

GUIDELINES ON THE USE OF GLASS IONOMER CEMENTS

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**FOREWORD
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Restoring carious teeth is one of the major treatment needs of both adults and children. Glass Ionomer Cements (GIC) are tooth-coloured materials that bond chemically to dental hard tissues and release fluoride for a relatively long period and therefore have been widely used as the materials of choice for the restoration of carious primary teeth. GICs nowadays have a wider range of use such as lining, bonding, sealing, luting and restoring of a tooth. To ensure good performance, the selection of GIC requires some understanding of its characteristics and indications for use.

To date there are no guidelines on the use of GICs and choices are based on clinicians' preference. This raises a concern on the inappropriate use of GICs as restorative materials for permanent teeth in

children and adults. Due to its physical properties, GIC has its limitations in load bearing areas and necessitates regular monitoring if placed on permanent dentition.

This document proposes recommendations based on sound, evidence-based professional knowledge. It is intended as an aid for oral healthcare providers when making decisions on the choice of GIC as a restorative material. I thank the committee members for their efforts and commitment and I hope this document will be of help for practitioners towards better clinical outcomes.

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1.0 INTRODUCTION

Glass Ionomer Cements (GIC) have been in clinical use since their inception 40 years ago. They have a wide range of uses such as lining, bonding, sealing, luting or restoring a tooth. The principal advantage of GIC includes good compressive strength, adhesion to tooth substance and fluoride release which may inhibit the progress of caries around the restoration. However, the disadvantages are poor tensile and flexural strengths, which preclude its use in load-bearing cavities¹. GICs in the market today have evolved over time, offering differences in performance, cost, ease of use, aesthetic appeal, long term effectiveness and safety². A recent systematic review on adhesive clinical trials ranked

¹ Combe EC, Burke FTJ, Douglas WH. Clinical Dental Materials. Kluwer Academic Publishers,1999.

² Van Duinen RN. Glass ionomer cement restorative materials: A sticky subject?. *Aust Dent J.* 2011, 56 Suppl 1:23-30.doi:10.1111/j.1834-7819.2010.01293.x.

GICs as exhibiting superior retention and clinical performance over resin adhesive systems³.

The type of restorative materials used is important as it influences the outcome of clinical procedure and satisfaction of the patient. The selection of materials requires understanding material characteristics and indications for use to ensure good performance. In Malaysia, GICs are widely used as fissure sealants and restoration of primary and permanent dentition. Thus, paediatric dental specialists have raised concerns on the inappropriate use of GICs as restorative materials in permanent molars in children.

To facilitate the development of this document, a working group was established in the Oral Health Division, Ministry of Health Malaysia in February 2013. The members undertook literature search and held several discussions on the use of GIC

³ Peumans M, Kanumilli P, De Munck J, Van Landuyt K, Lambrechts P, Van Meerbeek B. Clinical effectiveness of contemporary adhesives: A systematic review of current clinical trials. *Dent Mater.* 2005,21:864-881

based on current research and the stand of the American Academy of Paediatric Dentistry. This document is intended to assist primary oral healthcare providers in the selection and use of GICs in their practice.

2.0 LITERATURE REVIEW

Glass ionomers have been the mainstay for restorative dentistry in children. Their many formulations, clinical use and unique advantages have made these materials an essential part of everyday practice for paediatric dentistry⁴. Articles were mainly restricted to the use of GIC in Atraumatic Restorative Treatment trials and as fissure-sealants for permanent molars. GICs were found to have good performance as Atraumatic Restorative Restorations for permanent teeth. It has a higher caries-preventive effect than amalgam but

⁴ Joel HB. Glass Ionomer Cements. Position paper. *Pediatric Dentistry*. 2002; 24(5):430-438

no differences were found when compared to resin-based fissure sealants in permanent teeth⁵.

The findings of a 5-year longitudinal study in Malaysia involving 4,180 eight-year-old schoolchildren showed no difference in the occurrence of recurrent caries from the use of GIC as fissure sealants in first permanent molars compared to resin-based materials. GIC was thus confirmed to be a viable alternative to resin-based materials in the fissure sealant programme for school children in Malaysia⁶.

Two other controlled prospective studies concluded that high viscosity GICs exhibited good clinical outcomes as restorative material in Class I and Class II over two years of observation. However,

⁵Yengopal V, Mickenautsch S, Bezerra AC and Lea SC. Caries-Preventive Effect of Glass Ionomer and Resin-Based Fissure Sealants on Permanent Teeth: A Meta Analysis. *Journal of Oral Science*. 2009; Vol 51(3): 373-382

⁶Tan EH, Khairiyah AM, Norlida A, Norain AT. An evaluation of Malaysian School-based fissure sealant programme. A compendium of abstracts 2010, MOH Malaysia

GIC showed unacceptable high failure rates in Class II cavities, irrespective of cavity size^{7,8}.

A randomized control trial⁹ demonstrated that a 6-year survival of conventional amalgam restorations placed in clinic setting is not much greater compared to GIC restorations placed in field setting. However the study also reported on failure of GIC restorations due to loss of materials and fractures and suggested the need to adjust occlusion appropriately to relieve stress bearing areas and recommended the use of filled GIC in stress-bearing areas.

An investigation of ten cross-sectional studies involving 2,137 GIC restorations, indicated that secondary caries was the reason for failure of 17%

⁷Scholtanus JD, Huysmans MC. Clinical Failure of Class II Restorations of a Highly Viscous Glass-Ionomer Material over a 6 year Period: A Retrospective Study. *J of Dentistry*. 2007; Vol 35 (2):156-162

⁸Frankenberger R, Gracia-Godoy F and Nobert Kramer. Clinical Performance of Viscous Glass Ionomer Cement in Posterior Cavities over Two Years. *J of Dentistry*. 2009; Article ID 781462, doi:10.1155/2009/781462

⁹ Mandari CJ, Frencken JE, Van't Hof MA. Conservative Glass Ionomer Cement Occlusal Restorations can be as Effective as Conventional Amalgam Occlusal Restorations. *Caries Res*. 2003,37:246-253

to 40% of GIC restorations¹⁰. In 2006, a local study determined the median cumulative 5-year survival rate for GIC Class 1 molar restorations among 12-year-old school children to be at 9.2% with a mean duration of 2.53 (SD= 0.09) years¹¹.

In recent years, GICs as direct restorative materials have become more user-friendly with improved physical properties and resistance to dissolution compared to conventional glass ionomers¹². The most recent generation of glass ionomer materials has been termed fast-setting, high-strength, or reinforced glass ionomers¹³. Manufacturers have claimed them to be suitable as long-term temporary restoration of Class I and II cavities in permanent teeth, in addition to their suggested use in Class III

¹⁰ Deligeorgi V, Mjor IA, Wilson NHF. An overview of reasons for the placement and replacement of restorations. *Primary Dent Care* 2001;8:5-11

¹¹ Muz'ini M. Clinical Evaluation of Molars Restored with Glass Ionomer Cements in Kota Tinggi District Johor. A compendium of Abstracts 2012 (115). Oral Health Division, Ministry of Health Malaysia.

¹² Yap AUJ, Teo JCM, Teoh SH. Comparative wear resistance of reinforced glass ionomer restorative materials. *Oper Dent* 2001; 26: 343-348.

¹³ Van Duinen RNB, Kleverlaan CJ, de Gee AJ, Werner A, Felizer AJ. Early and long-term wear of "Fast-set" conventional glass ionomer Cements. *Dent Mater* 2005; 21: 716-720.

and V cavities, Class I and II cavities in primary teeth, fissure sealants, core build-ups and ART technique^{14,15}.

The findings of Qvist et. al.(2004)¹⁶ over eight years showed that Reinforced Modified GIC (RMGIC) restorations in primary teeth were preferred to conventional glass ionomer materials. Another finding also suggested that RMGIC placed on load bearing areas were satisfactory at 2 years¹⁷. For long-term wear, high viscous glass ionomers may compete with composites and thus should be considered as restorative materials¹³. Individual studies have also looked into the clinical performance of a new GIC Restorative System

¹⁴ Dentsply De Trey GmbH Professional Research. *Chemflex technical manual*. Pp 25. Germany: Dentsply De Trey, 1998

¹⁵ Ketac Molar quick product brochure. www.3mespe.com

¹⁶ Qvist V, Manscher E, Teglers PT. Resin-modified and conventional glass ionomer restorations in primary teeth: 8-year results. *J Dent* 2004; 32: 285-294.

¹⁷ Burke FJT, Siddons C, Phipps S, Bardha J, Crisp RJ and Dopheide B. Clinical Performance of Reinforced Glass Ionomer Restorations Placed in UK Dental Practices DOI: 10.1038/bdj.2007.529 *Brit Dent J* 2007; 203: E2

EQUIA found suitable for Class V and Class 1 permanent restorations¹⁸.

Strassler HE (2011)¹⁹ stated that the improvements to GICs make them amenable for use as routine restorations and provisional restorations. It can be used to successfully restore both primary and permanent teeth based on identified clinical indications. The direct-placement of GIC includes Class V restorations, provisional restorations for caries control, blocking out undercuts in crown and onlay preparations, as a base material to substitute dentine, posterior restorations in primary teeth, temporary restorations in anterior/posterior teeth, non-stress-bearing restorations, repair of crown margins due to sub-gingival caries and repair of endodontic root perforations.

¹⁸ Friedl K, Hitler KA, Friedl KH. Clinical Performance of a New Glass Ionomer Based Restoration System: A retrospective Cohort Study. *Dental Mater*. 2011,Vol 27(10):1031-1037.

¹⁹ Strassler HE. Glass Ionomers for Direct Placement Restorations- A peer reviewed Publication.2011.

http://www.ineedce.com/courses/2052/PDF/1104cei_glassionomer_web.pdf

Most commonly, GICs have been used as temporary restorations in the very young, uncooperative patients and for those with special health care needs where conventional cavity preparation and/or placement of conventional dental restorations are not feasible^{12,20}. As GICs help in maintaining the pulp vitality such as in deep and large carious lesions⁸, it is also used for caries control in children with multiple open carious lesions prior to definitive restoration of the teeth¹⁶. This is in line with the policy for Interim Therapeutic Restoration (ITR) by the American Academy of Pediatric Dentistry in 2008²⁰.

3.0 RATIONALE

Dental amalgam has long been the material of choice due to its physical properties, cost effectiveness and ease of handling. However, the Minamata treaty, which aims to protect human

²⁰American Academy of Pediatric Dentistry. Policy on Interim Therapeutic Restoration. Reference Manual, revisited 2008;35(6):13-14

health and the environment from anthropogenic emissions and release of mercury and mercury compounds, necessitates the phasing down of dental amalgam²¹.

With the development of tooth-coloured materials, there is now increasing use of composites and GICs to restore both the primary and permanent dentition. It is therefore timely that guidelines to streamline the selection of suitable cases and materials be formulated to ensure appropriateness of tooth-coloured restorative materials for better clinical outcomes.

4.0 OBJECTIVES

This document aims to provide evidence-based guidance on the use of glass ionomer cements as a restorative material.

²¹ http://en.wikipedia.org/wiki/Minamata_Convention_on_Mercury . Accessed on 29 May 2014

5.0 RECOMMENDED USE OF GICs

5.1 Indications

The choice of material and the selected formulation are critical to the success of the restoration. The selection of GIC should be based on the intended use of the product as stated by the manufacturer.

GICs are recommended as:

- **Cavity liner**

GICs can be used as cavity liners due to their inherent sealing and retention properties²². Highly flowable, low-viscosity conventional glass ionomers as well as resin-modified glass ionomers can be used.

²² Croll TP. Alternatives to silver amalgam and resin composite in pediatric dentistry. *Quintessence Int.* 1998; 29:697-703. Review

- **Cavity base**

GICs are the ideal dentine replacement materials. Its coefficient of thermal expansion is very close to that of dentine. In addition, the hydrophilic nature of GICs is well suited to bond and adapt to dentine surface⁵.

- **Luting cement**

GICs can also be used as luting agents. They are available as conventional GICs and as resin-modified versions with enhanced physical properties and ease of use²³.

- **Fissure sealant**

In children, GICs offer an alternative to resin sealants and should be considered for use as pit and fissure sealants in situations such as deeply pitted or fissured surfaces which are difficult to isolate, permanent first or second molars that are not fully erupted into the mouth and as a transitional

²³ Gracia-Godoy F, Bugg JL. Clinical Evaluation of glass cementation on stainless steel crown retention. *J Pedod.* 1987;11:339-344

sealant prior to placement of permanent resin sealant⁵. It was also found that both GIC and resin-based sealants exhibited significant caries-preventive effects, with 71% of occlusal decay prevented by a single fissure sealant application⁶.

- **Restoration**

In children, GIC may be used for:

- Class I, Class II, Class III, Class IV in primary teeth
- Class III and Class V in permanent teeth
- Caries control for high caries risk patients, restoration repair, Interim Therapeutic Restoration (ITR)²⁰ and Alternative Restorative Treatment (ART)²⁴.

In adults, GIC may be used for:

- Class V and abrasion cavities

²⁴ Oral Health Policies. Policy on Alternative Restorative Treatment (ART). Reference Manual, Revised 2004;29(7):7-8

with low aesthetic needs, root caries, caries control in high risk patients and as ITR.

All ITR should be reviewed within 6 months or earlier and should be replaced within a year with permanent restorations²⁰.

- **Alternative Restorative Treatment (ART)**

ART²⁴ formerly known as Atraumatic Restorative Treatment has been recognized by the American Academy of Paediatric Dentistry as an acceptable treatment for the management of caries when traditional cavity preparation and/or placement of traditional dental restorations are not possible. GIC is the material of choice for ART because of its bonding to enamel and dentine, fluoride release and ease of use. The success for ART restoration depends on the materials used, training of the operator and the extent of caries. RMGIC has been shown to have a higher success rate than low

viscosity GIC due to increased strength and greater resistance to loss^{25,26}. For high risk individuals, follow up care with topical fluorides and oral hygiene instructions may improve treatment outcomes²⁴.

5.2 Contra Indications for Use of GIC

GIC should not be used to restore proximal cavities (Class II) in permanent molars⁷.

5.3 Handling of GIC

Clinicians should refer to manufacturers' instructions for all GIC products. The use of encapsulated forms of GIC is recommended as it minimizes variations in handling.

²⁵ Mandari GJ, Frencken JE, Van't Hof MA. Six-year success rates of occlusal amalgam and glass-ionomer restorations placed using three minimal intervention approaches. *Caries Res* 2003;37(4):246-253

²⁶ Berg JH. Glass ionomer cements. *Pediatr Dent* 2002;24(5):430-437

As with other restorative materials, good oral hygiene may improve treatment outcomes.

6.0 TRAINING

Hands-on training on handling of various types of GIC should be undertaken.

7.0 CONCLUSION

GICs are viable and feasible for use in both primary and permanent dentitions. However, use of GIC requires understanding of the products and their characteristics. Dental practitioners heed recommendations made based on current literature laid out in this document.

This document is intended as reference for primary oral healthcare providers on the use of GICs as a restorative material. However, it should be read together with other related documents on prevention and control of dental caries. This

document shall be reviewed periodically to keep abreast with the dynamic developments of restorative materials.

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