Facial planning for orthodontists and oral surgeons

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The bite indicates a problem; the face indicates how to treat the bite. Models, cephalometric analysis, and facial analysis together should provide the cornerstones for successful diagnosis. Models and clinical bite examination indicate to the practitioner that bite correction is necessary. Facial analysis identifies positive and negative facial traits and dictates how the bite will be corrected to optimize esthetic facial goals. If the skeletal problem is significant enough to alter facial balance, the problem is most likely too severe to be corrected successfully with orthodontic tooth movement alone. Ideal occlusal harmony is achieved with the desired cosmetic facial changes dictating what orthodontic and surgical procedures should be used. If orthodontic tooth movement cannot produce the necessary facial changes, then surgery is indicated.

Each diagnostic tool contributes to the clinician's perception of facial and occlusal problems. Study models, cranial base cephalometrics, clinical examinations, and soft tissue cephalometrics have all been used to guide facial treatment. Together, these tools help to formulate an accurate treatment plan for the bite and the face. Conversely, these tools can influence treatment planning in negative ways.

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Model examination

Diagnosis and treatment planning of facial changes based on model analysis are unreliable. When bite changes are based solely on model assessment, the facial result can be negative. Models are essential for studying space requirements, arch forms, and interarch relationships, but they do not shed light on facial problems and therefore cannot accurately guide or predict facial changes. Drobocky and Smith[1] studied 160 patients (Class I models) who had 4 first premolars extracted and concluded that "ten to fifteen percent of cases could be defined as excessively flat (dished-in) after treatment."

Cranial base cephalometrics

Cranial base cephalometrics include all popular orthodontic analyses (eg, Steiner and Ricketts) that measure cranial base structures (eg, SN and FH). With the advent of cephalometric headfilms, these analyses were developed to guide occlusal corrections. It was theorized that when teeth are straightened and the occlusion is corrected to cranial base norms, optimal facial esthetics will result.[2-4]

Unfortunately, reliance on cephalometric analysis and treatment planning sometimes leads to esthetic problems.[5-12] The assumption that bite correction based on cranial base standards leads to correct facial esthetics is not always true and might, in some instances, result in less than desirable facial outcomes.[5-15]

When the cranial base is used as the reference line for measuring the profile, false findings can be generated because the cranial base is as variable as the dental and facial structures that it measures. Measuring a variable to a variable leads to variable facial outcomes (Fig 1).

Clinical facial analysis

A combination of clinical and soft tissue cephalometric examinations is necessary to successfully diagnose and plan the treatment for facial changes.[13-15]

In the past, the clinical facial examination has been subordinate to the cranial base cephalometric examination

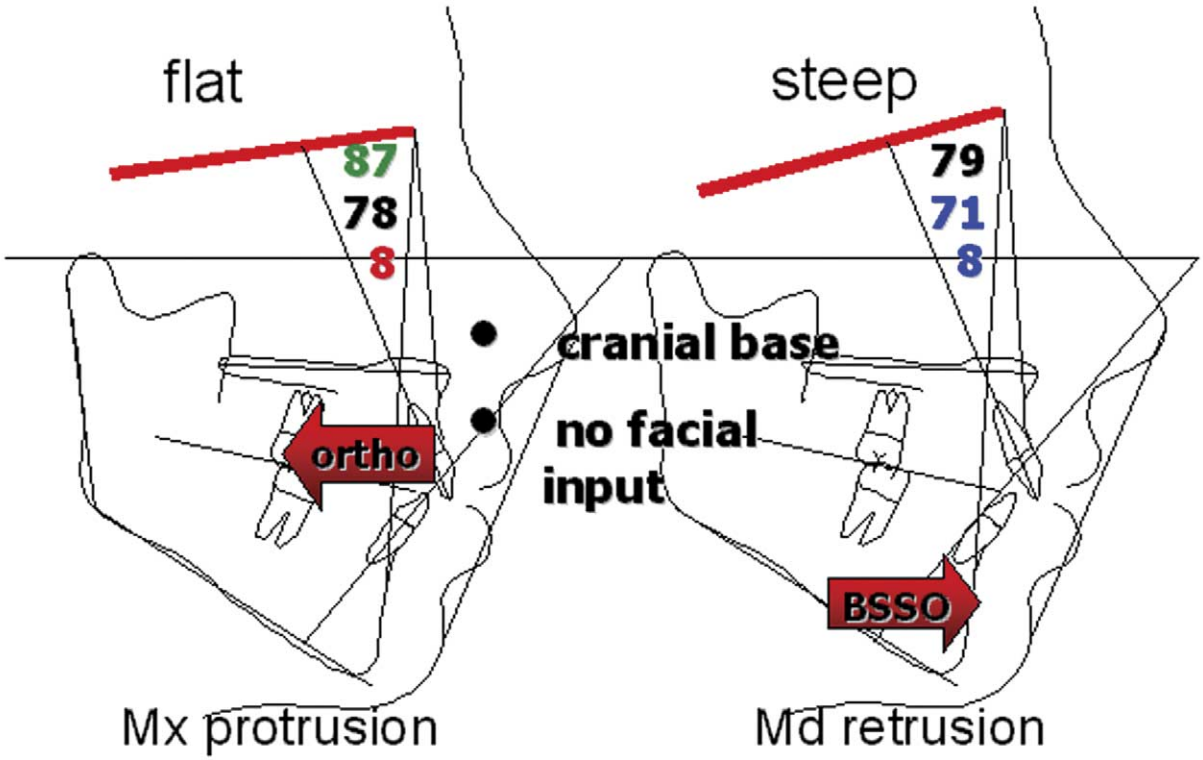

Fig 1. Identical tracings with different cranial base angulations. Diagnosis on left is maxillary protrusion, which indicates orthodontic maxillary incisor retraction as correct treatment. Diagnosis on right is mandibular retrusion, which indicates mandibular advancement surgery.

in treatment planning. Unlike cephalometric analysis, measuring and comparing changes with facial examinations are difficult. Normative values are available but are not used to guide diagnosis and tooth movement decisions as clearly as cephalometric values. This has led to some de-emphasis of clinical examinations in orthodontic treatment planning. In 1993, Arnett and Bergman,[13,14] presented an organized, 3-dimensional analysis of facial structure. This was later updated to integrate clinical facial examination with soft tissue cephalometric diagnosis and treatment planning.[15] The clinical analysis was based on key landmarks relevant to optimal orthodontic and surgical-orthodontic treatment. Specific areas of examination were used for diagnosis, orthodontic treatment planning, extraction patterns, and surgical treatment planning.

Natural head position, centric relation, first tooth contact, and relaxed lip position are necessary to accurately assess the face. Natural head posture is preferred because of its demonstrated accuracy over intracranial landmarks. Natural head posture has a 2° standard deviation compared with a 4° to 6° standard deviation for the various intracranial landmarks in use.[16,17] The patient should be in relaxed lip position because it demonstrates the relationship of soft tissues relative to hard tissues without muscular compensation for dentoskeletal abnormalities.

The clinical examination is 3-dimensional and is most useful for showing shapes and contours.[13-15] In particular, orbital rim, subpupil, and alar base contours are noted. Photographs are not adequate because of variations in head posture, mandibular location, and lip position. Traits for evaluation were selected based on their importance for accurate 3-dimensional diagnosis and treatment planning.[13-15]

The frontal view[13-15] provides information on the midlines, levels, outline, and heights of the face. Forms can be used for recording the findings (Fig 2), and this information is then used to determine the diagnosis and the treatment plan for the patient.

The clinical facial examination is used exclusively to plan 3 of these frontal factors—facial or occlusal cants, midline deviations, and general facial outline. Vertical facial planning is determined by information gained from the clinical facial examination and is later objectively confirmed with the soft tissue cephalometric analysis.

FACIAL EXAMINATION

name_____ **age**_____ **orthodontist**_____

FRONTAL VIEW

1. vertical	range	patient	possible ways to normalize vertical				
overbite	3 mm		LFI	BSSO	crown length change		orthodontics crown torque change
upper lip height	19-22 mm						lip length surgery
interlabial gap	1-5 mm		LFI	BSSO	overbite correction	lip posture change	lip length surgery
lower lip height	42-48 mm		LFI	BSSO	overbite correction	lip posture change	chin osteotomy – change height
lower 1/3 height	60-68mm	2+3+4	LFI	BSSO	overbite correcti on	submental lipectomy	chin osteotomy – change height
Mx incisor exposure (relaxed)	1-5mm		LFI		crown length change	lip length surgery	crown torque change
Mx incisor exposure (smile)	8 crown to 2 gingiva		LFI	full partial	crown length change	lip length surgery	gingivectomy
closed lip	strain less touch	strain redundancy	LFI	BSSO	overbite correction	Mx height change	lip length surgery
Mx incisor height	9.5-11.5 mm				crown length change		gingivectomy
upper vermilion	6-9 mm				lip reconstruction procedure		
lower vermilion	8-12 mm				lip reconstruction procedure		
middle 1/3	60-68mm						

2. vertical planning	
Mx1 plan-relaxed lip:	current relax ed exposure _____ ± desired change _____= goal _____ (> 5 mm advancement anticipated? yes increase impaction)
Mx1 plan-smile lip:	current smile exposure _____ ± desired change _____= goal _____ (> 5 mm advancement anticipated? yes increase impaction)
facial plan:	± Mx1 height change _____ ± overbite change _____ ± chin height change _____ = net _____ OK outline - interlabial gap

3. midlines	patient			possible ways to normalize facial midlines			
nasal tip	to right		to left	LFI		LFI-shorten septum	isolated septoplasty
philtrum	to right		to left			soft tissue midline which dental midlines are measured to	
Mx 11	to right		to left	LFI		orthodontics	canine cant change
Md 11	to right		to left		BSSO	orthodontics	canine cant change
chin	to right		to left		BSSO	chin osteotomy	canine cant change

4. facial levels	patient				possible ways to normalize facial levels		
eyes	R down		L down	visualizecant Y N			none
Mx canines	R down		L down	visualizecant Y N	LFI		orthodontics
Md canines	R down		L down	visualizecant Y N		BSSO	orthodontics
Md body level	R down		L down	visualizecant Y N		BSSO	heat treated HA augmentation
chin level	R down		L down	visualizecant Y N		BSSO	chin osteotomy

5. outline	patient						possible ways to normalize outline				
general	round	wide	narrow	long	short	normal	LFI	BSSO advance	overbite change	chin osteotomy – change height	buccal or submental lipectomy
zygomatic arch	R larger wide *normal* narrow			narrow *normal* wide larger L					HA augmentation		reduction osteoplasty
Md angle	R larger wide *normal* narrow			narrow *normal* wide larger L				BSSO	midline rotation	canine cant correction	cold cure HA graft
Md body	R larger wide *normal* narrow			narrow *normal* wide larger L				BSSO	midline rotation	canine cant correction	cold cure HA graft / buccal lipectomy
chin	narrow wide waist		flat angular		short long		posture change		chin osteotomy	cold cure HA	buccal lipectomy
alar base width *	alar base widfh _____mm			intercanthal width _____mm					alar base cinch	surgical narrowing	

Fig 2. Facial examination form.

PROFILE

1. high midface projection	patient						ways to normalize high midface projection	
glabella	protruded		*normal*	retruded			osteoplasty	
orbital rim	flat	soft	*normal*	prominent	R larger	L larger	heat cured HA augmentation	
cheekbone	flat	soft	*normal*	prominent	R larger	L larger	heat cured HA augmentation	reduction osteoplasty
subpupil	flat	soft	*normal*	prominent	R larger	L larger	LFI (MSLFI advances more than LFI)	heat cured HA

2. maxillary projection	patient							ways to normalize soft tissue nasal base – upper lip projection		
nasal base	concave	flat	soft	*convex*	prominent	R larger	L larger	LFI (MSLFI creates > than LFI)		**desired** could need **move_____mm**
ULA to TVL	retruded	*normal*	protruded	straight Mx sulcus		lip: thin thick		LFI	11 torque change	lip thickness change
upper lip support	weak	*normal*	strong	support: air teeth gingiva				LFI	11 torque chng	**desired** could need **move_____mm**
orthodontics 1	age	extractions	headgear	elastics	RPE	functional		LFI	11 torque chng	flatten occlusal plane
orthodontics 2	age	extractions	headgear	elastics	RPE	functional		LFI	11 torque chng	flatten occlusal plane
nasal projection	long	*normal*	short	tip: up down	dorsal: hump saddle			LFI (MSLFI shortens more than LFI)		rhinoplasty

3. mandibular projection	patient						ways to normalize lip and chin projection		
LLA to TVL	retruded	*normal*	protruded	11 defection	accent	flat labiomental fold	Mx11 torque change	LFI adv	Md11 torque change
							BSSO	steepen or flatten occlusal plane	chin augmentation or reduction
Pog' to TVL	retruded	*normal*	protruded	Pog' relative to: lower lip protruded retruded			Mx11 torque change	LFI adv	Md11 torque change
							BSSO	steepen or flatten occlusal plane	chin augmentation or reduction
throat length	short	*normal*	long	chin line	sag		Mx11 torque change	LFI adv	Md11 torque change
							BSSO	steepen or flatten occlusal plane	chin augmentation or reduction
									submental lipectomy
4. overjet	_____mm		does not indicate source of malocclusion				orthodontics	LFI	BSSO

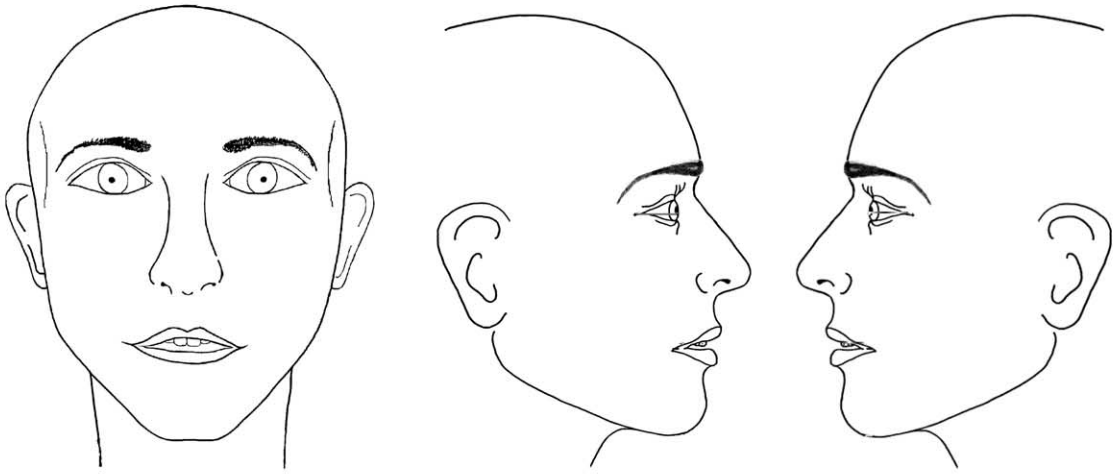

Fig 2. Continued.

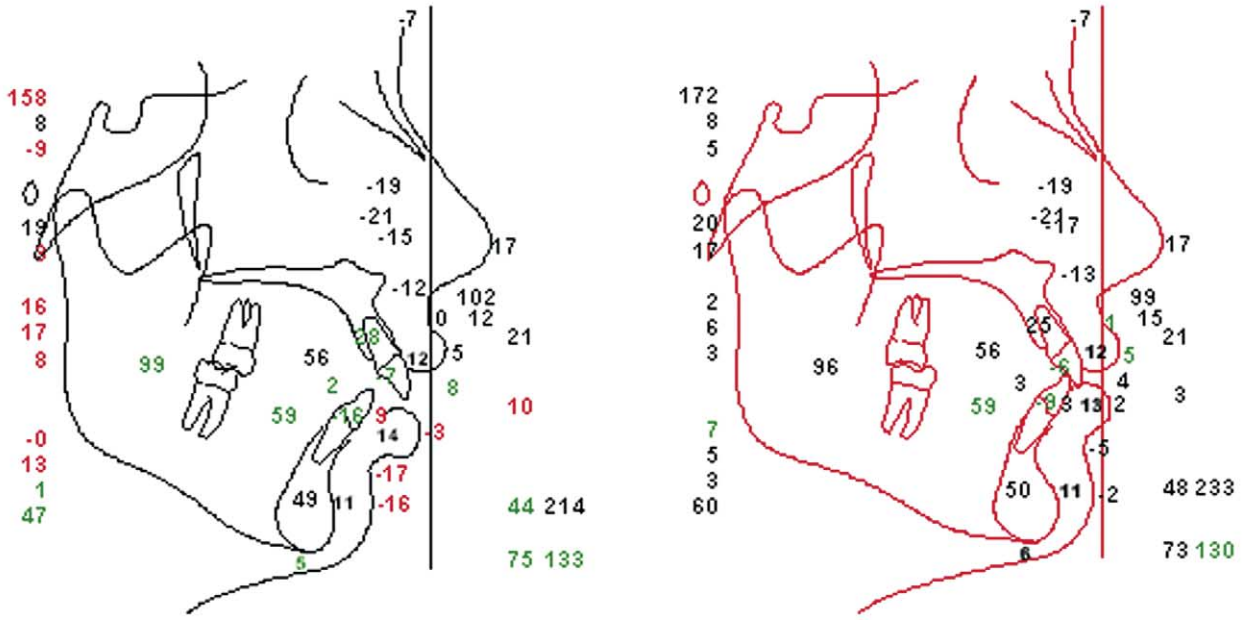

Fig 3. Soft tissue cephalometric analysis (STCA). *Left*, presurgical; *right*, actual surgical result. *Black*, 1 SD; *green*, 2 SD; *blue*, 3 SD; *red*, >3 SD.

The profile view[13-15] is used to assess the projections of the face. This evaluation must be undertaken with the joints seated; this shows the true positions of the mandible and profile. Projections analysis is divided into high midface, maxillary, and mandibular areas. Profile information is then added to the facial examination sheet (Fig 2).

Soft tissue cephalometrics

The clinical examination is extremely important and provides information in both the profile and the frontal views. It is, however, subjective. The advantage of soft tissue cephalometrics is that it provides the ability to make objective measurements of important structures and relationships.[13-15] Soft tissue cephalometrics is a method of quantifying facial disharmony and identifying its underlying causes. This is exceedingly important because, as a rule, better facial esthetics are achieved if the underlying problems are identified and treated at the source.

Soft tissue cephalometrics examines the profile and measures the heights and projections of the face; it has 2 components: soft tissue cephalometric analysis and cephalometric treatment planning.

Soft tissue cephalometric analysis

The 2-plane soft tissue cephalometric analysis excels at measuring positions and relationships of facial parts (Fig 3, *left*). For soft tissue cephalometric analysis, a patient is assessed in natural head position, with condyles seated, first tooth contact, and lips at rest.

The vertical and horizontal positions of soft and hard tissue landmarks are recorded relative to the patient's natural head position or true vertical line. Female and male values and standard deviations are recorded in the following areas:[15,18] dental and skeletal factors, soft tissue thicknesses, facial heights, true vertical line projections, and harmony values.

The dentoskeletal factors[15,18] have a great influence on the facial profile. These factors are changed with treatment to produce a balanced and harmonious profile. The profile at the end of treatment is greatly influenced by how the orthodontist and surgeon manage the dentoskeletal components.

Notably, harmony values,[15,18] as the name implies, provide a read on the balance between 2 parts of the face. They are sensitive indicators of facial parts imbalance. They can identify imbalance between 2 landmarks even when the landmarks are within normal ranges.

Cephalometric treatment planning

The profile is planned by using the cephalometric treatment planning[15,18] process (Fig 3, *right*). The dental and facial problems identified with the clinical and soft tissue cephalometric analysis examinations are corrected with the cephalometric treatment planning sequence. The soft tissue cephalometric analysis normal values are used during the surgical cephalometric treatment planning to

locate dental and skeletal structures in positions that support the soft tissue veneer in a balanced profile position.

Seven steps[15,18] are involved in the cephalometric treatment planning to optimize facial and occlusal results:

1. Correct the torque of the maxillary incisors
2. Correct the torque of the mandibular incisors
3. Position the maxillary incisor (LeFort I)
4. Autorotate the mandible to 3 mm of overbite
5. Move the mandible to 3 mm of overjet
6. Set the maxillary occlusal plane
7. Assess chin projection and height

Model analysis and cranial base cephalometrics are inadequate for surgical and orthodontic facial planning. A combination of clinical, facial, and soft tissue cephalometrics is effective at guiding treatment of the occlusion and the face in 3 planes of space for an improved esthetic outcome.

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