Short and sticky options in the treatment of the partially dentate patient

N. J. A. Jepson,[1] and P. F. Allen,[2]

As we move into the twenty-first century, patterns of dental disease in adults are changing. Surveys of adult dental health indicate that more people are keeping their teeth for longer in life. In many cases, the ravages of dental disease and the cumulative effect of a lifetime of restorative dentistry lead to gradual tooth loss. For many of these patients, restoration of a complete dentition may not be feasible nor desirable. In recent years, functionally oriented treatment planning has become acceptable in light of recent research findings. Using this approach, treatment efforts and resources are directed principally at retaining the 'strategic' part of the dentition in the long term, ie, the anterior and premolar teeth. This paper describes, with the aid of treated cases, a means of combining a shortened dental arch strategy with resin bonded bridgework. With the aid of recent research in this area of clinical practice, some suggestions as to the use of the technique are also described.

In brief

- Not replacing missing teeth is acceptable in some patients.
- Missing anterior teeth is a key factor influencing patients to seek replacement.
- Cantilevered, resin bonded bridges perform well clinically.

As recent surveys of adult dental health have shown, the retention of some natural teeth throughout life is now feasible for most of the adult population.[1] However, levels of dental disease in the current middle-aged cohorts in the UK are significant.

In a review of the most recent UK adult dental health survey, Downer suggested that the burden of replacement of existing restorations in this age group will be considerable.[2] One of the many challenges for the dental profession as we enter the twenty-first century will be how to plan effective dental care for middle-aged and elderly adults.

Retention of a healthy, natural, functioning dentition comprising not less than 20 teeth and not requiring a prosthesis has been described as a goal for oral health by WHO.[3] This indicates a shift away from the traditional treatment philosophy of restoring a complete dentition in all cases. In this paper, we describe applications of current restorative techniques, principally use of resin bonded cantilevered bridgework, in conjunction with a functionally oriented treatment philosophy.

Is replacement of missing teeth essential?

In the past, it was considered essential to replace all missing teeth, as failure to do so would result in occlusal instability and temporomandibular joint dysfunction.[4] This assumption has been challenged by a number of researchers who reported that such consequences were not inevitable if all missing teeth were not replaced.[5,6] Further reasons for replacing missing teeth include improvement of chewing function and cosmetic appearance. While loss of teeth leads to a decrease in objectively measured chewing efficiency, this does not appear to affect patients perceived chewing ability.[7] Furthermore, descriptive population studies indicate that posterior tooth spaces are well tolerated by patients, and most only seek some form of replacement when anterior teeth are missing.[8,9]

Research findings such as these indicate that while replacement of missing teeth may be possible, it may neither be necessary nor desirable in all cases.

When a partially dentate patient presents for treatment, possible treatment options are:

- Fixed prostheses
  - — tooth retained
  - — implant retained
- Removable partial denture
  - — tooth retained
  - — implant retained
- Restoration/maintenance of a functional (rather than complete) dentition
- Controlled progression to complete dentures.

The decision on which of these options to provide depends mainly on the following considerations:

- Patient motivation — how keen are patients to replace missing teeth?
- Periodontal status
- Willingness to undertake complex treatment over multiple visits
- Financial cost.

[1]*Senior Lecturer/Honorary Consultant,* [2] *Lecturer, Department of Restorative Dentistry, The Dental School, Framlington Place, Newcastle upon Tyne NE2 4BW*

REFEREED PAPER
Received 21.09.98; accepted 09.03.99
 187: 646–652

Table 1 Criteria for application of SDA

- Caries and periodontal disease confined mainly to molar teeth
- Good long-term prognosis for the anterior and premolar teeth
- Limited finances available for restorative care

Problems with removable and fixed options for replacing missing teeth

Removable partial dentures

When many teeth are missing, the use of removable partial dentures is a commonly used treatment option. Bergman *et al.*,[10] have shown that such prostheses are not likely to contribute to dental disease if well maintained. However, workers such as Berg[11] and Drake and Beck[12] suggest that partial denture wearers are often not meticulous in the care of their dentures, and, therefore, experience increased levels of caries and periodontal disease. These studies show that abutment teeth for partial dentures are particularly prone to periodontal attachment loss and root caries. The study by Drake and Beck of a large independently living population also indicated that levels of dental disease were correlated with denture fit. They reported that poorly maintained ill-fitting dentures contributed to disease prevalence.

Strict adherence to the principles of denture design during construction is not always evident, and this also is a component of the iatrogenic problems associated with partial dentures.[13] A well known example of this is the use of 'gum strippers', ie poorly supported acrylic partial dentures which strip the gingival tissues as they sink under occlusal load.

A further factor to consider is the apparent discrepancy between normative and subjective need. To elaborate, many studies have indicated that there is often an apparent discrepancy between professionally assessed (ie normative) need and patient demand (ie subjective need) for dental care.[14,15] Tooth loss is often accepted and tolerated by many adults, even when access to dental care is not a problem.[9] This was further shown by Jepson *et al.*[16] who, in a survey of patient acceptance of partial dentures, found that 40% of a 300 patient sample did not wear their partial dentures. Consonant with descriptive population studies,[8] they found that absence of an anterior tooth was a major influencing factor in patient acceptance of a partial denture. The conclusion is that patients are unlikely to wear a partial denture in the absence of self-perceived need. A further explanation may be that patients consider wearing a removable partial denture as less acceptable than not replacing missing teeth, and compliance may be greater if a more sophisticated option (eg an implant supported prosthesis) were offered.

Fixed bridgework

Restoration of short edentulous spans often lends itself to the use of fixed bridgework. Until recently, in the molar and premolar regions of the mouth, this involved full or partial crown preparations on one or both teeth adjacent to the tooth space, followed by placement of a conventional bridge. While this technique has been widely used, problems have been reported with loss of vitality of abutments and mechanical failure of the bridge.[17,18] More recently, resin bonded designs have been employed with some success.[19,20] In either case, problems arise when restoration of longer spans (eg > two teeth) is attempted. Flexure of metal castings in conventional bridgework increases with length of span, which may lead to failure of the bridge and/or abutments. Failure rates of resin bonded bridges also increase with the number of teeth replaced.[19] Furthermore, patient motivation is important, as failure to maintain a satisfactory level of oral hygiene is likely to lead to caries or periodontal disease affecting abutment teeth.

Implant supported prostheses

The option of restoring a fixed bridge or removable denture on endosseous implants is becoming more frequently used in the UK.[21,22] However, data on long-term survival rates of implant therapy in the posterior mandible and maxilla is limited. In addition, the procedure to place implants in the posterior maxilla or mandible can be complex, because of lack of bone, or proximity of the inferior dental nerve to the proposed implant site. Finally, implant procedures are expensive and may be beyond the financial resources of individual patients or care providers.

The shortened dental arch concept (SDA)

It would appear that economic resources from public funds for dental care are decreasing.[23] Effective use of the funds available to promote dental health would seem, therefore, of paramount importance. Recent figures from the Dental Practice Board for England and Wales indicate that it costs around 52 million pounds every year to fund the provision of partial dentures.[24] In light of the high level of non-compliance with partial denture wearing, whether this constitutes effective use of public funds is a matter of debate. Workers such as Yule,[25] and Drummond *et al.*[26] have indicated that new treatment strategies are required to meet the demands of the future elderly and to account for economic considerations in treatment planning.

The shortened dental arch concept (SDA) described by Kayser[27] is a framework for limiting treatment goals to meet patient aspirations. The conceptual underpinning for this strategy is that treatment efforts and resources are directed at the anterior and premolar teeth, which are considered essential for chewing function and appearance. The treatment aim is to achieve an acceptable, though sub-optimal, level of oral function. Absent molar teeth are only replaced if their absence gives rise to problems. Kayser and co-workers[28] describe the 'problem oriented approach' as a means of applying the shortened dental arch strategy. Basically, this involves making an inventory of patient perceived problems, and directing treatment at solving these problems. Criteria described by Kayser for application of SDA are shown in Table 1, with contra-indications to SDA shown in Table 2.

In a longitudinal study of oral function in shortened dental arches, Witter *et al.*[5,29] concluded that: SDA can provide sufficient occlusal stability; SDA provides satisfactory comfort and appearance; and, chewing and comfort were not significantly enhanced by the provision of removable partial dentures. While further work is required to investigate the

Fig. 1 Conventional, cantilever bridge replacing ⌊4 using ⌊3 as the abutment

long-term prognosis for dentitions managed by SDA, it would appear that this pragmatic approach has much to commend it. Using this approach, treatment is functionally rather than mechanically orientated. Patients' aspirations are fully incorporated into the treatment strategy, and finances are targeted at preserving the components of the dentition essential to the patient.

Case selection is critical when considering the SDA approach. The patient must be sufficiently motivated to maintain the remaining dentition, as loss of teeth may compromise function and appearance. Furthermore, as indicated earlier, the clinician must be confident that the remaining natural dentition has a good long-term prognosis.

Applications of the SDA concept

One of the goals of prosthodontic rehabilitation is to minimise the 'biological price' associated with tooth replacement. For some carefully selected patients, restoration of tooth spaces essential for appearance and chewing rather than complete restoration may be particularly indicated. In this respect, alternatives to using removable partial dentures to replace absent teeth, or to extend shortened dental arches include:

- Cantilevered, conventional bridgework
- Cantilevered, resin bonded bridgework
- Implant supported crowns/bridges.

This cantilever bridge design involves attaching a prosthesis to a single abutment tooth, as illustrated using a conventional bridge in fig. 1, thus accepting a reduced, but functionally acceptable, occlusal table. The advantages in this design include less tissue coverage and ease of access for oral hygiene procedures.

Possible designs of cantilevered bridgework include conventional crown retained pontics, and resin-retained pontics. Budtz-Jorgenson and Isidor[30] described the use of conventional cantilevered fixed bridges to extend mandibular shortened dental arches in an elderly population over a 5-year period. They concluded that the performance of these prostheses was far more satisfactory than the control group provided with removable partial dentures. Significantly, the prevalence of caries in the bridge group was dramatically less than the partial denture control group.

Recently, the technique of resin bonded bridgework has been described, and preparation guidelines have been reported.[31] Initially proposed as a fixed-fixed design, the technique involved minimal preparation of anterior or posterior abutment teeth.

Key considerations in providing resin bonded bridges are shown in Table 3.

Despite the advantages of this technique compared with conventional fixed and removable prostheses, resin bonded bridges are not widely used in the general dental services in the UK.[24] This may be influenced by the initially low survival rates reported for this technique, especially for posterior resin bonded bridges.[32,33] In a review of failure rates of single tooth restorations, Priest[34] described a number of factors which may account for this, including the very minimal preparation and quality of luting cements available when the technique was first described. However, Simon *et al.* found that use of preparation features such as grooves decreased the rate of debonds, and recommended that such features should be used routinely.[35] This finding was similar to that reported by de Kanter *et al.*[36] who recently described the findings of a 5-year multi-practice clinical trial of posterior resin bonded bridges. Their main findings were that proximal grooves in abutment teeth increased survival rates, and that the choice of cementation material appeared to have no influence on chances of failure. They also reported higher retention rates for maxillary bridges than those placed in the mandible. They suggested that this was because of shorter crown height, increased occlusal loads and greater tooth isolation problems in the mandible. Kilpatrick and Wassell[37] proposed partial occlusal coverage of abutment teeth with the bridge, as well as enhancing the rigidity of the framework to minimise these problems.

Table 2 Contra-indications to SDA

- Marked dento-alveolar malrelationship
- Parafunction
- Pre-existing TMD
- Advanced pathological toothwear
- Advanced periodontal disease
- The patient is under the age of 40 years

Evidence has been presented which suggests that a cantilevered design of resin bonded bridgework performs at least as effectively as fixed-fixed designs. Hussey and Linden[38] assessed, prospectively, the performance of cantilevered resin-bonded bridges provided in a hospital environment. They concluded that cantilevered resin bonded bridges performed well, with a low incidence of caries. An important caveat in their commendation of this treatment modality was that careful moisture control and handling of the cementation materials was critical to the outcome. They also reported higher success rates in replacement of missing premolar and lateral incisor teeth than central incisors and canine teeth.

Application of this technique in conjunction with a shortened dental arch strategy has a number of potential advantages, namely:

- The minimal preparation of teeth involved decreases the 'biological price'
- The technique is cost effective in terms

Table 3 Key considerations in providing resin bonded bridgework

Case selection

- Is there sufficient tooth structure for bonding?
- Is the occlusion favourable?

Preparation and cementation

- Cingulum grooves
- Occlusal rest seats
- Maximal, supra-gingival coverage of non-visible aspects of abutment teeth
- Good moisture control during bridge cementation
- Strict adherence to manufacturer's instructions when handling cements

of time to complete and provide the bridge, and maintenance costs are low

- Debond will cause the bridge to fall out, eliminating the risk of partial debond and the risk of caries associated with the fixed-fixed designs.

Using implant supported crowns or bridges are an alternative to using resin bonded bridgework to extend shortened dental arches. In view of the complex nature of this form of treatment, it should not be considered as the first option. However, in situations where potential abutment teeth are unsuitable for conventional and resin bonded cantilevered bridgework, implant therapy may be the treatment of choice.

When a shortened dental arch strategy is employed, regular check-up visits and periodontal maintenance is required to ensure long-term survival of the remaining dentition. The importance of adequate plaque control should also be emphasised to the patient.

In the following pages, a series of cases are presented (Cases 1 to 3) to illustrate the use of resin bonded bridgework in shortened dental arches. In each of these cases, patients either had unfavourable experiences with partial dentures, or refused to wear such a prosthesis.

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Case 1

This 66-year-old female was referred to the Newcastle Dental Hospital for an opinion regarding replacement of her existing P/ cobalt chromium based denture. She had not experienced any discomfort or retention problems with the denture, which had been constructed 18 months prior to her attendance at NDH. Her principal complaint was that she 'was always conscious of the denture' and that it 'never felt part of me'. She felt compelled to wear the denture, as her upper right lateral incisor was missing. In fact, she admitted that she only wore the denture on occasions where she was likely to come into contact with other people.

On examination, teeth present were

43 1|123

4321|1234567

Oral hygiene was fair, and no mobility of remaining teeth was noted. She had a class III malocclusion, with a tendency to overclosure. The P/ denture replacing 7652|4567 (fig. 2) was well retained, and fit was adequate. It was possible to make minor improvements to the denture, but it was felt that this would not address her presenting complaint. Further discussion with the patient indicated that if the space left by the upper right lateral incisor could be restored, she could happily manage without restoration of the posterior tooth spaces. Consequently, a cantilevered, resin bonded bridge was provided using the upper right first premolar abutment. To provide more stable occusal contacts, cantilevered resin bonded bridges were also provided in the upper left and lower right premolar regions (figs 3, 4). A course of oral hygiene instruction and simple scaling procedures was also undertaken. The patient was very pleased with the cosmetic end result, and reports no chewing difficulties. Her only 'problem' is tht she has not yet gotten out of the habit of reaching to her handbag for her denture when planning to go out!

Fig. 2 Anterior view of Patient 1 with upper partial denture replacing 2|456 in place

Fig. 3 Anterior view of patient 1 showing resin-bonded bridges replacing 2|4 and 4|

Fig. 4 Occlusal view of upper, cantilever resin bonded bridges placed for Patient 1. For both abutments, wide coverage of the retaining 'wings' maximises the bonding area. *Note* the reinforced design of the premolar retainer that results from the use of positive occlusal support mesially and distally

Case 2

This 80-year-old lady attended for review following routine conservation and provision of an upper partial cobalt-chromium denture 2 years previously. Although she had no complaints about the fit or retention of the denture, she reported only wearing it because it replaced the missing upper left lateral incisor, and tended to restrict its use to social occasions. She avoided its use for eating whenever possible as it interfered with taste and felt bulky.

On examination

$$\frac{7\quad 321|1\ 3456}{6\,54321|12345}$$

were present. All teeth were sound and their periodontal condition healthy. The design, fit and occlusion of the partial upper denture was very satisfactory and, apart from the replacement of the lost gingivally approaching clasp at 3|, improvement or modification was not possible or advised (fig. 5). During subsequent discussion, it became apparent that the patient's only concern was the missing |2 and that she was not unduly concerned by the missing 654| teeth. Accordingly, |2 was replaced using a resin bonded bridge cantilevered from |1 to avoid a tight occlusal contact between upper and lower canines (figs. 6,7). The patient was very satisfied with the appearance of the bridge, and reported no difficulties chewing despite the missing upper posterior teeth.

Fig. 5 Patient 2: Occlusal view of the well-designed upper partial denture replacing 654|2 teeth

Fig. 6 Anterior view of Patient 2 showing the resin-bonded bridge replacing |2

Fig. 7 Patient 2: Occlusal view of cantilevered resin bonded bridge replacing |2 using |1 as the abutment. Missing 654| teeth have not been restored

Case 3

This 72-year-old gentleman attended the Prosthodontics Department for replacement of 10-year-old complete upper and lower partial dentures following the successful completion of a course of periodontal treatment. Though an experienced denture wearer who found these and previous C/P dentures generally satisfactory, he was somewhat ambivalent towards the need for a /P denture which he wore largely because he been advised to do so. He did report occasional discomfort from this and previous lower partial dentures.

On examination only $\overline{321}|1\,34$ teeth remained. All teeth were sound and periodontally stable. C/P dentures were poorly adapted and unstable and required replacement (fig. 8). Following discussion with the patient, he was provided with cantilever resin bonded bridges to restore the lower arch as a part of a clinical trial investigating the efficacy of these restorations as compared to partial dentures in the restoration of patients with severely shortened lower dental arches. The three bridges used to replace $\overline{4}|\overline{2\ 5}$ teeth were cantilevered from $\overline{3\ }|\overline{34}$ teeth respectively and have now been in place for 2 years (figs. 9,10). The patient is very satisfied with the result and reports an improved comfort and chewing function. Lack of other lower posterior teeth has, to date, not affected the stability of function of the complete upper denture.

Fig. 8 Anterior view of Patient 3 showing the 10-year-old lower partial denture replacing 7654|2567 teeth and complete upper denture

Fig. 9 Anterior view of Patient 3 to show cantilevered, resin bonded bridges replacing $\overline{4}|\overline{25}$. The complete upper denture has been replaced along with the construction of the resin bonded bridges. Note the even occlusal contacts in the anterior and premolar region

Fig. 10 Lower occlusal mirror view of Patient 3 showing the three cantilevered, resin bonded bridges replacing $\overline{4}|\overline{25}$. The design of all retainers ensures the maximum bonding area, wrap round and support. Use of lingual cuspal coverage at $|\overline{4}$ further improves support and strength of the retainer. Compare this to the design of the retainer at $\underline{4}|$ where the functional palatal cusp prevents full coverage