Thresholds of Restorative Decision in Dental Caries Treatment among Dentists from Small Brazilian Cities

Jefferson Traebert[a]/Cláudia Irene Wesoloski[a]/Josimari Telino de Lacerda[b]/
Wagner Marcenes[c]

Purpose: To investigate the thresholds of restorative intervention in dental caries treatment, based upon the lesion depth seen in radiographs, among Brazilian dentists working in small cities. In addition, the threshold of restorative intervention was compared with demographic and work-related characteristics.

Material and Methods: The studied population comprised dentists (n = 89) who were working in 2000 in 20 small cities of the Midwest region of the Southern Brazilian State of Santa Catarina. Four different radiographs were shown of extracted premolars fixed upon a plaster base. The criteria for the radiograph analyses were proposed by Nuttall et al (1993).

Results: Of investigated dentists, 16.7% would restore a carious lesion confined to the outer half of the enamel and 33.3% would restore a carious lesion in the outer and inner half of the enamel, but without involving the enamel-dentine junction. The percentage that would restore lesions in the outer half of dentine was 91.7%. Dentists who had attended postgraduate courses in areas of interest of this study tended to adopt a more conservative treatment when compared with dentists who had not attended ($p < 0.01$).

Conclusions: There was a great variation in the thresholds of intervention based upon lesion depth seen in radiographic images among the investigated Brazilian dentists. An interventionist attitude was observed, which could result in over-treatment. It is highly recommended to educate general practitioners from the studied region in performing early diagnosis of lesions and non-invasive care in order to treat initial carious lesions with only remineralisation and monitoring.

Key words: caries depth, decision-making, radiograph, restorative decision, treatment threshold

Oral Health Prev Dent 2007; 2: 131-135. *Submitted for publication: 25.10.05; accepted for publication: 10.08.06.*

Several studies published in the international scientific literature report large variations in dentists' diagnoses, restorative decisions and treatment plans. These differences occur independently of extracted teeth, contact with patients or whether bitewing radiographs are examined (Lewis et al, 1996).

The possibility of cavitation in lesions that penetrate the dentine, seen in radiographic images, is just 52% (Mileman et al, 1992). Radiolucent radiographic images restricted to the enamel correspond to non-cavitated lesions, while radiolucent images in the internal half of the dentine correspond to cavitated lesions (Mileman et al, 1992). This has fundamental implications for dental practice in terms of the treatment of dental caries. It is known that active lesions of the enamel can be inactivated and, in dentine, even with the resulting bacterial invasion, the lesions can be inactivated, provided the factors involved in the disease process can be controlled (Maltz et al, 1999).

Previous studies have concluded that considerable clinical variability occurs in dental restorative treatment thresholds and decisions. In making restorative decisions, dentists state that they are influenced to varying degrees by the depth of proximal surface dental caries seen on bitewing radiographs (Kay et al, 1995). Lewis et al (1996) also concluded that considerable variation existed in restorative and depth deci-

[a] *Public Health Research Group, Universidade do Oeste de Santa Catarina, Rua Getúlio Vargas, 2125 Bairro Flor da Serra, Joaçaba-SC, CEP 89600-000, Brazil.*

[b] *Departamento de Saúde Pública, Universidade Federal de Santa Catarina, Campus Universitário Trinidade, Florianópolis, SC, CEP 88040-900, Brazil.*

[c] *Centre for Oral Biometrics, QMUL, Turner Street, London E1 2AD, UK.*

Reprint requests: *Dr. Jefferson Traebert, Rua Dr. Armínio Tavares, 111/302, Florianópolis-SC, 88015-250 Brazil. Tel: +55 48 3243-4390. Fax: +55 48 3324-0250. Email: jtraebert@unisul.br*

sions among dentists in Canada. Kay and Locker (1996) found that Canadian dentists operated with greater sensitivity but lower specificity than their Scottish colleagues and their action thresholds also differed.

In Brazil, this subject has rarely been studied. One investigation involving only 15 dentists concluded that there was great difficulty in standardising the diagnosis and the treatment decision in relation to caries of occlusal surfaces (Silva et al, 1994). Another recently published study investigated attitudes of 840 dentists from three large cities regarding restorative treatment decisions and concluded that dentists have an interventionist attitude in the treatment of dental caries (Traebert et al, 2005).

The objective of this study was to investigate the thresholds of restorative intervention in dental caries treatment, based upon the lesion depth seen in radiographs, among Brazilian dentists working in 20 small cities. In addition, the threshold of restorative intervention was compared with demographic and work-related characteristics.

Table 1 Frequency and proportion of dentists (n=84) participating in the study by their demographic and work-related characteristics

Variables	n (%)
Age (years)	
22–35	40 (47.6)
36–65	44 (52.4)
Gender	
Male	52 (61.9)
Female	32 (38.1)
Professional working experience (years)	
< 4	43 (51.2)
≥ 4	41 (48.8)
Postgraduate education	
Yes	53 (63.1)
No	31 (36.9)

MATERIALS AND METHODS

A cross-sectional study was carried out. The population of reference was all dentists working in the Midwest region of the Southern Brazilian State of Santa Catarina, which is composed of 20 small municipalities.

All 89 dentists working in the region in the year 2000 (Conselho Regional de Odontologia de Santa Catarina, 2000) were invited to participate in the study. A structured interview was performed by a single trained dentist (CIW) during working hours and at the dentists' dental surgery. Prior to the visit, the interviewer phoned the dentists in order to explain the objectives and importance of the study and ask for their participation. Confidentiality of the answers was assured and none of the interviewees responded against their will.

In the interview, four different radiographs of extracted pre-molars fixed upon a plaster base were shown. These teeth were extracted for orthodontic reasons and the radiographs were taken in the parallel plane. The criteria for the radiograph analyses were proposed by Nuttall et al (1993). The first radiograph showed a radiolucent carious lesion confined to the outer half of the enamel. In the second radiograph, the carious radiolucent lesion was located in the outer and inner half of the enamel, but without involving the enamel-dentine junction (EDJ). In the third radiograph, the caries radiolucent lesion involved all the enamel, the EDJ and the outer half of the dentine. Finally, the fourth radiograph showed a caries radiolucent lesion involving the outer and inner half of the dentine. It was also explained by the interviewer, according to Kay and Knill-Jones (1992), that the decision should be made in the following context: a 16-year-old adolescent will be attended by yourself in the following two years; the caries experience and oral hygiene are not as bad as your worst patients, but also not as good as your best patients; the adolescent is cooperative in his/her dental attitudes and he/she can afford any kind of treatment.

After observing all the radiographs, the dentists were asked if they would restore any of the situations shown in the bitewing radiographs, according to possible answers from Kay and Knill-Jones (1992): definitively restore, probably restore, maybe restore, probably not restore and definitively not restore. The interview also recorded gender, age of the dentist, years of work experience and if they had attended a postgraduate formal course in the area of interest of this study, such as restorative dentistry, cariology or paediatric dentistry.

The questionnaire and forms used in the interview were previously tested with 20 dentists who did not participate in the main study. A pilot study was also performed and no modification in the methodology was necessary.

The software SPSS 11.5 was used and data analysis included descriptive statistics of the distribution of the restorative intervention thresholds. To test the association between dentists' work-related characteristics and treatment decision, a two-by-two table was

constructed. Treatment decision categories were dichotomised as follows: definitively restore and probably restore were categorised as 'restore'; and maybe restore, probably not restore and definitively not restore were categorised as 'not restore'. Statistical significance for the association between the restorative intervention thresholds and gender, age, experience and attendance on postgraduate related courses was evaluated using Chi-square test or Fisher exact test when cell value was less than 5. The level of significance set was $p < 0.05$.

Table 2 Frequency distribution of dentists (n=84) that definitively restore and probably restore pre-molars according to the radiographic caries depth

Radiographic caries depth	n (%)
Carious lesion confined to the outer half of the enamel	14 (16.7)
Carious lesion in the outer and inner half of the enamel, but without involving EDJ	28 (33.3)
Carious lesion involving all enamel, EDJ and the outer half of dentine	77 (91.7)
Carious lesion involving the outer and inner half of the dentine	83 (98.8)

RESULTS

The response rate in this study was 94.4%. Only 5 out of 89 dentists did not participate because they were absent from their place of work.

The demographic and work-related characteristics of the studied population are shown in Table 1. The dentists' ages ranged from 22 to 65 years old, the proportion of males (61.9%) was higher than females (38.1%) whilst the majority of the study population (63.1%) reported having concluded a postgraduate course in areas of interest of this study. In addition, it was found that the median years of the work experience was 4 years.

Table 2 shows the prevalence of dentists that would restore or probably restore lesions according to radiographic caries depth. Of investigated dentists, 16.7% would restore a carious lesion confined to the outer half of the enamel and 33.3% would restore a carious

Table 3 Association between dentists' demographic and work-related characteristics and decision to restore approximal lesions. Chi-squared test or Fisher exact test.

	Case 1 - Carious lesion confined to the outer half of the enamel		Case 2 - Carious lesion in the outer and inner half of the enamel, but without involving EDJ		Case 3 - Carious lesion involving all enamel, EDJ and the outer half of dentine		Case 4 - Carious lesion involving the outer and inner half of the dentine	
Variables	Not restore n (%)	Restore n (%)	Not restore n (%)	Restore n (%)	Not restore n (%)	Restore n (%)	Not restore n (%)	Restore n (%)
Gender								
Male	44 (84.6)	8 (15.4)	37 (71.2)	15 (28.8)	6 (11.5)	46 (88.5)	1 (1.9)	51 (98.1)
Female	26 (81.3)	6 (18.7)	19 (59.4)	13 (40.6)	1 (3.1)	31 (96.9)	- (0.0)	32 (100.0)
p	0.68		0.27		0.24		1.00	
Age (years)								
22–35	35 (87.5)	5 (12.5)	26 (65.0)	14 (35.0)	3 (7.5)	37 (92.5)	- (0.0)	40 (100.0)
36–65	35 (79.5)	9 (22.0)	30 (68.2)	14 (31.8)	4 (9.1)	40 (90.9)	1 (2.3)	43 (97.7)
p	0.33		0.76		1.00		1.00	
Experience (years)								
≤ 4	38 (88.4)	5 (11.6)	29 (67.4)	14 (32.6)	3 (7.0)	40 (93.0)	- (0.0)	43 (100.0)
> 4	32 (78.0)	9 (22.0)	27 (65.9)	14 (34.1)	4 (9.8)	37 (90.2)	1 (2.4)	40 (97.6)
p	0.20		0.88		0.71		0.49	
Postgraduate education								
Yes	49 (92.3)	4 (7.5)	42 (79.2)	11 (20.8)	5 (9.4)	48 (90.6)	- (0.0)	53 (100.0)
No	21 (67.7)	10 (32.3)	14 (45.2)	17 (54.8)	2 (6.5)	29 (93.5)	1 (3.2)	30 (96.8)
p	< 0.01		< 0.01		1.00		0.37	

lesion in the outer and inner half of the enamel, but without involvement of EDJ; 91.7% would restore lesions in the outer half of the dentine.

Table 3 presents dentists' treatment decisions according to demographic and work-related characteristics. For case 1, a radiograph showing a radiolucent carious lesion confined to the outer half of the enamel, the majority of investigated dentists chose to adopt a conservative treatment. A statistically significant association was observed only when comparison between dentists who had and had not attended relevant postgraduate courses (specialists) was performed ($p < 0.01$). Specialists tended to adopt more conservative treatment when compared with non-specialists.

The same pattern related to case 1 was observed in case 2, in which a radiograph with a carious radiolucent lesion located in the outer and inner half of the enamel, but without involving the EDJ was analysed. In this case, specialists also chose a more conservative treatment option than non-specialists ($p < 0.01$).

For case 3, a radiograph showing a caries radiolucent lesion involving all the enamel, the EDJ and the outer half of the dentine and for case 4, a radiograph showing a caries radiolucent lesion involving the outer and inner half of the dentine, there was more consensus over the treatment decision, to perform a restoration.

DISCUSSION

The response rate in the present study was very high and the reason for non-participation was absence from the city during the research time, rather than a refusal to participate in the study. The methodology used in this study may be criticised because the dentists' decisions were based upon assessment of radiographs alone, and not upon clinical and tactile examinations of patients. Nevertheless, Elderton and Nuttall (1983) have stated that variability would remain if both patients and radiographs were available for examination.

As in the studies performed in developed countries (Lewis et al, 1996; Kay and Locker, 1996; Choi et al, 1998; Doméjean et al, 2004), the present study has demonstrated large variations among dentists in their restorative treatment decisions. However, our results showed a more conservative attitude in comparison with dentists from developed countries. However, it should be noted that the majority of the studies from developed countries were performed in the 1980s and 1990s. Thus it is difficult to compare our findings with other results, and any comparison should take into account that subjects in other studies belong to a different cohort. Mileman and Espelid (1988) reported that 65% of Norwegian dentists restored any lesion that reached the EDJ and the percentage for Dutch dentists was 50%. Also, a study with 20 dentists from Glasgow, Scotland, reported that 40% restored any lesion involving the EDJ (Kay and Knill-Jones, 1992). In a further investigation, it was shown that 75% of Canadian dentists and 55% of Scottish dentists would restore lesions confined to the enamel (Kay and Locker, 1996). In another study involving Canadian dentists, 18% would restore lesions without involvement of the EDJ and 56% would restore lesions that reached the EDJ (Lewis et al, 1996).

When comparing our findings with the results of another Brazilian study (Traebert et al, 2005) in which dentists from larger cities were investigated, a much more conservative attitude is observed among dentists from the smaller investigated cities. For instance, 31.5% of dentists in larger Brazilian cities would restore approximal surfaces with lesions confined to the external half of the enamel and 54.5% would restore when the lesion was located in the internal half of the enamel but without reaching the EDJ (Traebert et al, 2005). Our findings showed that in similar situations the figures are 16.7% and 33.3% respectively. However, it should be noted that in the first study the interviews were carried out by telephone. This difference in the methods could contribute to such a difference in the results.

In making restorative decisions, dentists state they are influenced to varying degrees by the depth of lesions seen on bitewing radiographs (Kay and Knill-Jones, 1992). In spite of the fact that caries depth determined by radiographs should not be the only basis for restorative decisions, the presence and extent of caries perceived in radiographs is an important consideration (El-Mowafy and Lewis, 1994).

The threshold at which restoration becomes the optimal treatment decision ought to be related to the dentist's knowledge of the rate and frequency of progression or regression of lesions (Darvell and Pitts, 1984). Considering that the chance of cavitations in radiographic lesions involving the EDJ and outer dentine is only 52% (Mileman et al, 1992) the results of the present study are of concern. It is probable that the dentists from the investigated small cities of Santa Catarina state are over-treating their patients because they may be restoring several teeth without cavitation, not allowing the possibility of remineralisation of the carious lesion. It is fundamental that the general practitioners should understand that traditional restorative dentistry is outdated and that what is needed is a change of direction in practice towards a non-invasive

preventive model, and that when an invasive restoration is necessary, one should always bear in mind the danger of initiating the repetitive restoration cycle (Elderton, 2003). There is a need to educate general practitioners in performing an early diagnosis of lesion and non-invasive care in order to treat initial carious lesions with remineralisation and monitoring, reducing the possibility of over-treatment.

Dentists' demographic and work-related characteristics such as gender, age and years of working experience were not statistically associated with the adopted decisions of operative treatment. However, in case 1 and case 2, in which the carious lesions did not involve the EDJ, dentists who had attended postgraduate courses demonstrated a more conservative attitude and opted to not restore the lesions. These results could be related to continuing education provided by postgraduate courses in specific areas such as restorative and paediatric dentistry and cariology, showing that continuing education plays an important role in enhancing dentists' knowledge of clinical disciplines in dentistry (Main et al, 1997). Choi et al (1998) reported that dentists' decisions were less variable and more accurate following an educative intervention, suggesting there is potential for improving consistency and accuracy in clinical decision-making through education.

In the present study, time of working experience was not associated with a more interventionist attitude. This result is different from those of the other Brazilian study (Traebert et al, 2005). However, the cut-off point in this investigation was 4 years of experience and in the previous study, the cut-off point was 10 years of experience. Such a methodological difference could explain, in part, the difference in the results.

It can be concluded that there is a great variation in the thresholds at which the investigated Brazilian dentists would restore carious lesions based upon radiographic images. Also, an interventionist attitude was observed, which could result in over-treatment. Specialists showed a more conservative attitude than non-specialists in two different cases. Other demographic and work-related characteristics were not associated with the thresholds of restorative decision. The basis for treatment decision should be an effective outcome according to several factors including patient-related and dentist-related aspects. A treatment decision combining an evidence-based approach together with clinical judgement, both enhanced by continuing education, would reduce variation in decisions and improve the quality of treatment as well as the possibility of over-treatment. It seems to be mandatory to educate general practitioners in performing early diagnosis of lesions and non-invasive care in order to treat initial carious enamel lesions only with prophylactic care and monitoring.

REFERENCES

1. Choi BCK, Fokovic A, Kay EJ, Main PA, Leake JL. Reducing variability in treatment decision-making: effectiveness of educating clinicians about uncertainty. Med Educ 1998;32:105-111.
2. Conselho Regional de Odontologia de Santa Catarina. www.crosc.org.br. Accessed 20 March 2000.
3. Darvell BW, Pitts NB. The progression of approximal caries in enamel: a mathematical model. Aust Dent J 1984;29:111-115.
4. Doméjean-Orliaguet S, Tubert-Jeannin S, Riodan PJ, Espelid I, Tveit AB. French dentists' restorative treatment decisions. Oral Health Prev Dent 2004;2:125-131.
5. Elderton RJ, Nuttall NM. Variation among dentists in planning treatment. Br Dent J 1983;154:201-206.
6. Elderton RJ. Ciclo restaurador repetitivo. In: Kriger L (ed). Promoção de Saúde Bucal. 3rd ed. São Paulo: Artes Médicas 2003;108-125.
7. El-Mowafy OM, Lewis DW. Restorative decision making by Ontario dentists. J Can Dent Assoc 1994;60:305-310.
8. Kay EJ, Knill-Jones R. Variation in restorative treatment decisions: application of Receiver Operating Characteristic curve (ROC) analysis. Community Dent Oral Epidemiol 1992;20:113-117.
9. Kay EJ, Brickley M, Knill-Jones R. Restoration of approximal carious lesions: application of decision analysis. Community Dent Oral Epidemiol 1995;23:271-275.
10. Kay EJ, Locker D. Variations in restorative treatment decisions: an international comparision. Community Dent Oral Epidemiol 1996;24:376-379.
11. 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;56:176-181.
12. Main, PA, Lewis, DW, Hawkins, RJ. A survey of general dentists in Ontario. Part 1: sealant use and knowledge. J Can Dent Assoc 1997;63:545-553.
13. Maltz M, Cavalcanti Fatturi Ruppenthal L, Jobim Jardim J. Bases biológicas para a remoção de dentina cariada. Rev ABOPREV 1999;2:11-19.
14. Mileman PA, Espelid I. Decisions on restorative treatment and recall intervals based on bitewing radiographs. A comparison between national surveys of Dutch and Norwegian practitioners. Community Dent Health 1988;5:273-284.
15. Mileman PA, Mulder H, Van der Weele LT. Factors influencing the likelihood of successful decisions to treat dentin caries from bite-wing radiographs. Community Dent Oral Epidemiol 1992;20:175-180.
16. Nuttall NM, Pitts NB, Fyffe HE. Assessment of reports by dentists of their restorative treatment thresholds. Community Dent Oral Epidemiol 1993;21:273-278.
17. Silva BB, Maltz M, Franco F. Diagnóstico e tratamento da cárie de superfície oclusal: variação entre examinadores. Rev Assoc Paul Cir Dent 1994;48:1231-1234.
18. Traebert J, Marcenes W, Kreutz JV, Oliveira R, Piazza CH, Peres MA. Brazilian dentists' restorative treatment decisions. Oral Health Prev Dent 2005;3:53-60.