Van Med J 32 (3):125 -128, 2025
DOI: 10.5505/vmj.2025.51523

Osteochondroma in the Pediatric Population: Clinical and Radiological Findings

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Abstract

Introduction: Osteochondroma is the most common benign bone tumor in children and young adults, typically localized in the metaphyseal regions of long bones. Osteochondromas rarely undergo malignant transformation, and cartilage cap thickness is an important factor in assessing this risk. This study aims to investigate the prevalence, clinical and radiological characteristics, necessity for surgical intervention, and malignant transformation potential of osteochondroma cases in the pediatric population.

Methods: This retrospective observational study included pediatric patients diagnosed with osteochondroma between 2015 and 2024. Demographic data, tumor localization, size, number of lesions, clinical symptoms, treatment methods, and follow-up outcomes were retrospectively analyzed. Data were analyzed using SPSS, and a p-value of <0.05 was considered statistically significant.

Results: A total of 67 patients were included in the study, with a median age of 11.4 years. The most common age range for diagnosis was 10–14 years. Osteochondroma was more prevalent in males (62.7%). The most frequently affected sites were the distal femur (26.9%) and proximal tibia (26.9%). The mean long axis of the tumors was 27.7 mm, and the mean short axis was 15.3 mm. Most cases (89.5%) were solitary. The mean cartilage cap thickness was measured as 4.95 mm.

Discussion and Conclusion: The findings of this study are consistent with the literature, highlighting the significance of age, sex, localization, tumor size, and cartilage cap thickness in the diagnosis and follow-up of osteochondroma. The critical role of cartilage cap thickness in assessing malignant transformation risk has been confirmed. These data are expected to guide clinical management.

Key word: Osteochondroma; bone neoplasm; radiologic imaging.

Introduction

Osteochondroma is the most common benign bone tumor in children and young adults, accounting for approximately 35–50% of all benign bone tumors. These lesions typically localize in the metaphyseal regions of long bones, particularly in the distal femur, proximal tibia, and proximal humerus (1). Osteochondromas are usually asymptomatic and are often detected incidentally during radiological evaluations performed after trauma. However, depending on their size, location, and relationship with surrounding tissues, they may cause symptoms such as pain, restricted movement, or neurovascular compression, necessitating surgical intervention (2). Histologically, osteochondroma consists of a bony outgrowth covered by a cartilaginous cap, and its longitudinal growth is typically associated with growth plate activity. Consequently, these lesions become more prominent during childhood and adolescence and generally cease growing once skeletal maturity is reached (3). Although osteochondromas are generally benign, they have a small potential for malignant transformation into chondrosarcoma (1–2%). Factors influencing this malignant. transformation risk includes lesion size (especially cartilage cap thickness), rapid growth, presence of pain, and genetic predisposition, such as multiple hereditary exostoses (MHE) (4,5). Early diagnosis and regular follow-up of osteochondroma in children are crucial, not only due to the risk of malignant transformation but also because of its potential effects on growth and development. Radiological imaging methods, particularly conventional radiography, and magnetic resonance imaging (MRI), serve as primary diagnostic and follow-up tools (Figure 1). These modalities provide critical information regarding the lesion's structure, size, impact on surrounding tissues, and malignant transformation potential (5,6). This study aims to examine the prevalence, clinical and radiological characteristics, surgical treatment requirements, and malignant transformation potential of osteochondroma in pediatric patients. By emphasizing the importance of early diagnosis and regular monitoring, this study seeks to contribute to the development of a more effective clinical approach.

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Received: 11.03.2025, Accepted: 23.05.2025

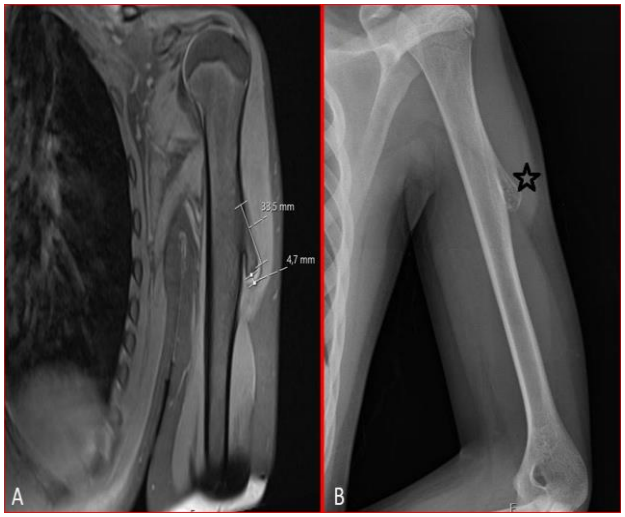

Figure 1: Image A: In a 9-year-old male patient, a 33.5 mm lesion with cortical continuity and bone marrow extension, consistent with a bony protrusion, is observed in the proximal diaphyseal region of the left humerus. On the T1-weighted fat-suppressed MRI image of the humerus, a cartilage cap measuring approximately 4.7 mm is distinguishable. **Image B:** Anteroposterior radiograph of the same patient's humerus. A bony mass with cortical continuity is evident on the lateral aspect of the humeral diaphysis (marked with a star).

Materials and Methods

Study design: This study was designed as a retrospective observational study. The primary objective was to evaluate the radiological and clinical characteristics of osteochondroma in pediatric patients through the analysis of past clinical data.

Study population: The study included pediatric patients diagnosed with osteochondroma in the radiology department between 2015 and 2024. The diagnosis of osteochondroma was confirmed through clinical and radiological assessments. Patients with a history of malignancy, insufficient follow-up data, or coexisting bone pathologies were excluded from the study.

Data collection and evaluation criteria: Demographic data, tumor localization, size, number of lesions, and clinical symptoms were retrospectively collected from electronic medical records and patient files. Clinical symptoms, radiological characteristics, and histopathological findings of osteochondroma were assessed as primary evaluation criteria

Table 1: Demographic, Clinical, and Radiological Characteristics of Patients with Osteochondroma

Category	Findings
Age Distribution (year)	- Age range: 1.5 - 17 - Median age: 11.4 - Most common diagnosis age range: 10-14
Gender Distribution	- Male: 42 (62.7%) - Female: 25 (37.3%)
Tumor Localization	- Distal femur: 26.9% - Proximal tibia: 26.9% - Humerus: 16.4% - Scapula: 13.4% - Other bones: 16.4%
Tumor Size	- Long axis average: 27.7 mm (SD: 16.5) - Short axis average: 15.3 mm (SD: 8.8)
Number of Foci	- Solitary tumor: 60 patients (89.5%) - Multiple foci: 7 patients (10.5%)
Cartilage Cap Thickness	-Average thickness: 4.95 mm

SD: Standard deviation

Statistical analysis: Statistical analyses were performed using SPSS version 22.0 (IBM Inc, Armonk, NY, USA). Descriptive statistics for the continuous variables were presented as Mean and

Standard deviation, while count and percentages for categorical variables. The normality of data distribution was assessed using the Kolmogorov-Smirnov test. A p-value of <0.05 was considered statistically significant.

Ethical approval: In our study, written consent was obtained from all the cases participating in our study, in accordance with the Declaration of Helsinki. Ethics Committee permission was obtained from Harran University Medical Faculty Clinical Research Ethics Committee with the decision dated 09.09.2024 and numbered hru/24.13.26.

Results

A total of 67 pediatric patients diagnosed with osteochondroma were included in the study. The patients' ages ranged from 1.5 to 17 years, with a median age of 11.4 years. The most diagnosed age group was between 10 and 14 years. Regarding gender distribution, osteochondroma was more prevalent in males, with 42 male patients (62.7%) and 25 female patients (37.3%) (Table 1). In terms of tumor localization, the distal femur and proximal tibia were the most frequently affected sites, each accounting for 26.9% of cases. Other commonly involved sites included the humerus (16.4%), scapula (13.4%), and various other bones (16.4%) (Table 1). The average long axis length of the tumors was measured as 27.7±16.5 mm, and the average short axis length was 15.3±8.8 mm). The majority of patients (89.5%, n=60) had solitary osteochondromas, while 10.5% (n=7) had multiple lesions. The average cartilage cap thickness, an important factor in assessing the risk of malignant transformation, was found to be 4.95 mm. This value remains well below the 2 cm threshold commonly associated with increased malignant potential, suggesting a low risk in the studied population.

Discussion

The data obtained in this study provide significant insights into the age distribution, sex distribution, tumor localization, tumor size, lesion count, and cartilage cap characteristics of osteochondroma in children when compared with findings in the literature. In our cohort, osteochondroma was most commonly diagnosed during early adolescence, aligning with the period of rapid skeletal development. This trend is in line with previous studies, which have also highlighted adolescence as the peak age for diagnosis due to accelerated bone growth during this stage of development (6,7) Our analysis demonstrated a male predominance in osteochondroma cases, which supports earlier reports in the literature. Studies by Garcia et al. and Tepelenis et al. have similarly indicated a higher frequency of this condition in male patients. This gender disparity may be attributed to differences in skeletal growth dynamics, along with underlying hormonal and genetic influences (1,8). In our study, the most frequent anatomical locations of osteochondroma were consistent with previously reported patterns, particularly in the metaphyseal regions of long bones. These areas, especially near active growth plates, are known to be predisposed to lesion development due to their high bone remodeling and growth activity. As highlighted by Tepelenis et al., such localizations—especially around the knee joint—warrant careful clinical monitoring and may sometimes require surgical intervention due to their proximity to critical structures (1). Tumor dimensions observed in our study were consistent with those previously documented in the literature. As emphasized by Murphey et al., the size of the lesion plays a crucial role in determining clinical management strategies, including the need for surgical intervention. Monitoring tumor size over time is therefore essential for guiding appropriate follow-up and treatment decisions (3) In our study, the majority of osteochondromas were solitary (89.5%). This result is consistent with the findings of Wuyts et al. and Bovée et al. (7,10). The literature also indicates that osteochondromas typically present as solitary lesions. Multiple osteochondromas are less common and are known to be associated with hereditary factors (8,10). Our findings regarding cartilage cap thickness align with established thresholds in the literature used to evaluate the risk of malignant transformation in osteochondromas. As noted by Kyriazoglou et al., a significantly thickened cartilage cap may indicate increased malignancy potential. In our cohort, the measured values remained below the concerning limit, implying a generally low transformation risk (6). Nevertheless, consistent radiological monitoring of cartilage cap thickness remains a key component of long-term management (6,11)

Study limitation: The primary limitation of this study is its retrospective design, as well as being a single-center study with an inability to perform histopathological evaluation for all lesions. These factors may limit the generalizability of the findings. Furthermore, the fact that some cases were diagnosed solely based on clinical and radiological evaluation without histopathological confirmation, and that no clinical follow-up was available for a portion of the patients, constitutes an additional limitation. Additionally, due to the

limited follow-up period, long-term clinical outcomes could not be assessed. However, the significance of this study lies in its detailed characterization of the clinical and radiological features of osteochondroma, contributing to the diagnostic and follow-up processes. These findings are expected to serve as a valuable foundation for future multicenter prospective studies. In conclusion, the findings of this study are consistent with the literature and provide important insights into the clinical management and follow-up of osteochondroma. Parameters such as age, sex, tumor localization, tumor size, lesion count, and cartilage cap thickness should be carefully considered in the diagnosis and treatment of osteochondroma.

Conclusion

The findings of this study are consistent with the literature and provide important insights into the clinical management and follow-up of osteochondroma. Parameters such as age, sex, tumor localization, tumor size, lesion count, and cartilage cap thickness should be carefully considered in the diagnosis and treatment of osteochondroma.

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Conflict of interest: The authors have no conflict of interest regarding this study.
Financial disclosure: No financial support has been received for this study.
Author contributions: Concept (M.D.), Design (M.D, H.E.T), Data Collection and/or Processing (M.D., H.E.T.), Analysis and/or Interpretation (M.D.)

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