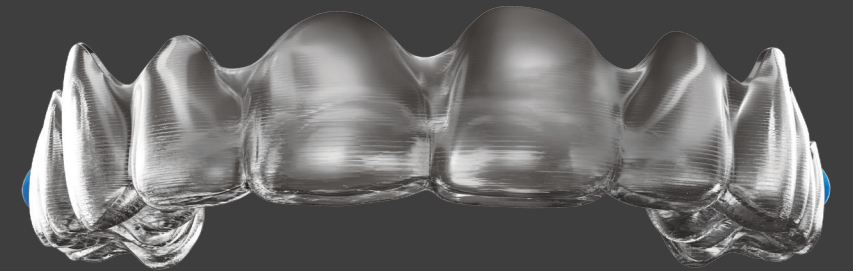


Weekly Changes of
Invisalign® Clear Aligners
in the Treatment of
Teenage Class II Patients

Weekly changes
of Invisalign®
clear aligners
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Class II patients



Summary

Innovations in Invisalign® clear aligner material and design, including SmartTrack® aligner material and SmartForce® features, have helped make it possible to change Invisalign® aligners weekly without slowing down the programmed velocity of tooth movement.

Weekly aligner changes may reduce treatment time, reduce the risk of patient burnout, and increase orthodontic practice efficiency.

This paper details my experience treating Class II malocclusions in growing teenagers with Invisalign® clear aligners changed on a weekly basis.

In my experience, Invisalign® treatment can provide similar results to traditional fixed appliances without the need for additional devices like headgear, functional appliances, or Class II correctors.



Dr Tarek El-Bialy has a Certificate of Specialty in Orthodontics, an MSc degree in Oral Sciences from the University of Illinois, IL, USA, and a PhD in Bioengineering, also from the University of Illinois. His orthodontic practice is in downtown Edmonton, AB, Canada, and he is a professor of Orthodontics and Biomedical Engineering at the University of Alberta, AB, Canada.

Introduction to weekly changes of Invisalign® aligners:

With the previous generation aligner material, the recommended aligner change interval was two weeks for every 0.25 mm of programmed tooth movement.

Align Technology now recommends orthodontists prescribe weekly aligner changes in their Invisalign® treatments.

This may reduce treatment times by up to 50% compared with changes every 2 weeks.

This recommendation is based on clinical analysis of more than 200 Invisalign® cases.

SmartTrack® material offers gentle, more constant force and, in the study of Wheeler and Patel, the amount of tooth movement achieved after 7 days of SmartTrack® aligner wear was greater than the amount achieved after 14 days of wear with the previous-generation aligner material.¹ A shorter lag phase was also observed.

This change in material and the improved material properties of SmartTrack® aligner material led me to start changing my treatment protocols to begin treating patients with weekly aligner changes. The transition to weekly aligner changes has improved the efficiency of my practice significantly, especially for complex orthodontic cases. As a result, I now present non-extraction, non-surgical, clear-aligner treatment options to teenage and adult patients across a broad range of malocclusions, including Class II and Class III, deep and open bites, and moderate to severe crowding.

Efficiently treating Class II malocclusion in teenagers

Treating teenagers with Class II malocclusion using clear-aligner therapy can be challenging if efficient mechanics are not used. Upper distalization mechanics, for example, typically require a large number of aligners due to the substantial amount of tooth movement needed. Class II elastics are also often used for anchorage control, which increases the compliance burden on the patient considerably. The risk of external apical root resorption (EARR) is also a concern in Class II cases as treatment time increases, particularly in cases with greater movement of the tooth apices.²

The following cases detail my use of Invisalign® clear aligners with SmartTrack® material and SmartForce® features by setting the upper arch and allowing the lower to reach its full growth potential.

Case 1

Age: 14 years

Sex: Female

Chief concern: Deep bite, narrow smile and improper bite

FIGURE 1. Initial records

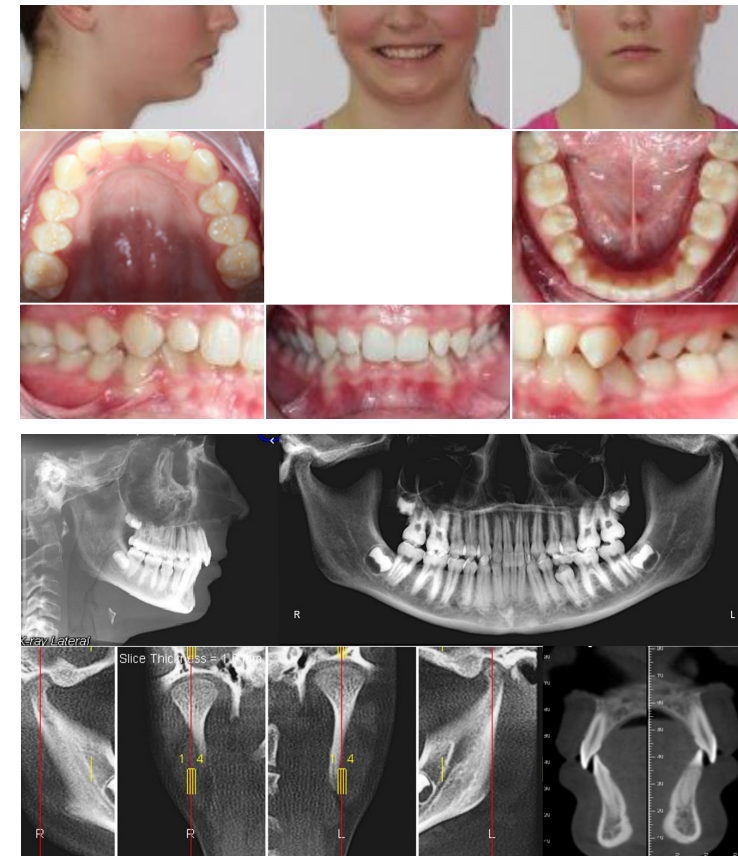


TABLE 1. Clinical findings

Class II bite relationship	
Right side	Full cusp Class II
Left side	Half cusp Class II
Class II division 2 incisor relationship	
Skeletal pattern	Class II, retrognathic mandible with forward growth potential
Overbite	Deep, with upper incisors tipped lingually
Upper arch	Mild crowding, constricted dental arch
Lower arch	Mild crowding

Treatment plan

- Weekly Invisalign® clear aligner changes.
- Procline the upper-central incisors to create enough horizontal clearance for the mandible to autorotate forward into Class I.
- Intrude the lower incisors to level the Curve of Spee to avoid an anterior interference when the mandible comes forward.
- Expand the upper arch so that a posterior crossbite is not created when the mandible advances.
- Distalize the upper molars slightly in the set-up. The goal is not to distalize the upper molars into Class I completely, but rather to initiate the mandibular growth process as detailed by Ricketts in his bioprogressive technique.^{3,4}
- Add Precision Cuts to the aligners on the upper canines and lower first molars. Light Class II elastics (3.5 oz. 5/16") should be worn during the day and shorter elastics (3.5 oz. 3/16") at night for anchorage control during the distalization.
- Disposable aligner tray seaters need to be used by the patient for 15 minutes three times each day (after meals) to seat the aligners fully and to maximize the expression of any tooth movements built into each appliance.

Treatment outcome

Previous traditional treatment options would ordinarily have required headgear, extractions and/or a separate functional appliance. However, by using Invisalign® treatment, after 6 months with weekly aligner changes (24 of 49 aligner stages), the Class II malocclusion was corrected to Class I. In contrast, with fixed appliances, either a separate functional-appliance phase would be needed initially, or the Class II malocclusion would be corrected near the end using a non-compliance device.

FIGURE 2. Progress photographs after 6 months of Invisalign® treatment. Class II malocclusion has been corrected



A button was bonded to the lingual surface of the lower-left second premolar and connected to elastics stretched over the lower aligner to two buccal aligner slits cut in the area of the lower-left second premolar. These elastics assisted with the correction of the lingually erupted second premolar after exfoliation of the lower-left primary second molar.

The total treatment time was 13 months (49 upper and lower aligners, aligners changed weekly, no additional aligners). In order to achieve proper overbite, overjet, and Class I canines, spaces distal to the upper lateral incisors were left for composite bonding, due to the anterior tooth-size discrepancy. The patient's oral hygiene and general dental health were excellent.

FIGURE 3. Photographs after treatment

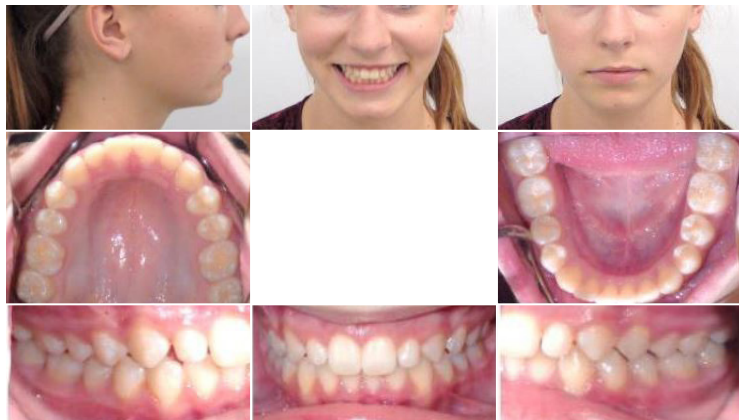
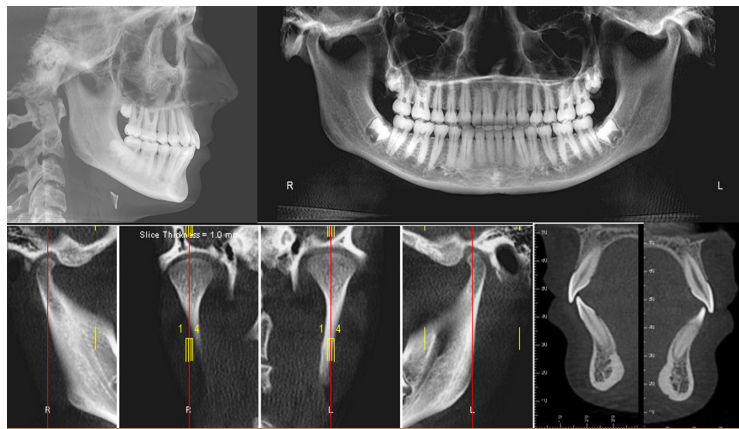


FIGURE 4. Final records



Radiographic analysis shows that proper incisor torque was achieved, along with good root angulation. Both condyles were seated, and no functional shift was detected. Cephalometric superimposition on sella-nasion (at sella) revealed forward mandibular growth during treatment, a 1° improvement to A point-nasion-B point angle (ANB), proclination of the upper incisors by 5°, and almost no change to lower incisor inclination (+0.3°).

FIGURE 5. Cephalometric superimposition (pre- and post-treatment)

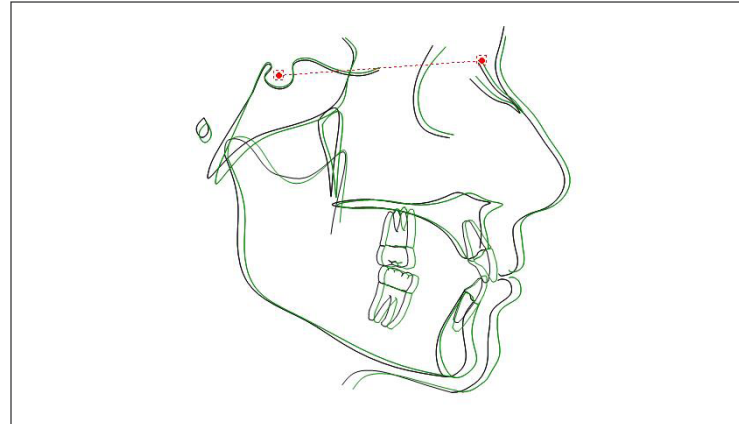


TABLE 2. Initial and final cephalometric measurements

		Norm	Initial	Final
Maxilla to cranial base	SNA (°)	82	86.7	86.8
	Mandible to cranial base	SNB (°)	80.9	82.6
	SN - GoGn (°)	32.9	27.4	25.9
	FMA (MP-FH) (°)	25	20.7	21.7
Maxillo-mandibular	ANB (°)	1.6	4.1	3
Maxillary dentition	U1 - NA (mm)	4.3	1.4	3.1
	U1 - SN (°)	102.5	104.1	108.9
Mandibular dentition	L1 - NB (mm)	4	4.9	4
	L1 - GoGn (°)	93	97.4	97.7
Soft tissue	Lower lip to E-plane (mm)	-2	-2	-1
	Upper lip to E-plane (mm)	-3.8	-4.1	-4.2

ANB, A point-nasion-B point angle; FH, Frankfort horizontal; FMA, Frankfort mandibular plane angle; Gn, gnathion; Go, gonion; GoGn, mandibular plane; L1, lower incisor; MP, mandibular plane; NA, nasion-A point; NB, nasion-B point; SN, sella-nasion; SNA, sella-nasion-A point angle; SNB, sella-nasion-B point angle; U1, upper incisor.

Case 2

Age: 11 years

Sex: Male

Chief concern: Crowded teeth and high (ectopically erupted) canines

FIGURE 6. Initial records

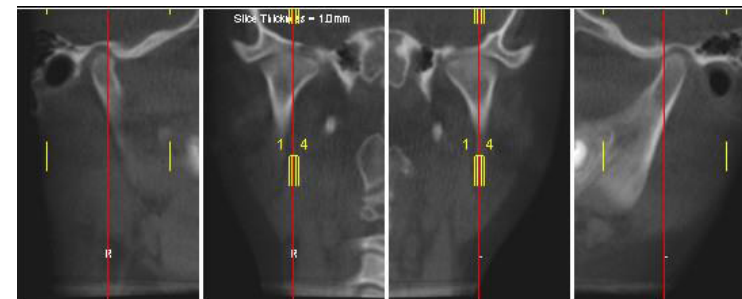
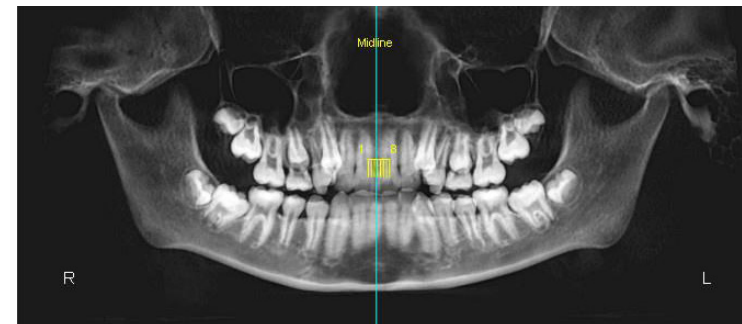


TABLE 3. Clinical findings

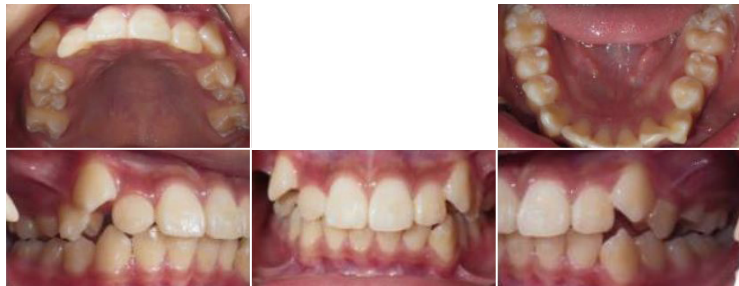
Class II malocclusion (bite relationship)	
Right side	Half cusp Class II
Left side	Half cusp Class II
Skeletal pattern	Class II, with a retrognathic mandible and forward growth potential
Overbite	Deep, with retroclined upper incisors and slightly proclined lower incisors
Upper arch	Severe crowding with ectopic canines and upper primary second molars (Es) still present, constricted arch
Lower arch	Severe crowding, constricted arch

Treatment plan

- Weekly Invisalign® clear aligner changes.
- Procline the upper incisors, level the Curve of Spee and distalize the upper molars slightly to optimize mandibular growth using a bioprogressive approach.
- Add precision cuts for light elastics to the upper canines and lower first molars (ultimately, elastics were not needed).
- After the primary second molars exfoliate, utilize the E-space to help relieve the upper crowding.
- Do not incorporate the ectopic canines into the initial upper aligners because of the large vertical discrepancy (which will weaken the aligner). Instead, use canine pontic spaces in the aligner to allow for passive canine eruption while the space is being developed. Include the ectopic canines in the additional aligners after they have erupted into the space developed with the initial aligners.

Treatment outcomes

FIGURE 7. Progress photographs after the initial aligner series (9 months, 34 upper and lower aligners, aligners changed weekly)



After 9 months of Invisalign® treatment (34 upper and lower aligners, aligners changed weekly), the molar relationship was improved, and the canines started to come down into the space that was created. The primary second molars had exfoliated, but the E-space was preserved by the upper aligners. After 17 months of treatment (35 upper and lower additional aligners changed weekly), both upper canines were in a good vertical position. The severe crowding was corrected in both arches, the right side was corrected to Class I, and the left side was slightly Class II by -1 mm. Oral hygiene and general dental health were both excellent. After a second set of 30 upper and lower additional aligners (aligners changed weekly), the treatment was finished, with both sides corrected to Class I. The total treatment time was 25 months, which is on par with a typical Phase 1 + Phase 2 treatment.

FIGURE 8. Final records

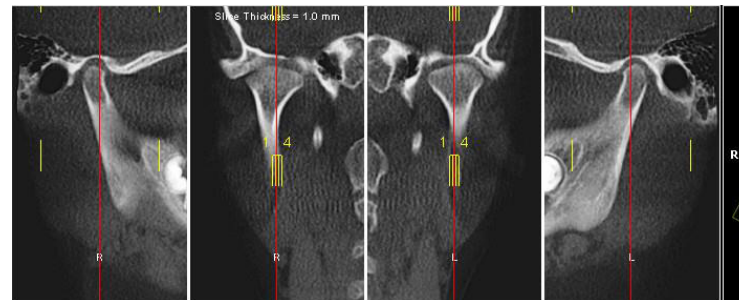


FIGURE 9. Cephalometric superimposition (pre- and post-treatment)

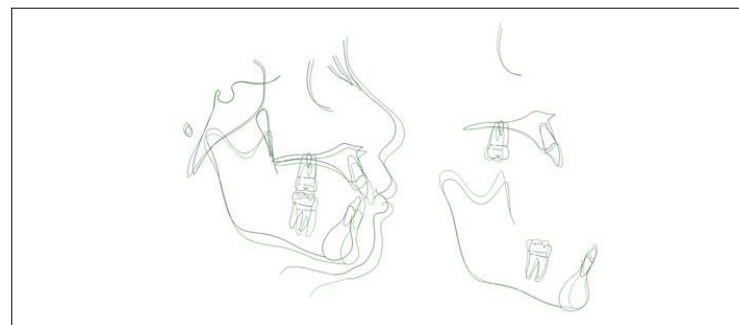


TABLE 4. Initial and final cephalometric measurements

		Norm	Initial	Final
Maxilla to cranial base	SNA (°)	82	82.7	81.6
	Mandible to cranial base	SNB (°)	80.9	75.8
Maxillo-mandibular	SN - GoGn (°)	32.9	37.2	34.5
	FMA (MP-FH) (°)	25	24.5	20.7
Maxillary dentition	ANB (°)	1.6	6.9	4.9
	U1 - NA (mm)	4.3	1.2	2.6
Mandibular dentition	U1 - SN (°)	102.5	96.9	94.1
	L1 - NB (mm)	4	7.6	5.5
Soft tissue	L1 - GoGn (°)	93	107.8	90.4
	Lower lip to E-plane (mm)	-2	3.6	2.5
	Upper lip to E-plane (mm)	-3.8	3.1	1.9

ANB, A point-nasion-B point angle; FH, Frankfort horizontal; FMA, Frankfort mandibular plane angle; Gn, gnathion; Go, gonion; GoGn, mandibular plane; L1, lower incisor; MP, mandibular plane; NA, nasion-A point; NB, nasion-B point; SN, sella-nasion; SNA, sella-nasion-A point angle; SNB, sella-nasion-B point angle; U1, upper incisor.

Cephalometric superimposition analysis revealed that good upper incisor inclination was achieved (+6°), along with forward growth of the mandible, which reduced the sagittal discrepancy significantly (Δ ANB = -5°). The lower incisors were proclined by +6° as a result of correction of the severe crowding, which is acceptable, because it has been shown that lower incisor inclination relative to the mandibular plane is reduced with age.^{7,8}

Case 3

Age: 10 years
Sex: Male
Chief concern: Increased overjet, overbite, and teeth sticking out

FIGURE 10. Initial records

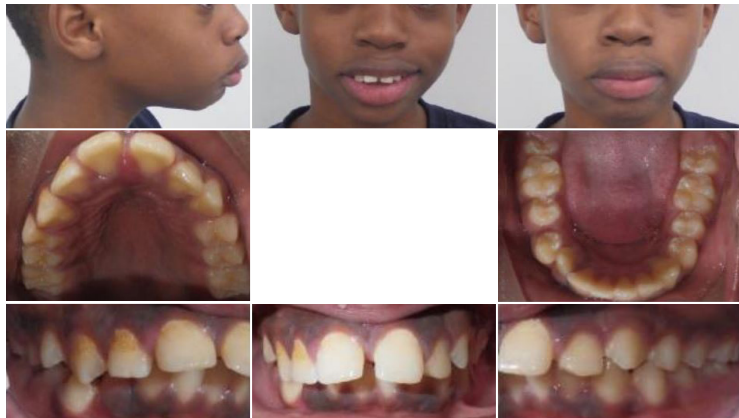
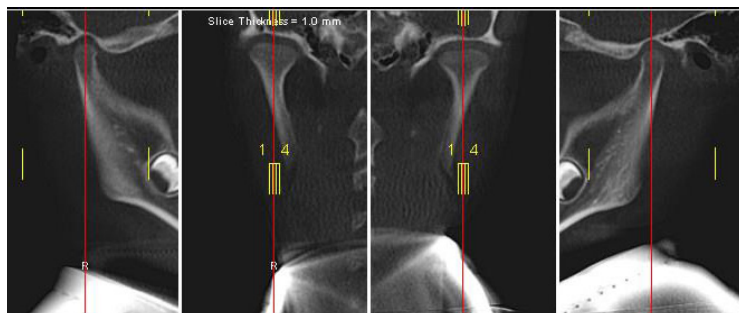


TABLE 5. Clinical findings

Class II bite relationship	
Severe bimaxillary dental protrusion	
Class II division 1 incisor relationship	
Right canine	Half cusp Class II
Right molar	Class II tendency
Left canine	Half cusp Class II
Left molar	Class II tendency
Skeletal pattern	Class II, with a severely retrognathic mandible
Overbite	Deep, with severely proclined upper incisors (+25°) and lower incisors (+12°)
Upper arch	Severe generalized spacing, with a constricted arch
Lower arch	Mild spacing, constricted arch, and lingually positioned lower-right canine

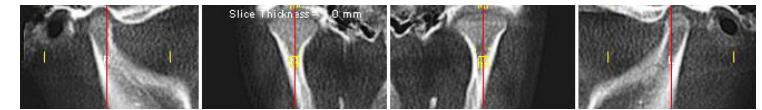
Treatment plan

- Weekly Invisalign® clear aligner changes.
- To maximize mandibular growth, level the Curve of Spee to avoid anterior interferences during space closure.
- Dental expansion of both arches by 3 mm per side to create sufficient arch width for incisor retraction.
- Apply buccal root torque to the posterior teeth to ensure adequate buccal overjet.



Treatment outcome

FIGURE 11. Progress photographs after 6 months of treatment. Class II malocclusion close to being fully corrected



After 6 months of Invisalign® treatment with weekly aligner changes (24 of 37 upper and lower aligners), the proclined incisors were improved significantly. The upper spaces were almost fully closed, and the canines were almost in Class I relationship.

After 9 months of Invisalign® treatment with weekly aligner changes (37 of 37 upper and lower aligners), arch development was completed, the canines were Class I on both sides, incisor inclination was ideal, and the midlines were centered. Additional lower arch leveling with additional aligners was still needed to close the slight posterior open bite on the left side. On the right side, buccal coordination of the lower first premolar was still needed. The patient's oral hygiene and general dental health have both been excellent so far.

FIGURE 12. Final records after initial aligner series



FIGURE 13. Cephalometric superimposition (pre- and post-treatment)

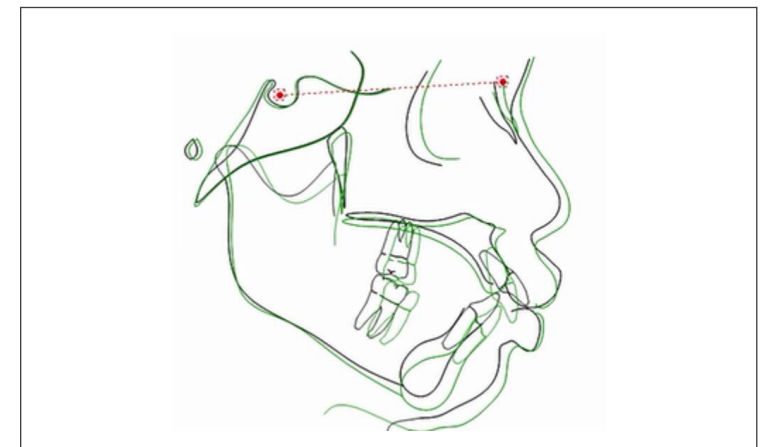


TABLE 6. Initial and final cephalometric measurements

		Norm	Initial	Progress
Maxilla to cranial base	SNA (°)	82	85.6	83.9
	Mandible to cranial base	80.9	78	79.1
	SN - GoGn (°)	32.9	34.2	34.3
	FMA (MP-FH) (°)	25	25.2	27.5
Maxillo-mandibular	ANB (°)	1.6	7.6	4.8
Maxillary dentition	U1 - NA (mm)	4.3	11.4	6.5
	U1 - SN (°)	102.5	127.5	103.4
Mandibular dentition	L1 - NB (mm)	4	11.2	8.1
	L1 - GoGn (°)	93	104.9	98.3
Soft tissue	Lower lip to E-plane (mm)	-2	7.4	9
	Upper lip to E-plane (mm)	-3.8	7.3	6.9

ANB, A point–nasion–B point angle; FH, Frankfort horizontal; FMA, Frankfort mandibular plane angle; Gn, gnathion; Go, gonion; GoGn, mandibular plane; L1, lower incisor; MP, mandibular plane; NA, nasion–A point; NB, nasion–B point; SN, sella–nasion; SNA, sella–nasion–A point angle; SNB, sella–nasion–B point angle; U1, upper incisor.

Cephalometric superimposition analysis shows an improvement of the sagittal discrepancy consistent with mandibular growth (Δ ANB = -3°). The upper incisor proclination was improved significantly (-24°). The lower incisor proclination was also improved (-7°).

Discussion

Each of the Invisalign® clear aligner treatments for the three teenage Class II malocclusions described here had aligners that were changed weekly, with 0.25 mm maximum tooth movement per aligner, and the elastic properties of the SmartTrack® aligner material were leveraged. As a result, the majority of the Class II correction was accomplished in as little as 6–9 months.

Upper incisor torque control was not difficult to accomplish with Invisalign® aligners, especially since Power Ridge® features are automatically built into the aligners whenever significant incisor torque is detected in the ClinCheck® set up. Notwithstanding this, orthodontists need to consider the complete jaw when planning treatment and be experienced in the use of elastics. This efficient treatment approach significantly reduces the risk of patient burnout and gives plenty of time for detailing with additional aligners if needed.

The key to success in these cases was removing the dental interferences that prevented the mandible from growing forward. In the upper arch, this meant proclining any retroclined teeth and expanding the arch to avoid posterior crossbites, as well as slight molar distalization to initiate the mandibular advancement. In the lower arch, this meant leveling the Curve of Spee and using light Class II elastics, if needed, to guide the mandible into the desired location. Dental expansion was the preferred method for arch length creation, but interproximal reduction may be needed if a Bolton discrepancy exists and the patients/parents are not in favor of restorations in the upper arch to restore tooth width.

Oral hygiene and enamel health were excellent. In addition, root health was excellent, with no clinically significant incisor root resorption observed. Similar apical findings are part of a preliminary study presented at the 2017 American Association of Orthodontists (AAO) conference in San Diego, CA, USA.⁹

In summary:

- SmartTrack® material and SmartForce® features lead to an increase in tooth movement predictability. Because of this, aligners made with SmartTrack® material are able to achieve the same or a greater amount of tooth movement with the same predictability as aligners made of EX30™ material, thus enabling weekly aligner changes.
- To maximize the efficiency benefits of weekly aligner changes, the velocity of tooth movement programmed into the aligner should not be slowed down. Simply instruct patients to change their aligners weekly, using the existing maximum lead tooth movement of 0.25 mm per aligner.
- I believe my results with Invisalign® treatment have been similar to those that can be accomplished with fixed appliances.
- The Class II corrections in the teenage patients shown here were achieved in as little as 6–9 months, which is similar to Class II correction times using other methods.
- Greater treatment efficiency helps minimize problems associated with longer orthodontic treatment, such as EARR, gingival inflammation, and enamel decalcification.

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Align Technology, Inc.
2560 Orchard Parkway
San Jose, California 95131, USA
Tel: 408-470-1000
Fax: 408-470-1010

www.invisalign.eu

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