Oral and Maxillofacial Surgery

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Future Vision for CBMF - Virtual Planning

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1. Introduction

The temporomandibular joint (TMJ) is a synovial joint capable of performing complex movements to provide 4 functions; phonation, swallowing, chewing and breathing. Anatomically composed of the mandibular condyle, disc, synovial fluid, ligaments and glenoid fossa [1]. The intra-articular pressure determined by the viscosity of the synovial fluid is approximately 50 mm / hg, to guarantee the movement of the joint.

To better understand the complex physiology of TMJ, it is important to individually analyze the structures that participate directly and indirectly in its formation and integration.

The objective is to be able to relate the binomial form-function, which will help us enormously in the interpretation of Temporomandibular Dysfunctions (DTM).

It seems to us that the dental relations between the maxilla and the mandible are an important factor to maintain the balance of the stomatognathic system and, logically, when these relations are in imbalance, both functional and anatomical, they can cause the collapse of this system.

TMJ has the ability to reshape for life in response to a number of different factors, with different causes and intensities, leading to total or partial functional loss [2-8].

This response capacity is determined by an inflammatory reaction that, if it is constant and in addition to the physiological response capacity, can: decrease the nutrition of the disc, lead to a deficiency of lubrication, proliferation of connective tissue, decrease of lytic enzymes and chondromalacia.

The main inflammatory mediators: interleukins 6, 1Beta, TNF can determine in varying amounts in the synovial fluid and, consequently, they can progress more quickly or slowly to osteoarthritis. The presence of these chemical mediators, enzymatic factors, and neuropeptides determined by synovial cells can determine the qualified course of the response.

The evolution of the process will determine the activation of the degenerative enzymes that cause the breakdown of the synovial cell of the cartilage. There will be an increase in the viscosity of the synovial fluid with the consequent increase in intra-articular pressure [4].

Disc nutrition will be compromised and lead to fibrosis, adhesions and synovitis. Osteoarthritis can progress from a functional condition to a pathological one.

The protein (fibrin) adheres to the synovial surfaces, affecting its response and, consequently, adhesions and connective tissue will form, compromising the movements of the condyle and the disc.

What determines the evolution of pathogenesis: 1) Phenotypic expression of cytokines 2) Metabolism of arachidonic acid and the consequent formation of prostaglandins and leukotrienes 3) Neural control of the process 4) Mechanism of degradation of the extracellular matrix 5) Modulation of the cell adhesion 6) O2 free radicals and heat shock proteins [27, 28].

This pathological condition is determined by the increase in joint load and, as a consequence of intra-articular pressure, determining a muscular insufficiency mainly of the lateral pterygoid. Less serious changes can be treated through a series of clinical procedures. Changes that present a richer clinic may have an indication of intra-articular interventions that can be listed: discopexy, eminectomy. The most complex cases: ankylosis, severe osteoarthritis, arthritis resulting from systemic comorbidity, seek understanding and more challenging surgical proposals.

Among these surgical proposals, widely discussed in the literature, is the autogenous bone graft (rib arch). The complications inherent in this procedure (pleural lesions, pneumothorax, hemothorax, infections and chronic pain in the donor area) have been a factor in the review of the proposal. A highly relevant factor is the inconve-

nience of not being able to control the growth of this type of graft, which can present excessive growth (heterotopic bone) leading to facial skeletal deformity [1].

TMJ prostheses do not present as many complications as autogenous grafts, as reflected in the literature, so they are valid as an alternative for joint reconstruction. Some authors report that the history of alloplastic TMJ reconstruction was characterized by attempts to restore its ideal shape and with the application of biomechanical principles documented in the orthopedic literature in the use of hip and knee joint prostheses [3, 18].

They are indicated for patients who have undergone multiple failed TMJ surgeries, who have chronic inflammation or pathological reabsorption of the TMJ, autoimmune and collagen diseases (rheumatoid arthritis, psoriatic arthritis, lupus, ankylosing spondylitis), ankylosis, sequelae, trauma sequelae, congenital deformities (hemifacial microsomy) and tumors of the articular region [2]. In these cases, reconstruction by installing a TMJ prosthesis has proven to be the best therapeutic option, as it is a safe and viable alternative [6].

Quinn4 mentions the reduction in surgical time, shorter hospitalization time and immediate restoration of function as an advantage for the use of TMJ prostheses, since it does not require a postoperative maxillomandibular block. Regarding the disadvantages that we can mention: the lack of predictability for a possible surgical reoperation and the loss of translation movement that causes loss of laterality and protrusion due to the disinsertion of the lateral pterygoid muscle and the high cost. Wolford et al. the ideal characteristics of a prosthesis such as: biocompatibility, functionality, adaptability and resistance to corrosion stand out.

2. Literature Review

2.1. Prosthetic system

In the past decades, various prosthetic systems have been developed and marketed, but in the long term they have shown unsatisfactory clinical results leading to significant postoperative complications. Currently, only three devices are available for use and approved by the United States Food and Drug Administration (FDA): TMJ Concepts (Ventura CA, USA), TMJ Implants (also known as Christensen) (Golden, CO, USA) and Biomet / Lorenz (Jacksonville, FL, USA) [10].

More recently, a Brazilian company ENGIMPLAN is studying and supporting a new prosthesis that joined Metalise to improve the software and printers to give quality to total prostheses.

TMJ Total Replacement Systems are "ball-fit" prosthetic joints similar to hip or femur prostheses in all systems studied [12].

In relation to the currently available prosthesis system, they are made up of three main components [22]:

(1) fossa component (temporal): formed by a high molecular content polyethylene (UHMWPE) designed to replace the temporal fossa with a titanium base and an articular eminence of the temporal bone. Available in three sizes: small, medium and large.

(2) Mandibular component: designed to replace the mandibular condyle and made of a cobalt-chromium alloy coated with a layer of titanium plasma to promote bone integration. Presented in three sizes: 45mm, 50mm and 55mm.

(3) Fixing screws: 6AL / 4V titanium compounds, the screws are self-drilling and self-retaining to facilitate insertion and stabilization. The screws of the temporary component have a diameter of 2.0 mm and those of the mandibular component are 2.7 mm. Unlike orthopedic systems that have alternative fixation components, ATM prostheses can only be fixed with screws.

2.2. Indications

The data available in all studies suggest that the main indication for total TMJ replacement is the presence of severe joint damage or mutilation that may be the result of different types of severe joint diseases or the failure of previous surgeries [12, 14, 22].

Most authors believe that all patients who are candidates for joint reconstruction should undergo clinical and imaging tests (panoramic radiography, computed tomography (CT), and, if necessary, magnetic resonance imaging (MRI)) that allow the diagnosis of serious changes such as ankylosis, condylar resorption and sequelae of trauma or previous surgical procedures, as presented as inclusion criteria in several studies analyzed. [12, 13, 14].

2.3. Surgical procedure

The prosthetic surgical installation follows a protocol well described in the literature by a series of authors [5, 13- 17]. Using, specifically, the surgical procedures described by Leandro et al and De Souza et al [13, 14], the following protocol is briefly described.

All patients should undergo general anesthesia with nasotracheal intubation and complete muscle relaxation. During anesthetic induction, a prophylactic antibiotic and a steroidal anti-inflammatory are administered.

After infiltration of a local anesthetic with a vasoconstrictor in the pre-auricular region, access to the surgical site is made through a preauricular incision, dissection of the superficial muscle layers, carefully identifying and preserving the facial nerve, until the capsule is identified. articulate to which it is incised. in its lateral portion to expose the region of the joint (condyle and articular fossa).

Under constant irrigation, a condylectomy or removal of the bone block from the joint region is performed. In the case of movement restrictions or if mandibular advances have been planned, a second osteotomy, a coronoidectomy, can be performed.

The mandibular fossa is flattened and the template of the temporary component of the prosthetic system can be adapted and installed after verifying stability and parallelism with the zygomatic

arch, in the case of common prostheses. In the case of personalized prostheses, only the correct planned adaptation must be observed

Maxillomandibular block (IMF) is performed to preserve or restore vertical dimension and occlusion. The mandibular branch is then accessed through a Risdom incision and communication between the accesses is obtained. The lateral surface of the mandibular ramus is smoothed (if necessary) and the mandibular component can be installed. After this placement, the temporary component can be installed.

The intermaxillary block is then removed and occlusion, vertical dimension, and mandibular movement should be verified.

The accesses are then carefully cleaned with saline and then closed with 4-0 absorbable sutures (polyglactin 910) for the deep layers and 5-0 nylon for the skin. In the opinion of several authors, there was no need for postoperative intermaxillary block (IMF). Postoperative medications (antibiotics, anti-inflammatories, and pain relievers) should be prescribed to all patients [26].

2.4. Expected Therapeutic Results

In general, the therapeutic results of the different types of TMJ prostheses reported in the literature tend to vary between the authors, basically due to the types of evaluation performed, the perception of the patients and the protocols applied or not in relation to physiotherapy. postoperative.

Despite the appearance of complications that require a surgical reintervention, they are not numerous, the authors report a significant improvement in objective (interincisal distance) and subjective parameters (pain intensity and mandibular function) with a significant reduction only in laterality values. .

Different studies have demonstrated an acceptable mandibular opening with minimal pain discomfort and absence of signs of implantation failure demonstrated by occlusal stability and the absence of open bite. The studies also showed acceptable results in relation to the maximum opening of the mouth before and after surgery, with an average follow-up of 6 years. The dental occlusion proved to be stable.

Regarding pain, the authors show a statistically significant drop in patients who refer it in cases where physiotherapy is applied early. Functional movements such as the mandibular opening in the preoperative and postoperative periods were approximately 30 mm. With reference to facial nerve injury, few cases have been reported and when they are present for a limited time.

2.5. Postoperative Follow-up

After discharge, patients are guided to start, after 24 hours after surgery, mandibular movement exercises and the choice of diet to the comfort of the patient.

Intense physical therapy should be started 48 hours after the procedure. In the first 2 weeks after surgery, physical therapy should consist of opening and closing movements and stimulation for the maximum opening of the mouth, keeping the mouth wide open for a few seconds.

From the third week, exercises should be introduced to force the opening of the mouth with the help of wooden spatulas inserted between the posterior teeth bilaterally, alternating the sides or simultaneously, keeping them in position for 2-3 minutes. The proposed therapy is carried out in weekly sessions for a minimum period of 2 months. Patients are encouraged to continue the exercise routine at home, performing them 3-5 times a day for a period of at least 12 weeks.

For clinical evaluation, each patient should be monitored weekly for the first two months after the surgical procedure. After that period, evaluations are done monthly up to 12 months after surgery, and then annually to assess progress.

Imaging examinations are performed at the first postoperative evaluation, after 6 months, and at annual visits after surgery, respecting the ALARA radiographic principle ("As Low As Reasonably Achievable", as low as possible) to minimize exposure to radiation.

3. Discussion

TMJ can be compromised as a result of a series of changes / loads that can significantly compromise the functioning of the stomatognathic system [3, 5]. In most cases, the TMJ and the muscles associated with it can present a series of signs and symptoms: pain in the pre-auricular region and / or mastigatory muscles, abnormal movements of the jaw, joint sounds (clicks and / or crackles)) during movement, otalgia, neck pain, headache, which give rise to what is called temporomandibular disorder (TMD) [7-10, 12].

These cases are generally treated by clinical procedures, such as the installation of intraoral devices, physical therapy, the correct reestablishment of occlusal contacts, pharmacotherapy and psychological treatments, which can promote the remission of clinical symptoms and restore the patient's quality of life [8 10].

However, TMJ can also be affected by more serious changes as a result of trauma (direct or indirect), pathological processes or even in response to incorrect clinical treatment for TMD, leading to limiting or even disabling dysfunction, compromising the functions of the system, facial aesthetics, difficulty in performing dental treatment, impacting the psychological development of the patient. In these cases, the indicated therapy is surgical treatment of the joint [1, 8, 9, 12].

Indications for TMJ surgery are osteoarthritis, systemic degenerative joint disease (rheumatoid arthritis, psoriatic arthritis, lupus, ankylosing spondylitis), condylar fractures, neoplasms, growth deformity, fibrous / bone ankylosis, and sequelae of previous trauma or joint surgery [1, 8, 9, 13].

In some cases, clinical evaluations and imaging studies lead to a diagnosis of severe joint alteration with concomitant and significant structural damage to anatomical components, for which more conservative surgical procedures such as arthroplasty, eminectomy or discopexy would be ineffective [8].

The restoration of the functions of the TMJ and the subsequent functional and / or aesthetic rehabilitation depend, therefore, on more aggressive procedures that aim to reconstruct the compromised joint structures [7, 8, 10, 11, 19].

For many years, the autologous graft technique was used for TMJ reconstruction using autogenous bones such as the fibula, metatarsals, clavicle, iliac crest, and rib.1 However, these procedures are associated with serious disadvantages and complications. . In addition to morbidity caused by the need for a second surgical site (donor area), the long period of hospitalization required, difficulty in placing the grafts (such as metatarsal bone fragments), overgrowth of the costochondral graft, malocclusion, and recurrent ankylosis led to the search for new surgical options [20, 21].

With this in mind, in recent decades, a number of alloplastic prosthetic systems have been developed for TMJ reconstruction. Compared with autogenous grafts, prosthetic systems have numerous advantages, such as the absence of morbidity at the donor site, the reduction of intraoperative surgical time, the possible decrease in hospitalization time, immediate functional movement and the maintenance of a postoperative occlusion stable.

Currently, TMJ prosthetic systems are available: TMJ Concepts, Biomet / Lorenz Microfixation TMJ Replacement System and Engimplan Most of the data in the literature comes from a series of case descriptions or clinical trials of the three systems presented. However, despite the small number of studies, the results obtained from these systems were generally satisfactory, which encouraged their use.

The various published studies of clinical experiences with variable periods, some long, demonstrate the effectiveness of the procedure. Taking into account the considerable improvement in the variables studied (MAI, function and fonation, diet and pain)

Correct surgical planning and proper technique are essential to obtain good results, since the articular approach is generally performed through a distorted anatomy, which increases the risk of complications such as scar formation, damage to facial nerves, alterations taste buds, perforation of the external auditory canal, perforation in the middle cranial fossa and “intense” hemorrhage from the infratemporal medial fossa.

The choice of prosthetic system is also of great importance for the proper recovery of the patient. The composition of the prosthetic components also seems to have a great influence on the postoperative results. The temporary component must be composed of a high-density polymer with a mixture of titanium foil. Current experience with complete TMJ prostheses with a metal-to-metal interface has resulted in obvious signs of wear metastasis.

Given the risks in using metal-to-metal joint prostheses, studies in the orthopedic area led to the development of new prosthetic knees and hips that articulate metal or ceramic components with UHMWPE, obtaining higher success rates [5, 24].

Laboratory studies submitted to the FDA that simulate their use over a 20-year period have shown no significant signs of wear on the prosthetic components [17, 26].

4. Conclusion

It can be concluded that, recently, the installation of TMJ prosthetic devices has increased substantially to resolve cases of severe joint changes. This is directly related to the development obtained over time in relation to biomechanical and biocompatibility principles, which makes its use safe and reliable, with satisfactory results.

In our study of 300 patients who underwent this procedure using the Biomet / Lorenz reconstruction system over a period of 10 years, and more recently with the Engimplan prosthesis, significant results were achieved in the recovery of mandibular functions and the reduction of pain level. , confirming the results of some previously published studies, which encourages its use as an option in cases where total reconstruction of the TMJ is necessary.

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