

## Limb-Sparing Using Total Hip Arthroplasty in a Dog with Femoral Head Osteosarcoma

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### ABSTRACT

**Background:** Osteosarcoma (OSA) is the most common primary bone tumor of the appendicular skeleton of dogs. It mainly affects the metaphyseal region of long bones in large and giant breed dogs. The markedly aggressive and metastatic character of the disease leads to an invariably poor to unfavorable prognosis. Although amputation is commonly performed, different surgical techniques may be used to preserve the limb. The most common methods of limb preserving surgeries involve the use of endoprosthesis and allogeneic or autologous grafts. This report describes the successful use of total hip replacement to treat a 3-year-old male dog, with OSA in the femoral head and neck.

**Case:** This report describes the successful use of total hip replacement to treat a 3-year-old male dog, with OSA in the femoral head and neck. The OSA stage IA located in the femoral head and neck was resected and treated through the limb-sparing. The bone defect and joint function was reconstructed with total hip arthroplasty technique using a cementless hip prosthesis. The result of the histopathological analysis of the excised bone tissue showed a minimally productive osteoblastic osteosarcoma. To date, the patient shows satisfactory movement rate and motion range, with no pain to palpation and without lameness in that limb. The radiographic follow-up after 24 months showed no local recurrence, metastasis pulmonary or complications related to the implant. Total hip arthroplasty resulted in safe recovery of orthopedic signs associated with osteosarcoma of the femoral head and neck, effectively acting as a limb preserving surgery after 32 months.

**Discussion:** The limb-sparing procedure is an option to control local tumors that has become more popular among owners that do not accept the amputation of the limb. Similarly, it is a good alternative when another condition may interfere with the other limbs or may require amputation of another limb. The size and the potential for weight gain of the dog in this study could compromise its ambulation later, and it was a factor in the decision for the limb-sparing surgery. The allografts can be used to reconstruct the proximal femur, but they were not considered a viable option for this patient because of the reported complications, including graft fracture, non-union with the host bone and collapse of subchondral bone. The hip region does not allow the realization of arthrodesis because this joint is highly mobile, so the use of prosthetics as described is ideal for the preservation of joint biomechanics. Furthermore, the implant provides rapid postoperative recovery and immediate stability. Mean survival times were not significantly different between the limb-sparing and amputation techniques without adequate chemotherapy. In this case, despite the recommendation, the patient was monitored continuously without the association of adjuvant treatments according to the owner's choice. The complications related with the use of cortical allograft, endoprosthesis, and pasteurized autograft include infection (31-60%), local recurrence (15-28%) or implant failure (11-40%). The implant luxation is the most common non-traumatic acute complication in the short term after limb-sparing surgery of proximal femur in humans and total hip replacement in dogs. To date, no complications have been observed after the procedure was performed. In conclusion, preservation of limbs in cases of osteosarcoma is favorable depending on the degree of involvement, but it requires specific techniques according to the location, to improve the quality of life and animal survival. In this case, the total hip arthroplasty for initial osteosarcoma in the femoral head and neck got an unexpected result, especially given the nature of osteosarcoma, limitations of wide excision with this approach and lack of adjuvant therapy.

**Keywords:** osteosarcoma, total hip replacement, proximal femur, canine.

## INTRODUCTION

Osteosarcoma (OSA) treatment may include palliative-intent techniques (involving analgesia, limb amputation alone without adjuvant chemotherapy and external beam radiation therapy) and curative-intent techniques, such as limb-sparing techniques, limb amputation or stereotactic radiotherapy combined with adjuvant chemotherapy [8].

Different surgical techniques may be used to preserve the limb and act as an alternative to amputation [23]. The use of limb-sparing techniques to treat patients with OSA consists of replacing the affected bones by an endoprosthesis or healthy bone. This technique has been widely studied and is described for tumors located in the proximal humerus, radius, femur and tibia [6,16].

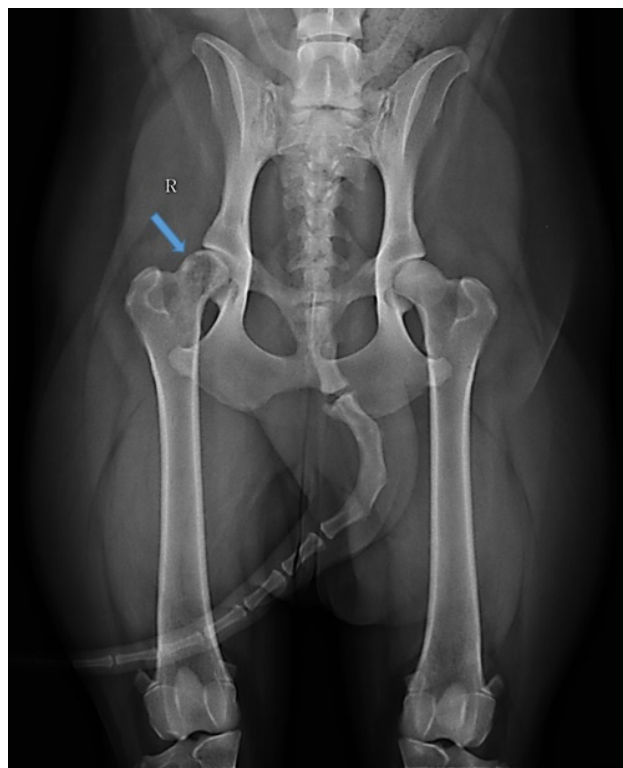
Total Hip replacement is used to treat severe and significant changes in joint functions [7,13]. This report describes the clinical and radiographic findings together with the surgical approach used to excise osteosarcoma of the femoral head and neck.

## CASE

A male, neutered, 3-year-old Labrador Retriever, weighing 35 kg was seen in the veterinary hospital. The patient had sudden lameness in the right pelvic limb for 15 days, with unknown primary etiologic cause. Upon orthopedic examination, the manipulation of the right hip joint was painful, especially during extension and abduction movements, with slight muscular atrophy. The radiographic image of the right hip region showed mild lytic bone reaction in the femoral head and neck, with a slight loss of cortical definition in the proximolateral aspect of the femoral head. A discrete poor femoral head coverage on the right hip and sclerosis in bilateral cranial acetabular rim were also observed (Figure 1). There was no evidence of metastasis in the three radiographic projections of the chest.

The radiographic and orthopedic examination findings suggested a primary bone tumor. However, at first, a bone biopsy was not performed. Thus, together with the pet owner, we opted for limb-sparing surgery using cementless hip joint prosthesis<sup>1</sup>.

The patient underwent inhalational anesthesia was placed in the lateral position and antisepsis of surgical area was performed. Prophylactic antibiotic therapy consisting of cephalothin sodium (30 mg/kg IV) and meloxicam (0.2 mg/kg SC) was administered

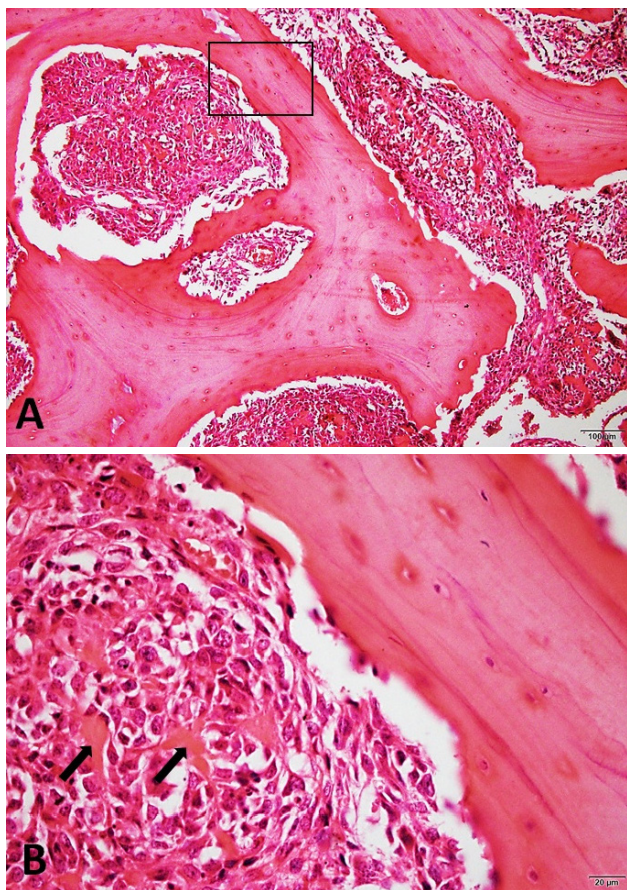


**Figure 1.** Preoperative craniocaudal radiograph showing the hip region of the dog with osteosarcoma. Note the lytic bone reaction in the femoral head and neck, with a slight loss of cortical definition in the proximolateral aspect of the femoral head (arrow).



**Figure 2.** Immediate postoperative craniocaudal radiograph of the hip region of the dog, showing the proper positioning of the prosthesis, after performing total hip arthroplasty.





**Figure 3.** Photomicrograph of minimally productive osteoblastic osteosarcoma. A- Overall appraisal of a pertinent region of the osteosarcoma involving the femur [Hematoxylin-eosin stain, X10]. B- Higher magnification (box outline in figure 3A) showing atypical osteoblasts with disorganized permeated osteoid (arrows). [Hematoxylin-eosin stain, X40].



**Figure 4.** Follow-up view after two years showing properly position and alignment of the hip prosthesis. Note the presence of decreased bone radiopacity in the proximal region of the right femur.

at the time of anesthesia induction. It was used the approach and surgical technique described by Roush [24]. The components used were one cementless 24-mm acetabular component and cementless number 7 femoral stem, with femoral head of 17 mm and neck +3. The periarticular soft tissues were routinely sutured using 2-0 poliglecaprone 25, and the skin with nylon monofilament 3-0 in standard separate single stitches.

Radiography in the immediate postoperative period displayed correct positioning of the prosthesis (Figure 2). Excised bone was submitted for histopathological examination confirming a minimally productive osteosarcoma. Presumably the osteosarcoma was confined within the bone and had not breached the periosteum. Microscopic features displayed erosion of necrotic lamella trabecular bone (Figure 3 A) with intertrabecular spaces filled with atypical malignant osteoblasts that appeared to have formed a small amount of osteoid (Figure 3B). Cutaneous sutures were removed at 10 days and clinically minimal pain and claudication were exhibited.

The dog displayed satisfactory motion range, with no pain to palpation and no lameness in that limb 32 months after surgery. The radiographic follow-up after 24 months showed no local recurrence or metastasis pulmonary. Despite of a decreased bone radiopacity in the proximal femur with mild bone resorption of the medial portion, the implant was stable and properly positioned (Figure 4).

#### DISCUSSION

The initial diagnosis based on clinical presentation and radiographic findings suggested a primary malignant bone tumor. However, in some cases, aspiration cytology or excisional or non-excisional biopsy is recommended [3,20]. This procedure should be carefully planned to minimize the impact of the device on the surgery site, especially limb-sparing surgeries [17]. Despite the age of the patient in question, we chose not to perform the biopsy prior to surgery, since the clinical symptoms, lesion location, radiographic findings indicated a primary bone neoplasia without the characteristics of fungal osteomyelitis or metastatic neoplasia. According to Liptak *et al.* [17], in their experience treating musculoskeletal system cancer, performing the preoperative biopsy is especially recommended when the history, clinical signs and tumor location are not typical of a dog with primary bone cancer.

The characteristics of the radiographic image may somehow be correlated with tumor type, since according to Pool [22] the minimally productive osteoblastic osteosarcoma causes lytic bone lesions that may change the local radiopacity. Usually, patients with appendicular OSA at the time of diagnosis present compromised structural integrity of cortical bone and obvious osteolysis [4].

The limb-sparing procedure is an option to control local tumors that has become more popular among owners that do not accept the amputation of the limb [9,25]. Similarly, it is a good alternative when another condition may interfere with the other limbs or may require amputation of another limb [4,18]. The size and the potential for weight gain of the dog in this study could compromise its ambulation later, and it was a factor in the decision for the limb-sparing surgery. Additionally, one of the main advantages of limb preservation is the satisfactory functional return in approximately 80% of dogs and the preservation of quadruped status especially in large dogs [19].

The allografts can be used to reconstruct the proximal femur, but they were not considered a viable option for this patient because of the reported complications, including graft fracture, non-union with the host bone and collapse of subchondral bone [21]. The hip region does not allow the realization of arthrodesis because this joint is highly mobile, so the use of prosthetics as described is ideal for the preservation of joint biomechanics. Furthermore, the implant provides rapid postoperative recovery and immediate stability [11].

Before the limb-sparing procedure, determining the appropriate surgical margin of the excision is of great importance, since implant failure risk is higher when more than 50% of the bone is affected, and improper excision margin predisposes to relapse. According to the literature, the recurrence rate after the limb-sparing surgery is between 24 and 60% [12], while others report it between 21 and 28% of affected dogs [5]. Furthermore, the incidence of metastasis may also be affected by this factor [12]. Several studies have been conducted to determine the accuracy of radiography, tomography, magnetic resonance and bone scintigraphy as methods to evaluate the extension of the appendicular OSA, but the results are still contradictory [15]. Davis *et al.* [5] reported that the use of radiography alone might be inadequate to determine the microscopic borders of tumors in some instances,

which contribute to the local recurrence. Although the technique used did not allow excising the affected area with the recommended safety margin, the main purpose of this approach was to keep the quality of life of the patient with functional limb support, and no complications related to the implant have been observed to date.

The association between surgical treatment and adjuvant therapies is advised to increase survival of OSA patients, including, chemotherapy, immunotherapy, and radiation therapy [14]. Although several studies have reported that the median survival time after only the surgical treatment is approximately 103-175 days, while 11-20% and 2-4% of the cases reach 1 and 2 years, respectively [3]. Mean survival times were not significantly different between the limb-sparing and amputation techniques without adequate chemotherapy [5]. In this case, despite the recommendation, the patient was monitored continuously without the association of adjuvant treatments according to the owner's choice.

The complications related with the use of cortical allograft, endoprosthesis, and pasteurized autograft include infection (31-60%), local recurrence (15-28%) or implant failure (11-40%) [9,25]. The implant luxation is the most common non-traumatic acute complication in the short term after limb-sparing surgery of proximal femur in humans and total hip replacement in dogs [10,26]. To date, no complications have been observed after the procedure was performed.

Although there has been observed radiographic evidence of bone resorption areas in the proximal femur, femoral stem showed no signs of displacement, subsidence or rotation. We hypothesized that those resorption areas developed secondarily to the stress shielding phenomena [1,2].

In conclusion, preservation of limbs in cases of osteosarcoma is favorable depending on the degree of involvement, but it requires specific techniques according to the location, to improve the quality of life and animal survival. In this case, the total hip arthroplasty for initial osteosarcoma in the femoral head and neck got an unexpected result, especially given the nature of osteosarcoma, limitations of wide excision with this approach and lack of adjuvant therapy.

#### MANUFACTURER

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**Declaration of interest.** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.



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