

Minimally invasive technique for curettage of benign bone tumors using endoscopic technique

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ABSTRACT

Objective: The purpose is to demonstrate that endoscopy resection can be used safely and effectively for the treatment of benign bone tumors. **Methods:** Ten benign bone tumors were treated by curettage using arthroscopy instruments, a new surgical technique that we called “minimally invasive endoscopic technique.” The curettage was performed by curette and high-speed burr through a small bone window in all cases using arthroscopy instruments. The tumor cavity was packed finally with bone cement or bone allografts. **Results:** Endoscopic curettage allowed to remove benign bone tumor tissue under video-endoscopic view with good magnification and minimal damage to the cortical bone. All patients had relief of symptoms and rapid function restoration, without any complication. At a mean follow-up of 24 months, no local recurrence was observed. **Conclusions:** Minimally invasive technique using an endoscope seems to be a well-suited method for access to lesions in difficult juxta-articular locations. In fact, the direct video-endoscopic view allows safer and less destructive excision. The extra-articular technique enters the tumor cavity via a tunnel drilled through the medullary canal, allowing to visualize possible residual tumor tissue or defects of the articular surface, without violating the joint and without taking away a much bigger cortical window.

KEY WORDS: Arthroscopy, benign bone tumors, endoscopic curettage

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INTRODUCTION

Aggressive benign bone tumors require treatment by curettage of the lesion and packing of the cavity with bone grafts or bone cement. Curettage of the pathologic tissue through a wide cortical window is usually mandatory to avoid the risk of local recurrence [1]. However, large cortical removal for creating the window may weaken the bone and increase the risk of fracture [2].

Minimally invasive approaches for the treatment of benign bone tumors have been reported in few articles [1,3-12].

Trans-articular arthroscopic excision of benign bone tumors such as chondroblastoma [3,6,7,9] and osteoid osteoma [10] have been reported in the literature. However, trans-articular removal of bone tumors using arthroscopic instruments can cause seeding of the entire joint or spread of tumor cells and potentially may lead to adverse consequences [9]. Moreover, another disadvantage of this technique is the possible cartilage damage during the tumor excision [1].

Otsuka *et al.* [4] reported a case of a chondroblastoma in the calcaneus with a secondary aneurysmal bone cyst treated by endoscopic curettage. However, this report seems to describe a needle aspiration of an aneurysmal bone cyst rather than a true endoscopic curettage of a chondroblastoma.

Stricker [1] reported three curettage excision of femoral head chondroblastoma using extra-articular endoscopic approach. This technique allowed to avoid hip arthrotomy to make a cortical window in the femoral head. At an average follow-up of 25 months, all three femoral head tumors have healed without recurrence and with no complications related to the approach.

This report presents an innovative minimally invasive technique for curettage and packing of benign bone tumors through a small cortical bone window using the endoscopic instrument. The current study is designed to evaluate the safety and effectiveness of this hypothesis and technique.

METHODS

Ten patients with benign bone tumors were treated by curettage of the lesion and packing of the tumor cavity with bone cement or bone allografts using a “minimally invasive endoscopic curettage” (MIEC). We obtained demographic, clinical treatment, and follow-up information from patients’ medical records [Table 1]. The patients had distinctive demographics and tumor distributions. There was a male predilection (6:4), and the patients’ age ranged from 11 to 50 years (mean, 26 years). The anatomical zone distribution of benign bone tumors were as follow: 3 around the knee, 2 in the proximal humerus, 2 in the proximal femur, 2 cases in the distal tibia and 1 case in the distal humerus.

The diagnosis included chondroblastoma in 3 cases, aneurysmal bone cyst in 2 cases, fibrous dysplasia in 2 cases and 3 cases with chondroma, giant cell tumor, and non-ossifying fibroma. Plain X-ray in 2 views was performed for all patients pre and post-operatively and on each follow-up visit. Magnetic resonance imaging (MRI) was programmed for all patients preoperatively. In case of juxta-articular lesions a computed tomography, (CT) scan was requested to check the integrity of surrounding cortical bone.

Surgical technique: A pneumatic tourniquet was inflated. The position of the canal was planned preoperatively, and a small skin incision was made accordingly. Using a high-speed burr, a limited orifice of the canal (about 1.5 cm × 2 cm) was made through the cortical bone. Subsequently, under fluoroscopic control, a tunnel was drilled down into the tumor lesion by a finer high-speed burr. The canal was opened and expanded into the tumor cavity. Blinded curettage was performed using a medium curette. Using endoscopic instruments, the precise inspection and curettage of the tumor cavity was planned and performed. Following curettage, under direct view using an arthroscope, the cavity was then burred by high-speed burr and irrigated abundantly. The integrity of the cavity's walls were checked endoscopically, and the residual cavity was filled with bone cement or bone allograft [Figures 1-4]. Bone cement was used in 4 cases while in 6 other cases the cavities were filled with bone allografts.

In case of chondroblastoma and giant cell tumor, the cavity was soaked with ethanol and phenol as the local adjuvant therapy prior to abundant irrigation. In these cases, the bone cement was used for better detection of possible recurrence.

Post-operative care consisted in immediate active and passive mobilization of the operated limb with early full weight bearing in cases of tumor of the lower extremities. Patients were checked at 2 weeks, and then at 4-month intervals for the 1st year. At each checkup, plain radiographs of the affected area were obtained. The median follow-up was 24 months.

Oncologic results, complication and the functional result were analyzed. Functional results according to the Musculoskeletal Tumor Society (MSTS) functional rating system were evaluated. The functional outcome in these patients was

Table 1: Clinical finding in 10 patients with benign bone tumor of the extremities treated with Minimally Invasive Endoscopic Curettage (MIEC)

Patient number	Diagnosis	Age	Sex	Location	Outcome
1	Chondroblastoma	18	M	Proximal femur	NED
2	Chondroblastoma	15	F	Distal femur	NED
3	Chondroblastoma	16	F	Proximal tibia	NED
4	Aneurysmal bone cyst	12	M	Proximal tibia	NED
5	Aneurysmal bone cyst	11	F	Distal humerus	NED
6	Giant cell tumor	39	M	Distal tibia	NED
7	Fibrous dysplasia	49	M	Proximal femur	NED
8	Fibrous dysplasia	50	M	Proximal humerus	NED
9	Non ossifying fibroma	17	M	Distal tibia	NED
10	Chondroma	41	F	Proximal humerus	NED

M: Male, F: Female, NED: Non evidence of disease

assessed using the functional evaluation system of the American MSTs [13].

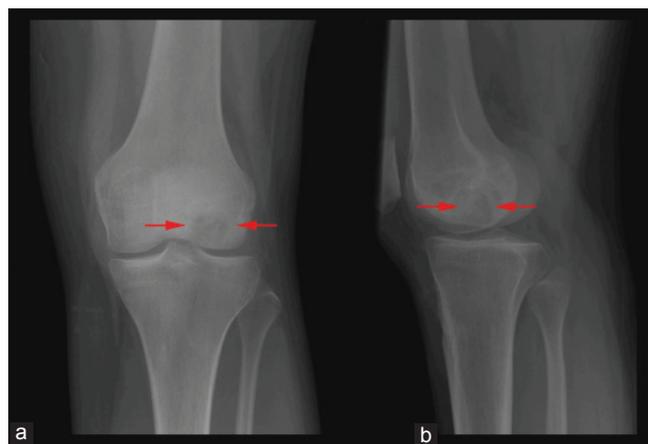


Figure 1: Postero-anterior (a) and lateral (b) radiographs of the knee show an osteolytic lesion of the distal femur (narrow arrows)



Figure 2: Sagittal magnetic resonance imaging T1 (a) and T2 (b) and axial T1 (c) scan shows homogenous intra-tumoral signal with transphyseal extent on T1 and hyper-intensive signal on T2

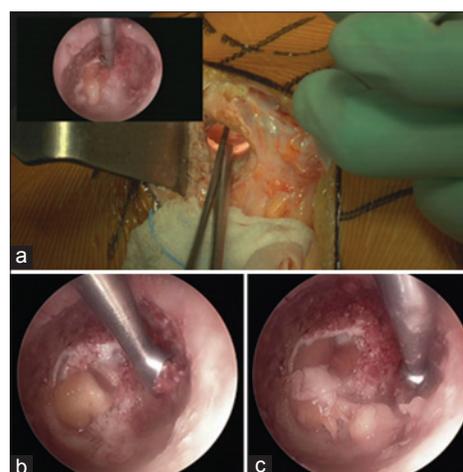


Figure 3: Intraoperative view of minimally invasive endoscopic technique; (a) small circular window permits endoscopic approach, (b) curettage and (c) high speed burring of the lesion under direct endoscopic view

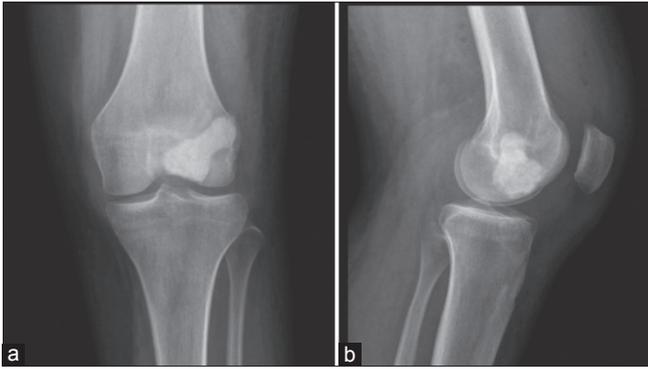


Figure 4: Postero-anterior (a) and lateral (b) radiographs of the knee show the packing of the cavity with bone cement

RESULTS

On radiographs, the bone lesions often appeared lytic without soft tissue extension. The mean size of the bone lesions was 3.7 cm (range, 1.7-6 cm). The lesions were well-defined by MRI, being hypointense on T1-weighted images and hyperintense on T2-weighted images.

Endoscopic curettage allowed a complete resection of tumor tissue with minimal damage to healthy bone in all cases. Using a small window in the bone, the endoscopy permitted to view the tumor cavity in a complete manner thus removing residual pathological tissue. Furthermore, it was possible to highlight a defect of the articular surface to avoid violating the joint. In 2 weeks, all patients had relief of symptoms and achieved rapid functional restoration, without any wound complications. At a mean follow-up of 24 months, no local recurrence was observed.

Functional results (MSTS) were good/excellent in all patients.

DISCUSSION

Aggressive benign bone tumors can recur after excision, possibly due to an incomplete removal of pathological tissue at the time of surgery. This fact leads to treat these lesions by open approaches through a large bone window.

We present the treatment of benign bone tumors by curettage of the lesions and packing the tumor cavity with bone cement or bone allograft using MIEC. Thank to this technique, the curettage could be performed through a small bone window, and the endoscopic view allowed a complete excision of tumor tissue.

To avoid cortical bone removal, percutaneous radiofrequency ablation has been reported as an alternative to surgery for treatment of selected tumors [5,14]. However, this procedure is effective and safe only for small lesions. In fact, in a series of 17 patients affected by chondroblastoma described by Rybak *et al.*, the lesions ranged from 0.8 to 2.5 (mean 1.4). There were one recurrence and a case of the late collapse of the articular cortex in the largest lesions of their series. The authors concluded that larger lesions beneath weight-bearing surfaces

should be approached with caution due to an increased risk of articular collapse and recurrence [5].

Moreover, Dierselhuis *et al.* [14] reported risk of fracture as a complication of radiofrequency ablation in two cases of bone tumors in the hip. The first case was a chondrosarcoma Grade I of the femoral head that developed a pathological fracture 3 months after the ablation therapy procedure, and the fracture occurred at the exact location of the ablated lesion and could be seen retrospectively on earlier MRI images during the follow-up. The second patient had a metastatic follicular carcinoma of the thyroid at the calcar region of the femur. 3 months after treatment, the patient had a pathological fracture at the site of the previous ablation.

We present a series of 10 cases of benign bone tumors treated by endoscopic curettage. Using a small window in the bone, the endoscopy permitted to view the tumor cavity in a complete manner thus removing residual pathological tissue. Furthermore, it was possible to highlight a defect of the articular surface, which helps to avoid violating the joint space.

A minimally invasive approach to the affected bone reduces the risk of iatrogenic fracture due to less cortical bone removal as compared to more invasive surgical procedures. The risk of a pathologic fracture depends both on the strength of the bone and on the loads applied to it. *Ex vivo* studies of the behavior of bones with simulated defects indicated that the load carrying capacity of a bone with a defect depends on many factors like the amount of bone loss, the cross-sectional structural geometry of the bone, the material properties of the remaining bone tissue, the location of the lesion with respect to the applied loads, and the loading mode [2]. Several studies showed that 2.5 cm lesion width, a 3.3 cm lesion length, and destruction of 50% of the cortex are associated with higher risk of pathological fractures [2].

Moreover, it is mandatory to pay attention to the shape of the cortical window while approaching to perform curettage of a benign bone tumor. Clark *et al.* [15] founded that an oblong hole with rounded ends afforded the greatest residual strength and the increasing the width of the hole caused a significant reduction in strength. They concluded that when a cortical window must be taken from the bone, a small circular hole should be made to reduce the risk of iatrogenic fracture.

There are a number of limitations to this study. First, this study involves a retrospective cohort of patients. Second, the case numbers are small, heterogeneous in diagnosis and lacks a control group. Third, the mean follow-up is only a 2-years period. Therefore, long-term follow-up in a larger series is required to evaluate whether the oncological and functional outcomes are indeed better or no different than with conventional approaches.

Our report shows that minimally invasive technique using an endoscopic approach is a well suited method for access to lesions in difficult juxta-articular locations. In fact, direct endoscopic visualization allows safer and less destructive excision. The extra-articular technique enters the tumor cavity via a tunnel

drilled through the medullary canal, allowing to visualize possible residual tumor tissue or defects of the articular surface, without violating the joint and without weaken the affected bone.

Extra-articular endoscopic assisted tumor resection has only been previously reported in one small case series [16]. Wong *et al.* performed curettage of benign bone tumors in five consecutive patients using a CT-based navigation system supplemented by visual guidance through an arthroscope. The distal femur was involved in three patients (2 with giant cell tumors, 1 with a chondromyxoid fibroma), the proximal femur in one patient (a chondroblastoma), and the proximal tibia in the last patient (a giant cell tumor). All patients could achieve a full range of joint movement and walk unaided at 4 weeks post-surgery. No local recurrence was noted [16].

Our paper supports the utility of curettage of benign bone tumors using an endoscopic approach. The instant endoscopic observation provides an instantaneous update of the progress of the surgical procedure within the cavity. Safe and adequate tumor clearance was thus possible, even though the canal to the tumor cavity was small. This minimal access approach could minimize morbidity and facilitate rapid functional recovery without compromising oncological principles.

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