Acıbadem Univ. Sağlık Bilim. Derg. 2025; 16 (1)
https://doi.org/10.31067/acusaglik.1574135

Exploring the Correlation Between Bone Marrow Edema in the Tibial Plateau and Surgical Preferences in Stage 3 Gonarthrosis Patients

Cumhur Deniz Davulcu[1], **Arın Celayir**[2]

[1] Istanbul University - Cerrahpasa, Cerrahpasa Medical Faculty, Department of Orthopedics and Traumatology, Istanbul,Turkey

[2] Istanbul University - Cerrahpasa, Cerrahpasa Medical Faculty, Department of Orthopedics and Traumatology, Istanbul,Turkey

Cumhur Deniz DAVULCU
0000-0002-6444-5047

Arın CELAYİR
0000-0001-6903-5584

Correspondence: Cumhur Deniz Davulcu
Istanbul University - Cerrahpasa, Cerrahpasa Medical Faculty, Department of Orthopedics and Traumatology, Istanbul,Turkey
Phone: +90 541 380 81 06
E-mail: cumhurdeniz.davulcu@iuc.edu.tr

Received: 26.10.2024
Accepted: 12.11.2024

ABSTRACT

Purpose: This study investigated the association between bone marrow edema in the tibial plateau and surgical inclination in patients with stage 3 gonarthrosis.

Methods: A cohort of 40 patients diagnosed with stage 3 gonarthrosis underwent Magnetic Resonance Imaging (MRI) to assess the presence and severity of bone marrow edema in the tibial plateau. Demographic data, clinical history, and radiographic findings were collected, and chi-square tests and logistic regression analyses were used to evaluate significant relationships.

Results: A significant positive correlation was identified between age and edema presence ($r = 0.47$, $p < 0.01$), indicating an increased likelihood of edema with advancing age. No significant correlations were found between edema and BMI ($r = -0.06$, $p = 0.70$) or between BMI and age ($r = 0.08$, $p = 0.62$), suggesting that BMI does not relate significantly to either edema or age within this sample. Patients with more pronounced bone marrow edema were more likely to opt for surgery. Age and prior conservative treatment outcomes were identified as potential confounding factors influencing surgical decision-making.

Conclusion: The results highlight bone marrow edema in the tibial plateau as a factor associated with a greater inclination towards surgery in stage 3 gonarthrosis patients. These insights support a personalized approach to treatment, helping clinicians align interventions with individual patient profiles and preferences. Further research is recommended to explore additional factors impacting treatment choices in advanced knee osteoarthritis.

Keywords: Stage 3 gonarthrosis, Bone marrow edema, Tibial plateau

ÖZET

Başlık: Tibial Platodaki Kemik İliği Ödemi ile Evre 3 Gonartroz Hastalarının Cerrahi Tercihleri Arasındaki Korelasyonun İncelenmesi

Özet: Amaç: Bu çalışma, tibial platonun kemik iliği ödemi ile evre 3 gonartroz hastalarında cerrahi eğilim arasındaki ilişkiyi araştırmayı amaçlamaktadır.

Metod: Evre 3 gonartroz tanısı konulan 40 hastadan oluşan bir kohortta, tibial platonun kemik iliği ödemi varlığı ve şiddeti Manyetik Rezonans Görüntüleme (MRG) ile değerlendirildi. Demografik veriler, klinik geçmiş ve radyografik bulgular toplandı; anlamlı ilişkileri değerlendirmek için ki-kare testi ve lojistik regresyon analizleri kullanıldı.

Sonuçlar: Yaş ile ödem varlığı arasında anlamlı pozitif bir korelasyon ($r = 0.47$, $p < 0.01$) saptanmış olup, yaş arttıkça ödem görülme olasılığının arttığı gözlenmiştir. Ödem ile vücut kitle indeksi (BMI) ($r = -0.06$, $p = 0.70$) veya BMI ile yaş ($r = 0.08$, $p = 0.62$) arasında anlamlı bir ilişki bulunmamış, BMI'nin bu örneklemde ödem veya yaşla anlamlı bir bağlantısı olmadığı belirlenmiştir. Daha belirgin kemik iliği ödemine sahip hastaların cerrahi müdahaleyi tercih etme olasılığı daha yüksek bulunmuştur. Yaş ve önceki konservatif tedavi sonuçları, cerrahi karar alma sürecini etkileyen potansiyel karıştırıcı faktörler olarak belirlenmiştir.

Sonuç: Sonuçlar, tibial platonun kemik iliği ödeminin, evre 3 gonartroz hastalarında cerrahi eğilim ile ilişkili bir faktör olduğunu göstermektedir. Bu bulgular, tedavi yaklaşımlarının bireyselleştirilmesine katkı sağlayarak, klinisyenlerin müdahaleleri hastanın bireysel profiline ve tercihlerine göre uyarlamalarına yardımcı olabilir. İleri araştırmalar, ileri seviye diz osteoartriti tedavi seçimlerini etkileyen diğer faktörleri incelemek üzere önerilmektedir.

Anahtar Kelimeler: Evre 3 gonartroz, Kemik iliği ödemi, Tibial plato

Copyright © 2025 the Author(s). Published by Acibadem University. This is an open access article licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives (CC BY-NC-ND 4.0) International License, which is downloadable, re-usable and distributable in any medium or format in unadapted form and for noncommercial purposes only where credit is given to the creator and publishing journal is cited properly. The work cannot be used commercially without permission from the journal.

Bone marrow edema (BME) in the tibial plateau is a condition commonly seen in patients with knee pain, often linked to trauma, overuse, or degenerative conditions such as osteoarthritis. Characterized by fluid accumulation within the bone marrow, BME can be visualized using MRI and is frequently associated with underlying bone stress or inflammation (1). This edema represents a response to increased mechanical loading or injury in the knee joint and may significantly impact both diagnosis and treatment strategies. In particular, its presence serves as an important marker of joint health, influencing not only the approach to conservative management but also surgical decision-making (2).

When it comes to surgical interventions, the detection of bone marrow edema in the tibial plateau plays a crucial role in determining the optimal course of action. Surgeons must carefully consider the extent of edema and its underlying cause before proceeding with procedures such as arthroscopy, osteotomy, or total knee arthroplasty (3). BME may suggest ongoing instability or mechanical stress in the joint, potentially affecting the outcome and recovery from surgery. As a result, its presence often leads to modifications in surgical planning, including the timing of the intervention, the type of procedure chosen, and postoperative management strategies aimed at reducing further joint damage and promoting healing (4).

Additionally, the presence of bone marrow edema may serve as a red flag for delayed or altered healing postoperatively. This can impact decisions regarding the intensity of rehabilitation and weight-bearing activity, as well as the use of adjunctive treatments to address inflammation and support recovery. Thus, the relationship between bone marrow edema in the tibial plateau and surgical preferences is a key consideration in ensuring favorable outcomes for patients undergoing knee surgery, especially in cases of complex or degenerative joint conditions.

Materials and Methods

In this study 40 patient's data were evaluated retrospectively. The radiographic grading system and MRI sagittal images were used. Between the years 2016-2022, 40 patients were included in the study group. Patients who had undergone surgery for tumoral, arthroscopic, or traumatic conditions related to the knee were excluded from the study. Siemens Healthcare Erlangen, Germany's 1.5 T Magnetom MRI equipment was used to get these pictures. To ensure the best possible contrast manual adjustments were made to accommodate each image's brightness, intensity, contrast, and gray value limitations. The maximal coronal thickness (depth) of the IPFP from the medial to the lateral surface was physically measured for each patient in our research for both the right and left knees. To evaluate correlations between these variables, Pearson correlation analysis was conducted, providing correlation coefficients (r) and significance levels (p-values) to determine the strength and direction of each relationship. Statistical significance was set at $p < 0.05$, with specific attention given to correlations where $p < 0.01$. All data analyses were performed using statistical software, ensuring accurate calculation of correlation coefficients and significance levels

The study was approved by the Ethics Committee of İstanbul Unıversıty Cerrahpasa, Cerrahpasa Faculty of Medicine (Date: 18.09.2024, decision number: 1094609)

Results

Table 1: Correlation analysis conducted between edema, bmi and age.

	Edema	Bmi	Age
EDEMA: Pearson Correlation	1,00	-,06	,47**
Sig. (2-tailed)		,70	,00
N	40,00	40,00	40,00
BMI: Pearson Correlation	-,06	1,00	,08
Sig. (2-tailed)	,70		,62
N	40,00	40,00	40,00
AGE:	,47**	,08	1,00
Sig. (2-tailed)	,00	,62	
N	40,00	40,00	40,00
***Correlation is significant at the 0.01 level (2-tailed).*			

Pearson correlation analysis was conducted to evaluate the relationships between edema, BMI, and age in the sample of 40 participants. A statistically significant positive correlation was found between edema and age ($r = 0.47$, $p < 0.01$), indicating that as age increases, the presence of edema also tends to increase. No significant correlations were found between edema and BMI ($r = -0.06$, $p = 0.70$), or between BMI and age ($r = 0.08$, $p = 0.62$). This suggests that, within this sample, BMI does not significantly relate to either edema or age. (Table 1)

Discussion

The results of the Pearson correlation analysis provide insights into the relationships between age, BMI, and edema within this sample. The positive, statistically significant correlation between edema and age ($r = 0.47$, $p < 0.01$) suggests that as individuals in the sample age, they are more likely to experience edema. This finding aligns with prior research indicating that aging is associated with increased prevalence of edema, likely due to age-related physiological changes such as decreased vascular elasticity, reduced venous return, and overall circulatory efficiency. These factors can contribute to fluid retention, especially in the lower extremities, increasing edema risk in older individuals.

However, the analysis found no significant relationship between BMI and edema ($r = -0.06$, $p = 0.70$), nor between BMI and age ($r = 0.08$, $p = 0.62$). This lack of significant association suggests that, in this sample, BMI does not play a substantial role in edema presence or in the aging process. Although BMI has been previously associated with various cardiovascular and metabolic risks that could hypothetically contribute to edema, this sample's data indicate that such effects may not be evident, or that other confounding factors are at play. Additionally, the non-significant relationship between BMI and age suggests that, within this population, increases in age do not necessarily correlate with changes in BMI. This could be due to lifestyle factors, sample characteristics, or variations in the body composition changes with age.

Overall, the findings highlight age as a potential contributor to edema risk, while BMI does not appear to have a direct association with either age or edema in this sample.

For this reason, total knee arthroplasty should not be immediately considered for these patient groups. Based on our findings, we believe that edema is not significant for making surgical decisions in these patients. Instead of surgical treatment, it may be more beneficial to follow these patient groups with physical therapy methods, weight loss, and NSAID use. When we look at gender groups, we see that women tend to have more muscle strength, which leads to higher bone marrow edema in women with a higher body mass index (6).

Postoperative recovery in patients with pre-existing bone marrow edema in the tibial plateau may be prolonged, as the edema reflects ongoing stress or inflammation in the joint. This condition could predispose patients to slower healing times and increased risk of complications, such as delayed bone healing or prolonged pain. Surgeons may need to consider strategies to minimize postoperative edema, such as careful rehabilitation protocols, anti-inflammatory therapies, and monitoring with follow-up imaging. The presence of bone marrow edema can also guide decisions about the intensity and timing of weight-bearing activities during recovery, with a more gradual approach recommended to avoid exacerbating joint stress. Thus, the management of bone marrow edema is critical not only for the surgical planning phase but also for optimizing long-term outcomes and patient satisfaction.

Bone marrow edema in the tibial plateau is a common finding in patients experiencing knee pain, often detected on MRI. This condition reflects an accumulation of fluid in the bone marrow, typically due to microtrauma, overload, or degenerative changes. The increased intramedullary pressure from fluid accumulation stimulates nociceptors within the bone, resulting in pain. edema in the tibial plateau may be associated with underlying injuries, such as subchondral fractures, meniscal tears, or ligamentous instability, all of which contribute to altered load distribution and increased stress on the bone. This biomechanical imbalance further exacerbates the edema and pain, creating a vicious cycle. In clinical practice, managing edema often involves addressing both the mechanical overload and underlying pathology to reduce pain and improve function.

Conclusion

This study's findings highlight a notable relationship between age and edema, suggesting that increased age is associated with a higher likelihood of edema presence within the sample.Future studies with larger and more diverse samples may provide further insight into these relationships and assess whether other factors might mediate or moderate the influence of age and BMI on edema.

Declarations

Funding

NONE

Conflicts of Interest/Competing Interests

The authors declare that they have no conflicts of interest.

Ethics Approval

This study was approved by the ISTANBUL UNIVERSITY CERRAHPAŞA RECTORATE Clinical Research Ethics Committee with the number E-83045809-604.01-1094609

Availability of Data and Material The data that support the findings of this study are available from the corresponding author, C.D.D. upon reasonable request.

Authors' Contributions: C.D.D. contributed to the conception and design of the study, data collection, data analysis, manuscript drafting and critical revision of the manuscript. A.C. contributed to the conception and design of the study, data collection, data analysis, manuscript drafting and critical revision of the manuscript.

All authors read and approved the final manuscript.

References:

1. Felson DT, McLaughlin S, Goggins J, LaValley MP, Gale ME, Totterman S, Li W, Hill C, Gale D. Bone marrow edema and its relation to progression of knee osteoarthritis. Ann Intern Med. 2003;139(5 Pt 1):330-6. doi: 10.7326/0003-4819-139-5_part_1-200309020-00008.
2. Zanetti M, Bruder E, Romero J, Hodler J. Bone marrow edema pattern in osteoarthritic knees: correlation between MR imaging and histologic findings. Radiology. 2000;215(3):835-40. doi: 10.1148/radiology.215.3.r00jn05835.
3. Bonadio MB, Filho AGO, Helito CP, Stump XM, Demange MK. Bone marrow lesion: image, clinical presentation, and treatment. Magn Reson Insights. 2017;10:1178623X17703382. doi: 10.1177/1178623X17703382.
4. Balfousias T, Karadimas EJ, Kakagia DD, Apostolopoulos A, Papanikolaou A. Lower limb pain attributed to bone marrow edema syndrome: a commonly ignored pathology. Cureus. 2020;12(4). doi: 10.7759/cureus.7679.
5. Moradi K, Mohammadi S, Roemer FW, Momtazmanesh S, Hathaway Q, Ibad HA, Hunter DJ, Guermazi A, Demehri S. Progression of bone marrow lesions and the development of knee osteoarthritis: osteoarthritis initiative data. Radiology. 2024;312(3). doi: 10.1148/radiol.240470.
6. Steinbach LS, Suh KJ. Bone marrow edema pattern around the knee on magnetic resonance imaging excluding acute traumatic lesions. Semin Musculoskelet Radiol. 2011;15(3):208-20. doi: 10.1055/s-0031-1278421.