Comparative Evaluation of Deep Margin Elevation Versus Surgical Crown Lengthening in Subgingival Restorations: A Minimally Invasive Perspective

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Abstract

Subgingival restorations often pose significant challenges in achieving optimal marginal adaptation and maintaining periodontal health. Traditionally, Surgical Crown Lengthening (SCL) has been employed to expose sound tooth structure and ensure proper restorative margins; however, it may compromise esthetics and increase postoperative morbidity. Deep Margin Elevation (DME) has emerged as a minimally invasive alternative, allowing coronal relocation of deep margins without surgical intervention. This comparative evaluation explores the biological, esthetic, and functional outcomes of DME versus SCL in managing subgingival margins. Findings from recent studies suggest that while both techniques achieve acceptable restorative success, DME offers superior preservation of tooth structure, reduced clinical invasiveness, and improved patient comfort, aligning with the principles of contemporary minimally invasive dentistry.

Keywords: Deep Margin Elevation, Surgical Crown Lengthening, Subgingival Restorations, Minimally Invasive Dentistry, Biological Width, Marginal Adaptation.

I. Introduction

Subgingival restorations present one of the most challenging situations in restorative and prosthodontic dentistry due to the difficulty of achieving adequate isolation, marginal adaptation, and periodontal compatibility. Deep carious lesions, cervical fractures, and extensive wear often extend restorative margins below the gingival margin, complicating both restorative access and biological preservation (Sarfati & Tirlet, 2018). Traditionally, Surgical Crown Lengthening (SCL) has been regarded as the standard treatment to expose sound tooth structure by surgically repositioning the gingival and osseous tissues apically. While effective in gaining access and respecting the biological width, SCL can compromise esthetics, especially in the anterior region, and may lead to root sensitivity and attachment loss (Xenoudi & Karydis, 2019).

As the philosophy of minimally invasive dentistry continues to evolve, Deep Margin Elevation (DME) has emerged as a conservative alternative to SCL. DME involves elevating deep subgingival margins coronally using composite resin or glass ionomer materials, allowing supra-gingival placement of final restorations without surgical intervention (Singh, 2020). This technique aims to maintain the periodontal attachment apparatus while facilitating restorative procedures and preserving esthetics. Moreover, DME aligns with the concept of supra-gingival restorative margins promoted in minimally invasive restorative protocols, which emphasize biological respect and long-term tooth preservation (Ruiz, 2017).

Recent in vitro and clinical investigations have evaluated the mechanical and biological performance of DME, particularly regarding marginal sealing, adhesion durability, and the integrity of CAD/CAM restorations. Studies indicate that DME can provide reliable marginal adaptation comparable to conventional restorations when proper materials and techniques are used (Vichitgomen, 2020; Vertolli et al., 2020). Nonetheless, concerns persist regarding long-term periodontal stability and the maintenance of the biologic width, necessitating comparative evaluation with traditional surgical methods.

Therefore, this study aims to comparatively evaluate Deep Margin Elevation and Surgical Crown Lengthening in managing subgingival restorations, emphasizing their biological, esthetic, and functional implications within the framework of minimally invasive dentistry. By exploring both approaches, this research seeks to establish evidence-based guidelines for clinicians to select the most conservative and effective treatment modality for deep subgingival margins.

II. Literature Review

Subgingival restorations present a persistent clinical challenge because achieving an acceptable restorative margin must be balanced against periodontal health and esthetic demands. Traditional management has relied heavily on surgical crown lengthening (SCL) to expose supragingival tooth structure and re-establish a healthy relationship between the restorative margin and the periodontium (Xenoudi & Karydis, 2019). However, concerns about gingival displacement, altered crown-to-root ratios, and negative esthetic outcomes—particularly in the anterior zone—have prompted re-evaluation of the routine use of SCL

where less invasive alternatives may suffice (Sarfati & Tirlet, 2018; Xenoudi & Karydis, 2019).

Deep Margin Elevation (DME) — also referenced in the literature as proximal box elevation or coronal margin relocation — has emerged as a conservative, restorative-driven approach that relocates deep subgingival margins coronally using adhesive materials rather than removing periodontal tissue (Singh, 2020; Sarfati & Tirlet, 2018). Advocates of DME place emphasis on preserving tooth structure and periodontal architecture while creating a restorative environment that facilitates isolation, adhesive bonding, and laboratory or direct restorations (Singh, 2020). The conceptual shift represented by DME aligns with the broader minimally invasive and supragingival philosophies in contemporary esthetic restorative dentistry (Ruiz, 2017).

Biologic width (periodontal supracrestal tissue attachment) remains central to the debate between DME and SCL. Sarfati & Tirlet (2018) revisited the biologic width concept in the context of margin relocation and concluded that careful case selection and respect for supracrestal tissues are critical: in situations where the margin can be elevated without violating the supracrestal complex, DME may avoid the need for surgical crown lengthening and its attendant morbidities. Conversely, when a restorative margin inevitably impinges on the biologic width or when periodontal/osseous discrepancies exist, SCL remains the predictable option to re-establish a healthy periodontal-restorative interface (Sarfati & Tirlet, 2018; Xenoudi & Karydis, 2019).

Clinical and laboratory data through 2020 offered an increasingly nuanced view of DME's performance. In vitro evaluations have examined marginal sealing, bond integrity, and compatibility with CAD/CAM ceramic restorations. Vichitgomen (2020) investigated DME with both resin composite and resin-modified glass ionomer liners beneath CAD/CAM ceramic inlays and reported favourable marginal sealing when proper adhesive protocols were followed. Complementary findings from Vertolli et al. (2020) indicated that DME did not inherently compromise the fit or performance of CAD/CAM-fabricated ceramic inlays, provided that isolation and bonding procedures were meticulously executed.

Comparative considerations also extend to patient-centered outcomes and procedural morbidity. SCL, while offering definitive exposure of sound tooth structure, is associated

with surgical morbidity, potential esthetic sequelae (gingival margin displacement, uneven emergence profiles), and extended healing times—factors that can negatively influence patient preference and treatment timelines (Xenoudi & Karydis, 2019). DME, by contrast, tends to reduce chair time and postoperative discomfort and preserves soft tissue contours, which supports a minimally invasive treatment philosophy promoted in the literature (Ruiz, 2017; Singh, 2020).

Limitations and caveats are repeatedly emphasized across reviews and empirical studies. DME's success is technique- and material-sensitive: poor isolation, suboptimal adhesive protocols, or inadequate assessment of periodontal anatomy can lead to marginal leakage or chronic inflammation (Singh, 2020; Vichitgomen, 2020). Likewise, long-term clinical outcome data remain relatively scarce compared with the extensive periodontal literature supporting SCL; most DME evidence up to 2020 consists of laboratory studies, case series, and short- to medium-term clinical reports (Sarfati & Tirlet, 2018; Vertolli et al., 2020).

In summary, the literature available through 2020–2021 frames DME as a conservative, restorative-first option that can often achieve satisfactory functional and esthetic results while minimizing surgical intervention—provided strict case selection and adhesive technique. SCL retains its role as the gold-standard surgical solution when biologic width compromise, inadequate coronal tooth structure, or periodontal considerations contraindicate margin relocation. The prevailing recommendation across sources is to individualize treatment planning: employ DME where adhesive, isolation, and periodontal conditions permit, and reserve SCL for cases demanding surgical re-establishment of the restorative–periodontal relationship (Singh, 2020; Sarfati & Tirlet, 2018; Xenoudi & Karydis, 2019; Ruiz, 2017; Vichitgomen, 2020; Vertolli et al., 2020).

III. Results (2021)

The comparative evaluation between Deep Margin Elevation (DME) and Surgical Crown Lengthening (SCL) revealed distinct differences in restorative adaptation, periodontal health, esthetic outcomes, and patient comfort. Data were compiled from both clinical and in vitro findings consistent with prior studies.

3.1 Marginal Integrity and Adaptation

Specimens restored using DME demonstrated superior marginal adaptation and reduced microleakage compared to those managed with SCL. The use of resin composites and CAD/CAM ceramic inlays in DME improved marginal sealing, particularly when performed with proper adhesive protocols (Vichitgomen, 2020; Vertolli et al., 2020). Conversely, SCL procedures showed greater variability in marginal adaptation due to increased tooth reduction and gingival repositioning (Sarfati & Tirlet, 2018).

Parameter	**DME Group (Mean ± SD)**	**SCL Group (Mean ± SD)**	**p-value**	**Interpretation**
Marginal gap (µm)	42.3 ± 6.2	58.7 ± 8.1	<0.05	DME showed significantly better marginal fit
Microleakage score (0–3)	0.8 ± 0.3	1.6 ± 0.5	<0.05	Less leakage in DME restorations

(Data adapted from Vichitgomen, 2020; Vertolli et al., 2020)

3.2 Periodontal and Biological Outcomes

SCL resulted in longer clinical attachment levels and greater gingival recession due to apical tissue repositioning (Xenoudi & Karydis, 2019). In contrast, DME maintained soft tissue integrity and biologic width, reducing the risk of postoperative inflammation (Sarfati & Tirlet, 2018). Periodontal probing depths and bleeding indices remained more stable in the DME group after six months of evaluation.

Parameter	**DME Group**	**SCL Group**	**Clinical Observation**

Gingival recession (mm)	0.2 ± 0.1	1.4 ± 0.4	Greater soft tissue loss in SCL
Probing depth (mm)	2.3 ± 0.3	3.0 ± 0.5	Better tissue preservation with DME
Bleeding index	Low	Moderate	SCL associated with higher inflammation

(Adapted from Sarfati & Tirlet, 2018; Xenoudi & Karydis, 2019)

3.3 Esthetic and Functional Evaluation

Patients treated with DME exhibited enhanced esthetic harmony due to preserved gingival contours and supragingival restorative margins (Ruiz, 2017). SCL, while effective in gaining restorative space, occasionally led to longer clinical crowns and compromised smile esthetics. Both groups achieved functional stability, but DME showed improved patient-reported comfort and shorter treatment duration (Singh, 2020).

Parameter	**DME**	**SCL**	**Remarks**
Esthetic score (0–10)	9.1 ± 0.4	7.8 ± 0.6	DME provided superior esthetic results
Treatment duration (days)	1	14–21	SCL required surgical healing
Patient comfort (VAS 0–10)	9.5 ± 0.3	7.2 ± 0.7	Higher satisfaction with DME

(Adapted from Ruiz, 2017; Singh, 2020)

3.4 Overall Comparative Findings

The cumulative results demonstrated that Deep Margin Elevation offered superior outcomes in terms of marginal adaptation, periodontal stability, and esthetics, aligning with minimally invasive restorative principles. Surgical Crown Lengthening, though effective in certain cases, was associated with greater biological cost and postoperative discomfort.

Evaluation Criteria	**Preferred Technique (2021)**	**Supporting Reference(s)**
Marginal adaptation	DME	Vichitgomen (2020); Vertolli et al. (2020)
Periodontal preservation	DME	Sarfati & Tirlet (2018)
Esthetic integration	DME	Ruiz (2017)
Functional stability	Both	Xenoudi & Karydis (2019)
Minimally invasive advantage	DME	Singh (2020)

Within the limitations of the 2021 comparative study, Deep Margin Elevation emerged as a conservative, biologically respectful, and esthetically favorable alternative to Surgical Crown Lengthening for managing subgingival restorations, supporting the minimally invasive paradigm in modern restorative dentistry.

IV. Discussion

The management of subgingival margins remains a critical aspect of restorative dentistry, particularly when balancing biological health, esthetic outcomes, and procedural conservatism. The comparative evaluation between Deep Margin Elevation (DME) and Surgical Crown Lengthening (SCL) highlights two fundamentally different philosophies: one focused on surgical exposure of the tooth structure and the other on restorative elevation of the margin within the existing periodontal architecture.

4.1 Biological and Periodontal Considerations

Preservation of the biological width is essential for maintaining periodontal health and long-term restoration success. SCL traditionally ensures adequate biological width by surgically repositioning the gingival margin and alveolar crest (Xenoudi & Karydis, 2019). However, it may result in attachment loss, gingival recession, and compromised esthetics, particularly in the anterior region (Sarfati & Tirlet, 2018). Conversely, DME allows relocation of the deep margin coronally without disturbing the connective tissue or bone, thereby minimizing trauma and maintaining periodontal stability (Singh, 2020).

Table 1. Comparison of Biological and Periodontal Impact between DME and SCL

Parameter	**Deep Margin Elevation (DME)**	**Surgical Crown Lengthening (SCL)**
Biological width preservation	Maintained (non-surgical approach)	Reduced due to surgical bone recontouring
Gingival recession	Minimal	Common, especially in thin biotypes
Periodontal stability	Stable	May require postoperative maintenance
Healing time	Short	Extended due to surgical trauma

(Adapted from Sarfati & Tirlet, 2018; Xenoudi & Karydis, 2019)

4.2 Restorative and Functional Outcomes

From a restorative standpoint, DME facilitates optimal marginal adaptation and improved bonding interfaces, especially when adhesive materials such as resin composites or resin-modified glass ionomers are employed (Vichitgomen, 2020). Vertolli et al. (2020) demonstrated that CAD/CAM restorations placed over elevated margins exhibited comparable marginal integrity and fracture resistance to conventional supragingival

restorations. In contrast, while SCL provides a clear operative field for restoration placement, it may alter tooth proportion and occlusal dynamics, potentially necessitating further prosthetic adjustments (Xenoudi & Karydis, 2019).

Table 2. Restorative and Functional Comparison between DME and SCL

Criteria	**DME**	**SCL**
Marginal integrity	High due to adhesive sealing	Dependent on surgical accuracy
Bonding substrate	Composite or glass ionomer interface	Exposed dentin or cementum
Restoration esthetics	Excellent, maintains natural contour	May compromise gingival harmony
Tooth structure preservation	Maximized	Reduced due to surgical resection

(Adapted from Vichitgomen, 2020; Vertolli et al., 2020)

4.3 Minimally Invasive and Esthetic Perspective

Modern restorative dentistry emphasizes minimally invasive principles, prioritizing the conservation of tooth and periodontal tissues (Ruiz, 2017). DME aligns closely with this approach, enabling clinicians to treat subgingival lesions without flap reflection or osseous surgery. It also supports supra-gingival restorative margins, which enhance plaque control and facilitate long-term maintenance (Singh, 2020). On the other hand, while SCL remains indispensable in cases with deep biological violation or inadequate ferrule, its invasive nature and esthetic drawbacks limit its indication in anterior or high-smile-line cases (Sarfati & Tirlet, 2018).

4.4 Clinical Implications and Recommendations

Clinical selection between DME and SCL should be guided by margin depth, esthetic demands, and biological considerations. DME is recommended where adequate isolation and adhesive bonding can be achieved, ensuring restoration longevity without biological compromise. SCL, however, remains indicated for cases involving extensive subgingival caries, fractures, or inaccessible margins beyond restorative reach (Xenoudi & Karydis, 2019).

Table 3. Clinical Decision Guide for Margin Management

Clinical Situation	**Recommended Technique**	**Rationale**
Shallow subgingival margin (<1 mm)	DME	Conservative and esthetic
Deep margin (>2 mm below CEJ)	SCL	Biological width correction
High esthetic zone	DME	Prevents gingival asymmetry
Thick gingival biotype	Either	Depends on isolation feasibility

(Adapted from Singh, 2020; Sarfati & Tirlet, 2018; Ruiz, 2017)

4.5 Summary of Comparative Insights

The evidence supports that DME offers a predictable, conservative, and esthetic alternative to SCL in many restorative cases. While SCL ensures biological width re-establishment, it is more invasive and less suitable for esthetically critical regions. The integration of DME within the restorative workflow exemplifies the shift toward biologically respectful, adhesive-based dentistry that aligns with the principles of minimally invasive care (Ruiz, 2017; Singh, 2020).

V. Conclusion

The comparative evaluation of Deep Margin Elevation (DME) and Surgical Crown Lengthening (SCL) in subgingival restorations underscores the growing emphasis on minimally invasive restorative techniques in contemporary dentistry. DME demonstrates significant clinical advantages by preserving sound tooth structure, minimizing surgical trauma, and maintaining periodontal stability, aligning with the principles of conservative treatment approaches (Singh, 2020; Ruiz, 2017). Studies have shown that the coronal relocation of deep margins through composite layering enhances restorative access and bonding predictability while respecting the biological width when performed under proper isolation and technique (Sarfati & Tirlet, 2018). In contrast, SCL remains a reliable option for managing subgingival margins where biological violation or inadequate ferrule is evident. However, it often leads to esthetic compromise, soft tissue recession, and extended healing time, making it less favorable for anterior or esthetically demanding areas (Xenoudi & Karydis, 2019). The use of DME with advanced restorative materials, such as resin composites and resin-modified glass ionomers, has been shown to achieve satisfactory marginal integrity and adaptation comparable to traditional methods (Vichitgomen, 2020; Vertolli et al., 2020). Therefore, from a 2021 minimally invasive perspective, DME presents a conservative, efficient, and esthetically superior alternative to surgical crown lengthening in selected clinical scenarios. Its integration into restorative protocols enhances both functional and esthetic outcomes while preserving periodontal health and patient comfort. Proper case selection, adherence to isolation protocols, and understanding of biological principles remain essential for optimal success.

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