Class I malocclusions

Class I malocclusions include those where the anteroposterior occlusal relationship is normal and there is a discrepancy either within the arches and/or in the transverse or vertical relationship between the arches.

Aetiology

1. Skeletal

In Class I malocclusions the skeletal pattern is usually Class I, but it can also be Class II or Class III with the inclination of the incisors compensating for the underlying skeletal discrepancy (Fig .1), i.e. dento-alveolar compensation. Marked transverse skeletal discrepancies between the arches are more commonly associated with Class II or Class III occlusions, but milder transverse discrepancies are often seen in Class I cases. Increased vertical skeletal proportions and anterior open bite can also occur where the anteroposterior incisor relationship is Class I.

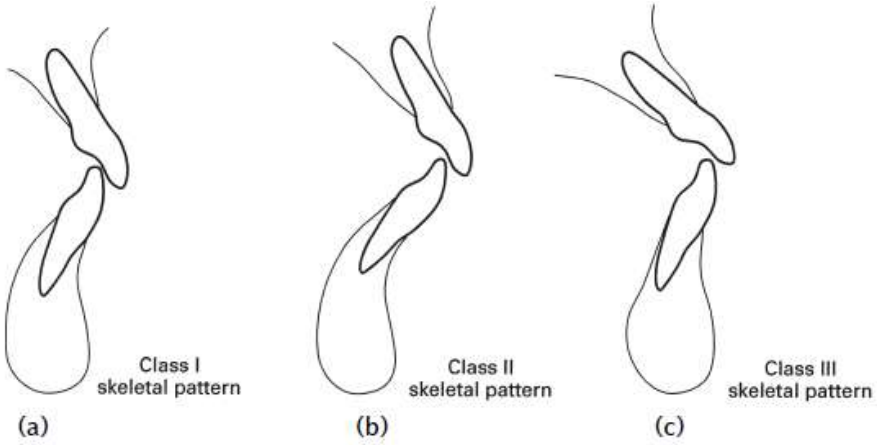

Fig. 1 (a) Class I incisor relationship on Class I skeletal pattern; (b) Class I incisor relationship on a Class II skeletal pattern; (c) Class I incisor relationship on a Class III skeletal pattern.

2. Soft tissues

In most Class I cases the soft tissue environment is favorable (for example resulting in dento-alveolar compensation) and is not an aetiological factor. The major exception to this is bimaxillary proclination, where the upper and lower incisors are proclined. This may be racial in origin and can also occur because lack of lip tonicity results in the incisors is moulded forwards under tongue pressure.

3. Dental factors

Dental factors are the main aetiological influences in Class I malocclusions. The most common are tooth/arch size discrepancies, leading to crowding or, less frequently spacing. The size of the teeth is genetically determined and so, to a great extent, is the size of the jaws. Environmental factors can also contribute to crowding or spacing. For example, premature loss of a deciduous tooth can lead to a

localization of any pre-existing crowding. Local factors also include displaced or impacted teeth, and anomalies in the size, number, and form of the teeth, all of which can lead to a localized malocclusion. However, it is important to remember that these factors can also be found in association with Class II or Class III malocclusions.

Crowding

Crowding occurs where there is a discrepancy between the size of the teeth and the size of the arches. Approximately 60 per cent of Caucasian children exhibit crowding to some degree. In a crowded arch loss of a permanent or deciduous tooth will result in the remaining teeth tilting or drifting into the space created. This tendency is greatest when the adjacent teeth are erupting.

The amount of crowding present is often classified as:

- Mild (<4 mm)
- Moderate (4–8 mm)
- Severe (>8 mm)

When planning treatment for crowding the following should be considered:

- The position, presence, and prognosis of remaining permanent teeth
- The degree of crowding which is usually calculated in millimetres per arch or quadrant
- The patient's malocclusion and any orthodontic treatment planned, including anchorage requirements
- The patient's age and the likelihood of the crowding increasing or reducing with growth
- The patient's profile

After creation of space to relief crowding a degree of natural spontaneous movement will take place. In general, this is greater under the following conditions:

- In a growing child
- If the extractions are carried out just prior to eruption of the adjacent teeth
- where the adjacent teeth are favourably positioned to upright if space is made available (for example considerable improvement will often occur in a crowded lower labial segment provided that the mandibular canines are mesially inclined)
- There are no occlusal interferences with the anticipated tooth movement

Most spontaneous improvement occurs in the first 6 months after the extractions. If alignment is not complete after 1 year, then further improvement will require active tooth movement with appliances.

Late lower incisor crowding:

In most individuals intercanine width increases up to around 12 to 13 years of age, and this is followed by a very gradual diminution throughout adult life. The rate of decrease is most noticeable during the mid to late teens. This reduction in intercanine width results in an increase of any pre-existing lower labial crowding, or the emergence of crowding in arches which were well aligned or even spaced in the early teens. Therefore, to some extent, lower incisor crowding can be considered as an age change. Certainly, patients who have undergone orthodontic treatment (including extractions) are not immune from lower labial segment crowding unless prolonged retention is employed. The aetiology of late lower incisor crowding is recognized as being multifactorial: the following have all been proposed as influences in the development of this phenomenon:

- Forward growth of the mandible (growth rotation) when maxillary growth has slowed, which result in a reduction in lower arch perimeter and labial segment crowding.
- Mesial migration of the posterior teeth owing to forces or from the anterior component of the forces of occlusion.
- The presence of an erupting third molar pushes the dentition anteriorly, i.e. the third molar plays an active role.
- The presence of a third molar prevents pressure developed anteriorly (due to either mandibular growth or soft tissue pressures) from being dissipated distally around the arch, i.e. the third molar plays a passive role.

Reviews of the many studies that have been carried out indicate that the third permanent molar has a statistically weak association with late lower incisor crowding. However this crowding can still occur in patients with congenitally absent third molars.

Calculating the space requirements

Space is required to correct the following:

- Crowding
- Incisor anteroposterior change (usually obtaining a normal overjet of 2 mm)

• Leveling of occlusal curves
• Arch contraction (expansion will create space)
• Correction of upper incisor angulation (mesiodistal tip)
• Correction of upper incisor inclination (torque)

Incisor anteroposterior change

It is often necessary to alter the anteroposterior position of the upper incisors, particularly when reducing an overjet. If incisors are retracted, this requires space; if incisors are proclined then space is created. The aim is to create an overjet of 2 mm at the end of treatment. Every millimetre of incisor retraction requires 2 mm of space in the dental arch. Conversely, for every millimetre of incisor proclination 2 mm of space are created in the arch. For example, if a patient presented with an overjet of 6 mm and the incisors needed to be retracted to create a normal overjet of 2 mm, then this would require space. Every millimetre of retraction requires 2 mm of space. So to reduce the overjet by 4 mm would require 8 mm of space. As discussed earlier the anteroposterior position of the lower incisors is often accepted for stability reasons. However, situations do occur when the position is altered, and similar space requirements apply in the lower arch.

Leveling occlusal curves

Where there is no occlusal stop the lower incisors may over-erupt. This may result in an occlusal curve which runs from the molars to the incisors and is known as a Curve of Spee. The amount of space required to level an increased curve of Spee is controversial, as it is affected by a number of factors, such as the shape of the archform and tooth shape. The depth of curve is assessed from the premolar cusps to a flat plane joining the distal cusps of first permanent molars and incisors.

Approximate space requirement to flatten a curve of Spee

Depth of curve (mm)	Space requirement (mm)
3 or less	1
4	1.5
5 or more	2

Creating space

The amount of space that will be created during treatment can also be assessed. The aim is to balance the space required with the space created. Space can be created by one or more of the following:

- Extractions
- Distal movement of molars
- Enamel stripping
- Expansion
- Proclination of incisors
- Derotation of posterior tooth
- A combination of any or all of the above

Distal movement of molars

Distal movement of molars in the upper arch is possible. This movement can be achieved with headgear. Extra-oral traction using headgear will usually produce up to 2–3 mm per side (creating 4–6 mm space in total). It therefore tends to be used when there is a mild space requirement where extractions may produce too much space. It can also be used in addition to extractions when there is a very high space requirement.

Examples of clinical situations when it may be used include:

- Class I incisor relationship with mild crowding in the upper arch
- Class II division 1 incisor relationship with minimally increased overjet and molar relationship of less than half a unit Class II
- Where extraction of first premolars does not give sufficient space to complete alignment
- Where unilateral loss of a deciduous molar has resulted in mesial drift of the first permanent molar

Temporary bone anchorage devices (TADS) offer an alternative to headgear in some cases. Appliances attached to these anchorage devices can be used to distalize upper molars. Distal movement of the lower first molar is very difficult and in reality the best that can be achieved is uprighting of this tooth.

Enamel stripping

Enamel interproximal reduction or ’stripping‘ is the removal of a small amount of enamel on the mesial and distal aspect of teeth and is sometimes known as reproximation. In addition to creating space, the process has been advocated for

improving the shape and contact points of teeth, and possibly enhancing stability at the end of treatment. On the anterior teeth approximately 0.5 mm can be removed on each tooth (0.25 mm mesial and distal) without compromising the health of the teeth. Enamel can be carefully removed with an abrasive strip. The teeth are treated topically with fluoride following reduction of the enamel.

Air-rotor stripping is a more controversial approach. This is a technique for removing enamel, predominantly from the buccal segments, using a high speed air-turbine handpiece. Advocates of this approach claim to create an additional 3–6 mm of space in each arch. There is potential for damage to both the teeth and the periodontium unless undertaken carefully and therefore should only be considered by a specialist. It is important that teeth are reasonably aligned before starting the procedure, and spaces must be opened up between teeth, either by separators or fixed appliances, before the enamel reduction begins.

Expansion

Space can be created by expanding the upper arch laterally – approximately 0.5 mm is created for every 1 mm of posterior arch expansion. Expansion should ideally only be undertaken when there is a crossbite. Expansion without a crossbite may increase the risk of instability and the risk of perforation of the buccal plate. Expansion of the lower arch may be indicated if a lingual crossbite of the lower premolars and/or molars exists. Any significant expansion in the lower arch, particularly the lower intercanine width, is likely to be unstable.

Proclination of incisors

Space can be created by proclining incisors, but this will be dictated by the aims of the treatment. Each millimetre of incisor advancement creates approximately 2 mm of space within the dental arch

Spacing

Generalized spacing is rare and is due to either hypodontia or small teeth in well-developed arches. Orthodontic management of generalized spacing is frequently difficult as there is usually a tendency for the spaces to re-open unless permanently retained. In milder cases it may be wiser to encourage the patient to accept the spacing, or if the teeth are narrower than average, acid-etch composite additions or porcelain veneers can be used to widen them and thus improve aesthetics. In severe cases of hypodontia a combined orthodontic–restorative approach to localize space for the provision of prostheses, or implants, may be required Localized spacing may

be due to hypodontia; or loss of a tooth as a result of trauma; or because extraction was indicated because of displacement, morphology, or pathology. This problem is most noticeable if an upper incisor is missing as the symmetry of the smile is affected, a feature which is usually noticed more by the lay public than other aspects of a malocclusion.

1 Hypodontia

Hypodontia is defined as the congenital absence of one or more teeth. The prevalence in a Caucasian population (excluding the third molars) has been reported as being between 3.5 to 6.5 per cent. The third molars are the most common missing teeth. The next most commonly missing teeth are the mandibular second premolars followed by the upper lateral incisors.

Features associated with hypodontia

- Familial tendency
- Association with syndromes (e.g. ectodermal dysplasia)
- Reduced lower facial height and increased overbite
- Small teeth
- Delayed dental development
- Retained deciduous teeth

Management of missing upper incisors

Upper central incisors are rarely congenitally absent. They can be lost as a result of trauma, or occasionally their extraction may be indicated because of dilaceration. Upper lateral incisors are congenitally absent in approximately 2 per cent of a Caucasian population, but can also be lost following trauma. Both can occur unilaterally, bilaterally, or together. Whatever the reason for their absence, there are two treatment options:

- closure of the space (and camouflage the adjacent teeth)
- opening of the space and placement of a fixed or removable prosthesis

The choice for a particular patient will depend upon a number of factors, which are listed below:.

- Skeletal relationship: if the skeletal pattern is Class III, space closure in the upper labial segment may compromise the incisor relationship; conversely, for a Class II division 1 pattern space closure may be preferable as it will aid overjet reduction.
- Smile line.

• Number and site of missing teeth. Are incisors missing unilateral or bilaterally?

• Presence of crowding or spacing.

• Colour and form of adjacent teeth: if the permanent canines are much darker than the incisors and/or particularly caniniform in shape, modification to make them resemble lateral incisors will be difficult; also, if a lateral incisor is to be brought forward to replace a missing single upper central incisor, an aesthetically pleasing result will only be possible if the lateral is fairly large and has a broad gingival circumference.

• The inclination of adjacent teeth, as this will influence whether it is easier to open or close the space.

• The desired buccal segment occlusion at the end of treatment; for example if the lower arch is well aligned and the buccal segment relationship is Class I, space opening is preferable.

• The patient's wishes and ability to co-operate with complex treatment: some patients have definite ideas about whether they are willing to proceed with appliance treatment, and whether they wish to have the space closed or opened for a prosthetic replacement.

• Long-term maintenance/ replacement of prosthesis

Median diastema

A median diastema is a space between the central incisors, which is more common in the upper arch. A diastema is a normal physiological stage in the early mixed dentition when the fraenal attachment passes between the upper central incisors to attach to the incisive papilla. In normal development, as the lateral incisors and canines erupt this gap closes and the fraenal attachment migrates labially to the attached mucosa. If the upper arch is spaced or the lateral incisors are diminutive or absent, there is less pressure forcing the upper central incisors together and the diastema will tend to persist. Rarely, the fraenal attachment appears to prevent the central incisors from moving together.

Factors, which may indicate the high frenum attachements, include the following.

• When the fraenum is placed under tension there is blanching of the incisive papilla.

• Radiographically, a notch can be seen at the crest of the interdental bone between the upper central incisors.

• The anterior teeth may be crowded.

Management can be subdivided as follows:

• Before eruption of the permanent canines intervention is only necessary if the diastema is greater than 3 mm and there is a lack of space for the lateral incisors to erupt. Care is required not to cause resorption of the incisor roots against the unerupted canines.

• After eruption of the permanent canines space closure is usually straightforward. Fixed appliances are required to achieve up righting of the incisors after space closure. Prolonged retention is usually necessary as diastema exhibit a great tendency to re-open, particularly if there is a familial tendency, the upper arch is spaced or the initial diastema was greater than 2 mm. In view of this it may be better to accept a minimal diastema, particularly if no other orthodontic treatment is required. Alternatively, if the central incisors are narrow a restorative solution, for example veneers, can be considered.

Bimaxillary proclination

As the name suggests, bimaxillary proclination is the term used to describe occlusions where both the upper and lower incisors are proclined. Bimaxillary proclination is seen more commonly in some racial groups (for example Afro-Caribbean), and this needs to be borne in mind during assessment (including cephalometric analysis) and treatment planning. When bimaxillary proclination occurs in a Class I malocclusion the overjet is increased because of the angulation of the incisors (Fig. 2). Management is difficult because both upper and lower incisors need to be retroclined to reduce the overjet. Retroclination of the lower labial segment will encroach on tongue space and therefore has a high likelihood of relapse following removal of appliances. For these reasons, treatment of bimaxillary proclination should be approached with caution and consideration should be given to accepting the incisor relationship. If the lips are incompetent, but have a good muscle tone and are likely to achieve a lip-to-lip seal if the incisors are retracted, the chances of a stable result are increased. However, the patient should still be warned that the prognosis for stability is guarded. Where bimaxillary proclination is associated with competent lips or with grossly incompetent lips which are unlikely to retain the

corrected incisor position, permanent retention is advisable. Bimaxillary proclination can also occur in association with Class II division 1 and Class III malocclusions.

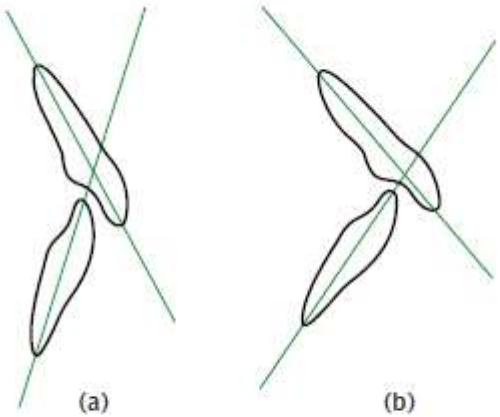

Fig. 2 (a) Class I incisor relationship with normal axial inclination (inter-incisal angle is 137°); (b) Class I incisor relationship with bimaxillary inclination showing increased overjet (inter-incisal angle is 107°).