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Clear aligner treatment for a four-year-old patient with anterior cross-bite and facial asymmetry: A case report

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Abstract

BACKGROUND

Clear aligners have been widely used to treat malocclusions from crowding, extraction cases to orthodontic-orthognathic cases, and practitioners are exploring the border of it. For the first time, clear aligners were used to early intervene anterior cross-bite and facial asymmetry.

CASE SUMMARY

This case report described a four-year-old child presented with anterior cross-bite and facial asymmetry associated with functional mandibular shift, who had undergone a failed treatment with conventional appliances. The total treatment time was 18 weeks, and a stable outcome was obtained.

CONCLUSION

The increasing need in early treatment highlights the need for clinicians to thoroughly investigate for the patient regarding clinical manifestation as well as patient compliance. We hope that our case will be contemplated by clinicians when seeking for treatment alternatives.

INTRODUCTION

As a major problem of the primary dentition, anterior cross-bite affects approximately 25.29% of Chinese children after deep overbite (33.66%) and spacing (28.34%), ranking the third^[1]. A study reported that 36% of subjects with anterior cross-bite exhibit functional shift^[2]. Untreated anterior cross-bite could lead to an undesirable growth modification that maxilla growth and dental development may be inhibited, which eventually may lead to severe skeletal deformity and cause aesthetic, functional or socio-psychological problems^[3]. Besides, children with untreated anterior cross-bite may have a facial asymmetry as a result of tooth interference that may induce a functional mandible displacement. If left untreated, the facial asymmetry would have the tendency to worsen, and cause increased risk of craniomandibular disorders in adolescents, even temporomandibular symptoms^[4].

Various methods have been used for the primary dentition correction such as removable transpalatal appliances with protruding finger springs, bonded resin-composite slopes and selective grinding^[5-6]. These correction strategies appeal to clinicians because of their simplicity, however, there are limitations to what can be achieved. Clear aligners have been widely used to treat malocclusions from crowding, extraction cases to orthodontic-orthognathic cases^[7], and practitioners are exploring the border of it. Clear aligner treatment is patient-friendly and esthetic-oriented that offers significant benefits over conventional appliances in terms of comfort and esthetics, which perfectly meet the need for orthodontic treatment in children. The long clinic visit length and less emergencies of clear aligner treatment are especially valuable in the time of the COVID-19 pandemic^[8]. This case report aims to explore the potential use of clear aligner in the deciduous dentition, which would extend the application of clear aligners.

CASE PRESENTATION

Chief complaints

A 3-year-and-9-month-old female patient sought orthodontic treatment in her parents' company, with a chief complaint of prominent lower anterior teeth and asymmetric face.

History of present illness

No history of present illness was reported.

History of past illness

No past illness was reported.

Personal and family history

No familial tendency of class III malocclusion was reported by the parents.

Physical examination

The patient was ¹ clinically assessed and fully investigated regarding oral hygiene, general health along with medical history, which were uneventful.

During the clinical examination, a lateral shift of the mandible was observed. Her profile was minor concave, with protrusion upper and lower lip (Figure 1). The mandible could not be retracted to an edge-to-edge bite. Functional mandibular shift was detected whereas nose-chin midpoints coincide when the mouth was wide open. No clicking sound or tenderness was detected in her TMJ area.

Laboratory examinations

No laboratory examination was required thus none taken.

Imaging examinations

Intraoral examination revealed a primary dentition phase. Anterior spacing was observed and the model analysis showed ³ 6.5 mm spacing in the maxillary arch and 5.3-mm in the mandibular arch. The cross-bite involved both maxillary and mandibular

incisors and upper right canine with a maximum negative over-jet of 4.5-mm and negative overbite of 1.5-mm. The lateral view ² revealed a slightly palatal inclination of upper incisors, and a labial inclination of mandibular incisors. The upper dental mid-line aligned ⁴ with the facial mid-line while the lower dental mid-line was deviated 3.5-mm towards the right. Centric occlusion exam revealed a flush terminal molar relation with cross-bites on the right side and mesial step on the left side. Besides, an obvious sharp cusp was seen on tooth 53, implying insufficient tooth wear (Figure 1).

FINAL DIAGNOSIS

Based on these findings, the diagnosis was established as primary dentition with anterior cross-bite and functional facial asymmetry.

TREATMENT

Treatment Objectives

The following treatment goals were established:
dismiss the etiology factors of habitual mandibular protraction and tongue thrusting
restore the normal inclination of the upper anterior teeth and to close the spacing of the lower anterior teeth to establish a proper overbite and overjet
improve facial esthetics and symmetry

Treatment Alternatives

Two treatment options were considered in this case. The first option was a removable appliance with protruding springs for the maxillary anterior teeth and selective grinding for the deciduous canine. And the second option was using clear aligners.

Before being diagnosed in our clinic, the patient was initially treated with a removable transpalatal appliance that incorporating bite plane and protruding springs. However, the treatment was interrupted because of the discomfort. What's more, the removable appliance is of no use treating mandibular displacement. Additionally, the cusp of tooth 83 was tilted mesially to tooth 53 and tooth 53 slightly rotates in a mesial

direction, which meant that grinding the cusps of tooth 53 was not an effective method. In this case, an Invisalign “Teen” package was chosen.

Treatment Planning

1 Polyvinyl siloxane impressions were taken and sent to Invisalign®. A virtual planning of tooth movement in three dimensions was performed through ClinCheck® software (Align Technology, San Jose, CA, USA). The initial occlusion of this patient was shown in Figure 2A(Figure 2A). Ellipsoid attachments were placed on the upper central incisors and the lower canines to improve retention, and rectangular attachments were placed on the occluding surfaces of the lower deciduous molars to obtain vertical clearance.

Expansion and proclination of the upper anterior teeth were carried out first, with a small amount of intrusion and distal rotation of the tooth 53 to relieve the occlusal interference. Simultaneously, the incisors were unlocked by bite attachments to seat bilateral condyles into centric relation, so as to solve the functional facial asymmetry. Subsequently, the upper anterior teeth were further proclined and the lower anterior teeth were retracted to close the spacing, which could further coordinate the upper and the lower arches(Figure 2B). Meanwhile, slight extrusion of incisors was necessary to avoid the anterior open bites. Myofunctional therapies included tongue elevation and correction of mandibular protrusion habit were performed in the process to ensure the long-term stability.

(Insert Figure 2)

Interventions

1 The patient was instructed to wear each aligner 22 h per day, even in school-time. 1 Nineteen aligners were scheduled, and a 5-day-change protocol was adopted because of the faster tooth movement during the deciduous dentition and a research reported that 1 that the amount of activation force imparted by the aligner slowly decreases and plateaued within 5 day^[10]. The duration of therapy was in line with conventional approaches.

A monthly follow-up was planned to monitor the wearing. During the treatment, no detachment condition was reported. No self-perceived pain, discomfort or impairment of function was reported during the course of treatment. When the patient was wearing the fourth aligner, her functional facial asymmetry was corrected as expected. The mid-lines of both arches were coincident followed by the cross-bite of tooth 53 resolved and reserve over-jet of teeth 52-62 reduced. At the same time, posterior cross-bite was corrected (Figure 3A). Anterior cross-bite was almost corrected in the thirteenth aligner by modifying the torque of maxillary incisors and closing the spacing in the mandibular arch (Figure 3B).

(Insert Figure 3)

OUTCOME AND FOLLOW-UP

The total treatment time was 18 weeks, only 22 aligners was used. The inclination of incisors was improved to achieve an optimal overbite and over-jet. Ideal canine and molar relationships and occlusion were established after the correction of posterior cross-bite. The frontal smiling view revealed a coincident facial mid-line and the dental mid-line. The later view showed a straight profile with labially inclined upper incisors, and improved facial esthetics(Figure 4). Besides, the aberrant neuro-muscular behavior of the mandible and the tongue was corrected after myofunctional therapy.

In the 6-month follow-up, although there was a minor relapse of spacing in the lower arch, an ideal occlusion was kept in both arches (Figure 5). Interestingly, tooth wear of cuspid 53 was seen, suggesting the establishment of canine-guided occlusion. The facial asymmetry was improved.

A 3-year follow-up at the age of 8 was recorded and stability of the treatment was obtained in the **mixed** dentition. Eruption of the permanent anterior teeth ended up in good positions, with maintenance of appropriate inter-incisal relations. An ideal symmetrical occlusion was achieved (Figure 6).

(Insert Figure 4&5&6)

DISCUSSION

Class III malocclusion can appear early in the deciduous dentition, and the deformity may vary from mild to severe throughout the development. This malocclusion often accompanies with varying degrees of mandibular deviation with few self-correction trends^[11-13]. It is perceived as a mainstream view that early intervention of class III malocclusion should start early at the stage of primary dentition, to curb the undesirable growth modifications during some of the most formative years, notwithstanding the controversial about the correct indication and stability^[14-15].

In treatment planning, the patient should be clinically assessed and fully investigated regarding dental, functional, profile and psycho-social correlations, oral hygiene, general health and family history. Furthermore, there is a lack of consideration regarding patient compliance level, and how it is a significant determinant for treatment outcome, especially in treatment of young children^[16].

Functional mandibular shift commonly arises as a result of tooth interferences or narrow maxilla^[17-18]. In this case, occlusal interference caused by the insufficient wear of tooth 53 influenced the mandibular closing trajectory that forced the mandible to protrude and displace laterally, resulted in the posterior cross-bite and mid-line shift. Moreover, tongue habits have caused transverse discrepancy in arch relationship, to be specific, a narrow maxilla with retroclined incisors and mandibular arch with scattered space, which facilitates the anterior cross-bite. Mandibular shift from centric relation(CR) to intercuspal position (ICP) is a key indicator for the diagnosis of functional mandible displacement.^[19] Mandibular displacement may be expedient mechanisms for postural adjustment consequent to occlusal disharmony and pain^[20]. In our case, habitual asymmetric posture was observed as the mid-line deviation of the mandible left-deviated mandibular dental mid-line correct itself as the mandible open from rest position. The mandibular dental mid-line patient widely opened her mouth from rest position. The diagnosis of the functional facial asymmetry would be more accurate after 'deprogramming' of muscle memory.

Selective grinding of teeth is a simple treatment approach to correct the functional mandibular shift in the primary dentition^[21], however, it may not be favorable when inter-canine width differential smaller than 3.3 mm or significant inter-molar width discrepancy was detected^[22]. Thus, in our case, grinding therapy may not be satisfactory. Removable appliances are commonly used for anterior cross-bite correction. However, discomfortableness was considered as its main disadvantage, which would reduce treatment effectiveness and expand treatment duration, especially in young patients. Facemasks combined with auxiliaries like rapid palatal expander have also been reported for the correction of anterior cross-bite^[5]. But lack of anchorage in deciduous dentition and the uncertainty about dental or skeletal effects limit the use of this device. Besides, the side effects including clockwise rotation of the mandible and extrusion of the molars shouldn't be neglected to prevent undesirable anterior open-bite^[23].

Compared with the conventional removable or fixed appliances, clear aligners blend seamlessly with crown anatomy, thus possess the ability in three-dimensional movement of the teeth with precision. Furthermore, the aligners' thickness could provide an adequate vertical clearance for cross-bite correction, avoiding the bulkiness of posterior capping which could minimize traumatic occlusion or tooth wear during cross-bite correction. Clear aligners can also prevent the aesthetic limitation and speech impairment and allows for optimal oral hygiene. Therefore, resulting in more positive feedback from the patients and significant improvements in children's compliance^[24].

In this case, tooth 53 was proclined with clear aligners to relieve the occlusal interference through the three-dimensional movement of intrusion and rotation. It's suggested that with more than 2/3 of vertical overbite to use bite ramps^[25]. In our case, additional attachments were placed on the occlusal plane to provide vertical clearance for cross-bite correction. Subsequently, the anterior cross-bite was corrected through the expansion of the upper arch anterior teeth and the retraction of the lower anterior teeth. It is worth mentioning that, because this patient had a shallow negative overbite, simple proclination of the upper anterior may cause anterior open bite and

aberrant tongue-thrusting habits. Therefore, slight extrusion of the incisors was designed to compensate. And the bite block effects brought by aligners thickness also helped to achieve better occlusal vertical control. During the course of treatment, it is necessary to check aligner fit at each follow-up, to compensate the poor retentive force due to anatomy short crowns of the primary teeth. Additionally, clear aligner treatment is more efficient and effective for both patient and clinicians, with the long interval between follow-ups, less emergencies or negative side effects, especially in the unprecedented and unpredictable time of pandemic^[26].

CONCLUSION

This case reported the effectiveness of clear aligners in correcting anterior cross-bite and facial asymmetry in the primary dentition, obtaining a satisfactory and long-term stable outcome.

Clear aligner therapy shows great potential in the early intervention of malocclusion of the deciduous teeth due to its accurate three-dimensional tooth movement control, low cariogenic rate and high coordination of children, which provides a new way for the correction of complicated cases of the deciduous dentition.

As encouraging results was achieved, application of clear aligners might be limited under thorough evaluation of benefits and burden. Further investigations are needed to standardize the treatment protocol.

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