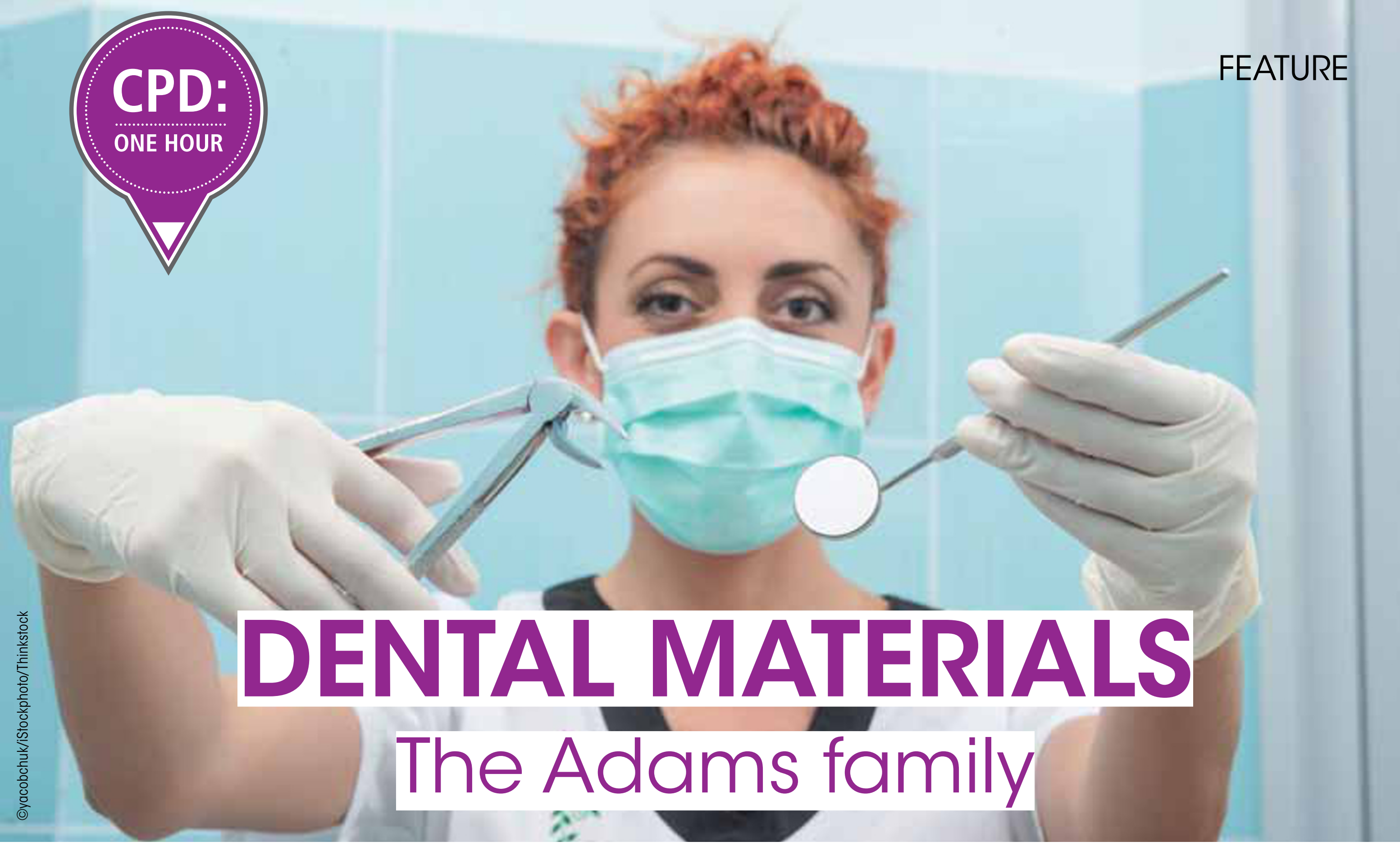

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DENTAL MATERIALS
The Adams family

J. I. J. Green[1] looks at the modified arrowhead clasp and related components.

INTRODUCTION
Clasps are retentive removable appliance components that work by engaging the areas beneath the most bulbous parts of a tooth, called undercuts. The first orthodontic clasp consisted of a loop of wire that fitted to the buccal gingival margin but the lack of buccal undercuts in teeth that are not sufficiently erupted led to attempts to design a clasp that would use the mesiobuccal and distobuccal undercuts, which are accessible when a tooth is less well erupted. The first such design was introduced by Victor Hugo Jackson in 1906.[1] The Jackson clasp is a simple orthodontic clasp but with squared corners that engage the mesiobuccal and distobuccal undercuts. Next came the Crozat clasp in 1920. Designed by George B. Crozat, it consists of a plain orthodontic clasp with an additional soldered piece of wire that engages the undercuts.[2] This was followed by the arrowhead clasp by Artur Martin Schwarz in 1938 that consists of a series of arrowheads and engages the mesiobuccal and distobuccal undercuts of two adjacent teeth.[3-5] In 1949 these concepts were largely eclipsed by a design by Charles Philip Adams[6-11] that dramatically improved the retention of removable appliances[12] and remains the most popular retention component for removable orthodontic appliances. This article gives a review of the Adams clasp and its related components.

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THE ADAMS CLASP
Although a distinct component in its own right, the Adams clasp was seen as a development of the Schwarz arrowhead clasp and was introduced as the modified arrowhead clasp.[6] Adams was a lecturer in orthodontics at Liverpool Dental School so the clasp has also been referred to as the Liverpool clasp and the term universal clasp has been used too. Unlike with Schwarz's design, the arrowheads of the clasp do not fit beneath the contact points of two adjacent teeth but work by engaging the mesiobuccal and distobuccal undercuts of a single tooth either standing in isolation or in proximal contact with the adjacent teeth. Adams also reported the following five benefits of his clasp:

1. Takes up minimal space in the buccal sulcus and in the baseplate
2. Can be used on any primary or permanent tooth
3. Can be used on a semi-erupted tooth
4. Strong, although resilient enough for every retention purpose
5. Construction does not require specialised pliers.

The Adams clasp is usually made with 0.7 mm diameter hard stainless steel wire but 0.8 mm gauge has also been advocated.[13] It is most commonly made for molars and premolars but can be used to clasp any tooth. Adams recommended that clasps for primary teeth should be made in 0.7 mm wire[10,11] but 0.6 mm wire can also be used. Adams also suggested the use of 0.6 mm wire for canines but thought that the temptation to clasp anterior teeth should be resisted.[11] A study of patients who were treated with reverse headgear appliances found that using Adams clasps on the maxillary central incisors could effectively prevent downward dislocation of the appliance when extra-oral traction force was applied.[14] In practice, the Southend clasp[15] is more commonly used for anterior retention.

The Adams clasp is predominantly used as a retentive component in orthodontics but is also used to retain appliances such as partial dentures,[16] obturators[17-20] and mandibular advancement appliances for patients with obstructive sleep apnoea.[21-24]

CONSTRUCTION
Preparation of an Adams clasp can be divided into five parts: model preparation, bridge, arrowheads, occlusal region and retentive tags. While the photographs that accompany this technique illustrate the construction of an Adams clasp for a permanent first molar, the same principles are applied for any tooth.

Model preparation
Before the clasp is constructed the mesiobuccal and distobuccal undercuts are identified. If


Fig. 1 A right angle is formed in a straight piece of 0.7 mm diameter hard stainless steel wire and held against the tooth to anticipate the bridge length


Fig. 2 A second right angle bend is made at the point of the second undercut

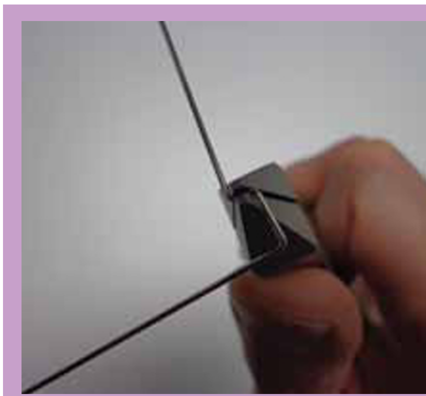
Fig. 3 An arrowhead is formed by first bending the wire at a right angle

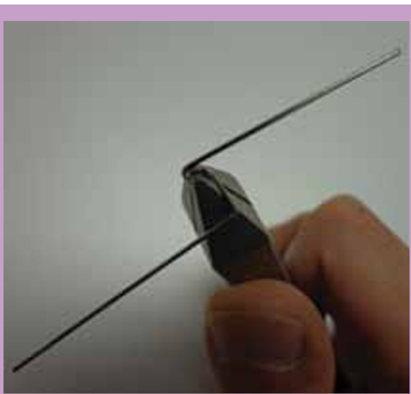
Fig. 4 The arrowhead is completed by holding the bridge of the clasp firmly against the beaks of the pliers and bending the wire through another right angle while using firm pressure on the wire near the first bend


Fig. 5 The arrowheads are bent at an angle of approximately 45°


Fig. 6 The arrowheads follow the tooth contour and fit the mesiobuccal and distobuccal undercuts

the tooth is not fully erupted, these undercuts will lie just below the gingival margin and the plaster representing the gingival tissue is trimmed to expose the undercuts. The sub-gingival morphology is carefully anticipated and reproduced when trimming the model. When in the mouth, the clasp will displace this tissue slightly to engage the undercuts. Conversely, if the tooth is fully erupted the arrowheads may not need to reach the gingival margin. In cases of gingival recession or over eruption it is important not to use the full depth of available undercut; if the arrowheads are positioned too far gingivally, too much undercut will be engaged and this will make it difficult or impossible to fit and remove the appliance.

Bridge
Construction begins by forming the bridge, the length of which is the distance between the mesiobuccal and distobuccal undercuts. Using a straight piece of 0.7 mm diameter hard stainless steel wire and Adams universal pliers, a right angle is formed and held against the tooth to anticipate the bridge length (Fig. 1). A second right angle bend is made at the point of the second undercut (Fig. 2).

Arrowheads
The arrowheads are approximately half the height of the clinical crown. The first arrowhead is formed by bending the wire at a right angle (Fig. 3). The arrowhead is completed by holding the wire tightly close to the tips of the pliers with the bridge against the beaks and bending the wire through another right angle while using firm pressure on the wire near the first bend. The wire is aimed between the plier tips, not around the tip of the pliers (Fig. 4). This process is repeated for the second arrowhead. The arrowheads are bent at an angle of approximately 45° (Fig. 5) to follow the tooth contour and fit the mesiobuccal and distobuccal undercuts (Fig. 6).

Occlusal region
The wire then crosses the occlusion. The wire is bent at half the height of the arrowhead (Fig. 7) and then away from the bridge to anticipate where the wire will meet the contact point (Fig. 8). The wire should touch the contact point with the arrowheads at 45° to the long axis of the tooth (Fig. 9). A bend is then formed at the contact point (Fig. 10). To minimise impact with the opposing dentition, the wire is kept as close to the teeth as possible whilst avoiding contact with the gingival tissue.

Retentive tags
The retentive tags will anchor the component in the acrylic baseplate. The wire follows the contour of the palatal or lingual mucosa but approximately 1 mm from the tissue to allow for acrylic encapsulation. The tags need to be long enough to be held within the acrylic but also clear of the anticipated baseplate border. To ensure that the wire is held firmly in the acrylic the end of the wire is turned down at a right angle and then cut off close to this bend (Fig. 11). This process is then repeated to complete the clasp (Fig. 12).

Rotated teeth
If a tooth is rotated a clasp is more likely to

Fig. 7 The arrowhead is held in the tips of the pliers and the wire is bent at half the height of the arrowhead

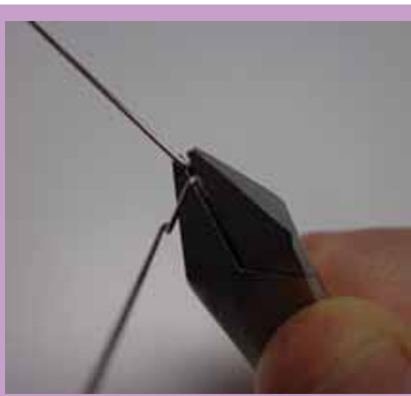

Fig. 8 The wire is bent away from the bridge to anticipate where the wire will meet the contact point

Fig. 9 The wire is adjusted so that it touches the contact point when the arrowheads are at 45° to the long axis of the tooth

Fig. 10 A bend is formed at the contact point to cross the occlusion

Fig. 11 The retentive tags follows the contour of the palatal or lingual mucosa but approximately 1 mm from the tissue to allow for acrylic encapsulation

Fig. 12 The completed Adams clasp

'65 YEARS AFTER ITS INTRODUCTION ADAMS' MODIFIED ARROWHEAD CLASP REMAINS A RELIABLE AND VERSATILE MEANS OF RETENTION…'

function better if the bridge is aligned with the arch rather than matching the rotation of the tooth.[11]

ADJUSTMENT

Another benefit of the Adams clasp is the ease with which it can be adjusted. To tighten an appliance that is too loose-fitting the arrowheads are gripped with the Adams pliers and bent slightly inwards; to loosen a clasp the arrowheads are bent slightly outwards.

RELATED COMPONENTS

Adams proposed a range of variations for his clasp.[10]

Single arrowhead Adams clasp

A single arrowhead Adams clasp is used in cases where a last standing molar is partially erupted. An arrowhead is placed in the mesiobuccal undercut and the bridge is modified to encompass the tooth distally due to the absence of a distobuccal undercut.[10]

Auxiliary arrowhead

Appliances commonly use clasps on the first molars and first premolars. When it is not possible to independently clasp a second tooth in the same buccal segment an auxiliary arrowhead may be used.[10] Also called an accessory arrowhead, this component fits the tooth adjacent to the main tooth being clasped and the free tag end is welded and soldered to the bridge of the main clasp (Fig. 13).

Double Adams clasp

While Adams did not commend their use,[11] a clasp can be constructed to fit two adjacent teeth (Fig. 14) and made in 0.8 mm wire.[13] Because this component only engages two undercuts it is unlikely to be as retentive as an Adams clasp in conjunction with an auxiliary arrowhead, although it can be used with another clasp, such as a ball clasp (Fig. 15).

AUXILIARY COMPONENTS

The Adams clasp is a very versatile clasp and the bridge can be used to incorporate or attach various components. An active component, such as a buccal canine retractor, can be soldered to the bridge. A labial bow may be soldered to the bridges of Adams clasps on an orthodontic retainer.

Adams proposed a distal extension that can be incorporated into the clasp to engage elastics for intermaxillary traction. A helix can be

Fig. 13 An Adams clasp with an auxiliary arrowhead

Fig. 14 A double Adams clasp

Fig. 15 A double Adams clasp used in conjunction with a ball clasp

Fig. 16 An Adams clasp with laser-welded extra-oral traction tube

incorporated into the bridge and a J hook can be soldered to the bridge for the same purpose.

Tubes can be soldered to enable the attachment of extra-oral traction headgear to a removable appliance.[11,14] Pre-cut stainless steel wire lengths with laser-welded tubes are also available for this purpose (Fig. 16).

AFTER ADAMS – THE DELTA CLASP

William Clark developed the delta clasp for his twin block appliance, stating that it maintains better retention and necessitates minimal adjustment because it does not open after frequent insertion and removal. The delta clasp retains the basic elements of the Adams clasp but the arrowheads are replaced with triangular loops that resemble the Greek upper case letter delta (Δ), which is where the clasp takes its name. The loops may also be made circular or ovoid in shape. Clark reported that delta clasps have less chance of fracture with 10% of twin blocks made with Adams clasps having at least one breakage against 1% of those made with delta clasps.[25-27] However, the delta clasp has not become widely adopted and the Adams clasp remains the most popular retention component for orthodontic appliances.

CONCLUSION

Many retention components have been proposed for orthodontic appliances but none have had the longevity of the Adams clasp. The increased use of thermoformed retainers and aligners[28-31] has undoubtedly had an impact on the use of removable Hawley type retainers[32] and hence Adams clasps. But 65 years after its introduction, Adams' modified arrowhead clasp remains a reliable and versatile means of retention for a range of removable dental appliances and this is likely to remain the case for the foreseeable future.

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