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Case report

Customized iliac prosthesis for reconstruction in giant cell tumour: A unique treatment approach

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ABSTRACT

Giant cell tumour (GCT) of flat bones of pelvis is extremely rare. GCT of the ilium and ischium represent less than 0.05% of all GCT. Iliac bone GCT has been treated traditionally by intra-lesion curettage with bone grafting, wide resection with or without reconstruction and hemi-pelvectomy in very aggressive tumours. None of the above treatments were without morbidities. Reconstruction using bone grafts and bone cement has also been inadequate. In GCT, where life expectancy is not decreased significantly, surgical treatment should be aimed at giving optimum functional outcome. We are reporting here a rare case of giant cell tumour of ilium bone in a 25-year-old female and its unique treatment approach. We designed a computed tomography (CT) based customized iliac prosthesis using Materialise Mimics and 3-Matic software. 3D model of pelvis was generated from the CT. After deciding the extent of resection on affected side, we virtually mirrored an identical portion of opposite ilium to the affected side. Connecting plates were made over the mirrored part and merged with it. Multiple relevant holes were made to attach various muscles to the prosthesis. Prosthesis was made in medical grade titanium by using Computerized Numerical Control (CNC) machine. The method is called as computer based subtractive manufacturing. Wide resection was done and the prosthesis was placed using multiple 3.5 millimetres screws through the connecting plates. Muscles were stitched to relevant holes using ethibond suture. Post-operative course was unremarkable. Patient was made to walk with full weight bearing after 5 weeks. Powers of abductors at 6 months is 4/5 and patient walks normally without a limp.

1. Introduction

Giant cell tumour of flat bones of pelvis is extremely rare. GCT of the ilium and ischium represent less than 0.05% of all GCTs. Iliac bone tumour has been traditionally managed by wide excision without reconstruction. This is more so in malignant tumours of iliac bone. Reconstruction using bone grafts and bone cement has also been inadequate. In GCT, where life expectancy is not decreased significantly, surgical treatment should be aimed at giving optimum functional outcome. We present here a case in which the iliac bone has been virtually designed for the patient in question in order to achieve a near normal outcome.

2. Case report

A 25-year-old female presented with complaints of dull aching pain and a gradually progressive lump in right iliac fossa associated with difficulty in walking since 8 months. The pain was continuous, diffuse, dull aching with no radiation. There was no history of fever, loss of weight, loss of appetite, night cries, vomiting, loose stools, constipation or abdominal injury.

General physical examination was normal and local examination revealed a firm, tender, non-mobile swelling with smooth margins arising from anterior part of ilium bone. There was no evidence of redness, rise in temperature or dilated veins over the swelling. Systemic examination and haematological investigations were normal.

X-ray pelvis revealed a large lytic expansile lesion involving right ilium bone with evident destruction and well defined margins (Fig. 1). Rest of the pelvic bones appeared normal. The serum calcium, serum phosphorus, alkaline phosphatase and parathormone were normal. X-ray of the chest was unremarkable.

Computed tomography (CT) scan of pelvis revealed an expansile lytic lesion involving the right iliac wing. There was no matrix

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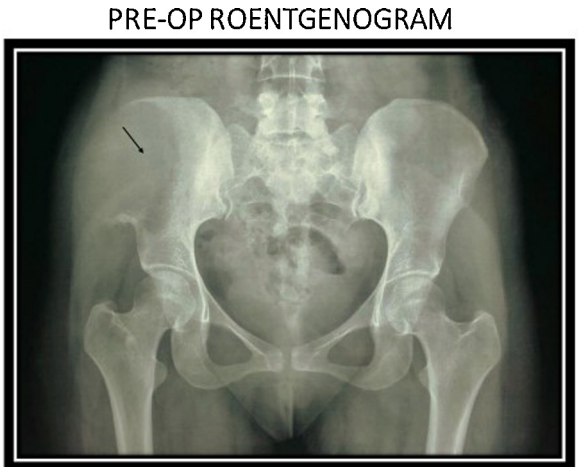

Fig. 1. Pre-operative X-ray pelvis – antero-posterior view.

calcification. Magnetic resonance imaging (MRI) showed large lesion in anterior part of iliac wing which was hypointense on T1 and heterogeneously hyperintense on T2 weighted images (Fig. 2).

Clinico-radiological work-up was suggestive of GCT of the right iliac bone, which was confirmed on histopathology. It was further classified as type I tumour based on location according to classification system for pelvic tumours by Enneking and Dunham, further modified by Sanjay et al. and grade II according to radiographical classification system of Campanacci.

Wide resection of tumour was done and removed portion of ilium was replaced by a CT based customized patient-specific titanium iliac prosthesis designed using Materialise Mimics and 3-Matic software.

Steps of designing the customized iliac prosthesis are described below.

1. A non-contrast computed tomography (NCCT) scan of pelvis with 1 mm cuts was performed and obtained in a compact disc (CD).
2. The NCCT pelvis was imported in the Materialise MIMICS software which serves to convert DICOM images of NCCT into 3D model in STL format.
3. A virtual 3-D model of pelvis (STL format) was generated using thresholding, region growing and calculate 3-D commands (Fig. 3).
4. The STL file of 3-D model was imported to 3-Matic software which allows engineering on 3-D models.

Fig. 3. Virtual 3D model of pelvis made from CT scan.

5. After planning the extent of resection, appropriate cuts were made on the affected side ensuring complete removal of tumour with a safe margin. Identical portion was marked from the normal side using wave brush command. This identical normal ilium was mirrored to the affected side (Figs. 4 and 5).
6. This normal portion was merged with the rest of pelvis. Plates were designed over it to form attachments of the prosthesis. These plates were then merged with the mirrored portion of ilium (Figs. 6 and 7).
7. Multiple relevant holes were made on the iliac crest region, ASIS and AIIS to stitch back muscles attached to the bone normally.
8. This virtual Iliac prosthesis was then exported in IGS format.
9. Real prosthesis was made in medical grade titanium from virtual model by using computerized numerical control (CNC) machine. The method is called as computer based subtractive manufacturing. Subtractive manufacturing is a process by which 3D objects are constructed by successively cutting material away from a solid block of material (Fig. 9).
10. This custom-made iliac prosthesis was then autoclaved.
11. After performing wide resection of tumour according to the virtual plan (Fig. 8), the prosthesis was fixed to the pelvis through its attachment plates using 3.5 mm titanium screws (Figs. 10 and 11).
12. Muscles were stitched back to the appropriate holes in prosthesis using ethibond number 5 sutures.

Size of the excised tumour was 10 cm × 8 cm × 6 cm.

Post-operative course was unremarkable. Patient was made to walk with full weight bearing after 6 weeks. Powers of abductors at 6 months is 4/5 and patient walks normally without a limp (Fig. 12).

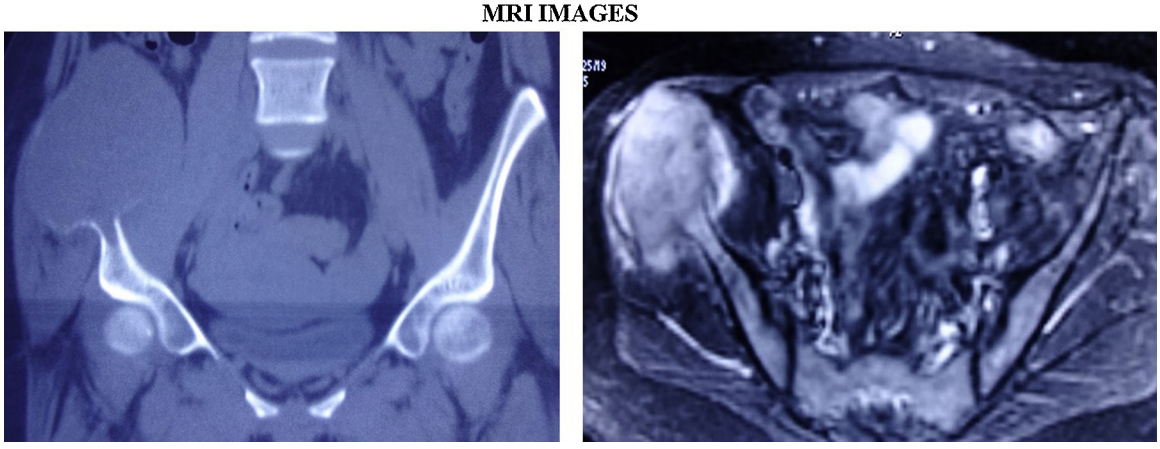

Fig. 2. MRI images showing lesion in right ilium bone.

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