

## Clinical report

# Total femur replacement for Ewing's sarcoma after wide resection of the proximal femur: a long-term follow-up case study

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**Background:** Total femur replacement is a relatively rarely performed procedure for the reconstruction of an affected limb after resection of a malignant bone tumor.

**Objective:** Report total femur replacement in a 17-year-old male patient after wide resection of the right femur for involvement of the proximal segment of the bone by Ewing's sarcoma.

**Results:** The complications that often arose from the use of the tumor prostheses after the tumor resection, e.g., infection and migration/dislocation of the artificial bonehead, were overcome successfully. The patient has been under follow-up for a relatively long period of time (16 years) since the surgery. The operated limb function is now rated at 70% according to the rating system by Musculo-Skeletal Tumor Society (MSTS). The patient has almost completely regained his ability to walk and carries on with activities of daily living.

**Conclusion:** If appropriate measures are taken to deal with the complications, favorable function of the operated limb can be expected to be maintained for long periods after reconstruction using this technique.

**Keywords:** Total femur replacement, Ewing's sarcoma, complications

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Total femur replacement is a relatively rarely adopted procedure from among the methods available for reconstruction of the affected limb after resection of a malignant bone tumor [1-6]. We performed total femur replacement in a 17-year-old male patient after wide resection of the right femur for involvement of the proximal segment of the bone by Ewing's sarcoma. The patient overcame complications that often arose from the use of the prosthetic joints after the tumor resection, e.g., infection and migration/dislocation of the artificial bone head. We report a case of the patient who has been under follow-up for a relatively long period of time (16 years) since the surgery.

## Case report

Around September 1991, a 17-year-old male adolescent was hit by a ball in the right leg near the hip joint and consulted with Bone-Setter. At that time, he was treated under the diagnosis of a pulled/torn muscle. Subsequently, he occasionally complained of pain around the right hip when walking. On September 17, 1992, the pain around the right thigh intensified, and he presented to our department. A plain X-ray revealed marked periosteal reaction, primarily at the diaphysis of the right femur. Based on a suspicion of malignant bone tumor, he was admitted to Department of Orthopedic Surgery, Nihon University Hospital on the same day for further examination and treatment.

On September 24, 1992, an incisional biopsy was performed under general anesthesia. Histopathological examination of the biopsy specimen revealed the diagnosis of Ewing's sarcoma. Then, the patient received preoperative chemotherapy using the RosenT-11 protocol (**Fig.1**).

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**Fig. 1** Radiographs of the dislocation of the tumor prosthesis. Bipolar head is dislocated above the acetabulum.

On August 11, 1993, wide resection + total femur replacement was performed. During the operation, the straight muscle of the thigh was preserved, with its continuity from the proximal to the distal segment retained completely. The femur was resected en masse (along with the gluteus medius muscle and tensor muscle of the fascia lata in the proximal region and the lateral great muscle, 2/3 of the intermediate great muscle, and 1/3 of the medial great muscle in the distal region) (wide resection). The operated limb was reconstructed with a total femur prosthesis. The apparatus used for the reconstruction was the Howmedica modular resection system (HMRS). The proximal femur component (120 mm) was bound to the distal femur component (120 mm) with a connection piece (60 mm) and a stem extension piece (100 mm). A bipolar femoral head with a cup diameter of 52 mm was used. Postoperatively, chemotherapy was administered, again using the T-11 protocol.

On January 12, 1994, the patient was discharged from the hospital, wearing a long leg brace and using a T-shaped walking stick. The subsequent course was uneventful, with no evidence of local recurrence or metastasis during the follow-up. Around May 1997, a cystoma-like swelling was noted in the region of the right greater trochanter, suspected to be caused by bursitis.

In October 2002, a yellow-brown exudate was aspirated in large amounts from the cystoma-like part of the greater trochanter. Culture of the exudate grew methicillin-resistant *Staphylococcus aureus* (MRSA). Thus, a diagnosis of prosthetic joint infection caused by MRSA was made. On October 16, one-stage revision was performed. Then, after debridement, revision of total femur replacement was performed, while retaining the tibial component (**Fig. 2**). The local infection subsided thereafter, and the patient followed a favorable clinical course.



**Fig. 2** Because the patient also complained of hip instability, installation of the acetabular component was carried out for revision total femur replacement.

On October 23, 2006, he fell in the bathroom, sustaining a fracture of the right patella. Therefore, he was hospitalized again and treated conservatively with the part immobilized by a plaster of Paris cast. On August 27, 2007, he slipped on the carrier of a truck and began to complain of right hip pain. He visited our department on the same day, and a plain X-ray revealed posterior dislocation of the prosthetic bonehead. Emergency surgery was performed for open reduction. Two weeks after the operation, a long leg brace was given for the patient, and he began to receive walk-training. He stayed at the hospital for about one month.

On July 16, 2009, 16 years after the first operation, he became aware of pain again in the right hip. At that time, hematological tests revealed evidence of inflammatory reaction, and a cystoma-like lesion was again seen in the region of the trochanter. However, culture of tissue specimens obtained from the swelling grew no bacteria. At the same time, a plain X-ray revealed migration of the bipolar head towards the acetabular side, and the patient complained of hip instability. On July 30, 2009, debridement was performed, and installation of the acetabular component was carried out for revision total femur replacement. In addition, a rectus abdominal myocutaneous pedicle flap was used to repair the defect, primarily in the region of the greater trochanter. The acetabular component used was the constraint type (cup diameter: 54 mm). The range of active movement of the hip joint was 20 degrees for abduction, 10 degrees for adduction, 10 degrees for external rotation, 10 degrees for internal rotation, and 65 degrees for flexion. The range of active motion of the knee joint was 30 degrees for flexion and 0 degree for extension. The strength of the quadriceps muscle of the thigh was rated at 3 by Manual Muscle Testing.

Assessment by the Musculo-Skeletal Tumor Society rating system (MSTS) yielded the following results: pain, 5; function, 3; emotional acceptance, 2; supports, 5; walking, 3; and gait, 3 (total, 70%). At present, 12 months after the operation, the patient is free of signs of local infection and hip instability. He can walk with the assistance of a T-shaped stick.

## Discussion

Total femur replacement was first reported by Buchman [2]. Only a few reports of the procedure have been published since. Case reports involving 10-

year or longer follow-up are rare. The mean follow-up period in previously reported cases is in the range of 1.5 to 4.8 years [3, 8]. Kalra et al. reported cases followed up for up to 28 years [6]. Present et al. [9] reported a case of total femur replacement followed up for 35 years. Complications arising from the prosthetic joints used after tumor resection include infection, breakage, loosening, and dislocation. In our case, we dealt with these problems in a timely manner, as appropriate. As a result, it has been possible to preserve the operated limb for as long as 16 years. There is still controversy over the optimum method of preventing and treating postoperative infections, etc. In our patient, we succeeded in controlling the infection through early detection and one-stage revision [10]. It is also important to cover the prosthetic joint with a myocutaneous flap rich in blood flow [11]. Nerubay et al. [12] reported an incidence of deep infection of 7%. Kalra et al. [6] used antibiotics to treat superficial infection and performed two-stage revision to deal with deep infection. When dealing with migration of the prosthetic bone head towards the acetabular side, it seems useful to install a control-type acetabular component as soon as possible and to replace the joint completely with a prosthetic one [13]. Bone head dislocation is one of the common complications arising after total femur replacement. This seems to arise from resection of the hip joint abductors, with the entire femur serving as a long lever arm. The incidence of this complication was reported by Kalra et al. [6] and Brend et al. [7] to be 11% and 12%, respectively. As a countermeasure against dislocation, they reported that reconstruction of the hip with a prosthesis after installation of an acetabular component would be desirable [14, 15]. The functional level, as assessed by the MSTS rating system, after reconstruction by this technique was reported to be 77.3% by Schindler et al. [16], 72.6% by Kalra et al. [6], and 72% by Cristian et al. [14]. Even in cases where complications arise, satisfactory function of the operated limb can be restored in all cases by taking appropriate measures.

In conclusion, total femur replacement is one of the useful methods of reconstruction in patients with malignant bone tumors requiring complete femur resection. If appropriate measures are taken to deal with the complications, favorable function of the operated limb can be expected to be maintained for long periods after reconstruction using this technique.

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