Restorative Certainty and Varying Perceptions of Dental Caries Depth Among Dentists

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Abstract

Objective: The question of whether dentists who most frequently identify tooth surfaces for definite restoration perceive dental caries as significantly deeper than other dentists is assessed. Methods: One group of 20 dentists independently examined 145 unrestored approximal tooth surfaces on 16 bitewing radiographs and recorded their restorative and depth decisions. Another group of 15 dentists similarly scored 304 unrestored surfaces on 30 bitewing radiographs. Each group of dentists was later divided into four subgroups according to the number of surfaces designated for definite restoration by each dentist. Results: As the number of tooth surfaces designated for definite restoration increased, mean caries depth (P < .05 for the high vs low subgroups) and the percent of dentinally carious surfaces increased, while the percent of surfaces assessed as sound decreased. Dentists with the lower numbers of surfaces designated for definite restoration came closest to the true histologic mean caries depth of the examined tooth surfaces. Conclusions: Dentists who designated high numbers of approximal tooth surfaces for definite restoration assessed caries as deeper than other dentists, and deeper than was proven histologically. [J Public Health Dent 1997;57(4):243-5]

Key Words: dental caries depth, restorative decisions, dental radiographs.

Dentists vary greatly in their restorative decisions. Although the criteria they use in these decisions are not well understood (1,2), dentists may be influenced by caries depth observed on the approximal surfaces of bitewing radiographs (3,4). In surveys and clinical simulation studies in Europe, about 20 percent (3) and 47 percent (4) of the variation in dentists' restorative decisions on approximal surfaces was explained by beliefs about caries depth. A recent Canadian study found that 50 percent of restorative decisions were explained similarly. However, a large range from 29 percent for one dentist to 69 percent for another was observed (5).

Dentists also vary in their stated restorative treatment thresholds according to caries depth — for example, when caries has reached the inner or outer enamel, or inner or outer dentin as seen on bitewing radiographs. Survey and clinical simulation data from Scotland (6) and Ontario (7) suggested that the majority of dentists would place a restoration before approximal caries reached the dentin. Recently, however, dentists have been shown to vary greatly in their understanding of the underlying nature of the lesion represented by their thresholds (8); more importantly, their stated thresholds may not represent what dentists actually do in dental practice.

Kay and associates (9) reported inconsistent numbers of tooth surfaces planned for restoration by dentists in the same threshold groups. Mileman and coworkers (4) found that only 3 percent of the variation in dentists' restorative decisions was explained by their treatment thresholds. Our recent findings generally supported this lack of validity; however, the mean number of restorations planned and the mean restorative and caries depth codes of each threshold group varied consistently with the verbal interpretations of the stated thresholds (10).

Because of the equivocal research findings when the depth-based treatment thresholds of dentists are used to explain their restorative decisions, we decided to investigate whether grouping dentists according to their conviction or certainty about restorative need when examining the same tooth surfaces on bitewing radiographs, rather than their hypothetically stated restorative threshold, would reveal differences in dental caries depth perceptions. Thus, the general purpose of this study is to examine the extent and direction of differences in dental caries depth perceptions among subgroups of dentists having different tendencies to "definitely restore" the same approximal tooth surfaces observed on bitewing radiographs. Specifically, our research question was whether dentists who frequently state that surfaces are definitely to be restored score dental caries significantly more deeply than dentists who less frequently identify surfaces for definite restoration.

Methods

The nature of the experimental radiographs used in this study and datagathering protocol have been described previously (5,9,10). The "North York" dentists from the previous study who each examined the same 304 unrestored approximal tooth surfaces on 30 bitewing radiographs formed one study group. The second group consisted of 20 dentists who were part-time members of the Oral Medicine or Restorative Departments at the Faculty of Dentistry, University of Toronto. Because these dentists had much less time available, 16 of the

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original 30 films were randomly chosen for them to examine. Each dentist in the second group independently examined the same 145 unrestored approximal tooth surfaces on these 16 bitewing radiographs. As in the previous study (10), these dentists first scored each surface using a six-point restorative probability scale (definitely, probably, might consider to restore, or not restore) and, about one hour later, scored the caries depth of each surface using a five-point scale (sound, outer half of enamel, inner half of enamel, outer half of dentin, inner half of dentin).

The distributions of the numbers of surfaces that the two groups of dentists had scored as "definitely needing restoration" were examined and, for each group, four subgroups using the actual numbers of such surfaces were identified (Table 1). The two outliers among the 17 North York dentists one dentist reported 94 and the other seven surfaces definitely needing restoration — were dropped from further analysis because they were so different from the high and low subgroups.

In establishing the subgroups, we were aware that the same or similar numbers of surfaces designated for definite restoration by dentists within each subgroup were not necessarily the exact same surfaces (5). However, use of the aggregate number of surfaces that presumably would be restored by the dentists in each subgroup as a grouping variable was consistent with the research question posed by this study.

The data were subsequently edited, coded, and entered into files for analysis with the SPSS/PC+ and SAS statistical packages. Using the aforementioned four subgroups, cross-tabulations, means, and ANOVAs were utilized for comparisons of caries depth scores. Since the number of dentists in each subgroup differed, the unbalanced design required the General Linear Models procedure of SAS to be used in four-way, nested ANOVAs of grc p means as previously described (10). Appropriate means and relative percentages based on microscopic determination of true caries depth from these experimental bitewing radiographs were determined.

Results

Table 1 shows for each group of dentists that, as the number of approximal tooth surfaces in each subgroup identified as definitely needing restoration decreases, the depth code means — based on the 304 and 145 surfaces each group examined — also decrease. The ANOVA for each group indicated that, although the overall differences among subgroup depth means were not significant (P=.11 and P=.15), the differences between the high and low subgroups were significant (Duncan's multiple range test, P<.05). True histologic mean caries depth was just above the mean depth of the subgroup least likely to identify

surfaces definitely to be restored with the North York dentists (0.61 vs 0.58) and just below for the same subgroup of University of Toronto dentists (0.55 vs 0.63).

Table 2 shows for each group of dentists that, as the number of approximal tooth surfaces in each subgroup identified as definitely needing restoration decreases, the percentages of surfaces scored as sound increase and the percentages of surfaces scored as dentin caries decrease. The true microscopic percentages of sound and of dentinally involved surfaces are similar to those of the lowest and second lowest subgroups of dentists regarding surfaces definitely to be restored.

Discussion

When independently examining the same approximal tooth surfaces on bitewing radiographs, dentists vary greatly in the number of surfaces they designate for definite restoration (Table 1). Those who most frequently identify surfaces for definite restoration perceive caries as deeper, on average, than those who do not, and deeper than has been proven histologically. They also report relatively few surfaces as sound and more surfaces as having dentin caries than the other subgroups and histological truth (Table 2). In each comparison of mean depth and percentage of surfaces sound or dentinally carious, the largest contrast occurs between the highest and lowest subgroups of definite

Subgroup	North York Dentists (304 Surfaces/DDS)				University of Toronto Dentists (145 Surfaces/DDS)			
	No. Dentists	No. Surfaces Definitely to Be Restored				No. Surfaces Definitely to Be Restored		
		Actual Range	Mean	Depth* Meant	No. Dentists	Actual Range	Mean	Depth* Mean†
1	3	56-62	61	1.00	3	34-43	38	1.10
2	6	36-46	40	0.81	3	23-27	25	0.94
3	3	32–34	33	0.79	6	15-19	16	0.73
4	3	18-28	22	0.58	8	9–13	12	0.63
Totals	15			0.80	20			0.77
Microscopic depth*				0.61				0.55

TABLE 1 Definite Restorative Decisions and Dentists' Mean Dental Caries Depth Perceptions from Bitewing Radiographs

*Depth codes: 0=sound; 1=outer half of enamel; 2=inner half of enamel; 3=outer half of dentin; 4=inner half of dentin. For comparisons here, the original North York depth code "at DEJ but not penetrating dentin" was recoded to inner half of enamel. †The significance among these means based on four-way, nested ANOVAs is described in text.

and	Dentinal Ca Nort (304	th York De Surfaces/	ntists DDS)	University of Toronto Dentists (145 Surfaces/DDS)			
Definite		Surfaces Scored (%)			Surfaces Scored (%)		
Restoration Subgroup*	No. Dentists	Sound	Dentinal Caries	No. Dentists	Sound	Dentinal Caries	
1	3	58.2	20.6	3	48.3	22.0	
2	6	65.5	17.1	3	52.0	17.7	
3	3	65.6	13.5	6	64.3	13.4	
4	3	70.0	8.8	8	67.8	10.2	
Microscopic %		72.7	13.1		61.4	14.0	

TABLE 2 Definite Restorative Decisions and Dentists' Perceptions of Frequency of Sound and Dentinal Caries Surfaces from Bitewing Radiographs

*Subgroups as defined in Table 1.

restorers (*P*<.05 for mean depth).

Although these simple findings are not intuitively surprising, we can find no similar data in the literature. The explanation may be that most studies of restorative decisions have not recorded both the restorative and depth decisions for later analysis.

We have reported differences among dentists in mean caries depth perceptions; however, analysis to explain these differences - for example, because of demographic and dental practice differences among the dentists - cannot be undertaken because such information was not provided as a condition of data availability. Nor do we have information on differences in these dentists' beliefs about the speed of caries progression or caries extension beyond that demonstrated by the radiographic image. However, it is unlikely that variations in true visual acuity explain the differences in mean caries depth reported here because nearly all of the subgroups, and especially those with the greatest tendency to restore, reported deeper caries than actual histological depth.

These were experienced dentists. As recently suggested by Bader and

Shugars (2), through a process of pattern recognition such dentists over time may develop various caries scripts that are linked closely with their restorative decisions, rather than following the hypothetical-deductive model of diagnosis and prognosis followed by selection of an appropriate treatment from the alternatives available. In their inventory of caries scripts dentists having greater tendencies to restore may have higher proportions of caries scripts involving deep caries that they automatically associate with definite restoration. Thus, when they identify restorative need, as they often do, they perceive, in a self-fulfilling way, lesions as deeper than they really are and deeper than perceived by other dentists.

At this early stage of the scripting theory the foregoing comments are, at best, unsubstantiated speculations. However, it has been substantiated that there is a paucity of studies on how restorative decisions are made and that more studies are needed to increase understanding (2). Although our findings need to be replicated by others, they may help to improve this understanding a little or, at least, encourage more explanatory research.

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References

- Bader JD, Shugars DA. Understanding dentists' restorative treatment decisions. J Public Health Dent 1992;52:102-10.
- Bader JD, Shugars DA. What do we know about how dentists make caries-related treatment decisions? Community Dent Oral Epidemiol 1997;25:97-103.
- Espelid I, Tveit AB, Haugejorden O, Riordan PJ. Variation in radiographic interpretation and restorative treatment decisions on approximal caries among dentists in Norway. Community Dent Oral Epidemiol 1985;13:26-9.
- Mileman PA, Mulder H, van der Weele LT. Factors influencing the likelihood of successful decisions to treat dentin caries from bitewing radiographs. Community Dent Oral Epidemiol 1992;20:175-80.
- Lewis DW, Kay EJ, Main PA, Pharoah MG, Csima A. Dentists' variability in restorative decisions, microscopic and radiographic caries depth. Community Dent Oral Epidemiol 1996;24:106-11.
- Nuttall NM, Pitts NB. Restorative treatment thresholds reported to be used by dentists in Scotland. Br Dent J 1990;169: 119-26.
- El-Mowafy O, Lewis DW. Restorative decision making by Ontario dentists. J Can Dent Assoc 1994;60:305-16.
- Nuttall NM, Pitts NB, Fyffe HE. Assessment of reports by dentists of their restorative treatment thresholds. Community Dent Oral Epidemiol 1993;21:273-8.
- Kay EJ, Nuttall NM, Knill-Jones R. Restorative treatment thresholds and agreement in treatment decision making. Community Dent Oral Epidemiol 1992; 20:265-8.
- Lewis DW, Kay EJ, Main PA, Pharoah MG, Csima A. Dentists' stated restorative treatment thresholds and their restorative and caries depth decisions. J Public Health Dent 1996;56:176-81.