Treatment recommendations for single-unit crowns

Findings from The National Dental Practice-Based Research Network

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ABSTRACT

Background. The objectives of this study were to quantify practitioner variation in likelihood to recommend a crown and test whether certain dentist, practice, and clinical factors are associated significantly with this likelihood.

Methods. Dentists in The National Dental Practice-Based Research Network completed a questionnaire about indications for single-unit crowns. In 4 clinical scenarios, practitioners ranked their likelihood of recommending a single-unit crown. The authors used these responses to calculate a dentist-specific crown factor (range, 0-12). A higher score implied a higher likelihood of recommending a crown. The authors tested certain characteristics for statistically significant associations with the crown factor.

Results. A total of 1,777 of 2,132 eligible dentists (83%) responded. Practitioners were most likely to recommend crowns for teeth that were fractured, cracked, or endodontically treated or had a broken restoration. Practitioners overwhelmingly recommended crowns for posterior teeth treated endodontically (94%). Practice owners, practitioners in the Southwest, and practitioners with a balanced workload were more likely to recommend crowns, as were practitioners who used optical scanners for digital impressions.

Conclusions. There is substantial variation 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). Recommendations varied according to type of practice, network region, practice busyness, patient insurance status, and use of optical scanners.

Practical Implications. Recommendations for crowns may be influenced by factors unrelated to tooth and patient variables. A concern for tooth fracture—whether from endodontic treatment, fractured teeth, or large restorations—prompted many clinicians to recommend crowns.

Key Words. Dentistry; prosthodontics; crowns.

JADA 2016:147(11):882-890

http://dx.doi.org/10.1016/j.adaj.2016.06.012

Dentists recommend single-unit crowns for many reasons. A tooth might have a large carious lesion, a fracture, or a large restoration, putting the tooth at risk of experiencing further breakdown. A tooth might be a source of pain, suggesting a crack, or a tooth might have been endodontically treated. These situations may prompt a dentist to recommend a crown to increase the tooth's longevity and optimize the patient's oral health.[1]

However, little scientific evidence exists to guide dentists when making certain treatment recommendations.[2,3] Most dentists would agree, for example, that a large restoration might be a reason to recommend a crown for a particular tooth. The question then becomes exactly how large a restoration has to be to justify recommending a crown for the tooth. Some dentists might repair a particular restoration, others might replace it, and still others might recommend placing an inlay or a single-unit crown.[4-6]

When making treatment recommendations, practitioners must manage a complex mix of clinical, social, and diagnostic factors.[7,8] They base their recommendations on patient assessment, perceived risks and benefits, personal preference, treatment cost, and clinical experience.[9] These complexities lead to variation in treatment recommendations among practitioners.[10-13]

Some treatment recommendations are not related directly to the clinical circumstance of the tooth.[14] For example, patients with a college education may be less likely to receive a recommendation for a crown.[15,16]

In circumstances for which clinical scientific evidence is absent, clinicians may gain valuable insight by observing colleagues and knowing which techniques other dentists report as effective. The results presented in this study detail clinicians' treatment decisions for single-unit crowns and which factors led to these recommendations. In addition, we identify nonpatient factors that may influence the decision to recommend a crown. The objectives for this study were to describe and quantify practitioner variation in likelihood to recommend a single-unit crown and test whether certain dentist, practice, and clinical factors are associated significantly with this likelihood.

METHODS

This study is based on a questionnaire completed by dentists in The National Dental Practice-Based Research Network (PBRN). The National Dental PBRN is a consortium of dental practices and dental organizations focused on improving the scientific basis for clinical decision making.[17] Detailed information about the network is available at its website (http://www.nationaldentalpbrn.org). The National Dental PBRN's applicable institutional review boards approved the study; all participants provided informed consent after receiving a full explanation of the procedures.

Enrollment questionnaire. As part of the enrollment process, practitioners completed an enrollment questionnaire that describes themselves, their practices, and their patient populations. This questionnaire is publicly available at http://www.nationaldentalpbrn.org/study-results/2016/ under the heading *Factors for Successful Crowns* and collects information about practitioner, practice, and patient characteristics. Questionnaire items, which had documented test-retest reliability, were from our previous work in a practice-based study of dental care.[18,19] The typical enrollee completes the questionnaire online, although a paper option is available.

Study questionnaire development. A study group of the authors, dentists with clinical expertise, statisticians, and laboratory technicians developed the questionnaire for this study. Its purpose was to measure practices in fabricating crowns and treatment recommendations for single-unit crowns. Instrument Design, Evaluation, and Analysis Services, a group with expertise in questionnaire development and implementation, as well as National Institute of Dental and Craniofacial Research program officers and practitioners with prosthodontic content expertise, reviewed the survey. After extensive internal review, Instrument Design, Evaluation, and Analysis Services pretested the questionnaire via cognitive interviewing by telephone with a regionally diverse group of 8 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 National Dental PBRN were eligible for the study if they met all of these criteria: completed an enrollment questionnaire, were practicing and treating patients in the United States, were in the National Dental PBRN's limited or full network participation category, and reported on the enrollment questionnaire that they perform at least some restorative dentistry in their practices. A total of 2,299 National Dental PBRN clinicians met these criteria.

We mailed (via the US postal system) preprinted invitation letters 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, we gave practitioners the option to request a paper version of the survey because this has been shown to improve response rates.[20] We asked practitioners to complete the questionnaire within 2 weeks. We sent a reminder letter after the second and fourth weeks to those who had not completed the questionnaire. After 6 weeks, we sent e-mail and postal mail reminders with a printed version of the questionnaire and offered practitioners the option of completing the online or paper versions. After 8 weeks, we made a final attempt by mailing the questionnaire with a letter that also encouraged the dentist to complete the questionnaire online. Data collection was closed after 12 weeks from the original e-mail invitation. We remunerated practitioners or their business entities $75 for completing the questionnaire if desired. We collected data from February 2015 through August 2015.

Questionnaire content. The first question of the survey confirmed that the invited clinician placed at least 1 crown in a typical month. The questionnaire is publicly available (http://www.nationaldentalpbrn.org/study-results/2016/) under the heading *Factors for Successful Crowns*. Among other questions, we asked practitioners why they recommended crowns for patients. We asked dentists to "rank the top three MOST COMMON reasons you recommend a crown in your practice, with 1 being the most common and 3 being the least common," and we gave them the following list: active caries, endodontic therapy, large restoration, broken restoration, esthetics, change vertical dimension, removable partial denture abutment, and other. The other category received a large number of responses related to fractured teeth or cracked teeth; we subsequently categorized these

ABBREVIATION KEY. **CF:** Crown factor. **PBRN:** Practice-Based Research Network. **MOD:** Mesio-occlusodistal.

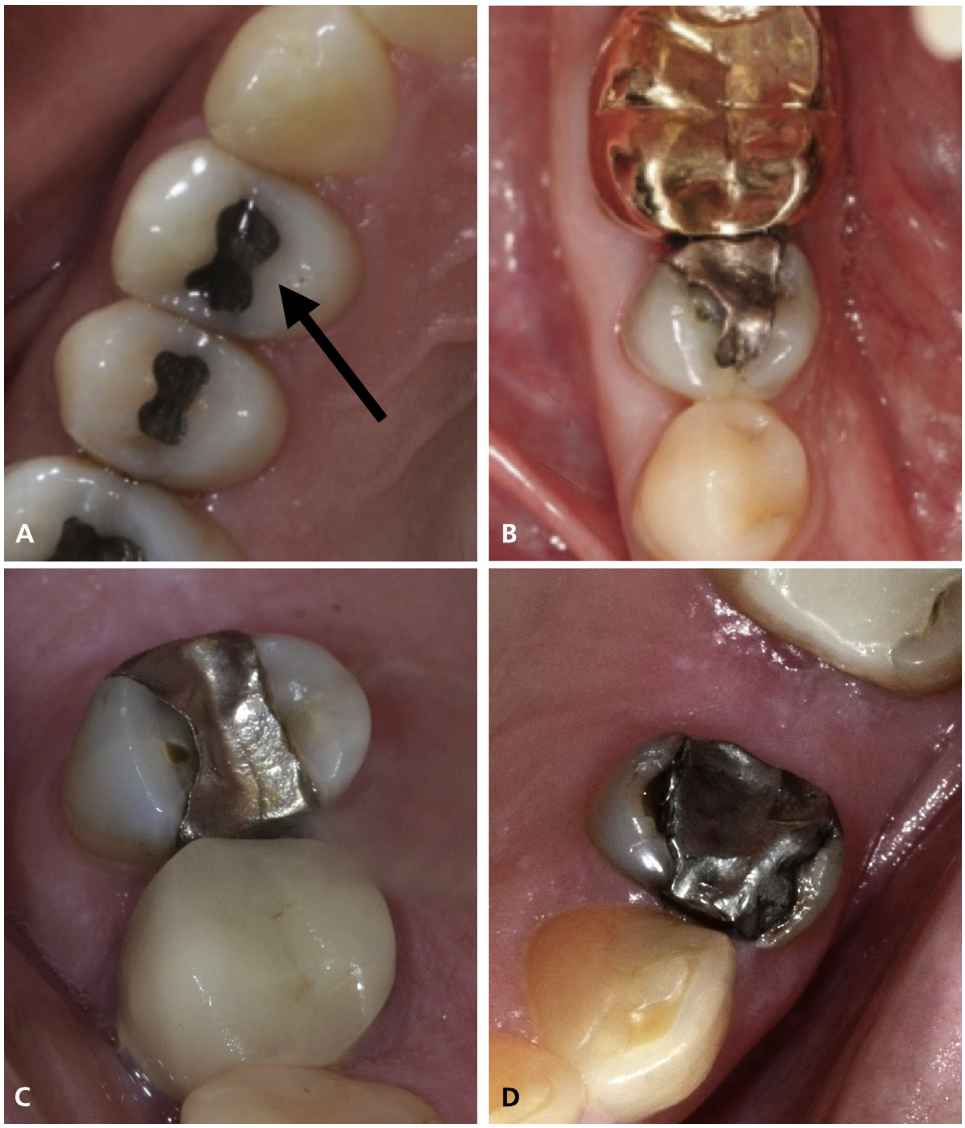

Figure. Images used in the questionnaire. **A**. The tooth has an occlusal alloy (arrow) and is the smallest of the restorations. **B**. The tooth demonstrates a disto-occlusal restoration. **C**. The tooth shows a mesio-occlusodistal alloy. **D**. The tooth has a restoration that occupies most of the occlusal surface and an apparent fracture of the buccal cusp.

during data analysis into an additional group labeled "fractured or cracked tooth."

Crown factor. We had a particular interest in learning which restorations would indicate the need for a crown on the basis primarily of the size and condition of the restoration and tooth. A series of 4 questions showed photographs of teeth with various restorations. We asked practitioners whether they would recommend a crown for each of the 4 teeth represented, shown in the figure from smallest to largest; in the questionnaire these were in a mixed order. Practitioners received this clinical scenario to accompany the 4 images: "Assume each patient is a 40-year-old female patient of yours who attends her annual recall visits on a dependable basis, has no relevant medical history, is at low risk for developing dental decay, has satisfactory occlusion with minimal wear, and is financially able to pay for a crown out-of-pocket."

The 4 response options were very likely to recommend a crown, likely to recommend a crown, not likely to recommend a crown, and definitely not recommend a crown; we assigned these values of 3, 2, 1, and 0, respectively. We summed the answers to the 4 questions for each clinician to create a crown factor (CF) (range, 0-12) for each dentist. We excluded practitioners who did not answer any of the 4 questions from this part of the study.

We tested other responses on this questionnaire and from the National Dental PBRN's enrollment questionnaire to determine whether they were associated significantly ($P < .05$) with the CF. These were questions relating to practice type, years in practice, perceived practice busyness, and insurance coverage of patients.

Statistical analyses. We conducted a power analysis based on an anticipated sample size of 1,500 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-retest reliability of the questionnaire items, 47 respondents completed the questionnaire twice online. For categorical responses, we used κ and weighted κ; for numeric items, we calculated a Pearson correlation coefficient to determine test-retest reliability. We presented

descriptive statistics as counts and percentages for categorical variables and as means and SDs for continuous measures. We evaluated potential predictors of CF by using analysis of variance and multiple regression analysis.

RESULTS

For this study, we selected 2,299 dentists to participate. Of these dentists, 101 were deemed ineligible before beginning the questionnaire (no longer in active practice, deceased, specialists who did not place single-unit permanent crowns). We deemed an additional 66 dentists ineligible once they had completed at least part of the questionnaire (did not place at least 1 crown each month). This left a total of 2,132 eligible participants, of whom 1,777 responded, for a response rate of 83%. Among the 47 test-retest participants, the mean (SD) time between test and retest was 15.5 (3.0) days. For categorical variables, agreement between time 1 and time 2 showed a mean weighted κ of 0.62 (interquartile range, 0.46-0.79). Mean test-retest reliability for numeric variables was 0.75.

Table 1 shows dentist and practice characteristics. Most respondents (73%) were male, and many (63%) had graduated from dental school 20 or more years earlier. Most of the respondents (73%) were practice owners. Respondents were split fairly evenly across regions, and most worked full time (86%). Only 3% of respondents were specialists, including 32 prosthodontists.

Dentists ranked the following crown indication factors the highest: fractured or cracked tooth, endodontic therapy, and broken restoration. These were followed by active caries and large restoration. Table 2 lists the responses.

As Table 2 shows, if a posterior tooth had been treated endodontically, practitioners were strongly in favor of recommending a crown, with 94% stating they would recommend a crown more than 75% of the time. This percentage was lower when considering anterior teeth with endodontic treatment. The responses were distributed evenly, with approximately one-half of respondents recommending a crown more than one-half of the time.

Practitioners viewed photographs of posterior teeth with restorations (Figure) and offered opinions of whether the tooth should receive a crown. These clinical photographs depicted teeth with a variety of restorations, from an occlusal alloy to a large mesio-occlusodistal (MOD) restoration. Table 3 displays the responses to these questions from the survey. In response to the occlusal alloy in figure A, 98% of respondents reported they would not likely or definitely not recommend a crown. The largest restoration, figure D, also produced a homogenous response, with 97% of practitioners reporting that they were very likely or likely to recommend a crown. The other restorations (Figures B and C) produced more divergent responses. A more complete data set is available as Supplemental Table A1 on the

TABLE 1

Characteristics of dentists participating in the survey.

CHARACTERISTIC	NO. (%)* (N = 1,777)
Dentist Characteristic	
Sex	
Male	1,282 (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	1,295 (73)
Associate in private practice	207 (12)
HealthPartners†	44 (3)
Permanente†	70 (4)
Public health, community	64 (4)
Academic	48 (3)
Network region‡	
Western	292 (16)
Midwest	180 (10)
Southwest	311 (18)
South Central	330 (19)
South Atlantic	327 (18)
Northeast	337 (19)
Time commitment	
Full time	1,508 (86)
Part time (< 32 h)	253 (14)
Specialty status	
General dentist	1,719 (97)
Specialist	56 (3)
Race	
White	1,451 (82)
Black	77 (4)
Asian	161 (9)
Other	70 (4)
Patient Population Characteristic	
Patient private insurance status	
< 40%	249 (14)
40%-79%	1,017 (58)
≥ 80%	476 (27)
Patients who visit regularly	
< 50%	274 (16)
50%-79%	1,044 (60)
≥ 80%	428 (25)

* Because of missing data and rounded values, not all numbers and percentages add up to 1,777 and 100%.
† Either HealthPartners Dental Group in greater Minneapolis, MN, or Permanente Dental Associates in greater Portland, OR.
‡ Reported on enrollment questionnaire as the state, subsequently categorized into 1 of the 6 regions of the network.

TABLE 2

Indications for crowns from 1,777 responses.

CROWN INDICATION	MEAN (STANDARD DEVIATION) RANKING*
Fractured or Cracked Tooth	1.8 (0.86)
Endodontic Therapy	1.9 (0.79)
Broken Restoration	1.9 (0.80)
Active Caries	2.1 (0.84)
Large Restoration	2.1 (0.79)
Change Vertical Dimension	2.7 (0.53)
Removable Partial Denture Abutment	2.7 (0.55)
Esthetics	2.8 (0.52)
CROWN INDICATION	**YES RESPONSE, NO. (%)†,‡**
Recommend Crown for Posterior Teeth After Endodontic Therapy	
> 75%	1,671 (94)
50%-75%	82 (5)
25%-49%	18 (1)
< 25%	4 (0.2)
Recommend Crown for Anterior Teeth After Endodontic Therapy	
> 75%	331 (19)
50%-75%	562 (32)
25%-49%	466 (26)
< 25%	416 (23)

* When considering the ranking, a lower number indicates a condition that is more likely to prompt a recommendation for a crown (range, 0-12).
† Survey responses show the leading reasons practitioners recommend crowns and how often practitioners recommend crowns for posterior and anterior teeth after endodontic therapy.
‡ Because of missing data and rounded values, not all numbers and percentages add up to 1,777 and 100%.

TABLE 3

Recommendations for crown placement by practitioners responding to the survey.*

RECOMMENDATION TO PLACE A CROWN	NO. (%)†
Figure A: Occlusal Restoration	
Very likely	6 (0.3)
Likely	33 (2)
Not likely	563 (32)
Definitely not	1,174 (66)
Figure B: Disto-occlusal Restoration	
Very likely	208 (12)
Likely	637 (36)
Not likely	843 (48)
Definitely not	86 (5)
Figure C: Mesio-occlusodistal Restoration	
Very likely	513 (29)
Likely	657 (37)
Not likely	533 (30)
Definitely not	73 (4)
Figure D: Mesio-occlusodistal With Fracture	
Very likely	1,546 (87)
Likely	176 (10)
Not likely	41 (2)
Definitely not	14 (1)

* Photographs of posterior teeth with restorations are shown in the figure.
† Because of missing data and rounded values, not all numbers and percentages add up to 1,777 and 100%.

Web site at http://www.nationaldentalpbrn.org/study-results/2016/.

Among clinician and practice variables, clinician's sex, race, specialty status, and full-time commitment were not associated significantly with the likelihood of recommending a crown on the basis of the 4 restorations shown in the questionnaire (Table 4). However, type of practice showed a significant association with CF, with practice owners and associates more likely than other groups to recommend a crown. Associates in private practice were more likely to recommend a crown than were Permanente, HealthPartners, or academic clinicians. Practice owners were more likely to recommend a crown than were academic or HealthPartners clinicians. Public health clinicians were more likely to recommend a crown than were academic and HealthPartners clinicians. Permanente dentists were more likely to recommend a crown than were HealthPartners practitioners. Patient private insurance status also was associated significantly with the likelihood of recommending a crown. In practices in which less than 40% of patients had private insurance, clinicians were significantly less likely to recommend a crown than were practices in which 40% to 79% of patients had insurance coverage.

Practitioners in the Midwest and Northeast were less likely to recommend crowns than were practitioners from other parts of the country. The highest CF was in the Southwest.

Perceived practice busyness was associated significantly with the likelihood of recommending a crown. Clinicians who reported a balanced practice load were more likely to recommend a crown than were practitioners who were too busy to see all their patients or practitioners who felt burdened by their schedules. Practitioners who reported being not busy were more likely to recommend a crown than were practitioners who reported they were overly busy.

The use of optical scanners and in-office milling units was associated with a higher CF. Practitioners with an in-office milling unit were more likely to recommend a crown than were dentists using either a commercial laboratory or an in-office laboratory. If clinicians used an optical scanner 75% or more of the time for crown impressions, they recommended a crown more often than did practitioners who used scanners less frequently or not at all (Table 4).

DISCUSSION

One clear area of consensus among dentists in this study is that crowns should be recommended when posterior teeth have been treated endodontically. This recommendation is consistent with evidence from the literature. Results from 1 study of more than 1 million teeth showed a correlation between lack of coronal coverage in endodontically treated teeth and tooth fracture.[21] Investigators in another study found the 5-year survival of endodontically treated molars without crowns was only 36%.[22] Investigators in an additional study found that molar survival without a crown was 50%, whereas survival increased to 98% with coronal coverage.[23] The authors of a retrospective cohort analysis suggested that uncrowned endodontically treated teeth had a 6 times higher incidence of extraction than did teeth with crowns; also, second molars were at higher risk than other teeth.[24] The same benefit, however, is not always noted for anterior teeth in many of these studies.[21-23,25] Other factors influence tooth longevity for endodontically treated teeth, such as number of missing teeth and plaque control.[26] In this sense, practitioners responding to this survey echoed findings in the literature when making clinical decisions, as manifested by their frequently recommending crowns for posterior teeth treated endodontically and sometimes recommending crowns for anterior teeth.

Broken cusps and fractured teeth were also reasons practitioners frequently cited for recommending crowns. The rate for coronal fractures is 89 per 1,000 person-years, with more fractures occurring in posterior teeth.[27] Expressed another way, a dentist with 1,000 patients in a practice might see 90 fractured teeth per

TABLE 4

Dentist and practice factors associated with the likelihood of recommending a crown.

CHARACTERISTIC	NO. OF PRACTITIONERS*	CROWN FACTOR,† MEAN (STANDARD DEVIATION)	*P* VALUE‡,§
Sex			
Male	1,279	6.6 (1.8)	.36
Female	481	6.7 (1.8)	
Race			
White	1,448	6.6 (1.9)	
Black	77	6.8 (1.7)	.41
Asian	159	6.5 (1.7)	
Other	70	6.9 (1.4)	
Type of Practice			
Owner of private practice	1,291	6.8 (1.8)	
Associate in private practice	207	6.9 (1.8)	
HealthPartners¶	43	5.0 (1.7)	**< .0001**
Permanente¶	70	6.1 (1.5)	
Public health, community	64	6.4 (1.7)	
Academic	48	5.3 (1.7)	
Network Region#			
Western	292	6.7 (1.8)	
Midwest	179	6.3 (2.0)	
Southwest	310	7.1 (1.8)	**< .0001**
South Central	329	6.7 (1.9)	
South Atlantic	326	6.7 (1.8)	
Northeast	336	6.3 (1.8)	
Practice Busyness			
Too busy	101	6.1 (1.7)	
Burdened	327	6.4 (1.9)	**.0002**
Balanced	908	6.8 (1.8)	
Not busy	434	6.7 (1.9)	
Time Commitment			
Full time	1,504	6.7 (1.8)	.11
Part time (< 32 hours)	252	6.5 (1.8)	
Patient Private Insurance Status			
< 40%	249	6.4 (2.0)	**.02**
40%-79%	1,017	6.7 (1.8)	
≥ 80%	476	6.5 (1.8)	
Laboratory			
Commercial	1,561	6.6 (1.8)	**.0003**
In-office traditional	47	6.3 (1.9)	
In-office milling	163	7.2 (1.8)	
Optical Scanner Use			
≥ 75%	146	7.2 (1.7)	**.0006**
< 75%	1,626	6.6 (1.9)	

* Because of missing data and rounded values, the numbers of practitioners do not add up to 1,777.
† Clinical photographs were used to calculate a crown factor number for practitioners responding to the survey. A higher number indicates a person is more likely to recommend a crown (range, 0-12). The crown factor was associated with some clinician and practice variables.
‡ Analysis of variance.
§ *P* values in bold are statistically significant.
¶ Either HealthPartners Dental Group in greater Minneapolis, MN, or Permanente Dental Associates in greater Portland, OR.
# Reported on enrollment questionnaire as the state, subsequently categorized into 1 of the 6 regions of the network.

year. Investigators in 1 study found a lower estimate, at 20.5 per 1,000 person-years.[28] Most of these expose the dentin, and approximately one-half extend beyond the gingival crest of the dentinoenamel junction. Serious consequences (pulpal involvement or extraction) of these fractures ranged from 7% to 15%.[29,30] Fracture lines in the enamel of posterior teeth also have been recognized as a risk factor for tooth coronal fracture,[3] where a tactilely detectable fracture line increased odds of fracture an astounding 75-fold. Given this evidence, and the incidence of reported tooth fractures, it seems reasonable that clinicians would recommend crowns when teeth are fractured or cracked.

Evidence in the literature supports placing crowns on teeth with large restorations to increase tooth longevity. Investigators in 1 prospective cohort study studied more than 40,000 patients for 3 months. In that time window, 238 fractures occurred. Approximately 77% of the fractured teeth had restorations that involved 3 or more surfaces.[28] Findings from other studies also suggest that larger restoration volume is associated with an increased fracture risk.[1,3,11,31,32] Clinicians responding to this survey listed large restoration as a reason to recommend a crown, but not as highly as endodontic treatment or a cracked tooth. Most clinicians likely will consider patient preferences, expectations, and other patient-centered factors when recommending crowns, in addition to the clinical findings. We did not explore these types of patient factors in this survey. Crowns are generally profitable for a dental office, and finances may affect treatment recommendations. We did not address these issues directly in the survey.

The response to the photographs of teeth with restorations was interesting. There are limitations to this question, such as the fact that practitioners were looking at a 2-dimensional photograph and therefore could not examine the tooth clinically. In addition, some practitioners might recommend an onlay or other restoration with cuspal coverage instead of a crown, but we did not provide this as a response option. Nonetheless, the responses highlight the variability among practitioners when making treatment decisions. The MOD restoration in a premolar (Figure C) produced the most divergent responses, with roughly one-third of practitioners each responding very likely, likely, or not likely to recommend a crown. More agreement existed with the small occlusal restoration (Figure A), for which 98% of practitioners were either not likely or would definitely not recommend a crown. Conversely, when shown a large MOD amalgam and a fractured buccal cusp (Figure D), 97% of practitioners endorsed very likely or likely to recommend a crown. It appears that more consensus exists regarding very large or small restorations, and great variation of treatment recommendations exists in the middle.

Variables significantly associated with the likelihood of recommending a crown (CF) were type of practice, network region, patient private insurance status, practice busyness, and optical scanner use. To our knowledge, this is the first time that such associations have been reported. Factors unrelated to the tooth or patient may influence treatment recommendations. Practice owners and associates recommended crowns more than did other clinicians. This tendency could be due to financial incentives to provide crowns, or it could be that the solo practitioner believes that the crown has the highest rate of success and wants to provide this treatment, regardless of cost to the patient. Practitioners in the HealthPartners group had a low propensity to recommend crowns, which could reflect an emphasis on preventive dentistry pervasive in this group, or perhaps a lack of financial incentive for the clinician to provide a higher-cost treatment option. Additional variation may be due to different dentists having different opinions in any given clinical situation regarding the benefit of a crown. Patient private insurance status was associated significantly with the CF. This association may reflect access-to-care issues or how patient preferences affect a practitioner recommendation. For example, if the clinician knows the patient has insurance coverage, he or she might be more likely to recommend a crown.

It is unclear why the likelihood of recommending a crown varied according to network region. This variance could be related to patient populations or to cultural differences, such as a wait-and-see attitude versus a fix-it-before-it-breaks attitude. Also, practice type varies across regions, which might confound this variable. Practice busyness was associated significantly with treatment recommendations. This factor also affects other aspects of clinical care, such as restoration longevity.[33] Generally, the busier a clinician is, the less likely he or she is to recommend a crown. Presumably, this is because making a crown would take more time than other options, such as a direct restoration, and further burden the schedule.

As the use of digital imaging and milling becomes more prevalent, it was interesting to observe that frequent use of an optical scanner was associated with a higher propensity to recommend a crown. Similarly, in-office milling was associated with a significantly higher CF. Recognizing that many practitioners with an optical scanner also will use an in-office milling unit, the presence of this technology implies more recommendations for crowns. This could be due to the increased efficiency of providing this treatment (1 appointment instead of 2) or higher patient demand for crowns, or these practitioners simply like placing crowns and are therefore more apt to have in-office milling or optical scanners.

This study has certain limitations, and conclusions should take these into account. In this study, we measured treatment recommendations by using hypothetical clinical scenarios, which may differ from actual clinical treatment behavior. This study relied on

questionnaire information rather than direct observation of procedures. In addition, although the response rate was good, nonrespondents might have reported different behavior. The questionnaire listed broken restoration as an indication for crowns but did not provide cracked tooth as a specific response. The latter was a popular choice listed in the other category. It is possible that with use of this as an additional, specific category more clinicians would have selected this as a reason. The 2-dimensional photographs used in the questionnaire could be interpreted in different ways, and this is a limitation of the study.

Although National Dental PBRN practitioners have much in common with dentists at large,[34,35] their crown procedures may not be representative of a wider group of dentists. In addition, National Dental PBRN members are not recruited randomly, so factors associated with National Dental PBRN participation (for example, an interest in clinical research) may make National Dental PBRN dentists unrepresentative of dentists at large. Although we cannot assert that National Dental PBRN dentists are entirely representative, we can state that they have much in common with dentists at large and offer substantial diversity in these characteristics. This assertion is warranted because substantial percentages of National Dental PBRN general dentists are represented in the various response categories of the characteristics in the enrollment questionnaire; findings from several National Dental PBRN studies document that National Dental PBRN general dentists report patterns of diagnosis and treatment that are similar to patterns determined from non–National Dental PBRN general dentists[36-38]; and there is similarity of National Dental PBRN and non–National Dental PBRN dentists according to the best available national source, the American Dental Association's 2010 Survey of Dental Practice.[39]

CONCLUSIONS

It is clear that a complex interaction of factors can influence treatment recommendations. Dominant factors include items associated with tooth fracture, such as endodontic therapy, cracked or fractured teeth, and large restorations. Other factors are more subtle and can be related to the clinician, such as where a practice is located, how busy it is, patient insurance status, or whether the practice uses an in-office optical scanner. When making treatment decisions, clinicians should recognize that factors other than the patient or the tooth itself may influence their decisions. ■

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Disclosure. None of the authors reported any disclosures.

This work was supported by grant U19-DE-22516 from the National Institutes of Health.

A Web site devoted to details about the nation's network is located at http://NationalDentalPBRN.org. The National Dental PBRN Collaborative Group includes practitioner, faculty, and staff investigators who contributed to this activity. A list is available at http://nationaldentalpbrn.org/tyfoon/site/fckeditor/SC%20_Part%201_Collaborative%20Group_use%20as%20template.pdf.

The authors are grateful to the network's regional coordinators who followed up with network practitioners to improve the response rate. Midwest region: Tracy Shea, RDH, BSDH; Western region: Stephanie Hodge, MA; Northeast region: Christine O'Brien, RDH; South Atlantic region: Hanna Knopf, BA, Deborah McEdward, RDH, BS, CCRP; South Central region: Claudia Carcelén, MPH, Shermetria Massengale, MPH, CHES, Ellen Sowell, BA; Southwest region: Stephanie Reyes, BA, Meredith Buchberg, MPH, Colleen Dolan, MPH.

Opinions and assertions contained herein are those of the authors and are not to be construed as necessarily representing the views of the respective organizations nor the National Institutes of Health. The authors obtained the informed consent of all human participants in this investigation after explaining the nature of the procedures fully.

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