

IN BRIEF

- This review demonstrates a lack of consistency in the direction of effect of oral health outcome measures with different frequencies of routine dental check.
- Six-monthly routine dental checks or any other specific frequency of routine dental check for adults or children cannot be advocated on the basis of existing evidence.
- There is a need for further primary research to investigate the relative effectiveness of routine dental checks of different frequency in terms of the separate impact on caries, periodontal disease, oral cancer and patient-centred oral health outcomes.

The effectiveness of routine dental checks: a systematic review of the evidence base

C. F. Davenport,¹ K. M. Elley,² A. Fry-Smith,³ C. L. Taylor-Weetman⁴ and R. S. Taylor⁵

Aims To systematically review the effectiveness of routine dental checks of different recall frequencies in adults and children.

Methods Search methods included electronic bibliographic databases up to March 2001, relevant internet sites, citation checking and contact with experts and professional dental bodies. Inclusion criteria: (1) Study design: any; (2) Population: deciduous, mixed and permanent dentition; (3) Intervention: 'Routine dental check': '*clinical examination, advice, charting (including monitoring of periodontal status) and report*' as defined in the NHS Executive General Dental Service Statement of Dental Remuneration; (4) Comparator: no routine dental check or routine dental check(s) of different recall frequency; (5) Primary outcomes: caries, periodontal disease, quality of life, oral cancer.

Results Twenty eight studies were identified for the review. Studies were poorly reported and clinically heterogenous which restricted comparison between studies and limited generalisability to the UK situation. There was no consistency across multiple studies in the direction of effect of different dental check frequencies on measures of caries in deciduous mixed or permanent dentition, periodontal disease or oral cancer in permanent dentition. No studies were identified linking empirical measures of quality of life associated with oral health and dental check frequency.

Conclusions There is no existing high quality evidence to support or refute the practice of encouraging six-monthly dental checks in adults and children.

Oral health can be defined as a general state of well-being as a result of a healthy and functioning mucosae, gingivae and dentition. General oral health is improving in most industrial countries in both children and adults.^{1,2} In the UK, despite an increasing incidence of oral cancer in adults and static levels of periodontal

disease in children there has been a marked observed improvement in general oral health (experience of periodontal disease, caries and tooth loss in adults and caries in children) over the past three decades.³⁻⁷ However important variations in oral health exist, reflecting a complex interaction of modifying factors for the development and management of oral disease. These modifying factors include age, diet, socio-economic status, ethnicity, tobacco use, fluoride use, dental attendance and clinician performance.⁸⁻¹³

Six-monthly dental checks have been customary in the General Dental Service in the United Kingdom since the inception of the NHS. NHS regulations recognise this practice and although the NHS does not explicitly recommend a specific dental check recall frequency, current remuneration policy provides incentives for regular recall of individuals. Dental practitioners can be remunerated for performing six-monthly checks¹⁴ and registration with an NHS dentist lapses with greater than a 15-month gap between visits.¹⁵

The improvement in oral health, accompanied by a greater understanding of risk factors for disease progression, has raised the question whether dental check recall intervals should be adjusted to reflect current oral health needs more closely in order to optimise the clinical and cost-effectiveness of dental checks.^{9-11,16} Most debate has focused on whether the traditional practice of a six-monthly 'blanket' recall which currently exists in the UK should be lengthened.

Possible disadvantages of lengthening recall intervals include moving away from a preventative approach resulting in more serious sequelae of caries (bigger restorations and an increased number of extractions) and a loss of opportunity to arrest the development of periodontal disease by encouraging improved personal oral hygiene and initiating appropriate treatment.¹⁰ There may also be risks to the development of patient-professional rapport and a loss of the potential for positive behaviour change, (advice on smoking and diet) that dentist-patient encounters provide. Possible advantages of lengthening recall intervals are a reduction in costs for both patients and the NHS and a reduction in inappropriate treatment – (mainly fewer numbers of fillings) as a result of allowing the natural arrest or regression of caries lesions in enamel and less exposure of patients to unreliable diagnosis of caries.^{9,15}

Researchers have attempted to define an optimal (cost-effective) dental check recall frequency in caries based on bitewing

¹Clinical Research Fellow, ³Information Specialist, ⁵Senior Lecturer in Public Health & Epidemiology, West Midlands Health Technology Assessment Collaboration, Department of Public Health & Epidemiology, University of Birmingham; ²Consultant in Dental Public Health Rowley Regis and Tipton PCT, Kingston House, 438 High Street, West Bromwich, B70 9LD; ⁴Consultant in Dental Public Health, Heron House, 120 Grove Road, Fenton, Stoke on Trent, Staffordshire ST4 4LX

*Correspondence to: Dr Clare Davenport, Department of Public Health and Epidemiology, University of Birmingham, Edgbaston, Birmingham B15 2TT
E-mail: C.F.Davenport@bham.ac.uk

Refereed paper

Received 28.08.02; Accepted 03.03.03

doi:10.1038/sj.bdj.4810337

© British Dental Journal 2003; 195: 87-98

radiological diagnosis of caries and modelling of average disease progression,^{8,12,17} restoration therapy longevity⁸ and risk of caries.¹³

A number of reviews have considered the effectiveness of dental checks of differing frequencies^{9,10} but none of these have been conducted using systematic methods and therefore likely to be subject to bias and not to be comprehensive. Therefore it remains uncertain as to what might be the optimal recall frequency for clinical examination for multiple types of oral disease, in deciduous, mixed and permanent dentition and taking into account a range of modifying factors for disease progression.

This review aims to systematically review the evidence for the effectiveness of routine dental checks in adults and children; specifically whether effectiveness is altered by the frequency of the dental check interval.

METHODS

Search strategy

A number of electronic bibliographic databases (Cochrane Library, MEDLINE; EMBASE and the National Research Register) were searched for randomised/non-randomised controlled trials and observational studies. The search took place up to March 2001 and there were no restrictions by language. Search terms included various configurations of a range of text words eg dental visits, dental frequency, dental recall and the MESH terms preventive dentistry, dental caries, tooth diseases and oral health. Search filters (ie pre-defined groupings of text and MeSH terms) to identify trials, cohort and case control studies were included where appropriate.

Citation lists from included references were examined in order to identify additional relevant studies. In addition we contacted experts directly and via relevant internet sites. These included the Faculties of General Dental Practitioners and Dental Surgery of the Royal College of Surgeons, England, the Scottish Dental Practice Board, the Dental Practice Board for England and Wales, (Eastbourne), the Central Services Agency, (Dental Information) Northern Ireland, Stakes National Research and Development Centre for Welfare and Health, Helsinki, Finland, the Dental Health Service Research Units at Sheffield and Dundee Universities and the Cochrane Oral Health Group specialised register of controlled trials.

Study selection

Identified studies were initially screened by one reviewer (CD) who excluded articles clearly of no relevance to the review. For remaining articles the following inclusion and exclusion criteria were applied by two independent reviewers (CD and KE).

Study design: Any comparative design.

Population: Children (<18 years) and/or adults (≥18 years) representing deciduous, mixed and permanent dentitions.

Intervention: Routine dental check as defined by the NHS in its dental remuneration statement:¹⁴ 'Clinical examination, advice, charting (including monitoring of periodontal status) and report'. In practice it proved impractical to strictly apply this criteria as studies invariably provided insufficient specific detail about the intervention. Studies were therefore included if the intervention was identified either as a 'dental check' or a 'dental check' followed by treatment initiated by the check.

Comparator: No routine dental check or routine dental check(s) of different frequency.

Outcomes: Caries, tooth loss, periodontal disease, quality of life, oral cancer.

Given the change in the epidemiology of caries^{1,2,3-7} and in dental treatment practice¹⁰ (a previous greater emphasis on a restorative rather than a preventative care philosophy) in the developed world since 1980, studies were excluded if the data of data collection took place prior to this date.

Assessment and reporting of study quality

The quality of included studies was assessed by one reviewer (CD) and for a random 50% of included studies by another reviewer independently (KE) using items from specific appraisal checklists appropriate to the study design ie controlled trial, cohort (prospective and retrospective), case control, cross sectional and case series.¹⁸ Some topic specific items were added to these checklists, for example measurement of oral health status at baseline and social class as a prompt to specific confounding variables.

Judgements on the appropriateness of statistical analysis were further independently checked by a statistician (RT). Study quality was compared across studies using the categories of selection bias and confounding, external validity, performance bias, attrition bias and appropriateness of statistical analysis (Appendix 1). A conservative approach was taken and if a feature was not reported it was assumed to be absent. Where a study did not meet a quality criterion, a judgement was made as to whether this constituted a minor or major threat to the validity of the study. These judgements were based on the context of this review. For example, a study with a non randomised design allocating individuals to differing groups of dental check frequency which provided no evidence of balance in the baseline characteristics of the groups has the potential for considerable selection bias and therefore judged as a major threat to validity. On the other hand, given the nature of the outcomes being assessed in this review, a study without blinding of outcome assessment would be unlikely to be a major source of assessment bias and therefore judged to be a minor threat to validity. This process was undertaken by two reviewers (CD and RT) independently.

Data extraction

Data extraction was undertaken using a pre-designed data extraction form by one reviewer (CD) and for a random 50% of included studies by another reviewer independently (KE). Where information was missing or further clarity was needed, authors were contacted (100% of studies). Replies were received from five out of a total of 24 authors.

To ensure continuity, one reviewer (CD) was responsible for the initial screening of abstracts, selecting papers based on the review inclusion/exclusion criteria, assessing the quality of included papers and making judgements about potential threats to validity. Overall agreement between independent reviewers (CD, KE and RT) for study inclusion decisions, quality assessment and data extraction was good (at least 70%) and all disagreements were resolved by discussion without recourse to a third party.

Data synthesis

Data synthesis using meta-analysis was not deemed appropriate due to the marked heterogeneity between studies arising most importantly from apparent differences in the intervention under investigation, poor quality of reporting and the wide range of outcome measures used for each of the primary outcomes being considered by the review (Table 1).

Instead a method of vote-counting was employed – the results of each study were summarised as either *positive*: a study that reports a statistically significant (ie $P \leq 0.05$) increase in outcome with a decrease in dental check frequency; *negative*: a study that reports a statistically significant decrease in outcome with a decrease in dental check frequency; or *neutral*: a study that reports a non statistically significant difference in outcome with a decrease in dental check frequency, fails to report a statistical significance or reports a bi-directional outcome.

In order to assess the impact of study quality on the findings a sensitivity analysis exercise was undertaken. Studies with one or more major threats to validity were excluded from the

vote-counting exercise in order that the results of those studies least subject to bias and confounding could be considered alone (Table 3).

RESULTS

Number of studies

A total of 2,596 potentially relevant citations and abstracts were initially identified of which 68 were formally assessed for inclusion. Twenty four papers reporting 28 studies were finally included in the analysis of which 25 reported outcomes relating to caries, nine reported outcomes relating to periodontal disease and two reported outcomes relating to oral cancer. No studies were identified investigating the relationship between dental check frequency and empirical measures of quality of life associated with oral health. Thirty eight studies were excluded on the basis of full publications. In 17 studies, dental checks were not the subject of the study; in three studies comparison groups were not subject to dental checks of different frequencies; in five studies the dental check offered to comparison groups was different in content (apart from frequency); in seven studies no primary or secondary review outcomes were reported; in five studies the date of data collection was prior to 1980 and one study was a descriptive review. Figure 1 summarises the selection and exclusion process.

Characteristics of included studies

Table 1 outlines key characteristics of studies included in the review. Studies were generally poorly reported particularly with respect to details of the intervention under investigation.

Six of the 28 studies were undertaken in a UK setting, 18 elsewhere in Europe and one each in Canada, the USA, Australia and Hong Kong.

In only two studies^{30,31} could it be assumed that the intervention under study was comparable specifically to the dental check as it currently applies in the UK and as outlined in the NHS Executive General Dental Service Statement of Remuneration. Seventeen studies investigated the relationship between long-term dental check behaviour pattern and oral health outcomes 19,20,23(a),23(b),24,25,28,29,31,32,34,35(a),35(b),35(c),36,38,39 and 12 studies investigated the relationship between recent dental check behaviour and oral health outcomes.^{21,22,23(c),26,27,30,31,33,37,40,41,42} Only 11 studies measured the intervention objectively either by following individuals prospectively or by retrospectively checking dental health records.^{23(a),23(b), 23(c),28,30,33,34,37,40,41,42} Although outcomes were measured objectively in the majority of studies the type of outcome measure used varied considerably limiting comparison between studies. In one study³⁰ the length of follow up was less than two years – a period that was judged inadequate for the outcomes (caries) being considered.^{8,12,17}

Quality assessment

Included studies comprised three controlled trials, three prospective cohort studies, three retrospective cohort studies, 17 cross sectional studies and two retrospective case series.

Table 2 summarises the main threats to validity arising from the execution of studies and data analysis. The frequency of 'unknown' responses illustrates the extent of poor reporting in studies.

The major threat to validity identified in the studies in this review was associated with an imbalance in patient characteristics across comparison groups. In three studies^{23(a),23(b),30} there was evidence of such imbalance and therefore considerable potential

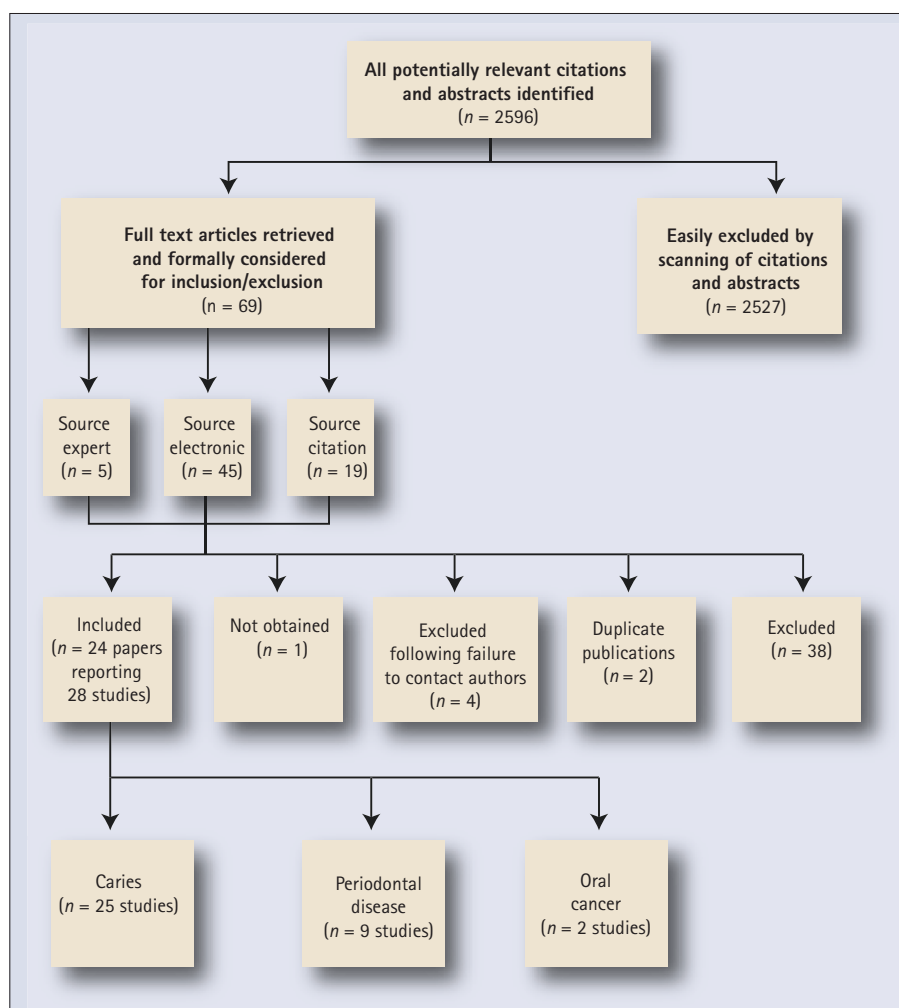


Fig 1 Summary of study inclusion and exclusion process.

for confounding. In an additional six studies^{25,32,34,38,41,42} patient characteristics were not reported in enough detail to allow assessment of similarity between comparison groups at baseline. Although multivariate statistical methods can be used to adjust for differences in characteristics, none of the nine studies reported such methods.

Two studies^{33,42} reported losses to follow up in excess of 20% which was considered to introduce attrition bias to such a level that it may be associated with a major threat to validity.

Although a number of studies failed to report outcome results using measures of variance, their methods of statistical analysis were appropriate and therefore not judged as a threat to validity. Similarly, the five studies which failed to report eligibility criteria may influence the external validity and generalisability of the study findings but do not pose a threat to internal validity.

Overall 28/28 (100%) of studies were judged to have a minor or major threat to validity arising from selection bias and confounding, 11/28 (39%) arising from problems with external validity, 24/28 (86%) arising from performance bias, 5/28 (18%) arising from attrition bias and 18/28 (64%) arising from inappropriate statistical analysis. Ten of the total 28 included studies (36%) were judged to have a major threat to validity on the basis of one criterion or more.

Outcomes

Table 3 summarises the results of the 28 included studies reporting the relationship between decreasing dental check frequency and caries, periodontal disease and oral cancer. Tests of statistical significance were not performed and could not be calculated by the review team for all or part of the reported results of nine out of a total of 28 included studies.^{23(a), 23(b), 23(c),31,33,35(a),35(b),35(c),37}

Caries

Deciduous dentition

A total of three studies in deciduous dentition investigated the relationship between dental check frequency and the outcomes 'decayed teeth' and 'decay experience' (dmft). All studies were classed as 'neutral'; in other words the studies either demonstrated no significant association between dental check frequency and the outcome under investigation, did not report tests of statistical significance or demonstrated a statistically significant bi-directional effect. No studies were identified investigating the relationship between dental check frequency and the outcomes 'filled teeth' or 'missing teeth' in deciduous dentition.

Mixed deciduous and permanent dentition

Three studies in mixed deciduous and permanent dentition investigating the relationship between decay and frequency of dental checks demonstrated conflicting results. Two studies were classified as 'neutral'. One study reported a significant increase in the number of deep cavities with a decrease in dental check frequency.

One study investigating the relationship between dental check frequency and fillings demonstrated a significant reduction in the number of fillings in individuals with dental check frequencies individualised by a dental practitioner on the basis of caries risk compared with individuals attending \geq every 12/12 under a blanket recall policy. One study reported no significant association between DMFT and frequency of dental checks. No studies were identified investigating the relationship between dental check frequency and the outcome 'missing teeth'.

Permanent dentition

Fifteen studies investigating the relationship between dental check frequency and decay demonstrated conflicting results. Eight studies demonstrated a significant increase in decay with a decrease in dental check frequency whilst seven studies were classified as

'neutral'. No studies reported a decrease in decay with a decrease in dental check frequency.

Nine studies investigating the relationship between dental check frequency and filled teeth demonstrated conflicting results. Five studies reported a significant decrease in fillings with a decrease in dental check frequency whilst four studies were classified as 'neutral'. No studies reported an increase in fillings with a decrease in dental check frequency.

Sixteen studies investigating the relationship between dental check frequency and missing teeth in permanent dentition demonstrated conflicting results. Eight studies reported a significant increase in missing teeth with a decrease in dental check frequency whilst eight studies were classified as 'neutral'. No studies reported a decrease in missing teeth with a decrease in dental check frequency.

Eleven studies investigating the relationship between dental check frequency and DMFT produced conflicting results. Two studies reported a significant increase in DMFT with a decrease in dental check frequency, two studies reported a significant decrease in DMFT with a decrease in dental check frequency and seven studies were classified as 'neutral'.

Periodontal disease

No studies were identified investigating the relationship between dental check frequency and periodontal outcomes in deciduous and mixed dentition.

Six studies investigating the relationship between dental check frequency and probing depth or presence of pockets produced conflicting results. Two studies demonstrated a significant increase in probing depth with a decrease in dental check frequency whilst four studies were classified as neutral. For the outcome measures bleeding, presence of plaque/calculus, bone score, gingivitis and periodontal health, all studies were classified as neutral.

Oral cancer

Two studies investigating the relationship between oral cancer and dental check frequency were classified as 'neutral'. One study demonstrated a significant relationship between time since last dental check and tumour size and stage at diagnosis but it remains unclear from the analysis as to whether there is a consistent (or linear) trend in outcome with decreasing dental check frequency. One study found no significant relationship between the presence or absence of a cancerous or pre-cancerous lesion at examination and time since last dental check ($\leq 12/12$ to $>12/12$).

Sensitivity analysis

It is hypothesised from empirical research⁴³ that studies of poor methodological quality would tend to overestimate the effect of an intervention ie would be more likely to result in either a significant increase or a significant decrease in outcome when comparing differing dental check frequencies. This did not appear to be the case for any of the primary outcomes being investigated in this review and therefore suggests that the results are robust to variations in the quality of included studies (Table 3).

DISCUSSION

The aim of this review was to assess the relative effectiveness of routine dental checks of different recall frequencies in adults and children.

Twenty eight studies met the inclusion criteria of this review.

A single study investigating the relationship between dental check frequency and decay in mixed dentition demonstrated an increase in decay with a decrease in dental check frequency. A further single study investigating the relationship between dental

continued on page 94.

Table 1 Key characteristics of included studies

AUTHORS Et COUNTRY	-Date of data collection -Follow up	POPULATION CHARACTERISTICS -'N' -Dentition (deciduous, mixed, permanent)	INTERVENTION UNDER STUDY		OUTCOMES REPORTED
			Frequencies compared (most frequent and least frequent)	Type	
Ambjornsen, 1986 ¹⁹ Norway	-1979-80 -Not applicable	-159 -Deciduous -Mixed -Permanent	Dental check: ≥ every 12/12 (regular) 'v' < every 12/12 (irregular)	Check and treat [†]	Mean DMFT Mean DT Mean MT Mean FT
Bjertness <i>et al</i> , 1986 ²⁰ Norway	-1984 -Not applicable	-144 -Permanent	Dental check: ≥ every 12/12 (regular) 'v' < every 12/12 (irregular)	Check and treat [†]	Mean DMFS Mean DS and DFS Mean FS
Halling and Bjorn, 1987 ²¹ Sweden	-1980 -Not applicable	-542 -Permanent	Last dental check: ≤ 12/12 ago to ≥ 24/12 ago	Check and treat [†]	Mean number of teeth. Mean bone score
Jullien <i>et al</i> , 1995 ²² UK	-Not stated -Not applicable	-2,027 -Permanent	Time since last dental check: ≤ 12/12 to > 12/12	Check* and treat [†]	Proportion of sample with a diagnosis of oral cancer/pre-cancer.
Ketomaki and Luoma, 1993 ^{23(a)} Finland	-1979-1985 -6 years	-1,215: Permanent -5,850: Deciduous	Dental check: every 6/12 to ≤ every 37/12	Check	Proportion of sample with caries lesions index increment
Ketomaki and Luoma, 1993 ^{23(b)} Finland	-1979-1985 -6 years	-2,353: Permanent -901: Deciduous	Dental check: ≥ every 12/12 to every 72/12	Check	Mean change dmft and DMFT/6 years. Mean change dmft and DMFT/yr.
Ketomaki and Luoma, 1993 ^{23(c)} Finland	-1988-1990 -2 years	-1177 -Mixed	Dental check: every 12/12 'v' Dental check frequency individualised according to caries risk; range 3-24/12.	Check	Mean change in dt and DT index /person/ 3 years.
King <i>et al</i> , 1986 ²⁴ Hong Kong	-Not stated -Not applicable	-662 -Permanent	Proportion of sample never had a dental check.	Check and treat [†]	Mean DMFT Mean DT Mean missing teeth Mean FT.
Lie and Mellingen, 1988 ²⁵ Sweden	-Not stated -Not clear	-123 -Permanent	Dental check: > every 12/12 (regular) to < every 24/12 or only in emergencies	Check and treat [†]	Mean missing teeth (not including wisdom teeth) Mean gingival sites with bleeding on probing. Mean probing depth. Mean bone score. Mean individuals with stainable plaque.

Table 1 continued overleaf

Table 1 continued Key characteristics of included studies

AUTHORS & COUNTRY	-Date of data collection -Follow up	POPULATION CHARACTERISTICS -'N' -Dentition (Deciduous, Mixed, Permanent)	INTERVENTION UNDER STUDY		OUTCOMES REPORTED
			Frequencies compared (most frequent and least frequent)	Type	
Lissau <i>et al</i> , 1990 ²⁶ Denmark	-1985 -Not applicable	-756 -Permanent	Dental check: > 2 times in last 36/12 (regular) 'v' ≤ 2 times in last 36/12 (irregular)	Check and treat [†]	Mean bleeding index. Mean pocket index. Mean calculus index.
Locker <i>et al</i> , 1989 ²⁷ Canada	-1987 -Not applicable	-247 -Permanent	≥ 1 dental check in last 12/12 'v' < 1 dental check in last 12/12	Check and treat [†]	Association between root caries (DFS and DS) and dental check frequency.
Lunder, 1994 ²⁸ Norway	-1986-1993 -6 years	-45 -Mixed	Dental check: every 12/12 'v' every 18/12	Check	Mean DMFS increment/6 years. Increment number of deep cavities /6 years.
Marques <i>et al</i> , 1994 ²⁹ Oslo, Norway & Porto, Portugal	-1984&1990 -Not applicable	- Norway: 200 Portugal: 322 - Permanent	Dental check: ≥ every 12/12 ('regular') 'v' < every 12/12 ('irregular')	Check and treat [†]	Mean DMFT Mean DS Mean missing teeth Mean FS.
Morrant <i>et al</i> , 1995 ³⁰ England	-Not stated -1 yr	-175 -Permanent	Attended for an asymptomatic dental check ≤ 12/12 ago 'v' Did not attend for an asymptomatic dental check ≤ 12/12 ago	Check*	Mean DMFT Mean DT Mean missing teeth Mean FS Mean individuals with presence of plaque.
Murray, 1996 ³¹ UK	-1988&1993 -Not applicable	-1,060: <u>Adult</u> -1,980: <u>Child</u> - Permanent	<u>Adult:</u> -Always regular dental checks to -Never had regular dental checks <u>Children:</u> Last dental check ≤ 6/12 ago to Dental check only if experiencing problems	Check*	Mean DMFT Mean DT Mean missing teeth Mean FT
Nordstrom <i>et al</i> , 1998 ³² Sweden	-1980-1990 -10 years	-180 - Permanent	Dental check: ≥ every 12/12 'v' Never/only if symptomatic	Check and treat [†]	Proportion sample with DMFT > 0. Proportion sample with DT. Total number of teeth in sample. Proportion sample With FT Proportion of sample with bleeding surfaces. Proportion of sample with attachment level > 3mm

Table 1 continued Key characteristics of included studies

AUTHORS AND COUNTRY	-Date of data collection -Follow up	POPULATION CHARACTERISTICS -'N' -Dentition (Deciduous, Mixed, Permanent)	INTERVENTION UNDER STUDY		OUTCOMES REPORTED
			Frequencies compared (most frequent and least frequent)	Type	
Nuttall, 1984 ³³ Scotland	-1978-1983 -5 years	-504 -Permanent	Dental check: ≥ every 18/12 ('frequent') 'v' At least one dental check in 5 years ('infrequent')	Check* and treat	- Average number of teeth extracted - Average number of fillings
Nuttall, 1991 ³⁴ Scotland	-1978-1988 -10 years	-702 -Permanent	≥ 11 dental checks in 10 years to 1 dental check in 10 years	Check* and treat [†]	Number of individuals becoming edentulous /10 years.
Nysson, 1992 Mini Finland ^{35(a)}	-1980 -Not applicable	-Not stated -Permanent	Dental check: ≥ every 24/12 to Dental check only if experiencing problems	Check and treat [†]	Proportion sample with any DT. Mean DT Mean number of teeth Proportion sample edentulous. Proportion of sample with pocket depth (shallow /deep). Proportion of sample with gingivitis. Proportion of sample without calculus+gingivitis+periodontitis.
Nysson, 1992 Jamsa ^{35(b)} Finland	-1990 -Not applicable	-Not stated -Permanent	Dental check: ≥ every 24/12 to Dental check only if experiencing problems	Check and treat [†]	As for: Nysson, V 1992 Mini Finland ^{35(a)} above
Nysson, 1992 (c) Varkaus ^{35(c)} Finland	-1990 -Not applicable	-Not stated -Permanent	Dental check: ≥ every 24/12 to Dental check only if experiencing problems	Check and treat [†]	As for: Nysson, V 1992 Mini Finland 35(a) above
Palmqvist <i>et al</i> , 1986 ³⁶ Sweden	-1982 and 1983 -Not applicable	-188 -Permanent	'Regular dental checks' 'v' Irregular dental checks' (includes previously regular now sporadic / emergencies only)	Check and treat	Mean proportion of DT sample. Mean number of remaining teeth in sample. Proportion of sample with pocket depth > 3 mm.
Riordan, 1995 ³⁷ Western Australia	-1980-1994 (yearly) -Not applicable	-121 406 - 240 145 -Deciduous -Permanent	Mean frequency of dental checks/ year of study: 6.6/12 to 12.8/12	Check	Mean dt. Mean DMFT
Rubright <i>et al</i> , 1996 ³⁸ USA	-1990-1994 -Not clear	-53 -Permanent	Time since last dental check: 12/12 to ≥18 years	Check and treat [†]	Proportion of sample with tumours and stage.

Table 1 continued overleaf

Table 1 continued Key characteristics of included studies

AUTHORS & COUNTRY	-Date of data collection -Follow up	POPULATION CHARACTERISTICS -'N' -Dentition (Deciduous, Mixed, Permanent)	INTERVENTION UNDER STUDY		OUTCOMES REPORTED
			Frequencies compared (most frequent and least frequent)	Type	
Sheiham <i>et al</i> , 1985 ³⁹ England	-1980 -Not applicable	-351 -Permanent	Dental check: every 6/12 to 'Never' ALSO -Regular (asymptomatic attendance) 'v' -Irregular (attends only when experiencing 'trouble')	Check* and treat †	Mean DMFT Mean DT Mean MT Mean FT
Wang <i>et al</i> , 1992 ⁴⁰ Norway	-Not stated -2 years	89: Deciduous 137: Permanent	Dental check: every 12/12 'v' every 24/12	Check	Mean dmft increment/2 years. Mean DMFS increment/ 2 years.
Wang and Holst, 1995 ⁴¹ Norway	-1991 -2 years	-Approx. 2,750 -Mixed	Dental check: ≥ every 12/12 'v' Dental check frequency individualised by dental practitioner.	Check	Mean number of new dt/DT/person/2years. Mean number of new filled surfaces (fs/FS) / person/ 2 years
Wang and Riordan, 1995 ⁴² Norway	-1989-1991 (yearly) -Not applicable	-1,256 -Permanent	Dental check: ≥ every 12/12 'v' Dental check frequency individualised by dental practitioner: (maximum interval 18/12)	Check	Mean sound surfaces. Mean DS.

Notes: Check = Dental check was a component of the intervention under investigation.
 Check* = Routine dental check as defined by the NHS dental remuneration statement
 Treat = Treatment was included as part of the intervention under investigation.
 Treat:† Unclear if treatment was part of the intervention under investigation.
 DMFT/dmft = Decayed, missing and filled teeth (decay experience).
 DMFS/dmfs = Decayed, missing and filled surfaces (decay experience).
 DT/dt = Decayed teeth.
 DS/ds = Decayed surfaces.
 DFS/dfs = Decayed and filled surfaces.
 FT/ft = Filled teeth.
 FS/fs = Filled surfaces.

check frequency and filled teeth in mixed dentition demonstrated a significant reduction in the number of fillings in individuals recalled for dental checks according to an assessment by a dental practitioner compared with individuals recalled at 12 monthly intervals. For all other caries outcomes there was no consistency in the direction of effect of outcomes across multiple studies with decreasing dental check frequency.

With the exception of studies investigating the effect of dental check frequency on probing depth or pockets, for all other periodontal outcomes the effect of changing dental check frequency was neutral.

For oral cancer outcomes two studies demonstrated that decreasing dental check frequency had a neutral effect.

On the basis of these results it can be concluded that there is no existing high quality evidence to support or refute the practice of encouraging six-monthly or any other specific frequency of dental check in adults and children. Furthermore, the included studies were poorly reported and clinically heterogenous which restricted

between study comparison and limited generalisability to the UK situation.

Potential limitations of the review

Quality of evidence

A major limitation of this review was the poor quality of evidence. There was a preponderance of studies of cross-sectional design which are particularly prone to selection bias and confounding.

The majority of data collection for studies included in the review occurred during the 1980s which will give rise to 'interference' when interpreting results due to the continuing decline in the incidence of caries since this date.

The evidence available to this review was also poorly reported. Inadequate description of patient characteristics and the intervention under study (the dental check) limits comparison between studies and may influence the synthesised results of these studies. Poor quality studies result in biases that may lead to overestimation

of an intervention's benefit.⁴³ However the fact that sensitivity analysis on study quality did not alter the pattern of results across the majority of outcomes under investigation suggests that variation in the quality of studies included in the review was not the primary reason for the general lack of consistency of outcomes observed across studies.

Definition of intervention

Eleven out of 28 studies restricted their measurement of dental check frequency to the most recent dental check attendance and only 11 studies measured the intervention objectively either by following individuals prospectively or by retrospectively checking dental health records. There is evidence of inaccuracies in individual reports of dental check attendance⁴⁴ and recent dental check attendance may not be representative of past behaviour. This raises questions about the accuracy and representativeness of the frequencies purportedly under investigation. Similarly studies reporting dental check frequencies based on a population policy of offering dental checks of a certain frequency are not measuring the attendance behaviour of individuals.⁴⁴

Comparison of the evidence reviewed with the current UK situation was limited. Only six of the studies included were conducted in the UK. There was a lack of information on access to and the content of the intervention under study and in only two stud-

ies^{30,31} could it be assumed that the intervention under study was comparable specifically to the dental check as it applies in the UK today and as outlined in the NHS Executive General Dental Service Statement of Remuneration. Differences in treatment practices occurring geographically and over time will in particular affect the outcome 'filled teeth' and outcomes associated with periodontal disease.

Synthesis of evidence

Synthesis of evidence in this review was restricted by clinical heterogeneity. Due to problems defining the intervention under study, the range of dental frequencies studied and the range of outcome measures used, the results were pooled using vote counting rather than meta-analysis. Vote counting has the limitation that it gives equal weight to studies regardless of their size and therefore potentially over- and underestimates the importance of small and large studies respectively. Pooling the results does not reflect important differences between studies whose results are being grouped such as the different frequencies being compared for each single outcome. For example in the investigation of caries in the permanent dentition, dental check frequencies across studies ranged from individuals attending for dental checks \geq every 6 months to individuals who had never had a dental check. It could be postulated that any effect of the frequency of dental checks on the outcomes

Table 2 Quality assessment of included studies (studies judged to have a major threat to validity present are shaded red)

STUDY REFERENCE AND DESIGN	CATEGORY AND CRITERIA (a, b or c) (See Appendix 1)							
	Selection bias and confounding			External validity	Performance bias	Attrition bias		Appropriate statistical analysis
	a	b	c			a	b	
Ambjornsen, 1986. ¹⁹ Cross sectional	n/a	✓	? (m)	✓	? (m)	n/a	n/a	X (m)
Bjertness et al, 1986. ²⁰ Cross sectional	n/a	X (m)	? (m)	✓	? (m)	n/a	n/a	X (m)
Halling and Bjorn, 1987. ²¹ Cross sectional	n/a	X (m)	? (m)	✓	? (m)	n/a	n/a	✓
Julien et al, 1995. ²² Cross sectional	n/a	✓	? (m)	✓	? (m)	n/a	n/a	X (m)
Ketomaki and Luoma, 1993. ^{23(a)} Retrospective cohort	n/a	X (M)	? (m)	X (m)	? (m)	? (m)	X (m)	X (m)
Ketomaki and Luoma, 1993. ^{23(b)} Retrospective cohort	n/a	X (M)	? (m)	X (m)	? (m)	✓	X (m)	X (m)
Ketomaki and Luoma, 1993. ^{23(c)} Controlled trial	X (m)	X (m)	✓	✓	? (m)	✓	X (m)	X (m)
King et al, 1986. ²⁴ Cross sectional	n/a	X (m)	? (m)	✓	? (m)	n/a	n/a	✓
Lie and Mellingen, 1988. ²⁵ Retrospective case series.	n/a	? (M)	? (m)	✓	? (m)	n/a	n/a	✓
Lissau et al, 1990. ²⁶ Cross sectional	n/a	X (m)	? (m)	✓	? (m)	n/a	n/a	✓
Locker et al, 1989. ²⁷ Cross sectional	n/a	X (m)	? (m)	✓	? (m)	n/a	n/a	X (m)
Lunder, 1994. ²⁸ Controlled trial	? (m)	X (m)	✓	X (m)	? (m)	✓	X (m)	✓
Marques et al, 1994. ²⁹ Cross sectional	n/a	X (m)	? (m)	✓	? (m)	n/a	n/a	✓
Morant et al, 1995. ³⁰ Retrospective cohort	n/a	X (M)	? (m)	X (m)	✓	✓	n/a	✓
Murray, 1996. ³¹ Cross sectional	n/a	X (m)	? (m)	✓	✓	n/a	n/a	X (m)
Nordstrom et al, 1998. ³² Cross sectional	n/a	? (M)	? (m)	X (m)	✓	n/a	n/a	X (m)
Nuttall, 1984. ³³ Prospective cohort.	n/a	✓	? (m)	X (m)	? (m)	X (M)	n/a	X (m)
Nuttall, 1991. ³⁴ Prospective cohort.	n/a	? (M)	? (m)	X (m)	✓	✓	n/a	X (m)
Nyssonon, 1992. ^{35(a)} Cross sectional	n/a	X (m)	? (m)	X (m)	? (m)	n/a	n/a	X (m)
Nyssonon, V 1992. ^{35(b)} Cross sectional	n/a	X (m)	? (m)	X (m)	? (m)	n/a	n/a	X (m)
Nyssonon, V 1992. ^{35(c)} Cross sectional	n/a	X (m)	? (m)	X (m)	? (m)	n/a	n/a	X (m)
Palmqvist et al, 1986. ³⁶ Cross sectional	n/a	✓	? (m)	✓	? (m)	n/a	n/a	X (m)
Riordan, 1995. ³⁷ Cross sectional	n/a	X (m)	? (m)	✓	? (m)	n/a	n/a	X (m)
Rubright et al, 1996. ³⁸ Retrospective case series	n/a	? (M)	? (m)	X (m)	? (m)	n/a	n/a	X (m)
Sheiham et al, 1985. ³⁹ Cross sectional	n/a	✓	? (m)	✓	? (m)	n/a	n/a	X (m)
Wang et al, 1992. ⁴⁰ Controlled trial	? (m)	X (m)	✓	✓	X (m)	✓	✓	✓
Wang and Holst, 1995. ⁴¹ Cross sectional	n/a	? (M)	? (m)	✓	X (m)	n/a	n/a	✓
Wang and Riordan, 1995. ⁴² Prospective cohort	n/a	? (M)	? (m)	✓	✓	X (M)	n/a	✓

Notes:

n/a = Not applicable; M = Major threat to validity present; m = Minor threat to validity present; ? = uncertain whether criteria met. ✓ = criteria met, X = criteria not met

Table 3 Results – vote counting and sensitivity analysis (direction of effect with decreasing dental check frequency unless otherwise stated in notes)

OUTCOME	With/without sensitivity analysis	Positive	Negative	Neutral	Total
Caries – deciduous dentition					
Decayed teeth (dt)	All studies	0	0	1	1
	Sensitivity	0	0	1	1
Filled teeth (ft)	No studies identified				
Missing teeth	No studies identified				
Decay experience (dmft/s)	All studies	0	0	2	2
	Sensitivity	0	0	1	1
Caries – mixed dentition					
Decayed teeth (dt/DT)	All studies	1	0	1 and 1*	3
	Sensitivity	1	0	1*	2
Filled teeth (ft/FT)	All studies	0	1*	0	1*
	Sensitivity	0	0	0	0
Missing teeth	No studies identified				
Decay experience (dmft/s/DMFT/S)	All studies	0	0	1	1
	Sensitivity	0	0	1	1
Caries – permanent dentition					
Decayed teeth (DT)	All studies	8	0	7	15
	Sensitivity	7	0	4	11
Filled teeth (FT)	All studies	0	5	4	9
	Sensitivity	0	5	1	6
Missing teeth	All studies	8	0	8	16
	Sensitivity	7	0	4	11
Decay experience (DMFT)	All studies	2	2	7	11
	Sensitivity	2	2	4	8
Periodontal disease – deciduous dentition					
No studies identified					
Periodontal disease – mixed dentition					
No studies identified					
Periodontal disease – permanent dentition					
Presence of bleeding	All studies	0	0	3	3
	Sensitivity	0	0	1	1
Attachment level	All studies	0	0	1	1
	Sensitivity	0	0	0	0
Probing depth/pockets	All studies	2	0	4	6
	Sensitivity	2	0	3	5
Presence of plaque/calculus	All studies	0	0	3	3
	Sensitivity	0	0	1	1
Bone score	All studies	0	0	2	2
	Sensitivity	0	0	1	1
Presence of gingivitis	All studies	0	0	3	3
	Sensitivity	0	0	3	3
Periodontal health (no plaque, gingivitis, periodontitis, calculus)	All studies	0	0	3	3
	Sensitivity	0	0	3	3
Oral cancer – deciduous dentition					
No studies identified					
Oral cancer – mixed dentition					
No studies identified					
Oral cancer – permanent dentition					
Tumour size and stage at diagnosis	All	0	0	1	1
	Sensitivity	0	0	1	1
Presence oral cancer/pre-cancer	All	0	0	1	1
	Sensitivity	0	0	1	1
Quality of life – deciduous dentition					
No studies identified					
Quality of life – mixed dentition					
No studies identified					
Quality of life – permanent dentition					
No studies identified					

Notes: Direction of comparison for outcomes is decreasing frequency of dental check (except for asterisk (*)) = direction of outcome when a blanket 12-month dental check frequency policy was compared with dental check frequencies individualised by the attending dental practitioner
 'All studies' = all studies included in vote counting; 'Sensitivity' = studies included in vote counting if no major threat to validity
 'positive' = reported statistically significant ($P \leq 0.05$) increase in outcome with a decrease in dental check frequency
 'negative' = reported statistically significant ($P \leq 0.05$) decrease in outcome with a decrease in dental check frequency
 'neutral' = no significant association between outcome and dental check frequency or no reporting of statistical significance or statistically significant bi-directional effect

measured may be restricted to specific re-call frequencies reflecting an individual's risk of oral disease. If it had been possible to take a dichotomous approach to sensitivity analysis and select studies on the basis of their similarities (eg similar dental check frequencies or those studies more applicable to the current UK situation) then a different pattern of results may have emerged. However given the range of the differences between studies (eg country of publication, study design chosen, intervention under study, population under study, outcome measures used) and the possible interaction between these characteristics, to adopt this approach would have been potentially misleading. The heterogeneity across studies further did not allow us to formally test for the presence of publication bias.

Finally, despite our attempt to restrict studies to those representing more recent trends in treatment practice there will still be unknown variation amongst practitioners which will affect outcome measures; particularly with respect to the number of filled teeth and outcomes associated with periodontal disease. For this reason results described by the synthesis must be interpreted with caution.

Implications of study for UK policy and to clinicians

There is lack of consistency in the direction of impact on outcomes in studies that have compared different frequencies of dental check.

Moreover the majority of included studies (22/28) have been undertaken outside of the current NHS setting. Only two studies investigating the relationship between dental check frequency and caries included six months as a dental check frequency and all other studies investigated less frequent dental check frequencies.

*Modernising NHS Dentistry – Implementing the NHS Plan*¹⁵ was published in September 2000. It forms the dental agenda of the modernisation programme for the NHS. It sets out the intention to redesign the NHS around patients to deliver fast, accessible care. Concerning modernisation of working patterns, the document suggests that the idea that everyone should visit the dentist every six months is one which is due for review and that by lengthening or individualising dental examination recall intervals access to NHS dentistry could be widened to a greater number of people.

This review indicates that there is no high quality evidence to either support or refute the current practice of encouraging six-monthly dental checks in children and adults.

Implications for future research

It is clear from this review that further primary research is required in order to assess the relative effectiveness of different frequencies of dental check in terms of the separate impact on caries, periodontal disease and oral cancer. Further, clinical outcome measures and methodological approaches to assessing the impact of dental interventions need to be developed. For example the use of a composite end-point such as DMFT has the potential limitation that it may fail to reflect true changes in the underlying individual variables of which it is composed. In addition the quality of design and reporting of future research should be improved with an increased emphasis on patient-centred oral health outcomes.

However the review highlights the difficulties in evaluating public health interventions such as the provision of dental checks. The use of trials and randomisation in settings such as these can be problematic. For example it is difficult to separate the effectiveness of checks from any subsequent treatment offered and variations will exist in the way that dental checks and treatments are offered and performed. Improved use of the considerable amount of data collected routinely within the NHS dental care system provides one method for further research and evaluation in dentistry.

The authors would like to thank Adrian Boulton, Deborah Hartland and Rebecca Mason for administrative support. This review was funded by the NHS R&D HTA Programme.

- Vehkalahti M, Tarkkonen L, Varsio S, et al. Decrease in and polarisation of dental caries occurrence among children and youth populations, 1976–1998. *Caries Res* 1997; **31**: 161–165.
- Marthaler T. The prevalence of dental caries in Europe 1990–1995. Symposium report. *Caries Res* 1996; **30**: 237–255.
- O'Brien M. *Children's dental health in the UK 1993*. London: OPCS Social Survey Division, HMSO; 1993.
- Kelly M, Steele J, Nuttall N, Bradnock G, Morris J, Nunn J, et al. *Adult dental health survey: oral health in the UK 1998*. London: ONS, The Stationery Office; 1998.
- Todd J E. *Children's dental health in England and Wales 1973*. London: HMSO; 1975.
- Todd J E, Dodd T. *Children's dental health in the United Kingdom 1983*. London: HMSO; 1985.
- Todd J E, Lader D. *Adult Dental Health, 1988*. United Kingdom. London: OPCS; 1991.
- Moles D R, Downer M C. Optimum bitewing examination recall intervals assessed by computer simulation. *Community Dental Health* 2000; **17**: 14–19.
- Anonymous. Routine six-monthly checks for dental disease? *Drug Ther Bull* 1985; **23**: 69–72.
- Elderton R J. Six-monthly examinations for dental caries. *Br Dent J* 1985; **158**: 370–374.
- Kay E J. How often should we go to the dentist? *Br Med J* 1999; **319**: 204–205.
- Kay E J, Brickley M, Knill-Jones R. Restoration of approximal caries lesions—application of decision analysis. *Community Dent Oral Epidemiol* 1995; **23**: 271–275.
- Scottish Intercollegiate Guidelines Network. *Prevention of dental caries in children at high caries risk: targeted prevention of dental caries in the permanent teeth of 6–16 year olds presenting for dental care*. Edinburgh: Scottish Intercollegiate Guidelines Network; 2000.
- NHS Executive General *Dental Service Statement of Dental Remuneration*. Amendment no.84. NHS Executive; 2000.
- Department of Health, England and Wales. *Modernising NHS dentistry – implementing the NHS Plan 2000*. URL: <http://www.doh.gov.uk/pdfs/dentalstrategy.pdf>
- Wang N J, Marstrand P, Holst D, Ovrum, Dahle T. Extending recall intervals—effect on resource consumption and dental health. *Community Dent Oral Epidemiol* 1992; **20**: 122–124.
- Brabner D, Downer M C, Moles D R, Naylor M N. Initial caries attack and average year old Isle of Wight children. *Community Dental Health* 1995; **12**: 190–193.
- Khan K S, Riet G, Popay J, Nixon J, Kleijnen J. Stage II: Phase 5. Study quality assessment. In: Khan K. S, Riet G, Glanville J, Sowden A J, Kleijnen J N H S, editors. *Undertaking Systematic reviews on effectiveness. CRD's guidance for those carrying out or commissioning reviews*. Centre for Reviews and Dissemination, University of York; 2001.
- Ambjørnsen E. Decayed, missing, and filled teeth among elderly people in a Norwegian municipality. *Acta Odontologica Scandinavica* 1986; **44**: 123–130.
- Bjertness E, Eriksen H M, Hansen B F. Caries prevalence of 35-year-old Oslo citizens in 1973 and 1984. *Community Dentistry Oral Epidemiol* 1986; **14**: 277–282.
- Halling A, Bjorn A L. Periodontal status in relation to education and dental attendance. A 12 year longitudinal and a cross-sectional study of a random sample of dentate middle-aged women in Gothenburg. *Swedish Dent J* 1987; **11**: 135–145.
- Jullien J A, Downer, Zakrzewska J M, Speight P M. Evaluation of a screening test for the early detection of oral cancer and pre-cancer. *Community Dent Health* 1995; **12**: 3–7.
- Ketomaki T, Luoma A R. *Dental caries and use of resources in relation to individual inspection interval in systematic oral health care*. Helsinki, Finland: Vantaa National Research and Development Centre for Welfare and Health; 1993.
- King N M, Ling J Y, Ng B V, Wei S H. The dental caries status and dental treatment patterns of 12-year-old children in Hong Kong [published erratum appears in *J Dent Res* 1987; **66**: 620]. *J Dent Res* 1986; **65**: 1371–1374.
- Lie T, Mellingen J T. Periodontal awareness, health, and treatment need in dental school patients. II. Periodontal conditions. *Acta Odontologica Scandinavica* 1988; **46**: 297–306.
- Lissau I, Holst D, Friis-Hasche E. Dental health behaviors and periodontal disease indicators in Danish youths. A 10-year epidemiological follow-up. *J Clin Periodontol* 1990; **17**: 42–47.
- Locker D, Slade G D, Leake J L. Prevalence of and factors associated with root decay in older adults in Canada. *J Dent Res* 1989; **68**: 768–772.
- Lunder N. Forlengede innkallingsintervaller. Effekter på ressursbruk og tannhelse hos et arskull barn fra 7 til 13 ar. *Norske Tannlaegeforenings Tidende* 1994; **104**: 100–102.
- Marques M D, Bjertness E, Eriksen H M. Caries prevalence of young adults in Oslo, Norway, and Porto, Portugal. A comparative analysis. *Acta Odontologica Scandinavica* 1994; **52**: 111–115.
- Morrant A M, Holloway P J, Taylor G O. A novel school dental screening programme. *Community Dent Health* 1995; **12**: 128–132.
- Murray J J. Attendance patterns and oral health. *Br Dent J* 1996; **181**: 339–342.
- Nordstrom G, Bergman B, Borg K, Nilsson H, Tillberg A, Wenslov J H. A 9-year longitudinal study of reported oral problems and dental and periodontal status in 70- and 79-year-old city cohorts in northern Sweden. *Acta Odontologica Scandinavica* 1998; **56**: 76–84.
- Nuttall N M. General Dental Service treatment received by frequent and infrequent dental attenders in Scotland. *Br Dent J* 1984; **156**: 363–366.
- Nuttall N M. The frequency of dental attendance of Scottish dentate adults between 1978 and 1988. *Br Dent J* 1991; **171**: 161–165.

35. Nyysson V. Use of oral health services and adult oral health in Finland. *Proc Finnish Dent Soc* 1992; **88**: 33-38.
36. Palmqvist S, Osterberg T, Mellstrom D. Oral health and socio-economic factors in a Swedish county population aged 65 and over. *Gerodontology* 1986; **2**: 138-142.
37. Riordan P J. Secular changes in treatment in a school dental service. *Community Dent Health* 1995; **12**: 221-225.
38. Rubright W C, Hoffman H T, Lynch C F, Kohout F J, Robinson R A, Graham S *et al*. Risk factors for advanced-stage oral cavity cancer. *Archives of Otolaryngology – Head Neck Surg* 1996; **122**: 621-626.
39. Sheiham A, Maizels J, Cushing A, Holmes J. Dental attendance and dental status. *Community Dent Oral Epidemiol* 1985; **13**: 304-309.
40. Wang N J, Marstrander P, Holst D, Ovrum , Dahle T. Extending recall intervals – effect on resource consumption and dental health. *Community Dent Oral Epidemiol* 1992; **20**: 122-124.
41. Wang N J, Holst D. Individualizing recall intervals in child dental care. *Community Dent Oral Epidemiol* 1995; **23**: 1-7.
42. Wang N J, Riordan P J. Recall intervals, dental hygienists and quality in child dental care. *Community Dent Oral Epidemiol* 1995; **23**: 8-14.
43. Schulz K F, Chalmers I, Hayes R G, Altman D G. Empirical evidence of bias. Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *J Am Med Assoc* 1995; **273**: 408-412.
44. Elderton R J. Longitudinal study of dental treatment in the general dental service in Scotland. *Br Dent J* 1983; **155**: 91-96.

Appendix 1 Categories for assessment of quality of included studies

Category	Yes (minor/major) No Unknown Not applicable to study design
1. Selection bias and confounding	
a. Was allocation to comparison groups concealed?	
b. Were the groups similar at baseline (particularly regarding oral health status)?	
b. Was statistical adjustment made to account for potential differences between groups?	
b. Were differences between groups noted?	
c. Is a different dental check frequency the only 'intervention' to explain any difference in outcome?	
2. External validity	
Were the eligibility criteria of the study stated?	
3. Performance bias	
Were assessors blinded to intervention allocation?	
4. Attrition bias	
a. Loss to follow up < 20%?	
b. Were results analysed according to intention to treat?	
5. Appropriate statistical analysis/ data presentation?	