Total Customized Alloplastic Reconstruction for Treatment of Severe Temporomandibular Joint Pathologic Conditions: A Case Series of Combined Intraoral and Extraoral Approach

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Abstract: Temporomandibular joint (TMJ) reconstruction with customized alloplastic implants has become a safe and effective treatment option of TMJ end-stage pathology with excellent outcomes reported in the literature. The purpose of this study is to report 5 cases of severe TMJ pathology and customized alloplastic reconstruction using a combined intraoral approach and extraoral approach. Four patients with TMJ involved for benign tumor and one patient with severe TMJ resorption were enrolled. Compromised joints were replaced with customized prosthesis under general anesthesia using an association of intraoral approach/extraoral approach. An implant handpiece with adapted drills for bone drilling and the insertion of screws was used to fixate the mandibular component intraorally; the fossa component was inserted via preauricular approach. The hemimandibulectomies/codilectomy with safety margin were successfully performed and for 2 patients Orthognathic Surgery was also required. Follow-up period was from 15 to 28 months (average 22 months), with no history of surgical site infection or damage to the prostheses. Occlusal relationship and function, as well as facial symmetry were kept stable in all patients. The combination of an intraoral and extraoral approach for total TMJ replacement with customized prosthesis may be an alternative and reliable strategy for pathologic reconstruction, keeping function and reducing aesthetic damage.

Key Words: Orthognathic surgery, TMJ pathology, TMJ prosthesis, TMJ reconstruction

Alloplastic temporomandibular joint (TMJ) replacement has been considered an enormous surgical success in TMJ surgery in recent years since numerous long-term studies have demonstrated not only their predictability and durability, but also their clinical gains.[1] The presently available alloplastic devices (mandibular component condylar head with ultrahigh molecular weight polyethylene fossa) have been documented to be a safe and effective option for the management of end-stage TMJ pathology for over 2 decades.[2–6]

At the time of this writing, alloplastic joint devices are indicated for terminal TMJ pathologies such as bony or fibrous ankylosis, congenital disorders, avascular necrosis, severe inflammatory and degenerative TMJ diseases, and tumors requiring extensive resection.[3,4] These TMJ pathologies can occur unilaterally or bilaterally and are often associated with dentofacial deformities, malocclusion, TMJ and myofascial pain, headaches, and ear symptoms, what leads to TMJ and jaw functional impairment.[7]

Reconstruction of TMJ is a complex surgical procedure and it entails improved mandibular form and function, reduction of pain and disability, containment of excessive treatment and cost as well as the prevention of further morbidity.[2] The surgical technique to be used and the selection of proper alloplastic devices is of utmost importance to accomplish these goals. To standardize communication and help clinicians in decision-making process, Elledge et al[8] proposed a classification system to extended TMJ reconstruction. Considering the extension of the fossa and mandibular components, authors classified TMJ replacement based on the design of alloplastic devices.[8]

Regularly, TMJ is approached via an endaural or a preauricular incision, and the mandibular ramus is approached via a submandibular incision.[7] Surgical techniques evolved over time and the use of customized devices and virtual assisted surgery allowed surgeons to perform more accurate and less invasive surgical procedures. Intraoral approaches have been previously described to install reconstruction plates after tumor excision successfully, avoiding damage to the marginal mandibular branch of the facial nerve, preventing the formation of external scars, and minimizing the plate's risk of transcutaneous exposure. Besides, it allows for direct visualization and confirmation of the desired occlusion during fixation.[9]

The purpose of this study is to report 5 cases of TMJ end-stage pathology treated with customized alloplastic prothesis via a combined intraoral approach (IA) and extraoral approach.

CASE SERIES AND SURGICAL TECHNIQUE

Ethics committee approval was obtained, and written consent was provided. The study protocol adhered to the principles of the Helsinki Declaration.

Unilateral Alloplastic Temporomandibular Joint Reconstruction

A total of 3 cases of benign tumor and unilateral TMJ alloplastic reconstruction were enrolled in this study (Supplementary Digital Content, Table 1, http://links.lww.com/SCS/D112). An incisional biopsy to confirm pathology diagnosis was performed in all cases. Due to the large extension and characteristics of the lesions, as well as the joint damage, total tumor/cist resection and immediate

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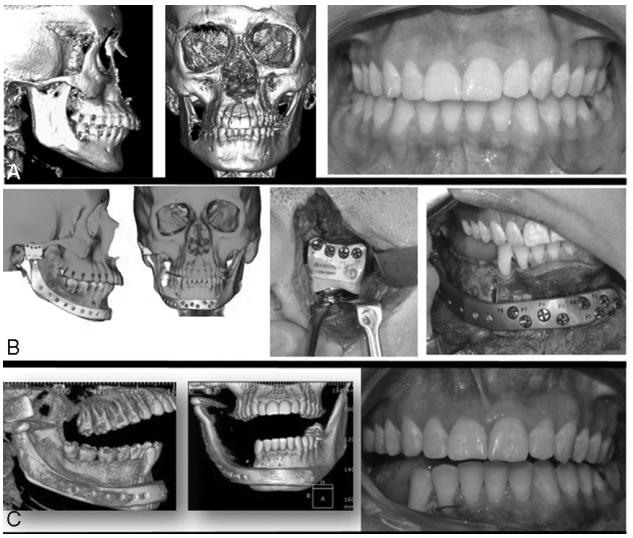

FIGURE 1. Unilateral alloplastic TMJ reconstruction after tumor resection. (A) Preoperative frontal and lateral views of the CBCT reconstructions, as well as occlusal view. (B) Surgical virtual planning for TMJ reconstruction using a customized device, intraoperative views of prosthesis installation. (C) Postoperative frontal and lateral views of the CBCT reconstruction and occlusal view at a week follow-up. TMJ, temporomandibular joint.

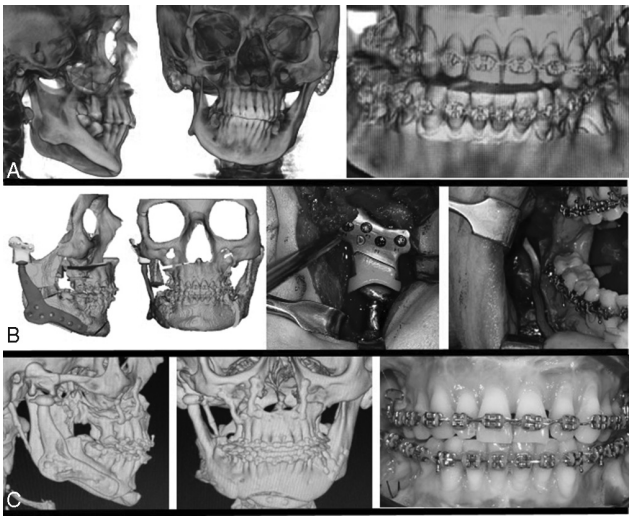

FIGURE 2. Unilateral alloplastic TMJ reconstruction and orthognathic surgery after right condylar resection. (A) Preoperative frontal and lateral views of the CBCT reconstructions, as well as reconstructed occlusal view. (B) Surgical virtual planning for TMJ reconstruction using a customized device, intraoperative views of prosthesis installation. (C) Postoperative frontal and lateral views of the CBCT reconstruction and final occlusion at a week and 6 months follow-up, respectively. TMJ, temporomandibular joint.

rehabilitation with a customized unilateral TMJ prosthesis was planned for all the 3 cases (Engimplan Medical Devices) (Patient 1: Fig. 1A). Surgery was performed under general anesthesia and intravenous antibiotic prophylaxis with 2 g Cefazolin was performed 1 hour before incision. A preauricular approach was made to access and install the TMJ fossa components; exchange of surgical instruments and dressing were performed before intraoral approach. Patients were put into occlusion and intermaxillary fixation was performed with screws and steel wires. Resections were performed according to lesion extension and the mandibular component of TMJ prosthesis was installed through an IA[9] (Patient 1: Fig. 1B). Occlusion and mouth opening were check in the operating room, confirming the adaptation of the prosthesis. Abundant irrigation was performed with a mixture of 100 mL saline solution plus 40 mg gentamycin before wound closure, which was performed in layers, with anchoring of the periosteum in the mandibular component; no intraoral drain was installed. Postoperatively, patients received intravenous cefazolin 1 g every 8 hours combined with anti-inflammatory therapy during hospital admission and were discharged 72 hours after surgery. After discharge, antibiotic therapy with 500 mg was continued 4 times daily, for 6 days.

Seven days after surgery, patients presented without significant motor nerve impairment, satisfactory mouth opening and very stable occlusions. Cone beam computed tomographs (CBCTs) confirmed good prosthesis adaptations after 6 months follow-up (Patient 1: Fig. 1C).

Bilateral Alloplastic Temporomandibular Joint Reconstruction and Orthognathic Surgery

A total of 2 cases of unilateral and bilateral TMJ alloplastic reconstruction and orthognathic surgery were enrolled in this study (Supplementary Digital Content, Table 2, http://links.lww.com/SCS/D112). Resection of compromised condyles and immediate rehabilitation with a customized bilateral TMJ prosthesis was planned (Engimplan Medical Devices), as well as maxillary Le Fort I osteotomy to correct the underlying dentofacial deformity (Patient 5: Fig. 2A). Surgery was performed under general anesthesia and intravenous antibiotic prophylaxis with 2 g Cefazolin was performed 1 hour before incision. A preauricular approach was done to access and install the TMJ fossa components; exchange of surgical instruments and dressing were performed before intraoral approaches. The patient was put into occlusion guided by the intermediate surgical splint generated by the orthognathic surgery virtual planning. Condyles and coronoid process were resected bilaterally and the mandibular components of TMJ prosthesis were installed through an IA[10] (Patient 5: Fig. 2B). Maxillary surgeries were performed through Le Fort I osteotomies and patients were put into occlusion guided by the final surgical splint. Maxillary fixation was performed with 4 L-shape plates and screws. Occlusion and mouth opening were checked in the operating room, confirming the adaptation of the prosthesis. Abundant irrigation was performed with a mixture of 100 mL saline solution plus 40 mg gentamycin before wound closure, which was performed in layers, with anchoring of the periosteum in the mandibular component; no intraoral drain was installed. Postoperatively, patients received intravenous cefazolin 1 g every 8 hours combined with anti-inflammatory therapy during hospital admission and were discharged 72 hours after surgery. After discharge, antibiotic therapy with 500 mg was continued 4 times daily, for 6 days.

At the first week follow-up, patients presented without significant motor nerve impairment, satisfactory mouth opening and stable occlusions. At 6 months follow-up, CBCTs showed a very good prosthesis adaptation (Patient 5: Fig. 2C).

DISCUSSION

Benefits of using custom made TMJ prosthesis based on orthopedic and biomechanical principles are widely known.[1,2,11] It has been proven to be a safe and efficient option when the patient presents a wide range of severe temporomandibular disorders.[11]

From a biomechanical point of view, unilateral reconstructions do not harm the contralateral joint, as long as it is healthy and has not undergone any surgical intervention.[5,12,13] Similarly, reports of stable occlusion and facial aesthetics suggests that simultaneous orthognathic surgery does not seem to overload jaw function,

confirming that TMJ reconstruction can withstand the reactive forces generated by a mandibular repositioning.[2,4,11] The precise fit of computer-generated custom implants reduces the chance of micromovement under loading, with less stress on fixation systems, thus increasing the lifespan of the implants themselves.[4,11] From a clinical point of view, it has important advantages over other reconstruction options, such as autogenous reconstruction or distraction osteogenesis. Customized devices allow immediate jaw function, low risk of re-ankylosis, no need for a secondary donor site, 1-stage procedure, decreased surgery time and mimic normal anatomy.[6,14,15]

Nonetheless, there are some limitations of TMJ reconstruction with alloplastic prosthesis and many of the potential concerns are related to surgical site infection (SSI) even when conventional extraoral approaches are performed.[4,16] Surgical site infection risk depends on several intrinsic and extrinsic patient-related factors, including preexisting medical conditions, amount and type of resident skin bacteria, nutritional factors, systemic disease, and habits.[15,17] Mercuri and Psutka[18] in a recent retrospective survey of 2476 TMJ alloplastic TJR cases involving 3368 joints reported 51 SSI cases (1.51%) occurring in that cohort over a mean of 6 months postoperatively (range, 2 weeks to 12 years). Of the devices, 32 (0.95%) required removal and/or replacement. Similarly, Wolford et al[17] presented a retrospective review of 579 TJR over a 12-year period and reported an overall infection rate 1.6% (9/579 prostheses). They found that the oral flora was the primary cause of the acute infections (occurring within 24 days of initial surgery) and the skin flora was the primary cause of delayed infections (occurring at >24 days after initial surgery). Their findings are in accordance with those reported by McKenzie and Louis,[19] who reported in their retrospective study that the majority of TMJ prosthesis infections were due to biofilm formation by normal skin flora at the time of prosthesis placement.

The IA is an alternative to the retromandibular/transparotid approach to install the mandibular component of TMJ replacement devices. Its usage to treat noncomminuted mandibular fractures and to install reconstruction plates are well reported in the literature resulting in no external scarring, lower risk for injury to the facial nerve and parotid gland.[9,20,21] However, it is expected to increase infection rates, since devices will be exposed to oral bacteria during installation.

Many protocols have been advocated to reduce the risk of TMJ replacement SSI infections.[15,17,19] Systemic intravenous antibiotic prophylaxis reduces the risk of postoperative infections when performed within 1 hour before surgical incision.[15] Broad spectrum antibiotics such as cefazolin, clindamycin, and cephalosporins are the most used preoperative antibiotics based on their good efficacy against staphylococcal species and uropathogens.[15,17,19] The antibiotics should be continued for 7 to 10 days postoperatively, especially for the high-risk patients.[15,17–19] Irrigation with an antibiotic solution before and after implantation of the device components may also provide some assistance in decreasing the potential for local contamination.[15,18] The antibiotic protocol used in the 5 reported cases included prophylactic and postoperative intravenous cefazolin, combined with oral cephalexin after hospital discharge; in addition, copious irrigation of wounds with saline solution plus gentamycin was performed, which resulted in no case of postoperative SSI infection.

The presented cases of benign tumor and severe condylar resorption represent indications of TMJ reconstruction with alloplastic prosthesis and the technical modification to install mandibular components seemed be safe and effective, despite the limited number of cases reported in this study. Customized implants associated with virtual planning allowed safer and easier surgery, decreasing surgical time and improving functional and aesthetics results. Yet, authors emphasize that appropriate selection of patients with careful diagnosis is critical to minimize the risk of TMJ prosthesis failure and postoperative complications.

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