Total temporomandibular joint replacement: A clinical case with a proposal for post-surgical rehabilitation

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SUMMARY. Objective: The literature on total alloplastic temporomandibular joint (TMJ) reconstructions is encouraging, and studies on total alloplastic TMJ replacements’ outcomes showed acceptable improvements in terms of both pain levels and jaw function. Nevertheless, a better standardization of both surgical and post-surgical phases should further improve the efficacy of treatment. Materials and methods: The case report describes the surgical and post-surgical phases of treatment in a patient who underwent a total unilateral joint replacement for TMJ ankylosis, along with a proposal for a post-surgical rehabilitation protocol providing strong passive and active physiotherapy and hyaluronic acid injections to the contralateral joint. Results: The post-operative (PO) course was uneventful. The patient showed a marked improvement up to about 60% in mouth opening and had no pain on either side at the 1-year follow-up. Conclusion: In a patient with unilateral TMJ ankylosis, total TMJ replacement was successful. A carefully tailored post-surgical rehabilitation protocol helped the patient to gain a clinically significant improvement in jaw function. Longer follow-up periods are needed to assess the long-term maintenance of results. Clinical trials are strongly recommended to assess the relative efficacy of different PO protocols. © 2008 European Association for Cranio-Maxillofacial Surgery

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INTRODUCTION

The disorders of the temporomandibular joint (TMJ) are included in a heterogeneous group of pathologies termed temporomandibular disorders (TMDs), which may manifest with a constellation of signs and symptoms (McNeill, 1997). TMDs are considered the most frequent cause of chronic orofacial pain (Rollman and Gillespie, 2000) but, despite the introduction of the Research Diagnostic Criteria (RDC) for TMDs (Dworkin and Leresche, 1992) has improved standardization of the assessment and classification procedures in the research setting (List and Dworkin, 1996; Rantala et al., 2003; Yap et al., 2003; Manfredini et al., 2004a, 2006), poor diagnostic homogeneity exists among epidemiological investigations on TMD. Symptoms occur mainly in the 20–40 years of age-range, with a strong female representation (female:male ratio is about 3:1). The estimated prevalence of TMD-related orofacial pain of about 12% and the prevalence of TMD signs is up to 60% (Dworkin et al., 1990; Leresche, 1997). TMD-related pain has a relevant psychosocial impact as well (Turner et al., 2001; Yap et al., 2002; Ferrando et al., 2004; Manfredini et al., 2004b,c).

TMD symptomatic management is mainly based upon a number of conservative and reversible treatments, such as occlusal splints (Dao and Lavigne, 1998; Turp et al., 2004), physiotherapy (Nicolakis et al., 2002), complimentary medicine (De Laat et al., 2003), cognitive-behavioural interventions (Dworkin et al., 1994), and local or systemic drugs (Dionne, 1997; Guarda Nardini et al., 2002, 2005, 2007; Manfredini et al., 2004d). Nevertheless, a small number of cases is resistant to traditional conservative therapies and may request a surgical approach to the TMJ (Nitzan and Dolwick, 1990, 2003; Valenti et al., 2002; Givon, 2004; Dimitroulis, 2005; Qudah et al., 2005; Erol et al., 2006). Recently, the number of treatment options for the management of patients who had previously experienced multiple failed TMJ therapies has been enlarged with the introduction of the TMJ prosthesis (Mercuri, 1998, 1999a).

Studies on total alloplastic TMJ replacement outcomes showed acceptable improvements in terms of both pain levels and jaw function, thus making these interventions worthy of further evaluation (Mercuri et al., 2002; Speculand et al., 2002; Mercuri and Giobbie-Hurder, 2004). Nevertheless, the indications for TMJ prostheses and their success and survival rates have yet to be defined (Guarda Nardini et al., 2008).

Considering the increasing interest in TMJ prosthetic replacement, it appears that both surgical and post-surgical phases of treatment need to be standardized. In particular, the existing literature shows that little attention has been paid to the post-intervention rehabilitation.

To address these concerns, the present case report describes the surgical and post-surgical phases in a patient who underwent a total unilateral TMJ replacement, along with a proposal for a post-surgical rehabilitation protocol.
CASE DESCRIPTION

A 35-year-old female patient (R.L.) was referred to the Department of Maxillofacial Surgery, University of Padua, Italy, for the treatment of a severe mouth opening restriction and pain in the TMJ (Fig. 1).

The patient gave a history of pain in the TMJ area and had undergone two previous operations.

At 25 years, she underwent surgery for temporomandibular disc repositioning due to persistent pain in the left joint associated with disc displacement. Symptoms and joint sounds resolved after the intervention, but 7 years later she started pain and functional limitation again.

At 32 years, she underwent a second surgery for left TMJ discectomy with condylar remodelling.

Post-operatively, the range of mandibular movements decreased rapidly, and the patient was referred to the TMD clinic, Department of Maxillofacial Surgery of the University of Padua, Italy. The maximum mouth opening was 5 mm, with absence of endfeel distance, and computerized tomography showed ankylosis of the left TMJ (Figs. 2 and 3). A RDC for TMD (Dworkin and Leresche, 1992) axis I diagnosis of disc displacement with reduction (group Iia) and osteoarthritis (group IIIb) was made for the right joint.

Several surgical options should exist to relieve TMJ ankylosis and try to restore function, ranging from the quite abandoned gap arthroplasty to interpositional arthroplasty, which provided the insertion of a biological (temporalis fascia, temporal muscle flap) or non-biological material (acrylic, silastic) between the bone structures (Su-Gwan, 2001; Valenti et al., 2002; Manganello-Souza and Mariani, 2003; Guven, 2004; Qudah et al., 2005; Erol et al., 2006; Manfredini et al., in press). Nevertheless, in the case of patients undergoing multiple previous operations, there is a high risk of reankylosis, and a TMJ replacement should be considered (Mercuri, 1998; 1999a). The literature suggests that a total TMJ replacement system is preferable to a partial replacement to avoid excessive stress and wear of the articular bone surface working against the prosthesis, which can prevent long-term functional restoration (Mercuri, 1999a; Quinn, 2000).

Considering these concerns, a total TMJ prosthesis in the left joint was preferred to the other surgical options, and the patient was scheduled for surgery.

The total TMJ replacement system is a “ball and socket” type prosthetic joint similar to a hip implant. The total TMJ replacement system comprises three components (Guarda Nardini et al., 2008):

- The condylar (or mandibular) implant, made of metal cobalt–chromium–molybdenum (Co–Cr–Mo) alloy or titanium alloy. In both cases the implants have a roughened titanium porous coating on the implant surface that contacts bone. Co–Cr–Mo alloy contains nickel.
- The fossa implant, made of a hard, plastic polyethylene. The fossa is made of high density polyethylene that has shown excellent wear resistance during mechanical testing.
- The screws, made of titanium alloy, are used to attach both the condylar and the fossa implants to bone.

In this case a total TMJ prosthesis was inserted (Bio-met/Lorenz, Warsaw, IN, USA) (Quinn, 2000).
The Biomet/Lorenz® prosthetic system is a stock prosthesis which is provided in three different sizes for both the condylar/mandibular and the fossa implants.

The fossa component is made up of ultra-high molecular weight polyethylene (UHMWPE), while the condylar/mandibular component is made up of a Co—Cr—Mo alloy with titanium surfaces.

The former is fixed to bone tissue by means of 4—7 screws of 2.0 mm diameter, while the latter is fixed by means of 7—11 screws of 2.7 mm diameter.

**SURGICAL TECHNIQUE**

The operation consists of two phases: the removal of the ankylosis and the positioning of the TMJ prosthesis. Thus, both preauricular access to the TMJ and temporal bone and a posteroinferior submandibular incision for access to the mandibular ramus were required (Quinn, 2000). The superior incision has a 45° release into the temporal hairline, and the dissection is kept as posterior as possible to avoid the facial nerve. The inferior incision was almost vertical (i.e., perpendicular to the lower two-thirds of the posterior border of the ramus) (Quinn, 2000).

Once access to the TMJ was gained through the preauricular incision, the release of the ankylosis was performed (Fig. 4). A 5—10 mm gap between the recontoured glenoid fossa and the mandible was created by removing the fibrous scar and heterotopic osseous tissue with surgical burs and chisels. Remodelling of the glenoid fossa and a partial excision of the coronoid process were performed to fit the fossa component of the prosthesis (Fig. 5).

Once the fossa component was placed and fixed, the patient was placed in the post-operatory intermaxillary relationship, which was secured with wire (Fig. 6). Condylectomy was then performed and the mandibular component of the prosthesis was placed and fixed (Fig. 7).

The intermaxillary fixation was then removed and the patient's mandible was manipulated to ensure that no obstructions to joint movement or improper fitting between the two prosthetic components were present. The patient was also forced intra-operatively to maximum mouth opening, in order to break adhesions on the contralateral side. Only after verifying the correct functioning and freedom of movement of the implant, the patient was then sutured and a control ortopantomography was taken (Figs. 8 and 9).

**POST-OPERATORY PROTOCOL**

While there is growing documentation and interest in the surgical aspects of the TMJ prosthetic rehabilitation, there is a paucity of data about the post-operative (PO) protocols. This appears to be an oversight, since the choice of appropriate PO rehabilitation has a strong influence on therapeutic outcomes. An accurate description of the post-operative rehabilitative program adopted allows a more appropriate comparison of the study findings, and its definition and standardization is of importance clinically.

In this case, the PO course was uneventful, and only PO pain medication and antibiotics were prescribed. There was no motor deficit on either side of the face.

The day after surgery, post-operatory mouth opening was 23 mm (Fig. 10).

Functional rehabilitation was started 1 week after surgery, by a combination of active and passive exercises. In particular, the patient was given an intensive regime of passive motion (TheraBite Jaw Motion Rehabilitation...
System*, Therabite, Philadelphia, PA, USA), which, according to some data, is important in improving jaw mobility after surgical procedures on the TMJ (Mercuri et al., 2002; Cohen et al., 2005; Gibbons and Abulhoul, 2006). The treatment regime was based on the protocol suggested by Therabite for cases of limited jaw mobility, and provided that the patient opens the mouth with assistance seven times, holds the maximum open position that can be sustained for 7 s, and performs these exercises seven times a day. The patient was asked to perform passive exercises for the first 3 months after surgery, and vigorous active physiotherapy was then introduced to maintain the mobility.

A cycle of hyaluronic acid injections was also provided to the contralateral TMJ, in order to improve function (Fig. 11). The protocol for joint injections was moderated from those adopted in larger joints, providing a cycle of five injections (one per week) of 1 ml low-molecular weight hyaluronic acid (Hyalgan®, Fidia, Abano Terme, Italy), performed according to the technique described elsewhere (Guarda Nardini et al., 2002, 2005, 2007).

Five follow-up assessments were performed (at 1 week, at 1, 3, 6, and 12 months). Mouth opening after 1 year was 41 mm and the patient said both sides were pain free (Fig. 12).

**DISCUSSION**

Data on total TMJ replacements suggest that a history of multiple previous failed operations is the most common indication for joint replacement, and patients with severe osteoarthritis, inflammatory arthrosis, connective or
autoimmune disease, ankylosis, absent or deformed structures, congenital deformities, and chronic pain also underwent the total joint replacement (Mercuri, 1999a,b; Quinn, 2000; Saeed et al., 2002; Wolford et al., 2003; Mercuri and Giobbie-Hurder, 2004; Christensen et al., 2005).

In general, total alloplastic TMJ replacements interventions have shown promising outcomes, and reported improvements are good for both subjective (pain, mandibular function, diet consistency, quality of life) clinical parameters, in both uni- and bilateral replacements. Mean pain reduction was within the 50–67% range, and increase in mouth opening was about 30% (Mercuri, 1999b; Mercuri et al., 2002; Saeed et al., 2002; Speculand et al., 2002; Wolford et al., 2003; Mercuri and Giobbie-Hurder, 2004; Christensen et al., 2005).

Nevertheless, the existing literature shows that little attention has been paid to the description of post-intervention rehabilitation, and findings might have been even more encouraging if the importance of post-surgical phases had been accurately emphasized.

Functional rehabilitation has a strong and well-documented importance in many fields of orthopaedics (NIH Panel, 2003) and passive jaw rehabilitation devices have been shown to have some value in PO TMJ rehabilitation (Mercuri et al., 2002; Cohen et al., 2005; Gibbons and Abulhoul, 2006).

In the case described, passive physiotherapy was performed for 3 months after surgery, and then active rehabilitation was introduced. The TheraBite system was adopted to perform passive jaw motion due to its effectiveness in terms of cost—benefit ratio and to its simplicity. Also, the adoption of an easy-to-use non-individualized system might help to improve standardization of PO protocols, thus making a comparative cross-study possible.

In order to improve jaw mobility and to avoid possible limitations in the range of movements due to the contralateral non-operated TMJ, a cycle of hyaluronic injections was also performed on the right joint. Hyaluronic acid, being an essential component for joints lubrication, may help to reduce joint friction (Cascone et al., 2002; Tanaka et al., 2005), and literature data are currently available on the efficacy of intra-articular hyaluronic acid injections in patients with disc displacement with reduction (Hepguler et al., 2002), disc displacement without reduction (Sato et al., 1997; Sato et al., 2001), and with osteoarthritis (Guarda Nardini et al., 2002, 2005, 2007).

Improvements in mouth opening at the 1-year follow-up were up to 60%, being more marked than those reported in the literature (Mercuri, 1999b; Mercuri et al., 2002; Saeed et al., 2002; Speculand et al., 2002; Wolford et al., 2003; Mercuri and Giobbie-Hurder, 2004; Christensen et al., 2005), and one can suppose that the adopted post-operative protocol was an important component to explain this finding.

CONCLUSIONS

The present report describes a successful case of an intervention for a unilateral total TMJ replacement in a patient with TMJ ankylosis. The PO course was uneventful, and a carefully tailored post-surgical rehabilitation protocol helped the patient to achieve a clinically significant improvement in jaw function.

It appears obvious that a single clinical case report has small scientific significance, and that longer follow-up
periods are needed to assess the long-term maintenance of results.

Nevertheless, it must be pointed out that a description of the post-operative protocols and an evaluation of the relative effectiveness of different regimens have not addressed aspects of TMJ total replacement to date, so that further studies are essential to improve knowledge about the management of post-surgical phases.

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