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CLINICAL RESEARCH

What German dentists choose for their teeth: A Web-based survey of molar restorations and their longevity

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ABSTRACT

Statement of problem. Which restorative material is best suited for treating the posterior molar region is unclear. As dentists presumably choose the most appropriate restoration, German dentists were asked how their own molars were treated.

Purpose. The purpose of this survey study was to examine molar restorations and their durability in German dentists.

Material and methods. In the official journal of the Federal Dental Association, German dentists were asked to participate in an online survey that gathered demographic data and information on the type and durability of their molar restorations. To reduce selection bias, the data were weighted for region, sex, and age of the dentist.

Results. The data set consisted of 1719 molars from 288 dentists. Restorations included gold inlays (25%), composite resin (24.3%), amalgam (11.8%), ceramic inlays (5.4%), glass ionomer cement or compomer (0.8%), gold crowns (21.8%), ceramic crowns (6.6%), and metal-ceramic crowns (4.3%). Notable differences were identified based on the sex, age, and region of the dentist. Women selected increased esthetic options, as did young dentists. Restorations made of gold, amalgam, and base metal had the highest longevity, at more than 20 years

Conclusions. Among German dentists, restorations with metallic materials dominated in molars, with gold accounting for the largest share. In recent years, the proportion of tooth-colored restorations has increased, and in particular, young dentists use composite resin and ceramics. (J Prosthet Dent 2021;125:805-14)

The decision regarding the optimal restorative material is challenging for patients and their dentists. For many decades, metallic restorative materials have been the gold standard for the restoration of caries in the stress-bearing posterior teeth. However, the increased esthetic demands of patients have led to the increased use of esthetic tooth-colored restoration materials,[1-3] which were first developed for anterior teeth. Depending on the size of the defect and the preference of the patient, amalgam, composite resin, compomer, cement, gold metal alloys, base metal alloys, and ceramic are the available options. These materials differ in esthetic, biological, physical, and cost aspects.

Amalgam is straightforward to process, can tolerate some moisture contamination, possesses antibacterial properties, leaves a minimal marginal gap minimizing secondary caries, and has excellent durability.[4,5] However, its mercury content has led to a partial prohibition in Scandinavia and a restriction for some patient groups in Germany.[6-8] Concern about this material has led to the increased use of tooth-colored restoration materials, such as composite resin, providing an esthetically pleasing and conservative restoration in a single visit.[9-13] For some time, composite resin has also been recognized according to the guidelines for class 2 cavities in posterior teeth.[14] Compared with amalgam, the placement process usually takes longer.[15] Moreover, composite resin materials do not have antibacterial properties; they tend to have marginal gaps, and in addition to having an allergy

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Clinical Implications

The way in which dentists restore their own molars is an indication of which material is most appropriate in the stress-bearing posterior region.

potential, systemic effects cannot be excluded.[16,17] In contrast, gold is highly biocompatible and exhibits high edge gap density.[18,19] Similarly, ceramic restorations fulfill the highest esthetic demands and are highly biocompatible.[20]

Although the prevalence of caries in the population has decreased, the latest German oral health study showed that in the 35- to 44-year age cohort, approximately 11 teeth per person were decayed and required restoration.[21] To obtain an indication of which material is best suited for posterior molar restoration, previous studies have questioned dentists on how their own molars were restored, with the results showing that dentists's molars were typically restored with metallic materials rather than with newer esthetically pleasing restorations.[22]

With recent improvements and the popularity of esthetic materials and the current discussion about dental amalgam,[2,9,12,23-26] there has been a change in preference over time, although the durability of amalgam is still higher than that of newer, more esthetically pleasing materials.[27-29] Hence, this study followed the example of previous studies and interviewed dentists in Germany about how their molars were treated after dental caries.

An online survey among German dentists was performed investigating the following research questions whose priority ordering was stated in advance.[30,31] First, are there any significant differences compared with the study of Rosenstiel et al?[22] Do German dentists prefer traditional metallic restorations? Second, are there sex-specific relationships as suggested by Rosenstiel et al?[22] Do women prefer esthetics (composite resin, ceramic inlay, ceramic crown), whereas men prefer amalgam, gold inlay, or gold crown, or is the suggested relationship between sex and esthetics confounded, for example, by the age of the dentists or by region? Third, what could be determined about the durability of the respective materials in the mouth of dentists?

MATERIAL AND METHODS

This study was conducted as a Web-based, anonymized survey among dentists in Germany. First, a draft of the online questionnaire and a study protocol were prepared, both of which were submitted to the Ethics Committee of the University of Greifswald (application number BB 068/16). The ethics committee approved the study, and dentists in Germany were invited to participate. An article was published in the journal *zm - Zahnärztliche Mitteilungen* (zm). This journal is an official organ of the German Federal Dental Association. It is published twice a month and reaches all practicing dentists in Germany. The article was released on July 1, 2017, in issue 13 and was also published online and referenced on its Facebook page in July 2017.

The article contained a short introduction to the topic and photographs of the teeth of the initiators to arouse reader attention. It also contained a link to the specifically programmed website of the dental clinic Greifswald, on which an introductory text, the online questionnaire, and a subsequent preliminary evaluation were available.

After a coding error was noticed during the evaluation of the collected data, the first online survey data set could not be analyzed. Thus, new data collection started in January 2018. For this purpose, the participants from the first data collection who voluntarily left their email address at the end of the questionnaire were sent an email in January 2018. The participants were informed about the circumstances and were, once again, asked to participate in the study. A reminder was sent via email 2 weeks later. The online questionnaire was accessible from January 2018 to June 2018, and the survey was anonymous.

The questionnaire gathered the following information about the participants: the sex, year of licensing, type of dental practice (for example, joint practice, private practice, university clinic), size of the city, and federal state in which the dentist worked. There was also a pull-down menu for each of the 8 first and second molars. In this pull-down menu, the participants were able to select one of the following for each molar: (1) restored, (2) not restored, (3) must be restored, (4) missing—not replaced, and (5) missing—replaced. When the restored item was selected, it was additionally possible to choose among 8 different direct and indirect restorative supplies (amalgam, composite resin, glass ionomer cement, ceramic crown or partial-coverage crown, ceramic inlay, gold crown or partial-coverage crown, gold inlay, metal-ceramic crown). Furthermore, the estimated age of the restorative care was queried. Here, 1 of the following 6 options had to be chosen: less than a year, 1-5 years, 6-10 years, 11-20 years, 21-30 years, or more than 30 years.

To clarify the objectives of the survey and to avoid bias, several design steps were applied by using external data.[32-35] The molars not to be restored were excluded as necessary for appropriate inference.[36] As recently recommended by the American Statistical Association, confidence intervals were used; *P* values were tretated continuously rather than in a dichotomous or threshold manner.[37-39]

Proportions and their 95% confidence intervals were adjusted for the dentist level unless stated otherwise. With data about the region, age, and sex of all the German dentists, inverse probability weighting was

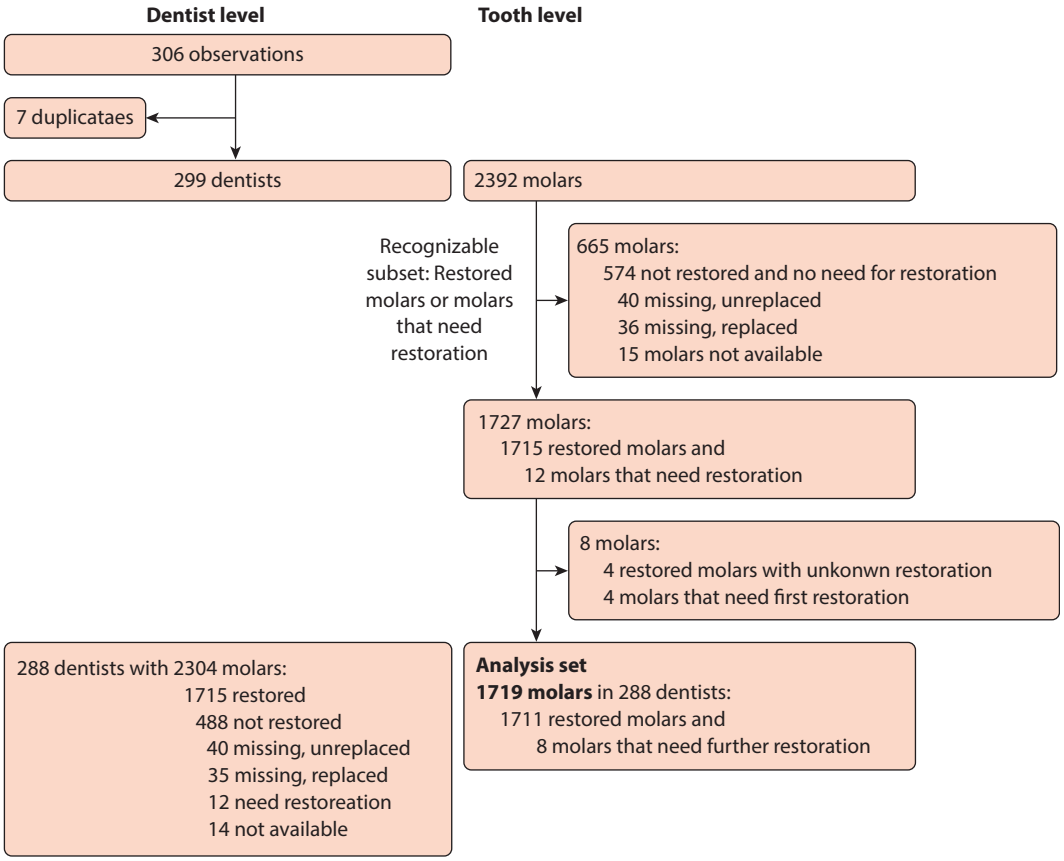

Figure 1. Dentist and tooth level for participants in German online survey.

applied to reduce selection bias.[40] These (corrected) proportions and the odds ratios adjusted for the dentist level from the multinomial logistic regression model of the type of restoration were calculated by using a statistical software program (STATA release 14.2; Stata Corp).[41] The type of restoration was predicted by sex, age (restricted cubic splines for 24.5, 27.5, 32.5, 37.5, …, and 77.5 years for the 12 age groups of 5 years),[42] region (west or east), type of dental office (4 levels: single practice, joint practice, university, or other), jaw (maxilla or mandible), and tooth type (first or second molar). The age of restoration was predicted by the sex, dentist age, type of restoration (7 levels because glass ionomer was excluded), interaction between restoration and age, region, type of dental office, jaw, and tooth type in ordinary regression models adjusted for dentist level by using R, version 3.5.1 (R Core Team [2018]. R: A language and environment for statistical computing. R Foundation for Statistical Computing. URL https://www.R-project.org/), especially the rms package.[43]

RESULTS

The analysis set that satisfied the recognizable subset criterion consisted of 1719 molars from 288 dentists (Fig. 1). Dentist characteristics are shown in Table 1. The women were younger than the men, especially in the western federal states.

Figure 2 and Table 2 show the distribution of the materials in Germany; Table 2 also shows the corresponding distribution from a similar study in the United States.[22] Notably, less amalgam (11% versus 47%) but more composite resin (24% versus 9%) is used by dentists in Germany today than by dentists in the United States in 2004. In Germany, the proportion of gold crowns was much higher in the western federal states than in the eastern federal states, whereas the proportions of ceramic crowns and metal-ceramic crowns differed to a smaller degree (Table 2). Differences between the unweighted and weighted proportions in Table 2 were small.

The observed proportions in the women and men are shown in Tables 3 and 4. The women had more esthetic restorations (for example, composite resin and ceramic). Among the women, composite resin had the largest share (32%), but gold restorations also had a high share (24% inlays and 19% crowns). In the molars of the men, gold inlays (27%) and gold crowns (27%) dominated evenly. Amalgam was used in 16% of the men, while it was less commonly used in the women (6%).

Table 1. Characteristics of dentists surveyed

	West				East			
	Women		Men		Women		Men	
Variable	**Observed**	**Weighted**	**Observed**	**Weighted**	**Observed**	**Weighted**	**Observed**	**Weighted**
N	104		104		50		30	
Proportion within the region	50.0	40.7	50.0	59.3	62.5	58.2	37.5	41.8%
Age group, y								
20-34	23 (22.1)	(25.5)	13 (12.5)	(11.2)	11 (22.0)	(17.6)	7 (23.3)	(11.6)
35-44	23 (22.1)	(26.9)	9 (8.7)	(17.3)	12 (24.0)	(18.2)	2 (6.7)	(17.0)
45-54	32 (30.8)	(26.9)	26 (25.0)	(30.3)	13 (26.0)	(24.1)	8 (26.7)	(26.7)
55-64	21 (20.2)	(16.9)	36 (34.6)	(28.2)	12 (24.0)	(34.7)	8 (26.7)	(36.9)
65-79	5 (4.8)	(3.9)	20 (19.2)	(13.0)	2 (4.0)	(5.4)	5 (16.7)	(7.8)
Median (first quartile – third quartile)	47.5 (37.5-55)		57.5 (47.5-62.5)		47.5 (37.5-57.5)		52.5 (37.5-62.5)	
Mean ±standard deviation	46.1 ±11.6	44.4	54.4 ±12.9	51.8	47.2 ±11.9	50.0	50.5 ±14.8	51.0
Total number of molars	604		629		318		168	
Number of dentists with								
4 molars	1 (1)	(1)	0 (0)	(0)	0 (0)	(0)	0 (0)	(0)
5 molars	1 (1)	(1)	2 (2)	(1)	0 (0)	(0)	1 (3)	(5)
6 molars	2 (2)	(2)	3 (3)	(2)	3 (6)	(7)	3 (10)	(6)
7 molars	19 (18)	(17)	14 (13)	(12)	14 (28)	(31)	4 (13)	(12)
8 molars	81 (78)	(80)	85 (82)	(84)	33 (66)	(62)	22 (73)	(76)

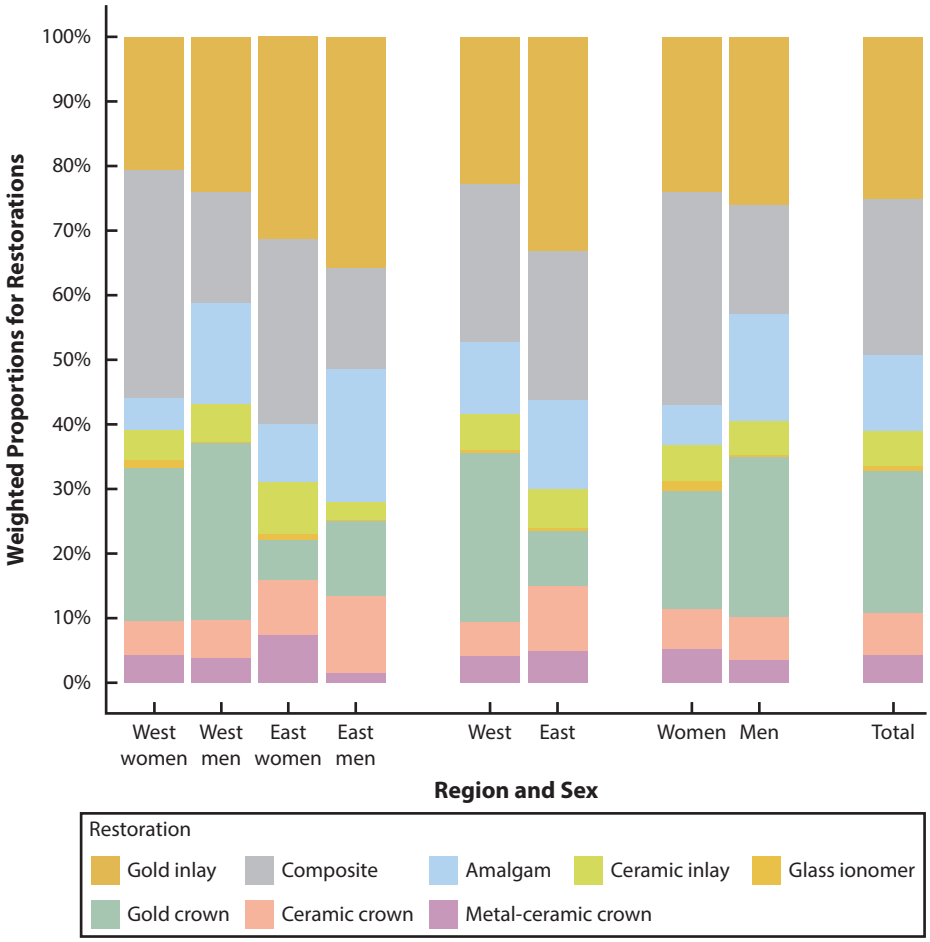

Figure 2. Weighted proportions for restorations across region and sex.

Table 2. Proportions of materials of 1719 restored molars across regions in German study among dentists compared with corrected proportions of Figure 1 in the study by Rosenstiel et al[22]

	Rosenstiel et al	German Study					
		West		East		Total	
Material	Proportion Related to 4608 Restored Molars Proportion	Unweighted (72.2% or 208 or out of 288 Dentists; 1233 Molars) Proportion (95% CI)	Weighted (78.4% out of 288 Dentists) Proportion (95% CI)	Unweighted (27.8% or 80 out of 288 Dentists; 486 Molars) Proportion (95% CI)	Weighted (21.6% out of 288 Dentists) Proportion (95% CI)	Unweighted (288 Dentists) Proportion (95% CI)	Weighted (288 Dentists) Proportion (95% CI)
Gold inlay	17	23.2 (18.7-28.4)	22.6 (18.2-27.8)	30.7 (23.1-39.4)	33.1 (24.8-42.7)	25.3 (21.4-29.7)	25.0 (21.0-29.6)
Composite	9	22.3 (18.1-27.1)	24.6 (19.8-30.1)	27.6 (20.4-36.1)	23.2 (16.4-31.8)	23.8 (20.1-27.9)	24.3 (20.2-28.9)
Amalgam	47	10.4 (7.3-14.5)	11.2 (7.8-15.8)	11.9 (7.2-19.2)	13.9 (8.2-22.5)	10.8 (8.1-14.3)	11.8 (8.8-15.8)
Ceramic inlay		4.7 (3.1-7.0)	5.3 (3.5-7.9)	6.4 (3.9-10.2)	5.7 (3.4-9.3)	5.2 (3.8-7.0)	5.4 (3.9-7.5)
Glass ionomer or compomer		0.9 (0.4-1.9)	0.8 (0.4-1.8)	0.8 (0.2-2.7)	0.8 (0.2-3.1)	0.9 (0.5-1.7)	0.8 (0.4-1.6)
Gold crown	13	28.4 (23.7-33.5)	25.8 (21.2-31.1)	8.4 (5.1-13.6)	8.3 (5.0-13.4)	22.7 (19.1-26.9)	21.8 (18.1-26.1)
Ceramic crown		5.6 (3.9-7.9)	5.5 (3.9-7.9)	9.7 (6.1-15.0)	10.0 (6.1-16.0)	6.7 (5.1-8.9)	6.6 (4.9-8.7)
Metal-ceramic crown	10	4.5 (2.9-7.1)	4.0 (2.5-6.4)	4.5 (2.4-8.5)	5.0 (2.6-9.4)	4.5 (3.1-6.6)	4.3 (2.9-6.2)
Indirect esthetic	4						

Confidence intervals are adjusted for 288 dentists.

Table 3. Number and unweighted proportions of materials of 1719 restored molars across region and sex in German study among dentists

	West				East				Total			
	Women (50.0% or 104 out of 208 Western Dentists; 604 Molars)		Men (50.0% or 104 out of 208 Western Dentists; 629 Molars)		Women (62.5% or 50 out of 80 Eastern Dentists; 318 Molars)		Men (37.5% or 30 out of 80 Eastern Dentists; 168 Molars)		Women (53.5% or 154 out of 288 Dentists; 922 Molars)		Men (46.5% or 134 out of 288 Dentists; 797 Molars)	
Material	n	Proportion (95% CI)	n	Proportion (95% CI)	n	Proportion (95% CI)	n	Proportion (95% CI)	n	Proportion (95% CI)	n	Proportion (95% CI)
Gold inlay	130	21.5 (15.5-29.0)	156	24.8 (18.6-32.2)	92	28.9 (20.2-39.6)	57	33.9 (21.0-49.8)	222	24.1 (18.9-30.1)	213	26.7 (20.9-33.4)
Composite	192	31.8 (25.0-39.4)	83	13.2 (9.1-18.7)	105	33.0 (23.7-43.9)	29	17.3 (9.2-30.0)	297	32.2 (26.6-38.4)	112	14.1 (10.3-18.9)
Amalgam	32	5.3 (2.9-9.6)	96	15.3 (10.1-22.4)	27	8.5 (4.0-17.0)	31	18.5 (9.4-33.0)	59	6.4 (4.0-10.1)	127	15.9 (11.2-22.1)
Ceramic inlay	24	4.0 (2.3-6.8)	34	5.4 (3.1-9.3)	26	8.2 (4.7-13.7)	5	3.0 (1.1-7.6)	50	5.4 (3.7-8.0)	39	4.9 (2.9-8.0)
Glasionomer or compomer	9	1.5 (0.6-3.6)	2	0.3 (0.1-1.3)	3	0.9 (0.2-3.9)	1	0.6 (0.1-4.1)	12	1.3 (0.1-2.7)	3	0.4 (0.1-1.2)
Gold crown	156	25.8 (20.2-32.4)	194	30.8 (23.8-38.9)	18	5.7 (3.3-9.5)	23	13.7 (6.3-27.2)	174	18.9 (14.8-23.8)	217	27.2 (21.3-34.1)
Ceramic crown	33	5.5 (3.2-9.1)	36	5.7 (3.5-9.1)	27	8.5 (5.1-13.7)	20	11.9 (5.1-25.5)	60	6.5 (4.5-9.3)	56	7.0 (4.5-10.7)
Metal-ceramic crown	28	4.6 (2.6-8.2)	28	4.5 (2.2-8.8)	20	6.3 (3.2-11.9)	2	1.2 (0.2-8.0)	48	5.2 (3.4-8.0)	30	3.8 (1.9-7.3)

Confidence intervals are adjusted for 288 dentists.

To clarify the role of age (and confounders such as geographic region), restoration as the exposure of interest was successively adjusted for sex, age, region, type of dental office, jaw, and tooth type in a multinomial logistic regression analysis with gold inlay as the reference restoration. The unadjusted odds of the men having composite resin was 0.5 times less than the odds of the women, which changed to 0.9 by adjusting for age. The 95% confidence interval of the final model in Table 5 indicated that the data were consistent with a true odds ratio between 0.4 and 1.8. In contrast, the corresponding odds ratio of having amalgam was only marginally confounded by age (from 2.4 to 2.5). The 95% confidence interval of the final model in Table 5 indicated that the data were consistent with a true odds ratio between 1.2 and 5.7 (P=.016).

Depending on the dentist's age, the odds of each material compared with the gold inlay as the reference is shown in Figure 3 (using the multinomial logistic regression model as for sex). The younger dentists had more esthetic restorations than the older dentists (Fig. 3B). Furthermore, the dentists chose more tooth-colored restorations in the last 10 years; thus, 59% of these restorations were composite resin, 7% were ceramic inlays, and 16% were ceramic partial-coverage crowns and crowns. Gold restorations were rarely chosen, with 7% gold inlays, 8% partial-coverage gold crowns and crowns, and only 3% amalgam. Regarding crowns, the number of gold crowns increased with the age of the dentists, as graphed in Figure 3C (P=.026), whereas whether younger dentists preferred ceramic crowns to gold crowns was uncertain, as graphed in Figure 3D.

Table 4. Weighted proportions of materials of 1719 restored molars across region and sex in German study among dentists

	West		East		Total	
	Women (40.7% out of 208 Western Dentists)	Men (59.3% out of 208 Western Dentists)	Women (58.2% out of 80 Eastern Dentists)	Men (41.8% out of 80 Eastern Dentists)	Women (44.7% out of 288 Dentists)	Men (55.3% out of 288 Dentists)
Material	Proportion (95% CI)	Proportion (95% CI)	Proportion (95% CI)	Proportion (95% CI)	Proportion (95% CI)	Proportion (95% CI)
Gold inlay	20.7 (14.8-28.3)	23.9 (17.9-31.3)	31.2 (22.2-42.0)	35.7 (21.4-53.2)	23.9 (18.7-30.0)	26.0 (20.2-32.8)
Composite	35.2 (27.9-43.3)	17.3 (11.6-25.1)	28.6 (20.3-38.8)	15.6 (6.8-31.9)	33.2 (27.4-39.7)	17.0 (11.8-23.8)
Amalgam	5.0 (2.8-8.8)	15.5 (10.2-22.8)	9.0 (4.4-17.7)	20.7 (10.1-37.8)	6.2 (3.9-9.7)	16.4 (11.4-22.9)
Ceramic inlay	4.4 (2.5-7.6)	6.0 (3.5-10.1)	7.9 (4.5-13.5)	2.7 (1.0-7.2)	5.4 (3.6-8.1)	5.4 (3.3-8.8)
Glasionomer or compomer	1.6 (0.6-4.0)	0.3 (0.1-1.3)	1.1 (0.2-5.5)	0.3 (0.03-1.9)	1.5 (0.7-3.2)	0.3 (0.1-1.1)
Gold crown	23.4 (18.1-29.8)	27.5 (20.7-35.4)	6.0 (3.5-10.1)	11.5 (5.4-22.9)	18.2 (14.2-23.1)	24.7 (18.9-31.5)
Ceramic crown	5.4 (3.0-9.3)	5.7 (3.5-8.9)	8.6 (5.0-14.4)	12.0 (5.2-25.4)	6.3 (4.2-9.3)	6.8 (4.5-10.1)
Metal-ceramic crown	4.3 (2.4-7.5)	3.9 (1.9-7.7)	7.4 (3.8-14.0)	1.5 (0.2-10.0)	5.2 (3.4-8.0)	3.5 (1.8-6.7)

Confidence intervals adjusted for 288 dentists.

Figure 4 and Table 6 present the age of the restoration as a function of the dentist's age. The age of gold inlays increased with dentist age, as did the age of metal-ceramic crowns, gold crowns, and amalgam, as graphed in Figure 4. For ceramic inlay and composite resin, such an increase was limited to approximately 50 years of age (Fig. 4, Table 6). In contrast with amalgam, the age of composite resin restorations decreased in older dentists.

Table 5. Odds ratios for sex and region from multinomial logistic regression analysis of materials

	Sex (Men) as Exposure (Reference: Women)		Region (East) as Exposure (Reference: West)	
Material (Outcome)	Odds Ratio (95% CI)	*P*	Odds Ratio (95% CI)	*P*
Joint test over all materials		.012		<.001
Gold inlay	1 (reference)		1 (reference)	
Composite	0.82 (0.37-1.81)	.624	0.69 (0.28-1.73)	.434
Amalgam	2.62 (1.20-5.73)	.016	1.05 (0.45-2.45)	.903
Ceramic inlay	1.16 (0.50-2.69)	.733	0.78 (0.33-1.83)	.570
Glasionomer or compomer	0.17 (0.04-0.82)	.027	0.52 (0.12-2.28)	.384
Gold crown	0.79 (0.44-1.41)	.419	0.19 (0.10-0.36)	<.001
Ceramic crown	1.14 (0.49-2.66)	.757	1.28 (0.53-3.09)	.575
Metal-ceramic crown	0.52 (0.21-1.26)	.148	0.72 (0.30-1.72)	.458

DISCUSSION

The authors are unaware of a previous study on how the molars of German dentists were treated after dental caries and showed that German dentists mostly chose gold restorations in their molars, consistent with the survey of Rosenstiel et al[22] in 2004. When the men were compared with the women among the German dentists, the men chose metallic restorations more often than the women, while the women chose esthetic restorations, especially composite resins, more often than the men. The choice of material was also affected by the dentist's region and age. The younger dentists preferred esthetic materials. Furthermore, gold restorations, together with other traditional metallic restorations, were the most durable.

Gold inlays were frequent and constituted the largest share of restorations for women and men from the eastern federal states, as well as for men from the western federal states. This finding can be justified by the many apparent advantages that gold restorations offer, especially in the posterior region.[18,19] However, despite the non–tooth-colored appearance, gold has always been an expensive material. Furthermore, gold was rare and difficult to obtain, especially in the former German Democratic Republic. These factors could explain the finding that there is less gold in the molars of dentists in the eastern federal states (the former German Democratic Republic) than in the molars of dentists from the western federal states of Germany.

Amalgam also has some of the positive aspects of gold. In addition to indications of increased longevity, German and international trends toward tooth-colored restorations are discernible, especially among women, probably because of esthetics.[3,5,9,22] This is also reflected in the present study in the subgroup of German dentists.

As an alternative to amalgam, composite resin is increasingly being offered and chosen. In addition to the possibility of direct, tooth-colored restorations, the properties of the materials have also been improving in recent years. Compared with the results of Rosenstiel et al[22] in 2004 in the United States, more dentists in Germany chose composite resin for their molars in 2018. The decisive factor here, regarding the use of amalgam, was mostly the age and, to a lesser degree, the sex of the dentists. The younger dentists had more composite resin and ceramic restorations than the older dentists. Possible explanations are the decreased prevalence and intensity of caries and relatively minor interventions, including those involving adhesive technology, to be as conservative of tooth structure as possible. Moreover, many dental

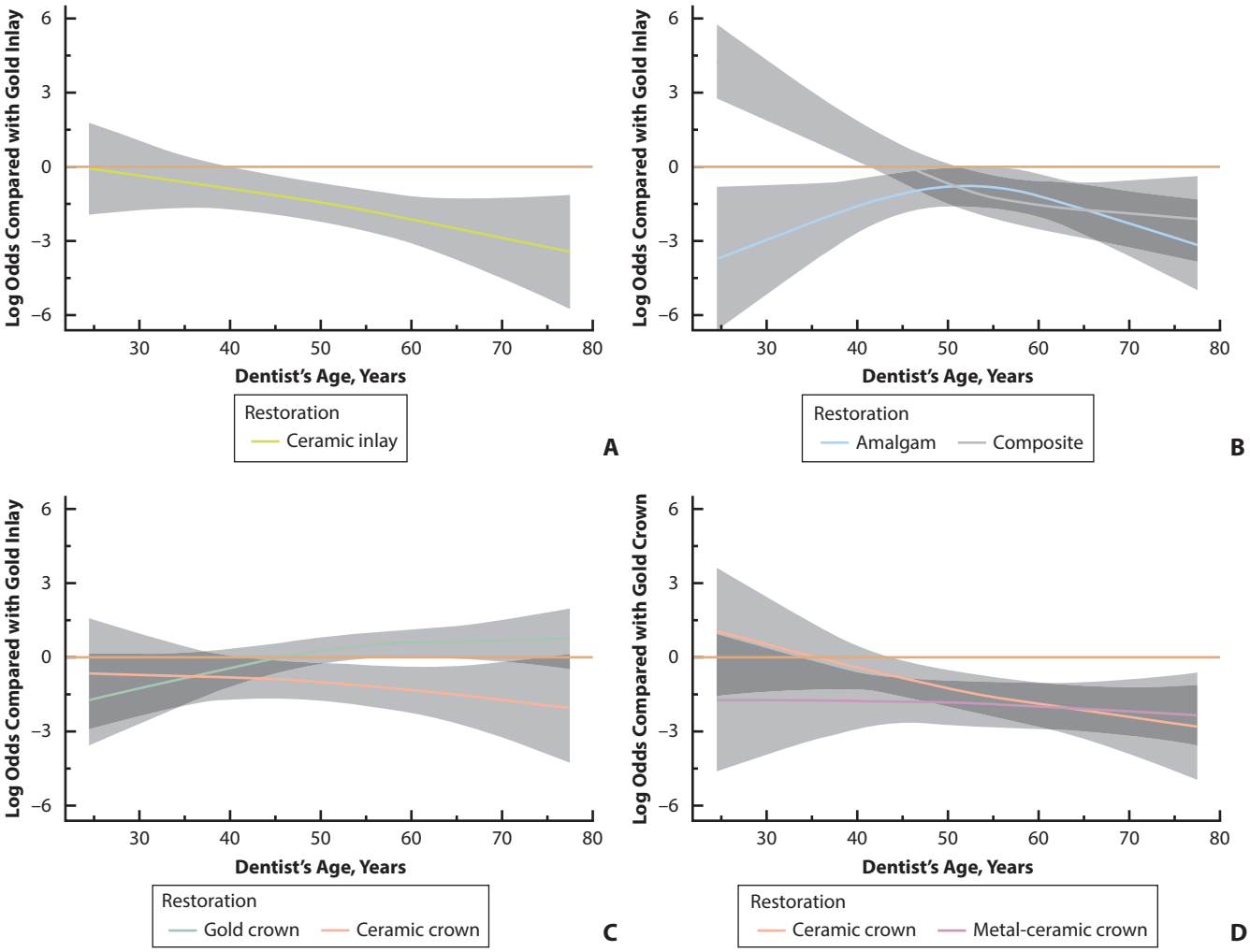

Figure 3. Restoration depending on dentist's age. Multinomial logistic regression for restoration as dependent variable and nonlinear age as exposure. As comparisons relative (log odds); A-C, Gold inlay. D, Gold crown chosen as reference restoration. Log odds adjusted for sex, jaw, tooth type, region, and type of dental office and corrected for region, age, and sex using inverse probability weights. Confidence intervals adjusted for dentist level.

schools no longer include amalgam as the preferred posterior restorative material in their curriculum.[44] Therefore, amalgam and its properties are less familiar to students and young dentists, and gold does not satisfy the requirements of increased esthetic demands and cost-effectiveness in the younger generations in particular.

Regarding the longevity of the various materials used in the dentists' molars, the results of this study confirmed that the longevity of metallic restorations was greater than that of more esthetic materials, similar to the results of other studies.[27-29] For example, the age of gold inlays increased with the age of the dentists, as did the age of metal-ceramic crowns, gold crowns, and amalgam. Additionally, dentists increasingly chose tooth-colored restorations over the last 10 years; this trend was already evident in the study by Rosenstiel et al[22] in 2004, in which 56% of the restorations performed in the last 5 years in the personal molars of dentists were tooth colored.

As other studies have shown, dentists are also increasingly opting for tooth-colored materials, especially composite resin, to treat their patients' posterior teeth.[45] However, it should be noted that resin materials and inlays are used for smaller cavities, while partial-coverage crowns and crowns are used for more substantial defects. Moreover, metallic materials, such as gold and amalgam, have been in use for much longer than composite resin and various ceramics, so only a limited comparison is possible.

This study had several limitations. First, the request to participate specified the university, as well as the doctoral

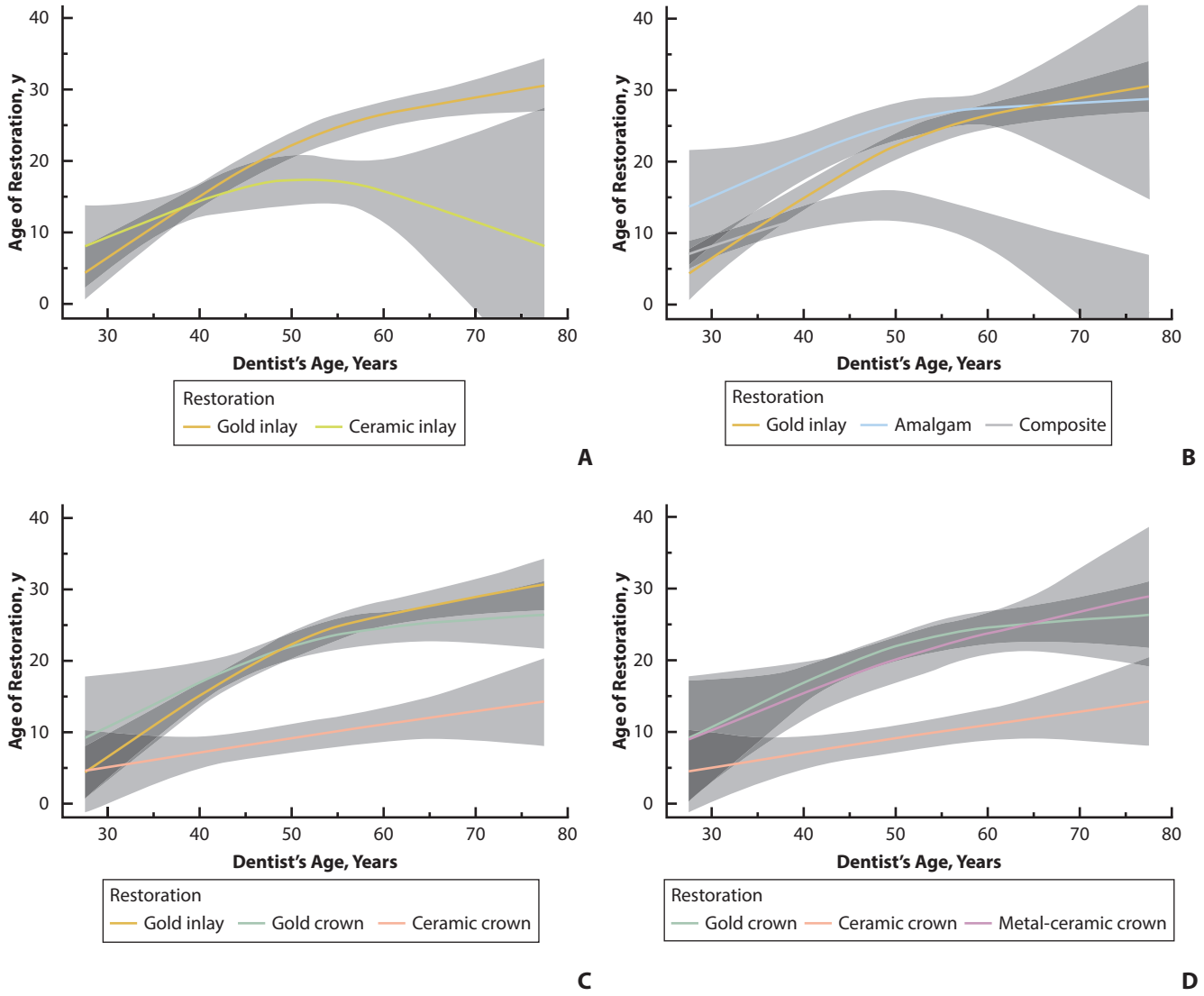

Figure 4. Restoration longevity depending on type of restoration and dentist's age. Ordinary least squares regression for age of restoration as dependent variable and interaction between restoration and nonlinear age of dentist as exposures. Predicted restoration age adjusted for sex, jaw, tooth type, region, and type of dental office and corrected for region, age, and sex by using inverse probability weights. Panel plots show following. A, Gold inlay and ceramic inlay. B, Gold inlay, amalgam, and composite resin. C, Gold inlay, ceramic crown, and gold crown. D, Gold crown, ceramic crown, and metal-ceramic crown in comparison. Confidence intervals adjusted for dentist level.

supervisor, and this might have influenced the participants. Second, although the acquisition of the data was carried out by self-disclosure, the profession of the participants requires a high level of knowledge of the material contained in their own teeth. Third, participation in the survey required a certain amount of effort and time to answer the questionnaire. Fourth, the sample size was small on the subject level; however, the data were analyzed on the tooth level adjusting for the subject level.

Despite these limitations, this study provided new insights and data because the study objective, population sampled, and research questions were clearly defined. To answer the research questions, confidence intervals were presented and interpreted because the American Statistical Association recently took a stand against the framework of *P* values and null hypothesis significance testing.[37-39] While *P* values are primarily related to testing and not to decision making, confidence intervals are related to effect sizes.[37] Furthermore, the survey reached a large audience in the target population of active German dentists. To reduce the selection bias usually expected in online surveys,[46] an effective weighting procedure adjusted for different percentages such as the sex and age of dentists in the federal states was used by using data from a central institution, the Bundeszahnärztekammer.[35] In the present study, those differences proved to be marginal, suggesting that the bias was not a major concern.

Table 6. Age of restoration and dentist's age for each material except glass ionomer

Material	Contrast	Test for Interaction or Joint Test for All Contrasts = 0	Dentist's Age			Difference in Change of Longevity of Restoration	
			32.5 y	47.5 y	62.5 y	Between 32.5 and 47.5 y of Dentist's Age	Between 32.5 and 62.5 y of Dentist's Age
		P	Age of Restoration (95% CI) *P*	Age of Restoration (95% CI) *P*	Age of Restoration (95% CI) *P*	Age of Restoration (95% CI) *P*	Age of Restoration (95% CI) *P*
Composite			9.3 (7.8-10.7)	13.8 (11.7-15.9)	8.9 (5.9-12.0)		
Amalgam			16.6 (11.0-22.3)	24.5 (21.4-27.5)	27.9 (24.3-31.5)		
	Amalgam vs composite	.001	7.4 (1.7-13.1), *P*=.011	10.7 (7.3-14.1), *P*<.001	19.0 (14.2-23.8), *P*<.001	3.3 (-3.2 to 9.8), *P*=.320	11.6 (5.3-18.8), *P*<.001
Gold inlay			8.8 (6.0-11.5)	20.7 (18.9-22.5)	27.2 (25.4-29.0)		
Ceramic inlay			10.7 (7.2-14.2)	17.0 (13.5-20.5)	14.9 (8.8-21.0)		
	Ceramic vs gold inlay	<.001	1.9 (-2.1 to 6.0), *P*=.350	-3.7 (-7.3 to -0.1), *P*=.042	-12.3 (-18.4 to -6.3), *P*<.001	-5.7 (-11.9 to 0.5), *P*=.073	-14.3 (-20.7 to -7.8), *P*<.001
Gold crown			12.3 (6.1-18.5)	20.9 (19.2-22.6)	25.0 (22.7-27.3)		
Ceramic crown			5.6 (1.4-9.8)	8.6 (6.7-10.5)	11.5 (9.0-14.0)		
	Ceramic vs gold crown	<.001	-6.7 (-14.1 to 0.7), *P*=.075	-12.3 (-14.6 to -10.0), *P*<.001	-13.5 (-16.6 to -10.4), *P*<.001	-5.6 (-13.5 to 2.3), *P*=.165	-6.7 (-15.7 to 2.2), *P*=.140
Metal-ceramic crown			11.6 (5.5-17.7)	19.1 (15.8-22.4)	24.6 (21.4-27.9)		

The loss of data caused by a coding error may have caused bias. However, the data comparisons show that distortion was more likely to occur during the first data collection, even if it had higher proportions than the second.[47] Indeed, information from the dentists who provided an email address is likely more reliable than information from the respondents who did not provide an email address.

CONCLUSIONS

Based on the findings of this survey of German dentists, the following conclusions were drawn:

1. Restorations made of metallic materials such as gold, amalgam, and base metals dominated in the molars, with gold accounting for the largest share.
2. In recent years, the proportion of tooth-colored restorations has increased.
3. In particular, younger dentists use composite resin and ceramics, which are also most frequently and increasingly offered to patients today.

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