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Non-surgical Correction of Craniofacial Microsomia with Occlusal Plane Canting

Tzu-Pin SU, Huei-Mei Tsai, Chia-Yi Pan, Yuen-Yung Tsang, Yu-Ling Cheng

ABSTRACT
An adult woman suffered moderate complications of cranio-facial microsomia (CFM) with different severity on both sides of the face. This anomaly leads to short ramal height, condylar pathology, chin deviation and facial asymmetry. The malformed dental arch, open bite and severe canting of the occlusal plane were the reasons for the patient to request the therapy. Orthodontic treatment was performed with pre-adjusted edgewise system assisted by temporal anchorage devices (TADs). These modalities were executed through leveling of the occlusal plane. The improvement was noticed for both better oral function and esthetics.

Keywords: Cranio-facial microsomia (CFM); Occlusal plan canting; Open bite; Temporal anchorage devices (TADs); Camouflage orthodontics

INTRODUCTION
The reported incidence of hemifacial microsomia (HFM) or craniofacial microsomia (CFM) varies from 1:3000 to 1:5600, ranking second and next to cleft lip and palate.1,2 The disorders usually limited to one side of the face, but bilateral occurrences with variation of severity can take place.3,4 Hemorrhage after trauma in the uterus happened around the lower half of the face can cause disturbance in local blood supply and resulted in under-developed mandible and malformed dental and facial structures.4,5

CFM involved either unilateral or bilaterally the external ear, middle ear, facial and neck muscles and the mandible, including tempo-mandibular joint (TMJ) and lower dentition. The treatment of growing patient often started at mix dentition stage, and the completion of the therapy went through to fixed orthodontics for fully correction in permanent dentition.6,7 Early orthodontic intervention usually involved with functional appliances to allow better growth of alveolar bone associated with tooth eruption and the mandibular condyle. Subsequently, on the affected side, the lower teeth could be fully erupted to increase the contact areas between upper and lower dentitions. Non-growers or individuals who have more structural deficiencies may need procedures such as distraction osteogenesis or other surgeries on hard and soft tissues.8

Some studies had pointed out that HFM is not progressive in nature; patients’ basic growth pattern of the face remains unchanged during growth period.9,10

Bilaterally occurred HFM was described as cranio-facial microsomia (CFM).1,11 It was reported that the bilaterally affected deformities (about 25% of HFM) were usually ranged in milder severity. Specific treatment design should be based on patient’s needs.

This patient desired the correction of her discernible facial asymmetry and dental malocclusion but declined any plastic or orthognathic surgery. This makes temporal anchorage devices (TADs) an attractive treatment aid. The screws can
be placed either bilaterally or single sided, help to prevent the bite opening or make the molar intrusion possible. TADs permit satisfactory orthodontic outcome dealing with over-erupted upper molars as well as tilted occlusal plane in this case. The intriguing design of using TADs will be demonstrated and discussed in detail accordingly.

CASE REPORT

Clinical Examination

The patient was a 23-year-old Chinese woman whose primary complaint was asymmetrical appearance of her face. According to the patient, she had been diagnosed as HFM by Kaohsiung Chang Gung Memorial Hospital at 9 years of age and worn a Twin Block appliance then which lasted only six months. Her present medical condition is fair and has no past history of other complications.

Patient's face was asymmetrical in frontal view but there was no significant difference between the level of her eyes. The patient had a convex profile with downward and backward rotated lower jaw (Figure 1). Her external ear of both sides has traces of CFM influence. These congenital ear anomalies are found as tags or malshaped auricle, more severe at right side (Figure 1). No impairment in function was ever found.

Submento-vertex view of the face only found little difference of the zygomatic projection at both sides but clearly showed the chin deviation to right side (Figure 2a). On the lower half of the face, lip canting and incompetency were revealed. The canted upper occlusal plane, that is right-side up and left-side down when seen from the front, was comprehended (Figure 2b). Old photographs of the patient appeared that her facial growth remained similar pattern of facial asymmetry over years (Figure 3).

The contact of upper and lower dentitions was poor. The open contact area distributed in many places and mostly at her anterior occlusion. There was a 13 mm overjet and both sides upper lateral incisors were blocked in (Figure 4). A 2-mm dental midline deviation to right side in comparison to the facial midline was found in the upper arch. There

Figure 1. The patient had facial asymmetry with smaller right side face. The chin deviation to right side was noticed. Her left mouth corner was slightly lower than the right side. Patient's bilateral external ears showed anomalies of different degree of involvement. The external ear anomalies were mild but definitely presented bilaterally, and not identical in severity.

Figure 2. Submento-vertex view of the face showed that both-side zygomatic projections were about the same size (2a). While smiling, distorting upper dental arch was noted, the lip canting and occlusal plane tilting of upper anterior teeth were uncovered (2b).
was a missing lower left premolar, and the basal alveolar process of the mandible was asymmetrical in shape and size. The dental arch was narrower and shorter in perimeter at left side (Figures 4 and 5). The canine and molar relationships were both Class II (Figure 5). The ramal height of the mandible was shorter than normal at both sides. Condylar heads and coronoid processes were quite different in their length and shape; the right side ramus was shorter and more severely deformed. The condylar head and glenoid fossa position at both sides were acceptable (Figure 6).

PA cephalometric radiograph using Grummons analysis revealed that the Menton point was deviated toward the right side. These two oblique lines Co–Me and Co’-Me made of Co (the head of condyle) to Me (the menton) were much different in length (Figure 7a). It was clear that patient's right-side face was actually smaller than the left. Landmark Za is distinguishing and clear. A line connected two Za and Z'a points at both sides (ZaaZ'a line) and another horizontal MM' line connecting occlusal surface of upper right and left first molars were further traced. The MM' line represented the upper occlusal plane recognizable from front view. The angle between these two lines was measured as 7° indicating the severity of pre-treatment occlusal tilting (Figure 7b).

As shown in Table 1, lateral cephalometric analysis discovered that the nasion point was in a higher position than normal, SNA angle was 75°, SNB angle was 69°, and the ANB angle was 6°. The mandibular plane angle was 58° which was much smaller than normal, and the ramal height of the mandible was shorter than normal at both sides. The canine and molar relationships were both Class II (Figure 5). The ramal height of the mandible was shorter than normal at both sides. Condylar heads and coronoid processes were quite different in their length and shape; the right side ramus was shorter and more severely deformed. The condylar head and glenoid fossa position at both sides were acceptable (Figure 6).

Figure 3. Patient’s early age photographs revealed similar facial pattern and dental malocclusion.

Figure 4. Large overjet with open bite was found. Overall occlusal contact was not tight. A 2-mm midline deviation to right in comparison to facial midline (yellow line) was present in upper incisors. As shown with yellow arrow, lower left second premolar was found missing. The canine and molar relationships were both Class II.

Figure 5. Pre-treatment diagnostic casts.
higher than normal. The upper incisors with an angle of $112^{\circ}$ to the SN plane were labially inclined a lot. The lower incisor to the mandibular plane angle was $94^{\circ}$. Both upper and lower lips were in front of the E-line.

**Diagnosis**

The above clinical and radiographic data indicated that the patient has bilaterally involvement of malformed external ear, malpositioned mandible and temporomandibular joint pathology. The diagnosis of this case is moderate cranio-facial microsomia, classified as Pruzansky-Kaban type IIa.13,14

**Treatment Objectives and Plan**

The treatment objectives for this case are: to correct the canting of the occlusal plane; to coordinate the widths of dental arches; to achieve dental Class I canine and molar relationships; to create an optimal overjet and overbite with proper inclination of the incisors; and to attain a suitable functional occlusion and facial esthetic improvement with a competent lip seal. The choice of teeth to be extracted was bilateral upper first premolars and lower right second premolar.

Camouflage orthodontic treatment is planned. The tilted occlusal plane would be corrected more efficiently in molar intrusion by the use of TADs. Screw insertion at upper left infra-zygomatic crest (IZC) and lower right side buccal shelf (BS) was
primarily essential. Intrusive force will be delivered on the upper left posterior teeth from an IZC screw. At lower right molar region, a BS screw serves to hold the molars from over erupting. Other screws to be placed will help to do the vertical control to block out the extrusive mechanics existed during tooth leveling and space closure.

An auxiliary arch wire is also important to be applied on the lower arch, which is continuous and equipped with intrusive anchorage bends on both sides to deliver counteract force for preventing lower molar extrusion.

The growth of the alveolar bone of lower left posterior teeth can then be accelerated in this way that the teeth erupt to reach the occlusal plane, the open contact area of the teeth gradually reduced, and the masticatory function largely enhanced.

**Treatment Progress**

Bilateral upper first premolars and lower right second premolar were extracted before bracket positioning and using pre-adjusted .022 slot straight wire system. Teeth except lower left central and

Figure 8. Tooth leveling progressed for 9 months after bilateral upper first molars and one lower left premolar were extracted. Two TADs were placed at upper dental arch. Retraction of upper incisors continued.

Figure 9. Bracketing at the lower incisors was completed as space gaining permitted.

Figure 10. In order to avoid the extrusion of the lower right posterior teeth, they were tied with the lower TADs by power chains.
lateral incisors were leveled with initial round Ni-Ti arch wires. Two upper TADs were placed at each side of infra-zygomatic crest region to ensure maximum anchorage (Figure 8).

The subsequent treatment was focused on the correction of occlusal plane canting. Eruption of short teeth and prevention of over erupted posterior teeth were both endeavored at the same time in order to increase surfaces of tooth contact.

After 9 months of treatment, better tooth alignment but no bite opening became noticeable. Arch wires were changed to .016 × .022 SSW on the upper arch and .016 × .022 NiTi on the lower. Extraction space had almost closed after 17 months of
treatment especially in the upper dentition (Figure 9). With the help of the screw inserted at left IZC, vertical dimension at upper posterior region was changed unilaterally and the upper left first molar was intruded in certain amount.

In the lower dental arch, two screws were further placed to reduce midline deviation and occlusal plane correction. The open bite was improving after twenty months progress of therapy. The TADs placed at the lower right molar region helped to prevent the lower posterior teeth from extrusion (Figure 10).

A resilient auxiliary arch wire, made of .018 inches Australian round wire, and with anchorage bending at both ends was then delivered to the lower first molars. The auxiliary arch wire served to balance off the force of extrusion coming from the adjacent teeth. The main and auxiliary arch wires were tied
together eccentrically in front of lower left canine bracket to spare the lower right teeth and left incisors from extrusion, the up and down inter-arch elastic pull further increase the differential bite closure on the lower left side (Figure 11).

Total treatment duration was 2 years and 8 months. Records were taken after bracket debond (Figure 12). Removable Hawley retainers were delivered.

**Treatment Result**

Intrusion of upper molars with TADs was uneventful but has limited achievement.

The occlusal canting was improved although not completely leveled in this case. Improved lip canting could be observed. The patient had acceptable occlusion and much better pleasing smile at finishing. Follow up facial and oral records were shown in Figure 13. Post-treatment panoramic and lateral cephalometric were taken (Figure 14), and two years follow up X-ray were in Figure 15.

**DISCUSSION**

Short ramal height, hyper-divergent mandible and chin deviation were the major complications of moderate CFM. In adults, two major treatment options were either camouflage orthodontics or to combine with orthognathic surgery, due to the fact that patients' TMJ growth has ceased. Camouflage orthodontics is a realistic choice which requires effective tooth movement to deliver the occlusal correction even though the skeletal discrepancy will be maintained, provided that the outcome was not against patient's expectations.

PA cephalometric measurement of mandibular length (Co to Me) was found larger at left side than the right in patient's initial records (Figure 7a). Extrusion of one side of the molars and lingually tilted lower molars on the opposite side were not uncommon. Leveling of the occlusal plane is one of the essential working lists should be done but have its limitations. The intrusion of patient's upper left first molar, while maintaining or increasing the vertical height of its counterpart tooth, that is the upper right first molar, is crucial.

In this case, dental correction is impressive with the assistant of TADs. The intrusive mechanics should be implied with TADs wherever there are risks to induce any tooth over erupted (Figures 10 and 11). The already elongated teeth, particularly the upper molars, needed to be reduced in their vertical dimensional height. Occlusal plane canting was improved via intrusion of molars and consequently, increase of the contact areas of the teeth and to close the bite can be obtained.

The focus of mechanical design was on the normalization of the canted occlusal plane. In the mandible, the patient has shorter than normal left ramal height, and her right side ramal height was even shorter than that of the left. This skeletal shortage made counter-clock rotation of the mandible difficult to achieve (Figures 15 and 16).
The patient had a missing lower left premolar, whether or not this defect may also connect to the pathogenesis of CFM is not clear. The maxilla and upper dentition were found with normal tooth size and numbers of teeth. Tooth extraction allowed mesial movement of the molars and enhancing bite closure. The mandibular plane angle decreased little at the end of treatment. The reciprocal closure of the extraction space with power chains induced the upper posterior teeth to move forward while retraction of the proclined incisors was possible. This is a double-winning to gain bite closure and esthetic improvement.

Upper occlusal plane canting was corrected via differential intrusion of molars. The upper right first molar has been extruded 1.5 mm while upper left first molar intrusion was 1 mm (Figures 10 and 16). During the treatment, the occlusal height of lower right molar should be kept from over erupting especially when the intrusion of the upper first molar was still acting (Figure 11). At finishing, it was found that lower left molar extruded slightly, whereas the lower right molar moved 3 mm forward and was intruded only slightly (Figure 16).

Part of the continuous auxiliary arch wire used was implementing extrusion of the lower teeth to approach the occlusal contact of the counterpart teeth particularly on the left side. The same auxiliary arch wire equipped with anchorage bends was inserted in tubes of bilateral lower first molars to apply an intrusive, counteracting force to prevent the involved molars from elongation (Figure 11).

Anterior open bite treated with orthodontic methods was reported as attainable through molar intrusion by the aid of TADs. Studies also pointed out the difficulties of preventing a significant 20–30% relapse at the first year after treatment. The use of ZaaZ’ plane (also known as facial width) as a horizontal reference line was handy in this case (Figure 7b). Zygomatic arch (ZA) located in the upper face, did not affected by CFM and matured early. It was found that the angle between MM’ and ZaaZ’ lines has been reduced 3° after orthodontic treatment (Figure 17). This occlusal plane leveling, added with mesial movement of upper and lower molars, and the three-dimensional changes of both dentitions (Figure 18) were all contributory factors of achieving the treatment goal in this case.

In cases with high mandibular angle, alteration of the occlusal plane and autorotation by orthognathic surgery usually has a promising esthetic outcome. The occlusal plane changed 3° in this case was not enough to produce a surgery-like effect of mandibular counter-clock wise rotation. However, the soft
tissue including oral muscles and the tongue seemed to be more or less stimulated after tooth leveling and the dental alignment became favorable.

Oral function was improved. The color scaled occlusal maps clearly illustrate the improvement of contact points and tight contact surface area (Figure 19).

CONCLUSION

CFM may require stepwise interventions including orthodontic treatment, orthognathic surgery, soft-tissue augmentation and genioplasty. Yet, when the expression of disorders was not severe, when the patient declined surgery, or when the complete catch up of facial structures could not be reached, it matters to use available orthodontic techniques to reduce the extent of malocclusion and to improve oral function and esthetics.

Defected mandibular growth was difficult to be changed, but occlusal plane canting could be managed with orthodontic mechanotherapy.

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