Joint Diseases and Related Surgery

Jt Dis Relat Surg
2024;35(2):377-385

ORIGINAL ARTICLE

# Chondromyxoid fibroma: A retrospective evaluation of 31 cases

Mustafa Onur Karaca, MD[1], Mustafa Özyıldıran, MD[2], Rauf Alizade, MD[1], Kerem Başarır, MD[3], Hüseyin Yusuf Yıldız, MD[1]

[1]Department of Orthopedics and Traumatology, Ankara University Faculty of Medicine, Ankara, Türkiye
[2]Department of Orthopedics and Traumatology, Sandıklı State Hospital, Afyonkarahisar, Türkiye
[3]Department of Orthopedics and Traumatology, Private Orthopedic Surgeon, Ankara, Türkiye

## ABSTRACT

**Objectives:** This study aimed to review a 35-year experience with chondromyxoid fibroma at our institution.

**Patients and methods:** The study retrospectively analyzed the records of 31 consecutive patients (17 males, 14 females; mean age: 30.5±15.7 years; range, 6 to 63 years) with chondromyxoid fibroma who were treated between January 1988 and December 2021. The clinical and radiological characteristics of lesions, tumor volume, and recurrence rates were assessed using the tumor archive of the hospital.

**Results:** The mean follow-up duration was 65.9±42.0 months. Pelvis, proximal tibia, and distal femur were the most common sites of localization. The initial surgical treatment was performed on 27 patients at our clinic, while four patients were referred to the clinic after recurrence. The overall recurrence rate was 16.1%. Intralesional curettage was applied to 21 (77.8%) out of 27 patients. The cavity created after curettage was filled with bone graft (autograft or allograft) in 15 (55.5%) cases. Bone cement was applied in four (14.8%) cases. Resection was applied to five (18.5%) patients. In two (7.4%) cases, intralesional curettage alone was performed. One of these two patients experienced recurrence, resulting in a recurrence rate of 50% in this patient group. No recurrence was observed in other treatment groups.

**Conclusion:** Intralesional curettage and filling the defect with bone graft or cement were effective for local control in most cases. Curettage alone was associated with high recurrence rates.

***Keywords:*** Adjuvant therapy, bone cement, bone graft, chondromyxoid fibroma, intralesional curettage, recurrence.

Chondromyxoid fibroma (CMF) is a relatively rare benign cartilaginous bone tumor. It constitutes fewer than 1% of all primary bone tumors.[1-3] It is a rare mixture of benign cartilage, myxoid, and fibrous tissues, taking its name from this characteristic.[4] Chondromyxoid fibroma was first described in 1948 by Jaffe and Lichtenstein.[5] They distinguished the neoplasm from chondrosarcoma based on its benign clinical behavior.

Chondromyxoid fibroma is more commonly observed in males than in females.[1,5,6] It most commonly develops in young patients during the second or third decades of life.[1,4,6] Chondromyxoid fibroma typically occurs in the metaphysis of long bones, such as the tibia and femur. Rarely, involvement of epiphysis or diaphysis may occur. In the literature, it has been reported that the tibia was the most frequently involved bone, followed by the ilium, ribs, and distal femur.[4,6,7]

Received: January 10, 2024
Accepted: March 19, 2024
Published online: April 26, 2024

**Correspondence**: Mustafa Özyıldıran, MD. Sandıklı Devlet Hastanesi, Ortopedi ve Travmatoloji Kliniği, 03500 Sandıklı, Afyonkarahisar, Türkiye.

E-mail: mozyildiran@gmail.com

Doi: 10.52312/jdrs.2024.1620

**Citation:** Karaca MO, Özyıldıran M, Alizade R, Başarır K, Yıldız HY. Chondromyxoid fibroma: A retrospective evaluation of 31 cases. Jt Dis Relat Surg 2024;35(2):377-385. doi: 10.52312/jdrs.2024.1620.



Pain is the most common symptom associated with the affected bone, followed by local swelling. A decrease in the range of motion, joint effusion, and pathological fractures are uncommon.[8-10] The characteristic radiographic appearance of CMF is a well-defined, eccentrically located radiolucent bone lesion in the metaphysis of long bones. Rarely, it may extend into the epiphyseal or diaphyseal regions. In small bones, thinning of

cortices and fusiform expansion of the bone may be observed. Calcification in CMF is rare, unlike other cartilaginous tumors.[4,6,11] The differential diagnosis of CMF includes benign lesions, such as chondroblastoma, giant cell tumor, aneurysmal bone cyst, simple bone cysts, fibrous dysplasia, nonossifying fibroma, enchondroma, and malignant neoplasms like chondrosarcoma. The definitive diagnosis is made histopathologically.[4,6,12]

According to the literature, the potential for spontaneous healing in cases of CMF is known to be low, and surgery is the primary treatment method. There are no comprehensive studies in the literature other than a limited number of case series since CMF is a rare tumor. Therefore, there is no consensus on the recommended surgical treatment. The treatment options include intralesional curettage alone, curettage with bone grafting or cementing, wide resection, or *en bloc* segmental resection. It is known that postoperative recurrence is common, especially in patients treated with intralesional curettage alone.[4,6,9,12]

This study aimed to review a 35-year experience with CMF at our institution.

## PATIENTS AND METHODS

This study retrospectively analyzed the records of 31 consecutive patients (17 males, 14 females; mean age: 30.5±15.7 years; range, 6 to 63 years) with CMF who were treated in the Ankara University Faculty of Medicine Orthopedic Oncology Center, Department of Orthopedics and Traumatology between January 1988 and December 2021. The sample consisted of 27 patients who underwent their initial treatment at our clinic upon diagnosis and four patients who were referred to our clinic after experiencing a recurrence.

The bone tumor archive of our hospital was utilized to identify patients diagnosed with CMF. The records in the hospital archive of all patients who underwent treatment with a diagnosis of CMF within the specified date range were examined. All patients whose diagnosis of CMF was histologically confirmed according to the postoperative pathology report were included in the study. Patients for whom surgery reports and postoperative pathology reports could not be accessed from the hospital records were excluded from the study. Additionally, patients with a follow-up period of shorter than two years were also excluded.

The preoperative radiological images of the patients were examined. Preoperative plain radiographs of all patients were accessed from the hospital records. Computed tomography (CT) was available for 25 patients, while magnetic resonance imaging (MRI) was available for 23 patients. Through the analysis of radiological images, data on lesion size, location, sclerotic rim, cortical destruction, and calcification were documented. The radiological measurements were conducted using a DICOM viewer (RadiAnt DICOM Viewer; Medixant, Poznań, Poland). The linear dimensions (length, width, and height) of the tumors were measured from the CT or MRI scans. The tumor was assumed to have an ellipsoidal three-dimensional shape, and the estimated volume was calculated using the following formula:

Volume = (1/6) x π (pi) x length x width x height.[13-15]

Patients were categorized according to surgical procedures by examining the operation reports in the hospital records. Patients were also classified based on whether bone grafting or cementing was administered after the curettage procedure. The presence of recurrence was explored through the examination of postoperative medical records and radiological images. Information about the time of the recurrence and subsequent treatment was documented. Postoperative complications, such as surgical site infection and pathological fracture, were investigated.

### Statistical analysis

Statistical analysis was performed using IBM SPSS version 22.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to characterize demographic variables of patients. Mean ± standard deviation (SD) and median values were used to present descriptive statistics. A p-value <0.05 was considered statistically significant.

## RESULTS

The mean follow-up period was 65.9±42.0 months. Pain was present in 30 (96.8%) cases as the first presenting symptom. Thirteen (41.9%) patients had local swelling. Five (16.1%) patients were observed to have limited range of motion. One (3.2%) patient was incidentally diagnosed with radiographs taken after a fall despite having no symptoms (Table I). In 25 patients, the preoperative diagnosis was confirmed by applying a trucut biopsy. In the other six patients, intralesional curettage was observed to be performed without biopsy.

The most common sites of localization were the pelvis (25.8%), proximal tibia (22.6%), and distal femur (12.9%; Table II). Two (6.4%) lesions were

**TABLE I**
Demographic variables and characteristic details of the patients

| | n | % | Mean±SD | Median | Min-Max |
|---|---|---|---|---|---|
| Age (year) | | | 30.5±15.7 | 27 | 6-63 |
| Sex | | | | | |
| Male | 17 | 54.8 | | | |
| Female | 14 | 45.2 | | | |
| Follow up period (month) | | | 65.9±42.0 | 36 | 24-350 |
| Symptoms | | | | | |
| Pain | 30 | 96.8 | | | |
| Swelling | 13 | 41.9 | | | |
| Decreased range of motion | 5 | 16.1 | | | |
| Incidental | 1 | 3.2 | | | |
| Lesion volume ($cm^3$) | | | 19.06±23.54 | 8.36 | 0.87-98.26 |
| Lung metastases | | | | | |
| Present | 0 | 0.0 | | | |
| Absent | 31 | 100.0 | | | |
| Postoperative complications | | | | | |
| Present | 1 | 3.2 | | | |
| Absent | 30 | 96.8 | | | |

SD: Standard deviation.

located in short bones, 10 (32.3%) lesions were found in flat bones, and 19 (61.3%) lesions were located in long bones. Of the 19 lesions in long bones, 15 (78.9%) were located in the metaphysis. Four (21.1%) lesions were located in the diaphysis. It was observed that the lesions in the phalanx, metacarpal bone, and metatarsal bone were located in the diaphysis. The mean tumor volume was measured as 19.06±23.54 $cm^3$ (range, 0.87 to 98.26 $cm^3$). No significant difference was observed in the mean tumor volume values between the groups of patients with and without recurrence.

The initial surgery of 27 patients was performed at our clinic. Intralesional curettage was applied to 21 (77.8%) out of 27 patients (Table III). Electrocauterization or burring was applied as adjuvant therapy in all of these cases to make the curettage procedure more effective. The cavity created after curettage was filled with bone graft (autograft or allograft) in 15 (55.5%) cases. Bone cement was applied in four (14.8%) cases (Figure 1). In two (7.4%) cases, only intralesional curettage was performed without the application of cementing or grafting. Resection was applied to five (16.1%) patients. A patient with a lesion in the second metatarsal bone was treated with ray amputation (Figure 2).

The overall recurrence rate was 16.1%. Local recurrence occurred in only one (3.7%) of the 27 patients for whom we performed the initial surgery at our clinic. This patient was a 43-year-old male who underwent only intralesional curettage due to a small-sized (<1 $cm^3$) CMF in the proximal tibia. Recurrence occurred 12 months after the initial surgery, and intralesional curettage with autografting was performed. On the other hand,

**TABLE II**
Anatomical locations

| Location | n | % |
|---|---|---|
| Pelvis | 8 | 25.8 |
| Tibia | 7 | 22.6 |
| Femur | 4 | 12.9 |
| Fibula | 3 | 9.7 |
| Calcaneus | 2 | 6.5 |
| Ribs | 2 | 6.5 |
| Clavicle | 1 | 3.2 |
| Olecranon | 1 | 3.2 |
| Phalanx (foot) | 1 | 3.2 |
| Metatarsal bone | 1 | 3.2 |
| Metacarpal bone | 1 | 3.2 |
| Total | 31 | 100 |

**TABLE III**
Surgical procedure types for 27 patients who received their initial treatment at our clinic *

| Location | n | % | Treatment methods |
|---|---|---|---|
| Tibia | 5 | | Curettage + autograft |
| Tibia | 2 | | Curettage |
| Ilium | 4 | | Curettage + cement |
| Femur | 2 | | Curettage + autograft |
| Femur | 2 | | Curettage + allograft |
| Fibula | 2 | | Resection |
| Fibula | 1 | | Curettage + autograft |
| Thoracic ribs | 2 | | Resection |
| Acetabulum | 1 | | Curettage + autograft |
| Acetabulum | 1 | | Curettage + autograft |
| Pubis | 1 | | Resection |
| Pubis | 1 | | Curettage + autograft |
| Clavicle | 1 | | Curettage + autograft |
| Olecranon | 1 | | Curettage + autograft |
| Metatarsal bone | 1 | | Ray amputation |
| Total | 2 | 7.4 | Curettage |
| | 2 | 7.4 | Curettage + allograft |
| | 4 | 14.8 | Curettage + cement |
| | 13 | 48.1 | Curettage + autograft |
| | 6 | 22.2 | Resection or amputation |
| | 27 | 100 | |

* Four patients referred to our clinic after recurrence were excluded in this table. Only the 27 patients who received their initial treatment at our clinic were included in this table.

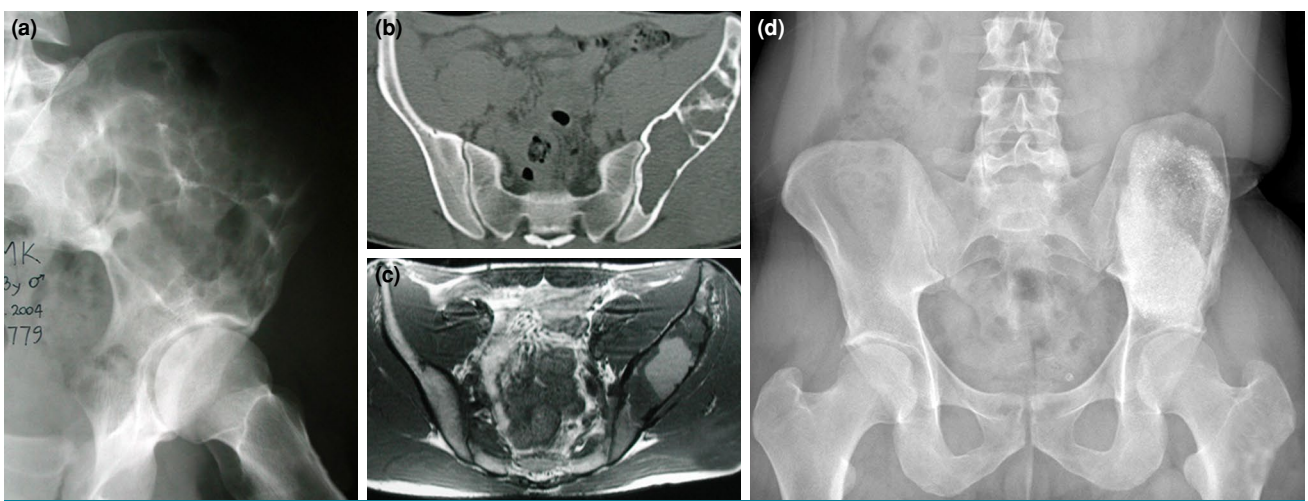


**FIGURE 1.** A 23-year-old male with CMF in the left ilium **(a)** preoperative radiogram; **(b)** preoperative axial CT section; **(c)** preoperative T2 weighted axial MRI section). Curettage and cementing was applied. **(d)** shows postoperative radiograms at 12 months.
CMF: Chondromyxoid fibroma; MRI: Magnetic resonance imaging.

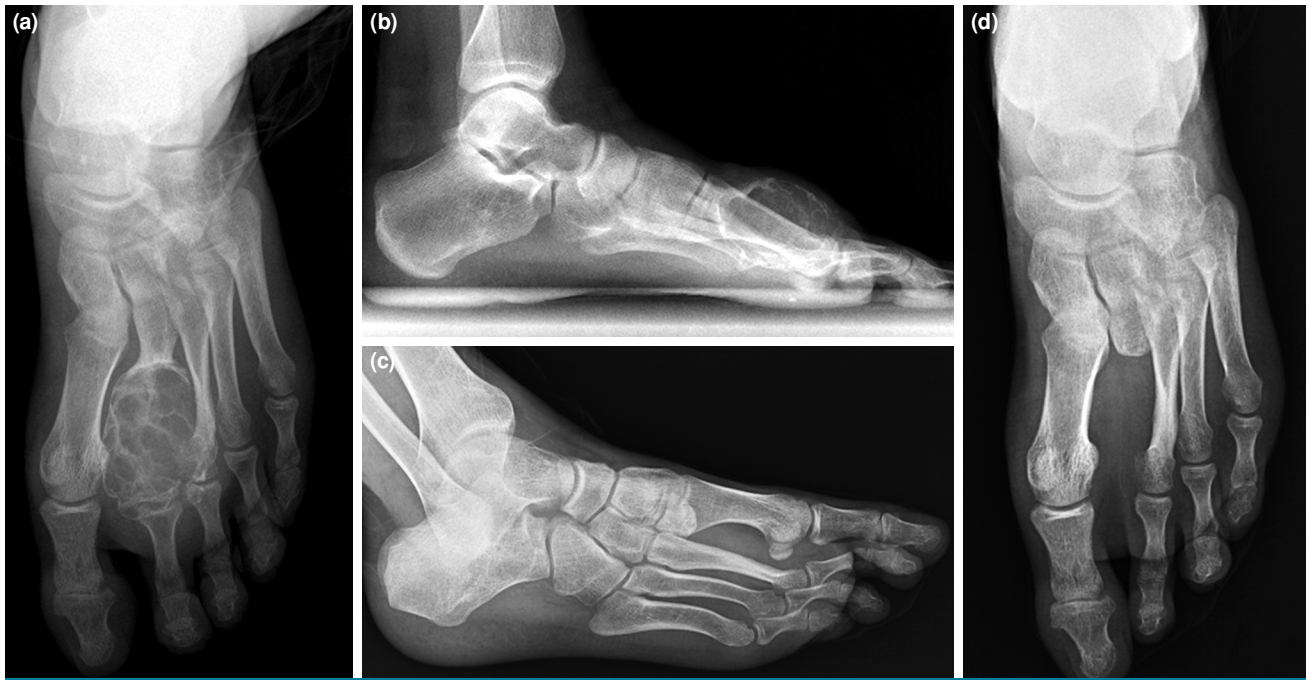


**FIGURE 2.** A 34-year-old male with CMF of the left second metatarsal bone treated by ray amputation. **(a, b)** Show preoperative radiograms. **(c, d)** Show postoperative radiograms at 12 months.
CMF: Chondromyxoid fibroma.

**TABLE IV**
Analysis of the recurrence cases

| | Recurrences | | | |
|---|---|---|---|---|
| Case | Location | Primary treatment | Time of recurrence | Treatment after recurrence |
| 1 | Proximal tibia | Curettage | 12 months | Curettage + autograft |
| 2 | Diaphysis of the first metacarpal bone | Curettage | 8 months | Curettage + autograft |
| 3 | Proximal phalanx of the great toe | Curettage | 6 months | Excision + autograft + arthrodesis |
| 4 | Calcaneus | Curettage | 5 months | Curettage + autograft |
| 5 | Calcaneus | Curettage | 6 months | Curettage + autograft |

*Initial treatment of "Case 1" was applied at our clinic. The other four patients (Case 2, 3, 4, and 5) were referred to our clinic after recurrence.

four patients underwent their initial surgeries at another center, and they were referred to our clinic following the development of a recurrence (Table IV). After reviewing the operation reports, it was discovered that only intralesional curettage without grafting or cementing was performed on all four patients. These four patients were reoperated, and curettage with autografting was applied to three of them. The other patient with recurrent CMFs in the proximal phalanx of the great toe underwent iliac crest autografting and metatarsophalangeal joint arthrodesis (Figure 3).

In two of 27 patients who underwent their first surgery in our clinic, only intralesional curettage was performed without cementing or grafting. One of these two patients developed recurrence, resulting in a recurrence rate of 50% in this patient group. On the other hand, there was no recurrence observed in the patient groups that underwent bone grafting, cementing, or resection. Although there was no significant difference due to the insufficient number of cases, higher recurrence rates were associated with intralesional curettage alone. All four patients referred from another institution due to recurrence

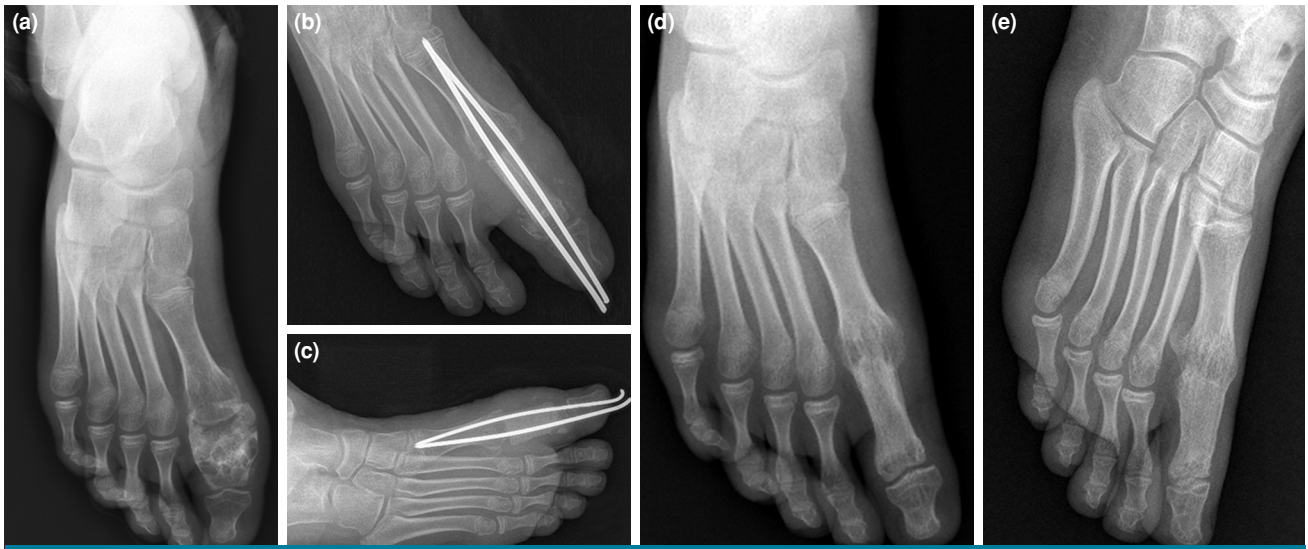


**FIGURE 3.** A 13-year-old female with CMF in the proximal phalanx of right great toe. **(a)** The patient, who underwent curettage at another institution, was referred to our clinic due to recurrence (preoperative radiogram). Excision was performed, followed by iliac crest autografting and metatarsophalangeal joint arthrodesis using two Kirschner wires. **(b, c)** Show radiograms on the first postoperative day. **(d, e)** Show postoperative radiograms at 12 months.
CMF: Chondromyxoid fibroma.

had undergone intralesional curettage alone as their initial surgery, supporting this finding.

Pathological fracture or lung metastasis was not observed in any of the 31 patients during the follow-up period. Postoperative wound dehiscence was observed in one (3.2%) patient. Superficial debridement was performed on this patient at the third postoperative week.

## DISCUSSION

Chondromyxoid fibroma is a relatively uncommon benign cartilaginous bone tumor.[1-3] The knowledge on this topic is based on a limited number of case series. According to the literature, CMF is commonly observed in young patients during their second or third decades of life.[1,4,6] In their case series, Wu et al.[1] reported that approximately 72% of the patients were younger than 40 years, with a mean age of 31.1 (range, 6 to 87 years). Similar to the this finding, the mean age of the patients was 30.5±15.7 in our study. A slight male predominance has been reported in the literature.[1,5,6] Consistent with this, the number of males was higher than the number of females among our patients, and the male-to-female ratio was 1.21. According to the case series in the literature, the tibia was reported as the most frequently involved bone, followed by the ilium, ribs, and distal femur.[4,6,7] Chondroblastoma is frequently localized in the humerus; in contrast, CMF has been reported to be rarely seen in the humerus.[1,4,16] Similar to the literature, the most common three tumor locations in our cases were the pelvis, proximal tibia, and distal femur. Pain and swelling were the most frequently observed symptoms in our series, which is compatible with findings reported in other studies.[8-10]

The typical radiographic appearance of CMF includes a well-defined radiolucent medullary lesion with a sclerotic rim. Cortical thinning and expansion are common. It is generally eccentrically located in the metaphysis of long bones; on the other hand, in small bones, such as the phalanges, metatarsals, and metacarpals, it may demonstrate diaphyseal involvement or involve the entire bone.[4,6,11] In CMF, periosteal reaction is not expected. In case of periosteal reaction, a fracture should be considered.[17] In the radiological examination of our cases, consistent with the literature, it was observed that the lesion borders were sharp, and cortical expansions were common. The majority of lesions were located in the metaphysis, while the lesions in the metacarpals and metatarsals were located in the diaphysis. Periosteal reaction or calcification was not observed in any of our cases. This finding also aligns

with the existing literature. Unlike other cartilaginous tumors, calcification is reported to be rare in CMF in most case reports.[4,6,11] In the literature, it is reported that the diagnosis of CMF in the pelvis, where clinical suspicion for chondrosarcoma is high, is particularly challenging.[4,18] Magnetic resonance imaging is useful to characterize the tumor and evaluate the extent. The MRI appearance of CMF resembles that of other cartilage-based lesions, exhibiting low signal intensity on T1-weighted sequences. On T2-weighted sequences, the lesion appears bright due to the presence of chondroid and myxoid components.[19,20] Computed tomography can be used to assess the cortical integrity and cortical expansion.[20,21]

The definitive diagnosis of CMF is established through concurrent histologic and radiologic examinations. In the differential diagnosis, CMF should be differentiated from other lesions, including chondrosarcoma, chondroblastoma, giant cell tumor, aneurysmal bone cyst, simple bone cysts, fibrous dysplasia, nonossifying fibroma, and enchondroma.[4,6,12] Histologically, CMF exhibits lobules containing variable proportions of chondroid, myxoid, and fibroid tissues. There are numerous spindle- to stellate-shaped cells in the periphery of the lobules within the myxoid and chondroid tissues. Fibrous tissues divide the myxoid and chondroid regions and consist of varying amounts of interstitial collagen fibers, histiocytes, fibroblasts, and multinucleated giant cells.[2,12,20] The biopsy sample should be big enough to confidently diagnose CMF and rule out chondrosarcoma. Sono et al.[18] emphasized the importance of obtaining adequate biopsy material in their case series, in which they examined pelvic-located CMFs. In cases of tumors located in the pelvis, they recommended incisional biopsy instead of needle core biopsy to obtain adequate biopsy material. In a series of 36 cases performed by Zillmer and Dorfman,[2] it was reported that 22% of cases had been misdiagnosed. They also mentioned that limb amputation was performed in two cases due to the misdiagnosis of benign CMF as chondrosarcoma. In our study, there was no misdiagnosis in any of the patients. Additionally, malignant transformation was not observed in any of our patients. Malignant transformation is reported to be very rare in the literature. In their clinicopathologic review, Wu et al.[1] reported malignant transformation in only two out of 278 cases. Radiotherapy was stated as a risk factor for malignant transformation.

The literature presents varying reports on the surgical treatment methods and recurrence rates of the CMF. There is a lack of consensus regarding the optimal surgical treatment. Treatment options encompass intralesional curettage alone, curettage with bone grafting or cementing, wide resection, or *en bloc* segmental resection. Intralesional curettage without grafting or cementing has resulted in a high recurrence rate in the majority of case series.[4,6,9,12] Wu et al.[1] reported a recurrence rate of 25% in their review of 278 cases. Gherlinzoni et al.[22] stated a recurrence rate of 80% in patients treated with curettage alone and 7% in patients treated with curettage and bone grafting. Lersundi et al.[12] reported a recurrence rate of 50% in patients treated with curettage alone and 10% in patients treated with curettage with bone grafting or cementing. In our study, recurrence was observed in one out of the 27 patients who underwent initial surgery at our clinic, and the recurrence rate was found to be 3.7%. The present study is among the largest series on CMF in a single institute and provides important information about recurrence and treatment strategies; our recurrence rate was observed to be lower compared to most studies in the literature.[23] We applied electrocauterization or burring as a local adjuvant therapy to all patients undergoing intralesional curettage to make the curettage procedure more effective; this may be one of the factors that ensure the low recurrence rate.[23] Consistent with the literature, we observed a higher recurrence rate in the patient group treated with intralesional curettage alone. Recurrence was observed in one out of two patients to whom we applied intralesional curettage alone (50% recurrence rate). On the other hand, recurrence was not observed in the patient groups that underwent bone grafting, cementing, or resection. Although the limited number of cases prevented a significant difference, higher recurrence rates were associated with intralesional curettage alone. This is also supported by the fact that all patients referred to our clinic from another institution due to recurrence underwent intralesional curettage alone in their first surgery.

This study is limited by its retrospective design. Due to the retrospective nature of the study, obtaining postoperative functional scores for the majority of patients was not possible. Absence of the functional scores is one of the weaknesses of the study. Another limitation of our study was the inability to apply statistical analyses in the intergroup evaluation due to the limited number of cases. However, this study is among the largest series on CMF in a single institute and provides important information about recurrence and treatment strategies.

In conclusion, CMF is a rare benign skeletal tumor of cartilaginous differentiation. The lesions are often confused with other benign or malignant tumors, both clinically and radiologically. In the differential diagnosis, all possibilities, including chondrosarcoma, should be considered. The definitive diagnosis is made through histopathological examination. Curettage with bone grafting or cementing is an effective treatment method. Curettage alone is associated with high recurrence rates.

**Ethics Committee Approval:** The study protocol was approved by the Ankara University Faculty of Medicine Ethics Committee (date: 09.02.2022, no: İ01-55-22). The study was conducted in accordance with the principles of the Declaration of Helsinki.

**Patient Consent for Publication:** A written informed consent was obtained from the patients and/or parents of the patients.

**Data Sharing Statement:** The data that support the findings of this study are available from the corresponding author upon reasonable request.

**Author Contributions:** Idea/concept: M.O.K., K.B., H.Y.Y.; Design: M.O.K., M.Ö.; Data collection/processing: M.Ö., R.A.; Analysis/interpretation: M.Ö., R.A.; Literature review: M.Ö., R.A.; Drafting/writing: M.O.K., M.Ö.; Control and critical review: M.O.K., H.Y.Y.

**Conflict of Interest:** The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

**Funding:** The authors received no financial support for the research and/or authorship of this article.

## REFERENCES

1. Wu CT, Inwards CY, O'Laughlin S, Rock MG, Beabout JW, Unni KK. Chondromyxoid fibroma of bone: A clinicopathologic review of 278 cases. Hum Pathol 1998;29:438-46. doi: 10.1016/s0046-8177(98)90058-2.
2. Zillmer DA, Dorfman HD. Chondromyxoid fibroma of bone: Thirty-six cases with clinicopathologic correlation. Hum Pathol 1989;20:952-64. doi: 10.1016/0046-8177(89)90267-0.
3. Budny AM, Ismail A, Osher L. Chondromyxoid fibroma. J Foot Ankle Surg 2008;47:153-9. doi: 10.1053/j.jfas.2007.08.013.
4. De Mattos CB, Angsanuntsukh C, Arkader A, Dormans JP. Chondroblastoma and chondromyxoid fibroma. J Am Acad Orthop Surg 2013;21:225-33. doi: 10.5435/JAAOS-21-04-225.
5. Jaffe HL, Lichtenstein L. Chondromyxoid fibroma of bone; a distinctive benign tumor likely to be mistaken especially for chondrosarcoma. Arch Pathol (Chic) 1948;45:541-51.
6. Bhamra JS, Al-Khateeb H, Dhinsa BS, Gikas PD, Tirabosco R, Pollock RC, et al. Chondromyxoid fibroma management: A single institution experience of 22 cases. World J Surg Oncol 2014;12:283. doi: 10.1186/1477-7819-12-283.
7. Desai SS, Jambhekar NA, Samanthray S, Merchant NH, Puri A, Agarwal M. Chondromyxoid fibromas: A study of 10 cases. J Surg Oncol. 2005 Jan 1;89(1):28-31. doi: 10.1002/jso.20113.
8. Baker AC, Rezeanu L, O'Laughlin S, Unni K, Klein MJ, Siegal GP. Juxtacortical chondromyxoid fibroma of bone: A unique variant: A case study of 20 patients. Am J Surg Pathol 2007;31:1662-8. doi: 10.1097/PAS.0b013e31806772ec.
9. Sharma H, Jane MJ, Reid R. Chondromyxoid fibroma of the foot and ankle: 40 years' Scottish bone tumour registry experience. Int Orthop 2006;30:205-9. doi: 10.1007/s00264-005-0046-y.
10. Armah HB, McGough RL, Goodman MA, Gollin SM, Surti U, Parwani AV, et al. Chondromyxoid fibroma of rib with a novel chromosomal translocation: A report of four additional cases at unusual sites. Diagn Pathol 2007;2:44. doi: 10.1186/1746-1596-2-44.
11. Yamaguchi T, Dorfman HD. Radiographic and histologic patterns of calcification in chondromyxoid fibroma. Skeletal Radiol 1998;27:559-64. doi: 10.1007/s002560050437.
12. Lersundi A, Mankin HJ, Mourikis A, Hornicek FJ. Chondromyxoid fibroma: A rarely encountered and puzzling tumor. Clin Orthop Relat Res 2005;439:171-5. doi: 10.1097/01.blo.0000174685.62379.6a.
13. Feldman JP, Goldwasser R, Mark S, Schwartz J, Orion I. A mathematical model for tumor volume evaluation using two-dimensions. Journal of Applied Quantitative Methods 2009;4:455-62.
14. Mayr NA, Taoka T, Yuh WT, Denning LM, Zhen WK, Paulino AC, et al. Method and timing of tumor volume measurement for outcome prediction in cervical cancer using magnetic resonance imaging. Int J Radiat Oncol Biol Phys 2002;52:14-22. doi: 10.1016/s0360-3016(01)01808-9.
15. Singhal S, Gill M, Srivastava C, Gupta D, Kumar A, Kaushik A, et al. Simplifying tumor volume estimation from linear dimensions for intra-cranial lesions treated with stereotactic radiosurgery. J Med Phys 2020;45:199-205. doi: 10.4103/jmp.JMP_56_20.
16. Yurtbay A, Coşkun HS, Çinka H, Erdoğan F, Büyükceran İ, Dabak N. The effect of adjuvant cryotherapy added to well-performed high-speed burr curettage on the long-term surgical outcomes of chondroblastoma cases. Jt Dis Relat Surg 2023;34:338-45. doi: 10.52312/jdrs.2023.936.
17. Wilson AJ, Kyriakos M, Ackerman LV. Chondromyxoid fibroma: Radiographic appearance in 38 cases and in a review of the literature. Radiology 1991;179:513-8. doi: 10.1148/radiology.179.2.2014302.
18. Sono T, Ware AD, McCarthy EF, James AW. Chondromyxoid fibroma of the pelvis: Institutional case series with a focus on distinctive features. Int J Surg Pathol 2019;27:352-9. doi: 10.1177/1066896918820446.
19. Wu KK. Chondromyxoid fibroma of the foot bones. J Foot Ankle Surg 1995;34:513-9. doi: 10.1016/S1067-2516(09)80030-6.
20. Roberts EJ, Meier MJ, Hild G, Masadeh S, Hardy M, Bakotic BW. Chondromyxoid fibroma of the calcaneus: Two case reports and literature review. J Foot Ankle Surg 2013;52:643-9. doi: 10.1053/j.jfas.2013.02.014.

21. Feldman F, Hecht HL, Johnston AD. Chondromyxoid fibroma of bone. Radiology 1970;94:249-60. doi: 10.1148/94.2.249.
22. Gherlinzoni F, Rock M, Picci P. Chondromyxoid fibroma. The experience at the Istituto Ortopedico Rizzoli. J Bone Joint Surg [Am] 1983;65:198-204. doi: 10.2106/00004623-198365020-00008.
23. Atik OŞ. Writing for Joint Diseases and Related Surgery (JDRS): There is something new and interesting in this article! Jt Dis Relat Surg 2023;34:533. doi: 10.52312/jdrs.2023.57916.