CUSTOM PROSTHESIS - THE MADRAS SCENARIO

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ABSTRACT

Limb salvage surgery with custom prosthesis has now been well established. This paper analysis our experience with the largest series from a single center in Madras, India. Eighty-seven cases have undergone prosthetic replacement surgery in 5 years. Eighty in bone tumors in limbs, 4 in spinal tumors and 3 in traumatic segmental loss. The average follow up was 21 months. 50% of cases were osteosarcomas which underwent neoadjuvant and post operative chemotherapy. Thirty-four cases were in the distal femur. CT scan, MRI and DSA were done preoperatively. The prosthesis were made as per specifications out of stainless steel or titanium. The functional results were 8.8% excellent, 50% good, 30 fair. The complications were flap necrosis, deep wound infection, stem fracture and local recurrence.

INTRODUCTION

Custom Orthopaedic Implant is an exciting and expanding field. It has always had an important place in Orthopaedic reconstruction. In recent years, the striking advances made in 3 dimensional computer modelling and in CAD CAM technology has led to exciting new possibilities. In addition, with the advances in materials such as bone growth stimulating coatings, bone substitutes and polymeric composites, the result will be a steady expansion in the use of custom implants in the future.

Custom prosthesis plays a vital role in the reconstruction of skeletal defects after tumour resection and an extensive segmental skeletal bone loss. Limb salvage by custom prosthesis is still in infancy in India due to the developing technology for fabrication and high cost. The present paper analyses our experience and results in Madras with custom prosthesis.

Place of Work : The present work on Limb salvage by custom prosthesis has been done at the Cancer Institute and M.N. Orthopaedic Hospital, Madras. The period of this study is from July, 1988 to June, 1993.

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DEMOGRAPHIC DATA

A total of 80 patients have been treated by custom prosthesis in the bone tumour series in the limbs. There were 41 males and 39 females. The age group ranged from 7 years to 65 years with a mean of 27 years. The follow up ranged from 1 month to 56 months with a mean of 21 months. Histopathologically there were 41 osteosarcomas, 27 osteoclastomas, 7 chondrosarcomas, 4 secondaries and 1 myeloma. The anatomical site of lesion was 34 distal femur, 25 proximal tibia, 11 proximal humerus, 2 shaft of humerus, 2 scapula and 6 proximal femur. According to Enneking surgical staging IA (22) IB 16) II A (30) II B (10) III (2). The surgical margins of resection was wide in 60 cases and marginal in 20 cases. Extra articular resection was performed in 55 cases and articular in 25 cases. The length of resection ranged from 60 mm to 250 mm,with an average of 136 mm. In the trauma series there were 3 patients. All were males. The location was 2 in the distal humerus and elbow and 1 in the proximal humerus. In the spine, 4 cases have had a custom prosthetic replacement of the vertebral body. Two were GCT, 1 secondary and 1 was a hemangioma.

INVESTIGATIONS

The investigations done include plain X-Rays, Scanogram, CT scan, MRI scan, Angiogram, DSA and Technetium (Tc) bone scan. A scanogram is done in all cases to evaluate the extent of the tumour and level of resection. Angiograms are done in cases of osteosarcomas to determine the relation of major vascular bundles to the tumor and its vascularity. CT scans are also done in cases of sarcomas to determine the extent of the lesion and presence of metastasis. CT scans are done to evaluate the intra and extraosseous extension of the tumor. CT of the chest is done in cases of sarcomas to detect early metastasis. The CT scan is used for determining the dimensions of the prosthesis to be manufactured.

Closed biopsy using a trephine is done for tissue diagnosis in tumors. Frozen section studies are done during surgery to determine tumor clearance. Electron microscopic studies are done on the excised tumor.

DESIGNING OF CUSTOM PROSTHESIS

The CT scan or MRI scan enables the following dimensions to be evaluated accurately for manufacturing the custom prosthesis.

Distal femur / Proximal Tibia.

1. Level of tumor clearance.
2. Level of resection (length of body of prosthesis).
3. Outer diameter of bone at resection level (diameter of body of prosthesis).
4. Inner diameter of remnant bone Intramedullary (IM) component length and diameter).
5. Dimension of adjacent bone (condyle and IM components).

Proximal humerus

1. Diameter of humeral head (prosthesis head prosthesis head diameter).
2. Level of resection (length of body).
3. Outer diameter of bone at resection level (diameter of body).
4. Inner diameter of remnant bone (IM component length and diameter).

PROSTHESIS

With the above dimensions, a blue print drawing is made of the required custom prosthesis. This is sent to the manufacturers and an average period of 9 days is required to fabricate the stainless steel prosthesis. Now a days we are having the prosthesis made of Titanium alloy. All the prosthesis have required intramedullary cement fixation.

CUSTOM PROSTHESIS IN BONE TUMORS

1. Distal Femur :

The patient was a 33 year old female who presented with an osteolytic lesion in the distal third of the left femur, involving both the condyles The closed biopsy diagnosis was that of a giant cell tumor grade II. A CT scan was done to measure the dimensions, and a custom prosthesis was designed and fabricated. Wide excision of the tumor with custom knee replacement was carried out. At follow up 56 months postoperatively, she was walking well. Knee flexion was 100 degrees and there was no extensor leg.

2. Proximal Tibia :

This 26 year old male presented with a painful swelling in the proximal third of the right tibia of 3 months duration. Two years previously, he had been treated elsewhere by curettage and grafting for a osteoclastoma tibia. Closed biopsy revealed the lesion to be a giant cell tumor (GCT) grade III. A wide excision was made and a custom prosthetic replacement was performed. The medial gastrocnemius with intact blood supply was transposed to cover the prosthesis. At follow up 40 months post-operatively there was a 100 degree flexion of the knee and a 20 degree extensor leg.

Fig.1 GCT Distal 1/3 (L) Femur.

Fig.2 Post-operative X-ray showing Prosthesis

3. Proximal Humerus :

This 13 year old female presented with an expansile lesion in the proximal third of the left humerus. Biopsy revealed it to be an osteosarcoma. Tikhoff Linberg resection and custom humeral replacement was done. The patient had 3 cycles of pre and post operative chemotherapy. At 36 months, there was a 30 degree circumduction of the shoulder with good elbow and hand function.

4. Proximal Femur :

The patient, a 15 year old female with multiple exostosis, presented with the complaint of an increasing size of swelling in the proximal third of the let femur. The swelling was extending anteriorly, laterally and posteriorly in the upper femur. An open biopsy revealed the lesion to be a low grade chondrosarcoma. Wide excision surgery was carried out and a custom upper femoral endoprosthesis was fitted. At follow up 36 months postoperatively she was able to walk independently with good movements at the hip.

Fig.3. Chondrosarcoma Proximal 1/3 (L) Femur.

FUNCTIONAL RESULTS

Functional results were rated according to Enneking's classification : 8.8% had excellent results, 50% had good results, 30% had fair results and 12.5% had poor results.

Fig.4 Custom Prosthesis Proximal Femur

CUSTOM PROSTHESIS IN SPINAL TUMORS

Twenty-eight years old male, presented with pain in back and weakness of both lower limbs -one month duration. He had tenderness D7 vertebra. The motor power was 3/5 in both lower limbs. The deep tendon jerks were absent and there was diminished sensation below D7. X-ray revealed a destructive lesion of D7 body Myelogram showed an incomplete block at that level. Transpedicular biopsy was done and was reported as a GCT.

An anterior decompression and vertebrectomy D7 was done. A Titanium prosthesis was used to span D6 and D8 between grooves for stability (Fig.6. He was mobilised with a Taylor's brace. At 6 months follow up, the

patient has regained full power in the limbs.

Fig.5 GCT D7 Vertebra.

Fig.6. Post-operative x-ray showing titanium prosthesis.

CUSTOM PROSTHESIS IN TRAUMATIC SKELETAL DEFECTS

Forty-six years male, presented with instability of right upper limb. He was involved in a road traffic accident one year ago where in he was hit by a car on his right humerus. He sustained a compound fracture of right humerus with a segmental loss of the distal half of humerus. This was treated elsewhere by debridement and the wounds had healed well. A custom humerus and elbow joint was designed and fixed with cement. One year follow up showed he had good stability of the right upper limb and 90 degrees of flexion.

COMPLICATIONS

The complications include flap necrosis, deep infection, local recurrence and stress fracture of the prosthesis.

The intra-operative complications include injury to the popliteal artery and injury to the lateral popliteal nerve which were repaired.

Flap necrosis occurred in 3 patients. A cross legged flap was done in one patient. He developed deep infection and ultimately went in for above knee amputation. The local recurrence occurred in 5 patients. They underwent amputation. Two of them died of chest secondaries.

Stress fracture of the implant occurred in 5 patients. Three months after the first implantation, one patient with a prosthesis of the distal femur fell and bent the stainless steel hip prosthesis at the junction between the shaft and the IM component. Revision was done with a Titanium hinge prosthesis. The patient had good function for 1 year after which she fell once again. There was a stress fracture between the shaft and IM component of the prosthesis. A second revision was done and a Howmedica Kinematic Rotating hinge knee was implanted.

DISCUSSION

In Madras, the actual technique of the limb salvage surgery has been the same as followed in Western countries.

In the performance of such major surgical procedure, the sociocultural background of the patients does influence decision making in the choice of surgery. The nonacceptance of Limb ablation by the Indian patients even in advanced stages throws a challenge to the surgeon in the choice of the patients. Hence it is often difficult to adopt strict criteria laid down in terms of indications and contra-indications for limb salvage.

The lack of high technology back up for the Indian surgeon strains ones capacity for innovation and narrows his field of choice in the selection of the material and design of the prosthesis. The constraints of the surgical resource based in terms of infrastructure and cost of adjuvant chemotherapy often forces the surgeon to accept the second best in survival rates.

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