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Child caries management: a randomized controlled trial in dental practice

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Keywords:	Caries, Caries treatment, Pediatric Dentistry, Restorative dentistry, Clinical studies/trials, Dental public health
Abstract:	This multi-centre, three-arm, parallel-group, patient-randomized controlled trial compared clinical effectiveness of three treatment strategies over three years for managing dental caries in primary teeth in UK primary dental care. Participants (3-7 years, with at least one primary molar with dentinal carious lesion) were randomized (1:1:1 via centrally-administered system using variable-length random permuted blocks) across three arms: C+P: conventional carious lesion management (complete carious tooth tissue removal; restoration placement) with prevention; B+P: biological management (sealing-in carious tooth tissue restoratively) with prevention and; PA: prevention alone (diet, plaque removal, fluorides and fissure sealants). Parents, children and dentists were not blind to allocated arm. Co-primary outcomes were: 1) the proportion of participants with at least one

	episode of dental pain and/or infection: 2) the number of episodes of dental pain and/or infection during follow-up (minimum: 23 months). 1144 participants randomized (C+P:386; B+P:381; and PA:377) by 72 general dental practitioners, of whom 1058 (C+P:352; B+P:352; PA:354) attended at least one study visit and were included in primary analysis. Median follow-up; 33.8 months (IQR 23.8, 36.7). Proportions of participants with at least one episode of dental pain and/or infection were: C+P:42%; B+P:40%; PA:45%. No evidence of a difference in incidence of dental pain and/or infection comparing B+P (adjusted Risk Difference (97.5% CI): -2% (-10%, 6%)) or PA 4% (-4%, 12%)) to C+P. Mean number of episodes of dental pain and/or infection were: C+P: 0.62 (sd 0.95); B+P: 0.58 (0.87); PA: 0.72 (0.98). Superiority could not be concluded for number of episodes comparing B+P (adjusted Incident Rate Ratio (97.5%CI): 0.95 (0.75, 1.21)) or PA (1.18 (0.94, 1.48)) to C+P. In conclusion, there was no evidence of a difference between the three treatment approaches for incidence, or number of episodes, of dental pain and/or infection experienced by these high caries-risk participants with established disease. Trial registration: ISRCTN77044005.

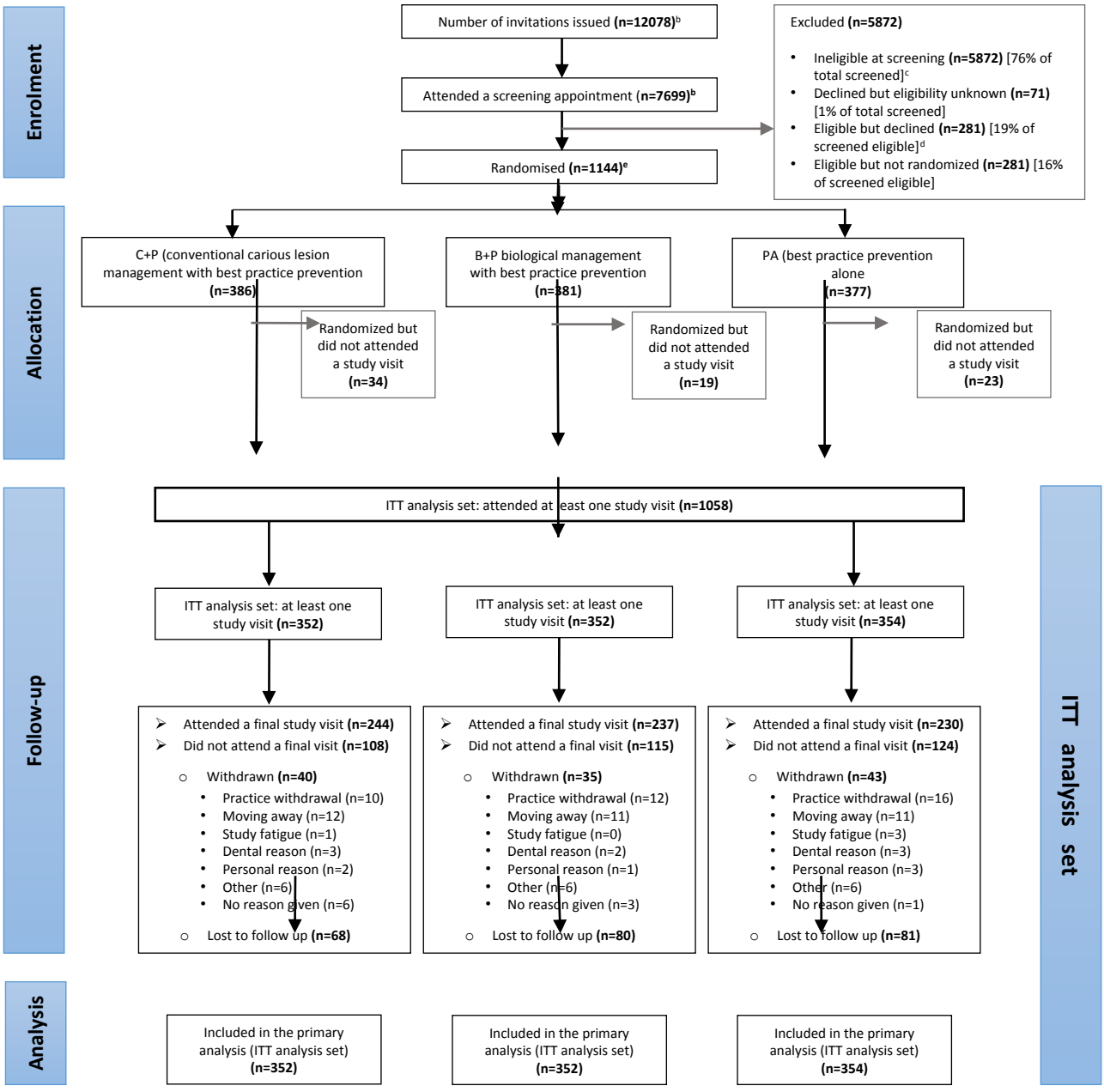
CONSORT 2010 checklist of information to include when reporting a randomised trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a randomised trial in the title	Yes p1.
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	Yes p2.
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale	Yes p3
	2b	Specific objectives or hypotheses	Yes p3.
Methods			
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	Yes p3
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons	Yes p4/5
Participants	4a	Eligibility criteria for participants	Yes p3/4
	4b	Settings and locations where the data were collected	Yes p3/4
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Yes p4.
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	Yes p4/5
	6b	Any changes to trial outcomes after the trial commenced, with reasons	Yes p4/5
Sample size	7a	How sample size was determined	Yes p5/6
	7b	When applicable, explanation of any interim analyses and stopping guidelines	None
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	Yes p6.
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Yes p6
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Yes p6.
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	Yes p6.
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those	No blinding

		assessing outcomes) and how	Yes p6.
	11b	If relevant, description of the similarity of interventions	Yes p4.
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	Yes p6/7
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses	Yes p6/7
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	Yes p7 and CONSORT diagram
	13b	For each group, losses and exclusions after randomisation, together with reasons	Yes p7 and CONSORT diagram
Recruitment	14a	Dates defining the periods of recruitment and follow-up	Yes p7.
	14b	Why the trial ended or was stopped	Yes p3
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Yes Table 1.
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	Yes Table 2.
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Yes Table 2 and 3
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended	Yes Table 3
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory	Yes Results section
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	Yes Results section
Discussion			
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	Yes discussion
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	Yes discussion
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	Yes discussion
Other information			
Registration	23	Registration number and name of trial registry	Yes p3

Protocol	24	Where the full trial protocol can be accessed, if available	Yes p3
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	Yes p11

*We strongly recommend reading this statement in conjunction with the CONSORT 2010 Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up to date references relevant to this checklist, see www.consort-statement.org.



[a] Prior to the start of the study, it was estimated that 18,717 children would be invited.
[b] Prior to the start of the study, it was estimated that 65% of children invited would attend a screening appointment; 64% attended.
[c] Prior to the start of the study, it was estimated that 85% of children screened would be ineligible; 76% were ineligible and 1% declined screening.
[d] Prior to the start of the study, it was estimated that 20% of children screened and found eligible would decline to take part in the trial; 19% of those eligible declined.
[e] Prior to the start of the study it was estimated that 12% of children screened would be randomised; 15% of those screened were randomised.

Figure 1. CONSORT flow diagram of participant journey through the trial

Child caries management: a randomized controlled trial in dental practice

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Keywords: Caries, caries treatment, paediatric dentistry, restorative dentistry, clinical studies/ trials, dental public health

Abstract

This multi-centre, three-arm, parallel-group, patient-randomized controlled trial compared clinical effectiveness of three treatment strategies over three years for managing dental caries in primary teeth in UK primary dental care. Participants (3-7 years, with at least one primary molar with dentinal carious lesion) were randomized (1:1:1 via centrally-administered system using variable-length random permuted blocks) across three arms: C+P: conventional carious lesion management (complete carious tooth tissue removal; restoration placement) with prevention; B+P: biological management (sealing-in carious tooth tissue restoratively) with prevention and; PA: prevention alone (diet, plaque removal, fluorides and fissure sealants). Parents, children and dentists were not blind to allocated arm. Co-primary outcomes were: 1) the proportion of participants with at least one episode of dental pain and/or infection: 2) the number of episodes of dental pain and/or infection during follow-up (minimum: 23 months). 1144 participants randomized (C+P:386; B+P:381; and PA:377) by 72 general dental practitioners, of whom 1058 (C+P:352; B+P:352; PA:354) attended at least one study visit and were included in primary analysis. Median follow-up; 33.8 months (IQR 23.8, 36.7). Proportions of participants with at least one episode of dental pain and/or infection were: C+P:42%; B+P:40%; PA:45%. No evidence of a difference in incidence of dental pain and/or infection comparing B+P (adjusted Risk Difference (97.5% CI): -2% (-10%, 6%)) or PA 4% (-4%, 12%)) to C+P. Mean number of episodes of dental pain and/or infection were: C+P: 0.62 (sd 0.95); B+P: 0.58 (0.87); PA: 0.72 (0.98). Superiority could not be concluded for number of episodes comparing B+P (adjusted Incident Rate Ratio (97.5%CI): 0.95 (0.75, 1.21)) or PA (1.18 (0.94, 1.48)) to C+P. In conclusion, there was no evidence of a difference between the three treatment approaches for incidence, or number of episodes, of dental pain and/or infection experienced by these high caries-risk participants with established disease. Trial registration: ISRCTN77044005.

Introduction

Dental caries, the most common childhood disease, has significant health and economic impact globally (Listl et al. 2015) and for the United Kingdom (UK) (Information Services Division 2014; Public Health Wales 2014; Royal College of Surgeons Faculty of Dental Surgery 2015; Vernazza et al. 2016).

In the UK, Dental Professionals (DPs) in primary dental care (non-specialist care in general practice or within the public health service) carry out most dental care for children. Two primary care studies questioned the success of conventional restorations in preventing pain and infection and challenged the value of operative treatment (Levine et al. 2002; Tickle et al. 2002) for primary teeth. Improved understanding of the dental biofilm in the establishment and progression of caries, and the effects of its manipulation, through modifying sugars in the diet, using topical fluoride, and sealing-in carious tooth tissue, have encouraged investigation of alternative approaches to caries management, including minimally-invasive techniques. Continuing uncertainty amongst DPs over how to most effectively manage carious lesions in primary teeth, together with growing evidence at a tooth level (Yengopal et al. 2009) for more successful minimally-invasive approaches, led the UK National Institute for Health Research to commission the FiCTION (Filling Children's Teeth: Indicated Or Not?) trial, comparing the clinical- and cost-effectiveness of three strategies for the management of dental caries in primary teeth for children aged 3-7 years, in UK primary dental care.

This paper reports clinical effectiveness of these three strategies, using the co-primary outcomes of dental pain (incidence and number of episodes) and/or infection. The secondary outcomes (cost-effectiveness from a healthcare perspective; participants' oral health related quality of life; dental anxiety; caries incidence; and preferences, acceptability and experiences of participants, parents/carers, and DPs) are summarized here and reported in full elsewhere (Maguire et al. 2019).

Methods

The trial protocol has been published (Innes et al. 2013), an updated version is available at http://www.nets.nihr.ac.uk/projects/hta/074403. The University of Dundee sponsored the trial which was registered with the ISRCTN (ISRCTN77044005). East of Scotland Research Ethics Committee provided ethical approval (REC reference: 12/ES/0047).

Trial Design and Setting

FiCTION was a pragmatic, multi-centre, three-arm, parallel group, open, patient-randomized controlled trial with 1:1:1 allocation, set in NHS primary dental care. For training and administration, practices were grouped into five clinical centers in Scotland (1), England (3) and Wales (1).

Participants

Children aged 3-7 years, with at least one primary molar tooth with a carious lesion extending into dentin, (defined according to the International Caries Detection and Assessment System (ICDAS) (Ismail et al 2007, Pitts 2004) for visual and/or radiographic diagnoses as extending into dentin and either cavitated or not) but with no associated pain or infection, were recruited by their dental practice. Children not accompanied by an adult with capacity to consent, with a medical condition requiring special dental consideration, currently involved in any other research, or moving from the area, were excluded.

Interventions

Participants were randomly allocated to one of three multi-component child-level treatment strategies. Throughout the trial these could be undertaken by any appropriately qualified DP, which might include a general dental practitioner (GDP), dental hygienist/therapist or dental nurse. DPs attended one day training in trial procedures and any clinical procedures self-identified as a training need. Although the detection of dental infection is a standard part of a dental clinical examination, given its importance as one of the primary outcomes, training specifically addressing this was included using photographs, radiographs and discussion. Training in clinical procedures was provided. Participants attended for dental care and review at intervals determined by their GDP, informed by national guidance relating to disease risk. In all three arms irreversible pulpitis, infection or pulpal exposure were treated with pulp therapy or extraction.

Best Practice Prevention Alone (PA) arm components (Public Health England 2014; Scottish Dental Clinical Effectiveness Programme 2018) were:

- Dietary investigation, analysis and intervention to reduce fermentable carbohydrate intake;
- Toothbrushing for plaque removal with a fluoridated toothpaste and, for over 7 year-olds, fluoride mouth-rinsing;
- Topical fluoride varnish (primary and permanent teeth); and
- Fissure sealants (permanent teeth).

Protocol dictated that within the PA arm there should be no rotary instrumentation to remove carious tissue, no sealing-in caries, and no restoration placement.

Conventional with Best Practice Prevention (C+P) arm protocol dictated local anaesthesia (LA) administration, complete mechanical removal of carious tooth tissue and placement of a restoration.

Biological with Best Practice Prevention (B+P) arm protocol dictated sealing-in carious tooth tissue with an adhesive restorative material or a preformed metal crown using the Hall Technique. Superficial carious tooth tissue could be removed to ensure the seal was complete but LA was not routinely required as protocol dictated that no affected dentin should be removed.

Co-primary outcomes

The original primary outcome – the proportion of participants with at least one episode of dental pain and/or infection (incidence) over the study period – was modified in May 2017 to include a co-primary outcome: the total number of episodes of dental pain and/or infection for each participant. Episodes were defined on a tooth-by-tooth basis; where there were two (or more) teeth with dental pain and/or infection at the same visit, this was recorded as one episode at that visit for that participant. If a participant had dental pain and/or infection on the same tooth at consecutive visits, this was considered a single episode, regardless of the time between visits. Full details of the definition of an episode of dental pain and/or infection are provided in Appendix 1.

Pain due to caries

Assessments for dental pain were carried out by the participant's dentists at each visit and recorded on a case report form (CRF). To differentiate between pain originating from caries rather than other causes (e.g. erupting or exfoliating teeth, mouth ulcers), the dentist formed a judgement based on patient/parent history and clinical evidence.

Dental infection

Clinical visual examination for dental infection, swelling, dental abscess or draining sinus, was specifically undertaken at every visit, and recorded on the CRF. Clinical examination was expected to be supplemented with radiographs (in line with FGDP guidelines (Pendlebury et al. 2004)) for signs of inter-radicular pathology. At the outset it was decided that if fewer than 80% of participants had radiographs within one year of entry to the trial, radiographs would not be used by the research team to supplement

clinical reports. We considered that if we found fewer than 80% of the children to have radiographs on entry to the trial (or within one year of entry) this would be too low (and not representative enough of the children across the trial) to be able to use the radiograph data to supplement the clinical data and we would rely on assessment of the clinical data alone for the outcome measure. Data were analysed using Stata V14 StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX, USA.

Secondary outcomes

The methods for assessing secondary outcomes are reported in full in Maguire et al. (2019). Cost-effectiveness from a healthcare perspective was assessed as incremental cost per incidence and incremental cost per episode of dental pain and/or infection avoided. Information on costs was collected via CRFs completed at every visit and costed using time/materials-based costing, which costs the quantity of each resource used to provide treatment (Drummond et al 2005). Participants' oral health related quality of life (COHRQOL) was measured at baseline and final visit using the 16 item Parental and Caregivers Perception Questionnaire (P-CPQ-16) (Thomson et al. 2013; Thomson et al. 2014). Dental anxiety was assessed at all visits using the Modified Child Dental Anxiety Scale (Howard and Freeman 2007) and additional single items assessing child and parent-reported anticipatory and treatment-related anxiety. Caries incidence was measured using the ICDAS at baseline and final visits. Qualitative methods evaluated preferences, acceptability and experiences of participants, parents/carers, and DPs.

Sample Size

Based on evidence from studies on similar populations with no restorations (Levine et al. 2002), conventional restorations (Tickle et al. 2002) and the Hall Technique (Innes et al. 2007), infection rates of 20%, 10% and 3% were expected in the PA, C+P and B+P arms respectively. The original target sample size to detect the hypothesized effect sizes (incidence of infection of 20% vs 10% for PA vs C+P; 3% vs 10% for B+P vs C+P respectively) was 1460 children (90% power, 2.5% significance level to adjust for 2 comparisons, 2-sided tests), allowing for 25% loss to follow-up and including an inflation factor of 1.09 to allow for potential clustering of the treatment effect at practice level. The trial was extended by 12 months due to a lower than anticipated recruitment rate. Under the revised time frames for recruitment and follow-up, it was projected that 1113 children would be randomized and followed up for an average of 35.5 months (minimum 23 months). Assuming a linear incidence of dental pain and/or infection over the modified follow-up period, the revised sample size of 1113 resulted in 82% power to detect the hypothesized effect sizes, allowing for 25% loss to follow-up.

Randomization and Blinding

The unit of randomization was the child, with allocation to the three treatment strategies in a 1:1:1 ratio, using variable-length random permuted blocks, and stratified by practice. Randomization was via a secure web-based system administered centrally by Newcastle Clinical Trials Unit. Parents, participants and dentists were not blind to the allocated mode of caries management.

Statistical Methods

Analyses were completed blind and performed according to a pre-defined statistical analysis plan (Maguire et al. 2019) and on the basis of a modified intention-to-treat (mITT), defined as all randomized participants with at least one CRF. The original power calculation was based on a comparison of incidences and as such was the only powered analysis; an exploratory hypothesis test for the unpowered comparison of the mean number of episodes is therefore reported. Models were adjusted for age at randomization (years) and time in the trial (years). Differences between practices were included as a random effect. As the study was powered on a significance level of 2.5% we report 97.5% confidence intervals (CI). The primary analyses of the co-primary outcomes were:

- Logistic regression for incidence of dental pain and/or infection. The comparisons between treatment arms (PA vs C+P and B+P vs C+P) were expressed as adjusted Risk Differences (aRD).
- Negative binomial regression for the number of episodes of dental pain and/or dental infection with the comparisons between treatment arms expressed as adjusted Incidence Rate Ratios (aIRR).

Sensitivity analysis included only participants with at least 23 months' follow-up. A per-protocol (PP) analysis was conducted, excluding participants who were deemed likely to have had dental pain and/or infection at consent and/or who were defined as having a 'major' deviation (i.e. a major cross-arm tooth-level treatment undertaken outside of the allocated arm's treatment protocol) at more than 20% of their visits. Exploratory multivariable regression analysis investigated the relationship between incidence and age, ethnicity, practice-level tap water fluoride concentration, practice-level Index of Multiple Deprivation and number of carious teeth at baseline. Time to first episode of dental pain and/or infection was included as a secondary analysis of the primary outcome measure using Kaplan-Meier survival curves to estimate event rates and a Cox proportional hazards model was fitted to estimate treatment effects, expressed as adjusted Hazard Ratios (aHR).

Results

Practice recruitment and characteristics

Of the 93 practices receiving a site initiation visit, 21 did not randomize any participants, leaving 72 practices across the five clinical centres randomizing at least one participant. Ten practices subsequently withdrew but data collected until the practices' withdrawal date were included in the analysis. Practice characteristics for size (number of registered patients), deprivation index (quintiles) and tap-water fluoridation status (ppm F) are shown in Appendix 2.

Participant flow

Of 7699 children screened at review appointments, 6555 (85%) were ineligible, primarily due to not having dentin caries in a primary molar. Between October 2012 and June 2015, 1144 participants were randomized: C+P:386; B+P:381; and PA:377. Of these 1144 randomized participants, 86 (8%) did not attend any study visits. The remaining 1058 participants (C+P:352; B+P:352; PA:354) from 68 practices comprised the mITT analysis set (Figure 1).

Baseline characteristics

There was balance between arms at baseline for demographic and clinical characteristics (Table 1).

Treatment provision and adherence to protocol

There were 7713 study visits. At least one component of prevention was delivered, primarily by GDPs, at 81% of all visits, with rates of delivery higher in PA (85%) but similar (at 79% each) in C+P and B+P. Operative care occurred at 34% of all visits (C+P 42%, B+P 42%, and PA 19%) and was also primarily undertaken by dentists (91% of all operative visits) (Appendix 3).

Less than half the participants (511/1058 (48%)) had a radiograph taken at any stage of the trial.

A major, cross-arm, deviation was recorded at 6% of the 7713 visits involving 263 participants of whom 46%, 39% and 15% were from C+P, PA, and B+P respectively. The main reasons given for cross-arm deviations were DP's clinical judgements (29%) and parent factors (28%) (Appendices 4 and 5). Most participants (89%) could be included in the PP analysis.

Co-primary outcomes

The co-primary outcome of incidence of dental pain and/or infection over a median (IQR) follow-up period of 33.8 (23.8, 36.7) months was 42% (148/352) in C+P, 40% (141/352) in B+P, and 45% (161/354) in PA (Table 2) with no evidence of a difference when comparing B+P (aRD (97.5% CI): -2% (-10%, 6%)) or PA (4% (-4%, 12%)) to C+P (Table 3). For the co-primary outcome of number of episodes of dental pain and/or infection, most participants, (910/1058 (86%)), had zero or one episode over the follow-up period (Table 2); the average number of episodes was 0.62 (sd 0.95), 0.58 (sd 0.87), and 0.72 (sd 0.98), in the C+P, B+P and PA arms respectively. Superiority could not be concluded when comparing B+P (aIRR (97.5%CI): 0.95 (0.75, 1.21)) or PA (aIRR (97.5% CI): 1.18 (0.94, 1.48)) to the C+P arm (Table 3). The sensitivity, PP, and exploratory analyses were consistent with the mITT analyses of the co-primary outcomes (Table 3, Appendices 6-10).

In the secondary analysis of the primary outcome measure, the estimated probabilities of having no dental pain and/or infection at 2 years post-randomization were 64% (97.5% CI: 58% to 69%), 65% (59% to 70%) and 56% (50% to 61%) (Table 2) in C+P, B+P and PA respectively; the overall Kaplan-Meier estimate of the median (97.5% CI) time to first episode of dental pain and/or infection was 3.1 (2.8, 3.6) years. There was no evidence of a difference in the time to first episode of dental pain and/or infection when comparing B+P (aHR (97.5% CI): 0.95 (0.73, 1.24)) or PA (aHR (97.5% CI): 1.19 (0.92, 1.53)) to C+P (Appendix 11).

Secondary Outcomes

Secondary outcomes are reported in Maguire et al. (2019) with a brief summary here to signpost relevant findings for context. On average, it cost £230 to manage dental caries in a child with at least one tooth with carious lesions into dentin over the follow-up period. PA was, on average, the least costly but the least effective for both co-primary outcomes; B+P and C+P would provide greater benefits, albeit at a higher cost. B+P had the highest probability of being considered cost-effective compared to PA and C+P at a willingness to pay threshold of £330 to avoid an incidence of dental pain and/or infection and £130 to avoid an episode of dental pain and/or infection. For dental anxiety (parent or child reported) and COHRQoL, there was no evidence of any statistically significant differences apart from parent-reported child anticipatory anxiety for PA vs C+P (6% lower in the PA arm; aRD -0.06 (97.5%CI: -0.11 to -0.003) or clinically significant differences when comparing either B+P or PA to C+P for any outcomes. There was also no evidence of any differences between treatment arms for incidence of caries in primary teeth or first permanent molars. Qualitative interviews with participant/parent dyads indicated that all three

treatment arms were generally acceptable to them but trust in the DP played a significant role. Procedures, including LA and dental extractions, were generally viewed more negatively.

Discussion

This large, pragmatic multi-centre trial embedded in primary dental care recruited a representative sample of dental practices, a diverse selection of GDPs, and participants with cultural/ethnic diversity (Office for National Statistics et al. 2017) (Table 1). As such, this trial provides findings generalizable to the UK population of regularly attending high caries risk children in the primary or mixed dentition attending primary care. No other similarly-sized RCT has been undertaken with children in primary dental care and none have followed-up clinical outcomes at the level of the child (rather than a single tooth) for as long. Median (IQR) follow-up was good at 33.8 (23.8, 36.7) months and a major, cross-arm, deviation was recorded at only 6% of the dental visits. The pragmatic approach taken, observing what DPs did for participants in each of the arms when requested to follow caries lesion management protocols, is highly relevant to daily practice and akin to establishing what might happen if guidance or policy were put in place to direct clinical practice towards using one particular approach.

Running an RCT in the relatively research-naïve environment of NHS primary dental care was challenging. Slow recruitment rates increased the length of time practices were involved in the trial, necessitating the update of existing, and training of new, practice staff (clinical and administrative) in trial procedures, and resulting in some research fatigue. Data collection towards the end of the trial required high levels of motivational input from research staff and practice teams, especially as some secondary outcomes were only measured at baseline and scheduled final visits. Practices also had to contend with requests from the trial team to verify any questionable or missing data. However, the resulting high quality of the data collected and the analyses conducted minimized potential for bias.

Although there was no evidence of a difference in the proportion of participants with at least one episode of dental pain and/or infection between arms, the incidence was higher than anticipated (C+P: 42%; B+P: 40%; PA: 45%) and consequently the associated CIs were also wider. This level of incidence of dental pain and/or infection is of some concern especially when observed in a developed country with comprehensive dental health services, although the rate of experience of dental pain ever during the trial (overall 36%) was higher than dental infection (25%) and may reflect differences between reported versus clinically observed outcomes. As the co-primary outcomes were measured at child (mouth) level, the incidence

was higher than in studies reporting on single tooth treatments. It is difficult to directly equate the findings of single tooth studies using single treatment strategies with those of FiCTION, a child-level trial with multi-component interventions (with up to 20 teeth involved per participant). The overall levels of dental pain and/or infection are probably comparable to single tooth studies and possibly even lower in FiCTION participants (de Amorim et al. 2018; Dorri et al. 2017; Innes et al. 2015; Santos et al. 2016; Yengopal et al. 2009). Nonetheless, the trajectory of dental caries, once established (Hall-Scullin et al. 2017; Warren et al. 2017), means that these high risk children require a high level of care. It is possible that low use of radiographic diagnosis may have affected clinicians' diagnostic thresholds, leading to undetected carious lesions and misdiagnosis of the lesions' extensiveness. This may have increased the potential for non- or late-management of lesions contributing to occurrences of dental pain and infection, although a counter-argument is that unnecessarily invasive treatment was avoided (Bader et al. 2001; Schwendicke et al. 2015; Wenzel 2004). The general practice primary dental care environment differs from secondary dental care where additional resources, with respect to time and expertise, lead to more favourable outcomes (BaniHani et al. 2019; Chadwick et al. 2001) and these factors may also have contributed to the rates of dental pain and/or infection seen. However, the FiCTION trial was designed to compare three treatment approaches within primary dental care and fulfilled this objective. The trial was sufficiently powered to detect any true differences between arms, particularly with regard to the incidence of dental infection events, as they formed the basis of the original power calculation. Possible explanations for finding no evidence of clinical superiority between the three caries treatment approaches are the combination of: i) the inevitability in the co-primary outcomes being observed in all arms since the participants began the trial with established dentinal lesions; ii) since radiographs were used infrequently, some initially undetected lesions progressed without being managed; iii) the co-primary outcomes being measured at child- rather than tooth-level meant the possibility of observing dental pain and/or infection from teeth treated prior to FiCTION, and iv) the pragmatic nature of the trial may have meant that DPs reverted to treatments most familiar to them rather than strictly following the evidence-based protocols. Future work could explore the possibility of looking at individual tooth outcomes in the FiCTION.

As with the co-primary outcomes, there was no evidence of a difference in caries incidence, COHRQoL or dental anxiety between the three caries management strategies, and all were generally acceptable to participants, parents and DPs without provoking anxiety. PA was, on average, the least costly and least effective treatment strategy for both of the co-primary outcomes. B+P has the potential to provide more oral health benefits; however this comes with additional costs and a judgement is required as to what value should be placed on the avoidance of dental pain and/or infection in primary teeth.

When dentin caries is present, the biological approach could be the most likely strategy to be considered cost-effective if society is willing to pay a minimum of £130 to avoid dental pain and/or infection in a primary tooth. The importance of trust in the DP was highlighted in the qualitative studies, with a conversation between child, parent, and DP to agree the best options for the individual child being key.

The social gradient in health inequity (Marmot 2005), with the poorest shouldering the highest burden, is reflected in the socio-economic distribution of dental caries. Children who experience caries in their primary dentition carry a greater burden of dental caries and its consequences into later life (Hall-Scullin et al. 2017). There was no evidence of a difference in clinical effectiveness between arms in children with established dentin caries when managed in primary dental care; consequently this study highlights that the primary prevention of disease is paramount and emphasises the importance of early prevention for young children to avoid dental caries altogether rather than trying to manage multiple dentinal carious lesions. DPs' willingness and abilities to deliver effective strategies and individual items of care should be carefully considered in any implementation strategies for policy, teaching and practice.

Author Contributions

Trial conception: NI, JC, GD, EM. Trial design: NI, AM, JC, GD, CD, ZM, EM, RH, RF, BC, FW. Trial conduct: NI, AM, JC, GD, ZM, LV, MR, BC, FW, EM. Data acquisition: NI, AM, GD, CD, ZM, MR, AA, RH, BC, FW. Data analysis: NI, JC, VR, TH, LV, ZM, NW, RH, AM, GD. Data interpretation: NI, AM, JC, GD, CD, VR, TH, LV, ZM, EM, NW, MR, RH, RF, BC, FW. Drafted manuscript; NI, AM, JC, VR, EM, NW, TH, MR. Critically revised the manuscript: all authors.

All authors gave final approval and agree to be accountable for all aspects of this work.

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References

Bader JD, Shugars DA, Bonito AJ. 2001. Systematic reviews of selected dental caries diagnostic and management methods. J Dent Educ. 65(10):960-968.

BaniHani A, Deery C, Toumba J, Duggal M. 2019. Effectiveness, costs and patient acceptance of a conventional and a biological treatment approach for carious primary teeth in children. Caries Res. 53(1):65-75.

Chadwick B, Treasure E, Dummer P, Dunstan F, Gilmour A, Jones R, Phillips C, Stevens J, Rees J, Richmond S. 2001. Challenges with studies investigating longevity of dental restorations--a critique of a systematic review. J Dent. 29(3):155-161.

de Amorim RG, Frencken JE, Raggio DP, Chen X, Hu X, Leal SC. 2018. Survival percentages of atraumatic restorative treatment (art) restorations and sealants in posterior teeth: An updated systematic review and meta-analysis. Clin Oral Investig. 22(8):2703-2725.

Dorri M, Martinez-Zapata MJ, Walsh T, Marinho VC, Sheiham Deceased A, Zaror C. 2017. Atraumatic restorative treatment versus conventional restorative treatment for managing dental caries. Cochrane Database Syst Rev. 12:CD008072.

Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. Methods for the Economic Evaluation of Health Care Programmes. Third ed. New York: Oxford University Press; 2005.

Hall-Scullin E, Whitehead H, Milsom K, Tickle M, Su TL, Walsh T. 2017. Longitudinal study of caries development from childhood to adolescence. J Dent Res. 96(7):762-767.

Howard KE, Freeman R. 2007. Reliability and validity of a faces version of the modified child dental anxiety scale. Int J Paediatr Dent. 17(4):281-288.

Information Services Division. 2014. Dental statistics - NHS registration and participation. Update of statistics as at 31st March 2014. ISD Scotland.

Innes NP, Clarkson JE, Speed C, Douglas GV, Maguire A. 2013. The FiCTION dental trial protocol - filling children's teeth: Indicated or not? BMC Oral Health. 13:25.

Innes NP, Ricketts D, Chong LY, Keightley AJ, Lamont T, Santamaria RM. 2015. Preformed crowns for decayed primary molar teeth. Cochrane Database Syst Rev. (12):CD005512.

Innes NP, Ricketts DN, Evans DJ. 2007. Preformed metal crowns for decayed primary molar teeth. Cochrane Database Syst Rev. (1):CD005512.

Ismail AI, Sohn W, Tellez M, Amaya A, Sen A, Hasson H, Pitts NB. 2007. The international caries detection and assessment system (icdas): An integrated system for measuring dental caries. Community Dent Oral Epidemiol. 35(3):170-178.

Levine RS, Pitts NB, Nugent ZJ. 2002. The fate of 1,587 unrestored carious deciduous teeth: A retrospective general dental practice based study from northern England. Br Dent J. 193(2):99-103.

Listl S, Galloway J, Mossey PA, Marcenes W. 2015. Global economic impact of dental diseases. J Dent Res. 94(10):1355-1361.

Maguire A, Clarkson JE, Douglas GV, Ryan V, Homer T, Marshman Z, McColl E, Wilson N, Vale L, Robertson M et al. 2019. Best practice prevention alone or with conventional or biological caries management for 3-7 year olds: The FiCTION three-arm randomized controlled trial. Health Technology Assessment (In press).

Marmot M. 2005. Social determinants of health inequalities. Lancet. 365(9464):1099-1104.
Office for National Statistics, National Records of Scotland, Northern Ireland Statistics Research Agency. 2017. 2011 census aggregate data. UK Data Service.
Pendlebury ME, Horner K, Eaton KA. 2004. Selection criteria for dental radiography. London: London : Faculty of General Dental Practitioners.
Pitts N. 2004. "Icdas"--an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management. Community Dent Health. 21(3):193-198.
Public Health England. 2014. Delivering better oral health. An evidence-based toolkit for prevention. London: Public Health England.
Public Health Wales. 2014. Child dental general anaesthetics in wales. Public Health Wales.
Royal College of Surgeons Faculty of Dental Surgery. 2015. The state of children's oral health in england. Royal College of Surgeons.
Santos AP, Moreira IK, Scarpelli AC, Pordeus IA, Paiva SM, Martins CC. 2016. Survival of adhesive restorations for primary molars: A systematic review and metaanalysis of clinical trials. Pediatr Dent. 38(5):370-378.
Schwendicke F, Tzschoppe M, Paris S. 2015. Radiographic caries detection: A systematic review and meta-analysis. J Dent. 43(8):924-933.
Scottish Dental Clinical Effectiveness Programme. 2018. Prevention and management of dental caries in children. Dental clinical guidance. Dundee: Scottish Dental Clinical Effectiveness Programme.
Thomson WM, Foster Page LA, Gaynor WN, Malden PE. 2013. Short-form versions of the parental-caregivers perceptions questionnaire and the family impact scale. Community Dent Oral Epidemiol. 41(5):441-450.
Thomson WM, Foster Page LA, Malden PE, Gaynor WN, Nordin N. 2014. Comparison of the ecohis and short-form p-cpq and fis scales. Health Qual Life Outcomes. 12:36.
Tickle M, Milsom K, King D, Kearney-Mitchell P, Blinkhorn A. 2002. The fate of the carious primary teeth of children who regularly attend the general dental service. Br Dent J. 192(4):219-223.
Vernazza CR, Rolland SL, Chadwick B, Pitts N. 2016. Caries experience, the caries burden and associated factors in children in england, wales and northern ireland 2013. Br Dent J. 221(6):315-320.
Warren JJ, Van Buren JM, Levy SM, Marshall TA, Cavanaugh JE, Curtis AM, Kolker JL, Weber-Gasparoni K. 2017. Dental caries clusters among adolescents. Community Dent Oral Epidemiol. 45(6):538-544.
Wenzel A. 2004. Bitewing and digital bitewing radiography for detection of caries lesions. J Dent Res. 83 Spec No C:C72-75.
Yengopal V, Harneker SY, Patel N, Siegfried N. 2009. Dental fillings for the treatment of caries in the primary dentition. Cochrane Database Syst Rev. (2):CD004483.

Figure and Table Legends

Figure 1: CONSORT flow diagram of participant journey through trial

Table 1. Participant characteristics at baseline, by randomized treatment arm [mITT analysis set, n=1058].

Table 2. Summary statistics for Incidence, Number of episodes and Probability of having no dental pain and/or infection at 2 years post-randomization (mITT analysis set, n=1058)**.**

Table 3. Estimates of the Risk Difference and Incident Rate Ratio over the follow-up period in dental pain and/or infection between randomized treatment arms; models are adjusted for age in years, time in study in years and a random effect for practice.

Table 1. Participant characteristics at baseline, by randomized treatment arm [mITT analysis set, n=1058].

Participant characteristic	*n*	**C+P** (conventional carious lesion management with prevention) n= 352	*n*	**B+P** (biological management with prevention) n= 352	*n*	**PA** (prevention alone) n= 354	*n*	**Total** n= 1058
Age (years) Mean (sd)	*352*	6.0 (1.3)	*351*	6.0 (1.3)	*354*	5.9 (1.2)	*1057*	6.0 (1.3)
Sex n (% female)	*349*	175 (50.1)	*349*	181 (51.9)	*349*	180 (51.6)	*1047*	536 (51.2)
Ethnicity[1] n (%)								
White	*313*	236 (75.4)	*322*	248 (77.0)	*320*	243 (75.9)	*955*	727 (76.1)
Black		9 (2.9)		11 (3.4)		10 (3.1)		30 (3.1)
Indian, Pakistani or Bangladeshi		37 (11.8)		38 (11.8)		36 (11.3)		111 (11.6)
Chinese		5 (1.6)		3 (0.9)		3 (0.9)		
Mixed race		11 (3.5)		13 (4.0)		13 (4.1)		11 (1.2)
Other		15 (4.8)		9 (2.8)		15 (4.7)		37 (3.9)
								39 (4.1)
d_3mft[2] mean (sd)	*339*	2.8 (2.7)	*333*	2.8 (2.8)	*334*	2.6(2.6)	*1006*	2.7 (2.7)
P-CPQ16[3] Mean (sd)	*300*	8.9 (6.7)	*314*	8.0 (6.3)	*309*	8.3 (6.2)	*923*	8.4 (6.4)
MCDASf[4] Mean (sd)	*336*	13.8 (4.9)	*324*	14.2 (5.3)	*329*	14.3 (5.3)	*989*	14.1 (5.1)

[1] Representing ethnic/ cultural variation was one of the strengths of the trial with the non-white population of the UK at 8.17 million (12.9% of the overall UK population) Office for National Statistics, National Records of Scotland and Northern Ireland Statistics, Research Agency (2017) 2011 Census Aggregate Data, UK Data Service., 24% of FiCTION children were non-white.
[2]Decayed into dentin, missing and filled primary teeth
[3] Parental-Caregiver Perceptions Questionnaire (16 item version)
[4] Modified Child Dental Anxiety Scale (faces)

Table 2. Summary statistics for Incidence, Number of episodes and Probability of having no dental pain and/or infection at 2 years post-randomization (mITT analysis set, n=1058)

Outcome	C+P (conventional carious lesion management with prevention) n=352	B+P (biological management with prevention) n=352	PA (prevention alone) n=354	Total n=1058
Incidence of dental pain and/or infection				
Dental pain ever[1] (%)	126 (35.8)	113 (32.1)	140 (39.5)	379 (35.8)
Dental infection ever[1] (%)	90 (25.8)	87 (24.7)	91 (25.7)	268 (25.3)
Dental pain and/or infection ever[1] (%)	148 (42.0)	141 (40.1)	161 (45.5)	450 (42.5)
Number of episodes of dental pain and/or dental infection				
Min	0	0	0	0
Median (IQR)	0 (0,1)	0 (0,1)	0 (0,1)	0 (0,1)
Mean (sd)	0.62 (0.95)	0.58 (0.87)	0.72 (0.98)	0.64 (0.94)
Max	7	6	5	7
Number (%)				
0	204 (58.0)	211 (59.9)	193 (54.5)	608 (57.5)
1	106 (30.1)	97 (27.6)	99 (28.0)	302 (28.5)
2	23 (6.5)	29 (8.2)	40 (11.3)	92 (8.7)
3	15 (4.3)	13 (3.7)	15 (4.2)	43 (4.1)
4	2 (0.6)	1 (0.3)	5 (1.4)	8 (0.76)
5	0 (0.0)	0 (0.0)	2 (0.6)	2 (0.2)
6	1 (0.3)	1 (0.3)	0 (0.0)	2 (0.2)
7	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.1)
Probability of having no dental pain and/or infection at 2 years post-randomization (97.5% CI)	64% (58%, 69%)	65% (59%, 70%)	56% (50%, 61%)	62% (38%, 48%)

[1] during the follow-up period of the trial

Table 3. Comparison of incidence and number of episodes of dental pain and/or infection between randomized treatment arms.

	Incidence		Number of episodes	
	Adjusted[1] Risk Difference[2] (97.5% Confidence interval [CI])		Adjusted[1] Incident Rate Ratio (97.5% Confidence Interval [CI])	
Analysis set	**B+P[3] vs C+P[4]**	**PA[5] vs C+P**	**B+P vs C+P**	**PA vs C+P**
Intention to Treat (mITT) (n=1057)	-2% (-10%, 6%) P=0.6	4% (-4%, 12%) P=0.2	0.95 (0.75,1.32) P=0.6	1.18 (0.94,1.64) P=0.1
At least 23 months in study (n=797)	1% (-9%, 10%) P=0.9	5 (-4%, 14%) P=0.2	1.02 (0.78,1.32) P=0.9	1.26 (0.98,1.50) P=0.04
Per Protocol (PP) (n=939)	-1% (-9%, 8%) P=0.9	2% (-6%, 11%) P=0.5	1.03 (0.80,1.34) P=0.8	1.17 (0.90,1.51) P=0.2

[1] Estimates of the Risk Difference and Incident Rate Ratio are over the follow-up period and models are adjusted for age in years, time in study in years and a random effect for practice.
[2] A risk difference less than zero indicates a lower incidence of dental pain and/or dental infection compared to C+P
[3] Biological management with best practice prevention
[4] Conventional carious lesion management with best practice prevention
[5] Best practice prevention alone

Child caries management: a randomized controlled trial in dental practice

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Appendix 1- Definition of an Episode

Several treatment visits (i.e. a course of treatment) can be associated with the same 'episode' of dental pain and/or infection. As such we needed a definition of an 'episode' of dental pain and/or infection due to caries; to avoid multiple counting of a child's pain. The two main reasons behind this were firstly, to avoid counting the same tooth more than once when a single episode of pain was ongoing and secondly, when a child had an episode of pain, this was the same experience of pain regardless of how many teeth were involved.

This definition of an episode was operationalised on a tooth by tooth basis using Case Report Form (CRF) data, according to the following algorithm:

Let Y=presence of dental pain and/or infection at a single treatment visit (as defined above); N otherwise

Let YY= presence of dental pain and/or infection at consecutive treatment visits (i.e. on consecutive CRFs)

Y on one or more teeth at a single treatment visit = an episode

Any number of consecutive "yeses" on the same tooth regardless of timeframe = a single episode [e.g. YYYYY over 5 months]

YY on different teeth (regardless of timeframe) = two separate episodes

YNY on the same tooth = two separate episodes (regardless of timeframe)

Although episodes were defined on a tooth-by-tooth basis, for a given child if there were two (or more) teeth with dental pain and/or infection at the same visit this was recorded as one episode at that visit for that child. For example, if a particular tooth had dental pain and/or infection at two consecutive visits and at the second of the two consecutive visits a different tooth also had dental pain and/or infection this would be counted as one episode.

The trial outcome, total number of episodes, was at the child level, however, tooth level number of episodes was collected in relation to dental pain and/or infection in order to define each episode.

Appendix 2: Practice characteristics; size, practice deprivation index (by quintile) and practice tap-water fluoridation status (n=72 practices that recruited at least one participant)

Characteristic	Number of practices (% of 72)
Region	
Scotland	25 (35)
Newcastle	19 (26)
Leeds/Sheffield	13 (18)
Wales	4 (6)
London	11 (15)
Number of registered patients	
1 – 4999	19 (26)
5000 – 9999	15 (21)
10,000 – 14,999	1 (1)
15,000+	1 (1)
No information	36 (50)
Deprivation index (quintile)	
1 (most deprived)	23 (32)
2	21 (29)
3	10 (14)
4	12 (17)
5 (least deprived)	6 (8)
Tap water fluoridation status (ppmF[1])	
<0.3ppmF	63 (88)
0.3-0.7ppmF	5 (7)
>0.7ppmF	4 (6)

[1] 0.7ppmF - 0.9ppmF is generally considered to be an optimal fluoride concentration for tap water in temperate climates.

Appendix 3: Total resource use per child per visit (C+P: conventional carious lesion management with best practice prevention; B+P: biological management with best practice prevention and; PA: best practice prevention alone)

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Number of visits						
Number of visits (all) (n=1058)	7.69 (4.21)	352	7.37 (4.08)	352	6.82 (3.65)	354
Number of first visits (n=1058)	1 (-)	352	1 (-)	352	1 (-)	354
Number of follow-up visits (n = 1006)[1]	6.96 (4.06)	338	6.73 (3.89)	333	6.15 (3.47)	335
Length of visits (mins)						
Length of visits (mins) (all)	21.76 (6.91)	352	21.24 (7.18)	352	20.11 (6.65)	354
Length of first visit (mins)	28.80 (11.93)	347	28.14 (11.14)	350	25.56 (10.20)	354
Length of follow-up visit (mins)	20.54 (6.99)[2]	338	19.38 (6.90)	333	18.64 (6.85)	335
Prevention						
Prevention	0.79 (0.22)	352	0.79 (0.22)	352	0.85 (0.19)	354
Prevention at first visit	0.81 (0.39)[3]	350	0.83 (0.37)	351	0.91 (0.29)	353

[1] Participants only had 1 visit (n=52). Please note that all average totals reported for follow-up visits are slightly underestimated it assumes missing values are equivalent to 0. Imputations for missing values are accounted for in *Appendix 6, Section 5 – Table 73*

[2] Interpretation: On average, each follow-up visit was 20 ½ minutes in duration

[3] Interpretation: On average, 81% of children randomized to C+P had prevention at their first visit

Prevention at follow-up visits	0.79 (0.23)[4]	338	0.78 (0.23)	333	0.85 (0.21)	335

[4] Interpretation: On average, each child randomized to C+P had prevention at 79% of their follow-up visits

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Prevention staff						
GDP providing prevention at first visit	0.71(0.46)[1]	349	0.72 (0.45)	349	0.77 (0.42)	344
Dental therapist providing prevention at first visit	0.07 (0.25)	349	0.07 (0.25)	349	0.08 (0.26)	344
Dental hygienist providing prevention at first visit	0.02 (0.13)	349	0.02 (0.14)	349	0.03 (0.17)	344
Oral Health Educator providing prevention at first visit	0.01 (0.11)	349	0.02 (0.15)	349	0.04 (0.19)	344
Childsmile[2]/Extended Duty Dental Nurse providing prevention at first visit	0.03 (0.16)	349	0.02 (0.13)	349	0.03 (0.16)	344
Other staff (dental nurse) providing prevention at first visit	0.01 (0.11)	350	0.01 (0.09)	351	0.01 (0.12)	353
Other staff (dental nurse trainee) providing prevention at first visit	0 (-)	350	0 (-)	351	0 (-)	353
Other staff member (CT1) providing prevention at first visit	0 (-)	350	0 (-)	351	0 (-)	353
Other staff member (dental student) providing prevention at first visit	0 (-)	350	0 (-)	351	0 (-)	353
GDP providing prevention at follow-up visits	0.69 (0.27)[3]	338	0.68 (0.27)	333	0.76 (0.26)	335
Dental therapist providing prevention at follow-up visits	0.07 (0.14)	338	0.06 (0.13)	333	0.05 (0.12)	335

[1] Interpretation: On average, 71% of children randomized to C+P had prevention provided by a GDP at their first visit
[2] Childsmile is a national programme designed to improve the oral health of children in Scotland and reduce inequalities both in dental health and access to dental services. http://www.child-smile.org.uk/professionals/about-childsmile.aspx
[3] Interpretation: On average, each child randomized to C+P had had prevention provided by a GDP at 69% of their follow-up visits

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Oral health educator providing prevention at follow-up visits	0.01 (0.07)	338	0.01 (0.06)	333	0.01 (0.05)	335
Childsmile/Extended Duty Dental Nurse providing prevention at follow-up visits	0.02 (0.08)	338	0.01 (0.04)	333	0.02 (0.06)	335
Other staff member (dental nurse) providing prevention at follow-up visits	0.03 (0.15)	338	0.02 (0.13)	333	0.03 (0.15)	335
Other staff member (dental nurse trainee) providing prevention at follow-up visits	0 (-)	338	0 (-)	333	<0.01 (0.01)	335
Other staff member (CT1) providing prevention at follow-up visits	0 (-)	338	<0.01 (<0.01)	333	0 (-)	335
Other staff member (dental student) providing prevention at follow-up visits	<0.01 (0.01)	338	<0.01 (0.01)	333	<0.01 (0.01)	335
Prevention (components)						
Brushing/Plaque Control advice provided at first visit	0.76 (0.43)[1]	350	0.79 (0.41)	351	0.88 (0.32)	353
Fissure Sealants provided at first visit	0.12 (0.33)	350	0.15 (0.35)	351	0.15 (0.36)	353
Fluoride Varnish provided at first visit	0.53 (0.50)	350	0.56 (0.50)	351	0.74 (0.44)	353
Diet Investigation/Advice provided at first visit	0.70 (0.46)	350	0.75 (0.43)	351	0.84 (0.37)	353
Brushing/Plaque Control advice provided at follow-up visits	0.73 (0.26)[2]	338	0.71 (0.26)	333	0.78 (0.24)	335

[1] Interpretation: On average, 76% of children randomized to C+P had the prevention pillar "Brushing/Plaque control advice" provided at their first visit.
[2] Interpretation: On average, each child randomized to C+P had the prevention pillar "Brushing/Plaque control advice" at 73% of their follow-up visits

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Fissure Sealants provided at follow-up visits	0.13 (0.20)	338	0.15 (0.22)	333	0.16 (0.23)	335
Fluoride Varnish provided at follow-up visits	0.51 (0.31)	338	0.54 (0.31)	333	0.62 (0.31)	335
Diet Investigation/Advice provided at follow-up visits	0.66 (0.29)	338	0.64 (0.30)	333	0.71 (0.29)	335
Prevention time						
Length of time providing prevention at first visit (mins)	10.18 (10.44) [1]	331	10.08 (8.75)	335	12.82 (8.03)	336
Length of time providing prevention at follow-up visits (mins)	6.58 (4.21)[2]	338	6.40 (3.96)	333	7.58 (4.16)	335
Operative Treatment						
Operative treatment at first visit	0.62 (0.49)[3]	349	0.63 (0.48)	351	0.16 (0.37)	353
Operative treatment at follow-up visits	0.36 (0.28)[4]	338	0.34 (0.26)	333	0.19 (0.24)	335
Operative treatment time						
Length of time providing operative treatment at first visit (mins)	18.31 (11.21)	336	17.94 (11.27)	337	12.42 (10.48)	350
Length of time providing operative treatment at follow-up visits (mins)	12.86 (7.08)	338	12.08 (6.47)	333	10.16 (6.55)	335

[1] Interpretation: On average, each child randomized to C+P had 10 minutes of prevention at their first visit
[2] Interpretation: On average, each child randomized to C+P received 6 and a half minutes of prevention at each follow-up visit
[3] Interpretation: On average, 62% of children randomized to C+P had operative treatment at their first visit
[4] Interpretation: On average, each child randomized to C+P had operative treatment at 36% of their follow-up visits

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Operative treatment staff						
Dental therapist providing operative treatment at first visit	0.04 (0.18)	342	0.03 (0.18)	343	0.02 (0.15)	349
GDP providing operative treatment at first visit	0.58 (0.49)[1]	342	0.60 (0.49)	343	0.14 (0.34)	349
Dental therapist providing operative treatment at follow-up visits	0.03 (0.09)	338	0.03 (0.08)	333	0.01 (0.04)	335
GDP providing operative treatment at follow-up visits	0.32 (0.29)[2]	338	0.29 (0.25)	333	0.17 (0.23)	335
Primary Teeth Treated						
Number of primary teeth treated operatively at first visit	0.98 (1.12)[3]	349	1.16 (1.32)	351	0.26 (0.70)	353
Number of surfaces treated at first visit	0.98 (1.05)	349	1.29 (1.50)	351	0.28 (0.80)	353
Number of primary teeth treated operatively at follow-up visits	0.55 (0.59)[4]	338	0.50 (0.46)	333	0.29 (0.48)	335
Number of surfaces at follow-up visits	0.67 (0.71)	338	0.74 (0.77)	333	0.35 (0.53)	335
Operative Treatment - Caries Removal						

[1] Interpretation: On average, 58% of children randomized to C+P had operative treatment provided by a GDP at their first visit
[2] Interpretation: On average, each child randomized to C+P had operative treatment provided by a GDP at 32% of their follow-up visits
[3] Interpretation: On average, each child randomized to C+P had 0.98 teeth treated operatively at their first visit
[4] Interpretation: On average, each child randomized to C+P had half a primary tooth treated operatively at each follow-up visit (or 1 primary tooth treated operatively for every 2 follow-up visits)

Average total complete caries removal per treated primary tooth at first visit	0.46 (0.49)[5]	349	0.06 (0.22)	351	0.04 (0.19)	353

[5] Interpretation: On average, each child randomized to C+P had complete caries removal on 46% of their operatively treated primary teeth at a first visit

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Average total partial caries removal per treated primary tooth at first visit	0.08 (0.25)	349	0.31 (0.44)	351	0.05 (0.21)	353
Average total 'None' caries removal per treated primary tooth at first visit	0.06 (0.24)	349	0.24 (0.41)	351	0.05 (0.21)	353
Average total complete caries removal per treated primary tooth at follow-up visits	0.21 (0.23)[1]	338	0.05 (0.12)	333	0.06 (0.16)	335
Average total partial caries removal per treated primary tooth at follow-up visits	0.05 (0.11)	338	0.11 (0.16)	333	0.04 (0.11)	335
Average total 'None' caries removal per treated primary tooth at follow-up visits	0.06 (0.13)	338	0.12 (0.18)	333	0.05 (0.11)	335
Restorations						
Restorations at first visit	0.58 (0.49)[2]	352	0.59 (0.49)	352	0.10 (0.30)	354
Average total amalgam restorations per treated primary tooth at first visit	0.08 (0.26)[3]	349	0.01 (0.11)	351	0.01 (0.08)	353
Average total glass ionomer restorations per treated primary tooth at first visit	0.13 (0.33)	349	0.15 (0.35)	351	0.05 (0.21)	353

[1] Interpretation: On average, each child randomized to C+P had complete caries removal on 21% of their operatively treated primary teeth at each follow-up visit
[2] Interpretation: On average, 58% of children randomized to C+P had restorative treatment on an operatively treated primary tooth at their first visit
[3] Interpretation: On average, each child randomized to C+P had an amalgam restoration on 8% of their operatively treated primary teeth at their first visit

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Average total conventional preformed metal crown restorations per treated primary tooth at first visit	0.01 (0.10)	349	<0.01 (0.05)	351	0 (-)	353
Average total composite restorations per treated primary tooth at first visit	0.17 (0.37)	349	0.07 (0.25)	351	0.01 (0.08)	353
Average total Hall Technique preformed metal crown restorations per treated primary tooth at first visit	0.02 (0.12)	349	0.12 (0.32)	351	0.01 (0.10)	353
Average total compomer restorations per treated primary tooth at first visit	0.04 (0.19)	349	0.03 (0.15)	351	0.01 (0.08)	353
Average total resin modified glass ionomer restorations per treated primary tooth at first visit	0.13 (0.33)	349	0.12 (0.32)	351	0.01 (0.08)	353
Average total sealant only restorations per treated primary tooth at first visit	0.02 (0.12)	349	0.08 (0.26)	351	0.01 (0.11)	353
Average total sealant over restoration per treated primary tooth at first visit	0.01 (0.09)	349	0.04 (0.18)	351	0 (-)	353
Average total pulpotomy restorations per treated primary tooth at first visit	0.01 (0.08)	349	<0.01 (0.05)	351	0 (-)	353
Average total restorations per treated primary tooth at follow-up visits	0.30 (0.27)[4]	338	0.27 (0.24)	333	0.12 (0.21)	335

[4] Interpretation: On average, each child randomized to C+P had a restoration on at operatively treated primary tooth at 30% of their follow-up visits

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Average total amalgam restorations per treated primary tooth at follow-up visits	0.03 (0.09)[1]	338	<0.01 (0.03)	333	<0.01 (0.04)	335
Average total glass ionomer restorations per treated primary tooth at follow-up visits	0.10 (0.19)	338	0.09 (0.17)	333	0.06 (0.15)	335
Average total composite restorations per treated primary tooth at follow-up visits	0.05 (0.12)	338	0.03 (0.09)	333	0.01 (0.08)	335
Average total conventional preformed metal crown restorations per treated primary tooth at follow-up visits	0.01 (0.05)	338	<0.01 (0.02)	333	<0.01 (0.02)	335
Average total Hall Technique preformed metal crown restorations per treated primary tooth at follow-up visits	0.01 (0.06)	338	0.07 (0.14)	333	0.01 (0.07)	335
Average total compomer restorations per treated primary tooth at follow-up visits	0.01 (0.06)	338	0.01 (0.03)	333	<0.01 (0.03)	335
Average total resin modified glass ionomer restorations per treated primary tooth at follow-up visits	0.07 (0.15)	338	0.06 (0.15)	333	0.03 (0.10)	335
Average total sealant only restorations per treated primary tooth at follow-up visits	0.01 (0.06)	338	0.01 (0.05)	333	0.01 (0.03)	335
Average total sealant over restoration per treated primary tooth at follow-up visits	<0.01 (0.03)	338	0.01 (0.05)	333	<0.01 (0.01)	335

[1] Interpretation: On average, each child randomized to C+P had an amalgam restoration on 3% of their operatively treated primary teeth at each follow-up visit

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Average total pulpotomy restorations per treated primary tooth at follow-up visits	0.01 (0.04)	338	0.01 (0.06)	333	0.01 (0.04)	335
Local anaesthetic (LA)						
Average total LAs attempted per treated primary tooth at first visit	0.26 (0.43)[1]	349	0.02 (0.12)	351	0.02 (0.11)	353
Average total LAs achieved per treated primary tooth at first visit (successful)	0.22 (0.41)[2]	349	0.01 (0.10)	351	0.01 (0.11)	353
Average total LAs not achieved per treated primary tooth at first visit (unsuccessful)	0.03 (0.17)	349	<0.01 (0.06)	351	<0.01 (0.03)	353
Average total LAs not attempted per treated primary tooth at first visit	0.22 (0.41)	349	0.37 (0.48)	351	0.05 (0.22)	353
Average total LAs attempted per treated primary tooth at follow-up visits	0.13 (0.19)[3]	338	0.05 (0.10)	333	0.04 (0.11)	335
Average total LAs achieved per treated primary tooth at follow-up visits (successful)	0.12 (0.18)[4]	338	0.04 (0.10)	333	0.04 (0.10)	335
Average total LAs not achieved per treated primary tooth at follow-up visits (unsuccessful)	0.01 (0.07)	338	<0.01 (0.03)	333	<0.01 (0.02)	335

[1] Interpretation: On average, each child randomized to C+P had LA attempted on 26% of their operatively treated primary teeth at their first visit
[2] Interpretation: On average, each child randomized to C+P had successful LA attempted on 22% of their operatively treated primary teeth at their first visit
[3] Interpretation: On average, each child randomized to C+P had LA attempted on 13% of their operatively treated primary teeth at each follow-up visit
[4] Interpretation: On average, each child randomized to C+P had a successful local anaesthetic attempted on 12% of their operatively treated primary teeth at each follow-up visit

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Average total LAs not attempted per treated primary tooth at follow-up visits	0.15 (0.21)	338	0.18 (0.21)	333	0.07 (0.15)	335
Other Procedures						
Average total extractions per treated primary tooth at first visit	0.01 (0.09)[1]	349	0.01 (0.08)	351	0.01 (0.10)	353
Average total lesions opened per treated primary tooth at first visit	0.01 (0.08)	349	0.02 (0.12)	351	0.04 (0.19)	353
Average total extractions per treated primary tooth at follow-up visits	0.04 (0.11)[2]	338	0.04 (0.10)	333	0.04 (0.11)	335
Average total lesions opened per treated primary tooth at follow-up visits	0.01 (0.03)	338	0.01 (0.03)	333	0.02 (0.08)	335
Radiographs						
Radiographs at first visit	0.18 (0.39) [3]	350	0.18 (0.38)	351	0.19 (0.39)	353
Radiographs at follow-up visits	0.10 (0.15)[4]	338	0.08 (0.14)	333	0.11 (0.17)	335
Inhalation Sedation/Relative Analgesia						
Inhalation sedation/relative analgesia at first visit	0.01 (0.08)	345	0 (-)	347	<0.01 (0.05)	348
Inhalation sedation/relative analgesia at follow-up visits	0.01 (0.07)	338	0.01 (0.04)	333	0.01(0.03)	335

[1] Interpretation: On average, each child randomized to C+P had 1% of their operatively treated primary teeth extracted at their first visit
[2] Interpretation: On average, each child randomized to C+P had 4% of their operatively treated primary teeth extracted at each follow-up visit
[3] Interpretation: On average, 18% of children randomized to C+P had a radiograph taken at their first visit
[4] Interpretation: On average, each child randomized to C+P had a radiograph taken at 10% of their follow-up visits

Resource Use (per visit)	C+P Mean (sd)	n	B+P Mean (sd)	n	PA Mean (sd)	n
Painkillers						
Painkillers prescribed at first visit	0 (-)[1]	344	0 (-)	346	0 (-)	349
Paracetamol prescribed at first visit	0 (-)	352	0 (-)	352	0 (-)	354
Ibuprofen prescribed at first visit	0 (-)	352	0 (-)	352	0 (-)	354
Painkillers prescribed at follow-up visits	<0.01 (0.03)[2]	338	<0.01 (0.03)	333	<0.01 (0.01)	335
Paracetamol prescribed at follow-up visits	<0.01 (0.01)	338	<0.01 (0.02)	333	<0.01 (0.01)	335
Ibuprofen prescribed at follow-up visits	<0.01 (0.02)	338	<0.01 (0.02)	333	<0.01 (0.01)	335

[1] Interpretation: On average, no children randomized to C+P were prescribed any painkillers at their first visit
[2] Interpretation: On average, each child randomized to C+P were prescribed painkillers at less than 1% of their follow-up visits

Appendix 4: Reasons for 'major' deviation from the randomized treatment arm's operative treatment protocol (n=429)

Reason for 'major' deviation	C+P n= 195	B+P n= 65	PA n=169	Total n=429
	Number (% of non-missing)			
Total (non-missing)	188	65	164	417
Parent factors	33 (17.6)	29 (44.6)	55 (33.5)	117 (28.1)
Child pre-cooperative for LA	82 (43.6)	3 (4.6)	1 (0.6)	86 (20.6)
Dentist's clinical judgement	23 (12.2)	19 (29.2)	78 (47.6)	120 (28.8)
Child anxiety	41 (21.8)	6 (9.2)	0 (0.0)	47 (11.3)
Food packing	0 (0.0)	1 (1.5)	16 (9.8)	17 (4.1)
Child Factors (not anxiety/ cooperation)	5 (2.7)	5 (7.7)	6 (3.7)	16 (3.8)
Other	4 (2.1)	2 (3.1)	8 (4.9)	14 (3.4)

Appendix 5: Direction of 'major' deviations only (n=429 'major' deviations)

Arm randomized to	Arm(s) treatment deviated to[1]	Number of 'major' deviations by arm (n=429)	Randomized arm deviated from – group total (%)
C+P	B+P	135 (69.2)	195 (45.5)
	PA [3]	52 (26.7)	
	B+P and PA [2]	3 (1.5)	
	C+P and B+P [2]	3 (1.5)	
	C+P and PA [2]	2 (1.0)	
B+P	C+P	52 (80.0)	65 (15.2)
	PA [2]	10 (15.4)	
	C+P and B+P [2]	1 (1.5)	
	C+P, B+P and PA [2,3]	1 (1.5)	
	C+P and PA [2,3]	1 (1.5)	
PA	C+P	90 (53.3)	169 (39.4)
	B+P	71 (42.0)	
	B+P and PA [2,3]	4 (2.4)	
	C+P and PA [2]	3 (1.8)	
	C+P and B+P [2]	1 (0.6)	

[1] Any treatment provided by a FiCTION clinician that moved the participant's treatment away from their randomized treatment arm was designated a 'major' treatment deviation and required completion of a TDF by the treating clinician (e.g. 'Prevention' **to** 'Biological').

[2] With instances in which a deviation was necessary to deliver treatment, the deviation could be towards more than one arm in a single visit (e.g. 'Prevention' to 'Biological' **and** 'Conventional").

[3] Best practice prevention was an integral part of each treatment arm. A 'major' treatment deviation to the 'Prevention' arm was true only if a clinician had attempted to deliver treatment to a participant by their designated 'Biological' or 'Conventional' arm, but had been unable to achieve completion of that treatment before moving towards prevention alone as contingency.

Appendix 6. Summary statistics for Incidence and Number of episodes of dental pain and/or dental infection restricted to participants with at least 23 months follow up (n=797)

Outcome	C+P n=269	B+P n=267	PA n=261	Total n=797
Incidence of dental pain and/or dental infection				
Dental pain ever[1] (%)	102 (37.9)	97 (36.3)	116 (44.4)	315 (39.5)
Dental infection ever[1] (%)	73 (27.1)	74 (27.7)	76 (29.1)	223 (28.0)
Dental pain and/or dental infection ever[1] (%)	121 (45.0)	122 (45.7)	130 (49.8)	374 (46.9)[2]
Number of episodes of dental pain and/or dental infection				
Min	0	0	0	0
Median (IQR)	0 (0,1)	0 (0,1)	1 (0,1)	0 (0,1)
Mean (sd)	0.66 (0.97)	0.67 (0.92)	0.84 (1.06)	0.72 (0.99)
Max	7	6	5	7
Number (%)				
0	148 (55.0)	145 (54.3)	130 (49.8)	423 (53.1)
1	88 (32.7)	85 (31.8)	74 (28.4)	247 (31.0)
2	18 (6.7)	22 (8.2)	36 (13.8)	76 (9.5)
3	12 (4.5)	13 (4.9)	14 (5.4)	39 (4.9)
4	1 (0.4)	1 (0.4)	5 (1.9)	7 (0.9)
5	0 (0.0)	0 (0.0)	2 (0.8)	2 (0.3)
6	1 (0.4)	1 (0.4)	0 (0.0)	2 (0.3)
7	1 (0.4)	0 (0.0)	0 (0.0)	1 (0.1)

[1] During the follow-up period of the trial

[2] When participants with less than 23 months follow-up are excluded, the overall incidence of dental pain and/or dental sepsis increases from 42.5% to 46.9% due to a lower proportion of participants with less than 23 months follow-up having experienced dental pain and/or sepsis. 75/261 (28.7%) of the participants excluded from this analysis set were in the study for less than six months.

Appendix 7. Summary statistics for Incidence and Number of episodes of dental pain and/or dental infection (PP analysis set, n=940)

Outcome	C+P n=311	B+P n=329	PA n=300	Total n=940
Incidence of dental pain and/or dental infection				
Dental pain ever[1] (%)	106 (34.1)	103 (31.3)	109 (36.3)	318 (33.8)
Dental infection ever[1] (%)	77 (24.8)	78 (23.7)	76 (25.3)	231 (24.6)
Dental pain and/or dental infection ever[1] (%)	124 (39.9)	127 (38.6)	126 (42.0)	377 (40.1)
Number of episodes of dental pain and/or dental infection				
Min	0	0	0	0
Median (IQR)	0 (0,1)	0 (0,1)	0 (0,1)	0 (0,1)
Mean (sd)	0.57 (0.89)	0.57 (0.87)	0.66 (0.94)	0.59 (0.90)
Max	7	6	5	7
Number (%)				
0	187 (60.1)	202 (61.4)	174 (58.0)	563 (59.9)
1	92 (29.6)	87 (26.4)	76 (25.3)	255 (27.1)
2	18 (5.8)	25 (7.6)	34 (11.3)	77 (8.2)
3	11 (3.5)	13 (4.0)	12 (4.0)	36 (3.8)
4	2 (0.6)	1 (0.3)	3 (1.0)	6 (0.6)
5	0 (0.0)	0 (0.0)	1 (0.3)	1 (0.1)
6	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.1)
7	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.1)

[1] During the follow-up period of the trial

Appendix 8: Descriptive statistics by dental pain and/or infection ever (yes/no), [mITT analysis set]

	Dental pain and/or infection ever			
Variable	**n**	**Yes n=450**	**n**	**No n=608**
Age (years), mean (sd)	450	5.9 (1.2)	607	6.0 (1.3)
Ethnicity (white), x(%)	402	312 (77.6)	553	415 (75.1)
Fluoride level (ppm)[1]	450		608	
Min		0.003		0.003
Median (IQR)		0.093 (0.039,0.181)		0.096 (0.049,0.231)
Max		1.024		1.024
Index of deprivation (deciles)[1]	450		608	
Min		1		1
Median (IQR)		3 (2,5)		3 (1,5)
Max		10		10
Number of decayed teeth at baseline (ICDAS level 5/6 cavitation)	433		573	
Min		0		0
Median (IQR)		2 (1,3)		1 (0,2)
Mean (sd)		2.1 (2.1)		1.2 (1.6)
Max		14		9

[1] These variables were measured at the dental practice level

Appendix 9: Exploratory univariate logistic regression models for dental pain and/or infection (each row is a different univariate model).

Variable	n	Risk ratio	97.5% Confidence Interval		P value
			Lower	Upper	
Age (years)	1057	0.99	0.92	1.06	0.6
Ethnicity (White)	955	1.08	0.85	1.37	0.6
Water fluoridation (ppm) [1]	1058	0.75	0.49	1.15	0.4
Index of deprivation (deciles) [1]	1058	1.03	0.98	1.07	0.3
Number of decayed teeth at baseline from ICDAS charting [level 5/6 cavitation]	1006	1.12	1.09	1.16	<0.001

[1] These variables were measured at the dental practice level

Appendix 10: Exploratory multivariable model adjusted for age, time in study, number of decayed teeth at baseline, ethnicity, index of deprivation and water fluoridation (n=922)

Variable	Risk difference	Lower 97.5% Confidence Interval	Upper 97.5% Confidence Interval	P value
Arm				
C+P	0.00			
B+P	-0.0006	-0.08	0.08	>0.9
PA	0.07	-0.01	0.16	0.06

Appendix 11: Time to first dental pain and/or dental sepsis modelled using a Cox proportional hazards model adjusted for age [n=1057].

Outcome: Time to first dental pain	Hazard Ratio	Lower 97.5% Confidence interval	Upper 97.5% Confidence interval	P value
Arm				
C+P	1.00			
B+P	0.95	0.73	1.24	0.7
PA	1.19	0.92	1.53	0.1

Appendix 12: FiCTION Trial recruitment sites and non-author contributors

Recruitment sites

We are grateful to the child participants, their parents and the GDPs and their clinical and administrative teams who supported the study, giving so generously of their time and also sharing their experiences with us. The practices are listed below;

Alderman Road Dental Practice, Amble Dental Practice, Anita Belbin Dental Surgery, Archway, Ash Dental, Atlas Road Dental Surgery, B Davidoff Dental Surgery, Barnhill Dental Practice, BG Easton, Bridge of Don Dental Practice, Bridge Street Dental Care, Broxden Dental Centre, Brundholme Dental Practice, Burnett Dental Group, Church Road Dental Practice, Colchester Dental Surgery, DCO Dental, Dean Road Dental Practice, Dental Care Perth, Devonshire, E2 Dental Practice, Eastside Dental Practice, Eston Dental Practice, Family Dental Care, Family Dental Practice, Forth Valley Smile Design, Framwellgate Dental Surgery, Hafren House, Hampden Dental Care, High Green, Hillcrest Dental Practice, Horizon (Blyth) Dental Clinic; Horizon (Whitley Bay) Dental Clinic; Jedburgh Dental Clinic; JEM, Kilbirnie Dental Centre, Kings Cross Health and Community Care Centre, Kingsmeadows Dental Practice, Kingsway Dental Practice, Leeds CDS, Llantarnam Dental Practice, Lomond Dental Centre, Louise Hunter & Associates, Montgomery Street Dental Care, Montrose Dental Care, Park View Family Dental (Formerly Mr A I Robson & Associates), Nanodent, Orgreave Dental Surgery, Parkhead Public Dental Service, Pearl Dental, Perfect Smile, Pollock Dental Care, Port Talbot Resource Centre (Dental Teaching Unit), Possilpark Dental Practice, Queensway Dental Clinic, Roseberry Dental Practice, Salmon Lane Dental Care, Shiremoor Dental Practice, Shotley Bridge Dental Care, Springburn Public Dental Service, Springfield Public Dental Service, Stanley Dental Practice, Stoke Newington Dental Practice, Sunderland Road Dental Practice, The Square Dental Practice, The Whitley Bay Dental Clinic, Thompson & Thomas Dental Care, Triangle Dental Practice, Wanstead Village Dental & Health Centre, Westbury Dental Practice, Whickham Dental Practice.

Non-author contributors

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