Case Study

TREATMENT OF GROWING SKELETAL CLASS III MALOCCLUSION USING MAXILLARY EXPANSION AND INTERMAXILLARY ELASTICS

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ABSTRACT

The present case study demonstrates the effective use of a Quad'helix appliance in combination with Class III mechanics for the treatment of a growing skeletal Class III malocclusion. The patient was a 10-year-old girl who had an anterior crossbite as her main complaint. Clinical examination revealed a skeletal Class III malocclusion with a retrusive maxilla. Orthopedic and orthodontic intervention included slow maxillary expansion followed by 26 months of combined treatment. The therapeutic approach aimed to stimulate maxillary growth and correct skeletal discrepancy. At the end of the treatment period, the patient achieved a Class I molar and canine occlusion, normal overjet, and a 2 mm overbite. Furthermore, a significant enhancement in profile was attained. This case supports the clinical efficacy of using maxillary expansion appliances in order to facilitates orthopedic correction in young patients with Class III skeletal patterns, while highlighting the benefits of early intervention in guiding facial growth and improving occlusal relationships.

Key words: Class III malocclusion, Orthopedics, Intermaxillary elastics, Maxillary expansion.

Introduction

When it comes to diagnostic and treatment plans, class III malocclusions with a substantial skeletal element frequently pose orthodontic challenges. Its etiopathogenesis is complex and multifaceted, as hereditary, functional, or mixed causes can be implicated. Moreover, the prognosis is more unfavorable when the malocclusion has a genetic origin, compared to one with an environmental origin. The primary causes of this condition include parafunctions, oral breathing, and more anterior and inferior tongue location.

Ideally, recognition of this malocclusion at a very young age, following careful observation of various facial, occlusal, and cephalometric characteristics, should be ensured to facilitate an early diagnosis, ideally during the deciduous dentition. For children with growing Class III malocclusions in particular, orthodontic treatment scheduling is constantly a challenge. In severe Class III cases, final treatment is typically postponed (for surgical possibilities). On the other hand, in mild or moderate situations, the sooner the interceptive phase is started, the more orthopedic impacts will occur, which will be detrimental to the inevitable orthodontic impact [1]. Furthermore, a child's early aesthetic advantage suggests higher self-esteem.

Patients with class III malocclusion can benefit from a wide range of treatment options, including the introduction of orthopedic appliances, to assist them attain better face aesthetics and proper occlusion (e.g.: chincups, facial masks, functional orthopedic appliances of the jaws), multibracket fixed appliances for orthodontic camouflage, preventative orthodontic appliances (such as the Eschler and Porter appliances or "W" arch), and a procedure combining orthodontic and orthognatic surgery [2].

The patient's age, the extent of malocclusion, the patient's main concern, and the clinical and radiographic analysis that will impact the patient's prognosis are all important considerations when planning a their treatment. However, there is no precise line separating what may be accomplished with orthodontic camouflage and what invariably calls for orthognathic surgery when treating skeletal Class III malocclusion. Despite the modest risks and low treatment costs, traditional orthodontic camouflage requires a lot of patient cooperation and time. One common orthodontic camouflage treatment strategy is the application of intermaxillary Class III elastics to resolve the sagittal discrepancy. To compensate for the skeletal disparity, class III elastics cause the upper and lower dentitions to migrate mesially and distally, respectively, with the upper dentition proclinating and the lower dentition retroclining [3]. Furthermore, the practitioner treats the transverse discrepency and takes into account either rapid or slow maxillary expansion in this therapeutic technique.

The patient in this case report had transverse misalignment and skeletal Class III malocclusion. An alternative camouflage treatment for Class III malocclusion in growing patients, a quad'helix appliance and Class III intermaxillary elastics, were utilized to successfully treat the patient.

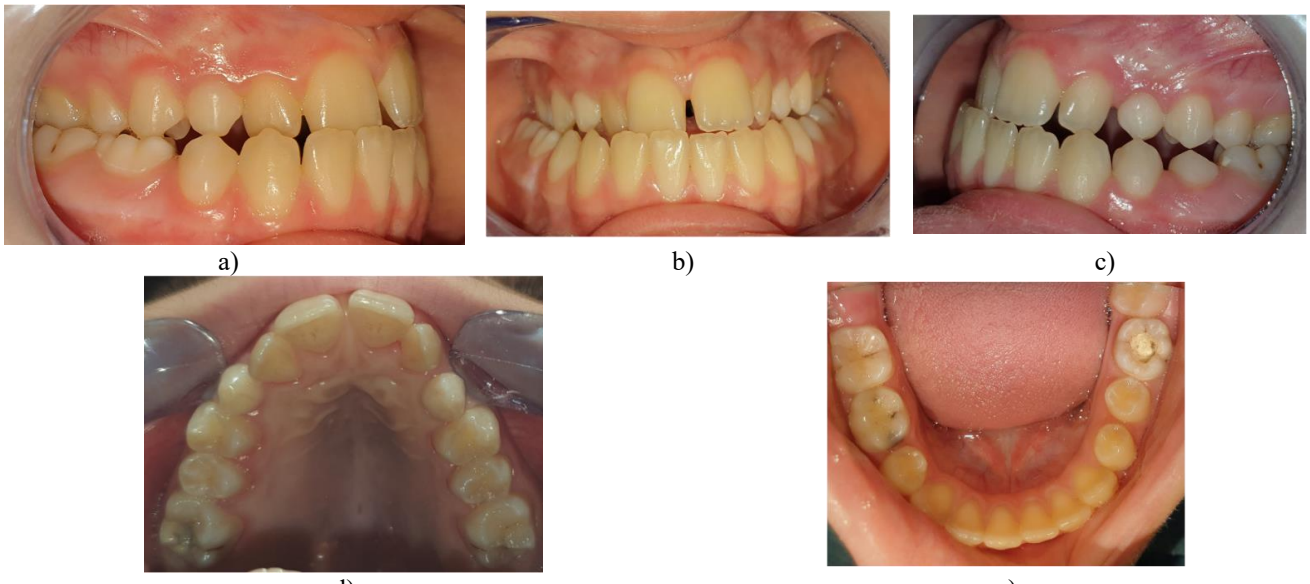
Case description

An anterior crossbite and misaligned upper front teeth were the main symptoms of a 10-year-old girl who sought orthodontic consultation. According to her parents, her face's appearance had a detrimental effect on her psychological health. There was nothing noteworthy about her medical and dental history. Clinical examination showed a bilaterally symmetrical and straight face on the frontal extraoral photograph **(Figure 1)**. The profile was concave with a slightly increased nasolabial angle and maxillary retrocheilia. According to the results of the intraoral examination **(Figure 2)**, the patient was at the late mixed dentition phase. In addition to a unilateral class III molar relationship on the left, there was bilateral class III canine relatioships. She had an anterior and right lateral crossbite, as well as a deficient posterior buccal overjet on the left side, which was associated with a transverse maxillary discrepancy. Clinical results were validated by dental cast assessment, and panoramic radiograph **(Figure 3)** screening revealed normal patterns [4].

According to the lateral cephalometric study **(Table 1)**, the patient had a hyperdivergent facial pattern (FMA=27°) with a retrognathic maxilla (77°) and a normal mandible (78°). In patients with proclined upper incisors (UI-NA = 26°) and regularly positioned lower incisors (LI-NB = 25°), dental compensation was seen. The patient was diagnosed with growing skeletal Class III malocclusion with sagittal and transverse maxillary deficit according to clinical examination, model analysis, and radiographic data.

a) b) c)

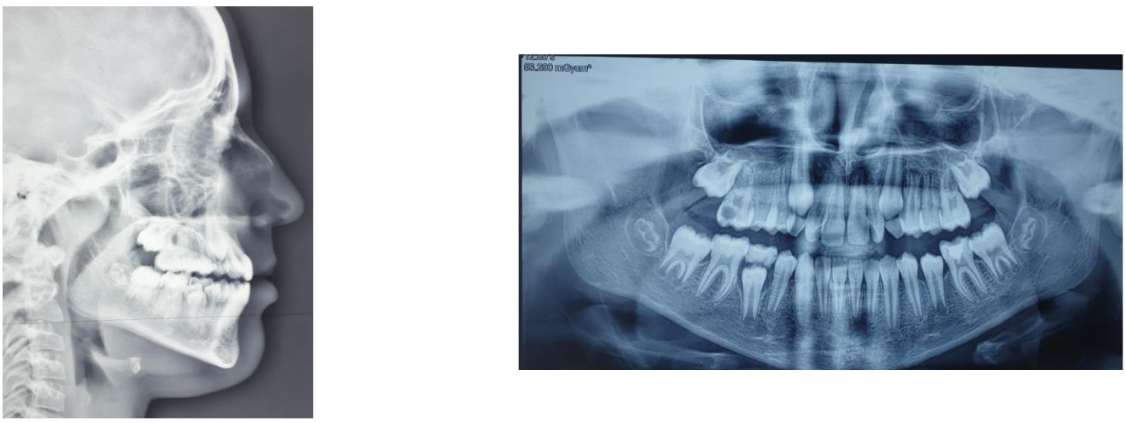
Figure 1. Pre-treatment extra-oral photographs.



a) b) c)

d) e)

Figure 2. Pre-treatment intra-oral photographs.



a) b)

Figure 3. Pre-treatment lateral cephalogram and panoramic radiograph.

Treatment objectives

Our goals were to: (1) fix the transverse discrepancy; (2) correct the anterior crossbite and skeletal pattern; (3) create a normal occlusion; (4) fix the dental midline deviation; (5) create an attractive profile; and (6) closely monitor any remaining jaw growth.

Treatment alternatives

The maxilla's inadequate development was the primary cause of the patient's skeletal class III malocclusion. The following treatment plan was reviewed with the patient and her parents in order to get their agreement, taking into account our therapeutic objectives:

Class III elastics are used for intermaxillary traction in orthopedic therapy, or a traditional facemask is used for maxillary protraction. The patient in our situation was between stages 3 and 4, which indicates that the pubertal growth spurt phase had already passed. In contrast, stage 1 of CVMI is the best time to use a traditional face mask. Furthermore, the patient wasn't ready to cooperate while wearing a facial mask. Therefore, the appropriate treatment option for our patient was to use Class III intermaxillary elastics along with maxillary expansion.

Treatment progress

A modified Quad Helix expander was used to extend the maxilla as the first step in therapy. The device consisted of 0.036-inch circular stainless steel orthodontic wire that was bonded onto the maxillary first molars using glass ionomer cement after being soldered to orthodontic bands. It was modified by adding an anterior extension arm in order to widen the premaxilla. Activation of the appliance had been realized before cementation. The patient was monitored once a week during the expansion's active period to track therapy success. In order to make modifications as needed, the appliance was periodically taken out and then put back in.

When the mandibular buccal cusp's occlusal slope and the maxillary lingual cusp's occlusal feature made bilateral, centric contact, the expansion was deemed sufficient. To account for the uprighting of the buccally tipped teeth when retention is stopped, a little overexpansion of 2 to 3 mm is advised. After sufficient expansion was accomplished, the appliance was kept in the extended but passive state for a retention period of six months. The Quad-helix appliance was also effective in achieving bilateral derotation of the first upper molars.

Concurrently, a fixed edgewise appliance was attached to the upper arch's permanent teeth and solely the lower arch's anterior teeth. Additionally, a bilateral fixed posterior acrylic bite plane was placed on the lower molar area. Both arches were leveled and aligned during the first synchronization and leveling stage utilizing light continuous arch wires. A discernible enhancement in arch alignment was achieved by moving from 0.014 round nickel-titanium wires to 0.016 x 0.022 nickel-titanium wires and then to 0.016 x 0.022 stainless steel (SS) wires. Class III intermaxillary elastics were utilized from the beginning to correct the anterior crossbite and distalize the lower teeth bilaterally. The application of this elastic system persisted until the maxillary and mandibular arches were fitted with .018 x .025 stainless steel wires. The patient's adherence to wearing elastic was regularly observed over this time, which resulted in a favorable treatment progression, particularly a positive overjet.

To achieve flawless occlusion, detailing and finishing were done after the front crossbite was corrected and a satisfactory occlusal relationship was established. Fixed retainers were applied to the upper and lower arches from canine to canine on the day of debonding in order to preserve the outcomes.

Treatment results

Eight months of class III intermaxillary elastic wear were part of the 26-month therapy period. It was possible to achieve a Class I occlusion with a 2 mm overjet, normal overbite, and appropriate interdigitation. In addition to improving the patient's overall face attractiveness, their profile became more straight **(Figure 4)**. The patient's and her parents' satisfaction with the treatment's functional and

esthetic results was expressed.

Transverse width increased as a consequence of the quad'helix appliance's ability to provide enough maxillary expansion with little segment tilting. At the end of therapy, the upper dentition's inclination had been rectified and was still within the standard deviation.

The anteroposterior relationship improved when the lateral cephalometric tracings were superimposed before and after therapy. The mandible rotated backward and downward to camouflage it's growth direction, while the maxilla developed anteriorly. A satisfactory root parallelism was seen on the panoramic radiograph. The gaps formed by the absence of the first teeth on the left inferior and right superior were preserved for potential implants. The radiograph also showed four germs of third molars, which will be monitored periodically until their eruption to prevent any eventual complications and determine their future on the arches.

Following therapy, the patient was slated for routine follow-ups every six months to assess the stability and retention of the outcomes. Additionally, she received instruction on the need of constantly wearing a retainer and practicing good dental hygiene

Figure 4. Post-treatment intra and extra-oral photographs.

Table 1. Pre-treatment and post-treatment cephalometric values

	Norm	Pre-treatment	Post-treatment	Three years after treatment
SNA	82° ± **2°**	78°	76°	78°
SNB	80° ± **2°**	79°	**78°**	**80°**
ANB	**2°**± **2°**	1°	**-2°**	**-2**
Witts appraisal	0mm± **2mm**	-5mm	**-3mm**	**-3mm**
U1-NA	22°	26°	**31°**	**30°**
U1-NA	4mm	0mm	**6mm**	**5mm**
L1-NB	25°	25°	**15°**	**15°**
L1-NB	4mm	5mm	**3mm**	**3mm**
U1-L1	131°	118°	**122°**	**123°**
GoGn/SN	32°	38°	**33°**	**33°**
FMA	25°± **3°**	27°	**25°**	**25°**
FMIA	67± **3°**	63°	**73°**	**75°**
IMPA	88°± **3°**	90°	**82°**	**80°**
Z angle	**73°**	74°	**74°**	**75°**
Upper lip		10mm	**11mm**	**13mm**

Total chin		10mm	**10mm**	**13mm**
Anterior facial height		45mm	**45mm**	**52mm**
Posterior facial height		70mm	**70mm**	**72mm**
Facial index	0.69	0.60	**0.60**	**0.72**

Results and Discussion

The goal of early orthopedic therapy for class III malocclusions is to address anatomical, functional, and psychological restrictions in order to stop a dysmorpho-functional cascade from developing. Depending on the patient's unique growth and the appropriate timing of the therapy, orthodontic treatment for a growing patient with a Class III malocclusion can be successful. It is generally preferable to limit the indication of early orthopedic treatments to dysmorphias of mild to moderate intensity, in the hope of achieving long-term stability of the results [5, 6]. As for severe cases of class III malocclusion, deciding whether to opt for early treatment or to postpone until the end of growth is still problematic for orthodontists. On one hand, the success of growth modification treatments is highly unpredictable. On the other hand, delaying intervention often means exposing the child to unnecessary worsening of his pathology, along with a late and more complex treatment. Hence, the importance of a clinician properly diagnosing the severity of skeletal discrepancies in growing patients and to create an adequate treatment plan.

A big or protruding mandible, a deficient or retrusive maxilla, a protrusive mandibular dentition, a retrusive maxillary dentition, and combinations of these skeletal and dental elements can all be seen in the Class III malocclusion [7]. 75% of Class III dysmorphia cases are caused by a maxillary deficit [8, 9], despite the fact that many Class III individuals have excess mandibular growth. This indicates that the maxilla plays a key role in the issue. Consequently, one of the most common orthopedic strategies for the early treatment of skeletal Class III patients combines rapid maxillary expansion with maxillary protraction utilizing a facemask. According to many authors [10-12], maxillary disjunction would disrupt the sutural system surrounding the maxilla, triggering a cellular response that would enhance the reaction to orthopedic forces and prolong the effect of the face mask. In addition, Haas [13, 14] stated that disjunction would cause a slight forward and downward shift of the maxilla, enabling faster correction of skeletal dysmorphia.

Furthermore, Kapust and Turley [1] demonstrated that the results of their study confirmed a true maxillary orthopedic effect obtained by associating expansion and a facemask. These statements, however, are in disagreement with the results of other studies [14-17] which reported that maxillary disjunction does not enhance the effect of a facemask, and that protraction remains an effective treatment of Class III malocclusion, whether or not associated with maxillary expansion. Despite the controversy, it seems only appropriate to include the maxillary expansion in the treatment plan, in order to correct maxillary deficiency, as well as participate in restoring nasal ventilation [18].

In our situation, we chose an altered version of this strategy, employing class III intermaxillary elastics for achieving an anterior displacement of the maxilla with little posterior displacement of the mandible and the Quad'helix appliance to accomplish maxillary expansion. Since the traditional orthopedic appliance (facemask) for maxillary protraction is only indicated in early mixed dentition [11, 12] and our patient had already outlived the puberty growth spurt phase, this was to be expected. Furthermore, some borderline skeletal Class III children who have a combination of maxillary retrusion and mandibular protrusion, when treated with the conventional orthopedic strategy that combines rapid maxillary expansion and a facemask, frequently result in a profile with bimaxillary protrusion [19]. Moreover, facemask therapy has several disadvantages, including aesthetic concerns and discomfort [20].

Moreover, when mandibular growth is finished, there is a considerable risk of relapse and a recurrence of reverse overjet, and the effects of a facemask are often mild and transient in individuals [21]. Numerous researchers have also shown that during FM therapy, the maxilla rotates counterclockwise and the jaw rotates clockwise, increasing the vertical dimension [22]. Besides, skeletal modifications made up just a tiny portion of the observed results, with dental compensations accounting for the majority of the modifications, particularly in teenage patients [23, 24]. In reference to Class III intermaxillary elastics, the literature notes that these auxiliary tools were utilized to correct Class III malocclusions and produce skeletal changes [25], despite the fact that these methods of treatment necessitate patient cooperation, which can challenge their use in clinical settings. De Alba *et al*. (1979) showed in research [26] that the vertical action of class III mechanics caused maxillary molar extrusion and counterclockwise rotation of the maxilla, which reversed mandibular growth direction and caused mandibular opening. These results were comparable to those of an investigation [25] by Nakamura *et al*. (2017), which found that these mechanics cause the mandibular molars to tip distally while the mandibular incisors uprighten. This combination of clockwise and counterclockwise rotation of the mandible results in an increase in the mandibular plane angle, which corrects the overjet and molar relationships and, consequently, slightly corrects the skeletal Class III relationship. A feasible translatory motion during mandibular rotation and a condylar repositioning as a result of the external pterygoid

muscle's action were also documented in the literature [26].

Our choice to use the Quad'Helix appliance to treat transverse maxillary deficiency stems from the fact that, in the absence of strong scientific data, selecting between the two expansion techniques still depends entirely on clinical judgment and the practitioner's preference [27]. Due to the vast research on the clinical implications of both slow and rapid maxillary expansion, it appears that both expansion modalities cause transverse alterations in the maxilla [27, 28]. However, RME therapies have been linked to adverse consequences such as discomfort, damage to the midpalatal suture, relapse, and molar tilting [29, 30]. In contrast, it is generally believed that slow maxillary expansion reduces the force-related adverse effects of RME by improving bone development in the intermaxillary suture and lowering tissue resistance surrounding the circummaxillary structures [31]. These statements are supported by the findings of a study [27] by Martina *et al*. (2012), which showed that SME is as effective as RME in generating skeletal transverse expansion of the maxilla. However, according to the research, it is necessary to assess the palatal expansion's long-term stability.

Conclusion

Skeletal Class III malocclusion in growing patients is a difficult anomaly. Hence, it is essential to assess and diagnose this malocclusion at a very young age to intervene appropriately and closely observe mandibular residual growth, thereby preventing further aggravation of the malocclusion in the future. Growing patients can benefit from non-surgical orthodontic camouflage that uses Class III mechanics and expands the maxilla to effectively correct skeletal Class III malocclusion.

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Conflict of interest: None

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Ethics statement: Written informed consent for publication was obtained from the patients, and the signed consent form has been submitted to the journal.

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