coltène®

ONE COAT BOND

Universal light-curing dental adhesive

Technical Product Profile

coltène whaledent®

Content

1. Summary

All the power you need in one drop – 100 % bond, 0 % acetone.

Coltène Whaledent presents a:

- Light-curing
- Single component
- One coat
- Solvent free
- universal dental adhesiv system.

Coltène® ONE COAT BOND is quick and easy to use. Just apply one drop of bond on to the prepared and conditioned tooth and light cure. It is delivered in a single component syringe. Independent studies confirm high bond strength and perfect marginal seal.

Coltène® ONE COAT BOND is compatible with water to support the total etch and wet bonding technique. Due to its excellent wetting properties there is no need for a chemical carrier such as acetone or ethanol. Thus this bond is a very economical and super concentrated universal adhesive. It also bonds composite to precious and non-precious metals, ceramics, set amalgams, glass ionomer cements and compomers. In addition it can be used to seal cervical areas.

Coltène® ONE COAT BOND is easy to use. It features a drip free precise handling because of its "no slump" gel consistency. This bonding agent is dispensed directly from the syringe onto any brush, enabling easy placing in the cavity instead of predosing in a mixing well. One syringe contains 1.2 ml of highly concentrated adhesive providing an average of up to 100 applications.

2.1 Introduction

Clinically the use of dentine bonding agents is attributed to the fact, that dental composites shrink during polymerization. In addition they have a different thermal expansion coefficient than dentine or enamel. Depending on this a marginal gap could be the result of insufficient bonding. To eliminate any tendency of marginal disintegration and thus bacteria infiltration, dentine bonding agents are very important in aesthetic restorative dentistry. These agents are also used to seal cavities, stabilize the tooth structure and bond composite to other kinds of dental materials.

2.2 Enamel Bonding

Pure Enamel-bonding has been used for some 40 years. Hereby a retentive pattern is prepared on the enamel with acids. Then the enamel is covered with low viscosity resins. These resins are based on the Bowen-Formula (e.g. Bis-GMA) and build the link between the etched enamel retention pattern and the hydrophobic composite. Enamel bonding agents are not capable to wet the dentine surface or to penetrate tubules and collagen network.

2.3 Dentine Bonding

2.3.1 General Considerations

Dentine is a heterogeneous material with different levels of mineralisation. Dentine liquor, an extra-cellular fluid from the pulp, fills the tubules and is responsible for the moist environment of dentine. After any preparation the dentine is covered with an inhomogeneous smear layer, which plugs the dentinal tubules. Prior to any bond application the smear layer has to be removed or modified.

2.3.2 Dentine Management

There are two main routes for preparation of the smear layer and application of bonding systems:

Smear layer removal
and subsequent priming and bonding

Some adhesive systems prepare the dentine by removing the smear layer with acids, especially phosphoric acid. This is called dentine-etching. Hereby the smear layer is removed and the dentinal tubules are opened. In addition a thin top layer of hydroxy-apatite of dentine is dissolved to expose the collagen fibers. The acid is rinsed with water and dried shortly with compressed air or a cotton pellet. Phosphoric acid has been used in many Japanese products as dentine conditioner for over a decade. The technique of acid etching of dentine is called „total etch technique" or, as wet dentine increases bond strength (Pashley et al., 1994[1]), it is also named „wet bonding technique". If the dentine is over-dried after etching the collagen fibers collapse and the bond strength decreases notably (Tay et al., 1996[2]). The enamel surface is relatively smooth in comparison to the sponge-like collagen network. So it is possible to dry the smooth enamel and keep the collagen network wet. After etching the dentine the collagen network is primed and the corresponding bond is applied.

Modification of
the smear layer with subsequent bonding

With other systems the smear layer is not removed but modified by a conditioner, containing organic acids which are able to dissolve the mineral components of dentine.

Modern 4th generation bonding systems use maleic-acids or diluted poly-acrylic-acids. During the first application process the primer wets the smear layer, then dissolves the smear layer and the hydroxy-apatite and finally precipitates it. When these acids are combined with hydrophilic bipolar low viscosity monomers (e.g.: HEMA) the conditioning of the dentine and the penetration of resins into the dentine is done simultaneously. These systems are called self conditioning primer systems. The conditioner remains on the surface and is not rinsed off. The problem of a collapsing collagen network through drying of dentine with compressed air is excluded. After this priming step the bond is applied.

2.3.3 Bonding Mechanisms

The break-through with dentine bonding systems appeared, when amphilic monomer resins, called coupling agents, enabled the adhesion between composite and dentine. These monomers have hydrophilic and hydrophobic groups. The hydrophilic groups are the links to the tooth structure, the hydrophobic groups link to composite. The early systems introduced were multi-component-systems with quite difficult and time-consuming procedures to prime the dentine prior to bond application.

After bond application and polymerization a hybrid-layer is built consisting of polymerized resins and collagen fibers. The bond strength depends on the penetration depth of the low viscosity primer monomers on the tooth structure. (Van Meerbeck et al., 1992[3]).

Volatile organic solvents such as acetone or ethanol remove the moisture inside the network and the primer monomers penetrate into this network and the dentinal tubules (Gwinnett, 1992[4]).

Despite of these technological improvements, marginal integrity remained to be of critical significance (Youngson et al., 1990[5]) making further modifications on existing bonding agents necessary. If the cavity walls are sealed the ingress of bacteria is avoided. The priming process has to perform so well, that the monomers impregnate the collagen network completely and no water is left between the demineralized dentine and the hybrid layer. Remaining water leads to „Nano Leakage" (Sano et al. 1995[6]) and dissolves the polymers. As a result of these findings special primer solutions were formulated to particularily wet dentine and modify the smear layer in a self-etching or self-conditioning priming process. Such prepared surfaces notably increase bond strength and enhance marginal seal (Gwinnett, 1994[7]).

2.4 Bonding Technologies

2.4.1 Self-conditioning priming and dentine bonding

Coltène introduced coltène® A.R.T. BOND, the Advanced Retention Technology Bond. This self-priming system, consisting of A.R.T. BOND Primer A&B and A.R.T. BOND Bond, performs clinical outstandingly as confirmed by a large number of independent researchers (see A.R.T. BOND broshure). Despite the mixing process of the two primer components, Primer A&B, this bond is already as easy to use as many one bottle prime and bond resins.

2.4.2 One bottle prime and bond resins

Since the introduction of Single-Component-Adhesives the demand for reliable and clinic-proven multi-component-systems dropped for the ease of having just one bottle of bond used as two-step "prime and bonding resins". After total etch it is still required to apply several layers of adhesive application with a well soaked brush. These systems, most of them are acetone or ethanol based, fulfill the requirements of a priming solution in preparing dentine, and moreover act as an adhesive when brushed to dentine and enamel again. Single bottle bonding systems are also called 5th generation systems.

2.4.3 Single coat bonding systems

These adhesives are the latest in bonding technology. They are single bottle bonding systems and require just one single coat after total etch (not consecutive coats with resoaked brushes) to apply one layer of adhesive on the tooth structure. Intensive research of Coltène/Whaledent lead to the unique universal adhesive Coltène® ONE COAT BOND. This bond combines the high clinical performance of multi-component systems with the easy procedure of a single coat bond application. Coltène® ONE COAT BOND reduces adhesive applications to just one single step, no matter to which material the composite (e.g. BRILLIANT or SYNERGY) is bonded to. It contains no volatile organic solvents but very hydrophilic mono-and difunctional methacrylates with hydroxy groups network to provide reliable clinical results.

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3.1 System

Modern „One bottle“ adhesive systems require multiple steps and contain two system components:

- Acid (mostly higher than 30% phosphoric acid) to condition the dentine and the enamel.
- Primer/Bond solution combined in a single bottle.

Depending on the manufacturer the following steps are typically required to restore teeth with composite in the direct technique with a one bottle bond (see table).

Steps	Traditional One bottle bond	coltène® ONE COAT BOND	
1. Acid etch	Yes	Yes	30 Seconds
2. Rinse	Yes	Yes	20 Seconds
3. Blot dry	Yes	Yes	2 Seconds
4. Adhesive application	Yes	Yes	20 Seconds
5. Adhesive set	Yes	No	
6. Additional adhesive coat	Yes	No	
7. Adhesive air thin	Yes	Yes	2 Seconds
8. Adhesive light cure	Yes	Yes	30 Seconds
9. Additional adhesive coat	Yes	No	
10. Additional adhesive dry	Yes	No	
11. Additional adhesive light cure	Yes	No	

3.2 Indications

Coltène® ONE COAT BOND is indicated to bond composite to:

- dentine and enamel
- precious and non precious metals
- ceramic
- set amalgam
- compomer
- glass ionomer

and sealing of cervical areas. To demineralize sclerotic dentine the use of high concentrated acids (e.g. coltène® ETCHANT GEL S, 35% phosphoric acid) or longer etching times are indicated.

3.3 Chemistry of the components

3.3.1 coltène® ETCHANT 15

Coltène® ETCHANT 15 is an application optimized etchant gel. Its chemical composition combines low acid concentration of 15% phosphoric acid with excellent conditioning results. The composition consists of water, phosphoric acid, amorph silicic acid, color pigments and surfactants.

The thickeners, a combination of amorph silicic acid and low molecular weight water soluble polymers improve the handling. The etchant becomes non slumpy and does not dry out. The residual fumed silica on the dental surface after rinsing with water do not effect bond strength. ONE COAT BOND contains a low percentage of silica too.

The green dye pigments, which are insoluble in water, cause no discoloration of any dental tissue. The green color is perfectly visible providing an easy application. A complete removal of the etchant is achieved by rinsing with water.

The surfactants support the moistening of the dental tissue. This causes best results both on enamel and dentine even under mild conditions of a 15% phosphoric acid. Coltène decided to use low acid concentration to reduce possibilities of postoperative sensitivity (Pashley et al., 1992[8]). Dentists can feel comfortable when using this total etch technique.

3.3.2 Coltène® ONE COAT BOND

Coltène® ONE COAT BOND is optimized in application and bond strength. Its very easy application (one bottle, one coat) generates outstanding results compared to any 4th and 5th generation systems.

Coltène® ONE COAT BOND is used with

the "total etch technique" and "wet bonding technique". Priming and bonding is carried out in one single step. The special gel like consistency of the bond offers optimized handling in combination with outstanding bond strength to dentine and enamel.
Coltène® ONE COAT BOND is a composition of hydroxyethylmethacrylate (HEMA), hydroxypropylmethacrylate, methacrylate modified polyacrylic acid, urethanedimethacrylate, glycerol dimethacrylate, amorph silicic acid, water (5%), initiators and stabilizers. This composition of bond formulation reduces the stress caused by composite polymerisation to the dental tissue and acts as absorber.
Each substance has a special function. The interaction of all components result in good bond strength after polymerization (Ruyter, 1995[9]).

Hydroxyethylmethacrylat,
Hydroxypropylmethacrylat:
Monofunctional methacrylates with hydroxy groups are compatible with water (hydrophilic). The small molecules are able to penetrate the collagen network and form hydrogen bridges among themselves and the collagen network (Nakabayashi et al., 1992[10]).

Methacrylate modified Polyacrylic acid
(MMA modified PAAc):
A hydrophilic polyacrylic acid with methacrylic acid ester and carbon acid side groups. The acid groups are able to form stable complexes with calcium ions present in dental tissues. They also form hydrogen bridges, especially to the collagen network. The methacrylic ester side groups are involved in the polymer network after polymerization.

Urethanedimethacrylate,
glycerol dimethacrylate:
These monomers are difunctional and form a strong polymer network after polymerization. They are also able to form hydrogen bridges.

Water:
ONE COAT BOND contains some water (5%) which is necessary for the manufacturing process. The water does not separate from the organic components because ONE COAT BOND is compatible with water to a certain amount.

Amorph silicic acid:
The fumed silica, also called nanofiller, generate the gel like consistency. ONE COAT BOND contains 5% of fumed silica, that reinforces the polymer network after polymerization.

Photoinitiators:
The photoinitiators are chosen to produce enough radicals, that initiate polymerization to get a strong polymer network with common polymerization lights.

Stabilizers:
The stabilizers are chosen to provide a minimum of 2 year shelf life at room temperature.
Coltène® ONE COAT BOND consists of 53% hydrophilic monomers and 41% low hydrophilic (hydrophobic monomers).

3.4 Bond application and mechanism of adhesion

ONE COAT BOND is directly dispensed from the syringe on to the brush. The gel like consistency allows exact dispensing of the desired amount of bond without dripping.

3.4.1 Wetting of the tooth

Successful bonding can only be achieved when the respective adhesive flows readily over the surface of dentine and enamel.

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This bond is rubbed in to the cavity with a brush. The rubbing breaks the gel consistency, and the bond becomes liquid. The full penetration and wetting of the dental tissue is assured.

3.4.2 Penetration of dentinal structure

Beyond initial wetting the porous dentinal structure must be infiltrated to resist to debonding of any part of the cavity. At this stage of application the hydrophilic monomers wet the dental tissue and form an organic layer with collagen fibers, dentine and enamel. The polar groups are orientated in the direction of the dental tissue and form hydrogen bridges and complexes with calcium ions as mentioned above. The hydrophobic parts of the molecules promote now the penetration of the other monomers, especially glycerol dimethacrylate and urethanedimethacrylate. Thus the water (in the case of wet bonding) is replaced by the monomers (Tay et al., 1996[11]). No additional solvent (acetone, ethanol, water) for the ONE COAT BOND is necessary. This effect, based on the special composition of the bond guarantees a good penetration into the tubules and the collagen network with bonding agent. In addition this provides a sealing of the dentinal tubules. With a short airblow of compressed air (2 seconds) the bond layer is thinned.

3.4.3 Micromechanical retention

Finally the polymerized adhesive has to interlock closely with the conditioned enamel and dentine surface. The methacrylate groups of the bond are polymerized by visible halogen light to form a stable network. The bond strength to the dental tissue is partly caused by molecular interactions between the dental tissue and the polymer matrix. The higher values of the bond strengths are achieved by micromechanical retention forming a hybrid layer in the collagen network and polymerized bond tags in the tubules. The mechanical stability of the cross-linked polymer network is enhanced by the large amount of difunctional (urethanedimethacrylate) and polyfunctional (MMA modified PAAc) methacrylates.

3.4.4 Stress resistance

Fumed silica, which acts in the polymerization phase as additional filler reduces the setting shrinkage and reinforces the polymerized bond (Miyazaki M. et al., 1995[12]). Excellent marginal integrity is a must for long-term performance.

4.1 List of studies performed

Several systematic studies where undertaken in order to verify the safety and performance of coltène® ONE COAT BOND. The bond strengths of coltène® ONE COAT BOND to tooth substrate were tested by independent researchers at several universities.

- In-Vitro Comparative Bond Strength of a New Dentine Bonding Agent J.O. Burgess, X.Xu, J. Gallo, G.J. Re, Louisiana State University, New Orleans, USA.
- Bond Strength of New Dentine Bonding System ONE COAT BOND. M.F. Burrow, University of Melbourne, AUS.
- Comparison of the Adhesive Bonding Characteristics of DE Bond (ONE COAT BOND) on Dental Materials. J.F. McCabe, Dental School, University of Newcastle upon Tyne, UK.
- Scherfestigkeitstest mit ONE COAT BOND K.-J. Reinhardt, Universität Münster, D.
- Prüfung des experimentellen Dentinhaftmittels (ONE COAT BOND) in Kombination mit Kompositmaterialen SE Composite (SYNERGY) an gemischten Klasse-V-Füllungen. J.F. Roulet, U. Blunck, Universitätsklinikum Charité, Medizinische Fakultät der Humboldt Universität zu Berlin, D.
- Ausstossversuche mit experimentellem Bond (ONE COAT BOND). B. Haller, Polyklinik für Zahnerhaltung, Universität Ulm, D.
- In-Vitro-Evaluation eines neuen Adhäsivsystems in gemischten keilförmigen Klasse-V-Kavitäten. F. Lutz, I. Krejci, Zahnärztliches Institut der Universität Zürich, Schweiz.
- In-Vitro-Evaluation eines neuen Adhäsivsystems in Klasse-II-Kavitäten. F. Lutz, I. Krejci, Zahnärztliches Institut der Universität Zürich, Schweiz.
- Rapport de recherche concernant l'évaluation du système adhésif ONE COAT BOND. S. Gonthier, L. Hitmi, J.-P. Attal, M. Degrange, Département de Biomatériaux, Faculté de Chirurgie Dentaire Paris V, France.
- Adhesive Fatigue Limit von One Coat Bond, A. Petschelt, R. Frankenberger, Universität Erlangen-Nürnberg, D.
- C. Kälin, S.J. Paul, P. Schärer, u.a., University of Zurich, University of Los Angeles, University of Basel; Evaluation of the interface between one-bottle bonding agents and dentin by cryopreparation and low-temperature scanning electron microscopy (LTSEM). A pilot study on perfused dentinal samples, in J. of Dentistry 26 (1998) 511-520.

4.2 Study results on Coltène® ONE COAT BOND:

Shear bond strength
on dentine after thermal cycling

Burgess J.O.:	25 ± 7 MPa (SYNERGY)
	25 ± 4 MPa (HERCULITE)
	19 ± 5 MPa (Z-100)
K.-J. Reinhardt.:	31.6 ± 1.3 MPa

Piston ejection tests after
storage in physiological NaCl solution

Haller B.:	18.5 ± 8.4 MPa

Shear bond strength
on dental materials after thermal cycling

McCabe J.F.:	*High Gold*	10.9 ± 3.1 MPa
	Midi Gold	10.2 ± 2.3 MPa
	Rexilium	19.2 ± 7.1 MPa
	Titanium	24.5 ± 4.7 MPa

Marginal integrity
perfect marginal adaptation in mixed class V cavities

Lutz / Krejci:	98.4 % (dentine)
	93.9 % (enamel)

Interface
Kälin, Paul, Schärer et al. (1998):
"Results. Acid-etching the dentin resulted in the removal of the smear layer for all materials tested. Those one-bottle DBAs which recommend the application of two consecutive resin layers (P&B 2.1 and Syntac SC) showed incomplete saturation of the dentinal surface after application of the first layer. With Syntac SC the incomplete saturation was more pronounced than with P&B 2.1. The use of Exp. (ONE COAT BOND) resulted in a much more homogeneous coverage of the dentin despite only one layer of resin having been applied."

References

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