Invisalign treatment of lower incisor extraction cases

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Aim: To demonstrate the use of the Invisalign appliance in lower incisor extraction cases.
Method: Twelve patients, consecutively treated by the removal of a single lower incisor and Invisalign appliances, were selected from the author's private practice. Pretreatment, treatment and post-treatment photographic records were obtained and are presented.
Results: All cases completed treatment, with a mean treatment time of 42 weeks. Fifty percent of the cases required a brief period of refinement (average six weeks) at the end of the initial projected treatment period.
Conclusion: The Invisalign appliance, in correctly diagnosed cases, with careful 'ClinCheck' set-ups and good clinical monitoring, can routinely produce satisfactory outcomes in patients who require the removal of a lower incisor.
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Introduction

The Invisalign system has been in general use for a decade and yet there is a paucity of information published in the academic literature. Presentations are often limited to a single case report. Proffit, in 2008, noted that Invisalign treatment had been in existence for long enough for evidence of its effectiveness to be published.[1] While noting that aligners can be used effectively, the lack of good evidence in the literature drew comment. This deficiency was partly addressed in 2009 by Kravitz et al., who published a relatively large scale prospective clinical study on the efficacy of tooth movement with Invisalign appliances.[2]

When first introduced to the dental profession, the Invisalign appliance was aimed at non-extraction treatment in which mild to moderate crowding and/or spacing was managed in cases requiring little or no buccal segment change. In 2016, the British Orthodontic Society website stated that: 'Aligners are most commonly used in cases needing alignment of teeth without extractions.'[3] It was further stated that cases in which aligners 'may require the use of additional techniques such as fixed appliances to achieve an ideal result' included cases requiring tooth extractions or complex tooth movements.[3]

The treatment of a lower incisor extraction case with Invisalign was first reported in 2002.[4] In a 2008 study of orthodontic diagnosis and treatment procedures, Keim et al. reported that, of the respondents to a survey, 7.2% of clinicians would routinely treat lower incisor extraction cases with the Invisalign appliance.[5]

The current article is a presentation of 12 consecutively treated patients whose treatment plan required the extraction of a single lower incisor. All were treated exclusively and solely with the Invisalign appliance, although use was made of auxiliary mechanics (buttons, power arms and elastics) in some of the cases (Table I).

The critical factors in successful treatment of lower incisor extraction cases are: an appropriate diagnosis and treatment plan; a well designed ClinCheck; competent clinical monitoring; and case refinement where needed. A brief review of these factors follows.

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Diagnosis

When crowding is sufficient that expansion of the dental arches or proclination of the incisors is not deemed desirable, the alternatives for the treating clinician are either interproximal reduction of enamel, usually from several tooth surfaces, or the extraction of teeth.

The indications for the extraction of a lower incisor in orthodontic treatment are:

- Moderate to severe lower incisor crowding and mild or no upper incisor crowding.
- Class I or mild Class III molar relationships bilaterally.
- Acceptable soft tissue profile.
- Minimal overbite and overjet.
- Minimal growth potential.
- Tooth-size (Bolton) discrepancy present.
- Tooth pathology (periodontal problem such as recession, or severe wear or fracture of a lower incisor).
- Where potential relapse is significant – severely rotated or displaced teeth are more likely to relapse after correction.
- Patient preference – if treatment is to be limited to the lower arch a tooth/arch size discrepancy may be created.[6,7,8,9]

There are two primary advantages of the extraction of a lower incisor. Invariably, the tooth is located at the site of crowding, which is seldom the case for posterior extractions. In addition, interproximal reduction may need to be performed on most lower teeth to gain the same amount of space as the removal of a single lower incisor (approximately 6 mm). The removal of a badly positioned lower incisor reduces the likelihood of that tooth relapsing. Of all the treatment modalities examined in the University of Washington retention and relapse studies, lower incisor extraction cases were considered the most successful long-term and significantly better than other treatment options.[10] Canut found similar long-term stability in lower incisor extraction cases.[6] The removal of a lower incisor allows the clinician to preserve lower intercanine width, the expansion of which has been suggested as a likely cause of post-treatment relapse.[11]

The primary disadvantage of lower incisor extraction is aesthetic: upon tooth removal an unsightly extraction space exists. An Invisalign solution is the placement of an aesthetic pontic in the aligner. The post-treatment consequence will almost always be a dental midline discrepancy and the potential of an open gingival embrasure (black triangle) is high (up to 70%).[8] A review of the literature by Zhylich and Suri identified the need to avoid poor outcomes including gingival recession, open interproximal gingival embrasures and increases in overjet and overbite.[9]

ClinCheck

The ClinCheck software allows the treating clinician to determine the treatment sequence, movement speed of teeth and the three-dimensional visualisation of the case at any treatment stage. The clinician is responsible for accepting the ClinCheck before aligner manufacture, and so it is vital that an effective, efficient and achievable treatment plan is designed. Features that are of great importance in lower incisor extraction cases include: the use of the longest possible rectangular attachment on the teeth adjacent to the extraction spaces to allow greater control of root movement; the incorporation of an aesthetic pontic where possible; and an appropriate movement rate of individual teeth throughout treatment.

An additional advantage of the ClinCheck software is that it allows the clinician to visualise a diagnostic wax-up of the case before an extraction is performed. Various alternatives may therefore be assessed and discussed with the patient and referring dentist.

Monitoring

The treating clinician needs to closely assess each case so that timely intervention may be instituted as soon as problems become evident. This greatly lessens the chance of an unfavourable case response and a failure of the aligners to satisfactorily complete the case.

Case refinement

Invisalign case refinement is analogous to finishing with straight-wire fixed appliances, in which tooth position is not ideal despite correct bracket placement and straight archwires. Invisalign treatment includes, free of charge, an unlimited number of additional aligners to allow the clinician to finish the case at the

desired and previously determined end point. Case refinement is required in approximately 70% of all cases, with complex cases often requiring more refinement than simple cases.

Materials and methods

The clinical treatment was performed in the author's private practice and informed consent was obtained from all participants. The first 12 consecutively treated cases in which a lower incisor was extracted were selected for inclusion in the study. The Invisalign appliance was the treatment method of choice. Patients were reviewed every six to eight weeks until the last aligner in the initial sequence had been worn for two weeks. Photographs were taken after approximately every nine aligners. At the completion of the initial aligner sequence, photographic records were taken and the need for case refinement considered. The average treatment time was 21 aligners or approximately 42 weeks.

Six of the 12 patients required case refinement in order to improve root parallelism on either side of the extraction space or to manage unintentional tooth intrusion during alignment. Extraction space closure occurred without difficulty in all cases and alignment of crowding was satisfactorily completed. The average length of case refinement was six weeks. An example of the use of auxiliaries to improve root parallelism in Case 7 is provided in Figures 1a–d. The choice of tooth to be extracted was determined by existing pathology rather than favourable root angulations, resulting in an open gingival embrasure after initial alignment.

Photographic records of all patients before and after treatment are available but only a representative sample of the first five cases is displayed (see Figure 2).

Results

Results are presented in Table I.

Table I. Results of the 12 patients treated with the Invisalign appliance.

Case	Tooth extracted	Number of aligners	Why extract?	Arches treated	Reason for refinement /use of auxiliaries
1.	31	17	Class III tending, Bolton discrepancy	Lower	Nil
2.	41	20	Induced Bolton discrepancy (due to 1 arch treatment)	Lower	Nil
3.	31	23 + 3 refinement	Pathology + Induced Bolton discrepancy	Lower	Root parallelism No auxiliaries used
4.	32	20	Induced Bolton discrepancy	Lower	Nil
5.	41	22 + 3 refinement	Induced Bolton discrepancy	Lower	Root parallelism
6.	42	22 + 13 refinement	Lip strain/crowding	Both	Extrude 41, 43 Buttons and elastic used
7.	41	23 + aux	Pathology	Lower	Root parallelism Power arms and elastics used
8.	41	25	Bolton discrepancy/ crowding	Both	Nil
9.	32	21 + Aux	Class III/ Bolton discrepancy	Lower	Extrude 31 Button and elastic used
10.	31	15 + 4 refinement	Class III tending, Bolton discrepancy	Both	Root parallelism
11.	41	17	Gingival recession	Both (upper with interproximal reduction)	Nil
12.	41	20	Crowding/protrusion	Both (upper with extraction of 15, 25)	Nil

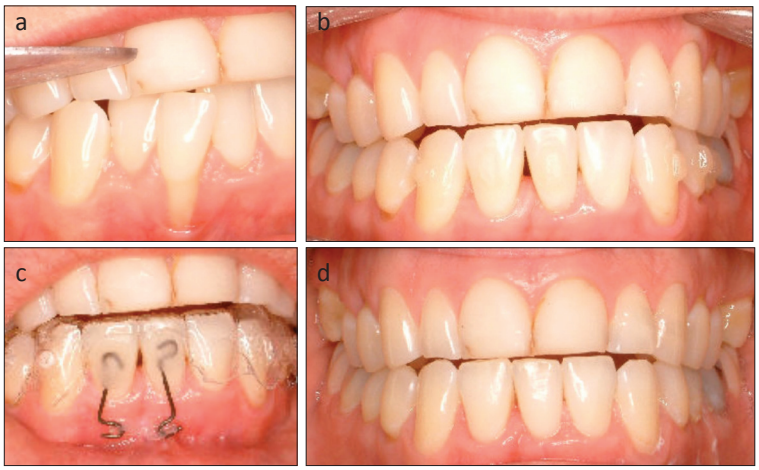


Figure 1. The use of auxiliaries to improve root parallelism. (a) The 41 to be extracted owing to labio-gingival dehiscence and patient choice for lower arch treatment only. (b) Result after 23 aligners. (c) Auxiliary power arms and chain elastic in place. (d) Result after six weeks.

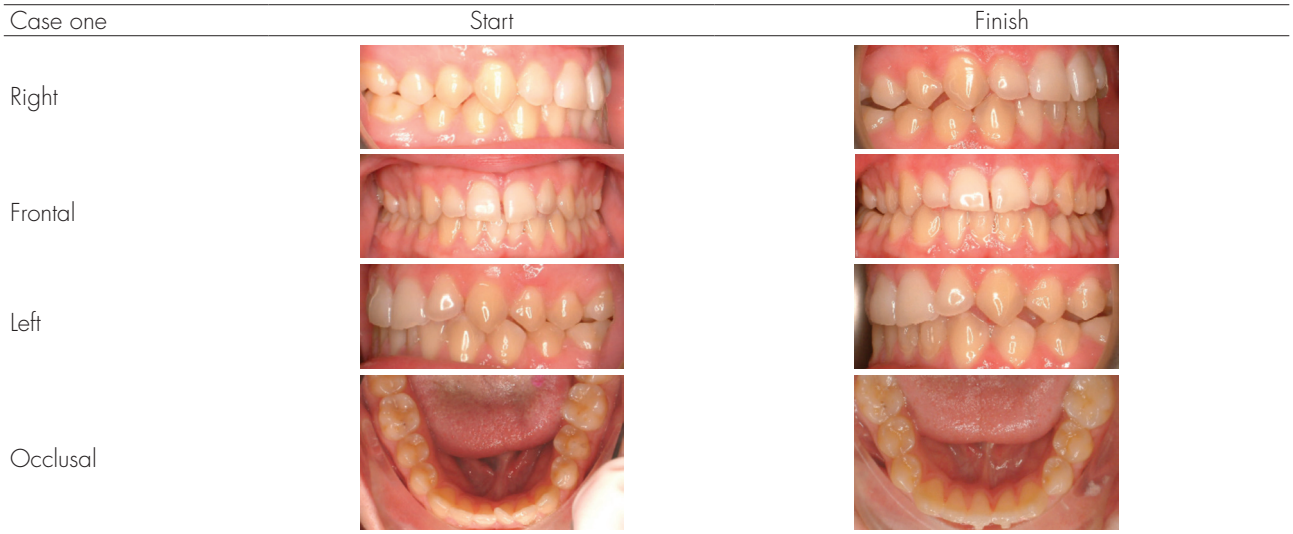


Figure 2a. Case one of five cases, each illustrated with eight images – four Start and four Finish. The four images are: right side; frontal; left side and occlusal lower.



Figure 2b. Case two.

Case three	Start	Finish
Right		
Frontal		
Left		
Occlusal		

Figure 2c. Case three.

Case four	Start	Finish
Right		
Frontal		
Left		
Occlusal		

Figure 2d. Case four.

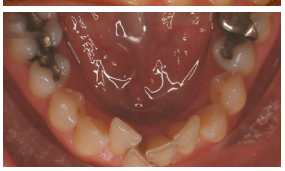
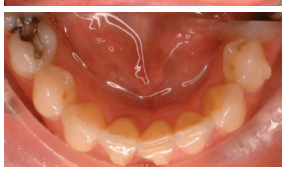
Case five	Start	Finish
Right		
Frontal		
Left		
Occlusal		

Figure 2e. Case five.

Conclusions

The decision to extract a lower incisor requires careful diagnostic judgement that determines the ease of treatment, which is usually relatively straightforward. Align Technology provides the treating clinician with the ability to check a 'virtual diagnostic wax-up' via the ClinCheck software program. A brief period of tooth root detailing (refinement) is often needed.

The Invisalign appliance is capable of producing satisfactory clinical outcomes in the treatment of lower incisor extraction cases. Treatment times are acceptable and the appliance is well tolerated by patients. Care and attention to diagnosis, ClinCheck set-up and treatment monitoring are all vital for a successful outcome.

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