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RESEARCH ARTICLE

XP Bond in Self-Cure Mode Used for Luting Porcelain Restorations: 4-year Recall

[1]Marco Ferrari, [2]Maria Crysanti Cagidiaco, [3]Cecilia Goracci, [4]Antonella Polimeni

[1]Professor and Chair, Department of Dental Materials and Prosthodontics, University of Siena, Siena, Italy

[2]Assistant Professor, Periodontics and Preventive Dentistry, University of Siena, Siena, Italy

[3]Assistant Professor, Department of Dental Materials and Prosthodontics, University of Siena, Siena, Italy

[4]Professor and Chair, Pediatric Dentistry Department, University La Sapeinza, Rome, Italy

Correspondence: Marco Ferrari, Professor and Chair, School of Dental Medicine, Policlinico Le Scotte, Viale Bracci 1 Siena-53100, Italy

ABSTRACT

Purpose: The aim of this clinical study was to evaluate some clinical parameters of Empress II restorations luted under clinical conditions with XP Bond in combination with SCA and Calibra cured in self-cure mode after 4 years of clinical service.

Materials and methods: Fifty-three restorations were placed in 38 patients from March 2006 until April 2006. No patient received more than two restorations. Luting procedures were performed following manufacturers' instructions. The restorations were evaluated for post-operative sensitivity, marginal discoloration, marginal integrity, secondary caries, maintenance of interproximal contact and fracture at baseline, after 2 weeks, 6 months, 1, 2, 3 and 4 years of clinical service.

Results: At the 4-year recall 49 restorations were reevaluated. The clinical examination showed that postoperative sensitivity did not affect any restoration. Only 5 restorations of 49 showed bravo score and 2 charlie for marginal integrity/stain.[1] restoration showed bravo score at vitality test and another restoration for interproximal contact. Secondary caries, retention and fracture parameters showed alpha scores.

Conclusion: All the evaluated restorations were in place and acceptable. The postoperative sensitivity recorded after using XP BOND with SCA and Calibra in self-cure mode was clinically acceptable after 4 years of clinical service and no serious endodontic complications were recorded.

Keywords: Ceramic crowns, Self-curing, Clinical trial, Bondings.

INTRODUCTION

In 2007, XP Bond was proposed and tested experimentally showing high values in microtensile bond strength data compared to other systems, when the adhesive was used with SCA and Calibra in self-cure mode.[1] Then, the baseline, the 1, 2 and 3 years reports of postoperative sensitivity and clinical parameters on XP Bond (Dentsply De Trey, Konstanz, Germany) used in combination with SCA and Calibra dual cure resin cement for luting indirect posterior porcelain restorations were published.[2-5] Postoperative sensitivity can be commonly found in vital teeth in which porcelain crowns were luted.[6]

When porcelain restorations are luted on vital abutments, a perfect bonding, which has to integrate all parts into one coherent structure, is a strong need.[7] Therefore, luting material and technique as well as the substrate characteristics represent success determining factors.[8]

Among different combinations of adhesive-luting materials dual-curing bonding systems are often the first choice,[9-18] because they allow polymerizing the adhesive materials and the resin cement below thick ceramic restorations.

The aim of the present prospective clinical trial was to evaluate the 4-year clinical behavior of Empress II restorations (Ivoclar-Vivadent, Schaan, Liechtenstein), luted with the adhesive system XP Bond (Dentsply DeTrey, Konstanz, Germany) with SCA (Dentsply Caulk, USA) and Calibra resin cement (Dentsply Caulk, USA), both used in self-cure mode.

MATERIALS AND METHODS

A consecutive sample of 53 restorations in 38 patients in need of one or two single-units was placed. Partial or full restoration was performed from the pool of patients accessing the Department of Restorative Dentistry of the University of Siena. Patients' written consent to the trial was obtained after having provided a complete explanation of the aim of study.

Inclusion Criteria

Males and females aged 18 to 60 years in good general and periodontal health were included.

Exclusion Criteria

Patients with following factors were excluded from the clinical trial:

1. Nonage (< 18 years)
2. Known pregnancy

3. Disabilities
4. Prosthodontic restoration of tooth can be expected.
5. Pulpitic, nonvital or endodontically treated teeth
6. (Profound, chronic) periodontitis
7. Deep carious defects (close to pulp, < 1mm distance) or pulp capping.
8. Heavy occlusal contacts or history of bruxism.
9. Systemic disease or severe medical complications
10. Allergic history concerning methacrylates
11. Rampant caries
12. Xerostomia
13. Lack of compliance
14. Language barriers.

Test Stimuli and Assessment

Before restoring the tooth, a pain measurement was performed utilizing a simple pain scale based on the response method. Response was determined to a one-second application of air from a dental unit syringe (at 40-65 psi at approximately 20°C), directed perpendicularly to the root surface at a distance of 2 cm and by tactile stimuli with a sharp #5 explorer. The patient was asked to rate the perception of sensitivity experienced during this thermal/evaporative stimulation by placing a mark on a visual analog scale or line beginning at 0 and ending at 10 (where 0 = no pain and 10 = excruciating pain). In order to translate these scores into easily understood pain levels, a score of 0 was defined as no pain, 1 to 4 as mild sensitivity (which was provoked by the dentist air blast), and 5 to 10 as strong sensitivity (which was spontaneously reported by the patient during drinking and eating). Only patients scoring low on the analog scale were included in the study, whereas high score cases were excluded by the assumption that irreversible pulp inflammation may be sustaining high sensitivity. The status of the gingival tissues adjacent to the test sites was observed at baseline and at each recall. Patients were recalled at our department for testing postoperative sensitivity after 2 weeks, 6 months, 1, 2, 3 and 4 years.

Clinical Procedure

For standardization purposes, the same operator performed all clinical procedures. Following anesthesia, rubber dam was placed, all carious structures were excavated, and any restorative material was removed. Preparation was performed using conventional diamond burs in a high-speed hand piece with no bevel on margins. The preparation design was dictated by the extent of decay and pre-existing restorations. The Residual Dentin Thickness (RDT) was evaluated on a periapical radiograph, and teeth with RDT thinner than 0.5 mm were excluded. After preparation, the impression of prepared tooth was taken and sent to the laboratory. A temporary restoration was inserted. One week after, the ceramic restorations were luted following manufacturer's instructions. The restorations were placed in the time period between March and April 2006 and examined for postoperative sensitivity at baseline after 2 weeks, 6 months, 1, 2, 3 and 4 years by the same operator. At each recall, data regarding postoperative sensitivity, stability and longevity were collected with reference to the USPHS criteria. Therefore, the following parameters were assessed: Postoperative sensitivity: the patient comfort with the restoration under function, cold and warm stimuli, and a gentle air stream was assessed. Sensitivity was defined by a scale from 0 to 10 as described above.

The null hypothesis tested was that the XP Bond in self-cure mode cannot prevent postoperative sensitivity after 4 years of clinical service.

The other evaluated clinical parameters were marginal discoloration and integrity, secondary caries, fracture, vitality test, retention and interproximal contacts.

RESULTS

The results are summarized in Tables 1 to 4. All 53 teeth were evaluated at baseline, after 2 weeks, 6 months, 1 and 2 years, 51 restorations after 3 years and 49 after 4 years of clinical service. At baseline, 3 patients showed preoperative sensitivity at 5 teeth. 10 cases of postoperative sensitivity were observed at the 2 weeks recall and only 3 after 6 months. In one case the postoperative sensitivity raised from 0 to 6 immediately after luting the restoration (after the anesthetic effect vanished) but dropped to grade 3 after 6 months. In 7 cases showing an increase in postoperative sensitivity after 2 weeks, the hypersensitivity disappeared completely after 6 months. In two cases a residual postoperative sensitivity of grade 2 remained after 6 months. After 2 years of clinical service postoperative sensitivity of modest entity residuated only in one patient. No adverse events/effects did occur. All other parameters showed alpha scores. After 3 years of clinical service postoperative sensitivity was not reported in any of 51 re-evaluated restorations. Five restorations showed bravo and 2 charlie scores for marginal parameters. One restoration showed bravo for pulp vitality (Table 3). After 3 years of clinical service, all restorations were still clinically acceptable.

During the 4 years recall, postoperative sensitivity was not reported in any of 49 re-evaluated restorations. Three restorations showed bravo and 2 charlie scores for marginal parameters. One restoration showed bravo for pulp vitality and another for interproximal contact (Table 4). After 4 years of clinical service, all restorations showed to be in a clinical acceptable range.

DISCUSSION

According to the results of this clinical study, XP Bond in self-cure mode could prevent postoperative sensitivity over 4 years of clinical service and the null hypothesis was rejected.

With the intention to control any additional source of variation beside the patient related variability, in this clinical trial one operator placed all the restorations. Two weeks after the placement of all restorations, postoperative sensitivity was

Table 1: Changes in pre- and postoperative sensitivity during the observation period of 2-year

Restoration	*XP Bond/SCA/Calibra [n]*		
	Preoperative sensitivity and or postoperative sensitivity 2 weeks after placement	*Type of restoration*	*Postoperative sensitivity (2-year)*
1 (#5)	6	Inlay (OD)	0
2 (#7)	1	Inlay (MOD)	0
3 (#10)	1	Inlay (MO)	0
4 (#11,14)	2	Onlay	0
5 (#26)	1	Onlay	0
6 (#20, 29)	3	Inlay (OMD) and onlay	0
7 (#32)	1	Inlay(OM)	0
8 (#39)	4	Onlay	0
9 (#43)	3	Onlay	1
10 (#46)	1	Inlay (OMD)	0
11 (#53)	3	Inlay(OMD)	0

Note: 1—lowest sensitivity, 10—highest sensitivity

Table 2: Performance criteria according to Ryge at (A) 6-month, (B) 1-year and (C) 2-year recall

A. ***Criteria*** *and* ***number*** *of restorations evaluated at 6-month recall*		*XP Bond/SCA/Calibra*			
		Alpha	*Bravo*	*Charlie*	*Delta*
• Marginal discoloration and integrity	53	53	0	0	0
• Secondary caries	53	53	0	0	0
• Vitality test	53	53	0	0	0
• Interproximal contacts	53	53	0	0	0
• Retention	53	53	0	0	0
• Fracture	53	53	0	0	0
B. *Criteria and number of restorations evaluated at 1-year recall*		*XP Bond /SCA/Calibra*			
		Alpha	*Bravo*	*Charlie*	*Delta*
• Marginal discoloration and integrity	53	51	2	0	0
• Secondary caries	53	53	0	0	0
• Vitality test	53	53	0	0	0
• Interproximal contacts	53	53	0	0	0
• Retention	53	53	0	0	0
• Fracture	53	53	0	0	0
C. *Criteria and number of restorations evaluated at 2-year recall*		*XP Bond/SCA/Calibra [n]*			
		Alpha	*Bravo*	*Charlie*	*Delta*
• Marginal discoloration and integrity	53	49	2	2	0
• Secondary caries	53	53	0	0	0
• Vitality test	53	52	1	0	0
• Interproximal contacts	53	53	0	0	0
• Retention	53	53	0	0	0
• Fracture	53	53	0	0	0

Table 3: Performance criteria according to Ryge at 3-year recall

Criteria and number of restorations evaluated at 3-year recall		*XP Bond / SCA / Calibra [n]*			
		Alpha	*Bravo*	*Charlie*	*Delta*
• Marginal discoloration and integrity	51	44	5	2	0
• Secondary caries	51	51	0	0	0
• Vitality test	51	50	1	0	0
• Interproximal contacts	51	51	0	0	0
• Retention	51	51	0	0	0
• Fracture	51	51	0	0	0

Table 4: Performance criteria according to Ryge at 4-year recall

Criteria and number of restorations evaluated at 4-year recall		*XP Bond / SCA/Calibra [n]*			
		Alpha	*Bravo*	*Charlie*	*Delta*
• Marginal discoloration and integrity	49	44	3	2	0
• Secondary caries	49	49	0	0	0
• Vitality test	49	48	1	0	0
• Interproximal contacts	49	48	1	0	0
• Retention	49	49	0	0	0
• Fracture	49	49	0	0	0

found in around 19% (11 cases) of the restored teeth with a medium score of 1.9. Only one case of these 11 showed a high degree of postoperative sensitivity (score 6), whilst in other cases the sensitivity was not spontaneous. The case in which the postoperative sensitivity was so high at the beginning (score 6) showed a residual sensitivity after 1 year but of degree 2, being clinically acceptable. This observation is in agreement with a study that reported hypersensitivity to be the most common postoperative complication.[16] However, at the 6-month recall, the score dropped from grade 6 (strong) to grade 3 (mild) and after 1 year to grade 2 and at 2-year recall almost no postoperative sensitivity was found.

After 1 year of clinical service, two restorations scored bravo for marginal stain/integrity, a score still clinically acceptable. This observation might be explained by marginal wear of the composite luting cement undermining the mechanical support.[8,13] This observation was confirmed after 2, 3 and 4 years of clinical service and lower scores were found for marginal stain/integrity. To prevent excessive marginal wear, it is therefore mandatory to have the narrowest gap possible between cavity preparation and ceramic restoration. Optimal fit (ranging from 50 to 100 µm) is to be preferred,[9] particularly if the margins extend below the cementum-enamel junction.[2,6] Further clinical recalls will clarify, if the margins can be affected during longer clinical service.

The utilization of a correct bonding technique is mandatory to achieve good clinical results in ceramic inlays luting.[2] In direct resin restorations, the bonding agent is routinely light-cured prior to the insertion of composite. In ceramic luting procedures precuring of the adhesive resin may make restoration seating more difficult. Also in this regard, the use of a self-cure bonding agent is advantageous. In the present study, a self-curing cement was chosen for luting the restorations. The self-cure cements are able to achieve adequate degree of conversion also at sites where light-curing may be hindered by the thickness of ceramic. The setting time of the resin cement can be also directly correlated to room temperature, glass plate and mouth temperature.

It is important to understand the underlying chemical principles for each system. In case of XP Bond, mixing with the self-cure activator SCA activates components of the SCA that are able to polymerize the adhesive interface upon contact with initiator from sufficiently initiated self- or dual-cure materials. Therefore, the self-cure mode for luting ceramic restorations of XP Bond mixed with SCA is only guaranteed when applied together with Calibra.

According to the data of this study, the mix of XP Bond with SCA in combination with self-activated Calibra showed clinically acceptable control of postoperative sensitivity at the 4-year recall. These findings will be re-evaluated during the next recall at 5 years.

CONCLUSION

XP bond with SCA and Calibra used in self-cure mode showed no residual postoperative sensitivity in 49 luted porcelain restorations after 4 years of clinical service.

Clinical relevance: The results of this 4 years study reveal good clinical performance of XP bond in combination with SCA and Calibra in self-cure mode.

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