sciendo

DOI: 10.2478/aoj-2001-0006

Case Report

Orthodontic treatment of a mildly crowded malocclusion using the Invisalign System™

V. Vlaskalic
BDSc, MDSc
Assistant Professor

R. Boyd
DDS. MEd
Professor and Chair
Department of Orthodontics
University of the Pacific
San Fransisco, USA

The 35-year-old male patient was treated at the University of the Pacific, San Francisco U.S.A., as part of an on-going study investigating the feasibility of the Invisalign System™ of tooth movement. The study called for 40 subjects, 10 with minor, 15 with moderate and 15 with severe tooth deviation. This patient fell into the "moderate" degree-of-difficulty category, due to the position of the maxillary incisors. Treatment time with the initial series of aligners was 14 months. Treatment objectives were met, with the exception of adequate anterior overbite.
Aust Orthod J 2001; 17:41–6

Received for publication: February 2001
Accepted: March 2001

Introduction

In 1998, Dr Robert Boyd, Chairperson of the Department of Orthodontics at the University of the Pacific, in San Francisco USA, was approached to conduct the first clinical trial of orthodontic tooth movement using a new technique[1] that incorporates computer technology developed by Align Technology Inc. The technique employs a series of conventional, clear, overlay-type removable appliances called "aligners". From an initial polyvinylsiloxane (PVS) impression and treatment plan, a virtual treatment sequence of tooth movements is created by Align Technology Inc., using a software program called ClinCheck,™ and is communicated to the clinician via the Internet. Once the virtual treatment is approved by the clinician, computer-generated models of the initial occlusion and subsequent stages of tooth movement are used to form the aligners. Each aligner is worn by the patient for between seven and ten days, until the final result is obtained.

When the trial began, the ability of the Invisalign™ software to design a series of appliances that could move teeth into an accurate position based on a 3-dimensional computer image was not known. Since then, the resolution and ability to manipulate the ClinCheck™ software has been greatly improved (Figure 1). In the past, similar clear, removable appliances had been used to induce minor tooth movement; however, the methods that employ those appliances require manual repositioning of the teeth on the study-cast, which becomes laborious with the many small increments involved in more significant movements.[2-6]

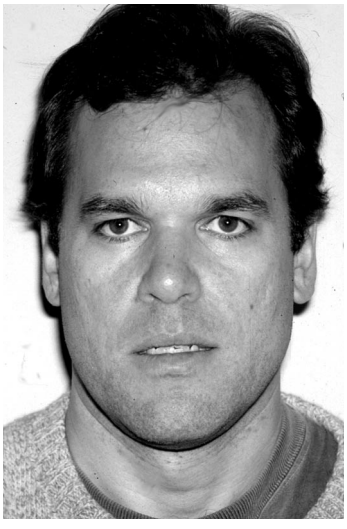
The subject of this case report was treated in the initial stages of the trial. The study called for 40 subjects, ten with minor, fifteen with moderate



Figures 3a to 3e. Pretreatment intra-oral photographs.



Figure 3b.



Figures 2a to 2c. Pre-treatment extra-oral photographs. Age:35 years, 1 month.

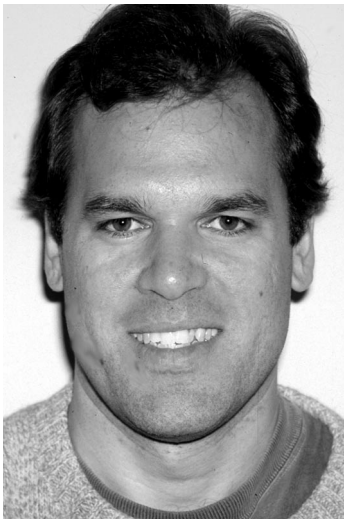


Figure 2b.

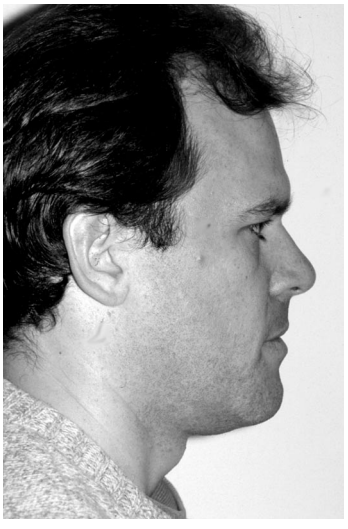


Figure 2c.

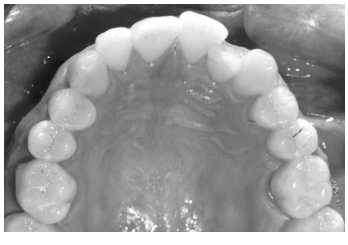


Figure 3d.



Figure 3e.

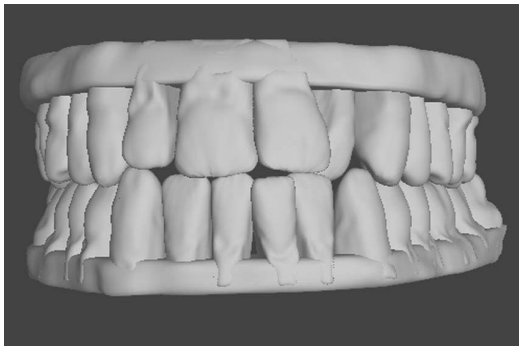


Figure 1. Anterior view of initial ClinCheck™ image (original software version).



Figure 3c.

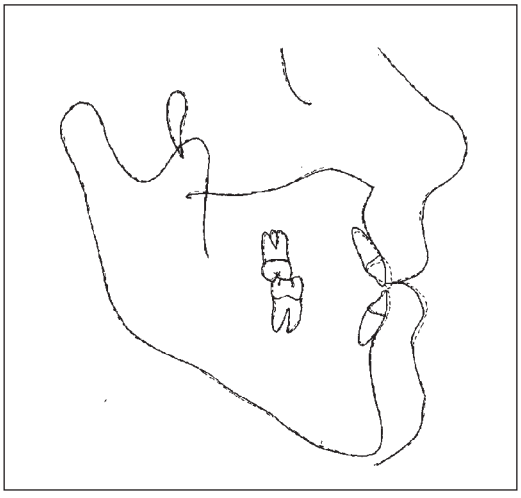


Figure 5. Cephalometric superimposition.

and fifteen with severe tooth deviation. Because of the position of the maxillary incisors, this patient was classified in the "moderate" degree-of-difficulty category.

Chief complaint

The male patient's chief complaint was his lingually placed 22.

Medical and dental history

The patient was 35 years, 1 month, at the start of treatment and had no prior history of orthodontic treatment. He was a night-time bruxer. No other relevant medical or dental history was revealed.

Diagnosis

The patient presented with pleasing facial aesthetics, and good tooth display on smiling. The zygomatic ridge was not prominent, although it did not appear excessively deficient. His profile was straight, revealing an aesthetic naso-labial angle and a strong chin (Figures 2a, b and c).

All permanent teeth were fully erupted. There was approximately 4 mm of crowding in the maxillary arch, and 5 mm of crowding in the lower arch. The right and left buccal segments were in a Class I canine relationship, and there was a Class III tendency on the molars. Overbite and overjet were of an edge-to edge nature. The maxillary and mandibular midlines were coincident with the face (Figures 3a to e).

Radiographic evaluation

Lateral cephalometric film evaluation revealed a mild dolichocephalic, Class III skeletal pattern, due largely to excessive mandibular length (Table I). The OPG image was consistent with a healthy, fully erupted dentition that included the third molars, and revealed minimal restorative work.

Treatment plan

The treatment plan called for a non-extraction, two-arch treatment approach. Occlusal goals were to maintain the Class I canine and molar relationship, and to increase the overbite to 3 mm and the overjet to 2 mm. The anterior teeth were to be aligned by expansion, while maintaining the original arch form and, if possible, avoiding a build-up of the maxillary lateral incisors.

Treatment progress

August 1998: Initial records taken (age: 35 years, 1 month).

April 1999: Attachments on 12 to 22 bonded; maxillary and mandibular aligners 1 and 2 delivered.

May 1999: maxillary and mandibular aligners 3, 4 and 5 delivered.

June 1999: maxillary and mandibular aligners 6, 7 and 8 delivered.

July 1999: maxillary and mandibular aligners 9 and 10 delivered.

August 1999: maxillary and mandibular aligners 11, 12 and 13 delivered.

September 1999: maxillary and mandibular aligners 14 placed. Maxillary anterior teeth not seating fully.



Figures 4a to 4e. Post-treatment intra-oral photographs.

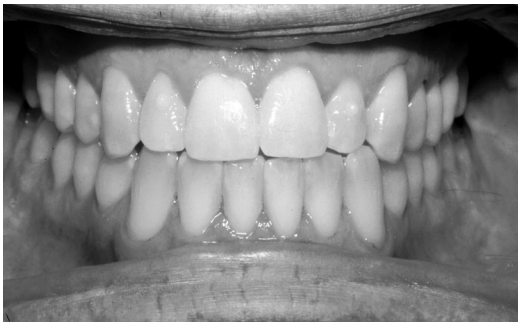


Figure 4b.

October 1999: maxillary and mandibular 15 aligners placed; not seating fully.

November 1999: maxillary and mandibular 16 aligners placed; new PVS impressions taken.

December 1999: new maxillary and mandibular aligners 16 placed. Maxillary and mandibular aligners 17 and 18 delivered.

January 2000: maxillary and mandibular aligners 19 and 20 delivered.

February 2000: maxillary aligners 21, 22, 23 and 24 delivered. Mandibular aligner 21 placed.

March 2000: maxillary aligners 25 and 26 delivered; mandibular aligners 22 and 23 delivered.

April 2000: maxillary aligners 27 and 28 delivered. Mandibular aligners 24 and 25 delivered. Teeth 18 and 28 cut off aligners.

May 2000: maxillary aligners 29 and 30 delivered (end of series); mandibular aligners 26 and 27 delivered. Teeth 18 and 28 cut off aligners.

June 2000: mandibular aligner 28 placed (end of series). Tooth 22 lingually positioned.

August 2000: maxillary and mandibular PVS impressions for construction of additional aligners; final records taken; maxillary aligner 30 and mandibular aligner 28 continued for retention.

Results

Treatment goals that were met include the alignment of the maxillary and mandibular anterior teeth and the overjet on all teeth, except the 22 (Figures 4a to e). Cephalometric superimposition revealed labial tipping of the maxillary and, to a lesser extent, the mandibular incisors (Figure 5). The patient is currently undergoing additional treatment to attempt further extrusion of the maxillary incisors, to increase the overjet on the 22, and to overcorrect the lingually positioned contact point on the mesial of the 41.

Comment

Although the patient was happy with the improved anterior aesthetics of his occlusion (Figures 6a and b), he did consent to undergo further treatment in order to meet the treatment goals. This revised virtual treatment plan will involve composite resin attachments on the maxillary anterior teeth in an attempt to extrude them and obtain adequate overbite. From this patient and others in the study, we have learned that tooth positioning involving tipping movement can be routinely achieved with the Invisalign System.™ Other, more difficult, movements, such as extrusion, bodily movement through extraction spaces and molar distalisation of more than 2 mm, are less predictable. However, the promising results of this study indicate that when composite resin attachments to the buccal and, sometimes, the lingual surfaces of the teeth are used, these difficulties may be overcome.

When evaluating the occlusal outcome of this case, it is evident that conventional fixed or removable appliances could have achieved the same or a better occlusal result in arguably less time. The major advantage of the Invisalign™ appliance is clearly its aesthetic, removable nature. Patients feel comfortable knowing that they can remove the aligners for oral hygiene or social purposes. The majority of patients enrolled in this study are professional adults who, for various reasons, would not elect to pursue orthodontic treatment with conventional fixed appliances.



Figure 4c.

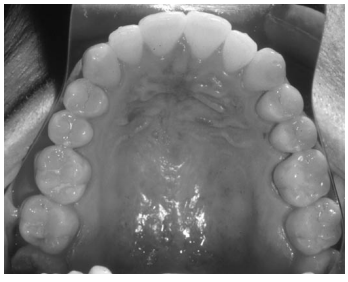


Figure 4d.



Figure 4e.



Figure 6a.



Figure 6b.

References

1. Boyd RL, Miller RJ, Vlaskalic V. The Invisalign system in adult orthodontics: mild crowding and space closure cases. J. Clin. Orthod. 2000; 34: 203-12.
2. Ponitz RJ. Invisible retainers. Am J. Orthod 1971; 59: 266-72.
3. McNamara JA, Kramer KL, Juenker JP. Invisible retainers. J Clin. Orthod. 1985; 19: 570-8.
4. Sheridan JJ, Ledoux W, McMinn R. Essix retainers: Fabrication and supervision for permanent retention. J. Clin. Orthod. 1993; 27: 37-45.
5. Rinchuse DJ, Rinchuse DJ. Active tooth movement with Essix-based appliances. J. Clin. Orthod. 1997; 31: 109-12.
6. Kesling HD. The philosophy of the Tooth Positioning Appliance. Am. J. Orthod. 1945; 31: 297-304.

Address for correspondence and reprints:

Dr Vicki Vlaskalic
University of the Pacific
School of Dentistry
2155 Webster Street
San Francisco 94115, USA
Email: Vvlaskal@SF.UOP.EDU

Table I.

SKELETAL	Pre-treatment	Post-treatment
SNA	86°	86°
SNB	86°	86°
ANB	0°	0°
Witts	-5mm	-5mm
A to N perpendicular	2mm	2.5mm
Pog to N perpendicular	9mm	9mm
Maxillary length	105mm	105mm
Mandibular length	155mm	155mm
Lower ant. facial height	96mm	96mm
Upper ant. facial height	59mm	59mm
Mandibular plane angle	28°	28°
Facial depth	93°	93°
Y- axis	57°	57°
DENTAL		
Mn1-Apog	6mm	7mm
Mn1-NB	8mm	8.5mm
	27°	27°
Interincisal angle	127°	122°
Mx1 to A perpendicular	6mm	9mm
Mx1 to NA	8mm	10mm
	26°	30°
SOFT		
Facial plane	93°	93°
Lower lip to E-plane	-5mm	-4.5mm