



Total Mandibular Joint Replacement as a Treatment Modality for Temporomandibular Joint Disorders: A Case Report

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ARTICLE INFO

Article Type: Case Report

Received: 10 April 2024

Revised: 18 August 2024

Accepted: 2 September 2024

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ABSTRACT

Temporomandibular Joints (TMJ) is a bilateral fibrocartilage joint. This joint is unique in that it is a bilateral joint that functions as one unit. As with the other joints, many conditions affect TMJ causing It not to do its tasks. These conditions are ankylosis, arthritis, trauma, congenital abnormalities, pathologic diseases, and chronic dislocation. Although as a rule less is often best in treating Temporomandibular disorder (TMD) sometimes it is necessary to use invasive modalities. Total mandibular joint replacement (TMJR) is one of them that has been in use since 1963 and has been developed since. It is used in End-stage TMJ diseases resulting in anatomical architectural form distortion and physiological dysfunction dictates the need for reconstruction. Although nowadays the use of TMJ prosthesis is popular, sometimes it has catastrophic results due to its complications. If there is no indication, this method may cause legal issues. This article provides an overview of the clinical indications and contraindications associated with the TMJR and outcomes for our custom TMJ prosthesis cases are presented.

Keywords: Temporomandibular joint replacement; Indication; Contraindication; Total joint, ankylosis; Degenerative joint disease.

Please cite this Article as:

Fallahi Motlagh M, Taghi Kiani M, Seyed Ashrafi MM, Fallahi Motlagh F. Total Mandibular Joint Replacement as a Treatment Modality for Temporomandibular Joint Disorders: A Case Report. J Craniomaxillofac Res 2024; 11(4): 249-257. DOI: [10.18502/jcr.v11i4.18713](https://doi.org/10.18502/jcr.v11i4.18713)



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Introduction

Temporomandibular Joints (TMJ) is a bilateral fibrocartilage joint. This joint is unique in that it is a bilateral joint that functions as one unit [1]. As with the other joints, many conditions affect TMJ causing it not to do its tasks. These conditions are ankylosis, arthritis, trauma, congenital abnormalities, pathologic diseases, and chronic dislocation. Although as a rule less is often best in treating Temporomandibular disorder (TMD) sometimes it is necessary to use invasive modalities [2]. Total mandibular joint replacement (TMJR) is one of them that has been in use since 1963 and has been developed since [3]. It is used in End-stage TMJ diseases resulting in anatomical architectural form distortion and physiological dysfunction, which dictates the need for reconstruction. Although nowadays the use of TMJ prosthesis is popular, sometimes it has catastrophic results due to its complications. If there is no indication, this method may cause legal issues. This article provides an overview of the clinical indications and contraindications associated with the TMJR and outcomes for our custom TMJ prosthesis cases are presented.

Indications

In general, TMJR is indicated when severe anatomical changes occur in the TMJ, which causes serious functional and aesthetic problems [4]. These problems include Ankylosis, arthritis, trauma, congenital malformations, chronic dislocation, and previous TMJ prosthetic failure.

Ankylosis: Temporomandibular joint ankylosis is defined as bony or fibrous adhesion of the anatomic joint components accompanied by a limitation in opening the mouth, causing difficulties with mastication, speaking, and oral hygiene as well as inadvertently influencing mandibular growth. According to Kazanjian's, classification it is divided into extracapsular (false ankylosis) and intracapsular (true ankylosis) [5]. The most common causes of TMJ ankylosis are trauma and infection. Infection occurring in the joint commonly occurs due to the spread of otitis media or mastoiditis or from the hematogenous route. Other etiological factors are tumors, degenerative diseases, intraarticular injection of corticosteroids, forceps delivery, and complications of previous TMJ surgery [6]. The goals of management in TMJ Ankylosis are resection, reconstruction, and rehabilitation. There are various modalities of treatment for TMJ ankylosis as gap arthroplasty, high condylectomy, condylectomy, and reconstruction with costochondral

graft [7]. Condylectomy with costochondral graft is a gold standard in treating ankylosis before adulthood [8]. Condylectomy and reconstruction with TMJ prosthesis is an option for treating ankylosis in adults [9]. With the available evidence and distinct advantages of TMJR, it appears to have become the gold standard of care, especially in adults [10,11,12].

Arthritis: TMJ arthritis is divided into Low and high-inflammatory varieties that have different pathophysiology, clinical course, and prognosis. The most frequent type of arthritis affecting TMJ is temporomandibular joint osteoarthritis (OA) which has a significant clinical prevalence and adverse effects on the TMJ. TMJ OA is a low inflammatory and chronic degenerative disease that affects both the cartilage and the subchondral bone [13]. The most common clinical signs and symptoms include pain, restriction in joint movement, and joint sounds. Pain is usually dull aching and may have occasional sharp components on movement. Pain is prevalent in the initial phases due to the presence of synovitis [14]. In the late-stage malocclusion and open bite can occur. There are several methods of temporomandibular joint osteoarthritis treatment, which may be allocated into one of three major categories regarding the complexity of treatment: conservative treatment (patient education, pharmacotherapy, splint therapy, physiotherapy), noninvasive surgical procedures (intraarticular injections, arthrocentesis, arthroscopy) and surgical procedures (open joint surgeries) [15]. Sometimes late-stage osteoarthritis is treated by total temporomandibular joint replacement [16].

Idiopathic condylar resorption: Idiopathic condylar resorption (ICR) is a poorly understood progressive disease that affects the TMJ and can result in malocclusion, facial disfigurement, TMJ dysfunction, and pain [17]. Diagnosis is based on the patient's history and clinical and radiological findings. Patients may report a worsening of their occlusion and aesthetics with or without TMJ symptoms and associated pain [18]. ICR management proved to be controversial among the surveyed surgeons. Multiple treatment options have been described in the literature, including medical management, orthognathic surgery, condylectomy and reconstruction with costochondral graft, and total joint prosthesis reconstruction. Surgical treatment may be indicated in the case of pronounced pain and massive functional disorders as well as for more serious deformities. However, timing and choice of surgical intervention remain controversial [19]. According to the available evidence and expert opinion, surgical treatment should generally be avoided in the active

(progressive) phase of condylar resorption. The recommendation was established that if it is not possible to sufficiently control the symptoms of active condylar resorption (pain, functional limitations) by conservative measures, condylectomy with subsequent reconstruction, e.g., using a costochondral graft (CCG) or comparable autologous procedures, or by total alloplastic joint replacement, if necessary, in combination with orthognathic surgery, may be indicated [20].

Trauma: TMJR does not play a noticeable role in primary or early secondary condylar fracture management [21]. TMJR may be considered in the management of condylar trauma, in several circumstances. There may be early significant structural damage and functional disability requiring reconstruction of the joint, or there may be delayed deformity or dysfunction of the TMJ, such as arthritis or ankylosis, which fails to respond to non-surgical or minimally invasive measures and fulfills the criteria for TMJR [22]. The indications for primary TMJ reconstruction after trauma are therefore fairly narrow.

Pathological conditions: Primary neoplasms originating in the TMJ are extremely rare. Their clinical manifestations are usually related to temporomandibular dysfunction (TMD) and include pre-auricular swelling, pain, trismus, deviation, restriction of mandibular movement, and malocclusion [23]. Several types of tumors can affect the TMJ, as any other joint, including benign tumors, such as osteochondroma, osteoma, osteblastoma, chondroma, chondroblastoma, non-ossifying fibroma, hemangioma or lipoma, as well as malignant tumors such as synovial sarcoma, osteosarcoma, chondrosarcoma and Ewing sarcoma [24,25]. The primary goals of mandibular reconstruction involving the TMJ after benign disease ablative surgery are a return to normal mandibular function and form by restoring continuity and developing a stable base upon which a functional dental occlusion can be established [26]. TMJR devices are a reasonable approach to reconstructing benign mandibular lesions involving the TMJ, especially when a primary reconstruction is possible [27]. Extended temporomandibular joint prostheses are used not only for the construction of joint components but also for adjacent mandibular and/or temporal bone defects. This can avoid donor site morbidity and long reconstructive surgery. An autologous osseous transplant is still available in case of implant failure [28].

Congenital disorders: congenital craniofacial deformities (CCD) with TMJ malformations include hemi-

facial microsomia (HFM), Goldenhar's syndrome (GHS), Treacher-Collins syndrome (TCS), Nager's syndrome (NAS), etc. Because these deformities usually have malformed or absent TMJ structures, TMJ reconstruction in conjunction with orthognathic surgery may be required to provide predictable and stable outcomes relative to function and esthetics [29]. Hemifacial microsomia (HFM) is the second most common facial birth defect after cleft lip and palate. Vento et al. described three mandibular types. In type I, the temporomandibular joint and ramus are well formed but smaller than normal. In type II, the temporomandibular joint, ramus, and glenoid fossa are hypoplastic and malformed. In type III, the entire ramus is missing [30]. HFM patients' reconstruction has always been a challenge for maxillofacial surgeons, and numerous reconstructive techniques have been described.

Surgical treatment depends on the patient's age and contemplates TMJ reconstruction in conjunction with orthognathic surgery, usually necessary following the completion of growth to maximize the functional and esthetic results [31]. TMJ and jaw reconstruction in patients with HFM has been described using autogenous tissue such as rib graft or sternoclavicular graft alone or in conjunction with orthognathic surgery, distractor osteogenesis, and extended total joint replacement [32]. Using TMJ TJP permits to solving of many HFM-related problems at one time while multiple TMJ operations create scar tissue and interrupt normal blood flow and normal physiologic nutritional distribution to the anatomic structures. This method should be used in adults and the other techniques are the first choice for children [33].

Treacher collin syndrome: Treacher Collins syndrome (TCS) is a rare congenital birth disorder characterized by severe craniofacial defects. It is an autosomal-dominant mandibulofacial dysostosis that occurs in 1 out of 50,000 live births [34]. The TMJ malformation is a complex deformity in Treacher-Collins syndrome (TCS). Condylar volumes are significantly smaller in patients with TCS [35]. The treatment protocol for these patients includes ipsilateral mandibular ramus and TMJ reconstruction with a custom total joint prosthesis, contralateral sagittal split osteotomy, and maxillary osteotomies to advance and transversely level the maxilla; It is best to perform these procedures in females at the age of 15 and in males at the age of 17 to 18 to prevent adverse effects of growth from the normal side. If done earlier, secondary orthognathic surgery may be indicated [36].

Long-standing condylar dislocation: The TMJ dislocation can be categorized into three groups: acute, recurrent, and long-standing. Long-standing or protracted lower jaw dislocation refers to a condition that persists for more than one month without reduction [37]. Spasms and shortening of the temporalis and masseter muscles and pericapsular fibrosis make reduction difficult. Manual manipulation and indirect traction techniques were usually unsuccessful, but patients need to be treated by these methods before the use of other more aggressive ones. There are different techniques for the treatment of long-standing TMJ dislocation as eminectomy, condylotomy, and myotomy, osteotomy [38]. Total joint replacements should be considered when all appropriate treatments fail in chronic protracted cases, especially in those with associated degenerative joint diseases, to recover proper TMJ function and anatomy [39].

Previously failed TMJ prosthetic: Revision and replacement of modern temporomandibular joint replacement systems are uncommon. The incidence of revision and replacement is about 3% and 4.9% [40]. The most common reasons for revision and replacement were identified as being heterotopic ossification (27.5%) and infection (21.1%) respectively [41]. The development of heterotopic bone around any TMJ TJR device will limit mandibular movement and cause pain. In the primary stage the management is non-surgical including either a nonsteroidal anti-inflammatory drug, such as indomethacin, or a bisphosphonate, such as etidronate, or local radiation therapy has been recommended [42,43]. Surgical removal of the heterotopic bone is used to preserve joint mobility in mild cases but in severe cases, both components of the custom device must be remade [44].

Failed Tissue Grafts: Traditional reconstruction methods based on the use of local osteotomy, distraction osteogenesis, bone graft with non-vascularized tissue (costochondral, sternoclavicular) or vascularized tissue (second metatarsal, fibula) with the eventual interposition of soft tissue (mainly temporal fascia flap) are still used by an experienced surgeon and in a low-income country, delivering good results. In adult patients, the failure of autogenous tissue reconstruction is one of the main indications for total alloplastic TMJ reconstruction [45].

Contraindications for total alloplastic joint replacements: Overall, there are few obligatory contraindications against restoration with total TMJ replacements.

The following patients are contraindicated:

- Patients with a severely deficient bone form (mandible, temporal bone), defects, bone mass, or poor bone quality are deemed unable to endure total replacement surgery.
- Severe immunocompromised patients.
- Those with a history of metal allergy related to artificial joints [46].
- Active local infections at the grafting site (eg, in the case of an infected joint prosthesis) [47].

Relative contraindications were as follows:

- Patients in the period of skeletally immature growth
- Patients with obvious abnormal habits, such as clenching, grinding, etc.
- Patients who cannot understand and accept medical instructions after surgery (including those with neuropsychiatric disorders).
- Patients with poor oral hygiene and auditory infection [48].

Case Report

Case1

A 45-year-old woman was referred to our clinic complaining mainly of pain, difficulty opening her mouth, difficulty chewing, and joint sound on her right side, that had persisted for one year. She had no specific medical history and showed the limitation of mouth opening (approximately 24mm) accompanying TMJ pain and crepitus on the right side and tenderness in palpitation. The radiography and computed tomography showed flattening of the condylar head (Figure 1). RF and ESR tests were within the normal range. The diagnosis was osteoarthritis of the TMJ. Conservative treatment was started with pharmacotherapy and then followed by arthrocentesis. Unfortunately, signs and symptoms didn't improve. The patient was a candidate for TMJR with a custom-made device (manufactured by BONASH Medical company). The periauricular and submandibular approaches were used to gain access to the TMJ area and the mandibular ramus, respectively. After accessing the temporomandibular joint area, resection of the condyle and creation of space for the placement of the temporomandibular joint prosthesis were performed using cutting guides. After that, intermaxillary fixation (IMF) was applied and prostheses were replaced and fixed to the bone (Figures 2,3). The post-operative period was uneventful, and the patient was discharged after three days. Postoperatively,

rehabilitation of the patient's jaw function was started 3 weeks later. She was pain-free on the right side of the TMJ with the facial nerve intact. 6 months later, the maximum inter-incisal opening was about 35mm (Figure 4).

Case 2

A 20-year-old man who had gunshot trauma was referred to our clinic with a complaint of facial asymmetry and chewing disorder. He had facial paralysis on the right side. The condyle segment was deformed and displaced medially (Figure 5). Therefore, resection of the right mandibular condyle and reconstruction with a total TMJ prosthesis (manufactured by BONASH Medical company) were performed (Figures 6, 7). No pain or signs of infection were observed at the end of the six-month follow-up. The maximum mouth opening was 38mm.

Case 3

A 26-year-old man was referred to our clinic with a complaint of inability to open his mouth. He had a history of trauma and condylar two years ago. Panoramic radiography and a 3D CT scan showed TMJ ankylosis on his right side (Figure 8). The treatment plan was a right condylectomy and reconstruction with a custom-made TMJ prosthesis. In this case, the BONASH Medical company prosthesis was used (Figures 9,10). The surgical approach consisted of a twofold intervention phase: the removal of the ankylosis and the positioning of the temporomandibular joint prosthesis. In the case under description, the post-operative course was uneventful. At the one-year appointment, a maximum mouth opening of 38 mm was recorded and there was no deviation in mouth opening (Figure 11).

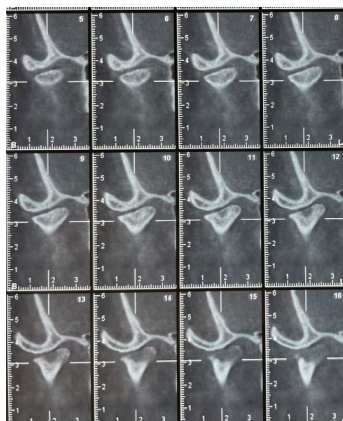


Figure 1. CBCT from right TMJ revealed flattening of the condylar head.

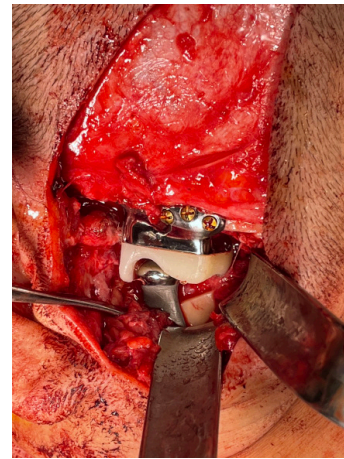


Figure 2. Intraoperative clinical images showed positioning and final fixation of the custom prosthesis with screws.

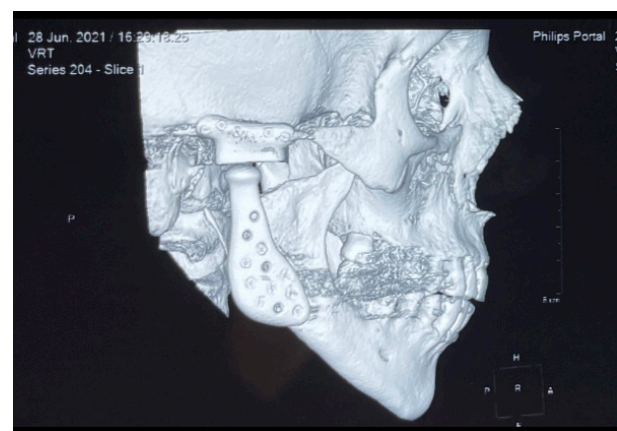


Figure 3. Postoperative 3D reconstruction of the temporomandibular joint prosthesis.

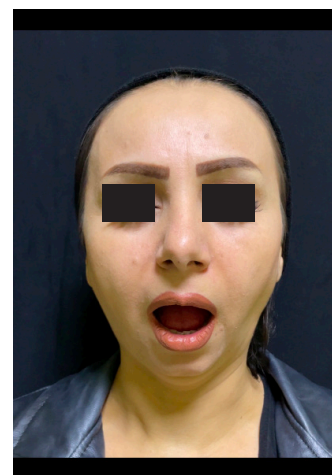


Figure 4. Six-month postoperative clinical images and maximum inter-incisal opening.

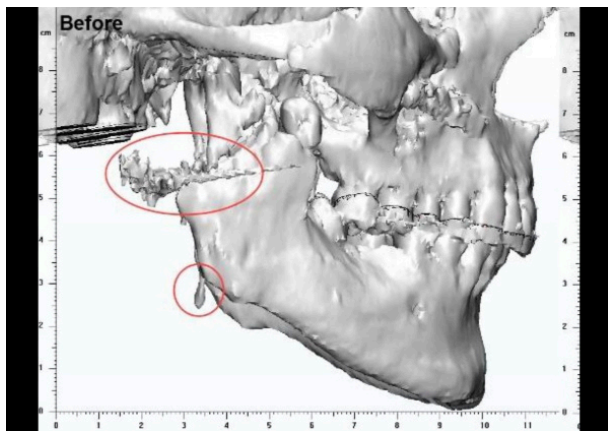


Figure 5. Ct scan from the right side showed a separated segment that displaced medially.

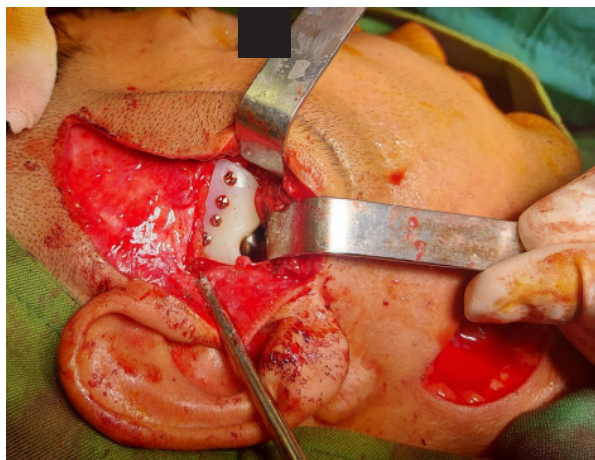


Figure 6. Intraoperative clinical images showed positioning and final fixation of the custom prosthesis with screws.

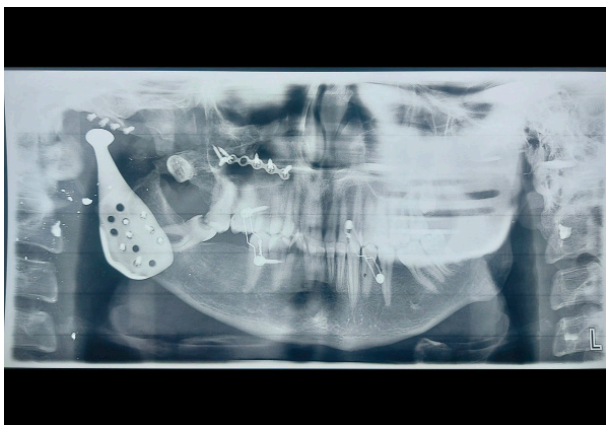


Figure 7. Postoperative panoramic radiography.

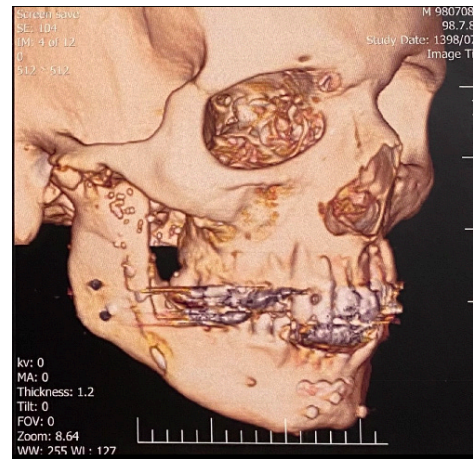


Figure 8. Temporomandibular joint ankylosis on the right side.

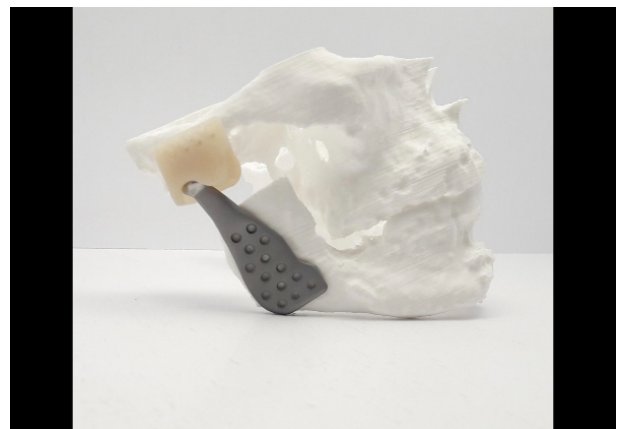


Figure 9. BONASH Medical company prosthesis was used in this patient.



Figure 10. Post-operative plain radiography shows the correct position of the prosthesis.



Figure 11. There is no deviation in mouth opening.

Acknowledgments

The authors wish to thank Bonash Medical Company for their precise manufacturing efforts.

Conflict of Interest

There is no conflict of interest to declare.

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