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**Case Report**

# "Wonders of Rapid Maxillary Expansion and Lower Premolar Extractions in Correction of a Skeletal Class III Case with Maxillary Deficiency and Mandibular Excess" – A Case Report on Non- Surgical Orthodontic Camouflage

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## Abstract

Transverse deficiencies should be a priority in orthodontic treatment, and should be corrected as soon as diagnosed, to restore the correct transverse relationship between maxilla and mandible and, consequently, normal maxillary growth. Corrections may be performed at the skeletal level, by opening the midpalatal suture, or by dentoalveolar expansion. The choice of a treatment alternative depends on certain factors, such as age, sex, degree of maxillary hypoplasia and maturation of the midpalatal suture. Thus, the present case report discusses rapid palatal expansion to correct maxillary hypoplasia in a female patient with advanced skeletal maturation and bilateral cross-bite with constricted maxilla.

**Keywords:** Constricted Maxilla, RME, Hypoplastic Maxilla, Concave Profile, Maxillary Deficiency, RME, Malocclusion, Palatal Expansion Technique, Correction of Crossbite, Crowded Dentition, Rapid Maxillary Expansion, Lower Premolar Extraction, Skeletal Class III pattern, Mandibular Excess, Orthodontic Camouflage.



## INTRODUCTION

Transverse deficiency [1] or maxillary hypoplasia [2] is one of the most detrimental problems to facial growth and to the integrity of the dentoalveolar structures. Therefore, it should be corrected as soon as diagnosed, to reestablish a normal transverse skeletal relationship between basal bones, fundamental to achieving a satisfactory and stable occlusion. It is usually characterized by posterior crossbite that may be unilateral or bilateral, total or partial, and may even not be present in cases with simultaneous mandibular arch constriction. Problems such as excessive vertical alveolar growth, crowding, deep and narrow palate with an intermolar distance of less than 31 mm, measured from the cervical margins, as well as large dark spaces in the buccal corridor, may be present, thus characterizing transverse maxillary deficiency as a syndrome [1]. In addition, transverse maxillary deficiency may be associated with anteroposterior problems, and may be classified as real or relative. A Class II relationship may disguise a transversal involvement of the maxilla due to a posterior positioning of the mandibular arch, whereas in Class III, the anterior positioning of the mandible may accentuate maxillary deficiency or even project a non-existent deficiency. The treatment of maxillary hypoplasia

consists of rapid maxillary expansion (RME), which opens the midpalatal suture [3, 4, 5] and should be conducted preferentially in growing patients, before suture ossification [3, 6, 31-35]. RME before skeletal maturation peak has greater skeletal effects than when it is performed after growth peak [7, 8, 36] and is an unpredictable treatment for patients in the end of adolescence or early adulthood. 9 According to several authors, the time during growth spurt or up to the age of 15 years is ideal for RME [6, 10, 37-40]. Transverse growth of the palate due to osteogenic activity of the midpalatal suture persists up to the age of 16 years in girls and 18 years in boys. 10 However, the fusion of the midpalatal suture varies greatly according to age and sex [9, 11, 12 , 13]. The individual variability of midpalatal suture fusion should be understood to predict whether RME is a viable alternative in late adolescents or young adults. 9 In patients in late adolescence or early adulthood, RME has limitations and complications, such as resistance to expansion, little or no opening of the midpalatal suture, predominance of dentoalveolar expansion instead of transversal gains of basal bone, excessive buccal tipping and extrusion of posterior teeth, gingival recession of supporting teeth, pain, palatal mucosa ulceration and even necrosis, as well as a high degree of relapse [3, 5 , 14]. The effect of RME on the palatal suture and periodontium depends on factors such as magnitude of the applied forces, treatment duration, frequency of activation and patient age. Alternatives to RME for patients with advanced skeletal maturation depend primarily on the degree of maxillary hypoplasia.In cases with mild to moderate maxillary hypoplasia (of less than 5 mm, clinically measured in the region of the molars) [15, 41-43] in patients not growing, slow maxillary expansion may be indicated. In these cases, transverse maxillary remodeling may be achieved by the expansion of the alveolar processes and buccal tipping of crowns of the posterior teeth. These results may be achieved with the same appliances used in RME, such as Haas or Hyrax expanders, but activated at a lower frequency, or after the expansion of the maxillary arch and constriction of the mandibular arch by means of a fixed appliance. In cases of severe maxillary hypoplasia (greater than 5 mm), several protocols for maxillary osteotomies have been developed to decrease the resistance to opening of the midpalatal suture, to separate the maxilla from its main cranial supports, and to obtain a permanent increase in maxillary width with minimal tooth inclination [16]. The two types of osteotomy more often found in the literature are the segmented Le Fort I maxillary osteotomy, which frees the maxilla from adjacent bones and defines segments to correct the transverse relationship during surgery (segmental maxillary expansion, SME) [17], and partial maxillary osteotomy with the support of expanders to reduce resistance to expansion (surgically-assisted rapid maxillary expansion, SARME) [5]. Recently, Lee et al. [4] suggested a non-surgical approach to RME as an alternative to optimize the potential of skeletal expansion in patients with advanced skeletal maturation using mini-implants (miniscrew-assisted rapid palatal expansion, MARPE). This system applies forces to the miniscrews placed close to the midpalatal suture, differently from other techniques, which apply forces to the teeth or periodontium, therefore avoiding the need of osteotomies [18, 19]. MARPE is a less invasive option than SARME, has a skeletal effect, fewer dento-alveolar effects, no surgical risks and reasonably stable results, in addition to being more affordable financially [20, 21]. Thus, the objective of this case report is to analyze and discuss different treatment approaches for the correction of maxillary deficiencies in patients with advanced skeletal maturation especially Rapid Maxillary expansion(RME) and describe the treatment of a female patient (14 years and 4 months old) presenting Class III skeletal malocclusion, transverse maxillary hypoplasia and bilateral functional bilateral posterior crossbite.

## CASE REPORT

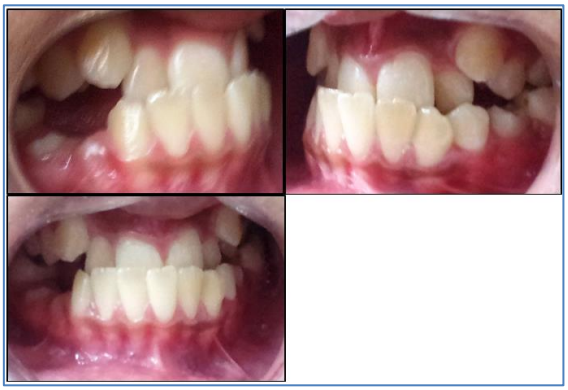
### Extra-oral examination

A female patient (14 y 4 m) in good general health was referred for orthodontic treatment by her dentist. Her main complaint was functional: “bite instability”. She wanted to correct her “crooked bite”. Facial esthetics was not a concern for the patient or her mother. The frontal facial analysis revealed discrete mandibular asymmetry with mandible slightly deviated towards the right of the patient. On Extraoral examination, the patient had potentially incompetent lips ,shallow mentolabial sulcus, increased lip strain, procumbent upper and lower lips, increased labial fullness and an acute Nasolabial Angle, a Leptoprosopic facial form, Dolicocephalic head form, average width of nose and mouth, increased buccal corridor space and a non- consonant flat smile arc. The analysis of her profile revealed an augmented lower third of the face and an antero-posterior deficiency of the middle third with a concave facial profile, The patient had no relevant prenatal, natal, postnatal history, history of habits or a family history. On Smiling, there was presence of severely crowded anterior dentition and an unaesthetic appearance and smile. The patient was very dissatisfied with her smile.

**Pretreatment extra oral photographs**

**Intra-oral examination**

Intraoral examination on frontal view shows presence of a reverse overjet and overbite with presence of bilateral posterior cross-bite and lower midline shift to the right by 2.5mm. On lateral view the patient shows the presence of a Class III Incisor relationship and a Class III Canine and Molar relationship bilaterally. Occlusal view showed presence of crowding in the maxillary and mandibular anterior region with presence of buccally and highly placed maxillary canines. The upper and lower arch showed the presence of a "V" shaped arch form.



**Pre-treatment intra oral photographs**

**Pre-treatment cephalometric readings**

| Parameters | Pre- treatment |
|---|---|
| SNA | 78° |
| SNB | 81° |
| ANB | -3° |
| WITS | -3mm |
| MAX. LENGTH | 82mm |
| MAN. LENGTH | 120mm |
| IMPA | 102° |
| NASOLABIAL ANGLE | 89° |
| U1 TO NA DEGREES | 23° |
| U1 TO NA mm | 3mm |
| L1 TO NB DEGREES | 29° |
| L1 TO NB mm | 4mm |
| U1/L1 ANGLE | 118° |
| FMA | 29° |
| Y AXIS | 76° |
| L1 TO A-POG | 3mm |
| CONVEXITY AT PT. A | -2mm |
| LOWER LIP- E PLANE | 3mm |
| N-PERP TO PT A | -1mm |
| N-PERP TO POG | 4mm |
| CHIN THICKNESS | 13mm |

**Diagnosis**

This 14 year old female patient was diagnosed with a Class III malocclusion on a Class III skeletal base with retrognathic maxilla and a prognathic mandible with asymmetry, a vertical growth pattern, reverse overjet and overbite, lower dental midline shift to the right by 2.5mm, bilateral posterior cross-bite, maxillary and mandibular anterior crowding, buccally placed maxillary canines, potentially incompetent lips, procumbent lower lips and a reduced nasolabial angle, increased buccal corridor space, a non- consonant flat smile arc and an anteriorly divergent face with a prominent chin and concave facial profile

**List of problems**

1. Maxillary retrognathism and mandibular prognathism
2. Class III skeletal pattern
3. Anteriorly divergent face and a concave facial profile
4. Bilateral posterior crossbite
5. Reverse overjet and overbite
6. maxillary and mandibular anterior crowding
7. Lower dental midline shift to the right
8. Buccally and highly placed canines
9. Increased buccal corridor space
10. Decreased nasolabial angle
11. Procumbent lower lip
12. Potentially incompetent lips
13. Prominent chin
14. Non-consonant smile arc

**Treatment objectives**

1. To correct maxillary retrognathism and mandibular prognathism
2. To correct the Class III skeletal pattern
3. To achieve orthognathic facial divergence and a straight facial profile
4. To correct bilateral posterior crossbite
5. To achieve ideal overjet and overbite
6. To unravel maxillary and mandibular anterior crowding
7. To achieve coincident dental midlines
8. To correct the buccally and highly placed canines
9. To reduce the unaesthetic buccal corridor space
10. To achieve an ideal nasolabial angle
11. To reduce lower lip procumbency
12. To improve lip competency
13. To reduce the increased chin prominence
14. To achieve a consonant smile arc
15. To achieve a Class I incisor, canine and molar relationship
16. To achieve a pleasing smile and a pleasing profile

**Treatment plan**

- Rapid maxillary expansion appliance for correction of constricted maxilla and bilateral posterior cross-bite
- Extraction of 34 and 44
- Fixed appliance therapy with MBT 0.022 inch bracket slot
- Initial leveling and alignment with 0.012", 0.014", 0.016", 0.018", 0.020" NiTi arch wires following sequence A of MBT
- Retraction and closure of spaces by use of 0.019" x 0.025" rectangular NiTi followed by 0.019" x 0.025" rectangular stainless steel wires.
- Group B anchorage in the upper arch and Group A anchorage in the lower arch to achieve a Class I incisor, canine and molar relationship
- Class III Elastics given bilaterally thereafter until achieving a positive overjet and overbite
- Final finishing and detailing with 0.014" round stainless steel wires
- Retention by means of Hawleys's retainers along with lingual bonded retainers in the upper and lower arch.

**Treatment plan, progress and mechanics used**

Initial treatment objectives included the correction of transverse maxillary hypoplasia with RME and improvement of smile esthetics, and preservation of the anteroposterior discrepancy and of the dental compensations. A Haas expander was used for RME, and the initial activation protocol was 4 activations on the first day (one full turn), followed by 2 daily activations for one week (1/2 a turn per day) [3] and reassessment. As there was no inter-incisal diastema, which is a clinical sign of midpalatal suture opening, slow maxillary expansion was initiated with two weekly activations (½ a turn per week) because the patient had a mild maxillary hypoplasia, and posterior teeth had a normal buccal inclination. The appliance was activated until there was overcorrection, with the occlusal aspect of the lingual cusps of the maxillary molars occluding against the occlusal aspect of the buccal cusps of the mandibular molars. The correction of crossbite eliminated the mandibular deviation and the deviation of the mandibular midline, as seen on intraoral images obtained after slow maxillary expansion. A fixed Edgewise appliance with a 0.022 x 0.028-in slot was used for maxillary alignment and leveling, together with 0.014 to 0.018-in NiTi archwires and 0.020-in and 0.019 x 0.025-in stainless steel archwires, expanded and with tightly attached ligature ties. The mandibular arch was aligned and leveled using 0.014-in to 0.018-in round stainless steel archwires and a 0.019 x 0.025-in rectangular archwire as the initial archwire. After extraction of mandibular 1$^{st}$ premolars, retraction of mandibular anterior arch was done with elastomeric chains. Class III intermaxillary elastics were used to correct the anteroposterior relationship and to correct the molar and canine relationship bilaterally. Bite Turbos were given on mandibular 1$^{st}$ molars bilaterally for opening of bite until the crossbite was corrected. Finally light settling elastics were given with rectangular steel wires in lower arch and 0.012" light NiTi wire in upper arch for settling, finishing, detailing and proper intercuspation. Class I incisor, canine and molar relationship was achieved and an ideal occlusion

was obtained at the end of the fixed apppliance therapy. The smile of the patient improved significantly from being non consonant and flat to more consonant and pleasing. The arch wires were stabilized for 30 days, and a removable maxillary wraparound retainer and a lingual arch in 0.7-mm stainless steel wire bonded to canines were used until the appliance was removed.

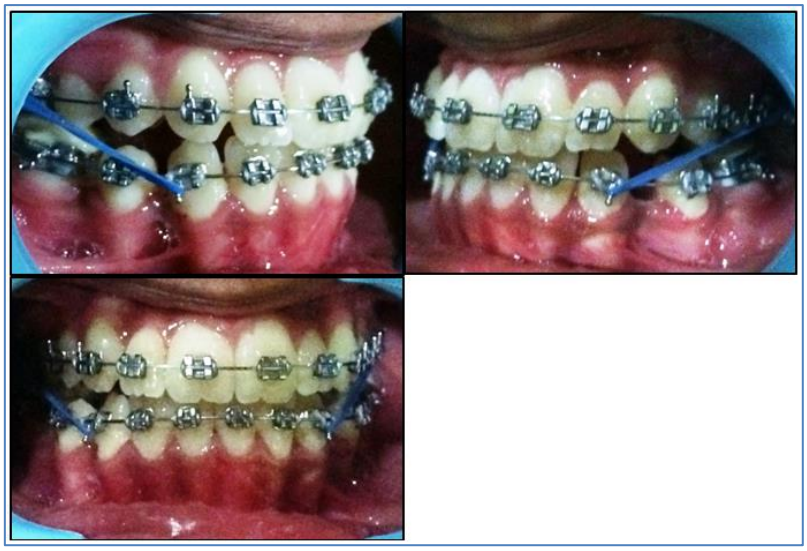
**Treatment results**

All pre-treatment objectives were achieved. Smile esthetics improved because of a decrease of the buccal corridor. Facial profile improved because of the repositioning of the lower lip after a discrete counter-clockwise rotation of the mandibular plane. The patient's skeletal pattern was enhanced and there was a discrete improvement of the anteroposterior relationship of the basal bones. The maxillary retrognathism and mandibular prognathism was corrected and made more ideal. Class I Skeletal pattern was achieved and anteriorly divergent face with a concave facial profile was changed to being orthognathic with a straight profile. The buccally and highly placed canines were bought in proper alignment. The axial inclination of maxillary incisors improved, but remained greater than normal, which compensated the skeletal Class III pattern. There was also a decrease of the L1-NB angle. Maxillary expansion corrected maxillary constriction, resulting in an increase in the intermolar distance, as well as eliminating mandibular deviation and consequently, mandibular midline deviation. Ideal occlusion was achieved with correct canine and molar relations and normal overjet, overbite and dental intercuspation. Good root parallelism was achieved. Although indicated, third molars have not been extracted yet and remain under observation. The nasolabial angle value showed improvement, there was improved lip competency and reduced lower lip and chin prominence at the end of the treatment.

**Mid-treatment cephalometric readings**

| Parameters | Mid- treatment |
|---|---|
| SNA | 80° |
| SNB | 81° |
| ANB | -1° |
| WITS | -1mm |
| MAX. LENGTH | 86mm |
| MAN. LENGTH | 115mm |
| IMPA | 98° |
| NASOLABIAL ANGLE | 92° |
| U1 TO NA DEGREES | 24° |
| U1 TO NA mm | 2mm |
| L1 TO NB DEGREES | 27° |
| L1 TO NB mm | 3mm |
| U1/L1 ANGLE | 123° |
| FMA | 28° |
| Y AXIS | 75° |
| L1 TO A-POG | 3mm |
| CONVEXITY AT PT. A | -1mm |
| LOWER LIP- E PLANE | 2mm |
| N-PERP TO PT A | -1mm |
| N-PERP TO POG | 2mm |
| CHIN THICKNESS | 12mm |

**Mid treatment extra oral photographs**



**Mid treatment intra oral photographs**

**Mid treatment radiographs**

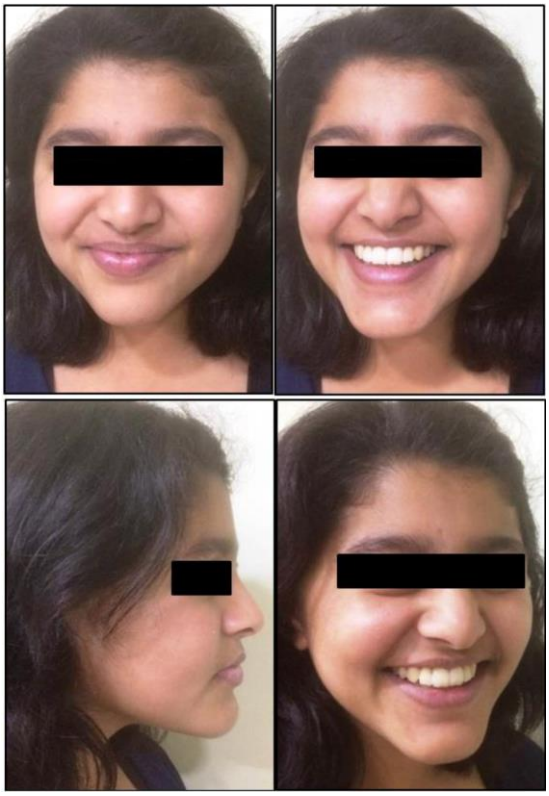
## DISCUSSION

The correct diagnosis of the severity of transverse deficiency and its skeletal and dento-alveolar components is fundamental for treatment success. The decision about the best treatment approach in the different cases of maxillary hypoplasia in patients with advance skeletal maturation depends on several factors, all of which should be analyzed together. The fusion of the midpalatal suture varies greatly according to age and sex. Persson and Thilander [11] reported on midpalatal suture fusion in patients aged 15 to 19 years. In contrast, there are reports of adult patients of different ages (27, 32, 54, 71 years) without signs of midpalatal suture fusion [9, 11 , 12, 13]. As early as 1987, Bishara and Staley [22] found that RME in late adolescence or early adulthood (young adults) might fail. Pain, ulcerations, palatal mucosa necrosis, accentuated buccal tipping of posterior teeth and gingival recession has been reported in the literature for cases in which RME failed [23]. Angelieri et al. [9] evaluated the skeletal maturation of the midpalatal suture using cone beam CT (CBCT) to avoid failures in RME or surgical separation in older adolescents or young adults. In that study, they reported that 25% of the girls 11 to 14 years old and 57% of those 14 to 18 had midpalatal suture fusion in the palatal or maxillary bone. In contrast, some studies found that the percentage of fusion [11, 12, 13] has been classified as more important than the presence or absence of the midpalatal suture. According to Persson and Thilander [11] RME may be performed using conventional orthopedic forces applied to the sutures, with a fusion index below 5%. Indices below 5% have been described for patients aged 18-38 years [24], 14 to 71 years [13] and 18 to 63 years [12]. However, those studies did not explain why it is difficult to open the midpalatal suture in patients older than 25 years. Most of the resistance to midpalatal suture opening seems to be explained by the fusion of circummaxillary sutures [13, 25]. In a recent study, Angelieri et al. [26] found an association of the maturation stages of the zygomaticomaxillary suture and the response to RME followed by protraction. In patients with advanced skeletal maturation, although the transverse skeletal gain is relatively small, dentoalveolar expansion may be an alternative to increasing palatal width and promoting posterior intercuspation at the end of a corrective orthodontic treatment, without, however, promoting the opening of the midpalatal suture, as radiographically evaluated [14, 27]. The present female patient, who was 14 years and 4 months old, had a maxillary transverse deficiency according to McNamara [1], as the intermolar distance, measured from the cervical margins, was shorter than 31 mm. The initial activation protocol was RME, but, because of the patient's age and the maturation of the cervical vertebrae, as shown on the lateral cephalometric radiograph, the midpalatal suture might not open. RME may vary greatly with age, sex, bone characteristics and midpalatal suture ossification, and may be an unpredictable procedure at the end of adolescence [9] Cone beam CT (CBCT) scans were not requested, because, according to Isfeld et al., [28] their use as a diagnostic tool in daily clinical practice, as suggested by Angelieri et al., [9] is impractical due to costs and availability of time and resources. Moreover, there is no scientific evidence to justify their use in the accurate determination of midpalatal suture maturation. The comparison of histologic morphology and CBCT morphology is not compatible, as histologic findings are microscopic, whereas axial CBCT views of the sutures have a macroscopic or naked-eye scale. Therefore, the maturation stages demonstrated by Angelieri et al. [9] using CBCT should be interpreted carefully, as part of an extended protocol for a subjective evaluation of midpalatal suture maturation. Because of that, other diagnostic criteria should be used for a subjective evaluation and a definition of the best clinical management. As soon as the absence of an interincisal diastema, the clinical sign of midpalatal suture opening, was detected, the activation protocol was changed to slow maxillary expansion, because maxillary hypoplasia was mild (30 mm) and there were no major complications. Posterior dentoalveolar inclination should also be taken into account during palatal expansion planning [3]. Mild or moderate transverse maxillary discrepancies (up to 4 mm), with normal or reduced inclination of posterior teeth, such as in the case in this study, may be corrected with slow maxillary expansion [27, 29], as the correction will result from tipping of the lateral bone bases of the palate and of the posterior teeth, as well as from the remodeling of alveolar processes. After the correction of crossbite, increased buccal tipping of the posterior teeth in the case reported here was corrected using buccal root torque, which also promoted the closure of the anterior open bite resulting from the expansion. Handelman [27] also found an increase in buccal tipping of molars after RME. An alternative to the treatment plan presented in this case may be MARPE [4]. According to Pereira et al., [30] palatal separation in MARPE is type I, a complete midpalatal suture separation from the anterior to the posterior nasal spine, whereas surgically-assisted RME is the incomplete separation of the midpalatal suture (type II separation). Moreover, Choi et al. [20] found a success rate of 86.96% in preserving skeletal and dentoalveolar expansion and stability of periodontal structures during retention. The activation protocol recommended for MARPE is ¼ of a turn every day [4] so that the tissues adapt to the forces applied and patient discomfort is minimized, considering the increase in the rigidity of the midpalatal suture with age [21]. The execution of RME along with fixed appliance therapy appropriately resulted in an improvement in the patient's profile in this case. The most important point to be highlighted here is the use of Class III Elastics. Class III Elastics played a very pivotal role in this case for drastically bringing improvement not only in the correction of the canine and molar relationships, but also very efficiently improving the patients profile changing it to more orthognathic at the end of the

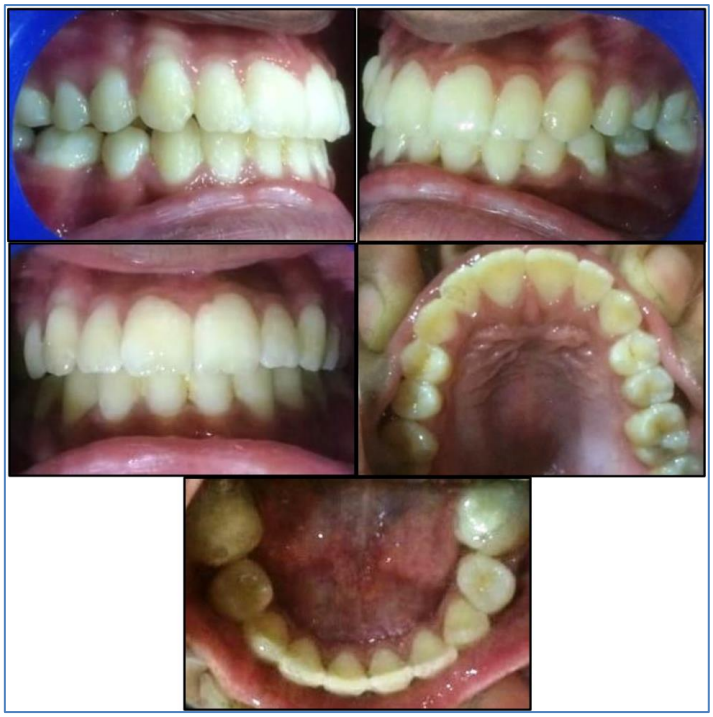
treatment. There was improvement in occlusion, smile arc, profile, lower incisor inclination and position of chin. Successful results were obtained after the fixed MBT appliance therapy within a stipulated period of time. The overall treatment time was 19 months. After this active treatment phase, the profile of this now 15 year old female patient improved significantly as seen in the post treatment Extra-oral photographs. The patient was extremely satisfied with the results at the end of treatment.

**Post-treatment cephalometric readings**

| PARAMETERS | POST - TREATMENT |
|---|---|
| SNA | 82° |
| SNB | 80° |
| ANB | 2° |
| WITS | 0mm |
| MAX. LENGTH | 89mm |
| MAN. LENGTH | 113mm |
| IMPA | 93° |
| NASOLABIAL ANGLE | 99° |
| U1 TO NA DEGREES | 25° |
| U1 TO NA mm | 1mm |
| L1 TO NB DEGREES | 22° |
| L1 TO NB mm | 1mm |
| U1/L1 ANGLE | 129° |
| FMA | 28° |
| Y AXIS | 75° |
| L1 TO A-POG | 1mm |
| CONVEXITY AT PT. A | 0mm |
| LOWER LIP- E PLANE | 0mm |
| N-PERP TO PT A | 0mm |
| N-PERP TO POG | 1mm |
| CHIN THICKNESS | 12mm |



**Post treatment extra oral photographs**



**Post treatment intra oral photographs**

**Comparison of pre, mid, pre-finishing and post treatment cephalometric readings**

| PARAMETERS | PRE- TREATMENT | MID- TREATMENT | POST-TREATMENT |
|---|---|---|---|
| SNA | 78° | 80° | 82° |
| SNB | 81° | 81° | 80° |
| ANB | -3° | -1° | 2° |
| WITS | -3mm | -1mm | 0mm |
| MAX. LENGTH | 82mm | 86mm | 89mm |
| MAN. LENGTH | 120mm | 115mm | 113mm |
| IMPA | 102° | 98° | 93° |
| NASOLABIAL ANGLE | 89° | 92° | 99° |
| U1 TO NA DEGREES | 23° | 24° | 25° |
| U1 TO NA mm | 3mm | 2mm | 1mm |
| L1 TO NB DEGREES | 29° | 27° | 22° |
| L1 TO NB mm | 4mm | 3mm | 1mm |
| U1/L1 ANGLE | 118° | 123° | 129° |
| FMA | 29° | 28° | 28° |
| Y AXIS | 76° | 75° | 75° |
| L1 TO A-POG | 3mm | 3mm | 1mm |
| CONVEXITY AT PT. A | -2mm | -1mm | 0mm |
| LOWER LIP- E PLANE | 3mm | 2mm | 0mm |
| N-PERP TO PT A | -1mm | -1mm | 0mm |
| N-PERP TO POG | 4mm | 2mm | 1mm |
| CHIN THICKNESS | 13mm | 12mm | 12mm |

## CONCLUSION

According to the literature and the clinical case described here, we concluded that slow expansion may be a treatment alternative to achieving a stable and functional occlusion in cases of early skeletal maturation of the mid-palatal suture at the end of adolescence. This case report illustrates how a case with Class III crowding can be managed with Extraction of 2 mandibular premolars by means of appropriate use of Rapid maxillary expansion, conventional MBT prescription along with efficient conservation of anchorage at the same time. The planned goals set in the pre-treatment plan were successfully attained. Good intercuspation of the teeth was achieved with a Class I molar, incisor and canine relationship. Treatment of the proclined and forwardly placed lower anterior teeth included the retraction of mandibular incisors with a resultant decrease in soft tissue procumbency and facial

concavity. The maxillary and mandibular teeth were found to be esthetically satisfactory in the line of occlusion. Patient had an improved smile and profile. The correction of the malocclusion was achieved, with a significant improvement in the patient aesthetics and self-esteem. The patient was very satisfied with the result of the treatment.

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