

# Total temporomandibular joint alloplastic reconstruction\*

## Reconstrução aloplástica total da articulação temporomandibular

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### ABSTRACT

**BACKGROUND AND OBJECTIVES:** Temporomandibular disorders are made up of a variety of diseases involving masticatory muscles, temporomandibular joint or both. With clinical treatment, most patients improve function and pain, however when this therapy has unfavorable results, surgical treatment should be considered. Total joint reconstruction with joint prosthesis is a type of surgical procedure. This study aimed at evaluating current status of temporomandibular joint reconstructions with total prostheses.

**CONTENTS:** A review was carried out by crossing selected descriptors in the last 25 years about prosthetic reconstruction of joint structures of the temporomandibular joint.

**CONCLUSION:** The scarcity of highly relevant scientific studies on temporomandibular joint reconstruction with prosthesis makes impossible a systematic review, leading the procedure to be still seen and indicated with caution.

**Keywords:** Joint prosthesis, Maxillofacial surgery, Temporomandibular joint disorders.

### RESUMO

**JUSTIFICATIVA E OBJETIVOS:** As disfunções temporomandibulares são constituídas por uma variedade de doenças que envolvem os músculos da mastigação, a articulação temporomandibular ou ambos. Por meio de tratamento clínico, a grande maioria dos pacientes apresenta melhora da função e do quadro de dor, porém quando essa terapia não apresenta resultados favoráveis, o tratamento cirúrgico deve ser considerado. A reconstrução total da articulação através de próteses articulares é uma das formas de tratamento cirúrgico. O objetivo deste estudo foi avaliar o estágio atual das reconstruções da articulação temporomandibular, por meio de próteses totais.

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**CONTEÚDO:** Realizou-se uma revisão por meio do cruzamento dos descritores selecionados no período dos últimos 25 anos sobre reconstrução por próteses das estruturas articulares da articulação temporomandibular.

**CONCLUSÃO:** A escassez de artigos científicos de grande relevância relacionados à reconstrução por próteses de articulação temporomandibular gera a impossibilidade da realização de uma revisão sistemática, o que faz com que o procedimento ainda seja visto e indicado com cautela.

**Descritores:** Cirurgia maxilofacial, Prótese articular, Transtornos da articulação temporomandibular.

### INTRODUCTION

Temporomandibular disorder (TMD) is a term used to define a variety of signs and symptoms involving masticatory muscles and/or the temporomandibular joint (TMJ). Major TMD symptom is pain, which in general affects masticatory muscles and the TMJ region.

Several clinical therapies are described to treat temporomandibular disorders aiming at relieving pain, decreasing inflammation, functionally improving this structure and preventing structural injuries or progression of joint diseases. However, patients not responding to such therapies may be subject to surgical treatment.

Numerous surgical procedures are described in the literature, being total joint reconstruction limited to cases where remaining therapies have failed or are not indicated.

Total TMJ prosthesis is made up of a component to replace the mandibular fossa and of another component to replace the condyle. Such procedure is able to restore the shape and function of the replaced joint.

This study aimed at evaluating, according to the literature, the current stage of TMJ reconstruction through total prostheses.

### BASIC CONCEPTS

TMJ, also known as craniomandibular joint, is one of the most complex human body joints<sup>1</sup>. In general the treatment of such structures adopts noninvasive techniques before considering surgical procedures<sup>2</sup>. Several clinical therapies are described for relieving pain, decreasing inflammation, functionally improving such structure and for preventing structural injuries or progression of joint diseases. However, patients not responding to noninvasive techniques may be referred to surgical treatment, including arthroscopy, joint lavage, disk

repair and even joint replacement<sup>3</sup>.

Until mid 1970s, TMJ surgeries were limited to cases of ankylosis, ablative postsurgical reconstruction, trauma or severe joint disease. Currently, TMJ surgeries are accepted to treat intra-articular disk disorders. Notwithstanding favorable results of such surgeries, some patients do not improve after such procedures. Clinically, those patients not only remain or have worsening of symptoms and disorder after each intervention, but also develop secondary anatomic limitations. Additionally, they have all the problems of those suffering from chronic pain<sup>4</sup>. So, there is the need to replace such structures by prostheses.

## PROSTHETIC RECONSTRUCTION OF THE TEMPOROMANDIBULAR JOINT

Ideal autogenous or alloplastic joint reconstruction is that which mimicks shape and function of replaced joint, being able to support the same forces experienced by normal joint and to reproduce its functional movements<sup>5</sup>. Ideal prosthesis features include the need for being nontoxic, biocompatibility, functionality, lightness, adaptability, stability and corrosion resistance<sup>6,7</sup>.

For any joint reconstruction with alloplastic material to be successful in the long term, it is necessary to pay attention to stability at fixation; to compatibility of materials used to build the device with adjacent tissues; to the design of the prosthesis, which should be built to support loads received by the joint along time; to careful evaluation of surgery indication and asepsis<sup>8</sup>.

A problem to be faced during joint reconstruction is the fact that many patients with indication for total TMJ prosthetic replacement have distorted anatomy resulting from numerous previous ineffective surgical procedures, which significantly impairs reconstruction<sup>9</sup>.

## TEMPOROMANDIBULAR JOINT PROSTHESES FEATURES AND COMPONENTS

Total TMJ prostheses may be of two types. Over-the-counter prostheses (BIOMET) are found in predefined shapes and sizes and have two components: fossa, or cranial component, made of ultra-high molecular weight polyethylene, and the mandibular component, made of cobalt chromium with a layer of titanium in the surface in contact with the bone structure. These two components are available in three different sizes, but the condyle and the fossa concavity have defined shape and sizes.

Components are fixed with titanium 2.0mm bolts for the upper component and 2.7mm bolts for the mandible component, being those fixed in the zygomatic arch and in the mandible branch, respectively<sup>10</sup>.

Over-the-counter prostheses are low cost solutions, however they may present micro movements which increase the risk of bone resorption<sup>11</sup>, and for not having satisfactory stability they may decrease longevity and present implant failure<sup>12</sup>.

Custom-made prostheses (TMJ Concepts) on the other hand,

consist of a component representing the glenoid fossa made of ultra-high molecular weight polyethylene cast with pure titanium which is fixed to the mandibular fossa with titanium bolts. The condyle component is made of molybdenum cobalt-chromium alloy and the titanium branch. The whole system is customized in bone prototyping produced by tomographic exams of patients' mandible and maxilla<sup>13</sup>.

The above-mentioned devices were approved by the Food and Drug Administration (FDA) in the United States to be used in humans<sup>10</sup>.

## INDICATIONS FOR TOTAL TEMPOROMANDIBULAR JOINT RECONSTRUCTION

Studies<sup>14</sup> have supplied the clinical basis for the approval of total TMJ prosthesis by the FDA in 1999 for joint abnormalities involving inflammatory arthritis, recurrent fibrosis or ankylosis, tissue grafting procedure failure, alloplastic reconstruction failure and loss of vertical mandible height and/or occlusal alteration generated by bone resorption, trauma, developmental abnormality or pathological injury.

Partial or total reconstruction with autogenous or alloplastic material has been used to treat joints with painful symptoms, those anatomically mutilated and those dysfunctional due to surgical procedures failure<sup>4</sup>.

It is also indicated for patients submitted to multiple unsuccessful TMJ surgeries, with infections, chronic inflammations or pathological TMJ resorption, autoimmune diseases and collagen diseases (rheumatoid arthritis, psoriatic arthritis, Sjögren syndrome, lupus, ankylosing spondylitis), ankylosis, sequelae from trauma, congenital deformities (hemifacial microsomia) and tumors in the TMJ region<sup>6,15</sup>.

## ADVANTAGES, DISADVANTAGES AND CONSIDERATIONS

Such dysfunctional and deforming pathologies may significantly change the anatomy of the joint region and of the mandible branch. In addition, mandibular advance and/or counterclockwise rotation may be needed to correct the dental-facial deformity associated to or created by TMJ condition aiming at obtaining satisfactory esthetic and functional results.

These repositioning movements may create a significant space between the fossa and mandibular branch/condyle. For these cases, a total customized joint prosthesis may assure accurate matching to the anatomical structures of each patient individually<sup>16</sup>.

In the autogenous TMJ reconstruction for bone or fibrous ankylosis, there is a great chance of formation of heterotopic bone, reactive bone, and/or fibrosis with new formation of ankylosis, and the high failure rate of autogenous tissues in the TMJ operated on several times indicates that total custom-made prosthesis might be the most effective alternative to repair such structures<sup>6</sup>.

The advantages of alloplastic reconstruction include the possibility of starting physiotherapy in the immediate postoperative

period, and the fact that a graft donor site is not needed thus decreasing surgical duration and possible morbidity, in addition to allowing patients' functional anatomy to be effectively mimicked<sup>17</sup>, as well as shorter hospitalization time and no need for maxillomandibular block in the postoperative period<sup>18</sup>.

Authors advocating the use of custom-made prostheses mention the perfect matching to remaining bone structure generating stability during fixation. In addition, they may be designed to support loads and forces present in different anatomic and functional situations, providing a more foreseeable result on loads generated during each specific situation<sup>9</sup>.

Disadvantages include the high cost of the device, possible material failure, long-term stability, in addition to its restricted use in patients in during the growth phase<sup>17</sup>. Other disadvantages are lack of predictability for surgical review, prosthesis size limit, loss of translation movement causing loss of laterality and protrusion due to lateral pterygoid muscle disinsertion<sup>18</sup>. The loss of lateral movement is generated by the need for condylectomy, lateral pterygoid muscle detachment and subsequent fibrosis and possible formation of heterotopic bone around the prosthesis<sup>6</sup>. In addition, alloplastic prostheses work with hinge movements preventing translation, so lateral movements cannot be performed with current prostheses<sup>10</sup>.

Total prosthetic TMJ reconstruction is advocated for improving pain, function, diet, maximum incisal opening and quality of life. So, the reconstruction of such structure with such devices assures a safe, effective and reliable prosthetic reconstruction of pathological or severely impaired TMJ, provided diagnostic and surgical criteria are carefully evaluated<sup>9</sup>.

Other surgeries may be associated to TMJ reconstruction. Orthognathic surgery associated to the installation of devices for total joint reconstruction allows for occlusal correction and significant improvement of patients' profile. When needed, these procedures should be combined for a satisfactory functional and esthetic result<sup>19</sup>.

Those not favorable to total prosthetic TMJ reconstruction do not consider patients' history. Many patients have ankylosis for years and some since their first year of life<sup>10</sup>. In addition, total TMJ prostheses are built in a way to allow both functional and esthetic improvement assuring stability after treatment<sup>19</sup>.

## DISCUSSION

The higher the number of surgical procedures performed in the TMJ, the lower the chance of significant improvement. Multiple joint surgeries create scar tissue, interrupting normal blood flow and nutritional physiological distribution to anatomic structures. This results in fibrocartilage, bone structures, joint disc, capsular ligament, neurogenic components and associated muscles degradation, which may generate dysfunction, joint pain, headaches, myofascial pain and maxillomandibular deformities<sup>6,7</sup>.

Patients operated on only once or those submitted to surgical procedures have better results<sup>20</sup>. However, those with chronic TMJ pain, operated on multiple times, are a complex population with a unique and challenging problem<sup>4</sup>.

Authors<sup>16</sup> report that 86% of patients submitted to just one surgery or to no previous surgical procedure respond well to treatment, and 14% have acceptable results. From patients submitted to two or more surgeries, 55% have good results, 26% reasonable and 19% poor results.

During the evaluation of 12 patients submitted to total prosthetic TMJ reconstruction, indications for total TMJ reconstruction were ankylosis, degenerative joint disease, condyle resorption and rheumatoid arthritis<sup>10</sup>. Authors<sup>9</sup> have reported that from 61 patients, representing 102 TMJ prostheses, 30 (48.4%) referred trauma as triggering joint symptoms, 4 (6.5%) had developmental problems and the 4 has reported arthritic disorders, 9 (14.7%) had primary masticatory muscle spasm symptoms and 14 patients (22.9%) had disorders of unknown reason.

Most patients were females. In the evaluation of 56 surgical patients, with a total of 100 prosthetic reconstructions, only one patient was male. Mean age was 39 years<sup>16</sup>. From a total of 61 evaluated patients, 57 (93.4%) were females with mean age of 41 years at surgery time and 4 (6.4%) were male, mean age of 41.3 years<sup>9</sup>.

Similar data were observed in different studies where 12 patients were evaluated (9 females and 3 males) with mean age of 29 years. In the evaluation of seven joint reconstruction cases, two patients were males and five females, with mean age of 55.7 years<sup>10</sup>.

In the evaluation of 38 patients treated with total prosthetic TMJ reconstruction, one mandibular component was lost for being fixed with just four 2mm bolts, which were replaced by a new mandibular component stabilized with eight 2mm bolts and remaining stable after 8 years of follow-up. In addition, five patients had heterotopic bone formation needing a new surgical procedure to remove the bone<sup>6</sup>. One patient (0.5%) had to have the implants removed due to pain and edema<sup>9</sup>.

Postoperative complications are minimal and rare. In 12 patients treated with total TMJ prostheses, no patient had postoperative complications and all incisions healed without edema or significant scars. With regard to facial nerve function, there has been decreased function in four nerve branches. Three months after surgery, all patients had recovered normal facial mobility. One patient had profuse bleeding after ankylosis removal, which was well controlled, not generating further complications. Radiographically, there has been no loosening of the fixation system or other complications associated to the fixation system<sup>10</sup>. From five patients, three had mild complications. One patient has reported bilateral paresthesia of the inferior alveolar nerve, which has regressed with time and presented postoperative occlusion class II. Two patients had condyle displacement in the postoperative period, being necessary surgical reintervention under general anesthesia for repositioning and the use of postoperative elastic bands for control<sup>10</sup>. In a postoperative follow-up of 10 years after total TMJ reconstruction in 61 patients, it was observed 71% pain decrease, 62% mandibular function improvement and 60% diet consistency improvement, being all results statistically significant ( $p < 0.001$ )<sup>9</sup>. A different study has also observed statisti-

cally significant improvement of interincisal opening, function and pain. However, there has been worsening of lateral movements<sup>6</sup>. All patients had acceptable mouth opening amplitude with minimum pain, in addition to stable occlusion and lack of open bite. Mouth opening has varied from a mean of 14.4mm preoperatively to a mean of 29.7mm postoperatively. Mean pain has varied from 6.7mm in the preoperative period to a mean of 1.7mm in the postoperative period<sup>10</sup>.

Some authors<sup>11</sup> advocate TMJ replacement by total prostheses to treat structures with severe problems. Others<sup>21</sup> conclude that patients with TMJ implants have altered sensitivity to sensory stimulations, in addition to decreased quality of life, suggesting that surgery for TMJ replacement should not be considered until new evidences proving the efficacy of such methods are obtained<sup>22</sup>.

In addition, the complex anatomy of TMJs is a challenge for their reconstruction and several normal joint movements were still not well reproduced by current artificial joints. However, this type of treatment has been effective for several patients<sup>10</sup>. And in long term follow up, such recommendations have shown to be effective, being advocated by major researchers and surgeons<sup>6,9,18</sup>.

## CONCLUSION

Correct indication and ideal surgical planning are critical as therapy for TMJ alterations. This way, multiple procedures which make the diagnosis unfavorable are avoided.

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