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Preparation Techniques Used to Make Single-Unit Crowns: Findings from The National Dental Practice-Based Research Network

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Abstract

Purpose: To: (1) determine which preparation techniques clinicians use in routine clinical practice for single-unit crown restorations; (2) test whether certain practice, dentist, and patient characteristics are significantly associated with these techniques.

Methods: Dentists in the National Dental Practice-Based Research Network participated in a questionnaire regarding preparation techniques, dental equipment used for single-unit crown preparations, scheduled chair time, occlusal clearance determination, location of finish lines, magnification during preparation, supplemental lighting, shade selection, use of intraoral photographs, and trimming dies. Survey responses were compared by dentist and practice characteristics using ANOVA.

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The authors deny any conflicts of interest.

Results: Of the 2132 eligible dentists, 1,777 (83%) responded to the survey. The top two margin configuration choices for single-unit crown preparation for posterior crowns were chamfer/heavy chamfer (65%) and shoulder (23%). For anterior crowns, the most prevalent choices were the chamfer (54%) and the shoulder (37%) configurations. Regarding shade selection, a combination of dentist, assistant, and patient input was used to select anterior shades 59% of the time. Photographs are used to communicate shade selection with the laboratory in about half of esthetically demanding cases. The ideal finish line was located at the crest of gingival tissue for 49% of respondents; 29% preferred 1 mm below the crest; and 22% preferred the finish line above the crest of tissue. Average chair time scheduled for a crown preparation appointment was 76 ± 21 minutes. Practice and dentist characteristics were significantly associated with margin choice including practice type ($p < 0.0001$), region ($p < 0.0001$), and years since graduation ($p < 0.0001$).

Conclusions: Network dentists prefer chamfer/heavy chamfer margin designs, followed by shoulder preparations. These choices were related to practice and dentist characteristics.

Keywords

Crowns; PBRN; survey

Dentists use crowns for a variety of reasons to restore the dentition to a state of physiological health.^{1,2} The indications for crowns are diverse, and may include factors such as endodontic treatment, cracks and fractures of the tooth, large restorations, esthetic shortcomings, or significant caries.^{1,3,4} When planning crowns, there is variation among dentists in the likelihood of recommending a crown. Although consensus exists in some areas (posterior endodontic treatment), variation dominates in others (size of an existing restoration).^{3,4} In fact, evidence suggests recommendations for crowns may be influenced by factors unrelated to tooth and patient variables.¹

Dentists must make a variety of clinical decisions when fabricating crowns for their patients. Depending on the restorative material, historic guidelines suggest an optimal design for tooth preparation based on fundamental principles for predictable successful prosthodontic treatment.^{5–13} These principles of tooth preparation may include preservation of tooth structure, retention and resistance form, marginal integrity, structural durability, and esthetic considerations.^{5–13} The internal line angles from axial wall to shoulder junction should be smooth, as studies have shown that sharp internal line angles may be associated with marginal fit discrepancies or fracture of the restorative material.^{13,14} Adequate occlusal reduction is also considered an important aspect of tooth preparation.¹⁵ Published principles for tooth preparation suggest the following tooth reductions for metal-ceramic crowns: 1.5 to 2.0 mm of occlusal reduction; 1.5 to 2.0 mm of axial reduction; and approximately 10° to 20° of total occlusal convergence.^{16–20}

Margin integrity has been found to be an essential factor in evaluating preparations for an indirect restoration and delivery of a crown with accurate fit.^{15,21–23} Prior studies have reported that a marginal opening of 100 μm was consequential when determining clinical acceptability.^{15,21} Poor margins may cause greater incidence of gingival inflammation, recurrent caries, plaque/calculus accumulation, and cement disintegration.¹² At the insertion

appointment, an open or defective margin may compel a dentist to re-impress and remake the crown.

Among the myriad choices and clinical factors that guide a dentist in recommending a crown, preparing a tooth for the crown, and then fabricating and inserting the restoration, relatively little is known regarding a general consensus for accepted best practices, or even what are commonly used techniques among practicing dentists. The purpose of this study was to investigate current techniques used by dentists to fabricate crowns in the United States. Furthermore, a potential association between dentist characteristics, practice characteristics, and preparation techniques was investigated. By recognizing clinically acceptable practices used by peers, dentists are able to evaluate their own clinical procedures and make changes where appropriate to increase treatment predictability.

MATERIALS AND METHODS

This study was based on a questionnaire completed by dentists in the National Dental Practice-Based Research Network (PBRN; “network”). The network is a consortium of dental practices and dental organizations focused on improving the scientific basis for clinical decision-making.²⁴ Detailed information about the network is available at its website.²⁵ The network’s applicable Institutional Review Boards approved the study; all participants provided informed consent after receiving a full explanation of the procedures. The methods for conducting this study are previously reported,²⁶ and reiterated here for the convenience of the reader.

Enrollment questionnaire

As part of the enrollment process, practitioners completed an enrollment questionnaire that described themselves, their practice(s), and their patient population. This questionnaire is publicly available at <http://www.nationaldentalpbrn.org/study-results/> under the heading “Factors for Successful Crowns.” The questionnaire solicited information about practitioner, practice, and patient characteristics. Questionnaire items, which had documented test/re-test reliability, were taken from the authors’ previous work in a practice-based study of dental care.^{27,28} The majority of respondents completed the questionnaire online, although a paper option was available.

Study questionnaire development

The questionnaire for this study was developed by a study group of the authors, dentists with clinical expertise, statisticians, and laboratory technicians. Its purpose was to measure current practices in treatment planning, as well as preparing and fabricating single-unit crowns on natural teeth. The survey was reviewed by IDEA Services (Instrument Design, Evaluation, and Analysis Services, Westat, Rockville, MD), a group with expertise in questionnaire development and implementation, as well as National Institute of Dental and Craniofacial Research (NIDCR) program officers and practitioners with prosthodontic content expertise. After extensive internal review, IDEA Services pretested the questionnaire via cognitive interviewing by telephone with a regionally diverse group of eight practicing dentists. Cognitive interviewers probed the dentist’s comprehension of each question. The

interviewers also asked practitioners to identify items of clinical interest that were not addressed in the survey. Results from the pretest prompted further modification of the questionnaire.

Dentists enrolled in the network were eligible for the study if they met the following criteria: (1) completed an enrollment questionnaire; (2) were currently practicing and treating patients in the United States; (3) were in the network's "limited" or "full" participation category; and (4) reported on the enrollment questionnaire that they currently do at least some restorative dentistry in their practices. A total of 2299 network clinicians met these criteria.

Pre-printed invitation letters were mailed (postal) to eligible practitioners, informing them that they would receive an e-mail with a link to the electronic version of the questionnaire. At the time of the e-mail, practitioners were given the option to request a paper version of the survey, as this has been shown to improve response rates.²⁹ Practitioners were asked to complete the questionnaire within 2 weeks. A reminder letter was sent after the second and fourth weeks to those who had not completed the questionnaire. After 6 weeks, e-mail and postal reminders were sent with a printed version of the questionnaire, and practitioners were offered the option of completing the online or paper versions. After 8 weeks, a final postal questionnaire attempt was made with a letter that also encouraged the dentist to complete the questionnaire online. Data collection was closed after 12 weeks from the original email invitation. Practitioners or their business entities were remunerated \$75 for completing the questionnaire if desired. Data were collected from February 2015 to August 2015.

Questionnaire content

The first question of the survey confirmed that the invited clinician restored at least one natural tooth with a full crown restoration in a typical month. Questions from the survey reported here focused on techniques used to prepare teeth for crowns. One such question asked practitioners to describe the margin preparation used for a posterior crown on a first molar, and possible choices were "chamfer or heavy chamfer," "shoulder," "shoulder with bevel," "knife edge," and "other." These represent options used for preparing the marginal detail of a crown. Generally, a chamfer has a rounded internal line angle with a continuous slope to where the finish line meets the axial wall of the preparation; a shoulder is a relatively flat ledge that meets the root surface with an cavosurface angle similar to 90°; a shoulder bevel has the addition of a brief cavosurface preparation, which creates an obtuse angle relative to the external root structure; and a knife-edge preparation uses minimal tooth preparation and a very obtuse cavosurface angle similar to the profile of the root surface itself. Other questions asked clinicians about their techniques for making crowns, such as the use of magnification, time scheduled for appointments, shade-matching techniques, and supplementary lighting use.

Statistical analyses

Power analysis was conducted based on an anticipated sample size of 1500 completed questionnaires. This sample size would yield sufficient precision to estimate response

percentages within $\pm 2.53\%$ at the 95% confidence level. To document test/re-test reliability of the questionnaire items, 47 respondents completed the questionnaire twice online. For categorical responses, kappa and weighted kappa were used; for numeric items, Pearson's correlation coefficient was calculated to determine test-retest reliability. Descriptive statistics are presented as counts and percentages for categorical variables, and as means and standard deviations for continuous measures. To determine if differences exist among groups responding to the survey, dentist and practice characteristics were compared to survey responses using ANOVA and multiple regression analysis. Results were considered significant at the $p < 0.05$ level.

RESULTS

Of the 2132 eligible dentists, 1777 (83%) completed the survey. Characteristics of the responding dentists are reported elsewhere,¹ and are presented in Table 1 for the reader's convenience. According to the results of this survey, the most-used margin configuration for crowns for posterior teeth was the chamfer/heavy chamfer (65%), followed by shoulder preparations (23%). For crowns restoring anterior teeth, the most-used margin configuration was the chamfer/heavy chamfer (54%), followed by the shoulder preparation (37%).

Other aspects of crown preparation were documented with this survey (Table 2). The most common handpiece reported for single-unit crown preparations was the air turbine high-speed handpiece (81%). The total scheduled chair time ($\pm$ SD) for a single-unit crown preparation, impression, and provisional restoration appointment was 76 ± 21 minutes. More than half (66%) of dentists chose 2 mm occlusal as their desired clearance for a metal-ceramic (PFM) crown; 25% chose 1.5 mm occlusal clearance. When describing the ideal location for a finish line for a single-unit crown, 49% reported they place it at the crest of the gingival tissue, 29% place it 1 mm below the gingival tissue, and 22% place it above the crest of the gingival tissue. When preparing a tooth for a crown, 79% of dentists reported the use of some sort of magnification. Fifty-seven percent report the use of extra lighting other than the usual operatory overhead lamp when preparing a tooth for a crown.

Questions regarding crown shade selection were presented in the survey (Table 2). When selecting shades for crowns, a combination of dentist, assistant, and patient input is used for posterior crowns 47% of the time; this increased to 59% for anterior crown shade selection. About 75% of dentists report using photographs to communicate shade selection with the laboratory on esthetically demanding cases. Clinicians reported they trim dies in the office 12% of the time.

When considering posterior crown margin design (independent of crown material), several dentist and practice characteristics were significantly associated with margin configuration (Table 3). Gender was significantly associated with margin design ($p < 0.001$), with females tending to use more shoulder preparations. Race was significantly associated with margin design ($p < 0.001$), with Black/African-American clinicians using less chamfer designs and more shoulder-bevel designs than other races. Years since graduation from dental school was significantly associated with margin design ($p < 0.001$), with more-experienced clinicians using shoulder-bevel and knife-edge margin designs more often. Other factors significantly

associated with margin configuration were region and type of practice. Practitioners in the Northeast tended to use shoulder-bevel and knife-edge preparations more often than other regions of the country.

When considering anterior crown margin design, several factors were also associated with margin configuration types (Table 4). Gender was significantly associated with margin design ($p < 0.001$), with females again using more shoulder preparations than males (44% vs. 34%). Significant variations in margin design were associated with the clinician's race, with Asian clinicians using a high percentage of shoulder designs (43%); dentists reporting Hispanic ethnicity also commonly used the shoulder preparation (49%), compared to non-Hispanic clinicians (36%). Regarding years since graduation, clinicians with more than 15 years since dental school graduation were less likely to use a shoulder preparation. Type of practice was significantly associated with margin design ($p < 0.01$); dentists in the Health Partners organization (a large group practice in Minnesota) used chamfer designs 77% of the time, while dentists in academic settings used the chamfer only 47% of the time. Network region and practice busyness were also significantly associated with margin configuration. Knife-edge margins, though only a small percent of overall margin designs, were concentrated in the South Central and South Atlantic regions. Clinicians in the Midwest favored the chamfer more than other regions. Dentists who classified their practice as not busy used more shoulder bevel margin designs than other practices.

DISCUSSION

The results of this study showed a higher prevalence of chamfer or heavy chamfer margin configuration compared to other types of crown preparations: shoulder, shoulder with bevel, and knife edge. Margin preference varied with practice and dentist characteristics in addition to the type of crown material. In this survey, dentists were able to conceptualize using their material of choice for anterior and posterior restorations, so it is likely that material considerations were included in selecting margin configuration. Typically, a shoulder preparation is associated with all-ceramic restorations, although it can be used for a variety of crown materials. Regardless of the margin configuration, a sufficient bulk of material is required to prevent material fracture and allow adequate space for restorative materials.^{17,30,31} Some evidence suggests a knife-edge or feather-edge margin may be associated with less gingival recession, but more bleeding on probing.^{32,33} The knife-edge preparation was frequently correlated with minimally invasive crown preparations.³⁴

Studies have shown that a clinician's gender is associated with treatment decisions and outcomes.^{35–38} However, it is unclear as to why females use more shoulder preparations than males, for both anterior and posterior crowns. It is tempting to speculate that females use all-ceramic materials more often than males, but results from this survey suggested the opposite. Regarding posterior crowns, females were more likely to use metal-ceramic crowns.³⁹ Margin design also varied based on years since graduation of the dentist, with more experienced clinicians less likely to use shoulder preparations. This may be associated with the relatively recent widespread use of all-ceramic crowns, and their associated demands for marginal bulk of material. Survey findings have shown that the leading choice of crown materials for an anterior crown is lithium disilicate, and the principal choices for

posterior crowns are all-zirconia and porcelain-fused-to-metal crowns.³⁹ The heavy chamfer margin typically used to prepare a tooth for a zirconia crown allows the restoration to have a bulk of material that is confined to the space created by the tooth preparation and withstand the forces of occlusion.^{40,41} Some other advantages are suggested for chamfer marginal design in the literature. Prior studies have shown the fracture resistance of deep chamfer margins was greater than that of other marginal configurations.^{15,42,43} Another study supported the use of heavy chamfer preparations for all-ceramic crowns, as more practices are driven by esthetics.⁴⁰ Most network dentists selected this margin for anterior and posterior single-unit crowns. The advantages of heavy chamfer finish lines are that they provide superior support for all-ceramic restorations, improve seating, and provide adequate bulk of material.⁴⁴

Network dentists who participated in this study reported the ideal location for a finish line for a single-unit crown is at the crest of the gingival tissue. Some reports show that equigingival margins are associated with plaque accumulation and gingival inflammation.^{45–48} Additionally, any amount of gingival recession can potentially cause a visible, unesthetic margin; however, it is possible that with the use of all-ceramic crowns, visible crown margins can be esthetically acceptable and finished easily to provide a smooth, polished interface at the gingival margin, reducing the undesirable attributes of equigingival margins.

In this group of dentists responding to this survey, a combination of the dentist, assistant, and patient selected the shade for posterior crowns almost half the time; for anterior crowns, dentists reported this group selects the shade 59% of the time. Twenty-five percent of the time, the dentist alone selected the shade for anterior crowns. Approximately 25% of dentists do not use photographs to communicate shade selection with the laboratory on esthetically demanding cases. It would be worth future research to investigate whether this group has a higher incidence of remakes.

This study did have certain limitations, and the interpretation of the study should take these into account, as previously reported.²⁶ When describing margin configuration, the crown material was not specified, only that the crown was posterior or anterior. Clearly, the choice of a particular margin design was confounded by the material variable. This study used self-reported information, which may differ from actual clinical treatment behavior. Additionally, although the response rate was good, it is possible that non-respondents would have reported different behavior. Although network practitioners have much in common with dentists at large,^{49,50} their crown procedures may not be representative of a wider number of dentists. Additionally, network members were not recruited randomly, so factors associated with network participation (e.g., an interest in clinical research) could have made network dentists unrepresentative of dentists at large. While it cannot be asserted that network dentists are entirely representative, it can be stated that they have much in common with dentists at large, while also offering substantial diversity in these characteristics. This assertion is warranted because: 1) substantial percentages of network general dentists are represented in the various response categories of the characteristics in the enrollment questionnaire; 2) findings from several network studies document that network general dentists report patterns of diagnosis and treatment that are similar to patterns determined from non-network general dentists.^{51–54}

and 3) the similarity of network dentists to non-network dentists using the best available national source, the 2010 ADA Survey of Dental Practice.⁵⁵

CONCLUSIONS

According to the results of this study:

1. Network dentists preferred chamfer/heavy chamfer finish lines for anterior and posterior crowns over other margin designs.
2. The choice of margin design is significantly associated with certain practice and dentist characteristics.

When developing practices, a clinician benefits from knowing how other dentists have been operating and what factors may influence these decisions.

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Table 1.

Characteristics of network dentists who participated in this survey

Characteristics	Number ¹ (n = 1777)	Percent (%)
Dentist characteristics		
Gender		
Male	1282	73
Female	483	27
Years since dental school graduation		
<10	292	16
10–19	367	21
20–29	382	22
30+	733	41
Type of practice		
Owner of private practice	1295	74
Associate in private practice	207	12
Health Partners ²	44	3
Permanente ²	70	4
Public health, community	64	4
Academic	48	2
Other	34	2
Network region³		
Western	292	16
Midwest	180	10
Southwest	311	18
South Central	330	19
South Atlantic	327	18
Northeast	337	19
Time commitment		
Fulltime	1508	86
Part time (<32 hrs)	253	14
Specialty status		
General dentist	1719	97
Specialist	56	3
Race		
White	1451	82
Black/African-American	77	4
Asian	161	9
Other	70	4
Patient population characteristics		
Private insurance status		

Characteristics	Number ¹ (n = 1777)	Percent (%)
Dentist characteristics		
<40% Private insurance	249	14
40–79% Private insurance	1017	58
80%+ Private insurance	476	27
Patient appointment regularity		
<50% of patients regularly visit	274	16
50–79% regularly visit	1044	60
80%+ regularly visit	428	25

¹ Due to missing values, reported sample sizes vary.

² Either HealthPartners Dental Group in greater Minneapolis, MN or Permanente Dental Associates in greater Portland, OR.

³ Reported on enrollment questionnaire as the state, subsequently categorized into one of the six regions of the network.

Table 2.

Techniques and practices for making single-unit crowns as reported by survey respondents (n = 1777).

Crown fabrication techniques and practices	Number^I (n =1777)	Percent (%)
Handpiece used		
Electric high-speed	345	19
Air-turbine high-speed, costing \$500 or less	678	40
Air-turbine high-speed, costing \$501 or more	735	41
Other	17	1
Occlusal clearance for PFM, molar		
1.5 mm	450	25
2.0 mm	1164	66
More than 2 mm	161	9
Ideal finish line location		
Above the crest of tissue	385	22
At the crest of tissue	865	49
1 mm below gingival crest	508	29
2 mm below gingival crest	16	1
Who selects shade, <u>posterior</u> tooth		
Clinician	624	35
Assistant	289	16
Lab	7	0.4
Patient	9	0.5
Combination of people	834	47
Other	14	0.8
Who selects shade, <u>anterior</u> tooth		
Clinician	499	28
Assistant	90	5
Lab	93	5
Patient	12	0.7
Combination of people	1048	59
Other	33	2
Photographs used for shade communication for esthetically demanding cases		
Yes, more than 50% of the time	616	35
Yes, 50% of the time or less	710	40
No	451	25

^I Due to missing values, reported sample sizes vary.

Table 3.

Dentist and practice characteristics associated with margin configuration for posterior single-unit crowns (frequency [percent])

Characteristics for posterior crowns	Chamfer	Shoulder	Shoulder bevel	Knife edge	P Value	Total
Overall	1133 (65)	395 (23)	146 (8)	74 (4)		1748
Gender						
Male	828 (66)	259 (20)	113 (9)	64 (5)	0.0005	1264
Female	298 (63)	132 (28)	32 (7)	10 (2)		472
Race						
White/Caucasian	929 (65)	313 (22)	124 (9)	64 (4)	0.005	1430 (83)
Black/African-American	42 (56)	19 (25)	11 (15)	3 (4)		75 (4)
Asian	106 (67)	48 (30)	1 (1)	3 (2)		158 (9)
Other	45 (67)	13 (19)	6 (9)	3 (4)		67 (4)
Ethnicity						
Hispanic	59 (59)	28 (28)	6 (6)	7 (7)	0.22	100 (6)
Non-Hispanic	1060 (65)	365 (22)	138 (96)	67 (4)		1630 (94)
Years since graduation						
Less than 5	48 (69)	18 (26)	2 (3)	2 (3)	0.0001	70 (4)
5 to 15	295 (68)	116 (27)	13 (3)	10 (2)		434 (25)
More than 15	787 (63)	261 (21)	131 (11)	62 (5)		1241 (71)
Type of practice						
Owner of private practice	799 (63)	301 (24)	119 (9)	58 (5)	0.0003	1277 (74)
Associate in private practice	140 (69)	49 (24)	9 (4)	6 (3)		204 (12)
Health Partners	39 (89)	2 (5)	3 (7)	0		44 (3)
Permanente	58 (87)	4 (6)	2 (3)	3 (4)		67 (4)
Public health, community	35 (56)	19 (31)	5 (8)	3 (5)		62(4)
Academic	32 (70)	6 (13)	6 (13)	4 (9)		46 (3)
Other	23 (68)	10 (3)	10 (29)	0		34 (2)
Network Region						
Western	193 (68)	63 (22)	19 (7)	9 (3)	0.0001	284 (16)
Midwest	137 (78)	29 (16)	6 (3)	4 (2)		176 (10)
Southwest	197 (64)	76 (25)	19 (6)	18 (6)		310 (18)
South Central	218 (66)	66 (20)	23 (7)	23 (7)		328 (19)
South Atlantic	213 (66)	83 (26)	16 (5)	16 (5)		323 (18)
Northeast	175 (54)	78 (24)	63 (19)	63 (19)		327 (19)
Practice Busyness						
Too busy	74 (75)	14 (14)	7 (7)	4 (4)	0.23	99 (6)
Burdened	221 (69)	69 (22)	20 (6)	10 (3)		320 (18)
Balanced	565 (63)	211 (24)	77 (9)	43 (5)		896 (51)
Not busy	272 (63)	101 (23)	42 (10)	16 (4)		431 (25)
Private insurance status						
<40% private insurance	34 (65)	11 (21)	5 (10)	2 (4)	0.99	52 (3)

Characteristics for posterior crowns	Chamfer	Shoulder	Shoulder bevel	Knife edge	P Value	Total
40–79% private insurance	484 (65)	168 (23)	60 (8)	34 (5)	0.37	746 (43)
80%+ private insurance	605 (65)	207 (22)	80 (9)	37 (4)		929 (54)
Practice hours						
Full-time (32+hours/week)	964 (65)	339 (23)	125 (8)	58 (4)		1486 (86)
Part-time (<32 hours/week)	162 (66)	50 (20)	19 (8)	15 (6)	0.23	246 (14)
Environment location of practice						
Inner city of urban area	136 (65)	44 (21)	15 (7)	13 (6)		208 (12)
Urban (not inner city)	307 (64)	109 (23)	40 (8)	21 (4)		477 (27)
Suburban	499 (64)	185 (24)	75 (10)	25 (3)	0.23	784 (45)
Rural	187 (69)	54 (20)	15 (6)	15 (6)		271 (16)

Table 4.

Dentist and practice characteristics associated with margin configuration for anterior single-unit crowns (frequency [percent])

Characteristics for anterior crowns	Chamfer	Shoulder	Shoulder bevel	Knife edge	P Value	Total
Overall	938 (54)	645 (37)	120 (7)	46 (3)		1749
Gender						
Male	701 (55)	432 (34)	96 (8)	37 (3)	0.0006	1266 (73)
Female	230 (49)	209 (44)	23 (5)	9 (2)		471 (27)
Race						
White/Caucasian	775 (54)	518 (36)	99 (7)	35 (2)	0.0007	1427 (82)
Black/African-American	40 (52)	21 (27)	8 (10)	8 (10)		77 (4)
Asian	81 (51)	69 (43)	7 (4)	0		159 (9)
Other	35 (51)	29 (42)	5 (7)	2 (1)		69 (4)
Ethnicity						
Hispanic	40 (41)	48 (49)	6 (6)	3 (3)	0.053	97 (6)
Non-Hispanic	891 (54)	589 (36)	113 (7)	42 (3)		1635 (94)
Years since graduation						
Less than 5	38 (55)	31 (45)	0	0	0.0003	69 (4)
5 to 15	220 (50)	192 (44)	21 (5)	7 (2)		440 (25)
More than 15	677 (55)	422 (34)	99 (8)	39 (3)		1237 (71)
Type of practice						
Owner of private practice	698 (55)	452 (35)	87 (7)	39 (3)	0.006	1276 (74)
Associate in private practice	102 (50)	89 (43)	9 (4)	5 (2)		205 (12)
Health Partners	33 (77)	9 (21)	1 (2)	0		43 (2)
Permanente	40 (59)	25 (37)	3 (4)	0		68 (4)
Public health, community	26 (42)	28 (45)	8 (13)	0		62 (4)
Academic	22 (47)	17 (36)	7 (15)	1 (2)		47 (3)
Other	12 (35)	17 (50)	4 (12)	1 (3)		34 (2)
Network region						
Western	156 (55)	107 (38)	19 (7)	2 (1)	0.005	284 (16)
Midwest	107 (61)	59 (34)	8 (5)	1 (1)		175 (10)
Southwest	147 (48)	137 (44)	20 (6)	5 (2)		309 (18)
South Central	176 (54)	109 (33)	26 (8)	18 (5)		329 (19)
South Atlantic	171 (53)	119 (37)	22 (7)	12 (4)		324 (19)
Northeast	181 (55)	114 (35)	25 (8)	8 (2)		328 (19)
Practice busyness						
Too busy	50 (51)	37 (37)	10 (10)	2 (2)	0.01	99 (6)
Burdened	181 (57)	118 (37)	13 (4)	5 (2)		317 (18)
Balanced	461 (51)	333 (37)	74 (8)	34 (4)		902 (52)
Not busy	245 (57)	156 (36)	23 (19)	5 (1)		429 (25)
Private insurance status						
<40% private insurance	28 (54)	15 (29)	6 (12)	3 (6)	0.523	52 (3)

Characteristics for anterior crowns	Chamfer	Shoulder	Shoulder bevel	Knife edge	P Value	Total
40–79% private insurance	408 (55)	269 (36)	49 (7)	18 (2)		744 (43)
80%+ private insurance	495 (53)	349 (37)	63 (7)	24 (3)		931 (54)
Practice hours						
Full-time (32+hours/week)	814 (55)	538 (36)	93 (6)	40 (3)	0.071	1485 (86)
Part-time (<32 hours/week)	119 (48)	100 (40)	24 (10)	5 (2)		248 (14)
Environment location of practice						
Inner city of urban area	104 (50)	79 (38)	13 (6)	11 (5)	0.239	207 (12)
Urban (not inner city)	258 (53)	183 (38)	35 (7)	7 (1)		483 (28)
Suburban	429 (55)	286 (37)	49 (6)	19 (2)		783 (45)
Rural	145 (54)	92 (34)	22 (8)	9 (3)		268 (15)