Clinical Case Report

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A single-component and hemi-hip prosthesis followed up for 43 years

A case report

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Abstract

Rationale: Giant cell tumor (GCT) is a locally aggressive bone tumor with a high recurrence rate if not completely excised. And reconstructive hip surgery using an artificial prosthesis in a young active patient is controversial because of problems related to the durability of the artificial joint.

Patient concerns: A 30-year-old man presented with right hip pain and other more severe symptoms, but without fever or night sweats. After 4 months, he experienced intense pain at the root of the right leg and limitation of motion after falling from a bicycle.

Diagnoses: Giant cell tumor.

Interventions: The patient was treated with surgical resection of the total tumor, and hemiarthroplasty of the hip joint using a custom-made titanium femoral prosthesis.

Outcomes: The patient could perform activities of daily living, even walking long distance without pain. He continued to work as a teacher for 30 years and retired 11 years after the surgery.

Lessons: A well-designed, custom-fitted, single-component, wear-resistant joint prosthesis should be the brand-new direction of development of artificial joints.

Abbreviations: GCT = giant cell tumor, PMMA = polymethylmethacrylate, THA = total-hip arthroplasty, UHMWPE = ultra-high-molecular-weight polyethylene.

Keywords: custom-made single-component titanium prosthesis, giant cell tumor, hemiarthroplasty, pathologic fracture, proximal femur

1. Introduction

Fifty-six years have passed since John Charnley designed and developed the total-hip arthroplasty (THA) procedure in 1962. Since then, the Charnley arthroplasty is the most commonly used cemented arthroplasty, and is still currently used in orthopedic clinics. A small head with a thick ultra-high-molecular-weight polyethylene (UHMWPE) acetabular component was used, and the components are cemented with polymethylmethacrylate (PMMA) to ensure the largest possible area of load distribution. However, the lifetime of the Charnley arthroplasty is skimped because that polyethylene debris and particle-induced osteolysis have been observed to occur with time, resulting in the failure of the total-hip arthroplasty (THA).

Giant cell tumor (GCT) is one of the common tumors of the bone in clinical practice; it accounts for approximately 5% and 20% of bone tumors in Western populations and Chinese populations respectively.[1,2] Although GCT is benign in terms of tissue structure, it has a general high recurrence rate after resection, and the possibility of pulmonary metastasis exists. GCT usually occurs in the distal femur and proximal tibia,[3–7] but rarely in the proximal femur. Compared with other locations, GCT of the proximal femur is clinically more difficult to treat.[8]

The traditional treatment of GCT is surgery, which is mainly dependent on the size and degree of the tumor. Although the functional outcomes of THA and bipolar hemiarthroplasty are satisfactory, reconstructive hip surgery using an artificial prosthesis in a young active patient is controversial because of problems related to the durability of the artificial joint. About 43 years ago, not only materials and design of hip prostheses but also surgical techniques were inadequate, as compared with the present. Under such disadvantageous circumstances, a young patient with a pathologic transtrochanteric fracture secondary to

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GCT underwent hemiarthroplasty in our institution, using a custom-made titanium prosthesis without any cemented fixation or biologic surface. We report this unusual case that has maintained good results without local recurrence or lung metastasis for 43 years. Follow-up radiographs showed new bone formation for about 3 years postoperatively at the site of muscle reinsertion to the femoral component. Written informed consent was obtained from the patient and the patient has provided informed consent for publication of the case.

2. Case report

In April 1974, a 30-year-old man presented with right hip pain and other more severe symptoms, but without fever or night sweats. After 4 months, he experienced intense pain at the root of the right leg and limitation of motion after falling from a bicycle. Radiography performed in the local hospital showed a pathologic transtrochanteric fracture of the right femur (however, his preoperative imaging data were lost); then, the patient went to our hospital on November 16, 1974, because the conservative treatment turned out to be invalid, as the puncture diagnosis indicated a grade II GCT.

On February 17, 1975, the patient underwent GCT surgery, with complete excision and hemiarthroplasty of the hip joint using a custom-made titanium femoral prosthesis under continuous epidural anesthesia. The operators started with the improved Smith–Petersen approach to expose the fracture position. Intraoperative observation showed the pathologic transtrochanteric fracture line, a large cystic lesion occupying both the femoral neck and the trochanteric area, and invasion of both the gluteal muscle group and parts of the vastus lateralis close to the tumor. Operators used a coping saw to snap the tumor segment completely and then packed the area with gauze to stop the bleeding. The femur was prepared with rasps, cleaned, and dried carefully. Owing to the large femoral bone marrow cavity, the operators grafted bone blocks from the right anterior superior of iliac crest to fill the cavity and used a custom-made titanium femoral prosthesis (length, 285 mm; femoral head diameter, 47 mm; produced by the Machinery Factory of Hongdu, Nanchang, China) to proximally match the acetabulum and distally insert into the marrow cavity. Because there were no cements yet at that time, they sutured the gluteus muscle group and vastus lateralis to the distal groove of the artificial femoral head after carefully cleaning the parts of the invaded muscles group. Finally, the operators determined the stability and reliability of the prosthesis by moving the right hip. Because of the primitive condition of lacking camera, the shape of the tumor, design of the prosthesis, and surgical procedures are represented as shown in Figure 1.

Postoperative pathologic reports revealed grades I to II GCT on the right transtrochanter of the femur, tumor cells invasion on the surgically removed segment, and dead bone formation. The patient recovered well postoperatively and began to walk 3 months after the operation without obvious pain or restricted movement. Follow-up radiographs were obtained at 3 and 44 years after surgery. The right hip joint activity of the patient presented with no obvious abnormality as compared with the opposite side, and imaging showed new bone formation at the upper medial part of the femoral prosthesis without bone resorption both at the acetabular side and at the upper lateral part of the femoral stem 3 years postoperatively (Fig. 2). Current radiographs, taken 43 years after hemiarthroplasty, showed no signs of loosening or migration, but the acetabulum is badly worn. New bone formation at the medial side of the femoral prosthesis was approximately combined with the distal femur but remained without apparent bone resorption around the prosthesis (Fig. 3). Although the right lower limb of the patient shortened by 5 cm compared with the opposite side, resulting to a slight limp, he could perform activities of daily living, even walking long distance without pain. The patient continued to work as a teacher for 30 years and retired 11 years after the surgery.

During the follow-up period, chest imaging did not show any signs of pulmonary metastasis, X-ray evidence of tumor recurrence, or signs of loosening. Clinically, the patient is still enjoying the excellent results of the hemiarthroplasty, with a total Harris hip score[9] of 74 points.

3. Discussion

The GCT is a locally aggressive bone tumor with a high recurrence rate if not completely excised. Its treatment modalities include curettage with or without bone grafting, which has high recurrence rate (>10%), usually within 2 to 3 years.[10,11] Thus, adequate removal is an important predictive factor of surgery outcome.[12] Meanwhile, according to Nakano et al[13] intralesional excision with adjunctive therapy such as phenol cauterization or cementing should be used to treat patients with such tumors to preserve the function of the extremities and avoid local recurrence. Neither local recurrence nor lung metastases have occurred in our patient, probably due to complete local excision and enough stability owing to the reattachment of the surrounding muscle group and adequate recovery period.

3.1. Press-fit without any cemented fixation or biologic surface

Pathologic fracture of the proximal femur, as in our patient, is a challenging problem in orthopedics. Choosing simply intralesional excision and internal fixation may result in a higher possibility of tumor recurrence. Although extensive resection of the proximal femur may decrease the rates of recurrence, the reconstruction and function of the hip after resection would be tremendous problems for operators, especially in young active people, who may place greater demands on their hip. Furthermore, during that time, artificial joints and cements were not yet available. Hence, there may have been some reluctance in recommending joint reconstruction as the primary treatment of choice to young patients and in considering joint salvage operations[6] because of its higher rate of mechanical failure, compared with that in elderly patients. However, the high incidence of recurrence after curettage and fixation, particularly at this anatomical site, must be stressed, and hip arthroplasty should be considered as the primary treatment of choice, rather than revising it as a secondary procedure, to avoid the possibility of recurrence, non-union, and other associated complications.[14] Furthermore, our patient's acetabulum was undamaged and intact; thus, we chose hemi-hip prostheses replacement. Our patient did not experience hip dislocation because the single femoral component, with its giant head diameter of 47 mm conferred the acetabulum perfectly. Although there was no Cement fixation but also biologic fixation in the distal femur, prosthesis handle was press-fit contacted with femoral medulary cavity by autogenous bone graft and also the muscle group reattached. Although the large titanium femoral head may have led to the thinning of the acetabulum, as shown in the 43-year follow-up radiograph, no findings of aseptic loosening have been detected.

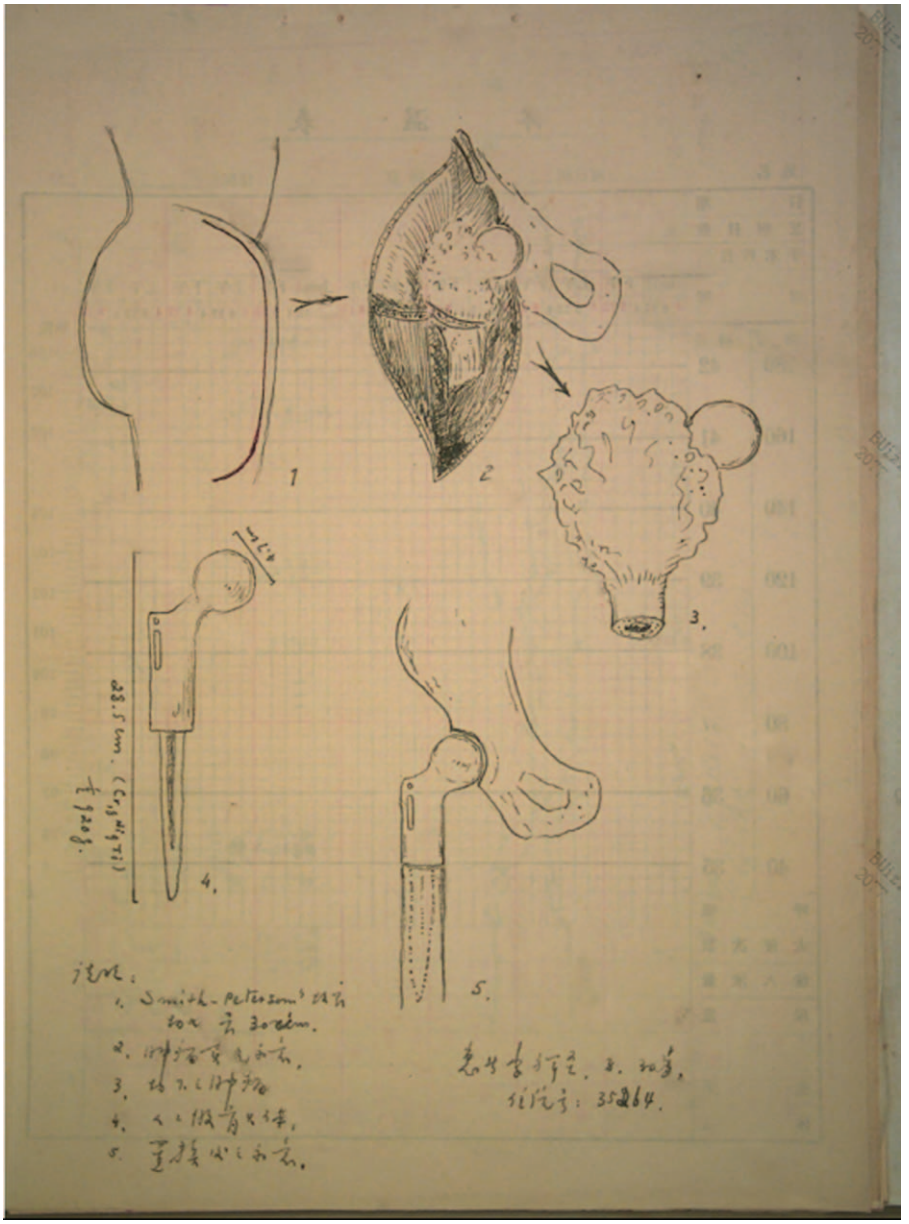

Figure 1. Operation procedure and intraoperative observation. (1) Improved Smith–Petersen operative incision. (2) The pathologic transtrochanteric fracture line. (3) The shape of the tumor occupying both the femoral neck and the trochanteric area. (4) The prosthesis was 285 mm (length), with a 47-mm-diameter femoral head, weighed 920 g, and was made of $Cr_{18}Ni_9Ti$. (5) The prosthesis perfectly matched the acetabulum and the insertion into the marrow cavity of the distal femur.

3.2. Single-component prosthesis with no poisonous wear debris

At present, we know that THA may lead to aseptic loosening because of wear resulting from the rubbing of the femoral prosthesis with the polyethylene sockets.[15,16] According to Schmalzried et al[17] prosthesis loosening was related to wear of polyethylene at the 90% confidence level. We attribute our patient's long-term excellent radiologic and functional results to the single-component prosthesis. Compared with modular femoral prosthesis, a single-component titanium prosthesis is stable, with no biologic wear particles from artificial joint-induced biologic osteolysis despite wear. Moreover, we believe that he dealt prudently with his artificial joint by keeping his body weight, daily activities, and social environment, which are important factors for achieving good results. Furthermore, the nature of the newly formed bone, which occurred only around the medial site of the femoral prosthesis, possibly contributed to the stability and active hip motion. It is postulated that the prostheses that allow direct soft-tissue attachment can improve limb and joint loading and minimize abnormal interface stress, thus avoiding implant failure and encouraging bony remodeling.

In conclusion, through this case, we propose that a well-designed, custom-fitted, single-component, wear-resistant joint prosthesis should be the brand-new direction of development of artificial joints.

Figure 2. Three-year postoperative radiograph showed new bone formation at the upper medial part of the femoral stem (white arrow) but no bone resorption.

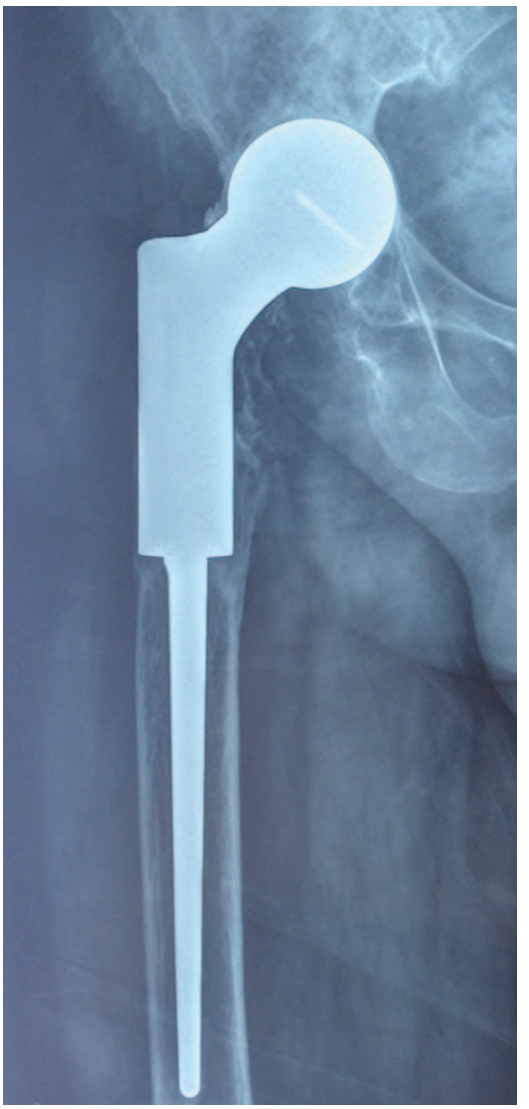

Figure 3. A 43-year follow-up radiograph showed wear of the acetabulum, with increased new bone information and still no bone resorption. No local recurrence, aseptic loosening, or migration was noted.

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