Resin-retained bridges have been used clinically since the 1970s, and offer a more conservative approach to the restoration of edentulous spaces than conventional bridgework. They are easy to place, cheap to fabricate and have been shown to be cost-effective. Despite this, they are not frequently used in general dental practice and they have an undeserved reputation for failure. Since their initial introduction, they have undergone a number of changes to their method of retention, and the materials used in their construction. This has resulted in a predictable, aesthetic restoration which, barring the use of implants, is often the treatment of choice where teeth adjacent to an edentulous space are minimally or not restored.

This article hopes to show the clinical techniques required to produce predictable resin-retained bridgework in general practice.

Resin-retained Bridges Re-visited Part 2. Clinical Considerations

Geoffrey St George, Ken Hemmings and Kalpesh Patel

Clinical Procedures for Success

Good history, examination (including special tests and diagnosis)

A thorough history and examination are needed, as in the case of a conventional bridge, and the following questions should be asked:

- Is the enamel on potential abutment teeth of good quality and in sufficient amounts?
- Is space available for retainers or does it need to be created?
- Is the enamel and dentine of sufficient opacity to obscure the metal of the retainers?
- Is the patient willing to accept a slight compromise in aesthetics to reduce the chances of bridge failure (e.g. extending the retainer wings onto incisal edges)?

Preparation versus non-preparation

The original concept of the resin-retained bridge was that the technique should involve little or no tooth preparation, simplifying the replacement of missing teeth and preserving precious tooth tissue on abutments. As time has passed the preparations used have become more extensive, mainly as a way of increasing retention and resistance form. Although studies carried out have shown the preparation of grooves and other retentive features increase retention and resistance as in conventional preparations, there are papers which show there is little benefit. Their use may be questioned for the following reasons:

- Grooves placed into teeth, which extend into dentine, may cause sensitivity between appointments and decreased quantity of available sites for bonding to enamel.
- The procedure is irreversible.
- Removal of a partially de-bonded fixed-fixed bridge becomes difficult without risking damage to the underlying tooth. Retainers which are still cemented may need to be cut off.

Shade-taking

The colour of the metal retainers and the choice of cement used need to be taken into account when choosing a shade for the pontic, as these factors will have some effect on the appearance of the abutment teeth when the resin-retained bridge is in place. One way to compensate for the shade change after cementation is by taking the shade with a cotton wool roll behind the abutment teeth. An alternative way is to try in the metal casting prior to the build-up of porcelain using an opaque temporary cement.
Finish lines (eg chamfers) are not required as metal work can be finished to a thin edge, 0.5-0.1 mm, supra-gingivally. The junction between metal and tooth is sealed with resin and rarely decays. Therefore consideration should be given to whether preparation is needed at all when comparing the advantages to the disadvantages of this approach. The authors consider that preparation of the tooth is only required to introduce guide planes when the path of insertion is a problem.

**Space creation**
Thick retainers increase bridge rigidity and can reduce the chances of bond failure, however space must be available to accommodate them. This can be achieved in a number of ways:
- Natural interocclusal spacing may be present eg after orthodontic treatment, when opposing teeth are missing, or where the occlusion results in minimal tooth contact.
- Sites of occlusal contact on abutment teeth can be adjusted. This will reduce the amount of available enamel for bonding and risks dentine exposure. Temporisation to avoid over-eruption of opposing teeth can be difficult, and may involve temporarily adding composite to the opposing tooth.
- Opposing teeth can be reduced. This may be acceptable if they are over-erupted, but often this involves the removal of sound tooth and the exposure of sensitive dentine.
- ‘Dahl’ type appliance. This follows the principles of the appliance devised by Dahl to create space in the worn dentition. Bridges are cemented in ‘high’ causing discusion of non-abutment teeth (Figure 1a). Over a number of months one expects to see intrusion of abutment teeth and compensatory over-eruption of other teeth (Figure 1b). The bridges cemented this way have been shown to be successful, and rarely, if ever, result in de-bonding or proclination of teeth. This is the preferred method used by the authors in most situations, but care must be taken with the following:
  - Teeth with little periodontal support or increased mobility. Splaying of abutment teeth may occur, rather than intrusion and compensatory eruption of the remaining teeth. Rotation of abutments may occur when cantilever bridges are cemented high on these teeth.
  - Patients with a large horizontal slide from their retruded contact position, to their intercuspal position. Posterior repositioning of the mandible may occur in these patients resulting in anterior guidance being lost. Luckily, these cases are rare in clinical practice.
  - ‘Occlusally-aware’ patients. The harmony in some patients’ mouths can be upset by the placement of high retainers. Again, these patients are rare.

**Impression and face-bow**
A face-bow mounted upper model relates the upper teeth to the hinge axis through the condyles, ensuring that the arc of closure on the articulator closely matches that in the mouth. This results in tooth-to-tooth contacts on the mounted casts which resemble those in the mouth, reducing occlusal errors and hence adjustments in the mouth/laboratory.

A standard impression using addition-cured silicone or other accurate material can be used to form the master cast. The opposing cast can be taken using alginate in a Rimlock tray.

**Temporisation**
This is only necessary if the abutment teeth are reduced, to provide space for retainers. If this method is chosen then it is usually easier to maintain any space created by adding composite to the incisal or occlusal surface of the opposing teeth, though in the view of the authors the ‘Dahl’ approach is preferred.

Those patients wearing dentures or orthodontic retainers should continue to wear them between appointments.

**Lab prescription**
Although the following procedures are carried out in the laboratory, it is the dentist’s responsibility to design the bridge and ensure that instructions are clear on laboratory forms.

**Extension of retainers**
For the greatest available surface for bonding and therefore maximum retention, retainers should cover as large an area as possible on abutment teeth, without compromising aesthetics or oral hygiene procedures. This means extending
metal onto surfaces to prevent opposing teeth from biting retainer teeth out of their retainers. This results in virtually full coverage of palatal/lingual surfaces on anterior teeth, and functional cusps and guidance surfaces of posterior teeth. This may result in poor aesthetics in the lower arch.

**Thickness of retainers**

Retainers should be thick enough to ensure they are sufficiently rigid to resist flexion, and prevent breakdown of the cement bond (Figure 2). Thicker retainers resist flexion better, but there is a limit to the amount that can be accommodated by the occlusion. A thickness of at least 0.6 mm should be regarded as a minimum. This can be measured at chairside and in the laboratory with the aid of measuring callipers.

**Thickness of connectors**

Flexion also occurs around bridge connectors, therefore these should be of sufficient dimensions to resist this. Flexibility of a joint is inversely proportional to its width at right angles to the applied force, and the cube of its width parallel to the applied force.

This means the occluso-gingival height has more significance in resisting flexion than the buccolingual width for posterior bridges where forces are largely applied perpendicular to the occlusal surface. The converse is true of anterior bridges. In practice, connectors should be as large as possible without compromising aesthetics or oral hygiene procedures interproximally.

It can be seen that bridges made for teeth with short crown height will have the double disadvantage of having reduced enamel to bond to and greater flexion, reducing their chance of success.

**Locating tags**

Some form of locating device is needed to ensure that when cementing the bridge, it seats in the same position as it did on the model upon which it was constructed. This will ensure the cement lute will be at a minimum, increasing bond strength, and decreasing to a minimum the amount of resin exposed at the margins. This has been achieved in the past by preparing horizontal rest seats on teeth, or by extending the metal of the framework onto their incisal edges/cusp tips in the form of a tag, to prevent displacement cervically (Figure 3a). The problem is worse with cantilever bridges than fixed-fixed bridges due to a reduced number of retainers. There is some unpublished evidence presented by Gough at the Eastman Dental Hospital that the use of a tag may, in fact, increase the thickness of the cement lute by preventing full seating of the bridge. This is probably due to the geometry of the lug, which when cast contracts, preventing seating of the bridge to its original position. It is suggested that rather than a tag, full coverage of just the incisal edges and cusp tips is attempted, with no overlap onto the labial surfaces of the teeth (Figure 3b).

**Construction technique**

The method of construction may have an effect on the accuracy of fit, and therefore the retention of resin-retained bridges. A study has shown that bridges constructed using a refractory die technique produce more accurate castings than those where the pattern has been lifted off a cast prior to investing. The same study showed that patterns made from wax were more accurate than those made from acrylic. Accurate castings will produce thinner cement lutes, which can result in greater cement bond strengths.

**Try-in, preparation of metal and cementation**

The resin-retained bridge is tried in to check aesthetics, occlusion and fit. Even without cement the bridge should have some degree of friction fit if it has a sufficient degree of wrap-around. A minimum of 180° wrap-around is recommended. Temporary cement may be used to retain the bridge while the patient assesses the appearance, although this should ideally be a non-eugenol containing type as eugenol has been shown to possibly reduce the bond strength of composite resins. Preparation of retainer surfaces is carried out immediately before cementation using a micro-sandblaster and 50 µ alumina. It can be carried out at the laboratory, or using a small portable intraoral sandblaster at the chairside. Whichever method is used, the glazed porcelain surfaces should be protected first to ensure they are not damaged eg using wax.
Following this, the metal should be steam-cleaned to remove any alumina or metal deposits, which may interfere with the bonding process.

Preparation is best carried out immediately before cementation, as with time the metal surface may become excessively oxidised reducing bond strength. This may be due to excessive oxide formation allowing cohesive failure within the oxide layer, or a change in the reactivity of the surface layer. If there is any delay between sand-blasting and cementation, then the bridge should be stored in distilled water to prevent an excessive oxide layer formation.

Isolation with rubber dam (Figure 4) is considered essential for the success of all enamel and dentine bonding procedures. It is just as important at the front of the mouth as at the back due to the high humidity present.

If used, rubber dam clamps should be placed on teeth adjacent to the abutments, or alternatives such as Wedjets or floss ligatures can be used. Care should be taken to ensure that the rubber dam is everted into the gingival sulcus of individual abutment teeth otherwise difficulty may occur due to the dam riding up the tooth and preventing seating of the retainer. Abutment teeth are cleaned with a rotating brush and a slurry of pumice and water. The bridge is then tried in to ensure it seats and then the fit surface is sand-blasted. The bridge is then cleaned with water and dried. Following this the teeth are etched with phosphoric acid for 15-30 seconds and then dried again. The cement is mixed according to the manufacturer’s instructions and is applied to the fit surface of the bridge, following application of ED Primer to the abutment surfaces. The bridge is positioned on the teeth and excess cement removed with a sable brush. Following initial setting with Panavia 21, Oxyguard is overlaid over the cement as its setting is inhibited by oxygen. This material, which contains polyethylene glycols, excludes air until the material is fully set, preventing unset resin from washing out at the margin.

The rubber dam is removed and no further adjustment is carried out until the review appointment (usually one week later) as it is crucial to leave the cement to polymerise fully and not risk a future de-bond by weakening the cement bond at this early stage.

If it is decided to temporarily cement a resin-retained bridge then a conventional glass-ionomer cement is often used eg Aquacem. The same steps above are followed with the addition of protecting the exposed cement at the margin with an unfilled resin, which is then light-cured.

Review
- Excess cement removal: this is best left to the review appointment so that any bonding to tooth/cement is not disturbed. It can be carried out with a white stone in a speed increasing handpiece, and at the same time thinning metal incisal edges if required.
- Checking occlusion and excursive contact: GHM paper is used either alone or in combination with Vaseline on the paper or a varnish on the bridge, as contacts on shiny occlusal surfaces are often difficult to see. It is important to remove any excursive contacts on pontics, where possible. It is advisable to use Shimstock to check holding contacts.

One should ensure that oral hygiene procedures are carried out and that plaque deposits and food debris are being removed from the bridge, the abutments and underneath the pontic with Superfloss (Figure 5).

It may take a number of months before teeth, which were initially out of contact, meet together if a resin-retained bridge is cemented ‘high’. During this time it will be noted that the mobility of abutments decreases as other teeth begin to occlude.

The bridge is reviewed periodically to check oral hygiene procedures are being carried out, and that de-cementation has not occurred. Patients should be warned of de-bonding and recall appointments tailored to the individual case.

Problems

Handling de-bonded bridges

The handling of de-cemented bridges will depend on the number of retainers present, and location in the mouth. Cantilever bridges can be easily re-cemented following cement removal from both tooth and bridge. Those bridges with multiple retainers rarely de-cement on all retainers at once, so a decision has to be made whether to:
- Attempt to remove the bridge.
  When little or no preparation
has been made to abutment teeth, it is often easy to remove cemented retainers by hitting a straight, sharp dental chisel applied to the cement lute (Figure 6). The chisel should be directed down the length of the cement lute, ensuring the tip rests purely on cement. Often a little preparation with a bur is needed to find a point of application. Dental floss should be tied around a connector and held by the assistant, to prevent inhalation or ingestion of the bridge.

It is important to warn patients that this technique ‘may’ cause chipping of enamel from abutment teeth despite care taken to avoid this. Even bridges temporarily cemented with glass-ionomer cement may cause this to happen. Any enamel lost can be repaired with composite resin.

Posterior retainers which have large amounts of wrap-around and occlusal coverage are best cut off, as removing with a chisel can cause damage to the underlying tooth structure. Interim conversion to a cantilever may be preferred as long as the pontic and retainer are monitored to ensure no movement occurs.

- **Consider removal of the de-bonded retainer.** Fixed-fixed bridges which repeatedly become de-cemented on one retainer, or where the remaining cemented retainer would be difficult to remove without damaging the underlying tooth, as on posterior teeth, are best treated in this way. A diamond bur in a high-speed handpiece is used, followed by finer finishing burs and a white stone to ensure no sharp edges or overhangs are left, enabling plaque control to be carried out. Care should be taken before retainer removal that excursive contacts will not result in pontic or abutment movement if the bridge has been converted to a cantilever.

#### Replacement.

A poorly designed bridge, which de-bonds repeatedly, is unlikely to succeed in the long term and will result in many additional appointments for re-cementing as well as patient dissatisfaction. It sometimes pays to replace a poor bridge especially if the framework no longer fits the teeth due to tooth movement. The reason for failure must be ascertained as replacement may simply result in further decementation if problems are not addressed. An alternative type of prosthesis may be more appropriate.

Cement is removed from the retainer wings using air-blasted alumina, followed by steam cleaning to remove any debris. Any cement remaining on the tooth is removed easily using a large flame shaped tungsten carbide bur in a speed increasing air-motor handpiece. This is done slowly and intermittently without water, which enables retained cement to be clearly seen and minimises damage to tooth tissue.

#### Span and pontic size

With conventional bridgework, if there is a discrepancy between the span present between abutments and the span necessary to replace the teeth missing, the abutment parts of the bridge can be modified in size to redistribute the space, producing a more aesthetic prosthesis. The degree to which this can be done with resin-retained bridges is limited, as re-contouring of abutment teeth is restricted to reduction of the tooth adjacent to the pontic. A small amount of re-contouring can be carried out by addition of composite to the mesial or distal tooth surfaces adjacent to the pontics. However this will eventually need re-polishing if stained, or replacing, which complicates maintenance of the bridge resulting in poorer aesthetics, and also reduces the bonding area between cement and enamel.

#### Visible retainers

To ensure maximum retention and to prevent opposing teeth from biting the abutment teeth out of the bridge, it is recommended to extend the metal retainer wings onto incisal/occlusal surfaces. This can create aesthetic problems, but can be overcome to some extent by glass beading the visible parts. Non-reflective metal tends to disappear in the darkness of the mouth. Incisal coverage may be thinned after cementation if aesthetics dictate.

Patients should always be warned if retainers will be visible. This can be difficult to demonstrate to patients, and may necessitate temporary cementation if doubts are raised at the time of fit.

#### Bruxism and worn teeth

Parafunctional habits are not an absolute contra-indication for resin-retained bridgework, but some precautions are necessary:

- Design features, which have already been mentioned, should be adhered to especially with respect to the amount of tooth surface covered to achieve maximum bonding to enamel. Incisal and cuspal coverage is more important in these patients to prevent teeth being bitten out of retainers.

- The night-time wearing of a hard acrylic resin splint will greatly reduce the chances of bridges de-bonding, as well as reducing future toothwear.

- Patients should always be warned of the increased risk of retainer de-bonds.

Lost tooth tissue due to toothwear can be restored on retainers with either the retainer itself, if not visible or minimal, or with composite resin when incisal edges and cusp tips have worn flat. Thinned incisal edges, which have become translucent, can be rebuilt with composite resin first to help mask retainer wings and cement. The composite resin in both cases is then treated like tooth tissue, when considering the available bonding area, and covered with the metal retainer.
Summary

- Good success rates with resin-retained bridges are achievable, though less than conventional crown and bridgework.
- Success is dependent on good bridge design and operator technique.
- Further education and training is required to overcome the reservations held by many general dental practitioners.

References

2. Berekally TL, Smale RJ. A retrospective clinical evaluation of resin-bonded bridges inserted at the Adelaide Dental Hospital.

Proprietary Names

Rimlock tray—Dentsply Ltd, Weybridge, Surrey, UK.
Wedjets—The Hygienic Corporation Akron, Ohio 44310, USA.
530-8611 Aquacem—Dentsply DeTrey GmbH, D-78467 Konstanz, Germany.
GHM paper and Shimstock—Hanel Roeko, D-89122 Langenau, Germany.
Superfloss—Oral-B Laboratories, Belmont CA94002, USA.

Correspondence: G St George, Conservation Department, Eastman Dental Hospital, 256 Gray’s Inn Road, London WC1X 8LD. E-mail: g.stgeorge@eastman.ucl.ac.uk

Letter to the Editor

Dental Bleaching

Sir,—I am writing regarding the current situation with regard to dentists using tooth-bleaching in their practices.

I understand that my predecessor has indicated that dentists are allowed to use techniques of external and of internal bleaching of teeth in any way provided that the patient or their carer agrees. These techniques themselves are not illegal.

The highly publicised legal case revolved around the supply of these products and whether they are medical devices or cosmetic products. It is the Government’s view that they are cosmetic products. Notwithstanding that, the Department of Health would not seek to interfere with a dentist’s therapeutic decision to utilise a bleaching technique where a dentist considers this to be in the best interests of the patient’s overall oral healthcare.

MARGARET SEWARD,
CHIEF DENTAL OFFICER.