Direct restoration of oblique fracture

Wrong overlay preparation

Fracture dissected out

On-going post-treatment
Temperature and pressure sensitivity Failed by no restoration of the fracture LET’S DO ENDO!

Potential movement in the remaining dentin will lead to: Disconnection of the dentin tubules Disconnection of the canal Disconnection of the root Disconnection of the pulp Disconnection of the fracture

Direct bonded composite onlay

Fracture dissected out

Cusp overlay No horizontal fracture in the enamel

Case Study

Patient presented having bitten on a hard sweet Very cold sensitive Pressure sensitive Dentin fracture dissected out, only removing dentin from the occlusal of the fracture

Dentin fracture dissected out, only removing dentin from the occlusal of the fracture

Direct bonded composite onlay

Fracture dissected out

Cusp overlay No horizontal fracture in the enamel

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Dentin fracture dissected out, only removing dentin from the occlusal of the fracture

Direct bonded composite onlay

Fracture dissected out

Cusp overlay No horizontal fracture in the enamel
Bonding highlights the near miss on the pulpal horn. Note how the new V4 Ring from Triodent does not distort the band in the region of the missing cusp.

everX Posterior (GC)

everX Posterior is an anisotropic material. It has different residual properties in the X, Y and Z axes. No stronger in compression. Strength in tension. Resists the fibers to be laid in the horizontal plane. Very similarly to resist tension out the horizontal plane. Resists crack propagation. Resists Poisson’s distortion.

Reconstruction

Thin layer of radio-opaque flowable composite

Reconstruction

Mean Fracture Load

GC EverX Posterior fibre reinforced composite placed into the core of the cavity

Reconstruction

2mm below occlusal table (to leave room for the final e.max onlay)

Crack Limiting and Stress Reduction

Mean Fracture Load (N)

GC EverX Posterior Z250


DO NOT use a bulk fill technique to replace the dentin. You WILL fracture the thin enamel wall!

Correct management of C-factor shrinkage is paramount to avoid pulling the cusp inwards and fracturing the enamel.
Completed restoration

Completed restoration
Failed Cervical erosion.
失败的原因是牙龈
当再次感染后。

Overlay or cusp removal?

White lines in the enamel:
White lines in the enamel.
Remove the cusp.
Tooth fractures that are not dealt
with properly are a major cause
of ongoing problems.

Direct bonded composite onlay

Alternative option to a cusp overlay.
When the fracture extends all
the way out to the enamel.
Completely remove the fracture.

Cervical erosions/abfractions

Use Ribbond to act as a stress distributor,
stress limiter.
Reduces the destructive forces on the bond
associated with Poisson effect tooth distortion.
Reduces the chance of debonding/loss of the
restoration.

Cervical erosions/abfractions

Cervical erosions/abfractions

Cervical erosions/abfractions

Cervical erosions/abfractions

Ribbond OK on a Premolar, Direct Premolar Restoration

Ribboned Premolar on an Endo Premolar

The Problem. What to do next?

The Problem

What about a crown?

Best aesthetics will be to leave
the cusp.
The risk - the tooth is biomechanically
weak following removal of cusps
and completion of endo.
Fracture risk.
Note - the mesial decay
removal was not joined to the
distal, retain all sound tooth
structure!

• Almost all the remaining
tooth structure is removed
with a crown prep.
Now, most of the load will
be on a post!
• This is a high risk treatment
option on premolars.
• Create a Ribbond torsion box inside the tooth to prevent crack propagation and create energy dissipation

The Solution

• Restorative tools
  Ash 6 Probe
  Microbrush

• GP removed 2mm into canals
• Margins bevelled
• V4 Ring and sectional matrix
• Isolation with an Isolite

The Solution

• Completed Triodont sectional V4 Rings and non stick matrices
• Keep the height of the matrix at the marginal ridge to act as a build up guide

• Enamel margins selectively etched
• Bonded: Kuraray SE Protect
• Critical inter-cuspal cross bracing retained

The Solution

• Thin layer of radiopaque flow placed only on the gingival margins.
• Because Ribbond works best when applied directly to the dentin.

The Solution

• First interproximal increment of A1 (enamel shade) <1mm thick.
• Both cavities at the same time
• Accurately built to height of marginal ridge

• 2nd interproximal increment of A1 (enamel shade)
• Both cavities at the same time

• 2mm wide Ribbond THM Ultra place bucco-lingually and pushed down into each canal
• Place a THIN layer of warm nano-composite on floor and compress Ribbond right through the composite
• Remove excess

• Completed Triodont sectional V4 Rings and non stick matrices
• Keep the height of the matrix at the marginal ridge to act as a build up guide
• The Ribbond in the canal entrances creates a torsional lock, stabilizing the core bucco-lingually and mesio-distally

• Wrap a 3mm wide length of THM Ultra completely around the walls of the cavity and interproximal composite

• Place 3mm wide length of THM Ultra buco-lingually
• Down the buccal wall, across the floor and up the palatal wall to stop at the dentino-enamel junction

• EverX Posterior (GC) glass fibre reinforced composite placed to stop 2mm from the occlusal surface

• Completion of the Ribbond torsion box core
Completion of the Ribbond torsion box core

- EverX Posterior (GC) glass fibre reinforced composite placed to stop 1.5mm from the occlusal surface

Aesthetic Composite Reconstruction

- 1st layer of A1 Gaenial Posterior with the fissure pattern and cusp lobes created with an Ash 6 probe
- (Jason Smithson technique)

Aesthetic Composite Reconstruction

- 2nd layer of Bleach Gaenial Posterior with the fissure pattern and cusp lobes created with an Ash 6 probe
- Brown stain placed in depths of fissures

Aesthetic Composite Reconstruction

- 3rd layer of Bleach Gaenial Posterior with the fissure pattern and cusp lobes created with an Ash 6 probe
- White nano-composite placed on cusp lobes

Aesthetic Composite Reconstruction

- Completed case

Every case is different!

The damage is different
Fracture dynamics vary enormously
What remains of the tooth varies
Patient’s economics have an impact

Case Report: 3 fracture modes

- 36 tooth is cold sensitive – short duration
- Sweet sensitive
- Pressure sensitive
- Distal marginal ridge fracture
- Faint distal radiographic enamel demineralization
- Marked dentin demineralization
Case Report: 3 fracture modes

- Symptoms:
  - Transient hot and cold sensitivity and pain on chewing
- Tests:
  - Transient sensitivity to cold
  - Pain on release of pressure on lingual cusps
- Diagnosis:
  - Reversible pulpitis associated with cracked cusps

Distal marginal ridge crack

Distal marginal ridge crack

Advanced Occlusal Effect Decay

“Inverted” enamel demineralization associated with occlusal effect decay

Preliminary cusp reduction for e.max onlay. Fractured lingual cusp dissected out. Distal crack reduced.

Preliminary cusp reduction for e.max onlay. Fractured lingual cusp dissected out. Distal crack reduced.

Crack Limiting and Stress Reduction Core

Crack Limiting and Stress Reduction Core

- Enamel acid etched
- SE bond everything - cure
- Very thin layer of unset flowable
- M/D 4mm Ribbond THM Ultra placed to cover dentin floor
- Wide enough to wrap slightly up walls
- Cure

- Two more pieces of Ribbond THM Ultra placed into unset flowable
- Cured
- Multidirectional stability due to the LENO weave
• Posterior composite placed incrementally on the mesial and distal walls of the matrix band in a thin 1mm layer
• Do not cover the floor (note you can still see the Ribbond)
• Core

• GC everX Posterior fibre reinforced composite placed into the core of the cavity
• 2mm below occlusal table (to leave room for the final e.max)

Temporary composite onlay everXPosterior should not be on an exposed surface

Onlay prep 2 months later
- Tooth settled immediately
- Adhesive e.max onlay prep
- BORM retained

Onlay restoration 2 months later

Remember this tooth? What did I do?

Biomimetic engineering

Tooth vital and symptomless. Mesial fracture open enough to retain a probe. DANGER!

Restorations removed
Basic e.max onlay prep outline
Note: enamel still present over the basal contours of the preps

Mesio-distal fracture carefully dissected out as far as possible, avoiding a pulp exposure
Tooth air-abraded, bonded
Ribbond THM Ultra layered buccolingually into the dissected mesio-distal fracture

Completed onlay preparation

Completed bonded e.max onlay

Central volume of cavity filled with everXPosterior fibre reinforced composite

Crack Limiting, Stress Reduction Bio-Base

Second layer of Ribbond THM Ultra
Split the Poisson effect fractures and the central area of the mesio-distal fracture

Note: everXPosterior is not a replacement for Ribbond.
It does not reinforce the tooth, the fibres only reinforce the composite

Crack Limiting, Stress Reduction Bio-Base

Crack Limiting, Stress Reduction Bio-Base

Crack Limiting, Stress Reduction Bio-Base

Reconstruction of the Compression Bio-Dome

Completed bonded e.max onlay

Successful endo is only the beginning of a successful restorative complex

The Biomimetic Compression Dome Only Works if you Adhesively Bond Everything

Are we designing our preps just to make our temporaries last for two weeks?
Adhesive onlay preps must have lateral resistance form

Not Placing Full Crowns on Endo Teeth
An alternative (and better) option based on the compression dome concept
“Minimally invasive dentistry is not only about cutting less, but also about preserving more tooth structure. We need to adapt the materials and techniques to the tooth’s needs and not the tooth to the material’s needs.”

Assoc Prof. Dr. Kosmas Tolidis
I have a huge number of amalgam onlays in my practice. If the patient insists, based on aesthetic concerns, I will now convert it to a bonded ceramic onlay.

22yr old 24yr old 28yr old amalgam endo core and onlays

The boring stuff

MOD cavities in endo molar teeth reduce their fracture resistance by 80%

Can you please fix my chipped filling?

Yes, it did have an amalgam onlay.
Problem? The design! The bevel onlays went the wrong way, acting like a wedge and placed the underlying cusps into tension

Not even this way!!!!
Poorly bonded composite core then FULL PFM

The important boring stuff

Teeth that have both RCT and full coverage showed a 28% failure in 10 years 3% failure rate per year
What about a Monoblock e.max endocore onlay?

Ceramic core is too stiff and transfers stresses to the surrounding tooth rather than helping absorb them.


Forces and stresses need to be evenly distributed and absorbed, and the core system should match the behaviour of dentin.


Composite and Amalgam Cores for Full Coverage

Full Ferrule Cementation Restorations

Lateral force creating a tensile loading in the core

Tension Zones

Destruction of the BioRim leads to overloading of cores and remaining tooth

What to do when a vertical fracture reaches the pulp?

Treatment decisions
Irreversible Pulpitis

- Options
  - Endodontics and restoration
  - Extraction
  - Partial denture
  - Bridge
  - Implant

To restore or extract? that is the question

- Remove the old dentistry
- Create endo access and remove pulp
- If the fracture in the mesial/distal wall extends into the pulp chamber floor, extract
- If there is any perio involvement associated with the fracture, extract

To restore or extract? that is the question

- If the pulpal floor is intact an option to offer is endo and restoration on the understanding that there is a failure risk
  - After endo:
    - Retain the BIORIM
    - Ribbond reinforced fully bonded core
    - BONDED e.max onlay or Lava Ultimate onlay

M/D crack under old amalgam leading to irreversible pulpitis

Ribbond/composite bonded core

the Biorim was maintained

Forces and stresses need to be evenly distributed and absorbed and the core system should match the behaviour of dentin

David Rudo – personal communication

"It requires a cultural leap to go from an understanding of the dental restorative complex based on strength to an understanding of the complex based on the components of the complex functioning in strain harmony. When the components of the restorative complex function in strain harmony, they mimic the behavior of the dentin, enamel, and root regions of the intact tooth functioning together through a continuum of graded interphases."

Minimal intervention Monolithic ceramic endo onlay IPS e.max CAD or Pressed, Lava Ultimate and processed composite

Pulp floor only, canal entrances sealed with C-GIC

The BIORIM/TEK restoration

Reduce cusps for a 2mm overlay, with 1-1.5mm rounded chamfer margin

Keep contours soft, flowing and rounded (mimic mother nature)
A second strip of Ribbond placed into the next increment of composite, leaving the central area empty, then filled after curing the 2nd Ribbond layer.

Re-creating the stress distribution system of the tooth

Even a bonded composite would be expected to survive!

A fully bonded structure, starting at the floor of the pulp chamber. It prevents the structural volume required to absorb and evenly distribute biomechanical stresses and re-create strain harmony.

Re-creating the stress distribution system of the tooth

Re-creating the stress distribution system of the tooth
The **Bio-dome** is the wall that supports the compression dome complex. Don't send it up the suction!!

Adhesively bonded e.max CAD (or pressed) onlay crown **Bio-dome** remains intact - Biomechanically stable.

Restoration/tooth interface is relatively "flat" and softly contoured lowers stress and reduces polymerization stresses.

Compare this to Mother Nature

Bio-dome: Biomimetically Emulating Nature Utilizing a Histo-Anatomic Approach; Structural Analysis
Panaghiotis Bazos, Pascal Magne.
The European Journal of Aesthetic Dentistry: Vol 6, No1 Spring 2011; 8‐19
Adhesively bonded e.max CAD (or pressed) onlay crown remains intact - Biomechanically stable

Margins are in a zone that avoids impression, perio, bonding and finishing problems

Creating a Ribbond Torsion Box

When loaded in fossa, Ribbond acts in tension pulling cusps together

Creating a Ribbond Torsion Box

Creating a Ribbond Torsion Box

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Creating a Ribbond Torsion Box
Creating a Ribbond Torsion Box

What do we call this type of restoration?
FIBRE UNIFIED COMPOSITE RESTORATION

GB's fibre reinforced
endow/Posterior composite
Multiple 1mm layers
Further enhances the resistance to the Poisson effect
A dentate replacement with increased resistance to crack propagation

Cross Section of Restoration

GC's fibre reinforced posterior composite
Further enhances the resistance to the Poisson effect

Cross Section of Restoration

What do we call this type of restoration?
FIBRE UNIFIED COMPOSITE RESTORATION

Composite onlay
A woven fibre laminate composite designed to absorb and distribute forces and prevent damaging stress concentrations by placing the tooth and restoration back into strain harmony

Unprotected endo tooth fracture!!

Ensue there is mechanical seal in the pulp chamber (LC/luxfil)

Ribbond Torsion Box

3mm wide strip of Ribbond
THM Ultra
Resists the splitting forces associated with occlusal pressures on the cusp incline planes

Protected endo tooth!!

Note all the retained buccal enamel and BO-RM

Protected endo tooth!!

Conservation of the buccal BO-RM

Complex Ribbond Endo Core

The core is fully bonded to the tooth
The restoration is fully bonded to the fibre reinforced bonded core as well as the remaining tooth.
Complex Ribbond Endo Core

Non-reinforced core – Full Crown

Non-reinforced core – Full Crown

Non-reinforced core – Full Crown

Ribbond fibre bonded core build up

Ribbond fibre bonded core build up

Non-reinforced core – Full Crown

Ribbond fibre bonded core build up

How this layer works

How this layer works

Completing the core

Energy distribution and energy concentration

PFM sheared off, taking the core with it. The full crown prep removed most of the PFM. The remaining sliver of dentin was insufficient to retain the crown.

Poorly bonded composite core. Stress concentration leading to leakage/caries (probe fits way in)

The full PFM reduction left little remaining tooth to help absorb and distribute stresses.

Crown was cemented, not bonded, so there is less stress distribution.

Reconstruct missing mesial and distal walls with bonded composite. Creates a wall to form circumferential Ribbond layer against

Circumferential wrap of 3mm Ribbond THM Ultra

A potential load creating a lateral shear force on the core

Stress is distributed through the fibres in the ring, spreading the load and dissipating it. Greatly reduces the risk of focused stress overload.

2nd mesio/distal layer of Ribbond
3rd buccal-lingual layer of Ribbond

Central core filled with everX Posterior fibre-reinforced composite

Completed core and prep

Fully bonded E4D e.max crown over a fully bonded woven fibre core

Non-reinforced core – Full Crown

This was all the dentin that remained!

There was no stress distribution

Non-reinforced core – Full Crown

There was no stress distribution

There was no Energy Sink or stress distribution, only stress concentration!
The gold onlay did not protect the buccal cusps.

Circumferential Ribbond THM Ultra

2nd layer of Ribbond THM Ultra and sticky flow is laid down circumferentially around the pulp chamber.

Ensure there is mechanical lock in the pulp chamber (1/2 round bur).

2nd Bucco-lingual layer

2nd layer of Ribbond THM Ultra and sticky flow is laid down bucco-lingually.

2nd Bucco-lingual layer

2nd Bucco-lingual layer

2nd Bucco-lingual layer

3rd Mesio-distal layer

3rd Mesio-distal layer

3rd Mesio-distal layer

Core build up

The internal core is built up incrementally.

Composite is also added to the outside of the Ribbond walls.
Completed Ribbond reinforced core

Laser gingivectomy on distal
First cord packed

Next patient presented to have a crown placed following endodontics.
Non-fractured core, retained cop patient.
Cusps not protected in the interim by the non-bonded partial onlay amalgam.

Bonded E4D e.max crown

Occlusal table has been kept narrow to reduce cantilever and torsional/forces on the core

Our Colleagues need updating!

New patient presented to have a crown placed following endodontics.
Non-fractured core, retained cop patient.
Cusps not protected in the interim by the non-bonded partial onlay amalgam.

Our Colleagues need updating!

Fractured buccal cusp and remnants of a distal vertical fracture.
Fracture does not involve the pulp chamber floor.
TOTALLY UNSTABLE! A full crown over the amalgam would not rescue it

GP removed from canal entrances and sealed with GIC.
Excess GIC removed from dentin floor.
Buccal fracture micro-dissected with AA.
Cleaned with AA.

Our Colleagues need updating!

4mm Ribbond THM Ultra prepared and sticky flow applied

Our Colleagues need updating!

Bonded with Kuraray Clearfil SE Protect
First layer of Ribbond applied to span the distal crack and cured

Our Colleagues need updating!

2nd layer of Ribbond applied to cross-hatch the first layer, ensuring it spans the distal fracture again.

Our Colleagues need updating!

GC everX Posterior fibre reinforced composite fills the centre of the pulp chamber
Undercuts around the Ribbond fibre core and buccal cavity filled with composite
Lingual Ribbond is retained.

Prep re-air-abraded immediately prior to bonding the E4D e.max restoration

An occlusal composite did not protect this root filled tooth!

23yr old new patient. Had been advised to have the tooth extracted!
Bonded with Clearfil SE Protect (everything is very shiny)
A thin distal wall of composite Creates a wall to bond a circumferential layer of Ribbond to

23yr old new patient. Had been advised to have the tooth extracted!
3 sequential layers of bucco-lingual and mesio-distal oriented THM Ultra Ribbond

23yr old new patient. Had been advised to have the tooth extracted!
Central space filled with GC everX Posterior fibre reinforced composite
23yr old new patient. Had been advised to have the tooth extracted!
Central space filled with GC everX Posterior fibre reinforced composite
Lengths were a bit too long
Just prep back with a diamond crown bur

23yr old new patient. Had been advised to have the tooth extracted!
80% of the tooth has been retained
Occlusal section heavily reinforced with Ribbond

23yr old new patient. Had been advised to have the tooth extracted!
Completed bonded a max occlusal compression dome

Premolar Ribbond Core Technique
• Due to the smaller pulp chamber/canals, a dual cure system is preferable
• Utilizes Kuraray Clearfil Tribond S Plus adhesive
• Clearfil DC Core Plus
• Ribbond THM 2 or 3mm

Arangam removed, case closed flap crown lengthening and a bonded composite placed. Basic gutted cavity prep and DP removed
2 strips into the teeth, without widening the canals

Amalgam removed, case closed flap crown lengthening and a bonded composite placed. Basic gutted cavity prep and DP removed
1 strip into the teeth, without widening the canals

Post-endo, compromised premolar

Ribbond wetted with S3 Bond then blotted dry.
DC Core Plus injected into chamber and the Ribbond placed into the chamber.

1st strip packed vertically into the chamber
2nd strip immediately packed into the chamber and any void filled with more DC Core Plus.
Wait 5 minutes for the DC Core Plus and Sillendorf to auto-cure then cure with a light.
This reduces the C-Factor shrinkage stresses on the bond.

Prepped, retraction cord in place

Note: the palatal BioRim is intact
Anti-rotation and additional stress distribution with a bonded onlay.

Which cusps can be saved?

Check occlusal contacts with bite paper after removal of old restoration
Compression - Usually safe
Tension - Risk of fracture

Chewing motion with bite paper
Compression cusps: If the base is wide, safe to keep.
Tension cusps: Tender, they will eventually fracture.
Form is principle, flexible in practice.

Chewing motion with bite paper
Load Direction
Buccal Tension Cusp has already been lost
Firm in principle, flexible in practice
Chewing motion with bite paper

Removal of the amalgam revealed a near vertical fracture under the palatal cusp. Danger of eventually transecting the pulp horn.

Chewing motion with bite paper

Careful dissection of the fracture, staying on the palatal side of the fracture line. Most of the fracture could be dissected out.

Chewing motion with bite paper

Air abraded prior to bonding an e.max 640-CAD/CAM restoration.

The invisible margin trick

After bonding, a bead of warmed composite is placed onto the buccal margin before seating the restoration into the unset composite.

Completed restoration

Extrapolate margins recontoured and bleaching retained.

Chewing motion with bite paper

Ends tooth. Lingual cusp was in tension. Catastrophic fracture! Buccal compression cusps are still intact.

What can I save?

Chewing motion with bite paper

Consider the opposing cusp recontour if needed.

What can I save?

Chewing motion with bite paper

Protecting a cusp that is not in occlusion. The “bear hug” rule: No lateral incisonal tension guide facets chew with bite paper.
Protecting a cusp that is not in occlusion
The “bear hug”

Premier Two-stripper 776.4F

Cusps – to overlay or not?
Distolingual cusp was cracked
Mesiolingual cusp was sound and has a wide buccolingual base

Completed e.max HT “bear hug”

Micro-occlusal design is critical

Endo Onlay Crown
Conserve valuable tooth structure with adhesive ceramics

Keep margins in enamel if at all possible
A hole in one!
Keep margins in enamel if at all possible

Cutting a full ferrule prep not only destroys the BORM but also removes all the enamel which is the best bonding surface we have!

Straight out of the furnace
No occlusal adjustment needed
Occlusal forces kept compressive and centralized
Limited torquing moment

The compromise
Accept some discolouration in the cervical region to preserve the BORM

We now come full circle

The primary goal is to help patients either maintain or regain a healthy Biofilm through pH management

The Original Microdentistry!
Avoid destroying the critical occlusal anatomical structures.
Diagnose early and accurately and treat accurately and minimally.

On previously compromised teeth, restore the compression dome/tension ring/peripheral rim complex and maintain the BIO-RIM with onlay adhesive restorations to restore true function to the tooth and reduce the potential for on-going collapse

Bibliography
www.advancedental-ltd.com
(Bibliography tab)
Contact
gwmilicich@xtra.co.nz
PDF of Endo Core Technique
password to read and print: ABD
More Ribbond endo core cases on Ribbond website