The role of prostheses after resection of primary sarcomas of bone

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With the advent of effective chemotherapy regimes and improved imaging techniques in the 1970's, limb salvage for bone sarcomas has become an accepted method of treatment. (Eckardt et al. 1987, Gebhardt et al. 1989, Ivins et al. 1989). Following resection of bone tumours, skeletal reconstruction may be achieved with allograft bone, autograft bone, bone transport, prostheses or a combination of the above (Feruzzi et al. 1991, Rock et al. 1991, Samek et al. 1991).

Early hip and knee prostheses were custom made and had rudimentary joint biomechanics and metal engineering. With improved patient longevity, these prostheses often failed due to breakage, loosening and joint bearing failure (Capanna et al. 1994).

Later prostheses addressed several problems, such as metal fatigue, fixation to bone and modularity, but still failed to solve the problem of muscle/tendon attachment, early bearing failure and aseptic loosening (Capanna, et al. 1994).

Current tumour prostheses aim to achieve early excellent function with longevity approaching that of other routine prosthetic joint replacements. State of the art metals, joint design and new plastic engineering, muscle/tendon reattachment devices and special attention to host prostheses fixation are a few of the recent advances (Malawer and Chou 1995).

Classification

Prosthetic reconstruction may be classified as:

Functional arthroplasty	– scapular
	– shoulder joint
	– proximal humerus
	– elbow
	– pelvis
	– saddle
	– hip joint
	– proximal femur
	– distal femur
	– total femur
	– knee
	– proximal tibia
	– ankle
Nonfunctional arthroplasty	– proximal humerus
Intercalary	– metal
	– ceramic

Custom / modular

Static length / dynamic length

Prerequisites

Prerequisites for functional arthroplasty include:

1) ability to reconstruct some or all motors to that joint,
2) a bony fulcrum,
3) ability to reproduce joint stability,
4) motivated and capable patients,
5) adequate bone fixation,

eg. lower limb prosthetic reconstruction is often functional, such as distal femoral resection with intact quadriceps.

Prerequisites for nonfunctional (spacer) arthroplasty include:

1) distal limb function, vascularity,
2) adequate bone fixation,

eg. many shoulder resections remain nonfunctional because rotator cuff and deltoid resection or absence of the fulcrum (glenoid). A spacer allows maintenance of distal limb/hand function.

Indications

Indications for prosthetic reconstruction as opposed to other methods already mentioned, depend on a number of factors.

Age

Very young patients tend not to be suitable for prosthetic reconstruction, given the problems of limb growth and longevity and bone prosthesis mismatching. Growing prosthesis do exist, but remain experimental (Kenan and Lewis 1991). Amputation, rotationplasty and vascular epiphyseal transfer may also be considered.

Elderly patients are a group well suited for prosthetic reconstruction. Immediate weight bearing, quicker operating time and reduced early complications make this method preferable to the other biological reconstructions.

Site

Certain anatomical sites are better suited to prosthetic reconstruction. Distal femur, proximal humerus and proximal femur have the best results for longevity, complications and function. Proximal tibia, scapula, pelvis, elbow, and ankle all have poor results (Rock et al. 1991). Intercalary resections are best suited to allograft reconstructions.

Prognosis

Similarly with elderly patients, those with a poor prognosis require a quick, low complication risk procedure, and one that allows early function. Prostheses offer these patients all of the above and so are preferred.

Functional requirement

Prostheses are designed for limited use, such as walking and sports including golf and swimming. Patients wishing to be more active should be counselled toward a longer lasting reconstruction, such as allograft arthrodesis.

Surgical technique

The distal femur is the most common site of occurrence of many primary bone sarcomas. It is also a site commonly reconstructed using a distal femoral knee prosthesis.

Following resection of the distal femur, the medullary canal is prepared to accept the stem of the prosthesis, which may be implanted, cementless or cemented. The resected portion of femur is replaced with the modular distal femoral component, size matched to the length of resected specimen. No muscle reattachment is required. The proximal tibia is resected proximal to the tuberosity, and so patella tendon reattachment is not necessary. A rotating hinge prosthesis is preferable to avoid early bearing wear, and reduce stress on host/prosthesis interfaces. The construct is then covered with a local muscle or a gastrocnemius transposition flap.

Complications

Early: Early complications of prosthetic reconstruction include infection (5-15%), instability (4%), and wound necrosis (5–15%) (Capanna et al. 1994, Eckardt et al. 1987, Gebhardt et al. 1989, Malawer and Chou 1995, Tomita et al. 1989).

Late: Complications include asceptic loosening (0–50%), prosthetic fracture (6%), polyethylene failure (10–41%) (Capanna et al. 1994, Malawer and Chou 1995).

In general 50% of patients in this group will suffer some form of complication, be it major or minor. Most complications can be treated without loss of limb, although infection may be impossible to eradicate. The use of prophylactic antibiotics and gastrocnemius flaps have greatly decreased the risk of infection (Capanna et al. 1994, Malawer and Chou 1995).

Summary

The advantages of the prosthetic replacement after resection of bone tumours include:

1) relatively simple technique,
2) modularity,
3) immediate function,
4) no disease transmission,
5) arthroplasty is possible.

The disadvantages include:

1) late complications – asceptic loosening,
   – bearing failure,
   – fracture,
2) muscle re-attachment,
3) bone stock loss.

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