

# Universal / Multi-Mode Adhesives in descriptive review: Innovative or traditional systems?



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## Introduction

Recently appeared on the market simplified adhesive systems (AS) designated as Universal (UAS) or "Multi-Mode" adhesives (MM) These AS can be used under Etch&rinse (ER), Self-Etch (SE) mode or with enamel selective etching.

## Objectives

Descriptive review of UAS regarding labelling (composition, solvent, acidity), advantages over ER and SE systems and performance evidences.

## Methods

Literature search in MEDLINE/PubMed, Science Direct was conducted, between the years 2010-2015, with the keywords: "Dentin/Enamel bonding agents", "self-etch adhesives", "etch & rinse adhesives", "universal adhesives", "multimode adhesives", "simplified adhesives". Fifty articles were identified. Methodology included publications of meta-analysis, narrative/systematic review, *in-vitro* and clinical trials.

## Results

Seventeen publications were selected: one meta-analyse, one systematic review, 13 *in vitro* and two clinical trials. UAS labelling/pH/solvent were registered (Table 1): *Scotchbond Universal (3M/ESPE)*; *Futurabond U (Voco)*; *Clearfil Universal Bond (Kuraray)*; *Xeno Select (Dentsply)*; *All-Bond Universal (Bisco)*; *G-Bond Plus (GC)*; *Adhese Universal (Ivoclar Vivadent)*; *Peak Universal Bond (Ultradent)*. In most UAS, the solvent is ethanol with or without water; classified as moderate (pH 1-2), mild (pH ≈ 2), ultra mild (pH> 2.5) in acidity. Main advantage associated with versatility of instructions for use (ER and/or SE) (Table 2). UAS effectiveness appears to depend on the chemical composition. Further clinical and laboratorial trials should be conducted to evaluate the effectiveness of these universal adhesive systems.

YEAR	B. Ref. AUTHORS	OBJECTIVES	UNIVERSAL ADHESIVES STUDIED	OTHERS AS STUDIED
<b>SYSTEMATIC REVIEW</b>				
2014	Sezinando	Understanding of the evolution of adhesive systems and which adhesion strategy might be more useful to clinical practice	All Bond / Xeno select/ Adhese Universal / G-aenial bond/ Clearfil Universal Bond / Scotchbond Universal	ER, SE, U
<b>META-ANALYSIS</b>				
2015	Wellington <i>et al.</i>	To determine whether the ER or SE mode is the best protocol for dentin and enamel adhesion by UAS	Scotchbond Universal / G-Bond Plus / Peak Universal / Futurabond U / Xeno select / All-Bond	n.a.
<b>IN VITRO STUDYS</b>				
2013	Bruno Seabra <i>et al.</i>	To evaluate the influence of 2 new multimode MDP-containing adhesives and several applications protocols of a zirconia primer on the shear bond strenght of composite resin to zirconia	All Bond / Scotchbond universal	n.a.
	Munoz <i>et al.</i>	To evaluate the dentin microtensile bond strenght, nanoleakage, degree of conversion within the hybrid layer for ER and SE strategies of simplified UAS	Scotchbond Universal / All Bond Universal / Peak Universal adhesive	Clearfil SE Bond, Adper Single Bond
	Hatta <i>et al.</i>	To evaluate the shear bond strenght of nanocomposite to stainless steel crowns using a new UAS	Scotchbond Universal	Adper single Bond Plus Prime&BondNT
2014	Mattar & Musalem	To study the tooth-restoration adhesive interface using a UAS, with the techniques of etching and self-etching using scanning electron microscopy	Single Bond Universal*	n.a.
	Kearns <i>et al.</i>	To assess the adhesive performance of three UAS (SE and ER protocols) with cuspal deflection and cervical microleakage score	Scotchbond Universal / Futurabond U/ Prime&Bond Elect Universal**	n.a.
	Wagner <i>et al.</i>	To compare the microtensile bond strenght and resin penetration into dentine of three UAS applied in two different etching modes (SE or ER) and the effect of thermocycling	Futurabond U/ Scotchbond Universal / All bond universal	Futurabond DC Futurabond M
	Luque-Martinez <i>et al.</i>	To evaluate the microtensile bond strenght and nanoleakage of three universal or multi-mode adhesives applied with increasing solvent evaporation times	All-Bond Universal / Prime&Bond Elect Universal** / Scotchbond Universal	n.a.
	Marchesi <i>et al.</i>	To investigate the adhesive stability (microtensile bond strenght, interfacial nanoleakage expression and matrix metalloproteinases activation) over time (24h, 6 months and 1 year)of a multi-mode one-step adhesive applied using different bonding techniques on human coronal dentine	Scotchbond Universal	Prime&Bond NT
2015	Munoz <i>et al.</i>	To evaluate the effect of an additional hydrophobic resin coating on the resin-dentine microtensile bond strenght, nanoleakage and in situ degree of conversion of three universal adhesives used in the ER and SE modes	All Bond Universal / G-Bond Plus / Scotchbond universal	n.a.
	Rodrigues <i>et al.</i>	To compare dentine permeability of different adhesive systems with and without hidrophobic resin and analyse the influence of pulpal pressure on the morphology of adhesive interface	Futurabond U	Adper Easy Bond, Adper Scotchbond 1 XT, Adper Scotchbond multi-purpose
	Hurtado <i>et al.</i>	To evaluate the nanoleakage of adhesive interface using a UAS by SE mode	Xeno select	n.a.
2015	Chen <i>et al.</i>	To examine the short-term in vitro performance of five universal adhesives bonded to human coronal dentin	Prime&Bond Elect Universal** / Scotchbond universal / All bond Universal / Clearfil Universal Bond / Futurabond U	n.a.
	Loguercio <i>et al.</i>	To evaluate the effect of adhesion strategy on the enamel, microshear bond strenght, etching pattern and in situ degree of conversion of seven UAS	Adhese Universal / All Bond Universal / Clearfil Universal / Futurabond U / G-Bond Plus / Prime&Bond Elect Universal** / Scotchbond universal	n.a.
<b>CLINICAL TRIALS</b>				
2013	Mena-Serrano <i>et al.</i>	To evaluate the 6-month clinical performance of Scotchbond Universal Adhesives in noncarious cervical lesions using two evaluations criteria	Scotchbond Universal	n.a.
	Perdigão <i>et al.</i>	To evaluate the 18-month clinical performance of a multi-mode adhesive in noncarious cervical lesions using two evaluations criteria	Scotchbond Universal	n.a.

\* Single Bond Universal (3M-ESPE) ≈ Scotchbond Universal; \*\* Prime & Bond Elect Universal (Dentsply Caulk, Milford DE, USA); ER = Etch & Rinse; SE=Self-Etch; n.a.- Not applicable

UNIVERSAL ADHESIVE (UAS)	COMPOSITION*	pH* ACIDITY	SOLVENT*
Scotchbond Universal (3M ESPE)	BISGMA, HEMA, decamethylene dimethacrylate, ethanol, water, silane 2-propenoic acid, 2-methyl-, 1,10-decanediol and phosphorous oxide (P205), copolymer of acrylic and itaconic acid, dimethylaminobenzoat(-4), camphorquinone, DMAEMA, methyl ethyl ketone	2,7 (ultramild)	Ethanol, water
Futurabond U (Voco)	Liquid 1: acidic adhesive monomer, HEMA, BISGMA, HDDMA, Initiator, catalyst, UDMA, pyrogenic silisic acids; catalyst; Liquid 2: ethanol	2,3 (mild)	Ethanol
Clearfil Universal Bond (Kuraray)	10-MDP, BISGMA, HEMA, ethanol, hydrophilic aliphatic dimethacrylate, colloidal silica, camphorquinone, silane coupling agent, accelerators, initiators, water	2,3 (mild)	Ethanol, water
Xeno select (Dentsply DETREY)	Bifunctional acrylates, Ethyl 2-[5-dihydrogen phosphoryl-5,2-dioxapentyl]acrylate, acidic acrylate, water, T-butanol	< 2 (moderate)	T-butanol, water,
All-Bond Universal (Bisco)	10-MDP, HEMA, BISGMA, ethanol, water, initiators	2,5-3,5 (ultramild)	Ethanol, water
G-Bond Plus (GC)	Acetone, water, dimethacrylate, 4-MET, phosphoric acid ester monomer, silicon dioxide, photo initiator	1,5 (moderate)	Acetone, water
Adhese Universal (Ivoclar Vivadent)	HEMA, BISGMA, ethanol, 1,10-decanediol dimethacrylate, methacrylated phosphoric acid ester, camphorquinone, 2-dimethylaminoethyl methacrylate	2,5-3 (ultramild)	Ethanol
Peak Universal (Ultradent)	Methacrylic acid, ethanol, HEMA, chlorhexidine di(acetate)	1,2-2 (moderate)	Ethanol

HEMA: 2-hydroxyethyl methacrylate; PENTA: dipentaerythritol pentaacrylate monophosphate; TEGDMA: triethylene dimethacrylate; 4-MET: 4-methacryloyloxyethyl trimellitic acid; BISGMA: Bisphenol A-glycidyl methacrylate; HDDMA: 1,6-hexanediol dimethacrylate; UDMA: urethane dimethacrylate. 10-MDP: 10-methacryloyloxydecyl dihydrogen phosphate; DMAEMA: dimethylaminoethyl metacrilate

\* According to Manufactures Directions For Use and safety data sheet

**Table 1** – UAS: Monomer/solvent composition; Acidity (pH) classification (Tay and Pashley, 2001 *cit in* Sezinando A, 2014): **Strong** - pH<1; **Intermediately strong** or **moderate**: 1<pH<2; **Mild**: pH≈2; **Ultra-mild**: pH>2,5

**Table 2** - Descriptive Review of publications (authors, year, objectives, UAS studied) included: Systematic/narrative review; Meta-analysis, *in vitro* study's; Clinical trials.

## Conclusions

Universal Adhesive Systems (UAS) do not greatly differ from traditional ER/SE systems; Chemical interaction is a crucial characteristic of UAS to enhance durability of dentin–resin interfaces; Similar performance to some SE, but less than some ER adhesives especially in enamel.

## Clinical Implications

UAS although versatile in application do not match technological innovation when compared to traditional ER and SE. AS innovation requires bio-protective and bio-promoter effects in the enamel and dentin.

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## Keywords

Dentin/Enamel bonding agents  
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Multimode adhesives  
Simplified adhesives

