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**Original article**

# Case series study: the diagnosis and treatment of fifty tumors and pseudotumors at the proximal femur

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**Abstract:** ***Introduction:*** Tumor and pseudotumor (TP) at the proximal femur (PF) can seriously affect mortality, extremity function, and body integrity. However, reports often focused on a specific tumor, not regional lesions. This study focuses on clinical findings, imaging, micro-pathology, and the treatment of all TP at the site. ***Methods:*** The study involved all patients who had a confirmed tumor or pseudotumor diagnosis at the PF. The clinical findings, X-ray, and biopsy were recorded and analyzed. Treatment was optional depending on the patient's situation and available condition of the hospital. The functional outcome, bone healing were defined at the last examination or two years of follow-up. ***Results:*** Fifty patients were involved in the study. Twenty-four patients had apparent tumors. TP at the PF, neck-trochanter, trochanters, and neck were 21 (42%), 16 (32%), 9 (18%), and 4 (8%) cases, respectively. There were 29 (58%) pathologic fractures. Biopsy was made for all patients. Twenty-three cases (46%) were malignant, and 8 (16%) cases were giant cell tumors. Thirty-three patients suffered from an operation. Ennerking's functional score was excellent, good, fair, and poor in 24 (48%), 5 (10%), 1 (2%), and 20 (40%) patients, respectively. For the last outcomes of 33 operated patients, 17 healed, three unchanged, one worse, and two dead. ***Conclusions:*** For the PF TP, the rate of malignant and pathological fracture was high. The giant cell tumor was not rare. The resection of the TP combined with grafts using ordinary fixation devices was satisfactory.

**Keywords:** proximal femur; tumor; pseudotumor.

## 1. INTRODUCTION

Tumor and pseudotumor (TP) of the bone are a field of Orthopaedic Pathology. Despite some reports from domestic hospitals, these reports often focused on a specific tumor such as giant cell tumor, osteosarcoma, fibrous dysplasia, metastasis tumor. Similarly, in global literature, reports also mentioned often one kind of tumor [1-3]. TP can appear at any bone, including the proximal femur (PF). The PF has an essential role in weight-bearing and movement of the body. TP at this site can seriously affect mortality, extremity function, and body integrity. Hence, a study of TP at PF is critical.

The TPs at the PF are often original or metastasis of carcinoma in old patients and benign neoplasm in adolescents. The diagnosis is difficult because the lesion is in the deep structures. Surgery is the first indication in case of pathologic fracture or progressive uncontrol painful TPs [2, 4]. The resection of malignant tumors in this site is considered a high-risk procedure of treatment. In the past, hip disarticulation or hemipelvectomy was the choice of malignant tumors, but these procedures caused severe disability and physiologic disturbance [5]. In developed countries, arthroplasty with exceptional or individualized implants was used a long time ago, but there have been only some scattered cases in

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developing countries, such as Viet Nam. In some countries, the available artificial hips are currently being used with inadequacy because they are not suited for each patient. In each case, the surgical method was indicated depending on the patient's circumstance and the available instruments of the hospital. In this study, the significant characteristics of clinical findings, imaging, micro-pathology, and the treatment of the TP at PF were observed, and the primary results of optional surgical or conservative treatment were analyzed.

## 2. MATERIALS AND METHOD

This study was carried out at Cho Ray Hospital, 7A Military Hospital, and Post and Telecoms Hospital. The research project was approved by the Bioethics Commission of the University of Medicine and Pharmacy at Ho Chi Minh City, Viet Nam. The legal document related was Bioethics Commission Approval: 470/ĐHYD-HĐ on 16th December 2016.

**Table 1.** The indicated procedure was based on stage classification. (Res: resection; Amp: amputation; R-C: radiation - chemotherapy)

| Stage | TP | Indication |
|---|---|---|
| 1 | Benign, non-malignization | Conservative, Res or curettage |
| 2 | Benign, seldom maglinization | Conservative and follow-up, En bloc Res |
| 3 | Borderline malignant, intra-compartment | En bloc Res + R-C or wide Res |
| | - Borderline malignant, extra-compartment | Wide Res |
| IA | Low malignant, intra-compartment, non-metastasis | Wide Res |
| IB | Low malignant, extra-compartment, non-metastasis | Wide Res, Amp |
| IIA | High malignant, intra-compartment, non-metastasis | Wide Res, radical Res+ R-C |
| IIB | High malignant, extra-compartment, non-metastasis | Amp, wide Res, radical Res + R-C |
| IIIA | Malignant, intra-compartment, metastasis | Wide Res or Amp, +/- removal metastasis tumor + R-C |
| IIIB | Malignant, extra-compartment, metastasis | Amp + R-C or salvage therapy |

The study involved all the admitted patients, from August 2015 to April 2018, who had a confirmed diagnosis of tumor or pseudotumor at the PF. The patient's personal information was recorded. The patient was examined to find out clinical findings related to pain, tumor, and hip movement. Then, the X-ray was performed, and the results were analyzed. On X-ray, the site of the TP was recorded. The lesion was defined as osteogenesis, osteolytic, or combined. The lytic TPs were classified into three types of Lodwick [6]. Biopsy was made before treatment, except for some cases where the defined diagnosis was apparent based on clinical and imaging findings. A biopsy was performed on the patients who suffered from the treatment operation or in recurrent cases. TPs were classified based on the clinical findings and the histologic characteristics. The Enneking staging system was used to classify the TPs [7], but two more categories were added to cover all of the patients. The procedures that the patient suffered from were recorded. Tumor or pseudotumor resections (curettage, block resection, wide resection, disarticulation) were used. The detailed indications are shown in Table 1. After resection, the bone defect was refilled by autologous graft, allograft, calcium derived, combined graft and Methyl Methacrylate cement, or artificial hip. Prophylactic and treatment osteosynthesis were applied in cases Mirels score > 9 in fracture risk or cases of already broken [8]. The patients were followed up in one, three, six, twelve, and twenty-four months. Recurrences and complications were recorded. X-rays were made for each examination. The healing was last defined based on clinical and X-ray findings at the last examination or two years follow-up. All complications that happened intra-operation, three months post-operation, and later were recorded. The functional outcome was assessed by the Enneking score [9]. The last outcome was classified into four groups. Heal was a non-recurrent tumor or pseudotumor, incorporation of graft, replaced implant stable, and valuable functional score. Unchanged was nothing changed until the last examination. Worse was clinical, and imaging findings became worse more than those at admission. Death was the patient died in the follow-up time.

## 3. RESULTS

Fifty patients were involved in the study consisted of 26 males (52%) and 24 females (48%). The average age was 44.1 (26-59). Groups of age are given in Table 2. The left side was involved in 35 patients, the right in 14 cases, and one bilateral tumor. The follow-up time was 19.4 ± 17.8 (1-72) months. The mean follow-up time of the malignant and benign group was 7.2 ± 11 (1-41) and 29.9 ± 15.8 (12-72) months, respectively.

**Table 2.** Group of ages and gender related to tumors

| Ages and gender | Number | Malignant n = 23 | Benign n = 27 |
|---|---|---|---|
| ≤ 40 years old | 22 (44%) | 4 (17.4%) | 18 (66.7%) |
| 41-60 years old | 17 (34%) | 10 (43.5%) | 7 (25.9%) |
| > 60 years old | 11 (22%) | 9 (39.1%) | 2 (7.4%) |
| Female | 24 (48%) | 12 (52.2%) | (44.4%) |
| Male | 26 (52%) | 11 (42.8%) | 15 (55.6%) |

There were five patients (10%) with no pain, 28 patients (56%) with spontaneous pain, and 17 patients when moving. In 50 patients, there were 24 (48%) apparent TPs. These TPs consisted of 4 (16.7%) hard, 17 (70.8%) firm, and 3 (12.5%) soft tumors. The TP boundary was distinct in 3 (12.5%) cases and vague in 21 (87.5%) cases. Pain at the TP was in 14 (28%) cases and tenderness in 7 (14%) cases. Thirteen patients had one or more additional tumors at the other site. The average time from the onset of the symptom to the first examination was four weeks. At the admission, there were 24 (48%) cases of fracture, 12 (24%) patients revealed after an injury, and three (6%) cases revealed accidentally.

On X-ray, TPs at the PF (trochanter-neck-head), neck-trochanter, trochanters, and neck were 21 (48%), 16 (32%), 9

(18%), and 4 (8%) cases, respectively. Osteolytic was 47 (94%) cases, and osteogenesis was 3 (6%) cases. For 47 lytic lesions, the TP margin was sharp in 16 (34%) cases, blurred in 31 (66%) patients. Among osteolytic TPs, geographic, moth-eaten, permeative, geographic plus moth-eaten, and moth-eaten plus permeative were 24 (51.1%), 2 (4.3%), 2 (4.3%), 8 (17.4%), and 11 (23.4%) cases, respectively. According to Lodwick classification based on X-ray, osteolytic TPs of stages 1A, 1B, 1C, 2, and 3 were 2 (4.3%), 15 (31.9%), 7 (14.9%), 12 (25.5%), and 11 (23.4%) cases, respectively. In the process of treatment, there were 29 (58%) pathologic fractures and 17 (34%) fracture risks. The Mirels score of the fracture risk group was 9.3 (8-11). Four patients had no fracture risk, consisting of 3 cases of osteochondroma and one case of multi-focal fibrous dysplasia.

**Table 3.** Classification of the TP according to benign or malignant, and resection methods

| Group of disease (n=50) | Non-operation | Curettage | En-bloc | Wide resection | Disarticulation | Number |
|---|---|---|---|---|---|---|
| n(%) | | | | | | |
| Benign | | 1 | 3 | | | 4(8) |
| Borderline | | 4 | | 3 | 1 | 8(16) |
| Primary malignant | 7 | 1 | | 1 | | 9(18) |
| Metastasis | 9 | 3 | | 1 | 1 | 14(28) |
| Pseudotumor | 1 | 14 | | | | 15(30) |

**Table 4.** Classification of the TP according to the name

| TP | Number | Ratio (%) |
|---|---|---|
| Carcinoma metastasis | 14 | 28 |
| Giant cell | 8 | 16 |
| Fibrous dysplasia. | 7 | 14 |
| Aneurysm bone cyst | 6 | 12 |
| Lymphoma | 4 | 8 |
| Osteochondroma | 3 | 6 |
| Sarcoma | 3 | 6 |
| Plasma cell myeloma | 2 | 4 |
| Bone cyst | 1 | 2 |
| Angioma | 1 | 2 |
| Fibroma | 1 | 2 |

**Table 5.** Classification of TPs according to the stage of extended Enneking

| Stage of Enneking | Number (n=50) | Ratio (%) |
|---|---|---|
| 1: Benign, non-malignization | 16 | 32 |
| 2: Benign, seldom malignization | 3 | 6 |
| 3 A-B: Borderline malignant | 8 | 16 |
| I A-B: Low malignant | 1 | 2 |
| II A-B: High malignant, non-metastasis | 1 | 2 |
| III A-B: Malignant with metastasis | 1 | 2 |
| Carcinoma metastasis | 14 | 28 |
| Primary, none mesenchymal malignant | 6 | 12 |

Biopsy was made once for 24 patients, twice for 25 patients, and three times for one patient. They were made on 44 (88%) patients before treatment. All 33 of 50 patients who suffered from the treatment operation were performed one more biopsy or the first biopsy (6 patients) in the procedure. Thirteen specimens were performed immunohistochemistry. The clinical findings and imagines were coincident with micropathology-immunohistochemistry in 48 (96%) patients. The benign or malignant TPs are shown in Table 3. According to the TP name, the kinds of TP are shown in Table 4. Stages of extended Enneking of the TP are shown in Table 5. After the results of the biopsy, seventeen patients stopped treating or treated with non-operation ways. Thirty-three (66%) patients suffered from an operation. The procedures are shown in Table 3. Autologous bone graft was used in fourteen patients, combined graft in four patients, cement in 2 cases, and synthetic bone graft in four patients. The devices were used on 28 patients. The numbers of DHS, locking plate, intramedullary nail, and artificial hip were 13 (46.4%), 3 (10.7%), 7 (25%), and 5 (17.9%), respectively. One case of trochanteric split fracture happened in operation. Five patients were involved in post-operative complications. They were limb shortening, infra-plate fracture, and artificial hip dislocation. In seven patients, the late accidents consisted of screw protrusion, progressive lytic bone, malunion, and recurrence. Ennerking's functional score was excellent, good, fair, and poor in 24 (48%), 5 (10%), 1 (2%), and 20 (40%) patients, respectively. The last outcomes are shown in Table 6.

**Table 6.** The results. Surgical vs. non-surgical and malignant vs. benign (p=0.000)

| Results | Surgical n (%) | Non-surgical n (%) | Malignant number | Benign ratio (%) |
|---|---|---|---|---|
| Heal | 27(81.9) | 2 (11.8) | 3 (13.0) | 26 (96.3) |
| Unchanged | 3 (9.1) | 7 (41.2) | 10 (43.5) | 0 |
| Worse | 1 (3.0) | 2 (11.8) | 2 (8.7) | 1 (3.7) |
| Dead | 2 (6.1) | 6 (35.2) | 8 (34.8) | 0 |
| Sum (n) | 33 | 17 | 23 | 27 |

## 4. DISCUSSION

Follow-up 50 cases of TP at the PF with 33 patients suffering from treatment operation, the characteristics of clinical figures, imaging, micro-pathology, and the relationship of the outcome with benign - malignant were recorded.

The male and female were the same. That means gender was not a factor of diagnosis. In this study, the ages of benign and malignant TP groups were different. The first group was dominant ages under 40; on the contrary, the prevalent ages of the second group were over 40. These matched some studies of benign TPs at the same site [10, 11] or bone metastasis carcinoma [12]. Almost all patients in this study had to go to the hospital because pain and pathologic fracture caused limb dysfunction, similar to some studies. Thus, the patients usually go to the hospital at a late time. The period from the symptom onset to the first examination was 22.4 ±

60.8 weeks. However, the potential beginning of disease might be a long time ago, such as in osteochondromas. Most patients with a tumor or pseudotumor would have spontaneous pain (56%) or pain when moving, but some patients did not feel pain, that why the patients did not go to the hospital for years. In this study, the hip movement was related to the kind of TP. The malignant tumor patients were about double the benign TP patients in affected activity. The cause could be the pathologic fracture was nearly double in the malignant group. There was no significant difference between the benign and malignant groups about gender, admission because of pain, injury, involved side, or accidentally revealed in this study so that these factors can not be used as a symptom for diagnosis. All patients in this study had a lesion at the PF, but the tumor presence was different. Some patients felt pain or slightly decreased the limb function in TP progress but without "tumor." The appearance tumor was seen in only 48% of the cases. There was also no relationship between the appearance of the tumor with the tumor kind in this study, so it is clinically difficult to give a defined diagnosis with a tumor at the PF.

About 12% of patients had a previous injury, but there was no relation with the present tumor or pseudotumor. Twenty-six percent of patients had a tumor or defined cancer at another organ. On these patients, the consolidation of metastasis was confirmed. It was told that a lytic bone tumor in patients more than 40 years old suggests a carcinoma metastasis, and if a patient has a malignant tumor at another organ, the diagnosis could be defined. In another view, the authors showed that about 10% of primary cancer would give metastasis at the PF. In which 50% of tumors are located at the neck, 30% at the infra-trochanter, and 20% at the intertrochanteric femur [12].

Eleven MRIs and CT-Scans were made in the study, but the data was insufficient. Therefore the imaging was analyzed with X-ray images. The TP at the PF was 42% of all. For these cases, removing the diseased tissue, performing bone graft and fixation was so difficult. In this study, all TPs were lytic, but 3 cases were osteochondromas. In a survey of benign TPs at neck-trochanter of the femur, lytic bone was recorded in 14/24 patients [13]. The osteogenesis lesion of this study was in a low ratio, with only three cases of osteochondroma. The others almost were osteolytic bone, in which the geographic type consisted of 51.1 %, related to the high ratio of benign lesions such as a simple cyst or aneurysmal bone cysts. The moth-eaten, permeative, or combined types consisted of a lower incident related to the primary cancers such as lymphoma, myeloma, or metastasis. This study showed that X-ray imaging had a relationship to the kind of TPs. The osteochondroma had the only osteogenesis, while the myeloma or carcinoma metastasis had scattered osteolytic bone, moth-eaten or permeative types. The results also showed that 34% of cases of lytic bone had a defined margin imagine and related to the benign TP. In fact, in this study, the operation was indicated for all the benign TPs, but the procedure could not be performed on two patients. In a survey of benign TPs of Seung Han Shin at the same site, the operation was performed on the patients with pain when moving and a high density on the lesion margin [14].

In this study, the X-ray IB was the most ratio of the geographic type, in which 80% was pseudotumor, and 13.3 % was borderline malignant. These cases were non-high-density margin or thin cortex, threatening fracture. In the X-ray II, the moth-eaten combined geographic lytic bone was the most part, in which the primary cancer was 33.3%, and metastasis was 66.7%. Generally, X-ray IC, II, and III incidences were higher in the malignant group than in the benign group. Vice versa, X-ray IA and IB were almost benign TPs. The geographic type was more met in the benign group than the malignant group among the lytic lesions. Similarly, the moth-eaten combined permeative and moth-eaten combined geographic were more met in the malignant group than the benign group.

The biopsy was made on all patients. Except for one case of making biopsy three times, the one time and twice biopsies cases were equivalence. The three-times biopsy case was a male, 60 years old, who had suffered from an osteosynthesis operation with DHS because of a primary diagnosis of well-differentiated gland carcinoma metastasis at the intertrochanter. The tumor spread rapidly and devastated the PF. The first biopsy resulted in carcinoma metastasis, but the immunohistochemistry was orientated towards a giant cell tumor. The result of the second biopsy was a giant cell tumor combined aneurysmal bone cyst. The thirst biopsy was made in the hip disarticulation procedure, and the last result was an aneurysmal bone cyst combined giant cell tumor. Patients whose X-ray images were typical such as osteochondroma or bone cyst suffered from the operation without biopsy. The resected tissues were sent to the laboratory for micro-diagnosis. All micro-pathology results coincided with the image and clinical figures. For all 44 patients who had the biopsy results, 17 patients were treated in a non-surgery way. The rest suffered from treatment operation, and the second biopsy was made in the procedure. All but except two cases, the two biopsies had the same result. The first results of two exceptional circumstances were connective tissue chronic inflammation. After the operation, the biopsy results were a giant cell tumor and fibrous dysplasia. Two different pathologists diagnosed these cases. It was thought that other pathologists should not diagnose the specimens of each patient because the results may be different due to the surgeon and pathologist. There were two complex cases for which the microscope slide consultation was organized to make the diagnosis. The final diagnoses were low malignant chondrosarcoma and low differentiated fibrosarcoma. The clinical and images findings of the TP at the PF were untypical, so that it was easy to make mistakes in diagnosis. It should be made MRI or CT scan for further evaluation [15]. Because the mesenchymal stem cell can differentiate into a wide rank of overlap tumors and the diagnosis was difficult, authors were not unified in classification. For the borderline tumor, the authors considered it as an "aggressive benign bone tumor" [16] or "aggressive benign neoplasm" [3]. Therefore, the role of immunohistochemistry was critical. In the study, immunohistochemistry was performed in 30% of patients following the suggestion of pathologists for the problematic cases. The results helped diagnose the metastasis of origin-unknown carcinomas such as hepatocellular carcinoma, renal cell carcinoma, or lymphoma.

Among 50 patients, the pseudotumor accounted for a high ratio, much more than metastasis and borderline. Following the tumor's name, carcinoma metastasis was the highest proportion, and the next were giant cell tumors, fibrous dysplasia, and aneurysmal bone cyst (Table 4). The lower

ratio was lymphoma, osteochondroma, chondrosarcoma. These results were similar to those of other researches [1, 17]. The PF was often the favorite site of benign TPs. In a study of 20 benign TPs at the PF, an author had 11 fibrous dysplasia. The rest were simple and aneurysmal bone cyst, fibroma, giant cell tumor, and chondroblastoma [18]. Another author had 35 patients with 14 fibrous dysplasia, 11 bone cysts, eight aneurysmal bone cysts, and two giant cell tumors [11]. A previous study concluded that about 10% of cancers would develop metastasis at the PF in the literature, but this site was not the favorite site of giant cell tumors. The morbidity of giant cell tumors at this site was less than 4% of all [12]. Unlike those studies, the giant cell tumor was 16% in this study, the second after metastasis 28%. These results showed that the giant cell tumor was not rare at PF.

In this study, the Ennerking staging system was used. This staging system was not applied to marrow-originating tumors such as lymphoma, multiple myeloma, Ewing sarcoma, round cell tumor, or carcinoma metastasis [8]. Twenty-eight patients were qualified to classify in this system. More than a haft of TPs were benign while seldom malignization and borderline each accounted for 17,8%, and the malignant was at a low incident. In order to make an overview of all TPs at the PF, two categories were added to the Ennerking staging system. According to this extended classification, the malignants were 23 cases, accounting for 46% (Table 5). This incident was too high so that one should be thought to be malignant when there is a tumor at the PF.

The ideal treatment method was still an operation with tumor or pseudotumor resection and bone graft combined osteosynthesis [19]. In the relationship to the treatment of benign TPs, it was said that the operation should be considered when patients had recurrent pain or abnormal gait [10]. The most benign TP cases were used curettage in this study. Curettage was used to be an ordinary way for the treatment of benign bone TPs [20]. In the present condition, curettage by a curette without additional nitrogen liquid, phenol, or heat ablation was still acceptable. Curettage was used even for borderline in this study. It was known that the curettage gave more recurrence but got more function than en bloc resection [21]. In literature, in a 38 years follow-up study, curettage was used successfully in 60% of giant cell tumors at PF [22]. En bloc resection was used in three osteochondromas. In fact, in two cases, the tumor was resected "en bloc." Another case was a giant tumor that was removed partially, and the stem was unexpectedly left. Although the image was unchanged after one year, this tumor can be recurrent or even become malignization. The wide resection in this study was used in 15.1% of procedures for borderline and metastasis tumors. This method helped reduce the recurrence but caused difficulty in saving the function, needing more complex processes. Two radical resections that were hip disarticulations were used in this study. One was for a spread carcinoma metastasis, and another was for an aggressive aneurysmal bone cyst. In those present conditions, no other procedure could be chosen.

The treatment rule used for all operations was tumor or pseudotumor resection, refill of the defect, and fixation or hip replacement. Bone graft was used in eighteen patients, of which 77.8% was autologous graft. Autologous bone graft was preferred because the graft was available and could be harvested concomitantly in operation. The used grafts were from the iliac crest or fibular in some cases. In cases of giant defects, the combined graft was used. The authors advised that autologous graft was the best, but grafts should be combined to enhance the volume [23, 24]. The substitute grafts such as cement or tricalcium phosphate were also used in this study to ensure the defect filling. In wide resection cases, the compensation was the artificial hip system. In this study, cement polymethyl methacrylate was used in two cases. The first case was a wide resection preceding hip replacement and the second case was carcinoma metastasis. The results were satisfactory. It was known that the cement polymethyl methacrylate was used successfully in 94% of 375 patients with metastasis [25]. In the study, prophylactic osteosynthesis was used in Mirels score $\geq 9$ [26]. The bone fixation was considered as a "gold standard" in the risk fracture of metastasis [27]. Although the conservation of the femoral head was difficult, the fracture site was removed, plus osteosynthesis with graft could result in an acceptable outcome [28]. Osteosynthesis for risk fracture was critical [14]. The authors agreed that prophylactic osteosynthesis was better than osteosynthesis for fracture [29]. In this study, many cases were needed prophylactic osteosynthesis because Mirels score > 9.3 [8]. The DHS, locking plate, or gamma nail was used in this study, while in the literature, kinds of devices were acceptably used for osteosyntheses such as locking nail, gamma nail, DHS, PFNA, or even carbon fiber nail [18,25,30].

There were five hip replacements in this study. All artificial hip used in this study was the ordinary hip system with a long stem. This kind of hip was available, not too expensive, and the Government Health Insurance paid for it. They comprised three giant cell tumors, one sarcoma, and one chemotherapy-response breast cancer metastasis. Hip replacement was an excellent method to conserve limb and hip function. A short (standard) stem artificial hip could be used successfully in some cases as long as the system was reinforced by the plate and screws [31]. Besides hip replacement, one spread tumor was successfully treated with curettage and bone graft conservating hip function in this study. In a survey of benign tumors, the result showed that the curettage and bone graft method could result in a good outcome with the recurrence incident was similar in two groups of fracture and risk fracture tumors [32].

In the treatment of benign tumors, borderline tumors, and pseudotumors, one suffered from a hip disarticulation. Although the patient was considered worse, the wound healed, and after a year, no recurrence was seen. Another patient was multi-focal fibrous dysplasia with slow development under the follow-up. The patient was treated with calcium and biphosphonate combined physiotherapy. The patient was better two years later (pain relief, normal hip function, deformity unchanged, and improved X-ray image). It can be said that the outcome of this case was excellence, and it was considered heal. Therefore the operation was canceled, although, in the literature, authors showed that prophylactic osteosynthesis in fibrous dysplasia was necessary. This case approved that in severe cases, biphosphonate was useful [33]. Some authors were also afraid of the PF deformity and advised operating to avoid arthrosis [34,35]. Fortunately, in this case, no deformation grew up. The rest cases were successfully treated by curettage plus bone graft and

osteosynthesis. This outcome was similar to those of many reports.

Among malignant tumors in this study, only seven patients suffered from an operation because of several conditions. Studies have shown that the operation on metastasis can improve the life quality and the hip replacement was better than osteosynthesis [12, 36]. And osteosynthesis, even nailing or plating, did not affect survival [37]. Two hip replacements, four nailings, and one disarticulation were performed in this study. Hip replacement was indicated on the patients whose survival was assessed long. Intramedullary nailing was used as a salvage procedure. In the sixth month of the follow-up time, two operated patients and six other patients had died. Overall, the treatment outcome of malignant was not as expected.

The intraoperative complications can be vessel and nerve damage, bone broken, fat embolism, and pulmonary edema. In this study, no significant intraoperative complications happened. A trochanteric split fracture was reinforced with a wire cerclage. The fixation was stable, and the bone healed.

Authors identified dislocation as a common complication after hip replacement in the treatment of PF tumors [4, 38, 39]. Indeed, there was a dislocation in 5 hip replacements of this study. The other late complications were similar to common osteosyntheses such as screw protrusion, infra-plate fracture, malunion, limb shortening, and tumor recurrence with osteolytic. In the situation of treatment TPs, it was difficult to avoid or prevent these complications.

Enneking's functional score significantly changed over time. In the healing patients, the partial and total scores were increased, while in the death patients, the scores decreased. In the unchanged patients, the score increased a little, but the last result was unknown. Previously, there was no study of all kinds of TPs at the PF. Hence it wasn't easy to compare the results. There were a small number of operation cases among malignants, so it can not be compared with another study. For all malignants in follow-up time, 20% was unchanged, 4% worse, and death 18% in this study, while in a similar study, the average survival of the patients was 10.6 months [40]. Table 6 shows that the outcome differed between the surgical and non-surgical groups and between the benign and malignant groups. These differences are understandable.

## Conclusion

The morbidity rate of PF TPs was high at middle age with male and female equivalent. About half of the patients had appearance tumors. Osteolytic was seen in most cases. The X-ray of Lodwick IC, II, and III was predominant in the malignant group. Vice versa, Lodwick IA and IB, was dominant in the benign group. There was a high rate of pathological fracture and risk of fracture needing osteosynthesis. For an overview, about 48% of the TPs at the PF were malignant. The giant cell tumor was not rare at the PF, accounting for 16%. The operation resulted in an outcome better than non-surgery ways, even in healing or mortality. The resection of the malignant tumor or pseudotumor combined bone graft using ordinary fixation devices was satisfactory. Besides wide resection and hip replacement, curettage and bone graft using osteosynthesis also gave a good result for the borderline tumor. For the low malignant, wide resection could provide an acceptable outcome. For primary high malignant and metastasis, surgery did not improve survival but was considered, if applicable, a salvage treatment to enhance the patient's life quality.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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