Best practices for Class II treatment in growing patients with Invisalign® mandibular advancement features

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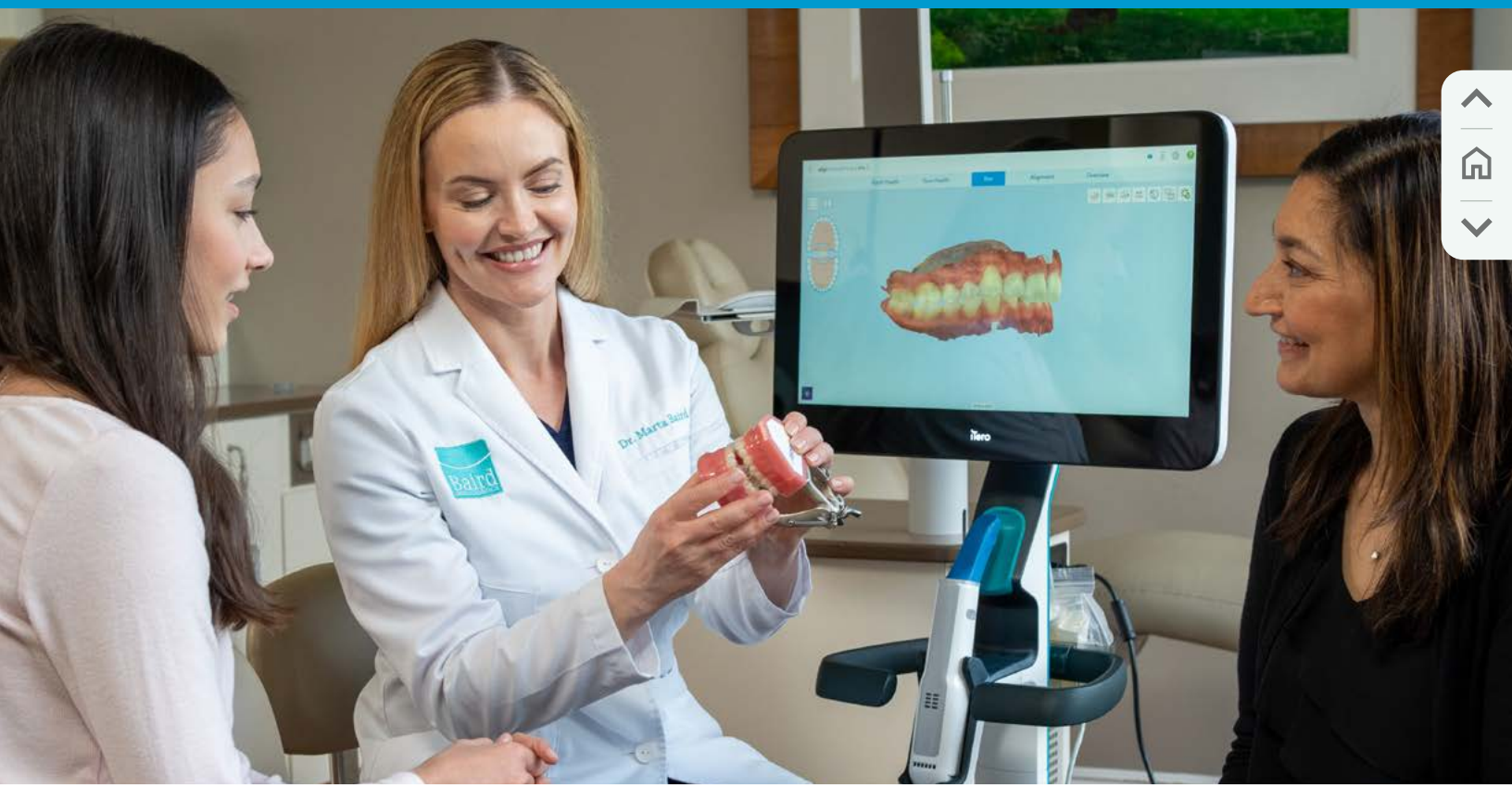

Introduction

This compilation of clinical evidence and real-world strategies for Class II treatment provides orthodontists with adaptable approaches that can be tailored to diverse clinical contexts and individual patient needs.

Disclaimers

- Cases included in this paper are for illustrative purposes only to show how doctors have successfully leveraged the Invisalign® System solutions for skeletal Class II malocclusions.
  This paper is not intended to provide medical or clinical advice.
- The term “Class” refers to molar classification unless otherwise indicated.

The opinions expressed in this case report are those of the author and are based solely on their personal experience, and may not reflect those of Align Technology, Inc. The author was paid an honorarium by Align Technology, Inc. in connection with writing this report.

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Clinical protocols and procedures for mandibular advancement with enhanced precision wings and occlusal blocks on Invisalign® aligners

Dr. Julie Bertrand
Kasterlee, Belgium

Dr. Bertrand graduated in 2006 as a general dentist from the Catholic University of Leuven, Belgium, where she also completed her orthodontic specialist certification in 2010. Thanks to Prof. Dr. Hugo De Clerck, she then completed a post-graduate fellowship at the University of Chapel Hill in North Carolina (USA) and started working in orthodontic practices in Tongeren and Waalwijk (NL) with Prof. Dr. Jan Schols. In 2015, Dr. Bertrand started her own practice in beautiful Kasterlee, Belgium (www.orthodontiekasterlee.be). In 2018, she started treating patients with Invisalign aligners and gained valuable clinical experience under the mentorship of Cobi Combee.

Background

In the past, we mostly used removable acrylic activators for Class II correction, followed by fixed appliances for orthodontic alignment. Today, parents in our practice can still choose between functional with fixed appliances vs. aligner-based Class II correction, but most parents choose the Invisalign® aligner treatment option. The main reasons have been their desire for greater comfort during treatment, fewer speech problems, and less irritation of the gingival tissues. Invisalign aligners with mandibular advancement are also able to correct the bite in smaller increments (e.g., 2 mm every 8 aligners), which patients adapt to more easily than the single mandibular jump with the activator. Clear aligners are also easier to wear during sports activities, so our active patients have better wear compliance with aligners than with traditional functional appliances. The activator also tends to procline the lower incisors even with an acrylic incisor cap, whereas with Invisalign aligners, the upper incisors can be proclined and the lower incisors retracted during bite correction to correct the dental compensations from the Class II malocclusion and provide incisor torque control.

Treatment timing for Invisalign with mandibular advancement

For Class II patients, we will ask the parents if their child is currently in an active growth phase to determine the optimal time to start functional appliance treatment. If a lateral cephalogram has been taken, we will try to begin treatment between CVM stage 3 (CS3) and stage 4 (CS4) (cf. Bachetti et. al.[1]). Boys in our practice typically start treatment around a year later than girls due to the typical timing of their growth spurt. We avoid starting treatment too early so that the patient's enthusiasm for orthodontic treatment is not spent when they are not growing very much. Having the permanent second molars fully erupted at the time when treatment begins is also advantageous because the appliances will fit with greater stability. Therefore, if a patient has growth potential remaining and their 7s are still erupting, not starting treatment right away may be helpful. In these situations, we will simply have the patient come back in another year to re-evaluate their jaw growth and dental eruption.

Treatment priorities

Improving the patient's facial profile is a high priority for us during treatment planning. We do not consider a nice bite with a poor facial profile to be a good treatment outcome. Because of this, we will avoid retracting the upper incisors if the facial profile will be compromised as a result. In non-growing patients who decline orthognathic surgery, leaving the bite in a Class II relationship to maintain the facial profile is preferred over extracting premolars to fix the bite but making the facial profile worse.

Orthodontic appliance selection considerations

In growing patients, mandibular advancement treatment with functional appliances is the preferred alternative to orthognathic surgery for many of our patients, and our preferred Class II correction feature with Invisalign aligners is the occlusal blocks feature. The main advantage of occlusal blocks for mandibular advancement is that the patient can find the desired bite position very easily. Also, the occlusal blocks are solid objects that are positioned directly over the posterior occlusal surface of the aligner, so the aligners maintain their shape even if the patient bites on the features with a strong biting force.

With the Invisalign enhanced precision wings feature, the mandible is propped open less during treatment, but patient training on how to position the lower jaw correctly is extremely important to avoid aligner distortion. Even with proper training, patients will sometimes flatten their enhanced precision wings when they bite down, which can cause the mandible to deviate towards the side with the crushed wings.

Furthermore, the aligner shell beneath the occlusal blocks feature completely encapsulates the anchor teeth, whereas with enhanced precision wings, the buccal tooth surfaces under the wings are not fully encapsulated. This means that attachments can be placed on the buccal surfaces of the posterior teeth when occlusal blocks are prescribed, but for enhanced precision wings patients, the teeth under the wings can only have lingual attachments bonded.

The main limitation with the occlusal blocks feature is the vertical height of the blocks, which makes high mandibular-plane angle patients and patients with anterior open bites not ideal candidates, since the bite will be significantly open during treatment. For patients with a high mandibular-plane angle or an anterior open bite who want a clear aligner option, we can use Invisalign aligners without the occlusal blocks feature to intrude the posterior teeth and reduce the mandibular plane angle by autorotating the mandible.

Treatment sequencing for mandibular advancement

Since the bite correction phase and the dental alignment phase can be combined with Invisalign aligners and mandibular advancement, treatment with Invisalign aligners is usually more efficient than treatment with traditional functional and fixed appliances. For example, activator appliances can be adjusted to some degree to improve the patient's orthodontic alignment, but generally the teeth are still crowded after the bite correction phase, so a separate alignment phase is needed. Invisalign aligners with mandibular advancement are designed so that sagittal correction and dental alignment can occur at the same time. The ability to make noticeable improvements to the dental alignment while the bite is simultaneously being corrected helps keep patients enthusiastic about their orthodontic treatment.

For Class II, division 2 patients, a brief alignment phase prior to starting the mandibular advancement phase (also called a "pre-MA phase") is highly recommended because the lingual inclination of the upper central incisors will often prevent the mandible from reaching the desired molar relationship. When enhanced precision wings are prescribed, we will typically use around 16 aligners for the pre-MA phase (i.e., the enhanced precision wings feature starts at aligner #17), whereas with occlusal blocks we can start the mandibular advancement feature earlier if the case allows (e.g., at aligner #9) since the amount of bite opening is greater with occlusal blocks than with enhanced precision wings.

The goal of the pre-MA phase is to orthodontically remove as many anterior interferences as possible so the mandible can move forward with minimal vertical opening. Premature contact of the lower incisors with the upper incisors will reduce the amount of Class II correction achieved and can also lead to a posterior open bite. With Invisalign treatment, anterior interferences can continue to be removed while the mandible is being advanced, so complete elimination of anterior interferences during the pre-MA phase is not required.

[1] Baccetti T, Franchi L, McNamara JA Jr. An improved version of the cervical vertebral maturation (CVM) method for the assessment of mandibular growth. Angle Orthod. 2002 Aug;72(4):316-23. doi: 10.1043/0003-3219(2002)072<0316:AIVOTC>2.0.CO;2. PMID: 12169031.

If the patient has upper anterior spacing to begin with, space closure should be initiated after the bite is corrected and not before, since anterior retraction can restrict the envelope of function and trap the mandible. For Class II, division 1 patients (and sometimes for division 2 patients), we will also increase the upper transverse dimension during the pre-MA phase, so the bite is better coordinated when the mandible is advanced.

During the mandibular advancement phase, the lower jaw is positioned forward in 2 mm increments every 8 aligners. These 2 mm steps continue until the sagittal goal in the ClinCheck® set-up is reached. We set our enhanced precision wings and occlusal blocks patients to an edge-to-edge incisal bite relationship in the ClinCheck set-up.

Use of Class II elastics in mandibular advancement treatment

Our mandibular advancement patients are instructed to wear Class II elastics at night during their bite correction phase to ensure engagement of the bite correction features while they sleep. The vertical force component of Class II elastics will extrude teeth if a bonded button is used as the elastic hook. In deep bite patients, extrusion of the upper canine is often undesirable, so instead of bonding a button, we will prescribe precision-cut hooks in the upper aligners on the upper first premolars instead. In the lower arch, we will bond buttons to the mesial half of the lower first molars to upright these teeth and level the curve of Spee.

For enhanced precision wings patients, elastic hooks in the lower arch need to be mesial to the lower wings during the mandibular advancement phase, but for occlusal blocks patients, buttons for elastics can be on the posterior teeth even during the mandibular advancement phase. With our enhanced precision wings patients, we prescribe precision cuts and attachments on the lower 4s at first and then switch to bonded buttons on the lower 6s after the mandibular advancement phase, but for our occlusal blocks patients, buttons are bonded on the lower 6s at the beginning of treatment and then left in place throughout the entire treatment. Since we always accommodate Class II elastics in our finishing aligners to fine-tune the midlines, not having to change the location of the elastic hooks for our occlusal blocks patients improves the efficiency of our treatment workflow.

Post-mandibular advancement protocol

A typical mandibular advancement phase with Invisalign® aligners in our practice takes around 26 aligners, or 6 months with weekly aligner changes. If anterior interferences remain at the end of the bite correction phase, a lateral open bite or posterior open bite will be present which can be resolved with additional aligners (without the mandibular advancement features). A deep curve of Spee, flared lower incisors, and upright upper incisors can all prevent the posterior teeth from interdigitating completely. To establish a stable occlusion post-MA, the root torque of the molars and premolars also need to be well-controlled with the finishing aligners.

Patients with a deep initial curve of Spee are more likely to have a lateral open bite after the bite correction phase, so we monitor the anterior coupling of these patients more closely. We have not noticed a difference in the severity of lateral open bite formation between occlusal blocks patients and precision-wing patients. The development of an asymmetric bite has not been observed in our patients treated with occlusal blocks, whereas with precision wing patients, this can happen if the patient flattens their wings on one side. Since the occlusal block feature is solid, the mandible can only slide down and forward.

If less than 5 mm of A-P correction or less than a half cusp distal occlusion is still needed after the last mandibular advancement aligner, the remaining sagittal discrepancy can be corrected using additional aligners and distalization mechanics supported with Class II elastics. Patients with 5 mm or more of A-P correction or more than a half cusp distal occlusion remaining need to be treated with an additional round of aligners with mandibular advancement. So far, we have not had to order an additional round of mandibular advancement aligners when occlusal blocks were used, whereas when enhanced precision wings were used, an additional round of mandibular advancement aligners was sometimes needed.

If a lateral open bite greater than 5 mm is present at the end of the mandibular advancement phase, the last set of mandibular advancement aligners can be cut distal to the first premolars on both sides to let the patient's bite passively settle for 6-8 weeks before re-scanning the teeth for additional aligners (the anterior segment of the aligner is worn full-time to hold the alignment achieved). If the posterior open bite is less than 5 mm, we will rescan the patient for additional aligners right away and hold the patient in the last aligner (without sectioning it) while the additional aligners are being made.

Our retention protocol for our younger patients is a bonded lingual wire 3-3 for the upper and lower arches, plus Vivera™ retainers or other clear retainers in the upper arch only.

Case example 1:
Profile improvement from non-surgical mandibular advancement treatment with Invisalign® aligners

Patient's age: 11 years old

Sex: Female

Chief concern: Proclined upper incisors with a high risk for dental trauma. We suggested waiting a year to allow the U3s and L5s to erupt, but the parents insisted on starting as soon as possible and understood that treatment would take longer.

Initial: Bilateral Class II division 1, with end-on molars, severe overjet, and a deep impinging overbite. Treatment plan: Invisalign aligners with enhanced precision wings for mandibular advancement. Mandibular advancement steps were 2 mm each and the ClinCheck® goal was set to an edge-to-edge bite.

Post-mandibular advancement: 16 pre-MA aligners and 26 MA aligners were used. A posterior open bite was observed after mandibular advancement due to premature anterior contacts.

After bite-settling with additional aligners: In this case we did not section the last MA aligners, but used additional aligners to settle the bite because the MA aligner fit became problematic due to the erupting canines. Afterwards, the midlines were centered and the bite was nearly Class I.

The patient was then scanned for finishing aligners, and buttons for Class II elastics were bonded on the U3s and L6s. Because of poor tracking of LR3, 13 additonal aligners were used to extrude the tooth (with a bonded button + vertical elastics and then a large horizontal attachment).

Final results: Bilateral Class I with normal overbite and overjet was achieved. The total treatment time from pre-MA to delivery of retainers was 2 years and 4 months.

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The before and after extraoral photos and lateral cephalometric radiographs show a significant improvement to the patient's profile.

Case example 2: Passive resolution of a transient posterior open bite formed during the mandibular advancement phase of Invisalign® treatment

Patient's age: 13 years old

Sex: Male

Chief concern: Proclined upper and lower front teeth.

Initial bite: Severe Class II on the left and right sides. Treatment plan: Invisalign aligners with enhanced precision wings for mandibular advancement. Mandibular advancement steps were 2 mm each and the ClinCheck® goal was set to an edge-to-edge bite.

Post-mandibular advancement: 19 pre-MA aligners and 36 MA aligners were used. A bilateral posterior open bite due to a steep curve of Spee was observed after the MA phase.

The patient's bite after passive bite-settling: The last MA aligners were sectioned 4-4 and worn for 6 weeks before re-scanning the patient for additional aligners. The right side resolved by ~50% and the left side recovered almost completely without using vertical elastics.

Final results after additional aligners: Class I occlusion with normal overbite and overjet was achieved. Two rounds of additional aligners were needed because after the first round, a premature contact still remained on the UR4. Class II elastics were used during the first round of additonal aligners, with precision cut hooks on the U4s and bonded buttons on the L6s. The total treatment time from pre-MA to delivery of retainers was 1 year and 10 months.

The before and after extraoral photos and lateral cephalometric radiographs show a significant improvement to the patient's profile.

Principles and best practices for mandibular advancement with enhanced precision wings and occlusal blocks on Invisalign® aligners

Dr. Andrea Conigliaro
Acreide SR, Italy

Dr. Andrea Conigliaro obtained his degree in Medicine and Surgery from the University of Catania, followed by a degree in Dentistry and Dental Prosthetics from the Universidad Europea de Madrid, where he also specialized in Orthodontics.

His dedication to education led him to become an adjunct professor at the University of Trieste, where he contributes to the training of future dental professionals. Dr. Conigliaro holds certifications from several prestigious boards, including the Italian Board of Orthodontics (IBO), the European Board on Orthodontic Aligners (EBAO), and the Italian Board of Aligners (IBOA), underscoring his commitment to excellence in orthodontic care.

He has completed three master's degrees in Orthognathodontics at Tor Vergata University in Rome, the University of Palermo, and the University of Turin, further enriching his multidisciplinary expertise. His work with Invisalign has earned him international recognition: he received the Invisalign EMEA Peer Review Award in 2021, serves as a clinical speaker, and is a certified provider. In 2020, he achieved the prestigious status of Diamond Apex Provider – one of the highest distinctions in the field.

He is a member of Società Italiana di Ortodonzia (SIDO), Sociedad Española de Alineadores (SEDA), Società Italiana di Allineatori (SIALIGN), Associazione Nazionale Dentisti Italiani (ANDI), and Associazione Italiana Odontoiatri (AIO).

Our philosophy for Class II treatment in growing patients

When a patient has a Class II malocclusion with mandibular retrognathia, the timing of their treatment is important, and we do not want to start their treatment too early or too late. Ideally, the bite correction phase of treatment will occur during their peak mandibular growth phase between stages CVMS II and CVMS III of the method described by Bachetti et. al.[1] This usually occurs between 10-12 years of age, but the exact timing will vary from patient to patient, so we will also look at the patient's height, ask about the parents' growth history, and evaluate the patient's dental development.

For Class II treatment with functional appliances to be successful, we also need to reverse any dental compensations present such as extruded lower incisors and retroclined upper incisors, so that condylar distraction of the mandible to Class I can occur with enough interarch dental stability to hold the sagittal correction in place as the jaw matures. Removing these dental compensations orthodontically takes time, so if the patient is older (12 or 13 years old for example), we may need to correct the sagittal relationship and remove the dental compensations in parallel so that we do not delay capturing their remaining mandibular growth. If the patient is younger (8 or 9 years old for example), we also have the option to remove dental compensations first and then correct the sagittal relationship afterwards, because the patient still has time before their mandible reaches its peak growth phase.

We prefer using Invisalign aligners to correct Class II malocclusions in growing patients because Invisalign® aligners can be designed to align the teeth orthodontically and correct the bite skeletally at the same time. The Class II correction features available with Invisalign aligners can position the mandible forward in small steps (we usually prescribe 2 mm increments) while the dental compensations are being eliminated. In the past, we used acrylic twin block appliances for Class II correction, but these appliances were not designed to align the teeth and correct the bite at the same time, so we would align the teeth before and after the bite correction phase using a different appliance, and this sequential approach was not very efficient.

In older patients where we want to start advancing the mandible as soon as possible, not having to eliminate dental compensations up front gives us a much better chance at capturing any remaining mandibular growth. The ClinCheck® software lets us design the Invisalign aligners so that the removal of dental compensations stays slightly ahead of the increments of mandibular repositioning. We will remove enough compensations for the first 2 mm increment of mandibular advancement and then advance the mandible by 2 mm. While the jaw and muscles adjust to the first 2 mm change, we will remove the dental compensations for the next 2 mm increment of mandibular advancement and then advance the mandible by another 2 mm. This process repeats until the sagittal goal is reached. With the Invisalign occlusal blocks feature for mandibular advancement, we can start mandibular advancement sooner (often times without any pre-MA phase) because the occlusal blocks temporarily open the bite right away.

Class II correction appliance design and patient selection

With Invisalign aligners, two feature options are available for skeletal Class II correction – enhanced precision wings and occlusal blocks. Enhanced precision wings are hollow vertical extensions of the aligner shell on the buccal surface of the aligner near the posterior teeth. The buccal position of the wings allows the mandible to be positioned forward with minimal vertical opening when the aligners are worn. In contrast, occlusal blocks are solid plastic blocks fused to the aligner shell on the occlusal surface of the aligner near the posterior teeth. The height and position of the occlusal blocks temporarily open the patient's bite while the aligners are being worn, but this also helps patients find their prescribed (new) bite more easily compared to patients with enhanced precision wings. The temporary bite opening that occurs with the occlusal blocks may not be ideal for dolichofacial patients or anterior open bite patients. The occlusal blocks will also concentrate the patient's biting force on the teeth beneath the blocks. These intrusion forces need to be factored into the treatment plan, especially in patients with a deep bite.

If mandibular advancement needs to start as soon as possible because the patient is older, the occlusal blocks option is preferred because this feature opens the patient's bite right away so the first bite jump increment can happen sooner. If more time is available because the patient is younger, the patient has the option to start treatment with a pre-mandibular advancement (pre-MA) phase without any Class II correction features in the aligners. We will typically have these patients wear around 10-12 aligners (changed every 7 days) to prepare the teeth for the first bite correction increment (a 2 mm step). While the mandible is being held forward by 2 mm, the teeth will continue to be aligned in preparation for the next 2 mm step. This cycle repeats until the mandible reaches an edge-to-edge incisor relationship that we have prescribed in the ClinCheck aligner set-up.

If the patient is unable to reach their sagittal treatment goal after 1 year of mandibular advancement treatment with aligners, we will switch our approach to a dentoalveolar solution and use Class II elastics with a bite jump in the set-up. In this approach, the Class II elastics guide the mandible to the desired position, and the bite-jump helps ensure that the teeth will fit together well in the guided position. We apply a similar principle with our enhanced precision wings patients when we use light elastics (0.25 inch, 4.5 ounce) to help the patient guide their mandible forward, especially when they are sleeping.

[1] Baccetti T, Franchi L, McNamara JA Jr. An improved version of the cervical vertebral maturation (CVM) method for the assessment of mandibular growth. Angle Orthod. 2002 Aug;72(4):316-23. doi: 10.1043/0003-3219(2002)072<0316:AIVOTC>2.0.CO;2. PMID: 12169031.

Case example

11-year-old female patient with a severe Class II, division 1 malocclusion. The chief concern of the parents was the excessive proclination of the upper incisors and an inharmonious facial profile.

- Overjet = 10.2 mm
- ANB = 5.0°
- Upper incisor angle = 112.5 (U1 to SN), 122.2° (U1 to FH)
- Lower incisor angle (IMPA) = 94.2°
- Moderate crowding of the upper and lower arches
- Deep curve of Spee, V-shaped upper arch, and thin periodontal biotype

The patient's initial bite: Severe Class II, division 1 malocclusion.

The patient wore 42 Invisalign aligners with enhanced precision wings along with light Class II elastics (0.25 inch, 4.5 ounce) to guide the mandible during sleep. The last four aligners were "transition phase" aligners, which included the precision wings, but no additional tooth movement.

No pre-MA phase was necessary. The mandibular advancement aligners were changed every 7 days. The MA phase lasted 10 months total, including the transition phase.

The patient's bite after mandibular advancement.

After the mandibular advancement phase, a slight open bite along with incomplete Class II correction on the left side was noted due to partial leveling of the curve of Spee. This patient used the last MA phase aligner only at night for about 40 days before a new scan was taken for additional aligners.

A Class I occlusion was achieved after additional aligners to completely level the curve of Spee.

Three additional intraoral scans were taken for finishing, which lasted a total of 18 months. Class II elastics with bonded buttons and cutouts in the aligners were used on the upper canines and lower first molars. The result was a Class I finish, with centered midlines and normal overbite and overjet.

Because of the patient's skeletal maturity at the start of treatment, I would treat this case today with occlusal blocks in order to temporarily open the bite more during the mandibular advancement phase.

Clinical tip for resolving a posterior open bite during mandibular advancement

In patients with strong mandibular musculature (e.g., patients with a brachyfacial profile), the enhanced precision wings may become flattened if the patient positions their mandible incorrectly and bites down on the wings. This can lead to buccal tipping of the teeth under the wings and the formation of a posterior open bite, especially if the palatal cusp of the upper first molar drops down. In this situation, instead of jumping in right away with new aligners or bonded buttons and vertical elastics to extrude the teeth, we will hold the patient in the best-fitting last aligner at night only for at least one month before ordering aligners from a new scan. The idea here is to let the patient's teeth naturally self-correct since they are designed to do this on their own at this stage of dental development. Since the desired tooth positions have already been built into the aligners, we will not section the aligner and risk letting the posterior teeth passively erupt in an uncontrolled fashion. Instead, the patient wears the last best-fitting aligner at night (along with light Class II elastics to help guide the jaw during sleep) to prevent the previously-corrected dental compensations from reappearing while the posterior teeth self-correct. After one month of wearing the last aligner at night only, we will re-scan the patient and order new aligners to completely level the curve of Spee and remove any remaining occlusal interferences that prevent the teeth from fully interdigitating.

Posterior open bite after the mandibular advancement phase

The patient's bite after night-only wear of the last mandibular advancement aligner for a month

The bite after the first round of additional aligners

Final results after the last round of additional aligners (before attachment removal)

Applying twin block learnings to mandibular advancement treatment of growing patients with Invisalign® aligners

Dr. Luis Huanca
Lausanne, Switzerland

After graduating and specializing in orthodontics from the University of Milan, where he also earned a PhD with a main focus on 3D imaging, Dr. Luis Huanca worked in Italy as the head of the orthodontic department of three hospitals in the area of Bergamo, where he was born and raised, and also in the dental office of his father. He then moved to Switzerland, where after a few years working in the community dental service, he opened his own practice, 3D Orthodontist, in Lausanne. Dr. Huanca has published numerous articles in international journals and is a frequent guest speaker at Master's programs in orthodontics at universities in Italy and abroad. He is also an Associate Professor (Privat-Docent) at the University of Geneva.

Principles of functional appliance treatment for growing Class II patients

During my orthodontic residency at the University of Milan, functional appliances represented a central component of Class II treatment in growing patients with retrognathic mandibles. The therapeutic principle was to reposition the mandible forward and maintain this position long enough to allow the condyles and muscles to adapt to the new jaw relationship. I received comprehensive training with a wide range of appliance designs – both removable and fixed – including the Activator, Frankel, Herbst, MARA, and Clark's Twin Block.

Among the removable options, I rapidly developed a preference for the Twin Block.[1] Compared to bulkier appliances, its design was less intrusive, the sliding blocks promoted a stable and consistent forward posture of the mandible, and – crucially – patients were able to speak comfortably while wearing it. These features collectively translated into superior compliance and, in my clinical experience, faster and more reliable sagittal correction.

As an early-career clinician, I observed a clear correlation: the greater the comfort of the appliance, the better the compliance, and consequently, the more effective the treatment outcome. With the Twin Block, the mandibular musculature quickly adapted to the advanced position and often retained this functional memory even after the appliance was discontinued.

For Phase 1 treatment of Class II patients, our protocol often began with preparation of the upper arch – typically with a fixed palatal expander, sometimes followed by a 2x4 appliance to align the anterior teeth – before initiating the functional phase with the Twin Block. In contrast, clear aligners now offer the possibility of achieving moderate dentoalveolar expansion and anterior alignment within the same appliance that will subsequently be used for Class II correction. An additional advantage is the ability to simultaneously treat the lower arch, facilitating coordination between the arches before mandibular advancement begins. This integration streamlines treatment and reduces the need to transition between multiple appliances, thereby improving efficiency for both the clinician and the patient.

In comprehensive treatment of adolescent Class II patients with retrognathic mandibles, the traditional Twin Block approach presents challenges primarily due to the extended treatment duration. Typically, the functional phase alone requires about one year, followed by 18 to 24 months of braces or aligners for alignment. The overall treatment time thus extends to 2.5–3 years, which is often considered lengthy.

If sagittal correction and alignment could be delivered within a single appliance system, the two phases could overlap, potentially reducing total treatment time to 18–24 months. While fixed Class II correctors have been designed with this purpose, they remain limited by appliance complexity, patient discomfort, and a higher risk of mechanical complications.

Treatment of growing Class II patients with Invisalign® aligners

With the Invisalign system, I generally begin with a pre-mandibular advancement (pre-MA) phase. This initial stage allows for dentoalveolar arch expansion, arch width coordination, and anterior alignment. Only once these objectives are at least partially achieved do I select the most appropriate strategy for Class II correction.

Two options are currently available within the Invisalign system for repositioning the mandible forward: occlusal blocks and enhanced precision wings. The occlusal blocks are located on the occlusal surface of the aligners, guiding the mandible downward and forward during wear. Enhanced precision wings, by contrast, are positioned buccally, allowing the mandible to advance with less vertical opening. In my clinical experience, patients often achieve their "advanced" bite more easily with occlusal blocks, as the solid inclined planes provide a stable and reproducible path of mandibular advancement. Enhanced precision wings, being hollow, can be flattened or permanently deformed if not engaged carefully.

Because the occlusal blocks temporarily increase the vertical dimension, they are best suited to patients with normal or deep overbite. For those with high mandibular plane angles or anterior open bite, enhanced precision wings may represent a more suitable option. However, it must be emphasized that Class II open bites and dolichofacial patients remain among the most challenging to treat with functional appliances, regardless of design. In such cases, alternative approaches such as dentoalveolar compensation through maxillary distalization combined with Class II elastics may be considered. Nevertheless, mandibular advancement therapy has a distinct advantage over distalization mechanics in its impact on facial convexity and profile. Indeed, a recent study from the UniCamillus group in Rome reported a +2 mm improvement in chin projection in patients treated with aligner-based mandibular advancement, compared to +0.5 mm with elastics and –1.6 mm in untreated controls.[2]

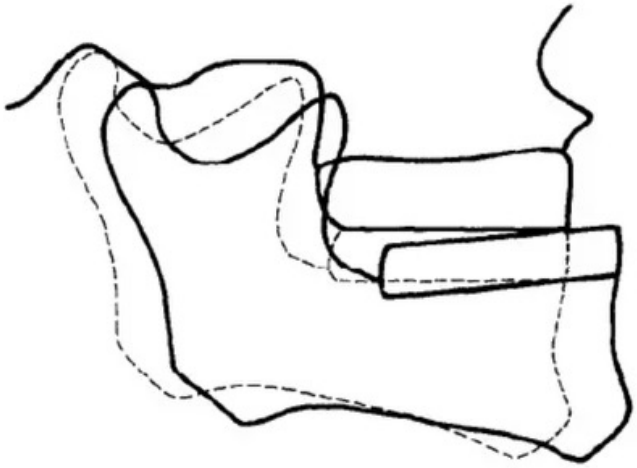
When programming mandibular advancement, I recommend setting the sagittal goal in the ClinCheck® set-up to at least –2 mm overjet (i.e., slight hypercorrection). This recommendation is supported by Pancherz's findings in patients treated with the Herbst appliance, where relapse of overjet and molar relationship averaged 2.2 mm and 1.7 mm, respectively, with most occurring within six months of treatment completion.[3]

The rate of mandibular advancement is also critical. Evidence indicates that small, incremental changes (e.g., 2 mm) produce greater skeletal effects than a large single advancement.[4] With aligners, these incremental steps can be digitally programmed, eliminating the need for repeated manual adjustments. In practice, a 2 mm advancement is typically introduced every 8 aligner stages until the therapeutic bite goal is reached. Hypercorrection to at least an edge-to-edge incisal relationship should always be targeted.

[1] Clark WJ. The twin block technique. A functional orthopedic appliance system. Am J Orthod Dentofacial Orthop. 1988 Jan;93(1):1-18. doi: 10.1016/0889-5406(88)90188-6. PMID: 3422118.
[2] Cretella Lombardo E, Lugli L, Lione R, Bollero P, Cozza P, Pavoni C. Orthodontic Management of Class II Malocclusion with Clear Aligners: Mandibular Advancement vs. Class II Elastics. Children (Basel). 2025 Apr 26;12(5):562. doi: 10.3390/children12050562. PMID: 40426741; PMCID: PMC12110437.
[3] Pancherz H, Hansen K. Occlusal changes during and after Herbst treatment: a cephalometric investigation. Eur J Orthod. 1986 Nov;8(4):215-28. doi: 10.1093/ejo/8.4.215. PMID: 3466794.
[4] Aras I, Pasaoglu A, Olmez S, Unal I, Tuncer AV, Aras A. Comparison of stepwise vs single-step advancement with the Functional Mandibular Advancer in Class II division 1 treatment. Angle Orthod. 2017 Jan;87(1):82-87. doi: 10.2319/032416-241.1. Epub 2016 Jul 1. PMID: 27366817; PMCID: PMC8388596.

Another advantage of the Invisalign® system is the flexibility to sequence treatment according to individual patient needs and growth stage, all within the same appliance platform. For example, in deep bite patients with a steep curve of Spee, anterior pre-contacts may initially prevent true sagittal advancement, producing only posterior bite opening. In such cases, correction of incisor inclination and leveling of the curve of Spee should precede mandibular advancement. Conversely, when arch coordination and anterior alignment are favorable from the outset, mandibular advancement may be initiated earlier, following only a short pre-MA phase. In some patients – particularly in Class II, division 1 cases with the arches already coordinated, or as a consequence of a well-conducted Phase 1 treatment – it is possible to start mandibular advancement immediately, without a preliminary pre-MA stage. In Class II, division 2 malocclusions, however, 7–10 months of alignment (30–45 aligners) are often required before sagittal correction can begin, whereas in Class II, division 1 cases, the preparation phase is generally shorter.

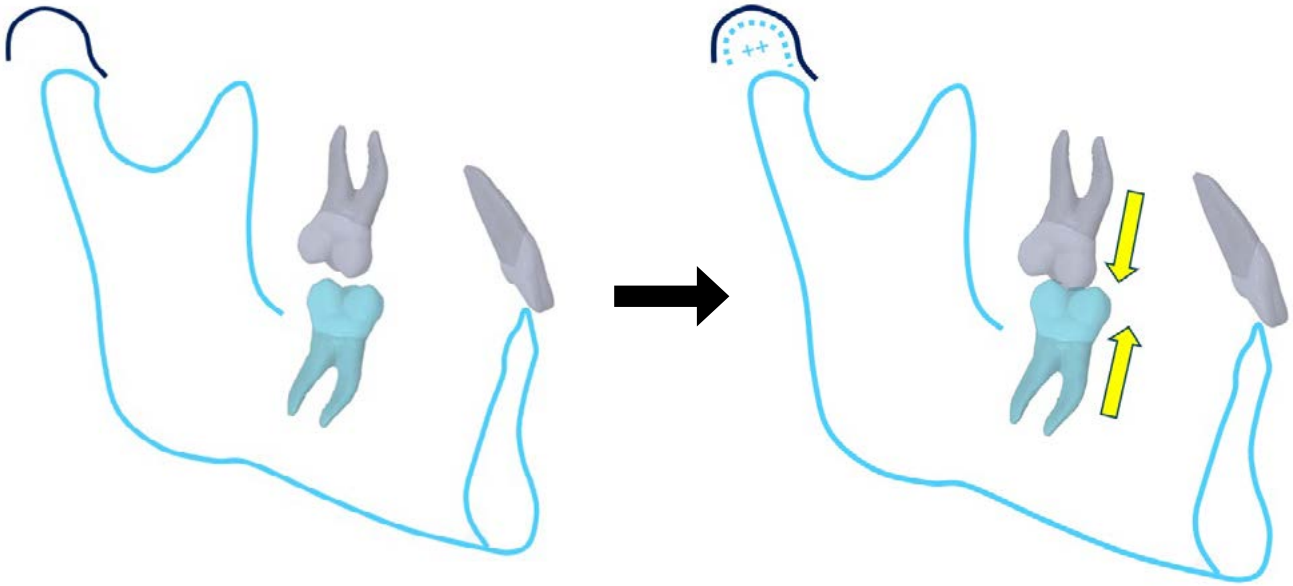
Regardless of timing, any forward repositioning of the mandible inevitably creates a posterior open bite due to condylar and fossa anatomy. This phenomenon, first described by Christensen in 1905, is not the result of molar intrusion but rather a positional effect.[5] The orthodontic solution lies in fully leveling the curve of Spee and coordinating arch widths so that incisors and canines do not interfere in the advanced Class I position.



Posterior open bite formation due to the Christensen phenomenon.[5] As the condyle slides down the articular eminence due to forward mandibular repositioning, the posterior dentition of the lower arch also drops downward, giving the appearance of a posterior open bite.

[5] Christensen C. The problem of the bite. D Cosmos, 1905;47:1184 95.

In growing patients, posterior eruption will usually complete the occlusion over time. Clinically, I often section the last aligner 3–3 to maintain anterior alignment while letting the posterior teeth settle for 6–12 months until a stable Class I occlusion is achieved. This practice is derived from how we manage the Christensen phenomenon in our patients treated with the Twin Block appliance.



In growing patients, the teeth will continue to erupt (yellow) while the sagittal correction is stabilized.

Left: A 13 year-old Twin Block patient's pre-treatment left buccal view.

Center: Left buccal view after 10 months of Twin Block therapy. The appearance of an open bite after Twin Block treatment is common due to the Christensen phenomenon.

Right: The open bite resolved after 2 months as a result of the natural tooth eruption response that occurs in growing patients.

Management of posterior open bite in Class II correction with Bolton analysis, occlusal contacts, and upper incisor torque in the ClinCheck® set-up

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After graduating from Ankara University Faculty of Dentistry, Dr. Türkyılmaz completed her orthodontic specialization training at Başkent University Faculty of Dentistry, Department of Orthodontics. Her graduate clinical thesis was on “Examination of the Effects of Miniscrew Supported and Conventional Maxillary Expansion Appliances with CBCT.” She currently practices orthodontics in Manisa, Turkey at Klinik 45 (www.klinik45.com) which offers a multidisciplinary approach to oral and dental health. The orthodontic practice is fully digital and offers Invisalign® treatment to kids, teens, and adults.

Our approach to Class II treatment in growing patients

Many of the Class II patients in our practice are mandibular retrognathic, so we will prioritize advancing the mandible to optimize their facial profile. Orthognathic surgery is always an option, but most patients do not want this option. Upper premolar extractions for retrognathic patients with mild to moderate crowding will usually make the facial profile worse, so we avoid this option. We can also extract 3rd molars and distalize the uppers with elastics support (and TADs as an absolute anchorage option) or IPR in the bicuspids secondarily, but with distalization mechanics, we usually only get a half cusp of Class II correction in the best case scenario.

For growing patients who need Class II correction, we follow one orthodontic protocol for children and another one for teens. For younger kids from ages 7-8 years (at the earliest), we will recommend 6 months of Phase 1 treatment to start decompensating the dentition and also to gauge the patient's treatment compliance. Since mandibular growth has not yet peaked at this age (especially for boys), we have time to set up the arches for mandibular advancement later. We will typically derotate and distalize the permanent upper first molars, expand the upper arch, procline the upper incisors, and level the lower occlusal plane during the early stages of their Class II treatment, and then advance the mandible to correct the sagittal discrepancy.

For older children and teenage patients (i.e., 10+ years old for girls and 11+ years old for boys), we do not want to spend too much time preparing the dentition for mandibular advancement since they may already be in the middle of their mandibular growth spurt. The longer the delay before starting mandibular advancement, the greater the risk of missing the patient's mandibular growth peak. Because of this, we want any pre-mandibular advancement (pre-MA) peak with our older children and teen patients' to be very short so that the patient can start the mandibular advancement phase in one or two months.

The parents of older children will usually want us to try to advance the mandible first even if their child's growth potential is limited, so we always need to establish realistic expectations and let them know the plan for managing any excessive overjet that remains. Once the patient's mandibular growth has stopped, any excessive overjet will be addressed in Phase 2 treatment using distalization mechanics with elastics for anchorage support, or with interproximal reduction to reduce the overjet.

Treatment options for mandibular advancement

For the mandibular advancement phase of Class II treatment, we prefer Invisalign® aligners in our practice because the aligners have very good lower incisor torque control. With other Class II correctors like Herbst, acrylic twin block, and monoblock appliances, anchorage loss and proclined lower incisors are more problematic, even with acrylic caps over the incisors. For our younger patients, we prefer using enhanced precision wings for mandibular advancement with aligners because eruption compensation features can be prescribed under the wings so the premolars can continue to erupt during the mandibular advancement phase.

Invisalign® aligners with enhanced precision wings position the lower jaw forward with minimal vertical opening when the aligners are worn.

For our older children and teenage Class II patients, we prefer the occlusal blocks feature to advance the mandible with aligners because in many cases, the blocks will open the patient's bite enough to allow the mandibular advancement feature to begin working right away. Class II patients with a severe deep bite can also benefit from the immediate vertical opening from the occlusal blocks.

Invisalign occlusal blocks can be started with minimal to no pre-MA phase due to the vertical opening by the blocks.

We try to keep the pre-MA phase for older patients very short – typically one to two months of pre-MA (7 or 8 pre-MA aligners changed weekly), but occasionally up to 100 days of pre-MA at most (20 pre-MA aligners worn 5 days per aligner). For Class II, division 2 patients, the retroclined upper central incisors can prevent the mandible from sliding forward into a Class I relationship, and these teeth usually take a little more time to de-torque. With occlusal blocks, however, the patient can initiate mandibular advancement with minimal to no delay.

During the sagittal correction phase, we prefer to advance the mandible in 2 mm increments instead of a single step for several reasons. The first is to reduce the delay in starting mandibular advancement. With incremental steps, we only need to decompensate the teeth enough for the first 2 mm step to occur, whereas with a large step more time is needed to decompensate the teeth. The second reason is that patients with severe overjet (more than 6 mm) may have difficulty with a sudden large change to their mandibular position. Some of these patients may end up biting to one side to find a resting place for their lower jaw. A mandibular deviation in patients using enhanced precision wings can cause wing biting on one side and buccal tipping of the teeth underneath the wings. The goal of incremental mandibular changes is to give the patient more time to adapt to the bite changes so that wing biting can be avoided. If an enhanced precision wings patient continues to flatten their wings even with gradual increments and proper training, we will rescan their bite and switch their aligners to the occlusal blocks feature, since the occlusal blocks are solid and cannot be crushed by the bite like the wings can.

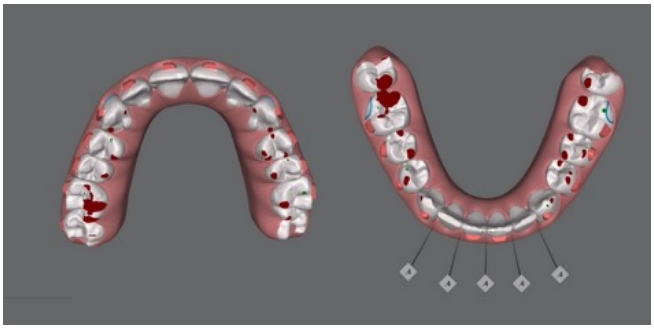
How to use the ClinCheck® set-up to manage a posterior open bite

A posterior open bite can be created during the mandibular advancement phase of Class II correction if the upper incisors are retracted into contact with the lower incisors before the curve of Spee is completely leveled. Premature contact between the upper and lower incisors will prevent the posterior teeth from reaching maximum intercuspation. If the premature anterior contacts are eliminated (by intruding the incisors, extruding the posterior teeth, or a combination of both) the posterior open bite will be fixed.

The following are suggested ways to manage a posterior open bite in this situation:

1. Don't panic. Understanding why open bites occur after mandibular advancement should help everyone stay calm. Also be sure to let the parents know beforehand what to expect during treatment, and that a posterior open bite can appear after the mandibular advancement phase. Remind the parents that additional aligners and elastics are usually needed after the mandibular advancement phase to complete the Class II correction.

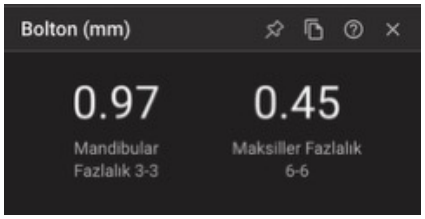
2. Ensure proper leveling with additional aligners and attachments by setting up the teeth in the ClinCheck software with heavy occlusion (red contacts) on the molars and premolars, and no occlusal contacts on the incisors. The canines should be in contact (green or red point contacts), but not in heavy contact (broad red contacts).



The combination of heavy posterior occlusal contacts and no anterior occlusal contacts in the ClinCheck set-up is designed to eliminate anterior interferences which prevent the posterior teeth from completely interdigitating.

3. Add additional buccal crown torque to the upper incisors in the ClinCheck set-up if they are initially upright or retroclined. The additional torque is intended to account for any vertical play between the anterior teeth and the aligner (i.e., incomplete aligner seating). The idea here is similar to high-torque orthodontic brackets which have additional torque built into the bracket to account for slot play. We accomplish this by setting our upper incisors to the desired position first and then using the ClinCheck tooth measurement table to confirm the addition of +5 to +10 degrees of extra inclination to the upper incisors.

4. Check for Bolton discrepancies to make sure that a Class I relationship with normal overbite and overjet is possible for the patient. Anterior interferences will occur in a Class I relationship if the mandibular width is excessive when the overbite is set to ideal. Our regional preference for managing mandibular excess is IPR in the lower incisors rather than leaving space for upper restorations, but both are possible options in the event of a tooth-size discrepancy.



The automated Bolton measurement in the ClinCheck software in this example shows a mandibular excess of almost 1 mm from 3-3 which we will eliminate with lower anterior IPR. A slight maxillary excess from 6-6 is also present which we will monitor. If we are not able to interdigitate the canines and molars well, we may consider posterior IPR in the upper arch to resolve this discrepancy.

5. Use Class II elastics in the additional aligners phase to continue re-training the patient's jaw in its new position. We use medium elastics on bonded buttons to the upper canines and lower molars because of the vertical force component generated by this configuration. If the canines do not need to be extruded, we will use precision cuts on the canines instead.

6. Box elastics (medium-heavy force elastics, 22 hours a day for 7-10 days) on buttons bonded to the 5s and 6s may be needed at the end of the additional aligners phase to completely close the bite. The aligners are not worn while the box elastics are used, so we will bond the upper and lower 3-3 with a fixed retainer beforehand to hold the anterior alignment and overjet in place while the elastics are worn.

Case example

This patient was a 10-year, 8-month-old female with a chief concern of having a short (retrognathic) mandible and a retruded lower lip.

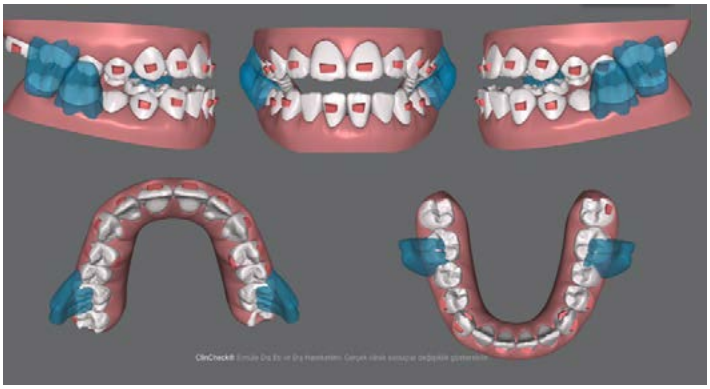
Initial photos:

Diagnosis

The patient was end-on Class II, division 1 on both sides. Her facial profile was convex due to a retrognathic mandible (ANB = 5°). The upper arch was constricted, and the upper incisors were protruded (SN-U1 = 128.6°). She had a severe deep bite (IMPA=100.6° degrees), mild upper anterior crowding, and severe lower anterior crowding.

Treatment plan

Our plan was to use Invisalign® aligners with enhanced precision wings for mandibular advancement, followed by additional aligners with Class II elastics to finish. Since the patient was able to slide her mandible forward by at least 2 mm with minimal vertical opening, no pre-MA phase was planned. 27 mandibular advancement aligners were ordered. The aligners were worn 22 hours per day and changed weekly.



The treatment goal was to use Invisalign aligners with enhanced precision wings to advance the mandible (stage #27 of 27 in the ClinCheck® set-up shown)

Additional aligners after the mandibular advancement phase

Progress photos of the patient after the mandibular advancement phase (27 of 27 Invisalign® aligners with enhanced precision wings were used).

After the mandibular advancement phase, the patient's right side was mild Class III and the left side was still Class II. The arches were not able to fully interdigitate in Class I for two main reasons – first because the curve of Spee was not completely level; second, a tooth-size discrepancy of mandibular excess was present.

The plan was to use additional aligners to completely level the curve of Spee. The Bolton tooth-size discrepancy would be resolved with IPR of the lower anterior interproximal contacts (3-3).

Final results:

Final results after 17 additional aligners (no mandibular advancement features in these aligners). Bilateral Class II elastics (3/16" medium) were used with precision cut hooks near the canines and bonded buttons on the lower first molars.

Final Results

Seventeen additional U/L aligners were used with Class II elastics on both sides to level the lower incisors and achieve Class I. To make space for retraction of the lower incisors to resolve the tooth-size discrepancy, IPR was performed on the lower 3-3 (0.4 mm per contact). Removing the anterior interferences allowed the bite to fully interdigitate in Class I. Box elastics were not needed with this patient.

The total treatment time was 14 months. Post-treatment ceph analysis showed an improvement of ANB from 5° (initial) to 1.5° (final), SN-U1 from 128.6° (initial) to 110.6° (final), and IMPA° from 100.6° (initial) to 99.5° (final).

After orthodontic treatment was completed, upper and lower bonded wire retainers were placed from 3-3 and Vivera™ retainers were ordered. Our patients change their Vivera retainers every 6 months and wear them 18 hours per day for the first retainer set, then 12 hours a day for the second set, and then at night only (8 hours a day) for the remaining sets.

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The opinions expressed in this case report are those of the author and are based solely on their personal experience, and may not reflect those of Align Technology, Inc. The author was paid an honorarium by Align Technology, Inc. in connection with writing this report.