

## Original Contributions

## Clinical Dentistry

## An end to linings under posterior composites?

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## ABSTRACT

**Background and Overview.** There is an uncertainty among dentists as to whether to place a lining under a direct posterior composite restoration and, if so, what material or combination of materials to use. In this article, the authors consider the evidence for the placement of a lining under posterior composites of different depths, including indications and contraindications for different lining materials.

**Conclusions.** The available evidence does not support the use of linings under direct, bonded posterior composites, unless being placed in deep cavities for therapeutic reasons.

**Practical Implications.** The best available evidence indicates that dentists can place posterior composites without linings, except for therapeutic purposes, with no adverse effect on postoperative complications, with possible improvements in performance in clinical service, and with efficiency savings in chairside time.

**Key Words.** Lining; lining materials; posterior composites.

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Results in the literature indicate increasing use of direct resin-based composites (“composites”) in the restoration of posterior teeth.<sup>1,2</sup> Dental schools in the United States and Canada, as well as elsewhere around the world, are teaching composites as the material of choice for restoring occlusal and occlusoproximal cavities in permanent teeth.<sup>3-7</sup> The trend toward the use of composites is set to continue, given ongoing improvements in the physical and handling characteristics of composites and related adhesive systems and the introduction of faster and easier composite placement techniques and facilitating devices, leading to, among other benefits, enhanced posterior composite longevity. Other drivers include the Minamata Convention phase-down of the use of dental amalgam, as well as moves to preventively oriented, minimal intervention in operative dentistry.<sup>2,7</sup> However, investigators have reported important variations in the teaching of posterior composites, with one of the greatest variations being teaching the use of linings,<sup>1</sup> if any, before posterior composite placement.<sup>3,8,9</sup> The term *liners* in this article includes liners and bases.

Blum and colleagues<sup>10</sup> found many dental practitioners in the United Kingdom to be uncertain as to whether to place a lining under a posterior composite and, if so, what material or combination of materials to use. Their study results demonstrated considerable variation in the selection of the ever-increasing range of lining materials for use in cavities of different depths and in the management of dental pulps of different status and prognosis.<sup>10</sup> This worrying uncertainty and variation in technique is confounded by lack of consistent teaching and messaging in relevant continuing education programs, clinical articles, and advertorial material within and between countries.

Traditionally, dental schools taught that all caries, except possibly for some residual softened, unstained dentin close to the pulp, should be removed before placing a restoration. Investigators in 3 literature reviews have concluded that there is substantial evidence that removing all caries in a symptomless, vital tooth is not required, especially if one is attempting to avoid pulpal exposure.<sup>11-13</sup> Thompson and colleagues<sup>11</sup> stated that once isolated from their source of nutrition by a restoration of sufficient integrity, bacteria in caries either die or remain dormant and therefore pose no risk to the tooth—“the seal’s the deal.”

Traditional caries removal always was followed by the placement of a lining on the floor and, when present, axial walls of the cavity,<sup>13</sup> except in cavities of minimum depth to be restored with

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dental amalgam or glass-ionomer cement (GIC), subsequent to the development of these materials. The placement of a lining was considered necessary for many different reasons, including protection of the pulp against thermal, electric, and chemical insults; promotion of the development of reactionary or reparative dentin; possible remineralization of any remaining softened dentin; and limiting the effects of restoration leakage.<sup>13,14</sup> In addition, a lining of a hard-setting cement was supposed to provide a solid, carefully crafted base against which restorative materials could be packed and condensed as appropriate. The evidence base for much of this traditional dogma is at best limited, with the relevant teaching having been handed down from one generation to the next over a period well in excess of 100 years.

Although some dental schools in the United States, Canada, and other countries around the world advocate the placement of a GIC lining in moderately deep cavities (that is, cavities that extended between one-third and two-thirds into the dentin) and deep cavities (that is, cavities that extended into the inner one-third of the dentin), research tends not to support this approach.<sup>3-5,15</sup> Many recommend the use of GIC as a lining on the misguided understanding that in bonding to dentin GIC also hermetically seals off the floor and, when present, the axial walls of the cavity and that the antibacterial effects of fluoride release are clinically significant throughout the clinical service of the restoration.<sup>16,17</sup> Fluoride ions released from GICs can be found in quantities of about 5 parts per million.<sup>18</sup> This approach is supported by laboratory study results demonstrating that fluoride ions have anticariogenic properties and inhibit secondary caries formation.<sup>19</sup> However, the clinical benefit of fluoride ion release from linings in clinical service remains unclear.<sup>20,21</sup> Furthermore, the time over which fluoride ions continue to be released from GIC linings at levels that can realize the claimed benefits is unknown. The prevalence of postoperative sensitivity after the placement of posterior composites has been reported to be up to 20% greater when the clinician has placed a GIC lining.<sup>10</sup> The key to understanding this conundrum may be the creation of microgaps between the dentin and the lining in the presence of moisture contamination.<sup>22</sup>

In a survey of 500 general dental practitioners investigating the use of linings under posterior composites, most practitioners (83%) always placed a lining before restoring a tooth with composite, except for shallow cavities, despite the inevitable consequence of less than a minimum effective thickness of lining (> 1.0-1.5 millimeters, depending on the material used) being placed in many cavities.<sup>10</sup> Forty-four percent of the practitioners reported using a GIC for this purpose, which was followed in decreasing order by a flowable resin composite (39%), a hard-setting calcium hydroxide liner (38%), and resin-modified glass-ionomer cement (RMGIC) (32%).<sup>10</sup> Eleven percent of respondents reported applying no lining before the placement of posterior composites, irrespective of the depth of the cavity.<sup>10</sup> These findings indicated a broad consensus of placing a lining in deep cavities and leaving shallow cavities unlined. There was, however, wide variation in the use of linings in moderately deep cavities. We concluded, therefore, that the use of linings beneath posterior composites in clinical practice was not evidence based, with a strong indication that the management of operatively exposed dentin in moderately deep cavities is a vexed issue among practitioners.<sup>10</sup>

Flowable composites (“flowables”) are bonded to tooth substrate by using a dental adhesive. However, the polymerization shrinkage and modulus of elasticity of flowables are relatively high, with the risk of bond disruption on polymerization, especially if there is a failure to follow directions for use meticulously. Such disruption may result in poor sealing of the dentin and microgaps, which typically become colonized with bacteria, followed by a buildup of bacterial by-products, causing irritation to the pulp, resulting in sensitivity and possibly carious changes in the dentin substrate.<sup>23</sup> The perceived benefits of flowables helping wet and thereby enhance adaption to adhesively sealed dentin substrates need to be weighed against the possible downsides of such an approach.

von Fraunhofer and colleagues<sup>24</sup> concluded that there is an increase in microleakage, postoperative sensitivity, and potentially secondary caries when a lining is present under a posterior composite. These consequences may be most marked if the lining is a RMGIC. Microgap formation may occur, primarily because the bond strength of RMGIC to dentin is typically less than that of RMGIC to an overlying adhesively bonded composite. Peliz and colleagues<sup>22</sup> postulated that microgap formation results in the movement of dentin tubular fluid, causing postoperative sensitivity. If the seal of the restoration is subsequently lost, bacterial ingress into microgaps may result in pulpal inflammation. Furthermore, failure of adhesion can occur by the formation of cracks between the tooth and the lining. Because the tooth is subjected to stress, these cracks can grow, allow

## ABBREVIATION KEY

- GIC:** Glass-ionomer cement.  
**RMGIC:** resin-modified glass-ionomer cement.

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