TITLE: Periodic Dental Examinations for Oral Health: A Review of Clinical Effectiveness, Cost Effectiveness, and Guidelines

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CONTEXT AND POLICY ISSUES

While there is no accepted universal definition, a routine dental examination generally involves the assessment of the teeth, gingiva, the bones and temporomandibular joint of the face, and mucous membranes within the mouth and throat by a dentist.[1,2] The purpose of a dental examination is multifactorial: the exam is designed to identify problems with the teeth, including decayed, damaged , or missing teeth, positioning of the teeth, and ensuring that there are no problems with previous dental work such as crowns or fillings.[2] In addition, the gingiva is evaluated for signs of periodontal disease including periodontal pockets and bleeding, and the mucous membranes in the mouth and throat are examined for signs of oral cancer.[2] Lastly, bones of the face and jaw and the biomechanics of the temporomandibular joint may be examined.[3] If problems are identified during the dental exam, the dentist can then develop an appropriate treatment plan.[2]

Dental problems can lead to significant patient morbidity and in some cases, mortality due to oral cancer.[4] While dental examinations are needed to identify and manage oral diseases and dental issues, there is debate about the ideal frequency of dental examination recalls; that is, how often a person should undergo a dental examination.[1] Given resource demands, the costs associated with dental care, and the fact that approximately 32% of Canadians do not have dental insurance, there must be a balance between the costs associated with dental care and the effectiveness of the dental examination for identification and management of dental conditions based on the progression of dental disease.[4-6]

The purpose of this Rapid Response report is to evaluate the clinical and cost effectiveness evidence for annual dental exams relative to other intervals, and to report the recommendations of clinical practice guidelines discussing the frequency of dental examinations. This report supplements a previous CADTH report evaluating the recommended frequency for dental scaling and polishing.[7]

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RESEARCH QUESTIONS

1. What is the comparative clinical evidence for dental examinations every 12 months compared with other intervals for the prevention of oral disease?

2. What is the cost-effectiveness of dental examinations every 12 months compared with other intervals for the prevention of oral disease?

3. What are the evidence-based guidelines regarding the frequency of routine dental examinations for prevention of oral disease?

KEY FINDINGS

Evidence suggests that annual or more frequent recall may result in increased tooth retention, but the ideal interval for routine dental examination is unclear. No evidence was identified examining cost-effectiveness. Younger individuals appear to benefit from annual dental exams, whereas those aged 60 years and older did not appear to benefit from annual dental exams in terms of presence of periodontal disease, but annual exams did increase the likelihood for having > 20 teeth. Those at high risk for periodontal disease may benefit from more frequent dental exams (two per year) compared to those at low risk for periodontal disease.

METHODS

Literature Search Strategy

A limited literature search was conducted on key resources including PubMed, The Cochrane Library (2014, Issue 3), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. The search was limited to English language documents published between Jan 1, 2009 and Apr 23, 2014.

Selection Criteria and Methods

One reviewer screened the titles and abstracts of the retrieved publications for relevancy, and evaluated the relevant full-text publications for the final article selection based on the criteria listed in Table 1.

Table 1: Selection Criteria

Population	Adults (age 18 to 65)
Intervention	Routine dental examination every 12 months
Comparator	Dental examinations at different intervals (e.g. 6, 18, 24 months or no examination)
Outcomes	Question 1: Oral health outcomes (e.g., caries, early detection of oral cancer, periodontal disease) Question 2: Cost effectiveness Question 3: Clinical practice guidelines recommendations
Study Designs	Question 1: Health technology assessments, meta-analyses, systematic reviews, randomized controlled trials, non-randomized

	studies Question 2: Health technology assessments, economic evaluations Question 3: Clinical practice guidelines

Exclusion Criteria

Studies were excluded if they did not meet the selection criteria, if they were duplicate publications, or were published prior to January 1, 2009.

Critical Appraisal of Individual Studies

The Downs and Black checklist was used to critically appraise the observational studies included in this report.[8] Summary scores were not calculated for the included studies, rather, a review of the strengths and limitations of each included study were described.

SUMMARY OF EVIDENCE

Quantity of Research Available

The literature search identified 483 citations, with an additional five citations identified from the grey literature. After screening of the abstracts, 22 potentially relevant studies were identified for full-text review. After full text review, a total of 3 studies were included in this review.

Three observational studies met the inclusion criteria. There were no economic analyses or clinical practice guidelines identified in the literature search.

Appendix 1 lists additional resources not included in this report, including a clinical practice guideline from 2004, and an ongoing randomized trial evaluating the relationship between varying dental exam intervals and dental outcomes (expected completion 2019).

The PRISMA flowchart provides the details of the study selection process (Appendix 2).

Summary of Study Characteristics

Details on study design, critical appraisal, and study findings are located in Appendices 3, 4, and 5, respectively.

Study Design

Among the three studies included in this review, all were observational studies.[9-11] The observational studies included a prospective cohort study,[10] a retrospective cohort study,[11] and a cross-sectional study.[9]

Country of Origin

One of the included studies was from the United States.[11] one study was from Sweden[9] and one from New Zealand.[10]

Patient Population

The patient populations varied across the studies. The study from Sweden included individuals from the Swedish National Study on Aging and Care, and participants ranged in age from 60 to 96 years old.[9] Giannobile and colleagues used the Delta Dental of Michigan dental insurance claims database (requiring >15 years of claims data for inclusion) to identify their study population, and the mean age of participants in this study was 47 years.[11] Thomson and colleagues included people from the Dunedin Multidisciplinary Health and Development Study conducted in New Zealand.[10] The Dunedin study recruited individuals at 15 years of age, and assessed them at 18 years, 26 years, and 32 years.[10]

Interventions and Comparators

For the included cohort studies, the intervention was an annual dental examination, and the comparator for the retrospective cohort was two visits per year.[10,11] The prospective cohort categorized the comparator group as non-routine attenders based on those who did not meet the criteria for routine attenders. Non-routine attenders were defined as those who did not regularly see a dentist for an exam, and did not have a dental visit in the previous 12 months.[10] In terms of the cross-sectional study, an annual dental exam was compared with two or more visits per year and less than one dental exam per year to identify the possibility of an association between dental exam frequency and dental outcomes.[9]

Clinical Outcomes

All of the studies examined health outcomes associated with varying dental recall exam intervals.[9-11] All three of the included studies evaluated tooth loss or total number of teeth.[9-11] In addition to total number of teeth, Renvert and colleagues examined alveolar bone loss, periapical lesions, and number of endodontically treated teeth.[9] Thomson and colleagues evaluated self-rated oral health, mean number of decayed, missing, or filled tooth surfaces (DMFS), and mean number of decayed surfaces (DS) in addition to missing teeth.[10]

Summary of Critical Appraisal

All three of the included studies were observational studies, and as a result, study participants were not randomized to dental exam recall interval.[9-11] Based on the lack of randomization, and the fact that two of the studies did not report whether they adjusted for potential confounding variables, such as brushing frequency or other home oral health care, in their statistical analysis,[9,11] the results of each study must be interpreted with caution due to the possibility of confounding. All studies clearly indicated their aim, objectives, and/or study hypotheses, and all of the studies clearly reported the methods for identifying the study outcomes.[9-11] None of the studies reported a sample size or power calculation, so for studies that did not detect a statistically significant difference between the intervention and control groups,[9-11] it is unclear whether the studies were not of adequate size to detect a difference, or whether a statistical difference truly does not exist between groups.

Summary of Findings

What is the comparative clinical evidence for dental examinations every 12 months compared with other intervals for the prevention of oral disease?

Giannobile and colleagues identified patients free of periodontal disease from the Delta Dental of Michigan dental insurance claims database.[11] They stratified study participants into two groups: high risk for periodontal disease, defined as the presence of at least one of three risk factors including current or recent smoking, a diagnosis of diabetes, or those with a positive interleukin-1 genotype buccal swab; those stratified into the low risk for periodontal disease did not have any of the risk factors present.[11] The study authors found that, for the outcome of tooth loss, low risk patients who had one preventive visit per year (event rate: 16.4/100 patients) did not have a significantly different event rate compared to low risk patients with two preventive visits per year (event rate: 13.8/100 patients) (P = 0.092).[11] However, for patients at high risk for periodontal disease, those who had two preventive visits per year were significantly less likely to have tooth loss (event rate: 16.9/100 patients) compared to those who had one preventive visit per year (event rate: 22.1/100 patients) (P = 0.002).[11] These results suggest that those at high risk for periodontal disease may benefit from dental exams every six months compared to every twelve months.

Renvert and colleagues examined patients from the Swedish National Study on Aging and Care – Blekinge, and the ages in this study ranged from 60 to 96 years old.[9] Study participants were divided into three groups: those who underwent an annual dental exam, those who underwent a dental exam twice yearly or more, and those who underwent a dental exam less than once yearly.[9] Among those 60 and 66 years of age, 73% of people who had an annual dental exam had > 20 teeth compared with 37% with > 20 teeth of those who went to the dentist infrequently, however, statistical testing was not reported for this outcome.[9] Among patients > 81 years old, 1.8% of patients with infrequent dental visits had > 20 teeth, while 37% of patients who had dental visits more than once yearly had > 20 teeth. The authors then completed statistical modeling to evaluate alveolar bone loss, periapical lesions, and the number of endodontically treated teeth while adjusting for age and number of missing teeth and found no statistically significant difference for these outcomes based on frequency of dental exams.[9]

Lastly, Thomson and colleagues evaluated a group of patients registered in the Dunedin at ages 18, 26, and 32 years.[10] They consistently found that, in those who were regular attenders for dental examinations (that is, those that had at least one dental exam per year), self-reported oral health was higher (P < 0.05 for all ages).[10] In addition, regular attenders were less likely to have tooth loss due to caries, had a reduced mean number of decayed surfaces, and a reduced mean number of decayed, missing, or filled tooth surfaces compared with those who did not annually have a dental exam (P < 0.05 for all comparisons and all ages).[10] The authors also noted that the difference in the measured outcomes was greater with longer exposure to attendance, with long-term routine attenders having the best oral health by age 32.[10]

Limitations

The conclusions of this report are limited by the observational nature of the studies included. In addition, none of the studies were completed in Canada, and as a result, it is unclear whether important differences exist in terms of the components of a dental examination between countries. Also, the comparisons in the included studies were limited by the dental exam interval time frames, as it would have been useful to have 18 month and 24 month comparisons in a wider variety of populations. It is clear that randomized controlled trials are needed in different populations, including those in good health and those with risk factors for periodontal disease, to identify the appropriate dental examination recall period. In addition, cost-effectiveness studies are needed to assess the economic implications of different dental examination intervals.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

Based on the studies included in this review, it appears that it may be beneficial to individualize the dental examination interval based on the patient's age and risk for periodontal disease. Evidence suggests that annual or more frequent recall may result in increased tooth retention, but the ideal interval for routine dental examination is unclear. Younger individuals appear to benefit from annual dental exams, whereas those aged 60 years and older did not appear to benefit from annual dental exams in terms of likelihood for periodontal disease, but did benefit in terms of number of teeth. Those at high risk for periodontal disease may benefit from more frequent dental exams (two per year) compared to those at low risk for periodontal disease. No cost-effectiveness evidence or evidence-based guidelines were identified.

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APPENDIX 1: Additional References Of Potential Interest

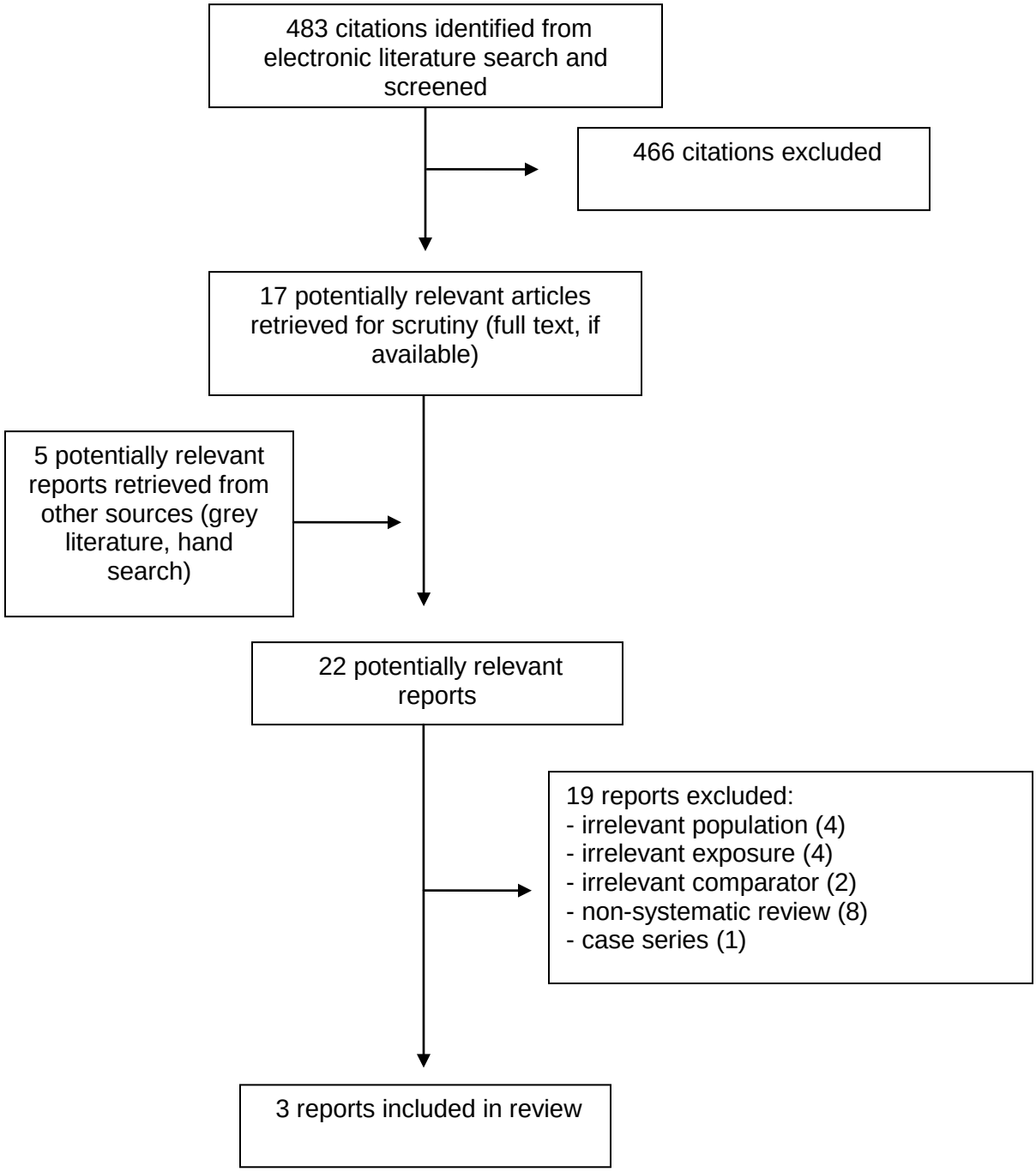
Outside of date range

Dental recall - recall interval between routine dental examinations [Internet]. London: National Institute for Health and Care Excellence; 2004 Oct. (Clinical guidelines CG19). [cited 2014 May 20]. Available from: http://www.nice.org.uk/CG19

Study in progress

Clarkson J. INTERVAL Dental Recalls Trial [Investigation of NICE Technologies for Enabling Risk-Variable-Adjusted-Length Dental Recalls Trial] - Full Trial Follow-on [Internet]. Dundee (UK): University of Dundee; 2014. [cited 2014 May 20]. Available from: http://www.nets.nihr.ac.uk/projects/hta/063599

APPENDIX 2: Selection of Included Studies



APPENDIX 3: Characteristics of Included Studies

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
Observational Studies					
Giannobile, 2013, United States[11]	Retrospective cohort study 16 years follow up	Patients were identified from the Delta Dental of Michigan dental insurance claims database Patients were classified into high risk for progressive periodontitis (had one or more factors present: present smoker or smoked in the previous 10 years, diagnosed with diabetes, or were interleukin-1 genotype-positive on a buccal swab)(n = not reported) and low risk for progressive peridontitis (none of the above risk factors) (n = not reported)	One preventive visit per year (n = 1584)	Two preventive visits per year (n = 3533)	Tooth loss, defined as ≥1 tooth extracted
Renvert, 2011,Sweden[9]	Cross-sectional study	Participants in the Swedish National Study on Aging and Care – Blekinge were randomly selected to undergo a dental exam and answer a questionnaire Aged 60 to 96 years	Dental exam once yearly (n = 480)	Dental exam ≥ twice yearly (n = 326) Dental exam < once yearly (n = 204)	Number of teeth Alveolar bone loss Periapical lesions Number of endodontically treated teeth
Thomson, 2010, New	Prospective cohort	n = 932	Routine attendance	Non-routine attendance	One or more teeth missing

First Author, Publication Year, Country	Study Design, Length of Follow-up	Patient Characteristics, Sample Size (n)	Intervention	Comparator(s)	Clinical Outcomes
Zealand[10]	study 14 years follow up (from age 18 to 32)	Included individuals from the Dunedin Multidisciplinary Health and Development Study Assessed individuals at the ages of 15 (results not reported here, based on study inclusion criteria), 18, 26, and 32 years	(those who usually visited for a check-up, and had a dental visit in the previous 12 months) (n = 549 at 18 years; n = 282 at 26 years; n = 254 at 32 years)	(those who did not meet the criteria for routine attendance) (n = 363 at 18 years; n = 622 at 26 years; n = 662 to 32 years)	due to caries Self-rated oral health Mean number of decayed, missing, or filled tooth surfaces (DMFS) Mean number of decayed surfaces (DS)

APPENDIX 4: Critical Appraisal of Included Studies

First Author, Publication Year, Country	Strengths	Limitations
Giannobile, 2013, United States[11]	• The aim of the study was clearly stated • The measurement of the primary outcome was clearly described • The overall characteristics of the participants were clearly described (although it was unclear how many were deemed high risk and low risk) • Participants were recruited from the same population	• Participants were not randomized to the interventions • The interventions were not clearly described, and in particular, whether it could have differed between those with 1 visit per year or 2 visits per year • It is unclear whether the statistical analyses adjusted for differences in confounders between groups • There was no sample size or power calculation reported
Renvert, 2011, Sweden[9]	• The objectives and hypotheses of the study were clearly stated • Participants were recruited from the same population over the same time frame • The dental examination to measure the study outcomes was clearly described, as was the questionnaire	• Participants were not randomized to the interventions • Characteristics of the study sample were not reported • While it was reported in the results that results were adjusted, this was not mentioned in the methods section. • There was no sample size or power calculation reported
Thomson, 2010, New Zealand[10]	• The aim of the study was clearly stated • Participants were recruited from the same population over the same time frame • The methods for outcome assessment were clearly reported • Losses to follow up were reported, and were minimal (96% of the original sample was included at the 32 year old exam)	• Participants were not randomized to the interventions • Characteristics of the study sample were not reported • Only adjusted for sex and socioeconomic status in statistical models • There was no sample size or power calculation reported

APPENDIX 5: Results of Included Studies

First Author, Publication Year	Main Study Findings	Authors' Conclusions
Giannobile, 2013, United States[11]	• 13.8% of those identified as low risk for periodontal disease and who had two preventive visits per year experienced tooth loss at 16 years compared with 22.1% of those who were high risk in those who had one preventive visit per year (no statistical comparison reported) • No significant difference was detected in tooth loss at 16 years follow up for low risk patients who had one preventive visit per year (event rate: 16.4/100 patients) compared to low risk patients with two preventive visits per year (event rate: 13.8/100 patients) (p = 0.092) • High risk individuals who had two preventive visits per year were significantly less likely to have tooth loss (event rate: 16.9/100 patients) compared to high risk individuals who had one preventive visit per year (event rate: 22.1/100 patients) (p = 0.002)	• "Among adult regular users of dental services with no prior diagnosis of periodontitis, or study showed that, for low risk patients, as determined by non-smoking, no history of diabetes, and absence of specified interleuken-1 genotypes, the percentage of patients with tooth loss events over 16 years associated with two preventive prophylaxis visits annually was not different from the percentage with habitually one visit annually." – page 697 • "For high risk patients, as indicated by one or more of the three risk factors, biannual preventive visits were associated with a lower event rate than one annual visit." – page 697 • "The present study may provide a proof-of-principle that resources could be targeted to selected groups for public health gain in the prevention of chronic disease." – page 700
Renvert, 2011, Sweden[9]	Number of teeth • In those 60 and 66 years of age, 73% of people who had an annual dental exam had > 20 teeth compared with 37% of those who went to the dentist infrequently (statistical testing not reported) Alveolar bone loss • After adjusting for age and number of missing teeth, frequency of dental visits was not associated with reduced alveolar bone loss (p = 0.18)	• "Ageing had an important impact on the number of remaining teeth, and the extent of alveolar bone loss (ABL). The extent of ABL did, however, not differ by the frequency of professional dental care and consistent with other studies." – page 74 • "Frequent dental visitors presented with more teeth while frequency of dental visits did not have an impact on alveolar bone levels, amount of

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	Periapical lesions • After adjusting for age and number of missing teeth, frequency of dental visits was not associated with a reduced likelihood of periapical lesions (p = 0.65) Number of endodontically treated teeth • After adjusting for age and number of missing teeth, frequency of dental visits was not associated with the number of endodontically treated teeth (p = 0.41)	deposits, gingival inflammation or periapical lesions." – page 74
Thomson, 2010, New Zealand[10]	One or more teeth missing due to caries • Age 18: 18.0% of routine attenders had one or more teeth missing due to caries compared to 31.4% of non-routine attenders (p<0.05) • Age 26: 10.6% of routine attenders had one or more teeth missing due to caries compared to 28.6% of non-routine attenders (p<0.05) • Age 32: 13.8% of routine attenders had one or more teeth missing due to caries compared to 26.3% of non-routine attenders (p<0.05) Self-rated oral health • Age 18: 57.0% of routine attenders reported better than average self-rated oral health compared to 42.5% of non-routine attenders (p<0.05) • Age 26: 67.4% of routine attenders reported better than average self-rated oral health compared to 45.4% of non-routine attenders (p<0.05) • Age 32: 73.9% of routine attenders reported better than average self-rated oral health compared to 43.6% of non-routine attenders (p<0.05)	• "We found that routine attenders have better self-reported oral health and less tooth loss and dental caries. We also observed that the differential was greater with longer exposure to attendance, with long-term routine attenders having the best oral health by age 32." – page 310 • "It is therefore appropriate for current oral health messages to strongly promote regular dental visiting." – page 311

First Author, Publication Year	Main Study Findings	Authors' Conclusions
	Mean number of decayed, missing, or filled tooth surfaces • Age 18: the mean number of decayed, missing, or filled tooth surfaces was 15.1 in routine attenders compared with 20.2 in non-routine attenders ($p<0.05$) • Age 26: the mean number of decayed, missing, or filled tooth surfaces was 14.3 in routine attenders compared with 17.5 in non-routine attenders ($p<0.05$) • Age 32: the mean number of decayed, missing, or filled tooth surfaces was 14.7 in routine attenders compared with 17.3 in non-routine attenders ($p<0.05$) Mean number of decayed surfaces • Age 18: the mean number of decayed surfaces was 1.7 in routine attenders compared with 3.2 in non-routine attenders ($p<0.05$) • Age 26: the mean number of decayed surfaces was 1.3 in routine attenders compared with 2.6 in non-routine attenders ($p<0.05$) • Age 32: the mean number of decayed surfaces was 1.2 in routine attenders compared with 2.7 in non-routine attenders ($p<0.05$)	