How Successful is Invisalign for Treatment of Class III Malocclusion?

Invisalign
Ask the Expert Series
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I have a positive message today about Invisalign...

- The Invisalign system works much better today than 10 years ago!
- We have new tools to solve even the most difficult malocclusions like mild to moderate Class II correction (distalization and bite jump protocols), open bite (G3), deep overbite (G5) and severe crowding with moderate to maximum anchorage (G6).

Intraoral scanning has made everything so much easier (no gagging, fast, no rejected impressions, and increased resolution)

- Class III treatment with Invisalign is the last major type of malocclusion which does not have a specific type of protocol yet.
We have a new scanner called the Element - has 40% quicker scan and 70% less weight - Wand 14 oz and has controls (no more foot pedal).

Wireless pedal
Mouse
Screen
Wand
Scanner body

Quality of impressions is better than PVS for small details

More surface details than PVS (including gingiva) - in future will be able to predict gingival form and post tx crown length

Intraoral scanning: Benefits to patient and doctor

- More comfortable impression experience (No gagging & easier for limited opening patients and MFP)
- Great marketing tool
- Scan time of 7 to 8 min for both arches
- No rejected impressions - 100% approval at time of scan
**Intraoral scanning:**
**Benefits to patient and doctor (con’t)**

- Short learning curve
- Images are not distorted by patient movement
- Increased resolution and fit of aligners
- Quick turn around (1 day) and quicker manufacturing times (4 to 5 days)

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**Central theme today for Class III treatment**

- A large body of scientific evidence shows that the size of the mandible is primarily genetically determined and cannot be changed in size significantly over the long term (for review see Ngan and Moon –AJODO, 2015)
- The maxilla is the more moldable jaw which can be moved forward in most individuals (for review see De Clerk and Proffit-AJODO, 2015)
- These studies show that the younger the patient, the more the maxilla can be moved mesially and widened for orthopedic change (works best in 6 to 8 yrs with reverse pull head gear for severe Class III)

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**Central theme today (cont.)**

- Recent studies on adolescents have shown that surgically placed microimplants and plates can also move the maxillary bone and teeth mesially with good vertical control, but many patients do not want these surgical techniques
Central theme today –cont.

- In the permanent dentition, the maxillary dentition can move mesially easier than the mandibular dentition can move distally in growing and even non-growing patients.
- The main problem with mesial movement of the maxillary dentition is that if only fixed appliances are used, usually the posterior teeth extrude which leads to a loss of vertical control.

Central theme today (cont.)

- My hypothesis today is: The key to successful Class III treatment is to control molar extrusion during mesialization of the upper dentition (based on my continued observations of increased vertical control since 1999 based on post-treatment cephalometric superimpositions).

How are posterior teeth controlled from extruding with Invisalign to control the vertical dimension and open bite? (my hypothesis)

- With fixed appliances, molars extrude during all movements except intrusion (center of rotation is in middle third of root).
How are posterior teeth controlled from extruding with Invisalign to control open bite? (my hypothesis)

- With fixed appliances, molars extrude during all movements except intrusion
- This opens the vertical dimension and allows the mandible to rotate down and backward
- This increases the degree of open bite

How does Invisalign close the anterior open bite? (my hypothesis)

- However, Invisalign has an increased bite force present on posterior teeth due to aligner thickness and arc of closure
- This creates an intrusive force on the posterior teeth
- The intrusive force prevents posterior teeth from erupting for vertical control of mesialization

How Successful is Invisalign for Treatment of Class III malocclusions?

Goals today

- To introduce a protocol for Invisalign treatment of mild to moderate dental Class III and mild skeletal Class III with Invisalign
- Treatment for moderate to severe skeletal Class III is still best treated with orthognathic surgery (but we can do pre and post surgical movements with Invisalign)
Important questions for Class III Correction with Invisalign:

1. Is mild to moderate Class III malocclusion a functional problem for patients - or just esthetic?
2. Is there published evidence that a mild to moderate Class III can be treated with Invisalign?
3. Why is Class III correction challenging with fixed appliances vs Invisalign?
4. What are the skeletal and dental characteristics to look for in selecting the best Class III cases for Invisalign?

5. When are TADs or mini plates needed to aid correction?
6. Can a Class III malocclusion with mild A-P and/or transverse (posterior cross bite) and/or vertical skeletal discrepancy be treated (deep and open bite)?
7. Can pre and post surgical orthodontic treatment be done with Invisalign?
8. How stable is Class III correction and what are the best retention methods?

Functional problems:
1. Adverse wear patterns on incisors
2. If lack of incisor occlusion, can be difficult chewing
3. Constricted and distally positioned maxilla may be a factor in sleep apnea (studies show expansion increases airway size and can lessen sleep apnea)
1. Is Class III malocclusion a functional problem or just an esthetic problem for patients? (cont.)

- Esthetic Issues:
  - Important to recognize differences in males and females in perception of esthetics
    - Males may look more masculine with prognathic mandible
    - Women may look too masculine with prognathic mandible

2. Is there published evidence that a mild to moderate Class III can be treated with Invisalign?

   Only case reports (lowest form of clinical evidence)
   1. Non surgical treatment (Boyd- Seminars in Orthodontics, 2002)

3. Why is Class III correction challenging with fixed appliances vs Invisalign?

   - Inconvenience of broken brackets and greater soft tissue irritation with fixed appliances (Wheeler, AJODO 2003 and Meithkie GOJ 2005)

   - Disclusion needed with hard bite ramps or bite blocks are frequently needed for correction of anterior crossbite (more uncomfortable for patients, affects speech and chewing/eating)

   - Greater Root resorption and periodontal problems (for review see Boyd, Compendium 2009 and Samekhim, PCSO Bulletin, 2015)
4. What are the skeletal and dental characteristics to look for in selecting the best Class III cases for Invisalign?

- Determine patient's chief complaint. Ask whether profile is an issue.
- Check Cr-CO
- Check lateral cephalometric analysis for extent of A-P discrepancy (SNA, SNB and ANB especially useful)

4. What are the skeletal and dental characteristics to look for in selecting the best Class III cases for Invisalign?

- Consider growth potential (tall males=late growth!)
- Main question is whether the upper incisor can be moved far enough anteriorly to correct the anterior crossbite (thickness of periodontal tissues or presence of gingival recession are limits)

5. When are TADs or mini plates needed to aid correction?

The usual reason is additional anchorage to close an open bite by intruding molars.

My opinion is that this is only necessary when an open bite is associated with long face syndrome and the patient has lip incompetence.
When are TADs or mini plates needed to aid correction?

3 degrees closure of mandibular plane angle from upper molar intrusion - mandible came forward 4 mm

6. Can a Class III malocclusion with mild A-P and/or transverse (posterior cross bite) and/or vertical skeletal discrepancy be treated?

Examples of Class III treatment

The big question about case reports is: “Can you treat this case and get similar results with Invisalign?”

Mild post orthodontic relapse due to late asymmetrical mandibular growth. Now age 23 (no growth in past 4 years)
Mild post orthodontic relapse due to late asymmetrical mandibular growth

Note mild anterior & posterior crossbite with midline deviation
- Retainer still fits but "bite is off"

Invisalign Prescription to order Class III correction with a bite jump at the last stage to correct to Class I canines and molars

7. A-P (Begital) Relationship:
If no sagittal movement is desired, select "Maintain" right and/or left.

- Maintain A-P relationship: [ ] right [ ] left

- Change A-P relationship:
  - Move R Canine to [ ] Full [ ] Partial [ ] Partial II [ ] Partial III [ ] Full III
  - Move R Molar to [ ] Full [ ] Partial [ ] Partial II [ ] Partial III [ ] Full III
  - Move L Canine to [ ] Full [ ] Partial [ ] Partial II [ ] Partial III [ ] Full III
  - Move L Molar to [ ] Full [ ] Partial [ ] Partial II [ ] Partial III [ ] Full III

- Indicate below how you want to address the above A-P Goals:
  - If nothing is indicated, then A-P will be maintained
  - For additional movement, select [ ] upper [ ] lower
  - Distalize Posterior
    - [ ] upper [ ] lower
  - Posterior Space Closure/Extraction
    - [ ] upper [ ] lower
  - Pre-Surgical Case
    - [ ] upper [ ] lower
  - Post-surgical Implant
    - [ ] upper [ ] lower
  - Skeletal Class III
    - [ ] upper [ ] lower
  - Skeletal Class II
    - [ ] upper [ ] lower
  - Skeletal Class I
    - [ ] upper [ ] lower
Treatment plan (the same for almost all Class III patients with 2-3 mm molar discrepancy)
- Level, align and coordinate arches (6 stages)
- Interarch correction at last lower stage to full Class I molars and canines with midlines on
- 4 to 5 oz Elastics on right side
- New protocol - Cut-out on upper right second molar and precision hook on lower right canine

Pre vs post Treatment
- Asymmetrical Class II elastics used on right side (4 mon. tx.)
- 2 mm CR-CO anterior-posterior shift present
- Will require Class III elastics for additional anchorage to retract lower anteriors and correct right side canines to Class I

Invisalign Prescription to order Class III correction with a bite jump at the last stage to correct to Class I canines and molars
ClinCheck from Jan. 2002 and will not play on new software.

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<td>U1-NA (°/mm)</td>
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Initial vs Final
Initial vs Final (2 mm anterior CR to CO shift)

Initial vs Final

Final
Pre vs post ceph - not enough lower lingual root torque

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<tr>
<td>POG-NB</td>
<td>1</td>
<td>1</td>
<td>2</td>
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</table>

Initial

Final

Treated to CR (2 mm CR-CO shift initially)
Enameloplasty done on #9 - note stability of open bite correction.
Patient History

- Name: MHx: NSF
- DHx: Mildly restored dentition

Kevin C. -25 yrs “I want my teeth straight”

Initial Pano - Note impacted third molars which need to be extracted
Cephalometric Radiograph

Pre-Cephalometric Analysis
-Class I skeletal with end on Class III dental

Problem List

- Skeletal
  - AP: Class III
  - Vertical: WNL
  - Transverse: WNL
- Soft tissue
  - Slightly convex
  - Competent lips
- Functional
  - None noted
- Dental
  - CEJ-I molar and CL-I canine
  - 0.5mm edge-to-edge
  - Crossbite
  - ULs and LUs
  - Crowding
  - Max. 4mm
  - Mid. 4mm
  - Max. 2mm distal to the R
- Radiographic
  - Mesially impacted UR8
  - Horizontally impacted LL8
Treatment Plan

- Invisalign with CL-III elastics
- IPR as needed

Invisalign Prescription to order Class III correction with a bite jump at the last stage to correct to Class I canines and molars

7. A-P (Sagittal) Relationship:

Maintain A-P relationship: [Right] [Left]

Change A-P relationship:

Move R Canine to
Move R Molar to
Move L Canine to
Move L Molar to

1. Indicate below how you want to achieve the above A-P Goals. (if nothing is indicated, A-P will be maintained)
   - IPR as needed
   - Distalize Protraction
   - Protraction/Space Closure/Extraction

Pre-Surgical Case
(Consider together movement after alignment/combination)

Why is root torque important!

- Stability is generally associated with an interincisal angle of about 130 degrees
- This frequently requires lingual root torque on upper and lower incisors (technicians may add it on their own)
- 100% of torque not generally observed (Align study showed 55 to 80% achieved in adults-can be higher in teens)
Class III correction – Important goal is to get a normal inter-incisal angle (130 degrees)

Additional lingual root torque is frequently needed on retroinclined lower incisors

If upper incisors are flared labially, they may need labial root torque

How do Power Ridges create lingual root torque?

1. Lingual Root Torque is defined as rotation about the incisal edge
2. Smaller opposing force to create a moment

Summary

- Total treatment time – 1 year 6 months
- 1st set aligners: total of 33 aligners
- Refinement: total of 12 aligners
- Achieved positive OB/OJ and CL-I occlusion
Post treatment

Pre vs Post-occlusal. Third molars extracted.
- No noticeable tooth resorption

Final Cephalometric Radiograph
Cephalometric Analysis

T1-T2 Superimposition: red is final

Pre-31 yr CC “my dentist told me my front teeth are wearing down from my bite”
### Initial Pano

![Initial Panoramic X-ray Image]

### Initial Cephalometric Xray

<table>
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<td>Wits Appraisal</td>
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<td>22</td>
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<tr>
<td>FMIA (L1-FH)</td>
<td>64</td>
<td>57</td>
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<td>IMPA (L1-MP)</td>
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<tr>
<td>II (º)</td>
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<td>126</td>
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### Same Invisalign Prescription to order Class III correction with bite jump but bite jump will be less because occlusion has a 2 mm CR- CO discrepancy

**7. A-P (Sagittal) Relationship:**

- If no sagittal movement is desired, select "Normal" Right and/or Left.
- Maintain A-P relationship: [ ] Right [ ] Left

**Change A-P relationship:**

- Move R Cusp to [ ] Full [ ] Partial [ ] No
- Move L Cusp to [ ] Full [ ] Partial [ ] No
- Move L Molar to [ ] Full [ ] Partial [ ] No
- Move R Molar to [ ] Full [ ] Partial [ ] No

*Indicate below how you want to achieve the above A-P Goals (if nothing is indicated, then A-P will be maintained):*

- [ ] Upper [ ] Lower
- [ ] Upper [ ] Lower
- [ ] Upper [ ] Lower
- [ ] Upper [ ] Lower
- [ ] Upper [ ] Lower
- [ ] Upper [ ] Lower

*Posterior Space Closure/Extraction Pre-Surgical Case Pre-Surgical Case after alveogram/occlusal*
### Comparison

#### Final Cephalometric Xray

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<th>Final</th>
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**Superimposition**

- Note mandible moved distal due to correcting CR-CO at arrow
- No change in Mandibular plane angle as no extrusion of molars
Pre-Class III with mild mandibular asymmetry and lower midline to right 2.5 mm (previous ortho)

Julia Q.

Pre Initial Pano
### Pre-treatment

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<td>POG-NB</td>
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- Pre-treatment involved level, align, and coordinate arches.
- Interarch correction as the last lower stage (Express case with 9 stages).
- Asymmetric elastics were used.
How are asymmetric elastics used

- Pre-midlines off 2 mm

Class III Class I

Aligners and elastics which have corrected midline

Cl II elastics Cl III elastics

Post-treatment
Pre, post and 1 yr retention

Pre, post and 1 yr retention

Pre, Case refinement and post

Note slight relapse of UL5
Pre, Case refinement and post

Pre

Case refinement

9 months Post

Pre and post

Pre

Post

Note closure of open bite
Pre and post

Pre - 36 y old with CC of "underbite" and "crooked teeth"
- he likes his profile
### Final Ceph Analysis

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<th>Group/Measurement</th>
<th>T1</th>
<th>Value</th>
<th>T2</th>
<th>Value</th>
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Superimpositions - no change in mandibular plane angle - black + pre Green + Post - excellent lower anterior lingual root torque

Initial Photos
Aaron A.  Age 42  Cc “spaces” and underbite - why did lower incisors move labially into crossbite?

Initial Ceph
Initial Analysis-Class I skeletal pattern

Case Refinement – IPR for black triangles and more midline correction

Final Ceph
Final Photos: Right side should have .5 mm more Class I correction with midline correction

Final Analysis

Superimposition
What about Class III deep overbite treatment? Is it different?

- The only thing different is you have to level the lower Curve of Spee to permit the correction of the anterior crossbite.

- Pre-55 yr old healthy Thai male
- CC: "underbite" and "spaces"

Previous treatment for periodontitis-healthy tissues now (Best resident Class III case at Summit 2012 A Rouleau)

Initial Panoramic Radiograph—note generalized horizontal bone loss—but gingiva is healthy
**Problem List**

- **Skeletal**
  - AP: Class III
  - Prognathic Mandible
  - Low Mandibular Plane Angle
  - Transverse: WNL
- **Soft tissue**
  - Anterior Divergent Profile
- **Functional**
  - WNL
- **Dental**
  - End on Class III molar / canine
  - OJ = -12mm
  - OB = 4mm
  - 5-5 x-bite
  - Maxillary spacing: 8mm
  - Mandibular spacing: severe 12+
  - Moderate curve of spee
  - Diastema = Mx 6mm/Md 8mm
  - Proclined lower incisors
- **Radiographic**
  - Localized severe bone loss L272
Treatment Plan
Invisalign with Class III elastics
IPR as needed

Post treatment

Pre vs post
Pre vs post Pano - no additional bone loss

Final Ceph

Cephalometric Analysis
T1-T2 Superimposition

Pre - Black  Post - Red
Note no extrusion of molars and excellent anchorage control

Summary
- Total treatment time – 1 year 6 months
- 1st set aligners: total of 33 aligners
- Refinement: total of 12 aligners
- Achieved positive OB/OJ and CL-I occlusion

How well do the new optimized attachments work? - 49 yr old Class III male with open bite – missing # 21 – upper left canine will be extracted

Note midline discrepancies on upper and lower
10 ½ months progress aligner # 27/31 with Class II-III 4 oz elastics

Comparison of lower canines rotational movement with one set of aligners (not possible until optimized attachments arrived)

14 months at aligner # 29 of 32
57 yr old male Class III open bite with 5 mm midline discrepancy and bilateral posterior crossbite

Initial

Pre vs 20 month progress

Pre

20 Months
30 months

1 yr post–tx –Slight open posterior bite

1 yr post– After equilibration which establishes a better cusp-fossa relationship
Can Cone Beam CT create a model accurate enough to make Invisalign appliances with an intraoral scan used for the crowns?

- No! (too much scatter)
- My prediction is that CBCT will become the standard for radiography for comprehensive orthodontic treatment in 3-4 years due to increased diagnostic ability, decreased radiation and cost
- Can be combined with facial coloration and intraoral scanning automatically by shape matching
- Models developed with Anatomage software (InVivo) and soon Align

7. Can pre and post surgical orthodontic treatment be done with Invisalign?


Pre-Had ortho as an adolescent- Later growth caused a significant mandibular asymmetry and maxillary retrognathism. Wants facial correction but will not accept fixed.

Published in J Clin Orthod. July 2015 (go online to see 3D movie)
Airway

Close up of resolution of intraoral scan vs teeth from a CBCT
Can Align shape match the intraoral scan (Clin Check) into the CBCT? (early in development)

8. How stable is Class III correction and what are the best retention methods?

- Retention of non-surgical treatment of Class III malocclusion has not been studied enough to know stability guidelines (only case reports)
- My opinion: If a good Class I occlusion is obtained, the same protocols should be used as for other types of malocclusion

...best retention methods?

- First the post treatment occlusion has to be optimized with even contacts between all teeth and no posterior open bite
- To obtain optimum occlusion after Invisalign, usually a 3-4 month finishing period is required
- Order 3 passive aligners at the end of treatment-the first with attachments and second and third set without attachments to "build retention into the treatment"
best retention methods?

- Then finishing of the occlusion can be done with closure of the frequently encountered (approx. 50 to 70%) posterior open bite by settling or up and down elastics elastics
- When the occlusion is finalized, obtain a new scan and order Vivera retainers for indefinite nighttime use

Make sure all your patients have Invisalign Insurance

1. Invisalign has a definite end of treatment time posted in patient file
   - But what if patient loses retainers or stops wearing them after treatment?
   - Solution: save last 3 aligners!
   - Teeth relapse the same direction toward pre-tx positions – pick the one that fits the best and move forward!
   - Retainers are too stiff to correct much relapse
2. Use Vivera to surround patient with retainers (they cannot say they “lost it”)

How long should Invisalign patients wear retainers?

- Try to achieve full time retainer wear for at least 4 to 6 months
- Then nighttime indefinitely (or accept relapse)
  - “Wear until you do not care about relapse!”
How well do most patients wear clear retainers for retention?

10 yrs retention (2012)
My opinion is there is better compliance with clear retainers
Why?

Consider comparing a Hawley type retainer after fixed appliances:
- Something new to get used to because of palatal acrylic and wires
- May effect speech
- Not as esthetic
- Bonded retainers will eventually break and will become removable retainers when this happens as patient does not want to pay twice
- However, clear retainers are the same appliance they had been wearing all through treatment, so there is nothing new to get used to

What if overjet or end on anterior occlusion is present?
Place bite turbos on canines (Bill Gierie)
What will the future bring?

- We routinely do "distalization" with well documented results for Class II cases with 2 mm or more Class II correction.
- But can we do "mesialization of the upper arch if the bite jump is more than 3 mm?"

Thanks!

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http://learn.invisalign.com/asksurvey

Upon completion of your survey you will have immediate access to your CE certificate.

*This survey is only available to the participants who attend the "live" presentation via the webinar/phone. Participants who complete the archived program on the Education Tab of the Invisalign Doctor Site need to complete a CE test to obtain their CE certificate.