

A Preliminary Evaluation into the Performance of Posterior Resin Bonded Cast Metal Restorations (Adhesive Onlays)

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Abstract - Posterior resin bonded cast metal restorations (adhesive onlays) were used in a variety of clinical scenarios including: management of tooth wear and cracked tooth, as retainers for fixed bridge work, for correction of the occlusal plane and in providing cuspal coverage following endodontic treatment. The mean length in service for the examined onlays was 42 months, with a range of 9-75 months. Two restorations in two patients failed resulting in an overall success of 94%. Patient satisfaction was high at 95%. Such restorations seem to be a viable option for managing a number of clinical scenarios.

KEY WORDS: Resin bonded cast metal restorations, adhesive onlays, cracked tooth, bridge retainers, tooth wear

INTRODUCTION

Resin bonded cast metal restorations (RBCMRs) involving occlusal surfaces have been traditionally described in the clinical management of patients with tooth surface loss and dental anomalies such as amelogenesis imperfecta (AI)¹. The advent of such restorations can be attributed to the development of newer chemically activated resin luting cements and surface treatment methods for enhancing bonding to alloys. Methods for enhancing bonding to alloys include electrolytic etching and air abrasion with aluminum oxide of nickel chromium alloys and tin plating or heat treatment of noble alloys²⁻⁵. The main cited advantage of these adhesive restorations is the preservation of sound tooth structure compared to full coverage conventional restorations where the traditional tenets of retention and resistance form necessitate the removal of valuable tooth structure.

Individual RBCMRs have been described in the literature in the management of pathologic wear. Creugers and Kayser described the use of such restorations in the management of patients with anterior wear as a result of attrition caused by a parafunctional habit⁶. More commonly these restorations can be used in young patients exhibiting tooth surface loss on the palatal surfaces of anterior teeth as a result of erosion⁷. Indeed in a retrospective survey of resin retained cast metal palatal veneers for the treatment of anterior palatal wear the majority of patients were in the 10-16 year category⁸.

Attrition with associated sensitivity and a reduction in vertical dimension as a result of dental anomalies such as AI can also be managed with RBCMRs. Hunter and

Stone described the management of AI by placing these restorations on all first permanent molars in supraocclusion⁹. The rationale in using RBCMRs in wear cases has been protection of the teeth from further mechanical or chemical damage, reduction of sensitivity and alteration of the morphology and guiding surfaces of the worn teeth¹⁰. Tooth wear is often associated with compensation and resultant loss of interocclusal space and vertical dimension, often necessitating the placement of these restorations in supraocclusion.

Other less cited uses of such adhesive restorations include the provision of rest seats and guide planes for removable partial dentures where potential abutments are intact but tooth morphology would require too much tissue removal for the planned path of insertion, and in the restoration of the cracked tooth where circumferential cuspal coverage is required¹¹⁻¹³.

RBCMRs are also used as retainers for resin retained bridges (RRBs). Retrospective clinical studies have clearly demonstrated the clinical success of RRBs¹⁴⁻¹⁵. However, the combination of a conventional full veneer retainer such as a porcelain fused to metal crown with a RBCMR retainer placed on lingual surfaces used to replace a missing tooth, termed a hybrid bridge has been shown to have unfavorably high rates of failure¹⁶.

Resin bonded cast metal restorations, sometimes referred to as adhesive onlays, have been suggested for use posteriorly¹⁷. However, there is a paucity of literature with respect to the success of these restorations when used posteriorly, where occlusal forces are very different from forces in the anterior region of the mouth. Channa et al reported in a retrospective study on the clinical evaluation of posterior resin bonded cast metal restorations and confirmed their success in a high-risk patient sample¹⁵. There is little empirical evidence to assess the success of these restorations when used in the management of dental conditions unrelated to wear or dental anomalies.

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When used cautiously RBCMRs involving the occlusal surfaces of posterior teeth may be adapted for use in clinical situations where:

- (i) the occlusal position of a tooth needs to be corrected, prior to providing an opposing fixed or removal prosthesis
- (ii) In the management of incomplete cracked tooth syndrome
- (iii) As retainers for fixed partial dentures where one tooth is a virgin abutment i.e. hybrid bridge
- (iv) As retainers for resin retained bridges (RRBs) where the position of the teeth cannot facilitate a path of insertion with retainers on lingual surfaces
- (v) In wear cases of adult patients where occlusal vertical dimension needs to be increased.

The aim of this study was to determine the preliminary performance of RBCMRs when used posteriorly in various clinical scenarios to ascertain whether there is merit to further use of such restorations as a viable treatment modality.

MATERIALS AND METHODS

Prior to selection of patients for this retrospective examination clinical records were examined and clinical criteria set out prior to recall of the patients. For inclusion into the study the following criteria had to be met: the reason for the placement of the onlay, date placed, the method of interocclusal space creation (cemented in supraocclusion or by tooth preparation), the type of alloy used, the type of surface treatment to enhance bonding, type of core placed i.e. enamel, dentine or restorative material, the location of the margin placement and the type of cement used to lute the restoration. Additionally only restorations involving the occlusal and extending onto the occlusal third of the tooth were included, which for the purposes of this study were referred to as adhesive onlays (Figure 1).

The clinical records of 23 potential patients having had 38 adhesive onlays placed between 2004 and 2010 were identified, from a private practice and teaching hospital (the University of the West Indies, School of Dentistry) in

Trinidad, and selected for examination. Prior to the recall of the patients the Ethics committee of the Faculty of Medical Sciences, The University of the West Indies, granted ethical approval.

One clinician or students under close supervision by the same clinician during this time period, either placed or supervised placement of the onlays examined. Restorations placed in the previous six months were not included to avoid skewing of data. Since the potential patient pool was small, patients were contacted by telephone and an explanation given for the recall examinations. Patients were recalled and subsequent clinical examinations were completed for all patients over a 13-week period by 2 clinicians who were calibrated prior to the recall of the patients. Examination of the patients and analysis of the data was undertaken by members of the research group not involved with the actual clinical management of the patient cases to guarantee unbiased results.

The outcome of the examination quantified the restoration as a success; if the restoration was still in place, the marginal integrity acceptable and the restoration was functioning in the capacity for which it was intended; or a failure if the restoration had debonded, had caries or an open margin or was no longer functioning in the capacity for which it had been placed. Additionally a simple yes/no answer was elicited from the patients to ascertain whether they were satisfied with the restoration or not.

Due to the small number of restorations being examined and the short time period being evaluated no attempt was made to calculate survival rates but only clinical outcomes.

RESULTS

Of the 23 patients identified, 1 patient had died and 1 patient could not be contacted. This accounted for a total of 2 onlays that could not be examined. 76% of the patients examined were male, accounting for 69% of the onlays examined and 24% female, accounting for 31% of the examined onlays. The ages of patients in this retrospective examination ranged from 23 to 76 years with a mean age of 53.6years. Table 1 shows the number of restorations in each age range for the patients examined. Table 2 shows the number of onlays placed for each respective clinical reason.

Sixty-nine percent (25) of the examined onlays were placed in the mandible whilst 31% (11) were placed in the maxilla. Tables 3a and b show the distribution of teeth restored in both arches.

Review of the clinical notes revealed that preparation of the teeth were used to create space for 89% (32) of the onlays provided whilst no preparation was utilized for 11% (4) of the onlays. Sixty-one percent (22) of the restorations were cemented with Rely X Arc luting cement, 36% (13) were cemented with Panavia F and 3% (1) were cemented with Rely X U-100. All the onlays placed were fabricated using Nickel-Chromium alloy and the fitting surfaces sandblasted with 50-micron aluminum oxide.

Of the onlays examined the length of time in service ranged from 9 to 75 months with a mean time of 42 months.

Ninety-four percent of the onlays were deemed a success, and were still bonded, with good marginal adaptation and



Figure 1. Buccal view of a fixed partial denture using an adhesive onlay as the retainer on tooth #1-6.

functioning in the capacity for which they were placed. Two onlays, accounting for 6% of all the onlays examined, were deemed failures with a total debond from the underlying tooth structure with no evidence of caries. Both these onlays were cemented with Rely X Arc luting cement. However these onlays were used as retainers for bridges with the other retainer still bonded with good marginal integrity and the prostheses still in place. The patients, at the time of examination, were unaware of the debonded retainer. In the absence of the exact time of the debond the length in service was calculated from the date of placement to the date of examination.

Patient satisfaction was high, with 95% of patients being satisfied with the restoration, reporting that they would have another placed in the future if required for the same clinical reason as previously or another cause.

Table 1. Number of patients and restorations placed according to age group (2 patients had restorations placed at different chronological times)

Age Range (yrs)	# of patients	# of onlays
20-30	1	1
30-40	3	3
40-50	8	4
50-60	15	9
60-70	4	3
>70	5	2

Table 2. Number of restorations delivered according to reason for placement

Reason for placement	No. of patients	No. of onlays placed
Tooth wear (with increase in OVD)	4	10
Correction of occlusal plane	2	2
Hybrid bridge retainer	2	2
RRB retainer	4	11
Cracked tooth	5	6
Provision of cuspal coverage	4	5

DISCUSSION

This preliminary assessment of adhesive onlays involving the occlusal surfaces and occlusal third of the axial height of posterior teeth shows promising results. Due to the small numbers of restorations examined and the relatively limited period of service no attempt was made to quantify survival rates of the restorations using statistical methods such as regression analysis. Instead the focus of the limited study looked at the clinical outcomes of success, failure and patient satisfaction.

Generally the sandblasted, Ni-Cr onlays cemented with resin luting cements were successful with only 2 failures. Due to the isolated nature of these events it would be difficult to postulate the cause of the failure. It should be mentioned, however, that preparation of the abutment teeth and subsequent cementation of both failed onlays were completed by undergraduate dental students. Djemal et al showed that resin bonded restorations, namely RRBs, showed lower survival rates when completed by less experienced practitioners¹⁵.

Only 5% of patients questioned reporting they were not satisfied with the restoration and would not have another one placed. Patient acceptance in this limited study could be attributed to two factors, namely, the age of the patient at placement of the onlay and the location of the restored teeth.

Such restorations have been discussed in the literature previously, mainly, for the management of tooth wear and amelogenesis imperfecta. In such cases, restorations are almost always placed in supra-occlusion⁸. Review of the clinical notes revealed that the majority of teeth restored with onlays (89%) were minimally prepared to facilitate placement. This preparation involved occlusal and axial reduction of 0.3-0.5 mm and a chamfer margin in enamel extending circumferentially around the tooth above the proximal contact points. Where the tooth was a lone standing tooth the chamfer was located well above the height of contour of the tooth, approximately 1-2 mm from the occlusal surface. Channa et al has suggested that the aim of preparation is not to increase retention but to act as a location guide for the restoration and improve the resistance of the casting¹³. Indeed only the chemical cement lute facilitated retention, of all the onlays placed in this study. This can be attributed to nickel chromium alloys being easily abraded with aluminum oxide to form a surface oxide layer which enhances bonding with resin

Table 3a. Distribution of teeth in the maxilla with adhesive onlays

Tooth Number	1-7	1-6	1-5	1-4	2-4	2-5	2-6	2-7
# of onlays	2	3	1	0	1	1	0	3

Table 3b. Distribution of teeth in the mandible with adhesive onlays

Tooth Number	4-8	4-7	4-6	4-5	4-4	3-4	3-5	3-6	3-7	3-8
# of onlays	1	4	4	2	2	1	3	2	5	1

luting cements³. The resin luting cements used to cement the onlays in this study were utilized based on availability at the time of patient presentation. When using the Rely X Arc cement a primer was applied to the fitting sandblasted surface to facilitate bonding whilst no primer was used when Rely X U100 or Panavia was used.

Further review of the clinical notes revealed that despite tooth preparation, at the delivery stage, a number of the onlays were perceived by the patients and confirmed with articulating foil to be in supra-occlusion. Careful monitoring of such patients revealed that there was eventual harmonization of the centric occlusion with no deleterious effects to the patients. The onlays seemed to behave in a similar fashion to a Dahl appliance with localized axial intrusion of antagonist teeth¹⁸.

Occlusal assessment at the time of examination revealed that a subgroup of patients for who onlays were placed as part of their overall management of tooth wear showed group function on the onlays and other teeth not restored with onlays. This could be attributed to the age of the patient, with older patients showing a propensity for group function particularly where tooth wear of the canine is marked.

Since the wear potential of Nickel-Chromium alloys is well documented it was expected that opposing teeth and restorations would show clinical signs of wear^{19,20}. Examination of opposing teeth and restorations showed no obvious or pathologic signs of wear however with an average length in service of 42 months this period may be too short to observe any changes in the contour of opposing teeth.

When using these restorations as retainers for bridges where the primary form of retention is via the cement lute, they were classified as being retainers for resin bonded bridges (RRBs). The two failures that occurred were when such restorations were used for this purpose. Like fixed-fixed RRBs where the cast metal retainers are on the lingual surfaces, periodic recall is advisable since it is possible for a retainer to debond with the patient being unaware of the debond with the sequelae of secondary caries¹⁵. Perhaps such retainers when used for resin-retained bridges should use cantilevered designs now favored with RRBs with lingual retainers²¹. Paradoxically one onlay was used in this manner in a cantilevered resin retained bridge design, with the bridge still in place and good marginal integrity of the adhesive onlay. Even though the retainers that failed were used for resin bonded bridges it is noteworthy to emphasize that the failures were not of a catastrophic nature where abutments were still restorable and could be utilized again, which is often not the case with full coverage retainers²².

The 2 onlays used as retainers in hybrid bridge designs were deemed a success at the time of examination although such restorations have been shown to have a high rate of failure due to debonding of the resin bonded cast metal retainers¹⁶.

The use of posterior adhesive onlays for the management of cracked tooth has been described previously¹⁵. Such an approach was done judiciously with careful diagnosis of cracked tooth. Review of the clinical notes revealed that onlays were only prescribed when the patient presented with pain on disclusion and either a healthy pulp or where reversible pulpitis was diagnosed. Probing depth measure-

ments together with the characteristic of the pocket i.e. a narrow apex with a wide base, were also taken into consideration prior to prescription of an onlay. Any diagnosis of cracked tooth with characteristic pocketing associated with such a condition was managed with a full coverage restoration.

Patients who received this treatment modality were monitored for any visible propagation or widening of the crack, evidence of a developing or worsening pulpitis or that of a necrotic pulp, development of the characteristic pocket and radiographic evaluation.

Teeth with pain on disclusion and symptoms of irreversible pulpitis or necrosis but absence of the characteristic pocket were first endodontically treated prior to the placement of the onlay. Such patients were monitored as above, without consideration of the pulpal status.

The patients who had onlays placed for cuspal coverage were those patients who had endodontic treatment of teeth with only occlusal access but no loss of marginal ridges. The remaining buccal and lingual/palatal walls were deemed to have insufficient thickness with the risk of fracture being high. This type of restoration, however, has been described as a case report for the restoration of posterior teeth with enamel-dentine fracture with vital pulps²³.

CONCLUSIONS

It can be concluded from this limited study on the use of adhesive onlays that these restorations may be adapted for multiple clinical indications due to its high success rate and good patient acceptance. The use of such restorations as retainers for resin bonded or conventional bridges and in the management of cracked tooth and for cuspal coverage shows promise.

ADDRESS FOR CORRESPONDENCE

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