

# An Alternative Approach for Treating Severe Injured Temporomandibular Joints by Gunshot Wounds

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## Abstract

Temporomandibular joint (TMJ) reconstruction is a challenging clinical problem that has been revolutionized due to the development of total alloplastic TMJ replacement (TMJ-TJR); however, the costs are still very high. We used an alternative approach to treat comminuted mandibular condyle fracture with an unviable condyle head caused by gunshot wounds. Our surgical technique consisted of an extended preauricular incision; removal of the fractured condyle, bone fragments, and foreign bodies; reshape/flattening of the fracture edge; fixation of the articular disc (if viable); lining of the TMJ with temporalis muscle/fascia; application of Erich arch bars; and early elastic therapy. We successfully used this approach in five sequential cases that resulted in a good mouth opening (>35 mm) and satisfactory occlusion with teeth in maximum intercuspation. We believe that this technique is an excellent option for treating severe injured TMJs in places where TMJ-TJR is not available.

**Keywords:** Condylar fractures, facial fractures, gunshot wounds, temporomandibular joint, temporomandibular joint reconstruction

## INTRODUCTION

Temporomandibular joint (TMJ) reconstruction is one of the most important clinical challenges in maxillofacial surgery, but the development of total alloplastic TMJ replacement (TMJ-TJR) was a watershed for TMJ treatment.<sup>[1]</sup> TMJ-TJR opened a new bunch of options for treating severely compromised TMJs and allowed surgeons an effective and predictable way to reconstruct these joints improving the patients' quality of life by either ameliorating or extinguishing the symptoms and recovering jaw function.<sup>[2]</sup> TMJ-TJR using alloplastic prosthesis was started in the 1990s and since that time it has been growing in popularity worldwide in the maxillofacial field. Although it is believed that the costs of long clinical treatment can be comparable, TMJ-TJR is still costly.<sup>[3]</sup>

In Northern Brazil, the prevalence of facial fractures caused by gunshot wounds is high (14.4%), which is even worse than those observed in war zones.<sup>[4]</sup> In our clinical practice, we identified a group of patients who presented with a pattern

of mandibular fractures caused by gunshot wounds that have directly affected the TMJ. In these cases, we observed a comminuted mandibular condyle fracture with or without the presence of a foreign body (projectile or its fragments). All proximal fragments (condyle head) were not viable for fracture reduction.<sup>[1]</sup> In our view, these cases present a clear indication for total TMJ-TJR at an appropriated time; however, the Brazilian public health system does not include this type of treatment in its list of procedures, especially because of the high cost associated with the prosthesis itself. Treatment costs are very important in public health, especially in low-income

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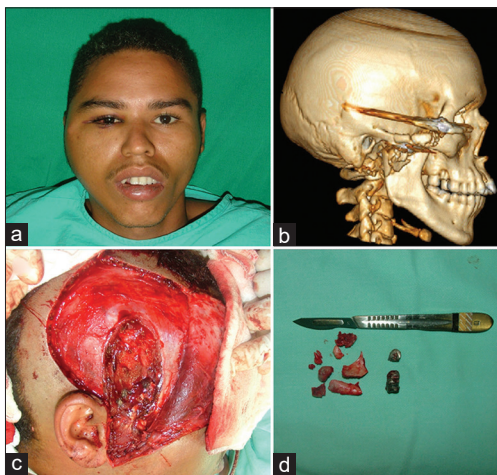
countries, and alternative options that make treatment cheaper are valuable.<sup>[5]</sup>

By dealing with this complex and restricted situation, we found an alternative approach to manage these cases in a way that showed reasonable and acceptable results. A few “traditional” concepts (because of the current trend in treating TMJ ankylosis with TMJ prosthesis) were used from a well-known protocol for the treatment of TMJ ankylosis suggested by Kaban *et al.* in 1990<sup>[6]</sup> to adapt and to treat these patients.

### SURGICAL APPROACH

Using the inclusion criteria previously described (mandibular condyle fracture with nonviable condyle head and caused by

a gunshot wound), we reviewed >3000 patients with facial fractures and our final sample consisted of five cases. We excluded cases that did not have this pattern of condylar fractures and did not have a reasonable number of teeth and stable occlusion that allowed us to apply the Erich arch bars and elastic therapy. These patients presented with similar



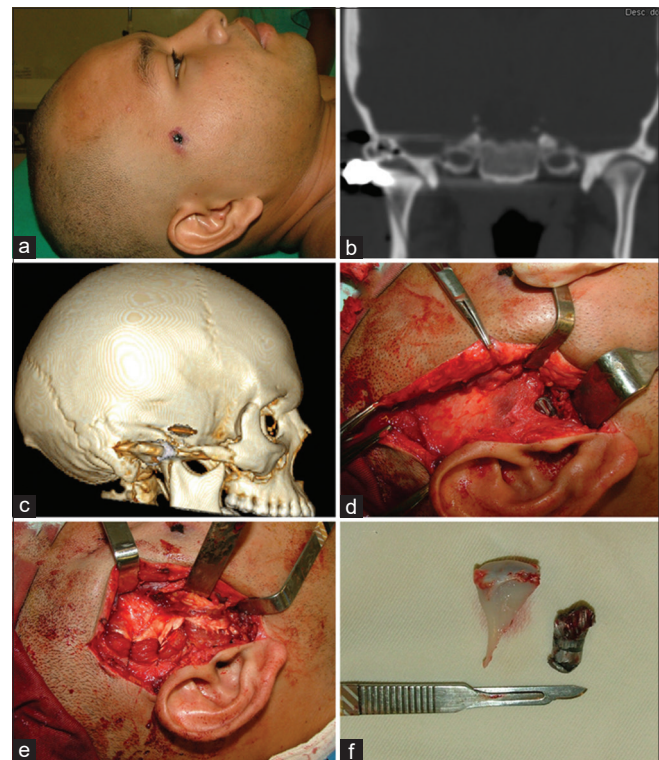
**Figure 1:** Frontal view of the patient (a). A three-dimensional reconstruction from computed tomography scan showing a comminuted fracture of the right condyle and a foreign body (projectile) (b). Lining of the temporomandibular joint with temporalis fascia (c). Removed bone fragments and projectile (d)



**Figure 3:** Postoperative frontal view 2 months after surgical treatment (a). Immediate postoperative three-dimensional reconstruction from computed tomography scan (b). Maximum intercuspation was maintained after the end of the elastic therapy and maintained after 6-month follow up (c). Unforced mouth opening (d)

Step-by-step surgical technique	
1	General anaesthesia through nasotracheal intubation
2	Application of Erich arch bars
3	Preauricular incision with temporal extension
4	TMJ exploration with confirmation of unviable condyle head, usually due to fracture comminution
5	Removal of the condyle head and other foreign bodies
6	If the disc is not too damaged, it is kept for further use (see step 8)
7	Flattening/reshape of the distal fragment with a drill Fixation of the remaining disc with two 1.5 mm screws
8	placed distally and laterally to the mandibular ramus and sutures with 2-0 nylon on the screw and disc
9	Creation of temporalis fascia and muscle flap Lining of the temporal flap on the TMJ and its suture to muscle/connective tissues medially to the mandibular ramus using 2-0 nylon sutures
10	
11	Layered wound closure

**Figure 2:** Step-by-step description of the surgical technique



**Figure 4:** Lateral view of the patient and entry gunshot wound (a). Coronal cut and three-dimensional reconstruction from computed tomography scan showing a head condyle fracture on the right side including a foreign body (projectile) (b and c). Surgical approach (d) and lining of the temporomandibular joint with temporalis fascia (e). Removed bone fragment and projectile (f)



clinical parameters preoperatively as shown in Case 1: limited mouth opening, pain, edema, and malocclusion with premature occlusal contact on the affected side [Figure 1].

### Case 1

A 19-year-old male patient who was a victim of a robbery and was hit by a gunshot with an entry wound behind his ear presented with a right comminuted condylar base process and zygomatic arch fractures [Figure 1]. This study was approved by the Local Research Ethics Committee under approval number 524680, and all participants signed informed consent agreement. The patient who appears on the images has signed informed patient consent authorizing the publication of his images.

All patients required immediate treatment to prevent site infection and were treated with the same surgical procedure [Figure 1c and d] that consisted of an extended preauricular incision, removal of the proximal and fractured small bone fragments (including the condylar head), removal of any foreign body, reshape/flattening of the fractured surface of the distal fragment, fixation of the remaining disc (if viable) with a nylon 2-0 sutures anchored to two 2.0 mm screws (inserted posteriorly and laterally to the condyle neck), lining of the TMJ with temporalis fascia, application of Erich arch bars, and early elastic therapy. Figure 2 shows a step-by-step description of the surgical technique.

All patients showed a similar outcome: a good mandibular motion (>35 mm), satisfactory occlusion with teeth in maximum intercuspation, deviation to the affected side during mouth opening, slightly roll rotation of the occlusal plane, painless, and no infection.

Reduction in the mandibular ramus height was compensated by muscular and dental adaptations.<sup>[7]</sup> Maximum intercuspation resulted from dental extrusion on the unaffected side and dental intrusion on the affected fracture side, causing a small rotation of the occlusal plane. Despite that, dental adaptations were mild and did not cause any periodontal or noticeable esthetic problem. Elastic therapy was monitored twice a week and was started with 2–3 Class II elastic bands, gradually removed until patients could keep a stable and reproducible occlusion, which lasted a maximum of 4 weeks. Patients were followed-up for a period of 6–12 months, and their occlusion and mouth opening were monitored. None of them showed any important reduction in mouth opening or premature occlusal contact/open bite as shown Figure 3 that describes the findings of Case 1.

### Case 2

A 20-year-old male patient who was a victim of a robbery and was hit by a gunshot on his zygomatic arch presented with a right comminuted condylar head and zygomatic arch fractures. The treatment was the same as described before and included the removal of the bullet and the condylar head and lining of the temporal fascia/muscle over the TMJ [Figure 4]. Postoperative findings included a slight deviation of the mouth opening to the left side, good maximum mouth opening, and slight dental adaptations.

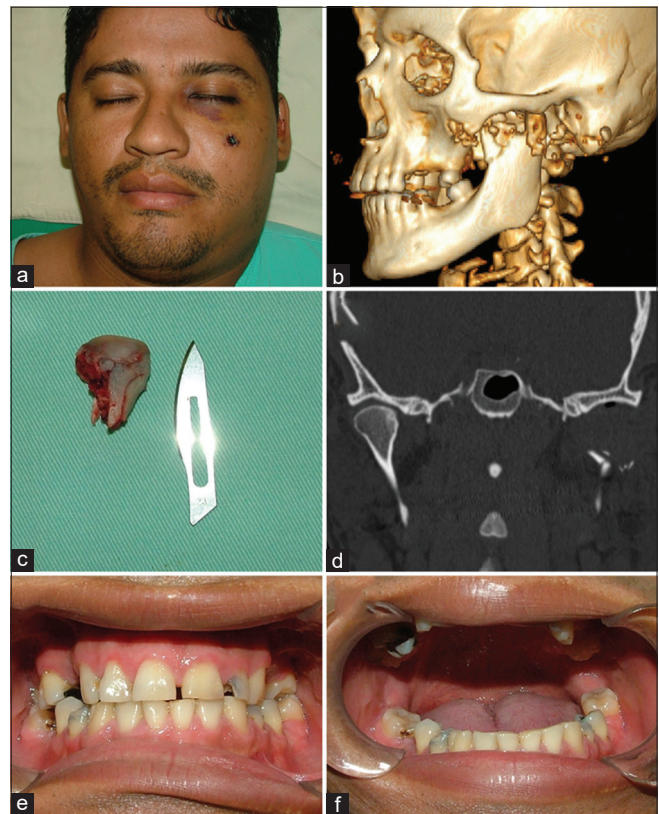
### Case 3

A 32-year-old male who was hit by a gunshot on his left cheek after a fight on the street presented with a left condylar head and left coronoid process fractures. The treatment was the same and included the removal of condylar proximal fragment and the other described steps of the technique [Figure 5]. Postoperative findings included deviation of the mouth opening to the left side, return to a pretrauma dental occlusion, 40 mm of maximum mouth opening, and left palpebral muscle weakness.

Patients' demographic data, fracture types, and the postoperative findings of the five cases included in this manuscript are shown in Table 1.

## DISCUSSION

Although we support the idea that TMJ-TJR may be the best option for such situations, it is not available in several public health systems, mainly because of the high costs of this device.<sup>[3]</sup> When the best options are not available, surgeons may have to use alternative approaches to treat their patients in the best way possible.



**Figure 5:** Frontal view of the patient showing the anterior wound caused by the gunshot (a). A three-dimensional reconstruction from computed tomography scan showing a comminuted fracture of the left condyle and coronoid process (b). Removed bone fragment (comminuted condylar head) (c). Postoperative coronal computed tomography scan showing the empty space left by the removed condyle head (d). Postoperative dental occlusion showing a similar intercuspation as pre-trauma dental occlusion (e). Unforced mouth opening showing a good mouth aperture (f)

**Table 1: Patients demography, fracture types, and postoperative findings of the five cases reported**

Case	Age	Gender	Fracture type	Postoperative findings
1	19	Male	Right condylar base process + zygomatic arch	Deviation of mouth opening, maximum mouth opening 39 mm, and dental adaptations
2	20	Male	Right condylar head + zygomatic arch	Slight deviation of mouth opening, maximum mouth opening 44 mm, and slight dental adaptations
3	32	Male	Left condylar head and left coronoid process	Deviation of mouth opening, maximum mouth opening 40 mm, and left palpebral muscle weakness
4	25	Male	Left condylar base process	Slight deviation of mouth opening, maximum mouth opening 45 mm, and left facial palsy/muscle weakness
5	31	Male	Left condylar neck	Slight deviation of mouth opening, maximum mouth opening 43 mm, and left facial palsy/muscle weakness

Alternatively, many other surgical therapies can be used to treat/reconstruct severe damaged TMJs. Bone graft,<sup>[8]</sup> dermis-fat graft,<sup>[7]</sup> distraction osteogenesis, silicone, and metal condyle<sup>[9]</sup> among many others have been described with variable but usually satisfactory outcomes. Among all these possibilities, we believe that our protocol is cheaper and less invasive than mostly of these options, and our results have achieved clinical outcomes as good as or even better than those previously reported.<sup>[7-9]</sup>

Here, we described our technique for treating severely damaged TMJ caused by gunshot wounds using adapted principles of TMJ ankylosis treatment to promote a good functional and symptomless outcome. This treatment does not prevent any further attempt of TMJ reconstruction, and the minor consequences of this approach can be corrected later by orthognathic and/or concomitant TMJ surgery if required.<sup>[10]</sup> We believe that this technique is a cheap excellent choice when there is an acute injury to the TMJ that can result in long-lasting good outcome and also as a preparation step to further TMJ reconstruction.

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### Conflicts of interest

There are no conflicts of interest.

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