

# Management of Right Pelvic Non Metastatic Grade 2 Chondrosarcoma using Surgical Resection, ECRT and Reimplantation and Fixation using Custom Made 3D Printed Plates: A Case Report

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## Abstract:-

**Case:** 21 year old female came with complaints of pain over right hip since 3 weeks which was acute in onset gradually progressive and dull aching in character. Examination showed there was restricted internal rotation and abduction of right hip movements, with no sensory or motor deficits of bilateral lower limbs. Blood investigations showed marginally elevated erythrocyte sedimentation rate, while the rest were within normal limits. MRI scan of pelvis showed margin enhancing focus at right acetabular roof region with perifocal marrow changes. Trucut biopsy was done and showed mildly hypercellular hyaline cartilage with lobular arrangement and focal myxoid change permeating the bone trabeculae and occasional peripheral aggregates of osteoclast giant cells. She was diagnosed to have right pelvic non metastatic chondrosarcoma and underwent right internal hemipelvectomy (partial type 1 and 2) using 3D printed cutting jig and ECRT (extracorporeal radiotherapy) of resected specimen with reimplantation and fixation using custom made 3d printed plates for posterior column, pre bent anterior column plate.

**Conclusion:** Despite the rarity of the condition, the possibility of non metastatic chondrosarcoma in pelvis should be taken into account in these circumstances. This case shows the role of surgical resection, ECRT and reimplantation of irradiated bone with help of 3D printing in management and draws attention towards early detection and definitive management with respect to the rarity of the disease and the site of the bone involvement.

**Keywords:-** Chondrosarcoma, ECRT- Extracorporeal radiotherapy, 3D printing.

## I. INTRODUCTION

Chondrosarcomas are malignant cartilaginous neoplasms with diverse morphological features and clinical behavior. They account for about 20% of all primary malignant tumors of the bone. They usually occur in axial skeleton-the pelvis or long bones .

The majority of chondrosarcomas are sporadic, but they may develop from the malignant transformation of osteochondromas and enchondromas. Chromosomal anomalies detected in chondrosarcomas include 9p21, 10, 13q14, and 17p13.

Primary or conventional chondrosarcoma arises in preexisting normal bone and is distinguished from the rarer secondary tumors, which occur in a preexisting enchondroma or osteochondroma.

The radiographic features of chondrosarcoma are often very characteristic, and a definitive diagnosis can usually be made by imaging examination alone.<sup>1</sup>

Here, we describe a case of pelvic non metastatic grade 2 chondrosarcoma. The patient was managed with right internal hemipelvectomy (partial type 1 and 2) using 3D printed cutting jig and ECRT (extracorporeal radiotherapy) of resected specimen with reimplantation and fixation using custom made 3d printed plates for posterior column, pre bent anterior column plate, without recurrence after 10 months follow up.

## II. CASE PRESENTATION

21 year old female came with complaints of pain over right hip since 3 weeks which was acute in onset, gradually progressive and dull aching in character, moderate in intensity. Pain aggravated on squatting radiating to right lower limb. Examination showed there was restricted internal rotation and abduction of right hip movements, with no sensory or motor deficits of bilateral lower limbs. Blood investigations showed marginally elevated erythrocyte sedimentation rate, while the rest were within normal limits. Patient presented with X ray of pelvis which showed no radiological abnormalities. (Figure 1)

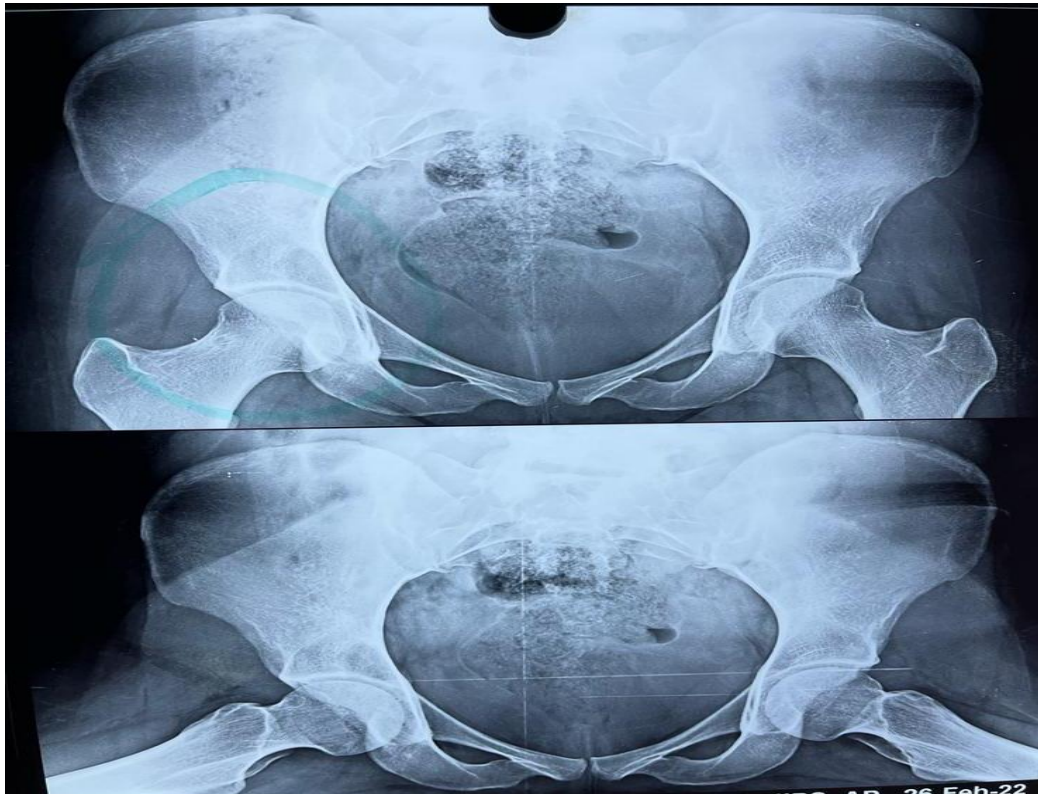


Fig. 1: X ray of pelvis with bilateral hip and frog leg lateral views

MRI of pelvis showed margin enhancing focus at right acetabular roof region with perifocal marrow changes. (Figure 2)

Based on the above given findings based on the imaging and co relating with the examination findings, the differential diagnosis which were thought of were chondroid matrix tumour or bone cyst.

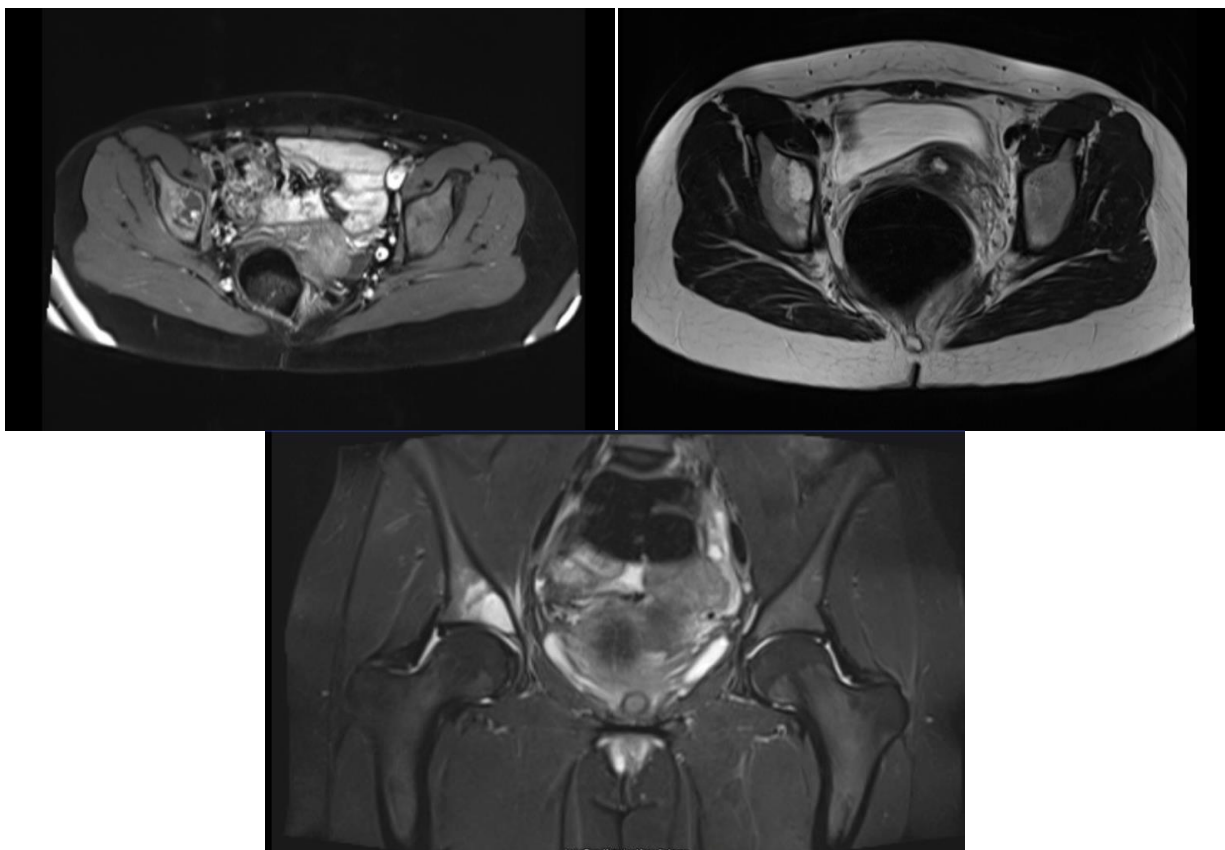


Fig. 2: MRI images of pelvis- coronal and axial sections showing hyper intense margin enhancing lesion at right acetabular roof

Keeping the above mentioned differential diagnosis in hindsight, the patient was evaluated further. Trucut biopsy was done from right acetabular region and was suggestive of cartilaginous tumour.

Patient was planned for right internal hemipelvectomy, pre operative planning was done using CT scan and 3D printed model which was patient specific. Osteotomy jigs were designed for accurate cuts. (Figure 3)

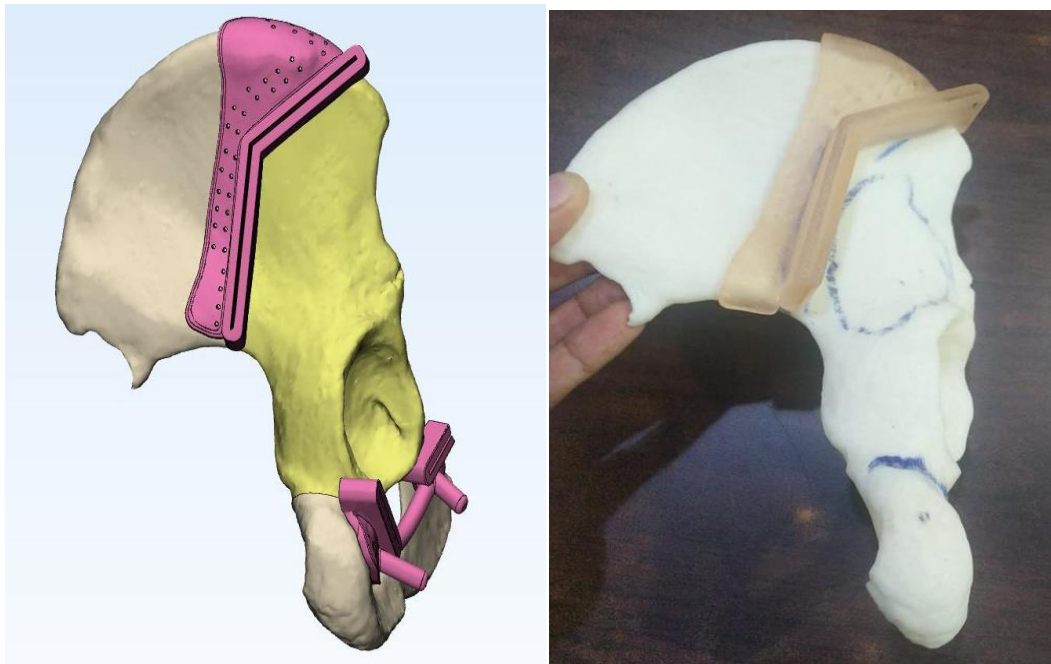


Fig. 3: Computer aided design (CAD) model of patients CT and designing patient specific 3D pelvic model and jigs  
The plate and screw for reimplantation and fixation were also pre designed for precision fit and correct screw placement. (Figure 4)

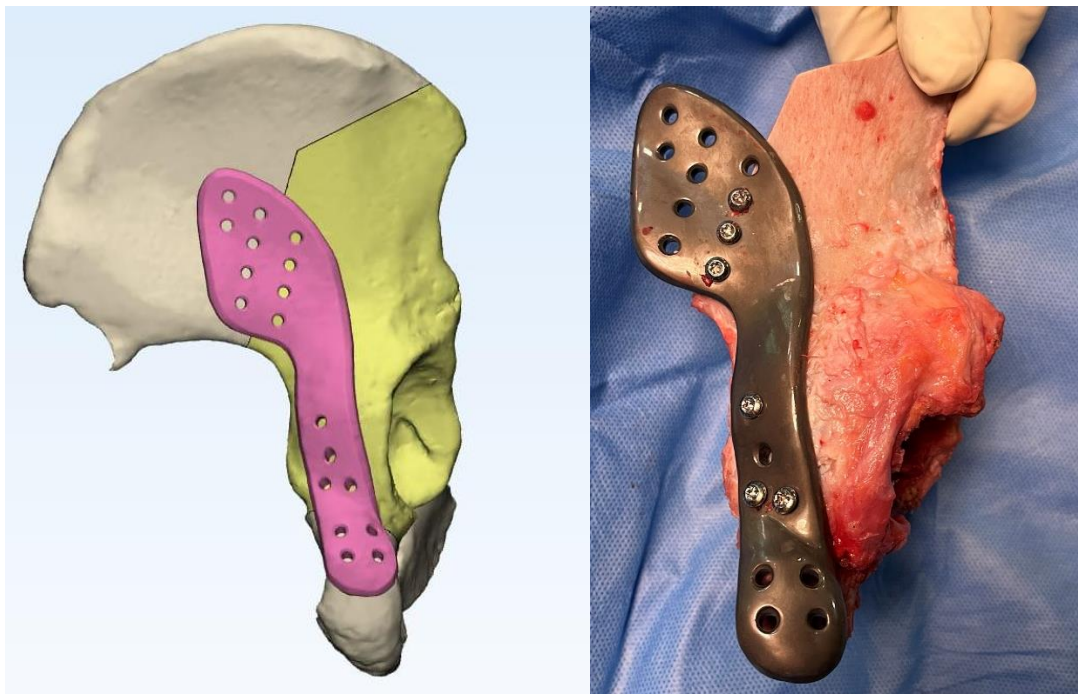


Fig. 4: CAD modelled and designed titanium pelvic plate

Patient underwent right internal hemipelvectomy- partial type 1 and 2 (Figure 5)

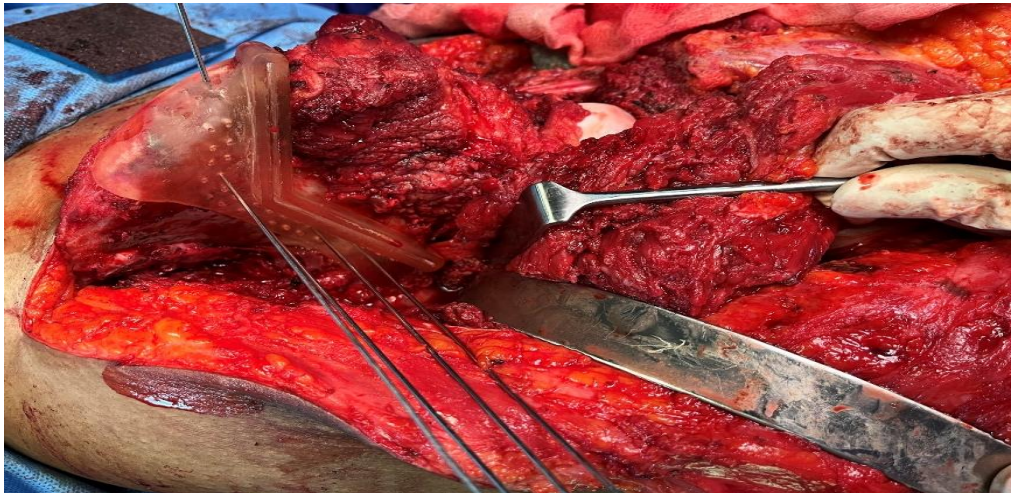


Fig. 5: Intraop image of hemipelvectomy using 3D printed jig

The resected tumour specimen was taken for ECRT- extracorporeal radiotherapy under aseptic precautions, target radiation 50 gray was achieved for tumour specimen (Figure 6).

The specimen was also sent for histopathological analysis and confirmed as Grade 2 chondrosarcoma. (Figure 7).

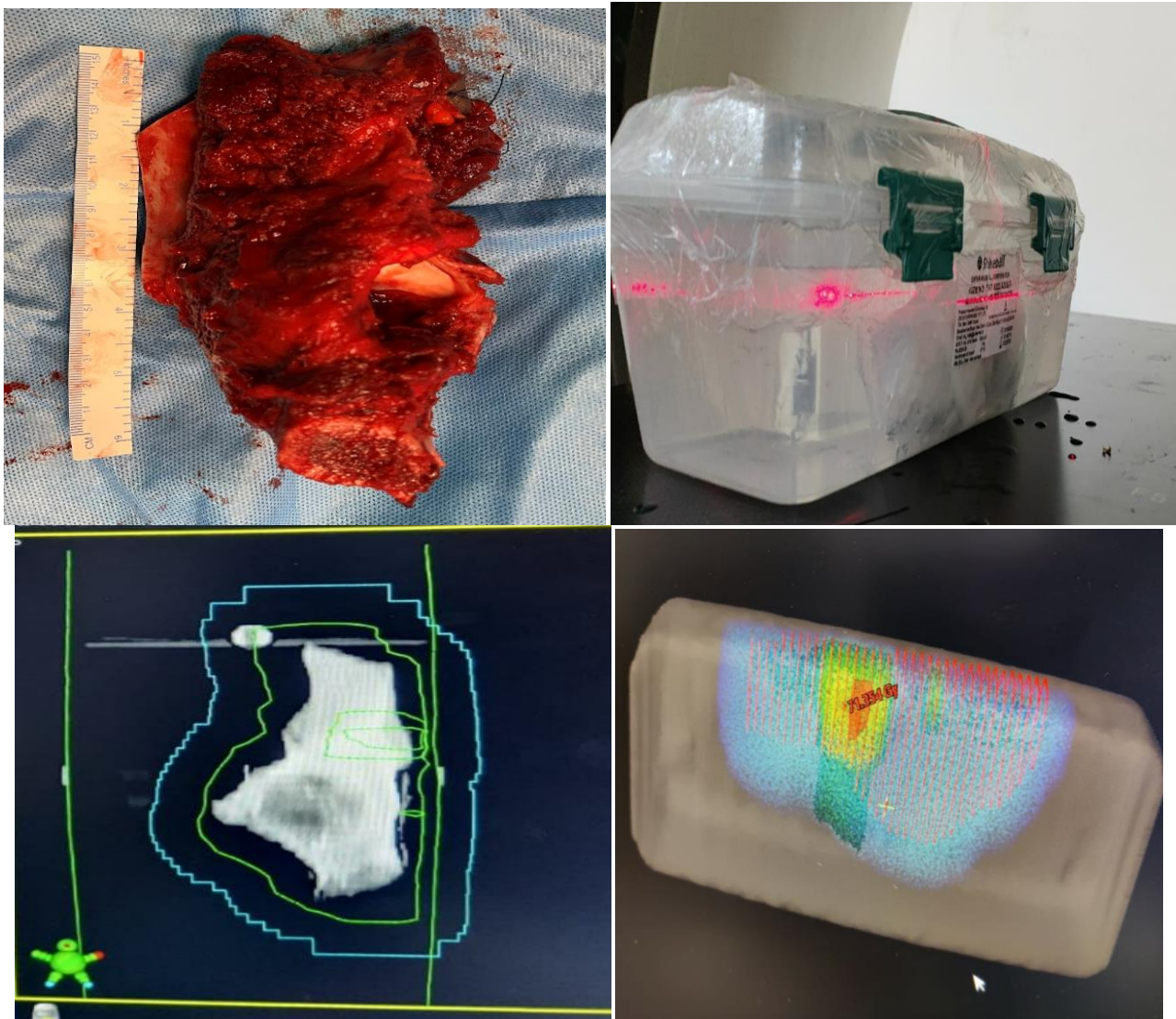


Fig. 6: Resected tumour specimen undergoing ECRT

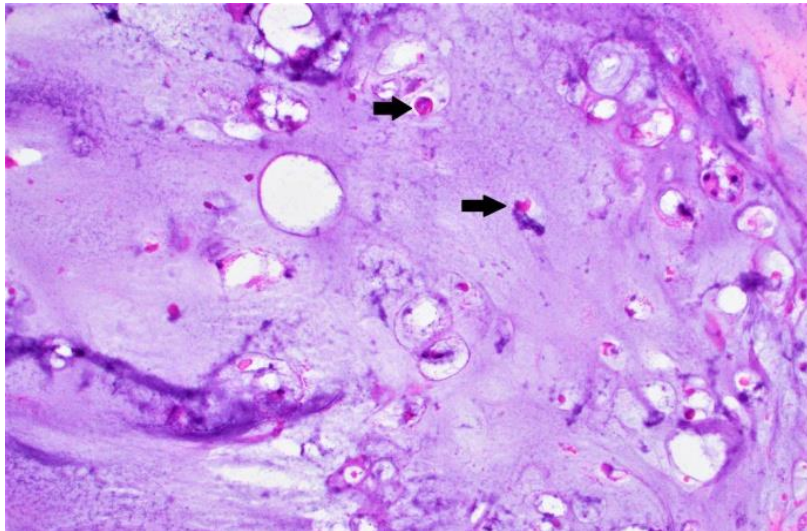


Fig. 7: Histopathological analysis showing hypercellular stroma, large chondrocytes

Post ECRT reimplantation of pelvis and fixation using was done using custom made 3d printed plates for posterior column, prebent anterior column plates. (Figure 8)

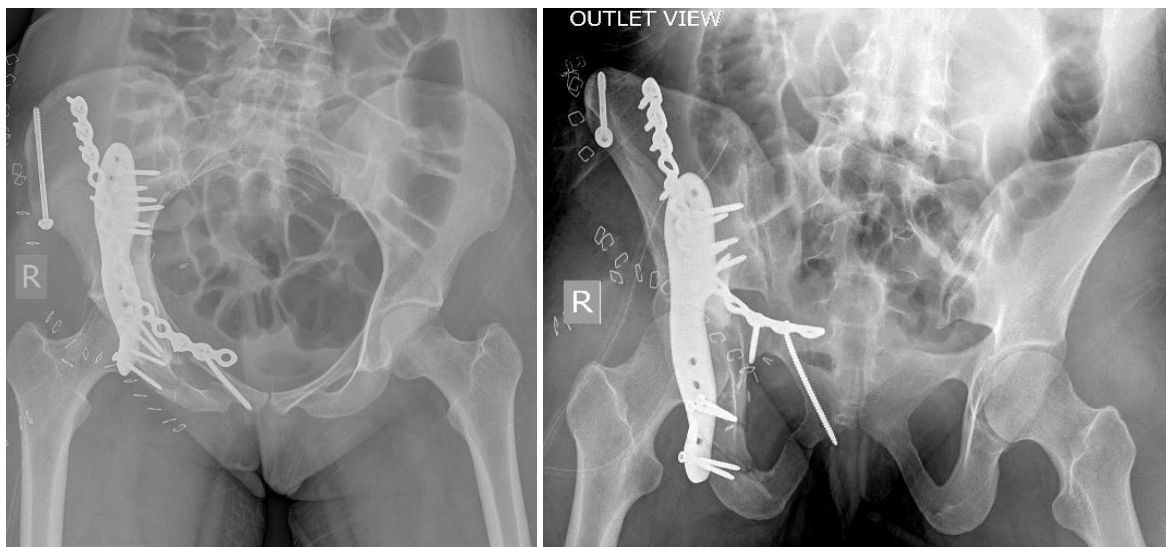


Fig. 8: Post operative X rays following refixation

Patient was started bedside mobilisation 4 weeks following surgery and weight bearing mobilisation was started 8 weeks following the surgery.

Patient is currently full weight bearing mobilising with ability to carry out activities of daily living. No signs of recurrence clinically or radiologically.

### III. DISCUSSION

Chondrosarcoma is a primary malignant bone tumour with cartilaginous differentiation. Tumours are typically larger than 4 cm. The cross section usually shows translucent, lobular, bluegray, or white, which indicates the existence of hyaline cartilage. There could be spots where myxoid or mucoid material is present, along with cystic alterations.<sup>1</sup>

According to histopathology they are classified as:

- Grade I: considered to be low-grade (locally aggressive), also called atypical cartilaginous tumour. Grade I lesions will often closely resemble normal cartilage. The distinction between benign and malignant often depends on the demonstration of a “chondrosarcoma permeation pattern” where the tumour infiltrates through the marrow cavity instead of being confined by the native architecture. Grade I chondrosarcoma is moderately cellular and contain hyperchromatic, plump nuclei of uniform size.
- Grade II: tumours contain a greater degree of nuclear atypia hyperchromasia, and nuclear size and are more cellular. Mitoses can be found.
- Grade III: tumours are more pleomorphic and atypical than grade II chondrosarcomas. Mitoses are more easily detected. The cells at the periphery of the lobules are less differentiated and become spindle.
- The fourth group of chondrosarcomas, considered as grade IV; is called dedifferentiated chondrosarcoma and makes up 10% of all chondrosarcomas

#### A. Investigations include:

- **Plain radiography:** may have lytic lesions in 50% of the cases, Intralesional calcifications: in about 70% of the cases (popcorn calcification or rings and arcs calcification), Endosteal scalloping, Permeative appearance or moth-eaten appearance in high-grade chondrosarcomas, Cortical remodeling, thickening, and periosteal reaction.<sup>2</sup>
- **Computed tomography scan:** shows matrix calcification in 94% of the cases, cortical breach in about 90% of long bone chondrosarcoma & heterogenous contrast enhancement.
- **Magnetic resonance imaging:** demonstrates a lobulated lesion with a high-signal intensity on T2 and a low or intermediate signal on T1-weighted images.<sup>3</sup>
- **Tissue biopsy:** biopsy should be taken from the most aggressive portion of cancer as determined by imaging will be conclusive.

#### B. Treatment modalities include:

- **Surgery:** The primary treatment modality of chondrosarcoma is surgical excision. Low-grade central chondrosarcoma can be treated with intralesional curettage, burring and surgical adjuvant application such as hydrogen peroxide.
- Tumours with intra articular or soft tissue involvement, larger tumours, axial or pelvic tumours must be treated with wide excision coupled with radiotherapy.<sup>4</sup>
- **Radiation therapy:** indicated to improve the high local failure rates. These indications include locally recurrent tumours intermediate to high-grade tumours, and tumours in locations where surgical resection is challenging or limited.<sup>5</sup>
- **Chemotherapy:** effective only in dedifferentiated chondrosarcomas containing a high-grade spindle cell component.

#### C. Concept of 3D printing:

3D printing/Additive manufacturing, is the construction of a three-dimensional object from a CAD model or a digital 3D model. Material is deposited, joined or solidified under computer control to create a three-dimensional object with material being added together typically layer by layer.

Modelling- Created with a computer-aided design (CAD) package, via a 3D scanner, or by a plain digital camera and photogrammetry software.

Printing- Before printing a 3D model from a file, it must first be examined for errors. printing can take anywhere from several hours to days, depending on the method used and the size and complexity of the model.

Materials used- Polymers, metals, graphene, biomaterial, gelfoam.<sup>6</sup>

Agarwal MG, Gundavda MK, Gupta R, Reddy R<sup>7</sup> conducted a study suggested that extra corporeal irradiation and reimplantation after acetabular resections resulted in good functional outcome and no fractures in irradiated specimen which is comparable to our case which

has both good functional outcome, without recurrence or fractures in the irradiated bone.

Reiner J. Wirbel, Michael Schulte, Bernd Maier, Martin Koschnik and Wolf E. Mutschler<sup>8</sup> conducted a study that suggested the best oncologic results in chondrosarcoma involving the innominate bone could be found in low-grade tumours, and the best functional results after continuity resection and restoration of the pelvic girdle which holds true in our case.

Facco G et al<sup>6</sup> conducted a study that inferred 3D printed models have proved themselves useful in the reduction of surgery time, blood loss and ionizing radiation, as well as they have improved surgical outcomes. 3D printed model is a valid tool to deepen the complex anatomy and orientate surgical choices by allowing surgeons to carefully plan the surgery. This concept was used in our case to pre operatively plan the cutting jigs and design patient specific pelvic plate which aided in decreased intraoperative duration and less blood loss.

In our case we found that management of pelvic non metastatic grade 2 chondrosarcoma using surgical resection, ECRT and re-implantation and fixation using custom made 3D printed plates had favourable outcome.

#### IV. CONCLUSION

Management of chondrosarcoma especially in axial skeleton is a challenging scenario and leads to dilemma between conservative management or aggressive surgical management along with adjuvant therapy to treating doctor.

Our case concludes that grade 2 chondrosarcoma pelvis are better managed with surgical resection, extracorporeal radiotherapy and re-fixation of the bone, which was aided by pre op planning with the help of 3D reconstruction, had excellent outcome.

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### CONSENT

The patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.