REVIEW ARTICLE

Effect of Deep Margin Elevation on Marginal Integrity and Microleakage of Indirect Restorations

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ABSTRACT

Another conservative option has been suggested to replace surgical crown lengthening, Deep Margin Elevation (DME), which is to be used when indirect restorations necessitate subgingival margins. The technology is based on the movement of the cervicular margin towards a more supragingival position with the help of adhesive restorative materials, which would favour impressions-taking, adhesive bonding, and general clinical management. Recent data indicate that DME could maintain periodontal health, increase access to restoration, and enhance the marginal adaptation of the indirect restorations. Nevertheless, its influence on marginal integrity and microleakage is still an area of research, and the differences can be seen based on restorative materials, adhesive guidelines, and margin position. Laboratory and clinical research suggests that although DME is able to attain similar sealing capacity to conventional margins placement, some limitations including the inconsistency of the operator and adhesive system choice should be taken into consideration. This review examines the biological and clinical justification of DME and its impact on marginal integrity and the evidence on microleakage with an emphasis on clinical implications and future research.

Keywords: Deep margin elevation, Marginal integrity, Microleakage, Indirect restorations, Adhesive dentistry.

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INTRODUCTION

The margins of the subgingiva pose a big challenge in the process of the restorative and prosthetic procedure. These are poor visibility, inability to access finishing and polishing, moisture control challenges, and the chances of periodontal irritation. As a part of conventional management, surgical crown lengthening may interfere with esthetics and lead to loss of attachments. Deep Margin Elevation (DME), as a minimally invasive method, has become a method in which the cervical margin is moved coronally with the help of resin-based restorative material.

This approach allows clinicians to perform in the supragingival field, which allows adhesive bonding, impressions, and enhancement of clinical outcome of indirect restorations. Even though DME has a high clinical value, the long-term effects of the product especially in terms of marginal integrity and microleakage are still under critical scrutiny.

Biological and Clinical Rationale

Biological considerations

- *Periodontal health*

Proper execution of DME respects the supracrestal tissue attachment (biological width), minimizing risks of inflammation or periodontal breakdown.

- *Tissue preservation*

Unlike surgical crown lengthening, DME avoids unnecessary bone removal or alteration of gingival architecture, maintaining esthetic harmony in anterior and posterior regions.

Clinical Advantages

- Enhanced accessibility for adhesive protocols and margin finishing.
- Facilitated impression-taking and digital scanning due to supragingival margin relocation.
- Reduced chairside time compared to surgical alternatives.
- Potentially improved long-term survival of indirect restorations.

Marginal Integrity with DME

Mechanisms of marginal sealing

Marginal integrity is achieved through a strong adhesive interface between the restorative composite (used for DME) and tooth structure. Resin composites or bulk-fill materials help relocate the margin coronally, thereby allowing the luting

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cement of the indirect restoration to bond in a more favorable environment.

Influence of Materials

Conventional composites

Provide excellent adaptation when placed incrementally but may be technique-sensitive.

Bulk-fill composites

Allow faster placement with reduced polymerization shrinkage stress.

Resin-modified glass ionomers (RMGIs)

Offer easier handling and fluoride release but generally weaker mechanical properties compared to resin composites.

Evidence from Literature

Several in vitro studies report that indirect restorations placed on elevated margins demonstrate comparable marginal integrity to those placed on natural tooth structures, provided proper adhesive protocols are followed. However, variability exists across studies due to differences in materials, margin depth, and bonding techniques.

Microleakage and Sealing Ability

Definition and clinical importance

Microleakage refers to the passage of bacteria, fluids, and ions along the restoration–tooth interface, potentially leading to postoperative sensitivity, marginal staining, secondary caries, and restoration failure. Evaluating the sealing ability of DME is crucial to determining its long-term clinical success.

Role of Margin Location

Supragingival margins

Generally associated with reduced microleakage due to favorable isolation and accessibility.

Subgingival margins

More prone to leakage because of compromised bonding conditions.

DME relocation

Seeks to convert subgingival to supragingival margins, thereby improving sealing ability.

Evidence from *In-vitro* and *In-vivo* Studies

Research outcomes on microleakage with DME are mixed. Some studies show no significant difference between elevated and non-elevated margins, while others report increased leakage with deeper margins. Differences in adhesive systems, restorative materials, and finishing protocols largely account for these inconsistencies.

Factors Influencing Outcomes

Adhesive protocols and layering techniques

- Etch-and-rinse adhesives provide reliable enamel bonding but are technique-sensitive when dentin margins are involved.
- Self-etch adhesives reduce procedural steps and postoperative sensitivity but may compromise enamel bonding.
- Selective enamel etching has been suggested as a balanced approach in DME cases.
- Incremental layering reduces polymerization stress, while bulk-fill resins simplify the procedure but may result in lower marginal adaptation if not carefully applied.

Type of luting cement

- Resin cements are the preferred choice for indirect restorations over elevated margins due to their superior adhesion and mechanical properties.

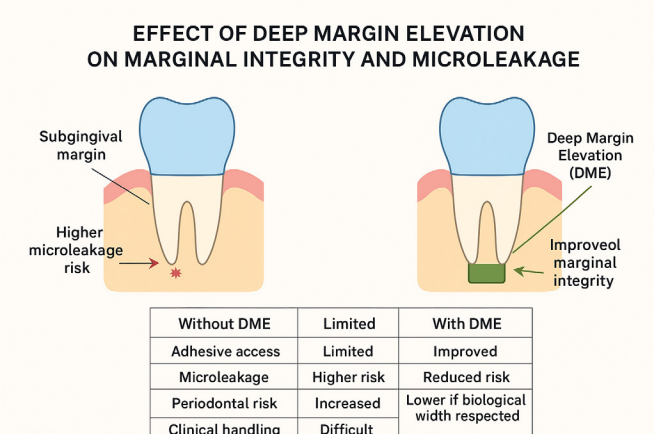

Figure 1

Table 1: Comparison of Microleakage and Sealing Ability with and without DME

Study findings	*Margin location*	*Restorative material used for DME*	*Outcome on microleakage*	*Remarks*
Comparable sealing ability to natural margins	Subgingival relocated to supragingival	Resin composite (incremental)	Minimal leakage	Proper isolation critical
Slightly higher leakage than natural margins	Deep subgingival (>2 mm) relocated	Bulk-fill composite	Moderate leakage	Depth influenced outcome
Higher microleakage observed	Margins close to alveolar crest	RMGI	Increased leakage	Material selection important
No significant difference between groups	Subgingival vs. DME elevated	Resin composite + universal adhesive	Comparable sealing	Operator technique significant

- Self-adhesive resin cements offer ease of use but may exhibit reduced bond strength to dentin compared with adhesive resin cements.
- Glass ionomer-based cements generally demonstrate higher microleakage in DME contexts.

Finishing, polishing, and surface treatments

- Proper finishing and polishing of the elevated margin improve marginal adaptation and reduce biofilm accumulation.
- Surface conditioning (e.g., silanization, air abrasion, universal adhesives) enhances bonding between indirect restoration and restorative interface.

Operator-related variables

- Clinical skill and precision during DME placement are critical.
- Errors in isolation, incremental placement, or adhesive application significantly increase microleakage and reduce marginal quality.

Clinical Performance and Longevity

Evidence from laboratory studies

In-vitro investigations demonstrate that restorations with DME margins show comparable fracture resistance and marginal integrity to restorations bonded directly to natural tooth structures, provided adhesive protocols are followed meticulously.

Clinical studies and long-term observations

- Short- to medium-term clinical trials report satisfactory survival rates of indirect restorations placed with DME.
- Marginal discoloration and staining have been observed but do not necessarily correlate with secondary caries or restoration failure.
- Failures are often linked to adhesive breakdown or improper case selection (e.g., extremely deep margins close to the alveolar crest).

Potential complications

- Secondary caries and microleakage at poorly adapted margins.
- Gingival inflammation when margins are placed too close to or invade the supracrestal tissue attachment.
- Increased risk of debonding in cases with inadequate polymerization or improper cementation.

Future Perspectives

Standardization of research methodologies

- Variability across studies in margin depth, restorative materials, and adhesive protocols complicates interpretation.
- Future research should focus on standardized in vitro designs and long-term randomized clinical trials to clarify outcomes.

Emerging adhesive systems and bioactive materials

- New universal adhesives with improved dentin bonding stability may enhance marginal integrity in DME.
- Bioactive restorative materials (e.g., calcium silicate-based composites, ion-releasing resins) may improve sealing and remineralization at the tooth–restoration interface.

Integration with digital dentistry

- Digital impressions and CAD/CAM workflows benefit significantly from supragingival margins created by DME.
- Future studies may explore the combination of DME with CAD/CAM restorations and novel luting systems for improved precision.

CONCLUSION

Deep Margin Elevation (DME) is a conservative, minimally invasive technique of subgingival margin management of indirect restorative dentistry. DME improves access to clinical protocols, including adhesive protocols, impression-taking, and finishing by positioning cervical margins in a more desirable supragingival position, which in turn achieves clinical efficiency and esthetic results. The available evidence shows that properly applied with proper adhesive guidelines, restorative substances, and careful choice of cases, DME can meet the marginal integrity and microleakage values with those of conventional strategies.

However, changes in material nature, operator technique, and margin depth can provide an impact on clinical outcomes. Although the short to middle term outcomes are encouraging, there is still not much evidence in the long term. New adhesive systems, bioactive restorative materials and digital processes have the potential to streamline DME to an even greater extent, as well as prolong the life of indirect restorations.

DME can be used as an alternative to surgical procedure in subgingival margins in clinical practice, but only in case periodontal considerations are adhered to and adhesive strategy based on evidence is followed.

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