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Bonding to oxide ceramics—Laboratory testing versus clinical outcome

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ABSTRACT

Objectives. Despite a huge number of published laboratory bonding studies on dental oxide ceramics clinical long-term studies on resin bonded oxide ceramic restorations are rare. The purpose of this review is to present the best available clinical evidence for successful bonding of dental oxide ceramic restorations.

Methods. Clinical trials with resin-bonded restorations that had no or only limited mechanical retention and were made from alumina or zirconia ceramic were identified using an electronic search in PubMed database. Overall 10 publications with clinical trials could be identified. Their clinical outcome was compared with that laboratory bond strength studies. **Results.** Clinical data provide strong evidence that air-abrasion at a moderate pressure in combination with using phosphate monomer containing primers and/or luting resins provide long-term durable bonding to glass-infiltrated alumina and zirconia ceramic under the humid and stressful oral conditions.

Significance. As simple and clinically reliable bonding methods to oxide ceramics exist, the rationale for development of alternative bonding methods might be reconsidered especially when these methods are more time consuming or require rather complicated and/or technique sensitive procedures.

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1. Introduction

In recent years one of the most popular research subjects in dental materials science has been – and still is – all-ceramic materials and within that field bonding to zirconia and other oxide ceramics [1–3]. Conducting a PubMed database search in May 2014 for articles dealing with the resin bond to dental zirconia ceramic reveals an astonishing increase of research

being published in the last two decades years (Table 1). While from 1990 to 1999 in total only 5 articles on this topic could be identified in the PubMed database, it increased to 15 articles in the years 2000–2004 and to 96 articles from 2005 to 2009 (Fig. 1). This number has already been topped by 151 articles, which have been published from 2010 until May 2014.

Unfortunately, the vast majority of the articles present laboratory research, reviews or case reports, while clinical trials are rare (7 out of 267 articles). The large number of articles

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Table 1 – Failure rates of oxide ceramic fixed dental prostheses retained by resin-bonded retainer wings or inlays related to the pontic location.

First author of most recent publication	Retainers	Location	N	Ceramic	Bonding method		Time in months	Failure and complication rates in %	
					Surface conditioning	Primer/luting resin		Failure	Debonding
Kern 2011 [10–12]	2 wings	Anterior	16	Alumina (In-Ceram Al)	Silica coating (Rocatec)	Espe Sil/Panavia	120	26.1	0
Kern 2011 [11,12]	1 wing	Anterior	21	Alumina In-Ceram Al/Zr	Air-abrasion with alumina	No primer/Panavia 21	120	5.6	0
Galiatsatos 2014 [13]	2 wings	Anterior	54	Alumina (In-Ceram Al)	Air-abrasion with alumina	Monobond S/Variolink II	96	14.8	3.7
Sasse 2013 [25,26]	1 wing	Anterior	16	Zirconia (e.max ZirCAD)	Air-abrasion with alumina	No primer/Panavia 21	64	0	6.3 ^a
Sasse 2013 [25,26]	1 wing	Anterior	14	Zirconia (e.max ZirCAD)	Air-abrasion with alumina	Metal/Zirconia Primer/Multilink automix	64	0	7.1 ^a
Sailer 2014 [27]	1 wing	Anterior	15	Zirconia (various)	As machined + ethanol cleaning	Clearfil Porcelain Bond/Panavia 21	53	0	13.3
Sasse 2014 [28]	1 wing	Anterior	42	Zirconia (various)	Air-abrasion with alumina	No primer/Panavia 21	62	0	4.8 ^a
Ohlmann 2008 [23]	2 inlays	Posterior	13	Zirconia (e.max ZirCAD)	Silica coating (Rocatec)	Monobond S/Panavia F	12	23.1	46.2 ^b
Abou Tara 2011 [24]	2 inlays with wings	Posterior	23	Zirconia (YZ cubes)	Air-abrasion with alumina	No primer/Panavia 21	20	0	4.3

^a All debondings were caused by traumatic incidents.

^b Adhesive failure between the framework and the luting cement was observed for all debonded IRFDPs.

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