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Deep Margin Elevation in Contemporary Restorative Dentistry: A Narrative Review

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ABSTRACT

Deep subgingival margin is a cause of persistent challenges in restorative dentistry, due to obstructing adhesive methods, compromising periodontal health, and limiting long-term efficacy. Therefore, this narrative review aims to examine Deep Margin Elevation (DME) as a minimally invasive substitute for surgical crown lengthening. The objective is to amalgamate biological and restorative principles, assess material and adhesive methodologies, and pinpoint areas requiring additional investigation. DME is the coronal repositioning of subgingival margin using resin-based restorative materials to enhance visibility, isolation, and marginal adaptability. Recent evidence shows that DME improves fracture resistance, marginal sealing, and periodontal compatibility, while conserving tooth structure and minimizing patient morbidity relative to surgical interventions. The results are affected by operator proficiency, material choice, and procedural discrepancies. The limited availability of randomized trials and the absence of established recommendations continue to pose substantial obstacles. DME presents a promising conservative strategy designed for minimally invasive dentistry. However, the extensive implementation shows a need for substantial proof and agreed-upon guidelines.

Keywords: Adhesive Dentistry, Deep Margin Elevation, Periodontal Health, Subgingival Margin

ABSTRAK

Margin subgingiva yang dalam tetap menjadi tantangan berkelanjutan dalam bidang kedokteran gigi restoratif karena menghambat prosedur adhesif, mengganggu kesehatan periodontal, dan membatasi keberhasilan jangka panjang. Tinjauan ini menelaah *Deep Margin Elevation* (DME) sebagai alternatif minimal invasif terhadap prosedur *surgical crown lengthening*. Tujuan utama adalah mengintegrasikan prinsip biologis dan restoratif, mengevaluasi metodologi material serta adhesif, serta mengidentifikasi area yang memerlukan penelitian lebih lanjut. Tindakan DME merupakan reposisi koronal margin subgingiva menggunakan bahan restoratif berbasis resin, yang meningkatkan visibilitas, isolasi, dan adaptasi marginal. Bukti penelitian terkini menunjukkan bahwa DME mampu meningkatkan resistensi fraktur, adaptasi marginal, serta kompatibilitas periodontal, sekaligus mempertahankan struktur gigi dan meminimalkan morbiditas pasien dibandingkan intervensi bedah. Namun demikian, hasil klinisnya sangat dipengaruhi oleh keterampilan operator, pemilihan material, dan variasi prosedural. Keterbatasan berupa kurangnya uji klinis acak terkontrol serta absennya pedoman standar tetap menjadi hambatan signifikan. Tindakan DME merepresentasikan strategi konservatif yang menjanjikan dan sejalan dengan prinsip restorasi gigi minimal invasif; meskipun demikian, penerapannya secara luas masih memerlukan bukti kuat dan konsensus protokol yang terstandarisasi.

Kata Kunci: Restorasi Gigi Adesif, *Deep Margin Elevation*, Kesehatan Periodontal, Margin *Subgingiva*

1. Introduction

Placing a posterior restoration with subgingival margin is among the most challenging aspects of adhesive and restorative dentistry. The margin often forms during the incident of severe decay, structural fractures, or the replacement of old unfit restorations. In these cases, the preparation often extends below the cemento-enamel junction (CEJ). When addressing the cases, the clinician needs to maintain technical accuracy, as well as balance adaptation of the restoration with the health of the gums and long-term stability of the tooth-restoration interface. Adhesive procedures commonly become complicated by clinical problems such as poor visibility, lack of isolation, and difficulty controlling moisture. Failure to fix the problems can lead to microleakage, marginal discrepancies, and recurring caries [1,2]. The problems show the significance of implementing restorative methods that minimize procedural invasiveness.

Surgical crown lengthening (SCL) and orthodontic extrusion (OE) have historically been regarded as effective methods for addressing deep margins. Both procedures are invasive, often take a long time to heal, and may not produce good results in terms of aesthetics and function. SCL can initiate loss of attachment, poor crown-to-root ratios, and damage to adjacent teeth [3]. Patient acceptance is limited by the associated discomfort, healing demands, and aesthetic concerns. Focus has transitioned to more conservative methods capable of repositioning margin coronally while preserving periodontal integrity [4,5].

The problems associated with subgingival margins are restorative and biological. Restoratively, limited access and inadequate isolation increase the risk of adhesive failure, inaccuracies in impression making, and compromised marginal adaptation [6]. Biologically, damage to periodontal attachment apparatus, specifically the biological width, predisposes patients to chronic inflammation, gingival recession, and bone loss [7]. Inadequate management of these conditions tends to increase probing depths, signifying compromise of periodontal supporting structures [8]. The described challenges suggest the growing demand for biologically driven methods that ensure predictable restorative outcomes while preserving periodontal integrity.

Deep Margin Elevation (DME)—described as cervical margin relocation or proximal box elevation—is currently considered a minimally invasive option. In principle, DME includes using a resin composite to relocate subgingival margin coronally, ensuring transformation into a more accessible supragingival or equigingival level (Figure 1) [9]. The method promotes easy use of adhesives, makes impressions more accurate, and protects periodontal attachment apparatus. Current evidence shows that DME reduces microleakage, improves marginal sealing, and lowers the risk of recurrent caries, enhancing the long-term efficacy of indirect adhesive restorations [10,11]. This method significantly allows clinicians to maintain healthy tooth structure and avoid invasive surgical procedures, even in complex clinical situations [12,13].

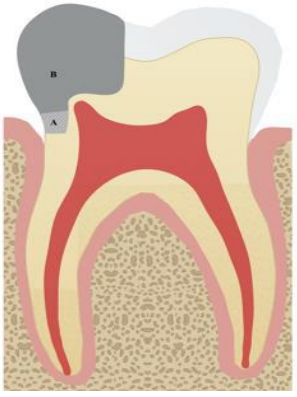

Figure 1. DME concept. (A) A sub-gingival composite layer. (B) Final restoration (Aldakheel et al., 2022)

The biological justification for DME is the consideration of periodontal apparatus, particularly the biological width. This area, which includes the junctional epithelium and connective tissue attachment, is very important for stabilizing periodontium. DME should preserve a minimum of 2.0–3.0 mm of supercrestal tissue attachment between the restorative margin and alveolar bone to prevent inflammation, attachment loss, and bone resorption [1,7]. This prevents violation into this critical area by positioning the margin coronally, which helps to keep both the gingiva stable and periodontium intact. Clinical studies consistently show favorable outcomes when DME is conducted under appropriate isolation and with meticulous finishing [4,14].

Adhesive dentistry development has been very important due to facilitating easier DME usage among many people. This method is currently more reliable because composite resins have become better, with stronger bonds, less polymerization shrinkage, and better mechanical properties [15,16]. The improvements enable clinicians to provide durable seals around repositioned margin, thereby reducing bacterial infiltration, which is crucial for the longevity of restorative procedures [2,17]. In this context, DME fits into the larger idea of minimally invasive dentistry, which focuses on keeping teeth healthy, protecting biological health, and improving the comfort of patients [18,19].

An increasing number of laboratory and clinical studies enhance the reliability of DME. Restorations executed using this method have shown similar fracture resistance, fatigue performance, and marginal adaptation to restorations without margin relocation [20,21]. Long-term follow-ups verify higher survival rates of indirect restorations implemented with DME and identify negligible adverse periodontal effects when appropriate protocols are adhered to [5]. Moreover, the method maintains aesthetic harmony and functional performance, forming a better option for patients than surgery [4]. Concerns persist regarding the potential for deeper probing during excessive margin elevation near the alveolar crest [8].

The results are promising but there are still some important knowledge gaps. A significant portion of the evidence originates from in vitro studies or observational designs, while randomized controlled trials remain scarce. Protocols for material selection, adhesive strategies, and layering methods have not been standardized, and results continue to be significantly influenced by the expertise of the operator, isolation methods, and material selection [4,5]. In areas such as Southeast Asia, where there are several deep caries and insufficient CAD/CAM systems, DME may be a better option.

This article differs from previous reviews by combining biological, adhesive, and restorative aspects into a single framework and examining how the ideas might affect minimally invasive practice in areas with few resources. The objectives are to (i) integrate the existing biological and restorative principles related to DME, (ii) rigorously assess materials, adhesive protocols, and clinical outcomes, and (iii) pinpoint deficiencies in the literature while providing suggestions for future investigations.

2. Methodology

A thorough literature search was performed using PubMed, Scopus, and Google Scholar up to August 2025. Furthermore, keywords consisted of “deep margin elevation,” “adhesive dentistry,” “subgingival margins,” and “periodontal health.” Studies published in English that addressed biological, restorative, or clinical aspects of DME were included in the selection. Case reports, letters, and non-peer-reviewed materials were excluded. Articles were selected based on relevance and methodological quality to provide a comprehensive narrative synthesis.

3. Discussion

3.1. Mechanical Performance and Marginal Integrity

This review examined the mechanical reliability of DME, particularly in relation to fracture resistance and marginal integrity. Ceramic onlays positioned after margin elevation have repeatedly shown resistance to catastrophic fracture comparable, and in some cases superior, to restorations without DME. People commonly believe that this condition occurs because elevation of the margin spreads stress more evenly, reducing the tendency of the structure to fail under functional load [22,23]. Additionally, moving the margin to a more coronal position often enhance accurate finishing. This improves sealing and lowers the risk of microleakage or bacterial penetration [24,25]. The results suggest that while DME appears mechanically reliable, most data are limited to laboratory studies, requiring further validation for the usage in long-term clinical resilience.

3.2. Restorative Materials and the Influence

The type of restorative material used is a key factor in the performance of DME. For example, flowable composites are often preferred due to being easily shaped. The low viscosity allows the flowable composites to fit closely to cavity walls, forming a tight seal and reducing gaps [26]. This benefit comes with a drawback because of less filler content, inability to handle occlusal forces as well as packable composites, leading to reduced usefulness in high-stress areas. Meanwhile, packable composites are more durable over time due to more filler content and may not shrink or break under pressure [27]. Resin-modified glass ionomers (RMGIs) have been suggested, specifically when managing moisture is challenging. RMGIs

chemically bond to dentin and cementum and show superior tolerance to wet conditions compared to resin composites [28,29]. In clinical practice, restorative material selection should be predicated on a thorough evaluation of adaptability, durability, and biological compatibility. There exists no singular solution, and the choice needs to be consistent with the biomechanical requirements of each case.

3.3. Longevity and Survival Outcomes

The strongest argument in favor of DME tends to come from survival studies of indirect restorations. Long-term data show that restorations with margin elevation work optimally. For instance, Samartzi et al. (2022) found that nearly 96% of people lived for 12 years, which is very encouraging [14]. Restorations mostly fail because of recurring caries and not catastrophic restoration failure. This suggests that the problem is with maintenance and preventive care, not the method used [30]. The unverified results support the view that DME does not compromise restorative longevity and may extend service life when executed with precision.

3.4. Periodontal Consideration

A common concern about DME is how the method is capable of affecting periodontium. Subgingival restorations are often very close to the biological width, making this area highly sensitive for clinical work. Fortunately, clinical evidence suggests that DME has minimal to no adverse effects on periodontal tissues when executed properly. Hausdörfer et al. (2024) conducted a prospective trial that found no significant differences in inflammation indices between DME and surgical crown lengthening. The observation signifies that elevated margins are biologically well tolerated [31]. This is pertinent compared to SCL, which frequently includes considerable surgical intervention, extended recovery periods, and increased morbidity [4,32]. Therefore, the conservative method of DME incorporates the contemporary philosophy of biologically respectful restorative dentistry, which emphasizes periodontal preservation in conjunction with restorative effectiveness.

3.5. Strategies for Adhesives and Clinical Guidelines

The success of DME depends on the applied adhesive strategy, such as immediate dentin sealing (IDS) that works efficiently. IDS protects newly exposed dentin, lowers the chance of contamination, and improves bonding in the long run [33]. Layering methods are crucial, as the application of composites in small amounts helps spread out polymerization stresses, which lowers the chance of gaps at the edges [9,34]. The use of well-fitting matrix systems is essential, particularly in subgingival areas, due to ensuring correct contour and contact points as well as stopping restorative overhangs. These technical details show that DME is easy to understand, but following the rules strictly is necessary for reliable results. In general, protocols appear to work, and clinical outcomes depend significantly on the operator, suggesting the importance of standard guidelines.

3.6. Risks and Limits

DME has many advantages and a few number of risks. For example, raising margins extremely close to the alveolar crest can shrink the biological width, leading to inflammation, gingival recession, or loss of attachment [9]. The method is very sensitive to isolation, as small mistakes in moisture control tends to weaken the adhesive interface, increasing the potential of decay or restoration failure [35]. These limitations serve as a reminder that DME is not a universal solution. The efficacy depends on the operator's clinical proficiency, meticulousness, and the case selection methodology.

3.7. Knowledge Gaps and Study Priorities

Important knowledge gaps still remain despite the availability of the promising data. A large proportion of the literature consists of in-vitro work or observational reports, while randomized controlled trials are still scarce. There is limited consensus on standardized protocols for material choice, adhesive systems, or layering strategies, which contributes to variability in reported outcomes [36]. Subsequent investigations need to emphasize the formulation of rigorously controlled clinical trials that directly juxtapose protocols and materials, alongside longitudinal studies concentrating on periodontal health and the preservation of biological width. Filling these gaps is essential to ensure that clinicians can use the guidelines with confidence in daily activities.

The evidence shows that DME provides a prudent yet efficacious method for subgingival margin management. DME combines mechanical reliability with biological compatibility considering that the

operator knows how to use periodontal anatomy and follows strict adhesive protocols. Although the procedure is still sensitive to method implementation and can be dangerous when executed wrongly, the general data suggest DME as a better option for patients than surgery. The next step is to ensure consistency of the protocols and gather the high-quality clinical data needed to make DME a common strategy in restorative dentistry.

4. Conclusion

In conclusion, this review suggests DME as a biologically respectful and minimally invasive method for managing subgingival margin in restorative dentistry. The evidence synthesized shows that DME provides reliable outcomes in terms of fracture resistance, marginal integrity, periodontal health preservation, and long-term restoration survival. Compared to conventional surgical methods such as crown lengthening or orthodontic extrusion, DME allows clinicians to preserve tooth structure and periodontal stability while achieving functional and aesthetic success. DME corresponds with the ideas behind minimally invasive dentistry and is a useful solution in both advanced and resource-limited clinical settings.

The results show that restorations with DME have similar or better mechanical performance than those without margin relocation, and often provide very few negative effects on the gums when the right steps are taken, but this review identifies significant knowledge gaps. Present evidence is predominantly reliant on in-vitro studies, with a scarcity of high-quality randomized clinical trials to inform standardized protocols. Additionally, patient-centered outcomes and regional practice considerations are still not properly understood. More investigations need to concentrate on extended clinical trials, the standardization of protocols, and studies incorporating patient-reported experiences. By filling in these gaps, clinical use of DME may become stronger, ensuring the method remains reliable and biologically sound to restore health.

5. Author Contributions

The authors contributed to every aspect as well as have reviewed and consented to the published version of this article.

6. Conflict of Interest

The authors declare no conflict of interest.

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