Ceramic Defects in Metal-Ceramic Fixed Dental Prostheses Made from Co-Cr and Au-Pt Alloys: A Retrospective Study

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Purpose: Ceramic defects in porcelain-fused-to-metal (PFM) restorations may depend on framework alloy type. This study assessed ceramic defects on cobalt-chromium- (Co-Cr-) and gold-platinum- (Au-Pt-) based PFM restorations. **Materials and Methods:** In this study, 147 Co-Cr-based and 168 Au-Pt-based PFM restorations inserted between 1998 and 2010 (139 patients) were examined for ceramic defects. Detected defects were assigned to three groups according to clinical defect relevance. **Results:** Ceramic defect rates (Co-Cr-based: 12.9%; Au-Pt-based: 7.2%) revealed no significant difference but a strong statistical trend (*U* test, P = .082). Most defects were of little clinical relevance. **Conclusions:** Co-Cr PFM restorations may be at higher risk for ceramic defects compared to Au-Pt-based restorations. *Int J Prosthodont 2015;28:487–489.doi:10.11607/ijp.4234*

Porcelain-fused-to-metal (PFM) restorations play a major role in conventional fixed dental prostheses (FDPs) and are considered the gold standard due to their good long-term outcomes.¹ Clinical failure is rationalized as a multifactorial phenomenon, since patient-related, biological, and technical factors affect longevity.² Ceramic defects are frequent technical complications.¹ A retrospective study by Eliasson et al³ revealed 17.6% ceramic fractures in 53 FDPs in 42 patients. However, the literature is lacking clinical studies on the effect of alloy type on ceramic defect rates in PFM fixed restorations. The aim of this retrospective study was to analyze the impact of the alloy type on veneering ceramic defects in conventional tooth-supported PFM restorations. As a null hypothesis, it was stated that cobalt-chromium- (Co-Cr-) and gold-platinum- (Au-Pt-) based PFM fixed restorations show similar rates of veneering ceramic defects.

Materials and Methods

This retrospective study was conducted between March and June 2011 at the Department of Prosthetic Dentistry, University Hospital Carl Gustav Carus, University of Technology Dresden (TUD), Germany.

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Ethical approval was obtained from the Ethics Committee of TUD (Eth.Nr. EK 229072010).

All patients who received Co-Cr- or Au-Pt-based PFM FDPs or single crowns between 1998 and 2010 at the mentioned institution were invited to participate in the study. Throughout that time period, clinical variables such as decision making, preparation design, impression technique, and standard procedures for try-in and insertion remained constant. All restorations were fabricated in two commercial dental laboratories. Data collection was obtained from dental records and a clinical examination. Within the clinical examination all PFM restorations were dried with air jet and inspected carefully for ceramic defects using a dental loupe (magnification: 2.5×). Additionally, the oral cavity was inspected for signs of parafunctional habits (abrasion, tongue and/or cheek impressions, and/or wedge-shaped defects). All clinical examinations were done by one dentist (BL). Ceramic defects detected were documented and assigned to one of the following three groups according to the study by Heintze and Rousson¹: group 1—intraoral polishing sufficient / no metal exposition / defect size maximum 2 mm in diameter; group 2: intraoral repair with composite required / possible metal exposition / defect larger than 2 mm in diameter; group 3: new restoration required. Statistical analysis used the Mann-Whitney U test and was performed using WinSTAT 2.0 software (Kalmia).

Results

A total of 139 patients participated in the study (Table 1). Co-Cr-based PFM restorations showed a veneering ceramic defect rate of 12.9% (mean function

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Table 1Distribution of Restorations with Respect to
Patients' Sex, Age, Signs of Parafunctional
Habits, Type of Restoration, Type of
Veneering, and Location

	Au-Pt	Co-Cr
Patients (n)	72	67
Men/women (n)	25/47	30/37
Age (y)	min: 37 max: 88 mean: 66	min: 38 max: 82 mean: 63
Signs of parafunctional habits yes/no (n)	18/54	15/52
Total number of restorations (n)	168	147
Time in function (mo)	min: 2 max: 159 mean: 65	min: 3 max: 80 mean: 33
Single crown (n)	139	127
Fixed dental prosthesis (n)	29	20
Veneered abutment (n)	50	43
Veneered pontic (n)	44	38
Veneered units (n)	233	208
Partially veneered restorations (n)	87	110
Fully veneered restorations (n)	81	37
Restorations in anterior region (n)	68	58
Restorations in premolar region (n)	92	79
Restorations in molar region (n)	8	10

time: 2.7 years) and Au-Pt-based restorations a rate of 7.2% (mean function time: 5.4 years). The majority of the 31 restorations with ceramic defects were allocated to group 1 (10 Au-Pt-based, 14 Co-Cr-based) (Tables 2 and 3). Statistical analysis revealed a trend toward higher ceramic defect rates in Co-Cr-based restorations (related to units: one-sided P = .077, two-sided P = .155; related to restorations: one-sided P = .041, two-sided P = .082).

Discussion

Kaplan Meier statistics with the log rank test is a standard for reporting survival data. However, the difference in time intervals between FDP insertion and defect detection (Au-Pt: 2 to 159 months; Co-Cr: 3 to 80 months) in this study may cause bias in favor of the Au-Pt PFM restorations. Thus, a more cautious approach using the U test was chosen.

Shear tests by Drummond et al⁴ found a significantly weaker bond in base metal alloys compared to noble alloys. Thus, base metal restorations might be more susceptible to adhesive fractures. Libby et al⁵ reported mean life spans up to two times longer for gold-based FDPs than for semiprecious or base metal PFM FDPs.

Table 2Frequency of Ceramic Defects Related to
Patients, Restorations, and Units with Respect
to Signs of Parafunctional Habits, Type of
Restoration, Type of Veneering, and Location

	Au-Pt	Co-Cr
Patients		
Number of patients with defects (%)	10 (13.9)	16 (23.9)
Men/women (n)	5/5	8/8
Signs of parafunctional habits yes/no (n)	6/4	8/8
Restorations		
Restorations with defects (n, %) Single crown (n, %) Fixed dental prosthesis (n, %)	12 (7.2) 9 (5.4) 3 (1.8)	19 (12.9) 14 (9.5) 5 (3.4)
Men/women (n)	6/6	10/9
Signs of parafunctional habits yes/no (n)	8/4	10/9
Restoration defects per region Anterior (n, %) Premolar (n, %) Molar (n, %)	5 (3.0) 5 (3.0) 2 (1.2)	10 (6.8) 5 (3.4) 4 (2.7)
Veneer type Partially veneered (n, %) Fully veneered (n, %)	7 (4.2) 5 (3.0)	12 (8.2) 7 (4.8)
Units		
Number of defect units (%) Single crown (n, %) Abutment (n, %) Pontic (n, %)	14 (6.0) 9 (3.9) 5 (2.1) -(0.0)	20 (9.6) 14 (6.7) 5 (2.4) 1 (0.4)
Men/women (n)	8/6	11/9
Signs of parafunctional habits yes/no (n)	10/4	11/9
Unit defects Anterior (n, %) Premolar (n, %) Molar (n, %)	6 (2.5) 6 (2.5) 2 (0.8)	12 (5.8) 5 (2.4) 3 (1.4)
Veneer type Partially veneered Fully veneered	8 6	13 7

Table 3	Defects Assigned to Three Groups According		
	to the Defect Relevance on the Clinical		
	Function of the PFM Restoration and		
	Statistical Analysis		

	Restoration defects		Unit defects	
Group	Au-Pt (n = 168)	Co-Cr (n = 147)	Au-Pt (n = 233)	Co-Cr (n = 208)
1	10	14	12	15
2	1	3	1	3
3	1	2	1	2
U test	one-sided $P = .041$, two-sided $P = .082$		one-sided $P = .077$, two-sided $P = .155$	

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Although group 3 defects were evenly distributed, this retrospective study showed a tendency toward higher defect rates in Co-Cr-based PFM restorations compared to Au-Pt-based restorations despite similar clinical standard procedures and a longer mean time in function of the latter. The data encourage further clinical studies on the effect of the metal substructure composition on ceramic failure risks, as this information is important in clinical decision making.

Almost half of the defects in both the Co-Cr- and Au-Pt-based groups were recorded in patients showing signs of parafunctional habits. However, due to the low number of incidences no statistical analysis was conducted with respect to bruxism or to extent of the veneering ceramic, sex, patient age, or location.

Acknowledgments

The authors reported no conflicts of interest related to this study.

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Literature Abstract

Patient-based assessment of tooth extraction with ultrasonic dental surgery

This study investigated the postoperative period and healing of tooth extractions performed with a traditional method and ultrasonic bone surgery. In addition, the healing of the sockets and the patient's psychological acceptance of the ultrasonic method were evaluated clinically. Two hundred patients requiring bilateral extractions in the maxilla or mandible were selected, thus providing 400 extractions. Periodontal therapy was performed on the patients 1 week before extractions, and good oral hygiene was maintained at the time of the extractions. All extractions were performed by 1 surgeon, and for each patient 2 teeth were extracted in the same visit. The time required for each extraction and number of complications was recorded. The extent of wound healing was evaluated clinically at 1, 7, 14, and 21 days. Daily evaluation of postoperative pain was performed by patients for 7 days using a visual analog scale. Their preference for the method of extraction was also assessed. Extractions using the ultrasonic method were found to require more time than the traditional method. Better wound healing and lesser postoperative pain were reported for the ultrasonic method. However, these differences were not statistically significant. Of the patients, 80% showed preference for the ultrasonic method, while 1% preferred the traditional method and 19% had no preference. The reasons given for this preference are improved delicacy and perceived comfort over the traditional technique. The authors concluded that Piezosurgery was effective in reducing complications and improving healing after extractions by reducing trauma to adjacent bone and soft tissues during tooth extractions.

Mozzati M, Gallesio G, Ullio L, Staiti G, Lucchina AG, Mortellaro C. *J Craniofac Surg* 2014;25:2081–2083. References: 24. Reprints: Dr Carmen Mortellaro, Department of Health Sciences, A. Avogadro University of Eastern Piedmont, Via Solaroli 17, 28100 Novara, Italy. Email: Carmen.mortellaro@med.unipmn.it—*Teo Juin Wei, Sinagpore* Copyright of International Journal of Prosthodontics is the property of Quintessence Publishing Company Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.