Enamel stripping and the spring aligner appliance—An update
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Irregularity of the mandibular incisors in an otherwise good occlusion is quite common in young adult patients. Through use of enamel stripping in the incisor region, it is possible to create sufficient space to align the teeth with a mandibular sectional removable appliance, commonly known as the spring aligner. This article reviews the methods of enamel stripping and describes the author’s preferred technique of enamel stripping and the various modifications of the spring aligner appliances that can be prescribed by the general practitioner to correct mandibular anterior crowding.

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Introduction

It is not uncommon for adolescents or adults to present with crowding and irregularity confined to the mandibular anterior teeth. Such a patient may or may not have had previous orthodontic treatment. If the crowding is sufficiently severe to warrant extractions, the most predictable way of aligning the teeth and effecting controlled space closure is by the use of fixed appliances. Should space analysis of the crowding reveal crowding up to 3 or 4 mm and that the buccal segments are in good Class I interdigitation, the use of a spring aligner appears to be a simple and esthetically acceptable method of treatment.

Enamel stripping

As early as 1944, Ballard advocated reduction of approximal surfaces of teeth to “correct a lack of balance” arising from a discrepancy in tooth size between left and right sides or between maxillary and mandibular labial segments. Bolton studied plaster casts of excellent Class I occlusions and found that the mandibular tooth substance mesiodistally from canine to canine was 74% to 81% of that of the corresponding maxillary canine-to-canine dimension. If the percentage is not within this range, reduction of mesiodistal tooth widths in the appropriate arch is indicated. Peck and Peck measured the mesiodistal and labiolingual measurements of mandibular incisors and concluded that, in occlusions with perfect mandibular alignment, there is a norm index (PI) that relates these two measurements. They recommended that, when tooth dimensions are outside the norm, the tooth be contoured by removing interproximal enamel.

More recently, Betteridge described an index to measure the degree of crowding in the mandibular labial segment. This index (BI) is a ratio of the sum of the mesiodistal widths of the six mandibular anterior teeth to the amount of space available. The crowding present in the mandibular labial segment is the difference between mesiodistal widths of the six mandibular teeth and the space available. Enamel stripping is carried out to reduce mesiodistal tooth tissue in the labial segment until it equals the space available for alignment.

Several authors have found that aboriginal populations consuming unrefined diets lost a total of 14 to 15 mm of tooth material in their lifetime. These authors concluded that, because present-day refined diets do not allow for this interproximal wear, crowd-
ing has a greater incidence in modern humans. For this reason, enamel reduction is justified.

Barrett advocated that stripping be performed in such a manner to offset or “keystone” the planes produced by stripping to an angle in opposition to the direction of anticipated relapse. These keystoned interproximal relationships would tend to resist relapse of the malposed incisors.

The amount of mesiodistal tooth substance permissible for enamel stripping is determined by the thickness of enamel. Several tables have been published to serve as a guide to the average amount of mesiodistal tooth reduction permissible. In general, the average thickness of interproximal enamel in the mandibular central incisor, mandibular lateral incisors, and mandibular canines is 0.52 to 0.54 mm, 0.65 to 0.68 mm, and 0.76 to 0.90 mm, respectively. Usually slightly less than half the thickness of enamel is permissible for enamel stripping, allowing the maximal total amount of space available for alignment of incisors to vary between 3 and 4 mm.

Enamel stripping techniques

Interproximal removal of mandibular incisor enamel can be carried out through several methods:

1. Metal abrading strips that can either be hand held or frame held can be used. However, these techniques are slow and inefficient.
2. Mechanically operated interdental stripping (e.g., specially designed reciprocating abraders or a custom-made dome stripper) may be a more efficient technique of enamel stripping.
3. Safe-sided disks (either single or double-sided) in conjunction with a conventional handpiece can also effect mesiodistal reduction of tooth widths. Although this technique is rapid, its use should not be encouraged because of the danger of soft tissue damage.
4. Air-rotor stripping (first advocated by Sheridan) with a bur. This technique can be used with good accuracy and speed. However, care has to be exercised to prevent excessive removal of tooth structure especially in moderately to severely imbricated incisors, where access to the interproximal surfaces is poor.

Air-rotor stripping with a long-shaft fine diamond

The author’s preferred method of enamel stripping is dependent on the space required. If the space required is less than 0.3 mm, hand-held metal abrading strips are used. Each contact point is stripped to allow the easy passage of two or three enamel strips through the contact points. Because the interdental papilla is usually just cervical to the contact point, the use of a topical anesthetic ointment in the papillary region may alleviate discomfort arising from hand-held stripping.

If the space required at the contact point is about 0.4 to 0.6 mm, the Hidi 559, a fine, 10-mm-long shaft, tapering diamond (Ash Instrument) is preferred. One week prior to enamel stripping, orthodontic rubber separators are inserted at each contact point where enamel stripping is to be carried out. When the patient returns for enamel stripping, the removal of separators creates tiny spaces between the teeth that will facilitate enamel stripping. Although the rubber separator stage is optional, it eases enamel stripping. The bur is held vertically in such a way to allow enamel removal at the contact point (Fig 1). In this respect, teeth with bell-shaped interproximal sides (as opposed to parallel-sided teeth) are more favorable for stripping. Grossly rotated teeth or severely inclined teeth where the contact points are subgingival (which in any case are poor indications for the spring aligner appliance and will require fixed appliance therapy) are also more difficult to strip without excessive removal of tooth structure and trauma to the gingival tissues. In these cases, stripping is performed only after initial alignment (with fixed appliances).

The author’s technique for enamel stripping, in which enamel stripping is effected by moving the bur attached to a high-speed air-turbine handpiece labiolingually (Fig 1), is distinctly different from the air-rotor stripping technique first proposed by Sheridan. Sheridan used a No. 6692 tapered fissure carbide bur (Brasseler) to reduce interproximal enamel by moving the bur occlusogingivally; the bur was held in a somewhat horizontal orientation (Fig 2). Such a technique (unless used in conjunction with a 0.020-inch wire guide between gingival tissue and the bur, as proposed by Sheridan) may allow nicking of the papilla during air-rotor stripping.

After the proximal surfaces are enamel stripped, the same Hidi 559 bur can be used to finish, round, and contour the buccoproximal and linguoproximal surfaces. Care has to be exercised not to create a chamfer or ledged finish at the most cervical aspect of the stripped enamel surface. Metal interdental enamel strips (Roeko, Roescheisen) as well as fine abrasive
strips (Sof-Lex, 3M Dental) may be used after air-rotor stripping to smooth the stripped enamel surfaces.

Fluoride is applied to the stripped enamel surfaces to protect the exposed subsurface enamel, which is less rich in fluoride than the surface enamel. Duraphat fluoride varnish (Woelm Pharma) is the preferred fluoride vehicle because it is easy to apply, is less sensitive to moisture control, and has a more acceptable taste.

Spring aligner appliance

The spring aligner appliance has also been termed a spring retainer or a spring Hawley appliance. Spring aligners are removable orthodontic appliances that are used to align crowded mandibular incisors where the anterior crowding is less than 4 mm. Spring aligners are very effective in correcting mandibular incisor crowding caused by labiolingual displacement. To a lesser extent, rotating of incisors can also be corrected. The limitation of spring aligners is that they cannot correct faulty axial inclinations of teeth and severe rotations. Should such corrections be required, fixed sectional appliances are still required. Where the intra-arch crowding is in excess of 4 mm and where complete-arch air-rotor stripping or extraction therapy is indicated for space requirements, a complete-arch fixed bonded appliance is preferred for precise control.

Although Barrer's spring retainer appliance was a sectional canine-to-canine appliance (Fig 3) aimed at aligning mandibular incisors, it can also be used to align canines. However, to align canines, the appliance has to be extended to include the premolars (Fig 4).

Laboratory stages

The laboratory stages have been described in several excellent articles. Briefly, the imbricated mandibular incisor teeth are sawed off the casts and realigned on the cast in the most anatomically ideal positions. The spring aligner wire (0.7-mm stainless steel) with loops on both the labial and lingual aspects of the teeth is then bent in close contact with the labial and lingual surfaces of the incisors and passed over the canine-premolar contact (Fig 3).

Next, a thin bar of clear acrylic resin is processed on the horizontal portions of the wire framework, making detailed and positive contact with all the facial and lingual surfaces of the anterior teeth.

The author's experience with more than 300 spring aligner appliances has led to several modifications:

1. Should the displacement of the tooth or teeth be relatively severe, the tooth or teeth on the cast setup are only partially aligned. As a guide, no more than 1-mm of movement or 20 degrees of derotation should be attempted for each tooth. Should the displacement be greater than this magnitude, sequential alignment via two or even three appliances should be used, with the appliances constructed on sequentially aligned cast setups.
2. Even if all four incisors require realignment, only a maximum of two incisors are aligned at a time on the cast setup. This is to ensure that the labiolingual reference points from adjacent teeth are preserved.

3. The horizontal portion of the wire work on the labial aspect should be at the middle third of the tooth. However, to ensure sufficient retention, this wire framework must be bent just below the point of maximal convexity of the labial aspect of the tooth.

4. To ensure sufficient retention, retentive components can be added to the sectional spring aligner. The retentive components (either soldered or embedded in the lingual acrylic resin plate) make the spring aligner a “safer” appliance by ensuring better retention.

**Retentive components**

Soldered clasp

The wire framework with the cold-cured acrylic resin bar adapting to the labial and lingual surfaces of the incisors (1 mm incisal and 1 mm cervical to the wire framework) remains the same as in the original Barrer design. However, circumferential (C) clasps are soldered to the canine-premolar crossover of the wire framework. These C clasps engage on the distobuccal undercuts of the premolars to allow better retention (see Fig 4). Sometimes a double C clasp can be added, engaging the distobuccal undercuts of both the first and second premolars (Fig 5). The C clasps are soldered to the spring aligner framework before cold-curing clear acrylic resin is added to the labial and lingual portions of the spring aligner. These appliances are considerably more retentive than the original sectional canine-to-canine removable appliance (without retentive components). Another advantage of soldered clasps is that these clasps need not pass through any additional embrasure areas.

Connectors to the acrylic resin plate

The terminal ends of the wire framework of the spring aligner appliance, instead of finishing at the midline lingually, are extended gingivally to form a tag to allow the wire framework to be attached to a lingual plate (Fig 6). The retentive component attached to the lingual acrylic resin plate may take the form of C clasps, ball clasps, embrasure hooks, triangular clasps (Fig 7), or Adams clasps (Fig 8). This principle of attaching the spring aligner appliance to the acrylic resin plate can be extended to the maxillary plate and used to align malpositioned maxillary incisors.

**Spring Hawley**

Pro Laboratories has designed an appliance that can also be used to align crowded mandibular incisors—the spring Hawley (Fig 9). However, in the author’s experience, the spring Hawley lacks flexibility and can only be used in cases of mild crowding (1.0 to 1.5 mm). Such an appliance is therefore not favored by the author.
Fig 5  Double circumferential clasps soldered to the spring aligner.

Fig 6  Wire framework of the extended spring aligner appliance modified to allow the tag to be embedded in a lingual acrylic resin plate.

Fig 7  Extended spring aligner appliance with triangular clasp.

Fig 8  Extended spring aligner appliance with Adams clasp.

Fig 9  Spring Hawley appliance.
Clinical adjustments

On the day of issue of appliance, the planned enamel stripping is performed. Because the teeth have been moved in the cast, no activation of the appliance is required with the exception of the retentive components, if used (eg, Adam’s clasp or triangular clasp). In the mouth, the spring aligner moves the natural teeth to the cast arrangement on which the spring aligner was constructed.

At subsequent appointments (3-week intervals for children, 4-week intervals for adults), the fit of the labial and lingual acrylic resin bars to the incisors is checked. Unless the acrylic resin bars fit snugly on the tooth surfaces, the spring aligner is still active. Space is checked between the incisors, and if space is insufficient further enamel stripping is performed with metal abrading strips, followed by the appropriate fluoride therapy. Teeth should not be air-rotor stripped more than once. Should the appliance require further activation, the appliance is best activated by using a three-pronged pliers at the wire crossover (see Fig 3) to approximate the lingual and labial wire loops and the acrylic resin bars.

Depending on severity, every millimeter of crowding takes about 6 to 8 weeks to correct. Therefore, in patients with 4-mm crowding, treatment time should not exceed 8 to 10 months.

Spring aligner as a retainer

The spring aligner when constructed on a perfectly aligned cast setup serves as a good retainer after treatment. Therefore, when the spring aligner is used to align teeth, the same appliance can be used as a retainer. The patient can then adopt a retention regimen of 3-month full-time wear followed by 6-month part-time wear.

Where treatment with fixed bondable appliances has been completed, the spring aligner serves as an excellent retainer for several reasons (hence its alternative name, the spring retainer). First, if the patient is uncooperative in the full-time retention phase and relapse is noted, enamel stripping can be carried out and the spring retainer can serve as an active appliance aligning the relapsed mandibular incisors. Second, unlike fixed lingual retainers, which require regular review and special care in oral hygiene procedures, the spring aligner appliance is removable, facilitating oral hygiene procedures.

In premolar extraction cases or where the premolars need to be retained because of extensive correction, the modified spring aligner appliance with an acrylic resin plate is preferred over the conventional sectional canine-to-canine retainer, to ensure that extraction spaces are kept closed.

Summary

The spring aligner is an esthetic appliance that, when used in conjunction with air-rotor stripping, can effectively be used to align up to 4 mm of crowding in the mandibular incisor region. In correctly selected cases, such an appliance offers an alternative to sectional fixed appliances or positioners.

References

17. Manual of Laboratory Appliances. Pacific Regional Orthodontic Laboratory.