



QUALITATIVE ASSESSMENT OF KNEE JOINT SPACE AND OSTEOARTHRITIS BY X-RAY

SHARMA S¹, YADAV K^{2*}, RATHER ZA², ANMOL¹, THAKUR A¹, ASHISH NEGI A¹
AND SHARMA S¹

1: Master in Radiography & Imaging Technology, Maharishi Markandeshwar University
Mullana Ambala, Haryana, India

2: Assistant Professor in Radiography & Imaging Technology Maharishi Markandeshwar
University, Mullana, Haryana, India

*Corresponding Author: Dr. Kripanand Yadav: E Mail: Kripanandyadav00@gmail.com

Received 6th May 2025; Revised 7th June 2025; Accepted 20th Aug. 2025; Available online 1st June 2026

<https://doi.org/10.31032/IJBPAS/2026/15.6.10258>

ABSTRACT

Osteoarthritis (OA) is a degenerative joint condition characterized by progressive cartilage loss and structural changes, often assessed through X-ray imaging. This study aims to evaluate joint space narrowing and associated features such as tibial spiking and osteophyte formation while investigating the correlation between osteoarthritis severity and patient Body Mass Index (BMI). Conducted among 40 individuals aged 21–90, the research employs X-ray diagnostics alongside patient medical histories to analyze symptomatic presentation and lifestyle factors. Findings indicate that osteoarthritis severity peaks in individuals aged 60–70, with a slight predominance in females. Symptoms such as pain, stiffness, and sleep disturbances are prevalent, while lifestyle factors—particularly low exercise rates, smoking, and alcohol consumption—contribute to progression. The study emphasizes the predominance of medial joint conditions, highlighting tibial spiking and osteophyte formation as key radiological indicators. BMI analysis reveals a higher incidence of overweight individuals, reinforcing the role of weight management in OA prevention.

The study underscores the importance of early detection through X-ray imaging and the need for proactive interventions, especially among high-risk age groups. Lifestyle modifications,

including maintaining a healthy BMI and increasing physical activity, emerge as critical strategies in mitigating disease progression. The findings reinforce X-ray imaging as a valuable tool for diagnosis and monitoring, enabling tailored interventions that address the multifaceted nature of osteoarthritis.

Keywords : Osteoarthritis, Antero-Posterior, Joint Space Narrowing, Magnetic Resonance Imaging, Physical Activity, Synovial Fluid

INTRODUCTION :

X-ray which produces images of a person's inside anatomy is a commonly used diagnostic technique. It is essential for diagnosing and assessing a wide range of illnesses, from simple fractures to more complicated illnesses. Utilizing radiation to enter body and create images of interior structures, X-rays offer vital information about a patient's health and aid in detection of possible problems [[1], [2]]. This process involves a small amount of radiation passing through body to generate an image of internal structures. X-ray radiation traverses most soft tissues such as skin muscles and organs but is absorbed by denser materials like bones. This absorption creates a pattern of light and dark areas on an X-ray film or detector which a radiologist then interprets to identify any abnormalities [[3]-[5]].

In order to diagnose and treat any knee-related health issues medical professionals may suggest a knee X-ray. Through this diagnostic process a black-and-white image of knee joint's interior structure is created, displaying soft tissues and bones such as patella (kneecap) femur (part of thigh bone) and tibia (a piece of shin bone) [[6], [7]].

Sometimes picture may also show fibula a portion of calf bone. When a patient has knee pain or instability [[8], [9]].

Furthermore an X-ray assesses joint's alignment and strength of soft tissue and bone components. Broken bones dislocated joints excess fluid loose bone fragments, bone spurs, osteoarthritis incorrect joint alignment infections bone thinning and bone cancer can all be detected with knee X-rays [[10], [11]].

X-ray images to identify early indications of arthritis such as bone spurs and degree of knee pain brought on by early arthritis. X-rays can show fractures or trauma albeit not all fractures will show up. For a more precise diagnosis medical professionals may suggest further pictures or follow-up X-rays [[12], [13]].

BONE ARTICULATION OF KNEE :

Femur and tibia and patella are three bones that making joint of knee which are synovial joint. The tibiofemoral joint and patellofemoral joint are two articulations that make up this intricate hinge joint. This joint is where tibia and femoral

communicate whereas kneecap and femur articulate at patellofemoral joint [[14], [15]]. In this study the radiation protection is given to patient by radiographer in following ways:

- 1) Collimating the rays to area of interest(FOV)
- 2) Providing the lead apron above knee.
- 3) Dose optimisation.

Normal vs Osteoarthritis knee radiograph :



Figure 1: Normal



Figure 2: Osteoarthritis

OA, often referred to as degenerative joint disease constitutes a pathological condition characterized by the gradual degradation of the natural cushioning mechanism between articulating bones—cartilage. As this degeneration occurs, the osseous structures of the joints experience increased contact with one another resulting in diminished shock-absorbing properties typically provided by cartilage. Numerous symptoms including as nociception edema rigidity decreased mobility and in some cases formation of osteophytes are brought on by this mechanical friction [[16]-[18]]. Longevity is an important risk factor for OA within the knee but it can also strike young people. In some cases, OA of the knee is hereditary but in others it may be

caused by disease or even obesity. Radiographic features of osteoarthritis include JSN, chondral sclerosis and osteophytosis. If these are not present another diagnosis should be considered. X ray has also been used to study other findings such as bone marrow lesions and synovitis. Joint space narrowing is asymmetric and least specific, while subchondral sclerosis is sclerotic changes at joint margins. Osteophytosis, the development of osteophytes joint erosions and subchondral cysts are common degenerative joint disease findings [[19]].

Radiologic interpretation :

- Space narrowing, Bone spur, Marginal sclerosed, Tibial spiking.



Figure 3: This radiograph shows Grade 4 osteoarthritis.(Image from MMDU,Mullana)

Impact of ageing on joint:

A frequent condition affecting synovial joints arthritis causes inflammation in the joint. In addition to edema, stiffness, and decreased joint motion, this frequently causes severe joint pain. Arthritis comes in over 100 different varieties Growing older, autoimmune diseases, viral or bacterial infections, deterioration of articular cartilage, and other unknown (probably genetic) variables can all cause arthritis [[9], [10]]. Age-related deterioration of cartilage in joint is associated with OA most common kind of arthritis. Sports involving running, bending or throwing actions, injuries to joints, physically demanding jobs, and becoming overweight are associated hazards that can lead to OA in later life [[20]-[22]].

Aim :

To comprehensively investigate the reduced joint space and osteoarthritis by use of x-rays.

OBJECTIVE:

- To measure the extent of reduced joint space by x-rays.
- To investigate the correlation between joint space narrowing, tibial spiking and osteophyte formation.
- To correlate the patient Body Mass Index(BMI) with progression of osteoarthritis.

MATERIALS AND METHODS

This study follows a descriptive analysis and prevalence-based design to assess osteoarthritis among patients, includes a total population of 40 diagnosed patients. X-ray imaging was performed using the "Allengers 525" unit (500 mA) to capture relevant images for evaluation. Data collection involved observing X-ray images by radiologists and radiotechnologists, followed by classification based on age and sex. The collected data was analyzed using

descriptive statistical tools, including frequency, mean, and percentage.

Ethical approval for this study was secured from the Institutional Ethics Committee, ensuring adherence to research guidelines. Sampling involved patient classification based on radiological assessments, and informed consent was obtained before examination. Necessary radiation protection measures were undertaken throughout the study. The key variables examined include demographic factors such as age, sex, clinical symptoms, and radiological outcomes. The study was conducted over a six-month duration from August to April.

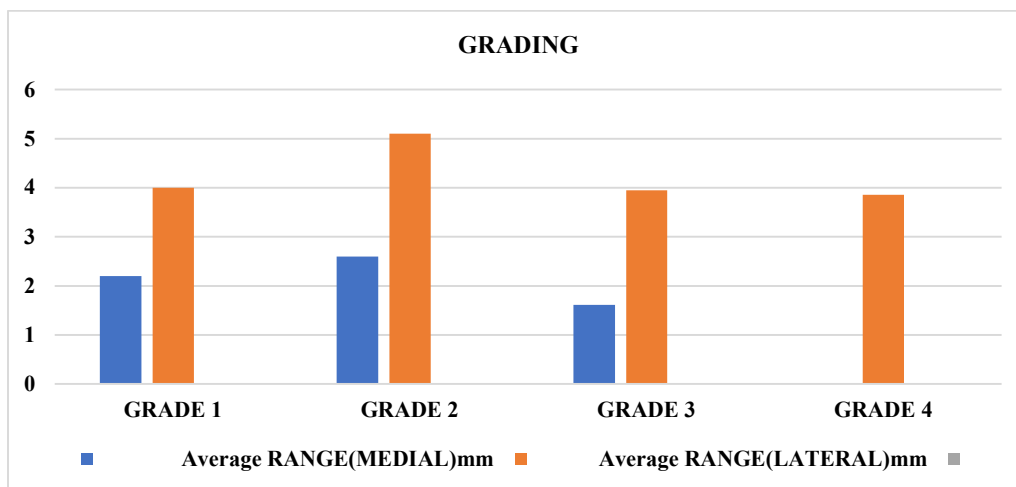
Inclusion criteria consisted of patients with confirmed or suspected knee pain, outpatients, individuals aged 21 years and above, and trauma cases. However, medical-legal cases (MLC) and uncooperative patients were excluded from participation. Instruments utilized for data collection included X-ray imaging equipment, DICOM controls, films, weighing machines, stadiometers, and specialized software (ImageWorksCR13.01) for measurement analysis. The study aims to provide comprehensive insights into osteoarthritis progression and its correlation with demographic and lifestyle factors.

RANGE OF JOINT SPACE NARROWING ACCORDING TO GRADING

The **Table 1** reveals that the average medial range decreases progressively across the grades, reaching zero in Grade 4, indicating a significant decline as the condition advances. In contrast, the average lateral range shows no consistent trend; Grade 2 has the highest lateral value, while the values for other grades fluctuate slightly. This suggests a clear progression in medial changes with increasing grades, while lateral measurements may not follow a predictable pattern.

REPRESENTATION OF PATIENT FALLING UNDER WHAT TYPE OF BMI

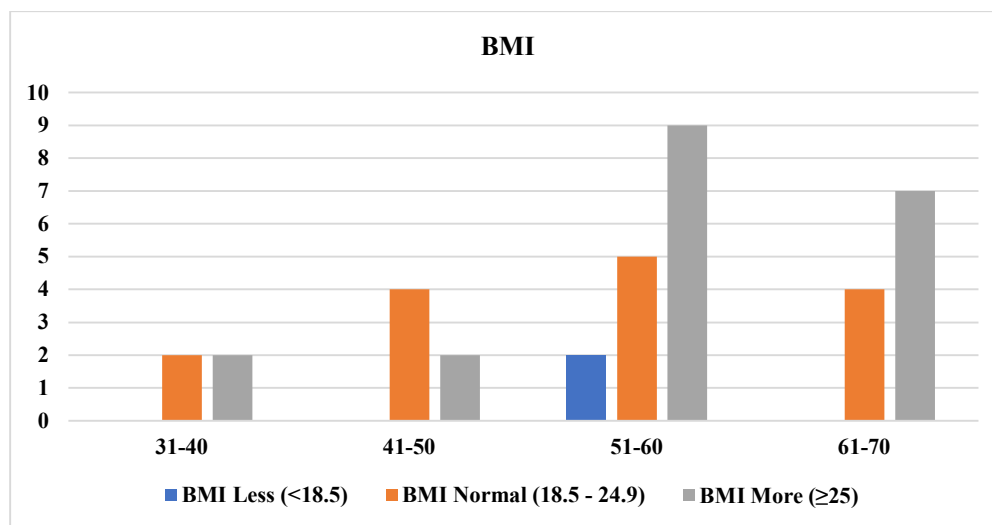
The data illustrates a pattern in BMI distribution across different age groups. The majority of individuals fall within the "Normal" (18.5-24.9) and "More" (≥ 25) BMI categories, with the "More" category being particularly prevalent among the 51-60 and 61-70 age groups, indicating a higher occurrence of elevated BMI as people approach middle age. Interestingly, the "Less" (< 18.5) BMI category is exclusively observed in the 71-80 age group, suggesting that underweight cases are primarily found in older individuals (**Graph 2**).



Graph 1: Represents the average range of joint space narrowing with grading

Table 1: Shows the Average J.S.N in medial and lateral with relation to grading

GRADING	Average RANGE(MEDIAL)mm	Average RANGE(LATERAL)mm
GRADE 1	2.2mm	4mm
GRADE 2	2.6mm	5.15mm
GRADE 3	1.61mm	3.95mm
GRADE 4	0mm	3.86mm



Graph 2: Graph shows the BMI under different age group

RESULTS

The analysis highlights the intricate factors affecting joint-related conditions, with age emerging as a key determinant. The highest prevalence is observed in the 60-70 age group, followed by a slight decline in individuals aged 70-80, indicating that joint health challenges peak in the sixth and

seventh decades of life. This underscores the importance of preventive strategies, medical intervention, and rehabilitation efforts for these age groups, while encouraging early lifestyle changes in younger individuals to mitigate disease progression. Gender analysis reveals a slightly higher prevalence among females, suggesting the need for

further exploration into hormonal influences and healthcare accessibility to develop more tailored treatments. The correlation between K/L grades and age reinforces the progressive severity of joint conditions, with advanced grades predominantly appearing in older populations. Similarly, osteophyte development peaks in middle age before declining, possibly reflecting changes in disease progression or treatment effectiveness. Symptoms such as pain, stiffness, and sleep disturbances highlight the debilitating nature of joint conditions, necessitating targeted healthcare interventions.

CONCLUSION

BMI distribution emphasizes the growing concern of elevated BMI levels in middle-aged and older individuals and their impact on joint health, reinforcing the role of weight management in reducing disease severity. Structural changes, including joint space narrowing, tibial spiking, sclerosis, and patellar beaking, provide deeper insights into anatomical alterations associated with disease progression. The predominance of medial cases indicates the necessity for condition-specific treatment approaches, ultimately guiding more effective medical strategies for improved joint health outcomes.

REFERENCES

[1] K. Thayalan, *The Physics Of Radiology And Imaging*, Chennai,

Tamil Nadu, India: Jaypee Brothers Medical Publishers (P) Ltd, 2014.

- [2] D. A. M. Curry, *Christenssen's Physics of Diagnostic Radiology*, Wolters Kluwer(India) Pvt Ltd, 4th edition Reprint, 2013.
- [3] I. E. Team, "Knee X-rays for Abnormality Detection," *Medtalks*, 28 February Published on, 2023. [Online]. Available: <https://www.medtalks.in/articles/knee-x-rays-for-abnormality-detection>.
- [4] G. Sendic, "Kenhub," 30 October 2023. [Online]. Available: <https://www.kenhub.com/en/library/anatomy/the-knee-joint>.
- [5] J. P. Lampignano, *Bontrager's Textbook Of Radiographic Positioning And Related Anatomy*, Ninth Edition, Elsevier, 2018.
- [6] A. Murphy, "Radiological protection," *Radiopedia*, 12 April 2017. [Online]. Available: <https://radiopaedia.org/articles/52566>.
- [7] David Zelman. <https://www.webmd.com/bio/david-zelman>, 30 June 2023. Available: <https://www.webmd.com/osteoarthritis/osteoarthritis-of-the-knee-degenerative-arthritis-of-the-knee>.
- [8] A. N. Mous, "Osteoarthritis (OA), Radiopedia," *Radiopedia*, 2 May 2008. [Online]. Available: <https://radiopaedia.org/articles/1794>

- [9] J.E.J.A.W.A.Y.J. Gordon Betts, *Anatomy and physiology 2e*, Houston, Texas: openstax, 2022.
- [10] F.J.B.O.B.C.C. Nigel Arden, *Atlas Of Osteoarthritis 2nd edition*, The Campus, 4 Crinan Street, London, N1 9XW: Springer Healthcare Ltd, 2018.
- [11] J. S. D. D. E. Vespe, “Joint Space Narrowing in the Osteoarthritic Knee,” *Journal of orthopedics for physician assistants*, vol. 11, p. no. 2, Jan. 2023.
- [12] H. Kaneko, “Synovial perlecan is required for osteophyte formation in knee osteoarthritis,” *Matrix Biology*, vol. 32, p. pp. 178–187, Apr. 2013.
- [13] S. T. Donell, “Subchondral bone remodelling in osteoarthritis,” *University of East Anglia*, vol. 4, no. 6, pp. pp 221-229, 03 Jun 2019.
- [14] Anri Patron, “Automatic Method for Assessing Spiking of Tibial Tubercles Associated with Knee Osteoarthritis,” vol. 12, no. 11, pp. pp 2603-2603, 27 Oct 2022.
- [15] Tayyaba Tariq, “Knee Osteoarthritis Detection and Classification Using X-Rays,” 2023.
- [16] “calculator.net,” Maple Tech. International LLC., 2008. [Online]. Available: <https://www.calculator.net/bmi-calculator.html?cage=25&csex=m&cheightfeet=5&cheightinch=10&cpound=160&cheightmeter=180&ckg=65&printit=0&ctype=metric>.
- [17] C. K. Charis Ntakolia, “Prediction of Joint Space Narrowing Progression in Knee Osteoarthritis Patients.,” *University of Thessaly*, vol. 11, no. 2, p. 285, 2021.
- [18] Aditya Kumar Mishra, “Cross-sectional study on the relationship between Body Mass Index and severity of knee osteoarthritis,” *Revista Română de Reumatologie*, 2024.
- [19] N. S. Özleyen, “Longitudinal Relationship Between Physical Activity and Joint Space Narrowing: Forty-Eight-Month Follow-Up Data From the Osteoarthritis Initiative,” *Memorial Sloan Kettering Cancer Center*, vol. 74, no. 7, pp. 1163-1171, 2022.
- [20] S Donnelly, D J Hart, D V Doyle and T D Spector, “Spiking of the tibial tubercles—a radiological feature of osteoarthritis,” *Ann Rheum Dis*. <https://doi.org/10.1136/ard.55.2.105>, p. 105–108, 1996.
- [21] D. T. Felson, D. R. Gale, M. Elon Gale, J. Niu, D. J. Hunter, J. Goggins, M. P. LaValley,

“Osteophytes and progression of knee osteoarthritis,” *Rheumatology*, Volume 44, Issue 1, January 2005, Pages 100–104, <https://doi.org/10.1093/rheumatology/keh411>

- [22] Avin Mohammed, “Most Association between lifelong daily activities and knee and hip osteoarthritis in a group of people attending Rizgary Teaching Hospital in Erbil city,” *Zanco Journal of Medical Sciences*, vol. 20, no. 1, pp. 1147-1, 2016.