Interdisciplinary approach for a patient with excessive gingival display – a case report

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Excessive gingival display is often an aesthetic concern for patients and a challenge for clinicians. Multiple causes are possible and focused treatment options should be considered. The aim of this article is to emphasise the importance of interdisciplinary treatment for patients presenting with excessive gingival display. A 49-year-old female patient who suffered from prominent teeth and a gummy smile was diagnosed with skeletal and dental Class II relationships and a hypermobile upper lip. Aesthetically pleasing outcomes and stable occlusal function were achieved as a result of orthodontic treatment and a surgical lip repositioning procedure. The outcome was maintained after a two-year follow-up.

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Introduction

Many parameters contribute to oral aesthetics. The three main structures – the lip framework, gingival scaffold and the teeth – combine to determine a patient’s smile.1 As early as 1970, Hulsey assessed lip-tooth relationships and concluded that having the upper lip at the level of the gingival margin of the maxillary central incisors was rated as the most attractive smile.2 Tjan divided the smile into three types: low, average and high smile. A medium or low smile line with little or no gingival display is considered the most appealing characteristic. However, a high smile displaying greater than 2–3 mm of maxillary gingiva is considered unpleasant.3-6 Patients with a ‘gummy’ smile may have low self-confidence that affects their psychological status. The perception of an excessive gingival display is subjective. Greater than 2 mm of gingival exposure is regarded as unattractive by orthodontists, whereas greater than 4 mm of gingival display is considered unpleasant by patients and laypeople.7 The prevalence of an excessive gingival display is reported as occurring in 7% of men and 14% of women.8 Prevalence rates that differ from the reported data may indicate that a clinician’s diagnostic method is inaccurate.9

An excessive gingival display is mainly attributed to three tissue components: (1) the underlying bone, (2) the lips, and (3) the teeth. A skeletal aetiology is related to a maxillary excess attributed to disproportionate growth in a vertical direction. A short upper lip or a hypermobile lip, controlled by elevator muscles, lifts the upper lip to a higher position. Encountered dental problems include incisal overeruption (anterior dentoalveolar extrusion), compensatory incisal eruption (incisal wear), and altered passive eruption. The objectives of the present article are to describe a case presenting with flared anterior maxillary teeth combined with an excessive gingival display that was resolved by orthodontic treatment and a surgical lip repositioning procedure.
Case report

Diagnosis and aetiology

A 49-year-old female patient presented to the Department of Orthodontics in the teaching hospital for a comprehensive evaluation. The patient was referred from a local clinic with the chief complaints of prominent upper anterior teeth, multiple spaces and a gummy smile. An extra-oral examination noted a convex profile and 9 mm of gingival display on full smile. An intraoral exam revealed full orthodontic fixed appliances, a large overjet, flaring and crowded upper anterior teeth, multiple spacing involving the lower anterior teeth, and bilaterally missing mandibular first molars (Figure 1). The clinical crown length of the upper anterior teeth was slightly shorter than expected values. Under local anesthesia, a 3 mm distance between the CEJ and alveolar crestal...
bone level was probed and confirmed. A lateral cephalometric radiograph assessment indicated a skeletal Class I jaw-base relationship with a low mandibular plane angle. The arch relationship was a dental Class II malocclusion (Figure 2). The upper lip length at rest was 26 mm and the upper lip length on full smile was 14 mm. The patient had lip mobility of 12 mm, which was greater than the normal of 8 mm, and so the patient was considered to have upper lip hypermobility. In summary, the patient was diagnosed with a vertical maxillary excess, an Angle Class II malocclusion, and hypermobility of the upper lip in combination with the loss of several teeth.

**Treatment objectives**

The treatment objectives were (1) to achieve an aesthetic smile by a reduction of the excessive gingival display while maintaining an acceptable facial profile, (2) to establish a normal occlusion, and (3) to achieve stable aesthetics and function for the long term.

**Treatment alternatives**

Orthodontic treatment was indicated to align and retract the flared maxillary anterior teeth (Figure 3). Secondly, orthognathic surgery, gingivoplasty, a lip repositioning procedure, or Botulinum injection were options provided to the patient to manage the excessive 9 mm gingival display caused by the vertical maxillary excess, altered passive eruption, and lip hypermobility. Finally, definitive metal-ceramic
prostheses were planned for the mandibular posterior teeth to re-establish the occlusion.

The patient declined orthognathic surgery because of the invasive surgical procedures, high morbidity and high cost. She also hesitated regarding Botulinum administration because of the temporary effects. Therefore, after orthodontic treatment, it was decided that a gingivoplasty and lip repositioning procedures be undertaken to manage the altered passive tooth eruption and upper lip hypermobility. Total upper arch distalisation and intrusion using temporary anchorage devices (BOMEi, Taoyuan City, Taiwan) was planned for reducing the vertical maxillary excess. The goal of the intrusion was to establish normal tooth show at rest and an acceptable incisal line and lower lip relationship.

**Treatment progress**

The fixed appliances on the teeth at initial presentation were removed and intraoral scans and panoramic and cephalometric radiographs were taken to provide baseline records. The upper second molars were planned for extraction to relieve the crowding and allow anterior tooth retraction. The lower inadequate prostheses were removed and the pontic space was planned for closure.

Orthodontic treatment was started after routine dental cleaning, oral hygiene control and education. A 0.018 × 0.025 inch preadjusted edgewise appliance (3M Unitek, CA, USA) was placed on the maxillary and mandibular arches, and 0.016 inch nickel–titanium (Ni-Ti) wires (Ormco Corp., CA, USA) were inserted for initial leveling. The maxillary incisors were unattached to avoid further proclination.

After three months of treatment, 0.016 × 0.022 inch Copper NiTi wires (Ormco Corp., CA, USA) were placed in both arches to initiate torque, control root angulations and apply rotation control. In accordance with the treatment plan, a 0.016 × 0.022 inch stainless steel arch wire (Ormco Corp., CA, USA) was placed in the upper arch to commence Class II molar relationship correction. Sliding jigs made of 0.09 inch stainless steel round wires (3M Unitek, CA, USA) were applied, along with temporary anchorage devices (BOMEi, Taoyuan City, Taiwan) over the maxillary second premolars and first molars to distalise the posterior teeth for further total retraction of the upper dentition.

After space was created, the upper incisors were leveled using sectional arch wires, following which, a continuous superelastic Ni-Ti alloy wire (L & H Titan, Tomy International, Tokyo, Japan) was inserted to realign the upper dentition. A 0.017 × 0.025 inch TMA (Ormco Corp., CA, USA) wire with a lever arm was placed in the lower arch to upright the mesially-tilted left second and third molar.

After the upper and lower arches were well aligned, 0.016 × 0.022 inch preformed NiTi arch wires (Ormco Corp., CA, USA) were placed in both arches to prepare for the insertion of the working stainless steel wire. Two months later, 0.016 × 0.022 inch preformed stainless steel arch wires (Ormco Corp., CA, USA) were inserted to start correction of the overjet and overbite and also commence residual space closure. Class II intermaxillary elastics (5/16 inch, 6 oz) were applied for four months to protract the lower second molars. Arch coordination and interdigitation were completed in the meantime. After the maxillary incisors were intruded and retracted, tooth show at rest improved to 2 mm and the incisal line was consonant with the lower lip upon smiling. Therefore debonding was arranged and, following removal of the appliances, upper and lower Hawley retainers were delivered and a canine-to-canine fixed retainer was bonded in the lower arch (Figure 4). The total treatment duration was three years and two months.

After orthodontic treatment (Figures 4, 5, 6), a 7 mm gingival show was still noted. A mock-up was made to assist further patient consideration regarding the teeth-gum-lip relationships. A gingivoplasty was performed to remove 1 to 2 mm of the gingival tissues over the maxillary anterior teeth. In addition, the maxillary anterior teeth were re-shaped from a square to a feminine triangular morphology to assist in the relocation of the alveolar crest to 2 to 3 mm subgingivally. Simultaneously, a lip repositioning procedure using a partial-thickness incision along the mucogingival junction was performed. A second parallel incision was made on the labial mucosa approximately 10 mm distant from the first incision. The epithelium was removed, and midline tissues were approximated with simple interrupted polypropylene sutures to ensure symmetry and proper midline placement. The remaining tissue union was completed with interrupted sutures (Figure 7).
Figure 5. Post-treatment dental cast, lateral cephalometric and panoramic radiographs.

Figure 6. Superimposed pretreatment (blue line) and post-treatment (purple line) cephalometric tracings. The upper lip was retracted and MPA was maintained.
Treatment results

After the post-orthodontic surgical procedures, the gummy smile was resolved, even on full smile. The patient was subsequently referred to the Prosthodontic Department to complete the final replacement of the mandibular first molars. At a five-month follow-up, scar tissues were noted over the lip repositioning incisions but the soft tissue condition was stable (Figure 8). At a two-year follow-up, a satisfactory occlusion with normal function and a more confident smile were achieved (Figure 9).

Discussion

A gummy smile may be caused by a combination of factors, such as vertical maxillary excess, a hyperactive upper lip, a short upper lip, altered passive eruption or altered active eruption of the maxillary anterior teeth. Accordingly, treatment should be performed to improve aesthetics and produce a stable and ideal result.10

Orthodontic treatment is often indicated during the first phase of interdisciplinary management to align teeth and create an optimal incisal plane corresponding to the curvature of the lower lip.2,6,11,12 On average, 2-3 mm and 3-4 mm of tooth should be displayed in repose in young men and women, respectively, but these values may decrease with age.10,13-15 In the present case, sectional orthodontic treatment was performed by bypassing the maxillary anterior teeth at the outset to avoid further incisor proclination. Temporary anchorage devices were placed over the maxillary second premolars and first molars to assist in space creation for maxillary anterior tooth retraction. The anterior teeth were then leveled after space creation.

Traditionally, patients presenting with a vertical maxillary excess could only be corrected by means of orthodontic treatment combined with orthognathic surgery. A lip repositioning procedure is an alternative treatment for degree I and degree II vertical maxillary excess, involving 2 to 4 mm and 4 to 8 mm of gingival display, respectively. The procedure was first introduced in 1973 and mechanically involves limiting the retraction of the smile elevator muscles and range of motion of the upper lip by reducing vestibular depth.16 An adequate amount of mucosal
tissue, which is double the amount of gingival display, should be excised. The borders of the remaining tissues are then approximated to adjust vestibular depth. The facial midline and dental midlines should be marked before local anaesthesia to ensure bilateral postsurgical symmetry. Lip repositioning is an invasive surgical procedure causing scar contraction but is also reversible. After two to three years of follow-up, cases have exhibited stable and satisfying outcomes. However, patients with minimal attached gingiva are a procedural contraindication given the difficulty in flap design and suturing, which would create an increased risk of relapse. In addition, a shallow vestibular depth and narrow attached gingiva may compromise oral hygiene measures.

The patient in the present report had a 9 mm gingival display. The aetiology included vertical maxillary excess, altered passive tooth eruption, a hypermobile upper lip and malpositioned teeth. The flared maxillary incisors, the large overjet and arch spaces were corrected by orthodontic treatment with the assistance of temporary anchorage devices. Some reduction of the excessive gingival display was observed after treatment. The patient chose to have a lip repositioning procedure rather than orthognathic surgery to correct the residual gingival display resulting as a consequence of the vertical maxillary excess and hyperactive upper lip. A gingivoplasty instead of osseous aesthetic crown lengthening was performed because the patient was satisfied with the proportions of the maxillary anterior teeth. Stable aesthetics and a functional occlusion were achieved after orthodontic treatment coupled with the surgical procedures and fabrication of the prostheses. Because of the integration of interdisciplinary treatment procedures, the patient was able to avoid the morbidity associated with orthognathic surgery and was still satisfied with the treatment outcome.
Summary
The present case report demonstrated an interdisciplinary approach to treat a patient who presented with a dental Class II malocclusion and excessive gingival display. Differential orthodontic treatment was performed mainly to retract proclined maxillary anterior teeth, close mandibular anterior spaces, and establish a normal overbite and overjet. The amount of gingival display was reduced by orthodontic treatment but not to the required extent. A gingivoplasty and lip repositioning procedure were subsequently carried out to change the shape of the anterior teeth and to reduce the function of a hypermobile lip. The integrated co-operation between orthodontics and periodontics achieved acceptable to tooth and gingival aesthetics as well as a stable occlusion after a two-year follow-up.

Conflict of interest
The authors report no professional or financial conflict of interest in relation to this case report. The patient provided permission for the publication of her clinical data and photographs.

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