported it as a physiological process however no data is available in Pakistan despite the lifestyle of our population.

METHODS

This cross-sectional prospective study was conducted in the Radiology Department, Liaquat National Hospital, Karachi, Pakistan, from March 2023 to August 2023. An approval from institutional Ethical & Review committee was obtained prior to conduct this study (Letter number 0880-2023 LNH-ERC). Sample size was calculated with the help of WHO software for sample size calculation taking prevalence of Anterior PD high signal intensity=82.7%[1] using marginal of error (d)=8% and 95% confidence level. The total calculated sample size was 86 patients. Total 86 patients of either gender with age between 25 to 75 years who were presented to radiology department for MRI of knee joint due to knee pain which was unrelated to trauma were included in the study. An informed consent was also obtained before including participants in the study. Patients with Fractures or Trauma, Tumor, Structural Deformity, Congenital Anomaly, Previous surgery history, Pregnancy were not part of this study.

Patients were selected based on their clinical history of knee pain and MRI images were evaluated on the basis of high signals in the anterior subcutaneous adipose tissues representing reticular fluid intensity/edematous changes on the STIR images. The relationships of these high signals were established with knee pain. Data were collected through a proforma based on 9 questions, included demographic data (name, age, sex,) and questions related to the cause of pain. Data were analyzed through the SPSS software and results were formulated. Mean and standard deviation were computed for quantitative variable i.e. age. Frequency and percentage were calculated for qualitative variables i.e. gender, diabetes, hypertension, ischemic heart disease, diagnosis, knee side, Signal on MRI for Right and Left Knee. Stratification was done with regards to age, gender, diabetes, hypertension, ischemic heart disease, diagnosis, knee side to see the effect of these modifiers on outcome (i.e. Signal on MRI for Right and Signal on MRI for Left Knee) by using chi square test/fisher exact test and considering p-value ≤0.05 as significant.

RESULTS

Among enrolled eighty six patients the mean age was 36.45±14.80 years. There were 61(70.9%) males and 25(29.1%) females. The comorbidities were found as 12(14%) had diabetes mellitus, 2(2.3%) had hypertension and 2(2.3%) had ischemic heart disease as presented in Table-I.

Age (mean±SD)	36.45±14.80
	n(%)
Gender	
Male	61(70.9)
Female	25(29.1)
Age group	
≤35 years	39(45.3)
>35 years	47(54.7)
Diabetes Mellitus	
Yes	12(14)
No	74(86)
Hypertension	
Yes	2(2.3)
No	84(97.7)
Ischemic Heart Disease	
Yes	2(2.3)
No	84(97.7)

Table-I. Frequency distribution of demographic and clinical findings

Most of the patients 75(87.2%) had knee pain. We observed limping gait in 24(27.9%) cases.

Complaint of knee swelling was noted in 31(36%) patients. The knee side involvement showed that 39(45.3%) had right knee involvement and 47(54.7%) had left knee involvement. The associated findings were found as 41(47.7%) had joint effusion, 21(24.4%) had degenerative changes, 7(8.1%) had baker cyst, 5(5.8%) had edema, 4(4.7%) had intra substance myxoid degeneration, 4(4.7%) had osteochondritis, 4(4.7%) had ganglion cyst, 3(3.5%) had subchondral cyst, 3(3.5%) had osteomyelitis, 2(2.3%) had pallegrini stieda lesion, 2(2.3%) had synovitis, 2(2.3%) had flat trochlear groove, 2(2.3%) extrosseous ostrochrondroma, and 2(2.3%) had ruptured cyst and 1(1.2%) had patellar tendinopathy, , as presented in Table-II.

	n(%)
Knee Pain	
Yes	75(87.2)
No	11(12.8)
Limping Gait	
Yes	24(27.9)
No	62(72.1)
Knee Swelling	
Yes	31(36)
No	55(64)
Knee Side Involved	
Right	39(45.3)
Left	47(54.7)
Associated Findings	
Joint Effusion	41(47.7)
Degenerative Changes	21(24.4)
Baker Cyst	7(8.1)
Edema	5(5.8)
Intra Substance Myxoid Degeneration	4(4.7)
Osteochondritis	4(4.7)
Ganglion Cyst	4(4.7)
Osteomyelitis	3(3.5)
Subchondrol Cyst	3(3.5)
Pallegrini Stieda Lesion	2(2.3)
Synovitis	2(2.3)
Flat Trochlear Groove	2(2.3)
Extraosseous Osteochondroma	2(2.3)
Ruptured Baker Cyst	2(2.3)
Patellar Tendinopathy	1(1.2)

Table-II. Distribution of Knee pain and associated findings

The high signal in STIR sequences on MRI was showed in 21(24.4%) knee. We observed signals in STIR sequences on MRI as 9(10.5%) in patients with right knee while 12(14%) in patients with left knee. The frequency distribution MRI finding for STIR is presented in Table-III.

	n(%)
STIR	
Yes	21(24.4)
No	65(75.6)
STIR in Right Knee side	
Yes	9(10.5)
No	30(34.9)
STIR in Left Knee side	
Yes	12(14)
No	35(40.7)

Table-III. Frequency Distribution of High signals in on MRI

Association of high signal STIR on MRI was evaluated using Chi-square test considering p-value ≤ 0.05 as significant. It was observed that most of the females had high STIR sequence as compared to males. High STIR signals were found in patients with age greater than 35 years. The comorbids were noted as 5(23.8%) diabetes mellitus, 2(9.5%) hypertension and 2(9.5%) ischemic heart disease patients had high STIR signals. Most of the 19(90.5%) knee pain patients also had high STIR signals. There is 4(19%) limping gait cases who had also high STIR while 56(86.2%) cases of limping gait had no high STIR signals. The knee swelling was observed in 8(36.1%) cases who had high STIR signals while 23(35.4%) cases of knee swelling had no high STIR. Most of the high STIR signals were found in left knee patients as compared to right knee. We found significant association of STIR sequences with the gender ($p<0.001$) and age group ($p<0.001$). There were insignificant association of STIR with the diabetes mellitus ($p=0.156$), hypertension ($p=0.057$), ischemic heart disease ($p=0.057$), knee pain ($p=1.000$), limping gait ($p=0.298$), knee swelling ($p=0.822$) and knee side ($p=0.792$). The detailed association of high STIR sequences with the gender, age, co-morbids and clinical findings is presented in Table-IV.

	High STIR Sequence		P-Value
	Yes n(%)	No n(%)	
Gender			
Male	8(38.1)	53(81.5)	<0.001*
Female	13(61.9)	12(18.5)	
Age group			
≤35 years	0(0)	39(60)	<0.001*
>35 years	21(100)	26(40)	
Diabetes Mellitus			
Yes	5(23.8)	7(10.8)	0.156**
No	16(76.2)	58(89.2)	
Hypertension			
Yes	2(9.5)	0(0)	0.057**
No	19(90.5)	65(100)	
Ischemic Heart Disease			
Yes	2(9.5)	0(0)	0.057**
No	19(90.5)	65(100)	
Knee Pain			
Yes	19(90.5)	56(86.2)	1.000**
No	2(9.5)	9(13.8)	
Limping Gait			
Yes	4(19)	20(30.8)	0.298**
No	17(81)	45(69.2)	
Knee Swelling			
Yes	8(36.1)	23(35.4)	0.822**
No	13(61.9)	42(64.6)	
Knee Side			
Right	9(42.9)	30(46.2)	0.792**
Left	12(57.1)	35(53.8)	

Table-IV. Association of gender, age, demographic findings and clinical findings with high STIR sequence on MRI.
Chi-square test was applied
*** Significant at 0.001 levels**

Association of the associated findings was also evaluated with the high STIR sequences on MRI. It observed that a significant association of high signal STIR was found with degenerative changes (p=0.024) and subchondral cyst (p=0.013). However, insignificant association of high signal STIR was found with joint effusion (p=0.318), baker cyst (p=1.000), edema (p=1.000), intra substance myxoid degeneration (p=0.249), osteomyelitis (p=1.000), osteochondritis (p=0.568), ganglion cyst (p=0.249), patellar tendinopathy (p=1.000), pallegrini stieda lesion (p=0.057), synovitis (p=1.000), flat trochlear groove (p=1.000), extrosseous ostrochrondroma (p=0.057) and ruptured baker cyst (p=1.000)..

The detailed results for association of high STIR sequences with the associated findings are presented in Table-V.

Associated Findings	Total n(%)	High STIR Sequence		P-Value
		Yes	No	
Joint Effusion				
Yes	41(47.7)	12(57.1)	29(44.6)	0.318**
No	45(52.3)	9(42.9)	36(55.4)	
Degenerative Changes				
Yes	21(24.4)	9(42.9)	12(18.5)	0.024*
No	65(75.6)	12(57.1)	53(81.5)	
Baker Cyst				
Yes	7(8.1)	2(9.5)	5(7.7)	1.000**
No	79(91.9)	19(90.5)	60(92.3)	
Edema				
Yes	5(5.8)	1(4.8)	4(6.2)	1.000**
No	81(94.2)	20(95.2)	61(93.8)	
Intra substance myxoid degeneration				
Yes	4(4.7)	2(9.5)	2(3.1)	0.249**
No	82(95.3)	19(90.5)	63(96.9)	
Osteochondritis				
Yes	4(4.7)	0(0)	4(6.2)	0.568**
No	82(95.3)	21(100)	61(93.8)	
Ganglion Cyst				
Yes	4(4.7)	2(9.5)	2(3.1)	0.249**
No	82(95.3)	19(90.5)	63(96.9)	
Osteomyelitis				
Yes	3(3.5)	0(0)	3(4.6)	1.000**
No	83(96.5)	21(100)	62(95.4)	
Subchondrol Cyst				
Yes	3(3.5)	3(14.3)	0(0)	0.013*
No	83(96.5)	18(85.7)	65(100)	
Pallegrini Stieda Lesion				
Yes	2(2.3)	2(9.5)	0(0)	0.057**
No	84(97.7)	19(90.5)	65(100)	
Synovitis				
Yes	2(2.3)	0(0)	2(3.1)	1.000**
No	84(97.7)	21(100)	63(96.9)	
Flat Trochlear Groove				
Yes	2(2.3)	0(0)	2(3.1)	1.000**
No	84(97.7)	21(100)	63(96.9)	
Extraosseous Osteochondroma				
Yes	2(2.3)	2(9.5)	0(0)	0.057**
No	84(97.7)	19(90.5)	65(100)	
Ruptured Baker Cyst				
Yes	2(2.3)	0(0)	2(3.1)	1.000**
No	84(97.7)	21(100)	63(96.9)	
Patellar tendinopathy				
Yes	1(1.2)	0(0)	1(1.5)	1.000**
No	85(98.8)	21(100)	64(98.5)	

Table-V. Association of associated findings with the High STIR sequence on MRI.

DISCUSSION

Our study showed no statistical correlation between knee pain and high STIR signals seen in pre-patellar bursa with 90.9% showing high signals with pain, while 85.3% showed high signals without pain. Similarly in a study conducted by E.N. Unlu, found no statistically significant difference in the prevalence of this signal intensity between the two groups (84.6% in knees with pain vs. 79.4% in knees without pain).[1] This suggests that the presence of high STIR signal intensity may not be a reliable predictor of knee pain. However, in contrast to this, results of a study done by Roth et al showed significant correlation of high signal intensity in quadriceps fat pad with knee pain.[4] Another study showed that majority of the patients were female accounting for 66% with an average age of 27 years and 34% were males with an average age of 30 years.[6] Diederichs et al conducted a study with similar results.[7] However the majority of patients in our study were males but the important thing to note was that the majority of the patients with high STIR signals were females about 63% and 36.4% were males. Patients over 35 years of age showed high signal compared to patients with less than 35 years leading us to believe that these high signals were caused by age related changes rather than a pathology.

Anterior subcutaneous edema is frequently seen on standard knee MRI scans. However, this finding can be misinterpreted as bursitis or inflammation by radiologists who are not experienced in musculoskeletal imaging or are not familiar with the patient's clinical symptoms.[1] Our study showed no significant correlation between high STIR signals and edema with 9.1% showing high STIR signals with edema while majority of about 90.9% showed high STIR signals without edema. This can be backed by two separate studies conducted by Roth et al and E.N. Unlu that had similar results. Moreover, clinicians may also mistake this finding as a sign of inflammation in patients complaining of anterior knee pain. This incorrect diagnosis could lead to unnecessary administration of anti-inflammatory treatments. Therefore, it is important for both radiologists and treating doctors to be aware of the potential for misinterpretation of this finding and to consider the patient's clinical history and symptoms before making a diagnosis or initiating treatment.[1]

Prepatellar bursa is a structure that consists of three compartments while infrapatellar bursa is divided into two i.e superficial and deep compartments.[8-10] The inflammation of prepatellar and superficial patellar bursa results from repetitive trauma from doing work that requires kneeling and is mostly found in people such as household help, carpet layers, clergymen and wrestlers.[11-14] In our study this signal was found in about 20-30% that were mostly female household help and carpet layers. However the limitation in our study was that we could not assess whether high signals seen in these 20-30% individuals were caused by praying as many people were not willing to give proper history related to this topic and we had keep the religious sentiment of people in mind.

CONCLUSION

It can be concluded that there is no statistical correlation between knee pain and high STIR signals seen in pre-patellar bursa with 90.9% showing high signals with pain, while 85.3% showed high signals without pain.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

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2	Bushra Shamim	Conceptualized the study, Proof reading.	
3	Raisa Altaf	Prepared study protocol, Draft writing.	
4	Rabia Ahmed	Draft writing.	
5	Nimra Ali	Data analysis.	
6	Muhammad Ali	Data collection and data entry.	