

Incidental Benign Bone Tumors on Knee Radiographs

Diz Grafilerinde İnsidental Saptanan Benin Kemik Tümörleri

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Abstract

Amaç: Diz çevresi yerleşimli benin kemik tümörleri, radyolojik incelemeler sırasında çocuk ve genç erişkinlerde sıkça tesadüfi saptanan bulgulardandır. Bu çalışmada çocuk ve genç erişkinlerde diz grafilerinde insidental saptanan benin kemik tümörlerinin yaygınlık ve özellikleri araştırıldı.

Gereç ve Yöntem: Ocak-Nisan 2022 tarihleri arasında hastanemiz ortopedi polikliniğine diz çevresinde kemik tümörü ilişkili bulgusu olmadan başvuran 296 hastanın retrospektif olarak incelenmesinden sonra, 35 yaş altı toplam 38 hasta çalışmaya dahil edildi. Diz radyografilerinin değerlendirilmesinden sonra, insidental benin kemik tümörlerinin tipleri, prevalansları ve radyolojik özellikleri incelendi.

Bulgular: Değerlendirilen toplam 21 erkek ve 17 kadın hastanın ortalama yaşı 17,5 yıl (dağılım, 7 ila 34 yıl) idi. Yirmi üç ossifiye olmayan fibrom (NOF) veya kortikal fibröz defekt (CFD), 9 osteokondrom, 3 enostoz, 2 fibröz displazi ve 1 encondrom olmak üzere otuz sekiz benin kemik tümörü tanımlandı. Dizin insidental benin kemik tümörlerinin toplam prevalansı %12,8 idi. En sık rastlanan insidental benin kemik tümörü, %7,8 prevalansı ile NOF veya CFD idi ve yaşamın ikinci on yılında daha sıkı, bunu osteokondrom (%3) izledi.

Sonuç: Bu çalışma, çocuk ve genç erişkinlerde diz radyografilerinde insidental benin kemik tümörlerini tanımlamakta ve ortopedik bakış açısıyla faydalı kanıtlar ve bilgiler sunmaktadır. Hem diz çevresinde yeni bir lezyon ile karşılaşıldığında hem de hasta ve yakınları bilgilendirilirken, bu insidental benin kemik tümörlerinin ve özelliklerinin göz önünde bulundurulmasını öneririz.

Anahtar Kelimeler: Diz Radyografisi, İnsidental Kemik Tümörü, Prevalans

Öz

Objectives: Benign bone tumors localized around the knee are common incidental findings in children and young adults during radiographic evaluation. This study aimed to investigate the prevalence and features of incidental benign bone tumors on knee radiographs in children and young adults according to age.

Materials and Methods: After a retrospective review of 296 patients who visited the orthopedic outpatient clinic of our faculty hospital without a sign of a bone tumor around the knee between January and April 2022, a total of 38 patients younger than 35 years of age were included. We evaluated the knee radiographs and examined the prevalence and type of incidental benign bone tumors, and radiological features.

Results: The mean age of the 21 male and 17 female patients was 17.5 years (range, 7 years to 34 years). Thirty-eight benign bone tumors including 23 non-ossifying fibromas (NOF) or cortical fibrous defects (CFD), 9 osteochondromas, 3 enostoses, 2 fibrous dysplasia, and 1 enchondroma were identified. The prevalence of incidental benign bone tumors of the knee was 12.8%. The most common incidental benign bone tumor was NOF or CFD with a prevalence of 7.8% and was more frequent in the second decade of life, followed by osteochondroma (3%).

Conclusion: This study defines the incidental benign bone tumors on knee radiographs in children and young adults and provides useful evidence and information from a perspective of an orthopedic doctor. We recommend considering these incidental benign bone tumors and their features around the knee if unfamiliar findings appear or when counseling patients and their families.

Key Words: Knee Radiograph, Incidental Bone Tumor, Prevalence

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Introduction

The knee is one of the most common locations of bone tumors, whether benign or malignant. These may be presented with pain or mass but sometimes there is no symptom and only can be detected incidentally. Conventional radiology is widely used as the first line of investigation in patients with knee disorders and is sufficient for diagnosis in many (1).

In daily clinical practice, conventional knee radiography is often performed in patients with a history of simple falls, overuse injuries, or sports injuries. Benign bone tumors may be detected during these exams in children and young adults without a previous history, although not very often.

Benign bone tumors are divided into three groups according to their biological behavior as active, latent and aggressive (2). Latent tumors including non-ossifying fibromas (NOF) or fibrous cortical defects (CFD), osteochondromas, enostoses or bone islands, and enchondromas, usually present as incidental findings during the radiographic evaluation contrary to aggressive or active tumors which present with symptoms like localized pain or pathological fracture. While it is easier to diagnose and estimate prevalence or incidence in active and aggressive tumors, the fact that most cases may be undiagnosed in latent tumors makes this difficult. Therefore, while there are a limited number of studies in the current literature with some prevalence estimates, there is no study showing the current rates in Turkey (3-5).

We aimed with this study to describe the prevalence, demography, and anatomical distribution of the incidental benign bone tumors around the knee in children and young adults based on conventional radiography, and compare our data with the existing literature.

Materials and Methods

We retrospectively reviewed all patients who were admitted to our clinic and had conventional knee radiography for any complaints between January and April 2022, after the approval of Ankara University Faculty of Medicine Human Research Ethics Committee (decision no: İ04-198-22, date: 13.04.2022). All patients aged under 35 were included and examined their plain knee radiographs for possible benign bone lesions by two reviewers (one senior surgeon, one junior surgeon). Patients with previous bone tumor history around the knee, and newly diagnosed malignant bone and soft tissue tumors around the knee were excluded from the study.

The following patient data was collected from records: age, gender and the circumstances of tumor detection. Tumor morphology on X-rays was assessed with picture archiving and communication system in all cases. The primary tumor site was

identified based on radiography and classified as femur, tibia, or fibula. They were also sub-grouped into metaphysis, epiphysis, and diaphysis. Additional specialized radiographic examinations such as magnetic resonance imaging (MRI) or computed tomography (CT) were also recorded if any.

The classification system proposed by Ritschl et al. (6) was used for NOF or CFD. According to Ritschl et al.'s (6) classification, there was four-stage as A, B, C, and D on the appearance of X-ray. Approximate tumor size was calculated for all NOF or CFD with the use of ellipsoid volume formula which was used for estimation of various types of bone tumors volume (7).

Results

After a retrospective review of three months, January-February-March 2022, admissions of patients aged under thirty-five years old, we arrived at 312 patients who had conventional knee radiographs. Initially, 16 patients were excluded due to having only an anteroposterior radiograph. By two authors, MOK and KB, the rest 296 digitalized radiographs were evaluated for the possibility of benign bone tumors. End of the evaluation, we reached 38 patients with benign bone tumors and they were all confirmed by the university bone and soft tissue tumor council.

There were 21 males and 17 females with a mean age of 17.5 years (range, 7 years to 34 years) at the time of the outpatient clinic visit. Fifteen patients were under 15 years of age, 18 patients were between 15 and 25 years, and 5 patients were between 25 and 35 years old.

Thirty-eight tumors were identified in 38 patients, including 23 NOF or CFD, 9 osteochondromas, 2 fibrous dysplasia, 3 enostoses, 1 enchondroma. The prevalence rate for all tumors combined was 12.8%. The overall prevalence rates were 7.8% for NOF or CFD, 3% for osteochondroma, 0.7% for fibrous dysplasia, 1% for enostoses, 0.3% for enchondroma. Tumor locations were femur in 25 (8.4%), tibia in 10 (3.4%), and fibula in 3 (1%) patients. As outlined in Table 1, of 23 NOF or CFD cases, stage A lesions were found in 12 patients (range, 7 years to 20 years), stage B in 7 (range, 11 years to 19 years), stage C in 1 (19 years), and stage D in 3 (range, 19 years to 32 years). The estimated tumor volume for all 23 NOF or CFD cases was a median of 1.5 cm³ (range, 0.2 cm³ to 30.8 cm³).

Discussion

Complaints about knee is one of the most common reasons of admission to an orthopedic outpatient clinic. Conventional knee radiograph is simple and widely used test in those patients. We studied incidentally detected benign bone tumors of the knee in children and young adults based on radiography. The incidental benign bone tumors were unexpectedly high in knee radiography. Estimation of prevalence and definition of

most common types in knee radiography may be helpful in the decision making for orthopedic patients. Although it is known the benign nature of these tumors, finding them during imaging studies still causes concern, numerous referrals happen to an orthopedic oncology clinic because of this reason. Also, another important issue is that patients and their families experience anxiety while they wait for the confirmation of a benign diagnosis.

Due to benign bone tumors being common incidental findings in children and are often age-dependent, we focused on pediatric age and a little older age group-young adults (4).

In our cohort, the prevalence of incidental benign bone tumors of the knee was 12.8%. NOF or CFD was the most commonly seen benign bone tumor, followed by osteochondroma, fibrous dysplasia, osteoid osteoma, enchondroma, and intraosseous ganglion cyst. the literature is limited for incidental benign bone tumors but still, our data for NOF or CFD 7.8% and osteochondroma 3% is comparable with the existing literature.

NOF and CFD are the most common focal lesions in bones, especially at the ends of long bones. They are usually located in the metaphyseal areas largely in bones forming the knee joint. An example was shown in Figure 1. Both lesions are histopathologically identical, formed of fibroblasts and histiocytes, some size and shape differences may be mentioned between them (8). However, this differentiation is a bit faint. It has been reported in the literature that it may be seen at rates of up to 5.3% to 30% of the asymptomatic population in the first two decades of life (3,4,8). In our study group, NOF or CFD prevalence was higher in the second decade of life, specifically in adolescent growth spur just before skeletal maturity which is one of the phases of rapid childhood growth as shown in Figure 2. Since they do not cause clinical symptoms, they are usually detected incidentally in X-ray examinations performed for injury, which is consistent with our findings that all patients' tumor was diagnosed in this way.

Not all NOF or CFD are the same appearance on X-ray. They are biologically active, may grow slowly and become filled with bone tissue over time. This variability may complicate the accurate diagnosis. The evolution of NOF or CFD based on appearance on X-ray was previously described by Ritschl et al. (6). He defined four-stage as A, B, C, D, and while the tumor matures, the stage progress from A to D. A small oval lesion represents stage A; when bone grows, the lesion becomes larger with polycyclic borders (stage B); in stage C mineralization starts and, when a completely calcified lesion was seen, it was named stage D. The majority of our NOF or CFD patients were stage A (12 patients, 52%), 7 patients were stage B (30%), only one patient was stage C and, 3 patients were stage D (13%). Approximate tumor volume was median of 1.5 cm³ (range, 0.2

cm³ to 30.8 cm³). As seen in Table 1, while the tumors with stage A were smaller, the tumors with stage B tended to be bigger.

Osteochondroma and exostosis is a relatively common benign bone tumor and is fairly frequent around the knee. They may present with or without symptoms, mostly a single lesion, but also may be part of osteochondromatosis (multiple hereditary exostoses). Here is an example of an incidentally detected one in Figure 3. As an incidentally diagnosed tumor, several studies reported a frequency of 2% to 4.5% (3,4). In our study, the estimated prevalence was 3% which is coherent with the previous literature.

We found less frequent additional three types of benign bone tumors in our study population. In two patients, it was fibrous dysplasia which is characterized by poorly organized irregular woven bone in a fibroblastic stroma. Solitary ones

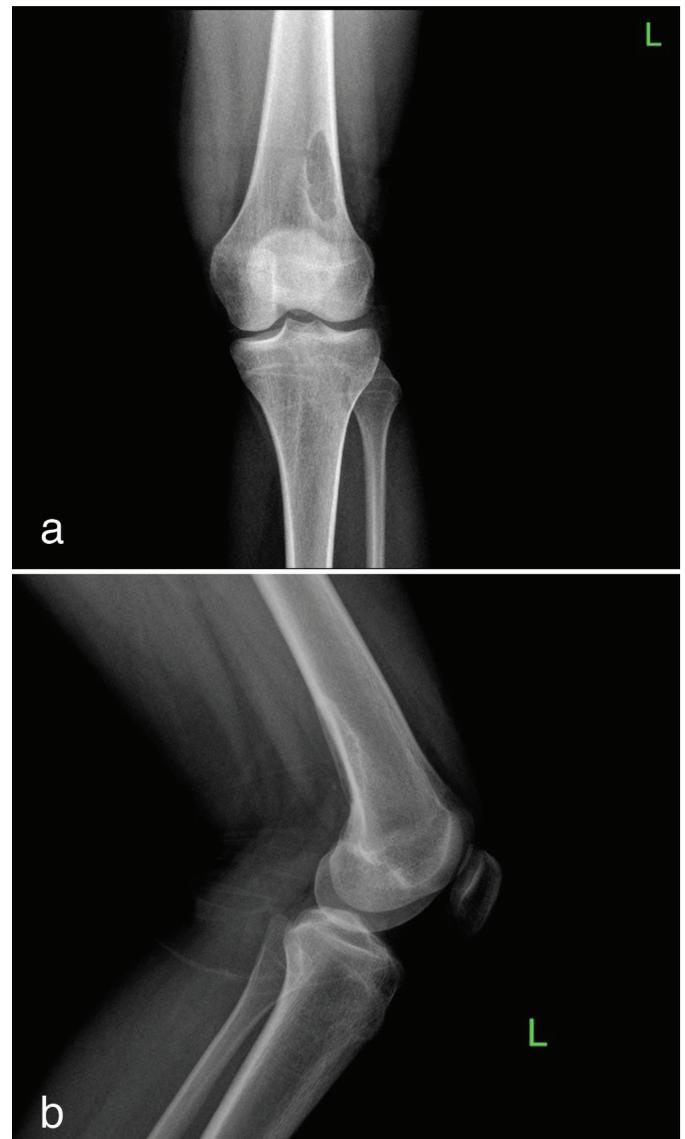


Figure 1: Knee radiographs of a 15-year-old patient's non-ossifying fibroma of the distal part of the femur (stage A)

Incidental benign bone tumor distributions by age

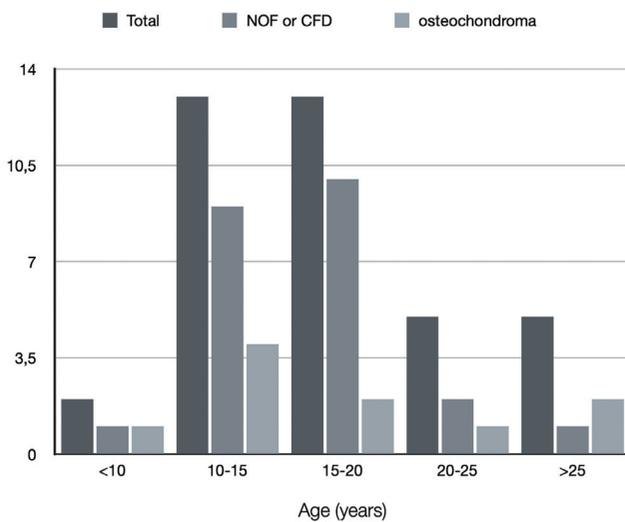


Figure 2: Distribution of the two most common tumors by age in the current study is shown

NOF: Non-ossifying fibromas, CFD: Fibrous cortical defects

are often incidental and asymptomatic. In a male patient aged 33, a well-defined lucent lesion with stippled chondroid calcification guided the diagnosis of enchondroma. Lastly, in three patients, a sclerotic hyperdense focal area named enostosis or bone island was found. Enostosis is an asymptomatic and incidental bone lesion too, reported in previous studies at 3.6% to 5.2% as an incidental finding which is a little frequent according to our results (1%). These results are based on mostly hand radiographs, not particularly on the knee. This might be the reason for the relatively low prevalence.

The characteristics and types of less frequent tumors are summarized in Table 2.

Study Limitations

Our study has its own limitations regarding its nature. The evaluation of the radiographs may depend on the viewer's decision although we had consensus meetings with the university bone and soft tissue tumor council. Some malignant bone tumors may mimic benign tumors, already literature exists on this (3). Confirmation of bone tumors with uncertain

Table 1: Characteristics of non-ossifying fibroma or cortical fibrous defect patients in current study

Patient	Age	Sex	Side	Bone	Location	Site	Ritschl's classification	Size (cm ³)
1	19	M	R	Femur	Distal	mp	D	0.3
2	14	M	L	Femur	Distal	mp	A	0.3
3	24	M	L	Tibia	Prox	mp	D	1.8
4	16	M	R	Femur	Distal	mp	A	1
5	15	F	L	Femur	Distal	mp	A	5.2
6	11	F	L	Femur	Distal	mp	A	0.2
7	11	M	R	Femur	Distal	mp	B	0.9
8	7	F	L	Femur	Distal	mp	A	0.5
9	15	F	R	Tibia	Prox	mp	B	1.8
10	17	M	R	Femur	Distal	mp	A	2.3
11	19	F	L	Femur	Distal	mp	B	30.8
12	12	M	R	Femur	Distal	dp	A	3.2
13	32	M	R	Femur	Distal	dp	D	0.2
14	12	F	R	Femur	Distal	mp	A	0.5
15	20	M	L	Tibia	Prox	mp	A	0.3
16	14	F	L	Femur	Distal	mp	A	0.3
17	17	F	L	Femur	Distal	mp	B	1.5
18	13	F	L	Femur	Distal	mp	A	0.8
19	16	F	L	Femur	Distal	dp	B	3.9
20	14	F	L	Femur	Distal	mp	A	21.6
21	15	M	L	Femur	Distal	mp	B	22.4
22	19	M	L	Femur	Distal	mp	C	13.9
23	12	M	R	Femur	Distal	mp	B	17.2

M: Male, F: Female, R: Right, L: Left, mp: Metaphysis, dp: Diaphysis
A, B, C, D represents the stages of Ritschl's classification

Table 2: Less frequent tumors and their characteristics

Patient	Age	Sex	Lesion	Side	Bone	Location	Site
1	16	M	Osteochondroma	L	Femur	Distal	mp
2	22	M	Osteochondroma	L	Fibula	Prox	mp
3	34	F	Osteochondroma	L	Tibia	Prox	mp
4	32	F	Osteochondroma	R	Tibia	Prox	mp
5	13	M	Osteochondroma	L	Femur	Distal	mp
6	13	M	Osteochondroma	L	Fibula	Prox	dp
7	9	F	Osteochondroma	R	Tibia	Prox	mp
8	13	M	Osteochondroma	R	Femur	Distal	mp
9	16	M	Osteochondroma	L	Tibia	Prox	mp
10	33	F	Enchondroma	R	Femur	Distal	ep
11	11	F	Fibrous dysplasia	R	Tibia	Prox	dp
12	25	M	Fibrous dysplasia	R	Tibia	Prox	dp
13	23	M	Enostosis	R	Femur	Distal	mp
14	22	F	Enostosis	R	Tibia	Prox	ep
15	19	M	Enostosis	L	Fibula	Prox	mp

M: Male, F: Female; R: Right, L: Left, mp: Metaphysis, dp: Diaphysis, ep: Epiphysis

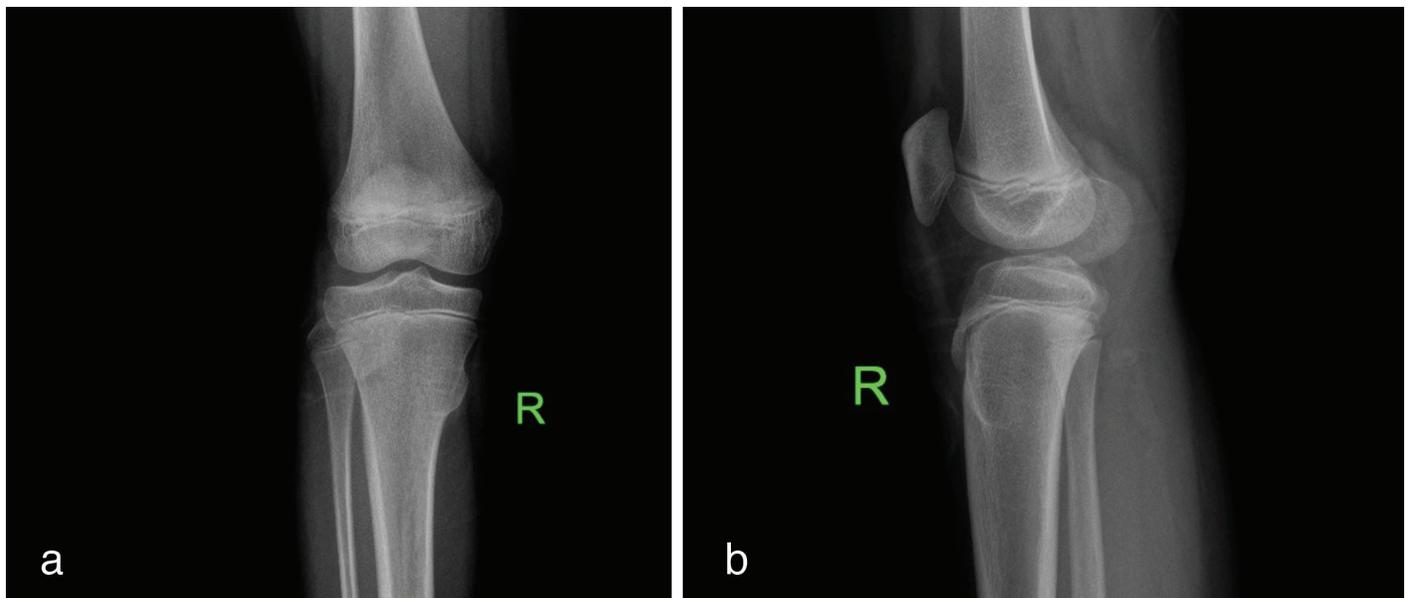


Figure 3: Knee radiographs of a 15-year-old patient show an osteochondroma of the proximal part of the tibia

diagnosis may be done with the help of additional studies such as CT, MRI, bone scan, or even biopsy.

Conclusion

In conclusion, we demonstrated the prevalence of different types of incidental benign bone tumors in conventional knee radiographs of children and young adults in orthopedic outpatient clinics, such as NOF or CFD, osteochondroma, fibrous dysplasia, enchondroma and enostosis. With the help of these

results, if any incidental lesion in the knee radiograph is faced, we should manage it and counsel patients and their families accordingly.

Ethics

Ethics Committee Approval: The approval from the Ankara University Faculty of Medicine Human Research Ethics Committee (decision no: İ04-198-22, date: 13.04.2022).

Informed Consent: Retrospective study.

Peer-reviewed: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.O.K., Concept: M.O.K., Design: K.B., Data Collection or Processing: K.B., Analysis or Interpretation: M.O.K., Literature Search: K.B., Writing: K.B.

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