Clinical Comparison of Postoperative Sensitivity for an Adhesive Resin Cement Containing 4-META and a Conventional Glass-Ionomer Cement

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Purpose: The aim of this clinical 2-year follow-up study was to compare the postoperative sensitivity of abutment teeth restored with full coverage restorations retained with either conventional glass-ionomer cement or a new adhesive resin cement containing 4-methacrylolyloxyethyl trimellitate anhydride (4-META). ***Materials and Methods:*** Sixty patients received 120 full-coverage restorations on vital abutment teeth, cemented with either a glass-ionomer cement (Ketac-Cem) or a new adhesive resin cement (Chemiace II). A randomized split-mouth design and a patient double-blind data acquisition protocol were used. The teeth were examined before cementation, after 1 week, and after 6, 12, and 24 months. ***Results:*** With regard to postcementation sensitivity, a low incidence was observed for both groups. With the adhesive resin cement, little postoperative hypersensitivity was observed after 1 week (13.3%), 6 months (5.9%), 12 months (2.1%), and 24 months (none); results were similar with the conventional glass-ionomer cement Ketac-Cem after 1 week (5.9%), 6 months (5.9%), 12 months (6.4%), and 24 months (none). After 6 months, 2 teeth of the Chemiace II group showed no sensitivity. Endodontic treatment was carried out for these 2 abutment teeth. After 24 months, no cases of postoperative hypersensitivity were recorded for either group. ***Conclusion:*** In this study, the incidence of postoperative hypersensitivity after cementation of full-crown restorations with a conventional glass-ionomer cement and a new adhesive resin cement was similar. *Int J Prosthodont 2007;20:73–78.*

with zinc phosphate cement.[5,6] Postcementation hypersensitivity may also be caused by irritation from cavity preparation, structure and quantity of the dentin, inflammation, and bacterial microleakage.[7–11]

New luting agents, particularly those with adhesive capabilities have shown both increased retention and reduced solubility compared to zinc phosphate or glass-ionomer cements.[12–17]

Resin cements adhere to tooth structure via the presence of a hybrid layer, an intermediate zone obtained by impregnation, diffusion, and monomer polymerization into dentin previously etched by acid conditioners. Some adhesive resin cements have used 4-methacrylolyloxyethyl trimellitate anhydride (4-META) as a component. Monomers with both hydrophobic and hydrophilic groups, such us 4-META, have excellent bonding characteristics to tooth and restoration surfaces.[18,19]

Postoperative sensitivity associated with adhesively luted restorations has been a common problem because the adhesive cements do not hermetically seal the adhesive-tooth interface. Often, the consequence is a postoperative hypersensitivity to cold resulting from the movement of fluids through the dentinal tubules, which is caused by the thermal influence.[20]

On the other hand, several studies have compared conventional glass-ionomer cements with other conventional luting materials regarding the postoperative hypersensitivity.[4–6,8,21–25]

No clinical studies have been performed comparing the postoperative sensitivity of teeth following cementation of restorations using conventional glass-ionomer cements versus adhesive resin cements containing 4-META.

Every patient received 2 independent full-coverage cast metal or porcelain-fused-to metal restorations; thus, a total of 120 cemented restorations were evaluated. In cases of fixed partial dentures with 2 abutments, only 1 abutment was included as a study tooth. In addition, another independent tooth was used for the second restoration. Depending on the extent of sound tooth structure after caries removal, a composite material (Clearfil Core, Kuraray Dental) was used in combination with a dentin adhesive (Clearfil New Bond, Kuraray Dental) for any necessary buildup of the selected abutment teeth. The abutments were prepared with an occlusal reduction of 1.5 to 2 mm, followed by a circular, 1.2-mm-deep chamfer preparation. All abutment teeth received acrylic provisional crowns (Tab 2000, KerrHawe) for the period between preparation and final cementation. The provisional crowns were retained with a zinc oxide–eugenol cement (Temp-Bond, Kerr).

Tooth sensitivity before cementation was tested using an ice spray (Frisco Spray, ad-Arztbedarf) applied with a foam pellet. The postoperative sensitivity reported by patients was recorded using a 3-point scale of "normal response" (sensation of cold but no pain), "severe response" (increased sensitivity causing a patient reflex), and "no response."

The fit of the restorations was checked with a silicone indicator paste (Fit-Checker, GC Dental) and an explorer. Areas of interference were reduced on the restoration with a diamond bur. The definitive restoration was considered acceptable when there was a passive fit on the abutment and the fit of the margins was judged to be acceptable with an explorer. The inner surface of the restoration was cleaned by airborne

mixtures were used within 1 minute after mixing and applied to the restoration. All restorations were seated first using finger pressure, and then a plastic crown setter (Kronensetz-Instrument 411, Becht) was pressed to the occlusal surface of the restoration until the restoration margins were completely seated in place. The restorations were secured in position until the cement had set completely. Excess cement was removed with an explorer and dental floss after 3 minutes.

Each restoration was followed up for a period of 24 months and clinically evaluated at baseline, 1 week, 6 months, 12 months, and 24 months after cementation. Tooth sensitivity was asessed and recorded using the ice spray test and the 3-point scale as described above.

Statistical analysis of the data was carried out using a generalized linear regression model with an additional random term to account for the specific correlation structure (each patient contributed 2 teeth). This method allowed assessment of the effects of cement material, age, and gender on the postoperative sensitivity measured at the first examination. Furthermore, the longitudinal evaluation of postoperative sensitivity was plotted against time. Statistical analysis was performed with the statistical software SAS and the procedure NLMIXED[26] with logit link and binomial distribution.

Results

Thirty-eight male and 22 female patients with a mean age of 44.4 years (range 22 to 65 years) participated in the trial. Fifty-one patients were examined after 1 week, 51 patients after 6 months, 47 patients after 12 months, and 48 patients after 24 months (Table 1). There was a high incidence of patient non-compliance. The patient compliance with clinical examination is shown in Table 1.

Table 1 Patient Compliance with Clinical Examination

Examination time	Compliance	Scheduled time (d)	Actual time (median, d)
Baseline	60	0	0
1 wk	51	7	9
6 mo	51	180	211
12 mo	46	365	405
24 mo	47	730	739

sensitivity at all examinations (see Table 2 for the incidence of "severe" hypersensitivity). Figure 1 shows that for some patients the tooth restored with Chemiace II cement was more sensitive and for some patients the tooth restored with Ketac-Cem cement was more sensitive. In 2 patients the tooth treated with Chemiace II showed no response; these 2 teeth were endodontically treated and no longer assessed at later examinations. In the remaining cases the temporary postoperative sensitivity observed at the first 3 examinations was absent at the final examination at 24 months. The results of the generalized linear model are shown in Table 3. No significant difference was observed for cementation with Chemiace II compared to Ketac-Cem. This is also shown in Fig 1 for the 1-week follow-up examination. Women showed a significantly higher rate of hypersensitivity and there was a significant decrease in hypersensitivity with age. The older the patient, the lower the probability of a hypersensitive response at the first examination (Table 3).

Discussion

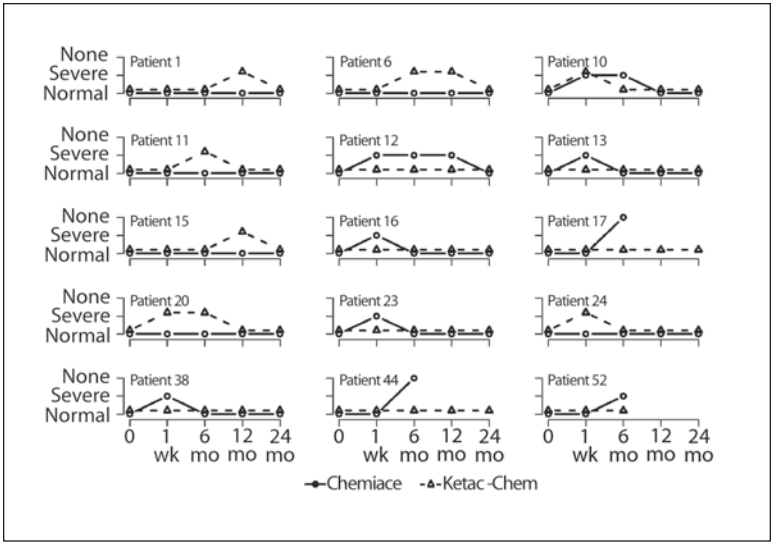

Fig 1 Detailed follow-up of the 15 patients with changes of tooth sensitivity for each cement. The remaining patients showed normal sensitivity at all examinations.

Table 2 Ratings of Postoperative Sensitivity by Observation Time

Observation time	Postoperative sensitivity (n)					
	Chemiace II			Ketac-Cem		
	Normal	Severe	None	Normal	Severe	None
Baseline	60	0	0	60	0	0
1 wk	45	6	0	48	3	0
6 mo	46	3	2†	48	3	0
12 mo	44	1	0	44	3	0
24 mo	46	0	0	48	0	0

*No significant differences of sensitivity for each follow-up period ($P > .05$).
†These teeth were endodontically treated after the 6-month follow-up.

Table 3 Results of Generalized Linear Model*

The initial low setting pH of glass ionomer has been reported and implicated as a cause for postcementation sensitivity.[4] Hickel and Voss[28] suggested that an ideal powder/liquid ratio can only be ensured with a capsule system, compared to the manual mixing procedure of cements. In this study, Ketac-Cem glass-ionomer cement was used in capsule form and served as a control. Possible problems reported for glass ionomers prepared by hand mixing were identified as powder/liquid ratio variations, which can influence the mechanical properties of the cement. Reducing the powder content for a constant volume of liquid reduces the porosity levels in the cement mass and extends the working and setting time.[29] The manual mixing procedure of the resin cement did not affect the postoperative hypersensitivity because the powder and the liquid did not contain any acid.

Pameijer and Nilner[30] compared 3 cements—zinc phosphate, glass-ionomer, and resin cement—in a 4-year follow-up study. Only patient-reported cases of postcementation hypersensitivity, without any thermal provocation tests, were considered. The authors concluded that postcementation hypersensitivity was a negligible problem.

Kamal et al[31] used immunohistologic analysis to examine the response of Class II molecule-expressing cells and macrophages to cavity preparation and restoration with a self-curing 4-META resin cement. Dentinal cavities on both sides of the maxilla were prepared in the maxillary first molars of rats. One side was restored with 4-META resin cement (Superbond C&B, Sun Medical), and the other side was left unrestored. After 3 days, the teeth restored with 4-META resin cement showed a mild inflammatory response at the pulp.

However, no significant differences between the 2 types of luting cements were observed. After 6 months, the postoperative hypersensitivity was 5.9% for both cements. Of the teeth in the 4-META resin cement group, 3.9% showed no sensitivity. After 12 months, there were fewer cases of postoperative sensitivity for the resin cement group (2.1%) compared to the glass-ionomer cement group (6.4%), but this difference was not statistically significant. After 24 months, no hypersensitivity was recorded in either group.

The pretreatment of the abutment teeth, as performed in this study, may influence the postoperative hypersensitivity.[32] Calcium hydroxide was used in both groups, because it is an accepted dentinal tubule protector. Several studies showed that a calcium hydroxide suspension applied on the abutment teeth before cementation reduces the dentin permeability.[33] Zaimoglu et al[34] investigated various desensitizing agents after tooth preparation. The results showed that calcium hydroxide allowed the formation of smear plugs and that the application of calcium hydroxide is effective in treating hypersensitivity without adversely affecting the retention. Mjör and Ferrari[11] attributed the reduced permeability of the dentin after exposure to calcium hydroxide to precipitations of crystalline material in the dentinal tubules.

Using a generalized linear model, it was observed that 1 week after cementation, the older the patient was, the lower the probability of hypersensitivity. Reduced tooth sensitivity in older patients has also been observed by Hilton et al.[23]

Women showed a significantly higher rate of postoperative hypersensitivity compared to men 1 week after cementation. This intersexual difference is in ac-

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