Clinical Significance

The clinical longevity seen with repaired, sealed, or refurbished techniques for defective restorations was similar to that seen with replacement techniques. The quality of evidence supporting these alternative methods was moderate, which should help to motivate clinicians to consider minimally invasive techniques for defective restorations rather than selecting replacement as their go-to method. Further studies need to be done to address the patient's perception of the repair and replacement of defective direct restorations and to evaluate factors such as dental pain, stress, anxiety, time, and cost.

treatments to address defective restorations has been considered less than attractive by many clinicians, who have been slow to adopt these approaches. The comparable outcomes between replacement and repair or other minimally invasive approaches should encourage clinicians to trust the new and evidence-based procedures.

De Carvalho Martins BM, da Silva EJNL, Ferreira DMTP, et al: Longevity of defective direct restorations treated by minimally invasive techniques or complete replacement in permanent teeth: A systematic review. *J Dent* 78:22-30, 2018

Reprints available from TKdS Fidalgo, Blvd Vinte e Oito de Setembro, 157 Vila Isabel, Rio de Janeiro, RJ, 20551-030, Brazil; e-mail: tatianaksfidalgo@gmail.com

Conventional and ART techniques for posterior restorations

BACKGROUND

With the phasing down of amalgam as the primary choice for restoring posterior teeth, other restorative materials have been developed to take its place. Resin composites are an all-purpose direct restorative choice that is generally useful when esthetic concerns are paramount. However, it is less useful in treatment environments where reticulated water and electricity are limited. Glass-ionomer cements (GICs) offer the advantages of fluoride release, biocompatibility, and reliable chemical bonds to enamel and dentin. In addition, resin-modified glass ionomer cement (RMGIC) can also overcome the drawbacks of previous materials. 'High-viscosity' GICs (HVGICs) were created with the Atraumatic Restorative Treatment (ART) technique in mind. These materials offer better mechanical properties, improved wear resistance, compressive and flexural strengths, surface hardness, and solubility compared to conventional GICs. The clinical performance of GIC restorations was evaluated in conventional and ART techniques used to restore occlusal and approximal cavities in permanent or deciduous posterior teeth.

METHODS

A search was done of the PubMed database between January 1983 and March 2018 to identify articles covering GIC clinical performance in the situations of interest. Sixty-seven articles were identified through the search. The parameters measured were annual failure rates (AFRs) and qualitative descriptions of the performance of the GIC materials.

RESULTS

The results were reported for permanent posterior teeth and primary posterior teeth. In addition, the reasons for failure were listed.

GICs in Permanent Posterior Tooth Restorations

The mean calculated AFR for conventional GIC restorations was 1.17% (range 0 to 4.68%) over a mean follow-up period of 3.78 years. This was lower than the 8.0% AFR of ART-GIC restorations (range 0 to 40.56%), which was obtained over a mean follow-up period of 3.19 years. When approximal or multi-surface permanent posterior restorations were considered, the mean AFR for conventional GICs was 6.90% (range 1.33% to 22.94%) over a mean follow-up period of 3.86 years. For the ART technique, the mean AFR was 10.7% (range 0 to 35.81%) over a mean follow-up period of 4.83 years. Higher mean AFRs were seen for approximal posterior restorations than for single-surface occlusal restorations irrespective of which restorative technique was used.

GICs in Primary Posterior Tooth Restorations

The mean calculated AFR for conventional GIC restorations in primary posterior teeth was 4.78%, which was higher than for

permanent posterior teeth. However, the AFR results for GIC-ART restorations in primary posterior teeth were comparable to those seen in permanent posterior teeth, with mean values of 8.95% and 8.0% in the primary and permanent dentitions, respectively. The mean AFR was 9.46% for the approximal conventional GIC restorations, which was slightly higher than in the permanent dentition. The conventional technique had a lower mean AFR when just RMGIC was considered. Mean AFRs for silver-reinforced and normal-viscosity GIC were 20.39% and 14.91%, respectively. When approximal ART-GIC restorations were considered in primary posterior teeth, the mean AFR was 25.77%, which was significantly higher than for the conventional technique (9.46%), and higher than for the permanent dentition.

Reasons for Failure

For single occlusal restorations, the most common reasons for failure when conventional restorations techniques are used included mechanical failure, such as restoration fracture, marginal fracture at the cavosurface margin, restoration loss, or material wear. Occlusal ART restorations in both primary and permanent dentitions most often suffered restoration loss, fracture, marginal defect, or excessive wear. In addition, some restorations failed because of carious dentin lesions and combined marginal defect and carious dentin lesions.

For approximal or multi-surface restorations, the most common reason for failure when conventional restoration techniques were used was restoration fracture. Loss of the approximal contact caused by wear or an edge fracture of the marginal ridge also led to restoration failure. For approximal conventional GIC restorations in primary teeth, the most common causes of failure were bulk fracture and loss of retention.

For ART-GIC restorations to manage approximal lesions, the most common causes of failure were loss of the restoration, gross marginal defects, and restoration fracture. Other reasons included recurrent caries associated with marginal fracture of the GIC and poor anatomic form, surface texture, and color match. When ART was used for primary dentitions, the operator's experience, improper GIC adaption causing cervical marginal gaps, and poor restorative meal consumption were found to be associated with a higher rate of failure.

DISCUSSION

The clinical performance of conventional and ART techniques of restoration differed depending on the dentition and site of the lesion being managed. For single-surface occlusal GIC restorations, the clinical performance of the ART technique was as good as that of conventional techniques and likely to yield comparable outcomes if the ART operator is experienced in the technique. ART-GIC therefore offers an acceptable alternative to conventional restorations in these lesions independent of which dentition is involved. The AFRs of approximal or multi-surface GIC restorations exceed those of single-surface occlusal lesions accomplished using the same technique in both primary and permanent teeth. For these approximal or multi-surface restorations, the conventional technique is superior, especially in the primary dentition. Approximal caries of primary teeth may have the best results when RMGIC is used in a conventional technique. Failures are most often caused by restoration loss as a result of fracture or dislodgment. Loss of approximal contact from chipping of the marginal ridge is the primary mode of failure of approximal lesions. GICs may not provide better survival than other materials for recurrent caries in posterior restorations.

Clinical Significance

Although single-surface (occlusal) restorations in permanent and primary posterior teeth are readily handled using the GIC-ART technique, this technique is less reliable and successful when used for load-bearing approximal restorations, especially in the primary dentition. Dentists need to consider the technique, the restoration material, and the dentition being addressed when selecting a course of action for the restoration of a carious lesion.

Ruengrungsom C, Palamara JEA, Burrow MF: Comparison of ART and conventional techniques on clinical performance of glass-ionomer cement restorations in load bearing areas of permanent and primary dentitions: A systematic review. *J Dent* 78:1-21, 2018

Reprints available from MF Burrow, Faculty of Dentistry, Prince Philip Dental Hosp, Univ of Hong Kong, Hong Kong Special Administrative Region, China; e-mail: mfburr58@hku.hk