Various Cements and Their Effects on Bond Strength of Zirconia Ceramic to Enamel and Dentin

Agata Prylinska-Czyzewska, DDS, PhD[a]/Pawel Piotrowski, DDS, PhD[b]/
Mariusz Prylinski, DDS, PhD[c]/Barbara Dorocka-Bobkowska, MD, DDS, PhD[d]

Zirconia ceramic disks (Cercon) were fabricated using a computer-aided design/computer-assisted manufacture system and fitted to hard tooth tissues from freshly extracted bovine mandibular incisors using seven cements (zinc phosphate, zinc polycarboxylate, Eco-Link, Panavia F 2.0, Clearfil SA Cement, MaxCem Elite, and GC Fuji Plus) with various physicochemical and bonding properties. Bond strengths were determined using a universal testing machine (Hounsfield H5KS) with a 5,000-N head and a cutting knife speed of 0.5 mm per minute. The study showed that the strongest bond between zirconia ceramic and hard tooth tissues was obtained with Panavia F 2.0 adhesive cement based on 10 methacryloyloxydecyl dihydrogen phosphate monomer. *Int J Prosthodont 2015;28:279–281. doi: 10.11607/ijp.4261*

Esthetics plays a crucial role in restorative dentistry. The widely available, highly advanced materials and processing technologies can satisfy the needs of both patients and dentists. The increasingly popular zirconia prosthetic restorations have been extensively reported with respect to the manner of placement as well as the types of cements capable of providing durable prostheses. It was believed that these prostheses may be fixed with traditional dental cements; therefore, this study aimed to determine which cement would provide the most durable bond in this type of dental restoration.

[a]*Lecturer, Department of Oral Rehabilitation, Poznan University of Medical Sciences, Poznań, Poland.*
[b]*Professor and Head, Department of Oral Rehabilitation, Poznan University of Medical Sciences, Poznań, Poland.*
[c]*Professor and Head, Department of Dental Technique and Technology, Poznan University of Medical Sciences, Poznań, Poland.*
[d]*Professor and Head, Department of Oral Pathology, Poznan University of Medical Sciences, Poznań, Poland.*

***Correspondence to:** Dr Barbara Dorocka-Bobkowska, Department of Oral Pathology, Poznan University of Medical Sciences, 60-812 Poznań, 70 Bukowska St, Poland. Email: b.dorocka@gmail.com*

Materials and Methods

The study involved 140 freshly extracted bovine mandibular incisors, 70 each for the enamel and dentin groups of samples. The roots of the teeth were immersed vertically in the fast polymerizing acrylic resin Vertex Castapress (Vertex Dental) in 3 × 3 × 2-cm silicone form molds, with the labial incisor surface parallel to the form mold base and projecting 3 mm above the form mold.

The first group of samples, prior to bonding the labial surfaces of the dentin, which were designated for zirconia ceramic fitting, had been manually abraded using 600-grit carborundum paper under running water to obtain a smooth and flat surface. In the second group, the tooth surfaces were abraded until the dentin became exposed. Depending on the number of teeth studied, 6-mm-wide and 2-mm-thick disks were prepared from Cercon zirconia ceramic (DeguDent) using computer-aided design/computer-assisted manufacture (CAD/CAM) technology. The disks were fixed to the bovine teeth with seven cements of various physicochemical characteristics (Table 1).

The specimens were then stored for 24 hours in distilled water at 37°C. The bond strengths were determined using a Hounsfield H5KS universal testing machine fitted with a 5,000-N head using a cutting knife speed of 0.5 mm per minute. The differences between the bond strengths of the cements (Fig 1)

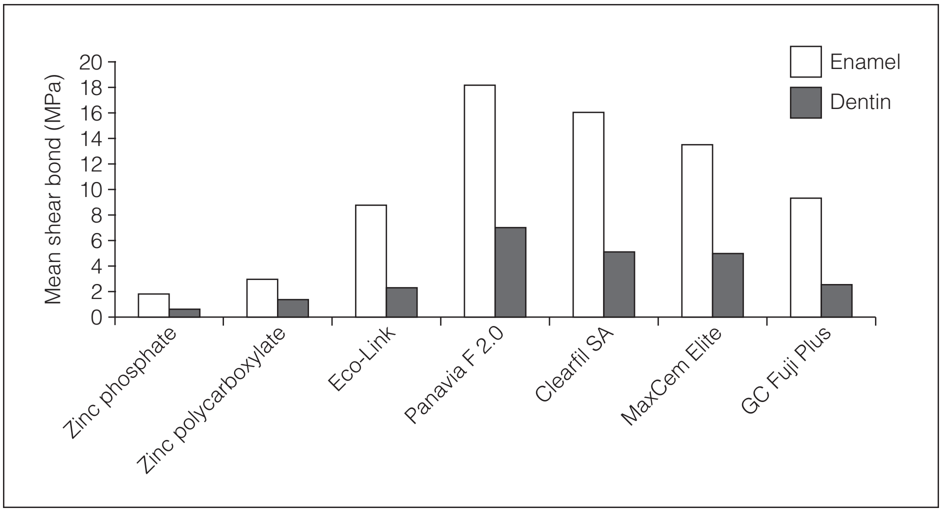

Fig 1 Mean shear bond of zirconia ceramic to enamel and dentin with different cements.

Table 1 Materials Used in This Study

Cement	Type	Manufacturer
Zinc phosphate	Chemical cure	Harvard Dental
Zinc polycarboxylate	Chemical cure	Harvard Dental
Eco-Link	Dual-curing composite resin	Ivoclar Vivadent
Panavia F 2.0	Dual-curing composite resin	Kuraray Dental
Clearfil SA	Dual-curing self-adhesive resin	Kuraray Dental
MaxCem Elite	Dual-curing self-adhesive resin	Kerr
GC Fuji Plus	Resin-modified glass-ionomer	GC

Table 2 Shear Bond Strength (MPa), SDs, and *P* Values for Enamel and Dentin with Seven Types of Cement

Cement	n	Enamel	Dentin	*P*
Zinc phosphate	10	1.90 ± 0.73	0.65 ± 0.17	.0001
Zinc polycarboxylate	10	3.00 ± 0.61	1.40 ± 0.61	.0001
Eco-Link	10	8.80 ± 0.82	2.32 ± 0.82	.0001
Panavia F 2.0	10	18.20 ± 1.21	6.99 ± 1.21	.0001
Clearfil SA	10	15.92 ± 2.48	5.07 ± 2.48	.0001
MaxCem Elite	10	13.50 ± 2.26	5.04 ± 2.26	.0001
GC Fuji Plus	10	9.42 ± 1.77	2.53 ± 1.77	.0001

were analyzed using a one-way analysis of variance and the Student *t* test. The threshold for statistical significance for all data analyses was set at $P = .05$, using the SPSS statistical package (IBM).

Results

These comparative studies showed that the strongest bond between zirconia and hard tooth tissue was obtained with Panavia F 2.0 cement. Statistical analysis revealed significant differences among all groups ($P < .05$; Table 2). The zirconia-to-enamel bond strength was significantly higher than that to dentin and was largely dependent on the type of cement used (Fig 1).

Discussion

The high bond strengths between zirconia ceramics and dentin and zirconia ceramics and enamel from bovine teeth using Panavia F 2.0 cement based on 10 methacryloyloxydecyl dihydrogen phosphate (MDP) monomer confirmed the findings of other authors[1,2] regarding strong adhesive properties and the stability of this bonding material in a wet environment. Lower shear stress values ($P < .0001$) were obtained with Clearfil SA Cement and MaxCem Elite self-etching bonding systems. According to De Munck et al,[3] this may be attributed to the fact that the bonding is limited to the superficial layers of dentin and enamel. The lowest bond strengths between enamel-zirconia and dentin-zirconia were obtained when zinc-phosphate and zinc-polycarboxylate cements were used as bonding materials. The low bond strengths of zinc phosphate toward gold alloys, lithium disilicate ceramics, and aluminum-oxide ceramics were addressed by Piwowarczyk et al.[4] The shear stress values for samples of zirconia ceramic bonded to enamel and dentin using zinc-phosphate and zinc-polycarboxylate cements appear to contradict previous findings[5] in that prosthetic restorations on a zirconia base do not need to be fitted adhesively to the abutment teeth. Instead, conventional dental cements can be used for this purpose.

Conclusions

- In bonding zirconia ceramic to hard tooth tissues, the bond strength was found to be significantly affected by the type of bonding material used.
- The highest bond strengths of zirconia ceramic to dentin and to tooth enamel were obtained with Panavia F 2.0, which appears to be related to its unique chemical composition.
- Bond strengths between zirconia ceramic and enamel were found to be significantly higher compared to zirconia ceramic and dentin, regardless of the type of cement used.

References

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Literature Abstract

Effect of platelet-rich fibrin on frequency of alveolar osteitis following mandibular third molar surgery: A double-blinded randomized clinical trial

The aim of this double-blind randomized clinical trial (RCT) was to investigate the effect that platelet-rich fibrin (PRF) may have on wound healing after surgical removal of mandibular third molar teeth, in terms of frequency of occurrence of alveolar osteitis (AO). Seventy-eight patients (mean age: 25 years) had bilateral surgical removal of mandibular third molars assessed to have the same level of difficulty. Surgery was carried out by a single surgeon using the same surgical protocol. PRF was randomly inserted by another operator into one of the wounds and the contralateral socket served as control (non-PRF). During postoperative follow-up, AO cases were treated with irrigation and placement of Alvogyl iodoform and prescription of antibiotics and analgesics. Results showed a frequency of AO of 14.74%. No significant differences were found according to statistical analysis based on demographic, preoperative, and perioperative variables. Third molar sockets that had PRF placed had significantly lower frequency of AO compared to those without PRF (odds ratio = 0.44, $P < .05$ to that of the control). The results of this study are in agreement with previous studies by other authors on the effect of PRF in preventing osteitis in third molar sites. However, at the time of writing, this study was the first RCT investigating PRF. The beneficial effects of PRF may be attributed to the hemostatic and cicatricial properties of the platelets, leukocytes, and cytokines within the natural fibrin matrix that supports and maintains the clot within the third molar socket after removal.

Eshghpour M, Dastmalchi P, Nekooei AH, Nejat A. *J Oral Maxillofac Surg* 2014;72:1463–1467. **References:** 29. **Reprints:** Dr Nejat: No 53, Mina 4, Bahar 10 Avenue, Sajad Boulevard, Mashhad 9187884486, Iran. Email: amir.h.nejat@outlook.com—*Debbie P.M. Hong, Singapore*