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# Atypical extraction in Class I malocclusion: A case report

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## Abstract:

The treatment of Angle Class I malocclusion by atypical extraction is rather challenging. The extraction of four first premolars often manages it. However, in cases of compromised and non-restorable teeth, the extraction decision may be altered, making the anchorage and the treatment mechanics more challenging. This article reports the clinical case of a 16-year-old patient from Sudan who presented with a chief complaint "My teeth are crooked and sticking out." He had Angle Class I malocclusion with a bimaxillary dentoalveolar protrusion. He had severe crowding in both arches and localized marginal gingivitis related to an ectopically erupted upper right canine (UR3) and lower right first premolar (LR4). The patient had a provisional restoration in the lower right first molar (LR6). Extraction of three first premolars and one first molar was the alternative of choice for this treatment, which restored function, providing improved periodontal health, achieved the desired facial esthetics, and allowed finishing with a stable and balanced occlusion. Management of angle class I malocclusion with atypical extraction patterns should be performed with careful mechanics and anchorage planning to obtain good results.

## Keywords:

Angle Class I, atypical extraction, bimaxillary protrusion, permanent first molar, poor root canal treatment

## Introduction

Angle Class I bimaxillary dentoalveolar protrusion is a malocclusion that is presented as protrusion and proclination of upper and lower incisors. Teeth proclination cause lip protrusion that results in lip incompetence and improper lip seal.<sup>[1]</sup> The term "bimaxillary protrusion" refers to the existence of a dentofacial relationship, which is an essential factor in deciding the amount and the direction of the anteroposterior movement of anterior teeth in a sagittal plane.<sup>[1,2]</sup>

Bimaxillary protrusion is a common characteristic feature in the Sudanese population.<sup>[3]</sup> The prevalence of bimaxillary protrusion in Sudanese is like Zimbabwean

population and lesser than the Nigerian population which is approximately 3.7%.<sup>[3,4]</sup> The goals of orthodontic treatment of bimaxillary protrusion include achieving pleasant dental and soft-tissue changes, through decreasing the soft-tissue protrusion and facial convexity after achieving the proper maxillary and mandibular incisors inclination from their retraction.<sup>[2]</sup>

The critical decision during the treatment of orthodontic cases that include extractions as an alternative to solve the problem of negative space discrepancy is to determine which teeth will be extracted. Several aspects must be considered, such as periodontal health, teeth condition, orthodontic mechanics, functional and esthetic alterations, and treatment stability.<sup>[5]</sup> Despite controversies, the extraction of teeth to solve dental crowding is a therapy that has been used for decades. Premolar extractions are the most common,<sup>[1,6,7]</sup> but there are situations in which atypical extractions facilitate

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mechanics, preserve periodontal health, and improve the facial profile.<sup>[8-10]</sup> Causes for the atypical extraction might be due to substantial defective filling, or poor endodontic treatment.<sup>[11]</sup> The extraction of molars in these cases might be an excellent alternative to the extraction of sound and healthy premolars.

### Case Report

A 16-year-old Sudanese boy with regular general appraisal and body built presented to the orthodontic clinic with a chief complaint that "My teeth are crooked, sticking out and I don't like my smile." He had no relevant medical history and no reported habits. Dentally, he had acceptable composite filling in the lower right permanent first molar [LR6] and a significant defective restoration in the lower left permanent first molar [LL6].

During the extra-oral examination, the profile view showed a convex profile, harmonious thick lips, an acute nasolabial angle, and almost a flat labiomental fold. The frontal view showed asymmetrical dolichofacial face type, increased lower facial third, and regular nose size but slightly deviated to the right. The patient has incompetent lips with regular lip length and morphology, and 0.5 mm incisal show at rest. Upon smiling, the patient had an inconsonant smile with full incisor crown length show with no gingival display and regular lip line. The patient has no occlusal cant. He had an average lip length and morphology; the upper midline is shifted 2 mm to the right with facial midline.

Intraorally, the patient had good oral hygiene with some racial pigmentation, localized attached gingival recession related to the ectopically erupted UR3 and LR4. He had a full set of permanent teeth erupted in his mouth except for the partially erupting lower right permanent canine (LR3), an acceptable composite filling in the LL6, and sizeable defective filling in the LR6. The patient had a Class II incisor relationship, angle class I molar relationship bilaterally. He had Class I canine relationship on the left side and undetermined canine classification on the right side. The malocclusion is complicated by proclined and protruded upper and lower incisors. He had moderate crowding in the upper arch and severe crowding in the lower arch.

Furthermore, he had 6 mm increased overjet, shallow bite that was around 10%, ectopic, and buccally positioned UR3 and LR4, partially and ectopically erupted LR3. The patient had multiple rotated teeth. The lower midline is 2 mm shifted to the right to the upper midline [Figure 1].

The arch forms of upper and lower casts were U shaped. Moreover, dental casts showed an asymmetric maxillary

arch in the transverse plane and anteroposterior plane due to constriction in the upper right posterior segment compared to the upper left segment and due to the UR3 that was in supraversion and buccally positioned. This caused the upper right segment to be a head of the upper left segment. Also, the mandibular arch had an asymmetric arch form in the anterior segment transversely and anteroposterior due to the LR3 which was partially impacted and rotated mesiolabially. The patient has mesiolabial rotation in LL3, LL2, and LR4. He also had a mesiolingual rotation in LR1. Space analysis using digital caliber indicated that there was moderate crowding (3.6 mm) in the upper arch and severe crowding (7 mm) in the lower arch. Bolton analysis revealed 2.6 mm overall mandibular excess (93.8%), including 0.9 mm of anterior maxillary excess (75.3%). Therefore, he had 1.7 mm posterior mandibular excess and average curve of Spee [Figure 2].

The panoramic radiograph showed that condyles and ramie were relatively symmetrical. Teeth morphology, bone level, temporomandibular joint, and maxillary sinus were normal, and there were no bony pathologies. Erupting lower right permanent second molar (LR7), impacted LR3, developing upper and lower third molars (crown formation stage) with future impaction tendency of the lower right and left third molars. The LL6 had a composite filling. The LR6 had poor root canal treatment and a comprehensive defective coronal restoration [Figure 3].

The patient cephalometric X-ray showed that the cervical vertebral maturation is in stage 4. The analysis of lateral cephalometric X-ray and its tracing [Figures 4 and 5] showed that according to Sudanese's norms,<sup>[3]</sup> the patient has a skeletal class III relationship ( $SNA = 76^\circ$ ,  $SNB = 75.9^\circ$ ,  $ANB = 0.1^\circ$ ) that was confirmed by Wits appraisal (-2.6 mm). He had a hyperdivergent maxillary mandibular plane angle ( $MMPA = 34.3^\circ$ ), and a relatively increased lower face height (anterior nasal spine-menton [ANS-ME] = 68 mm). According to the angular and linear measurements, he had proclined upper incisors (upper incisors to Nasion-A point [U1-NA] = 45.4) and protruded upper and lower incisors (U1-NA = 14.5 mm), (lower incisors to Nasion-B point [L1-NB] = 8.3 mm), (lower incisors to A-Pogonion [L1-Apo] = 8.4 mm). Furthermore, he had an acute nasolabial angle and protruded lower lip (Lower lip to Ricketts E plane = 4.3 mm) [Table 1]. The problem list is summarized in Table 2.

### Treatment objectives

The treatment objectives included addressing the patient's chief complaint through retracting maxillary and mandibular anterior teeth that lead to improving

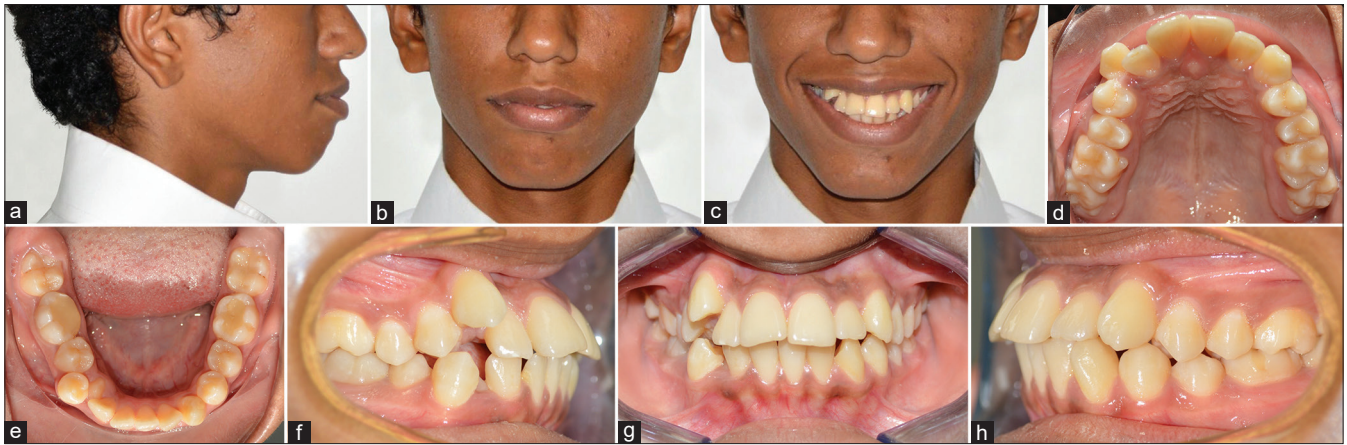


Figure 1: (a-h) Pretreatment extra-oral and intra-oral photographs



Figure 2: (a-e) Pretreatment study model



Figure 3: Pretreatment panoramic radiograph

the facial aesthetics and convexity, obtaining a balanced facial profile, competent lips, and a good lip seal. Also, it is important to control the vertical dimension of the

patient, as well as to alleviate the dental crowding of both upper and lower arches, maintain Class I canine classification bilaterally, obtain ideal overjet and overbite, correct the shifted dental midline, correct arch asymmetry, and correct Bolton discrepancy.

Finally, in order to achieve functional occlusion with maximum intercuspation, canine-guided mutually protected occlusal scheme with no interferences and achieve a definite smile arc.

### Treatment planning

Extraction of all first premolars usually performed to manage bimaxillary dentoalveolar protrusion. However, consultation with the restorative dentist

regarding the status of LR6 revealed that this tooth was questionable, and a decision made to extract upper right first premolar (UR4), upper left first premolar (UL4), lower left first premolar (LL4), and LR6. For anchorage preparation, a transpalatal arch (TPA) planned for the upper arch, and second molars were included to maximize anchorage. To control the vertical dimension, we will use short intermaxillary elastics on heavy stainless steel (SS) wire and try to avoid any extrusive force. For retention, supracrestal fibrotomy was performed for the rotated teeth. Furthermore, upper wrap-around removable retainer and lower lingual fixed retainer (3-3) were delivered to the patient.



Figure 4: Pretreatment cephalometric radiograph

### Treatment progress

TPA cemented on the upper first molars as an aid to the anchorage.<sup>[12]</sup> Referral of the patient to the dental surgeon for the extraction of the selected teeth. Comprehensive fixed orthodontic treatment using a pre-adjusted edgewise fixed orthodontic appliance, 0.018 × 0.025-inch Roth prescription. Postpone bonding of the upper and lower incisors to avoid excessive flaring while leveling and alignment. Initial leveling and alignment of the upper and lower teeth were performed using a round 0.014-inch nickel-titanium archwire (NiTi) and canines' laceback [Figure 6], followed by 0.016-inch NiTi and then 0.016 × 0.016-inch NiTi. During the leveling and alignment stage, placement of buccal and lingual buttons on the lower



Figure 5: Pretreatment cephalometric tracing

Table 1: Pretreatment and posttreatment cephalometric analysis

Measurements	Norms (mean+SD)	Pretreatment	Posttreatment
SNA	85.57°±1.66°	76.0°	83.0°
SNB	82.50°±1.89°	75.9°	83.4°
ANB	3.07°±1.39°	0.1°	0.4°
Convexity angle (NA-APog)	0°	1°	0.7°
Facial plan to SN (SN-Pog)	82.2°	75.7°	83.2°
SN-maxillary plane	7.19°±3.17°	6.2°	4.2°
SN-mandibular plane	29.41°±5.57°	33.1°	35.9°
Wits appraisal	-1 mm	-2.6 mm	-1.9 mm
MMPA	22.51°±5.16°	34.3°	34.7°
U1-NA	27.24°±6.46°	45.4°	32.5°
U1-NA	7.39±2.19 mm	14.5 mm	9.0 mm
L1-MP	117.67°±8.34°	93.1°	83°
L1-NB	9.34±2.5 mm	8.3 mm	5.4 mm
Upper anterior face height	57.06±4.09 mm	51.8 mm	44.8 mm
Lower anterior face height	76.26±5.77 mm	68 mm	71.6 mm
Face height ratio	75.1±6.50%	55.7%	60.3%
Inter-incisal angle	117.67°±8.34°	105.7°	128.4°
Upper lip → E-line	-0.9±2.3 mm	0.1 mm	-3.9 mm
Lower lip → E-line	1.5±2.4 mm	4.4 mm	1.6 mm
Nasolabial angle	90.7°	69°	80°

U1-NA=Upper incisors to Nasion-A point, MMPA=Maxillary-mandibular plane angle, L1-NB=Lower incisors to Nasion-B point

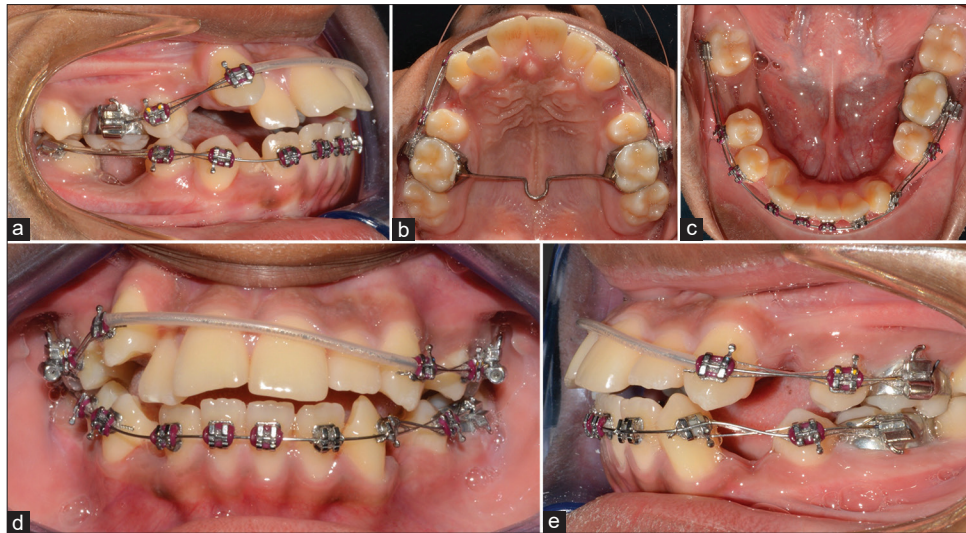


Figure 6: (a-e) Upper and lower 0.014-inch nickel-titanium archwire (NiTi) and caninesæ laceback, initial leveling and alignment

Table 2: Problem list

**Problem list**

Pathological	Localized marginal gingivitis in UR3, LR4. Poor restoration in endodontically treated LR6.
Skeletal	Skeletal class III pattern. Hyperdivergent mandibular plane angle.
Dental	Class II incisor relationship. Proclined and protruded upper and lower incisors. Class III molar relationship on the left side. Increased overjet (6 MM) Shallow bite (10%) Moderate crowding in the upper arch (3.6 mm), and severe crowding in the lower arch (7 mm). Ectopic eruption of UR3, LR3, and LR4. Partially impacted and rotated LR3. Upper midline shift 2 mm to the right in relation to facial midline Lower midline shift 2 mm to the left to the upper midline. Upper and lower arches are asymmetric in transverse and anteroposterior planes. Bolton discrepancy: - Mandibular posterior excess of 1.7 mm
Soft tissue	Protrusive lips in relation to Ricketts E-line. Acute nasolabial angle. Flat labiomental fold. Incompetent lips Slightly convex profile

UR3=Upper right permanent canine, LR3=Lower right permanent canine,  
UR4=Upper right first premolar, LR4=Lower right first premolar, LR6=Lower right permanent first molar, U1-NA=Upper incisors to Nasion-A point

right canine to derotate it by applying a couple of force was performed [Figure 7]. Once the canine derotated and aligned, canine retraction started on 0.016 × 0.022-inch SS archwire using power chain. Patient recall was every 3 weeks. Class I canines was achieved after 4 months. After canine retraction, the upper and lower incisors were leveled and aligned, and then the midline was corrected. Then incisors

were retracted using rectangular SS 0.016 × 0.022-inch SS archwire with T-loop in both arches that was activated by cinch back the wire every 3 weeks. For the protraction of the lower-left permanent second molar (LL7), space closure was accomplished by using rectangular SS 0.016 × 0.022-inch SS archwire with Omega closing loop. After space closure, arch coordination performed. Then, finishing and detailing using 0.017 × 0.025-inch titanium molybdenum alloy archwire (TMA) and 0.017 × 0.025-inch SS.

For maximum teeth interdigitation, bilateral short intermaxillary box elastics 1/4" medium 4 oz with Class II component was used for 2 months. After finishing the orthodontic treatment and achieving all the planned objectives, debonding, and removal of the fixed appliances. A removable wrap around maxillary retainer used for retention and instructions given to use it 24/7 in the 1<sup>st</sup> year, then only night time in the 2<sup>nd</sup> year. In the mandibular arch, a gold chain lingual fixed retainer bonded from canine to canine (Reliance, Itasca, IL, USA)

### Treatment results

The treatment was accomplished with satisfactory and pleasing results in 25 months. Evaluation of the patient's final records showed that the planned treatment objectives were achieved. A balanced facial profile with a competent lip seal and reduced facial prominence resulted. Upon smiling, the patient had a pleasant consonant smile with the upper midline centered to the facial midline, and full crown length of the incisal display. Intraorally, the results achieved in comparison with the pretreatment findings showed that symmetrical ovoid upper and lower arches with molar class I on the left side and class II on the right side, where the first molar was extracted, and class I canine relationship. Also,

the results showed that the midline was corrected with optimum overjet and overbite [Figure 8].

The final panoramic radiograph showed that the LR7 bodily protracted to occupy the space of the previously extracted LR6 [Figure 9]. The lateral cephalometric radiograph and the cephalometric tracing showed a remarkable incisor retroclination with a noticeable improvement in the overlying soft tissue of the face [Figures 10 and 11]. Superimposition of the pretreatment and the posttreatment cephalometric radiograph showed noticeable significant changes, including improvement of the angular measurement value of (U1-NA) from 45.4° to 32.5°, the linear value of (U1-NA) from 14.5 mm to 9.0 mm and the lower incisor to mandibular plane angle (L1-MP) from 93.1° to 83°. Profile and lips protrusion subsequently improved after the change of upper and lower incisors' inclination and proclination that was reflected by the positive changes of the interincisal angle from 105.7° to 128.4° [Table 1]. Soft-tissue changes were observed by improvement in the lip position. The pretreatment and

posttreatment lateral cephalometric superimposition radiograph confirmed the previous results [Figure 12].

By the end of the treatment, the lower right third molar (LR8) smoothly erupted at the extraction site.

### Discussion

Bi-maxillary protrusion could be of a skeletal or dental origin. A study performed by El hag *et al.*<sup>[13]</sup> reported that bimaxillary protrusion of skeletal origin excluded from the Sudanese study population sample, and it was mainly of dental component origin that characterized by proclined and protruded upper and lower incisors. Bimaxillary dentoalveolar protrusion in Sudanese recorded higher values than in Moroccans, Caucasians, Palestinians, Zimbabweans, and Saudis.<sup>[4,14-17]</sup>

Instead of using the usual extracting pattern that resembled in the extraction of all first premolars,<sup>[2]</sup> a decision was performed to extract the LR6 molar and the



Figure 7: (a-e) Upper and lower 0.016 × 0.016-inch NiTi, couple force on lower right canine for derotation

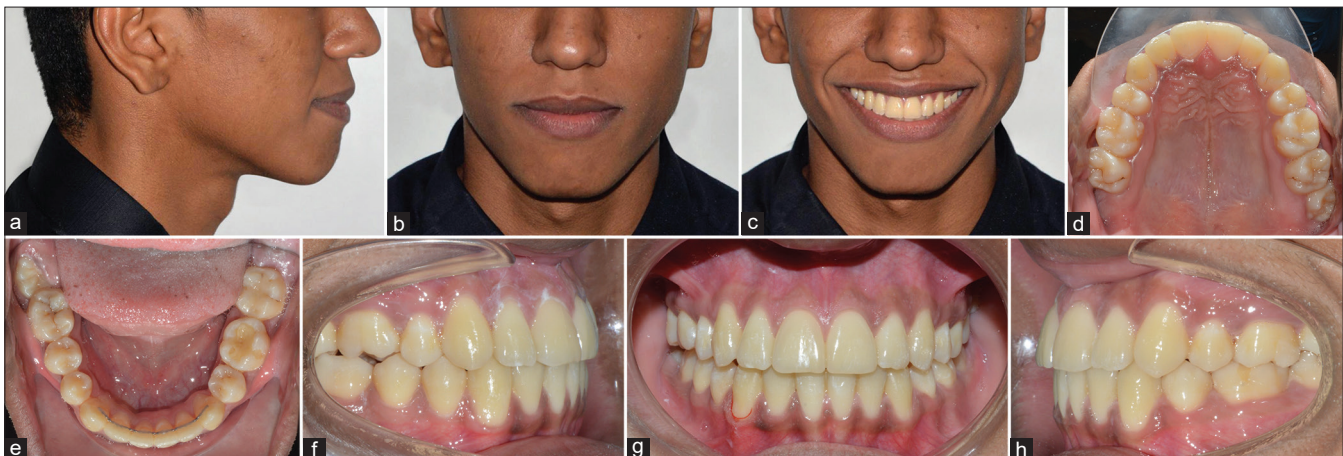


Figure 8: (a-h) Posttreatment extra-oral and intra-oral photographs



Figure 9: Posttreatment panoramic radiograph



Figure 11: Posttreatment cephalometric tracing

three first premolars in all the other quadrants to address the patient's chief complaint and achieve the required objectives. The decision to extract the LR6 in substitution to the LR4 was made to overcome the poor prognosis of the non-restorable LR6 tooth, and to preserve the healthy first premolar as it was recommended and reported previously.<sup>[18]</sup> Furthermore, Bolton analysis revealed a 1.7 mm posterior mandibular excess that aided in the decision to extract the non-restorable LR6. Maximum anchorage preparation was preferable in such a case. Although the application of maximum anchorage by using the mini-screws was considered the best to achieve the required anchorage, it still had multiple drawbacks with some patients, and complications associated with using titanium anchorage devices include screw fracture, irreversible hard tissue damage, and dislodgement.<sup>[19-21]</sup>

Anchorage preparation for this case was performed using proper and controlled mechanics. Concerning the lower arch, bonding the second molars and using the reciprocal anchorage during space closure in the lower right segment was performed until the canine became Class I relationship in that segment. In the upper arch, TPA was placed as an aid to the anchorage. Furthermore, the delay of bonding of the incisor teeth till achieving the proper canine relationship also controlled the anchorage requirement and avoided the flaring of incisor teeth.<sup>[22]</sup>



Figure 10: Posttreatment cephalometric radiograph

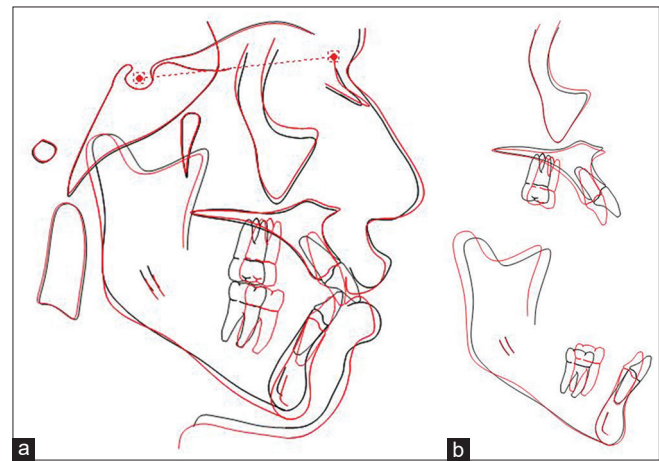


Figure 12: (a and b) Superimposition of the cephalometric tracing (Black: pre-treatment, Red: Post-treatment) a-Overall superimposition b-maxilla and mandible superimposition

Some of the extraction space of the right first molar was used to alleviate crowding in this side, and the rest of the extraction space was used for protraction of the lower right second molar. Class II elastics were used to maintain the anchorage in the upper arch and to help in protracting the lower posterior teeth.

It was reported by Schroeder *et al.*<sup>[23]</sup> that the extraction of four first molars prolonged the treatment time and negatively affected the prognosis. However, for this patient, a successful and acceptable duration of 25 months, to achieve the required objectives, including molar protraction and finishing the treatment. The results showed that molar extraction did not prolong the treatment duration.

One of the interesting observations is the positive effect and the smooth path of eruption that was provided to the lower third molars because of teeth extraction, as reported previously in multiple studies.<sup>[24,25]</sup> Third molar



Figure 13: (a-h) 1-year follow-up, extra-oral and intra-oral photographs

angulation and path of the eruption were facilitated, especially at the side in which the first molar extracted, and this agrees with what was reported by previous studies.<sup>[26,27]</sup>

There was no remarkable difference between the pretreatment and posttreatment measurements of lower anterior face height and mandibular plane angle. That indicates that the mechanics used in the treatment of this bimaxillary protrusion case had no unwanted effect on the vertical dimensions. Jacobs *et al.*<sup>[28]</sup> reported that space closure following first molar extraction using anterior and premolar teeth as an anchorage has a side effect of posterior displacement for the soft tissue, which was accompanied by unpleasant profile changes. Furthermore, previous studies reported a midline shift as another side effect of first molar extraction on one side. Interestingly, none of the previously mentioned side effects of extraction of the lower first molar tooth in the quadrant of the extracted first molar.<sup>[29]</sup>

By the end of the treatment, the LR8 easily erupted as the impaction tendency of that tooth decreased following the protraction of the LR7 to the extraction space.<sup>[26,30]</sup> Previous studies claimed the ease of third molar eruption following premolar or molar extraction.<sup>[24,25,30]</sup>

One-year posttreatment follow-up indicated successful treatment results with stable occlusion [Figure 13]. Furthermore, a noticeable improvement in the angulation and path of the third molar of the eruption [Figure 14].

## Conclusion

Although the patient had a bimaxillary protrusion with a high mandibular plane angle, the objectives were managed and addressed successfully with a pleasant esthetic smile and profile and without affecting the patient's vertical dimensions and without using

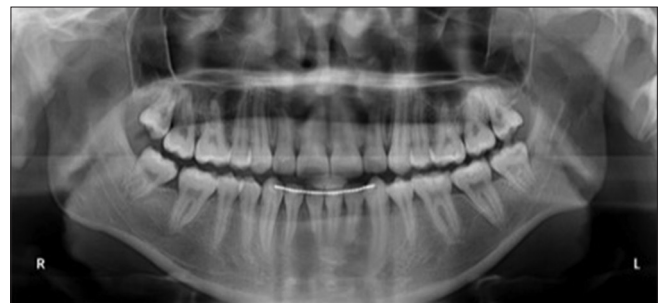


Figure 14: 1-year follow-up panoramic radiograph

mini-screws as a mean of anchorage. 1-year follow-up after orthodontic treatment successfully revealed promising results with stable, functional occlusion, and stable teeth interdigitation. The panoramic view revealed the improved position of lower third molars bilaterally.

## Declarations

- Ethics approval and consent to participate: N/A
- Consent for publication: Written informed consent obtained from the patient's guardian for publication of this case report and any accompanying images. A copy of the written consent is available for review by the editor of this journal
- Availability of data and material: All data generated or analyzed during this study included in this published article and its supplementary information files
- Authors' contributions: RA performed the clinical part in treating this case, MA supervises the case during treatment; all authors read and approved the final manuscript.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in



the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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