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Benign and Benign Aggressive Bone Lesions Located in the Femoral Head and Neck: Single-center Experience

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Abstract

Objective: The aim of this study was to present the mid-term outcomes and treatment management of benign and benign aggressive lesions of the femoral head and neck treated surgically in pediatric and adult patients.

Methods: A total of 27 patients who underwent surgical treatment for benign tumors and tumor-like lesions of the femoral neck and head were retrospectively analyzed. Patients were evaluated according to age, gender, diagnosis, follow-up period, lesion location, surgical method, complications, and recurrence development. Functional evaluation was performed using the Musculoskeletal Tumor Society (MSTS) and Toronto extremity salvage score (TESS). Early and late complications, such as infection, wound site issues, physeal injury, avascular necrosis (AVN), non-union, malunion, fracture, and implant failure, were investigated.

Results: The average age was 26 years (range, 8-54 years), and the follow-up period was 74 months (49-108). In 24 patients (89%), the tumor was located in the femoral neck, whereas in 3 patients (11%), it was located in the femoral head. The most common diagnosis was simple bone cysts (33.3%), and the most frequently applied surgical method was curettage + grafting + internal fixation (C + G + IF) (51.8%). The mean MSTS score was 84% (range, 50-100), and the mean TESS score was 96.1 (range, 75-100).

Conclusion: Hip-preserving approaches are important for functional outcomes in the treatment of lesions observed in the proximal femur. Attention should be paid to the nutrient arterial structures to prevent complications such as non-union and AVN. These rare tumoral formations should be considered in patients presenting with pain and limping.

Keywords: Bone tumor, femur neck, curettage, femoral head

INTRODUCTION

The proximal femur is a characteristic location for benign bone tumors and tumor-like lesions. Bone lesions, such as simple bone cyst (SBC), giant cell tumor (GCT), aneurysmal bone cyst (ABC), fibrous dysplasia, osteoblastoma, enchondroma, and chondroblastoma, can be seen in this region (1,2). These tumors are usually small and asymptomatic, but can cause symptoms such as pain, limping, bone destruction, deformity, and pathological fractures.

Surgical treatment is indicated for patients with pathological fractures or at risk of fracture, those with deformities or at risk of deformities, aggressive/recurrent lesions, and symptomatic patients with analgesic-resistant pain or antalgic gait pattern (3). Extensile curettage and reconstruction of the defect with appropriate bone grafts are generally the preferred treatment method. Filling the defect with cement is relatively less preferred due to the risk of fracture against shearing and torsional forces. Internal fixation methods are preferred based on the size, localization, and fracture risk of the lesion (4-6). Additionally, the use of local adjuvants is recommended to prevent recurrence (6). For the resection of lesions in the femoral head and neck, the anterior, lateral, anterolateral, or combined anterior and lateral approaches are used (7). Although arthroplasty is not

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recommended as an initial treatment option, it may be inevitable in aggressive, recurrent, and joint-destructive lesions (8).

Complications such as periarticular destruction, degenerative arthritis, avascular necrosis (AVN) of the femoral head, and non-union after pathological fractures may occur due to these lesions and pathological fractures. Due to the location and complex anatomy of the hip joint, the surgical treatment of lesions in the femoral head and neck poses a challenge for orthopedic surgeons. There is a high risk of injury to the periarticular muscles, joint capsule, cartilage, and bone during surgical treatment (7,9). As these tumors often occur in children and young adults with normal life expectancy, preventing these complications and achieving functional resection are essential.

There are few studies in the literature that describe the characteristics and treatment management of benign and benign aggressive lesions located in the femoral head and neck. The aim of this study was to present the mid-term outcomes and treatment management of benign and benign aggressive lesions of the femoral head and neck treated surgically in pediatric and adult patients.

METHODS

This single-center, retrospective study was conducted at the Orthopedic and Traumatology Clinic of University of Health Sciences Turkey, Ankara Dr. Abdurrahman Yurtaslan Oncology Training and Research Hospital between 2014 and 2022. Twenty-seven patients (15 women, 12 men) who underwent surgical treatment for benign tumors and tumor-like lesions of the femoral neck and head were retrospectively analyzed. Incidental small lesions diagnosed and treated by observation alone were not included in this study. The study protocol was approved by the Non-Interventional Clinical Research Ethics Committee of University of Health Sciences Turkey, Ankara Dr. Abdurrahman Yurtaslan Oncology Training and Research Hospital (approval number: 2024-04/42, date: 18.04.2024). The study was conducted in accordance with the principles of the Helsinki Declaration and written informed consent was obtained from all patients. Patients with uncertain histopathological results, those whose initial surgery was performed at another center and referred to our clinic due to recurrence, and patients who developed pathological fractures were excluded from the study. Patient data were collected by retrospective review of the patient information system and pathology reports. Indications for surgery included the risk of pathological fracture or pathological fracture, pain, growth of the lesion during follow-up, and aggressive lesions. All patients were evaluated preoperatively with direct radiography and magnetic resonance imaging, and in some patients, computed tomography was additionally used. Patients with characteristic benign lesions, such as simple bone cysts, enchondroma, or fibrous dysplasia, did not undergo preoperative biopsy, and the final histopathological diagnosis was confirmed using tissues obtained during surgery. Patients were evaluated according to age, gender, diagnosis, follow-up period, lesion location, surgical method, complications, and recurrence development. Functional evaluation was performed using the Musculoskeletal Tumor Society (MSTS) and Toronto extremity salvage score (TESS). Early and late complications, such as infection, wound site issues, physeal injury, AVN, non-union, malunion, fracture, and implant failure, were investigated.

Surgical Technique

Depending on the location of the lesion, direct anterior, anterolateral, or posterolateral approaches are used. For patients who did not undergo preoperative biopsy, tissue samples are taken for intraoperative frozen pathological examination to diagnose and confirm the diagnosis for those who underwent preoperative biopsy. The window of the cortical bone must be large enough to allow adequate curettage of the tumor until the underlying normal bone is exposed. Vascular and nerve structures were preserved in all patients. Extended curettage is performed using curettes and a high-speed burr. In particular, for lesions such as GCTs, ABCs, and fibrous dysplasia, local adjuvant treatment with cauterization and agents like phenol or alcohol is applied to extend the margin. In patients who have not completed skeletal growth, care is taken not to damage the physis during these procedures. After curettage, the resulting defect is filled with autogenous-allogeneic bone grafts or cement. In patients with pathological fractures or at risk of fracture, internal fixation (proximal femur plate, cannulated screw) is added to the treatment.

Statistical Analysis

Statistical analyses were performed using the SPSS (IBM SPSS Statistics 27) software package. Frequency tables and descriptive statistics were used to interpret the findings.

RESULTS

The average age during surgery was 26 years (range, 8-54 years), and the follow-up period was 74 months (49-108). In 24 patients (89%), the tumor was located in the femoral neck, whereas in 3 patients (11%), it was located in the femoral head (Table 1).

Histological diagnosis was simple bone cysts in 9 cases (33.3%), enchondroma in 4 cases (14.8%), chondroblastoma in 4 cases

Table 1. Demographics, localization, diagnosis, and treatment					
Age	**Gender**	**Side**	**Location**	**Diagnosis**	**Treatment**
33	F	L	Femoral neck	Giant cell tumor	C + G + IF
27	M	R	Femoral neck	Aneurysmal bone cyst	C + S + IF
8	M	R	Femoral neck	Simple bone cyst	C + G
13	F	R	Femoral neck	Simple bone cyst	C + G + IF
10	M	R	Femoral head	Chondroblastoma	C
45	M	L	Femoral neck	Enchondroma	C + G + IF
38	F	L	Femoral neck	Enchondroma	C + G + IF
32	F	R	Femoral neck	Enchondroma	C + G + IF
17	M	L	Femoral neck	Simple bone cyst	C + G + IF
33	F	R	Femoral neck	Simple bone cyst	C + G + IF
16	F	L	Femoral neck	Aneurysmal bone cyst	C + S + IF
38	M	R	Femoral neck	Fibrous dysplasia	C + G + IF
20	F	R	Femoral neck	Simple bone cyst	C + G + IF
27	M	R	Femoral neck	Simple bone cyst	C + G + IF
18	M	L	Femoral neck	Osteoid osteoma	Total excision
49	F	L	Femoral neck	Fibrous dysplasia	C + G + IF
19	F	R	Femoral neck	Simple bone cyst	C + G + IF
54	F	R	Femoral neck	Fibrous dysplasia	C + G + IF
22	M	R	Femoral neck	Simple bone cyst	C + G + IF
29	M	R	Femoral neck	Osteochondroma	Total excision
54	F	R	Femoral neck	Enchondroma	C + G + IF
19	F	R	Femoral neck	Aneurysmal bone cyst	C + S + IF
8	M	L	Femoral neck	Simple bone cyst	C + G
17	F	L	Femoral neck	Osteochondroma	Total excision
14	M	L	Femoral neck	Chondroblastoma	C + G
21	F	R	Femoral head	Chondroblastoma	C + G
19	F	R	Femoral head	Chondroblastoma	C + G
C: Curettage, G: Grafting, IF: Internal fixation, S: Cement, F: Female, M: Male, L: Left, R: Right					

(14.8%), ABC in 3 cases (11.1%), fibrous dysplasia in 3 cases (11.1%), osteochondroma in 2 cases (7.4%), osteoid osteoma in 1 case (3.7%), and GCT in 1 case (3.7%). The most common symptoms were pain and limping. The primary surgical method applied was curettage + grafting + internal fixation (C + G + IF) in 14 patients (51.8%), followed by curettage + cementation + internal fixation (C + S + IF) in 4 patients (14.8%), curettage + grafting in 5 patients (18.5%), total excision in 3 patients (11.1%), and curettage alone in 1 patient (3.7%) (Table 1, Figure 1). All 27 patients returned to full weight-bearing walking at an average of 13.5 weeks (4-20) postoperatively. The mean MSTS score was 84% (range, 50-100), and the mean TESS score was 96.1 (range, 75-100). Two patients who underwent anterolateral approach showed Trendelenburg gait in the early postoperative period. This pathological gait pattern disappeared after abductor strengthening exercises in these two patients. No infections, implant failures, pathological fractures, physeal injuries, femoral head AVN, or recurrences were observed in any patient. At the final follow-up, all patients had returned to normal unrestricted activities without pain in the operation area.

DISCUSSION

In the proximal femur, which is an anatomical region subjected to heavy mechanical load, there is a risk of fracture and deformation in the presence of active or aggressive benign tumors. These lesions are usually cystic or cyst-like bone defects extending from the subtrochanteric region to the femoral neck (10). Because these lesions typically occur in young and active individuals; thus, proper management is required after treatment to prevent fractures and ensure a functional joint (4).

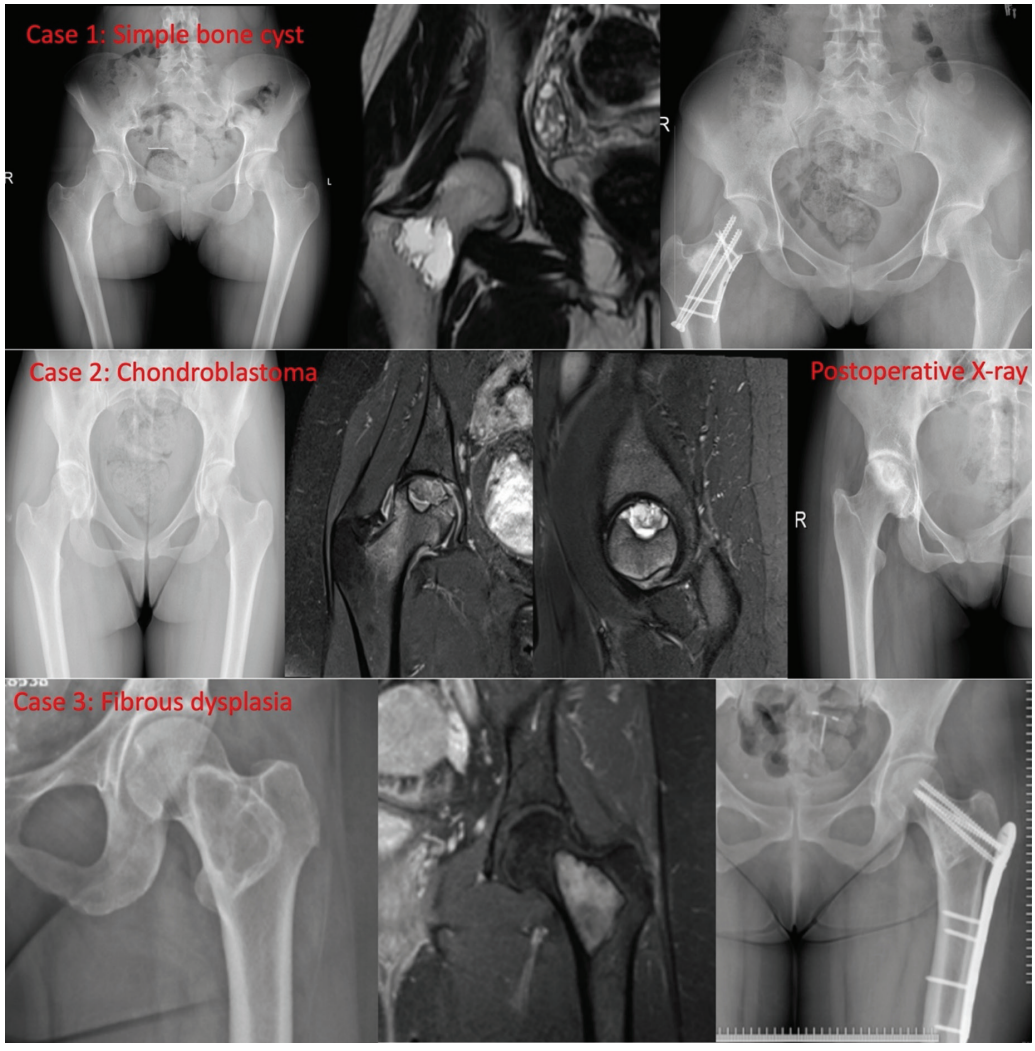

Figure 1. Case examples

When we reviewed the literature, the distribution of benign and benign aggressive lesions observed in the proximal femur significantly varied among case series. In some series, the frequency of GCT was high, whereas in others, fibrous dysplasia or ABC diagnoses predominate (3,11-13). In our case series, the most common pathology diagnosed was a SBC at a rate of 33.3%.

Enchondroma is a rare pathology of the femoral neck, and literature reports it mostly in case reports (1,14). In our case series, a total of 4 patients were diagnosed with enchondroma.

Osteochondromas can occur in any bone but are usually found in the metaphyseal region near the physis of a long bone. They are most commonly seen in the distal femur, proximal tibia, and proximal humerus (15). Rarely, intracapsular osteochondromas can be observed in the femoral neck. These lesions can cause problems, such as femoroacetabular impingement, labrum tears, nerve compression, hip dislocation, external snapping of the hip, and malignant transformation (16-19). Surgical exploration for resection also carries the risk of AVN (18,20). In our series, surgical resection of intracapsular osteochondroma cases was performed using the posterolateral approach without hip dislocation. No complications of AVN occurred during follow-up, and patients' pain and mechanical complaints were completely resolved.

The proximal femur is one of the anatomical regions where osteoid osteoma is frequently seen, but intra-articular osteoid osteomas are rare (21,22). Intra-articular lesions can cause pain, limping, synovitis, effusion, stiffness, local warmth, atrophy in surrounding muscles, and movement restrictions, mimicking inflammatory synovitis. In chronic cases, deformities, such as widening and shortening of the femoral neck with reduced epiphyseal height of the femoral head, may occur (23,24). In cases resistant to conservative treatment, surgical en bloc resection or minimally invasive methods, such as radiofrequency ablation

and cryoablation, are indicated (25). Postoperative follow-up showed resolution of symptoms and no recurrence.

For the surgical treatment of lesions in the femoral head and neck, anterior, lateral, anterolateral, or combined approaches are used, each with its advantages and disadvantages (3,7,10-13). The anterior approach is advantageous for lesions localized in the femoral head because curettage is difficult with the lateral approach because of its distance to the femoral head. However, a significant disadvantage of the anterior approach is that if the postoperative histopathological diagnosis favors malignancy, contamination around the femoral artery can lead to catastrophic outcomes such as amputation (3). The disadvantage of the lateral approach is usually temporary, but it may include limping due to abductor muscle damage (12). In our clinical practice, we decide the surgical approach based on the location of the lesion rather than using a single approach. For example, the direct anterior approach is preferred for lesions involving the femoral head, whereas the posterolateral approach is preferred for a posteriorly located osteochondroma. Consequently, we use direct anterior, anterolateral, or posterolateral approaches. Two patients in our case series showed postoperative abductor limping, both of whom underwent anterolateral approaches. Their limping complaints were resolved after abductor strengthening exercises, and they returned to normal walking patterns and were comfortably engaged in daily activities. Sharfman et al. (9) reported successful results in treating intra-capsular benign lesions of the proximal femur with arthroscopic surgical resection in a series of 3 cases published in 2016. Their series included 2 cases of enchondroma and 1 case of osteochondroma. In our opinion, hip arthroscopy can be performed in selected cases, but there may be issues with bone stability after lesion resection or curettage. We believe that it should be used only in selected rare cases.

There are various treatment protocols for benign bone tumors and tumor-like lesions in the proximal femur. These protocols include curettage with or without internal fixation (10-13,26,27). In pediatric patients, the treatment of these lesions is relatively more difficult because of the small diameter of the femoral neck and the open epiphyseal plate (10). Materials used to fill defects after curettage of the lesions include autografts, allografts, and cement. Literature shows that autografts are more commonly preferred for defect reconstruction (11,12,27). The use of fibular autografts, iliac crest autografts, and combined autografts and allografts has also been reported (6,10). Although autografts provide better bone integration, donor site complications are considered as a disadvantage (28,29). Allografts have disadvantages, such as poor bone integration, but the absence of donor site complications and the ability to use large amounts are advantages (11,30). Long-term successful results have also been reported with the use of allografts after curettage of benign lesions in the proximal femur (3,4). As a result, there is no consensus in the literature on which bone graft should be used to fill defects after curettage. In our case series, allografts were used in 4 patients.

It has been reported that the cytotoxic and thermal effects of methyl methacrylate monomer during the hardening of cement kill the remaining tumor cells and reduce the risk of recurrence (31). Considering these properties, the use of cement may be advantageous for aggressive lesions. Literature shows studies using cement after curettage for the treatment of aggressive lesions in the proximal femur (32,33). Filling the cavity with bone cement provides mechanical support and allows early weight bearing on the extremity (31,34). However, the use of cement in the proximal femoral region is limited because of its susceptibility to shearing and torsional forces and the risk of subchondral damage (34). In our case series, cement was used after curettage in only 4 patients. Of these patients, 1 had GCT and 3 had ABC.

Complications associated with these lesions and pathological fractures include growth disorders, varus or valgus deformity, infection, periarticular destruction, degenerative arthritis, heterotopic ossification, AVN, implant failure, malunion, and non-union (10,11,26,35). In Luo et al.'s (35) series of 16 pediatric cases, postoperative complications included varus deformity in 2 patients and early epiphyseal closure in 2 patients. They reported that patients who developed varus deformity initially presented with pathological fractures, and those with early epiphyseal closure had epiphysis affected by the lesion at the time of presentation. During follow-up, only 1 patient developed local recurrence (35). A systematic review published in 2021, which included 274 patients, reported a complication rate of 10.5% after surgical treatment of benign lesions in the femoral head and neck. The local recurrence rate was reported to be 12.5%. The recurrence rate was higher (29.7%) in patients with an open growth plate. The average time to recurrence after the initial surgery was 19.8 months. GCT had the highest recurrence rate (33.3%) after curettage. In cases of recurrence, it was reported that the recurrence rates were significantly lower in patients who received adjuvant therapy than in those who underwent curettage alone (26). No recurrences were observed in the 27 patients in our case series. The routine addition of physical and chemical adjuvant therapies after curettage in our clinical practice may have provided an advantage in preventing recurrence in our series.

Preventing complications and achieving a functional and painless hip joint is crucial in the treatment approach for bone lesions located in the proximal femur. Carvallo et al. (36) used the TESS and MSTS scoring systems to evaluate functional outcomes in patients with benign bone tumors in the proximal femur who underwent surgical treatment without pathological fractures. Consistent with our study results, they found an average TESS score of 89.9 and an MSTS score of 91.6 (36). Similarly, a study by Kundu et al. (13) found satisfactory MSTS scores after surgical treatment of bone lesions located in the femoral neck.

Study Limitations

This study has some limitations, such as its single-center and retrospective design. The relatively small number of patients can be seen as another limitation, although this is due to the inclusion of only benign tumors located in the head and neck of the proximal femur in our series rather than all benign tumoral lesions located in the proximal femur. The application of the same treatment approach by an experienced orthopedic oncology surgical team and the sufficient number of patients compared with the literature are the strengths of this study.

CONCLUSION

Hip-preserving approaches are important for functional outcomes in the treatment of lesions observed in the proximal femur. Attention should be paid to the nutrient arterial structures to prevent complications such as non-union and AVN. These rare tumoral formations should be considered in patients presenting with pain and limping.

Footnote

Ethics Committee Approval: The study protocol was approved by the Non-Interventional Clinical Research Ethics Committee of University of Health Sciences Turkey, Ankara Dr. Abdurrahman Yurtaslan Oncology Training and Research Hospital (approval number: 2024-04/42, date: 18.04.2024).

Informed Consent: The study was conducted in accordance with the principles of the Helsinki Declaration and written informed consent was obtained from all patients.

Authorship Contributions

Surgical and Medical Practices: İ.K., R.B., C.U., İ.B.A., Concept: E.A., C.U., Design: B.A., R.B., C.U., Data Collection or Processing: B.A., İ.B.A., Analysis or Interpretation: İ.K., E.A., İ.B.A., Literature Search: B.A., E.A., C.U., Writing: İ.K., R.B.

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