ORIGINAL ARTICLE

Methods Used for Reconstruction in Aggressive Bone Tumours: An Early Experience

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Summary

Improvements in the overall treatment of patients with aggressive, large tumours involving the bone have made it possible to preserve and salvage limbs instead of amputating them. Each patient is unique in his clinical presentation and social circumstance. The different reconstructive options available allow us to choose the most appropriate method suited to the particular patient and with minimal delay, even when resources are limited. The patient and the relatives actively participate in the choice. The early experience of the different techniques for reconstructing these bone defects at our hospital are presented in this paper.

Key Words: Aggressive bone tumours, Reconstruction

Introduction

Various methods can be used to reconstruct the large osseous defects after a wide excision has been done. Options include the use of allografts, with or without a metal prosthesis; endoprosthetic replacement; composite reconstruction using allografts and metal prosthesis; and arthrodesis[1]. Each technique has its capabilities and limitations. Aggressive bone tumours are not common. Patients in whom limb salvage surgery with reconstruction can be done is even less common because many patients present late in this country. The aim of this paper is to present a series of patients with different methods of bone reconstruction being done at the Sarawak General Hospital.

Materials and Methods

From a list of patients with aggressive bone tumours treated with excision and reconstruction at our hospital from April 1997 to August 2002, ten patients with different reconstructive methods who had longer follow-ups were selected. Four patients had osteosarcoma; another four had giant cell tumour; one had squamous cell carcinoma eroding into the tibia and one had a metastatic carcinoma from the breast. Two of the patients have died of their disease and the rest are being followed up.

Results

Fibula autograft for the distal radius (Fig. 1)
This is a 21-year-old man with giant cell tumour of the distal radius. The tumour was excised en bloc and the distal radius reconstructed with a 10cm length of the ipsilateral proximal fibula. The fibula autograft was fixed with a plate and union took place after two months. His wrist dorsiflexion and palmarflexion is reduced to 30 degrees but he has full function of his fingers. He has no pain and has been able to continue to work as a welder at three years of follow-up.

This article was accepted: 23 June 2003
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"Cement prosthesis" for the proximal humerus (Fig. 2)
This is a 10-year-old boy with osteosarcoma of the proximal humerus. Most of the muscles acting around the shoulder had to be removed in a wide excision of the tumour. With a freehand technique, bone cement was used to mold a "structural" proximal humerus incorporating a Steinmann pin bent at the proximal end to simulate the humeral neck. The distal end of the pin was inserted into the medullary cavity of the distal humerus. At two years, he has minimal range of motion at the shoulder joint, which comes mainly from scapulo-thoracic movements. However, his elbow, wrist and hand movements are full and he is able to lift a 1.5kg water bottle. The growth of the affected humerus has been affected and the left arm is shorter than the normal right arm but this is only obvious when the patient removes his shirt.

Fusion at the hip joint (Fig. 3)
This 40-year-old lady had osteosarcoma involving the pubic and ischial bones. After excision, the head of the femur was fused to the ilium with a cobra plate. She was able to ambulate with the aid of a walking frame post-operatively but died of lung secondaries six months later.

Endoprosthesis for the proximal femur (Fig. 4)
This 50-year-old lady had a pathological fracture at the subtrochanteric region of the femur due to secondaries from carcinoma of the breast. An MRI showed extension of the tumour down to 8cm from the lesser trochanter. Reconstruction was done using a large modular endoprosthesis with a bipolar cup. She was able to start ambulating within three weeks of the surgery. She subsequently developed spine secondaries with paraparesis and died of the disease three months later.

Allograft prosthesis composite for the distal femur (Fig. 5)
This method was used for a 39-year-old female patient with osteosarcoma of the distal femur. The distal femoral allograft was obtained from a bone bank in Singapore and a long stemmed prosthesis used to reconstruct the knee joint. We were not sufficiently aggressive in her rehabilitation in the immediate post-operative period which resulted in stiffness of the knee (0-30 degrees range of motion). It is now four years after the surgery. She walks with a slight limp and stretches out her limb on sitting. Otherwise, she lives a fairly life as a housewife.

Allograft fusion for the distal femur (Fig. 6)
This is a 32-year-old female patient with a giant cell tumour of the distal femur presenting with a pathological fracture. After discussing the options, she elected to have a knee fusion. The allograft was fixed to the femur and tibia with two plates. She was able to fully bear weight after six months. One year later, she had a fall and sustained a fracture through the substance of the allograft. The plates were subsequently removed and an interlocking nail inserted. (Fig. 6b) Two months later, she developed deep infection which did not clear with antibiotics and debridement. Amputation was offered but she refused. At the last follow-up a month later (fifteen months after first surgery), she still had a sinus with seropurulent discharge.

Autoclaved autograft for the distal femur (Fig. 7)
This is a 12-year-old girl with osteosarcoma of the distal femur. After a wide excision of the tumour, the soft tissue was removed from the bony part of the specimen. The tumour within the medullary cavity was curetted and the remaining cortical structure was autoclaved. The specimen was then cleansed thoroughly with saline and the defective parts rebuilt with bone cement. This was re-placed onto its original site and fixed with a reverse interlocking tibial nail; fusing the knee. At four months of follow-up after the surgery, the apposed bones have not united yet and the limb is immobilised in a bivalved light-weight cast. She moves around on her normal limb with the aid of crutches.

Tibial plate and fibula autograft for the distal femur (Fig. 8)
This 31-year-old man, a manual labourer, had a giant cell tumour of the distal femur resulting in a pathological fracture. The resulting defect after excision was reconstructed with a tibial plate and the fibula from the ipsilateral leg. Stability was accorded by a tibial interlocking nail. He developed infection at the tibial end. Debridement was done and the focal area of infection was covered with a gastrocnemius rotation flap. It is now nine months after the surgery and he is being followed up at a hospital near his home.

Femoral plate and fibula autograft for the proximal tibia (Fig. 9)
This 30-year-old lady had a giant cell tumour of the proximal tibia. The defect was filled in with a femoral plate and a vascularised ipsilateral fibula. An interlocking nail was inserted to stabilise the fusion. The last follow-up was five years after the surgery. The fibula has hypertrophied and although the knee is fused, she is satisfied with the overall result of the surgery.

Autoclaved intercalary bone segment for the tibial shaft (Fig. 10)
This 75-year-old man had a long standing squamous cell carcinoma at the anterior aspect of the leg which had eroded into a six-centimetre segment of the tibial shaft. The excised bone was autoclaved, placed back in its original position and fixed with a locking nail. A free vascularised fasciocutaneous flap from the thigh was used to cover the soft tissue defect. He was discharged after a month in the ward, ambulating with a walking frame. He is under follow-up at a hospital near his home; a year after the surgery.

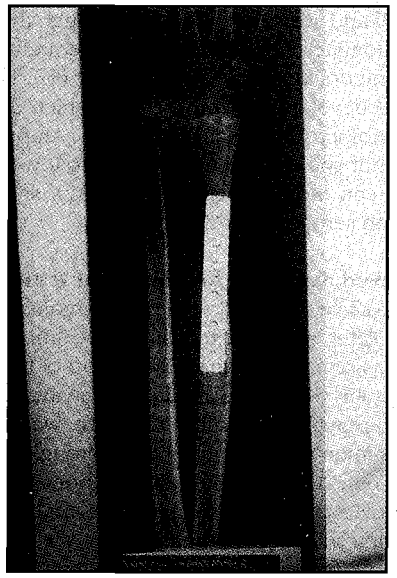

Fig. 1: Fibula autograft for the distal radius fixed by a plate

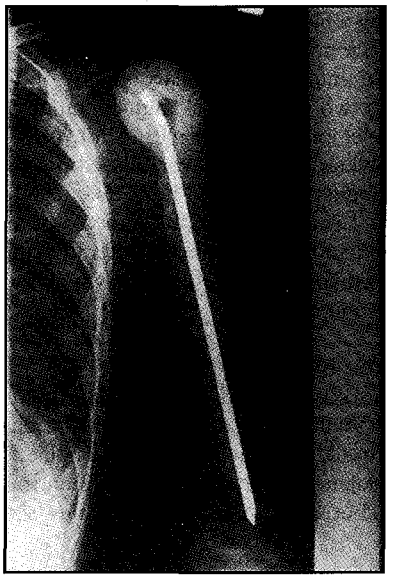

Fig. 2: "Cement prosthesis" for the proximal humerus

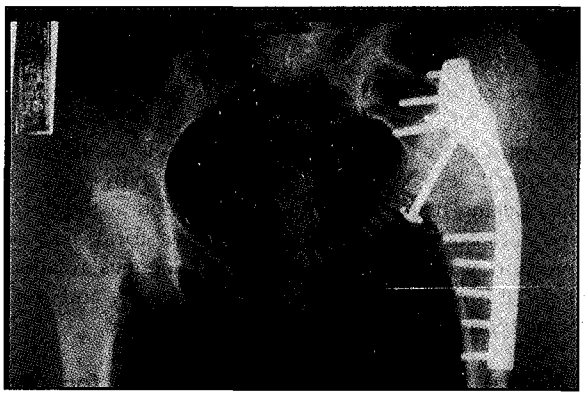

Fig. 3: Fusion at the hip joint

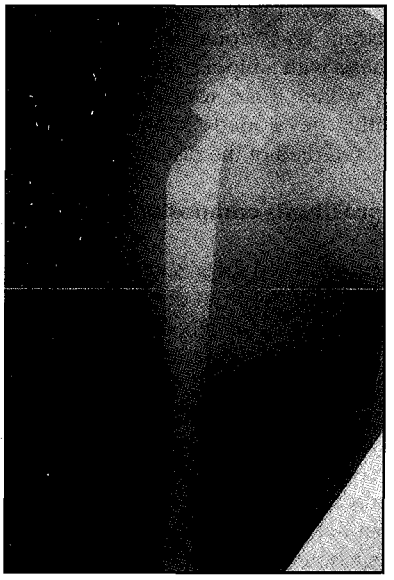

Fig. 4: Endoprosthesis for the proximal femur

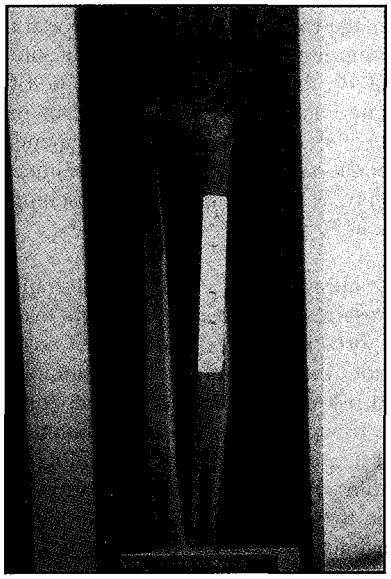

Fig. 5: Allograft prosthesis composite for the distal femur

Fig. 6a: Allograft fusion for the distal femur

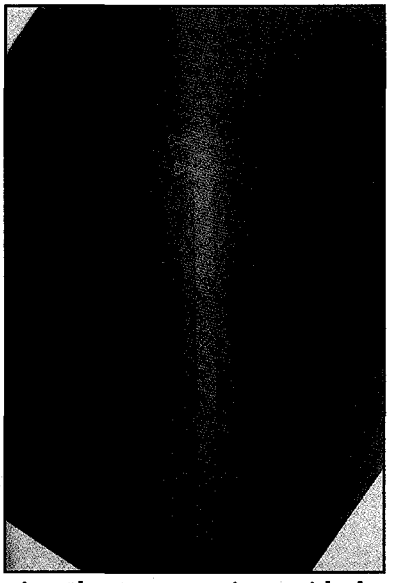

Fig. 6b: Same patient with the plates changed to an interlocking nail

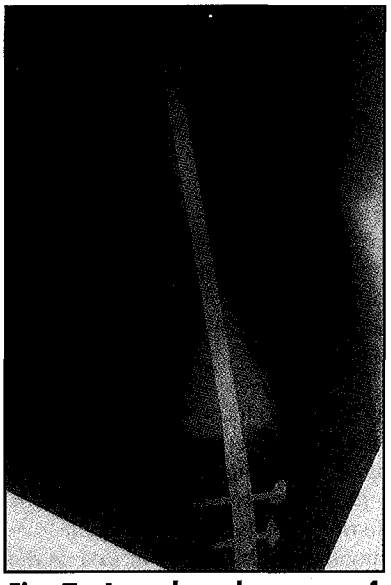

Fig. 7: Autoclaved autograft for the distal femur

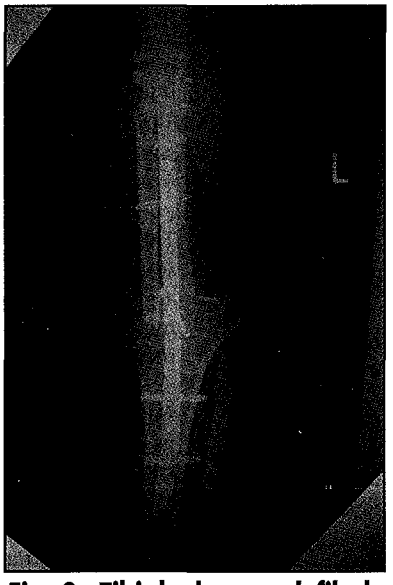

Fig. 8: Tibial plate and fibula autograft for the distal femur

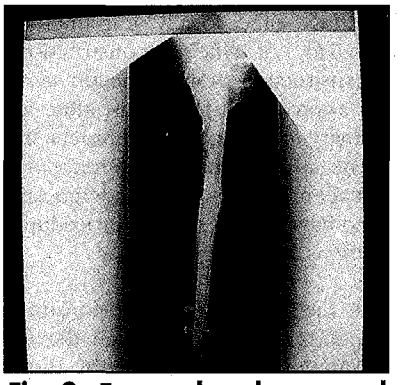

Fig. 9: Femoral plate and fibula autograft for the proximal tibia

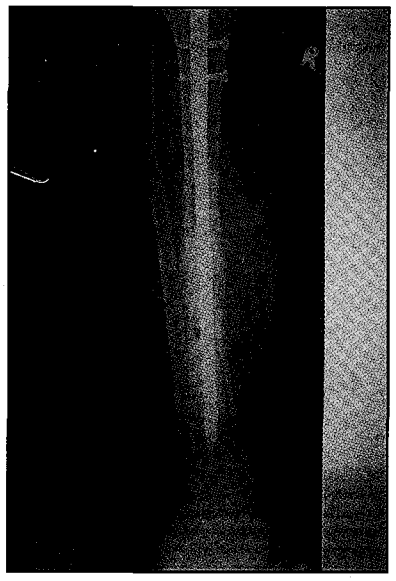

Fig. 10: Autoclaved intercalary bone segment for the tibial shaft

Discussion

Limb sparing surgery is indicated for patients in whom wide margins can be obtained without sacrificing so much tissue that the remaining limb is nonfunctional. Usually, the determining factor is the ability to spare major nerves. Major vessels need to be preserved or reconstructed. There must be adequate soft tissue coverage either locally or in the form of flaps to ensure survival of the reconstruction. The overall reconstruction should function as well as or better than an appropriate prosthesis after an amputation[2]. In primary malignant bone tumours, there does not appear to be any significant difference in long term survival between patients who undergo amputation and those who have a limb sparing procedure provided that wide margins are obtained[3].

The method of tumour reconstruction after resection depends on the patient's age, the anatomic site, stage of the tumour, and whether the tumour is metastatic or primary. In a developing country like Malaysia, we are also affected by the availability of implants and allografts; the cost and the potential compliance to post-operative care and follow-up.

The use of an oncologic, modular endoprosthetic reconstruction (Fig. 4) has the major advantage of allowing immediate or early joint motion and weight bearing. This advantage may be particularly important when adjuvant chemotherapy is planned or if life expectancy is limited[4], however, it costs tens of thousands of ringgit and has a limited life span. Unwin et al[5] reported results of 493 distal femoral replacements with a custom implant based on a fully constrained knee. The probability of surviving aseptic loosening was reported as 67% at 10 years.

Allograft-implant composites offer biologic reconstruction that restores bone stock and allows load sharing with the prosthesis. Besides the cost, disadvantages include fracture, infection, nonunion, graft resorption, and risk of viral disease transmission[4]. Our allografts were brought in from a tissue bank in Singapore. Without a special refrigerator, the allograft have to be used within 24 to 48 hours and this adds an extra stress factor on the operating team. One of our patients sustained a fracture through the allograft and the stabilising implant had to be revised. (Fig 6b)

We have just started to use autoclaved autografts in place of allografts. Asada et al[6] reported 10 complications in 23 reconstructions with autoclaved bone. They concluded that despite the complications, autoclaved autografts are viable options for reconstruction in many countries because of the difficulty of obtaining large quantities of fresh frozen allografts. Our patient with osteosarcoma was a small-sized 12-year-old child. (Fig. 7) No matching allograft was available at the accessible bone banks.

The autoclaved intercalary bone segment used for the squamous cell carcinoma of the tibial shaft (Fig. 10) gave a gratifying immediate result. The surgery was done at minimal cost and the patient was able to ambulate one month after the operation.

Autografts are readily harvested from the patient. There is no risk of transmitting disease and once union has taken place, it tends to be strong. However, there is added morbidity at the donor site and the surgery is prolonged. The main bone that is used is the fibula. We also harvested a femoral and tibial plate in two of the patients.

The majority of our patients have had an arthrodesis done at the joints rather than reconstructive prostheses with artificial joints. Two main reasons were the age of the patients (young) and the exorbitant cost of the endoprostheses. Some of our patients were manual workers or farmers who lived in inland areas far away

from the major hospitals. However, this procedure is complicated by a high incidence of nonunion, fatigue fracture and infection. Patients must adjust their lifestyles to accommodate the arthrodesis.

Even with limited financial and manpower resources in the context of a public state hospital, it is still possible to do limb salvage surgery with oncologic margins. However, most of the patients are still being followed up and we are in the process of collecting data on the different methods being used, in particular, the complications and functional status. We have only been able to present our early experience. It will be some years before we can discuss the recurrence rate.

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