

Association Between Fabella and Clinical Factors with Knee Osteoarthritis Severity Based on X-Ray Findings According to the Kellgren-Lawrence Classification at Royal Prima General Hospital Medan

Ricky Suryamin¹, Faisal Reza², Ica Y Pulungan²

¹Department of Radiology, Faculty of Medicine, Prima Indonesia University / Royal Prima General Hospital, Medan, Indonesia

²Department of Radiology, Faculty of Medicine, Prima Indonesia University, Medan, Indonesia

Abstract

Citation : Suryamin, R., Reza, F., & Pulungan, I. Y. 2026. Association Between Fabella and Clinical Factors with Knee Osteoarthritis Severity Based on X-Ray Findings According to the Kellgren-Lawrence Classification at Royal Prima General Hospital Medan. *Medicus*, 15(3), 68–73.

Keywords : body mass index; fabella; knee osteoarthritis; Kellgren-Lawrence; radiography
Correspondance : Ricky Suryamin
E-mail : rickysuryamin@hotmail.com
Online First : 22 June 2026

Background:

Knee osteoarthritis is a common degenerative joint disease associated with pain, functional limitation, and radiographic progression. The fabella, a sesamoid bone located in the lateral head of the gastrocnemius tendon, has been proposed as a possible contributor to knee biomechanics and osteoarthritis severity.

Methods:

This retrospective cohort study evaluated 274 patients who underwent knee radiographic examination at Royal Prima General Hospital Medan. The presence and condition of fabella, age, sex, and body mass index (BMI) were analyzed against knee osteoarthritis severity based on the Kellgren-Lawrence classification. Data were analyzed using univariate analysis and multiple linear regression.

Result:

Most patients were older than 56 years (74.8%), female (78.8%), and obese (91.2%). Fabella was non-degenerative in 47.4% of patients, degenerative in 17.9%, and not visible in 34.7%. Osteoarthritis severity was Grade II in 38.3%, Grade III in 39.4%, and Grade IV in 22.3%. Fabella ($B=0.391$; $p<0.001$) and age ($B=0.337$; $p=0.003$) were significantly associated with osteoarthritis severity, whereas sex ($p=0.952$) and BMI ($p=0.126$) were not. The overall regression model was significant ($F=19.955$; $p<0.001$; $R^2=0.229$).

Conclusions:

Fabella and age were significantly associated with higher knee osteoarthritis severity, while sex and BMI were not significant predictors in this cohort. Radiographic assessment of fabella may provide additional information in evaluating patients with knee osteoarthritis.

Introduction

Knee osteoarthritis is one of the most common degenerative joint diseases and is frequently associated with pain, stiffness, functional limitation, and impaired quality of life.^{1,2} Radiographic

evaluation remains important for confirming structural disease severity, and the Kellgren-Lawrence classification is widely used to grade knee osteoarthritis severity based on osteophyte formation, joint-space narrowing, sclerosis, and deformity.^{3,4}

Several clinical and demographic factors have been associated with knee osteoarthritis, including age, sex, obesity, occupational load, genetic predisposition, and previous trauma.⁵⁻⁸ Increasing age contributes to chondrocyte dysfunction, reduced cartilage regeneration, oxidative stress, and progressive cartilage thinning.⁷ Obesity may increase knee joint loading and inflammatory activity, while sex-related differences may reflect hormonal and biomechanical influences.^{5,6}

The fabella is a small sesamoid bone located posterior to the knee within the tendon of the lateral head of the gastrocnemius muscle. Although traditionally regarded as a normal anatomical variant, recent studies have suggested that fabella prevalence, morphology, and degenerative changes may be associated with knee pain, fabella syndrome, and osteoarthritis severity.⁹⁻¹² Because the fabella articulates with the lateral femoral condyle, repeated mechanical contact may alter posterior knee loading and potentially contribute to degenerative change.^{10,11}

Evidence regarding the association between fabella and knee osteoarthritis severity remains limited in Indonesian clinical populations. This study aimed to analyze the association between fabella and clinical factors, including age, sex, and BMI, with radiographic knee osteoarthritis severity according to the Kellgren-Lawrence classification at Royal Prima General Hospital Medan.

Material And Methods

This study used a retrospective cohort design. The study population consisted of patients who underwent knee radiographic examination at Royal Prima General

Hospital Medan. A total of 274 patients were included for analysis. The main dependent variable was radiographic knee osteoarthritis severity based on the Kellgren-Lawrence classification. Independent variables included fabella status, age, sex, and BMI.

Fabella was classified based on knee radiographic findings as not visible, non-degenerative, or degenerative. Age was categorized into 36-55 years and >56 years. Sex was recorded as male or female. BMI was categorized as underweight, normal, or obese according to the source dataset. Knee osteoarthritis severity was classified as Grade II, Grade III, or Grade IV according to the Kellgren-Lawrence grading system.

Data were analyzed using univariate statistics to describe respondent characteristics and study variables. Classical assumption tests included normality, multicollinearity, heteroscedasticity, and autocorrelation assessment. Multiple linear regression was performed to evaluate the association between independent variables and osteoarthritis severity. Statistical significance was defined as $p < 0.05$.¹³

Result

A total of 274 patients were included. Most patients were older than 56 years (205/274; 74.8%), while 69 patients (25.2%) were aged 36-55 years. Female patients predominated (216/274; 78.8%), whereas male patients accounted for 21.2%. Obesity was the most common BMI category (250/274; 91.2%). The overall distribution of clinical characteristics is shown in Table 1.

Table 1. Distribution of clinical characteristics and radiographic findings (n = 274)

Variable	Category	n	%
Age	36-55 years	69	25.2
	>56 years	205	74.8
Sex	Male	58	21.2
	Female	216	78.8

Variable	Category	n	%
Fabella	Not visible	95	34.7
	Non-degenerative	130	47.4
	Degenerative	49	17.9
BMI	Underweight	1	0.4
	Normal	23	8.4
	Obese	250	91.2
Kellgren-Lawrence grade	Grade II	105	38.3
	Grade III	108	39.4
	Grade IV	61	22.3

Fabella was not visible in 95 patients (34.7%), non-degenerative in 130 patients (47.4%), and degenerative in 49 patients (17.9%). Radiographic osteoarthritis was most frequently Grade III (39.4%), followed by Grade II (38.3%) and Grade IV (22.3%). These findings indicate that most patients presented with moderate to advanced radiographic osteoarthritis.

The regression assumptions were fulfilled. Residuals were normally

distributed (Kolmogorov-Smirnov $p=0.260$), all predictors showed acceptable tolerance and VIF values, the heteroscedasticity test was not significant for age, sex, BMI, or fabella, and the Durbin-Watson value was 2.027. Multiple linear regression showed that fabella and age were significantly associated with knee osteoarthritis severity, whereas sex and BMI were not significant predictors (Table 2).

Table 2. Multiple linear regression analysis for knee osteoarthritis severity

Predictor	B	Std. error	Beta	t	p-value	Tolerance	VIF
Age	0.337	0.112	0.192	3.007	0.003	0.704	1.421
Sex	-0.006	0.102	-0.003	-0.060	0.952	0.951	1.052
BMI	0.252	0.164	0.099	1.535	0.126	0.686	1.457
Fabella	0.391	0.059	0.362	6.652	<0.001	0.970	1.031

The multivariable model was statistically significant ($F=19.955$; $p<0.001$). The R value was 0.478, and the R^2 value was 0.229, indicating that 22.9% of the variation in knee osteoarthritis severity was explained by age, sex, BMI, and fabella status. Fabella had the highest standardized beta coefficient ($\beta=0.362$), followed by age ($\beta=0.192$).

Discussion

This study found that fabella status was significantly associated with radiographic knee osteoarthritis severity. The positive regression coefficient suggests that more advanced fabella findings, particularly degenerative changes, were associated with higher Kellgren-Lawrence grades. This finding is biologically plausible

because the fabella may alter posterior knee biomechanics and increase compressive contact with the lateral femoral condyle.⁹⁻¹² Repetitive friction or altered force distribution may contribute to cartilage stress and progressive degenerative change.

Previous studies have reported that the fabella is increasingly recognized as a clinically relevant structure rather than merely an incidental anatomical variant. Hou et al. described associations between fabella prevalence, degeneration, and knee osteoarthritis, while other population-based studies also reported relationships between fabella morphology and osteoarthritic severity.^{9,11,12} The present findings support the importance of carefully evaluating fabella on routine knee

radiographs, especially in patients with moderate to severe osteoarthritis.

Age was also significantly associated with higher osteoarthritis severity. This result is consistent with the degenerative nature of knee osteoarthritis and with previous literature describing increasing age as a major determinant of cartilage breakdown, reduced matrix repair capacity, oxidative stress, and decreased muscle strength.^{7,14} In the present cohort, most patients were older than 56 years, which may reflect delayed presentation after structural damage has already progressed.

Sex was not significantly associated with osteoarthritis severity after adjustment. Although osteoarthritis prevalence is often higher in women, particularly after menopause, the lack of association in this study suggests that sex alone may not determine radiographic severity once age, BMI, and fabella are considered.⁵ The predominance of older female patients may also reduce between-sex variability in hormonal and biomechanical factors.

BMI was also not significantly associated with osteoarthritis severity, despite the high proportion of obese patients in this cohort. Obesity remains a recognized risk factor for knee osteoarthritis through mechanical loading and inflammatory mechanisms.^{6,15} However, the dominance of obesity in this dataset may have restricted variability, limiting the ability of BMI to distinguish between severity categories. Other unmeasured factors, such as occupational knee loading, previous injury, physical activity, pain severity, and lower-limb alignment, may also explain radiographic severity beyond BMI.

The findings have practical implications for radiology reporting and clinical management. Identification of fabella, especially when degenerative changes are present, may provide additional information when evaluating knee osteoarthritis progression. This study also suggests that patients with advanced age and fabella findings may benefit from closer clinical monitoring, preventive counseling, and multidisciplinary management focused on preserving function and reducing progression risk.¹⁶

This study has limitations. Its retrospective design limits causal inference, and the analysis was based on available radiographic and clinical records. The study did not assess pain scores, functional impairment, occupational exposure, prior trauma, limb alignment, or detailed fabella dimensions. Future prospective studies with longitudinal follow-up, biomechanical variables, and advanced imaging modalities are recommended to clarify whether fabella contributes directly to osteoarthritis progression or acts as a marker of degenerative joint change.

Conclusion

Fabella and age were significantly associated with radiographic knee osteoarthritis severity based on the Kellgren-Lawrence classification in patients at Royal Prima General Hospital Medan. Sex and BMI were not significantly associated with osteoarthritis severity after multivariable adjustment. These findings suggest that radiographic assessment of fabella, particularly degenerative fabella changes, may provide additional clinical information when evaluating knee osteoarthritis severity.

References

1. Hunter DJ, Bierma-Zeinstra S. Osteoarthritis. *Lancet*. 2019;393(10182):1745-1759.
2. Sasono B, Amanda NA, Dewi DNSS. Faktor dominan pada penderita osteoarthritis di RSUD dr. Mohamad Soewandhie, Surabaya, Indonesia. *J Medika Udayana*. 2020;9(11).
3. Laporan Nasional Riskesdas 2018. Badan Penelitian dan Pengembangan Kesehatan; 2019. Available from: <https://repository.badankebijakan.kemkes.go.id/id/eprint/3514>.
4. Permatasari W, Amran M. Gambaran klinis dan radiologis menurut Kellgren and Lawrence pada penderita osteoarthritis genu yang berobat jalan di Poliklinik Ortopedi RSU Anutapura Palu tahun 2018. *Herb-Medicine Journal*. 2019;2(1).
5. Peshkova M, Lychagin A, Lipina M, Di Matteo B, Anzillotti G, Ronzoni F, et al. Gender-related aspects in osteoarthritis development and progression: a review. *Int J Mol Sci*. 2022;23(5):2767. doi:10.3390/ijms23052767.
6. Nedunchezhiyan U, Varughese I, Sun AR, Wu X, Crawford R, Prasad I. Obesity, inflammation, and immune system in osteoarthritis. *Front Immunol*. 2022;13. doi:10.3389/fimmu.2022.907750.
7. He Y, Li Z, Alexander PG, Ocasio-Nieves BD, Yocum L, Lin H, et al. Pathogenesis of osteoarthritis: risk factors, regulatory pathways in chondrocytes, and experimental models. *Biology*. 2020;9(8):194. doi:10.3390/biology9080194.
8. Gignac MAM, Irvin E, Cullen K, Van Eerd D, Beaton DE, Mahood Q, et al. Men and women's occupational activities and the risk of developing osteoarthritis of the knee, hip, or hands: a systematic review and recommendations for future research. *Arthritis Care Res*. 2020;72(3):378-396. doi:10.1002/acr.23855.
9. Hou W, Xu L, Wang J. Fabellar prevalence, degeneration and association with knee osteoarthritis in the Chinese population. *Sci Rep*. 2019;9:13046. doi:10.1038/s41598-019-49174-1.
10. Berthaume MA, Federico E, Bull AMJ. Fabella prevalence rate increases over 150 years, and rates of other sesamoid bones remain constant: a systematic review. *J Anat*. 2019;235:67-79.
11. Nolan M, Marting E, Applegate J. Fabella syndrome: anatomy, diagnosis, treatment, and outcomes. *Anatomia*. 2024;3:227-233. doi:10.3390/anatomia3040019.
12. Zhang K, Wang L, et al. Relationship between classification of fabellae and the severity of knee osteoarthritis: a study in the Chinese population. *Orthop Surg*. 2022;14(3). Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/os.13006>.

13. Kim Y, Kim H, et al. The prevalence of fabella and its association with the osteoarthritic severity of the knee in Korea. PubMed. 2022. Available from: <https://pubmed.ncbi.nlm.nih.gov/32556935>.
14. Wang X, Kattan MW. Cohort studies: design, analysis, and reporting. Chest. 2020;158(1S):S72-S78. doi:10.1016/j.chest.2020.03.014.
15. Weir C, Jan A. BMI classification percentile and cut off point. StatPearls. 2021.
16. Sibarian JJ, Kuntara A, Rasyid RPHN. Korelasi usia dan derajat osteoartritis sendi lutut berdasarkan sistem klasifikasi Kellgren-Lawrence di RSUP Dr. Hasan Sadikin Bandung tahun 2019-2020. J Med Health. 2021;3(1).
17. Helmi RY, Najirman, Manuaba IARW, Rahmadi AR, Kurniari PK, Chair M, et al. Indonesian Rheumatology Association recommendations for diagnosis and management of osteoarthritis (knee, hand, hip). Indones J Rheumatol. 2023;15(1):683-706. doi:10.37275/ijr.v15i1.225.

Author's Statement

The authors declared that all the images and figures in this manuscript is/are author's own work and/or has obtained necessary permission to re-use the content from the authors and publisher of respective materials.

(Ricky Suryamin)