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ASSOCIATION WITH BONE MARROW LESSIONS AND ITS GREATER MEDIAL PROXIMAL TIBIAL SLOPE IN MIDDILE AGED WOMEN

Dr. Shivananda Reddy N*

Assistant Professor of Orthopaedics, NRI Medical College and General Hospital, Guntur, Andhra Pradesh

ABSTRACT

Osteoarthritis (OA) is a prevalent musculoskeletal disorder characterized by articular cartilage degeneration, subchondral bone changes, and joint inflammation. Among the multifaceted factors influencing OA pathogenesis, Bone Marrow Lesions (BMLs) have become a focal point of investigation due to their association with pain, cartilage loss, and disease progression. Recent research has identified a potential connection between knee joint morphological parameters, particularly the Proximal Tibial Slope (PTS), and the development of BMLs. The medial aspect of the proximal tibia, in particular, has been implicated in biomechanical stress on the knee's medial compartment. This study aims to elucidate the association between BMLs and the Greater Medial Proximal Tibial Slope (MPTS) in middle-aged women. The focus on middle-aged women stems from the critical juncture in life when early signs of osteoarthritis often manifest. Moreover, as women are disproportionately affected by OA, they represent a crucial demographic for understanding disease dynamics. This investigation seeks to unravel the biomechanical factors contributing to BML development, particularly in the context of the MPTS. The study obtained ethical approval and involved 365 participants over a two-year period (June 2019-June 2010) at the NRI Medical College and General Hospital, Guntur, Andhra Pradesh Orthopaedic Ward. Inclusion criteria comprised patients aged 45-60 with bone marrow lesions, and female patients without radiographic abnormalities, while exclusion criteria included radiographic abnormalities, rheumatoid arthritis, incomplete data, and a history of knee injury. Lifestyle habits, including drinking, smoking, and exercise frequency, were assessed through a questionnaire. General health examinations and prophylactic interventions aimed to improve average life expectancy were conducted. The study employs advanced imaging techniques and rigorous statistical analyses to comprehensively explore the relationship between BMLs and the Greater Medial Proximal Tibial Slope in middle-aged women. Anticipated findings hold promise for informing early detection and targeted interventions in osteoarthritis, contributing to enhanced patient outcomes and a deeper understanding of the intricate interplay between knee morphology and joint health.

Key words: Trimalleolar Fracture, 1/3rd Tubular Plating, Medial Malleolar Screw.

INTRODUCTION

Osteoarthritis (OA) is a prevalent musculoskeletal disorder characterized by the degeneration of articular cartilage, subchondral bone changes, and joint inflammation. Among the various factors contributing to the pathogenesis of OA, Bone Marrow Lesions (BMLs) have emerged as a significant focal point of investigation. BMLs are localized areas of increased signal intensity on magnetic resonance imaging (MRI) and are associated with pain, cartilage loss, and progression of OA. [1]

While the etiology of BMLs remains multifactorial, recent research has suggested a potential connection between the morphological parameters of the

Corresponding Author: **Dr**. **Shivananda Reddy N**

knee joint and the presence of BMLs. In particular, the Proximal Tibial Slope (PTS) has gained attention for its potential role in influencing the development and progression of BMLs. The medial aspect of the proximal tibia, in particular, may play a crucial role, as its alterations have been implicated in increased biomechanical stress on the medial compartment of the knee. This study focuses on elucidating the association between Bone Marrow Lesions and the Greater Medial Proximal Tibial Slope (MPTS) in middle-aged women. The rationale for focusing on this demographic group stems from the fact that middle age represents a critical period where early signs of osteoarthritis often manifest. Furthermore, women are known to be disproportionately affected by osteoarthritis, making them a pertinent population to study in this context. [2]

Understanding the relationship between BMLs and the Greater Medial Proximal Tibial Slope is of paramount importance for several reasons. Firstly, it provides insights into the biomechanical factors contributing to the development of BMLs, potentially uncovering modifiable risk factors for intervention. Secondly, it addresses the need for gender-specific considerations in osteoarthritis research, as the prevalence and severity of OA can differ between men and women. Lastly, such investigations contribute to the broader understanding of osteoarthritis pathogenesis, potentially informing the development of targeted therapeutic approaches for this prevalent and debilitating condition. In this context, the present study aims to comprehensively explore the relationship between BMLs and the Greater Medial Proximal Tibial Slope in middle-aged women. By employing advanced imaging techniques and rigorous statistical analyses, we seek to provide valuable insights that may have implications for both the early detection and management of osteoarthritis, ultimately contributing to improved patient outcomes and a better understanding of the intricate interplay between knee morphology and joint health. [3]

MATERIAL and METHODS

According to the study conducted by Helsinki Declaration in the year 1964, our study has been conducted by taking the ethics committee permission. The study was conducted among 365 patients by taking the consent form from them who attended the ortho ward at NRI Medical College and General Hospital, Guntur, Andhra Pradesh, Orthopaedic Ward. During the period of 2 years i.e; June 2019-June 2010. By The aim of our study is to improve by conducting general health examinations and prophylactic interventions, we ensure the patients to improve average life expectancy. In the above study, it says that EKOA prevalence is higher in women than in men.

Inclusion criteria

Patients age between 45-60, bone marrow lesion patients, female patients without radiographic **abnormalities**

Exclusion criteria

Radiographic abnormalities, rheumatoid arthritis, incomplete data, history of knee injury.

Questionnaire was given in order to find out the lifestyle habits like drinking, smoking and frequent exercise. Evaluation was done by finding the height and weight, Body mass index was also calculated.

Radiographic evaluations and bone mineral density

By using the CXDI- 40EG digital radiography system, Plain knee radiographs were obtained. On the day of examination, a well experienced. Orthopaedic surgeons in radiographic examinations obtained full-extension, weight-bearing and anteroposterior radiographs of both knees with map positioning of foot . in most of the affected knees, if the KL grade >2, then it is known as knee OA.

On the same day, By using dual energy Bone mineral density (BMD) at one-third of the distal radius of the nondominant hand was measured by using X-ray absorptiometry using the DCS-600EXV bone densitometer (Hitachi Aloka Medical, Tokyo, Japan).[4]

Classification criteria for EKOA

Participants who fall under the criteria of Luytens classification criteria (18) are calssified into EKOA group and others were non- EKOA group.

Clinical examination required the presence of at least one of the following: joint line tenderness or knee crepitus.

Radiographs with KL grades of 0 or 1 in the standing and weight-bearing positions.

Questionnaires to the patients with availability of the Knee Injury and Osteoarthritis Outcome Score [5], with at least two of the following required to score positive (i.e.≤85%) like pain, symptoms, activities of daily living and knee-related quality of life.

After one week of other examinations, MRI was performed in the supine position with fully extended knee whereas for MPTA measurement, a slice was selected which showed the tibial anatomy medial and lateral menisci in the coronal view of MRI. [6] Based on the attachment of the posterior cruciate ligament and intercondylar eminence, central sagittal plane was determined on the slice. On the tibia two circles fitting the anterior and posterior cortices were placed on the slice. MPTS and LPTS were determined as the angle between the axis perpendicular to the tibial axis and the line connecting the two most proximal anterior and posterior subchondral bone points at the centre of the lateral and medial tibiofemoral compartments.35 randomly selected images are examined by the observers.

Pathological lesions on MRI

Two independent observers evaluated the pathological lesions on the knee joint MRIs by seeing the Whole-Organ MRI Score (WORMS) [7]. Synovitis, cartilage damage, BMLs, Cysts, bone attrition, osteophytes and meniscal lesions were evaluated based on WORMS. By estimated maximal distention of the synovial cavity, synovitis was graded from 0 to 3 collectively. BMLs, subchondral cysts, and subregions number with scores > 0 were calculated. By maximum meniscal damage grade of the entire knee, meniscal lesions were calculated.

STATISTICAL ANALYSIS

Data showing about Demographic and morphological parameters of proximal tibial in each group are expressed as mean ± standard deviation. The Mann–Whitney *U* and chi-squared tests were performed to compare the two groups because some demographic parameters were not normally distributed .Proximal tibial morphologies among age groups (< 40, 40–49, 50–59 and≥60 years) were compared using analysis of variance and Tukey's test. Correlations between the proximal tibial morphologies were evaluated by Spearman's rank correlation. SRS defined as the dependent variable, whereas age, BMI and proximal tibial morphological parameters were the independent variables. [18] Presence of BMLs as the dependent variable and age, BMI, BMD, lifestyle habits, presence of pathological lesions of cartilage, meniscal lesions, effusion, MPTA, MPTS and LPTS as independent variables in the non-OA and EKOA groups are done by Logistic regression analysis. Data analyses were performed using SPSS version 29.0 Statistical significance was set at p value < 0.05. [9]

RESULTS

Mean age group of the 365 participants (EKOA group: n=60 and non-OA group: n=305) was 50 ± 11 years. Demographic data showed no significant differences in Body mass Density, BMI and proximal tibial morphological parameters between the two groups. [10]

The MPTA, MPTS and LPTS were 85.1o±1.5^o, 3.6 ^{o} ±3.3 ^{o}, 1.5 ^{o}±3.7 ^{o}, respectively. The prevalence of cartilage lesions, BMLs, and effusions in the EKOA group were 33 (59.3%), 24 (44.4%), 23 and 1respectively, and was higher than those in the non-OA group (p=0.012, p=0.005, p=0.002, p < 0.001 and p=0.002, respectively). In this series, none were reported as large and all BMLs were located focally in the femoral condyle or the tibial plateau. Of the 365 participants, SRS was detected in 5. There is no significant correlation between MPTA, MPTS or LPTS. But there is a positive correlation between MPTS and LPTS By logistic regression analysis; Age and the MPTA were positively associated with BMLs in all the participants. [11]

In the non-OA group, there is a positive association between the cartilage lesion and BMLs. Conversely MPTS were associated with BMLs in the EKOA group. Furthermore, the MPTS was associated with the presence of SRS. ROC analysis revealed that the cut-off values for detecting SRS were 85.1° for the MPTA and 3.6° for the LPTS

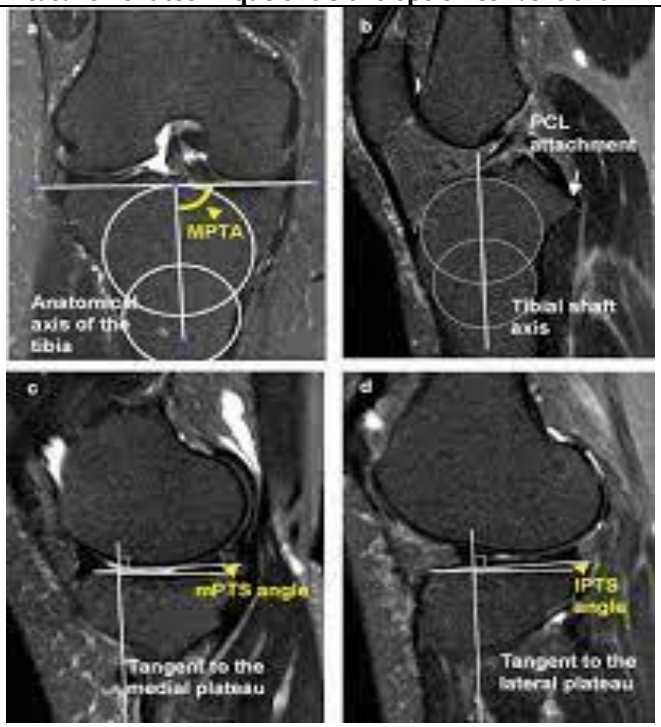
Table 1: Clinical characteristics of the participants with and without early knee osteoarthritis

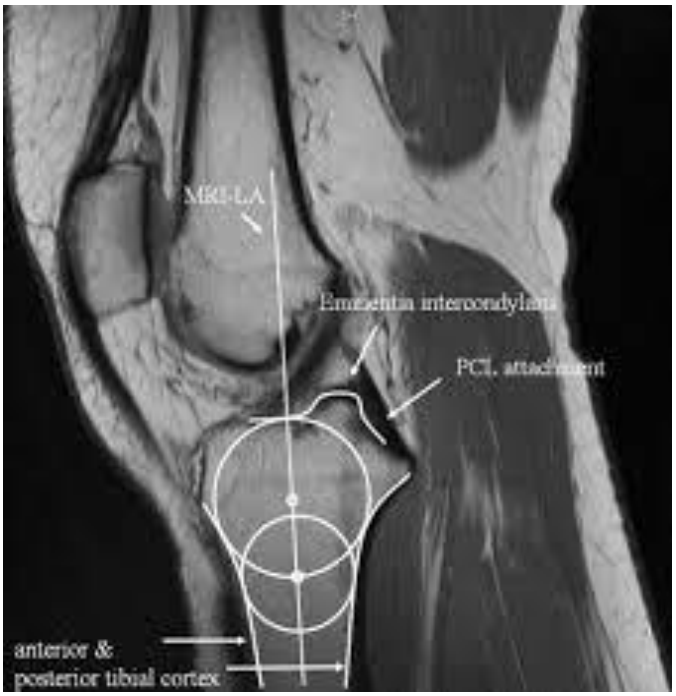
	Total	Non OA	EKOA	p-Value
Sample size	365	305	60	
Age	50±11	46±12.6	52±12	0.002
BMI(kg/m^2)	20.5±4.2	19.3±4.5	22.5±3.2	0.100
Bone mineral (g/cm^2)	0.61±0.1	0.63±0.1	0.64±0.09	0.506
Lifestyle habits				
Smoking	35	22	5	0.972
Drinking	140	112	19	0.882
Morphological parameters				
MPTA	85.1^o±1.5^o	85.1^o ±1.3^o	85.1^o ±1.2^o	0.185
Medial PTS	3.6^o ±3.3^o	3.2^o ±3.2^o	3.6^o ±3.5^o	0.562
Lateral PTS	1.5^o ±3.7^o	1.6^o ±3.3^o	2.0^o ± 3.4^o	0.216
MRI findings				
Cartilage lesion	150	126	33	0.012
Bone marrow lesion	100	82	24	0.005
Effusion	96	67	23	0.002
Spreading root sign	5	6	1	0.612

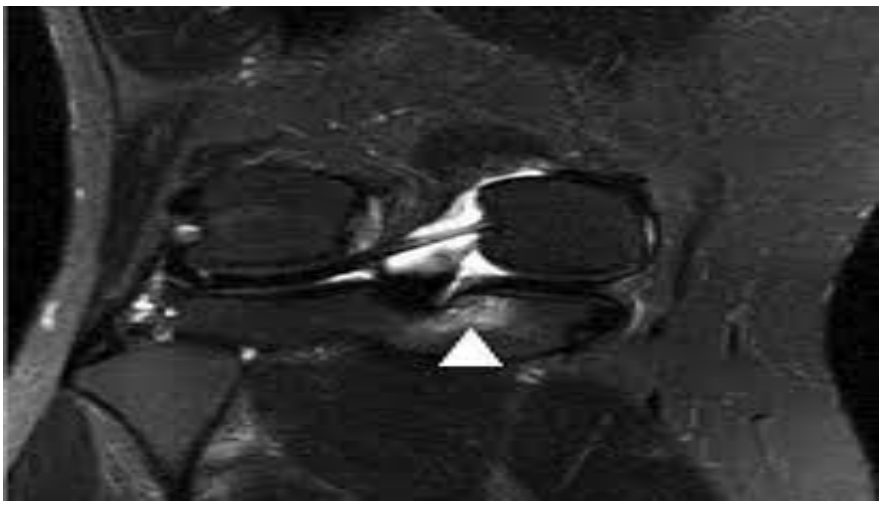
Table 2: Presence of bone marrow lesions with and without early knee osteoarthritis

	Non OA		EKOA	
	B	P value	B	P value
Age	0.05	0.02	0.49	0.17
BMI	0.02	0.45	0.03	0.64
Body mass density	-2.5	0.11	4.52	0.58
Cartilage lesion	0.50	0.02	0.81	0.45
Meniscus lesion	0.30	0.71	1.20	0.38
Synovitis	0.30	0.31	0.80	0.71
MPTA	-0.4	0.00	-1.61	0.03
Medial PTS	-0.02	0.62	0.75	0.02
Lateral PTS	-0.06	0.32	-0.12	0.12

Measurement technique of tibial slope on conventional MRI







DISCUSSION

The current study aimed to investigate the relationship between knee morphological parameters, demographic characteristics, and the presence of early knee osteoarthritis (EKOA) through a comprehensive analysis of clinical and radiological data.[13] The study involved 365 participants, divided into EKOA and non-OA groups, and assessed various factors including age, BMI, bone mineral density, lifestyle habits, and specific morphological parameters of the knee joint.[14-15] The mean age of participants in the EKOA group was 50 ± 11 years, and no significant differences were observed in body mass density, BMI, and proximal tibial morphological parameters between the EKOA and non-OA groups. This suggests that EKOA does not appear to be influenced by general demographic factors or basic morphological variations. [16] The study observed significant associations between EKOA and specific radiological findings. Similar findings were observed in Hikaru K. Ishibashi et al study. The prevalence of cartilage lesions, bone marrow lesions (BMLs), and effusions in the EKOA group was notably higher than in the non-OA group. [17] Interestingly, all BMLs were reported as focal and located in the femoral condyle or tibial plateau. The presence of spreading root signs (SRS) was rare, detected in only 5 participants, but positively correlated with the Medial Posterior Tibial Angle (MPTS). [18]

While no significant correlation was found between Medial Posterior Tibial Angle (MPTA), Medial PTS, and Lateral PTS, logistic regression analysis revealed that age and MPTA were positively associated with BMLs in all participants. [19] In the non-OA group, there was a positive association between cartilage lesions and BMLs. Conversely, in the EKOA group, MPTS was associated with BMLs, and furthermore, MPTS was linked to the presence of SRS. [20] reported that PSCLs were detected in 64% of patients who underwent surgery for an MMPRT. The study identified cut-off values for detecting SRS, with an MPTA of 85.1° and an LPTS of 3.6°. [21] These values could potentially serve as clinical indicators for identifying individuals at risk of developing spreading root signs, providing valuable information for early intervention and management.

Despite the valuable insights provided by this study, several limitations should be acknowledged. [22] The cross-sectional design limits our ability to establish causal relationships, and the study population may not be fully representative of broader demographics. Future research could benefit from longitudinal studies and a more diverse participant pool to enhance the generalizability of findings.

CONCLUSION

This research contributes to the understanding of the complex interplay between knee morphological parameters, demographic characteristics, and early osteoarthritis. The findings highlight the importance of specific radiological markers in identifying early signs of knee pathology, paving the way for targeted interventions and preventive strategies.

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