

Difficulties concerning limb salvage procedures for primary malignant bone tumors in developing countries

Mohammad El-Turk, MD. Firas Husban, MD.

Orthopedic department, King Hussein Medical Center, Royal Medical Services, Amman, Jordan

Introduction and Abstract

High grade primary malignant bone tumors were traditionally treated by amputation, prior to the advent of systemic chemotherapy, modern radiological techniques and advanced reconstruction options. Since these developments, surgeons have been able to offer limb sparing resections and reconstructions for the majority of patients with primary bone sarcomas.(1)

Limb salvage of large segmental and osteoarticular defects after tumor resection has become the standard of care for most patients with musculoskeletal tumors because overall survival is the same when compared with that seen in amputation patients (2). However, there is a difference in the local control of the disease with about 7% more in limb salvage procedures than radical amputation (3). Limb salvage is associated with higher morbidity, as short term complications like wound infection, bone graft fractures, dislocation of prostheses, wound dehiscence, non-union, malunion of bone graft, neurovascular compromise. And long term problems like limb length discrepancy, prosthesis failure, graft fracture, and late infections(4). Between January 2000 and February 2004, we did limb salvage surgeries to

14 patients with high grade primary malignant bone tumors. Only patients with salvageable limbs were selected, they were staged Enniking I or II (5). The patients who presented with displaced pathological fracture, multiple distant metastasis, tumor involving a main neurovascular bundle or tumor located at non salvageable anatomical location like hands and feet were excluded.

After radiological staging, histopathological diagnosis, grading, and three courses of pre-operative neoadjuvant chemotherapy according to the protocol of European osteosarcoma intergroup(6)., radical excision of the tumor with safety margins was done. The resulting defect was reconstructed by using bone autograft and plating for 5 patients, shortening-distraction osteogenesis using Ilizarov device in 4 patients, compromise prosthesis (as temporary mean) in 3 patients, tumor endoprosthesis (Kotz, HMRS-Rtating Hinge Knee) in 2 patients.

Patients received post operative chemotherapy according to the protocol of European osteosarcoma intergroup(6).. Follow up period was short 2 to 49 months, average 25 months. 1 patients(7%) developed local recurrence and required revision surgery. 2

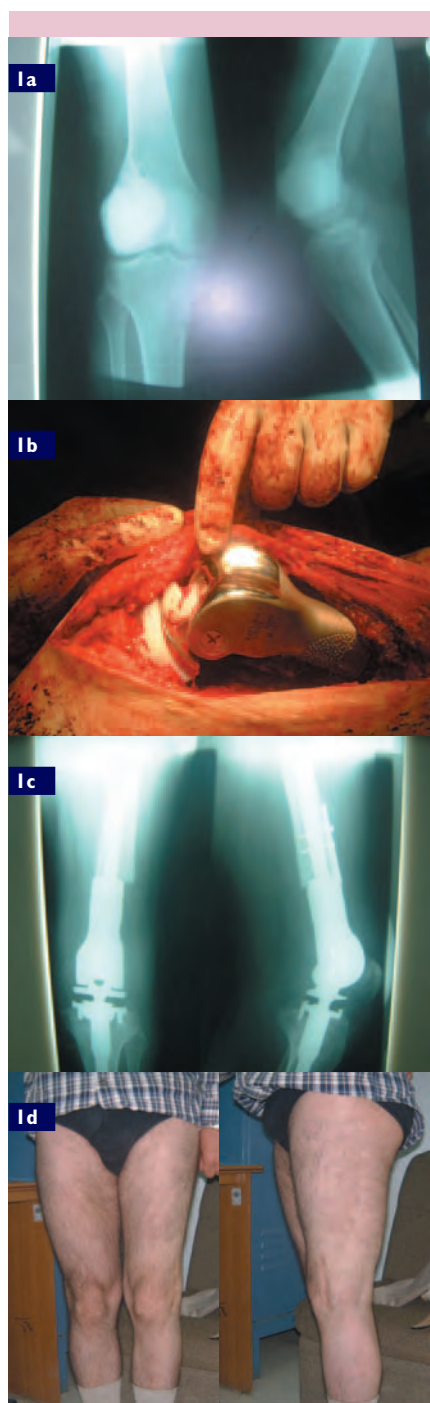


Figure 1 - (a) patient with malignant bone tumor in the distal femur, (a) pre excision X-ray, (b) Intra operative photograph shows the defect reconstructed using modular endoprosthesis (HMRS-Rotating Knee Hing Prosthesis), (c) post operative X-ray, (d) four months after surgery.

patients (14) developed lung and bone metastasis. 2 patients (14%) died.

Each of the reconstruction methods we used has its own advantages and drawbacks. We were able to shift our reconstructive technique according to the resources and facilities we can afford, and try to provide our patients the best function and self-image despite limited financial resources.

In this study we highlight that orthopedic surgeon in developing countries can be able to use different modalities and procedures to salvage the limb after tumor resection according to the patient needs and socioeconomic status of his country.

The main difficulties we faced as in other developing countries (a) most of the time our patients present at late stage, beyond salvage most probably due to cultural reasons. (b) The tumor service is expensive; it is hard to find funding for the expensive chemotherapy, tumor prosthesis, and repeated surgeries. (c) Our patients suffer from lengthy procedures like shortening-distraction osteogenesis using dynamic lengthening devices, or exposure to repeated surgeries due to failure of compromise prosthesis or fracture of bone grafts.

Material and method

Between January 2000 and February 2004 14 patients with high grade primary malignant bone tumors in their long bones were selected for limb salvage surgery. Many other patients were excluded either having multiple distant metastases at presentation or their limbs were beyond salvage due to involvement of a main neuro-vascular bundle, displaced pathological fracture, or sarcomas in certain anatomical locations like hand and feet. Eight males and six females were included in this retrospective study. The age varies from 11 to 35 years with Mean age 22 years. All the patients had preoperative radiological staging (plain x-ray to the affected bone, CT-scan and MRI to the affected bone, lung CT-scan, bone isotope scan), then incisional biopsy and histopathological

diagnosis and staging of the tumor was done. All the patients were staged according to Enniking classification (5) I, IIa, IIb. Then preoperative neo-adjuvant chemotherapy was given according to the protocol of European osteosarcoma intergroup(6). En-block excision of the tumor with the biopsy tract, surrounding affected muscles and bony safety margins 3 to 5 centimeters. The excision was intra-articular or extra-articular according to the degree of tissue involvement adjacent to the tumor with safety margins. The resulting defect in each patient was reconstructed by one of the following techniques:

- Arthrodesis and autologous bone graft using single or twin fibulae and bridging heavy duty plate and screws.
- Intercalary excision, autologous single or twin fibula bone graft, and fixation by bridging plate.
- modular tumor resection endoprosthesis (HMRS-Rotating Hing Knee-Kotz prosthesis).
- compromise temporary endoprosthesis, where an ordinary joint replacement prosthesis like Neer, Austin Moor, Meneapolis, or Wagner prosthesis is used to reconstruct the shoulder or hip joint in addition to synthetic mesh to reconstruct the joint capsul,the short prosthesis is lengthened using intramedullary nail in the center and plate on its anterior surface and all together were bound using acrylicmethacrylate bone cement, the plate was fixed to the distal bone by screws.
- Arthrodesis-shotening-distraction osteogenesis, using modified Ilizarov technique.

All the patients received 3-6 courses post operative adjuvant chemotherapy started in 2nd-3rd post-operative weeks according to the protocol of European osteosarcoma intergroup(6). Post operative physiotherapy and rehabilitation according the reconstruction procedure used. The patients were checked for recurrence by chest XR every 3 months, lung CT scan every 6 months, Tc 99 bone scan every 12 months.

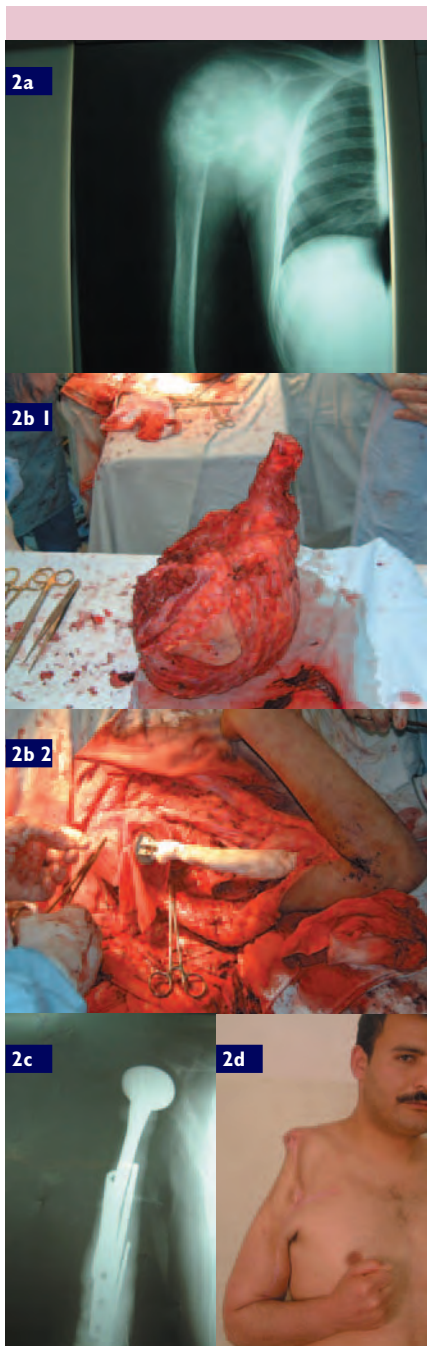


Figure 1 - (a) patient with osteosarcoma in proximal humerus, (a) pre excision X-ray, (b) Intra operative photograph shows the tumor excised and reconstructed using compromise prosthesis (Neer hemiarthroplasty prosthesis lengthened and fixed to the distal bone stump using nail and plate and screws and bone cement), (c) post operative X-ray, (d) photos show good function of the hand and elbow two years after surgery.

No of Patients	Type of the Tumor	Location	Limb Salvage Procedure Used
2	Osteogenic sarcoma	Distal femur	Kotz prosthesis
1	Osteogenic sarcoma	Tibial metaphysis and diaphysis	Intercalary excision + bone graft + plate
1	Ewing sarcoma	proximal tibial metaphysis and epiphysis	Extra articular excision –arthrodesis- bone graft + plate
1	Osteosarcoma	Proximal tibial metaphysis and diaphysis	Extra articular excision –arthrodesis- bone graft + plate
1	Malignant giant cell tumor	Distal femoral epiphysis	Knee arthrodesis –shortening –distraction osteogenesis(Ilizarov)
2	Osteosarcoma	Distal femur metaphysis + epiphysis	Knee arthrodesis –shortening –distraction osteogenesis (Ilizarov)
1	Osteosarcoma	Proximal tibia metaphysis + epiphysis	Knee arthrodesis –shortening –distraction osteogenesis (Ilizarov)
2	Ewing sarcoma	Proximal femur	Compromise temporary prosthesis
1	Osteosarcoma	Proximal humerus	Compromise temporary prosthesis (Neer)
1	Osteosarcoma	Proximal humerus	Arthrodesis – fibula graft + plate
1	Ewing sarcoma	Proximal ulna	Intercalary excision + bone graft +plate

Table 1 - shows the type of tumor, its anatomical location, and the method of reconstruction we used:

Results

In our short term follow period 2-48 months, average 25 months, the survival rate is about 86% .

One patient with proximal humerus compromised prosthesis (7%) developed local recurrence and revision was done with using the same prosthesis . 2 patients (14%) showed multiple distant metastases. 2 patients (14%) died; one of them died after 3 months due to fulminant lung infection, and the 2nd died after 24 months with disseminated metastases. 2 patients (14%) developed lung metastasis .

All patient with Ilizarov device need another 1-3 surgeries average 1.5 ; for readjustment of the device or loosening ,or pine tract infection . All the patients with fibulae autograft need another surgery once due to fracture of the graft in the form of removal of the previous plate and redo fixation by a new plate and cancellus bone graft. One patient with fibulae graft got wound infection and one got drop foot in the sound limb .The patient with compromise prosthe-

sis need another surgery within a year ;one patient with compromise prosthesis (Meneapolis) prosthesis got fracture of the stem of the prosthesis after 4 years ,then the prosthesis augmented with plate and bone cement .

One patient with compromise prosthesis (Neer) prosthesis in his shoulder got loosening, it was fixed again to the distal humerus .

The functional evaluation (according to the score of the musculoskeletal tumor society (7))of the surviving patient have shown the overall results were satisfactory excellent and good in ten patients (71.4%), fair in four patients (28.6%) at the latest follow up.

Discussion

Treatment of primary malignant bone tumors becomes more rewarding with the improvement in the diagnostic, staging tools, chemotherapy protocols, and surgical techniques with over all 5 years survival rates ranging 67-90 % (8). We used five different modalities for limb reconstruction following malig-

nant bone tumor resection; Arthrodesis and autologous bone graft, intercalary excision and bone graft, modular tumor resection endoprosthesis (HMRS-Rotating Hinge Knee-Kotz prosthesis), compromise temporary endoprosthesis, Arthrodesis-shortening-distraction osteogenesis, using modified Ilizarov technique.

Bone grafts are used to fill these defects but the size of the defects limit the use of autograft. Transported bone is 40% to 60% weaker than normal bone from six weeks to six months after transplantation and regain normal strength only after two years (9).

The use of endoprosthesis avoids early dependence on bone healing and preserve joint movement with immediate stability and early weight bearing, but this technique is hardly possible in a growing children as they need special prosthesis (Expandable prosthesis) (10). Endoprosthesis offers patients a more favorable functional outcome with a more energy-efficient gait when compared with limb amputation(2), however its considerable high cost to be implemented in developing countries (4).

Since the Ilizarov method has been introduced it has been widely used in the treatment of limb length discrepancy, nonunions, traumatic bone defect, deformity, and osteomyelitis in the case of musculoskeletal tumor surgery, however, the usefulness and effectiveness of reconstruction utilizing the Ilizarov method has not been studied in detail (11). Two stage lengthening, first by achieving union at the site of excision of the tumor, followed by a second stage of lengthening using Ilizarov technique is a lengthy procedure but provide the patient a strong limb with a stiff knee gait (4).

In our patients with auto-graft, we harvested the fibula from the other sound leg. This had caused morbidity in the form of scar, pain, and one patient had drop foot. Patient with bone graft needed to go back to operation room another time to treat complications like fracture or infection.

Seven patients 50% had arthrodesis (knees or shoulder) this provide an active young patient a stable joint but with the draw backs of the fused joints. We used temporary compromise prosthesis in 3 patients. because we were not able to get standard endoprosthesis, and it is considered a quick available alternative for proper custom made prostheses. The patients might need another proper prosthesis in the near future; so it works as a temporary measure.

We used Ilizarov device around the knee in young patients, shortening and lengthening was done at site of excision of the tumor. we overcome limb length discrepancy, provides healthy bone stock without the need to borrow bone from else where, the new generated bone is strong less liable to fracture or infection, also the patient might need a second stage lengthening in the future as the procedure can be repeated easily. Its cost is less compared to prosthesis or graft.

Its disadvantage is the discomfort of long application of the device to 12-18 months pin tract infection is a known minor complication of the device we were able to over-come with simple

wound care, antibiotics, and once we need to change the site of pins.

We used the HMRS-Rotating knee hinge prosthesis (Kotz) for 2 knees. It is easy to implant. Psychologically and functionally are good for the patient. The main disadvantage is its cost. Most of our patients can't offer its price. Its long term complications are like those of artificial joints.

Conclusion

Surgeons in the developing countries can use variety of methods for limb salvage. They are like bone graft, distraction osteogenesis, bone transport, compromise prosthesis, or proper reconstruction modular tumor endoprostheses, according to the available tools or socioeconomical difficulties.

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