

ISOLATED CAUTERIZATION AS AN ADJUVANT IN THE TREATMENT OF BENIGN BONE TUMORS

LUIZ EDUARDO MOREIRA TEIXEIRA¹, RICARDO HORTA MIRANDA², OTAVIO DE LUCA DRUDA¹,
JOÃO GARCIA DE AZEVEDO NETO², GRAZIANE DIEGO SANTOS RAJÃO²

ABSTRACT

Objectives: To evaluate the efficacy of cauterization as a sole adjuvant method in intralesional resection of benign bone tumors, taking into account associated factors that could influence local recurrence. **Methods:** 47 patients diagnosed with different benign bone tumors were included in this study, all of whom had been treated with curettage associated with cauterization as an adjuvant method. The medium follow-up was 32.7 ± 19.4 months. The recurrence rate was then evaluated in relation to age, sex, location of the tumor, histologic type, tumor grade (

B1, B2 or B3), and size and type of material used to fill the tumor cavity (PMMA or autologous bone). The type and percentage of complications were also included in the analysis. **Results:** Global recurrence was 19.1%. There was statistical significance relating tumor grade to time to recurrence ($p=0.028$). No other factors were found that directly correlated with global recurrence of the tumors. **Conclusion:** Cauterization proved to be a simple, inexpensive and effective adjuvant method for the treatment of benign bone tumors. **Level of Evidence:** Level IV, case series.

Keywords: Bone neoplasms. Bone and bones. Recurrence.

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INTRODUCTION

Benign bone tumors represent a heterogeneous group of bone lesions with variable histological characteristics and biological behavior. Although rarely lethal, they can result in important alterations of the bone architecture, causing not only mechanical fragility but also destruction of the adjacent joints.¹

These tumors are classified by the histological aspect or by their behavior and aggressiveness, where the staging system proposed by Enneking *et al.*² that divides tumors into latent (B1), active (B2) and aggressive (B3) is used the most often. The treatment of these lesions ranges from simple curettage to ample resection. Although simple curettage presents a greater risk of recurrence, ample resection increases morbidity and usually presents precarious functional results.³ Treatment should then be individualized, aiming to reduce recurrence and to preserve function.

Initial studies showed that simple curettage presented high local recurrence,⁴ especially in aggressive tumors. To reduce recurrence, various adjuvant methods were described, such as cryosurgery and intralesional application of phenol or ethanol.³ The use of these adjuvants reduces recurrence, but can increase complications such as pathological fractures and injury of adjacent soft tissues. Cauterization is a simple, low-cost method of easy access, but few studies describe its isolated

use as a method adjuvant to intralesional resection of benign bone tumors.

The aim of this study is to evaluate the results of isolated cauterization as a method adjuvant to the intralesional resection of benign bone tumors and the factors associated with the recurrence of these lesions, comparing its results with other methods described in literature.

PATIENTS AND METHOD

The study was approved by the ethics committee of the Orthopedics and Traumatology Service of Hospital das Clínicas da Universidade Federal de Minas Gerais (HC - UFMG) and of Santa Casa de Belo Horizonte.

During the period from January 2002 to March 2008, 71 patients diagnosed with benign bone tumors were submitted to surgical treatment in the Orthopedic Oncology Service of HC - UFMG and of Santa Casa de Belo Horizonte. Forty-seven patients were included in the study, in which the treatment consisted of curettage and isolated cauterization with as an adjuvant method. Patients that were submitted to simple segmental resection ($n=5$), to reconstruction with conventional prostheses ($n=2$), reconstruction with non-conventional prostheses ($n=8$), reconstructions with arthrodesis ($n=1$) and patients with follow-up of less than six months ($n=9$) were excluded from the study.

All the authors declare that there is no potential conflict of interest referring to this article.

1 – Orthopedic Oncology Service of Hospital das Clínicas da Universidade Federal de Minas Gerais, Brazil.

2 – Orthopedic Oncology Service of Santa Casa de Belo Horizonte, MG, Brazil.

Study conducted at the Orthopedic Oncology Service of Hospital das Clínicas da Universidade Federal de Minas Gerais e da Santa Casa de Belo Horizonte. MG, Brazil. Mailing address: Rua Pio Porto de Menezes 179, apto 101, Bairro Luxemburgo, Belo Horizonte – MG, Brazil. CEP: 30380-300. E-mail: luizmteixeira@yahoo.com.br

The average age of the patients was 27.0 ± 12.8 years, with 32 (68.1%) males and 15 (31.9%) females. Follow-up time was 32.7 ± 19.4 (ranging from seven to 79 months). The patients were staged as proposed by Enneking *et al.*² and two (4.3%) patients were classified as B1, 27 (57.4%) as B2 and 18 (38.3%) as B3. All the cases, except for two patients (clinical diagnosis of non-ossifying fibroma) were confirmed by incisional biopsy using a trephine needle, and the histological types are listed in Table 1.

The average size of the tumors was 8.4 ± 3.8 cm (minimum of 1.5 cm and maximum of 18 cm). The femur was the most common location, affected in 14 (29.8%) patients. (Table 2)

Table 1. Histological types of benign tumors.

Tumor	n	Frequency (%)	Accumulated Frequency (%)
GCT	24	51.1	51.1
ABC	11	23.4	74.5
CHONDROBLASTOMA	5	10.6	85.1
OSTEOBLASTOMA	2	4.3	89.4
CMF	3	6.4	95.7
NOF	2	4.3	100
TOTAL	47	100	100

Caption: GCT – giant cell tumor, ABC – aneurysmal bone cyst, CMF – chondromyxoid fibroma, NOF – non-ossifying fibroma.

Table 2. Distribution of tumors by anatomical location.

Location	n	Frequency (%)	Accumulated Frequency (%)
Proximal femur	4	8.5	8.5
Diaphyseal femur	1	2.1	10.6
Distal femur	11	19.1	29.8
Proximal tibia	9	23.4	53.2
Diaphyseal tibia	2	4.3	57.4
Distal tibia	6	12.8	70.2
Talus	2	4.3	74.5
Forefoot	1	2.1	76.6
Pelvis	4	8.5	85.1
Proximal humerus	4	8.5	93.6
Distal humerus	1	2.1	95.7
Distal radius	1	2.1	97.9
Rib	1	2.1	100
TOTAL	47	100	100

Source: SAME HC – UFMG, Santa Casa - BH.

Surgical treatment consisted of lesion opening through a wide bone window, which provided a view of the entire tumor cavity, allowing curettage with curettes in a series of sizes, until complete removal of the whole macroscopic tumor. The cavity was washed with margin expansion through abrasion boring. Caulerization was performed all over the cavity, under direct visualization until the whole surface takes on a darkened appearance due to debris carbonized for 5 minutes. (Figure 1) After a further pulsatile washing with 0.9% saline solution, the cavity was filled by autograft, bioceramics or polymethylmethacrylate (PMMA).

The cavity defect was filled with autologous bone graft in 28 (59.6%) patients and with PMMA in 19 (40.4%) cases. The autogenous cortico-cancellous graft was simple in 22 (46.8%) patients, structured in one (2.1%) case and combined in two (4.3%) and associated with bioceramics in three (6.9%) patients. The patients were monitored weekly until complete healing of the surgical site, then had monthly follow-up until the sixth postoperative month. From then on, they had clinical and radiographic follow-up every three months and follow-up through computed tomography or magnetic nuclear resonance of the surgical site. Simple chest x-rays were taken annually. In case of recurrence, the patients underwent further staging and a new local surgical procedure, including further curettage or resection with broad margins and reconstructions using prostheses or autografts.

Global recurrence was assessed and correlated with the following variables: age (above or below 20 years), gender, location (upper or lower limbs), histological type, staging (B1, B2, B3), size (larger or smaller than 10 cm), type of material used as filling (PMMA or bone graft). The rate and the type of postoperative complication were also analyzed.

The data were evaluated through simple descriptive analysis and based on survival curves by the Kaplan-Meier method. The univariate analysis was conducted through the survival curves with the log rank method and the multivariate analysis was conducted through the Cox model, considering p values ≤ 0.05 significant. The statistical study was carried out with the help of version 12.0 SPSS[®] software (Chicago, USA).

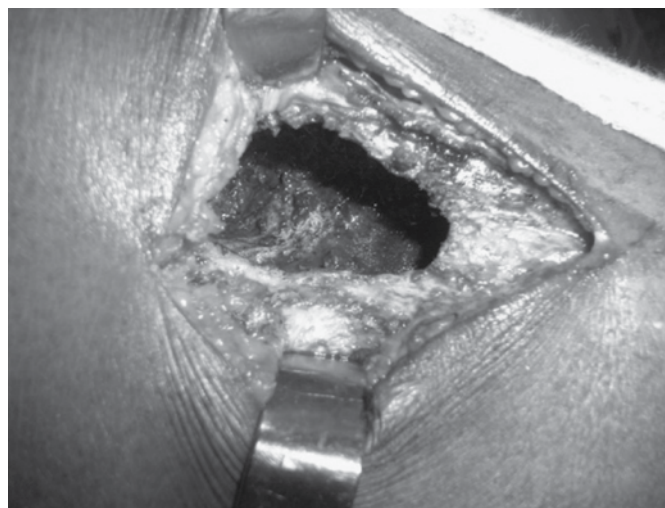


Figure 1. Preoperative aspect after performance of curettage and cauterization.

RESULTS

Relapse occurred in nine (19.1%) patients, with mean time of 14.0 ± 14.6 months. As regards the histological type, recurrence was observed in five (20.8%) cases of giant cell tumor (GCT), two (18.0%) of aneurysmal bone cyst (ABC), one (20%) of chondroblastoma and one (33.3%) of chondromyxoid fibroma (CMF). In the univariate analysis, age ($p=0.524$), gender ($p = 0.217$), location ($p=0.581$) and bone with tumor ($p=0.928$) did not present significant correlation with local recurrence. In the comparison among histological types no greater occurrence was observed in a specific type of tumor either ($p=0.246$). As regards lesion size, there was no significant correlation with recurrence ($p=0.642$).

Staging was not a variable that presented correlation with recurrence ($p=0.245$); however, the recurrence of B3 tumors occurred at an average 6.4 ± 2.0 months; while the B2 tumors recurred at 23.5 ± 18.7 months, considered a statistically significant difference ($p=0.028$). (Figure 2)

Regarding the type of surgery performed, relapses occurred in six (30%) patients submitted to filling with autograft and in three (18%) of the patients submitted to reconstruction with PMMA; however, this difference was not significant in the univariate analysis ($p=0.345$).

In evaluating complications, we observed four patients that presented postoperative complications with two (4.4%) cases of fracture and one (2.2%) of infection.

The multivariate analysis conducted through the Cox model did not show significance among the studied variables either.

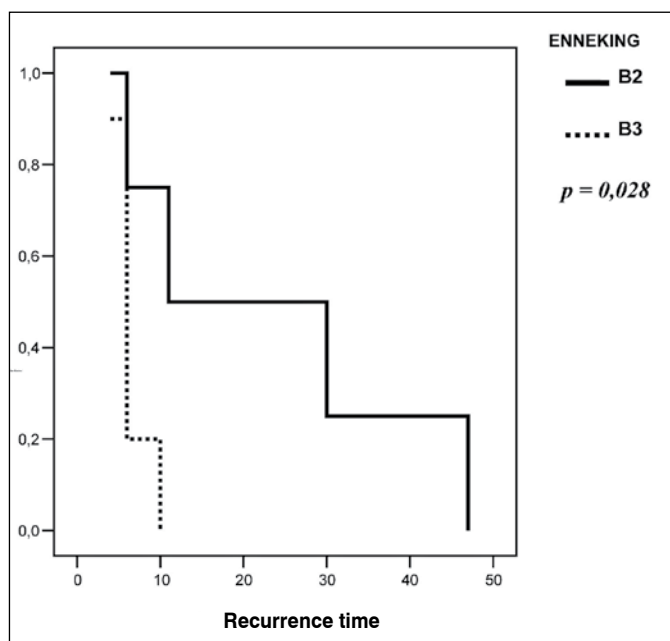


Figure 2. Local recurrence time according to the staging of Enneking et al.² (months).

DISCUSSION

The treatment of benign bone tumors is based on histological type, location, size and the biological behavior of these lesions. The main challenge in the treatment of these tumors

is to balance low surgical morbidity with acceptable rates of local recurrence.

Initial reports of simple curettage, especially of giant cell tumors, showed recurrence rates of up to 60%, suggesting more aggressive methods for local control of these lesions.⁵ Capanna et al.⁶ obtained recurrence of 45% in 280 patients treated with curettage compared to 18% in 387 in which some adjuvant method was added. The use of ample curettage, in association with local boring and chemical adjuvants, reduced recurrence especially in more aggressive tumors (B3); yet the choice of the ideal adjuvant method is still controversial.³⁻⁵

Several methods have been described in literature and have resulted in different recurrence rates.³⁻¹⁸ (Table 3) The most frequently used include application of phenol, cryotherapy and cavity filling with PMMA.

Phenol is used extensively as an adjuvant. After curettage, the phenol is sprayed inside the lesion or applied with the help of a swab, causing tissue necrosis at a depth of around 1 to 2mm.¹⁹ As it is extremely caustic, it must be handled with care, protecting the adjacent soft tissues. Moreover, it can be absorbed and result in undesirable effects in other organs such as the heart, lungs and liver.

Table 3. Local recurrence according to different adjuvant methods.

Author	Tumor	Patients (n)	Adjuvant	Recurrence
Capanna et al, 1990 ⁶	GCT	280	None	45%
Saglick et al, 1999 ⁷	GCT	21	None	33%
O'Donnell et al, 1994 ⁸	GCT	49	PMMA	24%
Turcotte et al, 2002 ⁹	GCT	62	PMMA	19%
Capanna et al, 1990 ⁶	GCT	147	Phenol	19%
Su et al, 2004 ¹⁰	GCT	56	Phenol	18%
Malawer et al, 1999 ¹¹	GCT	86	Cryotherapy	3%
Turcotte et al, 2002 ⁹	GCT	10	Cryotherapy	0%
Zhen et al, 2004 ¹²	GCT	92	Zinc hydrochloride	13%
Ghert et al, 2002 ¹³	GCT	47	Phenol + PMMA	13%
Ward and Li, 2002 ¹⁴	GCT	24	H ₂ O ₂ + phenol + cauterization	8%
Jones et al, 2006 ³	GCT	31	Ethanol	16%
Ramírez and Staton, 2002 ¹⁵	ABC	29	None	27,5%
Ozaki et al, 1997 ¹⁶	ABC	35	PMMA	23%
Ozaki et al, 1997 ¹⁶	ABC	30	None	60%
Marcove et al, 1995 ¹⁷	ABC	51	Cryotherapy	18%
Garin and Wang ¹⁸	Chondroblastoma	10	None	20%

GCT – giant cell tumor; ABC – aneurysmal bone cyst; PMMA – polymethylmetacrylate

Another method is cryotherapy, performed through the application of liquid nitrogen in the cavity with protection of the adjacent tissues using heated saline solution. The nitrogen acts by creating intracellular ice crystals, which will injure the cell membrane and cause necrosis of the exposed tissue, reaching a depth of about eight to 10mm.²⁰ It has a higher cost and its main complication is fracture resulting from persistent bone lesion.¹⁷ In our study, we used cauterization on its own as an adjuvant method. Some studies report its use, but in association with other methods such as phenol application.¹⁵ We observed that it is a simple, easily applicable method that resulted in recurrence in 19.1% of the cases, compatible with most studies from literature that used other adjuvants.⁵⁻¹⁷ We also observed that the rate of complications is low, with little repercussion in the adjacent tissues and with a low cost of use.

A controversial point is the use of PMMA as an adjuvant. Some studies suggest that PMMA would increase the tumor resection margin due to thermal and cytotoxic effects; however, other studies showed similar rates of recurrence with or without filling with PMMA after GCT curettage²¹. In this study, we observed that, although not significant, in tumors completed with PMMA

recurrence was 18%, while those filled with autograft had recurrence of 30%, suggesting that the use of cement can help in the local control of benign bone tumors, which is consistent with the findings of Camargo *et al.*²², who suggests adjuvant action of the bone cement. PMMA also presents the advantages of immediate mechanical stabilization and ease in recurrence identification.²

Our study also observed that tumors considered aggressive (B3) recur earlier than active tumors (B2), suggesting that less aggressive benign tumors should also be monitored for longer periods of time.

We also observed a low incidence of complications that occurred in 6.7% of the cases. The risk of pathological fracture was also lower than other methods, especially in the treatment with cryotherapy that presents an incidence of complications above 10%.¹¹

CONCLUSION

Cauterization proved efficacious as an adjuvant in the treatment of bone tumors, with results similar to the other methods described in literature and with low incidence of complications.

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