Abstract: This article explores the various treatment options available to replace missing teeth with a fixed prosthesis. It discusses the requirements for each treatment modality and its associated advantages and disadvantages.

Clinical Relevance: Patients generally do not consider a removable prosthesis to be an acceptable long-term solution to tooth loss, so knowledge of treatment options is essential for good clinical practice.

Today, numerous types of fixed prostheses are available to replace missing teeth. Developments in the field of implantology and adhesive dentistry have increased the options available for the partially edentulous patient but have also made treatment planning more complex. However, it still remains important to identify a positive ‘need’ to restore a space and to undertake a cost-benefit analysis for any proposed restoration – not only in financial terms but also in biological cost to tooth structure and the supporting tissues.

Fixed Options for Tooth Replacement

Fixed options for tooth replacement include the following:

- None;
- Resin-bonded bridge;
- Conventional bridge;
- Implant.

None

The replacement of missing teeth may not always be indicated or possible. Kayser stated that oral function was adequate in shortened dental arches where at least four occluding premolar units were left, depending on the age of the patient and preferably in a symmetrical position. Love and Adams found that unfavourable movement of neighbouring teeth into an extraction site did not necessarily occur and was unlikely if it had not occurred within 5 years of the extraction. This does not help the practitioner immediately after removing a tooth. However, this evidence is useful when assessing treatment needs for patients who have had an edentulous space for a number of years (Figure 1).

Resin-bonded Bridge

With improvements in the field of adhesive dentistry, resin-bonded bridgework has become a viable option for the long-term replacement of missing teeth. One study reported a median survival time of 7 years 10 months. Possible designs include: cantilever, fixed-fixed and hybrid where one of the retainers is conventional.

A major advantage of resin-bonded prostheses is that minimal tooth preparation is required and so they can usually be considered a reversible procedure. As dentine preparation is not involved, the integrity of a young pulp is maintained. Other advantages include the fact that anaesthesia is not normally required, soft tissues are not disturbed which simplifies impression procedures, and margins are supragingival, facilitating plaque removal. A failure rarely results in any adverse long-term consequences for the patient unless periodontal or orthodontic splinting has been employed.

Disadvantages include the fact that aesthetics may be compromised by ‘shine through’ of metal retainers, resulting in discolouration of the abutment teeth. This situation can be improved with the use of opaque luting cement but this can, in turn, result in a loss of translucency and a highly visible white line if used where there is incisal coverage. Although it is possible to assess the appearance of the bridge with ‘try in’ pastes prior to cementation, there is no trial phase to test
any occlusal changes. Generally, tooth movement will occur within six to nine months if the bridge is fitted ‘high’. Most bridges are cemented in this way. However, occasionally planned adjustment of the opposing tooth may be necessary at the time of fit for patients unable to tolerate occlusal change. Lower incisor reduction should be flat and not angulated, limiting the occlusal contact area to control the protrusive pathway and reduce wear.

Resin-bonded bridges require the same planning as any other fixed prosthetic bridge. They can be prescribed where there is sufficient enamel and the aesthetics of the abutment teeth is satisfactory. It should be noted that the occlusal coverage required when replacing posterior teeth can be particularly unsightly. The presence of composite restorations in abutment teeth is not a contra-indication, but these restorations should be replaced just prior to the impression stage of the procedure. Similarly, small amalgam restorations may be covered without detriment, but large restorations would indicate the use of a conventional retainers. The area of metal coverage should be maximized, ensuring rigidity of the framework, good occlusogingival height with incisal coverage if possible and wrap around interproximally. These design features provide maximum area for bonding and some physical resistance form. Guide planes also improve retention and appearance by reducing ‘interdental triangles’. Sandblasted, non-precious, nickel-chromium alloys are used for resin-bonded frameworks since they offer superior rigidity and provide a mechanical and chemical bond between the metal and composite resin-luting agent.

The commonest reason for failure is through debonding at the tooth-resin-metal interface. This typically occurs when the cement lute is subjected to shear forces created by unfavourable occlusal loading. Class II division 2 incisor relationships and significant bruxism are relative contra-indications to the use of resin-bonded bridges and should be considered higher risk when these situations are restored with such a prosthesis. The minimum number of abutments should be used and occlusal contacts should be entirely on the metal wings, since contact distributed between metal and tooth will cause the tooth to move away from the retainer, resulting in failure of the bond. If this occurs on only one wing in a fixed-fixed design bridge, caries may go undetected under that wing, resulting in disastrous consequences. The use of double abutments does not increase retention in resin-bonded bridgework and is generally not indicated, apart from occasionally in post-orthodontic and periodontal splint cases. There is no evidence to indicate the length of span that may be restored using this technique, but the longer the span the more rigid the framework must be (Figure 2).

A second reason for failure is contamination during cementation, which is indicated by a debond with an absence of cement on the abutment tooth. The use of rubber dam to prevent contamination and reduce moisture enhances success rates. A lack of cement on a debonded framework suggests contamination at this interface. A chair-side sandblaster or micro-abrasion unit is an invaluable piece of equipment in the practice. It is imperative that the residue of alumina particles is washed off the retainer prior to recementation.

Posterior resin-bonded bridges are based on the same principles of design as anterior bridges, although tooth preparation is more frequently required to create a distinct path of insertion. Tooth bulbosity in this region usually requires reduction and occlusal rests or, preferably, full occlusal coverage to resist heavier occlusal forces. It does not appear to be necessary to prepare grooves or boxes to enhance resistance form (Figure 3).

Conventional Bridge

The lifespan of conventional bridgework is thought to be in the region of 15 to 20 years. Designs include: fixed-fixed, fixed-moveable, cantilever and spring cantilever. Advantages of conventional bridgework are that it provides a predictable and aesthetic result. However, it is very destructive of tooth structure, which can lead to problems with the endodontic status of abutment teeth. Root canal treatment once a bridge is cemented is likely to necessitate a remake because the access preparation weakens the underlying dentine or core. It is therefore recommended that endodontic treatment be carried out for teeth of dubious vitality prior to bridge construction. Teeth with a very doubtful prognosis may be better extracted rather than attempting to incorporate them into a bridge design.

Fixed-fixed bridge designs allow stresses to be distributed more evenly between the abutments. They are most commonly used in the anterior region of the mouth, for long posterior spans over two units or when periodontal splinting is required. In these situations it is more important to share the load equally between the abutments, rather than using a stress-broken design where greater load is inevitably transferred through the fixed retainer. The height, width and depth of the connector should be maximized to provide sufficient rigidity to the framework. This reduces the stress placed on the cement lute (Figure 4).

Fixed-moveable bridgework is ideal for the replacement of one or two teeth in the posterior region of the mouth. The design exerts a ‘stress-breaking’ effect, reducing...
Generally, the use of double abutments is not recommended since it results in uneven distribution of stress and fracture of the cement lute of the weakest retainer, resulting in leakage and caries.

However, a posterior cantilever bridge where occlusal loads are high is one of the few situations where double abutments may be indicated. Typically, where an upper first premolar is to be replaced with a conventional cantilever bridge, the use of the second premolar and first molar is often recommended as the abutment teeth.

Hybrid bridges employ a combination of a conventional retainer on one abutment and resin-bonded wing on the other. The pontic from the adhesive portion of the bridge generally carries a male portion of an attachment, which inserted into a female attachment incorporated into the conventional retainer. They preserve tooth tissue by using the appropriate retainer for each abutment. However, problems exist with attempting to use two different cement types simultaneously at cementation. This type of bridge could be considered experimental as there is little in the way of long-term data regarding its survival (Figure 7).

All-ceramic bridges, including those produced with CAD/CAM (computer aided design/computer-aided manufacture) technology may also be considered experimental, as there is currently no substantial evidence-based evaluation of them. In contrast, there are good success rates published on the performance of all-ceramic crowns.

Pontic
Porcelain fused to metal modified ridge lap design is most commonly used for cosmetic reasons but cast metal may be appropriate where there is no aesthetic demand. Alternative pontic designs, including sanitary, bullet or ridge lap, are largely historical. The most important features of a pontic are that it has passive tissue contact with a convex, smooth fit surface and adequate embrasure space to facilitate cleaning. Where there has been tissue loss, the technician may require extra guidance with the design of the final prosthesis. Pink porcelain to replace lost tissue often produces a better appearance than simply resorting to the use of large teeth

Implant
Implants were originally developed for patients with difficulty adapting to complete dentures but are increasingly used as the tooth replacement method of choice for the partially dentate patient. Implants remain the most expensive method of tooth replacement. They have many advantages and are placed independently of potential abutment teeth. An implant-supported fixed bridge may be indicated where the length of the span is too great for resin-bonded or fixed bridgework, or there are no suitable abutment teeth. Success rates for partially dentate patients treated with implants are around 90% over 10–15 years.

The placement of implants is limited by the availability and density of alveolar bone. Access is also important and may be influenced by reduced mouth opening as found in Class II division 2 occlusions and placement in the molar regions. The proximity of anatomical structures to proposed implant sites must also be taken into account. Appropriate radiographs

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should be taken to locate incisive and inferior dental canals, nasal cavity, maxillary sinuses and the roots of neighbouring teeth.

Where there is insufficient bone for implant placement, grafting procedures may be required. The appearance of implant-retained prostheses may be unpredictable and is rarely better than conventional crown and bridgework. Soft tissue loss can be difficult to restore and loss of the interdental papilla is common, resulting in a long contact area rather than a contact point. Ridge augmentation techniques can be considered to enhance the final appearance but increase the complexity and length of treatment (Figure 9).

Replacement of a single tooth, multiple teeth or the whole arch is now possible with implants. They can be considered the tooth replacement of choice for most clinical situations but are particularly useful when dealing with unrestored, heavily restored and spaced dentitions. Certain medical conditions, such as haematological disorders, metabolic bone disease, psychological illness, alcoholism and poorly controlled diabetes, are relative contra-indications to implant treatment. Smoking* and active periodontal disease lower success rates. Similarly, implants are

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**Figure 8.** The use of pink porcelain to mask tissue loss.

**Figure 9.** Localized ridge defect following the traumatic loss of 3777.

**Figure 10.** Implants used to replace congenitally absent 213.

**Figure 11.** Implant-retained crowns 37.
not immune to the damaging occlusal forces generated by bruxist patients.

Ideally, 7 mm of interproximal and interocclusal space is required for implant placement, though many components are now available to help with problem situations. Age does not influence the likelihood of success of implants. However, some elderly patients find the procedures difficult to cope with. It is not advisable to place implants before growth is completed as they behave in a similar way to an ankylosed tooth.

Developments in the field of implantology include the use of immediate implants that are placed into a prepared extraction socket following tooth removal. They have the advantages that the number of surgical sessions is reduced, the waiting period for socket healing is eliminated, the alveolar ridge height and width is preserved and overall costs are reduced. The main disadvantages of this technique are that it is more demanding both surgically and prosthetically.

Immediate loading is also increasing in popularity. This involves fitting a provisional restoration immediately after implant placement in order to restore function and appearance, as well as improving the final soft tissue contour by allowing the gingivae to heal around a restoration with similar contours to the final prosthesis (Figures 10, 11).

CONCLUSIONS

Case selection is crucial to success when considering any form of tooth replacement. Whichever treatment modality is finally selected, it should suit the needs of the patient, be carefully planned and skillfully executed. The success and limitations of removable partial dentures and conventional bridgework are well known to the profession. Resin-bonded bridges and dental implants now have proven track records and should be offered to patients as predictable alternatives. It is the practitioner’s choice whether to undertake these relatively newer techniques or refer his/her patient for such care.

REFERENCES