Restoring teeth that are endodontically treated through existing crowns. Part I: Survey of pulpal status on access

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Objective: The purpose of this study was to identify the pulpal findings encountered by practitioners when accessing complete-coverage crowns that require nonsurgical root canal treatment and the relevance of coronal leakage to the success of the RTC. Method and materials: The survey package consisted of a cover letter stating the instructions, rationale, and purpose for the questionnaire, a questionnaire with 8 short-answer questions, and a stamped, self-addressed envelope. A randomized sample of active dentists (300 general practitioners, 300 prosthodontists, and 300 endodontists) was selected. Collected data were analyzed with the chi-square test. Results: A 60% response rate was obtained. Statistically significant differences were found among the practitioner groups, depending on the question. General practitioners and endodontists obtain access through crowns and maintain these crowns as final restoration significantly more often than do prosthodontists. Practitioners responded that teeth with complete crowns require nonsurgical root canal treatment after 5 to 10 years. Conclusion: Respondents believe that leakage must be addressed when endodontic access cavities in artificial crowns are restored after nonsurgical root canal treatment. General practitioners perform nonsurgical root canal treatment more frequently than do prosthodontists. Practitioners indicated that when teeth with complete crowns require nonsurgical root canal treatment, treatment is most often performed 5 to 10 years after placement of the crown. (Quintessence Int 2000;31:713-718)

Key words: complete-coverage crown, endodontist, general practitioner, leakage, prosthodontist, root canal treatment, survey

CLINICAL RELEVANCE: This report will help to establish guidelines for an evidence-based study to identify which materials minimize leakage when crowned teeth that require nonsurgical root canal treatment are restored.

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Complete-coverage artificial crowns provide the best treatment option for teeth that have large defective restorations. The crown protects the tooth from further insult and maintains it as a functional, esthetic unit. Some teeth may also receive this treatment to maintain or enhance the health of the periodontium. In spite of these advantages, between 2% and 24% of teeth restored with complete coronal restorations show subsequent signs of pulpal disease or degeneration that requires nonsurgical root canal therapy.\textsuperscript{1-5} Endodontists estimate that 20% to 50% of their cases involve teeth with complete-coverage crowns.\textsuperscript{6}

The cumulative insult of periodontal disease and treatment,\textsuperscript{7-10} caries,\textsuperscript{11-14} and restorative procedures\textsuperscript{15-19} often impacts the integrity of the dental pulp. Mechanical cutting of tooth structure with high-speed rotary instruments, the toxic effects of some materials applied to freshly cut dentin, and the adherence of bacterial plaque to dentin surfaces are major factors that result in irreversible inflammatory changes in the pulp.\textsuperscript{1,6,20,21} The additive effect of these results in a tooth with a complete-coverage restoration and seriously compromised pulpal health. Signs and symp-
Nonsurgical root canal treatment (NSRCT) must be regarded as incomplete until a proper coronal restoration is placed. This restoration is an integral part of establishing a barrier between the periradicular tissue and the oral cavity. Poor selection of restorative material or lack of a restoration may adversely affect the seal of the root filling, resulting in bacterial contamination of an otherwise favorable root canal treatment. The technical quality of a coronal restoration is as significant as and, in some cases, may be more important than, the technical quality of the endodontic treatment in achieving and maintaining apical periodontal health. This finding emphasizes that leakage is an ongoing process pertinent to all aspects of treatment. The materials available today, however, are unable to totally prevent this process of leakage, either singularly or in combination.

Surveys have been described as important information tools that can identify present conditions and detail current philosophies, techniques, and needs. Once the information is gathered, it can provide an overview of treatment rationales, which, when combined with scientific data and empirical, clinically reliable techniques, may lead to higher rates of successful outcomes in practice. Furthermore, key information may be gathered and tabulated in a timely fashion, assuring evidence-based guidelines for a scientific study.

The purpose of this study was to identify the pulpal findings encountered by practitioners when they access complete-coverage crowns that require NSRCT and the relevance of restoring this access permanently, in terms of coronal leakage. This information will help to establish guidelines for an evidence-based study to identify which materials minimize leakage in the restoration of crowned teeth that require NSRCT.

METHOD AND MATERIALS

The design of the questionnaire for this study was developed by a focus group of faculty from the disciplines of biostatistics and endodontics. The survey items were created to address a number of unresolved clinical issues. These issues included the practitioner's understanding of coronal leakage and the practitioner's preference of contemporary restorative materials to be used with various types of complete-coverage crowns. The questions focused on the clinical scenario of endodontically accessed teeth with preexisting complete-coverage crowns. The survey package consisted of a cover letter stating instructions, rationale, and purpose for the questionnaire, the questionnaire itself, and a stamped, self-addressed envelope. The survey had 8 short-answer questions. The questions applicable to this portion of the study are shown in Fig 1. The faculty focus group, as well as a group of endodontic graduate students, pretested the survey to ensure that the questions were clear, succinct, and accurately addressed the issues of interest.

A power analysis was used to identify the number of surveys required for a valid statistical analysis with a minimum of bias, assuming an anticipated response rate of 50%. The random sample consisted of 900 dental professionals, including active general practitioners (500), active prosthodontists (300), and active endodontists (300) throughout the United States. Mailing labels for these randomized groups were obtained from the following 3 associations, respectively: the American Dental Association, the American Association of Prosthodontists, and the American Association of Endodontists.

The survey covered different aspects of clinical scenarios and the dentists' choice of restorative material for sealing access openings following nonsurgical endodontic treatment through the various types of complete-coverage crowns. In part 1 of this survey, different case situations encountered in practice were addressed, including the longevity and failure of crowns, and pulpal condition, and the practitioners' views on the relevance of leakage to the ultimate success of the crown. Part 2 of this survey addressed the respondents' attitudes toward permanent restoration of teeth recently subjected to NSRCT and specific restorative techniques for sealing the access cavity of teeth treated through complete-coverage crowns.

After an interval of 60 days, a low response rate (16%) from general practitioners triggered a second mailing of the same questionnaire. After 90 days, all data were collected and analyzed statistically. Frequency tables and descriptive statistics were compiled for the various survey items. The attitudes and practices of general practitioners, prosthodontists, and endodontists, as ascertained from this survey, were compared using chi-squared tests of independence. All statistical analyses were performed with SPSS statistical software (version 9.0, SPSS).

RESULTS

Nine hundred surveys were mailed initially within a time span of 90 days. Of the 900 surveys sent out, 543 were completed and returned, representing a 60% response. This section of the survey targeted the issue of the longevity and failure of crowns, the pulpal condition on entry through a complete-coverage crown, the respondents' attitudes toward restoration of teeth recently subjected to NSRCT, and their views on the relevance of leakage to the success or failure of NSRCT.
I practice as a (an):
- Endodontist.
- Prosthodontist.
- General practitioner.

When doing root canal treatment (RCT) through a crowned tooth, the most frequent pulp status I encounter is:
- Necrosis ______%.
- Irreversible pulpitis ______%.
- I do not do RCT ______%.
- Other ______%.

When performing RCT on a tooth with an artificial crown, I:
- Go through the crown and restore access opening after RCT ______%.
- Remove the crown, use as a temporary crown, and then recement the original crown after RCT ______%.
- Remove the crown, use as a temporary, and make a new crown after RCT ______%.
- Remove the crown, make a temporary crown, and then create a new crown after completion of the root canal therapy ______%.
- Other ______%.

I consider coronal leakage as an important factor when restoring an access opening through a crown:
- Always.
- Frequently.
- Seldom.
- Never.

In your practice, when RCT is needed on a crowned tooth, what is the approximate age of the crown?
- 0 to 1 year.
- 1 to 5 years.
- 5 to 10 years.
- 10 to 15 years.
- 15 years or more.

The overall response rate to the first question (practice type) was 60% (543/900). Table 1 details the number of responses from each practitioner group. All practitioner groups had similarly high response rates; at least 55% of each practitioner group responded to this question.

The overall response rate to the second question (pulpal status) was 71% (546/543) (Table 2). There was a statistically significant difference ($P < 0.001$) between the response rate of prosthodontists (14/72 = 41%) and those of the other 2 groups of practitioners (endodontists, 191/191 = 100%; general practitioners, 86/120 = 72%) who access teeth and identify the pulpal status. Most prosthodontists (58/72 [81%]) indicated, in the response "other," that they do not perform root canal treatment and added that they refer patients to an endodontist. Only 28% (34/120) of general practitioners refer patients to endodontists.

Further data collected from the second question (pulpal status) indicated that endodontists and prosthodontists identified the findings of necrosis and irreversible pulpitis on an equivalent basis (50% necrosis & 50% irreversible pulpitis) in symptomatic teeth with complete-coverage crowns. General practitioners identified necrosis in 70% of the cases and irreversible pulpitis in 30% of cases. Because of the small number of responses from prosthodontists (47%), there was statistically more of a difference in the response between endodontists and prosthodontists than there was between endodontists and general practitioners.

The overall response rate to the third question (access route) was 70% (382/543). The responses to the question were categorized into 3 groups: (1) those who go through the crown to access the pulp chamber; (2) those who obtain access for NSRCT by removing the crown and using this crown as permanent restoration; and (3) those who obtain access for NSRCT with the original crown remaining as temporary, or making a provisional crown and creating a new complete coverage crown (Table 3). A statistically significant difference in the number of responses was recorded ($P < 0.001$) between prosthodontists (37%) and the other 2 groups of practitioners (endodontists, 100%; general practitioners, 69%).

The following data was obtained by those practitioners who responded "other" in the third question, in which no access route was selected by the practitioners: Sixty-three percent (110/175) of the prosthodontists refer the patients to an endodontist for the total procedure while only 30% (51/166) of general practitioners refer patients to endodontists for the whole procedure.

Endodontists and general practitioners obtain access through the crown significantly more often than do prosthodontists ($P < 0.001$) and showed a trend toward maintaining the existing crown as the final restoration. Prosthodontists used the crown as a provisional restoration or constructed a provisional acrylic resin complete-coverage restoration. This entry was statistically significant with regard to the response by both endodontists and general practitioners ($P < 0.001$).

The overall response to the fourth question was 97% (528/543). Table 4 indicates the respondents' beliefs about the importance of coronal leakage when the endodontically treated, crowned tooth is restored. All practitioner groups had similarly high response rates;
at least 97% of each practitioner group responded to the question. A chi-squared test of independence revealed no statistically significant differences among the 3 types of practitioners (endodontists, prosthodontists, and general practitioners) in the perceived importance of restoring access openings.

The overall response to the question regarding the age of the crown was 83% (452/543). While there was no statistically significant difference in response rates among the groups, endodontists had a lower response rate (76%) than they had for the other questions. The data in Table 5 indicate that a significantly greater number of practitioners believe that crowned teeth will require NSRCT in 5 to 10 years ($P < 0.001$). When all responses were combined, 36% of practitioners (161/452) believed that teeth with complete-cover- age crowns would require NSRCT in the first 5 years, 52% (233/452) expected it to be needed in the 5- to 10-year span, and 13% (58/452) predicted that it would be necessary after 10 years or more.
DISCUSSION

The total response to the survey (60%) compares with that attained by previous investigators who evaluated the response rates among dentists. The low response rate of general practitioners (16%) necessitated the mailing of a second survey to obtain a sufficient representative sample from the general practitioner population (55%). The final response was equivalent to the level of response considered acceptable; a response rate of less than 50% in a dental population may be suspect.

Hovland et al found no differences in attitudes, knowledge, or demographic data in the group that needed an additional request to return the questionnaire.

Endodontists (88%) and general practitioners (69%) indicated that they create endodontic access openings through complete-coverage crowns more often than do prosthodontists (51%). Notably, a significant number of prosthodontists (81%) indicated in the second question that they refer the endodontic treatment to their specialist of choice. Prosthodontists who initiate NSRCT (37%) remove the crown and subsequently use it as a provisional crown (34%), create an acrylic resin provisional restoration (35%), or create endodontic access openings through complete-coverage crowns.

The combination of extensive coronal restorations, such as crowns, and periodontal disease may have a greater impact on the viability of the dental pulp. Combined, all groups identified 5 to 10 years as the most common time period for pulpal demise in teeth with complete coverage restorations. Many endodontists (48%), however, identified pulpal degeneration at a much earlier stage, 1 to 5 years. This is attributable to the fact that endodontists treat pulpal inflammation and/or necrosis daily. Previous studies have identified the life span of crowns to be in a range similar to the 5- to 10-year range chosen in the survey.

The responses of the dental pulp to irritation, including caries, trauma, chemical insult, and thermal insult are multiple. Microscopic inflammatory changes in the pulp may be present in the complete absence of clinical symptoms and signs. Repeated episodes of caries, periodontal disease, and dental treatment are cumulative and ultimately approach a clinically significant threshold in which root canal treatment is essential, even when the tooth is asymptomatic. These teeth are not identified routinely and are said to exhibit a stressed pulp. The data collected in this survey suggest that the concept of a stressed pulp is valid and is therefore an issue to be considered during the treatment planning phase of the restorative treatment. These data also indicate that specialists do limit their practice to their chosen field.

Several investigators have identified coronal leakage as a major factor in bacterial contamination and the subsequent failure of nonsurgical root canal therapy. Contamination of dentin by saliva and the penetration of the dentinal tubules by bacteria and their by-products through leakage have a detrimental effect on pulpal tissue. Leakage around the margin of a cast restoration frequently extends toward the pulp through the dentinal tubules. This is a problem that is extremely difficult to assess clinically and radiographically. The importance of the integrity of the restoration in the access opening and the crown therefore cannot be understated. The importance of leakage that can penetrate these coronal restorations is evidenced by the significant number of responses to this question (97%); most respondents (85%) identified leakage as always being significant.

CONCLUSION

The data presented constitutes the first part of a 4-part series. The first 2 parts discuss the findings of a survey sent to 900 active practitioners, resulting in the following conclusions:

1. Respondents to the survey believe that leakage must be minimized when endodontic access openings are restored in artificial crowns on teeth that have undergone nonsurgical root canal treatment.
2. Endodontists and general practitioners obtain access through complete-coverage crowns and maintain these crowns as final restorations more often than do prosthodontists. Prosthodontists obtain access through the crowns, but replace the artificial crowns once the treatment has been completed.
3. The trend among practitioners is to limit practice to their specialty; however, general practitioners perform nonsurgical root canal treatment more frequently than do prosthodontists.
4. A wide range of dental practitioners believe that the majority of teeth with complete-coverage fixed crowns will require NSRCT in 5 to 10 years.

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