Facial and Dental Esthetics in Orthodontic Diagnosis and Treatment Planning: A Contemporary Review

Abstract

Background: Facial esthetics has moved from the periphery to the centre of orthodontic diagnosis and treatment planning. Where cephalometric hard-tissue norms once dictated treatment goals, contemporary orthodontics recognises that the soft-tissue envelope, the smile, and the dentition together determine whether a result is perceived as attractive.

Objective: To present a clinically oriented, hierarchical review of facial and dental esthetics for orthodontic diagnosis and treatment planning, organised under the widely used macro-, mini-, and micro-esthetic framework.

Review Summary: Macro-esthetics concerns overall facial proportion and symmetry, including the classical divine (golden) proportion described in facial and dental measurements. Mini-esthetics concerns the smile itself — its anatomy, neuromuscular basis, classification, smile arc, and the gummy smile. Micro-esthetics concerns the individual dental unit — tooth proportion, connectors and embrasures, gingival architecture, and axial inclination. The clinical implications of these principles for incisor positioning, deep-bite correction, and management of excessive gingival display are discussed, along with adjunctive tools such as digital smile capture, smile training exercises, and botulinum toxin.

Conclusion: A structured, hierarchical assessment of facial, smile, and dental esthetics allows the orthodontist to set treatment objectives that are both biologically sound and esthetically defensible, and should be incorporated into routine diagnostic records alongside cephalometric and model analysis.

Keywords: Facial esthetics; smile analysis; golden proportion; gummy smile; smile arc; orthodontic diagnosis

Introduction

Facial esthetics has received increasing attention in orthodontic diagnosis over the past four decades.[1] Early orthodontists applied largely artistic and intuitive ideals of occlusion and facial harmony when correcting malocclusion in growing patients; over time, this subjective approach has gradually given way to quantitative, reproducible methods of evaluating soft-tissue relationships and treatment goals.[1,2] Esthetics itself — the study of beauty — was established as a distinct branch of philosophy by Alexander Baumgarten in the eighteenth century, from the Greek *aesthesis*, meaning sensory perception.[2] Whether beauty is purely subjective, as suggested by David Hume's dictum that "beauty exists in the mind which contemplates it," or whether it rests on principles common to all observers, as Francis Hutcheson argued, remains debated.[2] What is clear clinically is that facial appearance has a measurable psychosocial impact, and that orthodontic treatment is sought as much for its esthetic benefit as for its functional one.

Modern diagnostic thinking has reframed the clinical examination in three interlocking layers of magnification: **macro-esthetics**, the proportions and symmetry of the face as a whole; **mini-esthetics**, the dynamic framework of the smile bordered by the lips; and **micro-esthetics**, the individual dental and gingival units that are seen within that frame.[3] This hierarchy is useful because it moves the clinician systematically from the coarsest to the

finest level of analysis, mirroring the sequence in which an observer's eye actually perceives another person's face. This review summarises the current evidence and clinical principles within this framework, with an emphasis on their application to orthodontic diagnosis and treatment planning.

Table 1. Hierarchical framework for orthodontic esthetic diagnosis (macro-, mini-, and micro-esthetics).

Level	Anatomic scope	Key parameters assessed	Representative diagnostic tools
Macro-esthetics	Face as a whole	Facial thirds and fifths; facial index; profile convexity/concavity; mandibular plane inclination	Frontal and profile clinical examination; divine (golden) proportion analysis
Mini-esthetics	Smile framework (lips, teeth, and gingiva within the display zone)	Smile type (social/enjoyment); smile arc; buccal corridor; gingival display	Static and dynamic smile photography/videography
Micro-esthetics	Individual tooth and gingival unit	Tooth width/height ratio; connectors and embrasures; gingival zenith; axial inclination; shade gradient	Golden proportion; Recurring Esthetic Dental (RED) proportion; gingival architecture analysis

Methodology

This narrative review draws on the orthodontic, prosthodontic, and periodontal literature relating to facial, smile, and dental esthetics, supplemented by classical texts on proportion in art and architecture, and was compiled as part of a postgraduate dissertation in orthodontics. Sources were organised under the macro-, mini-, and micro-esthetic framework described above, and are synthesised here to give the practising and postgraduate orthodontist a clinically oriented overview rather than an exhaustive systematic appraisal of the primary literature.

Macro-Esthetics: Facial Proportion

The purpose of facial evaluation in orthodontics is best framed not as a judgement of beauty, which is influenced by cultural and ethnic factors, but as an assessment of **facial proportion**.[4] A disproportionate or asymmetric face is a psychosocial problem in every culture, whereas a proportionate face is broadly acceptable even if it is not conventionally beautiful. The clinical examination therefore proceeds through frontal and profile analysis.

In frontal view, the face is conventionally divided into vertical fifths, bounded by the width of the eyes and the interpupillary distance, which should approximate the width of the mouth; and into vertical thirds, from hairline to glabella, glabella to subnasale, and subnasale to menton, an idea traceable to the proportional canons of Renaissance artists such as da Vinci and Dürer.[4] A small degree of facial asymmetry is present in essentially all individuals and should be distinguished from a clinically significant chin or nasal deviation. Facial width and height must be interpreted together, since the facial index — not either dimension alone — establishes overall facial type; normative anthropometric data for zygomatic width, gonial width, and vertical face height provide reference values, although these vary by sex and ethnicity (Fig. 1, Table 2).[4]

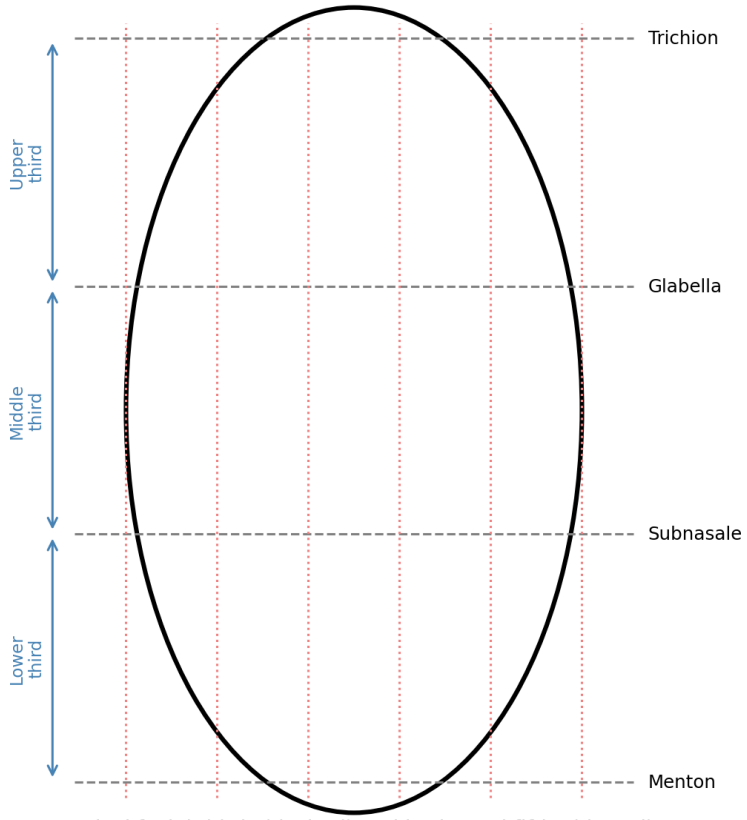

Fig. 1 Schematic of facial proportion analysis (frontal view)

Fig. 1. Schematic of facial proportion analysis in the frontal view, showing the vertical facial thirds (trichion–glabella–subnasale–menton) and the horizontal facial fifths bounded by eye and mouth width.

Table 2. Representative normative craniofacial soft-tissue measurements by sex (mean, SD in parentheses), commonly used as reference values in frontal facial proportion analysis.

Parameter	Male	Female
Zygomatic width (zy–zy), mm	137 (4.3)	130 (5.3)
Gonial width (go–go), mm	97 (5.8)	91 (5.9)
Intercanthal distance, mm	33 (2.7)	32 (2.4)
Pupil–midfacial distance, mm	33 (2.0)	31 (1.8)
Nasal base width, mm	35 (2.6)	31 (1.9)
Mouth width, mm	53 (3.3)	50 (3.2)
Face height (N–Gn), mm	121 (6.8)	112 (5.2)
Lower face height (Sn–Gn), mm	72 (6.0)	66 (4.5)
Upper lip vermilion height, mm	8.9 (1.5)	8.4 (1.3)
Lower lip vermilion height, mm	10.4 (1.9)	9.7 (1.4)
Nasolabial angle, °	99 (8.0)	99 (8.5)
Naso-frontal angle, °	131 (8.1)	134 (8.1)

Values are illustrative population means adapted from standard soft-tissue cephalometric/anthropometric references; ethnicity- and population-specific norms should be used where available.[4]

Profile analysis, sometimes termed the "poor man's cephalometric analysis," assesses three elements in sequence: (i) the anteroposterior relationship of the jaws, judged from the convexity or concavity of a line from nasion through soft-tissue A-point to the chin; (ii) lip posture and incisor prominence, judged by relating the lips to true vertical lines through soft-tissue A and B points, with lip incompetence (>3–4 mm interlabial gap at rest together with everted, prominent lips) indicating true incisor protrusion; and (iii) vertical proportion and mandibular plane inclination, a steep mandibular plane being associated with long anterior facial height and open-bite tendency, and a flat plane with deep bite.[4] Facial divergence and lip prominence are both strongly influenced by racial and ethnic background and must be interpreted against appropriate population norms rather than a single "ideal."[4]

A recurring theme in the facial-proportion literature is the **golden section**, geometrically defined by Euclid as division of a line such that the whole is to the longer part as the longer part is to the shorter, yielding the ratio 1.618:1 (φ).[5] Ricketts popularised the application of this "divine proportion" to the face and dentition, describing reciprocal φ relationships between forehead–eye, eye–nose, nose–mouth, and mouth–chin distances in the frontal view, and between trichion–eye, eye–mouth and nose–chin depths in profile, with the nasolabial region emerging as a recurring "area of congruence."[5] Similar φ relationships were proposed within the dentition itself, relating the widths of the lower incisor, upper incisor, canine, premolar and molar segments.[5] These golden-proportion analyses are conceptually attractive and provide a useful frame of reference, but subsequent clinical studies have found that naturally attractive dentitions and faces conform to the exact 1.618 ratio inconsistently, so the golden proportion is best regarded as a heuristic rather than a rigid clinical rule.[6,7]

Facial proportion is not merely an academic exercise: distorted or asymmetric features are a recognised contributor to psychosocial difficulty, and one of the stated aims of orthodontic treatment is to reduce the discrepancy between a patient's appearance and prevailing socio-cultural norms of facial harmony. Because those norms vary with ethnicity and geography, macro-esthetic assessment should always be interpreted against population-appropriate reference values rather than a single universal template, and the orthodontist should be cautious about imposing one ethnic ideal of proportion onto a patient from a different background.

Mini-Esthetics: The Smile

The smile is consistently identified as one of the most important determinants of facial attractiveness; in one survey of public perception of facial features, the smile was rated second only to the eyes, ahead of hair, skin and nose.[8] Modern orthodontic goals therefore extend beyond ideal occlusion to include a harmonious, dynamic smile, and impaired ability to smile freely has been associated with reduced self-esteem and social confidence.[9]

Anatomy and neuromuscular basis. The smile "display zone" is framed by the upper and lower lips and contains the teeth and gingival scaffold; its soft-tissue determinants include lip thickness, intercommissural width, interlabial gap, and the width-to-height smile index.[10] The dynamic smile is generated by a coordinated neuromuscular sequence originating in the non-motor cortex and relayed through the premotor and motor cortices to the facial nerve (cranial nerve VII), which activates the muscles of expression — principally zygomaticus major, levator labii superioris, and levator anguli oris.[10] Because this is a trainable motor pattern, repetitive smile exercises with visual feedback have been proposed, by analogy with other neuromuscular training, as an adjunct for patients relearning a confident smile after treatment, although controlled trial evidence for this specific application remains limited.[10,11]

Balanced smile and smile classification. A well-balanced smile depends not only on the occlusal plane–lip relationship but also on arch form, the width of the oral fissure, neuromuscular tone, and total facial expression, factors that are not fully captured by cephalometric analysis alone and require direct clinical and photographic assessment.[9] Sarver and Ackerman distinguished two basic smile types: the **social smile**, a static, voluntary, and reproducible expression driven mainly by zygomaticus major, and the **enjoyment smile**, a spontaneous, involuntary expression recruiting the periocular muscles in addition, producing greater incisor and gingival display.[12] The social smile is the more clinically useful reference for treatment planning because it is reproducible on demand.

Smile arc. The smile arc describes the relationship between the curvature of the maxillary incisal edges and the curvature of the lower lip during smiling. A *consonant* smile arc, in which the incisal curve parallels the lower lip, is generally judged more attractive than a *flat* or *reverse* arc (Fig. 2).[13] In practice, a consonant arc can usually be achieved by positioning the central incisor edges 0.5–1 mm incisal to the laterals, and is compromised by common finishing errors such as flattening the incisal plane or over-intruding the maxillary incisors.[14]

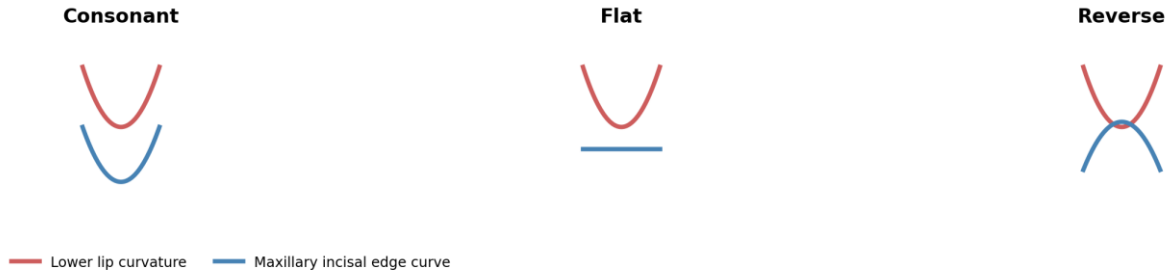

Fig. 2 Smile arc relationships: maxillary incisal curve relative to lower lip curvature

Fig. 2. Smile arc relationships between the maxillary incisal edge curve and the curvature of the lower lip: consonant, flat, and reverse patterns.

Gummy smile. Excessive gingival display, conventionally defined as ≥2 mm of maxillary gingiva visible on full smile, is a frequent esthetic concern and shows marked sexual dimorphism, being roughly twice as common in women.[14] Monaco and colleagues classified gummy smile by etiopathogenesis into four types: **dento-gingival** (altered passive eruption), **muscular** (hyperactive upper-lip elevators and zygomaticus major with normal lip length), **dento-alveolar** (vertical maxillary excess), and **mixed**, in which more than one mechanism coexists.[15] This classification is clinically useful because it directs the choice of therapy — periodontal crown lengthening or gingivectomy for the dento-gingival type, botulinum toxin or lip-repositioning surgery for the muscular type, and orthodontic incisor intrusion or orthognathic maxillary impaction for the dento-alveolar type (Table 3).

Table 3. Etiopathogenetic classification of gummy smile and corresponding management options.

Type	Etiology	Clinical feature	Typical management
Dento-gingival	Altered passive eruption	Excess gingiva between the muco-gingival junction and free gingival margin; normal upper lip length	Gingivectomy or surgical crown lengthening
Muscular	Hyperactive upper-lip elevators and zygomaticus major	Normal upper lip length; excessive lip elevation on smiling	Botulinum toxin to lip elevators; smile-training exercises
Dento-alveolar	Vertical maxillary excess	Increased subnasale–incisor	Orthodontic incisor intrusion;

Type	Etiology	Clinical feature	Typical management
		distance; increased overjet/overbite	maxillary impaction surgery (Le Fort I) in severe cases
Mixed	More than one mechanism concurrently	Variable; commonly vertical maxillary excess with short clinical crowns	Combined orthodontic, periodontal, and/or surgical approach

Smile capture. Because a lateral cephalogram cannot fully describe frontal or oblique soft-tissue behaviour, contemporary smile diagnosis relies on standardised digital photography and, increasingly, short digital video clips of speech and spontaneous smiling. Recommended static views include frontal-at-rest, frontal-smile, profile-at-rest, together with oblique and profile smile close-ups, allowing assessment of buccal-corridor form, incisal-plane cant, and the proclination or retroclination of the maxillary incisors that a single frontal photograph would miss.

Micro-Esthetics: The Dental Component

At the finest level of analysis, the individual anterior teeth and their gingival relationships determine the perceived quality of the smile.

Tooth proportionality. The maxillary central incisor is generally considered esthetically ideal at a width-to-height ratio of approximately 75–80%, though a range of 66–80% is described in the literature; a higher ratio produces a "square" tooth and a lower ratio a "long" one.[16] Because clinical crown height, rather than width, is most often deficient — from attrition, incomplete passive eruption, or gingival overgrowth — restorative or periodontal lengthening procedures are frequently required to correct disproportion.[16]

Connectors, embrasures and gingival form. Interproximal contact points progress apically, and incisal embrasures enlarge, from the midline posteriorly, giving the anterior segment its characteristic graded appearance; connector height between central incisors is approximately 50% of central incisor length, diminishing to about 40% between central and lateral incisors and 30% between lateral incisor and canine.[17] The gingival margin should describe a symmetrical oval or half-circular arc over the incisors, with the gingival zenith — the most apical point of the margin — positioned slightly distal to the long axis of the central incisors and canines.[17] Loss of interdental papilla height creates open "black triangle" embrasures, which commonly appear or worsen when crowded, rotated incisors are orthodontically aligned, particularly in adults.[18] Progressive medial axial inclination of the anterior teeth away from the midline, and a natural gradient of tooth shade — brightest at the central incisors, duller at the canines, with the premolars again lighter and more closely matched to the laterals — are further, more subtle, contributors to a natural-appearing result; both features tend to become less pronounced with increasing age as secondary dentin formation and enamel thinning reduce translucency.[17]

The golden and RED proportions in tooth width. Lombardi first proposed applying the golden proportion to anterior tooth width, and Levin later suggested that the visible width of the lateral incisor should be 1:1.618 to the central incisor, and the canine similarly to the lateral.[19] Empirical studies, however, have found the exact golden ratio infrequently in naturally attractive dentitions — Preston found it in only 17% of casts for the lateral–central relationship and 0% for canine–lateral — with a mean perceived ratio closer to 0.66–0.85.[20] Ward's Recurring Esthetic Dental (RED) proportion addressed this limitation by proposing

that the width ratio between successive anterior teeth need not be fixed at 62% (the golden proportion) but should simply remain *constant* as one moves distally from the midline, with the specific percentage — commonly 70–80% in practice — chosen to suit arch form and facial/body morphotype (Fig. 3, Table 4).[21] The RED proportion is now generally preferred over a rigid golden-proportion rule because it accommodates the wide natural variation in tooth width actually observed in attractive smiles.[21]

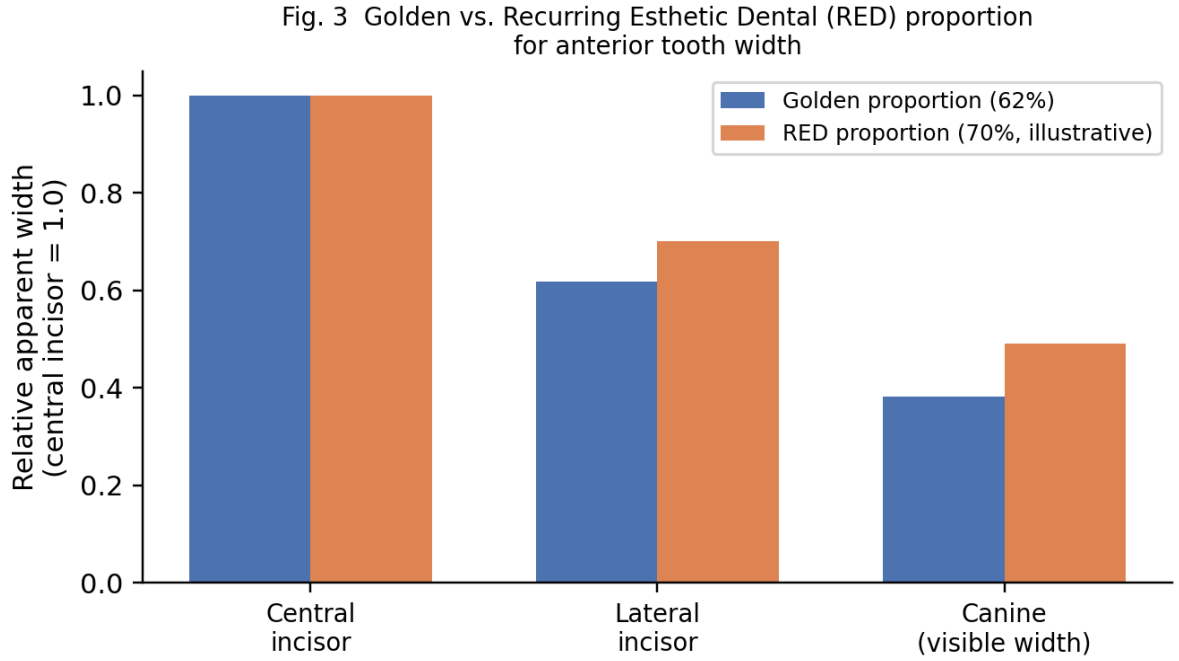

Fig. 3. Relative apparent widths of the maxillary central incisor, lateral incisor, and canine under the classical golden proportion (62%) compared with an illustrative 70% Recurring Esthetic Dental (RED) proportion.

Table 4. Relative apparent widths of the maxillary anterior teeth: golden proportion versus an illustrative Recurring Esthetic Dental (RED) proportion.

Tooth	Golden proportion (62%)	RED proportion (70%, illustrative)
Central incisor	1.00	1.00
Lateral incisor	0.62	0.70
Canine (visible width)	0.38	0.49

The RED percentage is selected by the clinician (commonly 70–80%) and applied consistently from the midline to the canine, rather than being fixed at 62% as in the classical golden proportion.[21]

Clinical Implications for Orthodontic Treatment Planning

Translating these esthetic principles into treatment mechanics has several practical consequences.

In **deep-bite correction**, a common iatrogenic error is over-intrusion of the maxillary incisors, which hides them behind the upper lip at rest and worsens with age as the lip drapes further. Where the maxillary incisor-to-lip relationship is already acceptable, correction should instead emphasise intrusion of the mandibular incisors, using base or utility arches, reserving maxillary intrusion for patients who genuinely display a gummy smile.[14] Finishing

should also aim to reproduce a consonant smile arc, most simply by keeping the central incisor edges 0.5–1 mm incisal to the laterals rather than finishing to a flat incisal plane.[14]

For **high smile types with excessive gingival display**, treatment is selected according to the underlying mechanism identified on classification: active orthodontic intrusion of the maxillary incisors (via intrusion or utility arches) for dento-alveolar vertical excess; periodontal gingivectomy or surgical crown lengthening — which, when performed correctly, stabilises at roughly 3 mm from the reduced bone level within six months — for altered passive eruption; and, for the muscular type, botulinum toxin to the upper-lip elevators or, in refractory or severe cases, maxillary impaction surgery or lip-repositioning procedures.[14,15] It is worth noting that mild gingival display is often well tolerated by lay observers and tends to diminish with age as a result of gradual lip drooping, so aggressive intervention is not always indicated, particularly in female patients for whom a degree of gingival show falls within normal variation.[14]

Records and documentation for esthetic diagnosis have expanded beyond the traditional frontal-at-rest, frontal-smile, and profile-at-rest photographs. Sarver and Ackerman recommend adding oblique and profile smile views to assess buccal corridor form, incisor proclination, and anteroposterior occlusal cant, and advocate short digital video clips of speech and spontaneous smiling to capture the *dynamic* smile, since a single static photograph cannot record the full range of lip and tooth movement that patients and observers actually perceive in conversation.[22,23] Incorporating such records alongside conventional cephalometric and model analysis allows soft-tissue and smile objectives to be set, monitored, and reassessed throughout active treatment rather than being addressed only at the finishing stage.

More broadly, macro-esthetic findings should influence the choice between camouflage and combined surgical–orthodontic correction. When a skeletal discrepancy is mild enough that facial balance is not markedly disturbed, orthodontic tooth movement alone can usually achieve an acceptable esthetic result. When the discrepancy is severe enough to distort facial proportion — for example, a Class III skeletal pattern with significant midface deficiency, or a long-face pattern with marked lip incompetence and gingival display — orthodontic camouflage is unlikely to normalise the face even if occlusal targets are met, and orthognathic surgery should be discussed with the patient from the outset rather than after non-surgical treatment has already been attempted and has fallen short esthetically.

Adjunctive Esthetic Modalities

A small number of adjunctive, largely non-orthodontic, techniques are increasingly used alongside conventional treatment to refine smile esthetics. **Smile training exercises**, performed by the patient in front of a mirror, aim to use repetitive, feedback-guided muscle activity to improve smile symmetry and confidence, extending established principles of neuromuscular motor learning to the muscles of facial expression, although this remains supported mainly by mechanistic rationale rather than randomised trial evidence.[10,11] **Restorative "smile lift" procedures** — lengthening worn incisors or building out posterior support — can compensate for age-related loss of lip support and muscle tone. **Botulinum toxin type A**, injected into the upper-lip elevators, has an established role as a minimally invasive option for the muscular type of gummy smile, with reported clinical improvement in the majority of treated patients within two to three weeks and a low, transient, and predictable side-effect profile; it is contraindicated in patients with known hypersensitivity to botulinum toxin or human albumin.[24,25] These adjuncts are best regarded as complements to, rather than substitutes for, orthodontic correction of the underlying skeletal and dental relationships.

Conclusion

Esthetic evaluation in orthodontics is most usefully organised as a hierarchy moving from macro-esthetics (overall facial proportion and symmetry) through mini-esthetics (the dynamic smile framework) to micro-esthetics (individual tooth and gingival form). Facial and dental analysis, cephalometric assessment, and study models together form the cornerstones of diagnosis, and facial soft-tissue findings should, where they conflict, take precedence in guiding how a given occlusal problem is corrected — since the goal of treatment is a functional occlusion housed within an esthetically favourable face, not the reverse. Where the skeletal disproportion is severe enough to compromise facial balance, orthodontic tooth movement alone is unlikely to be sufficient, and combined orthodontic–surgical planning should be considered from the outset. As digital photography, videography, and three-dimensional facial analysis become routine, orthodontists have an increasing opportunity — and responsibility — to build soft-tissue and smile objectives explicitly into diagnosis, treatment planning, and outcome assessment, rather than treating esthetics as an afterthought to occlusal correction.

A limitation of the present review, and of much of the underlying literature it draws on, is that many of the classical proportion-based analyses — the divine proportion, the golden percentage, and the RED proportion among them — rest on relatively small, ethnically homogeneous samples and on subjective panel ratings of attractiveness. Clinicians should therefore apply these frameworks as a structured starting point for diagnosis and communication with the patient, and adapt or discard the specific numerical targets where they conflict with the individual patient's facial morphotype, ethnic norms, or personal esthetic preference.

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