Temporomandibular Joint Ankylosis: Algorithm of Treatment

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Temporomandibular joint ankylosis, according to age of onset, causes severe functional and morphological disorders, as well as stunted craniofacial growth and development.

The primary goal of treatment is to resolve the functional and morphological disorders.

Method: Pre- and posttreatment clinical and cephalometric registries were conducted in 15 patients with temporomandibular joint ankylosis over a 10-year period (2002–2012). All the patients underwent complete removal of the ankylotic block, gap arthroplasty, and ipsilateral coronoidectomy. Distraction osteogenesis was performed on 12 patients.

Results: Fifteen patients, 8 female and 7 male, ranging from 3 to 30 years of age, were included in this study. The posttreatment follow-up period ranged from 3 to 13 years.

The mean preoperative maximum mouth opening was 3 ± 1.7 mm, and the mean postoperative maximum mouth opening was 36 ± 6.5 mm. The labial inclination with respect to the true horizontal decreased considerably ($6.2^\circ \pm 2.3^\circ$ preoperative to $1^\circ \pm 1.6^\circ$ postoperative). A correction of the mandibular deviation was measured at the symphysis with respect to the facial midline ($8^\circ \pm 2^\circ$ preoperative to 2° postoperative). Finally, the height ratio of both mandibular rami (the healthy side and the affected side) decreased considerably (1.27 ± 0.05 preoperative to 1.07 ± 0.06 postoperative).

Reankylosis only occurred in 2 patients, who were then successfully treated by means of gap arthroplasty.

Conclusions: The therapeutic algorithm proposed in the present work provides favorable functional and morphological results. Early and aggressive functional physiotherapy is essential to minimize the risk of reankylosis.

Key Words: Ankylosis, distraction osteogenesis, gap arthroplasty, mandibular distraction, temporomandibular joint, temporomandibular joint ankylosis, TMJ

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Temporomandibular joint (TMJ) ankylosis is defined as fusion of the joint's component surfaces (hard and soft tissues). It tends to occur in infants and adolescent patients. The most important clinical manifestation of TMJ ankylosis (TMJa) is the limitation or impossibility of performing mandibular movements.[1]

Treatment of TMJa is highly complex, due to its technical difficulty and high rates of relapse. Knowledge of etiology, pathophysiology, and mandibular biomechanics is fundamental for adequate treatment, which must be conducted early to achieve mandibular movement and prevent alterations in mandibular and maxillary growth and development.[1]

The mandibular condyle is considered an important agent in mandibular development due to its secondary cartilage.[2] Accordingly— as mandibular dynamics are restricted in people who have not finished their craniofacial growth and development—vertical, sagittal, and transverse development of the mandible on the affected side will be stunted, generating a facial asymmetry, and often, compromising correct growth and maxillary development. Furthermore, airway obstruction results from the lack of mandibular development.[3]

Temporomandibular joint ankylosis can be classified in the following ways: anatomically, as intracapsular or extracapsular; according to the tissue involved in the bone, as fibrous or fibro-osseous; and according to the extent of fusion, as complete or incomplete.[4]

A new classification integrating both anatomical and functional aspects was proposed by Chang, McCarthy, and Fariña in 2010.[1]

Surgical treatment via arthroplasty is the only way to release a fused joint. Within the therapeutic alternatives, we mention those performed within the ankylotic block and osteotomies performed at a distance from the block,[5] which consist of the resection of the ipsilateral and eventually the contralateral coronoid process.[1,4]

The main treatment objective of patients with ankylosis is to recover mandibular function; however, correcting the associated facial deformity, improving the upper airway, reducing pain, and preventing reankylosis are objectives that must be considered within the treatment.[4,6] We divided the objectives into 2 fundamental aspects that should be corrected in the same surgery and its postoperative evolution:

1. Physiological:
   - Mouth opening over 30 mm (interincisal distance considering maximum intercuspation as zero point)
   - Absence of pain in joint function
   - Recovery of respiratory function
   - Recovery of masticatory function (normal diet)
   - Prevention of reankylosis
2. Morphological:
   - Allowance of normal mandibular growth and development
   - Reestablishment of facial equilibrium and balance (correcting the deficiency)

The aim of this article is to establish a treatment algorithm for TMJa using bone transport for the reconstruction of the TMJ and elongation of the mandibular ramus, with special emphasis on functional and morphological objectives.

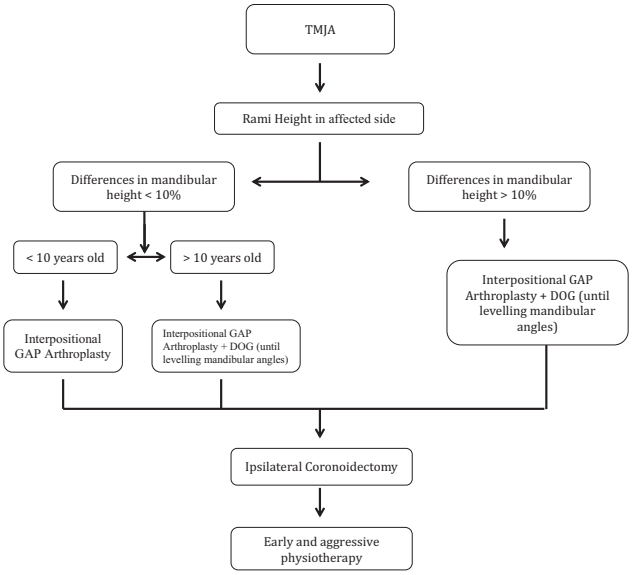

FIGURE 1. Treatment algorithm in temporomandibular joint ankylosis (TMJa). DO, distraction osteogenesis.

METHODS

A surgical treatment protocol was administered to patients with TMJa by the clinical practice of Dr Rodrigo Fariña (Hospital del Salvador, Hospital Exequiel González Cortés, and private practice) between 2002 and 2012 (Fig. 1).

Ankylosis was confirmed by a complete clinical study, radiography, and computed tomography scan. Cephalometric studies were performed on photographs, anteroposterior radiography, and orthopantomography.

The clinical evaluation was done directly on the patient (mouth opening) and with clinical frontal photographs that were standardized with a digital grid (tilted lip commissure plane).

1. Maximum mouth opening: measured between incisal border of upper and lower incisors with a caliper (Fig. 2A and B).
2. Tilted lip commissure plane: angle formed between a horizontal line drawn from each pupil (bipupilar line) and bicommissure plane (Fig. 2C and D).
   The radiographic evaluation was done with a frontal and panoramic X-ray
3. Deviation of the chin bone: the deviation of the chin was measured in degrees by the angle formed by the skeletal midline (vertical line in the middle of the base of the cristagalli apophysis) and the straight line that connects the center of the chin to the skeletal midline in the frontal x-ray (Fig. 2E and F).
4. Length of the mandibular ramus: this was determined by measuring the distance in millimeters between the highest condylar point and the gonial angle (total ramus height, including the condyle) in the panoramic x-ray (Fig. 2G and H).

The same radiographic and computed tomography scan clinical study was repeated 1 year after surgical treatment.

The treatment algorithm is described in Figure 1. To achieve the aforementioned objectives, we propose that the treatment of TMJa should consider:

1. Interpositional gap arthroplasty: consisting of the aggressive removal of the ankylotic block that limits the mandibular movement.
   a. Aggressive resection of the ankylotic segment (Fig. 3A).

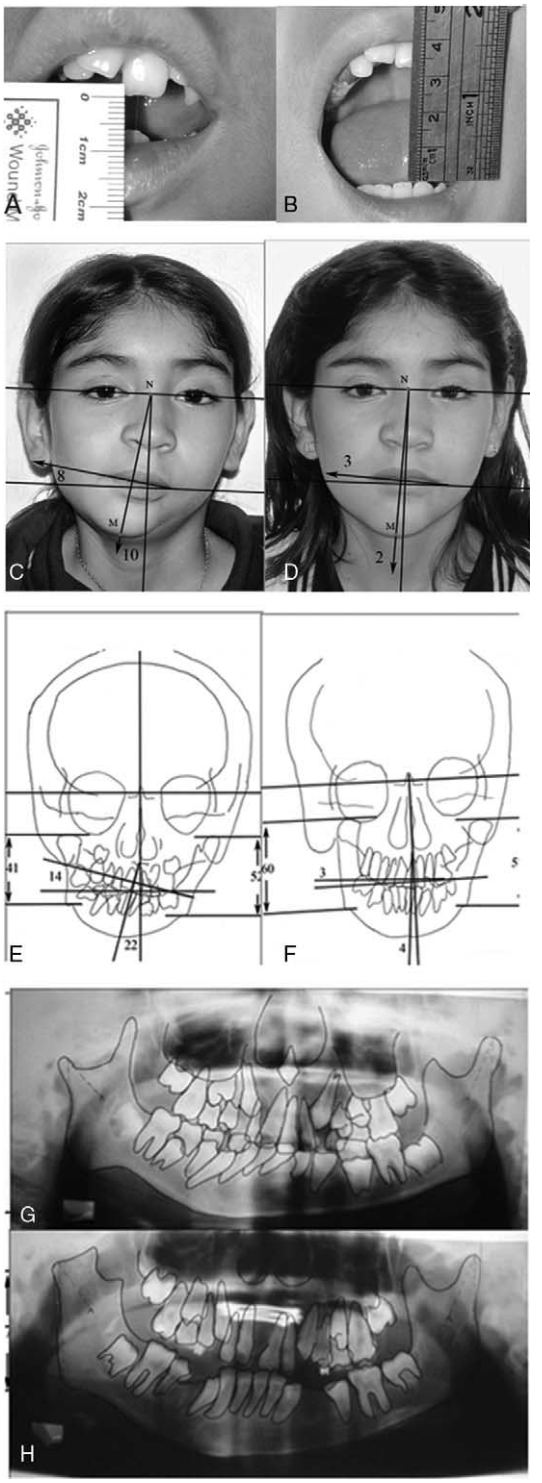

FIGURE 2. (A) Maximum mouth opening before surgery. (B) Maximum mouth opening after GAP arthroplasty and DOG. (C) Frontal view with tilted lip commissure plane before surgery. (D) Frontal view with tilted lip commissure plane after GAP arthroplasty and DOG. (E) Posteroanterior cephalometric study before surgery. (F) Posteroanterior cephalometric study after GAP arthroplasty and DOG. (G) Panoramic x-ray before surgery. (H) Panoramic x-ray after GAP arthroplasty and DOG (patient 2).

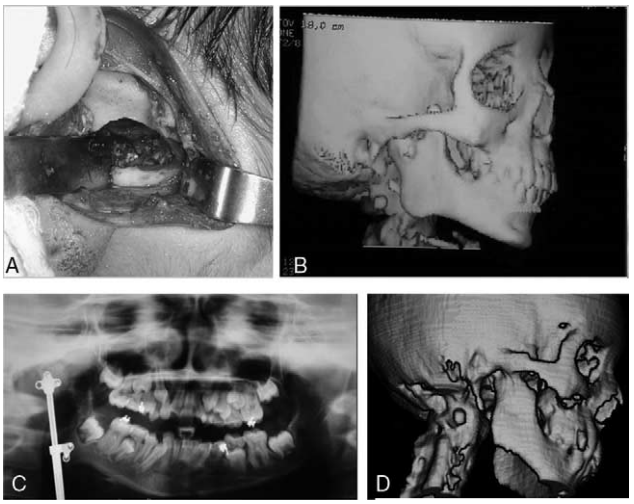

FIGURE 3. (A) Intraoperatory GAP arthroplasty. (B) Computed tomography scan with temporomandibular joint ankylosis and coronoid hyperplasia. (C) Panoramic x-ray, showing 20 mm of distraction osteogenesis. (D) Computed tomography scan after GAP arthroplasty and distraction osteogenesis (patient 2).

   b. Formation of a space between the bony surfaces (10 mm approx.), which allows free movement of the mandibular segment.
   c. Joint covering: interpositional element with temporal fascia or disc remnant.

2. Ipsilateral coronoidectomy: after the removal of the ankylotic block, an ipsilateral coronoidectomy should be performed, which is in a higher position; with the removal of the ankylotic block it would move to the cephalic.
3. Mandibular reconstruction: through the use of a bone transport disc, in case of severe asymmetries where the difference in height of both mandibular rami is greater than 10%. The goal of this reconstruction is to match the facial height of the diminished posterior affected side to the healthy side. The transport disc is designed based on a reverse L-osteotomy, beginning in the sigmoid recess and ending at the posterior border of the mandibular ramus. The internal distraction device is installed to separate the transport disk with a vertical vector. After a 5-day latency period, the distractor is activated at a rate of 0.5 mm every 12 hours, until symmetrization of both mandibular rami is reached in accordance with the previous clinical and imaging examination (Fig. 3B–D). The desired clinical parameters such as maximum mouth opening, lip tilt, correction of the mental deflection, and height of mandibular angles are checked.
4. Early and aggressive physiotherapy, permanently: physiotherapy is fundamental to ensure the stability of the results achieved. It consists of opening and closing movements and contralateral movements at least 4 times a day (30 repetitions of the exercises each time).

This study was approved by the Ethics Committee of El Salvador Hospital.

RESULTS

Fifteen patients participated in this study, 8 female and 7 male, with an average age of 11.4 years (ages ranged from 5 to 30 years). The characteristics of the group are described in Table 1.

Out of the 15 patients, 3 underwent gap arthroplasty alone and 12 underwent gap arthroplasty associated with distraction osteogenesis (DO) for mandibular reconstruction (Figs. 2–4).

Patients were followed up postoperatively for an average period of 6.9 years (3–13 years). The postoperative course was without adverse effects such as bleeding, infection, or motor complications due to facial nerve damage.

There were 2 patients of reankylosis during the follow-up period who were treated by a second gap arthroplasty with favorable outcomes (1 in the first year of follow-up, the other in the 5th year of follow-up).

The maximum mouth opening increased significantly in all the patients from 3 mm SD ± 1.7 mm preoperative to 36 mm (SD ± 6.5) postoperative. The labial inclination to the true horizontal decreased considerably from 6.16° (SD ± 2.3) preoperative to 1.06° (SD ± 1.6) postoperative. The deviation of the chin was corrected by relating it to the midfacial line, from 8° (SD ± 2) preoperative to 2° (SD ± 0.01) postoperative. Finally, the height ratio of both mandibular rami (healthy/affected side) decreased considerably from 1.266 mm (SD ± 0.047) preoperative to 1.071 mm (SD ± 0.063) postoperative (Table 2).

DISCUSSION

Temporomandibular joint ankylosis is a difficult pathological condition to address, due to the multiple consequences that it

TABLE 1. Patient Distribution According to Gender, Age, Side of Ankylosis, Treatment, Complication, Solution, and Total Follow-Up

Patient	Gender	Age	Side of Ankylosis	Treatment	Complication	Solution	Follow-Up (Years)
1	F	12	Left	GAP + DOG	Reankylosis	Secondary gap arthroplasty	8
2	F	13	Right	GAP + DOG	No		11
3	F	5	Left	GAP	No		8
4	F	30	Left	GAP + DOG	No		13
5	M	6	Left	GAP + DOG	Reankylosis	Secondary gap arthroplasty	9
6	F	10	Bilateral	GAP + DOG	No		7
7	M	13	Left	GAP + DOG	No		6
8	M	8	Right	GAP + DOG	No		5
9	M	10	Right	GAP + DOG	No		5
10	F	9	Left	GAP	No		8
11	F	11	Right	GAP + DOG	No		6
12	M	12	Right	GAP + DOG	No		4
13	M	10	Left	GAP + DOG	No		7
14	F	13	Left	GAP + DOG	No		3
15	M	9	Left	GAP	No		4
Average	8F/7M	11.4	9 left/ 5 right/1 bilateral	3 GAP /12 GAP + DOG	2 (13.3%)		6.9

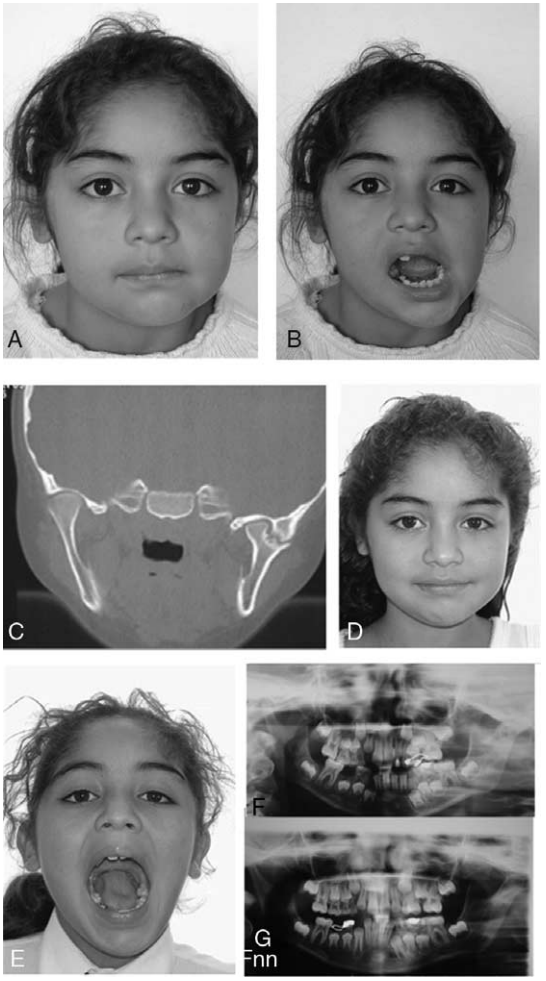

FIGURE 4. (A) Frontal view before surgery. (B) Maximum mouth opening before surgery. (C) Computed tomography scan of external TMJ ankyloses. (D) Frontal view after GAP arthroplasty (3 years after surgery). (E) Maximum mouth opening after GAP arthroplasty (3 years after surgery). (F) Panoramic x-ray of left external TMJ ankylosis before surgery. (G) Panoramic x-ray 3 years after GAP arthroplasty (patient 10). TMJ, temporomandibular joint.

entails, both functionally and aesthetically. Depending on the age of onset, it is associated with craniofacial asymmetry in the 3 senses of space, further complicating the treatment.

The literature describes several therapeutic alternatives depending on the age it appears, degree of deformation, and relapse.

The main objective of treatment is to recover adequate masticatory function; to this end, different authors have proposed the use of DO as a complementary method in the treatment of ankylosis. Li et al[7] reported the use of mandibular body DO to correct micrognathia; however, by his method it is not possible to recuperate the lost posterior facial height, thus failing to achieve adequate facial symmetry in patients of unilateral ankylosis. The same is true of the DO technique used by Kaban et al,[4] because distraction is intended to reconstruct the joint. We propose a vertical distraction whose vector is planned to bring the transport disk to the desired area to establish the new TMJ, in addition to the reconstruction of the mandibular ramus, achieving a suitable posterior facial height.[8]

The use of external distractors offers disadvantages compared with submerged devices, as they are less rigid and the distraction rate is not 1:1 between the activation device and bone separation; we do not recommend the use of these devices.[9]

It is important to mention that with the use of submerged distractors located in the mandibular ramus, it becomes complex to withdraw the device once the desired height is obtained. Therefore, it is recommended to use Fariña screws because it facilitates their removal, reduces manipulation of the recently distracted bone segment, and reduces surgery time.[10]

While the ipsilateral coronoidectomy is mandatory, in our experience it has not been necessary, under any circumstances, to perform contralateral coronoidectomy.[4]

The stability of the treatment fundamentally depends on 2 factors:

1. Complete removal of the ankylotic block.
2. Active physiotherapy, together with serial control (in our series of patients, 2 patients had relapse at the first and fifth postoperative years).

Some authors propose the use of autologous grafts for the reconstruction of the TMJ and mandibular ramus.[4,11–14] Numerous publications demonstrate the unpredictability of growth and development with significant rates of relapse.[12,15–18] Acute enlargement of the vertical dimension, stretching of the soft tissues, and compression of the graft with the skull base would be important factors that increase the risk of reankylosis.

A gradual pace of distraction allows for a better adaptation of the soft tissues, while giving a suitable time frame for physiotherapy without compression of the transport disc with the base of the skull.

Finally, it is significant to mention the importance of postoperative orthopedic management. The open bite that is generated by achieving the posterior facial height through DO should be contained with an acrylic occlusal plane or by resin stops at the level of posterior teeth. Such containment aims to avoid excessive compression of the reconstructed TMJ or distracted bone tissue, thereby reducing the possibility of reankylosis and/or loss of the verticality gained through DO due to bone compression.

In still-growing patients, these containment stops gradually wear out to allow vertical growth of the maxilla. If necessary, once the maxillofacial growth and development has been completed, the maxillary vertical deficit should be compensated by a Le Fort I osteotomy, similar to that described by Fariña et al[19] in the treatment of craniofacial microsomia.

TABLE 2. Maximum Mouth Opening, Tilted Lip Commissure Pane, Deviation of the Chin Bone, and Length of the Mandibular Ramus, Before and After Surgery

TMJ Ankylosis (n = 15	Maximum Mouth Opening (mm)	Tilted Lip Commissure Plane (°)	Deviation of the Chin Bone (°)	Length of the Mandibular Ramus (Health Side/Affected Side)
Before surgery	3 ± 1.732	6.167 ± 2.309	8 ± 2	1.266 ± 0.047
After surgery	36 ± 6.557	1.06 ± 1.607	2 ± 0.01	1.071 ± 0.063

TMJ, temporomandibular joint.

CONCLUSIONS

The therapeutic algorithm proposed in the present work provides favorable functional and morphological results. Early and aggressive functional physiotherapy is essential to minimize the risk of reankylosis.

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