Enhanced CPD DO C

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Use of Elastics in Orthodontics

Abstract: Intra-oral elastics are commonly used during orthodontic treatment and may be applied to several different clinical situations. They are useful for moving individual teeth, blocks of teeth and aiding growth modification. This article reviews the theory behind the use of intra-oral elastics and illustrates the theory with clinical examples.
CPD/Clinical Relevance: Elastics are an essential adjunct to orthodontic treatment and have numerous clinical applications.
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There are many different types of elastomerics available in orthodontics with varied uses (Table 1). This article focuses on elastic bands, which are highly versatile and have many practical applications in contemporary orthodontic practice.

Elastics exert their effect by applying force to either a specific tooth or groups of teeth to create movement. The force required depends on the type of tooth movement desired, and the number of teeth in the anchorage unit. Across the industry there is a standardized method of description of the diameter and weight of each elastic so that comparisons of relative force may be made, (Figure 1).

Elastomeric	Uses
■ Separators ■ Elastomeric ties (modules) ■ Elastomeric chain (powerchain) ■ Elastomeric thread (zing-string) ■ Intra-oral elastics	■ Making space inter-proximally to facilitate placement of bands ■ Ligating archwires ■ Closing space ■ Aligning teeth into the arch ■ De-rotating teeth ■ Aligning displaced teeth ■ Moving individual teeth ■ Moving blocks of teeth ■ Growth modification

Table 1. Different types and uses of elastics in orthodontics.

Force

The force level presented on the packaging by manufacturers is standardized, and represents the force applied by the elastic when it is stretched to three times its resting diameter. In theory, the correct size of elastic to use can be determined by measuring the distance between the points of application of the elastics and dividing by three. However, this is difficult to measure and unlikely to be precise clinically owing to the variable distances between attachments during treatment. A more precise method of measuring elastic force is with a stress–strain gauge between points of application.

The point of application of elastics to orthodontic appliances is determined by the clinician, and is dependent on both appliance type and desired treatment effect. There are many potential attachments: soldered or crimpable hooks on rectangular stainless steel archwires; circle loops bent into round stainless steel archwires; hooks incorporated into brackets and bands or attached using individual stainless steel Kobayashi ligatures or power-pins. Hooks and loops in removable or extra-oral appliances may also be used.

The force delivered by the elastic is dependent on not only the weight and diameter, but also the distance between the points of application: a larger distance will create increased stretch, resulting in greater force. The force dissipates over time owing

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Diameter		Weight				
		2oz*/2.5oz	3.5oz	4oz*/4.5oz	6oz/6.5oz*	8oz
3/4" (19mm)		Ernie (3M)* Hawk (AO)	Hal (3M) Giraffe (O)	Marmoset (AO)	Sheep (AO)*	
5/8" (16mm)		Andy (3M)* Egret (AO)	Paul (3M) Llama (O)	Chimpanzee (AO)	Gazelle (AO)*	
3/8" (9.5mm)		Tom (3M)* Hyena (AO) Ayers Rock (DB) Canada (OC)	Will (3M) Pink (TP) Big Ben (DB) Monkey (O)	Joe (3M)* Tiger (AO) Lavender (TP) Chichen Itza (DB) Came (O) Pakistan (OC)	George (3M) Rhinoceros (AO)* Navy (TP) Leaning Tower of Pisa (DB) Buffalo (O) Egypt (OC)	John (3M) Puma (AO) Violet (TP) Tiger (O)
5/16" (7.9mm)		Greg (3M)* Ferret (AO) Yellow (TP)* Stonehenge (DB) Parrot (O)* South Africa (OC)	Cliff (3M) Green (TP) Colosseum (DB) Penguin (O)	Louie (3M)* Panda (AO) Tan (TP) Great Wall of China (DB) Zebra (O) UK (OC)	Roger (3M) Manatee (AO)* Mauve (TP) St Petersburg (DB) Moose (O) Japan (OC)	Anna (3M) Leopard (AO) Fire Orange (TP) Panther (O)
1/4" (6.4mm)		Gary (3M) * Falcon (AO) Eiffel Tower (DB) Owl (O)* USA (OC)	Chuck (3M) Blue (TP) Parthenon (DB) Fox (O)	Elliot (3M)* Eagle (AO) Orange (TP) Pyramids (DB) Bear (O) India (OC)	Fred (3M) Sea Lion (AO)* Teal (TP) Statue of Liberty (DB) Ram (O) Mexico (OC)	Fran (3M) Jaguar (AO) Lime (TP) Leopard (O)
3/16" (4.8mm)		Pete (3M)* Dragon (AO) Mount Rushmore (DB) Quail (O)* Ireland (OC)	Dwight (3M) Red (TP) Golden Gate Bridge (DB) Rabbit (O)	Bill (3M)* Gorilla (AO) Grey (TP) Machu Picchu (DB) Kangaroo (O) Brazil (OC)	Bummer (3M) Tortoise (AO)* Fiesta Pink (TP) Atomium Brussels (DB) Impala (O) Australia (OC)	Roberto (3M) Cheetah (AO) Magenta (TP) Cougar (O)
1/8" (3.2mm)		Carlos (3M)* Wallaby (AO) White (TP)* Mount Fuji (DB) Hummingbird (O)	Dave (3M) Taj Mahal (DB) Chipmunk (O)	Cathy (3M)* Wolf (AO) Mount Everest (DB)	Debbie (3M) Elephant (AO)* Sydney Opera House (DB)	Gloria (3M)

Figure 1. The different diameters and weights of elastics and the relative forces achieved.

to both hysteresis within the elastic, and the reduction in the distance between the two points of application of force. The degree and rate of hysteresis is dependent on multiple factors, including the oral environment, and therefore, there is individual variation in elastic force between patients.

Class II/III anteroposterior correction

Elastics placed in a Class II or III vector are often used to gain, or maintain, anteroposterior correction, or support tooth movement in a desired direction (Figure 2). The elastic force, hours of wear and direction of the force vector can all be titrated to the required tooth movement

Class II and III elastics may also be used in conjunction with clear aligners to support planned molar distalization, and prevent unwanted increases in overjet. These can either be attached to cut-outs incorporated into the aligner, or bondable attachments directly to the tooth, which has the advantage of pulling the tooth or teeth into the aligner rather than pulling the aligners away from the teeth

Inter-arch Class II and III elastics can also be used to help to maintain the dento-alveolar changes achieved with functional appliances (Figure 3).[1] The benefit of transitioning to the fixed appliance phase of treatment with light intra-arch elastics

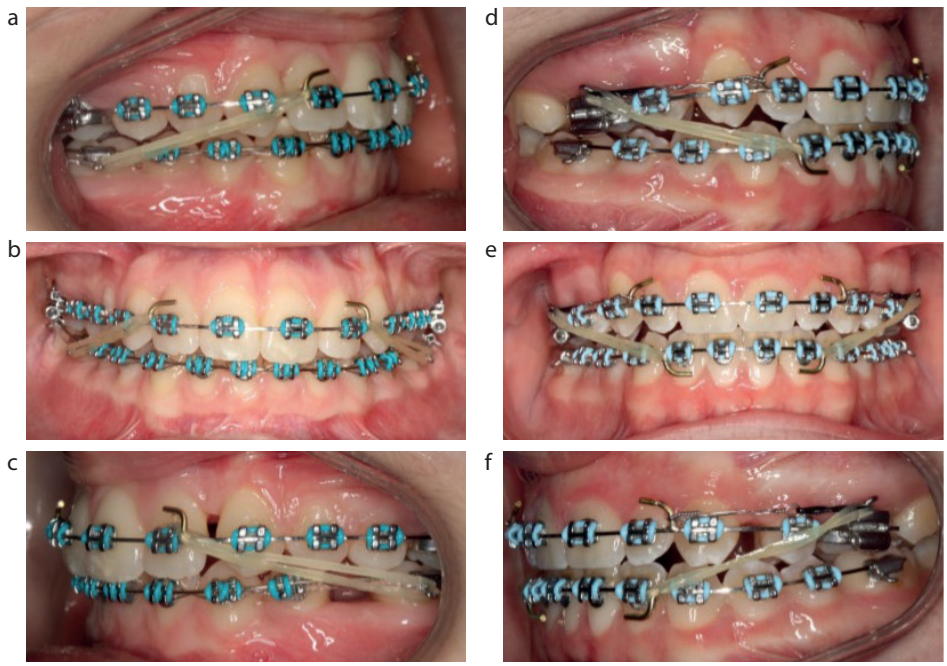

Figure 2. Intra-arch class elastics **(a–c)** in Class II and **(d–f)** Class III vectors.

is a smooth transition straight to the fixed appliance, which can be achieved without the need for any additional laboratory stages. Early molar extrusion might also be encouraged in patients with a reduced lower face height or deep overbite.

However, unwanted side effects may occur with the use of elastics in addition to desired tooth movements (Table 2). In particular, the use of light elastics on round NiTi archwires may cause tipping and lingual rolling of the molars, excessive retroclination of the upper labial segment, further proclination of the lower labial segment in a non-extraction case and clockwise rotation of the mandible in patients with high maxillary–mandibular plane angle, potentially worsening a tenuous overbite. These effects

Side effects of Class II elastics	Side effects of Class III elastics
■ Upper labial segment retroclination ■ Lower labial segment proclination ■ Upper labial segment extrusion and increased gingival show ■ Lower molar extrusion ■ Lower molars roll lingually	■ Lower labial segment retroclination ■ Upper labial segment proclination ■ Lower labial segment extrusion ■ Upper molar extrusion ■ Upper molars roll palatally

Table 2. Side effects of anteroposterior elastics.

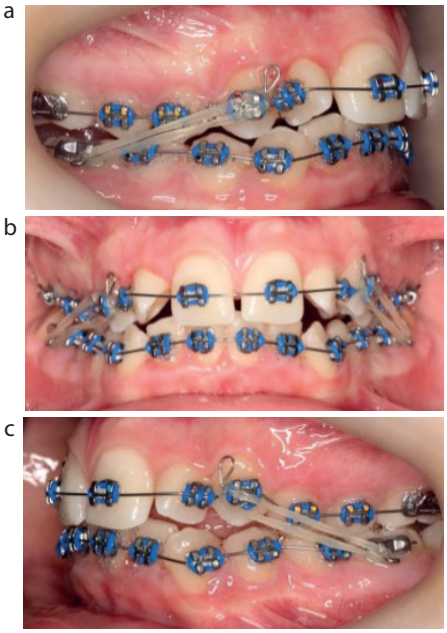

Figure 3. (a–c) Early light Class II elastics following functional appliance treatment.

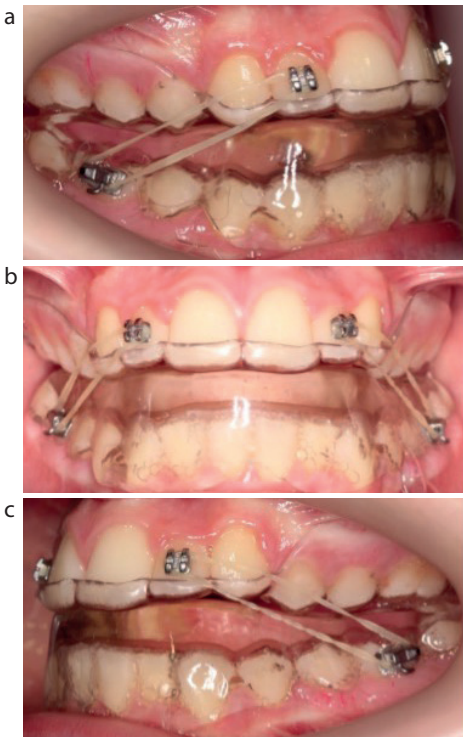

Figure 4. (a–c) Button and bead appliance for Class II correction with 1/4", 4.5 oz elastics (TP Orange).

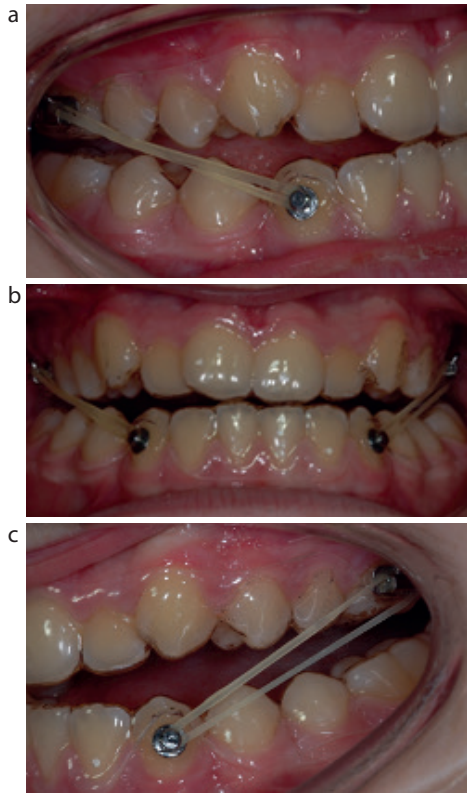

Figure 5. (a–c) SEC III with fulltime elastics from buttons on lower canines and upper first molars with 1/4", 4.5 oz elastics.

may be mitigated by increasing the size and rigidity of the archwires, placing additional torque in the archwire, using brackets with increased torque prescription, or by reducing the force of the elastics. Owing to the potential negative side effects, the use of elastics while in initial aligning archwires is not generally recommended.

Class II anteroposterior correction with button and bead appliance

In patients with Class 2 or 3 skeletal patterns and remaining growth potential, Class II or III elastics can be used to the support anteroposterior change in incisor relationship. This can be done in association with removable button and bead appliances, with the elastic vector modified depending on the malocclusion.[2] These may be considered more aesthetic by some patients than the more traditional functional appliances. However, they are still reliant on patient compliance with the elastics worn fulltime in combination with the appliance.

Class III anteroposterior correction with a modified SEC III appliance

Alternatively, a modified SEC III appliance with Class III inter-arch elastics, worn from buttons and acrylic splints, can be used for correction of Class III malocclusion (Figure 5).[3] Although initially recommended for wear in combination with a chin-cup, the authors have found this to be an effective treatment modality without the additional extra-oral traction.

Centreline correction

The use of asymmetric elastics in conjunction with fixed appliances can help to correct centreline discrepancies by supporting the direction of space closure, (Figure 6). Bilateral elastics with different vectors, or an elastic on one side only, can be used. The amount of elastic wear can be titrated by the patient because they can monitor the position of the centreline between appointments.

Anterior open bite closure

Anterior open bite correction is generally achieved by either anterior extrusion or posterior intrusion. While not generally a stable tooth movement, extrusion of the incisors to close an anterior open bite may be indicated when the full eruptive potential of these teeth has not been achieved. This is common in patients with non-nutritive sucking habits that have persisted into the permanent dentition. Correction can be achieved with the aid of an anterior box elastic attached to hooks in the upper and lower labial segments (Figure 7). Placement of a non-rigid archwire in one or both arches aids movement of the teeth towards each other. Permanent retention is required to maintain the extrusive tooth movement.

An alternative method for anterior open bite closure, by posterior intrusion, can be achieved through the use of multi-loop edgewise (MEAW), or 'Kim mechanics', with an anterior supporting elastic: 3/16" heavy elastics were recommended in the initial paper by Kim.[7] The strength of this elastic

Figure 6. (a, b) Asymmetric elastic for centreline correction using 5/16" 4.5 oz elastics.

needs to be titrated so that it does not overpower the posterior intrusive forces generated by the bite opening curves placed in the upper and lower multilooped or rocking-horse NiTi archwires.

Overbite reduction

Overbite reduction can be achieved with the use of inter-arch elastics by mandibular and maxillary molar eruption that occurs with the use of Class II and III elastics, respectively. Class II elastics are particularly useful for patients with an increased overjet and overbite because simultaneous correction can occur (Figure 8).

Crossbite correction

Elastics placed from lingual or palatal buttons to a buccal attachment in the opposing arch can be used for crossbite correction (Figures 9 and 10).

Space closure

Elastics can be used as part of cable mechanics for space closure with the patient applying the elastic between two attachment points on the brackets either side of the space to be closed (Figure 11). By the patient changing the elastic on a daily basis, the level of force remains relatively constant compared with other methods of space closure, including elastomeric chain, which is subject to hysteresis loss over time.

Single intra-arch elastics can also be used in conjunction with temporary anchorage devices (TAD) for both retraction and protraction of teeth during space closure (Figure 12). Placement of the elastic is performed by the patient at home, which has the advantage of mitigating the effect of force degradation between appointments, resulting in more consistent tooth movement. There is also improved oral hygiene when compared to other elastomeric attachments that may be used to apply force between teeth and TADs.

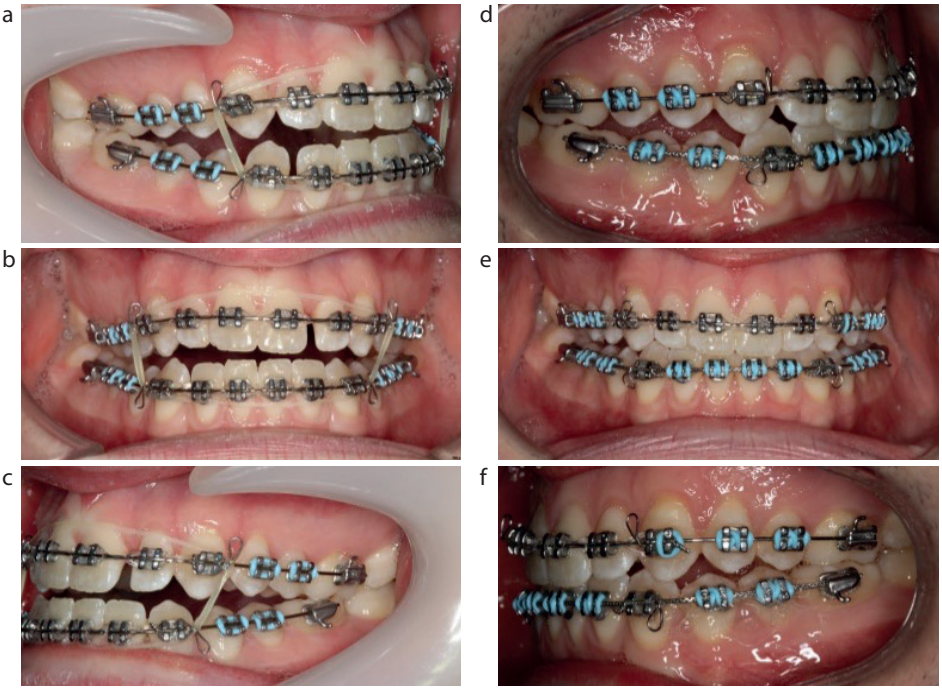

Figure 7. (a–f) Use of an anterior box elastic to reduce an anterior open bite.

Post-orthognathic surgery

Elastics are used post-orthognathic surgery to aid with occlusal settling and to help patients get used to their new occlusal position (Figure 13). Intra-maxillary elastics can reduce stress on the muscles of mastication and improve patient comfort post-operatively.[8] In the immediate post-operative period, intra-arch elastics may be used to maintain and maximize the occlusal fit, to correct any minor post-surgical occlusal discrepancies and to finalize the occlusion. Light forces are usually used, and the vector of force adjusted for each individual to achieve the desired movement.

Finishing

Settling elastics can be used to encourage inter-digitation of teeth in the buccal segments prior to removal of appliances. These can be applied in multiple different ways to different attachments to alter the vector of force to best aid settling in individual cases. One of the archwires needs to be flexible to facilitate movement of the teeth towards each other.

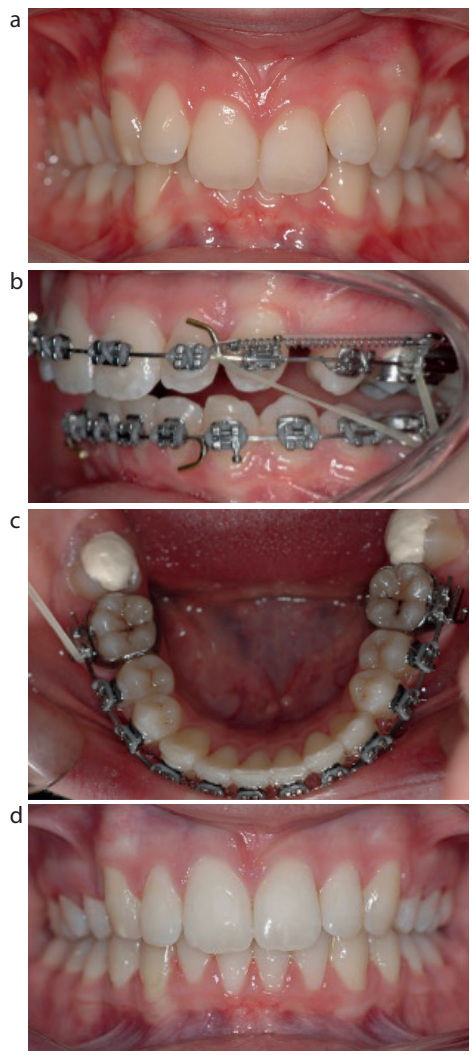

Figure 8. (a–d) Inter-arch elastics used for overbite and overjet reduction.

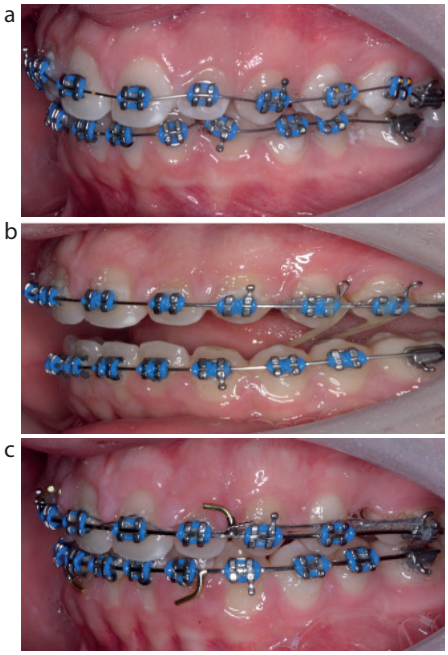

Figure 9. (a–c) Cross elastic from lingual buttons LL4 and LL5 to Kobayashi ligatures UL4 and UL5 for correction of lingual crossbite (3/16", 3.5 oz).

Figure 10. (a–d) The use of an elastic from buccal hooks on the LR3 and LR4 to a palatal button on the UR3 for correction of unilateral crossbite (3/16", 3.5 oz).

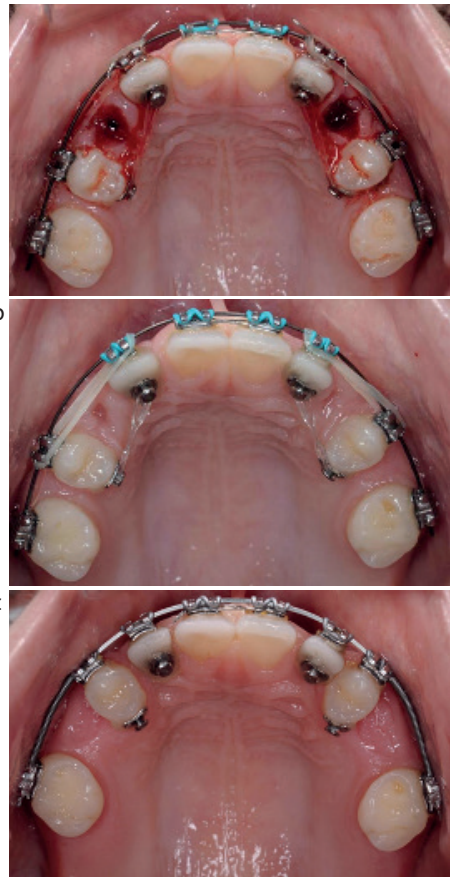

Figure 11. (a–c) The use of a buccal intra-arch elastic placed to attachments on the upper first premolar and lateral incisor brackets bilaterally to aid space closure.

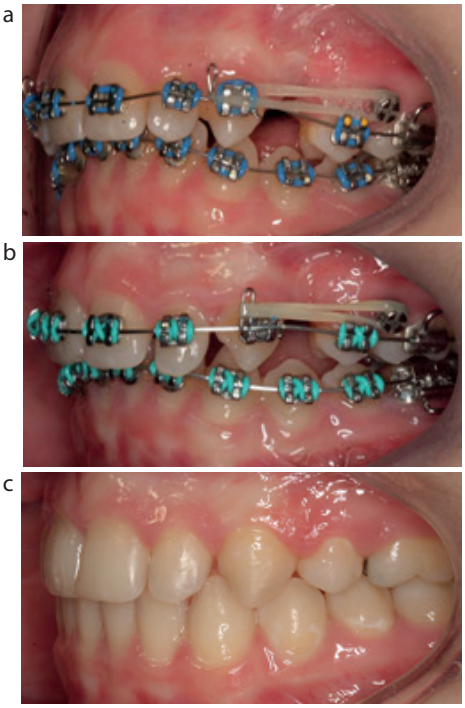

Figure 12. (a–c) Intra-oral elastic to distilize a canine. Applied by patient from a Kobyashi hook on the canine to a buccal temporary anchorage device placed between UL5 and UL6 (5/16", 4.5 oz).

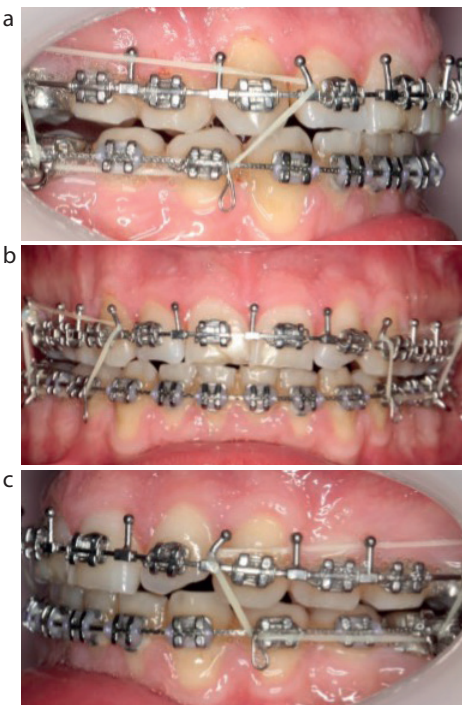

Figure 13. (a–c) The use of intra-arch elastics following bi-maxillary surgery.

Tip edge and Begg appliances

The tip edge appliance relies on light forces applied by intra-arch elastics to encourage differential tooth movement.[6] Class II or III elastics are used from the start of treatment to aid with overbite and overjet correction, and their use continues throughout all three stages of treatment to maintain these changes. The intra-arch elastics are attached to circle loops on round stainless steel archwires in stages I and II, and from ball hooks on rectangular stainless steel archwires in stage III (Figure 15). The force applied by intra-arch elastics with the tip edge appliance needs to be light so that the tip back bends in stage I are not overpowered, and overbite reduction is facilitated. The recommended elastic force level for the tip edge appliance is 2 oz.

Although now mostly superseded by the tip edge and straight-wire appliances, inter-arch elastics are also an essential component of the Begg treatment modality, and are used in a similar fashion. Intra-arch elastics can be used in combination with Begg brackets for simple tipping of teeth using a light force elastic to help in the initial aligning stages when a large amount of space closure is required. This is illustrated by a case with a large midline diastema following ectopic eruption of UR1 and UL1 due to supernumeraries in the anterior maxilla (Figure 16). Approximation of the upper central incisors with the elastic facilitated easier engagement into the Begg brackets for further alignment.

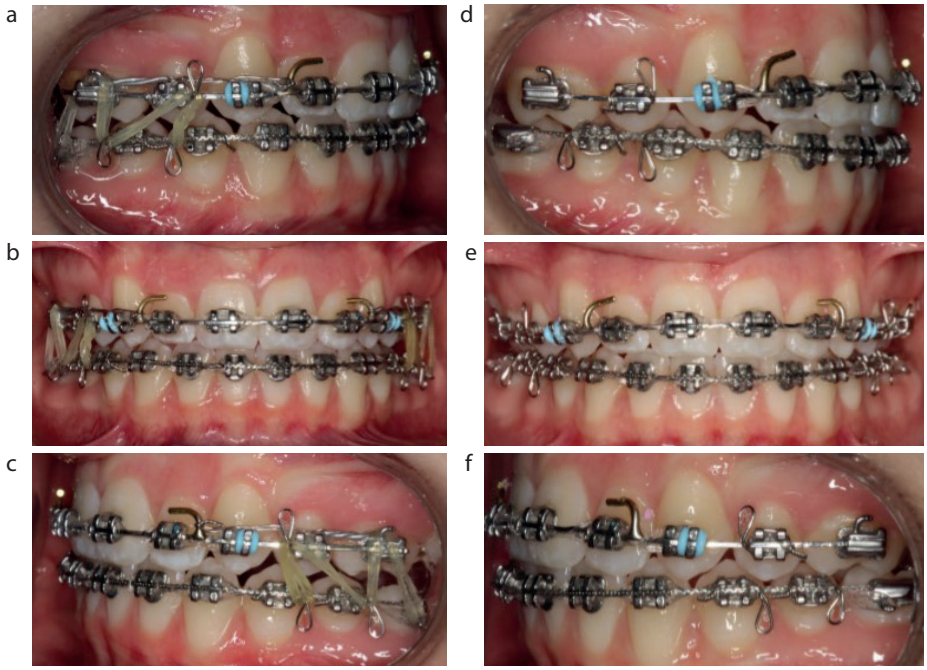

Figure 14. (a–f) The use of intra-oral settling elastics to finish the buccal occlusion.

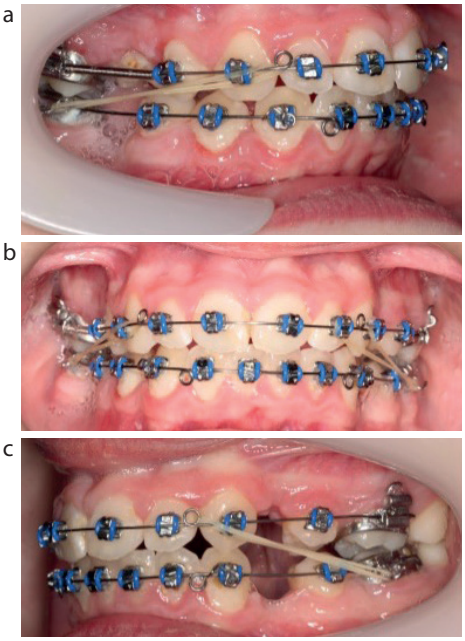

Figure 15. (a–c) Tip edge appliance with Class II intra-arch elastics from circle loops (stage I)

Extra-oral uses of elastics

Protraction facemask

Protraction facemasks are often used to encourage growth modification in young patients with Class III skeletal patterns. The facemask is attached to a fixed intra-oral appliance, usually buccal hooks on a rapid maxillary expander (RME), using elastics. These are then crossed over in front of the lips, before being applied to attachment points on the crossbar of the facemask (Figure 17). The ideal vector of traction being downwards and forwards at 30° to the occlusal plane. The ideal force for growth modification is 400 g/side, which can be assessed using a stress-strain gauge.[9–11] The size of elastics used depends on the distance between the intra- and extra-oral points of application; however, heavy elastics are recommended with 5/16" 8 oz and 5/16" 14oz commonly used.[11]

Extra-oral traction

Extra-oral elastics were a key component of interlandi headgear, although this is much less frequently used now. The elastics attach from the outer whisker of the facebow to the vertical straps of the headgear. The direction of force can be easily modified by altering the points of attachment of the elastics. Unlike intra-oral elastics, extra-oral elastics are not subject to the same levels of degradation and therefore greater intervals between replacement can be used.[12]

The use of an intra-oral elastic attached from the molar band to a soldered hook on the inner arm of the facebow has been described as a safety feature with the Kloehn facebow.[13] It aims to prevent accidental disengagement and reduce the chance of facial or ocular injury associated with this. The British Orthodontic Society recommend two independent safety features.[14] However, with the introduction of other safety features such as the locking facebow, masel neck strap and self-release modules, the Kloehn facebow is not commonly used.

Problems with elastics

Although elastics have multiple uses, there are limitations and side effects associated with them (Table 3). Although uncommon, the most severe side effect is a type I or IV sensitivity reaction to latex present in the elastic. Latex-free elastics are available that can be used as an alternative for patients with a confirmed latex allergy.[15,16]

Good patient compliance is essential to ensure that the elastics are worn as prescribed to achieve the desired effects. To help with compliance, the points of attachment should be easily accessible and patients should be clear about how to attach the elastics to these. A 'selfie' of the elastics may be useful as an aide memoire for when the patient has left the surgery. Patients who find it difficult to place elastics may benefit from elastic placers (Figure 18),

Elastic factors	■ Allergies ■ Manufacturer differences ■ Breakages
Patient factors	■ Allergies ■ Compliance (under/overuse) ■ Long or acrylic nails impeding elastic placement ■ Biological variability
Orthodontist factors	■ Poor positioning of hooks/attachment points ■ Poor instructions ■ Incorrect force of elastic ■ Lack of emphasis of importance
Dental factors	■ Type of tooth movement to be achieved ■ Unwanted side effects of class II/III elastics ■ Number of teeth in anchor block ■ Biological variability in speed of tooth movement

Table 3. Possible problems associated with orthodontic elastics

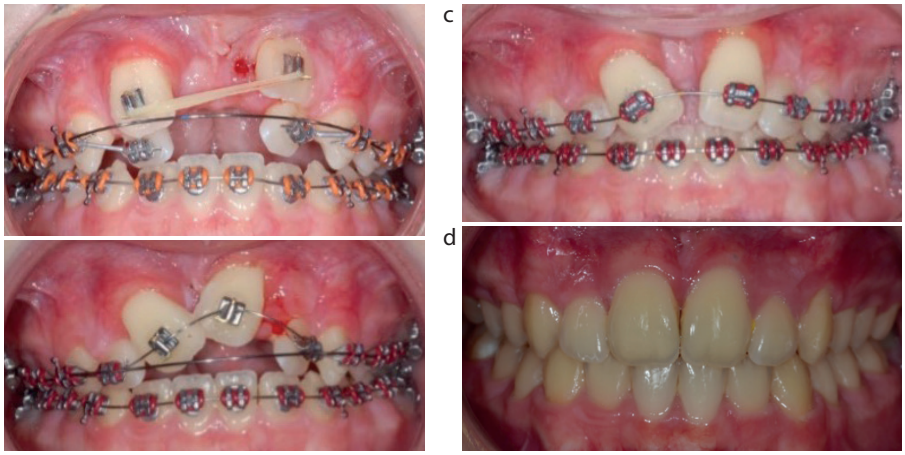

Figure 16. (a–d) Elastic applied to Begg brackets on UL1 and UR1 by patient and changed twice daily to maintain continuous force application.

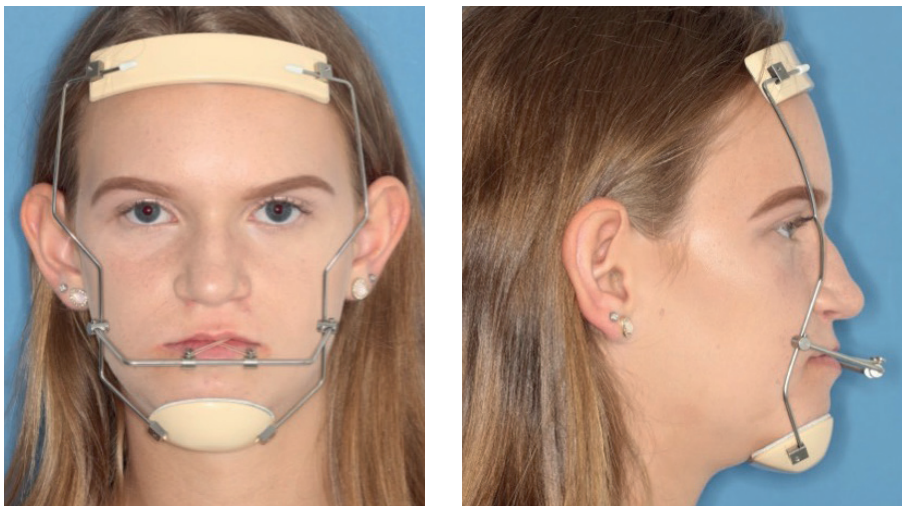

Figure 17. (a, b) Intra-oral elastics attached to protraction facemask (5/16", 6 oz).

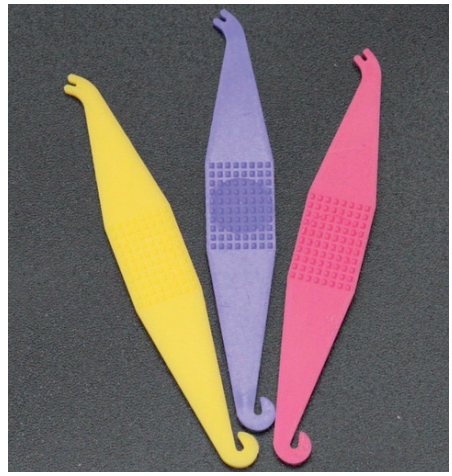

Figure 18. Elastic placers.

especially those with long or acrylic nails. So that elastics that are removed for eating are replaced as soon as possible, they can be placed on a finger like a ring as a reminder.

Due to hysteresis loss, the energy within the elastics will reduce with wear owing to the repeated loading and unloading placed upon them with eating and speech throughout the day. Therefore, patients should be reminded to change their elastics daily in order to get the maximum benefit. A chart may be useful in reminding patients to wear their elastics.

Conclusion

There are multiple and varied uses for elastics in orthodontics. An understanding of the effect of elastic length and diameter on force levels is important when choosing an elastic to achieve the desired orthodontic effect. Stock of a variety of elastic strengths and sizes is required because one type is not possible for all uses.

Compliance with Ethical Standards

Conflict of Interest: The authors declare that they have no conflict of interest.
Informed Consent: Informed consent was obtained from all individual participants included in the article.

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