

# Differential diagnosis and management of cartilage-derived tumors in the upper extremity: a focus on osteochondroma and bizarre parosteal osteochondromatous proliferation

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## ABSTRACT

**Aims:** Among cartilage-derived tumors in the hand, osteochondroma is the second most common benign lesion after enchondromas. Bizarre parosteal osteochondromatous proliferation (BPOP) is particularly rare in the hand and may be confused with malignant processes. This study presents the outcomes of surgically treated exophytic benign bone masses. The aim is to differentiate between these two lesions, which are very similar clinically, radiologically, and histopathologically.

**Methods:** Nine patients who underwent surgery due to a mass in the hand, with a histopathological diagnosis of osteochondroma-BPOP, were included in the study. Surgeries were performed under axillary anesthesia by a single surgeon certified in hand surgery. The demographic data of the patients, characteristics of the mass, and associated clinical findings were recorded. Functional outcomes at the final outpatient follow-up after mass excision were assessed using VAS and q-DASH scores. Surgical complications and recurrence were also investigated.

**Results:** The average age of the patients participating in the study was 40 years (range: 14-64 years). The average follow-up period after surgery was 30 months (range: 8-120 months). A total of 9 patients underwent surgery due to a palpable mass, with histopathologically confirmed diagnoses reporting 6 cases of solitary osteochondroma and 3 cases of BPOP. During the follow-up period, 1 patient developed a recurrent mass, and this patient with a diagnosis of BPOP underwent reoperation. Clinically, all patients experienced a resolution of preoperative complaints, and significant improvements were observed in clinical scores.

**Conclusion:** Symptomatic classical osteochondroma and BPOP lesions cause concern for patients. Successful outcomes can be achieved through surgical excision. However, after excluding malignancy, it is important to differentiate between these lesions. It will be beneficial to be aware of the high recurrence rates in cases considered similar to osteochondroma excision, such as BPOP lesions, and to maintain a diligent follow-up.

**Keywords:** Hand, benign, osteochondroma, bizarre parosteal osteochondromatosis proliferation

## INTRODUCTION

The differential diagnosis of tumors and tumor-like lesions in the upper extremity, particularly in the hand and wrist, is quite broad.<sup>1,2</sup> Cartilage-derived masses are often benign, with enchondromas being the most frequently encountered among these lesions.<sup>3,4</sup> Although osteochondromas are also commonly seen cartilage-derived tumors, they are relatively rare in the hand and typically occur in long bones such as the humerus and femur.<sup>5,6</sup> In contrast to osteochondromas, bizarre parosteal osteochondromatous lesions (Nora lesions) (BPOP), which are morphologically very similar to this tumor and cannot be distinguished from osteochondroma macroscopically, are more often found in the hand and foot.<sup>7,8</sup>

Hand osteochondromas and BPOP are clinically very similar, generally presenting as asymptomatic palpable masses.

However, if they are located in pressure points, they can cause pain and numbness. An important difference between these two masses is that, unlike osteochondromas, Nora lesions do not have continuity with the cancellous bone at the site of the lesion.<sup>9</sup> Although both lesions are benign, the risk of malignant transformation leading to secondary chondrosarcoma in osteochondromas is present even in solitary lesions at a rate of approximately 1%.<sup>10,11</sup> BPOP is much less common than osteochondroma, but the local recurrence rate is considerably high.<sup>12</sup> For this reason, distinguishing between these clinically similar lesions may be important for predicting recurrence.

In this study, we share the outcomes of nine cartilage-derived masses, excluding enchondromas, surgically treated in the hand and wrist. We aim to demonstrate that, in addition to

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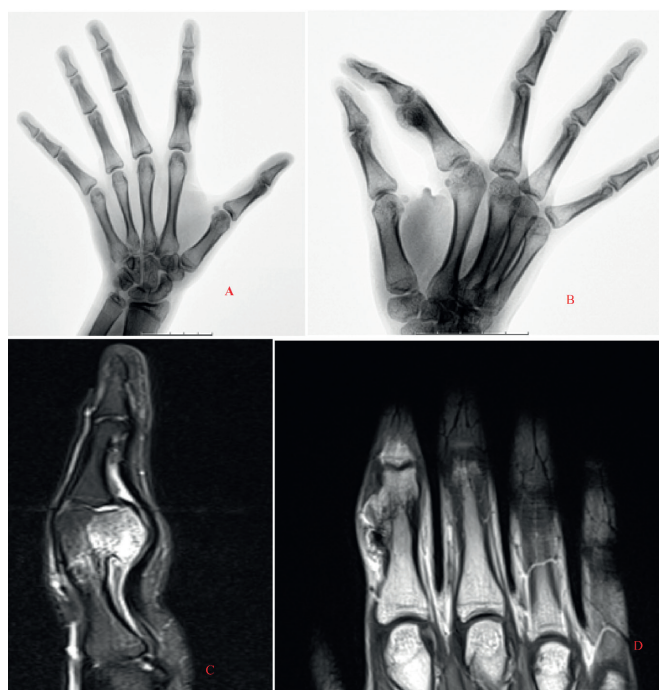
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commonly seen osteochondroma cases, rare lesions such as BPOP could also be present.

### METHODS

This study received ethical approval from the ethics committee of İnönü University Scientific Researches and Publication Ethics Committee (Approval Date: 05.11.2024, Decision No: 2024/6462). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. It is a retrospective study that includes 9 patients assessed for a mass in the hand at the hand surgery outpatient clinic between 2018 and 2022. Patients who were surgically treated for hand masses and diagnosed pathologically as osteochondroma-BPOP, as well as patients diagnosed with osteochondroma excluding hereditary multiple exostoses syndrome, were included in the study, based on complete electronic file records and outpatient follow-ups. Patients who were conservatively followed for hand masses, those who underwent surgery for hand masses and received a pathological diagnosis other than osteochondroma-BPOP, and those with incomplete or irregular outpatient records were excluded from the study.

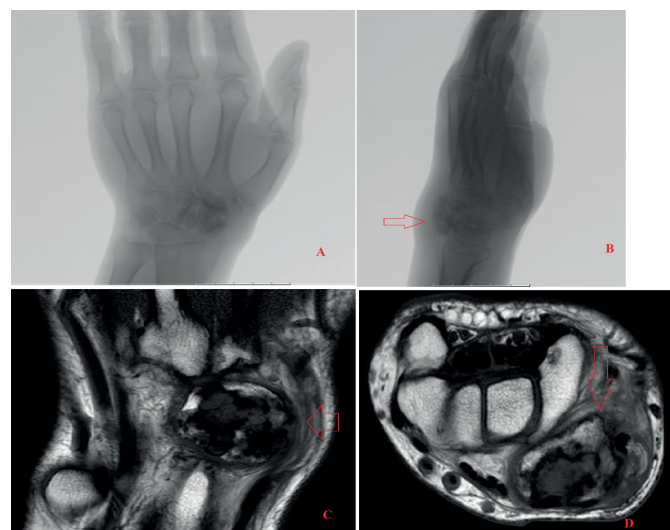
During outpatient visits, a detailed medical history was initially taken and complaints were investigated. Symptoms such as pain, numbness, and restricted movement were recorded, and the mass in the hand was assessed through physical examination. Questions regarding the presence of comorbidities and whether the patient had any masses in areas other than the hand were asked in the investigation. Three-dimensional imaging of the hand and wrist was requested according to the affected area. In order to evaluate the bone structure, computed tomography scans were performed, particularly for smaller masses when necessary. Contrast-enhanced magnetic resonance imaging was requested for all patients to assess the relationship of the mass with the surrounding soft tissue (Figure 1, 2). Following these investigations, surgical treatment was recommended for patients with bone masses suspected based on the preliminary diagnosis, and who were not considered malignant based on imaging results. Also, given the patient's medical history and the history of the mass (duration), and taking into account the presence of a cartilaginous cap on the radiological images, a preoperative biopsy was not planned.



**Figure 2.** A 14-year-old female patient. A bone mass in the distal part of the proximal phalanx of the second finger. X-Ray (A, B) and MRI images (C, D) of the mass. Osteochondroma is detected after excision

MRI: Magnetic resonance imaging

All surgeries were performed by a single experienced surgeon certified in hand surgery (X. X). The procedures were conducted under axillary anesthesia with the assistance of a tourniquet. Access to the masses was assessed based on anatomical location and preoperative imaging methods, and volar-dorsal approaches were used for the hand and wrist (Figure 3, 4). During all operations, soft tissue dissection was performed in accordance with hand surgical principles, and the masses were excised via marginal resection. Excisional specimens were sent to the pathology laboratory for analysis. In the postoperative follow-up, patients were monitored with a short arm splint until soft tissue healing was achieved, typically until the second week. Sutures were removed in the second week, the splint was discontinued, and the patients were allowed to perform movements of the hand and wrist. Outpatient follow-ups were conducted at the 2<sup>nd</sup> week, 2<sup>nd</sup> month, 6<sup>th</sup> month, and annually.



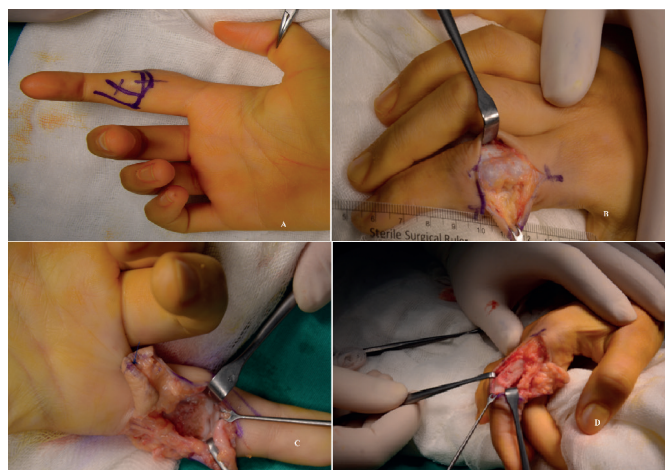
**Figure 1.** A 64-year-old male patient with a mass in his wrist. Preoperative X-Rays (A, B) and MRI images (C, D) of the patient. The mass has no medullary continuity with the carpal bones, and the diagnosis is BPOP (red arrows)

MRI: Magnetic resonance imaging



**Figure 3.** Intraoperative images of BPOP localized at the wrist. Preoperative (A), surgical exposure (B), excision material (C), surgical field (D)

BPOP: Bizarre parosteal osteochondromatous proliferation



**Figure 4.** Intraoperative images of osteochondroma located in the proximal phalanx. Preoperative (A), mass exposure (B), post-excision (C, D)

Demographic data of the patients, preoperative complaints related to the masses, the duration and location of the masses, as well as preoperative and postoperative VAS and Q-DASH scores were recorded. Patient clinical satisfaction was evaluated using a subjective satisfaction scale (very satisfied-satisfied-neutral-unsatisfied) following surgery. Potential postoperative complications and the development of recurrent masses were also investigated.

In the study, qualitative data were summarized using counts (percentages). Quantitative data were summarized using median (minimum-maximum) and mean±standard deviation. In statistical analyses, categorical variables were compared using Fisher’s exact Chi-square test. For analyses involving two dependent quantitative variables, the Wilcoxon signed-rank test was used. A p-value of <0.05 was considered statistically significant in all applied statistical analyses. All analyses were conducted using IBM SPSS Statistics 26.0 for Windows (New York, USA).

## RESULTS

The average duration from the first notice of the mass in the affected upper extremity to the date of surgery was 30 months (range: 8-120 months). Among the nine patients, 6 were female and 3 were male. The average age of the patients participating in the study was 40 years (range: 14-64 years). The demographic data of the patients and the characteristics of the masses that were surgically treated are presented in **Table 1**.

Among the 9 patients who underwent surgery for a mass in the hand, the diagnosis was osteochondroma in 6 patients

and BPOP in 3 patients. Of the 9 patients in the study, 6 (66.7%) were female, and 3 (33.3%) were male. Six cases (66.7%) were operated on the right side, while 3 cases (33.3%) were operated on the left side. The most common clinical complaint was pain, which was noted in 7 patients (77.78%). Two patients (22.22%) were surgically treated due to isolated swelling without any complaints. The most common mass location in the upper extremity was the phalanx, observed in 6 patients. Masses were operated on at the metacarpal level in 2 patients and at the wrist level in 1 patient. When examining recurrence, no recurrence was observed in 8 patients (88.9%), while recurrence developed in 1 patient (11.1%). Secondary surgery due to recurrence was performed on 1 patient (11.1%) diagnosed with BPOP. The evaluation of the clinical outcomes of the patients is presented in **Table 2**.

**Table 2.** Determination of clinical outcomes before and after surgery using scores

Measurement	Median (min-max)	p-value
Preoperative VAS	8 (7-10)	0.007
Postoperative VAS	1 (1-3)	
Preoperative QDASH	68 (45-86)	0.008
Postoperative QDASH	20 (10-36)	
Subjective satisfaction score	n (%)	
Excellent	4 (44.4%)	
Good	5 (55.6%)	
Fair	0	
Poor	0	

Min: Minimum, Max: Maximum, VAS: Value-added services, QDASH: Quick disabilities of the arm, shoulder, and hand

When evaluating the clinical outcomes of the patients, the changes in preoperative and postoperative VAS and Q-DASH scores were statistically significant (p-values of 0.007 and 0.008, respectively). Additionally, in the assessment of subjective clinical well-being, good results were achieved in 5 patients (55.6%) and very good results in 4 patients (44.4%). There were no moderate or poor results.

The most common complication observed after surgery was nonspecific numbness in the incision area, reported in 4 patients (44.4%), which did not clinically reflect any issues. No additional surgical procedures were performed for this condition. One patient with numbness had also experienced numbness prior to surgery. However, these two clinical presentations differed in severity and localization. No wound healing problems or infections were observed in any of the patients.

**Table 1.** Patient and mass characteristics

Patients	Gender	Age	Side	Complaint	Localization	Pathological diagnosis	Recurrence	Follow-up period (months)
1	Female	53	Right	Pain	Proximal Phalanx	Osteochondroma	No	13
2	Female	58	Right	Pain	Proximal Phalanx	BPOP	No	25
3	Male	64	Right	Pain	Carpus	BPOP	No	8
4	Male	38	Right	Pain+weakness	Metacarp	BPOP	Yes	24
5	Female	50	Left	Pain+weakness	Proximal Phalanx	Osteochondroma	No	27
6	Male	22	Right	Swelling	Proximal Phalanx	Osteochondroma	No	16
7	Female	22	Left	Pain+numbness	Metacarp	Osteochondroma	No	19
8	Female	14	Right	Pain+weakness	Proximal Phalanx	Osteochondroma	No	18
9	Female	37	Left	Swelling	Middle Phalanx	Osteochondroma	No	120

BPOP: Bizarre parosteal osteochondromatous proliferation

## DISCUSSION

In patients undergoing surgery for a mass in the upper extremity, particularly in the hand and wrist, the most common bone-origin pathology aside from soft tissue lesions is osteochondroma, excluding enchondromas. Preoperative imaging may reveal the rare entity of BPOP following osteochondroma excision. The surgeon should be aware of these two distinct clinical conditions and provide appropriate counseling to the patient and their family members. First and foremost, malignancy should be excluded, recognizing that osteochondroma carries minimal malignant potential, whereas BPOP may mimic a malignant process because of its tendency for local recurrence. Although osteochondroma is a common cartilage-derived tumor, its occurrence in the upper extremity especially in the hand and wrist is considered atypical. Conversely, while hand involvement is typical in BPOP, the condition itself remains rare.

To accurately differentiate between these two lesions, a clear understanding of their characteristic features is essential. Osteochondromas may present as solitary lesions or as multiple lesions associated with genetic conditions such as hereditary multiple exostoses, in which the risk of malignancy increases.<sup>13</sup> The typical age of presentation is under 20 years, with a predominance in females.<sup>11</sup> In contrast, BPOP has been associated with chromosomal abnormalities<sup>14</sup> and is generally observed in older individuals, most commonly in the third decade of life, with no gender predominance.<sup>15</sup>

In our series, a higher incidence of osteochondroma was noted in female patients, particularly during the second decade of life. The predominance of the female gender was statistically significant among osteochondroma patients. Older age groups are especially relevant when considering BPOP. Even when only demographic data are taken into account, surgeons may develop an initial suspicion that helps differentiate between these two types of masses.

In terms of localization, although the typical site for hand osteochondromas is not clearly defined, they are more likely to occur in the proximal phalanx.<sup>5</sup> BPOP lesions, on the other hand, are generally located in the metacarpal and phalangeal regions.<sup>7</sup> Atypical cases of BPOP have also been reported in the carpal-wrist area and the distal ulna.<sup>16,17</sup> In our series, we excised a large BPOP mass located in the wrist in one case, while the other two masses were situated in the phalangeal and metacarpal regions. A considerable proportion of the osteochondromas we operated on originated from the proximal phalanx, making this finding noteworthy in terms of localization.

Although swelling of the hand and its progressive growth may be asymptomatic, it is a source of concern for patients. A definitive diagnosis must be established, and malignancy should be excluded. Key initial considerations include the history of the mass, its duration, tenderness on palpation, and the physical characteristics of the lesion such as firmness and mobility. Direct radiographs and computed tomography (CT) should be performed to assess the relationship of the mass to the bone. In osteochondroma cases, it has been reported that, in addition to radiographs, ultrasound can reveal soft-tissue changes and provide diagnostic capabilities comparable to CT.<sup>18</sup> For osteochondromas located in uncommon sites, CT offers a significant diagnostic advantage.<sup>19</sup>

Plain radiographs and CT scans are generally insufficient for the differential diagnosis of BPOP and osteochondroma. MRI can also aid in distinguishing osteochondroma from BPOP radiologically. The radiologic distinction between the two lesions is typically based on whether the mass is confined to the periosteum of the originating bone or demonstrates medullary continuity.<sup>7</sup> However, there are cases that show medullary continuity radiologically but are reported as BPOP on histopathological evaluation.<sup>20</sup> In our cases, we relied on imaging studies following a detailed medical history and physical examination. Although a diagnosis may be suggested through imaging, differentiating between these two lesions can be quite challenging. Interpretation of the imaging by experienced radiologists may provide additional guidance.

In cases where osteochondroma is suspected based on imaging methods and medical history, complete excision is performed with an excisional biopsy. Preoperative biopsy is particularly repeated in cases that develop recurrence to rule out malignancy. Histopathologically, osteochondromas consist of exophytic bone covered by a cartilage cap, containing chondrocytes arranged similarly to the epiphyseal growth plate and mature hyaline cartilage.<sup>4</sup> In contrast, BPOP is described as a mass containing cartilage, bone, and spindle cells, characterized by irregular endochondral ossification with a partially irregular cartilage cap and a basophilic stroma (*blue bone*) found between the cartilage and bone.<sup>21,22</sup> For these two masses, where macroscopic differentiation is not possible, histopathological diagnosis is essential. In our series, we provided a differential diagnosis through histopathological examination.

Conservative approaches and non-surgical treatments are indicated in the management of osteochondromas, among which retinoic acid receptor gamma agonists are emerging as a new treatment option.<sup>23</sup> Additionally, spontaneous resolution has been reported in asymptomatic cases.<sup>24,25</sup> In asymptomatic young patients without skeletal maturity, non-surgical monitoring may be considered; however, in symptomatic cases, surgical treatment with marginal resection should be contemplated. For BPOP, surgical treatment is the primary management approach.<sup>20</sup>

When considering surgical treatment for patients with exophytic bone outgrowths, two important factors must be taken into account; the risk of malignant transformation and the likelihood of recurrence. Malignant transformation is more commonly associated with osteochondromas, whereas recurrence is characteristic of BPOP.<sup>26</sup> The recurrence rates of BPOP should not be underestimated, with reported rates reaching up to 50%.<sup>13,27,28</sup> Surgical outcomes for both osteochondroma and BPOP are generally satisfactory.<sup>20,29</sup> In our series, preoperative and postoperative evaluations demonstrated significant improvement in clinical outcomes and high levels of patient satisfaction. Among our three cases of BPOP, recurrence occurred in one patient; however, even in this case, pain and clinical symptoms markedly improved compared with the preoperative condition.

### Limitations

This study has several limitations. First, it is a retrospective study conducted at a single center. Another limitation is the rarity of these cases, which results in a small patient population. Finally, although there is no standardized

consensus for determining recurrence, a longer follow-up period in these cases could provide more meaningful information regarding recurrence development.

## CONCLUSION

As a result, although cartilage-derived tumors other than enchondromas are uncommon, they can be detected in the upper extremity, particularly in the hand and wrist. This localization is atypical for osteochondroma, yet it occurs with a notable frequency. Cases of BPOP, which closely resemble osteochondromas, are rare and must be differentiated. Suspicion regarding these two distinct clinical entities can be raised by considering patient demographic data and imaging findings. Establishing an accurate differential diagnosis is important, as surgical treatment has demonstrated favorable clinical outcomes. Due to the high recurrence rate associated with BPOP, not only appropriate treatment but also long-term follow-up and patient counseling are essential.

## ETHICAL DECLARATIONS

### Ethics Committee Approval

This study was approved by the İnönü University Scientific Researches and Publication Ethics Committee (Approval Date: 05.11.2024, Decision No: 2024/6462).

### Informed Consent

As this was a retrospective study, formal written informed consent was not required and was therefore not obtained.

### Peer Review Process

This manuscript was subject to external peer review.

### Conflict of Interest

The authors declare no conflicts of interest related to this study.

### Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

### Author Contributions

Concept: HUÖ, EE, OT, KE, HE, İBÇ; Design: HUÖ; KE; EE; Control: OT, İBÇ, HE; Resources: HUÖ, EE, OT, KE, HE, İBÇ; Materials: HUÖ, EE, OT, KE, HE, İBÇ; Data Collection and/or Processing: OT; İBÇ; HE; Analysis and/or Interpretation: EE; KE; HUÖ; Literature Review: HUÖ, EE, OT, KE, HE, İBÇ; Writing the Article: HUÖ; EE; KE; Critical Review: HUÖ, EE, OT, KE, HE, İBÇ.

### Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## REFERENCES

- Bayar E, Cengiz T, Şimşek ŞA, Coşkun HS, Dabak N. Hand tumors: retrospective evaluation of 223 patients in a single center. *Hand Microsurg.* 2025;14(1):14-22. doi:10.5455/handmicrosurg.194643
- Hacisalihoglu P, Ozcelik IB. Epidemiological and histopathological analysis of soft tissue tumors of the hand-9 years of experience from a single center. *Hand Microsurg.* 2019;8(1):1-8. doi:10.5455/handmicrosurg.16148
- Mysore M, Murthy S, Nekkanti S, Nanjesh P. A rare case of recurrent enchondroma of the thumb involving the first metacarpophalangeal joint- an unusual disease pattern. *Hand Microsurg.* 2018;7(3):160-165. doi:10.5455/handmicrosurg.282349
- Albanese KM, Lynch CP, Eswaran SP, Damron TA. Benign bone tumors of the hand: beyond enchondromas. *J Am Acad Orthop Surg.* 2024;33(17):e1000-e1016. doi:10.5435/JAAOS-D-23-01020
- Teodoreanu RN, Grosu-Bularda A, Liță FF, et al. Benign cartilaginous tumors of the hand, a five-year retrospective study. *Rom J Morphol Embryol.* 2022;63(4):625-632. doi:10.47162/RJME.63.4.04
- Khodnapur G, Patil A V, G S, M K B. Occurrence of osteochondroma at unusual location (metacarpal): a rare case report. *J Orthop Case Reports.* 2022;12(1):6-9. doi:10.13107/JOCR.2022.V12.I01.2592
- Nora FE, Dahlin DC, Beabout JW. Bizarre parosteal osteochondromatous proliferations of the hands and feet. *Am J Surg Pathol.* 1983;7(3):245-250. doi:10.1097/00000478-198304000-00003
- Smith NC, Ellis AM, McCarthy S, McNaught P. Bizarre parosteal osteochondromatous proliferation: a review of seven cases. *Aust N Z J Surg.* 1996;66(10):694-697. doi:10.1111/J.1445-2197.1996.TB00720.X
- Larbi A, Viala P, Omoumi P, et al. Cartilaginous tumours and calcified lesions of the hand: a pictorial review. *Diagn Interv Imaging.* 2013;94(4):395-409. doi:10.1016/j.diii.2013.01.012
- Herget GW, Kontny U, Saueressig U, et al. osteochondrom und multiple osteochondrome: empfehlungen zur diagnostik und vorsorge unter besonderer berücksichtigung des auftretens sekundärer chondrosarkome. *Radiologe.* 2013;53(12):1125-1135. doi:10.1007/S00117-013-2571-9
- Tepelelis K, Papathanakos G, Kitsouli A, et al. Osteochondromas: an updated review of epidemiology, pathogenesis, clinical presentation, radiological features and treatment options. *In Vivo (Brooklyn).* 2021;35(2):681-691. doi:10.21873/INVIVO.12308
- Berber O, Dawson-Bowling S, Jalgaonkar A, et al. Bizarre parosteal osteochondromatous proliferation of bone: clinical management of a series of 22 cases. *J Bone Jt Surg Ser B.* 2011;93B(8):1118-1121. doi:10.1302/0301-620X.93B8.26349
- Rueda-de-Eusebio A, Gomez-Pena S, Moreno-Casado MJ, Marquina G, Arrazola J, Crespo-Rodríguez AM. Hereditary multiple exostoses: an educational review. *Insights Imaging.* 2025;16:1. doi:10.1186/S13244-025-01899-6
- Matsui Y, Funakoshi T, Kobayashi H, Mitsuhashi T, Kamishima T, Iwasaki N. Bizarre parosteal osteochondromatous proliferation (Nora's lesion) affecting the distal end of the ulna: a case report. *BMC Musculoskelet Disord.* 2016;17:1. doi:10.1186/S12891-016-0981-3
- Gruber G, Giessauf C, Leithner A, et al. Bizarre parosteal osteochondromatous proliferation (Nora lesion): a report of 3 cases and a review of the literature. *Can J Surg.* 2008;51(6):486-489.
- Washington E, Menendez L, Fedenko A, Tomasian A. Bizarre parosteal osteochondromatous proliferation: Rare case affecting distal ulna and review of literature. *Clin Imaging.* 2021;69:233-237. doi:10.1016/j.clinimag.2020.08.019
- Tiwari V, Dwidmuthe S, Bhikshavarthi Math SA, Roy M, Chaudhari SR. Bizarre parosteal osteochondromatous proliferation (Nora's lesion) affecting carpal bones of the hand in a middle-aged female: a case report. *Cureus.* 2024;16:3. doi:10.7759/Cureus.56772
- Lin J, Wang W, Chen G, Chen C. *Nan Fang Yi Ke Da Xue Xue Bao.* 2013;33(9):1390-1393.
- Zhao T, Zhao H. Computed tomographic image processing and reconstruction in the diagnosis of rare osteochondroma. *Comput Math Methods Med.* 2021;2021. doi:10.1155/2021/2827556
- Chamberlain AM, Anderson KL, Hoch B, Trumble TE, Weisstein JS. Benign parosteal osteochondromatous proliferation of the hand originally diagnosed as osteochondroma: a report of two cases and review. *Hand.* 2010;5(1):106-110. doi:10.1007/S11552-009-9217-4
- Endo M, Hasegawa T, Tashiro T, et al. Bizarre parosteal osteochondromatous proliferation with a t(1;17) translocation. *Virchows Arch.* 2005;447(1):99-102. doi:10.1007/S00428-005-1266-7
- Nishio J, Shinohara Y, Nakayama S, Koga M, Aoki M, Koga T. Bizarre parosteal osteochondromatous proliferation revisited. *In Vivo.* 2025;39(4):1799-1809. doi:10.21873/Invivo.13981
- Garcia SA, Ng VY, Iwamoto M, Enomoto-Iwamoto M. Osteochondroma pathogenesis: mouse models and mechanistic insights into interactions with retinoid signaling. *Am J Pathol.* 2021;191(12):2042-2051. doi: 10.1016/j.ajpath.2021.08.003
- Badders JD, Carmichael KD. Spontaneous resolution of an osteochondroma. *Cureus.* 2023;15:4. doi:10.7759/Cureus.37565

25. Hill CE, Boyce L, Van Der Ploeg ID. Spontaneous resolution of a solitary osteochondroma of the distal femur: a case report and review of the literature. *J Pediatr Orthop Part B*. 2014;23(1):73-75. doi:10.1097/BPB.0000000000000010
26. Altay M, Bayrakci K, Yildiz Y, Ereku S, Saglik Y. Secondary chondrosarcoma in cartilage bone tumors: report of 32 patients. *J Orthop Sci*. 2007;12(5):415-423. doi:10.1007/s00776-007-1152-z
27. Abramovici L, Steiner GC. Bizarre parosteal osteochondromatous proliferation (Nora's lesion): a retrospective study of 12 cases, 2 arising in long bones. *Hum Pathol*. 2002;33(12):1205-1210. doi:10.1053/hupa.2002.130103
28. Paula SHVC de, Cascaes P de SL, Peralta-Mamani M, Soares AB, Junqueira JL, Soares MQS. Bizarre parosteal osteochondromatous proliferation in the jaws: a systematic review. *Oral Maxillofac Surg*. 2025;29(1). doi:10.1007/S10006-025-01352-4
29. Khare GN. An analysis of indications for surgical excision and complications in 116 consecutive cases of osteochondroma. *Musculoskelet Surg*. 2011;95(2):121-125. doi:10.1007/S12306-011-0143-6