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# The Inman Aligner for Anterior Tooth Alignment

**Abstract:** The Inman Aligner is a highly effective and unique evolution of the traditional spring retainer that uses super-elastic Nickel-Titanium open coil springs to move upper and lower anterior teeth with light but consistent forces, enabling correction of anterior crowding, rotations and some types of spacing.

**Clinical Relevance:** This article describes the appliance, its uses and limitations.

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With the recent introduction of the IOTN (Index of Orthodontic Treatment Need) scoring system, and decreasing of the NHS funding for orthodontic treatment in the UK, it is likely that more patients will not have mild and moderate discrepancies treated at an early age. With the increasing aesthetic awareness of the public, this will create a large number of patients who will seek to have these discrepancies treated later in life. Treatment options available for mildly crowded teeth include orthodontics and restorative dentistry. Patients may choose the restorative approach, ie porcelain veneers, over orthodontic techniques because of the longer treatment times of the latter, combined with either unsightly labial wires and brackets or the expense involved in 'invisible' braces.

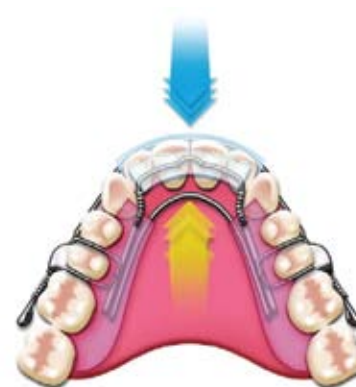
In cases where patients choose to have crowded lower anterior teeth treated with veneers, it is extremely challenging to prepare teeth conservatively owing to their diminutive anatomy and the minimum thickness of porcelain required. A balance

has to be found between over-preparing the teeth and placing over-contoured restorations. As a result, many practitioners have sought alternative treatments to avoid preparing the lower anterior teeth.

## The Inman Aligner

Spring aligners have been used for minor tooth movements for over 25 years. Early designs were developed for minor tooth movement and to treat slight rotations. Previous spring aligners were useful, but several problems limited the amount of tooth movement achievable. Their active components were made from stainless steel wire, which is relatively inflexible and lacks any innate springiness. Thus traditional removable appliances require periodic reactivation, leading to short-lived force application that limits the speed of tooth movement because of the need to allow the bone around the roots of the teeth being moved to 'rest' between successive activations. In addition, the direction of force application with traditional springs is less easy to control, leading to a 'mousetrap-like' force, which tended to unseat the appliance. These factors combine to limit the degree of correction that can be accomplished.

In developing the Inman Aligner,



**Figure 1.** The Inman Aligner.

Inman Orthodontic Laboratory has created a patented design that takes advantage of the gentle, steady and consistent forces generated by nickel titanium (NiTi). The design relies on piston-like components driven by NiTi coil springs. The forces are varied by altering the coil size and/or compressing the coil to create a stronger force. Don Inman has also designed lingual and labial components to function or move in parallel to the occlusal plane, eliminating the mousetrap like de-seating forces and allowing true bodily movement of teeth.

A standard Inman Aligner, as

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described in the following cases, consists of both lingual and labial NiTi driven components. The forces have the effect of 'squeezing' the teeth into alignment. Inman components can be used in isolation to retract teeth with a more steady force, requiring less adjustment than a standard labial bow retractor (Figure 1).

### Movement achievable

The movement achievable with an Inman Aligner is summarized in Table 1.

### Patient selection

Case selection for the Inman Aligner is critical. Only certain types of movement are possible and some patients will still need conventional orthodontic treatment or indirect restorations.

Certain criteria should be met before treatment proceeds:

- The patient should require movement of



Figure 2. The 'Required space'.



Figure 3. The 'Available space'.

incisor and/or canine teeth only;

- Root formation of the teeth to be moved must be complete;
- Crowding or spacing should be less than or equal to 3 mm. Arch evaluation must be performed to determine the amount of space required. Cases with over 3 mm of crowding will need alternative treatments;
- Sufficient fully-erupted posterior teeth to facilitate retentive clasps, with a reasonably

well-aligned arch form to facilitate the path of insertion of the appliance;

- Good periodontal health. Cases should be stable or, preferably, free from periodontal disease;
- Compliance. Patients must agree to wear the aligner for about 20 hours a day and be responsible for good appliance and oral hygiene.

### Model evaluation

The amount of crowding present is calculated by measuring the sum of the mesial-distal widths of the teeth to be moved.<sup>1</sup> This may be carried out with a calliper. Each width is plotted along a straight line and the total length measured. This distance is called the 'Required space' (Figure 2). If incisors only are to be moved, this will be from the mesial surface of one canine to the mesial surface of the other canine. If canines and incisors are to be moved, this distance will be measured from the distal surface of one canine to the distal surface of the other.

Using an orthodontic retaining or jewellers chain, the ideal arch form is then measured by hanging the chain from the distal of each canine and letting it align with the most ideal arch form after orthodontic correction. This is described as the 'Available space' (Figure 3) and it is measured by placing the length of chain against a millimetre ruler.

The 'Available space' is then subtracted from the 'Required space' and this gives the amount of crowding present or the space required by inter-proximal reduction.

### Laboratory requirements and 'model surgery'

Accurate upper and lower impressions are taken, preferably two of

Tooth	Movement	Potential
Incisors	Labially	Great potential
	Lingually	Great potential
	Rotation	Great potential
	Labial or lingual tipping	Great potential
	Mesially or distally (crowded cases)	Difficult, but possible as a 'domino effect'
	Mesially or distally (excess space cases with retraction)	Difficult, but possible
	Mesially or distally (excess space cases with no retraction, just mesial or distal movement)	Impossible
Canines	Uprighting of long axis (mesial or distal root torque)	Very difficult
	Intrusion/extrusion	Impossible
	Lingually	Possible
	Distally	Possible
	Labially	Difficult
	Mesio-labial rotation	Difficult
	Laterally	Nearly impossible
	Uprighting of long axis (mesial or distal root torque)	Nearly impossible
Disto-labial rotation	Impossible	
Intrusion/extrusion	Impossible	

Table 1. Summary of achievable movements.



Figure 4. Model surgery.



Figure 5. 0.5 mm interproximal reduction per contact, 2.5 mm from canine to canine.

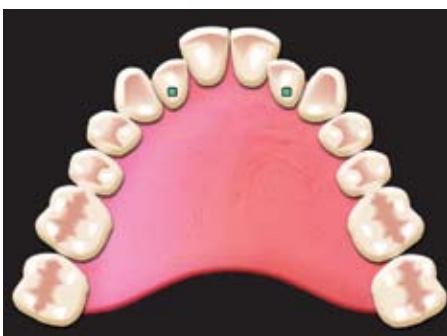


Figure 6. Lingual anchors.

the arch being treated. A bite registration and prescription should be completed and sent to a certified Inman Aligner Laboratory. The technician should be informed of the amount of crowding calculated. The teeth to be repositioned should be noted clearly.

All spring aligners should be constructed on casts on which model surgery has been performed. The anterior teeth to be corrected are sectioned off the model and reset in the ideal arch form in wax on a working cast. The appliance is then fabricated on the corrected cast so that, when worn by the patient, the 'built-in' forces correct the misaligned teeth (Figure 4).

#### Interproximal reduction

Interproximal reduction should be started at the fitting appointment. This is performed by using abrasive strips or discs. The total amount of reduction required will already have been calculated during model evaluation.

Many authors acknowledge that the reduction of one-half of the interproximal enamel on the mesial and distal of each incisor tooth is a safe technique.<sup>2</sup> This equates to 0.5 mm per contact making 2.5 mm of space possible between the canines. In some cases, the distal of the canine and mesial of the premolar can be reproximated, allowing for a total of 3.5 mm. These cases will require more experience using the system.

When using abrasive discs or strips, care must be taken to avoid causing any trauma to the interdental papilla.

Surfaces should be smoothed with fine polishing strips.

Ideally, all interproximal reduction should be performed on the first visit, as more accurate measurement of the amount removed can be assessed using a thickness gauge at this time. However, it is understandable that some clinicians may want to have a staged approach. This can be done if careful records of the amount of stripping are taken. The clinician must be aware of the thickness of the discs and strips being used.

An in-surgery fluoride rinse or application of topical fluoride is recommended after any enamel reduction procedure.

Studies by El-Mangoury *et al*<sup>3</sup> and Radlanski<sup>4</sup> have shown that there is no increased risk of caries after interproximal reduction, provided surfaces are smoothed correctly. The interproximal enamel is much thicker than labial enamel and is believed to have evolved to protect against the interproximal wear that resulted from abrasive primitive diets. As modern diets are less abrasive, much of this interproximal enamel is considered vestigial.

In their study, Radlanski *et al* studied teeth after interproximal air-rotor stripping using scanning electron micrographs. They stated:

*Even though plaque accumulation would be expected, the SEM analysis revealed no incidence of caries in the artificially*

*produced furrows. Therefore, interdental stripping can be considered a reasonable therapeutic technique, especially if care is taken to avoid abrasion in more gingivally located enamel.*

El-Mangoury *et al* reported that:

*Posterior interproximal enamel reduction does not appear to expose the enamel to pathological changes that could lead to caries, but to a period of demineralization, followed by remineralization. And, The roughness produced by stripping does not predispose to caries. Also, The results of this study establish a sound biological foundation for Sheridan's air rotor stripping technique.*

Studies by Heins<sup>5</sup> and Tal<sup>6</sup> have shown that there is no increased risk of periodontal disease despite the decreased interproximal space. Conversely, they showed it to be beneficial to periodontal health. Tal<sup>6</sup> showed that intrabony pockets were less common when the distance between teeth was reduced and more common when the distance increased. He stated 'The correlation between the interproximal distance and the presence of intrabony pockets was positive and statistically significant'. That is, the smaller the distance, the less the tendency for intrabony pockets, and the larger the distance, the greater the tendency for intrabony pockets (Figure 5).

#### Lingual/labial anchors

Owing to the lingual slope of the maxillary anterior teeth, the lingual component may tend to ride up incisally. By adding composite resin just incisal to where the component contacts, the component will function more efficiently. This can also be used for the labial surface, especially if teeth are being retracted (Figure 6).

#### Appliance adjustment

For the labial component (Figure 7), adjustment is fairly simple. An adjustment bead (Figure 8) can be incorporated into the appliance during construction. To increase the retracting force, the helices distal to the adjustment bead are wound in a clockwise direction to compress the open coil and tighten the assembly. If no adjustment bead is present, the terminal end of the wire is simply cut and re-bent. To decrease



**Figure 7.** The labial component NiTi spring.



**Figure 8.** Compress coil with an adjustment bead.



**Figure 9.** Lingual assembly removal.



**Figure 10.** Standard Lower Inman Aligner.

the retracting force, the coil spring is removed and cut so it is flush with the labial component.

For the lingual component, the lingual assembly may be removed by gently pulling it out (Figure 9). The NiTi coil may then be removed and replaced with a stronger force NiTi coil or a longer section of open coil to increase the force or a smaller, thinner coil to reduce it. The component is simply replaced by squeezing it and re-inserting it into the metal slots present in the acrylic.

### Case 1

The patient was a 24-year-old female who complained about the appearance of her lower anterior teeth. She gave a history of orthodontic treatment in her teenage years, having four premolars extracted and a fixed appliance fitted for a period of two years. She had been provided with a retainer at the time but was only told to wear it at night for 3 months. After this she had no follow up appointments with her orthodontist.

She had noticed that her lower four incisors became crowded again over

the three years prior to presentation. Treatment options discussed were invisible braces, conventional fixed brackets or an Inman Aligner. The minor degree of tooth movement required made the first two options disproportionately expensive, so the

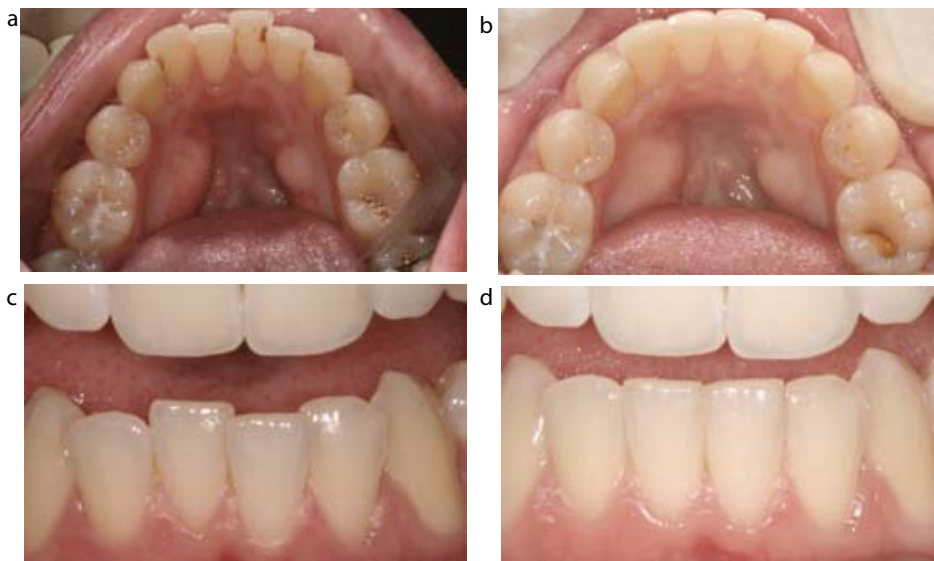
patient chose an Inman Aligner (Figure 10).

The amount of space required for reduction was calculated at 2.5 mm by measuring the available space (21.5 mm) and required space (24 mm) and subtracting the former from the latter. Interproximal reduction was performed using diamond strips (Brasseler, Germany). A total of 0.25 mm reduction at each contact was made on the fitting appointment. This was verified with a thickness gauge. The patient was seen after 2 weeks and a further 0.25 mm were reduced at each contact. The teeth were aligned in just over 6 weeks. The aligner was left in for a month to stabilize the tooth positions. Finally, orthodontic retention wire was bonded in place on the lingual surfaces, ensuring the patient could still use super floss for hygiene (Figure 11 a-d).

### Case 2

This patient was a 15-year-old male. His upper incisors were rotating and his upper left lateral was drifting palatally. This caused his upper centrals to appear too dominant. He had recently been to an orthodontist who had suggested removal of four second premolar teeth followed by a period of fixed brackets.

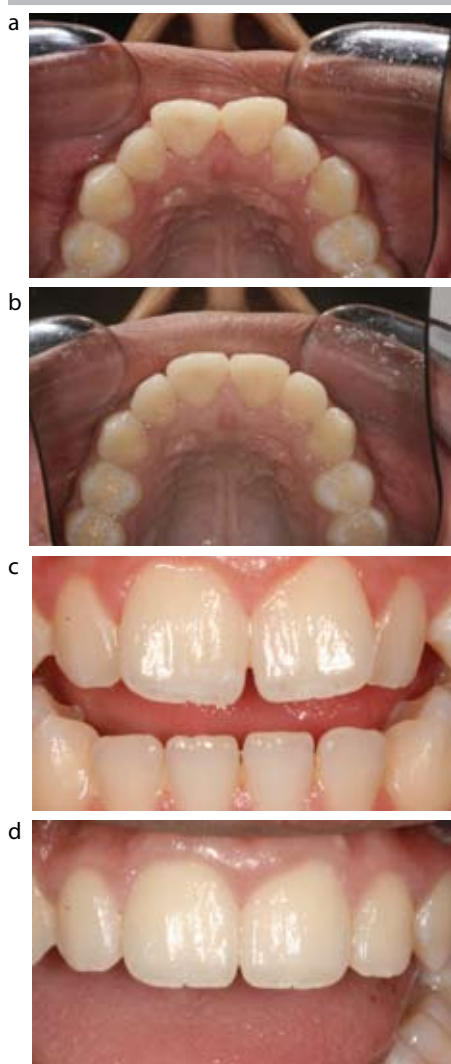
An Inman Aligner was considered because, if the crowding present is less than or equal to 3 mm, no extractions would be necessary. Space calculation showed that



**Figure 11.** (a) Occlusal lower before; (b) occlusal lower after 7 weeks; (c) close view before; (d) close view after 7 weeks.



**Figure 12.** Upper Standard Inman Aligner.



**Figure 13.** (a) Occlusal upper before; (b) occlusal upper after 6 weeks; (c) close view before; (d) close view after 6 weeks.

3 mm of crowding was present by subtracting the available space (27 mm) from the required space (30 mm). A standard upper Inman Aligner was prescribed (Figure 12).

The prescription instructed the



**Figure 14.** (a) Front smile view before; (b) front smile view after 13 weeks; (c) wide occlusal view before; (d) wide occlusal view after 13 weeks.

technician to reset the four central teeth and allowed for 3 mm of interproximal stripping. Only 2.5 mm of stripping was actually required over two appointments to align the teeth.

The teeth were aligned within six weeks. The Aligner was then left in at night time only as a retainer for four weeks. The patient is wearing a night-time essix-style retainer and has had no relapse a year after treatment (Figure 13 a-d).

### Case 3

This young lady presented complaining mainly about her rotated upper

right central tooth. She had considered invisible braces and veneers. Space calculation showed that treatment would be possible with an Inman Aligner. Because of the relatively low cost risk, she decided on this option, understanding that it would not be possible to achieve the correct golden proportion owing to the width and length of her lateral teeth. An Upper Inman Aligner was prescribed, but a midline screw was incorporated to allow for a small amount of dentist controlled expansion to provide a little more space. Midline screws can be used to release extra space in tight cases. However, these should only be turned by the operator and, to avoid occlusal interferences, only 1–1.5 mm of space should be claimed this way (Figure 14 a-d).

Treatment took 13 weeks, with three sessions of interproximal reduction. A total of 3 mm was stripped and 0.75 mm was gained with the expander. The patient was retained using orthodontic gold chain bonded from canine to canine. An upper essix retainer is also being worn nightly as back-up for retention.

### Case 4

This young lady had originally presented for porcelain veneers on her lower anterior teeth. After full case options were given, she decided to have an Inman Aligner to align the teeth before veneers might be placed to minimize the amount of preparation. The patient was fully aware that, after alignment and possible veneers, retention would be mandatory. A standard lower Inman Aligner was made and fitted. Interproximal reduction was carried out over two visits and the teeth aligned within 9 weeks. The aligner was used to retain the teeth passively for a further 4 weeks, after which a bonded ortho-chain retainer was placed. The patient was pleased with the alignment and that simple composite bonding could be used to treat the wear and establish canine and anterior guidance (Figure 15 a-d).

### Case suitability

These cases have been presented for prospective users to use as a guide for selecting suitable cases. All suitable cases have 3 mm or less crowding with little canine movement required (Figure 16 a-d).



**Figure 15.** (a) Aligner in position; (b) close view before; (c) lower occlusal view before; (d) lower occlusal view after.

### Retention

The following are recommended retainer types.

#### Bonded canine to canine retainers

These are fixed retainers commonly made from 0.0195" or 0.0175" multi-strand stainless steel wire. An indirect method can be used to adapt the wire to a working model. This can then be transferred to the teeth using a specially made jig and bonded with flowable composite resin to the backs of the aligned teeth. Alternatively, ortho-gold chain can be used and held in



**Figure 16.** (a–d) Suitable case types.

place with floss while curing is achieved.

The occlusion must be clear when placing a retainer on the maxillary arch. Advantages of this method are that the flexibility of the arch wire allows for physiological tooth movement and prevents bond fracture through occlusal forces. Periodontal ligament stability is also achieved with this technique.<sup>7</sup>

#### Essix retainers

These are thermoformed clear, thin appliances that are easily made and comfortable for patients. The recommended

regimen post-op for Inman Aligner treatment is to wear the retainer nightly for 18 months and then for two nights a week indefinitely.

### Conclusion

With the Inman Aligner, patients previously put off by the treatment time and fixed brackets of traditional orthodontic techniques or the expense of more recent invisible types of appliances could, if their case was suitable, achieve anterior tooth alignment with a simpler single appliance. These appliances are suitable for alignment of incisors and canines with up to 3 mm of crowding and represent a very conservative alternative to radical tooth preparation to achieve tooth alignment using porcelain restorations.

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