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Characteristics of Benign Bone Tumors Incidentally Detected on Magnetic Resonance Imaging in Patients Presenting with Knee Pain

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Abstract

Aim: Benign bone tumors are usually asymptomatic lesions that may be found incidentally or present with different clinical presentations. Due to their asymptomatic course, their exact rates are unknown. The purpose of this study was to determine the incidence of benign bone tumors incidentally detected on magnetic resonance imaging in patients with knee pain and to explore the links between benign bone masses and pain in the knee.

Method: The retrospective study was conducted at Adana City Training and Research Hospital. The files of cases admitted to the Orthopedics and Traumatology Clinic between January 1, 2021, and November 30, 2023, were analyzed. Radiological evaluation of the patients showed that 46.2% (n=25) of the masses were enchondroma, 24.1% (n=13) were intraosseous ganglion cysts, 13% (n=7) were non-ossifying fibroma, 5.6% (n=3) were fibrous dysplasia, 3.7% (n=2) were fibrous cortical defects, 3.7% (n=2) were subchondral cysts, 1.8% (n=1) were enostosis, and 1.8% (n=1) were chondromyxoid fibroma.

Results: Among 21,016 patients who applied to the orthopedics and traumatology clinic between January 2021 and November 2023, the data of 54 adult files in which images indicated the presence of benign bone tumors detected in the femur distal, tibia proximal, or fibula proximal bone regions within the 5 cm from the knee joint were analyzed. The mean VAS score was 3.78±1.75, minimum 1, maximum 8. The comparison of VAS scores showed that the mass being closer than 20 mm to the joint compared to being further away and the presence of additional pathology inside the knee compared to no additional pathology were significantly different (p=0.007).

Conclusion: The increased average mass size and the rate of presence in the tibia, compared to studies conducted on tumors of cartilage origin are noteworthy findings. The presence of additional pathology inside the knee was shown as a factor that developed a significant difference in the VAS scores in this particular group of patients.

Keywords: Knee, Intra-Osseous Ganglions, Chondroma, Neoplasm, Bone

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Diz Ağrısı ile Başvuran Hastalarda Manyetik Rezonans Görüntülemede İnsidental Saptanan İyi Huylu Kemik Tümörlerinin Özellikleri

Öz

Amaç: Benign kemik tümörleri genellikle asemptomatik lezyonlar olup tesadüfen saptanabilir veya farklı klinik tablolarla karşımıza çıkabilir. Asemptomatik seyretmeleri nedeniyle kesin oranları bilinmemektedir. Bu çalışmanın amacı diz ağrısı olan hastalarda manyetik rezonans görüntülemede rastlantısal olarak saptanan iyi huylu kemik tümörlerinin insidansını belirlemek ve iyi huylu kemik kitleleri ile diz ağrısı arasındaki bağlantıları araştırmaktır.

Yöntemler: Retrospektif çalışma Adana Şehir Eğitim ve Araştırma Hastanesi'nde yapıldı. Ortopedi ve Travmatoloji Kliniğine 1 Ocak 2021 ile 30 Kasım 2023 tarihleri arasında başvuran olguların dosyaları analiz edildi. Hastaların radyolojik değerlendirmesinde kitlelerin %46,2'sinin (n=25) enkondrom, %24,1'inin (n=13) intraosseöz ganglion kisti, %13'ünün (n=7) ossifiye olmayan fibrom, %5'inin (n=3) ossifiye olmayan fibrom olduğu görüldü. 6 (n=3) fibröz displazi, %3,7 (n=2) fibröz kortikal defekt, %3,7 (n=2) subkondral kist, %1,8 (n=1) enostoz ve %1,8 (n=1) kondromiksoid fibrom idi.

Bulgular: Ocak 2021 ve Kasım 2023 tarihleri arasında ortopedi ve travmatoloji kliniğine başvuran 21016 hasta arasından, diz ekleminden itibaren 5 cm içinde femur distal, tibia proksimal veya fibula proksimal kemik bölgelerinde tespit edilen iyi huylu kemik tümörlerinin varlığını gösteren görüntülerin bulunduğu 54 yetişkin dosyasının verileri analiz edildi. Ortalama VAS skoru 3,78±1,75, minimum 1, maksimum 8 idi. VAS skorları karşılaştırıldığında, kitlenin ekleme 20 mm'den daha yakın olması ile daha uzak olması ve diz içinde ek patoloji varlığı ile ek patoloji olmaması arasında anlamlı fark olduğu görüldü (p=0.007).

Sonuç: Kıkırdak kökenli tümörlerde yapılan çalışmalara kıyasla ortalama kitle boyutunun ve tibiada bulunma oranının artması dikkat çekici bulgulardır. Diz içinde ek patoloji varlığı, bu özel hasta grubunda VAS skorlarında anlamlı farklılık geliştiren bir faktör olarak gösterilmiştir.

Anahtar kelimeler: Diz, Kemik İçi Gangliyonlar, Kondrom, Neoplazm, Kemik.

INTRODUCTION

Knee pain is the second most common cause of hospital admission after back pain among musculoskeletal pathologies[1]. Although the incidence varies, approximately one in every five adults in the adult population is admitted to hospital with knee pain during their lifetime[2].

The knee joint is comprised not only of the bones of the femur, tibia, and patella but also of soft tissues such as cartilage, meniscus, ligaments, and synovial membrane. Given this complex structure, there can be a multitude of potential causes of pain[3].

Conventional radiographs and Magnetic Resonance Imaging (MRI) are frequently used in patients presenting with knee pain. Incidental bone lesions may be detected on MR imaging of the patients seeking health care for knee pain. Publications in the literature generally report incidental enchondromas in terms of incidental bone structures. Walden et al. reported this rate as 2.9% in their 2008 study on incidental enchondromas detected in knee MRIs[4]. Stomp et al. investigated the incidental incidence of enchondromas and atypical cartilaginous tumors and found the rate to be 2.8%[5]. However, not only enchondromas but also other benign bone tumors can be found in knee MR imaging. Although there are no clear rates in this regard, the incidence is certainly higher than the rates in studies on enchondromas. Benign bone tumors are usually asymptomatic lesions that may be found incidentally or present with different clinical presentations. Due to their asymptomatic course, their exact rates are unknown[6]. Generally localized in the lower extremity, peri-knee region location is common. Osteochondromas are observed most frequently which are followed by enchondromas, Osteoid Osteoma, Non-

Ossifying Fibroma (NOF), Fibrous Dysplasia, Intra-osseous Ganglion Cysts are common benign bone tumors[7–9]. To the best of our knowledge, no prior study has comprehensively evaluated all types of benign bone tumors incidentally detected on knee MRI in relation to clinical pain.

The purpose of this study was to determine the incidence of benign bone tumors incidentally detected on MR imaging in patients with knee pain and to explore the links between benign bone masses and pain in the knee.

METHODS

Study design and Data collection

The retrospective study was conducted at Adana City Training and Research Hospital. The files of cases admitted to the Orthopedics and Traumatology Clinic between January 1, 2021, and November 30, 2023, were analyzed. The patients aged older than 18, having been admitted due to knee pain, and having MRI images consistent with benign bone tumors in the distal femur, proximal tibia, or proximal fibula bone regions within 5 cm of the knee joint were included in the study. The cases with conditions or diagnoses, such as bursitis, arthritis, tendinopathy, baker's cyst, sprains and strains, rheumatoid arthritis, gout, knee joint infection, chondromalacia patella, knee cap dislocation, fractures, hyperextended knees, infected knee, cartilage tear, joint dislocation, iliotibial band syndrome, repetitive strain injury, acute knee trauma, malignant tumors, osteoid osteoma, and osteochondroma were not included in the study. Besides, since osteochondroma patients typically present with complaints of palpable swelling, and osteoid osteoma cases present with complaints of pain that occurs at night and is relieved by acetylsalicylate, the lesions of these patients are not detected incidentally but on MRI scans taken in response to these complaints, and therefore they were not included in the study.

The demographic data and the characteristics of the mass in the examined MRI images, the presence of meniscus, cartilage, soft tissue, additional bone pathology, and the Visual Analog Scale (VAS) scores were recorded. Patients who underwent biopsy or surgical intervention due to diagnostic uncertainty or suspected lesion aggressiveness were excluded from the study. The study flowchart diagram is presented in Figure 1.

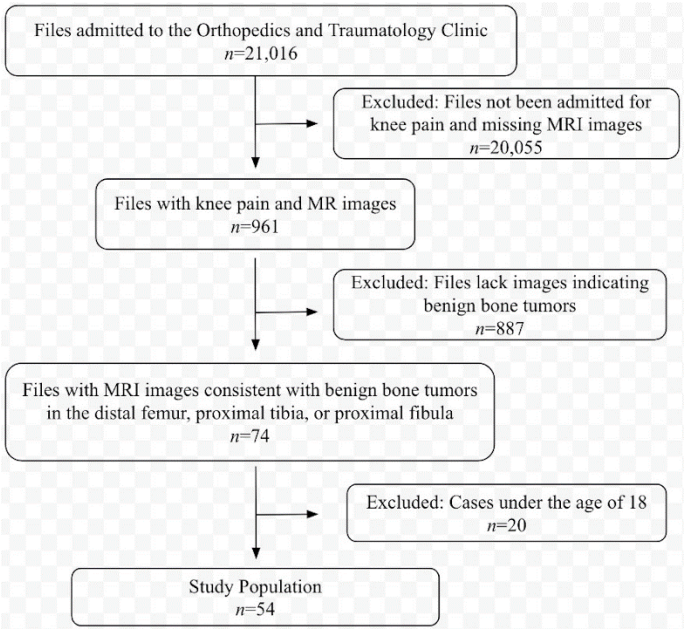

Figure 1. Flowchart of the study

Osteochondromas, osteomas, osteoid osteomas, osteoblastoma, giant cell tumors, aneurysmal bone cysts, fibrous dysplasias, and enchondromas are the most commonly detected benign masses in computed tomography images and the incidence rates are difficult to estimate since they are mostly asymptomatic and detected incidentally[6,10]. Nevertheless, discussion of the rare types is not included in the study as it may be of little scientific value.

The ethical approval was provided by the Adana City Training and Research Hospital Clinical Ethics Committee, which was formed on 23.11.2023 and has the number 2957. Informed consent was obtained from the patients before

the study. The patients' rights rules of the Declaration of Helsinki were followed.

Radiological assessment

The masses detected in the images of the patients included in our study were examined according to various parameters. The masses were radiologically classified and the anatomical location of each mass (femur distal, tibia proximal, fibula proximal), central or eccentric localization, the size (mass diameter), and the distance from the mass to the knee joint were measured and recorded.

The longest diameter on the MR images was used to measure the dimensions of the mass. The distance closest to the joint line in the sagittal and coronal MR planes was used to measure the distance from bone to joint. The MRI studies were conducted by using a 1,5 tesla MR (Ingenuity Core 128, Philips, Cleveland, USA, 2017).

Statistics

Statistical analysis was performed using SPSS version 25.0 for Windows. In addition to descriptive statistical methods (Mean, Standard Deviation, Frequency, Ratio, Minimum, Maximum), in the comparison of quantitative data, the Mann-Whitney U test was used for two-group comparisons of parameters that did not show normal distribution, and the Kruskal-Wallis test was used for three or more groups. Categorical data were compared using the Chi-square test. The Bonferroni method was used to compare multiple variables. The confidence interval was set as 95%, and $p<0.05$ was considered significant.

RESULTS

Among 21,016 patients who applied to the orthopedics and traumatology clinic between January 2021 and November 2023, the images of 961 patients who applied with complaints of knee pain and had knee MRI images were examined. The data of 54 adult files in which images indicated the presence of benign bone tumors detected in the femur distal, tibia proximal, or fibula proximal bone regions within 5 cm of the knee joint were analyzed.

The analysis included 54 patients, 40 (74.1%) female and 14 (25.9%) male. The mean age of the patients was 46.04 (min: 18, max: 71). 16.7% (n=9) of the patients were between 18 and 29 years old, 20.3% (n=11) were between 30 and 44 years old, 50% (n=27) were between 45 and 59 years old, and 13% (n=7) were 60 years old and over.

Radiological evaluation of the patients showed that 46.2% (n=25) of the masses were enchondroma, 24.1% (n=13) were intraosseous ganglion cysts, 13% (n=7) were non-ossifying fibroma, 5.6% (n=3) were fibrous dysplasia, 3.7% (n=2) were fibrous cortical defects, 3.7% (n=2) were subchondral cysts, 1.8% (n=1) were enostosis, and 1.8% (n=1) were chondromyxoid fibroma. The anatomical localization of the masses revealed that 51.9% (n=28) were located in the distal femur, 42.6% (n=23) in the proximal tibia, and 5.5% (n=3) in the fibular head (Table I). In terms of zones, 57.4% (n=31) of the masses were centrally located, and 42.6% (n=23) were eccentrically located. The mean size (diameter) of the masses of the patients was 29.17±16.32 mm, the minimum diameter of the masses was 5 mm, and the maximum diameter was 68 mm. 35.2% (n=19) of the masses had a mass size of less than 20 mm, and 64.8% (n=35) of the masses had a mass size of 20 mm and above. The average distance of the masses to the knee joint was 22.02±14.55 mm, with a minimum of 1 mm and a maximum of 50 mm. While the rate of masses with a distance of less than 20 mm to the knee joint was 51.9% (n=28), 48.1% (n=26) were found to be 20 mm or more (Table II).

The presence of additional knee pathology (bone, cartilage, meniscus, soft tissue) in the patients in the study showed that 24.1% (n=13)

had no additional pathology, while 75.9% (n=41) had additional pathology.

The mean VAS score was 3.78±1.75, minimum 1, maximum 8. The mean VAS scores of the cases are shown in Tables III and IV. The comparison of VAS scores showed that the mass being closer than 20 mm to the joint compared to being further away and the presence of additional pathology inside the knee compared to no additional pathology were significantly different (p=0.007) (Table II).

Table I: Mean VAS scores of patients with additional knee pathology according to mass type and location

(*n*=41)		VAS Mean±SD	*p*
Type of the mass	Enchondroma (*n*=25)	4,11±1,52	0,39
	Intraosseous Ganglion Cyst (*n*=13)	4,00±1,84	
	Fibrous Dysplasia (*n*=3)	3,25±1,89	
	Other (*n*=7)	4,71±1,38	
Anatomical Location of the mass	Distal Femur (*n*=28)	3,70±1,41	0,33
	Proximal Tibia (*n*=23)	4,42±1,77	
	Fibular Head (*n*=3)	5,00±1,41	

**The Kruskal-Wallis test was used. SD: Standard deviation.*

Table II: Mean VAS scores of patients with additional knee pathology

(*n*=54)		VAS Mean±SD	Z*	*p*
Mass size	<20 mm (*n*=19)	3,81±1,37	-0,94	0,34
	≥20 mm (*n*=35)	4,28±1,74		
Distance of the mass	<20 mm (*n*=28)	4,67±1,49	-2,71	**0,007** †
	≥20 mm (*n*=26)	3,29±1,44		
Localization of the mass	Central (*n*=31)	4,13±1,72	-0,12	0,90
	Eccentric (*n*=23)	4,06±1,47		

**The Mann-Whitney U test was used. SD: Standard deviation. † p<0.05.*

Table III: Mean VAS scores of the cases

(*n*=54)		VAS Mean±SD	Z*	*p*
Gender	Female (*n*=40)	3,78±1,83	-0,25	0,801
	Male (*n*=14)	3,79±1,57		
Mass size	<20 mm (*n*=19)	3,47±1,54	-0,79	0,427
	≥20 mm (*n*=35)	3,94±1,86		
Distance of the mass	<20 mm (*n*=28)	4,29±1,71	-2,44	0,01
	≥20 mm (*n*=26)	3,23±1,65		
Localization of the mass	Central (*n*=31)	3,84±1,93	-0,89	0,92
	Eccentric (*n*=23)	3,70±1,52		
Additional pathology	None (*n*=13)	2,77±1,87	-2,75	0,006
	Present (*n*=41)	4,10±1,61		

**The Mann-Whitney U test was used. SD: Standard deviation.*

Table IV: Mean VAS scores according to mass type and location

(*n*=54)		VAS Mean±SD	*p*
Type of the mass	Enchondroma (*n*=25)	3,60±1,65	0,49
	Intraosseous Ganglion Cyst (*n*=13)	3,69±1,88	
	Non-Ossifying Fibroma (*n*=7)	3,86±2,34	
	Fibrous Dysplasia (*n*=3)	5,67±1,52	
	Fibrous Cortical Defect (*n*=2)	2,50±0,70	
	Subndral Cyst (*n*=2)	4,50±0,70	
	Chondromyxoid Fibroma (*n*=1)	4,00±0,00	
	Bone Island (*n*=1)	4,00±0,00	
Anatomical Location of the mass	Distal Femur (*n*=28)	3,54±1,64	0,57
	Proximal Tibia (*n*=23)	4,09±1,83	
	Fibular Head (*n*=3)	3,67±2,51	

**The Kruskal-Wallis test was used. SD: Standard deviation.*

DISCUSSION

Studies on incidentally detected benign tumors around the knee in the literature have generally been conducted on enchondromas and atypical chondroid tumors. However, there are no detailed studies on all benign bone tumors. This study included not only enchondromas but also

other benign bone tumors incidentally detected around the knee. The analysis results of the cases in the study in relation to age and gender were similar to other publications in the literature[4,11,12].

In studies on enchondromas, the incidental detection rate around the knee was reported as 2.8% by Stomp et al.5 and Patel et al.[13] and 2.9% by Walden et al.[4]. In a study conducted on a larger population by Woltsche et al., this rate was found to be 1.45%[14]. In our study, enchondromas were detected in 25 of 961 patients; the rate was 2.6%. The number of cases in which a mass was incidentally detected around the knee increased to 54 (5.6%) when other types of benign bone tumors were included.

In our study, 53% of the masses were located in the femur, 42% in the tibia, and 5% in the fibula. When analyzed specifically for enchondromas, 64% were located in the femur, 32% in the tibia, and 4% in the fibula. We have not found a study in the literature on the anatomical locations of all benign bone tumors around the knee; however, the similarity between the results of the study conducted by Walden et al. on enchondromas and our study is noteworthy[4]. Besides, Stomp et al., in their study examining 49 patients, reported that in 38 cases, the enchondromas were localized in the femur and 8 in the tibia[5]. In terms of localization, Woltsche et al.[14] reported that 57.4% of enchondromas were centrally located; almost similarly, Walden et al.[4] reported that 57% were centrally located. Our findings indicated a higher rate of central localization, showing that 76% of enchondromas were centrally located. When benign bone tumors were evaluated in general, the rate decreased to 57.4%.

Karaca and Balaban reported non-ossifying fibromas and cortical fibrous defects as the most common incidental bone lesions on knee radiographs in a younger population, with a combined prevalence of 7.8%[15]. In our study, which included a broader adult age group and utilized MRI, non-ossifying fibromas constituted 13% of all benign bone lesions, indicating that while NOFs are frequently detected in adolescents, they can also be incidentally encountered in adults with knee pain.

In our study, the mean diameter of the masses was 29.1±16.3 mm. The mean values reported in other studies were considerably lower than in our study[4,14]. We think that the difference may be due to the inclusion of all benign bone tumors in our study. The proximity analysis of the masses to the joint line revealed that in 51.9% of the patients, the benign bone masses were closer than 20mm. In addition, there was a significant increase in VAS values in the cases with masses closer to the joint line.

Benign bone tumors are generally known to be asymptomatic[2]. In our study, the mean VAS value was 3.78±1.75. There were two variables significantly related to the VAS values: the presence of additional pathology in the knee and the mass being closer than 20mm to the joint. In patients with additional pathology (bone cartilage, meniscus, soft tissue pathology) detected in knee MRIs, the VAS values were significantly higher than in patients with only a mass and no additional pathology. In patients without additional pathology, the proximity of the mass to the joint had no significant effect on VAS scores. In our study, we did not find a significant effect of the types of mass on knee pain. The main factor affecting the pain of patients who applied with knee pain and had a mass image detected in their MRIs should be considered for the presence of additional pathology inside the knee joint. Stomp et al. stated that pain was increased in cases with higher BMI values, but they did not examine additional pathologies inside the knee[5].

Reports suggest that patients with incidentally detected benign bone tumors in the knee should be followed up at regular intervals[16]. Thus, our

clinical guides recommend that similar cases require follow-up visits at three months, six months, 12 months, and annual controls. The follow-up medical records showed that there was no change in the characteristics of the masses and clinical conditions regarding the knee joint in any of the 54 patients followed up. It should be noted that in the meantime, 3 patients had surgery for additional pathologies inside the knee joint, whereas the masses were not touched, adding that a significant decrease was detected in VAS values.

Based on our findings, we recommend that most incidentally detected benign bone lesions, particularly those located more than 20 mm away from the joint line and not associated with intra-articular pathology, can typically be followed conservatively. In contrast, lesions in close proximity to the joint and associated with high pain scores should be considered for closer radiological monitoring or further orthopedic evaluation, especially if clinical concern persists. This approach may help guide clinicians in managing incidental MRI findings and reduce unnecessary interventions. Similarly, recent radiological literature has emphasized the importance of recognizing benign incidental bone lesions as 'do-not-touch' entities to avoid unnecessary intervention, particularly when typical imaging features are present[17].

Limitations

This study has several limitations. First, due to its retrospective design, clinical correlations such as symptom progression over time and long-term outcomes could not be evaluated in a standardized manner. Second, the relatively small sample size limits the generalizability of our findings to larger or different populations. Third, the absence of histopathological confirmation means that the diagnosis of lesions was based solely on imaging characteristics. Finally, potential confounding variables such as body mass index, activity level, or comorbidities were not systematically controlled, which may have influenced pain perception and VAS scores.

CONCLUSIONS

Unlike most previous studies in the literature, which mostly assessed series that included only enchondromas, in our series, all benign bone tumors detected incidentally in knee MRIs were examined, and parameters including the localization, size, and effect on pain were assessed. The increased average mass size and the rate of presence in the tibia, compared to studies conducted on tumors of cartilage origin, are noteworthy findings. The presence of additional pathology inside the knee was shown as a factor that developed a significant difference in the VAS scores in this particular group of patients. Finally, we believe it is important to study the relationship between pain and radiologic findings in patients admitted for knee pain and found to have only benign masses in the knee joint. Thus, more comprehensive studies on this subject should be added to the orthopedic literature.

Ethics Committee Approval: The ethical approval was provided by the Adana City Training and Research Hospital Clinical Ethics Committee, which was formed on 23.11.2023 and has the number 2957. Informed consent was obtained from the patients before the study. The patients' rights rules of the Declaration of Helsinki were followed.

Conflict of Interest: The authors declared no conflicts of interest.

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