

Rethinking Deep Marginal Extension (DME)

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Deep Marginal Extension (DME) is a restorative strategy which aims to preserve dental structure and periodontal tissues, especially alveolar bone. This article outlines its periodontal rationale and its applicability in the fields of restorative and prosthetic dentistry. Much emphasis is given in describing the different modalities of performing DME and the decision making process. Both DME and Deep Margin Acquisition (DMA) should be in the armamentarium of every general dentist, endodontist, restorative dentist and prosthodontist. Several therapeutic solutions for predictably restoring deep subgingival cavity margins are given as are step-by-step photos of different clinical cases to help fully understand the decision workflow.

Introduction

Subgingival cavity margins generate significant technical and operative challenges in restorative dentistry, both direct and indirect. Soft tissues are always an obstacle when the clinician face deep margins, thus, the first decision to be made is how to perform DMA. Different approaches are available in order to access the subgingival cavity margins and make them restorable. The author proposes the following classification of DMA procedures:

- Soft tissue retraction: rubber dam, cord, Teflon
- Soft tissue ablation: blade, diode laser, electrosurgery, soft tissue burs
- Bone and soft tissue ablation: surgical crown lengthening (SCL)¹

- Dental tissue elevation: orthodontic extrusion, surgical extrusion technique (SET) and partial exodontic technique (PET)²⁻⁴

Whilst SCL, SET, PET and orthodontic extrusion allow a significant increase in the ferrule effect in prosthetic crown preparation, soft tissue retraction and ablation do not. Thus, the clinician needs to consider which strategy to follow.⁵ In this paper the author focuses on how to approach clinical cases with subgingival margins, those not needing an additional ferrule effect, by using the technique of DME.

The acronym DME, coined originally in 1993 by Dietschi and Spreafico⁶ as Deep Marginal *Elevation* contemplated placing a base of

composite resin to coronally displace proximal margins underneath indirect bonded restorations. The author considers the former definition lexically misleading, historically mistaken and technically misaddressed. Lexically misleading because the word elevation evokes the idea of moving the margin. In reality, with this kind of procedure, the cavity dental margin keeps the same pre-operative spatial position, with no significant potential gain of ferrule. The clinician just extends 'prosthodontically' the dental cavity margin by means of some filling material. Therefore the author proposes to keep the acronym DME but as meaning Deep Margin *Extension*. The use of the word 'elevation' should be applied to

orthodontic extrusion, SET and PET as these procedures truly alter the spatial position of the cavity margin without affecting the preoperative level of the alveolar bone.

Historically mistaken, because DME has been widely used in dentistry long before the composite era, by means of silver amalgam and cast metals which even today the author uses in selected cases (*Figures 1 and 2*). Technically misaddressed because DME is not only suited for bonded indirect restorations but is mainly indicated for direct restorations (two stage approach) and for conventionally cemented crowns.

DME: when and why

The author considers DME a useful and strategic approach in the following cases:

- Indirect bonded restorations (*Figures 2 and 3*)
- Indirect non-bonded restorations (*Figures 4 and 10*)
- Direct restorations (*Figures 5 and 6*).

Indirect bonded restorations

In designing a bonded indirect restoration, the clinician has to plan the margin positions of the restoration according to the needs and limitations of the adhesive cementation. Thus the restoration margins should be planned supra-gingivally, or above the level of the rubber dam, in order to perform the bonding procedure in a clean and safe field. While the clinician may predictably approach

Figure 1: Deep subgingival cavity margin, 4 mm below the free gingival margin. DMA was performed by means of electrosurgery. The seal was achieved by means of copper band and Teflon. The non-anatomical (matrixless) DME was achieved using silver amalgam. Shoulderless preparation for a crown in order to correct the marginal overhangs of the free hand DME and to create ferrule effect.



Figure 2: Deep subgingival cavity margin. Deep Marginal Acquisition was performed by means of electrosurgery. The seal was achieved using copper band and Teflon. The non-anatomical (matrixless) DME was achieved using silver amalgam. Flame burs were used distally for correcting overhangs. An e-max overlay was bonded.

the deep cavity margins in direct restorations thanks to the possibility of using wedge, Teflon and matrix in synergy, he or she may not have the same predictability in indirect bonded restoration. This is because it is not possible to use matrices or wedges that might interfere and impede the seating of the indirect restoration. Even if it is possible to sufficiently isolate the preparation - because the excess of luting composite resin needs to be eliminated prior to curing (as distinct from conventional cements which are eliminated after hardening) - there is a substantial risk of haemorrhaging or breaking the seal in borderline isolations.

Indirect non bonded restorations

In designing an indirect non-bonded restoration, the clinician has to plan the margin position of the restoration considering the limitation of the non-adhesive cementation procedure. The cementation with traditional cements - glass ionomer and zinc phosphate - offers the following advantages with respect to the adhesive cementation procedures:

- The cements do not stick to the composite of DME
- The cement is easily removed after hardening

Figure 3: Anatomical (matrixed) DME and ceramic overlay. Deep subgingival distal margin. Deep Marginal Acquisition was performed by means of electrosurgery. The seal was achieved using rubber dam isolation. The anatomical (matrixed) DME was achieved using a saddle matrix 50µ hard steel (TOR VM) adapted by means of Teflon and special plastic wedge for concavities (Green Diamond Wedge from Bioclear). An e-max overlay was bonded.



Figure 4: Non-anatomical (matrixless) DME and crown on shoulderless prep. Deep subgingival buccal and distal decay. DMA by means of electrosurgery. Isolation by means of rubber dam and Teflon tape. DME with composite, performed free-hand (placing a matrix would have created capillarity and breakage of the Teflon seal). Shoulderless prep for zirconia monolithic crown in order to correct overhangs on DME and in order to get ferrule effect.



Figure 5: Two step-direct restoration performed using the concepts of Progressive Matrixing and Wedging. Deep subgingival cavity margin acquired by means of Thermoacut bur. Isolation achieved by means of rubber dam. First step: anatomical (matrixed) DME using Bioclear Matrix B-303 and plastic Sabre wedge. Second step: Matrix reshaping for getting contact area, powered by wooden wedge .



- The procedure does not need strict isolation with rubber dam, thanks to the humidity tolerance of such cements
- The procedure can be performed subgingivally to some extent, eventually with the aid of cord and Teflon, thanks to the humidity tolerance and to the possibility to remove the cement after hardening (the critical point of every cementation procedure is the hardening phase)
- The procedure is less technically demanding and sensitive and less stressful for the clinician.

The possibility of cementing a non adhesive indirect restoration on subgingival margins offers other advantages:

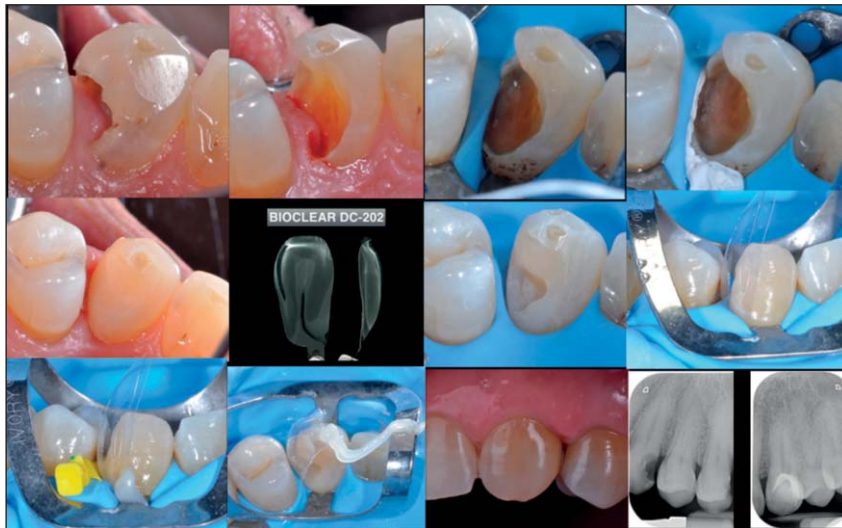
- Getting a more anatomical emergence profile and proximal shape
- Reducing the amount of DME surface in contact with soft tissues. Ceramic and zirconia have a superior biocompatibility with soft tissues than the direct filling material (composite and amalgam).

This would translate into a more predictable and healthy junctional epithelium.

Direct bonded restorations

Managing deep margins by means of direct restorations poses a series of challenges to the clinician. The main problem is to find a matrix able to reach the margin anatomically and simultaneously provide a proper contact area. Most often the possibility of sealing the cavity margin is not compatible with the

Figure 6: Two step-direct restoration performed using the concept of Delayed Matrixing and Wedging. Deep subgingival margin acquired by means of electrosurgery. Isolation achieved by means of rubber dam and Teflon. Non-anatomical (matrixless) DME, placing flowable composite free-hand. Correction of the overhangs using a flame burs. Re-isolation by means of rubber dam. Bioclear Matrix DC-202 powered by the diamond wedge for getting contact area and a correct proximal shape in continuity to the DME. One month Post-op photo showing the recovery of papilla, after its electrosurgery ablation.



- Progressive matrixing
- Delayed matrixing.

DME: the technique

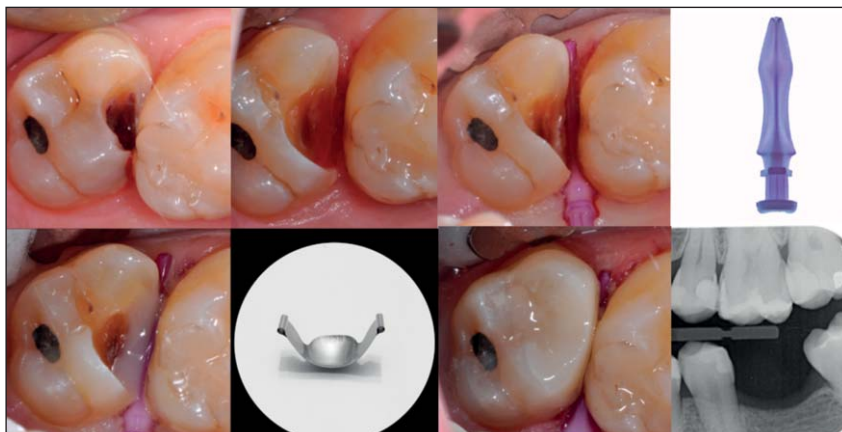
The author performs DME in two main ways:

- Anatomical (matrixed)
- Non-anatomical (matrixless).

The anatomical DME (matrixed) approach requires anatomical and well adapted matrices, according to the anatomy of the cervical margin and to the desired emergence profile to be created. There are many matrices available on the market and the author prefers the sectional rather than the classic circular (e.g. banana bands or Tofflemire bands), because the circular ones tend to produce more capillarity, nullifying in many cases all the efforts to get isolation. The author suggests the following matrices and wedges:

- Sectional Saddle Matrices (TOR VM). They are produced in 50 micron hard steel (making them very robust and easy to handle), having the maximum curvature in the cervical area (this feature making it easier to reach the deep cervical margin) (Figure 3)
- The Bioclear Matrices (Bioclear) are offered with different emergence and curvature profiles (Figure 5)
- The Bioclear Anatomical Wedges, Sabre and Diamond (Bioclear) (Figures 7 and 8)
- The Anatomical (matrixed) DME powered by Bioclear Wedges is very useful in paediatric dentistry before a root canal treatment and

Figure 7: Two step-direct restoration performed using the concept of Progressive Wedging and Delayed Matrixing. Anatomical DME using a special wedge as matrix. Subgingival cavity margin acquired by means of thermacut bur. Isolation and matrixing achieved by means of anatomical purple sabre wedge. The anatomical DME was performed using a wedge as a matrix, placing flowable composite to the most coronal part of the wedge. Correction by cylindrical burs of the coronal part of the DME, getting a smooth margin. Delayed matrixing by means of saddle matrix 50 micron-hard steel (TOR VM), powered by the same sabre wedge, for completing the restoration.



feasibility of getting a correct contact area in a single step. The author proposes in such cases to step the direct restorative procedure on the base of the following hierarchy:

- **First step** (DME phase): getting a cervical seal and anatomical emergence profile

- **Second step:** completing the restoration with an anatomical contact area.

The two-step approach is possible using a series of strategies (as shown in the clinical cases of Figures 5 and 6):

- Progressive wedging
- Delayed wedging

Figure 8: Matrixed DME by means of anatomical wedge. The use of anatomical wedges, such as Sabre and Diamonds from Bioclear allows managing DMS at the same time DME as pre-endo build-up in paediatric dentistry.



for simplifying the next filling session (Figure 8).

deep margins, in order to reduce capillarity and keep the seal.

The non-anatomical DME (matrixless) does not require any anatomical matrix and following isolation the filling material is placed free-hand with any marginal overhangs corrected with red-strip flame burs or red strip Batt-burs. Matrixless DME can be enhanced by the use of copper bands and Teflon (Figures 1, 2, 4 and 6). The matrixless DME is less technically demanding and requires less skill and expertise compared to the matrixed variation. Moreover, the avoidance of the matrix can be a strategic choice in cases of very

DME and the biological rationale

Some periodontists claim an alleged invasion of the biologic width (BW) when the DME technique is used. The BW is histo-anatomically constituted by the sulcus, the junctional epithelium (JE) and the connective tissue attachment (CT).⁷ As all clinicians may witness daily, the carious process never reaches or progresses apically to the level of the alveolar marginal bone. As the carious process advances apically,

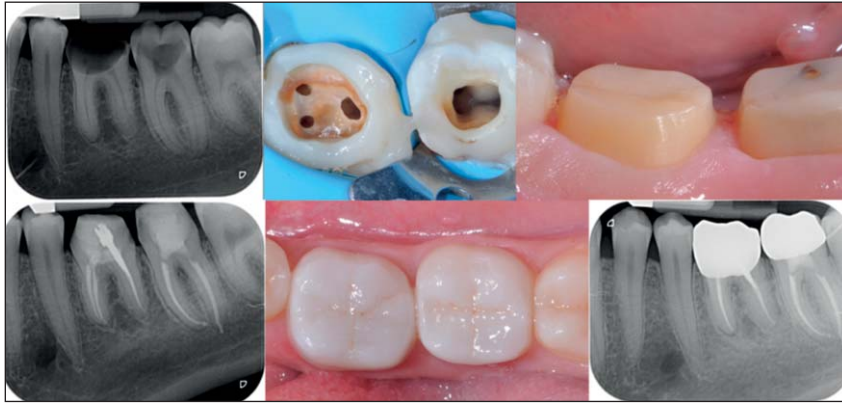
the connective attachment will move accordingly. Anytime we approach a carious lesion, the final cavity margin will be slightly coronal to the bone and most of the time coronally to the connective attachment. The reason is that the only structure that has a biologic reaction after the ‘invasion’ is the connective attachment. Connective attachment is very selective about surfaces: it needs cementum on one side and bone on the other. As the caries advances and destroys dentine and cementum, the connective attachment will move apically, always maintaining the same width. Yet Dragoo observed, histologically, in deep roots sub gingival caries restored with glass ionomer, adhesion of fibroblasts and connective tissue to the restorations.⁸ By contrast, the JE is not selective towards surfaces and is shaped by simple juxtaposition of epithelial structures through the hemi-desmosomes on a surface, as long as the surface is hard, smooth and clean. This surface, which in the ‘healthy environment’ is represented by the enamel, may be either enamel, cement, dentine, composite, zirconia or titanium. The sulcus is even less selective.

When we treat a carious lesion apical to the level of soft tissue the clinician replaces a dirty rough-soft material (decayed tissues, food, bacteria, etc.) with a clean-smooth-hard material (composite, ceramic, zirconia, metals etc.) (Figure 9). Therefore, after a DME we should expect the bone to maintain the same pre-operative marginal level. The improved environment surrounding



Figure 9: DME and periodontal rationale. Pre-op and post-op clinical and radiological data in order to check marginal bone level substituting the decayed tissue with composite (DME) and Zirconia (crowns on shoulderless prep).

Figure 10: Indirect non-bonded restorations on DME, DMA by means of electrosurgery. Isolation achieved by means of rubber dam and Teflon. Non anatomical (matrixless) DME, achieved by means of flowable composite, placed free-hand. Root canal treatment performed conserving part of the pulp sealing for trussing. Shoulderless prosthetic preparations for zirconia monolithic crowns in order to correct cervical overhangs and to get ferrule effect.



the bone and the soft tissues allows the formation of a healthy BW. SCL procedures in order to acquire deep margins may offend periodontists and should be considered a last resort for the following reasons:

- Risk of exposing furcation areas, transforming a carious patient into a periodontal patient⁹
- Increase of the crown-root ratio, that is mechanically detrimental
- Exposure of the root surface to the oral cavity, also affecting the adjacent teeth. This could be risky in patients with high caries risk profile
- The alleged advantage of SCL on the ferrule effect may produce in some cases a contrary effect upon the possibility of ‘ferrulisation’, constraining the clinician to drill further the peri-cervical part of the tooth,⁵ which is the most critical

area from the biomechanical point of view.

Nowadays, thanks to the evolution of equipment (e.g. microscope) and materials (e.g. introduction of Teflon) in restorative and prosthetic dentistry, the avoidance of SCL for acquiring a deep subgingival margin – due to caries - is just an issue of skills and expertise.

Thus SCL procedures should be a second choice, even with regard to the need of ferrule recovery: the clinician should consider this goal primarily different from a DMA procedure, such as orthodontic extrusion, SET and PET.^{2,4}

Conclusions

In the field on indirect restorations the author, on the basis of his

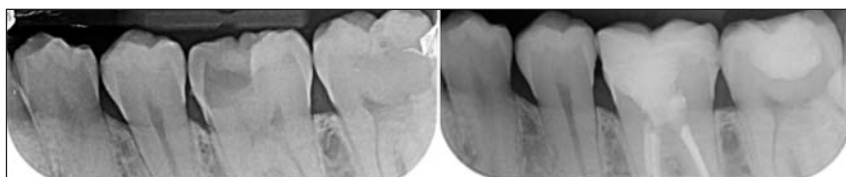
experience, suggests limiting the use of DME to non-bonded indirect restorations (Figure 10) contrary to what has been suggested by Dietschi, Spreafico and Magne.^{6,10} This suggestion arises from the following clinical problems:

- The impossibility of avoiding the adhesion of composite cement to the composite of the DME; even under microscope, the experience of the author suggests that it is practically impossible to get a perfect clean-up
- The impossibility of removing the excess of composite cement after hardening by means of blades, owing to the risk of damaging the DME (being made of composite like the cement)
- The impossibility of having an anatomical coupling amongst the matrix and the deep cervical margin, with unavoidable and periodontally unfriendly overhangs. Deep cervical margins are often jagged and with deep concavities, making them unmanageable by means of any matrix (Figure 11)
- The risk of creating capillarity owing to the matrix, especially circular ones, nullifying the seal
- The difficulties for the clinician in creating an anatomical emergence profile by means of the DME and of the technician in shaping an anatomical proximal profile owing to the ‘unfriendly’ geometry of DME (Figure 12)
- In deep sub gingival cases, generally owing to the coronal destruction, the clinician also has the need to create a ferrule effect using crowns (Figure 10).



Figure 11: Deep cavity margins. Jagged-waved margins and extreme concavities are very frequent clinical findings in deep margins. Such conditions are anatomically unmanageable by means of any matrix.

Figure 12: DME and proximal geometry. Pre-op and post-op radiographs. Examining the radiographs, it is possible to see the inability of the clinician to get a natural emergence profile onto the DME and the dental technician to subsequently create an anatomical proximal shape.



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