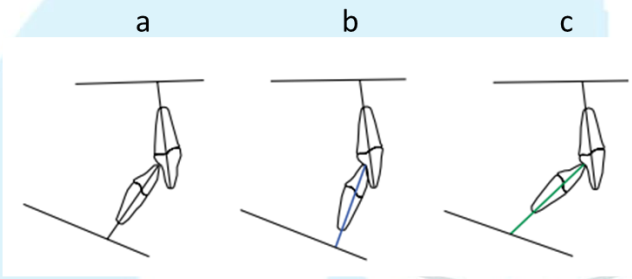
Treatment of Class II division 2 malocclusion

British Standards Institute define class II division 2 incisor relationship as an occlusion where the lower incisor edges occlude posterior to the cingulum plateau of the upper incisors, and the upper central incisors are retroclined. The overjet is usually minimal, but also may be normal or increased. Among Caucasians, the prevalence is reported to be about 10%.





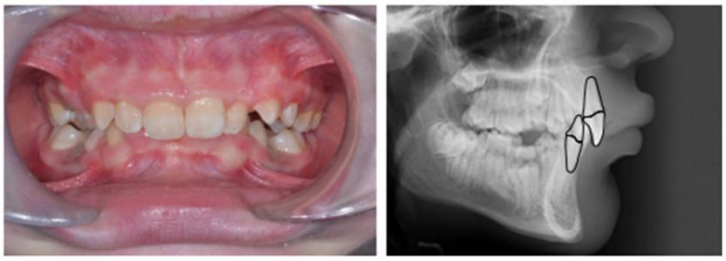
Class II division 2 malocclusion: the lower incisor edges occlude posterior to the cingulum plateau of the upper incisors and the upper central incisors are retroclined. The lower incisors may be normal inclination (a), retroclined (b), or proclined (c)

Etiologies of Class II div. 2 malocclusion

This malocclusion has a strong genetic component with most resulting from the interplay of skeletal and soft tissue factors.

Skeletal factor: Class II division 2 malocclusion is commonly associated with a mild class II anteroposterior skeletal pattern, but may also occur in association with a class I or even a Class III dental base relationship. Where the skeletal pattern is more markedly Class II, the upper incisors usually lie outside the control of the lower lip resulting in a Class II div.1 relationship, but where the lower lip line is high relative to the upper incisors, a class II div. 2 malocclusion can result.

The vertical skeletal dimension is important in the etiology of class II div. 2 malocclusions. Typically, the lower anterior face height (LAFH) and the Frankfort–mandibular plane angle (FMPA) and maxillary–mandibular plane angle (MMPA) are reduced as a result of a forward (anticlockwise) rotational pattern of growth. A reduced LAFH occurring in conjunction with a Class II jaw relationship usually results in the absence of an occlusal stop to the lower incisors. This has the effect of increasing the overbite through further eruption of the incisors.



Lack of an occlusal stop allowed the incisors to continue erupting, leading to a significantly increased overbite.

Soft tissue factor: The position and activity of the lips and the activity of the masticatory muscles have both been suggested as etiological factors in class II div. 2 malocclusions. The influence of the lips in class II div 2 malocclusions is usually mediated by the skeletal pattern.

If the lower facial height is reduced, the lower lip line will effectively be higher relative to the crown of the upper incisors (more than the normal one-third coverage). A high lower lip line will tend to retrocline the upper incisors.



Class II division 2 malocclusion with retroclination of all the upper incisors due to a high lower lip line, which is evident in the view of the patient smiling.

In some cases, the upper lateral incisors, which have a shorter crown length, will escape the action of the lower lip. In these cases, the central incisors are retroclined while the lateral incisors are average inclination or proclined, commonly with mesiobuccal rotation due to crowding.



Typical Class II division 2 malocclusion with retroclination of the upper central incisors. The lateral incisors, which are shorter, escape the effect of the lower lip and lie at an average inclination and are slightly mesiolabially rotated as a result of crowding.

Where the lips are strap - like regardless of the skeletal pattern, the upper and lower incisors may be retroclined (bimaxillary retroclination); this is sometimes associated with a gummy smile and may be aggravated by upper incisor over eruption.



Patient with bimaxillary retroclination due to the action of the lips.

Increased masticatory muscle force has been associated with anticlockwise rotational growth patterns and reduced vertical facial proportions. The cause-effect relationship is unclear and it is possible that altered muscular activity is a result of the underlying skeletal pattern or that it contributes to the development of the skeletal pattern.

The potentially increased muscular force is an important consideration during treatment planning and management, particularly in non-growing patients, as this may pose challenges for correction of the deep bite.

Dental factors: The increased overbite seen in class II division 2 malocclusion arises from the lack of effective occlusal stop to limit eruption of the lower incisors. This result in their continued eruption and an increased interincisal angle. This effect may be secondary to a class II skeletal pattern or a result of retroclination of the incisors by the action of the lips. In some cases the increased inter-incisal angle arises from an abnormal crown-root angulation in the central incisors.



Altered root crown angulation in the max illary incisors has been suggested as an aetiological factor in Class II division 2 incisal relationship.

There is also a higher incidence of palatally impacted maxillary canines and of peg-shaped or absent maxillary lateral incisors.

Common features of class II div. 2 malocclusion

Extra oral features

Typically, Class II division 2 malocclusions are associated with a mild Class II skeletal pattern with reduced vertical proportions. A forward rotational growth pattern tends to result in the mandible becoming more prognathic and this can be helpful in camouflaging the underlying anteroposterior discrepancy.

Both the reduced lower anterior facial height and forward rotation of the mandible commonly results in a more pronounced labio-mental fold.



Deep labiomental fold is typical of a forward (anticlock wise) rotational growth pattern, often seen with Class II division 2 malocclusions.

Occlusal features

The skeletal, soft tissue and dental etiological factors in class II div. 2 malocclusion result in a number of typical occlusal features:

▪ The upper central incisors are retroclined and the lateral incisors are at average angulation or proclined depending upon their vertical position relative to the lower lip.



▪ Crowding is commonly seen in conjunction with a class II div. 2 incisor relationship as any existing shortage of space is exacerbated by the retroclination of the upper central incisors.

▪ Mesio-labially rotated lateral incisors.

▪ Lower arch crowding is similarly exacerbated by retroclination of the lower labial segment, in cases where the lower labial segment has become ‘trapped’ behind the upper labial segment by an increased overbite

▪ The sagittal curvature of the occlusal plane, known as the curve of Spee, is commonly increased in class II div. 2 malocclusions.

▪ In a small proportion of class II div. 2 incisor relationships, a 'traumatic' overbite may occur, where the lower incisors cause ulceration of the palatal tissues, or retroclination of the upper incisors causes stripping of the labial gingivae of the lower incisors.



'Traumatic overbite' caused by class II division 2 incisor relationship. (a) Ulceration of the palatal mucosa of 1/1 caused by the occlusion of the lower incisor edges. (b) Stripping of the labial gingivae of the lower incisors caused by the severely retroclined upper incisors.

Another feature associated with a more severe underlying Class II skeletal pattern is lingual crossbite of the first and occasionally the second premolars. This may be a consequence of the relative positions and widths of the arches and/or trapping of the lower labial segment within a retroclined upper labial segment.



Particularly severe lingual crossbite of the entire left buccal segment due to a Class II skeletal pattern resulting in wider portion of upper arch occluding with narrower section of lower arch.

The aims (objectives) of treatment of Class II div. 2 malocclusion

Class II div. 2 malocclusion is one of the most challenging occlusal anomalies to manage due to the underlying etiological skeletal and soft tissue factors.

Stable correction of a class II div. 2 incisor relationship has two key components to prevent re-eruption of the incisors after treatment

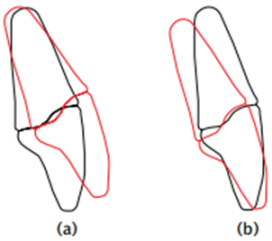
1- Correction of the inter-incisal angle: If re-eruption of the incisors and an increase in overbite is to be resisted, the interincisal angle needs to be reduced, preferably close to 135°, to create an effective occlusal stop.

It has been suggested that stability is increased if, at the end of treatment, an edge–centroid relationship is achieved, where the lower incisor edge lies 0–2 mm anterior to the midpoint of the root axis of the upper incisors, known as the centroid.



Edge–centroid relationship: the midpoint of the maxillary incisor root axis (centroid) lies palatal to the lower incisor incisal edge.

Incisor inclination can be corrected by movement of the crown, root, or both. As a result, there are a number of possible approaches to reducing the inter-incisal angle. The preferred treatment approach will depend upon the aetiology of the malocclusion, the presence and degree of crowding, the extra-oral profile and subsequent preferred incisor position, and the patient's age and wishes.



Correction of the upper incisor inclination can be achieved in two ways: (a) proclination of the incisor crown while the root position is maintained; (b) palatal torque of the incisor root while the crown posi tion is maintained.

Inter-incisal correction can be achieved through one or a combination of the following approaches:

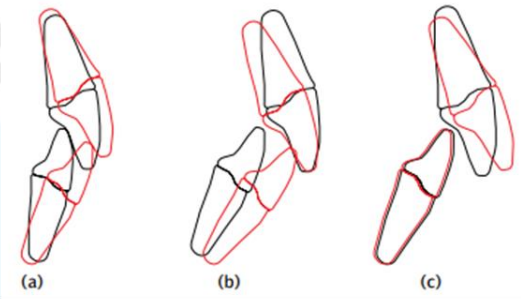
✓ Torquing the incisor roots palatally/lingually: Fixed appliances can be used to torque the incisor roots palatally or lingually while maintaining the crown position. Theoretically, if the incisor crown position is unchanged, treatment will have little effect on lip support and facial profile. It requires space in the arch due to the palatal/lingual shift in the contact points of the teeth, leading to a reduction in the arc circumference and a relative reduction in the arch length.

Also, torquing incisor apices is dependent upon the presence of sufficient cortical bone palatally/lingually and places a considerable strain on anchorage.

✓ Proclination of the lower labial segment: An alternative method for correcting the incisor angulation involves proclination of the teeth. This moves the crown of the tooth labially while maintaining the root position, resulting in space gain by increasing the arc circumference. The relative proclination or torque of upper and/ or lower incisors will determine the final incisor relationship. Proclination of the lower incisors may gain space for alignment and assist overjet and overbite

reduction; however, excessive movement of the lower labial segment increases the risk of relapse, bony dehiscence through the labial bone, and gingival recession.

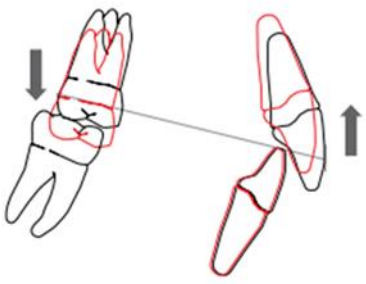
✓ Proclination of the upper labial segment, then managing as a class II div. 1 malocclusion: In the upper arch, proclination of the incisors will convert the incisal relationship into a Class II division 1 malocclusion, usually with an increased overjet. In cases where lip support is reduced, labial movement of the upper incisors may be desirable. Proclination of the upper labial segment results in an increased overjet. Management for correcting the anteroposterior inter-arch discrepancy to achieve a class I incisor relationship follows the same principles as a Class II division 1 malocclusion.



Effect of correcting the inclination of the incisors. Black lines = pre-treatment; red lines = treatment effect. (a) Proclination of both upper and lower incisors corrects the inter-incisal angle and reduces the overbite (e.g. in cases with bimaxillary retrusion). (b) Correction of overjet and overbite by proclination of the lower labial segment and torque of the upper incisor (e.g. in a more severe Class II malocclusion). (c) Proclination of the upper incisors without alteration of the lower incisor position usually leads to an increased overjet. This malocclusion can then be treated as a Class II division 1 malocclusion

2- <u>Reduction of the increased overbite:</u> A number of approaches can be used to correct the overbite, including:

✓ Intrusion of incisors: True intrusion of the incisors is difficult to achieve with fixed appliances alone, as the mechanics tend to pit intrusion of the incisors against extrusion of the buccal segment teeth. It is easier to move molars occlusally than to intrude the incisors into bone and consequently, the former tends to predominate. In practice, the effects achieved are relative intrusion, where the incisors are held still while vertical growth of the face occurs around them, plus extrusion of the molars.

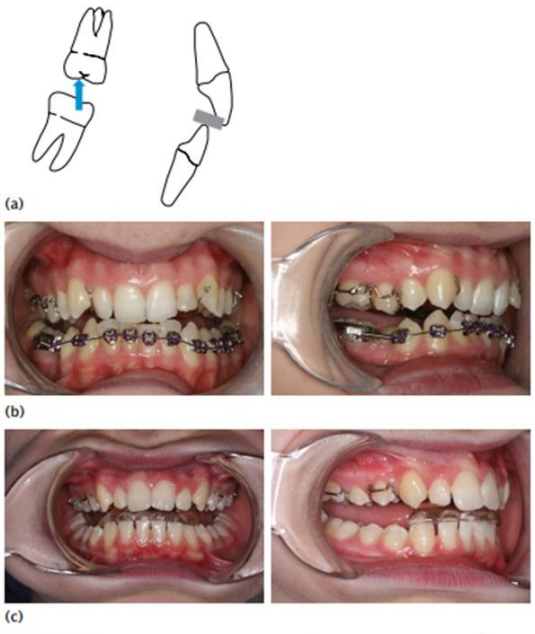


Incisor intrusion with fixed appliance with a continuous archwire will lead to some molar extrusion

Molar extrusion alongside incisor intrusion may be acceptable, or even desirable, in cases with reduced vertical proportions. However, in those with normal or increased facial proportions, it may be undesirable to have molar movement therefore anchorage balance should be altered to increase the true intrusion of incisors.

Increasing anchorage by using temporary anchorage screws or by reinforcing the anchorage unit posteriorly by including second permanent molars (or even third molars in adults) will aid intrusion of the incisors and help to limit extrusion of the molars .

✓ Eruption of molars: Eruption of the buccal segment will aid levelling of the curve of Spee and overbite reduction but this is limited to growing patients. This is most commonly achieved with an upper removable appliance that incorporates a flat anterior bite-plane (FABP) or a functional appliance.



a) The effect of 'opening the bite'. Further eruption of the incisors is limited while the molars are encouraged to erupt to reduce the overbite. (b) An upper removable appliance with a flat anterior bite plane. The posterior teeth are out of occlusion, providing space for eruption. The levelling effect can be increased by placing a lower fixed appliance. (c) A similar effect can be achieved using a functional appliance that separates the posterior teeth, such as a medium opening activator.

Eruption of the molars to correct the overbite results in an increase in the vertical dimension. This must be judged to be favourable to the overall facial balance and the patient must still be growing. Resistance to re-intrusion is aided if the treatment creates an effective occlusal stop and reduces the inter-incisal angle.

✓ Extrusion of molars: the major effect of attempting intrusion of the incisors is often extrusion of the molars which is advantageous in class II division 2 cases with reduced vertical proportions. It is very difficult to extrude the molars in a stable manner in adult patients due to the lack of growth.

✓ Proclination of incisors: Advancement of the lower labial segment anteriorly will result in a reduction of overbite as the incisors tip labially. However, in a few cases where the lower incisors have been trapped behind the upper labial segment by an increased overbite, fitting of an upper bite-plane appliance may allow the lower labial segment to procline spontaneously.

✓ Combination: Due to the difficulty in creating isolated effects with orthodontic appliances, it is likely that, in reality, any mechanics will result in a combination of these tooth movements to varying degrees.

✓ Orthognathic surgery (by mandibular advancement or lower labial segment set – down): In adults with a markedly increased overbite and those patients where the underlying skeletal pattern is more markedly Class II, a combination of orthodontics and surgery, is required.

✓ Restorative management (if loss of posterior occlusal support): it increases posterior occlusal vertical dimension.

The decision whether anterior or posterior vertical tooth movement is preferred depends on the amount of incisor and gingival show at rest and smiling and the lower anterior facial height.

Treatment methods of class II div. 2 malocclusion

Mild cases are best accepted, where the overbite is onto tooth tissue and the retroclination of the upper incisors is acceptably mild, treatment may be confined to relief of upper arch crowding sufficient for alignment of the lateral incisors.

Where the incisor relationship is to be corrected, this may be undertaken by:

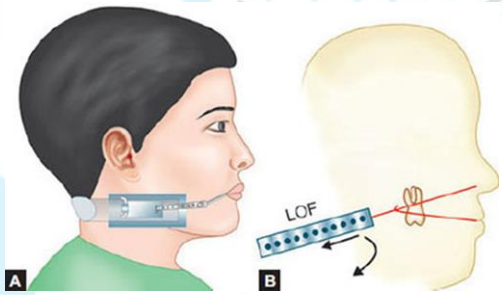
- Orthodontic appliance (Fixed and removable).
- Functional appliance followed by fixed appliances.
- Surgical - orthodontic treatment.

I. Fixed appliance: Fixed appliances can be used to correct the inter-incisal angle and reduce the overbite, as well as correcting other aspects of the malocclusion such as malalignment and crossbites. Where the skeletal pattern is milder, fixed appliances may be used to affect palatal/lingual root torque and/or proclination of the lower labial segment. Also, it used for overbite reduction by incisors intrusion and/or molar extrusion.



(a) A 12-year-old female with a Class II division 2 incisor relationship on a Class I skeletal pattern with crowded and rotated incisors. (b) The second premolars were extracted and fixed appliances were used. (c) At the end of treatment, the deep bite and crowding were corrected and some favourable mandibular growth is also evident (d, e).

Headgear can be used alongside fixed appliances to provide additional anchorage or for distal movement of the buccal segments. A direction of pull below the occlusal plane (cervical pull) is indicated in class II div. 2 malocclusions with reduced vertical facial proportions to aid extrusion of molar and increase face height.



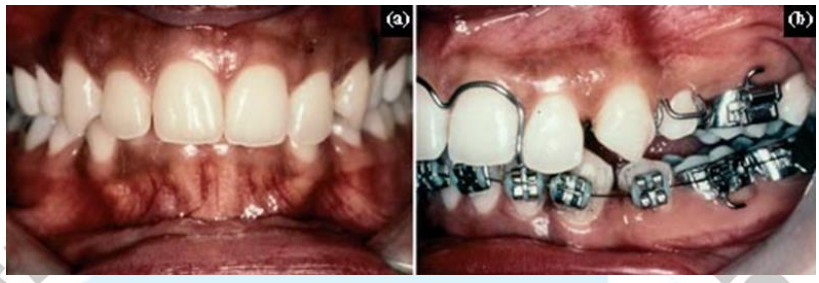
Skeletal anchorage from TADs has increased the scope for correction of more severe Class II division 2 malocclusions with orthodontics alone. TADs can be used with fixed or removable appliances to provide a point for direct application of force or to increase anchorage.

II. Removable appliance: Removable appliances are useful as a stand-alone treatment or as an adjunct to other appliances.

- In cases where the lower incisors have been trapped behind the upper labial segment by an increased overbite, fitting an upper removable appliance with flat anterior bite plane (FABP) may allow the lower labial segment to procline spontaneously.



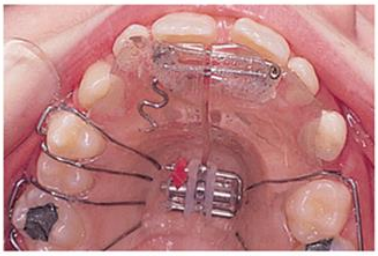
- Upper removable appliance with FABP used with a lower fixed appliance to eliminate interference from the upper incisors while the lower arch is aligned and levelled.



- Upper removable appliance also used with headgear to gain buccal segment correction.



- Upper removable appliance with anterior capping with traction to anterior temporary anchorage devices to intrude the labial segment.
- In some cases, a removable appliance might be used prior to the functional appliance to procline the incisors and expand the upper arch to ensure the correct buccolingual arch relationship at the end of treatment known as the 'Expansion and Labial Segment Alignment Appliance' (ELSAA).



A URA can be used prior to functional appliance treatment to procline the upper incisors and gain upper arch expansion, known as the 'Expansion and Labial Segment Alignment Appliance' (ELSAA).

III. Functional appliance: Functional appliances can be utilized in the correction of class II div. 2 malocclusions in growing patients with a mild to moderate Class II skeletal pattern.

Reduction of the inter-incisal angle is achieved mainly by proclination of the upper incisors, although some proclination of the lower labial segment may also occur.

Alternatively, to eliminate the need for an additional treatment stage, modifications can be incorporated into some types of functional appliance.

Twin-block functional appliances can be designed to incorporate a spring and a midline expansion screws into the upper block to procline the incisors and gain expansion respectively. Alternatively, a sectional-fixed appliance can be placed on the upper labial segment teeth to achieve alignment during the functional phase. After anteroposterior correction with the functional appliance, fixed appliances are nearly always required to detail the occlusion



(a) A Class II division 2 malocclusion. (b) A sectional fixed was used in conjunction with a twin-block appliance to procline the upper labial segment and gain anteroposterior correction.

IV. Orthognathic surgery: A stable aesthetic orthodontic correction may not be possible in patients with an unfavourable anteroposterior or vertical skeletal pattern, particularly if growth is complete. In these cases, surgery may be necessary. A phase of pre-surgical orthodontics is required to align the teeth. However, arch levelling is usually not completed, as extrusion of the molars is much easily accomplished after surgery.



Adult patient with severe Class II division 2 malocclusion on a marked Class II skeletal pattern with reduced vertical proportions. It was decided that a combined orthodontic and orthognathic surgery approach was required to correct this malocclusion.

Extraction

The decision to extract in Class II div. 2 malocclusion cases depends on the overall space requirements to correct all aspects of the malocclusion and the proposed final position of the incisors based on optimizing facial aesthetics.

In the lower arch, it is preferable to limit any lingual movement of the lower incisors to avoid worsening the overbite. In cases with little space requirement, it may be preferable to accept proclination of the lower incisors rather than risking lower incisor retraction.

Clinical experience suggests that space closure occurs less readily in patients with reduced vertical skeletal proportions and, as this is a common feature of class II division 2 malocclusions, this is often cited as a further reason to avoid lower arch extractions.

In cases where lower arch extractions are necessary, treatment mechanics must be planned and executed to ensure space closure without lingual movement of the lower incisors. Most commonly lower second premolars rather than first premolars are the extraction choice.

In the upper arch, extractions may be required to provide space and anchorage for torquing the incisor roots palatally or for retracting the labial segment. Care must be taken to determine the desired maxillary incisor crown position relative to the face and upper lip to prevent over-retraction of the upper labial segment.

Retention

Permanent retention is advised after most orthodontic correction and retention phase is particularly important in class II division 2 malocclusions, with regard to:

➢ Preventing an increase in overbite.

➢ Maintaining alignment of the lower labial segment, particularly if it has been proclined during treatment.

➢ Retaining any de-rotated teeth, for example, the upper lateral incisors.

To combat the forward (anticlockwise) pattern of mandibular growth rotation which tends to increase overbite, night - time wear of an upper removable retainer incorporating a flat anterior bite plane (to fit over the bonded retainer) is advised until growth has reduced to adult levels.



Key points

- Careful assessment of the aetiological factors contributing to the incisor relationship and the degree to which they can be reduced or eliminated is essential if treatment is to be successful.
- The threshold for extractions in the lower arch is higher than other malocclusions.
- The inter-incisal angle needs to be reduced and an adequate occlusal stop for the lower incisors created to increase the chances of a stable overbite reduction.
- For the best prospect of stable overbite reduction, the interincisal angle must be reduced favorably (close to 135 °) and the upper incisor centroid positioned at least 2 mm behind the lower incisor edge with a cingulum stop created on the upper incisors.
- The high lower lip line must also be eliminated to prevent relapse.

References

1) Littlewood SJ, Mitchell L. (2019): An introduction to orthodontics. 5th edition. Oxford University Press.
2) Phulari BS. (2017): Orthodontics: principles and practice: 2nd edition. Jaypee. 2017

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