Vertical Maxillary Excess Complicated with Mutilated Dentition Treated by an Interdisciplinary Approach

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CASE REPORT

Vertical Maxillary Excess Complicated with Mutilated Dentition Treated by an Interdisciplinary Approach

Shao-Ching Su, Huei-Mei Tsai, Ming-Jeaun Su, Yi-Min Liu

ABSTRACT

Vertical skeletal dysplasia can lead to excessive lower facial height and maxillary teeth elongation with gum exposure. Patients usually have long face, steep mandibular plane angle, often with mandibular retrognathism. The clinical manifestations include narrow nose, narrow upper dental arch, excessive incisal display, a significant backward and downward rotated mandible as well as vertical maxillary excess (VME). Traditional classifications which mainly based on sagittal jaw relation is inadequate in describing the vertical skeletal discrepancy. In this report, a VME case who also suffered from multiple missing posterior teeth, requires an interdisciplinary dental care. The main treatment objectives are to normalize overjet and overbite, improve chin projection, reduce the gummy smile, and establish satisfactory occlusion with stable posterior support. A three-pieces Le Fort I with a unilateral posterior segmental maxillary impaction was done to correct the over-erupted molars. In the mandible, sagittal split osteotomies with genioplasty were performed. An esthetic improvement and balanced oral function were both achieved after all teeth being restored. The benefit of this comprehensive approach among orthodontist, oral surgeon and prosthodontist to correct a severe dentofacial deformity were also discussed.

Keywords: Vertical maxillary excess (VME); High mandibular plane angle; Gummy smile; Interdisciplinary treatment

INTRODUCTION

Vertical maxillary excess (VME) can cause a hyperdivergent facial pattern with or without anterior open bite. It is recognized as one of the most challenging malocclusions to treat, especially in non-growing patients. Non-surgical orthodontic camouflage by tooth extraction or vertical control with the aid of temporary anchorage devices (TADs) have been proposed. However in this case, tooth extraction was not applicable because of multiple missing teeth. Besides, the over-erupted maxillary molar was beyond the limits of intrusion even with the assistance of TADs. The interdisciplinary treatment combining orthodontic mechanotherapy, orthognathic surgery and prosthodontic rehabilitation remain the most efficient way to treat such cases with severe VME.

Usually, the vertical movement of Le Fort I maxilla impaction may cause sagittal improvement of the mandible position by autorotation, in addition, bilateral sagittal split osteotomies (BSSO) could move the mandible along the corrected occlusal plane for further sagittal jaw improvement. A genioplasty may be accompanied if a more prominent chin projection is required.

A differential impaction of the maxilla could be performed with safety according to various treatment objectives. In this case, a three-piece maxillary osteotomy was executed for differential intrusion of the over-erupted teeth and closure of the edentulous space during surgery.

Conflicts of interest: The authors declare that there is no conflict of interest.

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CASE REPORT

Clinical Examination

A 26-year-old Taiwanese female came with a chief complaint of gummy smile, difficult lip closure and full mouth rehabilitation. Pre-treatment facial and intraoral photographs revealed the lip incompetence, excessive gingival display in the incisor region (Figure 1a–c). A Class II canine relationship with 11 mm overjet and 2 mm overbite was demonstrated. The maxillary arch was narrow with posterior end-on bite on her right side. The maxillary left molars were super-erupted due to prolonged loss of the antagonist teeth. Both mandibular second premolars were tilted lingually (Figure 2a–e). The curve of Spee was 2.5 mm. Tooth size analysis showed a large anterior Bolton ratio of 82%. The patient denied history of any major systemic diseases and temporomandibular joint discomfort.

Cephalometric analysis measurement revealed an excessive lower anterior facial height with extremely high mandibular plane angle and a large ANB angle (Figure 3a–b). Both maxillary and mandibular incisors were retroclined while lower lips were protrusive relative to E-line (Table 1).

Diagnosis

The patient was diagnosed as Class II malocclusion with vertical maxillary excess, backward and

Figure 1. Pre-treatment facial photographs showed classic features of VME: long face, incompetent lips, excessive incisal display, broad buccal corridor and reduced chin prominence (a–c).

Figure 2. Pre-treatment intraoral photographs revealed narrow maxillary arch form with posterior end-on bite (arrow in b), elongated maxillary left molars (arrow in c), multiple missing posterior teeth and lingually tilted mandibular second premolars (arrows in e).
downward rotated mandible, retroclination of anterior teeth in both arches and super-erupted maxillary molars.

**Treatment Objective and Plan**

The impaction of maxilla by Le Fort I osteotomy and a three-piece segmental osteotomy were planned to correct the skeletal discrepancy. Maxillary edentulous space would be closed by advancement of posterior segment and leave a space in right premolar area for future prosthesis. The interdental space on the left side occlusion could be obtained by further intruding the posterior left segment.

In the mandible, BSSO with genioplasty was planned to further advance the mandible and chin after autorotation. Lower anterior tooth stripping and re-fabrication of the maxillary crowns were required to normalize the Bolton ratio.

**Treatment Progress**

Before orthodontic treatment, mandibular third molars were extracted. The 0.022-in. pre-adjusted brackets were bonded and nickel-titanium alloy archwires with reverse curve of Spee in the lower arch were used for initial leveling and alignment. After 14 months of treatment, stainless steel wires were placed in both arches and space were gained between maxillary central and lateral incisors to optimize anterior occlusal relationship before surgery. Two TADs were applied in the lower left anterior region to assist occlusal plane leveling (Figure 4a—e). After the curve of Spee was flattened, upper and lower arch coordination was confirmed and ready for orthognathic surgery (Figure 5).

The model surgery of three-piece Le Fort I osteotomy was performed as follows: the maxilla was impacted by 2 mm in the posterior region and 9 mm in the anterior region. This differential impaction resulted in a counterclockwise rotation of the maxillary occlusal plane (Figure 6). The posterior region was separated in two halves and posterior segments were expanded 2 mm in transverse dimension. Furthermore, the left posterior segment was trimmed 3 mm at the cutting line and then advanced to close the space and intruded for another 2 mm to achieve occlusal clearance (Figure 7).
Figure 4. Space was created between maxillary central and lateral incisor before surgery (arrow in a). Mandibular TADs were used to assist tooth alignment (circle in c).

Figure 5. Panoramic radiograph (a) and lateral cephalogram (b) taken after pre-surgical orthodontic tooth movement. Overjet remained large for further surgical mandibular advancement.

Figure 6. Post-surgical panoramic radiograph (a) and lateral cephalogram (b) demonstrated significant skeletal changes and an enlarged airway.
BSSO was performed on the mandible with 5 mm advancement at both sides. A vertical reduction genioplasty was also performed by advancing the pogonion by 5 mm and reducing the vertical height (Figure 8). Also, nasal alar cinch suture was performed as an adjunct to prevent the nasal base widening.

Post-operative orthodontic treatment was initiated at one week after surgery. A mandibular removable bite plate was fabricated to maintain the left edentulous space until proceed to future prostheses (Figure 9). Wire bending and inter-maxillary elastics were used for final occlusal detailing (Figure 10). During this period, maxillary lateral incisors received root canal treatment. Root resorption of mandibular anterior teeth was noted (Figure 11). The total treatment time of 25 months. The central incisors were changed to provisional crowns after debond. A maxillary wraparound retainer and a mandibular Hawley retainer were provided.

**Treatment Result**

Facial esthetic was altered by advancement of the chin and reducing the lower facial thirds (Figure 12). Her gummy smile was corrected with a slight reduction in incisal display. Lip incompetence was completely eliminated. The nose tip was turned upward and the upper lip was slightly shortened secondary to the impaction of maxilla (Figure 13). Normal overjet and overbite were achieved. Sufficient space was obtained for restorations on the maxillary right premolar and mandibular left molar (Figure 14).

The cephalometric superimposition revealed ANB angle was decreased by $8^\circ$ and pogonion was significantly advanced 20 mm. Mandibular plane
angle was reduced 17° and lower anterior facial height was reduced 9 mm. The maxillary molars were mesialized 3 mm and left molars were intruded 2 mm. The maxillary central incisors were retracted by a minimal amount; however, the inclination was improved after counterclockwise rotation of maxillary occlusal plane. The mandibular molars were upright by 3 mm and mandibular incisors were slightly intruded (Figures 15 and 16 and Table 2). At 2-year follow up, all restorations were fabricated and the occlusion remained stable (Figure 17). Radiographic examination showed minimal skeletal change during retention period (Figure 18).

DISCUSSION

The patient has an under-developed maxilla in transverse dimensions but also has excess dento-facial growth in vertical dimension. The maxillary incisors were upright and elongated before the treatment. If the maxillary edentulous space was closed by orthodontic movement without dealing with the existing skeletal vertical problem, the incisors would to be more retroinclined and elongated. Wolford et al. introduced the concept of altering the occlusal plane in the maxillo-mandibular complex (MMC) as an effective management to maximize functional and esthetic outcomes in patients with facial deformities. Le Fort I osteotomy with
differential impaction to induce a counterclockwise rotation can simultaneously normalize the incisor inclination. An additional benefit of counterclockwise rotation of MMC is upper airway enlargement, although it was not the main concern of this case. Compared to straight forward maxillomandibular advancement, rotation of MMC is more effective in treating severe obstructive sleep apnea (OSA). The MMC rotation could avoid too protrusive maxilla with adequate mandible advancement, which is favorable for Chinese population.

Postsurgical skeletal relapse is another major concern after the occlusal plane alteration, especially counterclockwise rotation. Although the procedure enables improvement in the esthetic results, controversial reports on the stability were documented. Some authors found poor skeletal stability after counterclockwise rotation. Two major factors for postsurgical relapse include: 1) soft tissue stretching resulting from elongation of the pterygo-masseteric sling and suprahyoid musculature; 2) pre-operative temporomandibular joint instability that could be a predisposing factor for the relapse. In contrast, other studies reported that rotational advancement of the mandible is a stable procedure. Nevertheless, several surgical techniques may be applied for promoting the postoperative stability. A modification of the lingual horizontal cut, which leaves the pterygo-masseteric sling on the proximal mandibular segment, might reduce the elongation of the sling. Pre-stretching the suprahyoid muscles before fixation might improve the skeletal stability. A hybrid fixation technique using both mini-plates and screws could be used to enhance the mechanical stability. In this case, counterclockwise rotation of the MMC was accompanied by maxillary impaction so that the chance of lengthening the pterygo-masseteric sling could be minimized.

In vertical maxillary excess malocclusion, the key to decide the amount of maxillary superior repositioning is the incisal display. When the maxilla is positioned superiorly, an average of 2–4 mm of
maxillary incisor exposure at reposed upper lip posture is required. The patient’s age, gender, smile curve and the effect of concomitant sagittal repositioning of maxilla should be taken into consideration when decide the upper lip to incisor relationship. However, post-surgical studies indicated that the upper lip can be shortened by 20% when the maxilla is repositioned superiorly, the predictability of clinical result is controversial because of the variable soft tissue changes following maxillary repositioning. When planning the Le Fort I impaction, sufficient bone between maxillary root apices and nasal floor must be removed. Although in VME patients, usually there are vertical dentoalveolar compensation (over-erupted teeth), sometimes the inferior aspect of the nasal septum may need to be trimmed in order to prevent septal deviation following large amount of impaction. Besides, the nasal endotracheal tube, no matter how carefully it is placed, nose distortion may increase the difficulty to assess the dental midlines, incisor exposure, upper lip height, and the nasolabial angle. A number of orthognathic surgeons have used submental intubation to obtain an unimpeded view of the whole face without distortion. On the other hand, excessive maxillary impaction can result in adverse changes of the lip and nose including alar flaring, upturning of the nasal tip, flattening of the nasolabial region and reduced vermillion exposure. Additional surgical techniques such as the alar cinch suture, resection of the anterior nasal spine, grinding the piriform aperture, and thinning

Figure 14. Intraoral photographs after active treatment demonstrated that normal overjet and overbite. Sufficient space was left for restoration of maxillary right premolar and mandibular left molar.

Figure 15. Final panoramic radiograph and lateral cephalogram after combined orthodontic and orthognathic surgical treatment.
of the columella could also help to minimize the unfavorable changes.  

There is a growing trend towards the application of TADs for achieving surgery-like results in order to avoid the invasive procedure of surgery. However, extensive molar intrusion by TADs poses the risk of apical root resorption and orthodontic relapse. The amount of root resorption was 0.3 mm for a 2 mm maxillary molar intrusion in average. Relapse rate was reported to be up to 23% after orthodontic intrusion. On the other hand, simultaneous maxillary impaction as well as mandibular advancement is considered a stable procedure for the treatment of vertical maxillary excess. Segmental osteotomy has been used in the present case to surgically intrude the over-erupted teeth for prosthodontic space creation. Stabilization of the segment can be achieved by rigid fixation for bone healing. A trans-palatal arch would be helpful in maintaining the arch width. To ensure a good result, it is crucial to establish a stable solid occlusion during the consolidation period. A removable resin bite plate for lower left edentulous area was fabricated soon after the surgery to preserve the posterior vertical dimension.

When the LAFH is to be reduced, the curve of Spee in mandibular arch should be levelled in the preoperative stage. If the amount of LAFH reduction should be maximized, the lower arch leveling should be achieved by incisor intrusion rather than premolar/molar extrusion. In this case, although lower left anterior TADs were used to correct lower

Table 2. Comparison between pre and post treatment cephalometric analyses.

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<tr>
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<td>Lower lip-E line (mm)</td>
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Figure 16. Lateral cephalometric tracing superimpositions of before and after treatment. Maxillary left molars were drawn in dotted line, while right molars were in solid line.
anterior canting before surgery, the amount of lower anterior intrusion was not adequate while lower right molars were slightly extruded during uprighting. Therefore an adjunctive vertical reduction genioplasty was helpful to enhance the reduction of lower anterior vertical excess.

Figure 17. Two-year follow up facial and intraoral photographs. Stable result was demonstrated after all restorations were completed.

Figure 18. After 2 years of retention, panoramic radiograph (a) and lateral cephalogram (b) exhibited minimal skeletal change.
CONCLUSION

Customized treatment objectives need to be determined based on thorough diagnosis and complete evaluation of the case from all three dimensions. Acknowledgement of the surgical procedure and its associated soft and hard tissue changes are important in order to plan the orthodontic and surgical movements ahead. A well collaboration among all dental specialties was required for achieving a satisfactory dental occlusion with esthetic improvement and adequate oral function.

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