

#Biomimetic Restorative Dentistry

#INTRODUCTION

{ The word 'biomimetic' is derived from a Latin word, where "bio" means life, and "mimetic" means imitation or mimicking. Hence #biomimetic is the art of mimicking nature.

What is the biomimetic restorative Dentistry

the traditional restorative techniques was prioritised
the need of the material rather than tooth needs

Biomimetics in restorative dentistry respect the biological structure of the tooth .

restoring the functional, mechanical and aesthetic requirement of teeth as naturally as possible .

Basically it aims to replace the damaged portion of teeth far more conservatively in contrast to the traditional tooth preparation which involves extensive and invasive preparations to facilitate retention and resistance forms.

CLINICAL PRESENTATIONS OF STRESS DISTRIBUTION IN TEETH AND THE SIGNIFICANCE IN OPERATIVE DENTISTRY

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Stress distribution in human tooth structure can be visualized through the use of Moiré fringes, which has improved the clinical understanding of recently identified anatomical structures in molar occlusal surfaces. This article discusses the concept of a "peripheral rim of enamel" and describes the manifestation of compressive and tensile fractures within the peripheral rim of enamel and dentin. It also emphasizes the benefits of microdentistry techniques and minimally invasive preparation designs for the long-term preservation of the natural tooth structure.

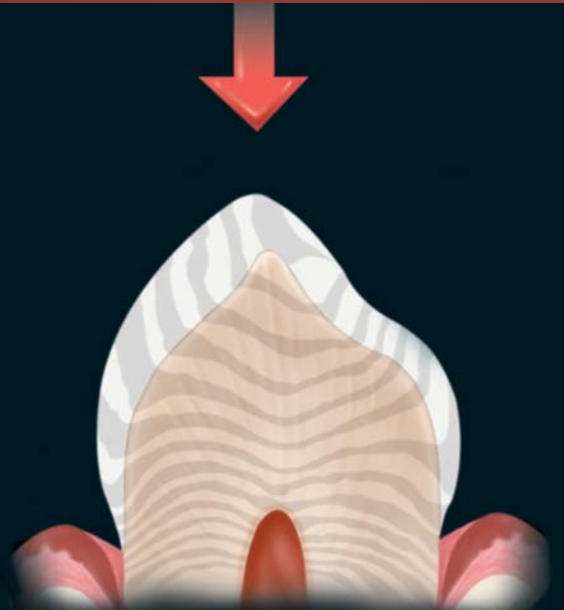
Key Words: Moiré fringes, stress, microdentistry, caries, peripheral, enamel

Publication of one recent article that demonstrates stress distribution within tooth structure has improved clinicians' understanding of subtle compression and stress fracture presentations in teeth.¹ Until the publication of this benchmark article, numerous fracture presentations observed clinically have been difficult to explain. Strain

mechanical stress distribution system.^{4,7} This understanding has resulted in the development of a discipline termed microdentistry. This philosophy urges the use of modern methods of caries detection for early accurate minimal intervention in the caries process to preserve internal mechanical structures within the tooth that are vital to its long-term mechanical viability.

Moiré Fringes

To understand the various presentations of tooth fracture caused by the disruption of the natural stress distribution mechanism within the tooth, the significance of the Moiré fringes must be considered. To date, stress studies that utilize polarized light have generally been conducted with plastics to show stresses that occur when loads are applied. This technique is not effective in natural dentition due to their inability to transmit light, so these studies



The DEJ is a zone approximately 200 μm thick where collagen density and mineral content are each approximately 50%, compared to a 30% collagen/70% mineral ratio in the body of the dentin. Since the DEJ is more elastic due to its greater collagen content, it allows micro compression to occur between the enamel and the dentin, which enables the enamel rim — with its high elastic modulus — to transfer a vertical load directly to the root structure

TABLE 1-1 Physical properties of dental hard tissues and corresponding biomaterials

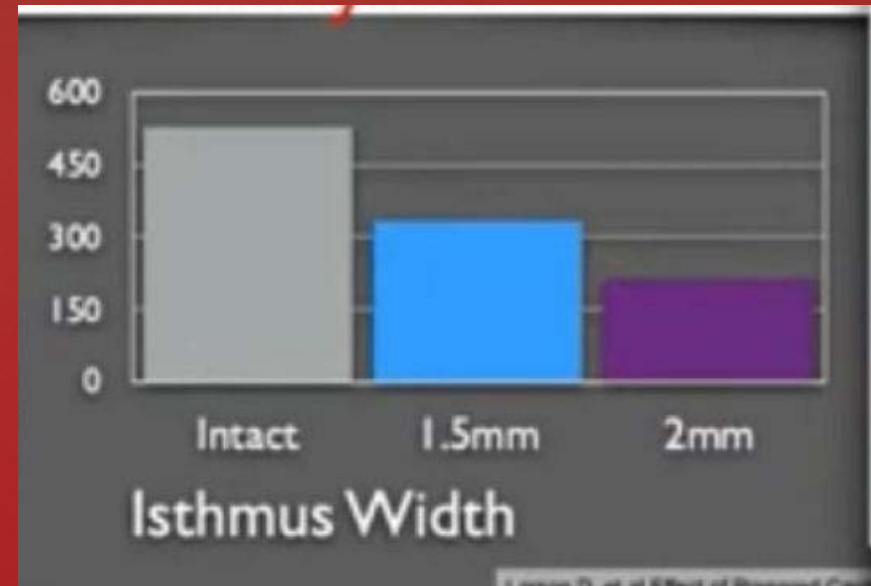
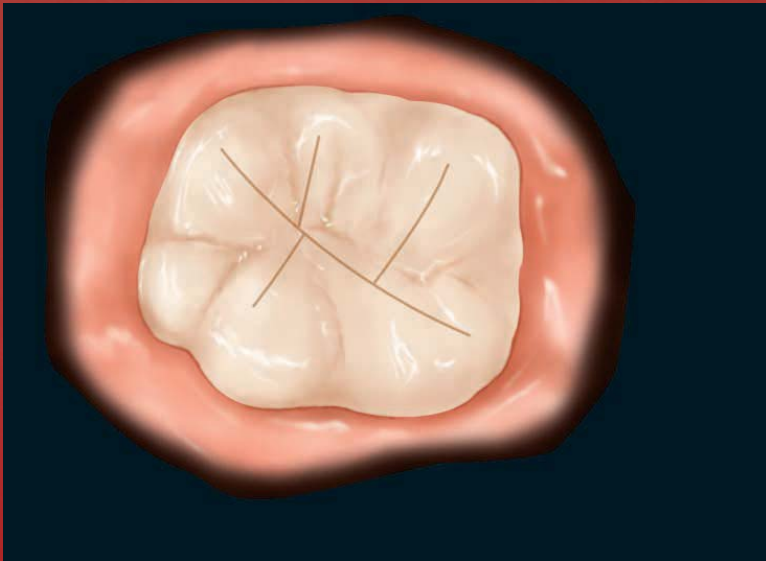
	Elastic modulus (GPa)	Thermal expansion coefficient ($\times 10^{-6}/^{\circ}\text{C}$)	Ultimate tensile strength (MPa)	Corresponding material	Elastic modulus	Thermal expansion coefficient	Ultimate tensile strength
Enamel	$\sim 80^{37}$	$\sim 17^{38}$	$\sim 10^{39}$	→ Feldspathic porcelain	$\sim 60-70^{40}$	$\sim 13-16^{41}$	$\sim 25-40^{42}$
Dentin	$\sim 14^{43}$	$\sim 11^{38}$	$\sim 105^{43}$	→ Hybrid composite resins	$\sim 10-20^{44}$	$\sim 20-40^{45}$	$\sim 40-60^{46}$
DEJ	-	-	-	→ Dentin adhesives	-	-	-

A subocclusal transverse oblique ridge that extends from the distolingual to mesio buccal aspects of mandibular molars.

A supporting web of enamel is connected to this structure.

Termed Rainey Ridges (Terney 1996)

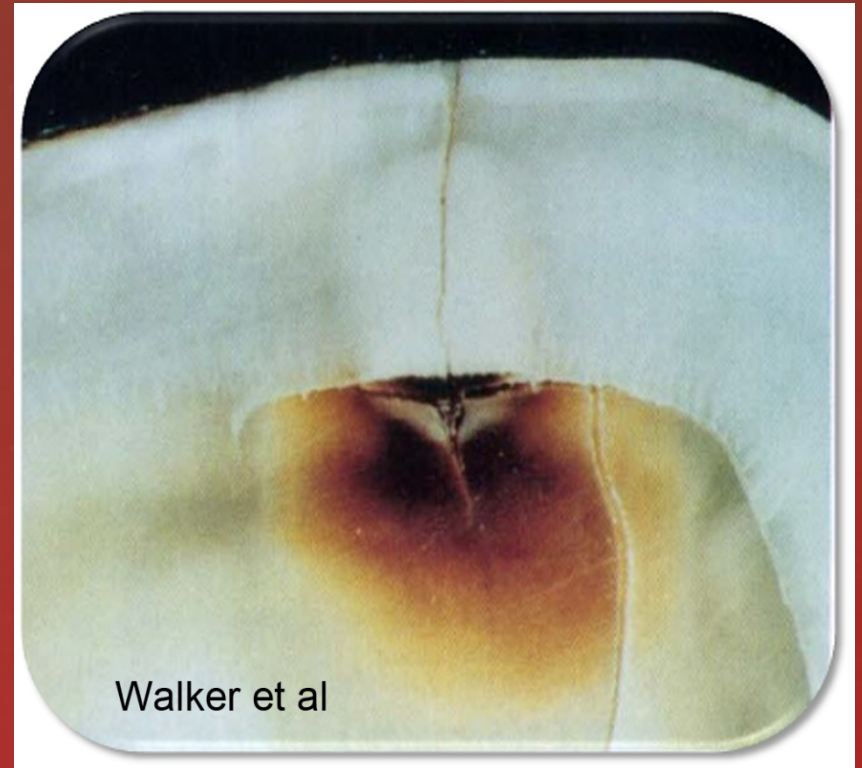
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Allow bacteria to form hidden
caries



#Peripheral rim fractures



Cusp fracture

1. preserve pulp vitality.
2. structural analysis
3. reducing the residual stress
4. maximum the bond strength.

#

#Objectives of biomimetic Dentistry

Use of caries detecting dye.

#

Each operator had a different sense of hard and soft tissue &

Clinically the interphase between the outer and inner carious dentin & layers was inconsistent.

Fusayama made progress toward a solution of this problem. &

#



#Peripheral Seal Zone

A systematic approach to deep caries removal end points: The peripheral seal concept in adhesive dentistry

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The objective of this article is to present evidence-based protocols for the diagnosis and treatment of deep caries lesions in vital teeth. These protocols combine caries-detecting dye with anatomical and histologic knowledge to arrive at ideal caries removal end points for adhesive restorations. DIAGNOdent laser fluorescence technology can also be used to confirm these end points. These ideal caries removal end points generate a peripheral seal zone that can support long-term biomimetic restorations. A review of the published literature since 1980 on caries, caries diagnosis, and caries treatments and their relationships to adhesive bonding techniques was carried out. Combining anatomical measurements and pathologic and histologic knowledge with caries-detecting dye and DIAGNOdent laser fluorescence technologies can produce ideal caries removal end points for adhesive dentistry without exposing vital pulps. (*Quintessence Int* 2012;43:197–208)

Key words: adhesive dentistry, biomimetic restorations, caries removal, indirect pulp capping

The most common pathology clinicians treat is caries and its resulting decay.¹ The treatment of this disease involves the diagnosis and management of the patient's biofilm and then the remineralization or restoration of the damaged tooth structure.^{2–6} Treating decay without treating the cause of decay is a problem that the CAMBRA (Caries Management By Risk Assessment) program is seeking to resolve.^{6,7} Small lesions can often be treated nonsurgically, according to the revised International Caries Detection and Assessment System (ICDAS II).⁸ After the systemic disease is treated and incipient lesions are remineralized⁹ or infiltrated,¹⁰ clinicians are left to determine how

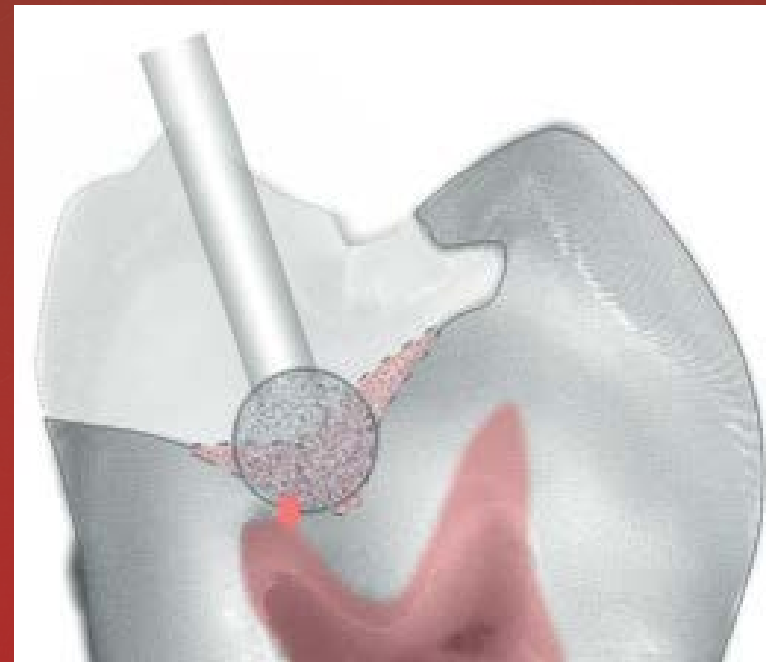
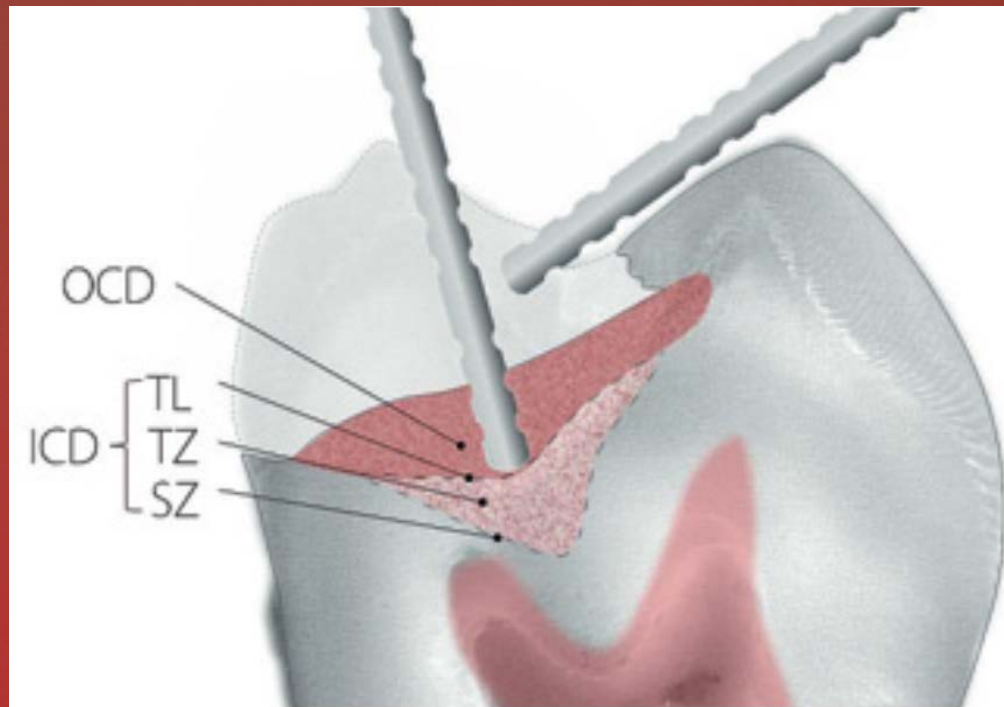
junction (DEJ), complete removal of caries by the traditional visual and tactile technique has been successful. The minimally invasive dental treatments for these smaller lesions using air abrasion, sonic diamond tips, glass-ionomer cement, and bonded composite resin have reduced the need for traditional preparations that eliminate important anatomical structures.^{11–16} However, for lesions of medium and large depths, more sophisticated techniques are required for determining ideal caries removal end points (Fig 1).

Using traditional visual and tactile techniques for these larger lesions is often inconsistent for determining optimal caries



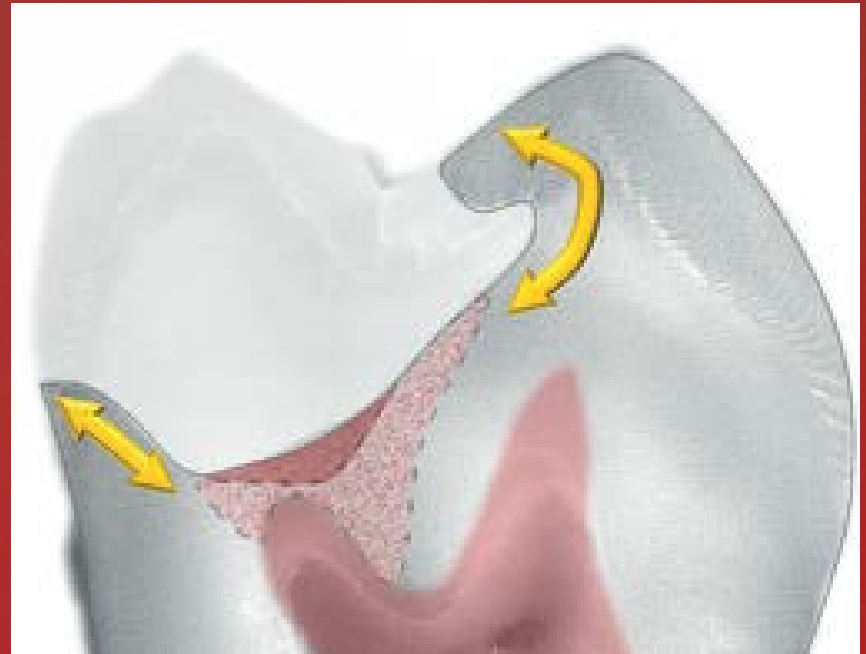
The concept of a peripheral seal zone is that the enamel, DEJ, and superficial dentin constitute the caries-free area of a highly bonded adhesive restoration.

2012





Caries removal end points for a deep lesion.
The peripheral seal zone has been created without exposing the pulp. A small amount of outer carious dentin is left on top of the inner carious dentin inside the peripheral seal zone.



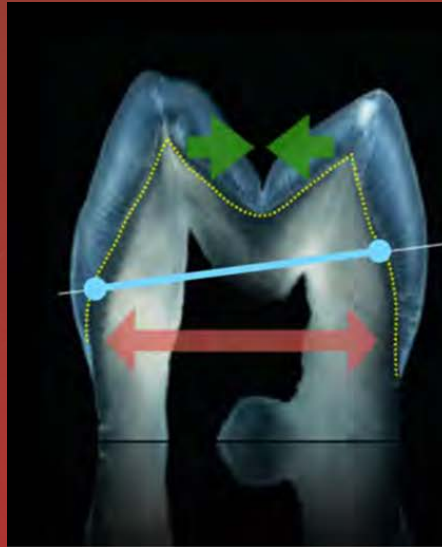
#Caries removal end points

Tension cusps less than 3 mm thick are at risk of # and should be reduced for cuspal flex 3x as normal hydrated cusp, coverage.

Holding cusps Less than 2 mm thick should reduced for cuspal coverage.

structural analysis

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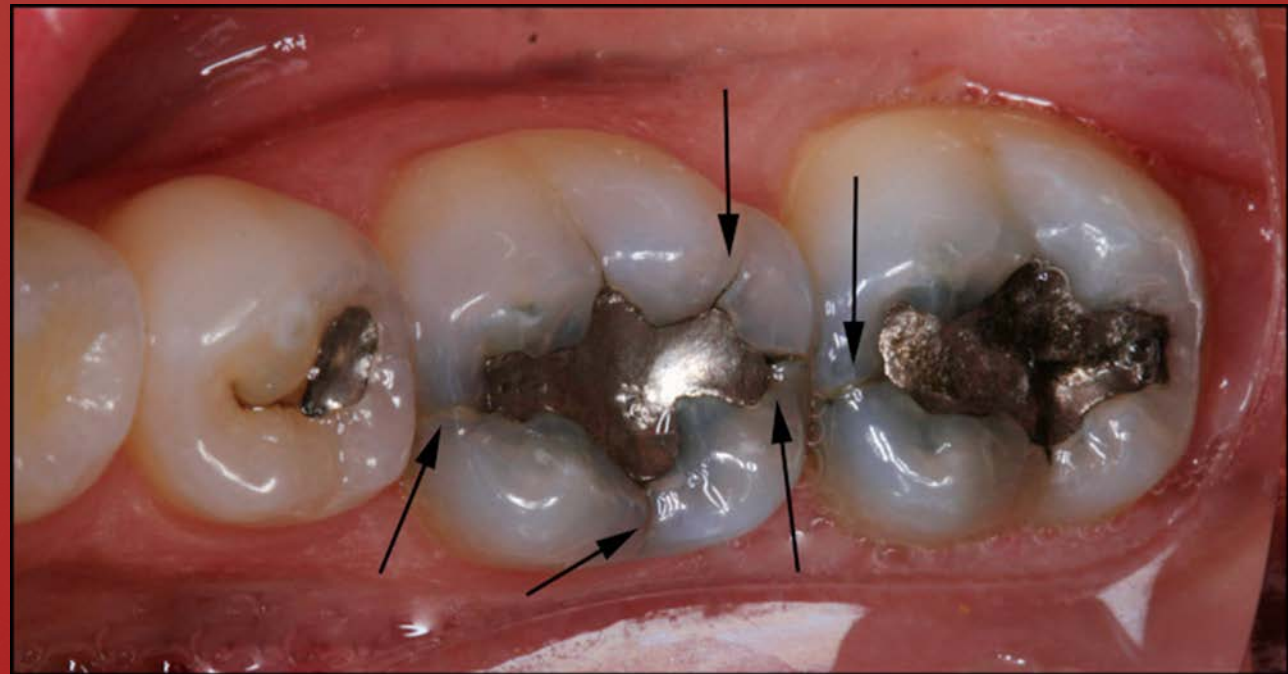
Enamel compression dome is in
radial compression above
inflection plane

Enamel compression dome is in
radial tension below the
inflection plane

#Risk factors

1. peripheral rim fracture &
2. isthmus greater than 2 mm &
3. cuspal thickness &
4. deep box \geq 4mm &

#Alleman 2021 &



Crowns and onlays should not be finished on tooth tissue in deep margins .boxes deeper than 4 mm encroach on the bio rim.

The deep margin should be elevated with composite.

Non uniform enamel prism orientation .

#DEEP MARGIN ELEVATION

#Aluminum oxide 28 micron &

Remove unsupported enamel prisms &

Compact the smear layer and produce a uniform HL &

Increase the bonding surface area thus increasing the &
#bond strength to Enamel & Dentine.

#

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#AIR ABRATION

MMP,S degrade the collagen in the dentin when in acidic enviroment
so when you etch dentine ,MMPS are activated
#and you need deactivation with CHX

4. Deactivate matrix metalloproteinases.

This prevents 25% to 30% of bond strength from being degraded.⁴⁵ Deactivation can be achieved by using a 30 second treatment with 2% chlorhexidine (eg Consepsis, Ultradent), benzalkonium chloride (eg Micro-Prime B, Danville or Etch 37, Bisco), or a dentin bonding system with the MDPB monomer (eg SE Protect, Kuraray).⁶



5. Employ gold standard bonding systems.

Use a gold standard dentin bonding system that can achieve a microtensile bond strength of 25 MPa to 35 MPa on enamel and 40 MPa to 60 MPa on flat dentin surfaces. The available data indicates that three-step total etch dentin bonding systems and two-step self-etch dentin bonding systems offer the best clinical performance.^{19,46}

6. Utilize immediate dentin sealing. The application and polymerization of dentin bonding agents at the time of preparation (and before an impression is taken) has numerous advantages and will ultimately increase the microtensile bond strength by 400% when compared to the traditional approach of bonding the dentin at the cementation appointment.^{17,18} This is fundamental to achieving maximum bond strength.

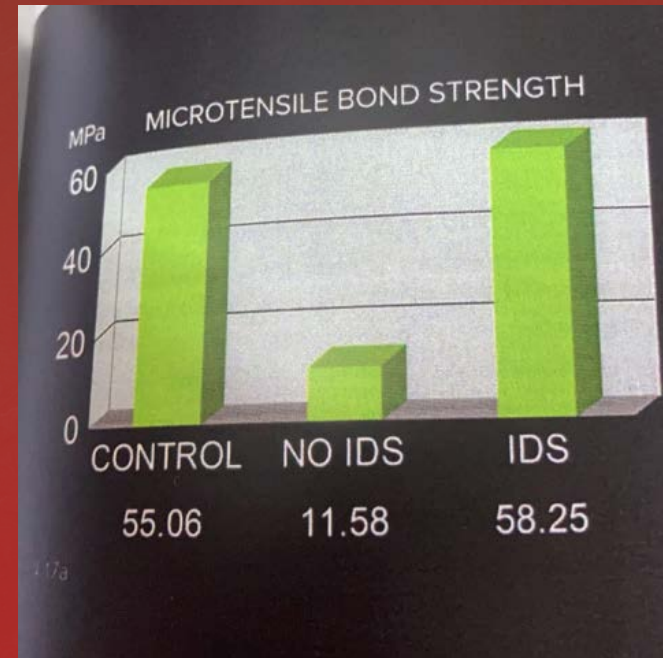
#Immediate dentin sealing



#20+ reasons for IDS

- 1.the bond is strong .
- 2.Bonding to freshely cut dentin.
- 3.Allow stress –free bond development.
- 4.Pre-curing the bonding agent give the hieghest bond strength.
- 5.Selective wet dentin bonding.
- 6.Decrease the bacterial leakage.
- 7.Relief from sensitivy during temporization
- 8.Reinforcement of remaining tooth structure
- 9.Sealing of ETT

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EverX Flow

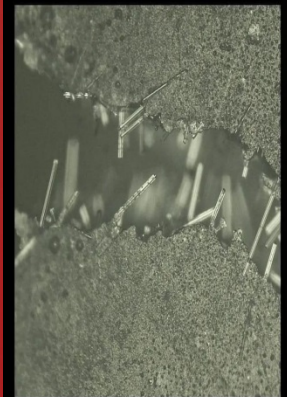


Use fiber reinforced composite to reduce the shrinkage during polymerization and mimics the modulus of elasticity of dentine

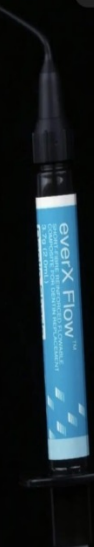
#We should not stress the biobase or hybrid layer

#Dentine replacement

EverX Flow
Flowable composite

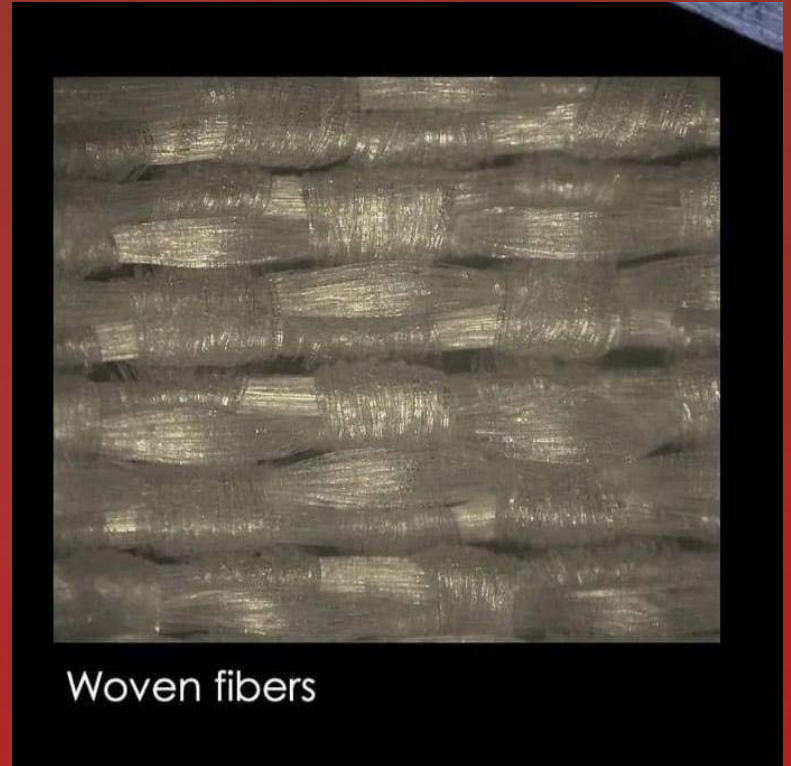


Randomly oriented short fibers



Ribbon has a woven fibers ,so it resist the crack in any direction

It can be placed in the first layer of composite above the bio base

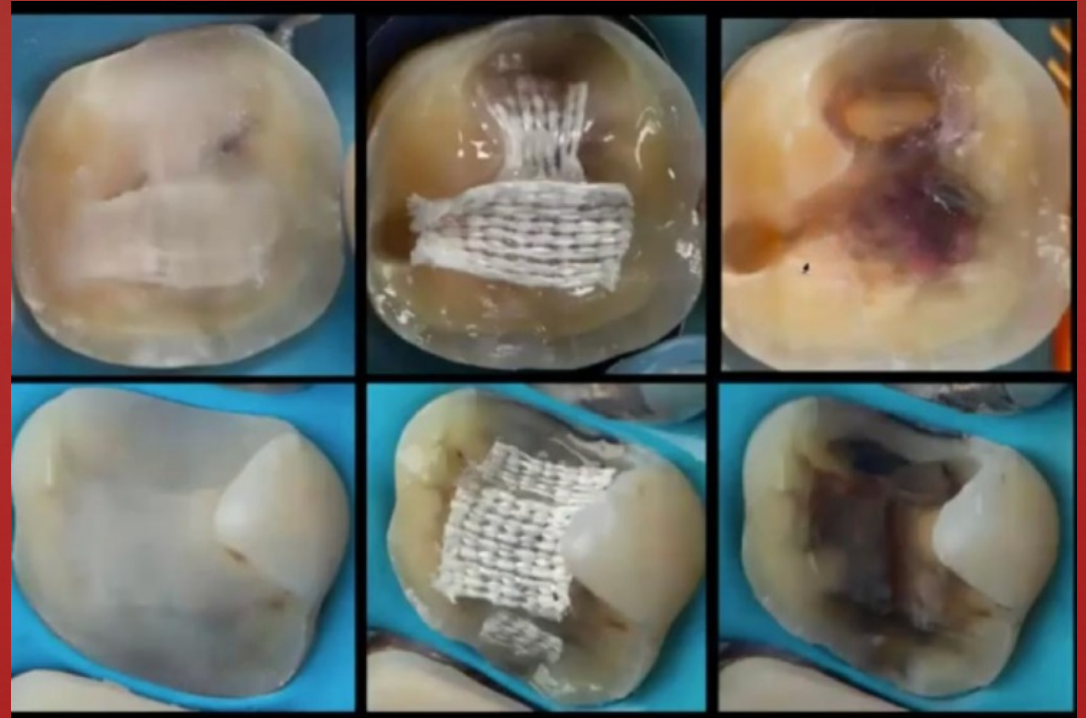


#RIBBOND

It mimics the DEJ and allows stress distribution through the restoration

#This effectively prevent hyperloading on the HL

#Ribbond



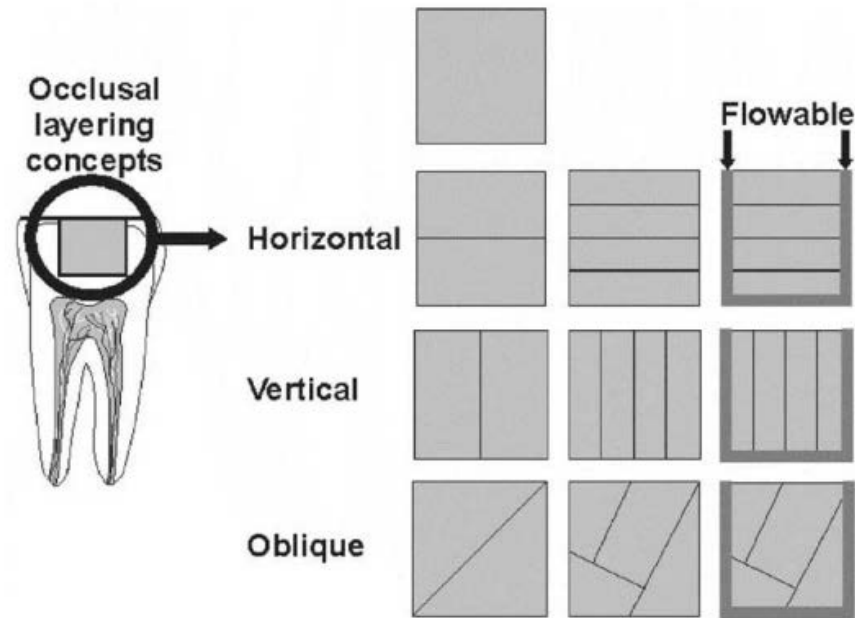


Figure 2 Layering concepts for the high c-factor groups.

Influence of c-factor and layering technique on microtensile bond strength to dentin.

#Nikolaenko et al 2004

Layering techniques

When a minimally invasive philosophy is adopted, and biomimetic restorations become an option, dentists notice a significant change in their practices. The incidence of post treatment endodontics is reported by Biomimetic dentists to reduce by 80-90%, because they are diagnosing fractures accurately and treating them appropriately.

#

#THANK YOU

