

## Review Article

# Chondroblastoma: Is intralesional curettage with the use of adjuvants a sufficient way of therapy?



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## ARTICLE INFO

## Article history:

Received 20 August 2020

Revised 12 November 2020

Accepted 21 November 2020

Available online 5 December 2020

## Keywords:

Chondroblastoma

Adjuvants

Hydrogen peroxide

Intralesional curettage

## ABSTRACT

**Background:** Chondroblastoma is a rare benign cartilaginous bone tumor that represents 1–2% of all primary bone tumors. It is characterized by aggressive growth, possible recurrence after surgical treatment and, in rare cases, metastasis. Surgical management is the primary treatment and includes intralesional curettage with or without adjuvants. Local recurrence rates vary between less than 10% up to more than 30%.

**Methods:** In this retrospective study between 2009 and 2020 we analysed 38 cases of chondroblastoma with a mean follow-up of 27.9 months who underwent a surgical treatment in our institution. Epidemiological data, radiographic and histological examinations, different surgical techniques, complications and local recurrence were evaluated to comment on the question if curettage with or without adjuvants is a sufficient way of therapy.

**Results:** The study includes 25 male (65.8%) and 13 female (34.2%) patients with a mean age of 17.2 (11–51) years. The most common location of manifestation was the proximal epiphyseal humerus (34.2%), followed by the proximal tibia (26.3%) and the distal femur (15.8%). Joint involvement occurred in 28 patients (73.7%). In all cases intralesional curettage was performed; in 25 cases (65.8%) the resulting cavity was filled with bone substitute, in 7.9% (3 cases) with bone cement and in 10.5% (4 cases) with autogenous bone graft. Adjuvant hydrogen peroxide was used in 64.9% of the cases. The overall recurrence rate was 39.5% (15 cases). The following subgroup analysis showed a recurrence rate of 100% (4/4 cases) after curettage and defect reconstruction with autogenous bone. In the case of intralesional curettage and filling of the cavity with bone substitute but without use of adjuvant the recurrence rate was 50% (4/8 cases). A low recurrence rate of 11.8% (2 cases) was observed in the case of intralesional curettage, using hydrogen peroxide as adjuvant (17 cases) and bone substitute for defect reconstruction.

**Conclusions:** Chondroblastoma represents a rare pathology. Therapeutically an aggressive intralesional curettage with use of hydrogen peroxide as adjuvant and filling up the defect with bone substitute leads to low recurrence rates.

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## 1. Introduction

The benign chondroblastoma was identified by Jaffe and Lichtenstein in 1942. They confirmed the cartilaginous origin of the lesion and differentiated it from other epiphyseal lesions as the giant cell tumor of bone [1]. It is a rare, locally aggressive bone tumor that accounts for approximately 1–2% of all benign bone tumors. Males are affected more often than females. It occurs primarily in adolescents and young adults [1]. Chondroblastoma may show pulmonary metastases; malignant transformation of the tumor is described in rare cases [2].

Despite superficial similarities, there are several important differences between the giant cell tumor of the bone and the chondroblastoma. Histologically, cells are different, and clinically the tumors have different characteristics [3]. Chondroblastomas often occur in the epiphysis and apophysis of long bones, giant cell tumors in the meta-epiphyseal region [4]. The most common sites of localization of chondroblastomas are the proximal humerus, the proximal tibia, the proximal and distal part of the femur. The tumor may also occur in the bones of the hand, the foot, the skull or facial bones [2]. Patients with chondroblastoma are mostly adolescents or young adults. However, the peak age for giant cell tumors is in adulthood [3]. Open growth plates have to be considered when aggressive surgery in terms of an intralesional curettage is planned. Limb leg discrepancy or deformities may result from affection of the growth plate during surgical treatment [5].

Clinical manifestations include pain, local swelling, effusion and limited motion of the affected joint [6]. In radiographs chondroblastoma occurs as osteolytic lesion, often with joint affection [7]. The diagnosis can be stated after open or needle biopsy of the lesion.

Surgical treatment is the standard treatment for chondroblastoma [7], especially if the growth plate or joint surface are at risk. Intralesional curettage with or without the use of adjuvants is the most common treatment [7]. Resulting bone defects can be filled up with bone substitute or bone cement. Adjuvants can be the intraoperative use of phenol [1] or hydrogen peroxide [7] for flushing the resulting cavity after curettage [7]. Nevertheless, a marginal or wide resection is an option for selected patients [6]. There are also reports about the use of radiofrequency ablation or radiation with or without combined surgical treatment [8]. Reported local recurrence rates vary between less than 10% and more than 30% [5,6,9,10]. In this study we analyze the efficacy of intralesional curettage with or without the use of bone substitute, autologous bone graft or bone cement for defect reconstruction and the additional use of hydrogen peroxide as adjuvant.

## 2. Materials and methods

This retrospective study analyses 38 cases of chondroblastoma who were treated in the clinic for general orthopaedics and tumor orthopaedics at the university hospital Muenster, Germany between 2009 and 2020. No financial support was received for this study. Epidemiological data, radiographic and histological examinations, different surgical techniques, complications and local recurrence were reviewed. Imaging studies at time of presentation, including radiographs and MR-scans were analysed in each case, especially regarding joint involvement. The diagnosis was stated by histological and immunohistological examination in the pathology department of the university hospital Muenster. The initial treatment consisted of an intralesional curettage with filling up the resulting cavity with bone substitute (synthetic calcium phosphate bone graft), autogenous bone or bone cement (PMMA). The intraoperative use of hydrogen peroxide as an adjuvant was documented. Short- or long-term complications were analysed. Patients

underwent follow-up with clinical and radiographic examinations (radiographs and MR-scans) at three-month intervals in the first two years and at six-month intervals for the following four years.

Statistical analysis was performed with the use of SPSS software, Version 26 (IBM, Armonk, New York, USA). Continuous variables like age and time of follow up were described using the mean and the maximum and minimum. Recurrence rates were analysed by chi-square test with likelihood ratios. Cumulative recurrence-free survival was evaluated by Kaplan-Meier analysis with log-rank testing to determine significant differences.

The study protocol was approved by the regional ethics committee (reference no.: 2020-198-f-5).

## 3. Results

This study includes 38 patients with the diagnosis of a chondroblastoma. Out of these, 25 patients were males (65.8%) and 13 females (34.2%) (Table 1) with a mean age of 17.2 (11–51) years (Table 2). The mean follow up time was 27,9 months. The most common location of manifestation was the proximal humerus (13; 34.2%), followed by the proximal tibia (10; 26.3%), the distal femur (6; 15.8%), the proximal femur (13.2%) and the pelvic region (5.3%; Table 3). In 3 cases (7.9%) the histologically diagnosed chondroblastoma was associated with a secondary aneurysmal bone cyst. Joint involvement occurred in 28 patients (73.7%). In 50% of the cases (19) plain radiographs or CT scans of the lung were performed. No metastases were found in these patients.

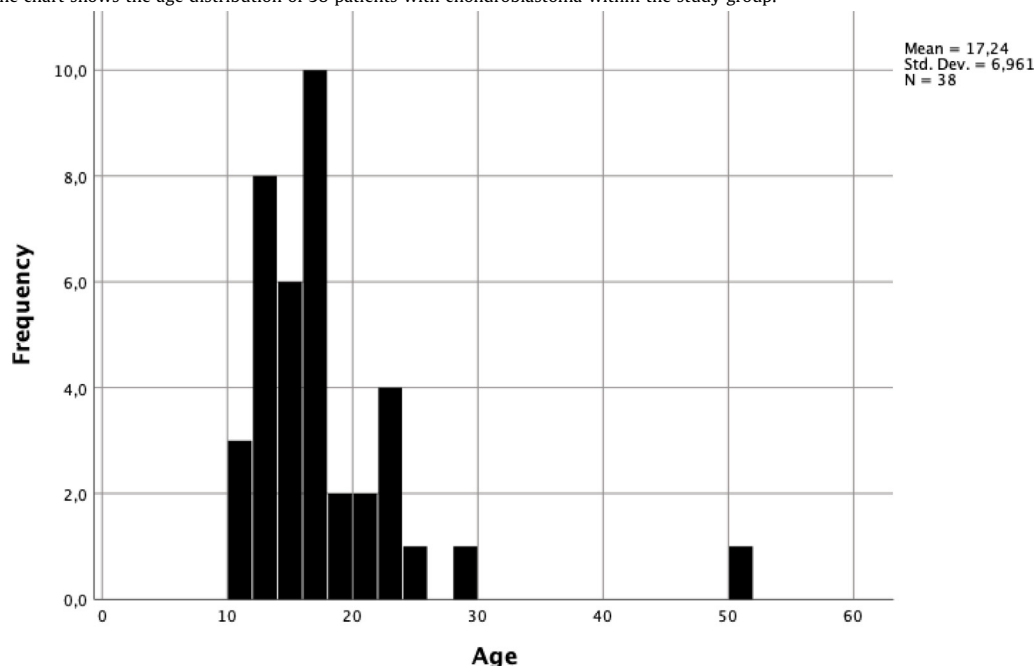
As most common treatment intralesional curettage (Figs. 1–4) was performed. In 24 cases hydrogen peroxide was used as adjuvant (63.2%), in 25 cases (65.8%) the resulting cavity was filled with bone substitute, in 4 cases (10.5%) with autogenous bone graft and in 3 cases (7.9%) with bone cement. Intraoperative complications occurred in 2 cases in the form of a remaining fragment of bone cement in the affected joint resulting in an arthroscopy. In another case an incomplete curettage with a persistence of chondroblastoma was followed by a re-curettage few days after the initial surgery.

The overall recurrence rate after intralesional curettage was 39.5% (15 cases). Locations with the highest local recurrence rate after initial curettage were the pelvic region with 100% recurrence (2/2 patients), the distal femur 66.7% (4/6 patients) and the proximal humerus 46.2% (6/13). Analysing the results of local recurrence regarding defect reconstruction after intralesional curettage statistically significant differences ( $p < 0.01$ ) were found: in the subgroup with autogenous bone filling the recurrence rate was 100% (4 cases), in the subgroup with filling of the cavity with bone cement 66.7% (3 cases) and in the subgroup with filling of the cavity with bone substitute 24% (25 cases). In the subgroup with intralesional curettage, defect reconstruction with bone substitute and additional use of hydrogen peroxide as adjuvant the recurrence rate was 11.8% (2/17). The mean follow-up time until local recurrence arose were 9 months. The standard surgical treatment after initial curettage in case of local recurrence was a re-curettage in 93.3%. Due to secondary arthrosis a hip joint endoprosthesis had to be implanted in one case (Figs. 5–10).

## 4. Discussion

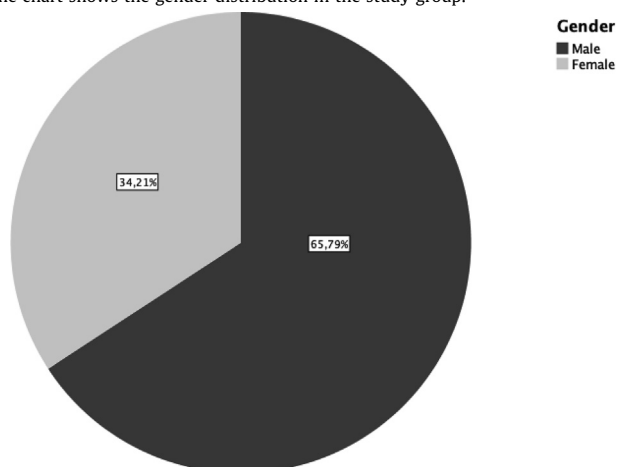
Chondroblastoma is a rare benign cartilaginous bone tumor that represents 1–2% of all primary bone tumors [9,11,12]. Regarding the epidemiology chondroblastoma occurs more often in male than in female patients [1]. In our study male patients represent 65.8%, females 34.2% of the collective; the mean age is 17.2 (11–51) years. This is according to other studies where the peak age is reported to be in adolescence [3,5,9,11]. In literature most common locations

**Table 1**  
The chart shows the age distribution of 38 patients with chondroblastoma within the study group.



for chondroblastoma manifestation are the proximal humerus, the proximal femur and the proximal tibia [13,14]. Our results indicate the proximal humerus (13 cases; 34.2%), followed by the proximal tibia (10 cases; 26.3%) and the distal femur (6 cases; 15.8%) as most common locations. Localization is often described in epiphyses and apophyses. In our study the majority of cases were localized in the epiphyses with joint affection in 28 cases (73.7%). Today, several therapeutic options are debated for a standardized treatment of chondroblastoma. Among them curettage with or without the use of an adjuvant and filling the cavity with autologous bone graft, allogenic bone graft, bone substitute or bone cement (PMMA) are the most common surgical techniques reported in literature [1,15,16]. A more aggressive variant of surgical treatment is a marginal or wide resection [6]. Even cryosurgery using liquid nitrogen as a local adjuvant has been described [11]. Lalam et al. used percutaneous radiofrequency heat ablation to treat chondroblastoma [17].

**Table 2**  
The chart shows the gender distribution in the study group.

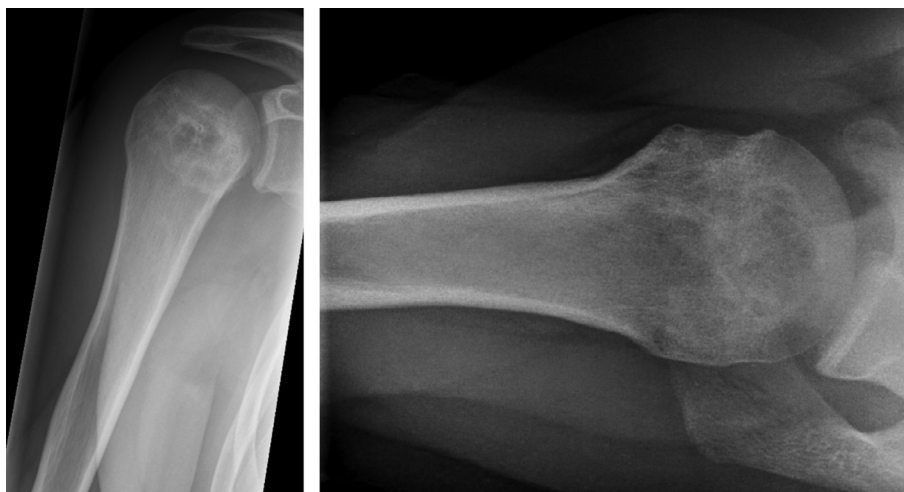


Tomic et al. [15] stated that an aggressive growing chondroblastoma needs an aggressive surgical treatment. Hsu et al. [16] recommended to use a high speed burr for curettage, especially for aggressive lesions. Other adjuvant treatment like phenolization or the use of hydrogen peroxide are described by different authors [1,7,18]. Even bone cement and the resulting heat from the exothermic polymerization can be used as adjuvant. Nevertheless, these adjuvants should be used carefully because of possible damage of articular cartilage, neurovascular structures or the skin [1].

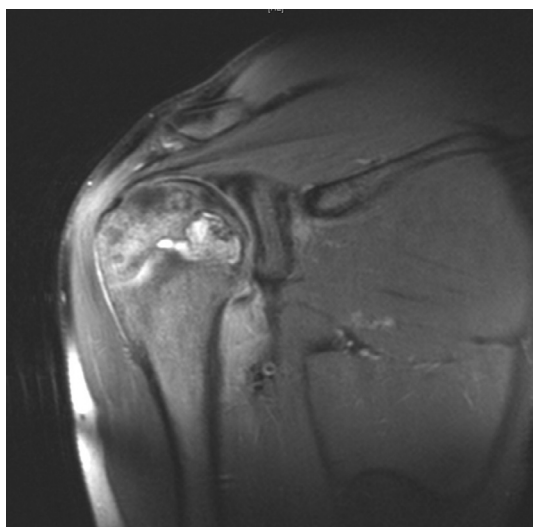
In our study extended intralesional curettage with filling up the resulting cavity with bone substitute was the most common surgical procedure (25 cases). In four cases autologous bone graft was used, in three cases bone cement for defect reconstruction. Our results suggest that both alternative techniques did not result in better recurrence rates. The recurrence rate in the bone cement group was 66.7% and in the bone graft group was 100%; however, it has to be considered that both groups had small number of cases with four and three patients respectively. Lin et al. [3] described a recurrence rate of 8.3% among 48 patients with chondroblastoma where the majority of the patients got a intralesional curettage and defect reconstruction with autologous bone graft. Ebeid et al. [7] did not identify any statistically significant difference of recurrence rates after intralesional curettage and defect reconstruction with bone substitute, bone cement or autologous bone graft in a

**Table 3**  
The table gives information about the localization of chondroblastoma in the study group.

Localization	Frequency	Percent
Prox. Humerus	13	34.2
Prox. Tibia	10	26.3
Dist. Femur	6	15.8
Prox. Femur	5	13.2
Pelvis	2	5.3
Talus	1	2.6
Sternum	1	2.6
Total	38	100.0



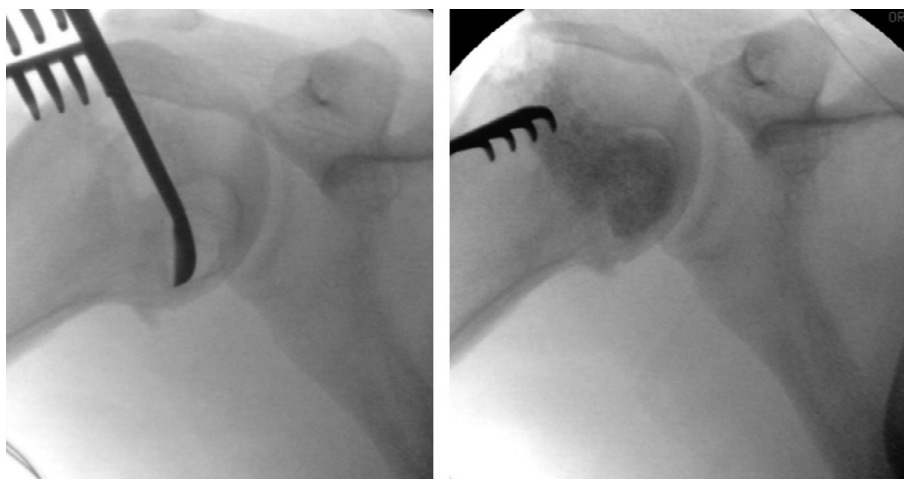
**Fig. 1.** Radiographs of a 17 years old patient show a manifestation of chondroblastoma in the proximal humerus.



**Fig. 2.** Additional MR scan gives information about the extent of chondroblastoma in the proximal humerus.

study with 91 patients with chondroblastoma. However, our study showed significantly different recurrence rates ( $p < 0,01$ ) after intralesional curettage and defect reconstruction with bone substitute, bone cement or autologous bone graft.

Hydrogen peroxide as a local adjuvant is expected to kill potentially remaining tumor cells in the tumor cavity after aggressive curettage. Currently there is no report about the impact of hydrogen peroxide on chondroblastoma cells in literature but Omlor et al. [18] demonstrated in an in-vitro model the impact on tumor cells of giant cell tumors. They stated that the use of hydrogen peroxide reduces “viable tumor cells and leads to induction of apoptosis”. They proved that hydrogen peroxide treatment significantly reduced the recurrence rate and increased cumulative recurrence-free survival in the treatment of patients with giant cell tumor [18]. Ebeid et al. [7] used hydrogen peroxide as adjuvant performing intralesional curettage in a study with 91 patients but could not prove the positive effect with statistical significance. The overall recurrence rate in their study was 3.3%, in 64.8% of cases where hydrogen peroxide was used as adjuvant. Concluding, the authors recommend extended intralesional curettage with the use of a high speed burr and an adjuvant like hydrogen peroxide as treatment for chondroblastoma.



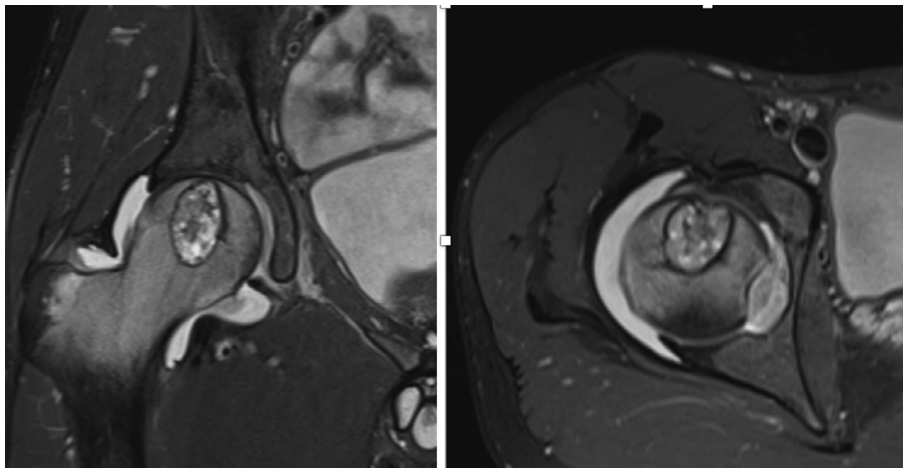
**Fig. 3.** Intraoperative radiographs demonstrate an intralesional curettage and defect reconstruction with bone substitute.



**Fig. 4.** Radiographs 12 months after intralesional curettage and defect reconstruction with bone substitute show a good consolidation without local recurrence.



**Fig. 5.** The initial radiographs show a manifestation of chondroblastoma in the proximal femur of a 17 year old patient.



**Fig. 6.** The initial MR-scan of the same patient gives idea about the extent of chondroblastoma in the femoral head.

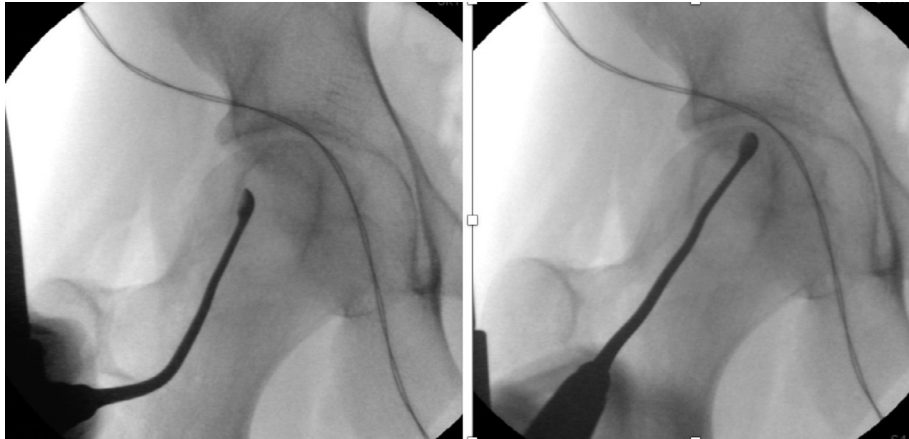


Fig. 7. Within the operation an intralesional curettage and defect reconstruction with bone substitute were performed.

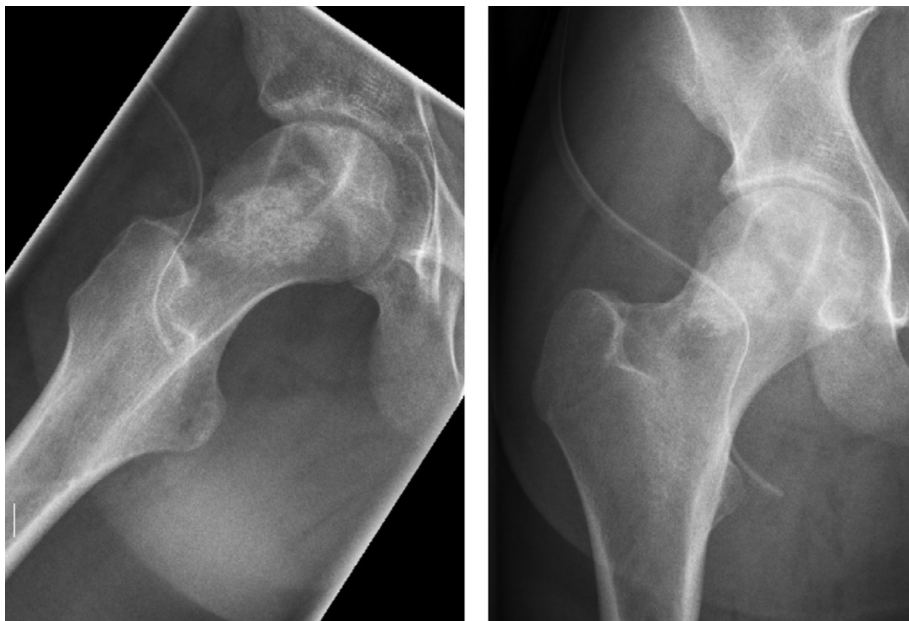


Fig. 8. The postoperative radiographs show defect reconstruction with bone substitute.

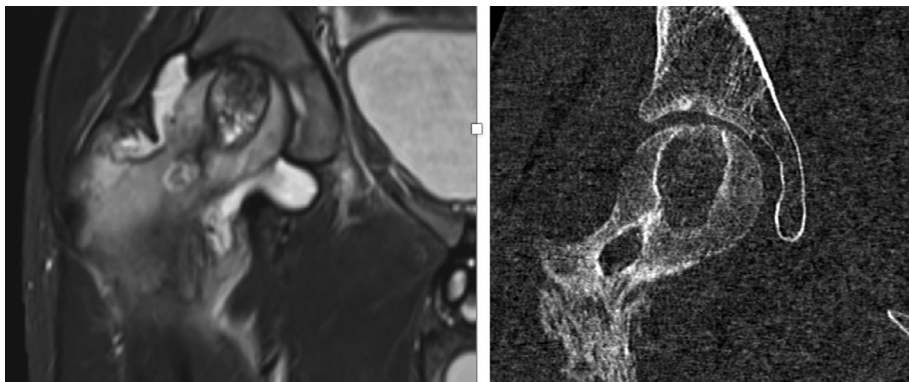


Fig. 9. A, B: a MR-scan (A) and CT-scan (B) scan 4 months after operation show local recurrence of chondroblastoma with progressive destruction of the femoral head.



**Fig. 10.** 5 months after curettage an implantation of a hip endoprosthesis due to local recurrence and secondary arthrosis was performed.

In our study group the overall recurrence rate of 39.5% was comparably high. The following subgroup analysis even showed a recurrence rate of 100% after curettage and defect reconstruction with autogenous bone. In the subgroup of patients with an intralesional curettage and subsequent defect-filling with bone substitute but without use of hydrogen peroxide as adjuvant got a recurrence in 50% of the cases. However, patients of this subgroup treated with hydrogen peroxide showed a significantly lower recurrence rate of 11.8% ( $p < 0,05$ ). Under the treatment of intralesional curettage and subsequent defect-filling with bone substitute and use of hydrogen peroxide as adjuvant our recurrence rates fall within the previously in literature reported range between less than 10% and more than 30% [5,6,9,10]. Thus, this study confirms the positive effect of hydrogen peroxide on the recurrence rate of chondroblastoma after initial curettage.

This study has limitations; it is a retrospective, not randomized study with a limited number of patients and a limited time of follow-up. Therefore, larger studies are necessary to confirm the above mentioned results.

## 5. Conclusions

Chondroblastoma is a rare tumour of the bone. It grows aggressively and tends to local recurrence after intralesional curettage.

Therapeutically an aggressive intralesional curettage with use of hydrogen peroxide as adjuvant and filling up the defect with bone substitute leads to acceptably low recurrence rates and is a sufficient way of therapy.

This is the first review describing the positive effect of hydrogen peroxide as an adjuvant in case of intralesional curettage of chondroblastoma.

Secondary arthrosis can occur after manifestation in the epiphysis and aggressive growth of the tumor destroying the articular surface; this may result in the necessity of joint replacement.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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