SECOND EDITION

RECONSTRUCTIVE PLASTIC SURGERY

VOLUME THREE

THE JAWS
THE LIPS AND CHEEKS
FACIAL BURNS
THE CERVICAL REGION
THE EARS
FACIAL PALSY
THE AGING FACE

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Principles and Procedures in Correction, Reconstruction and Transplantation

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RECONSTRUCTIVE PLASTIC SURGERY

CHAPTER 30

DEFORMITIES OF THE JAWS

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The mandible and the maxilla constitute a major portion of the facial skeleton. Because of this and the intimate interrelationship of the facial bones, small alterations can produce a wide range of facial deformities. These deformities can be classified into three main groups.

Congenital Malformations. Congenital malformations of the jaws may be unilateral or bilateral. They are often associated with such conditions as mandibulofacial dysostosis (Treacher Collins syndrome), craniofacial microsomia, craniofacial dysostosis, and other types of anomalous development of the first and second branchial arches (see Chapters 54, 55 and 56).

Developmental Malformations. Developmental malformations can be caused by several factors. These include:

1. *Congenital anomalies of adjacent structures.* Jaw malformations associated with congenital facial paralysis, hemangioma, or torticollis are examples of this type.

2. *Trauma.* Faulty development due to injury in early life results in varying degrees of deformity. These injuries can assume diverse forms: a fall on the chin producing an unnoticed condylar fracture and injury to a growth center (see Chapter 26), a facial burn with tight, deficient, and contracted soft tissues compressing and deforming the underlying skeleton.

3. *Abnormal neuromuscular patterns.* Asymmetrical maxillary and mandibular growth following facial nerve paralysis sustained during the period of early mandibular development is an example of this type of malformation. Another example is an open-bite produced by faulty tongue habits.

4. *Infection.* Osteomyelitis or adjacent soft tissue infection, particularly if it occurs early in life, may result in severe deformity.

5. *Endocrine imbalance.* The classic example of this type of deformity is mandibular prognathism associated with acromegaly.

6. *Nutritional deficiencies.* These are rare in developed countries. Vitamin D deficiency represents an appropriate example.

Acquired Deformities. Loss of bone as the result of partial or total resection of the mandi-

ble or maxilla in the treatment of malignant tumors produces severe deformities when the bone loss is extensive. The deformities and their repair are also discussed in Chapters 60, 61, and 62.

Traumatic deformities of the mandible are the result of: (1) loss of mandibular bone, which is not replaced at or soon after the time of injury; (2) malunion of fractures of the mandible; or (3) temporomandibular joint derangement, with or without ankylosis.

These deformities may affect any portion of the jaw—the dentoalveolar process, the denser bone of the body, the ramus, or the mandibular condyle. Similarly, deformities of the maxilla can involve the central nasomaxillary complex, the dentoalveolar process, or the entire maxilla.

Malocclusion of the teeth is a frequent accompaniment of the deformity. Correction of the malocclusion often provides a guide for planning the reconstructive procedure.

Developmental Malformations of the Jaws

General Considerations. Most of the problems discussed in this chapter relate to the harmony and balance of facial proportions. It must be emphasized at the outset that facial beauty is an emotion experienced by the viewer rather than an intrinsic physical property possessed by a particular human countenance. Thus, despite the work of countless investigators from the time of Leonardo da Vinci to the present, no valid norm for beauty has been established (see Chapter 1). The individual's concept of pleasing facial proportions and symmetry merely reflects his personal, ethnic, cultural, and esthetic background and experiences and constitutes a subjective and personal opinion rather than a universal criterion.

The problems of facial malformation require that decisions be made concerning the restoration of harmony and balance; the successful attainment of these objectives is the surgeon's goal. The patient and clinician must agree on the basic source of distress before correction is attempted. Exceptionally, overemphasis on minor facial blemishes occurs because of emotional difficulties; conversely, a patient with a quite obvious malformation may prefer to accept the deformity rather than undergo rehabilitative procedures. In most instances, however, an agreement must be reached on the nature of the facial malformation before it is possible to plan the corrective procedure. In the consideration of jaw malformations, the term "malformation" may be interpreted variously: to the anatomist and physiologist, it represents the effects of morphologic and functional deviation; the geneticist and anthropologist are concerned with hereditary and evolutionary components; the orthodontist is concerned with malocclusion of the teeth and facial harmony; to the plastic surgeon, the esthetic balance and the appearance of the integumental contour are the principal interests. These views are complementary, and some appreciation of each aspect is of great assistance in the diagnosis and treatment of these malformations.

Component Concept of Jaw Malformations. Establishing a diagnosis and a plan of treatment is simplified by analyzing a jaw deformity in terms of its components: (1) facial hard and soft tissues, (2) dentoalveolar complex, and (3) skeletal relations of the maxilla and mandible to each other and to the cranium (cephalometry). Each part should be analyzed separately. This will help clarify and define the problem.

HARD AND SOFT TISSUES OF THE FACE. Anatomic landmarks are displaced or absent in malformations of the jaws. From a reconstructive standpoint, it is convenient to use simple morphologic descriptions, supplemented, when indicated, by pertinent information regarding neuromuscular dysfunction.

Anthropometric points of the face are used in categorizing facial malformations (Figs. 30–1 and 30–2). Commonly used landmarks are *trichion,* the midpoint at the hairline of the forehead; *nasion,* the most anterior point of the midline of the frontonasal suture; *subnasale,* the point beneath the nose where the columella merges with the upper lip in the midsagittal plane; and *menton,* the lowest median point of the mandible. *Gnathion* is a bony chin point defined by the bisection of the angle formed by the mandibular and facial planes. *Tragion* is the notch immediately above the tragus of the ear; *orbitale* is the lowest point on the infraorbital margin; the Frankfort horizontal passes through these points.

The width of the face is divided in half by a vertical mid-sagittal line passing through trichion, nasion, subnasale, and gnathion (Fig. 30–2). The height of the face is divided in approximately equal thirds by horizontal lines drawn through nasion and subnasale. The

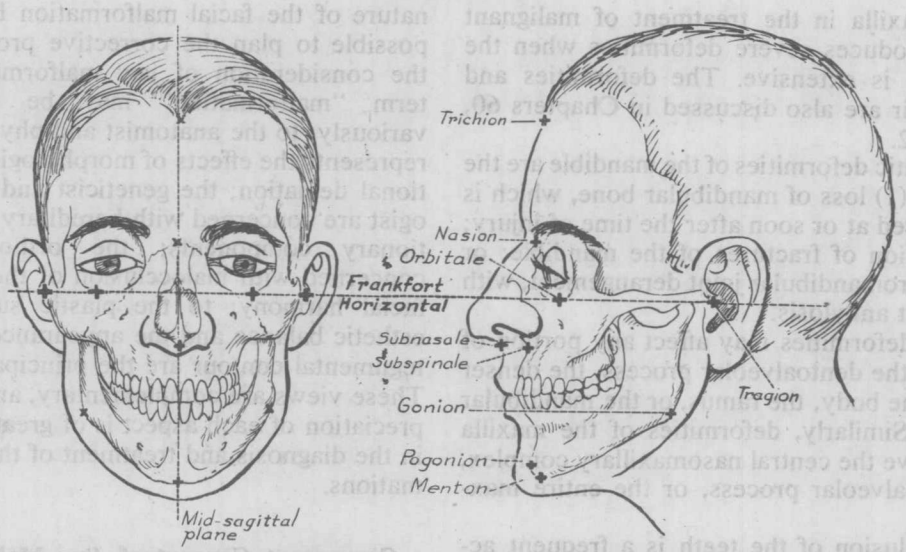

FIGURE 30–1. Anthropometric landmarks. These points of reference are essential in orienting the face.

lower third of the face, subnasale to gnathion, can be further subdivided into three equal parts. The lips should meet near the junction of the upper and middle thirds. These subdivisions can be used as a general guide in classifying and assessing the degree of existing facial deformity.

An acceptable facial profile is one in which the chin is situated between two vertical lines which cross the Frankfort horizontal at right angles: the anterior line tangential to the supraorbital ridge, and the posterior line drawn downward through orbitale (see Fig. 30–2, *A*). Gonzalez-Ulloa and Stevens (1968) placed the

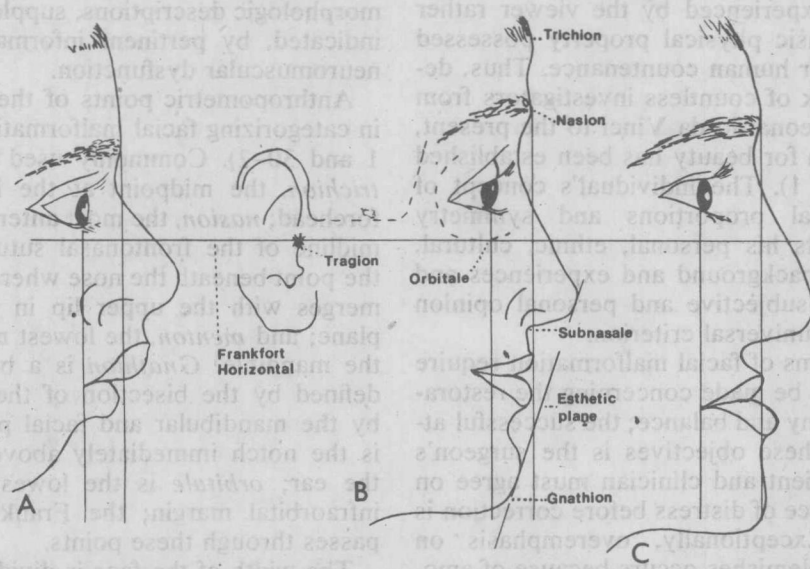

FIGURE 30–2. Determining the correct anteroposterior chin position. The anterior plane is tangential to the forehead and descends at a 90-degree angle with the Frankfort horizontal. The posterior plane also descends at right angles to the Frankfort horizontal from orbitale. *A*, In mandibular micrognathia, the chin and lower lip are posterior to the anterior plane. *B*, In the average profile, the chin is situated between the anterior and posterior planes. The lips are contained within the "esthetic plane," which is drawn tangentially from the tip of the nose to the chin. The upper lip is slightly more posterior to the plane than is the lower lip. *C*, In mandibular prognathism, the chin and lower lip protrude beyond the anterior plane.

anterior silhouette of the chin on a vertical line beginning at nasion and drawn at right angles to the Frankfort horizontal.

Lip posture and position are prominent features of the lower facial profile. In an acceptable profile, the lips are situated near the anterior line that is tangential to the supraorbital ridge. The upper lip is anterior to the lower. Ricketts (1957) correlated the lip, nose, and chin profile to a line drawn tangential to the nose and the chin, which he called the esthetic plane (see Fig. 30–2). The lips are contained within this line, with the upper lip slightly posterior to the lower lip when it is related to the line.

Lip posture is closely related to the position and forward inclination of the maxillary incisor teeth (Jackson, 1962). Changes in vertical intermaxillary distance will also influence lip posture. The anteroposterior skeletal jaw relationship can alter the lip profile; a change in lip posture following correction of a prognathic mandible is a good example.

Competent lip posture implies adequate lip seal: the lips are able to contact one another naturally without strain of the orofacial musculature when the mandible is in a position of physiologic rest. *Incompetent lip posture* occurs when the lips are unable to form a seal under similar unstrained conditions; this is a characteristic of certain malocclusions as well as of more serious facial deformities (Fig. 30–3).

Incompetent lip posture is functionally re-

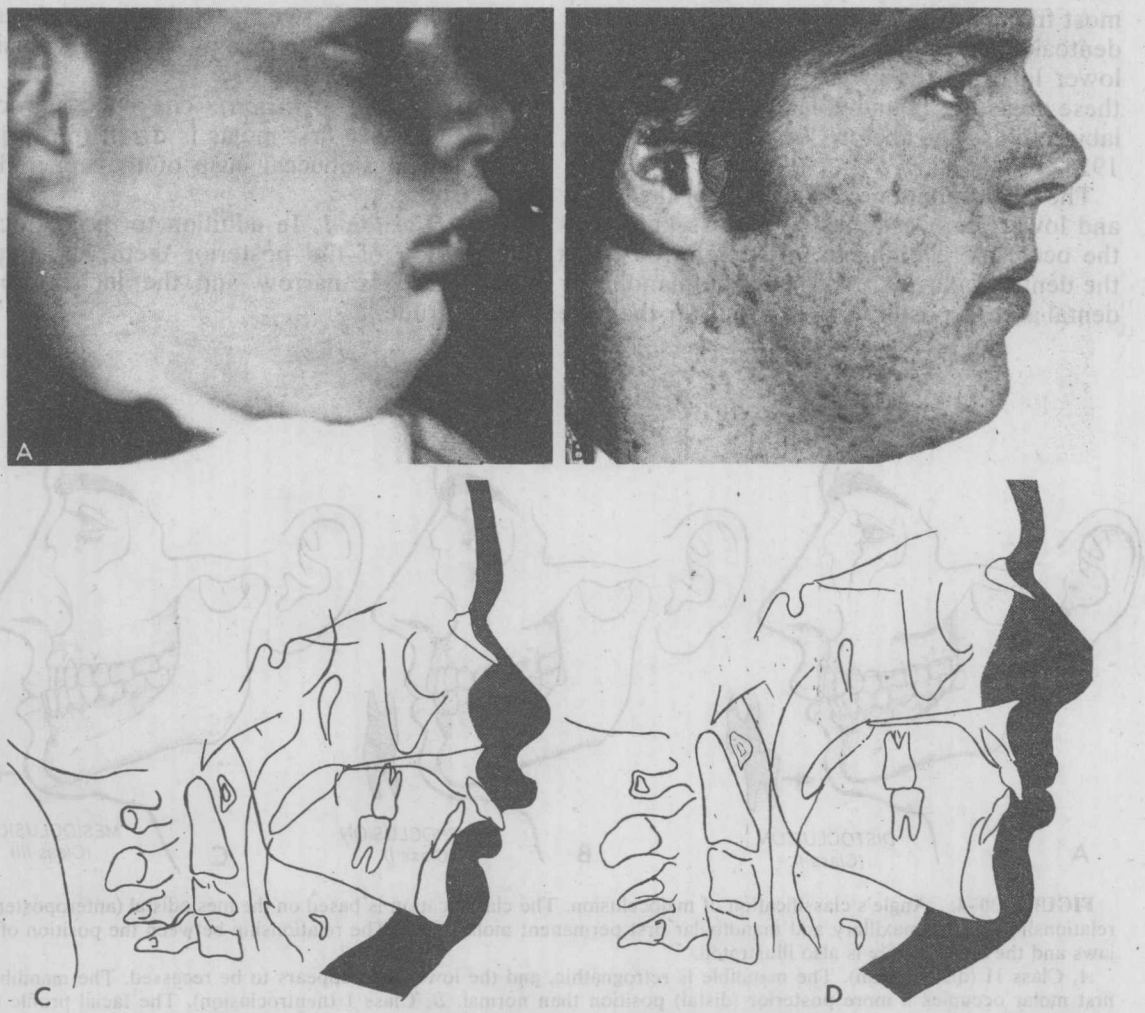

FIGURE 30–3. Malocclusion as a cause of incompetent lip posture. *A*, Photograph of child showing incompetent lip posture and malocclusion. *B*, Improved lip posture after orthodontic treatment. *C*, Tracing of cephalogram showing malocclusion (Class II, Division 1) prior to orthodontic treatment. Note the incompetent lip posture caused by maxillary dentoalveolar protrusion. *D*, Tracing showing improved lip posture following orthodontic therapy.

lated to the soft tissue contour of the chin. In an attempt to achieve lip seal, particularly in deglutition, the patient with incompetent lips contracts the mentalis muscle. Habitual contraction of the mentalis muscle eliminates the concavity of the labiomental fold and imparts a chinless appearance. The bony chin is often also affected.

The bony chin becomes more prominent throughout childhood and adolescence (Meredith, 1957), but a disturbance in the orofacial muscular balance may interfere with this pattern.

This basic discussion of lip incompetence illustrates the complex interplay between soft tissue form, skeletal support, and neuromuscular patterns.

THE DENTOALVEOLAR COMPLEX. Poor dentoalveolar relationship is a major cause of facial imbalance. The parts of the lower face most frequently affected by the position of the dentoalveolar structures are the upper and lower lips and the lower portion of the nose; these areas are bounded laterally by the nasolabial folds and below by the chin (Case, 1921).

The interdigitation of the cusps of the upper and lower teeth establishes what is known as the occlusal relationship, often referred to as the dental occlusion. Normally the mandibular dental arch is posterior to and smaller than the maxillary arch. The buccal or lateral cusps of the upper teeth project laterally from the buccal cusps of the lower teeth. The upper incisor teeth and canines (cuspids) overlap the corresponding lower teeth anteriorly. The mid-sagittal line passes between the central incisors. The mesiobuccal cusp of the maxillary first molar is aligned axially with the mesiobuccal groove of the mandibular first molar. When these relationships are disturbed, a malocclusion is produced.

Classification of malocclusion. Angle's (1899) classification of malocclusion is widely accepted in the United States. It is based on the mesiodistal (anteroposterior) relationship of the maxillary and mandibular first permanent molars (Fig. 30–4).

Class I (neutroclusion). The first molars are in adequate relationship. Irregularities of the anterior teeth may be present because discrepancy between tooth size and arch length causes a crowding and malocclusion of the anterior teeth.

Class II (distoclusion). The buccal groove of the lower first molar is distal (posterior) to the mesiobuccal cusp of the upper first molar.

Division 1. In addition to the distoclusion of the posterior teeth, the upper arch is narrow and the incisors protrude.

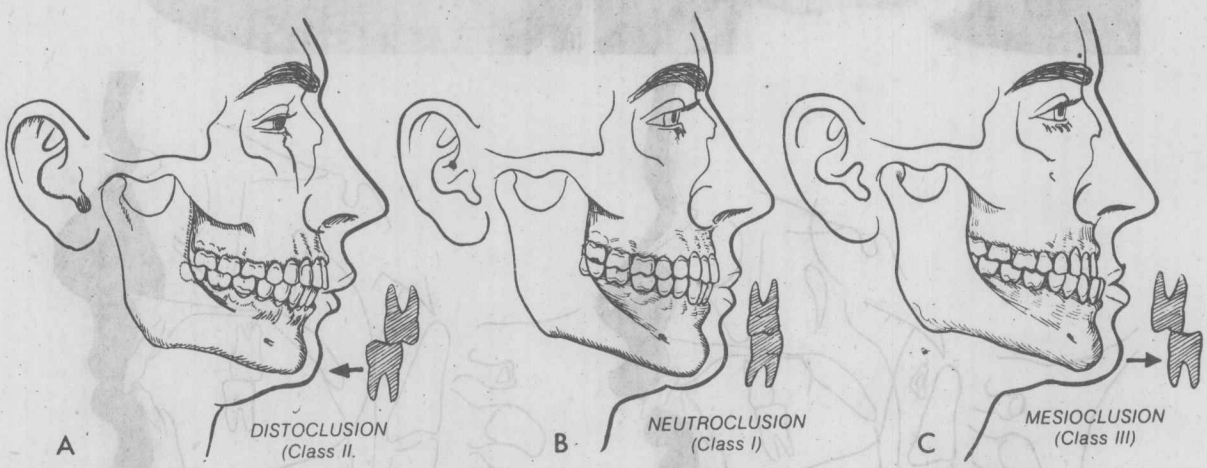

FIGURE 30–4. Angle's classification of malocclusion. The classification is based on the mesiodistal (anteroposterior) relationships of the maxillary and mandibular first permanent molar teeth. The relationship between the position of the jaws and the facial profile is also illustrated.

A, Class II (distoclusion). The mandible is retrognathic, and the lower face appears to be recessed. The mandibular first molar occupies a more posterior (distal) position than normal. *B*, Class I (neutroclusion). The facial profile falls within the normal range. The maxillary and mandibular first molar teeth are in an ideal anteroposterior relation. The mesiobuccal cusp of the maxillary first molar is aligned correctly with the mesiobuccal groove of the mandibular first molar tooth. *C*, Class III (mesioclusion). Dental occlusion found in mandibular prognathism. The mesiobuccal groove of the mandibular first molar is mesial (anterior) to the mesiobuccal cusp of the maxillary first molar.

Division 2. The posterior teeth are in distoclusion. The upper incisors are inclined in a lingual direction and are crowded.

Class III (mesioclusion). The buccal groove of the lower first molar is mesial (anterior) to the mesiobuccal cusp of the upper first molar. The mandibular teeth are in an anterior relationship to the corresponding maxillary teeth.

The original Angle classification describes dental malocclusion between the mandibular and maxillary teeth. These anteroposterior *dentoalveolar* malocclusions are often reflected in the facial profile (Fig. 30–4). A patient with a Class I malocclusion generally has a normal facial profile; the patient with a Class II, division 1 malocclusion may have the typical "bird-face" profile; and the patient with a Class III malocclusion appears to have a protruding lower jaw. However, these correlations do not always exist, and not all types of malocclusion affect the facial profile. For this reason, the Angle classification is inadequate to appraise dentofacial balance; it is also misapplied to describe malocclusion caused by *skeletal* jaw deformities.

SKELETAL RELATIONS OF MAXILLA AND MANDIBLE (CEPHALOMETRY). The dentoalveolar structures are supported by the skeletal portion of the jaws. Changes in skeletal relationships have direct bearing on the dentoalveolar complex. Skeletal relationships are best studied with the aid of the cephalometric roentgenogram.

By means of cephalometric roentgenography, a simultaneous record of the dental, skeletal, and soft tissue components of the face is obtained, as well as a proper evaluation of the relationship of these elements. With this technique, the patient, the film, and the X-ray tube are positioned accurately in a fixed relationship within the cephalometric apparatus. Numerous efforts have been made to correlate certain dental and skeletal relationships seen on the cephalometric roentgenogram with the characteristics of a well-balanced face (Tweed, 1946; Downs, 1948; Steiner, 1953). Considerable variability is apparent even among individuals specifically selected for study because of satisfactory facial balance (Riedel, 1957; Burstone, 1958; Peck and Peck, 1970).

The use of cephalometric roentgenography was first proposed as an aid in the diagnosis and planning of surgical-orthodontic treatment of facial malformation in 1954 by Converse and Shapiro. At present it is widely used for this purpose; in addition, it provides a valuable record for studying postoperative changes.

Anthropologists and orthodontists have established cephalometric landmarks which can be used to follow facial growth patterns and to study skeletal jaw relationships. The common landmarks (Figs. 30–5 and 30–6) include:

S (sella): the center of sella turcica.
N (nasion): the frontonasal suture.
ANS: anterior nasal spine.
Point A (subspinale): the most posterior point between the anterior nasal spine and the crest of the maxillary alveolar process.
Point B (supramentale): the most posterior point between pogonion and the crest of the mandibular alveolar process.
Po (pogonion): the most anterior point of the symphysis of the mandible.
Gn (gnathion): the point on the chin determined by bisecting the angle formed by the facial and mandibular planes.
G (gonion): the most posterior and inferior point at the angle of the mandible.
P (porion): the superior edge of the bony auditory meatus.
O (orbitale): the most inferior point on the infraorbital rim.
FH (Frankfort horizontal): a line drawn from porion to orbitale.
MP (mandibular plane): a line at the lower border of the mandible tangential to the most inferior point of the gonial angle and the profile image of the symphysis.
UI (upper incisor): a line drawn through the long axis of the upper cental incisor.
LI (lower incisor): a line drawn through the long axis of the lower central incisor.

The angles formed by the intersection of the lines drawn through various points are used to analyze the skeletal and dentoalveolar deformities.

The angles used to measure skeletal deformities relate the mandible and the maxilla to each other and to the cranial base (SN). These angles are illustrated in Figure 30–6. The angles used to measure dentoalveolar deformities relate the maxillary and mandibular teeth to each other and to their respective jaws. These angles are illustrated in Figure 30–6.

A summary of the cephalometric angles, what they represent, and their interpretation is shown in Table 30–1. Angular values used in the table apply to Caucasian patients. The range of angles will differ in the Oriental face and the Negro face (Cotton, Takano and Wong, 1951).

The component by component analysis of jaw malformations helps to minimize errors and provides maximum insight and understanding of the problem. Analysis of each com-

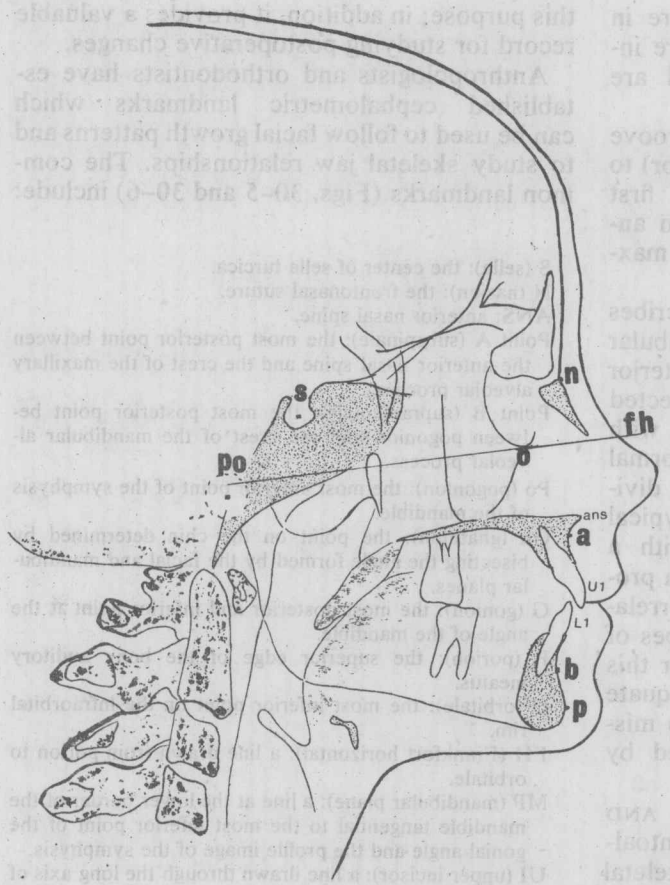

FIGURE 30–5. Cephalometric landmarks. Basic points used in cephalometric analysis.

ponent cannot stand alone. The skill with which the clinician interprets and integrates the individual parts will go a long way in determining the success of the treatment.

It must be emphasized that measurements are useful in evaluating the deformity; the final planning of the corrective surgery requires careful study of hard and soft tissue cephalometric tracings. The projected changes in facial contour are made first by modifying the tracings.

Classification of Jaw Malformations. Jaw malformations can be classified in various ways. The Angle classification is commonly used to describe both the dentoalveolar and skeletal malocclusions (Salzmann, 1966). Sassouni (1969) devised a classification to differentiate between skeletal and dentoalveolar malocclusions and to determine the various effects they have on facial soft tissue contours. The nomenclature and classification employed in this chapter are shown in Table 30–2.

When mandibular development is impaired, as in cases of injury to the condylar area in childhood, hypoplasia of the mandible results in a typical birdlike appearance of the face, and the condition is referred to as *mandibular micrognathia* (small jaw). *Mandibular retrognathism* (backward jaw) describes a condition in which the jaw, normal in size, is retruded. *Microgenia* designates a small chin; the chin may be abnormal in an otherwise well-developed jaw. Displacement of the chin to one side, due either to unilateral underdevelopment or infrequently to overdevelopment of the jaw owing to condylar hyperplasia, results in a deviation from the mid-sagittal plane and a posterior crossbite; such a condition is designated by the term *laterognathism* (deviated jaw).

Prognathism (forward jaw), which may af-

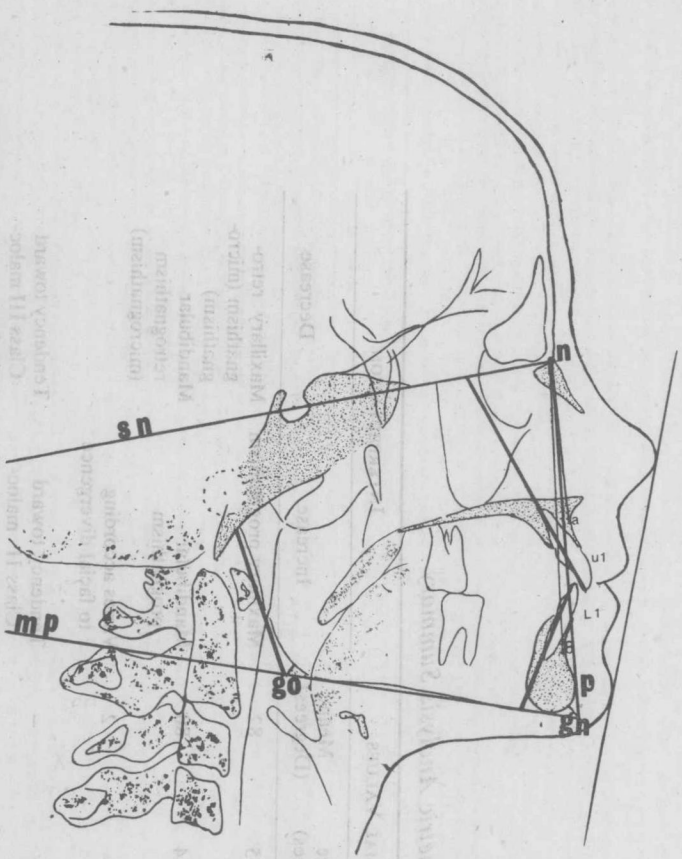

FIGURE 30–6. Cephalometric lines and angles. Basic cephalometric lines and angles used to analyze dentoalveolar and skeletal relationships of the jaws to the anterior cranial base (SN). The esthetic plane is drawn from the tip of the nose to the chin, as reviewed on profile.

U1-SN (upper central incisor–sella-nasion): represents the inclination of the maxillary central incisors; indicates the degree of protrusion or retrusion of the maxillary dentoalveolar arch.

L1-MP (lower central incisor–mandibular plane): measures the inclination of the mandibular central incisors; indicates the degree of mandibular dentoalveolar arch protrusion or retrusion.

U1-L1 (upper central incisor–lower central incisor): relates axial inclination of the central incisor teeth of both jaws; shows tendencies of bimaxillary protrusion.

SNA (sella–nasion–point A): shows the anteroposterior relation of the maxilla to the cranial base; used to determine the degree of maxillary prognathism or retrognathism.

SNB (sella–nasion–point B): represents the anteroposterior relation of the mandible to the cranial base; used to determine the degree of mandibular prognathism or retrognathism.

ANB (point A–nasion–point B): relates the mandible to the maxilla in an anteroposterior direction; used to determine discrepancy between the two jaws.

MP-SN (mandibular plane–sella nasion): denotes the total facial height; indicates tendency toward open and closed bite.

fect the mandible or the maxilla, is characterized by an anterior displacement of the jaw, the teeth of the affected jaw being anterior to the teeth of the opposing jaw. This can be due to either an enlargement of the jaw or an alteration in its relationships. The term "progenie" (forward chin) is used in the German literature for mandibular prognathism.

When the maxilla is underdeveloped, the term *maxillary hypoplasia* is employed; *maxillary micrognathia* describes a small jaw retarded in its growth. The term *maxillary retrognathism* suggests that the maxilla is normal in size and retroposed. An example would be the posterior position of the maxilla in malunited fractures. This condition may give an illusion of mandibular prognathism; however, the deformity is often a *pseudomandibular prognathism,* the mandible being within the norm in size and position and the maxilla being retruded.

When both the maxillary and mandibular anterior teeth protrude, the condition is called *bimaxillary protrusion.* This is normally seen in the Oriental and the Negro. *Apertognathism* (open bite) is present when the vertical intermaxillary distance is increased to a point where the teeth fail to occlude. When this occurs between the incisor teeth, it is termed an anterior open bite. When the premolars and molars fail to contact, the term posterior open bite is used. Normally the mandibular teeth are lingual to their corresponding teeth in the maxillary arch. When the reverse is present, a *crossbite* is produced (Fig. 30–7). Crossbites occur in the anterior as well as the posterior arches. Overbite refers to the vertical overlap of the teeth when the jaws are in normal full closure; the horizontal overlap is termed *overjet* (Fig. 30–8).

Diagnosis

FACIAL DIAGNOSIS. In addition to the clinical examination, full-face and profile photographs are taken, the face positioned in accord with the Frankfort horizontal and the

TABLE 30–1. *Cephalometric Analysis Summary*

Component	Measurement	Relationship	Normal Values		Interpretation	
			Range (Degrees)	Mean (Degrees)	Increase	Decrease
Skeletal	SNA	Maxilla to cranial base	79–85	82	Maxillary prognathism	Maxillary retrognathism (micrognathism)
	SNB	Mandible to cranial base	76–84	80	Mandibular prognathism	Mandibular retrognathism (micrognathism)
	ANB	Maxilla to mandible	0–4	2	Varies according to facial divergence	
	SN-MP	Vertical facial height	–	–	Tendency toward Class II malocclusion	Tendency toward Class III malocclusion
Dentoalveolar	Ul-SN	Upper central incisor to cranial base	100–110	104	Maxillary protrusion	Maxillary retrusion
	Ll-MP	Lower central incisor to mandibular plane	87–99	93	Mandibular protrusion	Mandibular retrusion
	Ul-Ll	Upper central to lower central incisor	120–140	130	Bimaxillary retrusion	Bimaxillary protrusion