Skeletal Factors Affecting Occlusal Development

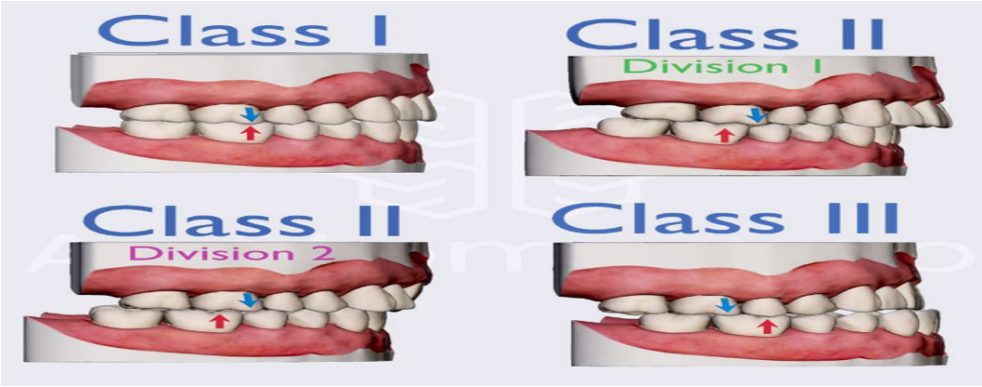
The final form of the occlusion and the position of the teeth exhibit a wide range of variation. The main factors responsible for producing this variable can be divided into two groups: 1. General factors which play a general effect on the occlusion and play a part in the development of every occlusion and secondly, 2. localised factors which may be the main factor in producing malocclusion in an individual.

The general factors could be skeletal, soft tissue and variation between teeth size and arch size. The general factors will always present producing ideal occlusion or some occlusal variations. These are usually interrelated; the muscles are attached to the jaws and variation in jaw position may produce variation in muscle action which in turn may alter the relevant variation in the size of the dental arch. The presence of local factors in combination of general factor adds further complication to the occlusion.

Skeletal factors

The relationship between the jaws has an important effect on dental arch relationship.

Skeletal malocclusion occurs due to the distortion of the maxillary and/or mandibular development or growth (which will affect the size, shape and the relative position of the jaws) and will have a huge impact on the positioning, alignment and health of the primary and permanent teeth.



Jaws relationship

It can be considered under three headings: (each of these should be considered in three axes: anteroposterior (Sagittal), vertical and transverse).

1- Jaws in relation to the cranial base

The jaws are part of the structure of the head and it is possible for each jaw to vary in its positional relationship to other structures. Each jaw can vary independently in its relationship to the cranial fossa. For orthodontic diagnosis, jaws are related to the anterior cranial base. Why?

2- Jaws in relation to each other

The ***anteroposterior*** jaw relationship is called the skeletal relationship or pattern.

Skeletal patterns

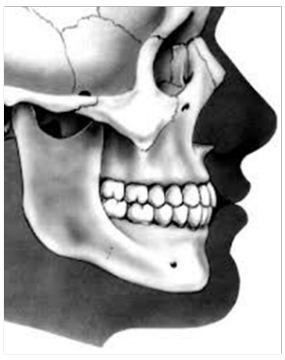
Skeletal Cl I when the mandible in occlusion is normally related to maxilla which is 2-3mm ahead.

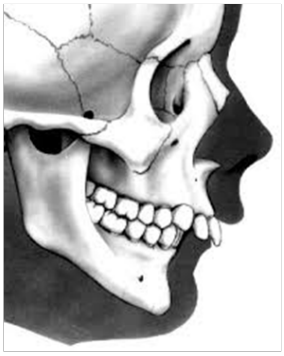
Skeletal Cl II when the mandible in occlusion is posteriorly positioned to maxilla.

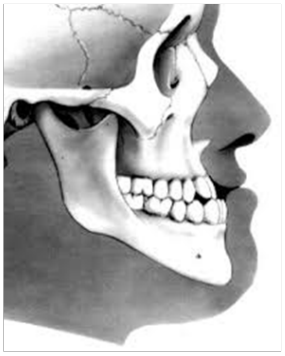
Skeletal Cl III when the mandible in occlusion is too far forward.

The variation of skeletal relationship can be:

1. Variation in the size of the jaws.
2. Variation in the position of the jaws in relation to the cranial base.







The dentoalveolar structure has an arch form which is wider posteriorly (intermolar distance) than anteriorly (intercanine distance). In transverse (lateral) relationship, the jaws match in size so that the occlusion of the buccal teeth in transverse

direction is normal. However, variations in size and position of the jaws may result in buccal crossbite or scissorbite.

In Vertical relationship, the space between the upper and lower skeletal bases is the intermaxillary space. The height of the space depends on the shape of the mandible and the resting length of the muscles of mastication. As the facial profile is divided into three thirds, the intermaxillary space represents the lower third of the facial height.

The lower facial height, from the lower boarder of the chin (soft tissue menton) to the base of the nose (soft tissue subnasale), and the middle facial height, from the base of the nose to the line drown between the eyebrows (glabella) should be approximately equal.

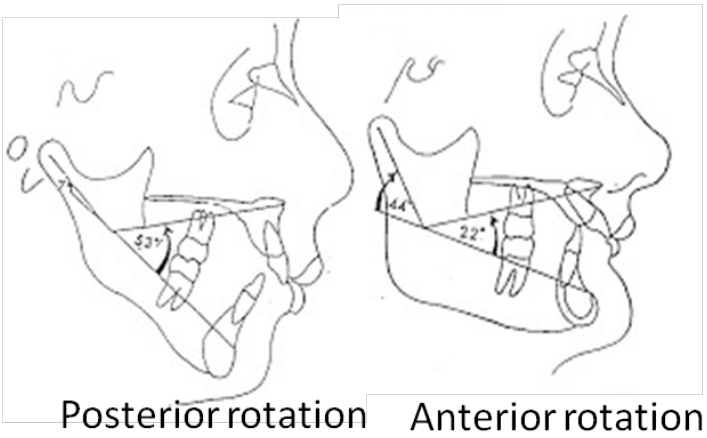
Rotations of the mandible

According to the growth of the mandible, there are two types of rotations: anterior and posterior rotation of the mandible

Muscle factors have great influence on mandibular growth direction In posterior growth of the mandible:

- The mandibular angle will be more obtuse.

- The shape of the lower border of the mandible is a good predictor. There is bone apposition below the symphysis and resorption anterior to the gonial angle (mandibular angle) produces a concavity throughout the lower border. In addition, notching occurs anterior to the gonial angle. This results in an "S" shaped curve on the lower border.
- There will be an increase in the lower anterior facial height.
- Dentoalveolar retroclination of the lower anterior teeth. Openbite may occur.



3- Alveolar bone in relation to the basal bone

Teeth are supported by the alveolar bone which in turn is based on the basal bones of the jaws (maxilla or mandible). Although the division of jaw bones into basal and alveolar components is artificial, it is useful to accept that as they differed in the development and function.

Arch malrelationship may occur in three planes of spaces also.

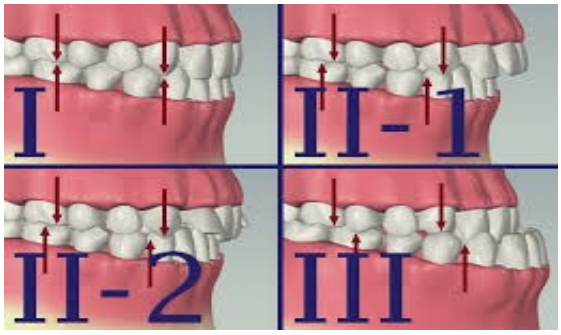
The anteroposterior arch malrelationships are the basis of Angle's classification. From the sagittal view, although the buccal segments reflect jaws malrelationships, it is possible to find cases with normal skeletal malrelationship and arch malrelationships and vice versa, i.e. Cl 2 or Cl 3 Angle's classification on Cl I skeletal pattern or Cl 1 angle's classification on Cl II or Cl III skeletal Pattern.

Angle's classification

- Edward Angle in 1899

  The classifications based on the relationship of the mesiobucal cusp of the maxillary permanent first molar and the midbuccal groove of the mandibular permanent first molar.

The labial relationship often but not always follows the buccal segment relationship.



Incisor classification

Class 1

The lower incisal edgeS occlude with or lie immediately below the cingulum plateau of the upper incisors.

Class 2

The lower incisal edges occlude behind the cingulum plateau of Class II division I:

Cl 2 div i

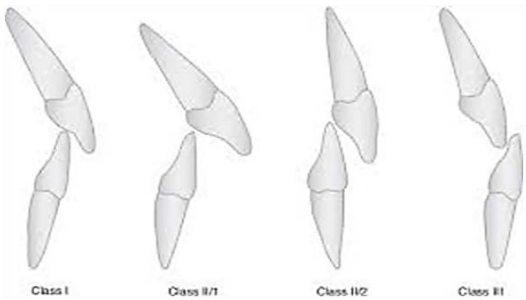
The upper central incisors and the upper incisors are proclined or average proclination and there is an increase in overjet

Class 2 division ii

The upper central incisors are retroclined (the lateral incisors may be proclined) the overjet is usually average or may be increased.

Class III

The lower incisal edges occlude anterior to the cingulum plateau of the upper incisors the overjet may be either reduced or reversed.



Dentoalveolar compensation

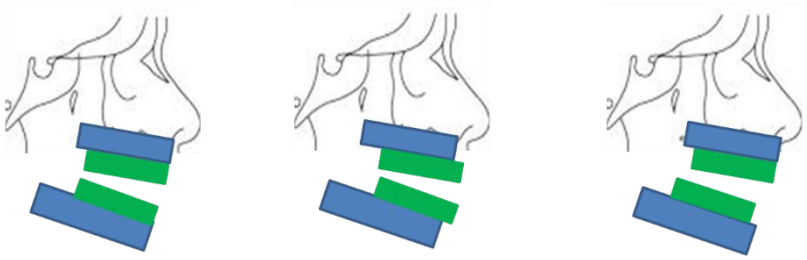
It refers to an existing state of affairs.

The upper and lower teeth could be guided to establish an occlusion when transverse and anteroposterior malrelationships of the jaws occur.

The vertical jaw malrelationship could be compensated by eruption of teeth or growth of the alveolar bone.

When the skeletal malrelationships are severe, the dentoalveolar compensations are not sufficient to establish normal occlusion and result in crossbite, openbite and anteroposterior arch malrelationships.

Soft tissue is attached to the skeleton (basal bones) and may have an impact on preventing compensation such as short upper lip.

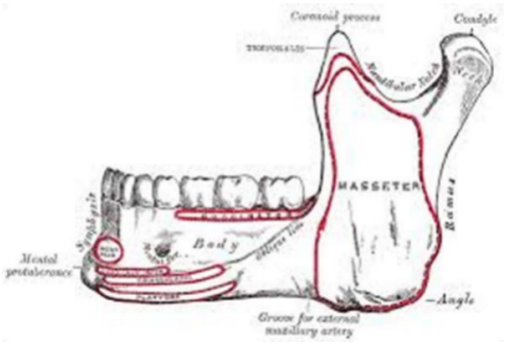


SOFT TISSUE FACTORS AFFECTING OCCLUSAL

DEVELOPMENT

The teeth erupt into an environment of functional activity governed by the muscles of mastication, of the tongue and of the face.

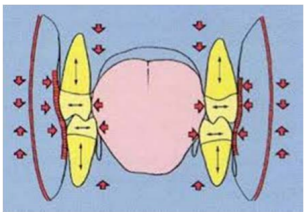
The muscles of the tongue, lips and cheeks exert their action by the virtue of its origin and insertion. These have their origin on the basal part of the jaws and hence, the position and the action of the muscles have an influence on the teeth. The muscles interrelated to bony structure in guiding the erupting teeth.



The neutral zone

The fact that the lips and cheeks function outside and the tongue within the dental arches has led to the concept of a "neutral zone" existing between the inner and outer perimeters of the dental arches, where the forces of lips and cheeks on the one hand and of the tongue on the other are balanced, and within which the teeth are positioned.

Although the teeth erupt into an environment of active muscular forces, and are guided into their occlusal positions by muscle movement, it seems reasonable to believe that. Once they have reached their occlusal positions, all the forces acting upon them are equalized to maintain the relatively stable situation which we known as the occlusion.



The lips

Several muscles making up the lips can be considered as a single functional unit. They play their part in occlusal development by virtue of their size, form and function. The form and function of the lips can be considered in two planes; vertical and sagittal.

Vertical form of the lips

Ideally, the upper and lower lip muscles, meet together in their position of resting posture (lip competence). In this resting condition there is a minimum muscle contraction to maintain the position of the lips. This has been called the position of electrical silence where minimum electrical action potential is detected by elecromyography.

Lip incompetence occurs when lips don't meet in rest position and a space between the lips is pronounced. Why?

High mandibular gonial angle places the origin of the lower lip too far in relation to upper lip. (lip length, shape)

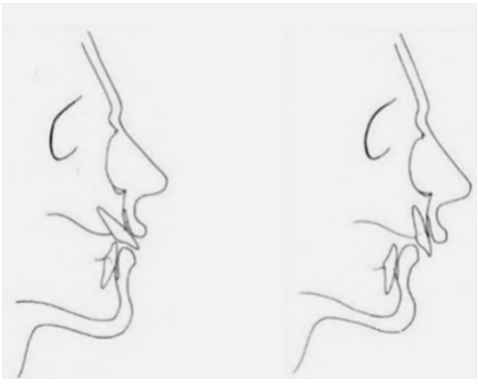
The importance of discrepancies in the size and the form of the lips lies in the fact that the lips are brought together during swallowing and speech movement. Sometimes when the lips are apart muscular contraction will require to bring them together during swallowing and speech (potentially competent). Some people maintain a conscious lip closure for much of the time. Hence, exert extraforces on the erupting teeth where the extent of this effect depends on the sagittal relationship of the lips.

Sagittal relationship

Depend on the relationship of the basal bone of the jaws.

In Cl II or Cl III, the difficulty of putting the lips together may cause the lower lip to modify the eruptive path of upper incisors. This may either reduce or increase the primary effect of the underlying skeletal discrepancy. Cl II skeletal pattern (mild)----severe dental effect (compensation).

Cl II sever-----no marked effect of the lips (the lower lip is too far to exert force).



It is equally possible for lip activity to produce Class 2 or 3 occlusal relationships on Class I skeletal relationship by altering the inclination of the incisor teeth during eruption or produce Class 1 occlusion on Class II or III skeletal relationship if the skeletal discrepancy is not severe.

The lower lip plays more part than the upper in functional movements and governing the position of the lower incisors. It may cause reteroclination of the lower incisors in normal function during swallowing speech and smiling activity. Therefore, the position of them is dependent on lip activity. (stability after orthodontic treatment?)

Lip line

The level at which lips meet together in normal function. The position of the lip line in relation to incisors plays important part in governing the position of those teeth.

The ideal level of lip line is approximately at the centre of the crowns of upper incisors. In low lip line, part of the lower lip may function behind the upper incisors causing proclination.

The tongue

Its extrinsic muscles attached to the inner aspect of the mandible, the hyoid bone, the palate and the styloid process (the arch of the lower jaw). It affects the developing teeth by the virtue of its size, resting posture and its function. The resting position of the tongue is ideally completely within the dental arches filling the space enclosed by the teeth.

The size of the tongue in relation to the size of the lower jaw is rarely at fault, but occasionally, if the lower jaw is larger than the upper jaw the size of the tongue is too large to fit within the upper dental arch.

The muscular function of the tongue is concerned with mastication, swallowing and speech.

Its effect on developing teeth is mainly with regard to swallowing.

In normal swallowing:

1. Closure of the lips.
2. Teeth in light occlusal contact.
3. Tongue elevated to the palate.
4. Momentary clenching of the teeth as food passes into the pharynx.

Variation of normal swallowing

Adaptive swallowing involves the positioning of the tongue between the teeth during swallowing, and may be carried out with the buccal teeth apart or together.

The forward tongue position is an adaptation to form an anterior oral seal during swallowing, as with an adaptive postural position of the mandible.

In adaptive posture position the tongue is slightly protruding between the teeth to touch the lower lip (tonge-lower lip anterior oral seal) due to vertical or sagittal lip discrepancy. This prevents the full vertical development of the dentoalveolar structures resulting in incomplete overbite to open bite.

1. Adaptive swallowing

i. Tooth apart adaptive swallowing

In swallowing with the buccal teeth apart, the tongue is positioned between the teeth and therefore, does not fill the upper arch. Pressures, both muscle and air pressures, within the upper arch are therefore reduced, and this may lead to narrowing of the arch and the production of buccal cross bite, usually unilateral cross bite. Full vertical development of the anterior dento-alveolar segments may be prevented by the tongue, leading to incomplete overbite.

ii. Tooth together adaptive swallowing

The adaptive swallowing with the buccal teeth together involves the forward positioning of the tongue between the incisor teeth during swallowing. This usually results in production of an incomplete overbite or anterior open bite.

Endogenous tongue thrust

In a small proportion of subjects the swallowing activity is accompanied by an anterior thrust of the tongue which appears to be a basic neuromuscular mechanism. This so-called 'endogenous' tongue thrust is sometimes associated with an anterior lisp during speech.

It usually affects the developing teeth to the extent of preventing the full vertical development of the anterior dento-alveolar segments, so that an incomplete overbite or, more usually, an anterior open bite, develops.

The upper and lower incisors may be proclined by the action of the tongue, though sometimes the lower incisors are retroclined by the contraction of the lower lip during swallowing.

The 'adaptive' tongue activity will change if the teeth are moved so that the adaptation becomes unnecessary, but the 'endogenous' tongue thrust will not change, and will reproduce original tooth positions if these are altered (an open bite caused by the tongue thrust would be likely to recur).

Unfortunately, it is not always possible to make a clear distinction, particularly from a single clinical assessment. A tongue thrust associated with a noticeable lisp and a wide anterior open bite may reasonably be assumed to be of the 'endogenous' type, particularly if a parent has the same condition. There are, in fact, no established criteria for distinguishing between the variations in tongue activity.