

Evidence-practice gap in treatment recommendations for proximal caries among Brazilian dentists

Lacuna entre a evidência e a prática nas recomendações de tratamento para cárie proximal entre dentistas brasileiros

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ABSTRACT

Little is known about how Brazilian dentists' treatment decisions for proximal carious lesions are compared to current evidence-based recommendations, so better understanding is needed to close any potential evidence-practice gap. **Objectives:** This cross-sectional study aimed to quantify the evidence-practice gap about proximal carious lesions treatment and identify dentist factors associated with this evidence-practice gap. **Methods:** Brazilian dentists (n=214) from Araraquara, São Paulo State, "completed a questionnaire about their dentist and practice characteristics and a translated version of the "Assessment of Caries Diagnosis and Caries Treatment" from the U.S. National Dental Practice-Based Research Network. Five radiographic images of proximal carious lesions in low-risk and high-risk patient scenarios were used. Associations between treatment recommendations and lesion, dentist, and practice characteristics were tested for statistical significance ($p < 0.05$). **Results:** Lesions confined to the enamel would be restored by 35% and 71% of dentists in the low-risk and high-risk patient scenarios, respectively, suggesting a substantial evidence-practice gap given that surgical intervention of enamel lesions is not consistent with current evidence. The lesion depth threshold to recommend a permanent restoration differed between the low-risk and high-risk patient scenarios ($p < 0.001$). Specific dentist/practice characteristics (dentist gender, graduate of a public dental school, postgraduate training, use of caries risk assessment) were significantly associated with the evidence-practice gap, but the magnitude of these differences was not major. **Conclusion:** A substantial evidence-practice gap in treatment of proximal carious lesions was found for the sample overall, even when clinical scenarios presented low-risk patients. Global strategies are needed to close this substantial evidence-practice gap.

Indexing terms: Decision making. Dental caries. Practice patterns, dentists'.

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RESUMO

Pouco se sabe se as decisões de tratamento dos dentistas brasileiros para lesões cáries proximais são comparadas às recomendações atuais baseadas em evidências, portanto, é necessário um melhor entendimento para fechar qualquer potencial lacuna entre a evidência e a prática. **Objetivos:** Este estudo transversal teve como objetivo quantificar a lacuna entre a evidência e a prática na decisão de tratamento das lesões cáries proximais e identificar os fatores associados a essa lacuna entre a evidência e a prática.

Métodos: Cirurgiões-dentistas brasileiros ($n=214$) de Araraquara, Estado de São Paulo, preencheram um questionário sobre suas características odontológicas e clínicas e uma versão traduzida do "Assessment of Caries Diagnosis and Caries Treatment" da U.S. National Dental Practice-Based Research Network. Cinco imagens radiográficas de lesões cáries proximais em cenários de pacientes de baixo risco e alto risco foram usadas. Associações entre recomendações de tratamento e lesão, dentista e características da prática foram testadas ($p<0,05$). **Resultados:** As lesões confinadas ao esmalte seriam restauradas por 35% e 71% dos dentistas nos cenários de pacientes de baixo risco e alto risco, respectivamente, sugerindo uma lacuna entre a evidência e a prática substancial, dado que a intervenção cirúrgica das lesões do esmalte não é consistente com as evidências atuais. O limiar de profundidade da lesão para recomendar uma restauração permanente diferiu entre os cenários de pacientes de baixo risco e alto risco ($p<0,001$). Características específicas do dentista/prática (sexo do dentista, graduado em uma faculdade pública, pós-graduação, uso da avaliação de risco de cárie) foram significativamente associadas à lacuna entre a evidência e a prática, mas a magnitude dessas diferenças não foi importante. **Conclusão:** uma lacuna entre a evidência e a prática substancial na decisão de tratamento de lesões cáries proximais foi encontrada para a amostra como um todo, mesmo quando os cenários clínicos apresentavam pacientes de baixo risco. Estratégias globais são necessárias para fechar essa lacuna entre a evidência e a prática.

Termos de indexação: Tomada de decisões. Cárie dentária. Padrões de prática odontológica.

INTRODUCTION

Proximal caries is one of the primary lesions occurring during adulthood [1] while also having a significant prevalence among children [2] and adolescents [3]. It is significantly associated with pre-existing caries risk and with caries on the adjacent tooth surface [4].

Due to its slow progression rate [5], especially in regions with a substantial caries reduction [6], prevention of proximal caries lesions may be achieved using non-invasive treatment such as improved daily toothbrushing with fluoridated dentifrices [5] and fluoride application [6]. Dental flossing before or after toothbrushing [7] has also been demonstrated as an essential and easy at-home measure to prevent proximal caries [8].

Evidence-based treatment decision-making for proximal carious lesions (PCL) takes into account whether the PCL is non-cavitated or cavitated. Non-cavitated PCLs in low caries risk individuals or within dental enamel may be arrested by interdental cleaning and topical fluoride application [1]. For non-cavitated PCLs that are into dentin and in patients at high caries risk, micro-invasive strategies and procedures such as sealing and resin infiltration should be given due consideration [1] because they are effective in arresting non-cavitated proximal caries progression [6]. However, cavitated PCLs should be treated with surgical restorative procedures [1,6].

Because radiographically detected PCLs that are only into enamel are rarely cavitated [9], dentists should manage them using preventive or micro-invasive procedures. However, many dentists or dental students report that they would restore PCLs that are only into enamel. About 7% of Palestinian [10], 18% of Californian dentists [11], 21% of United Arab Emirates [12], 27% of London [13] and 55% of Brazilian dentists [14] would restore PCLs limited to the enamel. A systematic review has demonstrated that 5% to 88% of dentists would surgically restore enamel PCLs [15]. A meta-analysis found that 21% of dentists or dental therapists would surgically restore enamel PCLs, although the probability that they would restore enamel PCLs was twice as high when patients were at high caries risk compared to when these patients are at low caries risk [16].

When a patient's caries risk is considered, most dentists from the Dental Practice-Based Research Network in the U.S. (66%) and in Japan (74%) indicated that they would surgically restore an enamel PCL when the patient is at high caries risk. In contrast, only 39% of U.S. and 47% of Japanese dentists indicated that they would do when the same lesion is in a low caries risk patient [17,18]. In Brazil, data on decision-making process for management of proximal caries are either limited, or not derived from evidence-based studies.

Although clinical research is designed to benefit clinical practice, systematic reviews have demonstrated across a wide range of health care fields that it is common for there to be a substantial gap between what clinical evidence says should be occurring and what is actually done in everyday clinical practice [19]. This gap is referred to as the “evidence-practice gap (EPG)” [20]. In dental care, operative dentistry procedures comprise a large percentage of the care provided, so closing the EPG in this area presumably has substantial potential to improve patient outcomes and reduce costs. One component of operative dentistry, the treatment of PCLs, is particularly salient with regard to the EPG. The literature reviewed above suggests that a substantial EPG may exist with regard to treatment of PCLs, given that surgical intervention of enamel lesions is not consistent with current evidence. Therefore, the objective for the current study was to quantify the EPG about treatment of PCLs among Brazilian dentists and identify dentist factors associated with this EPG.

METHODS

Participants

The participants for this cross-sectional study were 214 dentists from Araraquara, São Paulo State, Brazil. To invite dentists to participate in the study, a list of 801 professionals was created consulting the Council of Dentistry of São Paulo State, the regulatory body for dentists, and internet sources. To encourage a higher response rate, dentists were mailed the questionnaires to their work address with a pre-paid return envelope. Non-respondents were also contacted by telephone and received a second copy of the questionnaire. Data collection took place from October 2014 to December 2015.

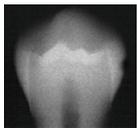
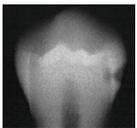
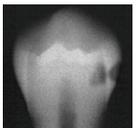
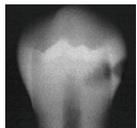
Two hundred and seventeen dentists responded. Responding dentists who reported treating dental caries, practicing in Araraquara, were not retired, and completing at least one of two clinical case scenarios that involved treatment of a PCL, were included in the present analysis, comprising 214 dentists.

The research was undertaken with the understanding and written consent of each participant and according to the ethical principles, including the World Medical Association Declaration of Helsinki. Ethics approval for the research was given by an Institutional Review Board (Research Ethics Committee; protocol number #78/11).

Measures

Study dentists received two paper questionnaires. They completed an enrollment/demographic questionnaire that provided demographic data and information about their clinical training and individual practices and a translated version [21] of the “Assessment of Caries Diagnosis and Caries Treatment” from the U.S. National Dental Practice-Based Research Network. Dentists were presented with a series of five radiographic images of PCLs in a mandibular premolar (table 1). Case 1 (E1) showed a radiolucency in the outer half of the enamel; Case 2 (E2) had a radiolucency in the inner one-half of the enamel; Case 3 (D1) was one-third into the dentin; Case 4 (D2) was in the middle one-third of the dentin; and Case 5 (D3) was in the inner one-third of the dentin. The images were accompanied by patient scenarios of differing caries risk; a patient with minimal risk and a second scenario describing a patient with multiple factors associated with higher risk for caries. Study dentists were asked to choose at which lesion depth (E1, E2, D1, D2, or D3) they would first choose to perform a surgical restorative treatment, judging from the radiographic image of the given proximal surface for each of the case scenarios. Dentists and practice factors used as explanatory variables included dentist gender, graduation from a public/private dental school, receiving a post-graduate degree (masters or doctorate), years since dental school graduation, practice model, the percentage of pediatric patients seen in the practice (using a cut-point of 40%), the likelihood of using a radiograph to help diagnose proximal caries, the percentage of patients given an individualized caries prevention regimen, and whether caries risk was assessed in any way.

Table 1. Percentage of dentists who would recommend surgical restorative treatment this level of interproximal caries for a low-risk and high-risk patient. [Images reprinted from Espelid et al. [22] with permission.]

Level 1 (E1)	Level 2 (E2)	Level 3 (D1)	Level 4 (D2)	Level 5 (D3)
				
Low-risk patient scenario. The patient is a 30-year old female with no relevant medical history. She has no complaints and is in your office today for a routine visit. She has been attending your practice on a regular basis for the past six years.				
5% (n=10)	30% (n=64)	54% (n=115)	10% (n=21)	1% (n=3)
High-risk patient scenario. The patient has 12 teeth with existing dental restorations, heavy plaque, and calculus, multiple Class V white spot lesions, and is not missing any teeth.				
16% (n=35)	55% (n=117)	27% (n=57)	2% (n=4)	<1% (n=1)

Note: One dentist did not complete the low-risk scenario. For subsequent analyses, D2 and D3 were collapsed because of the low expected value for D3.

Statistical analysis

First, descriptive statistics were calculated for all study variables. Responses for each clinical case scenario were scored as follows: (E1 = 1, E2 = 2, D1 = 3, D2 = 4, D3 = 5) to create ordinal variables. To determine whether dentists were sensitive to the clinical risk scenarios, scores for the low-risk scenario were compared with the high-risk scenario. A critical value of $p=.05$ was used for all analyses. Associations between treatment decisions and dentist and practice variables were tested for each risk scenario using the Pearson Chi-square statistic when explanatory variables were categorical and Somer's d when practice variables were ordinal. Next, a difference score was calculated as a "risk sensitivity index" to reflect the change in the level at which they would first choose to perform a permanent restoration based on the risk characteristics of the clinical scenarios (calculated as low-risk level minus high-risk level). Dentists were classified as choosing surgical restorative treatment at a later level in the high-risk patient (+1), intervene at the same level (0), or intervene at a later level in the low-risk patient (-1). Lastly, we tested whether sensitivity to caries risk as measured by the risk sensitivity index was associated with dentist and practice variables following the same pattern as for each individual case scenario based on measurement level.

RESULTS

The sociodemographic breakdown of the sample was 61% (n=130) female, with an average age of 42.1 years (SD=12) and an average of 19.6 years (SD = 12) of dental practice. Seventy-seven percent (n=164) were educated at a private dental school, whereas 23% (n=50) attended a public dental school. Twenty five percent (n=53) of dentists had received a post-graduate degree (master's degree or doctorate). Fifty-six percent (n=120) indicated they worked in a private practice model, 22% (n=47) in public service, whereas 20% (n=43) reported both private and public service components to their practice model. Four dentists (2%) chose "other" as their practice model.

The lesion depth at which dentists first choose to intervene surgically for a PCL differed between the low-risk and high-risk scenarios, and the correlation was positive and strong ($d = .603$, $p < .001$). Table 1 summarizes the percentages of dentists who would first perform a surgical restorative treatment for each depth of decay as presented by the set of radiographs for both patient scenarios. Lesions confined to the enamel would be surgically restored by 35% and 71% of dentists in the low- and high-risk scenarios, respectively.

We then analyzed for associations between treatment decisions and dentist and practice variables. The results are shown in table 2 for the low-risk patient. For the low-risk patient scenario, dentists who trained in a public institution ($p = .045$) or held a post-graduate degree ($p = .047$) tended to first restore at a later stage of caries depth than those who trained in a private dental school or had not received an advanced degree. The dentist's gender, years since

dental school graduation, practice model, the percentage of pediatric patients seen in the practice (using a cut-point of 40%), and whether caries risk was assessed in any way were not associated with the lesion depth at which they would intervene surgically. In addition, the likelihood of using a radiograph to help diagnose proximal caries or the frequency of recommending an individualized caries prevention regimen were also not associated with lesion depth at which surgical intervention would be done.

Table 2. Percentage of dentists who would recommend surgical restorative treatment this level of interproximal caries for a low-risk by dentist and practice characteristics.

Level of intervention	E1	E2	D1	D2/3	Significance
Gender of the dentist					
Male (83)	7%	30%	48%	15%	.269 ^a
Female (130)	3%	30%	58%	9%	
Type of dental school graduation					
Public (163)	2%	30%	56%	14%	.045 ^a
Private (50)	12%	28%	48%	12%	
Post-graduate degree					
Yes (53)	0%	23%	60%	17%	.047 ^a
No (160)	6%	33%	52%	9%	
Years since dental school graduation? (missing = 1)					
1-10 (60)	3%	33%	50%	13%	.366 ^b
11-20 (50)	4%	26%	58%	12%	
21-30 (63)	5%	24%	62%	10%	
31 or greater (39)	8%	41%	41%	10%	
Practice model type ^c					
Private practice exclusively (119)	7%	31%	52%	10%	.504 ^a
Public service exclusively (47)	0%	21%	66%	13%	
Combination of public service and private practice (43)	5%	35%	47%	14%	
Percent of patients peds (missing = 2)					
<40% (185)	5%	31%	52%	12%	.609 ^b
40% or greater (26)	3%	25%	64%	8%	
When you examine patients to determine if they have a caries lesion on a proximal (mesial or distal) surface, on a posterior tooth, on what percent of these patients do you use radiographs to help diagnose the lesion?					
0-24% (51)	2%	43%	43%	12%	.309 ^b
25-49% (32)	9%	28%	56%	6%	
50-74% (42)	5%	24%	62%	10%	
75-99% (42)	3%	19%	62%	17%	
100% (46)	7%	33%	50%	11%	
For what percent of patients do you give individualized caries preventive regimen? (missing = 2)					
0-24% (55)	4%	36%	44%	16%	.569 ^b
25-49% (31)	3%	28%	58%	11%	
50-74% (25)	8%	18%	70%	5%	
75-99% (35)	3%	32%	51%	14%	
100% (42)	7%	35%	49%	9%	
Do you assess caries risk for individual patients in any way (missing = 10)					
Yes (75)	6%	23%	59%	13%	.293
No (128)	5%	36%	50%	10%	

^aPerson's Chi-square was used for testing for a significant association between two categorical variables. ^bSomer's d was used for testing for a significant association between two ordinal variables. Note: One dentist did not respond to the low-risk scenario; consequently, 213 dentists are included in this table. ^cFour dentists endorsed "other" and were not used in the analysis for the practice model variable. Note: Some rows do not sum to 100% because of rounding error.

The results for the high-risk patients are shown in table 3. For the high-risk patient scenario, female dentists ($p = .048$), dentists who held a post-graduate degree ($p = .011$), or assessed caries risk in some way ($p = .046$) were less likely to restore at an earlier depth (enamel) than male dentists, those who had not received a post-graduate degree and did not assess caries risk. In addition, the likelihood of using a radiograph to help diagnose proximal caries was associated ($p = .014$) with a placement of a restoration in lesions located in dentin rather than in enamel. The type of school where the dentists received their degree, years since dental school graduation, practice model, the percentage of pediatric patients seen in the practice, and the likelihood of recommending an individualized caries prevention regimen were not significantly associated with lesion depth at which surgical intervention would occur.

Table 3. Percentage of dentists who would recommend surgical restorative treatment this level of interproximal caries for a high-risk by dentist and practice characteristics.

Level of intervention	E1	E2	D1	D2/3	Significance
Gender of dentist					
Male (84)	21%	55%	23%	1%	.048 ^a
Female (130)	13%	54%	30%	3%	
Type of dental school graduation					
Public (164)	14%	59%	25%	3%	.173 ^a
Private (33)	24%	42%	32%	2%	
Post-graduate degree					
Yes (53)	4%	59%	32%	6%	.011 ^a
No (161)	21%	53%	24%	1%	
Years since graduation					
1-10 (60)	13%	53%	28%	5%	.146 ^b
11-20 (51)	16%	59%	26%	0%	
21-30 (63)	11%	59%	27%	3%	
31 or greater (39)	31%	46%	23%	0%	
Practice type					
Private practice exclusively (120)	18%	54%	26%	3%	.697 ^a
Public Health exclusively (47)	17%	45%	34%	4%	
Combination of public service and private practice (43)	12%	67%	21%	0%	
Percent of patients peds (missing = 2)					
<40% (185)	17%	55%	25%	2%	.164 ^b
40% or greater (26)	11%	51%	35%	3%	
When you examine patients to determine if they have a caries lesion on a proximal (mesial or distal) surface, on a posterior tooth, on what percent of these patients do you use radiographs to help diagnose the lesion?					
0-24% (51)	29%	47%	22%	2%	.014 ^b
25-49% (32)	21%	59%	16%	3%	
50-74% (43)	5%	70%	26%	0%	
75-99% (42)	14%	38%	43%	5%	
100% (46)	11%	61%	26%	2%	
For what percent of patients do you give individualized caries preventive regimen? (missing = 2)					
0-24% (56)	18%	66%	14%	2%	.071 ^b
25-49% (36)	17%	56%	28%	0%	
50-74% (40)	10%	58%	28%	5%	
75-99% (37)	14%	54%	30%	3%	
100% (43)	23%	35%	40%	2%	
Do you assess caries risk for individual patients in any way (missing = 10)					
Yes (71)	16%	44%	38%	3%	.046
No (129)	17%	60%	20%	2%	

^aPerson's Chi-square was used for testing for a significant association between two categorical variables. ^bSomer's D was used for testing for a significant association between two ordinal variables. ^cFour dentists endorsed "other" and were not used in analysis for the practice model variable. Note: Some rows do not sum to 100% because of rounding error.

Table 4 summarizes the percentages of dentists who would delay surgical restorations at the dentine level for high and low risk patients, or intervene at the same lesion level, as represented by the set of radiographs using the risk sensitivity index (calculated as low-risk level - high-risk level of intervention). Dentists who received their degree at a

Table 4. Sensitivity to change in caries risk as calculated by low-risk intervention level minus - high-risk intervention level by dentist and practice characteristics.

Risk sensitivity Index	Delay intervention to a later stage (dentine) with high-risk patient (+1)	No change in treatment decision (0)	Delay intervention to a later stage (dentine) with low-risk patient (-1)	Significance
	(n = 6)	(n = 127)	(n = 80)	
Gender of dentist				
Male (83)	1%	35%	64%	.385 ^a
Female (130)	4%	39%	57%	
Type of dental school graduation				
Public (163)	1%	38%	61%	.040 ^a
Private (50)	8%	36%	56%	
Post-graduate degree				
Yes (53)	0%	45%	55%	.183 ^a
No (161)	4%	35%	61%	
Years since graduation (missing = 1)				
1-10 (60)	5%	40%	55%	.670 ^b
11-20 (51)	0%	34%	66%	
21-30 (63)	5%	35%	60%	
31 or greater (39)	0%	41%	59%	
Practice model type ^c				
Private practice exclusively (119)	3%	40%	56%	.882 ^a
Public Health exclusively (47)	2%	30%	68%	
Combination of public service and private practice (43)	2%	37%	61%	
Percent of patients peds (missing = 2)				
<40% (175)	3%	35%	62%	.130 ^b
40% or greater (36)	3%	50%	47%	
When you examine patients to determine if they have a caries lesion on a proximal (mesial or distal) surface, on a posterior tooth, on what percent of these patients do you use radiographs to help diagnose the lesion?				
0-24% (51)	0%	33%	67%	.017 ^b
25-49% (32)	6%	22%	72%	
50-74% (43)	5%	36%	60%	
75-99% (42)	2%	41%	57%	
100% (46)	2%	52%	46%	
For what percent of patients do you give individualized caries preventive regimen? (missing = 2)				
0-24% (56)	0%	31%	69%	.007 ^b
25-49% (36)	3%	28%	69%	
50-74% (40)	5%	43%	53%	
75-99% (37)	5%	35%	60%	
100% (43)	2%	54%	44%	
Do you assess caries risk for individual patients in any way (missing = 10)				
Yes (75)	6%	36%	59%	.219 ^a
No (128)	2%	41%	58%	

^aPerson's Chi-square was used for testing for a significant association between two categorical variables. ^bSomer's *d* was used for testing for a significant association between two ordinal variables. ^cFour dentists endorsed "other" and were not used in analysis for the practice model variable. Note: One dentist did not respond to the low-risk scenario; consequently, 213 dentists are included in this table. Dentists were classified as choosing to restore at a later level in the low-risk patient (+1), intervened at the same level (0), or intervened at an earlier level in the low-risk patient (-1). One dentist did not respond to the low-risk scenario; consequently, 213 dentists are included in this table. Some rows do not sum to 100% because of rounding error.

public dental school were more likely than graduates of a private dental school to delay a restorative intervention at dentine level for caries development in a low-risk patient compared to a high-risk patient ($p = .040$). The greater the likelihood of using a radiograph to help diagnose proximal caries, the less likely the dentist would delay a restorative intervention to dentine level in a low-risk patient compared to a high-risk patient ($p = .017$). Similarly, the greater percentage of patients who receive individualized caries preventive regimen, the less likely the dentist was to delay a restorative intervention to the dentine level in a low-risk patient compared to a high-risk patient ($p = .007$). The dentist's gender, a post-graduate degree, years since dental school graduation, practice model, and the percentage of pediatric patients seen in the practice, and whether caries risk was assessed in any way were not associated with a change in the level of restorative intervention as a function of caries sensitivity risk.

DISCUSSION

This study assessed treatment decisions for PCLs among Brazilian dentists. Lesions confined to the enamel would be restored by 35% and 71% of dentists in low-risk and high-risk scenarios. This suggests a substantial EPG given that surgical intervention of enamel lesions is not consistent with current evidence. Specific dentist/practice characteristics (dentist gender, graduate of a public dental school, postgraduate training, use of caries risk assessment) were significantly associated with the EPG, but the magnitude of these differences was not major. Instead, the main finding was a substantial EPG in treatment of PCLs for the sample overall, even when clinical scenarios presented low-risk patients.

Although there is a possibility that the participants misinterpret the severity of the lesions on the radiographic images, it is believed that their treatment decisions represent the depth of the lesion chosen to start the treatment [17].

Non-surgical treatment decision for enamel proximal lesions is crucial in a Minimal Intervention context [23]. One-third of participant dentists reported surgically restoring enamel carious lesions in a low-risk patient. When the scenario included a high-risk patient, most dentists chose surgical restorative treatment for enamel lesions. Percentage of dentists who chose surgical restorative treatment for proximal lesions limited to enamel varies worldwide from 7% to 27% [10-13,24,25]. Overall, 21% of dentists or dental therapists would surgically restore enamel lesions, almost doubling up the probability of restoring enamel lesions when patients were at high caries risk compared to low-risk populations [16].

Traebert's studies have also found high percentages of Brazilian dentists choosing to surgically restore enamel lesions. They found 54.5% [14] and 33.0% [26] of dentists working in large and small Brazilian cities, respectively, from South Region, would choose for invasive treatment of enamel lesions. Brazilian dentists reported that their practices could be influenced by learning with clinical research articles and case reports [27]. Moreover, in a group of Brazilian dentists, most did not know the current dental caries concepts but knew minimally invasive procedures. Approximately half did not use such procedures in daily practice, nor believe in their effectiveness or know about their use [28]. These findings may bring some concern about treatment decision-making and indicate an evidence-practice gap among Brazilian dentists. Considering the limited application of evidence-based dentistry due to its complexity [29], identifying and embedding emerging evidence into clinical practice requires a different kind of work [30]. Therefore, there is an urgent need to investigate dental practices and teaching across the country and implement initiatives such as dental PBRN to close the gap between evidence and practice.

Despite the scarcity of data on the reasons for choosing distinct treatment thresholds according to the patients' caries risk, the clinicians' perspective may affect treatment decision-making [16]. Dentists' beliefs regarding compliance with oral hygiene instructions in high caries risk patients may interfere in the decision to surgically treat proximal caries lesions [31]. Other factors can also influence clinical decision-making, such as dentists' beliefs on the speed of the caries

progression, their performance for adequately diagnosing the presence and extent of caries, and their importance to the cost of diagnostic errors [15]. One can speculate that dentists' beliefs on better oral health behavior and lower lesion progression rates in low-risk patients than high-risk ones would provide greater security for postponing invasive treatment in low-risk patients. However, no data can assure this speculation, and future studies can reveal how dentists assess patients' related factors during the decision-making process.

Globally, no trend towards greater use of minimally invasive restorative procedures in the treatment of caries lesions has been observed over the years [25]. Moreover, the demand to understand the current status of restorative thresholds for carious lesions and the decision-making process favoring evidence-based practice and reducing overtreatment is great [16]. Thus, efforts should be directed towards identifying needs and proposing strategies to reduce the gap and offer high-quality, safe, effective and person-centered care [30].

This study has some limitations such as a) the cross-sectional design; b) a sample composed of a self-selected group of dentists; c) dentists reported their treatment decision by answering a survey and not at the actual treatment time [17]; the premise that dentists' treatment decisions accurately reflect their dental practice. On the other hand, the questionnaire proved to be a viable tool to investigate dental practice among distinct dentists.

CONCLUSIONS

A substantial EPG in treatment of PCLs was found for the sample overall, even when clinical scenarios presented low-risk patients. Our findings indicate an EPG. There is a need to carry out studies and initiatives at the national level to address caries management, assess the evidenced-practice gap, and the barriers to close such a gap. This study adds to international evidence that an EPG exists in this clinical area and that global strategies are needed to close this substantial EPG.

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Collaborators

EPS Tagliaferro, conceptualization (equal), data curation (lead), funding acquisition (equal), methodology (equal), project administration (equal), supervision (equal), writing - original draft (lead), writing - review & editing (equal). JL Riley III, conceptualization (equal), formal analysis (equal), methodology (equal), writing - original draft (equal), writing - review & editing (equal). GH Gilbert, conceptualization (equal), methodology (equal), writing - original draft (equal), writing - review & editing (equal). SRC Silva, conceptualization (equal), writing - original draft (equal), writing - review & editing (equal). FL Rosell, conceptualization (equal), writing - original draft (equal), writing - review & editing (equal). A Valsecki Junior, conceptualization (equal), writing - original draft (equal), writing - review & editing (equal). VV Gordan, conceptualization (equal), methodology (equal), writing - original draft (equal), writing - review & editing (equal).

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