

The Role of Orthodontics, Orthognathic Surgery and Adjunct Surgical Procedures in the Esthetic Rehabilitation of the Face and Smile: Potential and Limitations

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ABSTRACT

For nearly a century, orthodontists have mainly focused on occlusion as the primary objective of orthodontic therapy. The introduction of the soft tissue paradigm has shifted treatment planning from hard tissue to soft tissue and reinforced the key role of facial esthetics in orthodontic diagnosis and treatment planning. Whereas occlusion is rooted in measurable definitions of Class I and other “keys to occlusion”, esthetics is more subjective, based not only on the orthodontist’s assessment but also on personal and cultural preferences rather than rigid norms. The aim in this paper is to demonstrate that orthognathic surgery potentially narrows the gap between esthetics and function, even though surgery may have its own limitations. Three reports are presented on patients whose clinical examination, records evaluation and treatment planning have focused on facial and smile esthetics, and treatment approaches that combined orthodontics, orthognathic surgery and appropriate adjunct procedures to enhance the overall esthetic outcome.

Introduction

Patients increasingly seek treatment to improve their facial esthetics. Available evidence suggests that self-confidence, self-esteem, and quality of life improve when patients are satisfied with their appearance.¹ The practice of orthodontics has evolved from the initial views of orthodontic pioneers who had deep-rooted but opposing philosophies. Edward H. Angle focused on occlusion and full complement of teeth that would be naturally consonant with facial esthetics. Challenging Angle’s premise, Calvin Case advocated extractions to treat protrusion,² and Tweed to reach better stability of results.³ Consequently, treatment with extraction of premolars, based on hard tissue analysis and a standardized position of the mandibular incisor over basal bone, often resulted in compromised flattened or “dished in” profiles.⁴

The current goals of orthodontic treatment are optimal facial esthetics, a pleasing smile and an ideal occlusion.⁵ The emerging soft tissue paradigm is escorted by the individual concern with facial appearance,⁶ which becomes more challenging in adult patients, often necessitating adjunct therapies that need coordination among a treating team of specialists along with the patient as a member in the decision-making process. When orthodontic treatment alone may not achieve facial and smile esthetics, surgical and cosmetic procedures help reach the desired result. The aim in this article is to describe the orthodontic and surgical diagnosis, treatment planning and delivery processes that can be used to enhance treatment

outcome, demonstrating the potential of orthognathic surgery to bridge the gap between esthetics and function.

Patient 1

A 30-year-old female who was not satisfied with previous treatment attempts to enhance her smile sought improvement of her dental and facial appearance. She had received orthodontic treatment with extraction of the maxillary first premolars and first molars, followed with extensive restorative interventions including root canal treatments, full coverage crowns, and porcelain veneers. The patient’s facial profile was convex with a retruded mandible and a decreased lower facial height. She had a low lip line upon smiling, exposing less than half of the maxillary incisors’ clinical crown heights. She presented with an overjet of 10 mm, Class II molar and canine relationships, an 80% impinging overbite, and a 3 mm midline deviation (Fig. 1).

The cephalometric analysis revealed a skeletal Class II anteroposterior relationship with an ANB angle of 8° and a Wits appraisal of 10 mm. The panoramic radiograph confirmed that the maxillary first premolars, first molars and third molars along with the mandibular right first molar and left third molar, had been extracted. The maxillary second premolars, second molars and the mandibular right second molar were tipped mesially. Six teeth had been treated endodontically, full crowns covered the maxillary right central incisor, the mandibular left first molar and

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Fig 1. Patient 1. Pretreatment facial and intraoral photographs.

right second molar, and extensive occlusal restorations were present (Fig. 2). The alveolar bony heights across the teeth were not leveled.

Treatment objectives and plan

The treatment objectives were to address the low lip line upon smiling, which was the patient's main chief complaint, correct the severe overjet and impinging overbite, and improve the vertical and anteroposterior deficiency of the lower third of the face.

Treatment combining orthodontics and double jaw orthognathic surgery was indicated: a Le Fort 1 osteotomy to displace the maxilla

downward and a bilateral sagittal split osteotomy and genioplasty to move the mandible forward and downward and obtain normal overjet and overbite.

Treatment progress

Presurgical orthodontic treatment was initiated with a normal progression of archwires (from 0.014-inch nickel-titanium alloy up to 0.019 × 0.025-inch stainless steel in standard edgewise brackets with 0.022 × 0.028-inch slots). The vertical position of the incisors was used to determine vertical facial height at surgery.⁷ The over erupted mandibular incisors were used to direct the mandible downward at the chin level when the mandible was advanced to a normal overbite and overjet during surgery, thus correcting the reduced lower facial height. To this end, the mandibular arch was not leveled presurgically and a curve of Spee was maintained in all archwires including the surgical stabilizing wire. Consequently, upon mandibular advancement, a lateral openbite was generated with tooth contacts only on the anterior and posterior teeth.⁷

Tooth movement was resumed two weeks after surgery by replacing the heavy stabilizing wires with 0.016-inch stainless steel working archwires. Extrusion of the posterior teeth was achieved with flat archwires and lateral box elastics and was facilitated by the absence of tooth contacts in the buccal segments. Finishing and detailing movements were completed on 0.016-inch stainless steel archwires. Total treatment time was one year and 4 months, including 9 months for pre-surgical orthodontics.

Treatment results

Remarkable facial changes were observed with the resolution of the mandibular retrusion and facial convexity. Upon full smile, the entire clinical crown heights of the maxillary anterior teeth were visible and a consonant smile arc was achieved. A well-interdigitated Class II molar and Class I canine buccal occlusion was established with normal overjet and overbite and coincident midlines (Fig. 3). The post-treatment panoramic radiograph revealed optimal root parallelism except for the

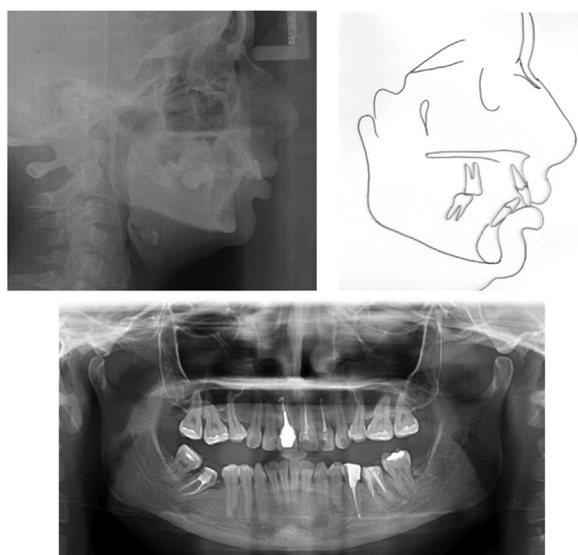


Fig 2. Patient 1. Pretreatment lateral cephalometric radiograph, tracing and panoramic radiograph.



Fig 3. Patient 1. Posttreatment facial and intraoral photographs

mandibular right second molar, which remained slightly tipped. The posttreatment cephalometric radiograph and superimposition analysis showed the downward positioning of the maxilla and forward and downward positioning of the mandible (Fig. 4).

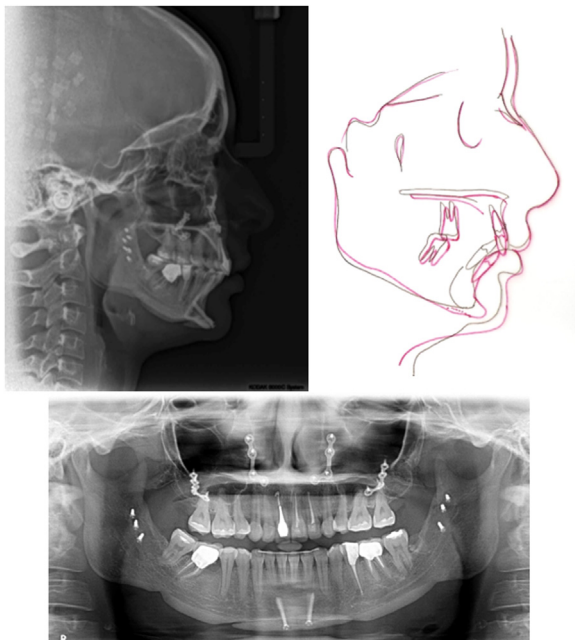


Fig 4. Patient 1. Posttreatment lateral cephalometric radiograph, tracing and panoramic radiograph.

Patient 2

A 53-year-old female presented with a chief complaint of unpleasant smile and missing posterior teeth. She had initially sought restorative treatment but her dentist recognized the need for a multidisciplinary approach to address her malocclusion. Her facial profile was convex with a marked labiomentral fold. Upon smile, she displayed gingival tissue and prominent maxillary canines relative to the adjacent incisors. Intraorally, she presented with a Class II division 2 malocclusion with a deep overbite. The maxillary left first premolar and first molar had overerupted into the mandibular extraction sites (Fig. 5). The cephalometric analysis revealed a skeletal Class II relationship (ANB angle of 10°; Wits appraisal of 6 mm) and retroclined maxillary and mandibular incisors. The spaces of the extracted maxillary right first molar and mandibular left first premolar and first molar were visible on the panoramic radiograph. The third molars had also been extracted (Fig. 6).

Treatment objectives and plan

The main treatment objective was to address the smile esthetics, which was the patient’s chief complaint, by correcting the maxillary incisor inclinations. At the dentist’s request, the second objective was to facilitate the restorative process by creating adequate mesio-distal and crown height spaces for three single-tooth implants to replace the extracted teeth.

The treatment plan combined orthodontics and orthognathic surgery. The maxillary incisors were proclined to develop the overjet and reveal the true magnitude of the skeletal discrepancy between the maxilla and the mandible. A bilateral sagittal split osteotomy and genioplasty were planned to advance the mandible and the chin.



Fig 5. Patient 2. Pretreatment facial and intraoral photographs.

Treatment progress

Treatment was started in the maxillary arch with standard edgewise brackets bonded on all the maxillary teeth and a normal progression of archwires to level, align, intrude the over erupted teeth and procline the incisors to normal inclination. The mandibular arch was bonded 8 months later and a similar progression of archwires was used to align

and procline the mandibular incisors and coordinate the arches in preparation for the mandibular advancement surgery. An overjet of 9 mm was created pre-surgically (Fig. 7A). After surgery, Class II box elastics were worn for two weeks between the 0.019 × 0.025-inch surgical stabilizing wires, which were replaced by 0.016-inch stainless steel wires two weeks after surgery for final occlusal coordination. The pre-surgical orthodontic movements were achieved in 18 months and the total treatment in 2 years.

Treatment results

Facial esthetics was enhanced with improved lip support and a resolution of the profile convexity. Smile esthetics was significantly improved with well aligned teeth and an ideal display of maxillary clinical crown heights. The combined orthodontic and surgical approach had a face lift effect and contributed to a more youthful facial appearance. A well-interdigitated Class I buccal occlusion was established with optimal overjet and overbite. The teeth that had over erupted in the mandibular extraction spaces were intruded and optimal mesio-distal and crown height restorative spaces were created. Tooth mass discrepancy caused by undersized maxillary lateral incisors was addressed by leaving spaces distal to the maxillary lateral incisors in preparation for composite build-ups (Fig. 8). The superimposition of pre- and post-treatment cephalograms showed the forward and downward positioning of the mandible and the proclination of the maxillary and mandibular incisors (Fig. 7).

Patient 3

A 36-year-old female complained of an unpleasant smile and flared maxillary incisors. Her dental history included endodontic treatment on the maxillary right second premolar and on the mandibular first and

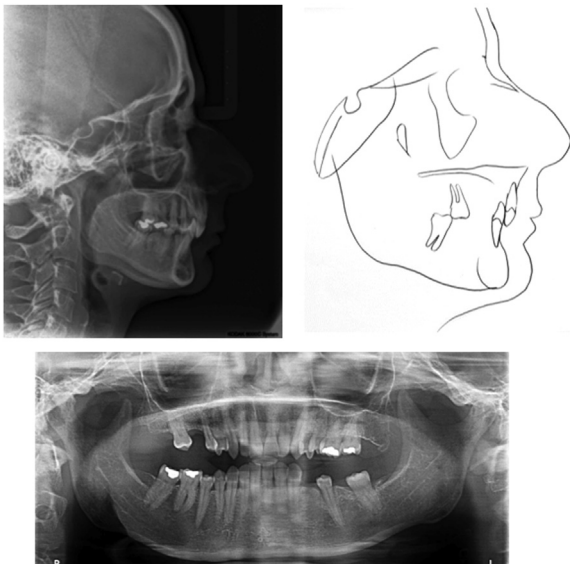


Fig 6. Patient 2. Pretreatment lateral cephalometric radiograph, tracing and panoramic radiograph.

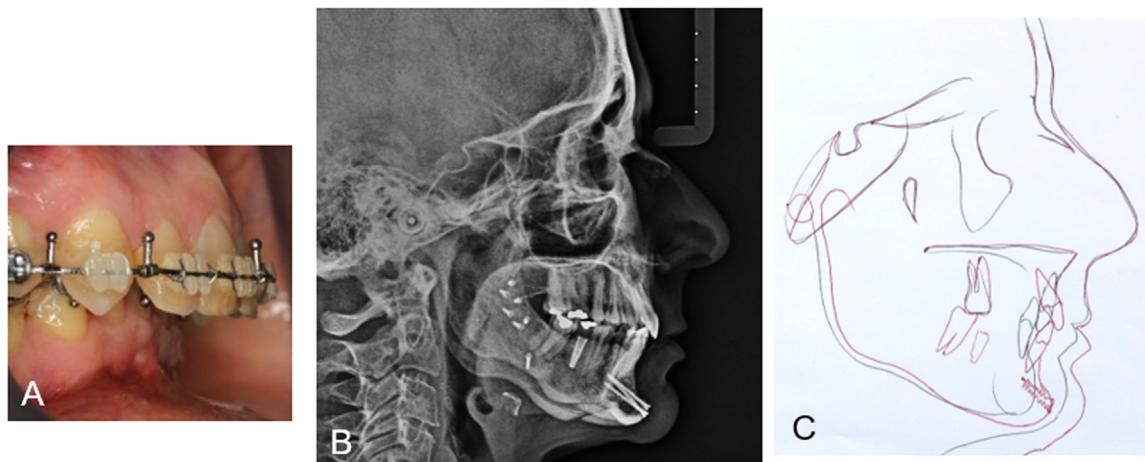


Fig 7. Patient 2. (A), Presurgical intraoral photograph; (B, C), Posttreatment lateral cephalometric radiograph and tracing.

second right and left molars. These teeth had also received extensive restorative treatment. She had a marked concave profile with a slightly reduced lower facial height and a decreased naso-labial angle associated with an everted upper lip redundancy (Fig. 9). The face was symmetrical with no incisor display at rest. An asymmetric posterior gingiva was visible upon smile, with more display on the left side. Her reverse smile arc was accentuated by the high position of her maxillary incisors. A 9 mm overjet was compatible with a full Class II molar occlusion. Additional findings in the esthetic zone were a maxillary midline diastema and the low gingival level on her lateral incisors and canines relative to the central incisors.

The cephalometric analysis revealed a skeletal Class III relationship with an ANB angle of -2° and a Wits appraisal of -1 mm. The maxillary incisors were proclined (maxillary incisor to NA angle = 47°). The

occlusal plane was parallel to Frankfort horizontal; the mandibular plane angle was also reduced (FMA angle = 17°). The panoramic radiograph revealed endodontic treatment and full coverage crowns on the mandibular first and second molars and the maxillary second premolars. The third molars had been extracted (Fig. 10).

Treatment objectives and plan

The patient’s main chief complaint and the primary treatment objective were to improve the smile esthetics. Specifically, the following changes were needed: reduce the posterior gingival smile and improve the smile arc by aligning the maxillary incisal edges parallel to the lower lip curvature; correct the severe overjet and proclined maxillary incisors and achieve a proper Class I buccal intercuspation. The ideal approach included a combined orthodontic and double jaw orthognathic surgery:



Fig 8. Patient 2. Posttreatment facial and intraoral photographs.



Fig 9. Patient 3. Pretreatment facial photographs and dental cast.

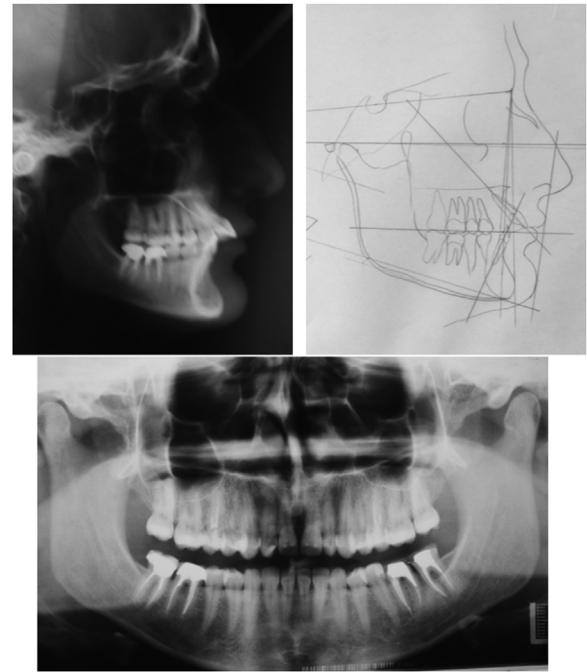


Fig 10. Patient 3. Pretreatment lateral cephalometric radiograph, tracing and panoramic radiograph.

a Le Fort 1 osteotomy to rotate the maxilla clockwise by posterior impaction and anterior extrusion. A bilateral sagittal split osteotomy would move the mandible downward anteriorly to a normal overjet and overbite.

Treatment progress

After bonding standard edgewise brackets on all teeth, a progression from light to heavier archwires helped level and align the teeth, close spaces, and coordinate the arches for surgery. Two weeks after surgery, the 0.019 × 0.025-inch stabilizing wires were replaced with 0.016-inch stainless steel working archwires for final alignment and arch coordination. Total treatment time was 2 years and 2 months, and the presurgical stage lasted 19 months.

Treatment results and adjunct procedures

Normal incisal display at rest is evident on the posttreatment close-up anterior view (Fig 11 A). A consonant smile arc with the maxillary

incisal edges running parallel to the lower lip curvature was attained (Fig 11 B). However, the asymmetric lip elevation combined with altered passive eruption leading to short clinical crowns on the maxillary lateral incisors and canines contribute to more gingival display on the patient's left side (Fig 11 B, C). Botulinum toxin type A (Botox) injection was used as an adjunct procedure to control the left hyperactive upper lip elevator muscles.⁸ A periodontal crown-lengthening surgery on the maxillary arch was performed to normalize the anterior gingival levels (Fig 11 D, E).

Remarkable facial changes and a more youthful appearance were observed following the resolution of the profile concavity. Smile esthetics improved with an optimal vertical and transverse tooth display on full smile. A well interdigitated Class I buccal occlusion was established with optimal overbite and overjet, tooth alignment and proportionate gingival heights (Fig 12). The cephalometric superimposition analysis confirmed the clockwise rotation of the occlusal plane and downward positioning of the maxilla and mandible anteriorly (Fig. 13).



Fig 11. Patient 3. (A), Posttreatment close-up view in rest position; (B), Posttreatment smile close-up view; (C), Posttreatment intraoral photograph; (D, E), Posttreatment close-up view and intraoral photograph after periodontal crown-lengthening surgery and Botox treatment.



Fig 12. Patient 3. Posttreatment facial and intraoral photographs.

Discussion

Angle’s definition of an ideal occlusion with a full complement of teeth and his assumption that facial esthetics would follow has proven to have limitations when used as a universal approach to treatment. On the other hand, planning treatment from a profile view and basing outcomes on hard tissue analysis and cephalometric norms also has not produced harmonious soft tissue outcomes, as the thickness of the facial soft tissues may camouflage or exacerbate the underlying hard structures.^{4,9} Moreover, treatments designed on the appearance of the profile only without proper assessment of the front facial view ignore how patients see themselves. Fortunately, this gap has been narrowed in

contemporary orthodontics with the three-dimensional evaluation of facial esthetics, which complements the goal to obtain ideal and more stable occlusal results that prevailed even in the early period of orthognathic surgery, especially in challenging severe skeletal dysplasias.

The key to facial esthetic planning is a comprehensive clinical examination that focuses on smile esthetics, lip-tooth relationship, anterior tooth displays at rest and during facial animation, facial proportions, symmetry and soft tissue (facial and gingival) coverage. The orthodontist should consider all available treatment modalities and adjunct procedures to reach optimal esthetic outcomes. Individual traits must be considered, particularly when they represent therapeutic limitations to achieving optimal esthetics.⁴ In this context, the following question

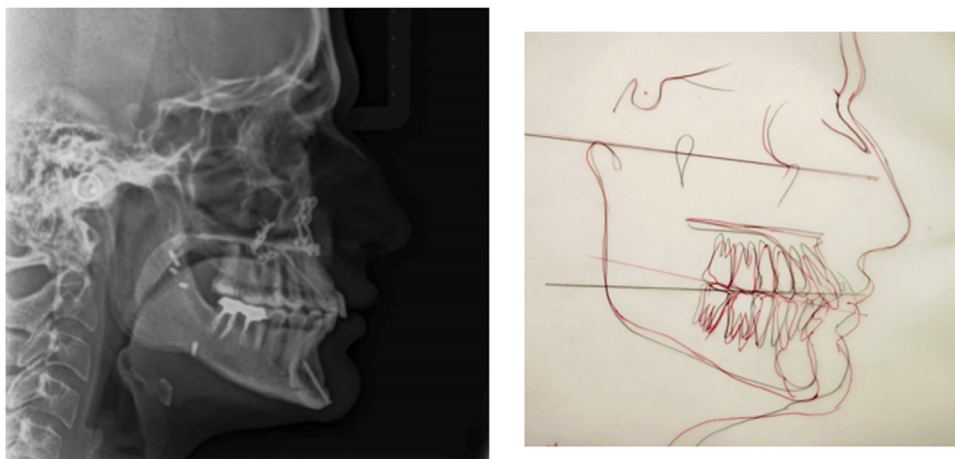


Fig 13. Patient 3. Posttreatment lateral cephalometric radiograph and tracing.

arises: Is orthodontic research and practice keeping-up with evolving facial esthetic considerations?

Gaps related to the inability to apply canons of beauty in the individual patient are recognized, disclosing the multifaceted answers to the question that would include the following measures:

1. Understand the role of soft tissue thickness in camouflaging or exacerbating the severity of malocclusion
2. Routinely include soft tissue outcomes along with hard tissue results in orthodontic publications
3. Design proper research protocols to investigate adjunct cosmetic procedures such as fillings and injections
4. Offer orthognathic surgery when orthodontic treatment alone is expected to produce suboptimal results, in the context of the patient's complaint and expectations.
5. Work with a team of specialists that understand the multiple aspects of adult multidisciplinary treatment.⁸

Conclusion

In current practice, both facial and dental esthetic outcomes of treatment are critical for patient satisfaction. Means of norms cannot be used as universal guidelines as each patient is different and unique. Constitutional and therapeutic limitations exclude the use of universal guidelines based only on norms. This “gap” between esthetic limitations and expectations must be considered for each patient and should be addressed in research that focuses on individual variations.

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Patient consent was obtained.

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Author contributions

All authors attest that they meet the current ICMJE criteria for authorship.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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