ORIGINAL ARTICLE

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Dates:

Accepted 4 December 2012

To cite this article:

Int J Dent Hygiene **11**, 2013; 216–225. DOI: 10.1111/idh.12018 Garton BJ, Ford PJ. Root caries: a survey of Queensland dentists.

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Root caries: a survey of Queensland dentists

Abstract: Background: Root caries stands to be a significant burden for Australia's ageing population. The objective of this study was to describe Queensland dental practitioners' perceptions of root caries prevalence, presentation and predisposing factors as well as diagnosis and recording practices. Methods: Using the Queensland Dental Board register, all 2 515 dentists and dental specialists practising in Queensland were invited to participate in a guestionnaire-based postal survey. Results: Of the 660 responses received, 638 were included for final analysis. Use of diagnostic measures such as surface elasticity and contour were reported frequently. A majority of respondents (77%) reported not recording root caries in a way that could be distinguished from coronal caries. Dietary analysis was the most commonly reported adjunctive aid for risk assessment. Recommendations for use of remineralizing agents were frequently reported (home use 90%; in office use 71%). Salivary impairment was reported to be an important risk factor for root caries by 93% of respondents, but only 18% reported performing salivary analysis. A large proportion of respondents (32%) considered patients with diabetes to be of low or no risk of root caries. Conclusions: While the Queensland dental practitioners who participated in this survey demonstrated an awareness of root caries and its predisposing factors, clinical risk assessment particularly for patients with diabetes should be further examined.

Key words: dental practitioners; professional practice; Queensland; root caries; survey

Introduction

Root caries stands to be a significant problem for Australia's ageing population (1, 2). Patients are remaining dentate for longer and as a result are presenting more root surfaces at risk of caries. Root caries is described as a softening of the tooth root structure, following exposure to the oral cavity due to a loss of alveolar bone height and connective tissue attachment and subsequent gingival recession (3). The lesions may display a 'ringbarking' pattern, located at the cementoenamel junction or as recurrent caries associated with existing restorations involving the root surface. This oral disease poses a complex challenge for dental practitioners, as surgical intervention must contend with moisture contamination and the lesion's close proximity to the pulp chamber. The ability to assess risk accurately and to implement appropriate preventive strategies will reduce the need for complex restorative treatments and associated dental morbidity.

It has been reported that 6.7% of the Australian population have untreated root caries (1). The condition is more prevalent in older adults

than in any other age group (1, 2). Given the increase in prevalence of chronic systemic diseases, such as diabetes, which may mediate root caries risk through reduced salivary function and enhancing susceptibility of loss of attachment (4, 5), root caries is likely to become more common.

A comparison of existing clinical studies of the prevalence of root caries provides inconsistent findings due to diverse study designs and unreliable diagnostic criteria (6–8). The root caries contribution to oral disease burden within the Australian population remains ill-defined at present. In addition, information about dental practitioners' knowledge and risk assessment strategies regarding root caries is not available in the existing literature. The aim of the current study therefore was to describe how Queensland dental practitioners perceived the issue of root caries: its occurrence, predisposing factors, diagnosis and management.

Study population and methods

Ethical approval for the study was granted by the University of Queensland, Dental Sciences Research Ethics Committee. All Queensland dental registrants, including specialists were invited to participate in this study. A total of 2 520 registrants were contacted. Three mail-out envelopes were returned as undelivered mail and were subsequently excluded from the total sample pool. Respondents who reported practising outside of Queensland were excluded, reducing the final sampling frame to 2 515.

A survey was designed to investigate Queensland dental practitioners' awareness of root caries and their self reported clinical behaviours, including recording, diagnosis and risk assessment. The survey comprised two sections. Firstly, demographic information of the participants was collected including area of practice and location within Queensland. This section was designed so that data could be compared with workforce information collected previously by the Australian Institute of Health and Welfare (9). Secondly, the survey collected information using a combination of closed- and open-ended responses regarding participants' perceptions of root caries presentation (10, 11) and its predisposing factors, as well as diagnosis and potential barriers to diagnosis (Appendix 1).

Feedback from a number of dental practitioners was used to inform the final survey design. The dentists who provided feedback for the survey were excluded from the final results. Recipients received a single mailout containing a letter of introduction, the survey and a reply paid envelope. Postage of the mailout was performed by the Dental Board of Queensland. Data were collected over a period of 16 weeks from June 2010 to September 2010.

Data analysis

For each proportion reported (practice data and root caries item responses), the 95% confidence intervals (95% CI) were determined. Non-overlapping 95% CIs for a parameter by different groups were assumed to indicate a statistically significant difference.

Results

Of the 2 515 dental practitioners who were invited to participate, 660 had returned the questionnaires to the investigators, and thus, the unadjusted response rate was 26.2%. The adjusted response rate, after excluding 22 respondents who were either not practising clinically or did not complete the survey, was 25.4% (n = 638). The characteristics of the responding dental practitioners were not significantly different to that of the Australian dental practitioner population, apart from that there were significantly less respondents whose primary area of practice was administration in the study sample

	Table 1.	Geographic and	practice characteristics	of the surve	y respondents
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	Respondents ($n = 638$)		Australian de population (<i>r</i>	ental practitioner n = 9 678)*
	n	% (95% CI)	n	% (95% CI)
Area of Queensland				
South-east Queensland corner	397	62.2 (58.5–66.0)		
Major regional	181	28.4 (24.9–31.9)		
Other	53	8.3 (6.2–10.4)		
Question not answered	7	1.1 (0.3–1.9)		
Main area of practice				
General practice	551	86.4 (83.7-89.0)	8 200	84.7 (84.0-85.4)
Registered specialist/Restricted practice	69	10.8 (8.4–13.2)	1 129	11.7 (11.0–12.3)
Administration	1	0.2 (0.0–0.5)	87	0.9 (0.7–1.1) [†]
Education	5	0.8 (0.1–1.5)	145	1.5 (1.3–1.7)
Other	3	0.5 (0.0–1.0)	118	1.2 (1.0–1.4)
Private sector	526	82.4 (79.5–85.4)	8 088	83.6 (82.8-84.3)
Public sector	103	16.1 (13.3–19.0)	1 590	16.4 (15.7–17.2)
Question not answered	9	1.4 (0.5–2.3)		

*Teunsner et al. (9).

[†]Non-overlapping confidence intervals, indicating statistical significance.

CI, confidence interval.

(Table 1) (9). Responding dental practitioners were predominantly located in the south-east corner of Queensland (the most densely populated part of the state and defined as south of Nambour, east of Gatton and including the capital city of Brisbane) (62%), and 28% of respondents were located in a major regional centre (population of 40 000 or more). Eightysix per cent of respondents were in general practice, while 11% were registered as dental specialists or restricted practice. Private sector practitioners accounted for 82% of the respondents, and 16% of survey respondents were primarily employed in the public sector. These practice characteristics did not differ significantly between the study sample and the population level data (9).

When practitioners were asked to estimate the age of patients experiencing the greatest prevalence of root caries, patients aged 55 years and over were indicated by 81% of respondents (Table 2). Thirty per cent of public sector dentists reported that the group experiencing the greatest incidence was patients aged <55 years, compared with 14% of private sector dentists, representing a significant difference between the sectors.

Surface elasticity (85%) and contour (84%) were the most common diagnostic criteria for root caries employed by dental practitioners. Other diagnostic criteria frequently cited included colour (75%), surface texture (61%) and radiographic assessment (58%). Root caries was recorded in a way that could be distinguished from coronal caries by 23% of dental practitioners. Fourteen per cent of respondents indicated they did not believe it to be necessary to record root lesions in a manner that distinguished them from coronal caries lesions. A majority (54%) of dental practitioners, however, indicated that they did not record root caries in a specific manner because their current charting system did not allow for it. These diagnostic and recording behaviours did not differ significantly between private and public sectors (Table 3).

Dietary analysis was the most frequently employed adjunctive clinical aid for risk assessment for root caries (57% of respondents reported that they used it often), while salivary analysis was used regularly by a smaller proportion (18%) of practitioners. Microbial analysis was found to be very rarely employed for root caries risk analysis with approximately 92% of dental practitioners never using it (Table 4). Recommendation for the home use of remineralizing agents for the management of root caries risk was frequently reported, with 90% of practitioners 'often' using this aid while in-office remineralizing agents were used 'often' by 71% of practitioners (Table 4).

Time and cost were the most commonly perceived barriers to the use of adjunctive risk assessment clinical aids (Table 5). Nineteen per cent of respondents indicated that salivary analysis was not useful to them in assessing risk of root caries, with a significantly higher proportion of these respondents being from the private sector (20.3% versus 10.7%). Recommendations for home and in-office remineralizing agents presented the fewest barriers with 85% and 83% of respondents indicating no barriers for the respective management strategies. A significantly greater proportion of private sector respondents, however, reported no barriers to the use of these strategies. Public sector respondents were consistently more likely to report the barrier of not having the authority to order adjunctive aids, in comparison with respondents employed in the private sector.

Most dental practitioners (93%) perceived that salivary impairment carried a high risk of root caries (Table 6). Poor oral hygiene was also cited as a high risk factor by most respondents (80%), while diabetes and existing coronal caries were the factors most frequently allocated medium risk. A large proportion (32%) of respondents considered each of diabetes and existing coronal caries to be of low or no risk of root caries (Table 6). When dental practitioners were asked to nominate the root caries risk factor they considered to be the most important, salivary impairment was the most frequent response (48%), followed by poor oral hygiene (36%) (Table 7).

Discussion

The respondents' areas of practice and employment sector characteristics were found to be very similar to the Australian dental practitioner population (9, 12). Within Queensland at the time of the survey, information on retirement status and non-clinical registrant status data was not collected by the Dental Board, and therefore, these registrants could not be

Table 2	Practitioner estimates	of nationt and aroun	experiencing great	test incidence of	root caries
Table 2.	Fractitioner estimates	or patient age group	experiencing grea	lest incluence of	root carles

	All respondents ($n = 638$)		Private s	ector (<i>n</i> = 526)	Public sector ($n = 103$)		
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	
Patient age (years)							
<55	109	17.1 (14.2–20.0)	76	14.4 (11.4–17.5)	31	30.1 (21.2–39.0)*	
0–17	8	1.3 (0.4–2.1)	4	0.8 (0.0–1.5)	4	3.9 (0.2–7.6)	
18–29	19	3.0 (1.7–4.3)	13	2.5 (1.1–3.8)	5	4.9 (0.7–9.0)	
30–54	82	12.9 (10.3–15.4)	59	11.2 (8.5–13.9)	22	21.4 (13.4–29.3)	
>55	515	80.7 (77.7–83.8)	439	83.5 (80.3–86.6)	69	67.0 (57.9–76.1)*	
Question not answered	9	1.4 (0.5–2.3)	7	1.3 (0.4–2.3)	2	1.9 (0.0–4.6)	

*Non-overlapping confidence intervals, indicating statistical significance. CI, confidence interval.

Table 3.	Dental practitioners	' reported use of	f diagnostic criteria	and clinical	recording behaviour

	All respondents ($n = 638$)		Private	Private sector ($n = 526$)		Public sector ($n = 103$)	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	
Criteria (multiple options could							
be selected by respondents)							
Colour	475	74.5 (71.1–77.8)	306	58.2 (54.0-62.4)	73	70.9 (62.1–79.6)	
Contour	538	84.3 (81.5–87.1)	448	85.2 (82.1-88.2)	81	78.6 (70.7–86.6)	
Elasticity	539	84.5 (81.7–87.3)	448	85.2 (82.1–88.2)	83	80.6 (72.9–88.2)	
Texture	388	60.8 (57.0-64.6)	313	59.5 (55.3-63.7)	68	66.0 (56.9–75.2)	
Radiographic	370	58.0 (54.2-61.8)	306	58.2 (54.0-62.4)	57	55.3 (45.7-64.9)	
Other	50	7.8 (5.8–9.9)	42	8.0 (5.7–10.3)	8	7.8 (2.6–12.9)	
Charting root caries as distinguished							
from coronal caries							
Yes	145	22.7 (19.5–26.0)	114	21.7 (18.2–25.2)	29	28.2 (19.5–36.8)	
No							
Not necessary	91	14.3 (11.5–17.0)	76	14.4 (11.4–17.5)	14	13.6 (7.0–20.2)	
Charting system won't allow	347	54.4 (50.5–58.3)	292	55.5 (51.3–59.8)	49	47.6 (37.9–57.2)	
Other	15	2.4 (1.2–3.5)	11	2.1 (0.9–3.3)	4	3.9 (0.2–7.6)	
Question not answered	6	0.9 (0.2–1.7)	6	1.1 (0.2–2.0)	0	0.0 (0.0–0.0)*	

*Non-overlapping confidence intervals, indicating statistical significance.

CI, confidence interval.

Table 4.	Dental practitioner	s' reported use of a	diunctive clinical aids for	the risk assessment and	management of root caries

	n	Often % (95% CI)	n	Seldom % (95% CI)	n	Never % (95% CI)
Dietary analysis	363	56.9 (53.1–60.7)	180	28.2 (24.7–31.7)	95	14.9 (12.1–17.7)
Salivary analysis	117	18.3 (15.3–21.3)	190	29.8 (26.2–33.3)	329	51.6 (47.7-55.4)
Microbial analysis	3	0.5 (0.0–1.0)	48	7.5 (5.5–9.6)	586	91.8 (89.7–94.0)
Home remineralizing	572	89.7 (87.3–92.0)	38	6.0 (4.1–7.8)	27	4.2 (2.7–5.8)
In-office remineralizing	451	70.7 (67.2–74.2)	135	21.2 (18.0–24.3)	51	8.0 (5.9–10.1)

CI, confidence interval.

excluded from the sample pool. These people would have been unlikely to respond, negatively impacting on the response rate. With approximately one quarter of all practitioners returning completed surveys, the response rate for this survey was reasonable given the single mail-out study design. Response rates for mailed questionnaire-based studies have been shown to be impacted by a lack of time and modest priority of postal surveys given by general practitioners (13). The self-report nature of the data collected in this study introduces the possibility of recall bias; however, this aspect of the study design is required to allow investigation of dentists' knowledge and perceptions of the issue of root caries.

Most dental practitioners perceived that they encounter root caries most often in patients aged 55 years and over. This finding is supported by current research which shows that root caries has a higher prevalence among older adults than any other age group (1, 2). The National Survey of Adult Oral Health (NSAOH) (2004–2006) (1) found that root caries prevalence increased with age, reporting that while 7.1% of patients aged 35–54 years presented with untreated root caries, this increased to 29.9% for the 55 years and over age group. The results of the current study indicated that patients aged <55 years and who attended public dental services may be at increased risk of root caries when compared to their private sector counterparts. The NSAOH (2004–2006) found that the

prevalence of untreated root caries in patients eligible for public dental care across all age groups was higher compared with patients who attended private dental practices (1). These patients tended to have fewer years of schooling, lacked dental insurance and they usually attended the clinic for a dental problem, rather than for a check-up (1). Root caries may therefore be a greater problem for the public sector and so efforts to improve root caries risk assessment and management in public dental services should be a priority.

Elasticity and surface contour were the most frequently used criteria for diagnosing root caries by the respondents of this survey. Clinical investigators are in agreement that root caries is 'soft' when gently probed with an explorer, preferably a rounded-tip periodontal probe (14). Colour was widely used as an indicator for active root lesions yet has been shown to have little correlation with caries activity status (15). Dietary analysis was found to be the most commonly employed adjunctive clinical aid. The use of dietary analysis in risk analysis for root caries is supported by the literature (16, 17). Papas *et al.* (16) found that five sugar exposures per day resulted in an 80% increase in root caries risk, while Steele *et al.* (17) showed that nine or more sugar intakes more than doubled the risk.

The practitioners in this study reported very low usage of microbial analysis for the assessment of root caries risk. Presently however, the microbial profile of root caries is not well

	n	Dietary analysis % (95% CI)	n	Salivary analysis % (95% CI)	n	Microbial analysis % (95% Cl)	n	Home remineralizing agents % (95% CI)	n	In-office remineralizing agents % (95% CI)
All respondents										
Cost	49	7.7 (5.6–9.7)	205	32.1 (28.5–35.8)	254	39.8 (36.0–43.6)	44	6.9 (4.9-8.9)	32	5.0 (3.3–6.7)
Time	216	33.9 (30.2–37.5)	296	46.4 (42.5–50.3)	281	44.0 (40.2-47.9)	11	1.7 (0.7–2.7)	36	5.6 (3.9–7.4)
Not useful for me	37	5.8 (4.0-7.6)	118	18.5 (15.5–21.5)	201	31.5 (27.9–35.1)	14	2.2 (1.1–3.3)	27	4.2 (2.7–5.8)
Not evidence based	4	0.6 (0.0-1.2)	8	1.3 (0.4–2.1)	19	3.0 (1.7–4.3)	5	0.8 (0.1–1.5)	9	1.4 (0.5–2.3)
No authority to order	18	2.8 (1.5–4.1)	97	15.2 (12.4–18.0)	132	20.7 (17.5–23.8)	8	1.3 (0.4–2.1)	13	2.0 (0.9–3.1)
Other	21	3.3 (1.9–4.7)	40	6.3 (4.4-8.2)	55	8.6 (6.4–10.8)	20	3.1 (1.8–4.5)	20	3.1 (1.8–4.5)
No barriers	362	56.7 (52.9-60.6)	151	23.7 (20.4–27.0)	82	12.9 (10.3–15.4)	540	84.6 (81.8–87.4)	528	82.8 (79.8–85.7)
Private sector										
Cost	42	8.0 (5.7–10.3)	178	33.8 (29.8–37.9)	221	42.0 (37.8–46.2)	31	5.9 (3.9–7.9)	23	4.4 (2.6-6.1)
Time	169	32.1 (28.1–36.1)	246	46.8 (42.5–51.0)	242	46.0 (41.7–50.3)	9	1.7 (0.6–2.8)	28	5.3 (3.4–7.2)
Not useful for me	30	5.7 (3.7–7.7)	107	20.3 (16.9–23.8)*	172	32.7 (28.7–36.7)	13	2.5 (1.1–3.8)	22	4.2 (2.5–5.9)
Not evidence based	4	0.8 (0.0-1.5)	8	1.5 (0.5–2.6)*	16	3.0 (1.6–4.5)	4	0.8 (0.0–1.5)	6	1.1 (0.2–2.0)
No authority to order	9	1.7 (0.6–2.8)*	69	13.1 (10.2–16.0)*	90	17.1 (13.9–20.3)*	1	0.2 (0.0–0.6)*	5	1.0 (0.1–1.8)*
Other	19	3.6 (2.0-5.2)	38	7.2 (5.0–9.4)*	51	9.7 (7.2–12.2)*	13	2.5 (1.1–3.8)	15	2.9 (1.4–4.3)
No barriers	311	59.1 (54.9–63.3)	126	24.0 (20.3–27.6)	64	12.2 (9.4–15.0)	459	87.3 (84.4–90.1)*	443	84.2 (81.1–87.3)*
Public sector										
Cost	7	6.8 (1.9–11.7)	25	24.3 (16.0–32.6)	32	31.1 (22.1–40.0)	14	13.6 (7.0–20.2)	9	8.7 (3.3–14.2)
Time	44	42.7 (33.2–52.3)	50	48.5 (38.9–58.2)	41	39.8 (30.4–49.3)	2	1.9 (0.0-4.6)	10	9.7 (4.0–15.4)
Not useful for me	7	6.8 (1.9–11.7)	11	10.7 (4.7–16.6)*	25	24.3 (16.0–32.6)	1	1.0 (0.0–2.9)	5	4.9 (0.7–9.0)
Not evidence based	0	0.0 (0.0-0.0)	0	0.0 (0.0–0.0)*	3	2.9 (0.0-6.2)	1	1.0 (0.0–2.9)	3	2.9 (0.0-6.2)
No authority to order	9	8.7 (3.3–14.2)*	26	25.2 (16.9–33.6)*	40	38.8 (29.4–48.2)*	7	6.8 (1.9–11.7)*	8	7.8 (2.6–12.9)*
Other	1	1.0 (0.0–2.9)	1	1.0 (0.0–2.9)*	3	2.9 (0.0-6.2)*	7	6.8 (1.9–11.7)	5	4.9 (0.7–9.0)
No barriers	48	46.6 (37.0–56.2)	23	22.3 (14.3–30.4)	15	14.6 (7.8–21.4)	72	69.9 (61.0–78.8)*	71	68.9 (60.0–77.9)*

Table 5. Dental practitioners' reported barriers to the use of adjunctive clinical aids for the risk assessment and management of root caries (multiple options could be selected by respondents)

*Shaded cells show non-overlapping confidence intervals, indicating statistical significance.

CI, confidence interval.

understood; and so current chairside tests may not be relevant or useful. On the other hand, respondents indicated time and cost constraints as barriers to microbial analysis, rather than that the technique was 'not supported by evidence'. This may be a reflection of the lack of clear guidelines relating to risk assessment for root caries, indicating the need for further research and recommendations to practice. Although a definitive panel of microorganisms associated with root caries has not yet been identified, a recent review indicated that Lactobacilli and *Candida* species were significantly associated with root caries incidence (18). While Candida species have been contentiously linked with the development of coronal caries, their acidogenic potential (18) may contribute to lowering pH at the susceptible root surface.

Management aids such as home and in-office remineralizing agents appear to be widely employed. Patients at high risk of root caries have been defined as having three or more root caries lesions in the last 3 years and/or severe periodontitis, including marked gingival recession (3). Recommendations for these patients have been suggested to include: water fluoridation; quarterly high-strength topical fluoride varnish treatments; high fluoride gels with home care instructions; amorphous calcium phosphate for home use; antimicrobial therapy (chlorhexidine varnish or mouth rinse); salivary testing; dietary evaluation; xylitol-containing chewing gum; and semi-annual bite-wing radiographs (vertical) (3, 10, 11, 19). The evidence however for any of these management regimes is limited due to the unreliability of current diagnostic methods (11).

Reported barriers to the use of adjunctive clinical aids for the risk assessment and management of root caries tended to be centred on cost and time constraints, followed by the aids

Table 0. Dental practitioners perception of levels of tisk of root cares relating to tisk factors

	n	High risk % (95% CI)	n	Medium risk % (95% CI)	п	Low or no risk % (95% CI)
Poor oral hygiene	508	79.6 (76.5–82.7)	115	18.0 (15.0–21.0)	15	2.4 (1.2–3.5)
Diabetes	151	23.7 (20.4–27.0)	282	44.2 (40.3–48.1)	205	32.1 (28.5–35.8)
Salivary impairment	596	93.4 (91.5–95.3)	33	5.2 (3.5–6.9)	9	1.4 (0.5–2.3)
Existing coronal caries	158	24.8 (21.4–28.1)	275	43.1 (39.3–46.9)	205	32.1 (28.5–35.8)

CI, confidence interval.

Table 7. Dental practitioners' perception of the most important risk factor for root caries

Risk factor	п	All respondents % (95% CI)
Salivary impairment	305	47.8 (43.9–51.7)
Poor oral hygiene	232	36.4 (32.6–40.1)
Existing coronal caries	2	0.3 (0.0–0.7)
Diabetes	1	0.2 (0.0–0.5)
Other	81	12.7 (10.1–15.3)
Question not answered	15	2.4 (1.2–3.5)

CI, confidence interval.

being deemed 'not useful'. It appears that the combined pressure of time and treatment priorities may constitute a barrier for some dental practitioners in adequately addressing their patients' preventive needs. Within the public sector, barriers to the use of clinical aids for risk assessment and management of root caries were mostly that practitioners did not have access to the associated products as they lacked the authority to order the items, when compared to their private sector counterparts.

Further issues were raised in response to the last survey question, 'Any additional comments', by private practitioners questioning how to charge appropriate fees for risk assessment and, whether health funds would offer a rebate. These issues in some cases were thought to be linked with patients' decision-making processes regarding payment for 'unnecessary' treatment. Patient compliance was raised as an issue by several respondents. It was stated by some practitioners that patients were disinterested in preventive care, and patients 'just want a 'quick fix' restorative approach'. Costs for the patients were often indicated as a barrier for preventive care.

Only 23% of practitioners reported charting root caries in a form which was distinguishable from coronal caries lesions. Interestingly, most practitioners indicated that they did not chart it because they could not, rather than they did not believe it was necessary. A small group of respondents who did not record root caries, elaborated further to say that while they did not record the root caries on the odontogram, a specific note was made in the written notes of the patient record. Of those respondents who indicated that they use a computerized dental record programme, all stated that the charting system would not allow them to chart caries on an odontogram. These findings suggest that perhaps a revision of charting systems is required to accommodate collection of data over time for not only the individual, but also the population.

Salivary impairment was reported to indicate a high level of risk of root caries by 94% of respondents, yet only 18% reported often performing salivary analysis. This low reported use of salivary analysis may be due to a perception that a visual analysis of saliva was not regarded as a 'salivary analysis' for the purposes of the survey. Many respondents made particular note of salivary impairment caused by factors such as smoking, polypharmacy and radiation therapy. Smoking has been found to have a relationship with the development of root caries (20–22), as has the use of xerostomic medications (6, 22). One respondent highlighted the lack of multidisciplinary communication in the care of patients, stating that many medical practitioners and specialists do not consider the oral implications prior to prescribing and/or changing a patient's medications.

Almost a third of respondents considered patients with diabetes to be of low or no risk of root caries. This finding indicates a knowledge gap regarding the bi-directional relationship of diabetes and oral disease (23-25). It has been established that patients with diabetes are at an increased risk of oral complications such as coronal caries, root caries, candidiasis, erosion, xerostomia and periodontal disease (4, 5). The presence of diabetes mellitus modifies the risk of periodontal disease, with the potential to increase its incidence and severity (4). Poorly controlled diabetes has been shown to increase the risk of developing periodontal disease threefold (26). Recent studies (27-29) have investigated the presence of increased glucose concentrations in gingival crevicular fluids of diabetic patients. Increased systemic glucose concentrations have been found to result in increased glucose concentrations in the gingival crevicular blood. This change to the local environment at the root surface of susceptible patients may increase the available fermentable substrate for cariogenic bacteria and consequently the risk of root caries.

Many survey respondents offered additional suggestions regarding predisposing factors for the development of root caries. Factors such as increased use of acidic drinks (soft drinks and 'energy' drinks) were proposed, as well as mental health problems, alcohol and illicit drug use, and methadone therapy. A broad range of predisposing factors have been identified in the literature to date for root caries and these include oral, medical, mental, behavioural and social conditions (20). Root caries is therefore a complex oral condition which is influenced by more that just oral factors (20, 22).

It is likely that responding practitioners had a greater interest in the topic than non-respondents, and consequently, these results are likely to reflect some degree of volunteer bias. The rates of salivary analysis and awareness of diabetes as a predisposing factor for root caries reported in this study therefore are likely to be an overestimation of the real situation. As such, this may indicate that appropriate risk analysis for root caries is not occurring consistently in practice.

Conclusion

The practitioners who responded to this survey reported that root caries was a condition experienced across all age groups. While practitioners reported that it occurred most frequently in older patients, many indicated that they were seeing root caries also in younger patients and this may be a result of particular lifestyle factors. While the Queensland dental practitioners who participated in this survey demonstrated an awareness of root caries and its predisposing factors, clinical risk assessment particularly for patients with diabetes should be further examined.

Root caries is a condition of increasing significance to the oral health of the Australian population and is likely to increase the burden on dental services and practitioners. It is a condition which is preventable and potentially reversible. Although targeted risk assessment and prevention of root caries can minimize its incidence, the appropriate dental workforce, resources and funding must be available to allow for patients to receive the preventive care that they require.

Clinical relevance

Root caries poses significant preventive and restorative challenges for the dental team. Ageing populations are increasingly remaining dentate, and root caries is likely to become an area of greater importance in dental practice. Given the lack of published data on this topic, the aim of the current study was to describe how dental practitioners understood and managed root caries. The results suggest that improvements are required in systems for recording root caries lesions and that there is a lack of consistency with respect to risk assessment strategies.

Future studies should explore the perceptions and behaviours of the wider dental team. The dental hygienist (or oral health therapist) can play a key role in the risk assessment and management of root caries. The dental hygienist's role is also to positively influence their patients' oral health behaviours and health beliefs regarding oral diseases including root caries.

Acknowledgements

The authors would like to acknowledge the Queensland dental practitioners who took part in this study, the Dental Board of Queensland for the mailout of the surveys, and the financial support provided by Clinical Education and Training Queensland (Oral Health), Queensland Health.

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Appendix

Survey instrument

Root caries in Queensland dental practices: a survey of dentists and dental specialists. Please mark the boxes and write responses in the spaces provided, where appropriate.

DEMOGRAPHIC

1 Please indicate the practice activity you currently perform as a dental practitioner. If you are working more than one job/location, please provide information about your two main jobs/locations. Estimate usual direct patient care hours per week as best you can.

	Mair	Location		
Area of Queensland	Area of practice	Type of practice	_	
South-east Qld corner	General practice	Private		Public
(E.g. south of Nambour & east of Gatton)	Registered specialist	Solo operator		Dental hospital
Major regional centre (E.g. Towns or cities with a population > 40,000)	Restricted practice	Multiple operators		Mainly school dental service
	Administration	Locum		Defence forces
Other 🗌	Teaching/Education	Industry		Other public 🔲
	Research			Tertiary education institution
Direct patient care hours per week	Other (please specify)			Other (please specify)
	2nd 1	ocation		
Area of Queensland	2nd I Area of practice	Ocation Type of practice		
Area of Queensland	2nd I Area of practice General practice	Ocation Type of practice Private		Public
Area of Queensland South-east Qld corner	2nd I Area of practice General practice	Type of practice Private Solo operator		Public Dental hospital
Area of Queensland South-east Qld corner (E.g. south of Nambour & east of Gotton) Major regional centre	2nd I Area of practice General practice Registered specialist Restricted practice	Type of practice Private Solo operator Multiple operators		Public Dental hospital Mainly school dental service
Area of Queensland South-east Qld corner (E.g. south of Nambour & east of Gotton) Major regional centre (E.g. Towns or cities with o population > 40,000)	2nd Area of practice General practice Called Specialist Called Registered Specialist Called Practice Called Administration Called Calle	Cocation Type of practice Private Solo operator Multiple operators Locum		Public Dental hospital Mainly school dental service Defence forces
Area of Queensland South-east Qld corner (E.g. south of Nombour & eost of Gotton) Major regional centre (E.g. Towns or cities with a population > 40,000) Other	2nd I Area of practice General practice Registered specialist Restricted practice Administration Teaching/Education	Cocation Type of practice Private Solo operator Multiple operators Locum Industry		Public Dental hospital Mainly school dental service Defence forces Other public
Area of Queensland South-east Qld corner (E.g. south of Nombour & east of Gotton) Major regional centre (E.g. Towns or cities with a population > 40,000) Other	2nd I Area of practice General practice Registered specialist Restricted practice Administration Teaching/Education Research	Cocation Type of practice Private Solo operator Multiple operators Locum Industry		Public Dental hospital Mainly school dental service Defence forces Other public Tertiary education institution
Area of Queensland South-east Qld corner (E.g. south of Nombour & east of Gotton) Major regional centre (E.g. Towns or cibes with a population > 40,000) Other Direct patient care hours per week	2nd I Area of practice General practice Registered specialist Restricted practice Administration Teaching/Education Research Other (please specify)	Location Type of practice Private Solo operator Multiple operators Locum Industry		Public Dental hospital Dental hospital Mainly school dental service Defence forces Other public Other public Tertiary education institution Other (please specify)

The above table has been adapted from the Dental Board of South Australia, Application for Renewal of Registration as a Dentist, 2000/01.

2 If you are a *registered specialist*, please indicate below your dental specialty.

3 In what year did you graduate from your undergraduate dentistry degree?

□ 2000-2009

- □ 1990–1999
- \Box 1980–1989
- □ 1979 and earlier

CLINICAL PRACTICE

4 Please estimate the number of patients you see with active root caries in your practice. Please indicate one only.

 $\hfill\square$ Less than one a month

 \Box 1–3 per month

□ 1–5 per week

 $\square >5$ per week

5 In relation to the patients you see in your practice, please indicate which one of the following age ranges experiences the greatest incidence of root caries?

□ 0–17 years

 \square 18–29 years

 $\hfill\square$ 30–54 years

 $\square \geq 55$ years

6 Root caries lesions can be identified using a variety of criteria. When examining a patient in your practice, which of the following criteria do you use to determine the presence and/or severity of an active root caries lesion? *Please mark as many options as applies*.

Colour

 \square Contour/cavitation

□ Surface elasticity

□ Surface texture

□ Radiographic imaging

□ Other, please specify: -

7 Do you record root caries lesions in a way that distinguishes them from coronal caries lesions, in your charting?

□ Yes

□ No

-If no, is this because:

 \square I do not think it is necessary

□ My charting system will not allow

□ Other, please specify: ——

8 Please indicate the frequency with which you use each of the following adjunctive clinical aids with patients whom you have identified as being at risk for root caries. *Please mark only one frequency selection for each aid*.

		Often	Seldom	Never
a.	Dietary analysis			
b.	Salivary analysis E.g. flow rate/volume, consistency, buffering capacity			
C.	Chairside Microbial Analysis E.g. for bacterial counts and/or plague testing			
d.	Recommendation for home use of remineralising agent(s)			
e.	In office application of remineralising agent(s)			
f.	Other, please specify:			

9 Where appropriate please indicate below, any factors that restrict your use of adjunctive clinical aids for root caries. *Please select as many options as applies for each aid*.

	(a) Dietary analysis	(b) Salivary analysis	(c) Chairside microbial analysis	(d) Home use of remineralising agents	(e) In office application of remineralising agents
Cost					
Time					
Not useful for me					
Not based on evidence					
I do not have the authority to order the associated products					
Other, please specify:					

Additional comments: _____

10a In a patient with exposed root surfaces, there are several risk factors for the development of root caries. Of the factors below please indicate, in your opinion, the level of risk each factor represents. *Please mark only one column selection for each factor*.

	Low risk	Medium risk	High risk	Not relevant
Poor oral hygiene				
Diabetes				
Salivary impairment				
Existing coronal caries				

10b From your experience in clinical practice, which risk factor do you feel is most commonly associated with the development of root caries?

I

Any additional comments?

Please place completed questionnaire, in enclosed postage paid envelope.

* * *

Thank you for participating in this questionnaire.

* * *

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