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Case Report

Reconstruction of mandibular defect with extended temporomandibular joint prosthesis: a case report

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ABSTRACT

Mandibular defects resulting from tumor resection or traumatic injuries can lead to considerable functional and aesthetic limitations on the patients. These defects disrupt a range of mandibular functions, primarily compromising mastication by impeding the mandible ability to form a stable opposition to the maxilla. Furthermore, it affects speech, swallowing, breathing, and alters lower facial contour which negatively changes facial aesthetics. Extended temporomandibular joint reconstruction (eTMJR) presents a helpful surgical modality in such complex presentations with significant bony involvement. This technique surpasses the limitations of conventional TMJ reconstruction by including the reconstruction of concomitant mandibular and/or temporal bone abnormalities. This case report is for a 42-year-old male who underwent extended total mandibular joint replacement surgery to address a significant left mandibular defect extending to the midline. Preoperative planning incorporated advanced techniques involving 3D printing, digital planning, and surgical guidance. The patient received a transitional removable partial denture to replace missing teeth and to achieve the planned occlusion intraoperatively. At the six-month follow-up, the patient demonstrated outstanding clinical outcomes.

Keywords: Temporomandibular joint, Extended temporomandibular joint reconstruction, Alloplastic reconstruction, Mandibular defect

INTRODUCTION

Mandibular defects arising from tumor resection or traumatic injuries can lead to considerable functional and aesthetic limitations on the patients.[1] These defects disrupt a range of mandibular functions, primarily compromising mastication by impeding the mandible ability to form a stable opposition to the maxilla. Furthermore, they affect speech, swallowing, breathing, and alter lower facial contour, which negatively changes facial aesthetics. They are typically classified according to their anatomical location and extent.[2] The Jewer classification system categorizes mandibular defects based on location and complexity of reconstruction. "C" defects involve the central jaw with both canines, "L" defects are lateral segments without condyle involvement, and "H" defects include hemimandiblectomy.[3] Reconstructing large, complex mandibular defects requires a customized approach to restore both form and function. Choosing the optimal technique for consistent, successful outcomes remains a challenge.[1] However, when the defect incorporates the TMJ, it necessitates combined reconstruction of the mandibular segment and joint articulation. Several surgical techniques using autogenous tissues or alloplastic materials have been described. Vascularized bone grafts, particularly the fibula-free flaps represent the gold standard due to their wide applicability, moreover, they offer the additional benefit of facilitating the reconstruction of extensive mandibular defects.[4] Despite their widespread use in mandibular reconstruction, free fibula flaps demonstrate susceptibility to failure, mainly attributable to thrombotic

complications in the supplying vasculature. An analysis of 129 patients undergoing fibula-free flap reconstruction for mandibular and maxillary defects revealed a complete flap failure rate of 12.4% and a partial failure rate of 7.8%. Notably, venous thrombosis manifested as the primary etiological factor.[5] On the other hand, non-vascularized bone grafts, such as costochondral grafts (CCGs), were initially recommended for the reconstruction of pediatric TMJ due to their growth potential and anatomical resemblance to the TMJ. However, their unpredictable growth patterns have become a remarkable drawback, potentially leading to future additional reparatory procedures. Moreover, Immediate placement of dental implants is not attainable.[6] The evolution of alloplastic patient-specific extended total TMJ reconstruction (eTMJR) prostheses, facilitated by virtual surgical planning (VSP), represents an impressive advancement in TMJ reconstruction.[7] This innovative approach overcomes the limitations of other techniques by enabling the creation of custom-made implants that precisely replicate articular components and reconstruct the entire TMJ complex including mandibular, temporal, and zygomatic defects.[8] Furthermore, it eliminates donor site morbidity and can be completed in a shorter timeframe compared to procedures requiring donor site harvest, leading to reduced operative time.[9] Overall, VSP-driven eTMJR prostheses hold promise for achieving optimal aesthetic and functional outcomes in patients with complex TMJ and craniofacial defects. We report the first case in Saudi Arabia of a patient treated with extended total mandibular joint reconstruction prosthesis.

CASE REPORT

A 42-year-old Saudi male presented to our department of maxillofacial surgery at dental university hospital in Riyadh, Saudi Arabia, seeking mandibular reconstruction following resection of a left mandibular ameloblastoma extending to the ipsilateral mental foramen. The patient's mandibular defect reconstruction necessitated a multi-stage surgical approach due to subsequent complications. Initially, a reconstruction using reconstruction plates was attempted. However, these plates eventually fractured, necessitating a secondary surgical intervention. To achieve a more durable reconstruction, a vascularized free fibula flap was carried out during the second surgery. Unfortunately, this approach suffered from anastomosis challenges, compromising the flap and prompting a tertiary intervention for salvage. Despite these efforts, the salvage attempt was unsuccessful, and ultimately, flap exploration was required. All Previous surgical interventions were performed at a different institution before the patient was referred to our clinic. Clinical findings revealed severe facial deformity on the left side. The occlusion was not reproducible, and the centric relation could not be obtained without assistance. The patient was suffering from severe pain and clicking related to the right TMJ. Radiographical examination revealed a major mandibular defect on the left side of the mandible extending beyond the mental foramen (Figure 1) with early signs of osteoarthritis on the right side of the TMJ due to chronic overload. The patient demonstrated sequelae of prior surgical interventions, including depression and malnutrition, attributed to compromised masticatory function and facial aesthetics. Following a comprehensive evaluation, the patient provided informed consent for mandibular reconstruction via implantation of a custom-fabricated prosthetic joint.

Figure 1: Panoramic radiograph at the time of presentation.

Pre-surgical planning

With the help of VSP, the dimensions and the extent of the prosthetic condyle were made to restore the functional and esthetic defects. Upper and lower removal partial dentures were made to create vertical support and to re-produce a stable centric relation during the fixation (Figure 2).

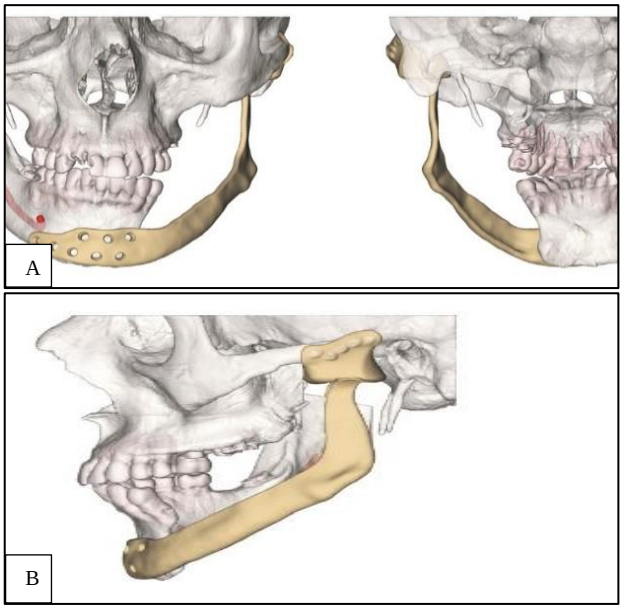

Figure 2 (A and B): Definitive computer assisted design of prosthetic framework.

Surgical phase

The patient was brought to the operating room, awake and oriented in a supine position, monitors were connected, general anesthesia was induced, and intubation was performed. Furthermore, the patient was prepared and draped in a sterile manner exposing the face, the preauricular area, and the neck bilaterally. The ear was plugged with a cotton gauze peanut. Mouth and nose were covered and shut with an Ioban sheet. Moreover, surgical marking was done. The preauricular area was approached by endural incision, then subcutaneous dissection was done to the temporoparietal fascia, then temporalis fascia through the avascular plane, and then continued down to the joint capsule. Afterward, the zygomatic arch was identified and subperiosteal dissection was done to protect the temporal branch of the facial nerve. The retromandibular area was approached by an incision through the skin, subcutaneous, and then subplatysmal dissection reaching the pterygomandibular sling to reestablish the envelope for the condylar prosthesis. Tunneling was done to have communication with the two incisions for prosthesis installation. One of the challenging steps intraoperatively was the severe scarring and fibrosis involving all the anatomical layers due to the multiple re-operations. Furthermore, the fossa was debrided, and all soft tissues were removed. The native mandible was exposed to the contralateral mental foramen to provide enough room for the extended condyle prosthesis fixation. After that, the surgical incisions were covered in a sterile manner, then the upper and lower arch bars were secured to the remaining teeth. Furthermore, the upper and lower removable partial dentures were inserted to reestablish the vertical support and the centric relation and secured by intermaxillary fixation (Figure 3).

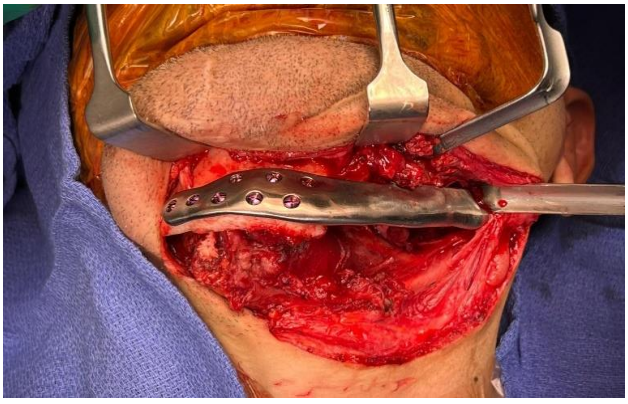

Figure 3: Intraoperative photograph with the framework in place.

Subsequently, the patient was prepared and draped again in a sterile manner. The preauricular and retromandibular areas were irrigated with gentamycin then the templates of the mandibular fossa and the condylar prosthesis were tried to confirm the adaptation and the position of the definitive prosthesis. Initially, the mandibular fossa was fixated to the temporal bone then the extended condylar prosthesis was rigidly fixated to the native mandible. Afterwards, the surgical site was closed with Vicryl 4.0 in a layered fashion, and monocryl 5.0 was used to close the skin. A postoperative lateral cephalometric radiograph obtained following the surgery confirmed the appropriate placement of the extended condylar prosthesis (Figure 4).

Figure 4: Postoperative lateral cephalometric radiograph with the framework in its place.

After 24 hours in the intensive care unit, the patient was extubated and shifted to the general ward for 6 days then discharged home after a total hospital course of 7 days in a stable condition.

Post-surgical patient rehabilitation

Postoperatively, the patient underwent physical rehabilitation to improve the facial nerve weakness which was present because of the previous surgeries. In addition, dental rehabilitation via the fabrication of a removable partial denture for the replacement of missing dentition on the left upper and lower quadrants (Figure 5 and 6).

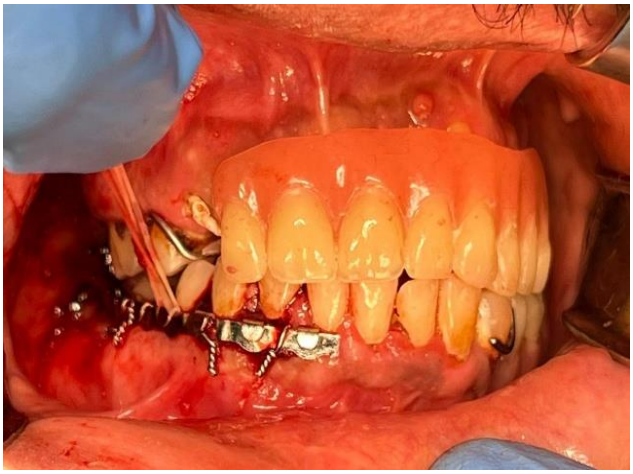

Figure 5: Intraoperative view of the replaced teeth.

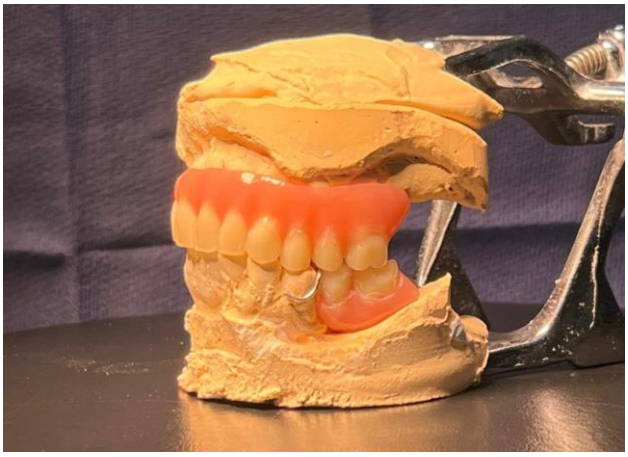

Figure 6: Removable partial denture replacing the teeth in the resected area.

At the six-month follow-up, the patient's results were outstanding. The surgical sites had healed effectively and demonstrated ideal stability. The mouth opening improved and extended up to 36 mm.

DISCUSSION

Mandibular defects involving the condyle present a significant reconstructive challenge. While techniques like condylar plating on the recipient bone segment, fibular bone sculpting for adaptation, and subsequent fixation to the residual joint capsule and disc offer potential solutions, these approaches are often limited by the substantial risk of secondary ankylosis arising from heterotopic ossification. This sequela can lead to a significant decline in functional capacity and a marked restriction in mandibular mobility.[10] Extended total temporomandibular joint reconstruction procedures offer a compelling treatment option for such cases. These procedures boast a high success rate, effectively restore aesthetics and precisely reconstruct the complex anatomy of the affected area.[11,12] A study by Khattak et al for 27 case reports and series investigating the use of extended total temporomandibular joint reconstruction (eTMJR) prostheses. Among these patients, 11 were presented with ameloblastoma and underwent eTMJR. The age range spanned from 14-72 years, and the follow-up period varied between 4-84 months. Preoperative and postoperative comparisons revealed significant improvements in multiple parameters, including maximal incisal opening, pain levels, occlusion, dietary, and facial symmetry. Additionally, the aesthetic outcomes were reported as satisfactory.[8] Following the resection of left mandibular ameloblastoma, our patient exhibited a bony defect encompassing the glenoid fossa and condylar/ramus region. This defect resulted in altered TMJ mechanics, manifesting as a deviation of the mandible towards the left side during opening and malocclusion. Reconstruction of the defect with extended total mandibular joint reconstruction (eTMJR) prosthesis was undertaken to restore both function and aesthetic. A study by Alba et al has demonstrated the usefulness of eTJR prostheses in patients with ameloblastoma treated with segmental resection and subsequent reconstruction with custom-made total joint replacement.[13] Furthermore, the use of CAD-CAM 3D-printed devices made it possible to reproduce the resected segments. The alloplastic custom-made device was fabricated and fixed into position with titanium alloy screws.[14] A retrospective study done by Ho-Kyung et al summarized that instead of using autogenous bone for mandibular and zygomatic repair, a 3D-printed titanium implant could be utilized effectively without inducing donor site morbidity.[15] To the best of our knowledge, a surgical rehabilitation of this kind has never been performed in Saudi Arabia. The surgical rehabilitation of the left TMJ was carried out using the Zimmer-Biomet Micro-fixation (Zimmer Biomet 3i, Jacksonville, FL, USA) system reconstruction device. A retrospective cohort study done by Alero et al in a total of 33 patients concluded that patients treated with the Zimmer Biomet micro-fixation patient-matched TMJ prosthesis have experienced improvements in pain, maximum interincisal opening, and the ability to masticate.[16]

CONCLUSION

Additionally, prosthodontic rehabilitation involved the fabrication of removable partial dentures to replace the missing teeth and associated structures. The patient is being followed up biannually for close monitoring and to assess long-term maintenance of the results.

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