A complex orthognathic surgical approach correcting a Class III malocclusion involving traumatic dental injuries and a maxilla fracture

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This case report describes a complex approach to orthodontic preparation for surgical treatment of a Class III facial skeletal deformity in a patient who suffered a unilateral maxilla fracture that also featured maxillary left central incisor avulsion, maxillary right central incisor extrusion, and maxillary right lateral luxation. A 12-mm negative overjet was formed by extraction of the maxillary right lateral incisor and closure of the residual space by retraction of the maxillary right central incisor, maxillary left lateral incisors, and maxillary right and left canines. Forward and impaction movement of the maxilla and retrusion and a counterclockwise turning movement of the mandible were then performed. Maxillary first premolars were reshaped to establish a maxillary canine shape, maxillary canines were reshaped to be maxillary lateral incisors, and a maxillary left lateral incisor received a central incisor crown, with a Class II molar relationship with good occlusion after 2 years of follow-up. This case was a great challenge that included complex multidisciplinary procedures, and the results indicated successful treatment of an orthodontic preparation for surgical treatment in a patient after maxillary fracture associated with dental trauma. (Am J Orthod Dentofacial Orthop 2019;155:702-13)

Complex dentofacial traumas can result in irreversible changes, such as loss of teeth and impairment of facial esthetics. Challenges exist for an esthetic and functional result and depend on the number of teeth involved, the type of trauma experienced, the time elapsed after the accident, and the extent of the skeletal and facial soft tissue damage. Although combined orthodontic and orthognathic surgical treatment has become a common treatment modality for the correction of dental and facial deformities,[1] orthodontic management of traumatized permanent teeth can be unpredictable owing to the risk of ankyloses and root resorption.[2]

The present case report presents a complex multidisciplinary approach in the treatment of a patient with dental and skeletal Class III malocclusion who had previously experienced maxillary fracture with the loss of the maxillary left central incisor by avulsion and the luxation of maxillary right central and lateral incisors and the maxillary right canine.

DIAGNOSIS AND ETIOLOGY

A 30-year-old woman with leukoderma presented to the private orthodontic office of the first author (R.B.R.) for orthodontic treatment 6 months after suffering a facial trauma with a maxilla fracture and loss of a maxillary left central incisor by avulsion. Two plates were adapted to achieve fracture stabilization by the second author (R.A.R.), and endodontic treatment was performed on the maxillary central and lateral right incisors and maxillary right canine owing to dental luxation during the traumatic dental injury (Figs 1-3).

Regardless of facial trauma, the patient had a Class III facial skeletal deformity, so orthodontic treatment and orthognathic surgery were recommended.

For orthodontic planning, initial intraoral photographs and dental casts showed an Angle Class III relationship, an anterior crossbite that was a ~2 mm negative overjet, incisor crowding in both arches, a

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Fig 1. Pretreatment facial and intraoral photographs.

5-mm negative discrepancy in the mandibular arch and 3.5 mm in the maxillary arch, right deviation of the upper midline that was ~2 mm by inclination, and 3 mm gingival dehiscence in the maxillary right canine. Radiographic images showed that the mandibular right third molar was partly impacted (Fig 3).

Facial analysis revealed a concave profile, mandibular prognathism associated with maxillary retrognathism and absence of lip sealing, normal exposure of the upper incisors with a low smile line, and inclination of the upper midline during smiling and thin lips (Fig 1).

The patient reported that the current tooth positions were the same before the facial trauma, and the actual chief complaint was to improve the smile esthetics. There was no previous history of this type of malocclusion in her family, and she had no temporomandibular disorder symptoms.

TREATMENT OBJECTIVES

The treatment objectives were to (1) solve the maxillary and mandibular crowding, (2) correct the maxillary midline inclination, (3) provide a negative overjet of ~10 mm for skeletal maxilla and mandible repositioning through orthognathic surgery, (4) correct gingival dehiscence in the upper right canine, (5) establish a stable and functional occlusion, (6) provide smile esthetics, (7) improve the face profile, and (8) improve the patient's quality of life.

TREATMENT ALTERNATIVES

Considering the concave profile and Angle Class III relationship, the treatment alternatives were based on a combined orthosurgical approach. Correction of a 5-mm negative discrepancy in the mandibular arch

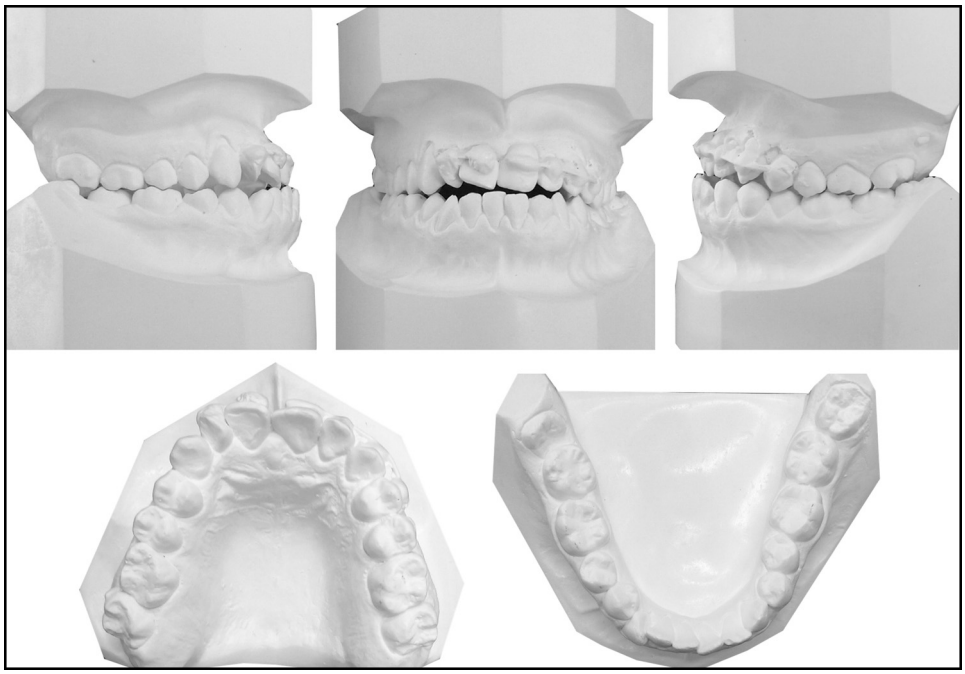

Fig 2. Pretreatment study casts.

was considered through mandibular incisor projection, while relief of the crowding increased the negative overjet, as required for surgical preparation.

For orthodontic alignment of the maxillary arch and retraction of anterior teeth to provide a negative overjet, we considered 4 options:

1. Extraction of the maxillary right and left first premolars, retraction of the maxillary incisors and canines, and space maintenance to implant in the maxillary left central incisor position.
2. Extraction of the maxillary right lateral incisor and closure of the residual space by retraction of the maxillary right central incisor, maxillary left lateral incisors, and maxillary right and left canines. Positioning the maxillary left lateral incisor in the maxillary left central incisor position, maxillary canines on maxillary lateral incisor position, and maxillary first premolars in the maxillary canine position.[3-5]
3. Extraction of the maxillary right central incisor and closure of the residual space by retraction of the maxillary right and left lateral incisors and maxillary right and left canines. Positioning the maxillary lateral incisors in the maxillary central incisor position, maxillary canines in the maxillary lateral incisor position, and maxillary first premolars in the maxillary canine position.[3-5]
4. Extraction of both maxillary lateral incisors, space maintenance for implantation in the maxillary left central incisor position, and residual space closure by retraction of the maxillary central incisor and maxillary right and left canines. Positioning the maxillary canines in the maxillary lateral incisor position and the maxillary first premolars in the maxillary canine position.

Regardless of the option chosen, the surgical procedures involved combined surgery with maxillary advancement and mandibular retraction, which required the extraction of maxillary and mandibular third molars.

Among the options presented, we initially discarded option 1 because of the risk of pathologic changes during orthodontic retraction of the traumatized teeth, such as ankylosis[6,7] and root resorption,[8] which could result in more dental element loss in addition to the removal of 2 premolars.

We considered options 2 and 3 to be safer because they did not involve the extraction of the premolars and because the periodontal evaluation in plan 2 involved less tooth movement and maintenance of a maxillary central incisor with a better esthetic prognosis.

TREATMENT PROGRESS

Six months before the beginning of the orthodontic approach, the patient had a unilateral maxilla fracture on the right side that also featured maxillary left central incisor avulsion, maxillary right central incisor extrusion,

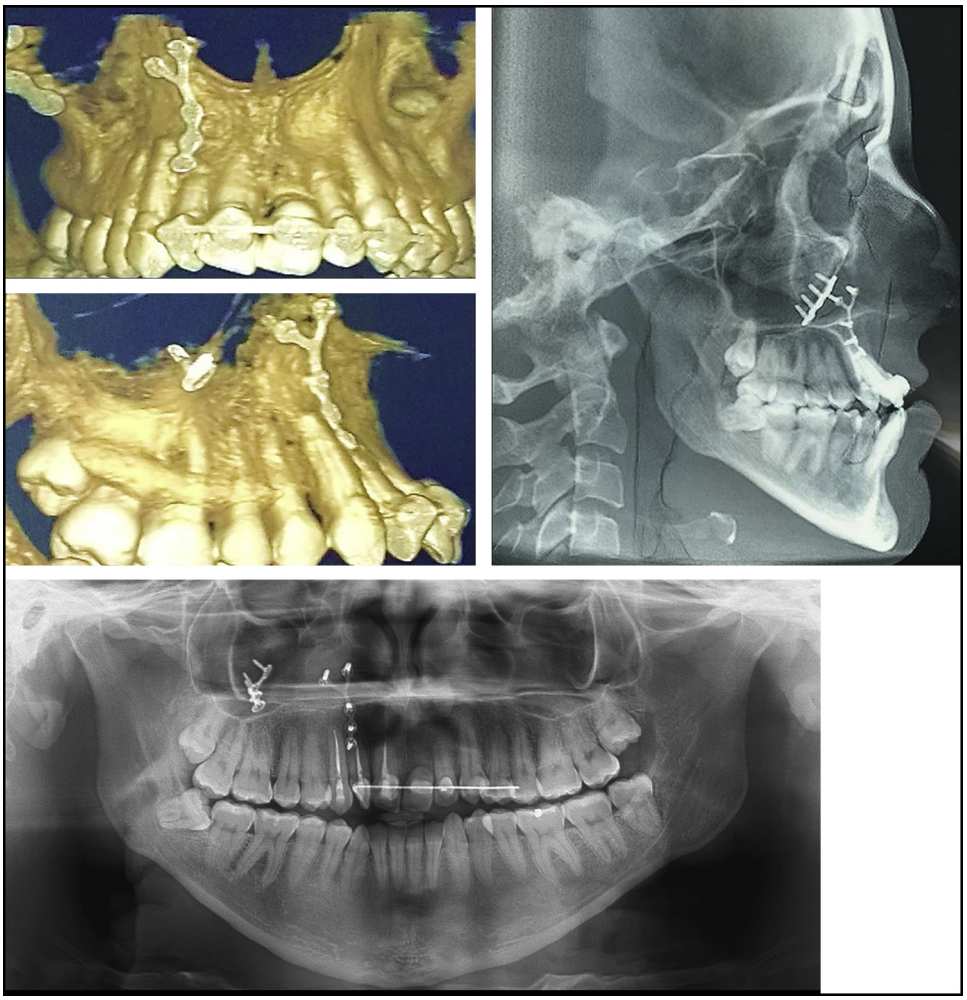

Fig 3. Pretreatment tomography and panoramic and lateral cephalometric radiographs.

and maxillary right lateral luxation. Initially, she had surgery by the second author (R.A.R.) to reduce the maxilla fracture with the use of the Synthes system with an L-plate with intermediate (system 2.0) in the zygomatic pillar region and a Y-plate with intermediate (system 1.5) in the piriform pillar. Dental trauma was treated with 0.028″ stainless steel wires and composite light-curing resin (applied in the vestibular face of the anterior maxillary teeth), and a provisional crown was placed on the maxillary left central incisor. After 2 weeks, the maxillary right central and lateral incisors and canines underwent endodontic treatment owing to the absence of pulp vitality.

Considering the orthodontic treatment, initially the patient was referred to a maxillofacial surgeon (R.A.R.) for extraction of both maxillary and mandibular third molars. Then, the first author prepared 0.022 × 0.028″ preadjusted edgewise bracket bonds in both arches without braces in the right maxillary lateral incisor and left maxillary central incisor crown that were fixed with the archwire. The archwire sequence in both arches was 0.014″ nickel-titanium and 0.016″, 0.018″, and 0.020″ stainless steel archwire.

During the initial alignment, the right maxillary lateral incisor and left maxillary central incisor crowns were decreased by interproximal wear to allow correction of anterior crowding. Then, a 0.019 × 0.025″ stainless steel archwire was prepared, and the maxillary lateral right incisor was extracted. A composite resin was adapted to the distal face of the maxillary right central incisor to allow space closure without the presence of a nonesthetic space in this region because it was an esthetic area (anterior region; Fig 4). The increase in the negative overjet was achieved by means of space closure of the maxillary right lateral incisor and maxillary left central incisor, while the maxillary

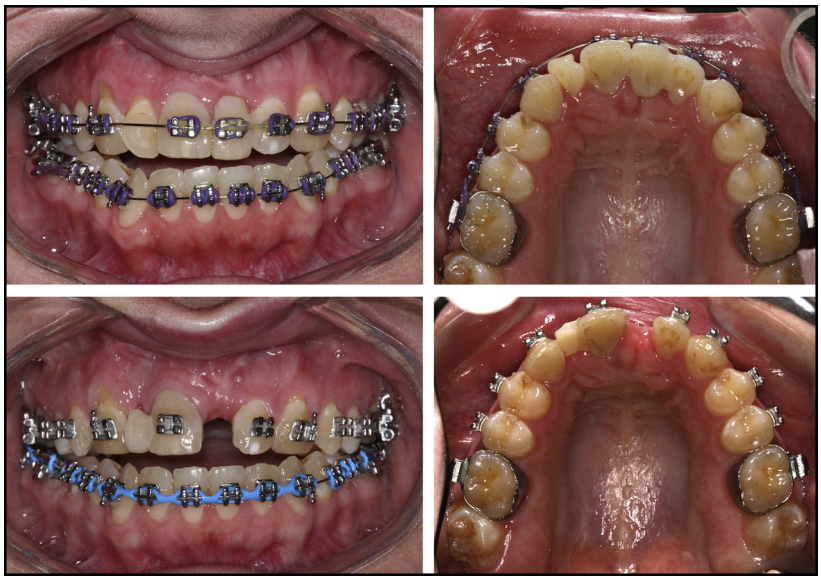

Fig 4. Treatment progress.

Fig 5. Presurgical facial and intraoral photographs.

Fig 6. Postsurgical facial and intraoral photographs.

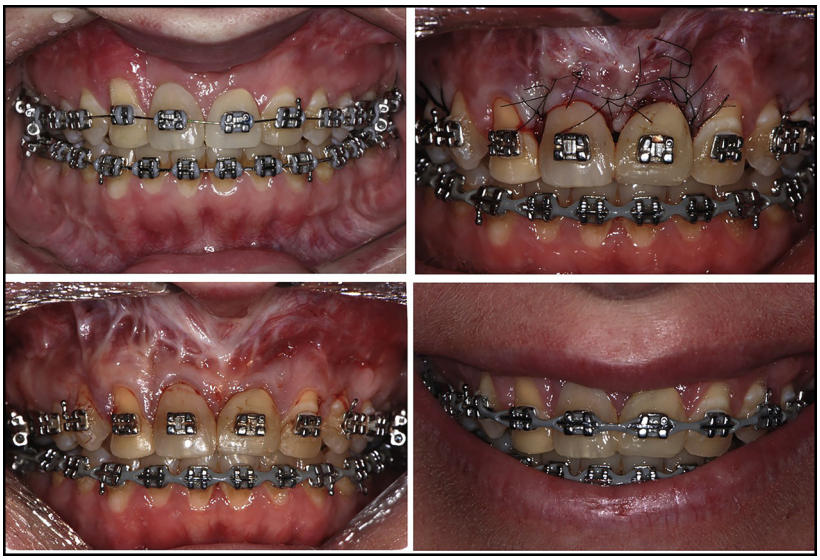

Fig 7. Clockwise from top left: slow extrusion of canines; surgical moment of a connective graft for volume in the elements of the maxillary central incisor; improvement of the arch of the smile after surgery; and a new gingival margin of the upper teeth.

canines were moved to the maxillary lateral incisor position and the maxillary left lateral incisor was moved to the central position (Fig 5).

After 16 months of active treatment, all maxillary arch spaces were closed with the retraction of the maxillary incisors, and the inferior crowding was corrected at

Fig 8. Debonding.

Fig 9. One-year posttreatment facial and intraoral photographs.

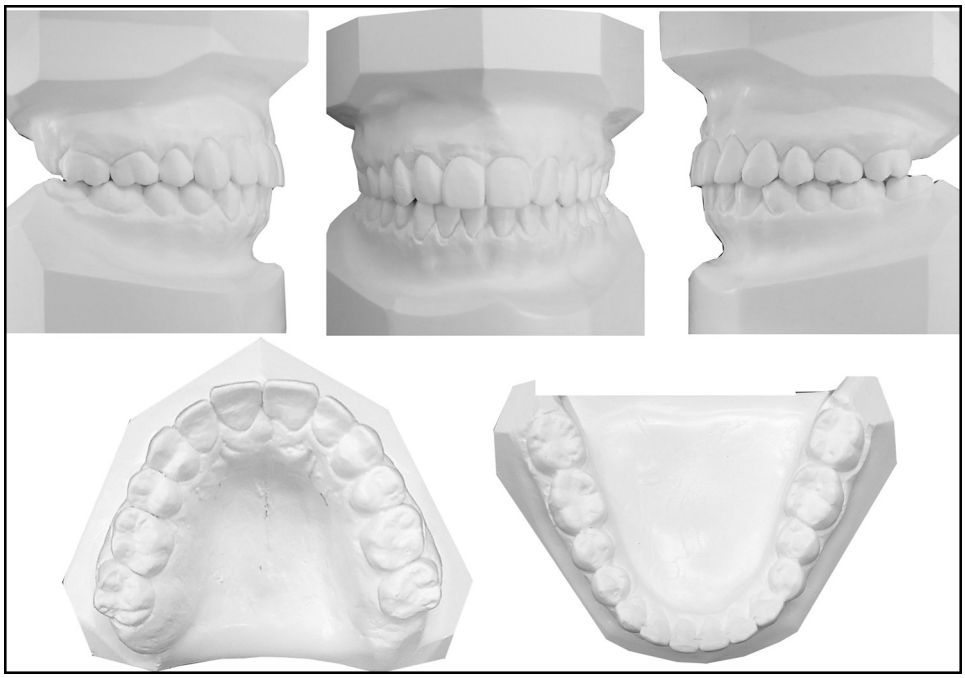

Fig 10. One-year posttreatment study casts.

the expense of the projection of the mandibular incisors, resulting in a 12-mm negative overjet, at which time the surgical arches were installed with the use of a 0.019 × 0.025″ stainless steel archwire as the basis. The surgical planning was elaborated with an aim toward movement of advancement and impaction of the maxilla with retrusion and a counterclockwise turning movement of the mandible.

A Le Fort I osteotomy was performed in the maxilla, and a sagittal osteotomy was performed in the mandible. After the osteotomies and bone repositioning, the segments were immobilized by rigid internal fixation with the use of Osteomed system titanium plates and screws (2.0 system). Four L-plates (system 2.0) and 16 monochorionic titanium screws were used for the maxilla, and 2 sagittal plates and 12 monocortical titanium screws were used in the mandible. Nasal plication was performed with nylon number 0 thread and a VY-technique suture with the use of Vicryl 4.0 (Ethicon). Surgical procedures were performed by the second author.

After orthognathic surgery, a 2-mm positive overjet and 2-mm positive overbite were established with a coincident upper and lower dental midline and a satisfactory intercuspation (occlusion) of the molars and premolars, with an Angle Class II molar relationship (Fig 6).

During the postoperative period, the occlusion was maintained through interocclusal elastics in a vertical direction. Slow extrusion of the maxillary right canine was performed to improve the gingival margin because this tooth was positioned in the maxillary lateral incisor position. Six months after orthognathic surgery, gingival surgery for an increased crown was performed in both maxillary first premolars, which were positioned in the canine position, and the maxillary left lateral incisor, which was positioned in a central position. After more than 3 months, a connective graft for gingival volume was executed in the maxillary incisors (these conjunctives aimed to increase the volume, considering the presence of canines in the lateral position). Periodontal surgeries were performed by the fourth author (M.R.B.; Fig 7).

Thirteen months after surgery, the appliances were removed, completing 30 months of active treatment time. A 0.018″ wire retainer was bonded to the lingual surface of the mandibular incisor and canines, and a removable wraparound retainer was adapted to the maxillary arch[9,10] (Fig 8).

After appliance removal, both maxillary first premolars were reshaped with the use of composite resin addition to establish a maxillary canine shape. The maxillary canines were reshaped in the maxillary lateral incisors. The maxillary left lateral incisor received a porcelain crown, and the remaining teeth were cleared. The esthetic procedures were performed by the third author (C.E.A.F.; Fig 9).

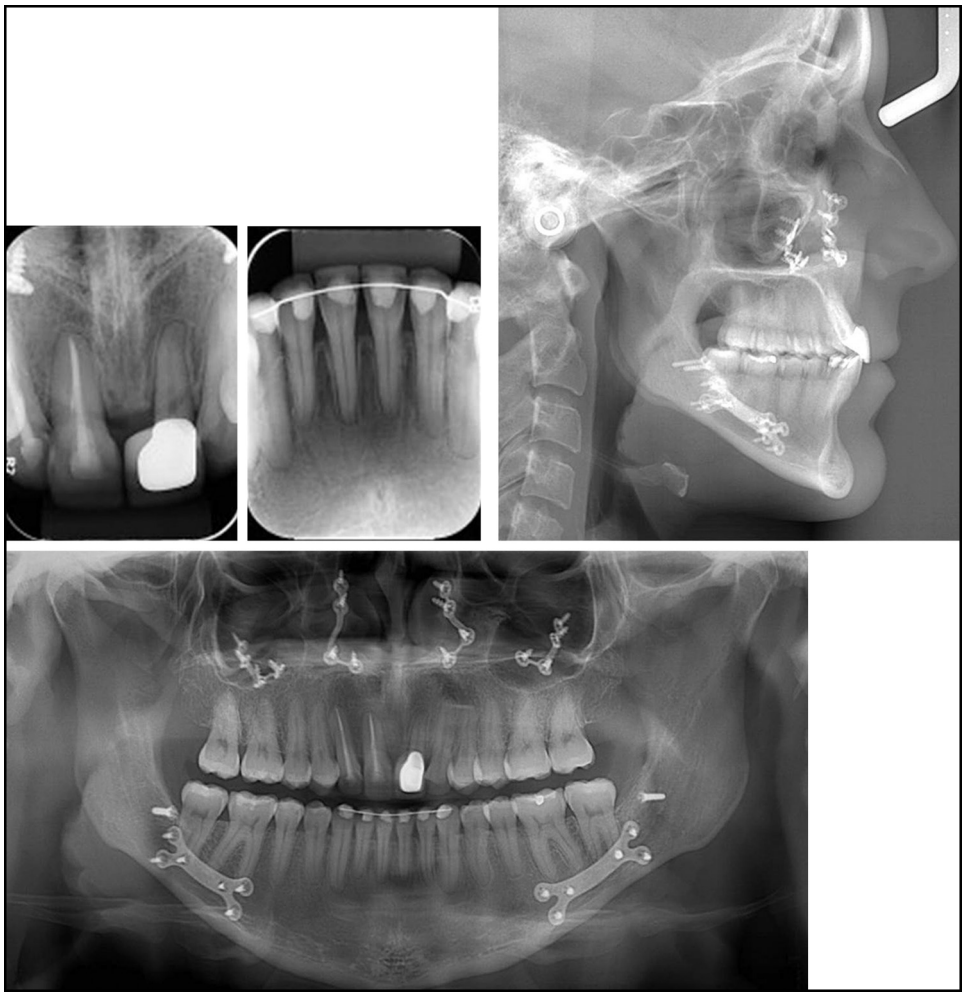

Fig 11. One-year posttreatment radiographs.

TREATMENT RESULTS

Maxillary and mandibular crowding were successfully relieved, with satisfactory stability and correction of the maxillary midline inclination (Figs 9 and 10).

The maxilla and mandible repositioning by means of orthognathic surgery was performed, and great improvement of facial esthetics was established, with facial symmetry, a passive lip seal, and good incisor exposure during speech and smiling. The orthodontic surgical treatment resulted in ideal incisor inclination inside the bone, a bilateral Class II molar relationship with satisfactory intercuspation, maxillary first premolars in the canine position, a good gingival position and periodontal health, and maxillary and mandibular dental midlines that were coincident with the facial midline (Figs 9 and 10).

The panoramic radiograph showed correct parallelism between the dental roots and integrity of the alveolar bone height and root tissue (Fig 11). Superimposed lateral cephalometric tracings presented retraction of the maxillary incisors, advancement and impaction of the maxilla, and retrusion and counterclockwise mandible movement (Fig 12).

The treatment results were well maintained, with good occlusion and aesthetics after 24 months at the end of active treatment (Fig 13). The patient reported excellent dental function, absence of muscle pain or joint alterations, dental and facial esthetics satisfaction, and an improved quality of life.

DISCUSSION

In orthodontic treatment associated with dental trauma and dental luxation, the side-effect risks during orthodontic movement should be considered. Regarding the need for surgical preparation involving considerable tooth movement, an important consideration is the

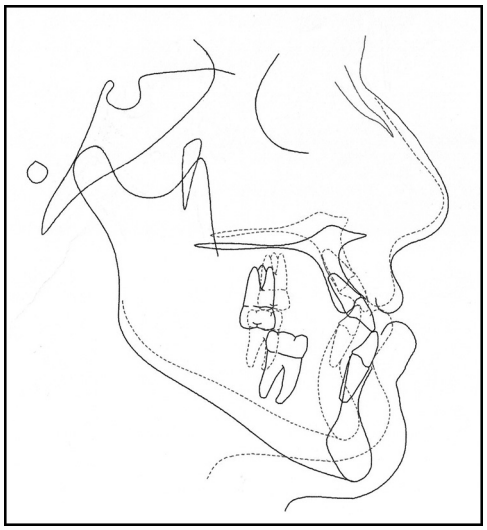

Fig 12. Superimposed lateral cephalometric tracings: pretreatment (*solid line*) and 1 year after treatment (*dashed line*).

uncertain prognosis regarding dental-traumatized tooth movement, due to either the risk of ankyloses of teeth or the risk of dental root resorptions. The literature indicated that the parameters associated with the use of rectangular wire, the presence of incisor irregularity, and the history of trauma were not identified as risk factors,[11] but previous trauma and tooth morphology are unlikely causative factors.[12] Moreover, ankylosis is a known complication of replanted or severely intruded permanent incisors.[1,2] Regarding endodontic treatment, we considered this as a preventive factor for apical root resorption in adult orthodontic patients.[13]

Taking this information into account, we decided to avoid extraction of teeth that were not involved in dental trauma, so we proceeded with the treatment plan of exodontia of the maxillary right lateral incisor and closure of the residual space by retraction of the maxillary right central incisor, maxillary left lateral incisors, and maxillary right and left canines. Positioning the maxillary left lateral incisor in the maxillary left central incisor position, the maxillary canines in the maxillary lateral incisors position,[3,14] and the maxillary first premolars in the maxillary canines position and disregarding the maxillary first premolar extraction to achieve a negative overjet was the most common alternative for Class III skeletal surgery preparation.

Regarding the decision to impact the maxilla, we considered that the incisor exposure in relation to the upper lip increased during the initial cephalometric tracing and that impaction of the same would reduce the risk of gingival exposure after surgery, in addition to improving a facial height decrease, which was increased at the beginning of treatment.[1]

Good gingival position and periodontal health were achieved, and the maxillary and mandibular dental midlines were coincident with the facial midline, demonstrating that despite the atypical extractions, prosthetic complementation was of great value for the conclusion of the case. Occlusion with the molar Class II relationship[15] with first premolars reshaped to establish a maxillary canine shape and maxillary canines reshaped in maxillary lateral incisors has been described several times in the literature,[3,4,14] whereas the maxillary left lateral incisor in the central position has not been reported in the literature. The possibility of an implant in the maxillary left central incisor position was considered if there was no satisfactory adaptation of the crown in the lateral incisor.

The decision to use a 0.018″ retainer bonded to the lingual surface of all teeth by the mandible right first premolar to the mandible left first premolar was because there was greater potential of crowding correction relapse. A removable wraparound plate was installed in the maxillary arch to maintain the transverse dimension and new position of the teeth. It is recommended that the lower retainer remain bonded indefinitely to avoid decreasing the intercanine width. The patient was instructed to use the wraparound plate for 12 months, during which time the periodontal ligament could replace its fibers.[9,10]

The patient reported satisfactory dental function, the absence of muscle pain or joint alterations, dental and facial esthetics satisfaction, and improved quality of life, which are similar to the results described in the literature when dealing with Class III patients.[16]

SUMMARY AND CONCLUSION

In orthodontic treatment associated with dental trauma with dental luxation, the side-effect risks during orthodontic movement should be considered. Adding to this is the need for surgical preparation involving extractions, and unconventional preparations for surgery can be adopted.

The case presented here was a great challenge with complex multidisciplinary procedures. It resulted in successful treatment based on orthodontic preparation for surgical treatment after a maxillary fracture associated with dental trauma with an uncertain prognosis.

The ultimate results showed stability of an atypical occlusion with a molar Class II relationship, maxillary first premolars in the canine position, maxillary canines in the lateral incisor position, and one maxillary lateral

Fig 13. Two-year posttreatment facial and intraoral photographs.

incisor in the central incisor position, with optimal dental and facial esthetics.

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