Trabecular Metal Augmented Reconstruction of Acetabular Defect after Removal of Periacetabular Giant Cell Tumors in A Young Male: A Case Report with Review of Literature

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Abstract

Introduction: Giant cell tumors (GCTs) are benign, epiphyseal, locally aggressive bone tumors. Pelvic GCTs are sparingly encountered and present a challenging scenario for the surgeon to not only diagnose but also to treat appropriately. Multiple treatment options are available as per the literature but no single approach is universally accepted. Moreover, due to the complex anatomy of the pelvis, novel treatment options have also been tried.

Case Report: A 30-year-old male presented to the outpatient clinic with complaints of gradually progressive dull aching pain in his right hip for 6 months. On radiological investigation, he was found to have a lytic lesion in the right periacetabular region. Image-guided biopsy revealed GCT on histopathological examination. The final management included extended curettage of the tumor and reconstruction of the remaining defect with trabecular metal (TM) augment supplemented with reconstruction plate. The patient resumed full activity and remains asymptomatic and disease free at 5 years follow-up.

Conclusion: To the best of our knowledge, this is the first reported case for the use of TM augment in reconstruction of bone defect following curettage for GCT in pelvis.

Keywords: Giant cell tumor pelvis, trabecular metal, acetabular reconstruction.

Introduction

Giant cell tumors (GCTs) are benign tumors arising from the epiphyseal region of bones [1]. They are most frequently encountered in the age group of 20–50 years with females affected more often than males. GCTs of the bone account for approximately 3–8% of all primary bone tumors and pelvic GCTs account for only about 1.5–6.1% of bone GCTs [1, 2]. When long bones are involved, patients present to the orthopedic outpatient clinic most commonly with pain accompanied by a swelling over the affected region. Uncommonly, when the tumor involves the pelvis, the patient presents with a dull aching pain in the groin or over the hip joint [1]. After imaging and histopathological confirmation, the treatment options for pelvic GCTs that have been tried include radiation therapy (RT), surgery with intralesional margin (S[IL]), surgery with an intralesional margin along with RT, surgery with intralesional margin and cryosurgical technique, microwave inactivation of tumor and intralesional curettage, and surgery with wide margin (S[W]). Resection along with appropriate reconstruction with cement/allograft/prosthesis/alloprosthetic composite might be required to fill the created defect [1, 2, 3, 4, 5]. However, due to the anatomic complexity of pelvis with the innominate bones, no single standard treatment is available for the treatment of pelvic GCT, especially the ones involving periacetabular region [1].

Case Report

A 30-year-old male presented to the outpatient clinic with complaints of gradually progressive pain in his right hip for 6 months. The pain was dull aching and non-radiating and causing him a great deal of difficulty in walking. On examination, hip movements were painfully restricted globally. On radiological investigation (Figs. 1-3), he was found to have a lytic lesion in the region 2 of the right acetabulum according to the Enneking and Dunham's classification [6] modified by Sanjay et al. [7]. PET scan revealed no other metabolically active region of uptake in the body. CT-guided needle biopsy revealed features consistent with GCT.

Definitive surgery was done wherein curettage of the lesion was done through the standard posterior Kocher-Langenbeck approach [8]. The bony margins were extended with the use of high-speed burr (MIDAS-Rex) and the use of chemicals (phenol and absolute alcohol). Following tumor tissue removal, the surgical site was washed with copious amounts of hydrogen peroxide and normal saline.

The surgical defect, which was most prominent superior to the acetabular cartilage and with a very thin remaining layer

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Figure 1: AP and iliac views showing lytic lesion in the right acetabulum.

Figure 2: CT scan images confirming the location of lesion.

of subchondral bone, was visualized and measured. Augment trial implants from Revision Acetabular System (Zimmer–Trabecular Metal™ Acetabular Revision System [TMARS]) were used to identify the most appropriate augment size and type under visual and image intensifier guidance. The corresponding TM augment (Zimmer TMARS) was implanted and held in place provisionally with clamps, and secured using 3.5 mm screws through the molded 3.5 mm reconstruction plate after pre-drilling. Standard closure was done over a suction drain.

Postoperatively, the patient was allowed passive and active range of motion at the hip, along with non-weight-bearing walker aided ambulation from day 1. The patient was discharged on the 2nd post-operative day after check X-ray (Fig. 4). The wound healing was uneventful. The patient was followed up at 15 days (for wound inspection and suture removal), 6 weeks (for check X-ray), 3 months (again check X-ray – following which the patient was allowed weight-bearing), 6 months, and thereafter every 6 months. The intraoperative specimen was sent for histopathological examination and confirmed GCT.

The last follow-up was at 5 years post-operative, wherein the patient is asymptomatic, with no activity restrictions, disease free as per clinical (Fig. 5) and radiological examination, with excellent functional scores [9] (Harris Hip Score 90/100).

Discussion

GCTs are also known as "Osteoclastoma" as they are characteristically seen to have multinucleate giant cells on histopathological examination along with two other cell types', that is, round cells – similar to monocytes, and spindle-shaped stromal cells – that resemble fibroblasts. The latter are the proliferative variety and hence responsible for the expansile nature of GCTs.

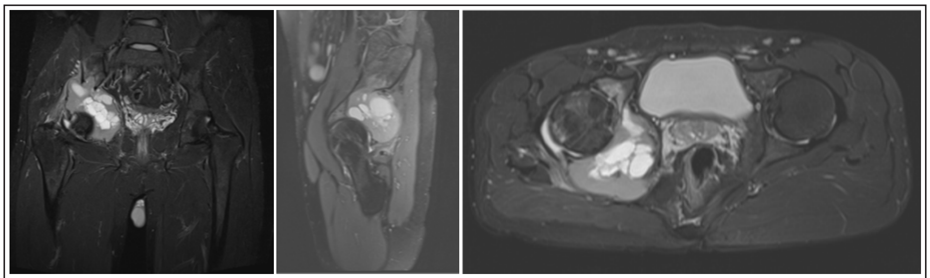

Figure 3: MRI images showing posterosuperior soft-tissue involvement by the tumor.

Figure 4: Post-operative X-rays showing the use of TMARS to reconstruct the acetabular defect.

The patient reported in our case is a young male who presented with gradually progressive pain in his right hip. A patient suffering from long bone GCT generally presents with pain and localized swelling over the involved region, though pelvic GCTs generally have a vague presentation of a dull aching pain in the groin or over the anterior aspect of hip joint which may delay the patient from seeking medical attention [10].

GCTs rarely affect the pelvis. Zheng et al. [11] in one of the largest series reported so far analyzed the data of 29 patients from five centers with pelvic GCTs. The systematic review by Zheng et al. [12] included 119 patients; they even reported a slight female preponderance in the occurrence of pelvis GCT which has been seldom reported in the previous literature due to small sample sizes.

The patient in our report was found to have the tumor localized to region II of pelvis as per the classification system of pelvic tumors locations by Enneking and Dunham [6]. They classified tumor locations into Region I (iliac region), Region II (acetabular region), and Region III (pubic and ischial region).

A GCT on plain X-ray appears like a lytic lesion in the epiphysiometaphyseal region with multiple complete and incomplete septations inside the lesion. CT scan and MRI are also useful diagnostic tools mainly used for staging and planning treatment; CT shows thinning of cortices with septations inside the lesion. MRI appearances of GCTs are high-intensity signals on T2-weighted images, high contrast media enhancements, fluid levels, and signs of hemorrhage and hemosiderin deposition [13].

Other diagnostic aid is cytological evaluation with some recent literature coming up to emphasize the diagnostic value of fine-needle aspiration cytology also [14]. The measurement of serum acid phosphatase helps not only in diagnosis but also in measuring the efficacy of treatment and serves as a marker of possible recurrences [15].

The treatment was decided after taking key factors into consideration, that is, the site and size of lesion, the available modalities, the surgical approach to be used, type of curettage to be carried out, the material to be used for filling up any created defect, and the need for any adjuvant modalities. Various treatments have been tried in the past, each one with its different set of crests and troughs. Even though surgical risks can be avoided using radiotherapy, it can still cause early and late skin changes, pathological fractures, or neuritis [16]; intralesional curettage was reported to be associated with delayed infections, poor wound healing, and loosening of screws/bone cement [3]; in addition to these, patients who underwent cryotherapy/RT along with surgery had non-union as an additional complication [17]. Patients who underwent the above treatment options had almost similar recurrence rates but the least recurrence had been reported with wide resection [18]. The most commonly recommended treatment option for GCTs has been intralesional curettage followed by filling of bone defect with either bone graft or cement. However, it had been found to have recurrence rates of up to 36% [3, 4]. Hence, adjuvant therapies have been used in an attempt to reduce recurrence wherein polymethylmethacrylate (PMMA) cement has been used extensively [19]. It had been used in the management of tubular bone and pelvic defects [20] following GCT excision and also shown to be useful in the management of osseous defects in the foot and ankle [21]. Bone graft had also been used for filling post-excisional defects with allografts been used successfully for treatment of carpal, metacarpal, and phalangeal GCTs of the hand. However, the grafts carried a risk of non-union and secondary collapse due to their avascular properties [22].

In our case, the options of surgical treatment were intralesional excision (curettage – conventional or extended) or extralesional excision (marginal or wide resection) [18]. Extralesional excision would have required sacrificing the weight-bearing aspect of joint with a large amount of bone loss which would be challenging to fill. Options of reconstructing such a defect would require the use of either a saddle prosthesis or a customized pelvic implant/3D printed implant, or a total hip replacement with some form of customized/modular mega-prosthesis; or hip arthrodesis. All these options would have limited the patient's mobility and/or function.

Achieving tumor-free bone was crucial but restoration of function and a good quality of life for the patient was also a priority. Intralesional curettage (which would have involved removal of almost all of the subchondral bone just superior to the cartilage of the involved hip joint in the weight-bearing area) would require filling the defect with biological (autograft/allograft/combined graft with or without graft extenders) material or a non-biological (PMMA cement) material. The drawbacks with all the options are manifold – such as – autograft is only available in limited volume and leaves behind donor site morbidity; with allograft, procurement, uptake/incorporation, infections, and immune reactions are potential hurdles; PMMA cement loosening and late infections are well-known problems themselves [23].

To circumvent all these pitfalls, a new technique of reconstruction of defects using TM augments was thought of using the Zimmer-TMARS.

The thought process behind placement of TMARS in the weight-bearing region supplemented with cancellous bone autograft and plate fixation was not only to provide structural support to the weight-bearing area but also to enable bony ingrowth around the metal. Due to its biomechanical and biocompatible properties, the association of TM cups and augments may prove to be an effective tool in the management of bone defects in acetabular reconstruction as was hypothesized by Grappiolo et al. [24].

TM is a biomaterial made out of tantalum characterized by high 3D porosity (70–80%), high friction, and low modulus of elasticity. It provides primary stability at the time of procedure and allows deep bony in growth, leading to secondary biologic fixation [25].

Figure 5: Clinical pictures showing the patient comfortably squatting and sitting cross-legged with comparable active SLR on both sides.

TM implants offer several advantages, that is, no dearth of availability, good stability similar to bone, low implant cost, and no donor site morbidity [26].

The described treatment options along with our proposed line of treatment were discussed with the patient. In our case, the tumor could have been approached by the anterior or lateral approach which could have provided good exposure to the involved region but an extensile posterior approach would have provided exposure to the soft tissues that were also involved by the tumor. Hence, the posterior surgical approach was used for surgery [8].

To the best of our knowledge, TM has not been previously used in such a scenario but Horisberger et al. [25] have described successful tibia-talus-calcaneal arthrodesis using a TM spacer at the ankle fusion site. Available literature regarding the use of TM cups with or without augments contains studies performed in patients with bone defects ranging from Paprosky Grade IIA to Paprosky Grade IIIB with pelvic discontinuity hence the data arising out of these studies are a non-homogenous population managed with different surgical techniques and cannot be compared [27, 28]. Most of the recurrences have been reported to occur within the first 2 years of treatment [18] but the patient under study in our report remained symptom free at 5 years of follow-up. Although fewer recurrences have been reported with wide resection than with intralesional procedures, the previous literature has shown the local recurrence rates to be reduced when intralesional procedures were combined with an adjuvant procedure [11, 12, 18, 23]. GCTs are otherwise benign tumors but are locally aggressive with a potential for local recurrence and a potential for malignant transformation [29]. The local recurrence rate for pelvic GCTs has also been reported to be higher than other sites probably because of the large sizes that these lesions can attain before becoming clinically symptomatic [27, 30].

The patient under study remained symptom and recurrence free at 5 years of follow-up, with an excellent function as per serial clinical and image examinations.

Conclusion

A novel technique has been described here wherein the bony defect following extended curettage of GCT in the region II of acetabulum was done and the defect was reconstructed using TM augment (TMARS) in a young male with excellent functional results and no evidence of recurrence at 5 years follow-up. To the best of our knowledge, this use of TM augment for the treatment of GCT is the first such report.

References

1. Karpik M. Giant cell tumor (tumor gigantocellularis, osteoclastoma)-epidemiology, diagnosis, treatment. Ortop Traumatol Rehabil 2010;12:207-15.

2. Trieb K, Bitzan P, Lang S, Domikus M, Kotz R. Recurrence of curetted and bone grafted giant-cell tumors with and without adjuvant phenol therapy. Eur J Surg Oncol 2001;27:200-2.

3. Boons HW, Keijser LC, Schreuder HW, Pruszczynski M, Lemmens JA, Veth RP. Oncologic and functional results after treatment of giant cell tumors of bone. Arch Orthop Trauma Surg 2002;122:17-23.

4. Blake SM, Gie GA. Large pelvic giant cell tumor-a case report and a review of current treatment modalities. J Arthroplasty 2004;19:1050-4.

5. Reid R, Banerjee SS, Sciot R. Giant cell tumour. In: Fletcher CD, Unni KK, Mertens F, editors. Pathology and Genetics of Tumors of Soft Tissue and Bone. Lyon, France: IARC Press; 2002. p. 309-13.

6. Enneking WF, Dunham WK. Resection and reconstruction for primary neoplasms involving the innominate bone. J Bone Joint Surg Am 1978;60:731-46.

7. Sanjay BK, Frassica FJ, Frassica DA, Unni KK, McLeod RA, Sim FH. Treatment of Giant cell tumor of the pelvis. J Bone Joint Surg Am 1993;75:1466-75.

8. Moore AT. The Moore self-locking vitallium prosthesis in fresh femoral neck fractures: A new low posterior approach (the southern exposure). In: American Academy of Orthopaedic Surgeons: Instructional Course Lectures. Vol. 16. St. Louis: CV Mosby; 1959.

9. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: Treatment by mold arthroplasty. An end.result study using a new method of result evaluation. J Bone Joint Surg Am 1969;51:737-55.

10. Sung HW, Kuo DP, Shu WP, Chai YB, Liu CC, Li SM. Giant cell tumor of bone: Analysis of two hundred and eight cases in Chinese patients. J Bone Joint Surg 1982;64A:755-61.

11. Zheng K, Yu X, Hu Y, Wang Z, Wu S, Ye Z. Surgical treatment of pelvic giant cell tumor: A multi-center study. World J Surg Oncol 2016;14:104.

12. Zheng K, Wang Z, Wu S, Ye Z, Xu S, Xu M, et al. Giant cell tumor of the pelvis: A systematic review. Orthop Surg 2015;7:102-7.

13. Breitenseher M, Dominkus M, Scharitzer M, Lechner M, Trieb K, Imhof H, et al. Diagnostic imaging of giant cell tumors. Radiologe 2001;41:568.

14. Agarwal S, Agarwal T, Agarwal R, Agarwal PK, Jain UK. Fine needle aspiration of bone tumors. Cancer Detect Prev 2000;24:602-9.

15. Goto T, Lijima T, Kawano H, Yamamoto A, Arai M, Matsuda K, et al. Serum acid phosphatase as a tumour marker in giant cell tumuor of bone. Arch Orthop Trauma Surg 2001;121:411-3.

16. Caudell JJ, Ballo MT, Zagars GK, Lewis VO, Weber KL, Lin PP, et al. Radiotherapy in the management of giant cell tumor of bone. Int J Radiat Oncol Biol Phys 2003;57:158-65.

17. Marcove RC, Weis LD, Vaghiawalla MR, Pearson R. Cryosurgery in the treatment of giant cell tumors of bone: A report of 52 consecutive cases. Clin Orthop Relat Res 1978;134:275-89.

18. Guo W, Sun X, Zang J, Qu H. Intralesional excision versus wide resection for giant cell tumor involving the acetabulum: Which is better? Clin Orthop Relat Res 2012;470:1213-20.

19. Leggon RE, Zlotecki R, Reith J, Scarborough MT. Giant Cell tumor of the pelvis and sacrum: 17 Cases and analysis of the literature. Clin Orthop Relat Res 2004;423:196-207.

20. Labs K, Perka C, Schmidt RG. Treatment of stages 2 and 3 giant cell tumor. Arch Orthop Traum Surg 2001;121:83-6.

21. Thomas JL, Jaffe KA. Use of polymethylmethacrylate in large osseous defects in the foot and ankle following tumor excision. J Foot Ankle Surg 1999;38:208-13.

22. Patradul A, Kitidurmrongsook P, Parkpian V, Ngarmukos C. Allograft replacement in giant cell tumor of the hand. Hand Surg 2001;6:59-65.

23. Meneghini RM, Meyer C, Buckley CA, Hanssen AD, Lewallen DG. Mechanical stability of novel highly porous metal acetabular components in revision total hip arthroplasty. J Arthroplasty 2010;25:337-41.

24. Grappiolo G, Loppini M, Longo UG, Traverso F, Mazziotta G, Denaro V. Trabecular metal augments for the management of paprosky Type III defects without pelvic discontinuity. J Arthroplasty 2015;30:1024-9.

25. Horisberger M, Paul J, Wiewiorski M, Henninger HB, Khalifa MS, Barg A, et al. Commercially available Trabecular metal ankle interpositional spacer for tibiotalocalcaneal arthrodesis secondary to severe bone loss of the ankle. J Foot Ankle Surg 2014;53:383-7.

26. Sporer SM, Paprosky WG. The use of a trabecular metal acetabular component and trabecular metal augment for severe acetabular defects. J Arthroplasty 2006;21 Suppl 6:83-6.

27. Balke M, Streitbuerger A, Budny T, Henrichs M, Gosheger G, Hardes J. Treatment and outcome of giant cell tumors of the pelvis. Acta Orthop 2009;80:590-6.

28. Huang HC, Hu YC, Lun DX, Ma J, Xia Q, Ji J, et al. The clinical application of femoral head exclusion after resection of pelvic tumors around acetabulum. Zhonghua Gu Ke Za Zhi 2011;31:635-9.

29. Mori Y, Tsuchiya H, Karita M, Nonomura A, Nojima T, Tomita K. Malignant transformation of a giant cell tumor 25 years after initial treatment. Clin Orthop Relat Res 2000;381:185-91.

30. Campanacci M, Baldini N, Boriani S, Sudanese A. Giant-cell tumor of bone. J Bone Joint Surg Am 1987;69:106-14.

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