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Çukurova Anestezi ve Cerrahi Bilimler Dergisi
2018 Adana

EVALUATION OF RISK FACTORS FOR RECURRENCE IN HAND ENCHONDROMAS, THE EFFECT OF PATHOLOGICAL FRACTURE AND GRAFT SELECTION ON CLINICAL RESULTS

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Abstract

Aim: Enchondroma is the most common tumor of phalanx and metacarpus. Various techniques and methods have already been investigated for a long time. We aimed to examine the clinical and radiological results of curettage and bone substitute used in a broad spectrum of patients with an enchondroma.

Methods: Forty-seven patients operated with the diagnosis of enchondroma were included in the study. Curettage and filling of the cavity with bone substitutes were performed. The mean age of the patients was 29.32±15.08 years, and follow-up was 28.47±25.10 months. Patients who did not comply with standard follow-up protocol were excluded. An experienced orthopedic surgeon evaluated radiological results, and MRI reports and images for patients with recurrences were extracted from the hospital database. Clinical assessment was made according to ROM and observed deformity.

Results: Mean consolidation time was 3.08±2.19 months. The recurrence rate was 6.4%. There was no difference between groups admitted with fracture and w/o fracture, allograft and autograft group in terms of clinical and radiological results.

Conclusions: Curettage and grafting was still an upcoming and safe method for enchondroma.

Keywords: *Enchondroma, curettage, bone substitute*

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Received: 20.09.2022, Accepted: 27.09.2022, Available Online Date: 27.09.2022

Cite this article as: Mirioğlu A, Kıran VC, Kundakcı B, et al. Evaluation of risk factors for recurrence in hand enchondromas, the effect of pathological fracture and graft selection on clinical results. J Cukurova Anesth Surg. 2022;5(3):280-7.

Doi: 10.36516/jocass.1177645

Introduction

Enchondroma is the hand's most common primary bone tumor[1]. Due to their benign nature, they usually do not give any symptoms. In clinical practice, the diagnosis is often made incidentally by radiographs obtained after trauma or other reasons[2]. It can be diagnosed by plane radiographs and, MRI and CT images[3]. Although the treatment is intralesional, curettage alone or placement of autograft, allograft, or other bone substitutes into the cavity is often sufficient. Although enchondromas are defined under the class of benign tumors, the need for treatment is summarized under three main purposes. 1. Confirming histopathological diagnosis, 2. Eliminating the risk of fracture, and 3. preventing the progression of the deformity[4].

Previously, only curettage was recommended for treatment[5-6]. Afterward, it was suggested that the cavity formed after curettage should be filled by the bone substitute[7-8]. Theoretically, the accumulation of osteoprogenitor cells in this region by hematoma due to iatrogenic fracture after curettage and new bone may make this approach rational[4]. However, the weakness of the bone and the time it takes to heal have made it attractive to use bone substitutes to increase mechanical support[9].

In case of fracture at the time of diagnosis, the approach may vary according to different schools. Accordingly, while some authors state that it would be appropriate to wait for the healing of the fracture and to perform curettage and grafting after the union is achieved, they suggest that if surgery is planned after the diagnosis of the fracture, the immobilization period required by the fracture should be included in the immobilization period after the surgery[10].

Two problems encountered in follow-up are tumor recurrence or weakened bone fractures. Although malignant transformation is not typical, it is generally more expected in advanced ages and areas other than the hand. In this article, we retrospectively evaluated the enchondromas encountered at hand.

Materials and Methods

Patients treated with standard curettage with or without graft for hand enchondroma between 2011 and 2020 were retrospectively analyzed, after obtaining ethical approval from the ÇÜTF institute with the decision number 125/21. A total of 47 patients (table 1) were included in the study. Thirty (63.8%) patients were female and 17 (36.2%) were male. Considering the patient's complaints, the first symptoms were pathological fractures in six (12.8%) patients and a painful mass in eleven (23.4%) patients. Pathology was found incidentally in 30 (63.8%) of the patients. In 21 (44.7%) patients, the pathology was seen on the right hand, while in 26 (55.3%) patients on the left. The mean follow-up period was 28.47±25.10 months. Patients without direct radiographs during the pre- and postoperative period, and magnetic resonance images before the operation were not included in the study. The histopathological results of the patients were taken as the criterion for definitive diagnosis. The volume of enchondromas was measured by MRI (figure 1) before the intervention. This guided us in determining the amount of allograft and autograft to be used.

Surgical technique

Indications for patients who underwent surgery were pain, progressive deformity, or enchondroma causing problems using the involved finger. Informed consent forms have also elucidated the patients regarding graft material. The choice of allograft or autograft was left to the patient. Autograft was used in 37 (78.7%) patients and allograft was used in five (10.6) patients. X-ray examinations were taken with a standard cartridge, and a digital low dose to determine the presence of calcification in the bone and accompanying soft tissue. To determine the natural structure of the deformed bone, ra-

diographs were obtained bilaterally. Evaluation of the ultimate pathology was made according to size, shape, contour, extent, and topography. In adult patients, if an autograft will be used, the graft will be taken from the iliac wing of the patient, so the surgery was performed under general anesthesia. In pediatric patients, general anesthesia was used regardless of the type of bone replacement. Regional anesthesia was used in 9 patients. General anesthesia was applied to 38 patients.

After determining the proximal and distal borders of the mass under the fluoroscopy imaging device, appropriate incisions were made. The window was created equal to the tumor size to see the entire lesion (figure 2). An angled or ring-shaped curette was used. Curettage with bone burr was added to contribute to mechanical curettage in all cases. Thermal damage was achieved with electrocautery inside the cavity. Afterward, the cavity was filled with autograft or allograft. The construct was strengthened with two crossed K wires or a plate if there was a concomitant pathological fracture or severe weakening of the bony cortex. The previously removed cover was also subjected to the processes that the cavity was exposed to and placed in its original place. The periosteal repair was performed first, and the remaining layers were adequately closed. A short arm splint was applied for pain and edema control for three weeks.

Follow-up

The patients who had no problems after the operation were discharged after wound dressing on the first day. The sutures were removed in the 2nd week, and the splint was removed in the 3rd week. After the splint, a gentle passive motion was started. The active movement was started after consolidation seen on X-ray or fracture healing.

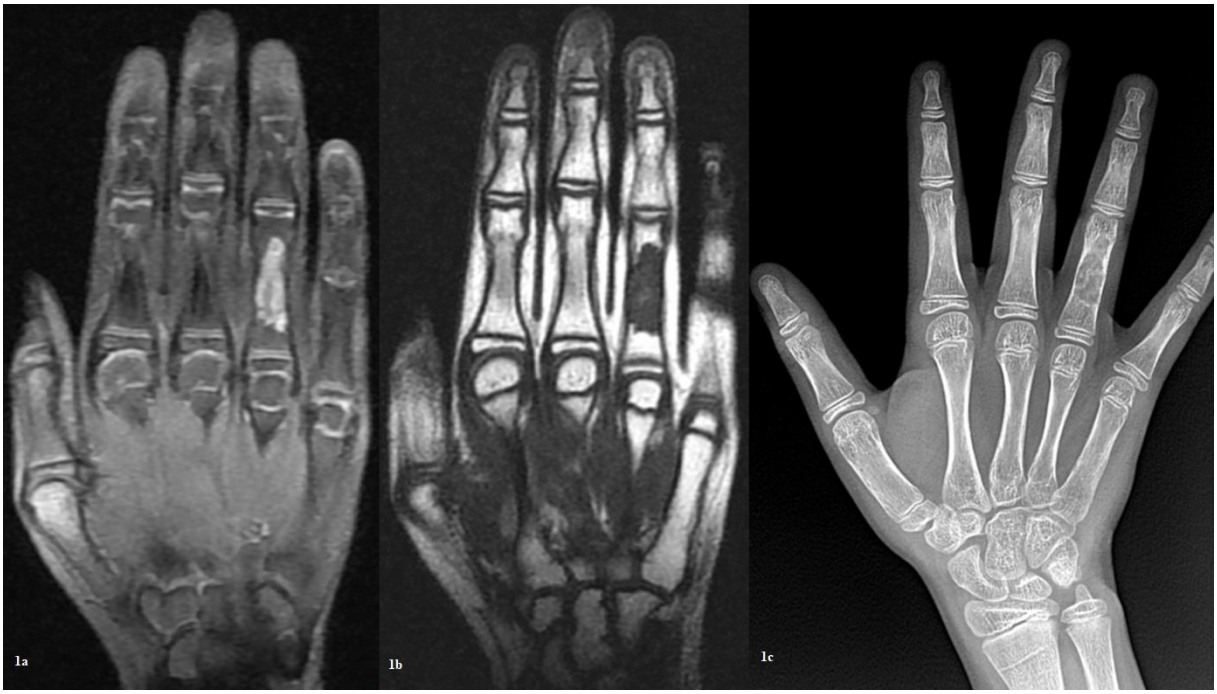

Figure 1. MRI and X-ray samples of a patient with enchondroma in the fourth metacarpal
1a: MRI T2 sequence image
1b: MRI T1 sequence image
1c: X-Ray image

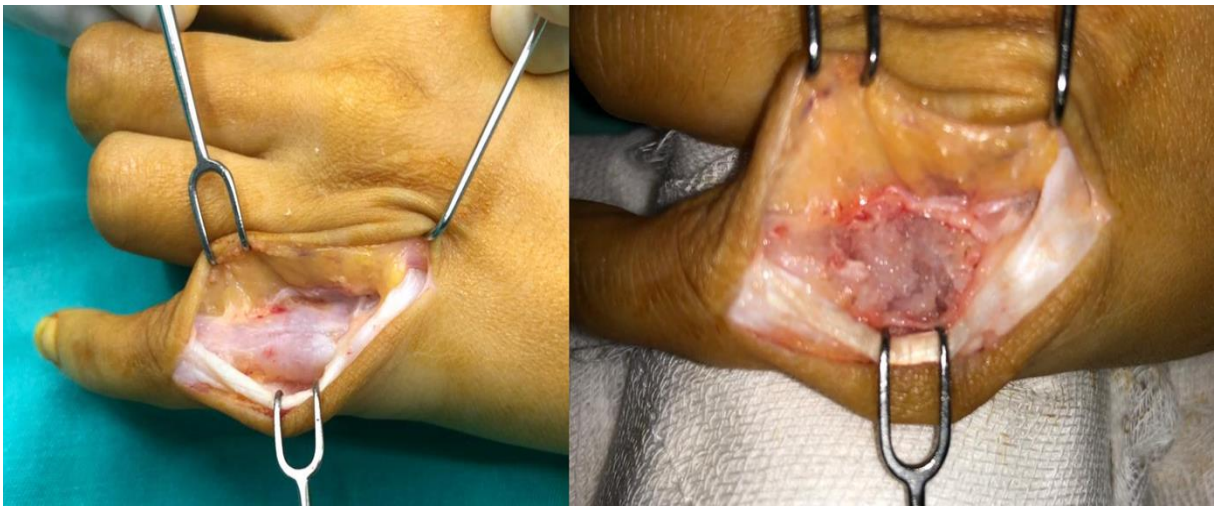

Figure 2. Intraoperative view of the patient who was operated for enchondroma in the left-hand 5th metacarpal

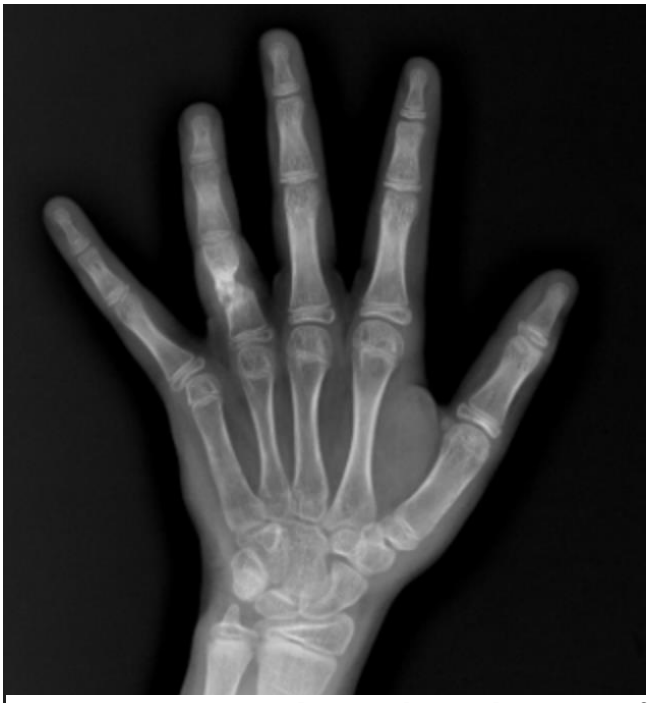

Figure 3. Recurrence direct radiography image of the patient who was operated for 4th finger proximal phalanx enchondroma

Patients were called to the outpatient clinic on the 6th, 12th,18th, 24th week, and every three months for regular follow-up. X-rays of the patients were obtained. MRI was requested if there was a finding suggestive of recurrence in or around the curetted and grafted area. Criteria for functional assessment were loss of motion (<20% compared to the contralateral limb), scar formation, residual deformity and classified as good, fair and poor[6].

Statistics

SPSS 23 package program was used for statistical analysis of the data. Categorical measurements were summarized as numbers and percentages, and continuous measurements as mean and standard deviation (median and minimum-maximum where appropriate). Chi-square test or Fischer test statistics were used to compare categorical variables. In the comparison of continuous measures between the groups, the distributions were controlled, the Student T test was used for the variables that met the parametric distribution prerequisite, and the Mann Whitney U test was used for the MCA variable that did not meet the parametric distribution prerequisite. Repeated Measurement Variance analysis was used in the pre- and postoperative evaluations of AI. Statistical significance level was taken as 0.05 in all tests.

Table 1. Patients characteristics

PATIENTS	AGE	GENDER	FOLLOW-UP	BONE	SIZE	LAST DEFORMITY	SUBSTITUTE	SIDE	RECURRENCE	FRACTURE	HİSTOPATHOLOGY	FIXATION	CONSOLIDATION	FUNCTION
1	24	M	92	METACARP	32	NA	OTO	LEFT	NA	ACUTE	ENCHONDROMA	PLATE	4 MONTHS	GOOD
2	23	M	38	PHALANX	18	NA	OTO	LEFT	8 MONTHS	ACUTE	ENCHONDROMA	PLATE	6 MONTHS	GOOD
3	39	F	112	METACARP	19	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	4 MONTHS	MODERATE
4	27	F	30	METACARP	26	40 DEGREE FLEX	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	5 MONTHS	GOOD
5	31	F	108	METACARP	21	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	5 MONTHS	GOOD
6	25	M	8	PHALANX	23	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	PLATE	2 MONTHS	GOOD
7	20	F	25	PHALANX	20	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	5 MONTHS	GOOD
8	23	F	24	PHALANX	10	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	13 MONTHS	GOOD
9	49	F	76	PHALANX	15	18 DEGREE FLEX	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	5 MONTHS	GOOD
10	38	M	23	PHALANX	24	14 DEGREE EXT	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	8 MONTHS	GOOD
11	40	M	27	PHALANX	15	NA	ALLO	LEFT	NA	INTACT	ENCHONDROMA	NA	4 MONTHS	MODERATE
12	10	F	32	PHALANX	28	PSEUDO 32 DEGREE FLEX	ALLO	LEFT	NA	INTACT	ENCHONDROMA	NA	3 MONTHS	GOOD
13	37	M	24	METACARP	11	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	3 MONTHS	GOOD
14	10	M	36	METACARP	28	NA	OTO	LEFT	NA	ACUTE	ENCHONDROMA	NA	1.5 MONTHS	GOOD
15	4	M	28	PHALANX	17	NA	ALLO	RİGHT	NA	INTACT	ENCHONDROMA	NA	3 MONTHS	GOOD
16	4	F	36	PHALANX	28	NA	ALLO	RİGHT	NA	INTACT	ENCHONDROMA	NA	2 MONTHS	GOOD
17	25	F	25	PHALANX	9	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	3 MONTHS	MODERATE
18	34	M	18	PHALANX	12	18 DEGREE EXT	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	3 MONTHS	GOOD
19	41	M	28	PHALANX	18	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	6 MONTHS	MODERATE
20	33	F	36	PHALANX	15	NA	AMP	RİGHT	NA	INTACT	ENCHONDROMA	NA	NA	NA
21	2	F	18	METACARP	5	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	1.5 MONTHS	GOOD
22	54	M	18	PHALANX	28	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	3 MONTHS	GOOD
23	46	F	62	METACARP	8	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	2 MONTHS	GOOD
24	26	F	12	PHALANX	35	NA	AMP	LEFT	NA	INTACT	ENCHONDROMA	NA	NA	NA
25	62	F	50	METACARP	16	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	2 MONTHS	MODERATE
26	7	F	12	PHALANX	32	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	2 MONTHS	MODERATE
27	44	F	45	METACARP	12	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	2 MONTHS	GOOD
28	14	F	12	PHALANX	18	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	1.5 MONTHS	GOOD
29	19	F	14	PHALANX	19	10 DEGREE EXT	OTO	LEFT	NA	INTACT	ENCHONDROMA	PLATE	1.5 MONTHS	GOOD
30	31	M	24	PHALANX	14	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	3 MONTHS	GOOD
31	29	F	6	METACARP	10	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	1.5 MONTHS	GOOD
32	19	F	12	PHALANX	22	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	2 MONTHS	GOOD
33	54	F	9	METACARP	9	NA	NA	RİGHT	NA	INTACT	ENCHONDROMA	NA	2 MONTHS	GOOD
34	18	F	22	METACARP	16	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	4 MONTHS	GOOD
35	43	F	35	METACARP	16	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	1.5 MONTHS	GOOD
36	43	M	6	METACARP	19	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	4 MONTHS	MODERATE
37	11	F	36	METACARP	8	NA	NA	LEFT	NA	INTACT	ENCHONDROMA	NA	1.5 MONTHS	GOOD
38	17	M	36	METACARP	24	NA	OTO	LEFT	NA	ACUTE	ENCHONDROMA	K-WIRE	3 MONTHS	GOOD
39	26	F	6	PHALANX	7	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	1.5 MONTHS	MODERATE
40	31	M	18	PHALANX	20	NA	ALLO	LEFT	NA	INTACT	ENCHONDROMA	NA	3 MONTHS	POOR
41	30	F	13	PHALANX	15	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	1.5 MONTHS	GOOD
42	14	F	6	METACARP	9	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	1.5 MONTHS	GOOD
43	9	F	12	PHALANX	14	NA	OTO	LEFT	3 MONTHS	ACUTE	ENCHONDROMA	NA	6 MONTHS	POOR
44	48	F	4	PHALANX	6	NA	OTO	RİGHT	NA	ACUTE	ENCHONDROMA	NA	1.5 MONTHS	MODERATE
45	43	M	6	PHALANX	5	NA	OTO	LEFT	NA	INTACT	ENCHONDROMA	NA	1.5 MONTHS	GOOD
46	42	F	12	PHALANX	15	NA	OTO	RİGHT	NA	INTACT	ENCHONDROMA	NA	2 MONTHS	GOOD
47	51	M	6	METACARP	18	25 DEGREE FLEX	OTO	LEFT	3 MONTHS	INTACT	ENCHONDROMA	NA	6 MONTHS	MODERATE

Results

The mean postoperative consolidation time was 3.09±2.19 months. Recurrence (figure 3) was seen in three patients (6.7%) during the follow-up period. The mean time to recurrence was four months. No chondrosarcoma or an alternative pathology was detected in any patient. No correlation was found between enchondroma size and recurrence (p=0.677) Deformity was observed in seven patients (14.9%) at the last follow-up. Flexion (20.3 degrees) deformity was observed in three patients, and extension (18.5 degrees) deformity was observed in four patients. Flexion deformity was observed in three patients and extension deformity was observed in four patients. Fixation was applied to five (10.6%) patients. While deformity was observed in one patient who was fixated, deformity was observed in 6 of 36 patients who were not fixated. It was shown that the application or non-application of fixation did not cause a significant difference in the development of deformity (p=0.571). There was no significant difference in union time in patients who used allograft and autograft. Two (4%) patients underwent amputation at the appropriate level. Two (4.25%) patients had poor results due to dense scar tissue on the dorsum of the hand. While moderate results were obtained in 10 (21.27%) patients, good results were obtained in 33 (70.21%) patients. Two amputated patients were not included in the functional evaluation. Whether there was a fracture at the time of admission and whether fixation was applied or not had no effect on the functional outcome.

Discussion

In the historical process, many studies have been carried out on the treatment of patients with enchondroma. In our study, we showed that curettage and grafting are effective methods in hand enchondromas. Enchondroma was diagnosed in all patients included in the study as a result of X-ray and MRI, and histopathology was consistent with enchondroma in all patients. In this context, we believe that direct X-ray and MRI will be sufficient to diagnose enchondroma. In addition, we found that surgery performed without waiting for union in the presence of pathological fractures did not differ from surgery performed after union in terms of postoperative complications or long-term deformity. Regarding selected graft materials, using autograft or allograft did not affect the treatment results.

Treatment of enchondromas of the hand was initially reported as a plan with curettage alone. However, placing a bone substitute into the created cavity has become popular, although it has remained a debatable topic[4-11]. We put a bone substitute in the cavity in patients, and we believe that such an approach would be more reliable, considering that the consolidation period is not long, which will pose a risk in terms of fractures and deformities that may occur after the cavitary wall is thin in patients. However, we did not ignore the necessity of supporting these two approaches with randomized controlled studies.

At the time of diagnosis, accompanying pathological fracture with existing pathology is common in hand enchondromas. About 40% of the patients are admitted to the hospital with fractures. The fracture rate of the patients in our study was %12.8. Our institute is a tertiary health institute, and patients with fractures could be treated in other institutes since they were admitted to the emergency department. In our research, most cases were either referred from other institutes or preferred to be treated in tertiary health centers. This could explain the inconsistency with the literature. While some authors advocate simultaneous surgery for fracture and pathology, some recommend surgery for pathology following the healing of the fracture[12-14]. We generally think that the view in the first part would be more practical and logical. We are considering that the majority of the fractures occurring in the finger fractures are unstable and the possibility of reduction loss in the

follow-up with conservative treatment; when the union occurs, the deformity caused by the pathology may make the subsequent surgery more complicated due to the additional deformity risk of malunion that will appear as a result of fracture healing. The similar cosmetic and functional outcomes in our patients with acute fractures at the time of diagnosis can be explained by the fact that the consolidation time of the bone placed in the cavity and the time required for fracture healing is similar. In the literature, recurrence rates in enchondromas range from 0% to 13%. Two propositions stand out in this regard[15]. First, relapse cases are usually seen in the early postoperative period and require more frequent follow-up of patients in the early postoperative period. Second, recurrent enchondromas may be low-grade chondrosarcomas. Of the patients we included in our study 6.7% There were recurrences. The mean recurrence time was 4 months. This is consistent with the first proposition. The mean age of the patients with recurrence was 11.67. Considering the age of the patients and the fact that none of them had Ollier's disease, which increased the susceptibility to malignancy, we think this situation does not comply with the second proposition. Moreover, the histopathology results of the patients support this situation.

There are studies on the relationship between the difference in graft materials used and the recurrence rates[16]. Although some studies have reported that recurrence rates are higher in patients using allografts, there are also publications showing that autograft use also increases recurrence rates[15]. In a study evaluating the clinical results of using different grafts, it was revealed that the recurrence rates in both groups were similar and even similar to the placebo groups that did not use a bone substitute[16]. Our study shows that it is not related to the use of different bone substitutes in terms of recurrence rates. At this point, we think that using any of the graft options to be preferred in hand enchondromas will not make a difference in patient outcomes.

One weakness of the study was significant differences between number of cases in each group. X-Rays, MRI were evaluated by single surgeon which could lead to bias. Besides, study groups were purified. The patients with osteochondromatosis, Ollier, and Mafucci disease were excluded which could lead to the misinterpretation of the results in cases of recurrences or possible malignancy. These are the main weakness of the study.

Enchondromas are among the most common cases encountered in the clinical practice of clinical orthopedic and hand surgeons. The fact that it can cause pathological fracture and deformity depending on its progression confirms the need for treatment. In this context, surgical curettage and placement of bone substitutes into the cavity are sufficient in terms of clinical and radiological results, regardless of the nature of the placed substitute, whether there is an accompanying fracture or not at the time of application.

Author contributions

All authors contributed to the study conception and design. All authors read and approved the final manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

Funding

Authors declared no financial support.

Ethical approval

This study was approved by the Institutional Investigation and Ethics Committee with the approval number of "125/21" -2022 and conducted at Cukurova University in Turkey

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