Pediatric TMJ Ankylosis: Treatment Using Vertical Sliding Osteotomy of the Mandibular Ramus

Paula Cristina Felix Falchet,1 Caio Cesar de Souza Loureiro,2 Thais Cristina Araújo Moreira,1 João Gavranich Júnior,1 and Luiz Fernando Lobo Leandro1

1Oral and Maxillofacial Surgery Section – Hospital Santa Paula and Hospital Santa Cecília, São Paulo, Brazil
2Oral and Maxillofacial Surgeon, Member of the Brazilian Society of Oral and Maxillofacial Society, São Paulo, Brazil

Correspondence to:
Caio Cesar de Souza Loureiro
E-mail: csloureiro@gmail.com

Abstract
Temporomandibular joint (TMJ) ankylosis or hypomobility involves fusion of the mandibular condyle to the base of the skull. It is most frequently caused by trauma, presents with restriction in mouth opening in early stages and, in children, it may result in facial growth retardation. Various methods are available for surgical correction, such as autogenous grafts, gap arthroplasty, and prosthetic reconstruction. However, such techniques present several disadvantages and may lead to relapse, decrease in the vertical height of the posterior mandible and, in the case of prosthetic reconstruction, be contraindicated for the treatment of pediatric patients. The aim of this paper is to present a case of bilateral TMJ ankylosis in a 9-year-old patient treated by the technique of vertical sliding osteotomy, a simple surgical procedure indicated for the treatment of TMJ ankylosis in children, with the results after a 3-year follow-up.

Keywords:
osteotomy, sliding osteotomy, temporomandibular joint, ankylosis

Introduction
Temporomandibular joint (TMJ) ankylosis may be defined as an interference with the mobility of the jaw due to a bony or fibrous adhesion uniting anatomical components of the joint. Limited mandibular movement ranges from a mild interference to a complete inability to open. The jaw is also restricted in protrusion and lateral excursion to varying degrees depending on the extent and type of articular involvement (1, 2).

Most cases of TMJ ankylosis are related to facial trauma, although this pathology may also be a response to infections or systemic diseases, such as ankylosing spondylitis, rheumatoid arthritis, or psoriasis (1, 3–7).

In children, TMJ ankylosis leads to impairment of speech, difficulty with mastication, poor oral hygiene, rampant caries, disturbances of facial and mandibular growth, malocclusion, and acute compromise of the airway, which may negatively affect the patient physically and psychologically (3, 4, 7, 8).

Several surgical techniques have been developed to treat this pathology. The most commonly used are gap arthroplasty, interposition arthroplasty, and excision and joint reconstruction. For all treatment choices, a long period of rehabilitation physiotherapy is necessary to prevent bone formation within the joint, minimize fibrosis, and avoid cicatricial retractions, trismus, atrophy, and muscle spasm (1, 1, 9, 10).

Cases treated by total joint reconstruction usually require the placement of autogenous bone grafts (metatarsal, fibula, iliac, sternum-clavicular joint, costochondral) or prosthetic devices. Although satisfactory results may be obtained by these procedures, considerations must be made regarding the donor-site morbidity and high cost of the treatment (1, 4, 5).

Caldwell and Letterman (1954) introduced the vertical rami osteotomy (VRO) for the correction of prognathism. This technique was modified by Loftus et al. (1986), who introduced the vertical sliding osteotomy (VSO) of the mandibular ramus to correct
mandibular deformations, especially those associated with condyle resection or absorption that may lead to a vertical dimension loss, thus avoiding the disadvantages of other techniques (11–13).

The purpose of this paper is to present a case of a 9-year-old child who underwent bilateral TMJ reconstruction due to TMJ ankylosis by means of the VSO technique, with a 3-year follow-up.

**Case Report**

A 9-year-old patient was referred to the Oral and Maxillofacial Service of the Hospital Santa Cecilia (São Paulo, Brazil) with mouth opening limitation, malocclusion, and masticatory deficiency. Medical history revealed that the patient had a fall at age of 5 years with direct trauma to the chin region. At that time, radiological images revealed bilateral condyle fracture but no treatment (surgical or conservative) was performed.

During clinical evaluation, mouth opening was restricted to 7 mm and the patient could not perform lateral or protrusive mandibular movements.

Computed tomography examination presented extensive masses around both TMJs that confirmed the ankylosis diagnosis.

The treatment of choice for this case was resection of the ankylosis mass and condyle reconstruction by means of a vertical sliding osteotomy (VSO).

The patient was admitted to Hospital Santa Cecilia for the surgical procedure under general

![Fig. 1. Patient at 9 years of age. Mouth opening was limited to 7 mm due to an untreated bilateral fracture of the TMJ that occurred at 5 years of age.](image1)

![Fig. 2. Computed tomography scan in axial (a) and coronal (b) slices showing enlargement of the condyles and fusion with the base of the skull.](image2)

![Fig. 3. Removal of the ankylosic block with a chisel.](image3)
anesthesia with fiber-optic nasotracheal intubation. Preauricular and retromandibular approaches were used for resection and reconstruction, with identification and preservation of the marginal mandibular branch of the facial nerve.

Through the bilateral preauricular approaches, the TMJs were exposed. The fractured condyles with the ankylosic masses were carefully removed with chisels and round burs after an arthrotomy cut was given at the level of the sigmoid notch, and the glenoid fossa was sculpted to the same level as the original fossa. At this moment, a mouth opening of 40 mm was achieved after mandibular manipulation.

After this evaluation, a temporary intermaxillary fixation was performed to correct the vertical dimension and occlusion. Vertical osteotomy of the rami was then performed through the submandibular approach using a reciprocating saw under intense irrigation. The cut was posterior to the antilingula prominence and directed superiorly to the sigmoid notch and inferiorly to the mandibular angle.

The posterior block of the osteotomized bone was slid superiorly, placed in the glenoid fossa, and shaped according to the previous design to create a neocondyle. Semirigid fixation was achieved with L-shaped 2.0-mm manipulates.

On the right side, the articular disc was in good condition and was used as an interposition structure to avoid reankylosis. Unfortunately, on the left side, the articular disk was compromised and had to be removed. Due to this, a thin layer of temporal deep fascia and muscle was harvested and the graft was inserted over the glenoid fossa and sutured with the zygomatic periostium.

The intermaxillary fixation was removed and a new mouth opening evaluation was performed, confirming a 40-mm range. The wounds were then closed using absorbable suture (polyglactin 910) for deeper layers and 5-0 nylon suture for the skin.

Fig. 6. A 40-mm mouth opening was obtained immediately after removal of the intermaxillary fixation.

Fig. 7. (A) Mouth opening at follow-up 2 years after surgical treatment. (B) Facial profile (lateral view) of the patient at the 2-year post-operative follow-up.
The patient was discharged from the hospital 2 days after the procedure and intense physical therapy was introduced immediately, with the objectives of encouraging and enabling the implementation of mandible movements, preventing progression of cicatrical tissue formation, and rehabilitating the myofunctional restriction, which was essential to stabilize the opening of the mouth, release the jaw movements, and link them to improving the functionality of the stomatognathic system.

The therapy consisted of:

1) Directed mobility of the perioral muscles by isotonic movements: lip protrusion and retraction movements, lateral lip movements to either side, contraction of the buccinator against finger resistance placed internally, sequential movements of tongue propulsion and retraction, and maximum elevation and lowering of the tongue tip during maximum protrusion, aiming for spontaneous opening of the mouth. The exercises were performed in two series of 20 movements for lips and cheeks exercises and 10 movements for the tongue exercises, due to the effort required for the latter.

2) Mandibular movements.

- Isotonic exercises:
  - Opening and closing movements: protrusive and retrusive movements through induction of lower incisal contact with the upper lip; and lateral movements with the aid of tongue rotation, in sequences of 10 movements with maximum effort.
  - Increasing the maximum aperture, keeping the jaw in the limit of greater amplitude obtained for a few seconds.
  - Forcing the mouth open with the use of wooden spatulas supported between the posterior teeth, bilaterally, alternating sides, or simultaneously for 2 to 3 minutes.

- Isometric Exercises:
  - Protrusive movement, maintaining the contraction in the most anterior mandibular position for 10 seconds;
  - Mandibular lateral movements lasting for 10 seconds, repeatedly.

The proposed physical therapy was performed in 25 individual sessions with a frequency of once a week for 6 months, with requests for frequency of practice at home of three to five times per day during the first 12 weeks.

During the first 6 months after surgery, the patient was monitored weekly. After this period, monthly appointments were scheduled until the twelfth month after surgery. Thereafter, the monitoring has been conducted every three months for evaluation of progress in the case.

At the 3-year follow-up, no complications were observed and a 37-mm range of mouth opening was preserved.

**Discussion**

The term ankylosis is of Greek origin and means “stiff joint.” It may be defined as “**inability to open**
month due to either a fibrous or bony union between the head of the condyle and glenoid fossa.” (6, 8).

This is a highly distressing condition in which the temporomandibular joint (TMJ) is replaced by scar tissue, resulting in the fusion of the mandibular condyle to the base of the skull (5, 10).

This disabling condition causes speech impairment, difficulty with mastication, poor oral hygiene, and abnormalities of facial growth, generating significant psychological stress (4, 8).

In most cases, this pathology is associated with trauma, but local or systemic infection, tumors, degenerative diseases, intra-articular injection of corticoid, forceps delivery, and complication of previous TMJ surgery have also been implicated (1, 10).

When the cause is trauma, the main hypothesis is that the hypomobility is related to the formation of an intra-articular hematoma, along with scarring and excessive bone formation. Infection of the TMJ usually occurs secondary to contiguous spread from otitis media or mastoiditis, but it may also result from hematogenous spread of infectious conditions such as tuberculosis, gonorrhea, or scarlet fever. Systemic causes of TMJ ankylosis include ankylosing spondylitis, rheumatoid arthritis, and psoriasis (3, 6).

The classification of TMJ ankylosis is made according to its location (intra-articular or extra-articular), type of tissue involved (bone, fibrous, or fibro-osseous), and extent of fusion (complete or incomplete) (1, 5, 8).

Treatment for this condition must be initiated as soon as it is recognized, aiming for the re-establishment of the joint function. In children, immediate treatment is necessary to promote proper growth and function of the mandible and to facilitate positive psychological development (3).

Although there is no consensus about the best way to treat TMJ ankylosis, three surgical procedures are commonly performed (1, 4, 5, 10).

1) Gap Arthroplasty. This is a procedure in which a resection of 10 to 15 mm of bone between the articular cavity and mandibular ramus is created without any interposition material and has the advantage of simplicity and short operating time. On the other hand, it has the disadvantage of generating a pseudo-articulation, with shortening of the mandibular ramus that may lead to the development of an open-bite in bilateral cases or premature occlusion on the affected side with contralateral open bite in unilateral cases. In addition, it seems to increase the risk of recurrence (1-4).

2) Interpositional Arthroplasty. This is a technique in which an interposition material (autogenous or alloplastic) is added between the new sculpted glenoid fossa and condyle to prevent re-ankylosis by eliminating contact between the bone surfaces. Various materials such as skin, dermis, flaps of temporal muscle/fascia, silicone, and cartilage may be used. However, there are possible disadvantages, such as morbidity at the donor site and unpredictable resorption when autogenous material is used and the risk of foreign body reaction when alloplastic material is used (1, 4, 6).

3) Resection and Joint Reconstruction. In the joint reconstruction technique, following the resection of the ankylosic block, the compromised structure is restored to establish the vertical dimension and the condylar structure. It may be performed with autogenous grafts (costochondral, iliac crest, or coronooid process grafts) or with alloplastic materials (articular prostheses). Costochondral grafts are the most widely used, because they are biologically compatible and functionally adaptable, presenting growth that makes this material the optimal choice to be used in children. Conversely, costochondral grafts also present some disadvantages that include fractures, reankylosis, donor site morbidity (requiring another operative site with its attendant complications and poor patient compliance), and variable growth behavior. Alloplastic joints allow a closer reproduction of the normal anatomy of the joint, restoring the vertical dimension, avoiding donor site morbidity, reducing operation time, lowering the risk of recurrent ankylosis. Although several studies have demonstrated problems associated with the first prosthetic systems that were developed such as wear of the prosthesis in joint surfaces and foreign body
reaction, such problems seem to have been solved in the development of new systems. Thus, its use in the treatment of TMJ ankylosis in adults is strongly indicated; however, it is not recommended for the treatment of pediatric patients (1, 4, 5, 16).

Although it is an unusual technique, the vertical sliding osteotomy of the mandibular rami can be extremely effective for the treatment of TMJ ankylosis. This technique, first described by Loftus et al. as a modification of the vertical ramus osteotomy technique presented by Caldwell and Letterman, allows the TMJ reconstruction, restoring the joint function while avoiding the disadvantages of other techniques. Through this technique, the reconstruction of the TMJ is performed using the block of osteotomized mandible itself without need of a new surgical approach to obtain the graft, significantly decreasing the morbidity of the surgical procedure. Furthermore, the vertical sliding osteotomy technique is a good choice of treatment in pediatric patients, in whom the placement of a TMJ prosthesis is contraindicated (9, 11-13).

Moreover, mild to moderate displacement of the bone fragments permit enough bone in contact to stimulate the formation of a fracture callus and to restore continuity by forming a new ramus that is able to resist mastication forces (9, 11, 13).

Possible complications related to this procedure, such as damage to the facial nerve or the mandibular nerve bundle, are easily avoided by judicious surgical planning and careful execution of each stage of surgery (5).

Although an interposition material may be necessary to prevent bone-to-bone contact, either the articular disc (if undamaged) or the temporalis fascia can be used and may be obtained through the pre-auricular approach made for the removal of the ankylosis block (4, 11, 15).

The case presented in this paper demonstrates the surgical correction of bilateral TMJ ankylosis using the vertical sliding osteotomy technique. Through this procedure, it was possible to increase the mouth opening range of a 9-year-old patient from 7 mm to 40 mm immediately after the surgical procedure. Intensive physiotherapy treatment was conducted to recover function through guided exercises and functional orientation of the mandible. Mandibular muscles atrophied from disuse due to restricted movement need to be intensely stimulated after surgery. Mandibular mobilization should be initiated as soon as possible, to influence the formation of cicatricial tissue so that it does not restrict mandibular movements. It is also essential for stabilizing the mouth opening and releasing the jaw movements, as presented in this case (16).

At the 3-year follow-up, no complications were observed and a 37-mm range of mouth opening was preserved.

References