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EGYPTIAN TOTAL TMJ PROSTHESIS: A THREE-YEAR FOLLOW-UP OF 22 JOINTS

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ABSTRACT

The TemporoMandibular Joint (TMJ) is the unique structure that facilitates the complex articulation of the mandible to the base of the skull, through its upper bony component the glenoid fossa and eminence. TMJ can be severely compromised both anatomically and functionally by many etiologic factors, including but not limited to: developmental abnormalities, ankylosis, destructive arthritis, comminuted fractures, locally invasive pathosis as ameloblastoma or bengin tumors as Keratocystic Odontogenic Tumor (KCOT), or even malignancies. Reconstruction of the TMJ has been subject to extensive research and a wide variety of materials. As is the case with most reconstructions, autogenous grafts both vascularized and none, as chostochondral, fibula, radial, iliac crest and even scapula and metacarpal grafts have been employed especially in children and adolescents. Needless to point out, the well-known disadvantages of such grafts as their unpredictable outcome and donor site morbidity. On the other hand, alloplastic TMJ prosthesis that were introduced to overcome the autogenous graft disadvantages, had a very disappointing and rather scandalous debut with materials such as: vitalium, Proplast-Teflon (PTFE), Polymethylmethacrylate (PMMA) and Polydimethylsiloxane (silicone rubber); all of which turned out to be rather destructive than reconstructive. After learning from our mistakes and having a better understanding of the destructive forces the TMJ can have on prosthetic materials, ultra high molecular weight polyethylene (UHMWPE) and titanium separately or in combination have been employed with better outcomes and less failures/reactions. Custom made TMJ prosthetics using CAD/CAM and Rapid Prototyping using different manufacturing techniques are essentially valuable in cases of mandibular resections with disarticulation following disfiguring lesions. Tissue engineering of TMJ on scaffolds (natural/synthetic) using stem cells and bioactive molecules are prospective solutions, yet further research is necessary. In this study, we are rather *addressing destructive lesions that are limited to TMJ, where stock TMJ prostheses provide results similar to the more expensive custom made and tissue engineered reconstruction solutions*.

KEYWORDS: ORTHOMed TMJ Prosthesis; Total TMJ Prosthesis; Stock TMJ prosthesis; TMJ Reconstruction

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INTRODUCTION

The need for temprormandibular joint (TMJ) total reconstruction in mature adult patients are numerous (Abramowicz, Barbick, Rose, & Dolwick, 2012) due to severely compromised TMJ both anatomically and functionally by many etiologic factors, including but not limited to: developmental abnormalities, ankylosis, destructive arthritis, comminuted fractures, locally invasive pathosis as ameloblastoma or bengin tumors as keratocystic odontogenic tumor (KCOT), or even malignancies. (Mercuri L.G., 2003) (Bianchi B, 2013) (Abramowicz, Barbick, Rose, & Dolwick, 2012) Autogenous tissue grafts (i.e., costochondral, sternoclavicular, temporal myofascial, auricular cartilage, dermis, sliding ramus osteotomy) can be used for TMJ reconstruction in many of these conditions. However, this comes at the hefty risk of significant incidence of failure of such autogenous grafts as some of these conditions can have an adverse affect on them. (Wolford, Cottrell, & Henry, 1994) (Henry CH, 1993) (Beheiri, Helmy, El-Beialy & Abdel Aziz, 2014) The TMJ prosthesis presents some advantages as it reduces the duration of surgery, reduces morbidity and provides function immediately (Quinn, 2000).

Total TMJ replacement as a unit has been shown to be superior to partial TMJ replacement (Jones, 2011) There are two different types of TMJ implant on the market, custom-made and stock models. Each has some advantages and disadvantages associated with their geometry. (Antonio Ramos, 2015) Disadvantages include: in the short term the cost of the prosthesis; and in the long term material wear, corrosion and particles (Royhman D, 2014), failure of components and screws may lead to screw loosening (Mercuri, 1998) and wear between components and the screw fixings (Quinn, 2010) (Shen P, 2014) Wolford et al 2003 (Wolford L.M., 2003) set the criteria for success of a total joint prosthesis to be: (1) biocompatible materials, (2) functionally compatible materials, (3) low wear, flow, and fatigue coefficients when loaded under functional conditions, (4) adaptability to anatomical structures, (5) rigidly stabilized components, and (6) corrosion resistant and non-toxic.

PATIENTS AND METHODS

All included adult patients in this study suffered different forms of TMJ pathosis, mainly ankylosis, and were in need for surgical disarticulation and TMJ reconstruction following specific CT scan protocol (Figure 1). The Total ORTHOMed TMJ prosthesis (Egyptian-made) is composed of a condylar titanium alloy with highly polished articular head; while the fossa/eminence component is made from ultra high molecular weight polyethylene (UHMWPE). The condylar component is designed to fit 2.3mm extension or reconstruction plates using locking 2.3mm screws. (Figure 2)

This 3-year prospective study evaluated the first 11 consecutive patients, treated with bilateral TMJ ORTHOMed stock total joint prostheses, operated by the same surgical team. All patients were females with an average age of 34years (ranging from 28 to 43 years) that returned for clinical and radiographic evaluation. All patients were followed-up for a minimum of 3 years postoperatively. The TMJ was approached through an endaural incision. A gap arthorplasty or condylectomy was performed according to the case. Debridement of the surgical field and bony recontouring of either TMJ bony component stumps was performed if indicated. A submandibular incision was used to gain access to the mandibular ramus and allow for direct visualization of the seating and adaptation of the prosthesis condylar component to the ramus. The mandible was appropriately mobilized, an occlusal splint placed if indicated, and intermaxillary fixation applied. The fossa/eminence component of the prosthesis was then inserted and stabilized to the lateral aspect of zygomatic arch with 4 to 5, 2.3mm diameter bone screws. The condylar component was placed through the submandibular incision and stabilized with 4, 2.3mm diameter

locking bone screws. The intermaxillary fixation was released and the occlusion checked for proper interdigitation. The incisions were then closed in a layered manner. Patients were routinely covered with broad-spectrum antibiotics (usually penicillin and for allergic patients: cephalosporin), NSAIDS, as well as, corticosteroids –that were gradually tapered off over 72 hours- intraoperatively and at least for the first postoperative week.

Descriptive statistics and paired t-tests ($P<0.001$) were used to compare presurgical and longest postoperative follow-up data.

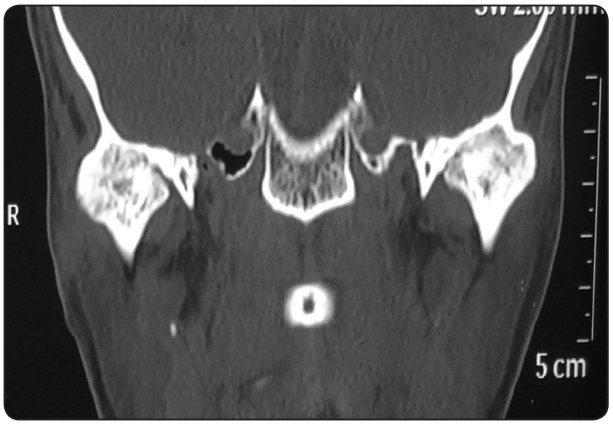

Fig. (1) A coronal cut of the CT scan preoperatively.

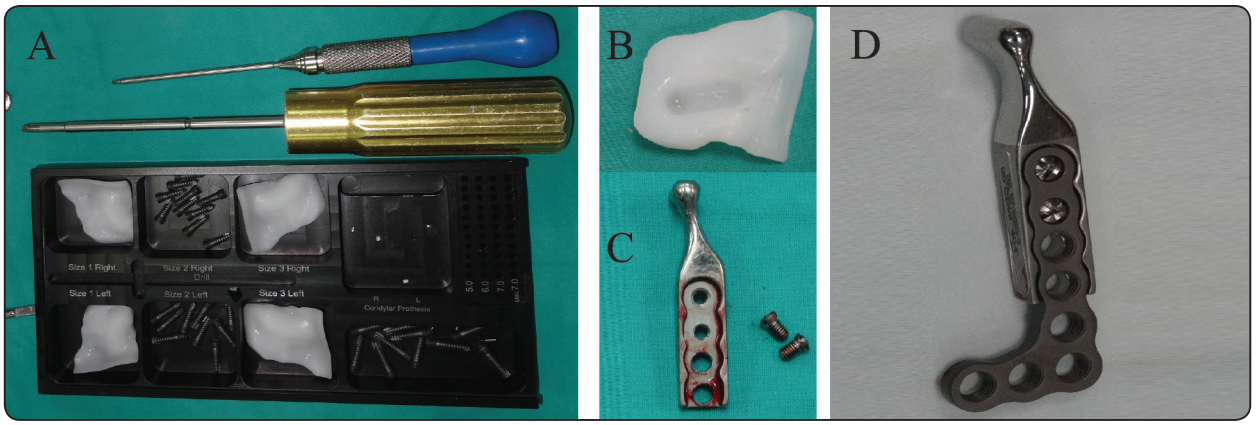

Fig. (2) ORTHOMed Total TMJ Prosthesis. (A) The Set with different Fossa/Eminence component sizes; (B) The UHMWPE Fossa/Eminence component, with the lateral aspect facing upwards; (C) the Titanium condylar component of prosthesis; (D) Condylar Prosthesis with Extension Plate.

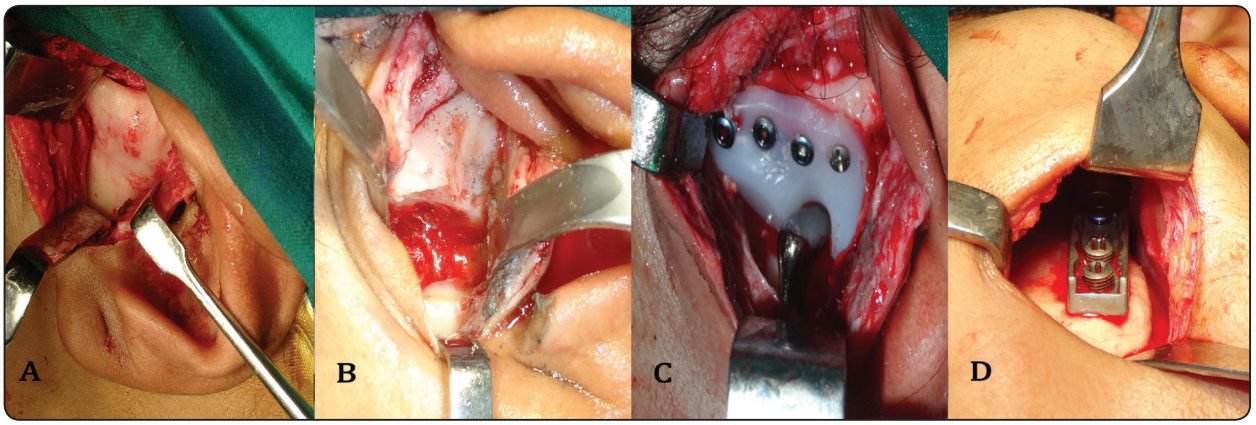

Fig. (3) Surgical procedures: (A) Incision & layered dissection to the ankylotic mass through an endaural incision and to the ramus through a submandibular incision; (B) Gap arthroplasty; (C) The Fossa/Eminence component secured in place with 4-5, 2.3mm screws; (D) The Condylar component secured to the lateral aspect of the ramus using 4, 2.3mm specially designed screws, through a submandibular incision.

RESULTS

The mean maximum interincisal opening achieved was 36.5mm from a preoperative mean of 9mm (Figure 6). Visual analogue scales for pain, improved form a mean of 8.5 to 1.5 postopertively (0=no pain; 10=worst pain); while those for jaw function (0=normal function; 10=no function) improved form a mean of 8.5 to 1.5 postopertively and patient satisfaction (0=Disatisfied; 10=Fully satisfied) improved form a mean of 2 to 9 postoperatively. All of which were statistically significant improvements P<0.001. All patients had uncomplicated healing and no signs of device failure were noticed up until the end of their follow-up after 3 years (Figure 4-6).

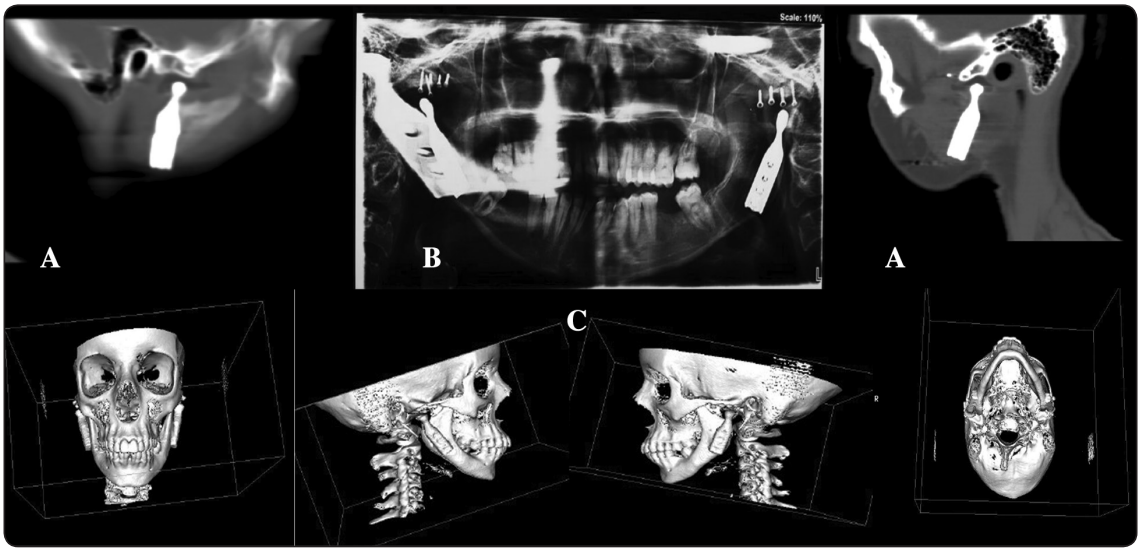

Fig. (4) Postoperative radiographs. (A) 3-year postoperative Sagittal CT cuts; (B) Immediate postoperative panoramic radiograph; (C) 3-years postoperative 3D reformatted cuts (lower panel)

Fig. (5) 3-years postoperatively. Extraoral photographs (Upper panel) and Reformatted 3D with soft tissue profiling from CT scans (lower panel).

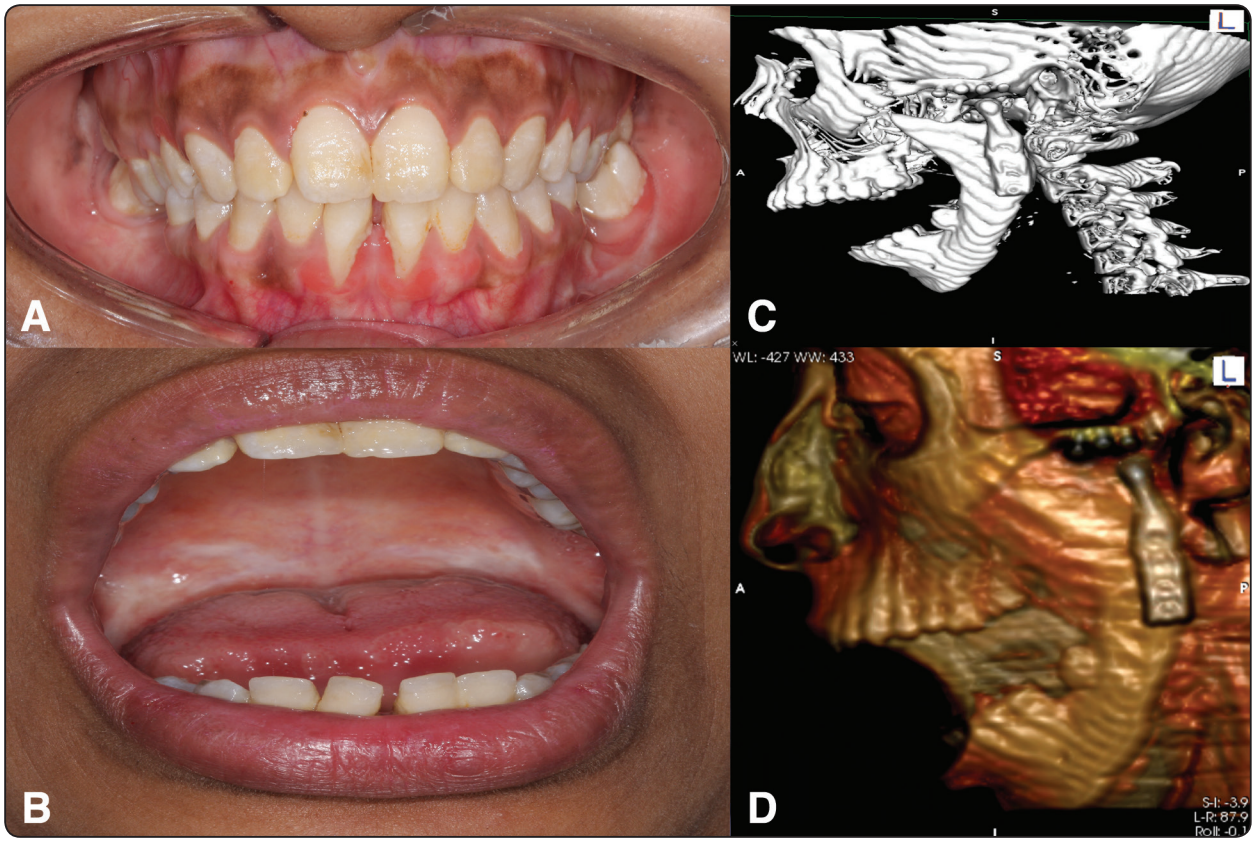

Fig. (6) 3-years postoperatively. (A) Occlusion (photograph); (B) Maximum interincisal opening (photograph); (C) 3D reformatted from CT scan in maximum mouth opening; (D) 3D reformatted from CT scan in maximum mouth opening with soft tissue overlay.

DISCUSSION

Resorting to total TMJ prosthesis is not the primary line of treatment for many TMJ pathosis, and it usually follows previously failing/failed approaches. Despite the reported 4 year success rates for pain, occlusal stability, and jaw function with autogenous grafts for TMJ reconstruction: Costochondral (12%), sternoclavicular (21%), dermal (8%), temporal fascia (13%), temporal fascia with mandibular sagittal split osteotomies (31%), and auricular cartilage (25%). (Henry CH, 1993)Yet, Wolford et al (Wolford L.M., 2003) demonstrated also significant increase in failure rates for all autogenous tissue groups as the number of prior TMJ surgeries increased. After two previous TMJ surgeries, the long term success rate for autogenous tissue grafts approached zero. Ankylosis (decreased function) and pain were the most common causes of failure.

Autoimmune, connective tissue, redeveloping heterotopic bone and inflammatory diseases can also attack autogenous grafts in the TMJ area if the joint is involved in the disease process. (Wolford L.M., 2003) The commonly reported development of fibrosis and reactive/heterotopic bone around the prostheses, causing pain and limited jaw function was not encountered in any of the included 22 patients. Hence, in this study, no fat grafts were necessary as reported by Wolford and Karras. (Wolford & Karras, 1997) This might be attributed to the limited dissection and ensuring placement of the prosthesis in a properly haemostatic field and mimimal dead space available for blood clot formation and consequent matrix for the fibrous

ingrowth and pluri potential cells migrating into the area that could develop bony and dense fibrous tissues. (Wolford & Karras, 1997) Moreover, the fact that none of our patients had more than one previous TMJ surgery, nor malignancy might have favored our results; which is also in accordance with the presented results by Wolford et al. (Wolford L.M., 2003) While the use of a custom-made total joint prosthesis may improve the results and reduce intra-operative adaptation time of stock TMJ prosthesis; yet, they also come with a hefty preoperative preparation, the need for computerized surgical guides and a heavy financial burden for the patient, especially in Egypt with lack of health insurance to support such operations. Quoting Abramowicz et al (Abramowicz, Barbick, Rose, & Dolwick, 2012) on their statement and sharing their point of view: Opponents of the stock system state that stock joints have a higher potential for development of infection (Mercuri L. , 2006) (Wolford LM, 2010) owing to repeated trying-in of components to determine the closest fit. This can be drastically decreased by estimating the size prior to the operation simply by overlaying the components of the stock joints on plain radiographs. Similarly, templates are used intraoperatively to determine the fit and only then is the final joint prosthesis inserted. (Abramowicz, Barbick, Rose, & Dolwick, 2012) The success of the custom system has been well described, all be it by few authors. This is especially true for the complex, multiply-operated patient, who has unusual anatomical variations of the fossa, condyle, and/or ramus. For a patient who had minimal surgical intervention and has a normal anatomy, this system may require unnecessary expense and time. (Abramowicz, Barbick, Rose, & Dolwick, 2012)According to this study, for our patients with a maximum of single previous TMJ surgery, a stock TMJ prosthesis can be an acceptable option and ORTHOMed Total TMJ Prosthesis has provided this solution at an affordable price for the patients in he local market.

CONCLUSIONS AND RECOMMENDATIONS

Stock Titanium Condyles and HMWPE Glenoid Fossa/Eminence as Total TMJ prosthesis are suitable reconstructive solutions at a very low cost. Short term follow-up (up to 3-years) of 22 TMJ prostheses have shown the lack of cardinal signs for revision as: 1) Failed component/components; 2) Breakage of a component or components and/or fixation screws; 3) Aseptic loosening; 4) Subacute or chronic infection; 5) Osteolysis; 6) Peri-prosthetic bone fracture and 7) Ankylosis or heterotropic bone formation. The screw design and size was accurate enough to sustain forces as far as the study was conducted (3-years).

There were NO signs of tissue reaction due to wear products from friction of titanium against UHMWPE, either in the form of clinical signs or symptoms or in the CT scans (soft tissue window). Finally, a lower profile condylar plate has been requested from ORTHOMed, Egypt and is in the works to reduce the bulkness of the condylar prostheses especially in cases that do not require attaching an extention/reconstruction plate.

LIMITATIONS

This is a 3-year prospective study on a limited number of patients (22 joints), this should be taken into consideration when analyzing the results. Further research with longer follow-up intervals and on a larger sample of patients should be commenced, so as to avoid catastrophes that had been encountered in the history of TMJ prosthesis (Proplast-Teflon).

ETHICAL APPROVAL

The work not required approved by the appropriate ethical committees related to the institutions in which it was performed.

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