# Restoring the Interproximal Zone Using the Proximal Adaptation Technique—Part 1

CE 2

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**Abstract:** *The concepts of the preadhesive era sanctioned the mechanical removal of healthy, sound tooth structure to perform restorative procedures. This mechanical systematic approach to enhance the retention of the restoration by modifying the cavity form included 6 principles: outline form, resistance form, retention form, convenience form, removal of caries, and finish of the enamel walls, margins, and toilet of the cavity. This philosophy was challenged during the adhesive era with a biologic approach. Dramatic changes in the understanding and control of caries, with a reduction in the incidence and severity of caries, and even the process of detecting decay with chemical agents, has forced clinicians to re-think and modify their preparation designs and principles. Some of the mechanical principles are still being used with current adhesive dentistry and clinicians wonder why they continue to have microleakage, recurrent decay, and sensitivity. The effect of this misdirection could be one of the reasons for the relatively short longevity for some adhesively placed restorations. These adhesive design concepts require the clinician to modify nonadhesive techniques when considering preparation design, restorative material selection, adhesive protocol, and placement procedures and techniques. Although the original design principles are outdated by today's standards they are still applicable in the modern dental practice by simply modifying the 6 basic principles. The clinical objectives in the era of minimally invasive adhesive dentistry has become prevention, preservation, and conservation.*

## The Evolution of the Preparation Design

In 1881, MH Webb demonstrated a concept of preparation whereby the margins of enamel were free from contact with the adjacent tooth, preventing extension of decay and promoting cleansing by saliva and ingested fluids.[1,2] Around the same time, GV Black introduced the phrase "extension for prevention,"[3,4] indicating that by extending the preparation to the proximal line angle, the margins of the restoration would self-clean via food excursion.[1] His concept also included extending preparations through enamel fissures to allow cavosurface margins to be placed on nonfissured enamel.[5]

These concepts sanctioned the removal of healthy, sound tooth structure to perform the necessary restorative procedure.[4] When Black proposed these principles, the industry focused on controlling rampant caries. Unfortunately, this focus was not based on scientific knowledge of the disease or any scientific rationale.[6,7]

By the middle of the 20th century, clinicians challenged existing principles using more conservative preparations to preserve the maximum integrity of the natural tooth.[1,7] The last half of the 20th century introduced adhesive surface preparation of the enamel and dentin (ie, acid-etching and self-etching) and composite resin technology, which allows minimally invasive procedures without a standard geometric preparation form.[1]

Prevention from extension, an evolving concept, seeks to minimize the biologic loss of the natural tooth as a whole[8,9] by combining prevention, remineralization, and minimal intervention for the replacement of natural tooth structure and/or restorations.[10]

### *Learning Objectives:*

*After reading this article, the reader should be able to:*

- discuss the evolution of the preparation design.
- describe the principles of the modern adhesive preparation design.
- explain the 3 clinical objectives of contemporary restorative dentistry.

In the past, extension for prevention used restorative materials and cavity preparation designs to arrest the caries process. At the time, neither the fluoride ion nor the process of remineralization was known.[8] In the new era of prevention from extension, many of the old limitations are no longer applicable because of advances in research and technology. With modern assessment and management, the clinician can limit the size of the preparation, retaining areas of demineralized dentin and enamel, which can heal through remineralization. Many restorative materials are now bioactive and can arrest and eliminate the carious lesion.

Dramatic changes in our understanding and control of the caries process have forced us to rethink past preparation designs and principles. The need for extension for prevention[3,4] has been replaced with a more conservative approach to tooth preparation—the adhesive preparation design. Traditional methods of discerning decay from stained tooth structure that involve experience and skill have been supplemented with caries-detecting agents and improved illumination and optical aids.[11]

However, several of the restorative concepts and principles of the past are still being used with current adhesive dentistry, leaving many clinicians with recurrent microleakage, decay, and sensitivity. The effect of this misdirection could be one of the reasons for the relatively short longevity of composite restorations.[12,13] Advances in material science and adhesive technology require clinicians to modify nonadhesive restorative techniques for application to restorative adhesive concepts regarding diagnosis, material selection, preparation design, restorative placement techniques, pulp protection, restorative finishing, maintenance,[14-17] and patient selection.

## The Biologic Approach

The principles of the modern adhesive preparation design contain a biologic approach,[18] which represents a key component of adhesive dentistry.[19] Advancements in restorative materials and adhesive technology require an adhesive design concept when considering preparation design, restorative material selection, adhesive protocol, and placement procedures and techniques. Metal-free direct and indirect restorative systems depend on conservative and thorough adhesive preparation designs. Consideration should be given to tooth type, location in the arch, size and type of carious lesion, treatment of decayed or nondecayed unrestored teeth or restoration replacement, relationship between occlusal function and preparation boundaries, type of restorative technique (ie, direct, semidirect, or indirect), quantity and quality of remaining tooth structure, mechanical forces on remaining structures, presence of defects, and the parameters for extension of the preparation to the esthetic zone.[20,21]

### *Outline Form*

The preparation design is controlled by the extent of the carious lesion in decayed unrestored teeth; with metallic restoration replacement, the preparation design is adapted for maximum tissue preservation.[22] The outline form should have smooth curves and remain in the enamel and within the occlusal contacts.[20] There is no fixed or standard geometric configuration.

The outline form is a function of the carious process, the existing restoration, defective or missing tooth structure, and/or type of restorative technique. This modified outline form conserves tooth structure, protecting occlusal function and providing resistance to occlusal wear.[1]

### *Retention and Resistance Form*

The resistance form is provided by rounded internal architecture for direct preparations, as well as rounded internal and external lines for indirect preparations, with no abrupt changes in the preparation dimensions.[20] This design contributes to the resistance form because it improves mechanical stress distributions.[22] Rounded lines provide a more complete internal adaptation and improve the accuracy of indirect restorations.

Because they do not require increased axial wall length for frictional retention and achieve retention through bonding,[23] the depth of the preparation can be shallower for resin-bonded adhesive restorations. The retention form is achieved by a micromechanical adhesion (retention from resin tags interlocking with the retentive pattern of etched tooth tissues) to enamel and dentin using adhesive protocol. Adhesive restorative materials have a greater potential for bonding to tooth than metallic restorations, which require mechanical retention. The enamel makes a significant contribution to the retention and strength of the restoration, as long as

the enamel is strong, completely mineralized, and well supported by dentin. Incorporation of bevels provides union at the ends of the enamel rods, instead of at their long axis, increasing surface area, strength, and retention.[24]

The adhesive restoration does not require as much volume to resist clinical fracture, enabling a more conservative preparation design.[25] The depth of the restoration is not as significant because adhesive resin systems can be bonded to dentin and enamel. These resin systems have a low elastic modulus for absorbing occlusal stress, so dentin properties are not required.

### *Convenience Form*

The convenience form continues to apply to adhesive restorative techniques because adequate isolation is crucial for success. Magnification improves visibility and access to the restorative field. Rubber dam application provides the clinician with access and visibility for placement techniques and procedures.[26,27]

Minimally invasive procedures require creative restorative techniques that place no limits on the size of the restoration or the extent of the intervention. These techniques include efficient tissue cutting to provide precise caries removal and cavity preparation for difficult to access regions.[24,28]

### *Removal of Caries*

The removal of caries defines the cavity outline form. Infected carious dentin should be removed and no further removal of tooth substance is required.[29-31] The advances in caries-detecting agents provide the clinician with an objective assessment for defining and removing carious dentin, which can be used in combination with the subjective assessments from visual and tactile criteria[32-38] and judgment of the clinician. The cariostatic effect[39] and sealing ability[39-41] of adhesive restorative materials provide other avenues to arrest,[40,42-46] control, and protect against recurrent caries.

### *Finish of the Enamel Walls and Margins*

Surface finishing of the walls of the preparation is accomplished with fine diamond burs to provide a smooth interface for adhesion and to optimize the restoration margin angles. A smooth surface provides improved internal adaptation for direct and indirect composite resin restorations, liners, and resin cements and facilitates bonding to the remaining tooth structure. Fine diamonds should be used to finish the preparation for semidirect[21] intracoronal restorations; coarse diamonds may create microretentions that lock the restoration inside the preparation.[21]

For indirect restorations, the walls should be free of undercuts; however, internal undercuts should be filled with an appropriate light-cured resin material or glass ionomer to avoid destructive preparations.[22] The walls should be tapered and all finish lines smoothed for proper internal adaptation during laboratory fabrication and bonding.

### *Cavity Debridement*

Adhesive success depends on precise, meticulous procedures and techniques, and the access provided by adequate isolation is essential.[47,48] Adhesive protocol requires a clean, dry operating field, which is provided by the application of the rubber dam. The adhesive interfaces be free of blood, saliva, tooth debris, and contaminants. Bacteria in the preparation may invade the dentinal tubules and cause pulpal inflammation and necrosis.[49-52] Although Brännstrom's concept of disinfecting to reduce sensitivity and eliminate or minimize bacterial growth under restorations has not been scientifically proven, it seems prudent.[49,53] Cavity cleaners and disinfectants that contain benzal-konium chloride or 2% chlorhexidine gluconate can be used to clean the cavity preparation and to remoisten the cavity before placing an adhesive that bonds in moisture.[53]

## Clinical Objectives of Minimally Invasive Dentistry

From the onset of disease to initial placement of the restoration, the clinical objectives of contemporary restorative dentistry should include prevention, preservation, and conservation. The primary objective is to prevent the placement of the initial restoration.[24]

Minimally invasive dentistry begins with contemporary restorative procedures such as remineralization, sealants, and preventive resin restorations. These procedures, in conjunction with preventive measures (eg, dietary modifications, frequent professional plaque control, fluoride administration, specific antimicrobial treatment, and improved oral hygiene, may reduce dental caries. This approach allows the patient and clinician to reevaluate the outcome of the preventive measures and reduce the potential for

invasive intervention.[54] Educating patients and involving them in treatment decisions may result in acceptance of preventive and restorative strategies, as well as improved compliance and oral health.[55]

The second clinical objective of contemporary restorative dentistry is to preserve tooth structure during preparation. When Webb and Black were practicing, a clinician's diagnostic ability was limited to visual (color) and tactile detection of the carious and sound dentin.

Discoloration in chronic caries provides a demarcation to a zone of bacteria, but in acute caries, discoloration is less distinguishable and bacteria may extend beyond the discoloration.[56] A more definitive diagnosis and evaluation can be obtained from scientific methods that include caries-detecting agents, electrical resistance, electronic caries detectors, quantitative lasers, light fluorescence, and light transmission.[24,57-61] These alternative procedures provide objective assessments that can be used in combination with the subjective assessments[32-38] and judgment of the clinician to improve the identification and removal of infected carious dentin.[62]

The final clinical objective is to conserve the tooth-restorative complex and increase the longevity of the restoration between replacements. The first 2 objectives—prevention and preservation—provide stimulus for the third because smaller restorations have an increased lifespan.[63,64] In addition, restoring natural dentition with bonded composite resin reinforces the cusps of the restored teeth,[65,66] resulting in increased structural integrity of the composite-tooth–restorative complex, exceeding that of the amalgam-tooth–restorative complex.[67,68] Proper composite finishing and polishing protocol can influence and indirect restorations by affecting wear resistance[69] and marginal integrity.[70]

## Conclusion

Whereas this article (Part 1) primarily focuses on the modern adhesive design principles, Part 2 will provide the preoperative considerations and restorative adhesive concepts for developing directly placed composite resin restorations. A description of the author's proximal adaptation technique will demonstrate an alternative method for restoring incipient lesions in the interproximal zone.

## Disclosure

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