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A novel treatment strategy for high grade chondrosarcoma patients utilizing a biological allograft and a native femoral head: a report and review of literature.

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ABSTRACT

Backround and Aim: Chondrosarcomas are amongst the most common malignancies affecting the musculoskeletal system. Despite the fact that overall incidence of these tumours is relative rare, approximately 3 new cases are diagnosed each year per 100,000 inhabitants with a higher tendency to affect people above the age of 50 (1). In more advanced disease, adequate surgical resection margins are difficult to achieve especially when sites such as the pelvic compartment are affected. Surgical approaches tend to be limited to amputation of wide en-block resections with endoprosthesis of the femur leading to significant morbidity in patients. Our aim was to present a possible treatment alternative for future treatment alternatives in patients diagnosed with high grade pelvic chondrosarcomas using a biological allograft from a cadaveric donor which matches the patient's native femoral head.
Materials and methods: We present a case of a 63-year-old woman complaining of pain in her leg which has been affecting her for over a year. Using a biological allograft from a cadaveric donor and the patient's native femoral head a wide en-bloc excision was performed to treat her central chondrosarcoma.
Results: The patient was successfully treated using a biological allograft while maintaining her native femoral head. Unforseen aseptic necrosis developed two years following the procedure and was treated using a metal endoprosthesis. MSTS functional scoring remained unchanged following both procedures.
Conclusion: Wide en-bloc excisions during the oncological treatment of pelvic chondrosarcomas using biological allografts and native femoral heads may be used without impairing care or functional outcome in the future.
Key Words: Pelvic chondrosarcoma, biological allograft, native femoral head.

Introduction

Chondrosarcomas are the second most common primary malignancy affecting the musculoskeletal system (1). They are often the result of malignant transformations from benign precursor lesions of hyaline cartilage in bones that undergo endochondral ossification, and their outcomes are strongly correlated to their histological grading (2). The growth of low grade tumours is slow, they rarely metastasize, and have excellent results following surgical treatment which is postulated to be due to the low vascularization and division of cells in cartilaginous tissue (1). This however is paradoxical, because it makes treatment of these tumours difficult as they are often both chemo and radiotherapy resistant. With higher grade chondrosarcomas however, the presence of increased cellularity, vascularization, and mitosis are apparent resulting in the theory that resistance is inherited and maintained through anti-apoptotic pathways (3).

Due to the elusiveness of these cancers, they are often diagnosed at a later stage, are larger in volume, have an increased tendency to metastasize, and their subsequent treatment and location is often associated with worse incidence of morbidity and mortality (4-6). Many chondrosarcomas are present as benign masses and are restricted to locally aggressive invasion of surrounding tissues with little to no metastatic potential (7, 8). In higher grade chondrosarcomas, the increased cellularity of the tumours, combined with the diminished cartilaginous matrix allow for metastatic progression of the tumour with as many as 20-30% of patients developing metastases following treatment (7-9). Patients with low grade tumours or non-axial presentation of malignancies have demonstrated better prognosis, overall survivability, less recurrence and less metastases when compared to higher grade lesions which is likely attributable to adequate resection margins attained during surgical treatment (10).

There are few methods of surgical treatment of high grade pelvic chondrosarcoma described in literature. The major aim of surgical intervention is radical excision of malignant tissue and reconstruction either using metal hardware or biological allograft. Radical treatment can only be achieved through the use of surgical procedures such as wide en-bloc excisions especially for higher grade chondrosarcomas (1). These operations however, are demanding due to the use of extensive reconstructive procedures and inherent characteristics of malignant chondrosarcomas, leading to the high morbidity seen in patients (1, 11). They often require the use of custom made alloplastic grafts made of osteoinductive hydroxyapatite (12). Intralesional and marginal excision of tumours may be done in low grade chondrosarcomas followed by local adjuvant therapy without the significant impact that is associated with wide en-bloc excisions while maintaining local control (13). Local adjuvant therapy such as the use of phenol or other cryosurgery techniques is however, limited to low grade chondrosarcomas confined solely within the bone (13). When tumours are present in non- resectable portions of the body such as the base of the skull or are present as large lesions within the pelvis, only palliative treatment is available as an option (1, 7). The use of biological allografts has been attempted to provide positive functional outcomes however, it has often involved endoprothesis of the femur to avoid local neoplastic dissemination, resulting in a prolonged procedure, increasing the risk of iatrogenic complications as well as intraoperative bleeding. There has been little or no studies examining of using biological allografts to treat chondrosarcomas, while maintaining the patient's native femoral head. The aim of our report was to present the possible solution of radical pelvic region of high grade chondrosarcoma treatment using biological allograft in combination with native femoral head.

Case Presentation

The following case report presents a 63-year-old woman who was complaining of left lower limb pain, as well as a loss of hip joint function, and mobility for approximately one year. Overall the patient was in good standing health with no other co-morbidities.

1. Materials and Methods

CT: There was presence of significant destruction in the left acetabular region.

Biopsy: Was taken and the presence of a G3 central chondrosarcoma was confirmed by the department of histological pathology. Subsequently bone scintigraphy and MRI was performed. The MRI revealed, a malignant process developing in the anterior medial and posterior portions of acetabular chondral tissue. Medially, there was a 4-cm quadrant of destroyed connective tissue surrounding the acetabular joint and local penetration of approximately 0.7-cm towards the sacral radices. The upper portion

of the tumour had penetrated into the pelvic body, anteriorly, and medially up to approximately the sacro-iliiac joint. There was a presence of periosteal tissue destruction approximately 7-cm vertically and 5-cm in the sagittal plane with local infiltration as up to 2-cm foci. The definitive destructive focus of the tumour was approximately 10-cm vertically, 6.5-cm horizontally and 5.7-cm in the sagittal plane. In the left leg, paraoseal tissue including m. gluteus min, m. obturator internus, m. piriformis, m.quadratus femoris, and m. gluteus medius, along with intramuscular fat tissue were found to be oedematous. MRI didn't reveal any presence of pathological lymph nodes, nor infiltration into surrounding neurovascular tissues.
Radiolabelling of metabolites revealed the presence of lesions during scintigraphic examination.

Differential Diagnosis

Chondrosarcoma, Ewing's sarcoma, Osteochondroma.

2. Results

Treatment plan included radical hemipelvectomy, using biological transplant and preserving the patients femoral head, matching its size with an allogenic transplant with a similar acetabular size.

Intraoperatively, a 30cm long ilio-inguinal incision was made which was made up to the trochanteric zone of the Femur. The layers of tissue were divided until the femur was reached, resecting m. gluteus minimus, medius, and maximus from both the tumour and iliac crest.

There was a 1-2 cm resection of the iliac crest near the superior and inferior spines along with the anchoring points of the muscles. The m. iliopsoas was divided to access the hip joint, the capsule was cut from the labrum. Tissues were divided in the groin region to mobilize the femoral nerve, artery and vein. Resection of the upper portion of the ischium was made as well. The ilium was resected along the crest until the posterior iliac spine.

Abdominal muscles were also resected from the crest with a partial resection of the iliac muscle which had been affected by the tumour.

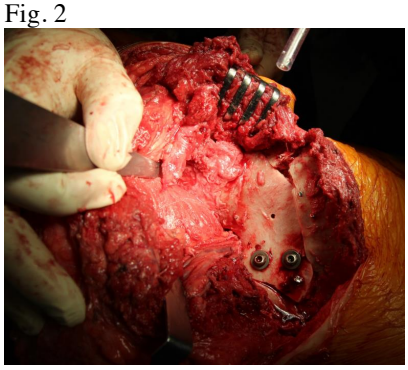
The ischial plexus was separated alongside the sciatic nerve. The sacroileal joint was separated which included the division of the gamellius, obturator, and piriformis muscles and the obturator nerve. Further resection of the ischium was made and the hip joint was mobilized and resected.

Biological allograph cadaver donor tissue was inserted into the defect, under x-ray monitoring and osteosynthesis was accomplished using two plates and screws.

Fig. 1

The following image depicts the cadaveric bone graft being placed into the patient. Single screws were used to join the graft tissue specifically the iliac crest, with the patient's own tissues.

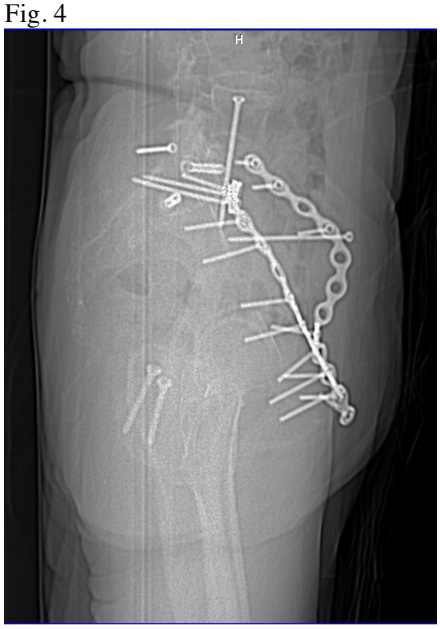
Fig. 2



Two screws were used to fasten the sacroiliac joint. Following osteosynthesis, the femur was reduced into the acetabular space and the joint capsule was fastened to the allograft. Abdominal muscles, along with the primary extensors of the hip were attached to the iliac crest. The wound was thoroughly cleaned and two drains were inserted.

Fig. 3

Fig. 4



Following the surgical procedure, the patient was treated with active drainage and antibiotics which proved to be effective during the monitoring of inflammatory blood markers. The patient made a full recovery from the radical surgical intervention.

Approximately two years following this procedure, the patient returned with a constant pain and limited mobility in the same joint. Imagining was done and concluded that following the transplantation, third to fourth degree joint arthrosis in the form of aseptic necrosis had developed presenting itself as a decreased acetabular space, subchondral sclerotic osteophytes, and protrusion. A planned surgical intervention was discussed and agreed upon.

Fig. 5

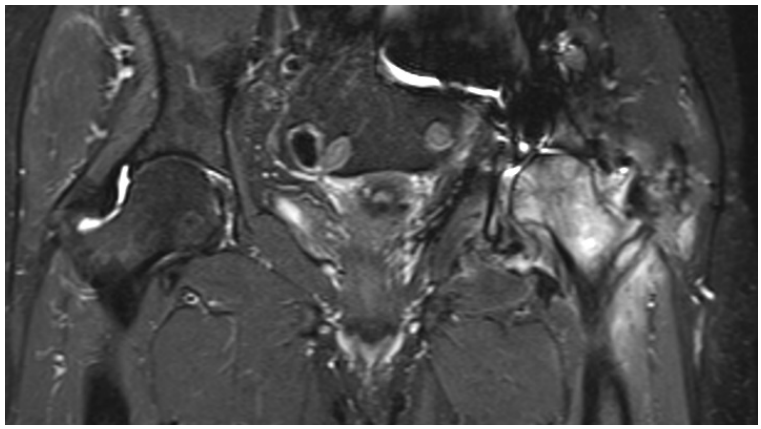
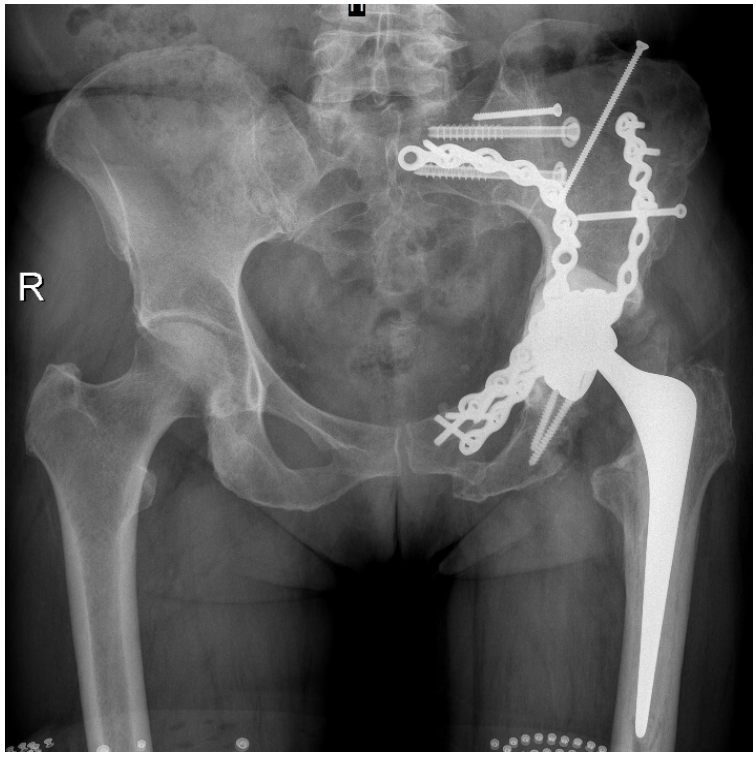


Fig. 5 demonstrates the presence of aseptic necrosis that developed in the time since the surgical procedure.

Alloplastic repair of the joint was done with a total hip replacement using cemented implants. These improved mobility, stability and pain in the affected joint.

Fig. 6



6. Discussion

There is a lack of a formal consensus on a wide range of topics regarding primary cancers affecting the pelvic region. Chondrosarcomas, Ewing's sarcomas, and osteosarcomas constitute 5-10% of primary bone cancers however, are the most frequent types affecting the bony pelvic structures (5, 14). Due to the anatomical location of these particular tumours, they are often diagnosed at a later stage resulting in volumetrically larger and less differentiated cancers in patients (5, 6). This corresponds to the higher incidence and rates of dissemination seen in these types of cancer (4).

Initial diagnosis of patients should be done using x-rays or other more specific

computer tomography imagining techniques so that other pathologies affecting the region are excluded.

Enhanced visualization and tumour localization and distribution can be then followed up using scintigraphy or magnetic resonance imagining. These will also allow for preoperative planning and matching required for the implementation of biological transplants.

While location and size are the most fundamental factors dictating the surgical approaches in treatment, clear resection margins, and the outcomes following surgery concerning the neurovascular status of the patient's limb are the also critical when choosing between internal or external hemi-pelvectomies (4). In this patient, there was the presence of a high-grade chondrosarcoma in the pelvis, a region generally difficult to operate in.

Advances in medicine over the last few decades, have allowed for limb salvage techniques involving partial resection of pelvic structures to become a viable treatment option for patients suffering from cancer while, still maintaining similar outcomes regarding survival, recurrence, and complication rates (6, 15). Enneking and Dunham proposed a classification scheme for various partial resection types and subtypes involving the region which, is still used by surgeons today and frequently cited in literature (16).

It is also the basis for treatment when deciding to utilize pelvic reconstruction techniques (4). Pelvic reconstruction using biological or prosthetic approaches or a combination of both is a complex process and requires the consideration of a number of factors. Analysis of the patient's history, current morbidities (diabetes, frequent UTI's, smoking status), future exposures (radiation therapy or long-term steroids and/or non-chemotherapeutic immunosuppressants), outlook of the patient, and ultimately the age as well as the functional demands, play a role in deciding on the reconstruction type (4). Biological (allograft) prosthesis, like the one that was used in our patient, provides higher stability, longevity, and is more resistant to various physical stresses (when considering the patient's overall survival)(4).

Hemipelvectomies used for the treatment of primary bone cancers, are rare surgeries and are often associated with high rates of complications resulting in high rates of future morbidity as well as mortality (17). The most frequent postoperative complication presents itself in the form of local recurrence (4, 18). When compared to external hemipelvectomies and subsequent limb amputations, internal limb sparing procedures require prolonged periods of rehabilitation for the preservation of normal function (16, 19).

Based on the aforementioned factor's, we decided that a biological arthroplasty would be the most suitable treatment option for her Chondrosarcoma. In our patient, a wide excision was performed incorporating a modified Enneking 2 procedure. Clear resection margins were obtained and she has been cancer free for the past three years. Recovery was smooth up until 2 years following surgical intervention which, was complicated with an unforeseen case of aseptic necrosis confirmed by MRI. Hip arthroplasty was performed alleviating the pain and the decreased mobility.

The functional scoring of the patient according the MSTS classification was 29 following both surgeries which was higher than the average when compared to other studies analysing similar outcomes during internal hemipelvectomies (20).

Our case is limited in its scope but has been successful in radically treating an otherwise healthy female from this aggressive tumour using an alternative strategy and avoiding a metal endoprosthesis during initial treatment. Satisfactory MSTS scores were achieved which, may give insight into future treatment strategies for oncological patients suffering from pelvic chondrosarcomas.

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