

**Ankylosed temporomandibular joint replacement with custom total joint prosthesis and custom miniplates**

**Tratamento de anquilose da articulação temporomandibular utilizando miniplacas customizadas e próteses articulares customizadas**

**Reemplazo de la articulación temporomandibular anquilada con prótesis total y mini placas personalizadas**

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**Resumo**

No Tratamento de uma anquilose articular bilateral em um paciente com histórico de múltiplas cirurgias corretivas desde a fase de desenvolvimento, é necessário além da substituição total da articulação por uma prótese articular de mandíbula a cirurgia ortognática. Paciente do sexo masculino, 44 anos, com anquilose bilateral da articulação temporomandibular, onde a anatomia foi completamente substituída por grande massa óssea, foi tratado utilizando cirurgia ortognática com guias de corte personalizadas e material personalizado para fixação da maxila, mandíbula e mento, além da instalação de duas próteses

articulares customizadas em uma cirurgia de estágio único. Miniplaca e prótese customizadas da articulação são o estado da arte em cirurgia. Este é o primeiro relato na literatura utilizando miniplacas e próteses articulares personalizadas concomitantemente para o tratamento da anquilose. O tratamento foi bem sucedido e o paciente se beneficiou de estética e função adequadas.

**Palavras-chave:** Substituição total de articulação, Anquilose, Cirurgia ortognática, Dispositivos para fixação cirúrgica, Miniplacas customizadas.

### **Abstract**

When managing a severely ankylosed joint in a patient with a history of multiple previous operations since the development phase, it is necessary besides the total joint replacement also the orthognathic surgery. Custom miniplates and total joint custom-made prosthesis are the state of arts in accuracy and precision; therefore use them concurrently in a complex surgery, such this, is a suitable treatment option. A 44-year-old male patient with bilateral temporomandibular joint ankylosis where the TMJ architecture was completely replaced by a large bone mass was treated through orthognathic surgery with customized cutting guides and customized material for maxilla, jaw and chin fixation, in addition to the installation of two complete custom-made joint-prosthesis in one-stage surgery. This is the first report in the literature using custom Miniplates and Joint-Prosthesis for treatment of Ankylosis. The treatment was successful and the patient benefited from adequate aesthetics and function.

**Keywords:** Total joint replacement; Ankyloses; Temporomandibular joint; orthognathic surgery; Surgical fixation devices; Custom-made miniplates.

### **Resumen**

En el tratamiento de la anquilosis articular bilateral en un paciente con antecedentes de múltiples cirugías correctivas desde la fase de desarrollo, se requiere cirugía ortognática además del reemplazo total de la articulación con una prótesis articular. Un paciente masculino de 44 años con anquilosis de la articulación temporomandibular bilateral, donde la anatomía fue completamente reemplazada por una gran masa ósea, fue tratado mediante cirugía ortognática con guías de corte personalizadas y material personalizado para fijar el maxilar, la mandíbula y el mentón, además de instalación de dos prótesis articulares personalizadas en una sola etapa de cirugía. Las miniplacas y las prótesis articulares personalizadas son lo último en cirugía. Este es el primer informe en la literatura que utiliza miniplacas y prótesis articulares personalizadas concomitantemente para el tratamiento de la

anquilosis. El tratamiento fue exitoso y el paciente se benefició de una estética y función adecuadas.

**Palabras clave:** Anquilosis; Cirugía ortognática; Reemplazo total de la articulación; Dispositivos de fijación quirúrgica; Mini placas personalizadas.

## 1. Introduction

The Ankylosis of the temporomandibular joint is a rare disease resulting from the fusion of the mandibular condyle with the base of the skull, involving anatomical and clinical changes. When it is bilateral and from childhood can cause severe retrognathia (Manemi et al., 2009).

Customized orthognathic surgery plates have been increasingly used to transfer the planned movements virtually to the transoperator accurately (Brunso et al., 2016). Customized temporomandibular joint prosthesis is indicated for total ankylosed joint replacement in patients who have failed to respond to conservative and minimally-invasive treatment. It can improve dietary scores, maximum mouth opening, and pain. Its improved anatomical fit makes it more functional and aesthetic than the stock prosthesis, besides allowing the correction of the growth deformity caused secondarily to the temporomandibular joint ankylosis (Sidebotton & Gruber, 2019).

Reconstruction in a single time is possible and benefits the patient and the surgeon. (Manemi et al., 2009), Sidebotton & Gruber, 2019).

## 2. Methodology

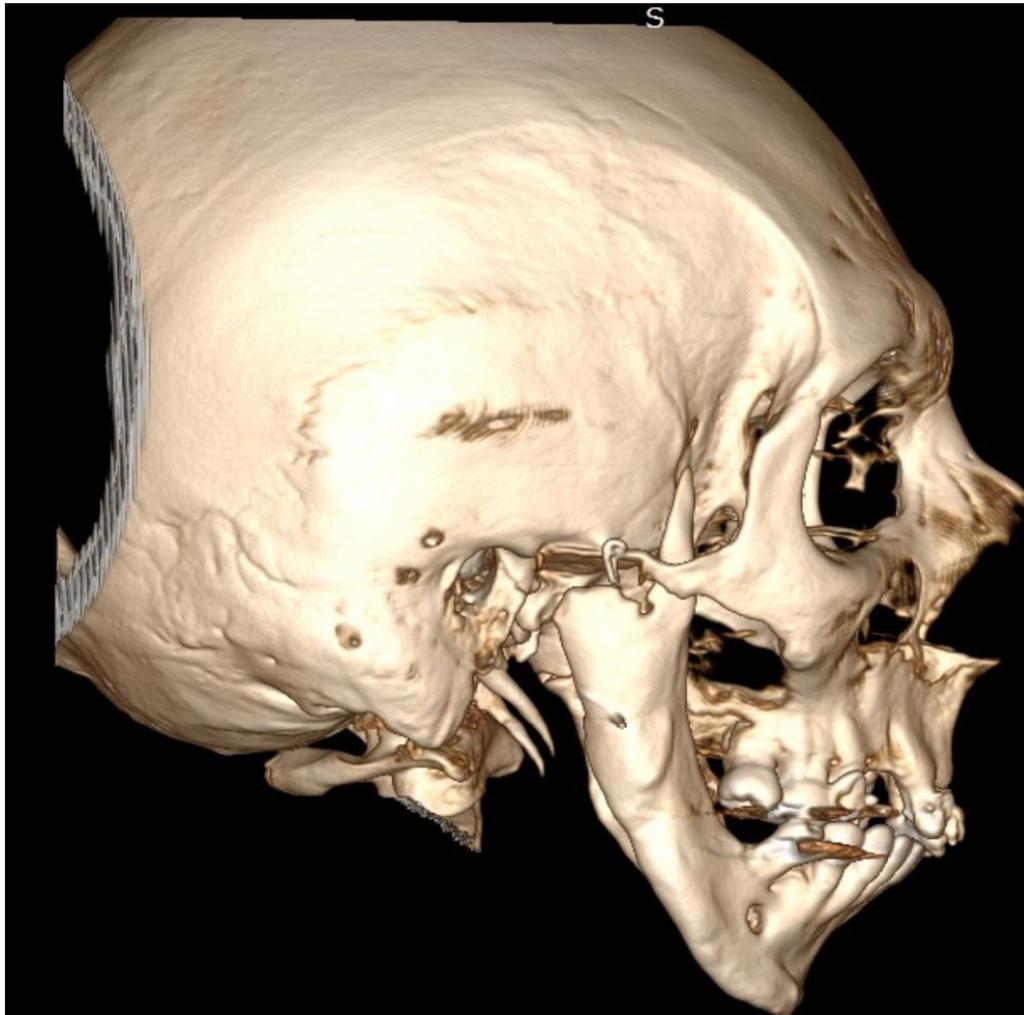
This is a descriptive qualitative case study, your particularity is the fact that it is the first report in the literature of a clinical case using custom-machined miniplates and customized total joint prostheses, in a single-stage surgical treatment for the treatment of bilateral ankylosis. (Pereira et al., 2018).

Because the patient does not open his mouth, dental scanning is not possible, and due to ankylosis is difficult to define anatomically in the software the modeling of the joint component. These two steps necessary for virtual planning are extremely important in a complex case like this, where any change in the planned position can cause major mismatches in joint prostheses.

### 3. Case Report

Male patient, melanoderma, 44 years old, with bilateral temporomandibular joint ankylosis, where the TMJ anatomy was totally replaced by large bone mass. It was subjected to multiple previous treatments such as: Interpositional arthroplasty and a costochondral graft in a pediatric patient, interpositional arthroplasty and coronoidectomy in adulthood.

**Figure 1** - 3D Reconstruction of Ankylosis of the temporomandibular joint resulting from the fusion of the mandibular condyle with the base of the skull.



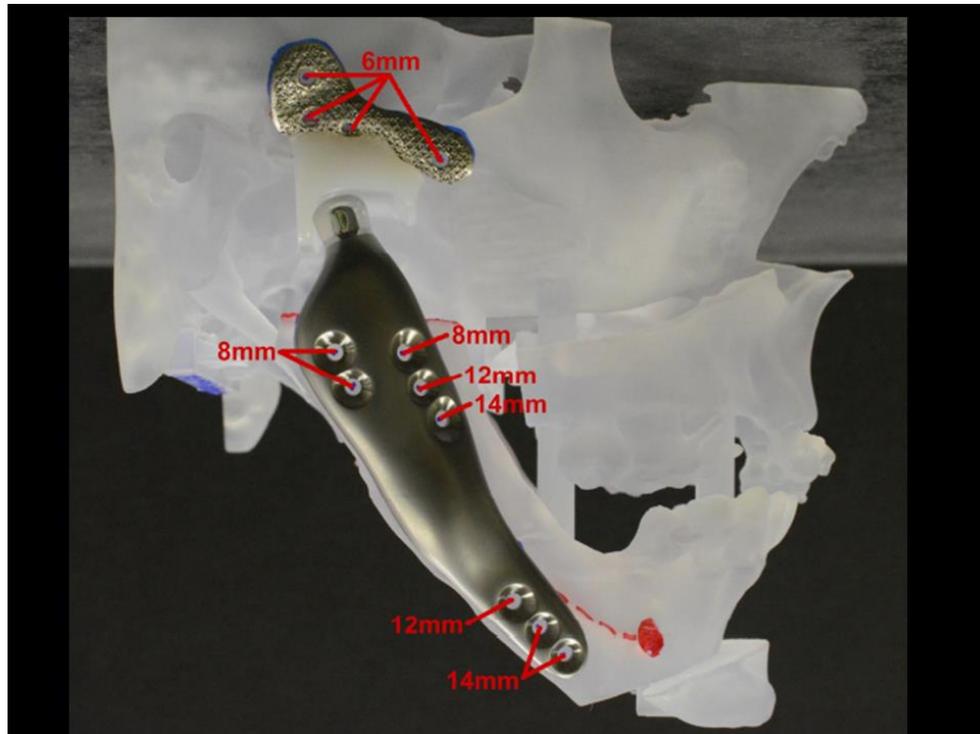
Source: Doctor José Thiers Carneiro Júnior, 2019.

We can see in Figure 1, temporomandibular joint ankylosis, where the TMJ anatomy was totally replaced by large bone mass. It was subjected to multiple previous treatments.

The proposed treatment was orthognatic surgery with virtual planning and creation of customized cutting guides and fastening material for maxila, mandible and chin (CPMH,

Brasília, Brasil). Concomitant with removal of ankylosed bone mass and bilateral total joint prosthesis (TMJ Concepts, Ventura, USA), that replaces the condylar head and glenoid fossa.

**Figure 2** - Pos-operative stereolithography model. Custom-made fossa prosthesis and mandibular ramus prosthesis.



Source: TMJ Concepts, 2019.

We can see in Figure 2, the final test of the prosthesis adapted in 3D biomodel with postoperative movements. This image will serve as a visual guide for the surgeon to position the prosthesis, and also a visual guide for the length and position of the screws to be installed.

For virtual planning we use the software Dolphin imaging 11 (Dolphin, Chatsworth, USA), which uses 3- dimensional CT to enable CAD-CAM construction. The files generated for pre and pos-operative stereolithography (STL) allowed the modeling in the 3-matic software (Materialise, Leuven, Belgium) to make the cut guides printed in 3D with bio-compatible and autoclavable Dental SG resin (Formlabs, Somerville, EUA) used for osteotomies of maxilla, mandible and chin, as well as the basis for the manufacture of individual titanium-machined fixation components ( Júnior et al., 2018). The TMJ prosthesis (titanium, cobalt-chromium-molybdenum, and ultra-high-molecular-weight polyethylene) were modeled in the 3D biomodel with postoperative movements (maxillary advancement of 4 mm, anticlockwise rotation of the occlusal plane, mandibular advancement of 9 mm and chin advancement of 6 mm). In this way the patient reestablished aesthetic (improvement of

facial profile) and function (correction of mandibular maxillary discrepancy and increase of airways) (Johnson et al., 2017).

#### 4. Surgical Procedure

Surgery performed under general anaesthesia with naso-endotracheal intubation. Pre-auricular and retro-submandibular approaches were made to expose the TMJ, zygomatic arch, mandibular condylar head and mandibular ramus. Surgical templates were and optimal fit was achieved. Osteotomies were traced by piezo electric piece. A resection of the ankylosed process was performed.

**Figure 3** - Pre-auricular and ankylosed process.



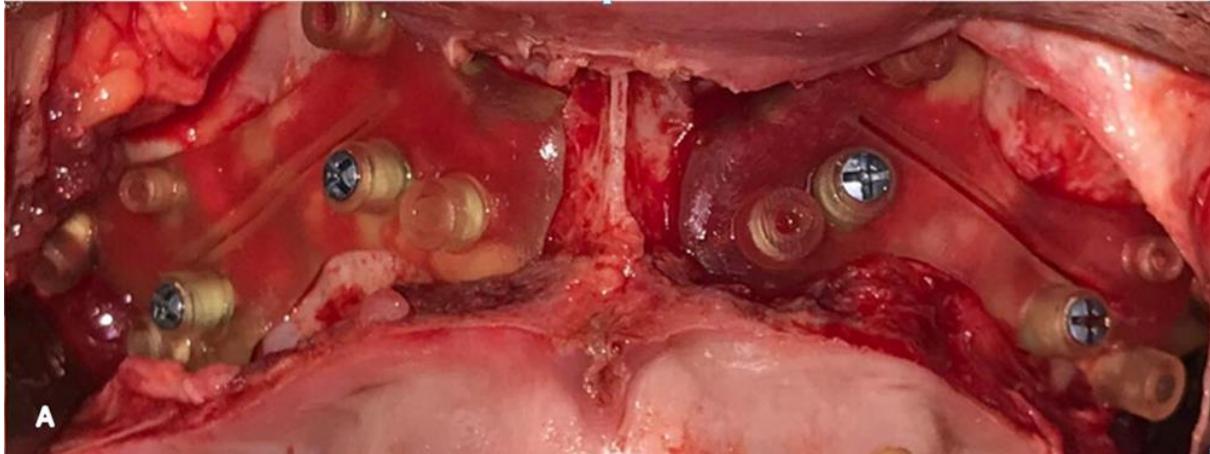
Source: Doctor José Thiers Carneiro Júnior

We can see in Figure 3, Ankylosis of the temporomandibular joint resulting from the fusion of the mandibular condyle with the base of the skull.

A maxillary vestibular incision was made for exposure of the maxillary bone. Before the Le Fort I osteotomy, the bone-supported guides were inserted to make the drilling guides

for the miniplates. The Le Fort I osteotomy was performed according the guides and the maxilla was released. Custom-made machined miniplates have a format according to the anatomic bone structure of the patient and are fixed to the maxillary fragments so that all holes of the miniplates correspond to the holes made with the guides positioning the maxilla at the planned site.

**Figure 4 - A - Bone-supported guide.**



Source: Doctor José Thiers Carneiro Júnior, 2019.

We can see in Figure 4 A, guides were inserted to make the drilling guides for the miniplates).

**Figure 4 B - Maxillary custom-made miniplate. 2.0 System.**



Source: Doctor José Thiers Carneiro Júnior, 2019.

We can see in Figure 4 B, all holes of the miniplates correspond to the holes made with the guides positioning the maxilla at the planned site.

The custom-made fossa prosthesis was then inserted and secured with screws of individual length according to the virtual plan.

Patients' occlusion was stabilized using intermaxillary splint and then mandibular ramus prosthesis was inserted and secured with the screws of individual length using the same holes previously drilled for the cutting guide fixation (Setembronio et al., 2019).

**Figure 5** - Pos-operative Custom-made fossa prosthesis and mandibular ramus prosthesis.



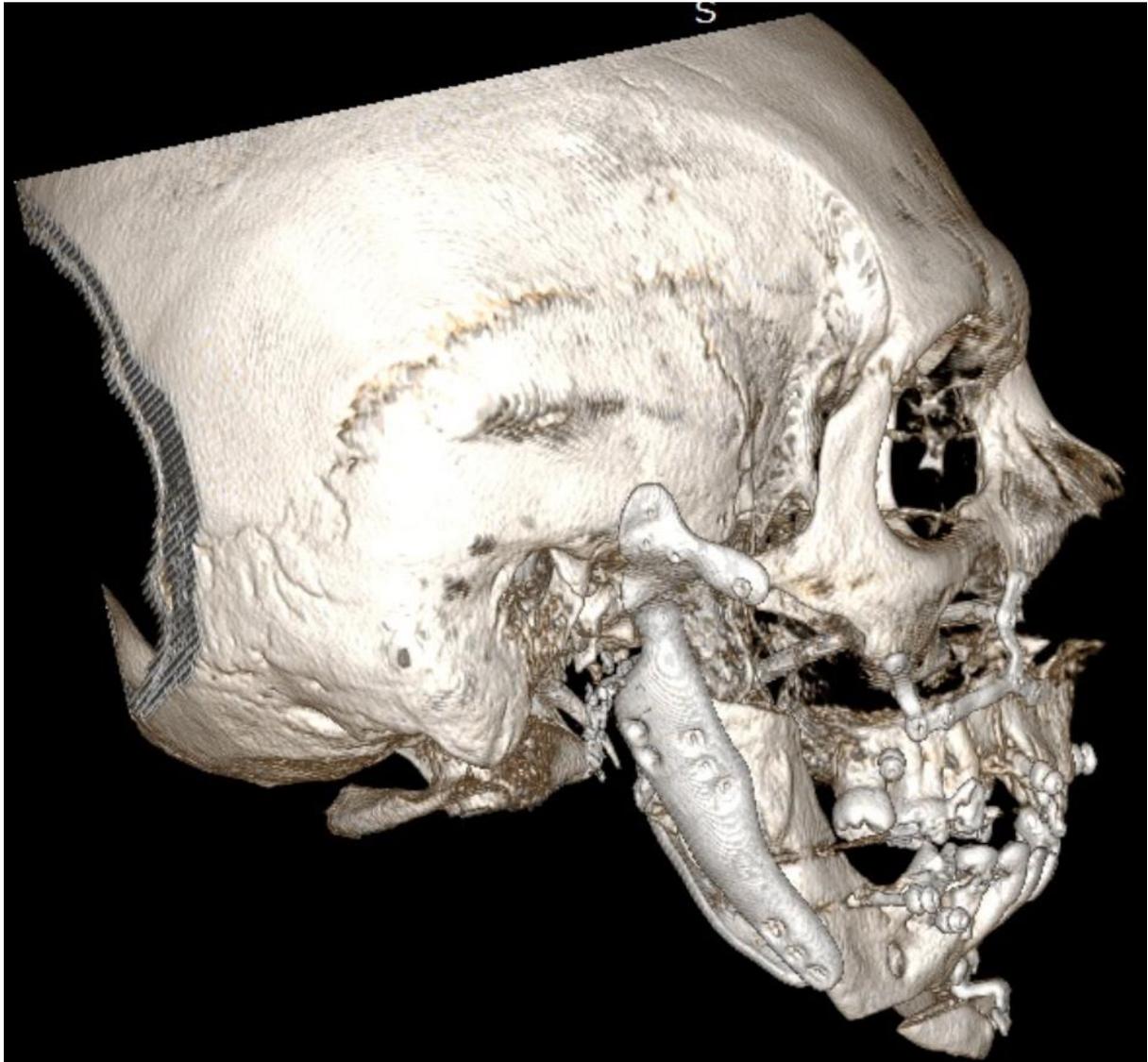
Source: Doctor |José Thier Carneiro Júnior, 2019.

We can see in Figure 5, Pre-auricular and retro-submandibular approaches, custom-made fossa prosthesis and mandibular ramus prosthesis

Fat removed from the patient's abdomen was inserted over the joint component and the multi-layer closure of the wounds was performed.

The postoperative included physical therapy rehabilitation and oral administration of antibiotic, anti-inflammatory, analgesic and myorelaxant.

**Figure 6** – Postoperative 3D reconstruction.



Source: Doctor José Thiers Carneiro Júnior, 2019.

We can see in Figure 6, the good adaptation of the prostheses and customized mini plates, replicating the virtual planning.

## **5. Final Considerations**

When managing a severely ankylosed joint in a patient with a history of multiple previous operations since the development phase, it is necessary besides the total joint replacement also the orthognathic surgery. Custom miniplates and total joint custom-made prosthesis are the state of arts in accuracy and precision; therefore use them concurrently in a complex surgery, such this, is a suitable treatment option.

The treatment of TMJ ankylosis with orthognathic surgery and prosthesis, in most cases start by mandible, because it is easier to make small adjusting when we do the fixation of maxilla using conventional miniplates. That without compromising aesthetics and function.

Therefore, if you will use a maxilla custom miniplate, it is better to start surgery by maxilla, due to the fact, that the customized maxilla miniplate does not accept any change in positioning, and in cases of TMJ prosthesis, even though it is customized it will probably have some millimetric movement of the planning, due to difficulty of cutting and fitting the prosthetic joint cavity in the ideal position, affecting occlusion and causing displacement of the prosthesis.

Starting the surgery by the maxilla with custom miniplate, when place the TMJ prostheses, we make the intermaxillary block and we can easily correct small changes in positioning and finish the case well.

#### **Conflict of interest**

We have no conflicts of interest.

#### **Ethics statement/confirmation of patient's permission**

Ethics approval not applicable. The patient's permission was obtained.

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#### **Porcentagem de contribuição de cada autor no manuscrito**

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