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CASE REPORT

Multidisciplinary Management of Aggressive Giant Cell Tumour of the Mandible Using Denosumab, Virtual Surgical Planning, and Patient-Specific Implants: A Case Report with Myasthenia Gravis Considerations

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Abstract

Introduction This report describes the management of an aggressive mandibular giant cell tumour (GCT) in a 59-year-old male with comorbid myasthenia gravis (MG).

Case Report A multidisciplinary approach incorporating neoadjuvant Denosumab, virtual surgical planning, and patient-specific implants enabled precise tumour resection and reconstruction while minimising anaesthesia-related risks.

Results and Conclusion The use of advanced techniques significantly reduced surgical time and enhanced functional and aesthetic outcomes. This case highlights the feasibility and effectiveness of integrating modern chemotherapeutics and digital technologies in surgically managing complex maxillofacial tumours, particularly in patients with high perioperative risk due to systemic conditions like MG.

Keywords Giant cell tumour · Patient specific implant · Virtual surgical planning · Myasthenia gravis · Denosumab · Craniofacial Tumours

Introduction

Giant cell tumours (GCTs) are common bone tumours, accounting for 4–10% of primary bone tumours and 15–20% of benign variants [1]. They are aggressive and have a high recurrence rate of over 20–50% [2]. The H3F3A gene mutation causes GCTs to express high levels of RANKL, leading to osteolysis and blockage of osteoclast–osteoblast contact, decreasing bone remodelling [3]. Monoclonal antibodies, like Denosumab, can suppress GCTs' aggressive nature. Virtual surgical planning (VSP) and patient-specific implants (PSI) have become increasingly feasible for reconstructing complex craniofacial skeleton deformities, reducing surgical time and hospital stay while increasing surgical accuracy and functionality [4, 5]. This case report highlights the importance of a multidisciplinary approach, including chemotherapy and pre-operative virtual surgical planning and the use of patient-specific implants, to reduce GCT aggressiveness and shorten the surgical time, particularly in patients with myasthenia gravis who are at risk of systemic respiratory failure and obtain optimal surgical outcomes.

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Case Presentation

A 59-year-old male patient with myasthenia gravis (MG) presented with swelling in the left side lower jaw region for six months. He was a known diabetic under medication and history of treatment for MG with Physostigmine 60 mg for four years and Prednisolone 20 mg, which was gradually tapered down to 10 mg with no active symptoms of myasthenia gravis at the time of presentation. The patient presented with gross facial asymmetry and non-tender hard swelling over the left lower third of the face (Fig. 1). Computed tomography revealed an expansile lobulated lesion with internal septations, minimal ground glass matrix, considerable cortical thinning, and cortical breaks in the left mandible. The histological analysis identified the lesion as a giant cell tumour (Fig. 3a).

Due to the patient's medical and anaesthetic risks, a multidisciplinary approach was adopted to avoid additional procedures. Denosumab (120 mg weekly for five weeks) reduced the lesion's size. Virtual surgical planning defined resection margins (Fig. 2a) and enabled the creation of 3D cutting guides and implant positioning (Fig. 2b), facilitating fibula contouring to match mandibular symmetry, occlusion, and future flap orientation at the recipient site.

The surgeon's role in enabling a smooth workflow included precise coordination and planning of surgical timing to earlier in the day, designing and enabling a guided

Fig. 1 Extraoral and intraoral features at the time of first presentation

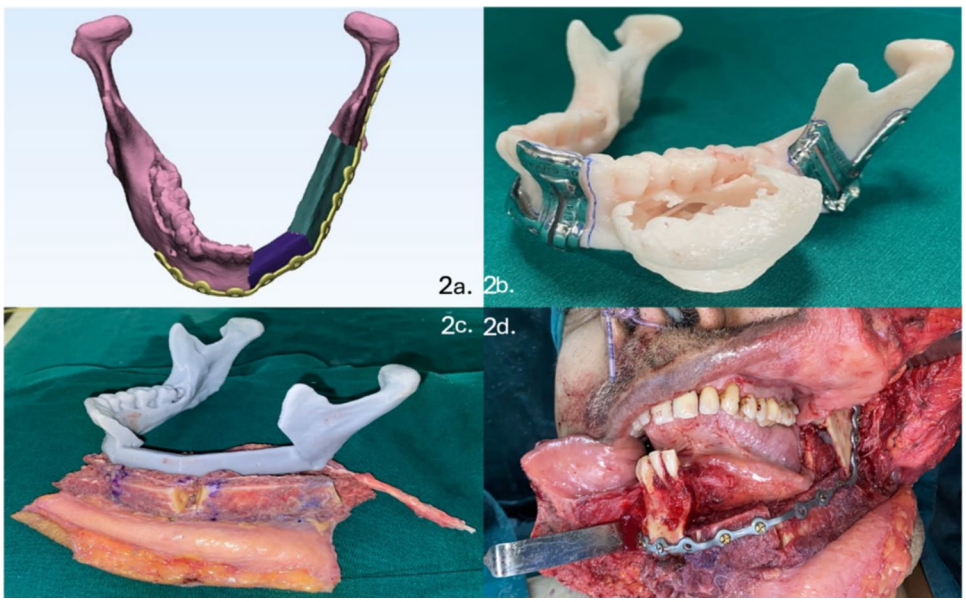

Fig. 2 **a** Virtual surgical planning with the recontoured fibula bone and patient-specific implant in position, maintaining overall symmetry of mandible. **b** Cutting guides fabricated for resection of tumour with position screws that align with the implant screw sites. **c** Contoured harvested fibula bone and pedicle and oriented according to the model guides. **d** Fixation of the contoured fibula bone onto the resected mandible using the patient-specific implant

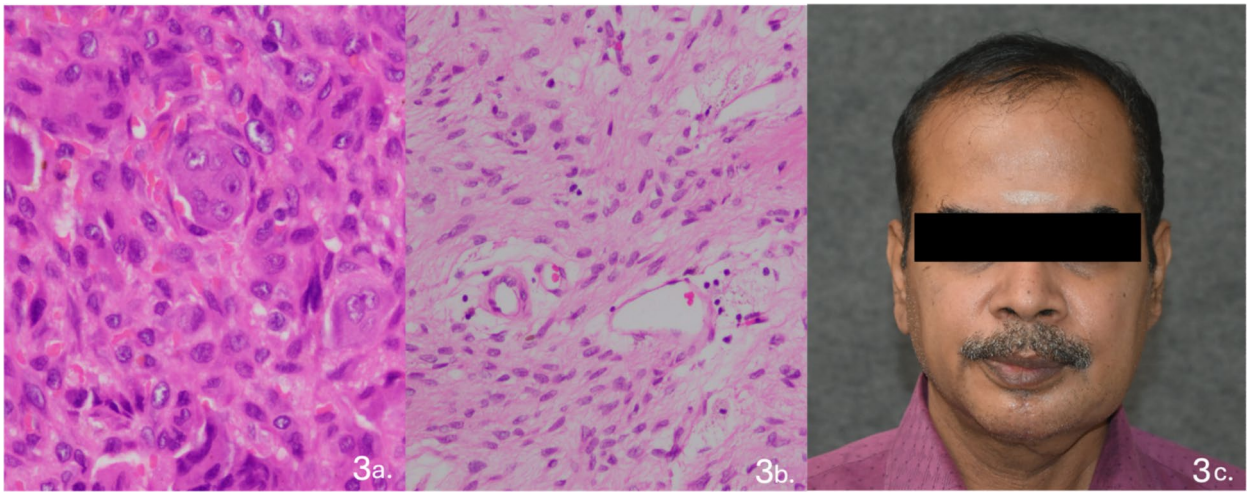

Fig. 3 **a** Histopathology image prior to Denosumab course showing multiple giant cells. **b** Histopathology image after Denosumab therapy showing scarce giant cells. **c** Post-operative extraoral image of the patient following resection and reconstruction

resection with VSP and cutting guides with neck dissection of 1a and 1b regions, marking of implant screw sites (Fig. 2b), contouring the harvested fibula (Fig. 2c), and reconstruction with PSI. A single reactive lymph node and favourable characteristic changes related to post-Denosumab treatment were observed histologically (Fig. 3b). The use of PSI enabled expedited insertion of the harvested and contoured fibula flap inset and decreased total anaesthesia time while also achieving optimal occlusion and symmetry of the reconstructed mandible (Fig. 3c) with good margins from the tumour.

Discussion

Giant cell tumours (GCTs) account for just 2% of head and neck tumours but are aggressive and may metastasise to the lungs [6]. Surgery is the mainstay of treatment, with recurrence rates ranging from 70% for curettage to 7% for wide resection. Neoadjuvant therapies like Denosumab, which target the RANK/RANKL/OPG pathway, reduce tumour aggressiveness by inhibiting osteoclast activity and promoting osteogenesis in stromal cells. However, while Denosumab improves surgical outcomes, it does not lower recurrence rates or support conservative treatment alone [7]. Anaesthetic planning is crucial for patients with musculoskeletal conditions such as myasthenia gravis (MG), who are at risk of post-operative respiratory failure and benefit from shorter, well-planned surgeries [8]. These patients exhibit heightened sensitivity to muscle relaxants due to reduced functional AChRs, necessitating pre-operative respiratory assessment [9]. Freehand surgical techniques are often subjective and error-prone. In contrast, virtual surgical planning (VSP) and patient-specific implants (PSIs) improve accuracy, reduce operative time, and support complex reconstructions. Together, VSP and PSI reduce surgical time, minimise neuromuscular blockade, lower the risk of post-operative myasthenic crisis (POMC) and reduce ICU stays and total hospital stays [4, 10]. However, the report's single-case nature and the high cost and limited accessibility of VSP and PSIs restrict widespread adoption, despite their advantages for patients with MG, other comorbidities, and precise with optimised results for reconstruction in general.

Conclusion

Large aggressive jaw tumours require resection and restoration using osteocutaneous free flaps. Treatment can be challenging due to underlying medical conditions. Modern concepts, like VSP, PSI, and advanced chemotherapy, help control tumours and achieve successful results in a shorter surgical time. This multidisciplinary approach can be generalised successfully for optimal results.

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Declarations

Conflict of interest None.

References:

1. Eckardt JJ, Grogan TJ (1986) Giant cell tumor of bone. Clin Orthop Relat Res 204:45–58

2. Sobti A, Agrawal P, Agarwala S, Agarwal M (2016) Giant cell tumor of bone: an overview. Arch Bone Jt Surg 4(1):2–9
3. Behjati S, Tarpey PS, Presneau N, Scheipl S, Pillay N, Van Loo P et al (2013) Distinct H3F3A and H3F3B driver mutations define chondroblastoma and giant cell tumor of bone. Nat Genet 45(12):1479–1482
4. Chang EI, Jenkins MP, Patel SA, Topham NS (2016) Long-term operative outcomes of preoperative computed tomography-guided virtual surgical planning for osteocutaneous free flap mandible reconstruction. Plast Reconstr Surg 137(2):619–623
5. Wilde F, Hanken H, Probst F, Schramm A, Heiland M, Cornelius CP (2015) Multicenter study on the use of patient-specific CAD/CAM reconstruction plates for mandibular reconstruction. Int J Comput Assist Radiol Surg 10(12):2035–2051
6. Silvers AR, Som PM, Brandwein M, Chong JL, Shah D (1996) The role of imaging in the diagnosis of giant cell tumor of the skull base. AJNR Am J Neuroradiol 17(7):1392–1395
7. Chawla S, Henshaw R, Seeger L, Choy E, Blay JY, Ferrari S et al (2013) Safety and efficacy of denosumab for adults and skeletally mature adolescents with giant cell tumour of bone: interim analysis of an open-label, parallel-group, phase 2 study. Lancet Oncol 14(9):901–908
8. Blichfeldt-Lauridsen L, Hansen BD (2012) Anesthesia and myasthenia gravis. Acta Anaesthesiol Scand 56(1):17–22
9. Churchill-Davidson HC, Richardson AT (1953) Neuromuscular transmission in myasthenia gravis. J Physiol 122(2):252–263
10. Jiao P, Wu F, Liu Y, Wu J, Sun Y, Tian W et al (2023) Analysis of influencing factors of postoperative myasthenic crisis in 564 patients with myasthenia gravis in a single center. Thorac Cancer 14(5):517–523