Malocclusion

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Learning outcomes

1. Understand the features of normal and ideal occlusion
2. Describe the classification of malocclusion
3. Describe the aetiology of malocclusion
4. Explain developmental or acquired occlusal abnormalities

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Normal and Ideal occlusion

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What is an Ideal Occlusion?

- A term given to a dentition where the teeth are in the optimum anatomical position, both within the mandibular and maxillary arches (intramaxillary) and between the arches when the teeth are in occlusion (intermaxillary)
- The ideal relationship of teeth can be defined in terms of *static* and *functional* occlusion.
- While previously orthodontists may have concentrated on achieving a static, anatomically correct occlusion, it is now accepted that a functional occlusion is more important.
- A functional occlusion is an occlusion which is free of interferences to smooth gliding movements of the mandible with no pathology

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Who described the features of an ideal occlusion?

- **Edward Angle** was an American dentist born in 1855.
- He felt the key to normal occlusion was the relative anteroposterior position of the first molars, which he used to define the dental arch relationship.
- Almost 100 years after Angle, **Lawrence Andrews** redefined the concept of an ideal static occlusion by describing it in terms of ***six individual keys***, including an updated ideal relationship for the first molars (1972).

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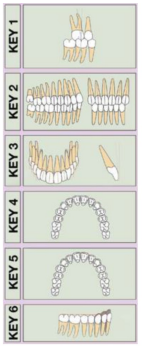
Andrews' six keys of occlusion



- Class 1 molar relationship
- Correct crown angulation
- Correct crown inclination
- No rotations
- No spacing
- Flat occlusal plane

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Classification of malocclusion

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What is Malocclusion?

- Malocclusion is defined as an *appreciable deviation from the ideal that may be considered aesthetically or functionally unsatisfactory*.
- Malocclusion has been described in many ways ranging from specific classifications to indices of treatment need and outcome.
- A wide range of occlusal traits can constitute a malocclusion
- The ability to classify malocclusion not only helps in describing a patients occlusion but also aides in; recording of prevalence of malocclusion in a population, treatment planning, assessment of treatment need, treatment difficulty and success of orthodontic treatment.

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Prevalence of Malocclusion

The prevalence of malocclusion and particular occlusal anomalies depends on the population studied (e.g. age and racial characteristics), the criteria used for assessment, and the methods used by the examiners (e.g. whether radiographs were employed).

In the UK, it is estimated 9% of 12-year-olds and 18% of 15-year-olds are undergoing orthodontic treatment, with a further 37% of 12-year-olds and 20% of 15-year-olds requiring treatment (Child Dental Health Survey 2013).

This suggests the overall prevalence of moderate– severe malocclusion is around 40–50% in adolescents

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Commonly used classifications and indices

- Angles Classification (molar classification)
- British Standards Institute classification (incisor classification)
- Canine classification
- Index of Orthodontic Treatment Need (IOTN)
- Peer Assessment Rating (PAR)
- Index of Complexity, Outcome and Need (ICON)
- Index of Orthognathic Functional Treatment Need (IOFTN)

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Angles Classification

- Angle classified occlusion according to the molar relationship
- His classification was based upon the premise that the first permanent molars erupted into a fixed position within the facial skeleton.
- We know that this is not necessarily the case for example; drifting of the molar in early loss of primary teeth or crowding in the permanent dentition distorting the molar relationship.
- Angle's classification is still used today but to describe molar relationship

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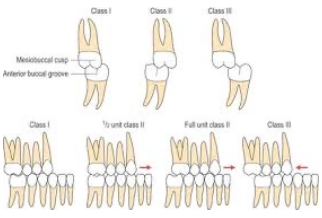
Angles classification..

Angle described three groups;

- *Class I or neutrocclusion*—the mesiobuccal cusp of the upper first molar occludes with the mesiobuccal groove of the lower first molar. In practice, discrepancies of up to half a cusp width either way were also included in this category.
- *Class II or distocclusion*—the mesiobuccal cusp of the lower first molar occludes distal to the Class I position. This is also known as a postnormal relationship.
- *Class III or mesiocclusion*—the mesiobuccal cusp of the lower first molar occludes mesial to the Class I position. This is also known as a prenormal relationship



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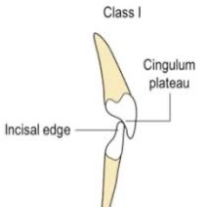
British Standards Institute classification

- This classifies the malocclusion based upon the relationship of the maxillary and the mandibular incisors
- This represents a truer reflection of the underlying skeletal base relationship and also highlights what is often of most concern to the patient.
- The classification is defined upon the relationship of the mandibular incisor tip to the cingulum plateau of the maxillary central incisors.



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British Standards Institute classification

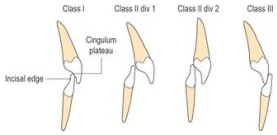
• *Class I*—the lower incisor edges occlude with or lie immediately below the cingulum plateau of the upper central incisors.

• *Class II*—the lower incisor edges lie posterior to the cingulum plateau of the upper incisors. There are two subdivisions of this category:

- *Division 1*—the upper central incisors are proclined or of average inclination and there is an increase in overjet.

- *Division 2*—the upper central incisors are retroclined. The overjet is usually minimal or may be increased.

• *Class III*—the lower incisor edges lie anterior to the cingulum plateau of the upper incisors. The overjet is reduced or reversed.



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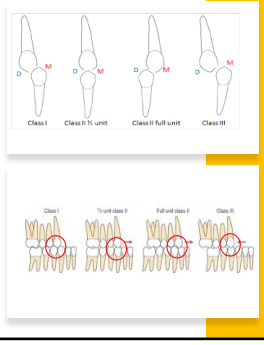
Canine Classification

- Class I-the maxillary permanent canine should occlude directly in the embrasure between mandibular canine and first premolar
- Class II- the maxillary permanent canine occludes in front of the embrasure between the mandibular canine and first premolar
- Class III- the maxillary permanent canine occludes behind the embrasure between the mandibular canine and first premolar.

Similarly to the molar relationship, the severity of the canine relationship can also be described in terms of tooth units and can be influenced by local factors such as crowding.



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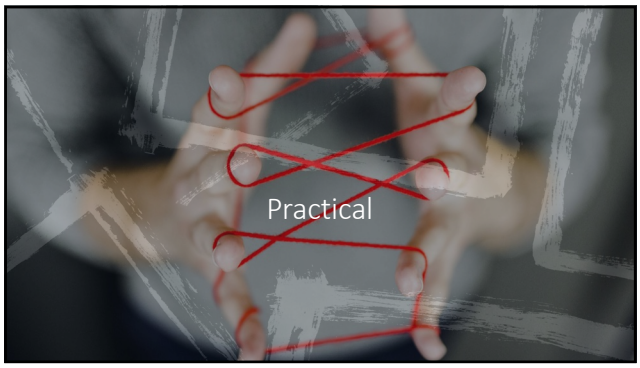

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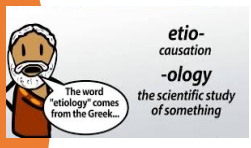
Aetiology of Malocclusion



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Aetiology of Malocclusion

- A malocclusion should be regarded as a developmental condition and the sum of a number of complex occlusal traits, which demonstrate multifactorial inheritance.
- In certain cases specific factors and pathologies can be indentified as the cause of a malocclusion but in the majority of cases the aetiology is less clear.
- In each individual there is a close interaction between genetics and environment during development and growth of both the jaws and dentition; it is at this interface that the aetiology of malocclusion resides.

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Aetiology of Malocclusion

We will examine the aetiology of the malocclusion under three sections:

1. Skeletal factors
2. Soft tissue factors
3. Local/dental factors

Within each section we will focus on:

- Specific causes
- Genetic influences
- Environmental influences

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Skeletal Factors- Specific causes

Disturbances in utero

- The majority of defects caused in utero are incompatible with survival, however, a number of specific causes are known to exist.
- Agents capable of causing embryological defects are called teratogens.

Examples of these include:

- Aspirin – Cleft lip and palate
- Smoking – Cleft lip and palate
- Retinoic acid – Cleft lip and palate, Treacher Collins Syndrome
- Alcohol – Foetal alcohol syndrome

Less than 1% of children are estimated to have had a disturbance in embryological development that resulted in the need for orthodontic treatment.

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Skeletal Factors- Specific causes

Skeletal growth disturbances

These include:

- **Foetal Moulding**- pressure on the developing face can lead to distortions at birth.
- **Amniotic bands**
- **Birth trauma**
- **Childhood fractures**- the most common fracture is that of the condyle of the mandible.
- **Rheumatoid arthritis**- This is a destructive process that can affect the temporomandibular joint causing abnormal growth and development of the mandible.
- **Acromegaly**- an anterior pituitary tumour causes an excess amount of growth hormone. The manifestations include continual growth of the mandible creating a Class III skeletal relationship.
- **Congenital anomalies**

-Hemimandibular hypertrophy
-Hemifacial microsomia
-Cleft lip and palate
-Syndromes of the head and neck
-Fibrous dysplasia
-Cystic hygroma
-Neurofibromatosis

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Fracture of the left condyle causing later facial asymmetry

Hemimandibular Hypertrophy showing intra and extra-oral effects

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Skeletal Factors- Genetic causes

Are malocclusions inherited?

- It can be seen that some malocclusions are inherited by observing families.
- Some features such as the shape of the nose and the smile can be seen to run in families.
- This can also be seen with the shape of the jaw e.g. the famous "Hapsburg jaw" where a prognathic mandible was shown to run in the German royal family.
- This suggests that there are inheritable influences on the skeletal bases but do these inherited characteristics cause a malocclusion?

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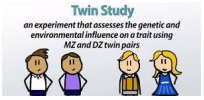
Skeletal Factors- Genetic causes



- Animal experiments and studies on human populations have failed to determine the effect of inheritable characteristics on malocclusion.
- Studies have been carried out by Lundstrom (1984) on monozygotic and dizygotic twins.
- He showed that genetic influences may be overestimated due to the difficulty in removing environmental factors.
- A longitudinal study from the Bolton group (Harris and Johnson, 1991) concluded that the inheritability of skeletal characteristics was high.
- Mandibular prognathism (Class III) has the strongest inheritable tendency followed by long face deformity.

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Skeletal Factors- Genetic causes

Why is it important to recognise the genetic influence on skeletal growth?

- Orthodontics alone can, in many cases, camouflage skeletal jaw discrepancies and treat malocclusions (except when severe).
- However, it is important to determine the contribution of genetics and the environment to the particular malocclusion in question.
- The greater the genetic component the worse the prognosis for a successful outcome with orthodontics
- Whether we can influence the skeletal bases in the long term their genetically determined form is still very much under investigation

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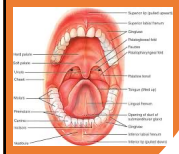
Soft Tissue Factors



Why are they important??

- The soft tissue environment establishes and maintains the harmony/disharmony in the development and arrangement of teeth
- Because the soft tissues largely determine the limitations of orthodontic treatment, from the perspectives of function and stability, as well as aesthetics, the orthodontist must usually plan treatment within the patient's limits of soft tissue adaptation
- This places greater emphasis on clinical examination of soft tissue function and aesthetics.

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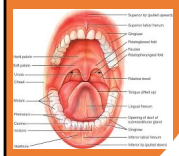
Soft Tissue Factors



Cheeks/Lips

Lip line / Class II / I

- The lower lip should cover 1/3 to 1/2 of the upper incisor in the anterior-posterior and vertical position to aid stability (Ballard, 1967).

In Class II division 2 cases with a reduced lower face height the lip line can be increased and exert an increased effect causing retroclination of the upper incisors.

Competence

- Where the lips are incompetent, the tongue with the palate, incisors or lower lip will strive to achieve an anterior oral seal.
- Natural physiological control should improve with age. In severe skeletal patterns lip competence is unachievable.

Lip trap

- This is a secondary effect. In moderate to severe Class 2 skeletal patterns the lower lip can be trapped behind the upper incisors exacerbating the Class II division 1 incisor relationship. Upper incisors would be proclined and lower incisors retroclined.

Strap-like lower lip

- A tight mentalis muscle causes retroclination of the incisors and a square shaped lower arch (Class II division 2 incisal relationship).

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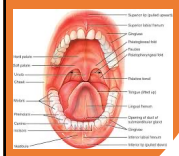
Soft Tissue Factors



Tongue

1. At rest

Size and position

-Cohen (1976) found a negative correlation between the size of the tongue and the interincisal angle suggesting that a large tongue results in proclination of the lower incisors.

- A forward position of the tongue at rest may also have an effect on tooth positions.

-Forces between the tongue and lips are never balanced therefore there are other factors at play. (Equilibrium theory)

-Turner et al., (1997) suggested that due to the forces from the tongue, closure of lateral open bites is often difficult and unstable.

2. In function

- **Adaptive tongue thrust** – In malocclusions such as anterior open bite or an increased overjet an anterior oral seal is created by the tongue to lower lip causing an adaptive swallow. This may correct with treatment. The pressure from the swallowing pattern is of insufficient duration to have an impact on the tooth position/ malocclusion and is, therefore, the unlikely cause of the anterior open bite.
- **Endogenous tongue thrust**– Rare and difficult to treat.

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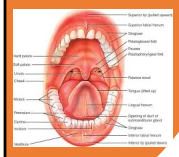
Soft Tissue Factors



Muscles of mastication

Usually adapt to the new vertical position of teeth. The actions of these muscles are thought to bring the lower jaw into the correct relationship with the teeth of the upper jaw rather than a direct influence on the eruption of the teeth. This is controversial and poorly understood- no evidence biting forces or effects of a soft diet are a cause of malocclusion.

Periodontal ligament

Shock absorber and stabiliser. (Equilibrium Theory)

Fraenum

Persistent midline diastema

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Soft Tissue Factors- Specific Causes

Muscle dysfunction e.g. underdevelopment of the masseter muscle.

-Can cause skeletal growth disturbance due lack of the total soft tissue matrix.

-Lower motor neurone palsy/ facial palsy

-Torticollis which is excessive muscle contraction can restrict growth much like that seen with scarring.

All the above would cause a facial asymmetry due to growth restriction of the affected side.

Lower motor neurone palsy

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Soft Tissue Factors- Specific Causes

Muscular dystrophy and Cerebral palsy

A decrease in tonic activity of all affected muscles causes the mandible to drop downwards away from the facial skeleton resulting in an increased facial height, severe Class II profile, excessive eruption of posterior teeth, narrowing of the maxilla and an anterior open bite. Gross lip incompetence and a forward tongue position can contribute towards labial flaring and spacing of the anterior teeth.

These can also be considered as epigenetic factors, where there is an indirect influence of the muscles on the skeleton, which is under genetic control.

Down's Syndrome

Loss of neuromuscular tone can cause a tongue thrust. Following treatment this may result in an unstable end result.

Cleft lip and palate

Soft tissue restriction of growth of the maxilla

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Soft Tissue Factors- Environmental Cause

Digit Habit

The effects of a digit habit are to alter the pressures of the soft tissues and thus distort the equilibrium.

The severity of the habit will depend on the duration (hours) per day.

The main effects are:

- o Proclination of the upper incisors
- o Retroclination of the lower incisors
- o Maxillary constriction
- o Unilateral crossbite with displacement
- o Anterior open bite (can be asymmetric)

This is caused by a combination of interference with eruption of the incisors and excessive eruption of the posterior teeth causing a step in the occlusal plane as a distinct feature.

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Soft Tissue Factors

Respiratory effects.

The resting position of the head and mandible may also have an influence on the malocclusion.

Solow and Tallgren (1976) found that extension of the head produced an increased anterior face height, reduced posterior face height, Class II profile, increased cranial base angle and inclination of the mandible to the anterior cranial base.

Respiratory needs are one of the primary determinants of the posture of the jaws and tongue and it has been suggested that an altered respiratory pattern/ chronic nasal obstruction may alter this.

This change in position in the head, jaws and tongue could alter the pressures on the jaws and teeth and thus their development.

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Soft Tissue Factors

Respiratory effects-mouth breathing .

While a relationship between nasal obstruction and mouth breathing cannot be denied, evidence has shown that the relationship between mouth breathing and dentofacial form is not so clear cut.

Nasal obstruction can be seen to have an effect on the pattern of growth as seen in animal and human experiments but this is not the major aetiological factor.

The majority of long-faced individuals have no evidence of nasal obstruction and in these cases there must be another associated aetiological factor.

Adenoid face

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Local and Dental Factors

1. Deciduous dentition

Natal teeth

These are present at birth (or erupt soon after)
10% are supernumeraries therefore should be unless causing feeding problems.

Germination/ fusion – Rare and cause difficult aesthetics. Germination can increase crowding, where as fusion theoretically does not increase crowding but will effect tooth size disproportions.

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Local and Dental Factors

1. Deciduous dentition

Delayed loss of deciduous teeth

The consequences of this can cause:

- o Local malocclusion
- o Ectopic eruption of permanent teeth
- o Space loss locally
- o Impaction of permanent teeth
- o Submergence of primary teeth
- o Centre line discrepancy
- o Aesthetics

Early loss of deciduous teeth

The consequences that this can cause are:

- o Loss of space for permanent successors
- o Eruption of permanent teeth into a position of malocclusion
- o Overeruption of opposing teeth
- o Loss of centre line if premature loss is anteriorly (see pic above)

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Local and Dental Factors

2. Permanent dentition

Abnormalities in tooth position

Primary failure of eruption
Impacted first permanent molars

This can occur in 0.5% of cases. In some cases observation may be sufficient and in others
disimpaction may be required. Techniques for disimpaction include separation with wires or
elastics and distalisation. This can include headgear or removable appliances with screws or
palatal springs.

Ectopic crypts
This can lead to local rotation, misplaced development, impaction and transpositions This can be seen particularly in the cases of lower third molars, lower second premolars and upper canines. The second premolars appear to have an ability to improve in their position spontaneously. Observation therefore may be all that is required.

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Local and Dental Factors

2. Permanent dentition

Abnormalities in tooth position

Dilacerations

The crown is displaced relative to the root. This is usually associated with the central incisors and can be associated with trauma but not in all cases.

If severe will cause failure of eruption and may potentially require extraction.

Mild cases may be able to be brought into the line of the arch with good aesthetics.

- 71% are of developmental cause with labially positioned crowns.
- 22 % are due to trauma with palatally positioned crowns.
-7% are due to cysts or the presence of supernumeraries.

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Local and Dental Factors

2. Permanent dentition

Abnormalities in tooth number

Supernumerary teeth

-Incidence 1% (Dibiase, 1969)
-Also associated with Cleft lip and palate, Cleidocranial dysplasia and Gardner's syndrome.

There are various forms
o **Conical** – 5% are inverted and often in the midline (mesiodens). Formed early and may erupt causing displacement.

o **Tuberculate** – Formed late and prevent eruption of the incisors

o **Supplemental** – Identical and often found at the end of a series. Cause crowding and displacement.

o **Odontomes** – Complex/ compound.

C O S T

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Local and Dental Factors

Hypodontia

- A meta analysis indicated that the overall prevalence for Europeans is 4.6% in males and 6.3% in females (Polder et al., 2004).
- The condition is associated with microdont teeth, Cleft lip and palate, Down's and Ectodermal dysplasia.
- Incidence of absent lower second premolars is 2.8% and upper lateral incisors is 1.6%. 25-35% of third molars are absent.

- Absent lower incisors - Rare.
- Absent lower second premolars - Can develop late. E's may also be left in situ in well aligned arches if good root morphology is seen.
- Absent upper lateral incisors – Can be uni- or Bilateral. If unilateral then the remaining tooth can be microdont. Increased incidence of ectopic canines (Becker et al, 1995. If the upper lateral is absent then impaction of the canine is 2.5 times more likely).

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Local and Dental Factors

Abnormalities in tooth form

Macrodont

Upper central incisors. This can be produced by fusion of two permanent incisors/ supernumerary
or germination of one tooth.

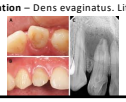
Microdont

Upper lateral incisors. Check root morphology as can be built up.

Additional cusps

Invagination – Dens in dente. Important to check tooth quality.

Evagination – Dens evaginatus. Little consequence.



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Aetiology of specific malocclusions

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Class II division 1

Features

- 76% have a skeletal II pattern, 18% a skeletal I and 6% a skeletal III pattern.
- Generally the patient presents with a small mandible, deep bite and proclined or upright incisors.
- Dentoalveloar compensation may mask the severity of the malocclusion but the profile may still be poor.
- In skeletal II cases both the cranial base length and angle are increased.

Genetic

- Harris, 1975 showed that these patients usually had a reduced body of mandible and smaller overall mandibular length than Class I patients, with a higher correlation between the patient and the immediate family than random pairing of unrelated siblings. This supports the concept of inheritance.

Environmental

- Soft tissues can exert an influence on the position and inclination of the incisors and the need for a tongue/lower lip seal as an anterior lip seal during swallowing.
- The latter can retrocline the lower incisors and the tongue can procline the upper incisors exacerbating the severity of the overjet.
- A lower lip trap may procline the upper incisors further.
- Lip incompetence can also have an effect on the inclination of the incisors due to the imbalance of the pressures on the teeth.
- Digit habits can produce a Class II division 1 malocclusion even with an underlying Class 1 skeletal pattern due to effects on the dentition.

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Class II division 2

Features

- These cases usually present with a mild skeletal II pattern, reduced anterior face height and Frankfort-mandibular planes angle.
- A skeletal I or III skeletal pattern can also be seen.
- These patients have a tendency to a forward growth rotation that contributes to the deep bite and reduced lower face height.
- The reduced facial height can have an influence on the position of the lower lip against the dentition.
- Intraorally they usually present with a deep bite and retroclined central incisors, high lip line and frequent scissor bites.
- Peck et al (1998) describes smaller teeth mesio-distally than average.
- In skeletal II cases both the cranial base length and angle are increased compared to the skeletal pattern of a Class I malocclusion.

Genetic

- Familial occurrence has been shown in twin studies. (Peck et al, 1998).
- Markovic et al (1992) showed in a twin study of Class II division 2 cases, 100% concordance for the Class II division 2 features suggesting strong evidence for genetics as the main aetiological factor.

Environmental

- Ballard (1963), Houston (1975) and Mills (1982) all described the activity and position of he lips as the main aetiological factor associated with the development of a Class II division 2 malocclusion.
- If the lower lip activity and position are considered to be genetically influenced (and there is some evidence to support this) then this would meet the views of the geneticists who consider the predominant role of genetic factors in the aetiology of these cases.

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Class III

Features

- These cases usually present with a skeletal III pattern but occasionally the skeletal pattern is Class I.
- In 25% cases there is a small retruded and narrow maxilla contributing to the increased frequency of crossbites.
- However, the malocclusion can also be due to excessive mandibular growth or a combination of both (Guyer et al, 1986).
- There is a wide range of vertical relationships.
- Dentoalveolar compensation in severe skeletal cases is often not sufficient to maintain a positive overbite and overjet.
- In skeletal III cases both the cranial base length and angle are usually reduced (Ellis and McNamara, 1984) contributing to the mandibular prognathism.

Genetics

- This is probably the most famous genetic trait as discussed earlier. Twin studies have shown concordance of mandibular prognathism to be six times higher in twins than siblings.
- Inheritance as the aetiology of this malocclusion has been shown.

Environmental

- Factors such as enlarged tonsils, hormonal disturbances, posture and premature loss of first permanent molars have all been suggested as possible contributors to the development of Class III malocclusion.
- Soft tissues do not generally play a part, however, there is a tendency for the lips and tongue to contribute towards dentoalveolar compensation.

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Summary

- The development of malocclusion results from the simultaneous and synergistic influence of genetics and the environment.
- The interaction between genetics and the environment produce the necessary determinants of facial and dental morphology.
- It is important to reflect on the hereditary and environmental features of a malocclusion prior to treatment planning in order to devise the most appropriate treatment and produce an aesthetic, functional and stable result.

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Questions?

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