

VOLUME 2, 1990

NUMBER 2 (AUGUST)

ISSN



THE JOURNAL OF  
PAKISTAN ORTHOPAEDIC  
ASSOCIATION

PUBLISHED BY PAKISTAN ORTHOPAEDIC ASSOCIATION  
(NORTHERN CHAPTER)  
LAHORE

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## DEVELOPMENT OF CUSTOM MADE TOTAL HIP PROSTHESIS IN PAKISTAN

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### Abstract:

A case with recurrence of Giant Cell Tumour involving the upper end of Femur in a 19 year old girl is presented. The case had been previously tackled in a peripheral hospital by excision of head & neck and Austin Moore Arthroplasty followed by Radiotherapy. The diagnosis had been confirmed by histopathology. After confirmation of recurrence by histopathology, resection of the trochantric & upper shaft of femur along with the A.M Prosthesis was followed by Total Hip replacement with custom made (all developed in Pakistan<sup>+</sup>) Femoral component & imported Acetabular Cup.

### INTRODUCTION:

Total Hip replacements are carried out for different irreparable problems of the hip joint. First successful use of total hip prosthesis bonding to bone with cement was performed in 1964 (Charnly, J). The implants and techniques were fully established towards late sixties. Problems associated with different materials, different designs and techniques were clearly understood towards the end of seventh decade. Problems associated with bone cement were solved by developing cementless more anatomical designs with surface treatment to permit bone ingrowth. Throughout Nineteen

Eighties different designs of cementless Total Hip Joints were used throughout the world. Restoring the continuity of a major long bone after segmented resection in a patient who has had a bone tumor or has sustained severe trauma is one of the most difficult problems in Orthopaedic Surgery (Okada et al, 1988). Autogenous or allogenic grafts of bone have been commonly used to replace and reconstruct defects (Enneking et al, 1977; Enneking et al, 1980; Mankin et al, 1982; Miller et al, 1947; and Wilson, P.D. and Lane, E.M., 1965). One alternative to bone grafting is replacement with a custom-made prosthesis, fixed

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+ The cost of manufacturing these implants have been borne by the patient. The authors have received no funds/grant in any form from any Government or Non-Government Department/Association Agency, for the development.

with cement (Bradish, et al, 1987) Seales et al; 1983; Sim, F.M. and Chao, E.Y.S.,1979).

The use of custom designed or individually designed implants in adults hip surgery is not a new idea. Over the years these implants have been used in a variety of settings, most commonly in major tumour resections in which a magnificent amount (usually greater than one third) of upper femur is sacrificed as a means of tumour control. Also individualized implants have found a role in the treatment of severely compromised femurs after failure of cemented total hip prosthesis (Cape110, W.C.,1989). The use of custom manufactured femoral prosthesis as part of routine total hip arthroplasty has been suggested by Amstutz et al (1989). However there are several disadvantages, including possible inaccuracy of fit, inadequate instrumentation and high cost. Recently the linking of three dimensional size data obtained from C.T Scan to Computer Aided Design/Computer Aided manufacturing technology has been reported to have shorted the time for design and manufacture and also provides improved dimensional accuracy of the implant. (Bargar, 1989).

In February 1989 during 17th Open Scientific meeting of Hip Society, production of custom made prosthesis is from measurements taken during the surgical procedure was reported by two groups. (Stutberg et al, 1989, Mulier et al 1989). Both have manufactured prosthesis according to the measurements obtained during the same surgical procedure using computer aided manufacturing machines with in 40 min.

#### CASE REPORT:

A 19 year old female was shifted from the department of Radiotherapy and Oncology on 13th March, 1990. Three and a half month before her admission the patient had treatment for osteolytic lesion of upper end of femur with pathological fracture of the neck of the femur.

Hemiarthroplasty of the hip joint had been carried out with Austin Moor prosthesis in one of the orthopaedic units outside Lahore. Material curretted from trochanteric area during the procedure was subjected to histopathology and diagnosis of Giant Cell Tumour was established. After the wound had healed the patient was referred to the department of Radiotherapy and Oncology for further management in middle of January 1990. In Radiotherapy Department 5000 rads of radiotherapy was given to the tumour area and patient was referred to our department for further management in the middle of March, 1990 because it still continued to be painful.

Plain radiography of the hip revealed erosive lesion of the trochanteric area around the stem of the Austin Moore prosthesis which was engaged in the shaft of the femur only by its lower one fourth part of stem (Fig.1).

Tc 99 bone scan revealed abnormal uptake in the area of pathology. Biopsy was repeated. Histopathology report revealed a Giant Cell Tumour with areas of fibrosis. Resection of tumour with healthy margins and soft tissue attachment and replacement with custom made prosthesis was planned.

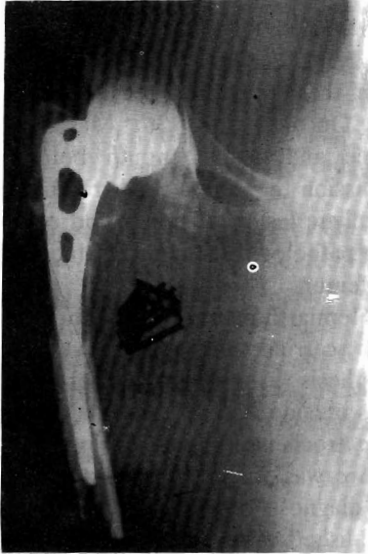


Fig: (1)  
X-rays of patients before surgery by us in may 1990. Oteolytic lesion in proximal femur was a Giant cell tumour.

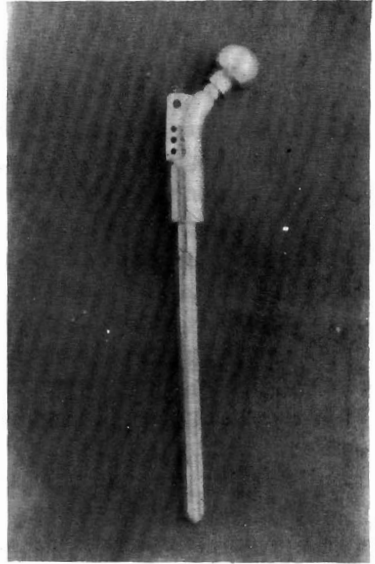


Fig: (2)  
Femoral component of custom made total hip prosthesis developed in early 1988. The head component (made by Zimmer) had been used.

Very high cost of imported custom made prosthesis did not allow us to move in that direction. It was therefore, decided to manufacture femoral part of the prosthesis locally and use imported polyethylene acetabular cup, and of course the bone Cement. Imported 316L cold worked stainless steel bar was procured. Services of one metallurgical and mechanical Engineer were obtained. Basic design drafting was carried out jointly and manufacturing was completed at the Metal Industry Development Centre Sialkot.

Although the authors have done similar exercise in early 1988 when only part of femoral component was manufactured locally (Fig.2).

The patient (65 years old female) suffering from Reticulum Cell sarcoma of upper end of femur died five months after surgery because of pulmonary metastasis.

This time complete femoral component including two modular sizes of the head of the femur were manufactured locally (Fig.3a,b).

Certified imported stainless steel ASTM F56 (316L) containing chromium-17.00 to 20.00%; Nickel-12.00 to 14.00%; Molybdenum-2.00 to 4.00%; Manganese 2.00% max; Silicon - 75% max; Carbon 0.03% max; phosphorus 0.025% max; Sulphur - 0.010% max; was used. Alloys with chromium generates a protective, self regenerating oxoid film

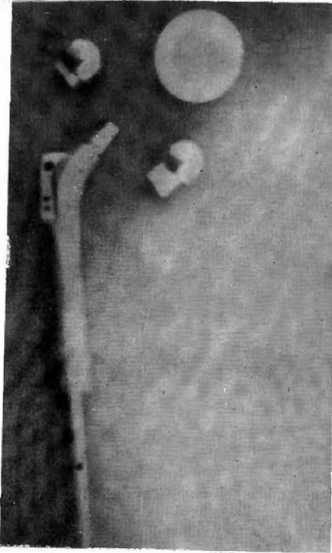


Fig: (3 a)  
Custom made total hip prosthesis developed in April, 1989.  
(loose parts)



Fig: (3 b)  
Assembled together.

which resist perforation, has a high degree of electrical resistivity, and thus provides major protection against corrosion. The nickle imparts more corrosion resistance and out standing fabricability. The Molybdenum addition provides exceptional resistance to pitting corrosion.

The manganese and silicon additions are limited and serve to control problems in manufacturing. The presence of carbon is undesirable. Under certain conditions the carbon segregates from the major elements of the alloy, taking with it a substantial amount of chromium forming chromium carbide precipitates. Local deposition of chromium deprives those zones of corrosion resistance and since the carbides form most frequently at the alloy crystal interfaces, the resultant coarrosion occurs selectively in the intercrystal line paths. (Galante, J.O. 1984).

Before manufacturing the real prosthesis, a prototype of aluminium was manufactured to identify and solve possible problems. Major problem was to obtain desired shape with required dimensions without any type of heat treatment (heat treatment can alter the mechanical properties of steel).

Ultra high density polyethylene acetabular cup (Zimmer) and bone cement (Refobacin palacos R MERCK) which are imported from other countries were obtained from the market. Patient was operated in May, 1990. The Tumour was resected along with Austin Moor Prosthesis and upper one half of the femur contained in periosteum (Fig.4a,b).

Through standard anterolateral hip approach extended distally, total hip replacement was carried out (Fig.5).



Fig: (4 a)  
Shows the resected upper portion of the femur with Auston Moor prosthesis and surrounding soft tissue attachments.

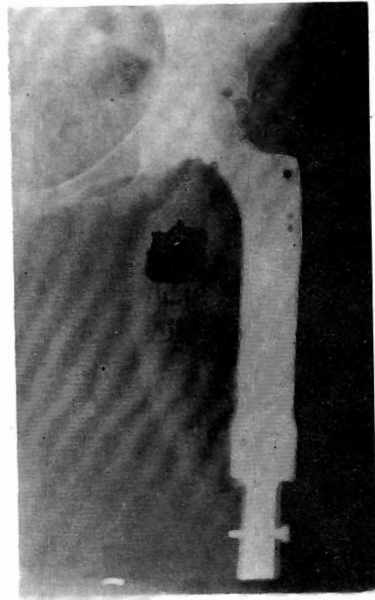


Fig: (5)  
After replacement of the resected hip and femur by the custom made total hip joint.

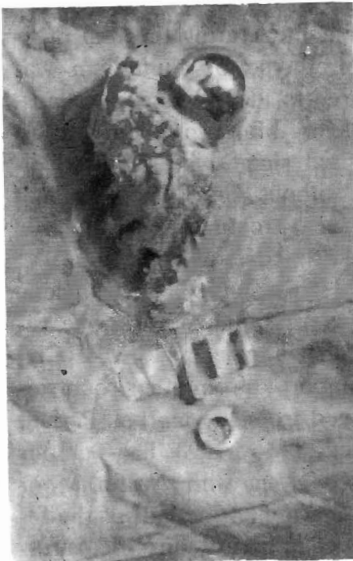


Fig: (4 b)  
Section through upper end of the femur showing areas of fibrous tissue in which tumour has been destroyed by radiotherapy.

#### DISCUSSION:

Total hip replacement following resection of a Giant Cell Tumour has been done in the past by one of us (Naseer M. Akhtar) using a ready made imported charnley type resection prosthesis. Development of custom made total hip was attempted locally for the first time in early 1988. Neck, Trochanteric part and stem could be manufactured locally and imported metallic head and high density polyethylene acetabular cup were used. This total hip was used by one of us (Syed M. Awais) in a sixty years old female suffering from Reticulum cell Sarcoma of the trochanteric area.

In the present case it has been possible to develop the technique of manufacturing the head of the femur, as well,

locally, which we believe is a major breakthrough in the development of implants in the country.

Use of resection prosthesis in Tumour Surgery is very popular throughout the world. However, this is not true for developing countries like ours especially for the custom made prosthesis. Firstly the use of imported prosthesis causes delay in the treatment which sometimes is very important in tumour surgery. And to place orders and provide technical feed back to the manufacturers require special efforts.

Secondly the cost of imported custom made prosthesis is beyond the paying icapacity of our population. In present case manufacturing of the femoral component costed only five thousand rupees. The total amount with cement & acetabular component was about ten thousand rupees which is almost 40 thousand rupees less than the price of imported component.

One patient in whom a malignant tumour had developed in bone adjacent to a total hip replacement was reported (Penman etal, 1984).

Possibility that implanted foreign materials might induce local malignancy have been raised recently (Bleck 1988). Investigation in this matter has already

been requested (Apley, A.G.1989). In this direction it is felt that the benefits of joint replacement might out weight any risk a thousand fold. However there is no excuse for suppressing facts.

Patient has been discharged from the department and is allowed to walk freely with the help of a cane in opposite hand which will be used for few months (Fig.6).



Fig: (6)  
Shows the patient walking with the help of cane in opposite hand, June, 1990.

#### REFERENCES

1. AMSTUTZ H. C., NAOSER. S., MORE, R. C., AND KABO; S.M.: Preliminary results of an off-the shelf press-Fit stem, An Anthropometric total hip femoral compound using Exoct-Fit Principles Clin. Orthop.; 249:60, 1989.
2. APLEY, A. G EDITORIAL: Malignancy and Joint Replacement: the tip of an iceberg? J. Bone and Joint Surg:71-B:1: 1989.
3. BARGAR, W.L: Shap the implant to the patient. A Rationale for the use of custom-Fit cementless total Hip Implants: Clin. Orthop.249:73, 1989.
4. BLACK J. Editorial: Does corrosion matter? J.B Vne and Joint Surg:70-B: 617-52; 1988.



5. BRANDISH, C.R.; KEMP, H. B. S.; SCALES, J.T.: AND WILSON, J.NO: Distal Femur replacement by custom made prosthesis. Clinical followup and survivorship analysis. *J. Bone and Joint Surg.* 69-B (2) 276-284, 1987.
6. ENNEKING, W.F.; AND SHIRLEY, P.D.: Resection. Arthrodesis for malignant and potentially Malignant lesions about the knee using an intramedullary Rod and Local Bone Grafting. *J. Bone and Joint Surg.* 59-A:223-236, March 1977.
7. ENNEKING, W. F.; EADY, J.L.; and BURCHARDT HAND: Autogenous cortical Bone Grafts in the Reconstruction of Surgical Skeletal Defect: *J. Bone and Joint Surg.* 62-A:1039-1058, Oct. 1980.
8. GALANTE, J.O: Metals used in Orthopaedic Surgery, in Orthopaedic knowledge update-1, American Academy of Orthopaedic Surgeons, Chicago, Illinois, 1984.
9. MULIER, J. C., M. MULIER, L. P. BRODY, H. STEENHOUDT, Y. CAUWE, M. GOOSSENS, AND M. ELLOY; A new system to produce Intraoperatively custom femoral prosthesis from measurements taken during the surgical procedure. *clin. Orthop.* 249:97:1989.
10. OKADA, Y., SUKA, T., SIM, F.H., GOVSKI, J. P., CHAO, E. Y.S.: Comparison of replacement prosthesis for segmental defects of bone, *J. Bone and Joint Surg.* 70-A:160-172, FEB. 1988.
11. PENMAN HG, RING PA: Osteosarcoma in association with total hip replacement. *J. Bone & Joint Surg.*; 66-B:632-634; 1984.
12. SCALES, J. T. AND WRIGHT, K.W.J.: Major Bone and Joint replacement using custom implants. In *Tumor Prosthesis for Bone and Joint reconstruction the design and application* pp 149-168. Edited by E.Y.S. Chao and J. C. Ivins New York, Thieme-Stratton 1983.
13. SIMH F.H. AND CHAO E.Y.S.: Prosthetic replacement of the knee and a large segment of the Femur or Tibia. *J. Bone and Joint Surg.* 61-A: 887-892, Sept, 1979.
14. STUTBERG, S. D., B STULBERG, R.L. LIXSON; The Rationale, Design characteristic and preliminary Results of a primary custom total hip prosthesis is; *clin. Orthop.* 249-79:1989.
15. WILLIAM N. CAPELLO; Fit the patient to the prosthesis, An Argument against the routine use of custom Hip Implants. *Clin. Ortho.* 249; 56 1989.