

Invisalign

Current Guidelines for Effective Treatment

Daniel A. Kuncio, D.D.S.

ABSTRACT

Invisalign is an increasingly popular technique for aligning teeth and correcting malocclusions orthodontically. This article analyzes the current professional literature published on Invisalign and the benefits and risks of using the technique for both patients and doctors. The steady increase in the number of cases treated with Invisalign and where the technique is going in the future is investigated. Ten guidelines for Invisalign treatment and patient selection are given, along with case examples.

Align Technology revolutionized orthodontic tooth movement with its invention and marketing of the Invisalign system. Although the idea of moving teeth naturally using clear thermoplastic aligners to apply pressure to the dentition has been around for many decades, Align's engineers applied new CAD/CAM and mass customization technologies to greatly increase the use of aligners. According to Align's website, Invisalign has been used to treat over 2.4 million patients worldwide, with over 80,000 dentists trained in the technique. Since its founding in 1997, Align has earned over 500 patents for its technologies and has another 200 patents pending. These are without debate impressive numbers, as are Align's financial figures that show record revenue of \$164.5 million in the third quarter of 2013 alone.¹

So, what has created such an upswing in demand? Certainly there are major advantages to using Invisalign over fixed appliances (braces). The aligners can be removed for eating, brushing and intimacy; patients experience less dental pain, have better oral hygiene and fewer dietary restrictions; and the treatment planning software (ClinCheck) is an excellent tool for visualizing and analyzing potential treatment outcomes, especially when preparing for future restorative work.^{2,3}

Of course, there is also the "invisibility" factor, but lingual braces are probably more undetectable to laypeople than Invisalign, and have been around for decades. They're just not as comfortable and cannot be removed.⁴

These are all valid and important points, but my inkling is that the more significant factors in these surging sales of Invisalign are Align's massive advertising campaign, Internet group-discount companies like Groupon and Living Social driving down the cost to the patient, and Invisalign's relative ease of use for the practitioner. A PVS impression or digital tooth scan is the major pretreatment step in the Invisalign technique. And the most laborious clinical step is bonding the composite attachments to teeth, which can usually be done in one step from a template. Both of these procedures can even be done by certified dental assistants, leaving the doctor only the treatment planning and interproximal reduction (IPR) to complete.⁵ Research presented at the AADR meeting found that Invisalign cases used significantly less chair time than conventional braces treatment, and had an overall shorter treatment time.⁶

But if you step back and take a look at the big picture, this is a potentially precarious position for the treating doctor. He or she takes 100% of the responsibility for the outcome of each case (see Invisalign's terms and conditions¹); is confronted with a public perception (and hi-tech computer software) that Invisalign is a product that can place teeth virtually anywhere in the mouth with relative ease no matter who the doctor is; and is facing shrinking profit margins, forcing more production and, therefore, less clinical time with each patient.

A look at the published research on the Invisalign technique reveals mixed results. The last systematic review was in 2005, and it yielded inconclusive results—another published review is overdue.⁷ Invisalign has been proven to resolve moderate anterior tooth crowding predictably, but treatment outcome studies have highlighted Invisalign's weaknesses compared to conventional braces in treating anterior-posterior discrepancies, large rotation-



Figure 1. Typical attachment protocol with G4 attachments. Some patients may be disappointed with esthetics on maxillary anterior teeth, so our practice makes sure to show potential patients this example, both with and without aligners in. Then potential downside of not having those attachments is discussed.



Figure 2. Perfect Invisalign candidate: full adult dentition; no large vertical, transverse or anterior-posterior problems; reciprocal space closure needed (equal space closure in anterior to posterior and posterior to anterior directions) so as not to require special anchorage considerations, like elastics or mini-implants.¹⁹ Treatment time: 20 months; 1 refinement.

al movements and the extrusion of teeth.^{8,9,10} More post-treatment relapse of anterior dental alignment has also been found in Invisalign cases.¹¹ Two independent studies recommend leaving the aligners in the mouth for longer than the two-week intervals the company advocates, probably for better bone and periodontal ligament (PDL) formation.^{11,12}

Align has attempted to improve treatment outcomes with several generations of composite tooth attachments and softer, more resilient, aligner material.¹ Even though the theory behind these improvements seems sound, Align does not publish its internal clinical findings and, thus, the data cannot be peer-reviewed. The time is now. We need blind, randomized, prospective studies comparing the outcomes of Invisalign to traditional braces. And if we really want a modern study, Invisalign treatment should be compared to fixed appliances using digital treatment planning software (Insignia or Suresmile). Surely, with thousands of practitioners all over the world using both techniques, such a study could be done.

There are several published Invisalign case studies that show impressive space closure, crowding alignment and moderate open bite correction.^{13,14} The Invisalign website and other case reports show patients who almost certainly feel they have a more attractive smile—and the improved quality of life that such changes bring should not be dismissed.^{1,15} But many of these published cases have occlusions that stand little chance of passing the American Board of Orthodontics (ABO) standards and could potentially make patients more prone to future dental problems.^{16,17,18}

This is the dilemma that all clinicians using Invisalign face: At what point, if ever, do the esthetic concerns trump the health issues? Is a beautiful smile worth an increased chance of certain dental problems later on in life? I'm sure many patients would say yes and many doctors would say no. But if we clinicians are not satisfying our patients' demands, we'd all be out of business very soon.

I believe the solution is not only studying the literature and educating ourselves as to the capabilities of the Invisalign appliances, but also having an honest conversation with our patients about what these appliances can and cannot do; what has a high percentage chance of working; what is risky even with multiple refinements (ordering more aligners from a new scan or impression); and what the potential consequences can be. This conversation should be documented and signed by the patient.

To help dentists navigate this challenging terrain, I have provided basic guidelines below for case selection and general advice and troubleshooting tips. This list is certainly not comprehensive, but should, I hope, help the thousands of Invisalign clinicians in New York State.

1. Until you decide to invest in a digital tooth scanner (only the iTero and 3M True Definition brands are currently compatible with Invisalign), try a two-phase PVS impression with putty to make a quick custom tray and then a light body wash (Genie or Henry Schein brand is fine). True, it's an extra

step, but you or your assistant will get a perfect impression every time, which will eliminate redoes and will capture that elusive distal side of the upper second molars. An excellent impression leads to better results. Take the bite registration first and use it to measure the correct size of impression tray, avoiding multiple fittings.

2. Use Invisalign's new G4 composite attachments, but note that the well on these attachments is usually much smaller, making the use of heavier filled composites challenging. Flowable composite (Kerr brand) is easier to place, but these resins tend to shrink more and abrade faster, preventing full expression of the aligner. Align claims to have unpublished



Figure 3. Invisalign combined with restorations (veneers on maxillary lateral incisors and composite bonding on mandibular central incisor, done by Zenovia D. Kuncio, DDS). Mandibular incisor was extracted to relieve crowding and address tooth-size discrepancy. Treatment was effectively simulated with ClinCheck software. Maxillary laterals were difficult to rotate and extrude, and black triangles persisted in mandibular anterior due to tipping of teeth—Invisalign cannot move tooth bodily without perfect attachment or complete contact-free side to upright after tipping. Patient was offered lingual and esthetic fixed appliances (Incognito/Simpleclear), but chose Invisalign with restorations for removable feature. Treatment time: 21 months; 2 refinements.

studies on composite attachments as well, but it's hard to see how the attachment/aligner interface will ever be as accurate as a wire/bracket interface. Theoretically, using a digital scanner, a clinician should be able to bond attachments first and then have the aligners manufactured. But, as of this publication, Align does not seem to be pursuing that avenue.

3. Use the Align-issued Ivoclar (or other similar density composite) if you have large spaces to close or root movement to accomplish. Overcorrect these movements in the refinement phase (after most other problems have been corrected) and instruct the patient to use Aligner Chewies as often as possible to help seat the aligner and create the correct force vectors. Even using all of these steps, however, will not guarantee that the clinician will be able to diverge roots for implant spaces—we've needed to switch to braces at least temporarily in every such case thus far.
4. Make sure the patient is aware that Invisalign attachments are not "invisible" to other people (Figure 1). Currently, G4 attachments cannot be placed on the lingual side of teeth, so another outcome/esthetics decision needs to be made and documented.
5. Try Brasseler coarse strips in the mini-stripper handle for patient comfort and ease of use for IPR of .2 mm or less. If more reduction is indicated, break the contact with the strips and



Figure 4. Patient had moderate crowding and posterior crossbite, but insisted on Invisalign appliances. We discussed limitations of Invisalign with potential consequences and treatment plan was signed. He ended up with excellent esthetic improvement, but posterior crossbite remains, as does small open bite, affecting anterior guidance. Better functional result was probably obtainable with fixed appliances, but patient is extremely satisfied with esthetic results. Did we do our job? Treatment time: 20 months; 1 refinement.

use the Brasseler double-sided mesh disk. Postpone all IPR as far into treatment as possible to get clear access through the contact point (expand and procline teeth first). This will ensure more accurate measuring with the IPR gauge. Tell the Invisalign tech the exact ClinCheck stage you wish to start your IPR and where. Attempt mostly posterior IPR unless you want to change the shape of the anterior teeth for esthetic reasons.

6. Do not attempt rotations over 30° unless you plan to use fixed appliances to align the rotated teeth first. If using Invisalign only and the tooth is not in an esthetic area, do not attempt to rotate the tooth at all, because the subsequent aligners will not fit and a new PVS impression or scan will be needed almost immediately. If a tooth is rotated 20° to 30° and is in an important esthetic area, you can attempt the correction with large buccal and lingual rectangular Ivoclar attachments, but educate the patient that several refinements may be needed and do not promise a 100% correction.
7. Overcorrect space closure with a “C-chain” aligner that will overcorrect all anterior spaces with three extra aligners at the end. You may not need all of these extra aligners, but you can sometimes avoid doing an entire refinement to close a small gap.
8. Ask the patient to leave the final three aligners in for three weeks each (unless using an accelerator like AcceleDent or Propel). This should allow for better bone and PDL formation toward the end of treatment and will, it is hoped, lead to better, more stable final results.¹¹ Patients stop feeling the aligner forces after only a few days, but if they move to the next aligner too soon, they can potentially damage tissues.¹⁹ As always, compliance is a major factor with Invisalign and 22-hour/day wear is a must (Figure 2), as is nightly retainer wear after treatment or a fixed retainer.
9. Do not attempt the extrusion of teeth unless you plan and discuss with the patient the use of elastics or fixed appliances, or possible restorations (Figure 3). Due to the “watermelon seed” effect, every rotational force put on a tooth with Invisalign has an inherent intrusive vector.²⁰ Anterior open bites are corrected with intrusion of posterior teeth and subsequent bite closure, not extrusion of anterior teeth.¹⁴
10. Do not promise to correct skeletal Class II or Class III malocclusions, posterior crossbites, severe open bites (larger than 2 mm), or TMD symptoms with Invisalign (Figure 4). Advanced users have had some success correcting these conditions, but these techniques require full orthodontic records with a traced cephalometric radiograph and are beyond the scope of this article.

The bottom line to general practitioners is please use the Invisalign technique cautiously and conservatively. Invisalign has and will continue to produce thousands of beautiful smiles and healthy occlusions and is our first choice for removable esthetic orthodontic treatment—we prefer Invisalign over ClearCorrect

and other clear aligners due to the superior treatment planning software—but is most certainly not for every patient and is extremely case-sensitive. Seek the guidance of your trusted orthodontist to select the cases that have a high probability of success, and keep patients informed about issues that might not be completely corrected. Don't forget that Align's primary responsibility is to its shareholders. The patients are our responsibility. ✍



Dr. Kuncio is an orthodontist in private practice on the upper west side of Manhattan who has treated or supervised the treatment of hundreds of Invisalign cases since 2006. He is a diplomate of the American Board of Orthodontics and a clinical attending and assistant professor of orthodontics at Montefiore Medical Center/Albert Einstein College of Medicine, New York, NY. Dr. Kuncio has no financial affiliation with Align Technology or any other dental company. Queries about this article can be sent to Dr. Kuncio at drkuncio@gmail.com.

REFERENCES

1. The Invisalign website. <http://www.invisalign.com>. 2012.
2. Schaefer I, Braumann B. Halitosis, oral health and the quality of life during treatment with Invisalign and the effect of low-dose chlorhexidine solution. *J Orofac Orthop* 2011; 71(6):430-41.
3. Miller K. A comparison of treatment impacts between Invisalign aligner and fixed appliances therapy during the first week of treatment. *Am J of Orthod Dentof Orthop* 2007;131(3):302.e1-302.e9.
4. Shalish M, Cooper-Kazaz R, Ivgi I, Canetti L, Tsur B, Bachar E, Chaushu S. Adult patients' adjustability to orthodontic appliances. Part 1: a comparison between Labial, Lingual and Invisalign. *Eur J Orthod* 2011; (Epub).
5. New York State Department of Education website. <http://www.op.nysed.gov/prof/dent/dentasst.htm>. 2011.
6. Orthodontic Products website. <http://www.orthodonticproductsonline.com/news-bites/2012-04-16-04.asp>. 2012.
7. Lagravere MO, Flores-Mir C. The treatment effects of Invisalign orthodontic appliances: a systematic review. *JADA* 2005;136:1724-1729.
8. Krieger E, Seifert J, Marinello I, Jung BA, Wriedt S, Jacobs C, Wehrbein H. Invisalign treatment in the anterior region: were predicted tooth movements achieved? *J Orofac Orthop* 2012; 73(5): 365-376.
9. Djeu G, Shelton C, Maganzini AL. Outcome assessment of Invisalign and traditional orthodontic treatment compared with the American Board of Orthodontics objective grading system. *Am J Orthod Dentofacial Orthop* 2005;128(3):293-298.
10. Kravitz N, Kusnoto B, BeGole E, Obrez A, Agran B. How well does Invisalign work? A prospective clinical study evaluating the efficacy of tooth movement with Invisalign. *Am J Orthod Dentof Orthop* 2009;135(1):27-35.
11. Kuncio D, Shelton C, Maganzini AL, Freeman K. Invisalign and traditional orthodontic treatment postretention outcomes using the American Board of Orthodontics Objective Grading System. *Angle Orthod* 2007;77(5):864-869.
12. Vardimon AD, Robbins D, Brosh T. In-vivo von Mises strains during Invisalign treatment. *Am J Orthod Dentof Orthop* 2010;138(4):399-409.
13. Boyd RL. Esthetic orthodontic treatment using the Invisalign appliance for moderate to complex malocclusions. *J of Dental Education* 2008;72(8):948-967.
14. Schupp W, Haubrich J, Neumann I. Treatment of anterior open bite with the Invisalign system. *J Clin Orthod* 2010;44(8):501-507.
15. Olsen J, Inglehart MR. Malocclusions and perceptions of attractiveness, intelligence, and personality, and behavioral intentions. *Am J Orthod Dentof Orthop* 2011;140:669-79.
16. Nicosisis J. Aligners can for your cants. *Orthodontic Products* 2013; 8:16-19.
17. American Board of Orthodontics website. <http://www.americanboardortho.com>. 2013.
18. Stenik A, Espeland L, Berg RE. A 57-year follow-up of occlusal changes, oral health, and attitudes towards teeth. *Am J Orthod Dentof Orthop* 2011;139:S102-8.
19. Proffit, WR. *Contemporary Orthodontics*, 3rd Ed. 2000; pg. 296-304, 347-348.
20. Hahn W, Engelke B, Jung K, Dathe H, Fialka-Fricke J, Kubein-Meesenburg D, Sadat-Khonsari R. Initial forces and moments delivered by removable thermoplastic appliances during rotation of an upper incisor. *Angle Orthodontist* 2010; 80(2): 239-246.