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Coronally Moving Sub-Gingival Margins: An Approach for Better Restorations- A Narrative Review

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Abstract: Deep proximal carious lesions with subgingival margins present a significant restorative challenge due to compromised isolation, difficulty in achieving marginal integrity, and risk of supra-crestal attachment violation. These techniques have emerged as a conservative substitute of invasive surgeries by relocating the deep sub-gingival margins to a supragingival position with the help of adhesive restorative materials. Current evidence suggests that, when appropriately indicated and executed, DME facilitates improved marginal adaptation, preservation of periodontal health, and successful restoration of teeth with deep subgingival margins. This represents a minimally invasive and clinically effective approach in contemporary restorative dentistry.

Keywords: *Composite; Sub-Gingiva;Deep Margin;Crown Lengthening.*

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I. INTRODUCTION

Management of deep interproximal carious lesions had always been a challenge in day-to-day clinical practice since many years. The loss of the interproximal walls further complicates this restorative approach as it results in creation of very large compound cavities that may have a mesio-distal extension as well [1]. Extensive proximal carious lesions with deep subgingival margins are very usual in clinical practice and dental practitioners are often challenged with this restorative predicament.

This coronal movement of deep sub-gingival margin is also referred to as Deep margin elevation (DME), coronal margin relocation (CMR), proximal box elevation, cervical margin relocation and open sandwich technique. First formulated by Dietschi and Spreafico in 1998, it is a technique that is used to elevate or reposition or relocate sub gingival margins into supra gingival position using several materials so as to increase the marginal integrity as well as resulting in enhanced bond strength [2]. It was later on modified by Magne and Spreafico in 2012 who had further detailed the protocol and did an extensive study to investigate the consequences of elevation of the deep sub-gingival margins on the indirect restorations. Today, modern clinical dentistry is directed towards conservative approach, as a outcome of which the minimally invasive procedure of deep margin elevation can act as a substitute to the invasive procedures of crown lengthening. The approach via surgical means might be accompanied by anatomic complications which includes proximities to the root concavities, furcation involvement, loss of clinical attachment and healing parameters as well [3].

Hence deep margin elevation had been an important approach to restore those deep sub-gingival cavities without encroaching the periodontal health of the patients. This article aims to provide a narrative explanation regarding the existing literature on deep margin elevation, the classification, merits and demerits, the methodology, the material aspect, its relation to biologic width and the alternative treatment modalities available.

II. INDICATIONS AND LIMITATIONS OF DEEP MARGIN ELEVATION

➢ *Indications of Deep Margin Elevation Technique*

- Sub-gingival cavity margin should be at least 2mm above crest of alveolar bone.
- Should not require any additional ferrule effect for direct and indirect restorations [6]

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➢ *Three Crucial Criteria for Deep Margin Elevation Technique*

- Availability of proper isolation
- Near to perfect sealing of the sub-gingival margin at the cervical level
- Non encroachment of connective tissue component of biologic width [6].

➢ *Limitations of Deep Margin Elevation*

- Distance greater than 2mm is required to perform DME.
- Difficulty in achieving anatomical proximal profile.
- Circular matrices increases the likelihood of capillary formation leading to dissolution of the marginal seal .
- Precision-intensive technique [6].

III. CLASSIFICATION OF DEEP MARGIN ELEVATION

The study by Venuti P et al., in his study, had proposed a classification for deep margin elevation which included- [7].

➢ Class 1: Soft tissue retraction through rubber dam, cord and Teflon
➢ Class 2: Soft tissue ablation through blade, diode laser, electrosurgery and soft tissue bur
➢ Class 3: Bone and soft tissue ablation through surgical crown lengthening
➢ Class 4: Dental tissue elevation through orthodontic extrusion, the surgical extrusion technique and the partial exodontic technique.

According to the classification by Venuti P et al., only class 1 involved the non-invasive method of margin repositioning. The rest three were done by invasive means. Surgical extrusion is considered to be a last treatment resort because of its invasiveness that comes with the chances of pdl damage and the need for endodontic therapy in permanent teeth. Although, the orthodontic forced extrusion can preserve pulp, but the treatment is time-taking and often demands fiberotomy on a weekly basis [8].

➢ *Another Classification System was Proposed by Ghezzi C et al. [9], had Segregated this Procedure into Three Types:*

- Class 1: Nonsurgical CMR
- Class 2a: Surgical CMR via gingival approach
- Class 2b: Surgical CMR via osseous approach

IV. MATERIALS USED FOR CORONAL MOVEMENT OF SUB-GINGIVAL MARGINS

Cavities that extend into the sub-gingival area with cervical margins extending below the cemento-enamel junctions (CEJ) create significant technical and operative problems including total or partial loss of cervical margin seal in the absence of enamel, improper isolation due to seepage of saliva, blood, gingival crevicular fluid in that area. This in turn ultimately leads to decreased bond strength, micro-leakage and ultimate failure of restoration. It also causes problem in impression taking in case of indirect restorations. Hence to overcome this problem, the gingival margin area must be accessible and so as to make it accessible, it has to be raised into supra-gingival position with the help of certain dental materials [10]. The current adhesive technology and modern resin composite materials have proven to be a boon for the restoration of severely damaged teeth with deep margins [11].

➢ *Hence the Different Materials that Can be Used for the Process of Deep Margin Elevation are:*

- Conventional composites
- Flowable composites
- Bulk fill composites
- GIC
- RMGICs

➢ *Conventional Composites*

It has been studied that incremental placement of composite resin material in a thickness of 1mm creates lesser void as compared to a single large increment of 3 mm thickness owing to the reason of polymerization shrinkage, which ultimately leads to debonding followed by interfacial gaps formation.[10]. This includes both bulk fill composites and packable composites.

➢ *Flowable Composites*

They have inferior mechanical properties as compared to conventional composite material. So, it is preferred that flowable composites, if possible, should not be used for moving the margin coronally as they are more susceptible to degeneration when subjected to thermocycling, especially when used in layers of 2mm thickness. Also, Zavattini et al. found in his studies that flowable composite material had caused greatest micro-leakages [10]. But due to their less viscous formulation they can be used in areas where conventional composites cannot be packed easily.

➢ *Bulk Fill Composites*

According to various studies bulk-fill composites are one of the best preferable dental materials for carrying out deep margin elevation because of the low technique sensitivity because it is easier to seat the material, has got enhanced consistency and low instrument pushback. They have favourable depth of cure with increment thickness of 4-5mm due to the changed and amplified initiator methods, polymerization stimulators, newer resins, and special fillers. Zhang et al. also observed that DME with bulk-fill composites had resulted in higher fracture resistance as compared to the ones done using conventional and also concluded that these bulk-fill composites had a tendency to bond directly with the tooth substrate including dentin [10].

➢ *Glass Ionomer Cement& Resin Modified GIC (RMGIC)*

GIC and RMGIC have less favorable properties and mechanical characteristics as compared to composite resins, which include higher solubility rate, less polishable surface, and inadequate bond strength to tooth substrate. Additionally, a previous study demonstrated that margins raised using composite and the teeth in which DME was not performed

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had resulted in lesser microleakage than those elevated with RMGIC [10]. However still, it can be used as an alternative to composite resins.

V. TECHNIQUE OF DEEP MARGIN ELEVATION

- The first step of restoring deep proximal cavities is careful assessment of extent of the carious lesion or the limit of the crack, its closeness to the pulpal tissue and the level of bone crest from that area. This can be evaluated with help of periodontal probes and periapical radiographs.
- Once the rubber dam isolation is achieved and the carious lesion is excavated with the help of high-speed handpiece and spoon excavators, circumferential stainless-steel matrix (usually Tofflemire matrix) is placed encompassing the tooth in such a manner that it seals the cervical margin impeccably, without interfering the gingival tissue and the rubber dam, with satisfactory anatomical adaptation without under or over contouring. In severe deep lesions "matrix-in-a matrix" technique is advantageous. If wedge affects the profile of matrix, packing with Teflon tape is a good alternative.
- The surface on which the new margin has to be created then needs to be made ready for composite placement by application of bonding agent. After application of bonding agent, it needs to be light cured.
- Composite resin should be placed in incremental technique with the thickness of the layer of 1-1.5 mm. The final margin should be raised by at least 0.5 mm from the old sub-gingival margin. The composite is then light cured. A layer of glycerin should be applied over the final restoration so as to remove the oxygen inhibition layer.
- At the next appointment or on the day of final restoration, appointment or on the same day, the existing composite surface that includes the new margin that has been raised, needs to be cleaned and air-abraded. The final restoration is done in incremental pattern or according to manufacturer instructions with the help of bonding agents of any generation.
- Several matrix systems can be employed while conducting Deep Margin Elevation.

- *Modified Tofflemire Matrix*

A Universal or Tofflemire retainer with a curved matrix is sufficient enough to achieve proper coronal margin relocation. The matrix needs to be sustained by remining buccal and lingual walls of tooth substrate.

- *Matrix in Matrix (m.i.m)*

In case of very deep and localized defect, a small piece of metal matrix can be placed in between the tooth margin and the current matrix that is in use and so as to retain this matrix, Teflon tapes can be used instead of wedges. [12].

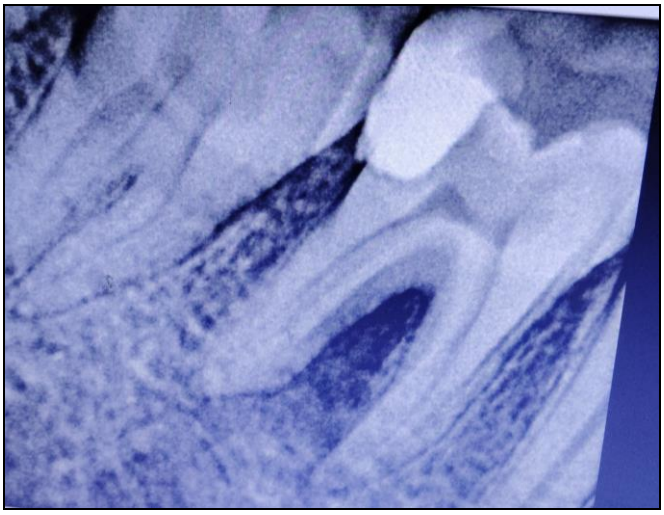

Fig 1 Pre-Operative Radiograph of 46 Depicting Secondary Caries Beneath the Previous Restoration.

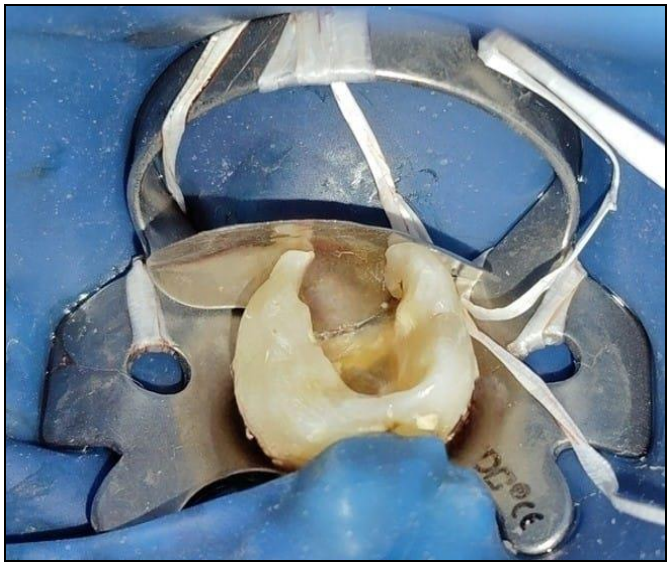

Fig 2 Pre-Operative Picture of 46 Showing Matrix Band Placement Before Performing Deep Margin Elevation

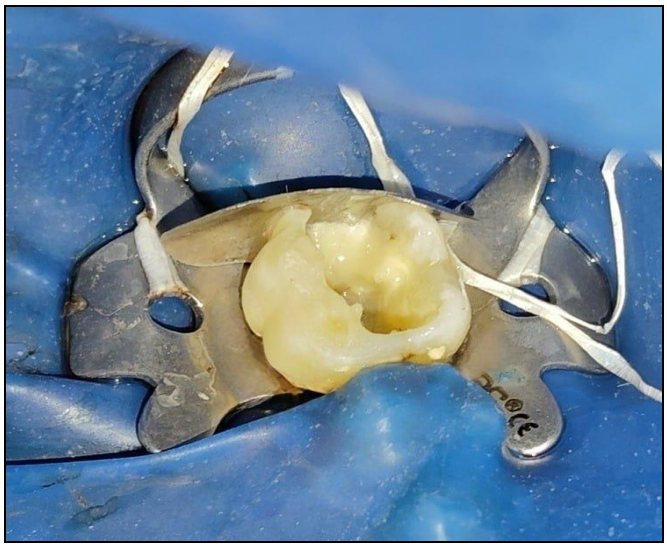

Fig 3 Deep Margin Elevation Done Using Flowable Composite Under Rubber Dam Isolation Irt 46

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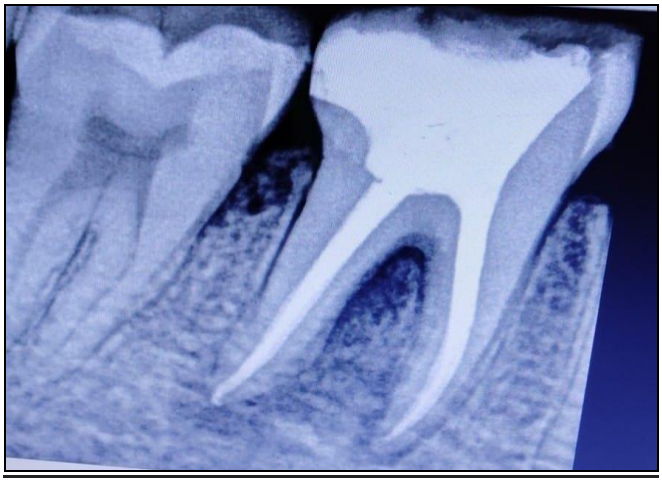

Fig 4 Post Operative Radiograph Depicting Restoration Done After Deep Margin Elevation

VI. BIOLOGICAL WIDTH AND DEEP MARGIN ELEVATION

The inter-relationship between periodontal apparatus and the restorative interface of teeth is symbiotic in nature. They both are interchangeably related to each other and the health or condition of one affects the other. Preservation of the gingival health is essential for establishing the longevity of tooth apparatus and the restoration [13]. Sufficient knowledge and understanding of this relationship in dentistry is of paramount importance so as to ensure adequate form, function and esthetics, and comfort of the dentition [14].

Application of adhesive material had been much more challenging when it had occurred beyond the gingival confines of tooth due to the saliva contamination and furthermore, overhanging margins also act as a challenging factor. [15-17].

Deep sub-gingival margins are associated with surged bleeding on probing (BoP). For this reason, it is advised to position the margins supra-gingivally. [18-20].

The tooth as a whole, including the pulp and periodontium function as a single unit from biological point of view [21].

➢ *There are Different Facets of a Dental Restoration that Directly Influences the Health of Supporting Structures Which Include:*

- Placement of margin.
- Adaptation of margin.
- Contour of restoration.
- Occlusal function [21].

➢ *It is a Must to Have a Diseased Free Periodontal Apparatus Before Beginning with the Restorative Treatment, Because of:*

- Shrinkage of gingiva post-surgery
- Alteration of teeth's orientation. Resolution of inflammation after treatment tends to move the teeth, often back to their original position. Restorations of teeth before periodontal treatment may produce injurious tensions and pressures on the treated periodontium.
- Susceptibility of injury during therapeutic interventions [21].

Supra-crestal tissue attachment (STA) comprises of a sulcular depth of 0.69 mm, an epithelial attachment of 0.97 mm, and a connective tissue attachment of 1.07mm. Hence, STA width is stated to be 2.04 mm, which represents the sum total of the epithelial and connective tissue attachment measurements [22].

The proportion of BW is inconsistent and relies upon the intraoral location. It's been documented that three millimeters of gap in between the margins and crest of alveolar bone has resulted in better prognosis of periodontal health for four to six months. [23]. It ensures sufficient preservation of BW despite cervical margins being placed 0.5 mm internally to gingival creviceS24].

➢ *BW Encroachment Culminates in:*

- Long-standing gingivitis adjacent to the restoration margin
- Positive BOP
- Focal gingival overgrowth associated with negligible osseous loss
- Apical migration of gingiva
- Osseous loss [21].

VII. ALTERNATIVES TO DEEP MARGIN ELEVATION

The various other options that can be opted for and can act as a substitute for deep margin elevation include based upon different clinical situations include-

➢ *Surgical Crown Lengthening:*

In this process, the margin of the cavity is generally exposed or raised above the level of gingival margin. As a result of which, a new margin is created on which the restoration is done. The important decision lies in choosing between all the alternatives, which technique to be employed. From a conservative point of view, deep margin elevation which involves non-invasive elevation of the margin of tooth associated with the preservation of tooth structure, periodontal tissues and alveolar bone, will always be a viable option. [26].

Hence, this decision must be completely evaluated and pros and cons of each treatment option must be kept in mind. Crown lengthening often leads to post-operative complications such as [17,31]

- Loss of pdl attachment.
- Furcation involvement.
- Coronal migration of marginal gingiva.
- Violation of the ferrule effect

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➢ *Partial Exodontic Technique*

This encompasses extrusion of partial portion of the tooth structure with minimal amount of surgical trauma, mainly using a periotome. The surgical procedural steps are as follows: Following delivery of LA, atraumatic extraction is executed with the help of periotome cut the periodontal ligament without producing any trauma to the osseous entity. Simple extrusion is accomplished using a hemostat. Final restoration is executed following 2- month interval [32,33].

➢ *Orthodontic Tooth Extrusion/Forced Eruption*

This strategy is based upon doctrines of orthodontics and osteo-physiology, through implementation of continuous pulling forces so as to generate delayed or accelerated extrusion based upon the technique employed. The intention is to reveal the sound tooth structure for optimal placement of the restoration margin structure, allowing for preservation of the biological width as well as esthetics [34,35]. Coronal migration of the gingival tissue, periodontal ligaments, and the bone also occurs due to the light tension on the periodontal ligament, resulting in osteoblast activation and deposition of new bone.

The rationale of fiberotomy procedure that is carried out mid-treatment is contingent upon maintaining inflammation at the gingival level, which hinders the motion of coronal movement of osseous structure. Circumferential fiberotomy is executed by means of BP blade to resect the supra-crestal fibers under local infiltration. The procedure is repeated in every 7 to 10 days, to maintain inflammation at the marginal bone area [34].

Orthodontic tooth eruption is the preferable procedure for conventional crown lengthening, especially for esthetic areas, as it helps in preservation the periodontium of the adjacent teeth. Nevertheless, this treatment modality is a collaborative clinical management of all the three departments concerning the above. [34]. Orthodontic extrusion is unattainable in [34,36]

- Unfavourable position of tooth axially;
- Deteriorated condition of periodontal tooth structure;
- Compromised radicular length
- Converging radicular anatomy
- Broad radicular morphology

VIII. CONCLUSION

This approach of coronal movement of margin is based on the doctrine of biomimetic restorative dentistry, which aims for conservation of tooth structure while employing esthetic and functional restorative materials that closely resembles the properties of restorative materials. Proximal lesions extending up to subgingival margins are frequently experienced in routine clinical practice, posing a significant restorative challenge for clinicians.

Composite resin remains the primary material of choice for deep margin elevation. Although composites have been known for their drawbacks of plaque accumulation and technique sensitivity specially in states of compromised isolation and polymerization shrinkage, these limitations had been substantially reduced due to filler technology advancements which involves better quality and loading.

Deep margin elevation serves as a viable and promising option for restoration of deep sub-gingival cavities and diligent choice of the technique and restorative material can lead to successful sub-gingival restoration.

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