CASE REPORT

Orthodontic and surgical treatment of a patient with an ankylosed temporomandibular joint

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This article describes the surgical and orthodontic treatment of a girl with facial deformities and functional involvement. The left temporomandibular joint was ankylosed, and the lower third of the face was markedly deficient, with mandibular retrusion and severe laterognathism to the left side. Mouth-opening was limited, and the patient had problems speaking and chewing. Two surgical procedures had been performed previously at another institution. We treated the patient with condylar surgery while she was still growing, followed by orthodontic treatment and orthognathic surgery after growth was complete. Twelve-year follow-up records are presented. (Am J Orthod Dentofacial Orthop 2007;131:785-96)

Maxillomandibular discrepancies corrected with a combination of orthodontic treatment and surgery are challenging to orthodontists and maxillofacial surgeons. Attaining good functional and esthetic results is even more difficult if the patient has associated pathologies, such as temporomandibular joint (TMJ) ankylosis. This anomaly can be defined as fusion between the mandibular condyle and the glenoid fossa, reducing or restraining joint movements and ultimately restricting chewing and inducing esthetic, nutritional, psychologic, and social problems.

Etiologic factors have been widely discussed in the literature, and trauma followed by infection is cited frequently.[1-7] Unilateral or bilateral joint fusion is often a result of trauma, such as condylar fracture from forceps during parturition, with subsequent fibrosis and calcification of the articular space. Other etiologies include myositis ossificans,[8] osteochondroma,[9] orthognathic surgery,[10] or systemic diseases such as ankylosing spondylitis (Bechterew's disease),[11] lupus erythematosis, and rheumatoid or psoriatic arthritis.[3] Basically, there are 3 types of intracapsular ankylosis: bony, fibrous, and fibro-osseous. Bony ankylosis requires aggressive treatment because of the esthetic and functional impacts of near-complete restriction of mandibular movements. Extracapsular ankylosis is a rare condition that can affect the TMJ; it shows the same 3 types as intracapsular ankylosis.[1,8,12]

TMJ ankylosis can occur during or after growth. Its occurence can be divided into 4 groups: (1) growing patients without dentofacial deformities, (2) growing patients with dentofacial deformities, (3) adults without dentofacial deformities, and (4) adults with dentofacial deformities. These groups require individual considerations in treatment planning, but all require arthroplasty for the bony ankylosis. Surgical treatment is mandatory for mobility restoration, and myofunctional therapy is an essential component of the healing process. In addition, dental compensations resulting from the skeletal deformity are a marked difficulty during presurgical orthodontics.

Surgical procedures available for treating this condition include (1) corticoid infusions[13]; (2) gap arthroplasty[5,14-16]; (3) arthroplasty and costochondral graft[14,17]; (4) interposition arthroplasty, associated with ipsilateral or bilateral coronoidectomy[6,16,18-21]; (5) distraction osteogenesis[22]; (6) joint reconstruction with alloplastic prosthesis[23]; (7) arthroscopic laser debridement[24]; (8) postoperative ionizing radiation[25]; and (9) bilateral arthrotomy.[10] Therefore, there is no consensus in the literature, and this has led authors to test various options of treatment based on previous studies and on their own clinical experiences.

The purpose of this article was to describe the treatment of a patient with a severe facial deformity that included TMJ ankylosis. Condylar surgery was performed while the patient was still growing, followed by combined orthodontic treatment and orthognathic surgery after growth was complete. Twelve-year follow-up records are shown.

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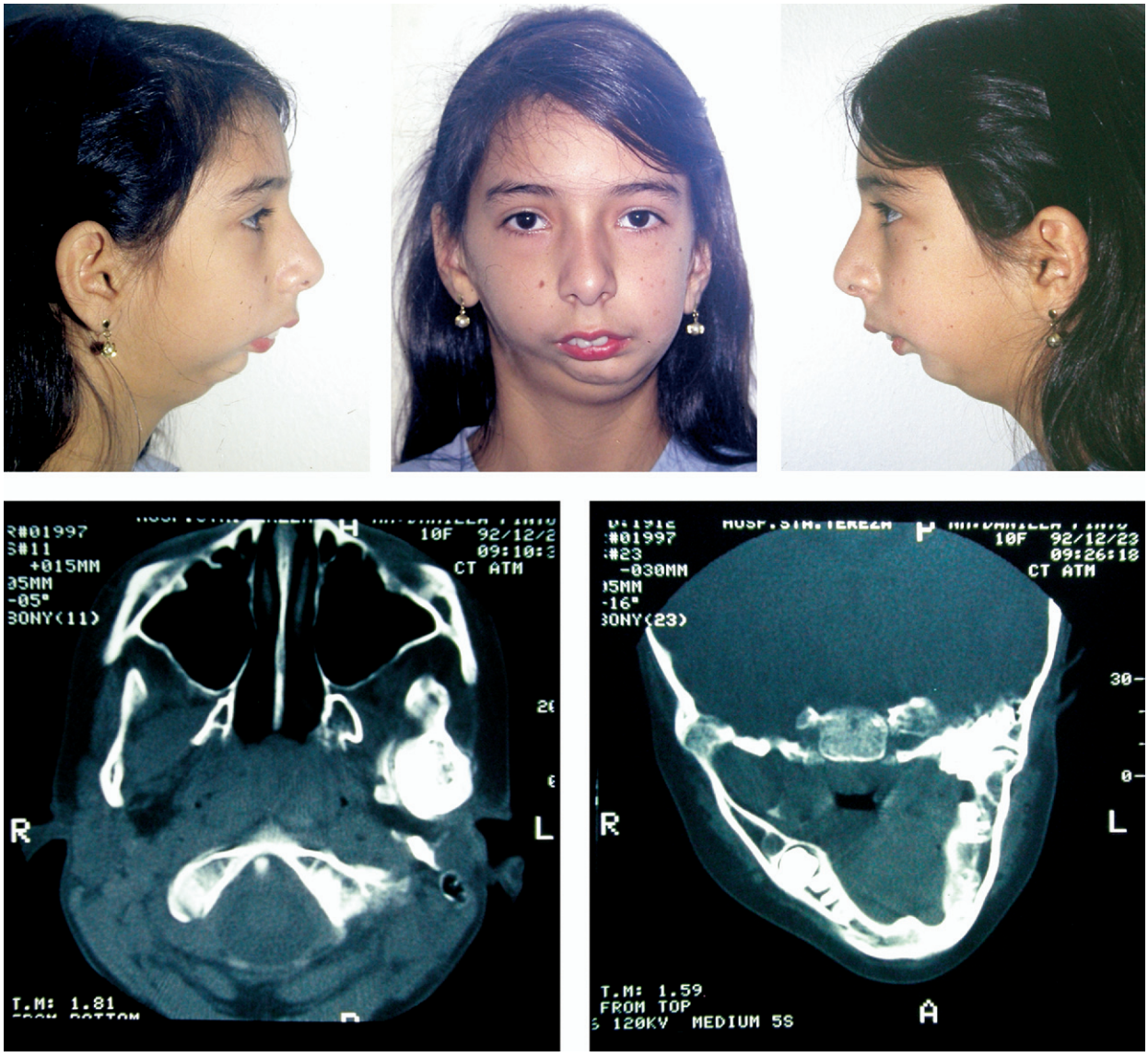

Fig 1. Extraoral photographs and tomographic views (age 10 years 9 months).

DIAGNOSIS AND ETIOLOGY

The patient came to the Oral and Maxillofacial Surgery Department of the State University of Rio de Janeiro, Rio de Janeiro, Brazil, when she was 10 years 9 months of age (Fig 1). She had a severe facial deformity with functional and esthetic involvement. Facial and radiographic examinations showed that the left TMJ was ankylosed; her medical history indicated that the condylar fracture was due to forceps during birth. The lower third of the face had a marked deficiency, with mandibular retrusion and severe laterognathism to the left side resulting in facial asymmetry. Her lips were incompetent, with the lower lip trapped under the maxillary anterior teeth. Limited mouth opening and mandibular deviation during closure were obvious functional problems, and both chewing and speaking were affected. Two surgical procedures were performed at another institution at ages 5 and 8 years. However, tomographic examinations showed ankylosed bone on the left condyle, suggesting some relapse of the previous treatment. Different left and right mandibular body lengths could be also observed.

When the patient was 11 years old, a costochondral graft was performed between the mandibular body gap and the ankylosed joint; a gap arthroplasty was also performed, along with a sagittal split osteotomy to

Fig 2. Postsurgical extraoral photographs, mouth opening, and panoramic radiograph (age 11 years).

move the right mandibular side forward. The arthroplasty procedure followed the protocol of Kaban et al.[2] Figure 2 shows the results. The mandibular deviation was corrected, the mandibular retrusion considerably reduced, and the right side of the face was changed, generating favorable facial symmetry. Total mouth opening of 25 mm was attained, and this was considered acceptable given the severity of the problem. Better lip resting posture could also be observed. The postsurgical panoramic radiograph shows the positioned graft, the sagittal osteotomy fixation, and the periform suspensions for the maxillomandibular rigid block. It also shows the mandibular left canine and second premolar impactions, a missing maxillary left first molar, and general lack of space and unfavorable root tippings.

A 4-year postoperative evaluation showed relapse of the ankylosis and resorption of the costochondral graft. Another arthroplasty was performed when the patient was aged 15 years 6 months, and the mandibular left impacted canine was removed. A new costochondral graft was performed at 16 years 5 months, but growth was unfavorable during follow-up. According to the literature, costochondral grafts have unpredictable growth patterns.[26]

The patient was 16 years 8 months old when she came to our orthodontic department to start presurgical orthodontic treatment (Figs 3-5, Table). She and her parents were concerned about her appearance and functional limitations. The functional analysis showed mouth opening limitation, abnormal swallowing and speaking, tongue protrusion during rest or function, and mandibular deviation to the left on opening movement. The panoramic radiograph clearly shows an ankylosed left condyle with an abnormal mandibular ramus and the gap between the ankylosed bone and the mandibular body. Mandibular articulation occurred on the fibrotic tissue inside the gap. The frontal view shows the laterognathism, a high lower third of the face, a smile with high maxillary incisor exposure, and lip incompe-

Fig 3. Pretreatment extraoral and intraoral photographs (age 16 years 8 months).

tence. The lateral view shows the severe mandibular retrusion with chin deficiency, a high cervical angle, a large nose, and an obtuse nasolabial angle.

The maxillary and mandibular dental midlines were deviated to the left, 3 and 8 mm, respectively. A vestibular crossbite on the right side and severe crowding in both arches were also present. The dental relationship was Class II on the right and Class III on the left, the latter resulting from mesial drift of the mandibular teeth through the canine space; the posterior teeth were tipped lingually. The overjet was 8 mm, and the anterior openbite involved the second premolars and a deep curve of Spee. The occlusal views show a narrow maxillary arch and a square mandibular arch, with 6- and 15-mm negative discrepancies, respectively. The mandibular left canine and the maxillary left first molar were missing, and the mandibular teeth were tipped lingually, especially on the left side. The dental cast views are more reliable than the intraoral photographs because of the mouth-opening limitation.

TREATMENT OBJECTIVES

Surgical and treatment objectives were identified. The presurgical objectives were to (1) align and level the arches, eliminating the negative discrepancies; (2) remove dental compensations and attain a bilateral Class II relationship with favorable incisor inclinations; and (3) establish a normal transverse relationship and normal posterior tooth torque, achieving a stable presurgical arch coordination. The posttreatment objectives were to (1) correct the mandibular retrusion and lateral deviation, reaching acceptable facial esthetics; (2) establish a normal intermaxillary relationship with a Class I molar relationship; (3) reduce maxillary incisor exposure during smiling; (4) align the facial and dental midlines with the chin; (5) establish correct overjet and overbite, and (6) achieve a better anterior oral seal.

TREATMENT ALTERNATIVES AND PROGRESS

Considering the etiology, the severe skeletal deformity, and the patient's history, the first option suggested to the patient and her family was combined orthodontic and surgical treatment. Despite the previous surgical procedures, the patient was receptive to the treatment and wanted to cooperate. The second option, orthodontic camouflage of the skeletal problem, was rejected because of the many limitations for occlusal correction and no chance for esthetic improvement.

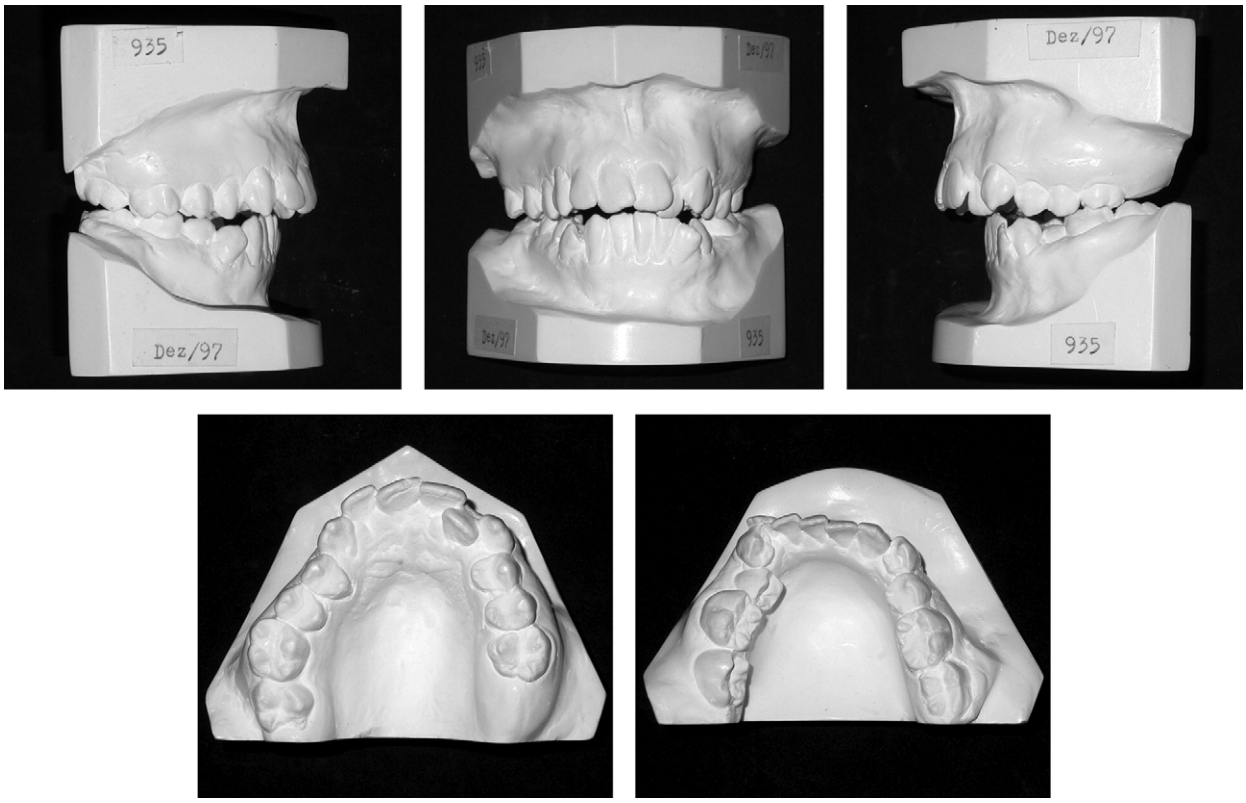

Fig 4. Pretreatment dental models.

Fig 5. Pretreatment panoramic radiograph.

The maxillary first premolars and the mandibular right first premolar were removed to create space for alignment. The mandibular left first premolar was maintained in the position of the previously extracted canine. Initially, treatment was started with standard edgewise .022 × .028-in fixed appliances bonded to the premolars and the canines, with bands on the mandibular first molars, the mandibular right second molar, the maxillary right first molar, and the maxillary left second molar. A lingual arch was welded to the

Table. Cephalometric measurements

Measurements	*Pretreatment*	*Presurgical*	*Posttreatment*
Skeletal			
SNA angle (°)	70	71	73
SNB angle (°)	66	66	68
ANB angle (°)	4	5	5
Wits appraisal (mm)	+3.5	+4	+2
Convexity angle (°)	12	11	8
Facial angle (°)	71	71	74
SND angle (°)	61	62	65
Pog-NB (mm)	−3.5	−1	+2.5
GoGn/SN (°)	50	49	45
FMA (°)	45	45	42
Y-axis (°)	75	75	77
N-ANS (%)	38.7	39.7	36.8
ANS-Me (%)	61.3	60.3	63.2
Dentoalveolar			
1/NA (°)	25	28	15
1-NA (mm)	8	7	4
1/NB (°)	22	31	33
1-NB (mm)	4.5	7.5	7.5
1/1 (°)	129	116	127
IMPA (°)	85	94	98
Ocl/SN (°)	25	26	26
Soft-tissue			
UL-S line (mm)	0	−3	−5
LL-S line (mm)	0	−1	−9

Fig 6. Presurgical extraoral and intraoral photographs.

mandibular first molar bands, and the maxillary and mandibular canines were moved distally with teardrop loops. The maxillary and mandibular incisors were bonded after 6 months, and continuous archwires were introduced. The spaces were closed, and the maxillary right second molar, the maxillary left third molar, and the mandibular left second molar were leveled after 1 year of treatment. After the second year of treatment, .019 × .025-in archwires were placed, and adjustment bends were made. Presurgical impressions were taken to verify arch compatibility and obtain a stable intermaxillary relationship for the orthognathic surgery. After this phase (Figs 6 and 7), the following characteristics were observed: decompensated torques and angulations, molar and canine Class II relationship, aligned parabolic arches, leveled curve of Spee, 4-mm positive overjet, 8-mm maxillary incisor exposure, 1-mm positive overbite, and the maxillary and mandibular dental midlines deviated 2 mm to the left of the facial midline.

The orthognathic surgery was performed when the patient was 20 years old, with a 4-mm maxillary impaction and a 2-mm maxillary rotation to the right to correct the midline (Figs 8 and 9). A 5-mm advancement was made in the right side of the mandible with a sagittal split osteotomy. On the left side, the modified sagittal split osteotomy allowed distal drift of the mandibular body, pushing the gap fibrotic tissue and promoting mesial displacement of the mandible. An advancement and lateralization genioplasty was performed when the patient was 20 years 8 months old.

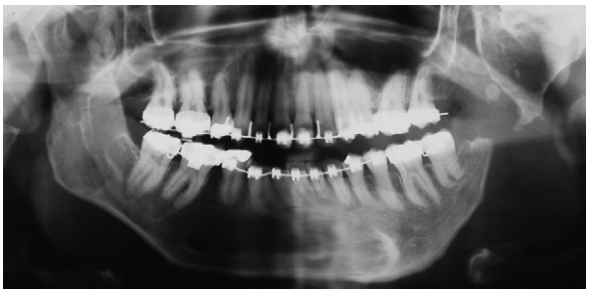

Fig 7. Presurgical panoramic radiograph.

The orthodontic postoperative phase was based on the improvement of the left-side molar relationship and the correction of the mandibular midline deviation,

Fig 8. Postsurgical intraoral photographs.

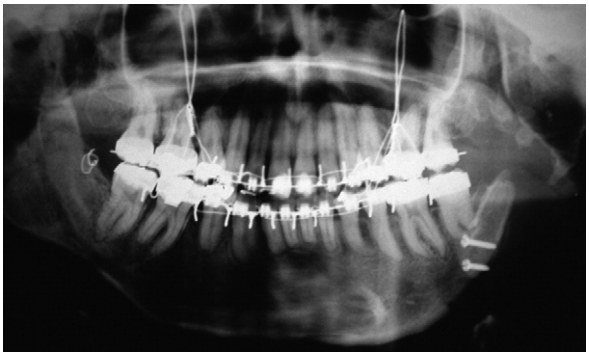

Fig 9. Postsurgical panoramic radiograph.

problems probably related to the unstable mandibular advancement on the left side. Class II elastics on this side and an active transpalatal bar in the maxillary arch were used for this purpose. After some finishing bends and box elastics to improve the interincisal relationship, the treatment was concluded when the patient was 23 years old.

TREATMENT RESULTS

Figures 10 to 12 show the treatment results. Extraoral photographs show a more symmetrical face, better middle and lower facial proportions, a more attractive smile, and more natural lip posture. The left and right facial anatomies are now similar, although a slight chin deviation to the left remains. The lateral photograph shows a concave soft-tissue profile, a prominent chin, a definite cervical region, and an obtuse nasolabial angle. The mandibular deviation to the left was not totally corrected, but satisfactory facial harmony was attained.

The intraoral photographs show good intercuspation, a bilateral Class I molar relationship, nearly coincident midlines, a 1-mm positive overbite, and a 2-mm positive overjet. The occlusal photographs show aligned and parabolic arches. Masticatory function was radically restructured, resulting in a centralized stable bite, with incisal guidance and lateral canine disclusion. The retention appliances consisted of maxillary circumferential and mandibular fixed (bonded left first premolar to right canine) retainers. Figure 13 is an overall superimposition based on the structural method, and Figure 14 shows the pretreatment, presurgical, and posttreatment cephalometric radiographs.

DISCUSSION

There is a lack of documentation or case reports regarding TMJ ankylosis and its treatment in the orthodontic literature. Most of the articles appear in surgery journals and describe surgical technique variations, unique cases, or small treated groups. Therefore, an aim of this case report was to focus on the orthodontic problems of this type of treatment.

Unilateral TMJ ankylosis during active growth develops into a Class II asymmetric malocclusion with chin deviation to the affected side, because the unaffected side grows normally. When the ankylosis develops in an adult, it generates few esthetic problems, but it can cause functional restrictions.

In growing patients without dentofacial deformities, an isolated arthroplasty is sufficient to restore mandibular movement and normal facial growth, preventing the development of facial asymmetry.[14] In growing patients with facial deformities, arthroplasty must be supplemented with various procedures, such as a costochondral graft,[2,4,14,17,19,20,26,27] osteogenic distraction,[22,28] or orthognathic surgery to recover facial balance. In our patient, the arthroplasty was associated with a costochondral graft on the same side and mandibular advancement on the opposite side when she was 11 years old. The costochondral graft has an unpredictable growth pattern: it can be excessive, insufficient, or adequate to correct the facial asymmetry.[26,27] Despite being often used by surgeons, the final result is not reliable, and additional surgical procedures are sometimes needed We observed an unsatisfactory result after 2 graft surgeries, when the patient was aged 11 years and 16 years 5 months.

Adults without facial deformities require arthroplasty and joint reconstruction with an alloplastic prosthesis or a muscle flap.[23] Adults with dentofacial deformities require orthognathic surgery in addition to arthroplasty.[14] This was ultimately the situation with our patient, and she underwent maxillary impaction, mandibular advancement on the right side, and modified mandibular body advancement on the left side.

The long-term surgical follow-up was important to the final result, especially concerning relapse of the ankylosis. Likewise, the first surgical approach was vital to the patient's psychosocial and functional well-being. The patient was cooperative and patient through several surgical and orthodontic procedures and 12 years of follow-up.

In addition to the routine radiographic examinations, some studies recommend the use of computed tomography and 3-dimensional tomographic reconstruction to diagnose ankylosis.[29] Conventional computed tomography (Fig 1) was of great value in diagnosing our patient's problem, because it showed the exact anteroposterior and lateromedial dimensions of the ankylosed bone. Modern diagnostic and surgical planning procedures such as volumetric tomography and rapid prototyping might also have been useful and are encouraged in future situations.

The patient's caries history must be emphasized. Figures 2 and 5 show several restorations between the ages of 11 and 16 years. Her limited mouth opening could be partly to blame.

The presurgical orthodontic treatment was made difficult by extensive dental compensations, involving intra-arch asymmetries, anomalous arch forms, deviated midlines, and extremely compensated torques. In the maxillary arch, symmetrical mechanics were applied, regardless of the unfavorable arch form. In the mandibular arch, severe asymmetry and a 15-mm negative discrepancy required maximum anchorage and challenged the orthodontic mechanics. Even so, the attained presurgical molar relationship was similar on both sides in preparation for the orthognathic surgery. Despite the long treatment time and the extensive orthodontic movements, the amount of root resorption was low.

The severe functional limitation of the mouth-opening restriction was an additional challenge during the orthodontic appointments. At the end of treatment, mouth opening was considered acceptable. The establishment of a stable relationship on the left side was another challenge during treatment. It was directly influenced by the unstable articulation between the left mandibular body and the fibrosis of the osseous gap. This condition raises a questionable prognosis regarding the orthosurgical correction stability on this side, with risk of relapse. On the other hand, the attained occlusion on the right side was considered excellent, with a stable molar and canine Class I relationship.

CONCLUSIONS

- TMJ ankylosis requires early treatment to reduce the development of facial deformity, esthetic problems, functional and psychological disturbances, and dentoalveolar compensations.
- Gap arthroplasty and costochondral graft surgeries are indicated for the treatment of this condition, despite the low predictability of the results and the need for additional surgical procedures.
- Despite the difficulties regarding presurgical orthodontics and orthognathic surgery, the combined treatment showed satisfactory results and achieved many of the treatment objectives.

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Fig 10. Posttreatment extraoral and intraoral photographs.

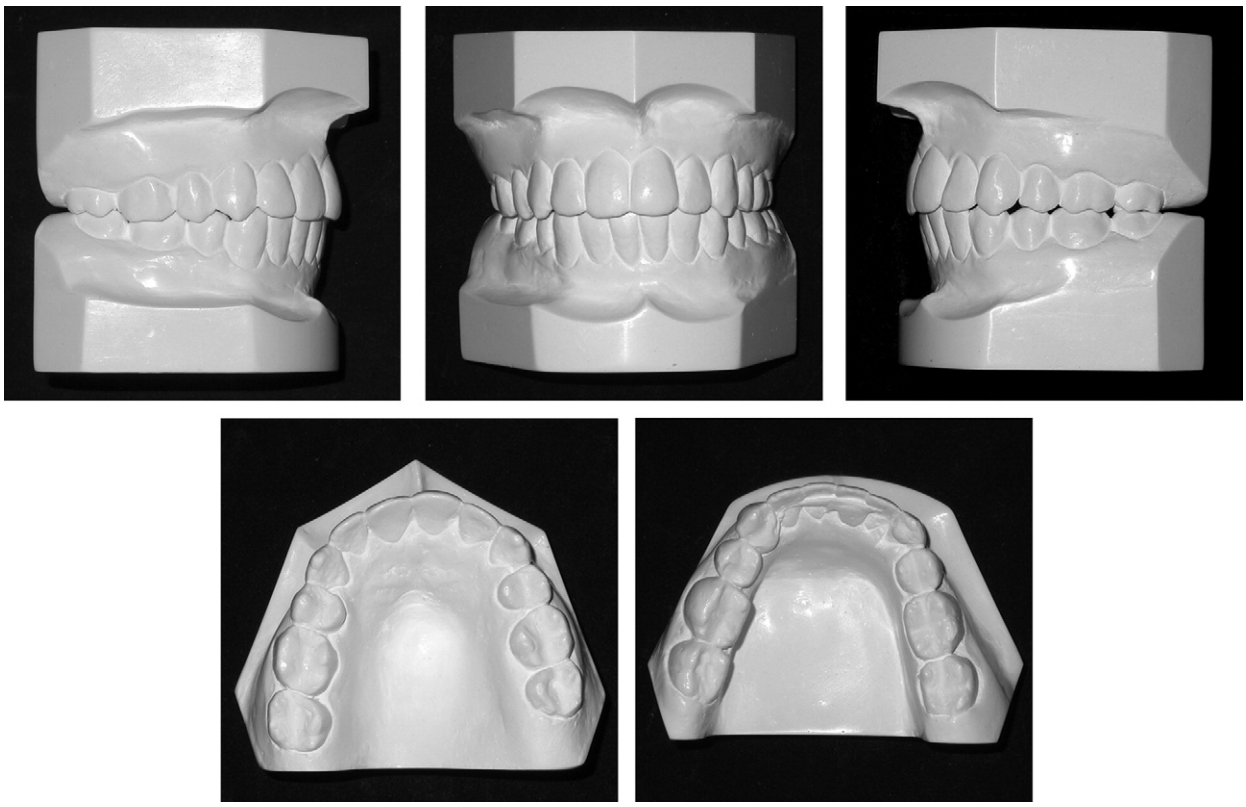

Fig 11. Posttreatment dental models.

Fig 12. Posttreatment panoramic radiograph.

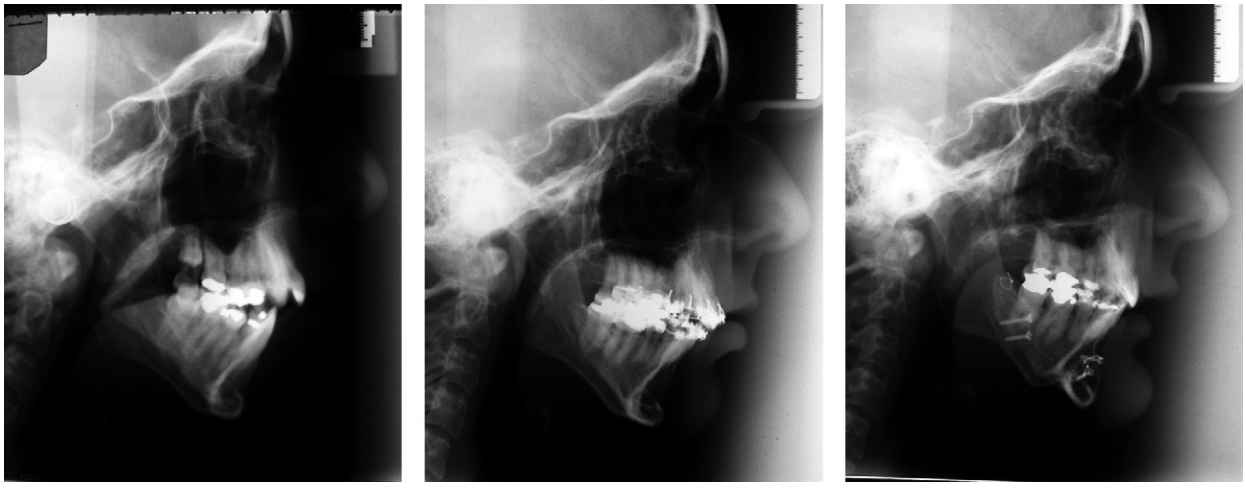

Fig 13. Cephalometric radiographs.

Fig 14. Cephalometric superimposition based on structural method.