

Post-operative pain and morbidity in children who have tooth extractions under general anaesthesia: a service evaluation

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Key points

Raises concerns about the adequacy of pain management during general anaesthesia for dental extractions for children.

Demonstrates that children who undergo primary tooth extractions under general anaesthesia experience pain afterwards.

Suggests how the current analgesic regimens might be modified to optimise care and to inform future guidelines.

Abstract

Introduction Children find dental extractions under general anaesthesia (GA) painful despite national analgesic guidelines.

Aims To report on children's post-operative pain, morbidity, families' satisfaction and analgesic regime during GA dental extractions.

Design A prospective service evaluation.

Setting King's College Hospital, London.

Methods Children (n = 143) self-reported pain using the Faces Pain Scale-Revised (FPS-R) pre- and post-operatively and one week later by telephone as reported by the child's parent/carer. Morbidity was assessed using the Morbidity Checklist & Post Hospital Behaviour Questionnaire and each family's satisfaction using the Treatment Evaluation Inventory.

Results Children were a mean age of six years and had seven primary teeth extracted. When given intravenous (IV) fentanyl (n = 69), either alone (n = 11) or in combination with paracetamol (n = 58) the children had 0.17 times odds of not having post-op pain compared to patients who received only paracetamol (logistic regression, p = 0.006). After one week 99% of families were satisfied with the service but 11% reported that their child still had post-operative morbidity.

Conclusion Three quarters of children reported pain following extractions of primary teeth under GA. Use of IV paracetamol and fentanyl reduced the immediate post-operative self-reported pain. After a week most families (99%) were satisfied with the treatment their child had received and morbidity was reported by 11% of families.

Introduction

In the United Kingdom, general anaesthesia (GA) for extraction of carious primary teeth in children is the commonest reason for hospital admissions.¹ Children are commonly anaesthetised using anaesthetic gases such as sevoflurane and an intravenous cannula is also inserted for safety; this is most often

placed once the child has lost consciousness. This extraction-only treatment is known to result in physical and psychological morbidity, causing 'distress', 'crying', 'complaining of mouth pain' and 'psychological trauma, (nightmares, bad memories, feeling depressed) post GA.² The Fifth National Audit Project (NAP5) Survey reported that, from a sample of 620 GA cases of which 60% were children, 31% were given neither an opioid nor local analgesia (LA).³ National guidelines from the Association of Paediatric Anaesthetists of Great Britain and Ireland suggest six possible peri-operative analgesic regimes that contain only oral or IV paracetamol and non-steroidal anti-inflammatory drugs but not short acting opioids such as fentanyl (Table 1).⁴ The selection of the analgesic regimen is usually based on a

discussion between the operating dentist and the anaesthetist but the choice rests ultimately with the anaesthetist since it is incorporated into the children's overall general anaesthetic care plan.

When undergoing dental rehabilitation, pain and morbidity increases when primary teeth are extracted and no LA used⁵ or when perhaps anaesthetists believe that LA only is all that is required. A previous study reported that following tooth extraction under GA, 92% of children complained of procedure related symptoms, with 39% of them crying on the way home and most of them continuing to cry at home. Children also reported nausea, sickness and prolonged bleeding.⁶ Another study of 425 children in 32 different GA centres throughout Scotland, reported that 53% of children had a

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sore mouth and 31% were unable to eat for 24h post-operatively.²

A recent prospective randomised study comparing administration of IV paracetamol to children before the start of dental rehabilitation (restorations and extractions) under GA to the end of treatment, showed lower pain and requests for analgesics on the ward with fewer children experiencing postoperative pain at home.⁷

The benefit of using LA for dental treatment under GA has been reviewed, however, it was difficult to draw a conclusion regarding its benefit in reducing postoperative pain due to variation in interventions, outcome measures and treatment types of the reviewed studies.⁸

Prior to the publication of 'A conscious decision' in 2000,⁹ only those teeth with obvious clinical signs of sepsis were commonly removed under GA however, this practice often led to a re-attendance rate of around 25%.^{2,10,11,12,13} This repeat GA continues to be a problem with recent literature reporting a range from 33% to 59% in the NW of England^{14,15} and as we know, GA is never without risk even though halothane is no longer used. As a result, referral for GA for tooth extractions has become a treatment of last resort and pre-operative assessment is more rigorous, leading to better detection of caries, and subsequent inclusion of unrestored carious teeth into the extraction planning.^{4,16} Therefore, there has been an increase in the mean number of teeth extracted from an average of three teeth in the past to an average of seven teeth per child presently.^{2,10,17}

The paediatric dental team at King's College Hospital (KCH) in London, UK follows the national practice of removing all unrestored carious primary teeth. The service is one of the largest GA tooth extraction services in the UK and we wanted to assess pain management and family satisfaction with the service.

Aims

- To report on post-operative pain and physical and psychological morbidity, especially 'sore mouth', in the children who have undergone primary tooth extractions under GA at King's College Hospital
- To report how post-operative pain and morbidity is linked to the number of primary teeth that are extracted and/or to the number of sextants around the mouth from which primary teeth are extracted

Table 1 Association of Paediatric Anaesthetists of Great Britain and Ireland Analgesic Regimens⁴

	Pre-operative	Peri-operative	Post-operative
Option 1	Oral paracetamol 20 mg/kg, 1 hr pre-operatively	-----	Oral ibuprofen 5–10 mg/kg, PRN
Option 2	Oral paracetamol 20 mg/kg, 1 hr pre-operatively	Diclofenac 1 mg/kg per rectum (PR) after induction	-----
Option 3	Oral paracetamol 20 mg/kg and oral ibuprofen 5–10 mg/kg, 1 hr pre-operatively	-----	-----
Option 4	Oral ibuprofen 5–10 mg/kg, 1 hr pre-operatively	-----	Oral paracetamol 20 mg/kg, PRN
Option 5	Oral ibuprofen 5–10 mg/kg, 1 hr pre-operatively	IV paracetamol 15 mg/kg	-----
Option 6	-----	IV paracetamol 15 mg/kg	Oral ibuprofen 5–10 mg/kg, PRN

- To report on peri-operative analgesia prescribing compared to ADA guidelines
- To report on the families' overall satisfaction with the GA service.

Methods

A prospective service evaluation of a GA service based at KCH Day Surgery Unit. Approval for this service evaluation was obtained from the Paediatric Department Audit Lead and the Clinical Director of the Dental Institute at KCH. Informed verbal consent was obtained from parents of children undergoing GA. Their consent to take part was verified by their agreement to complete peri and post-operative questionnaires and their agreement to provide their phone number in order to follow up with questions one week after the procedure. All data were anonymised.

Children self-reported pain using the Faces Pain Scale-Revised (FPS-R)¹⁸ at the medical pre-assessment appointment, which was approximately two weeks before the GA date, and on the day of GA on the ward pre-operatively and post-operatively at discharge by one of the authors.

Descriptive data were collected from patients' case notes on the day of the GA: child gender, age in years, number of primary teeth removed, number of sextants that had teeth removed, use and dose of LA during the procedure, use of systemic analgesics peri-operatively and post-operatively, type of general anaesthetic drugs used and overall duration of the procedure in minutes.

One week later, using telephone interviews, families scored post-operative morbidity

using the Morbidity Checklist & Post Hospital Behaviour Questionnaire,¹⁹ child's oral pain using the FPS-R self-reporting as before¹⁸ and the family's satisfaction using the Treatment Evaluation Inventory.²⁰

The aim was to collect a consecutive convenience sample of 100 children who were already scheduled on the GA extraction-only list. Due to anticipated retention difficulties in completing the follow-up telephone interviews, a drop-out rate of 30–40% was anticipated. Data collection took place between April 2015 and December 2015 and stopped once 100 families had completed the telephone follow-up. Thus following screening of case notes, 284 potential participating families were identified and approached, 143 (50.4%) fulfilled the inclusion criteria and agreed to take part.

Inclusion and exclusion criteria from study:

1. Inclusion criteria
 - Children aged 4–10 years old
 - Medically fit and healthy children
 - Scheduled for extraction of primary teeth only under GA.
2. Exclusion criteria:
 - Medically compromised children
 - Non-English speaking families
 - Children booked for extraction of permanent teeth
 - Families who did not wish to take part

Statistical analysis

All data were anonymised and descriptive data was used to summarise the outcomes of the sample using the mean, standard deviation

Table 2 Characteristics of the children and their treatment

Total n = 143	
Age (years)	Mean (6.36) Range (4–10)
Male	80 (55.9%)
Female	63 (44.1%)
Number of teeth extracted	Mean (7.20) Range (1–20)
<7	64 (44.8%)
> or = 7	79 (55.2%)
Number of sextants with teeth extracted	Mean (3.95) Range (1–6)
(1)	10 (7%)
(2)	13 (9.1%)
(3)	17 (11.9%)
(4)	51 (35.7%)
(5)	38 (26.6%)
(6)	14 (9.8%)
Duration of GA(minutes)	Mean (36.4)

Table 3 Use of analgesia (systemic, local and oral) during and after dental general anaesthesia

During GA			After GA				
Systemic analgesics	127/143 (88.8%)	Local analgesia	0.0 ml	5/143	3.5%	Oral analgesics	141/143 (98.6%)
None	16/143 (11.2%)		0.55 ml	12/143	8.4%	None	2/143 (1.4%)
Paracetamol	58/143 (40.6%)		0.73 ml	5/143	3.5%	Paracetamol	4/143 (2.8%)
Fentanyl	11/143 (7.7%)		1.1 ml	41/143	28.7%	Ibuprofen	124/143 (86.7%)
Combined	58/143 (40.6%)		1.47 ml	4/143	2.8%	Combined	13/143 (9.1%)
			1.65 ml	8/143	5.6%		
		2.2 ml	68/143	47.6%			

and frequency. Since the FPS-R data scores had a few categories that were not normally distributed, these data scores of post-op pain at discharge and post-op pain one week after were grouped into two categories as 'No pain' and 'Pain'. Further analyses were carried out on the grouped data. Logistic regression analysis was carried out to find out the significant predictors of post-op pain. The presence or absence of pain served as the dependent variable whereas the extraction, LA, systemic analgesic and sextant served as the predictor variables. The analysis was carried out using Stata 12.0.

Results

Characteristics of the children and families

One hundred and forty-three families agreed to take part and 100 (70%) completed the post-GA follow-up questionnaires after one

week. Forty-three participants (30%) were lost to follow-up as they either did not answer or the telephone number was unobtainable. The mean age of the children was 6.36 years and there were 80 (56%) boys. The mean number of primary teeth extracted was 7.20 ranging from 1–20 teeth. The mean number of sextants was 3.95. Further details are shown in Table 2.

General anaesthetic drugs

Most of the children 134/143 (93.7%) had a gas induction using a mixture of O₂ with nitrous oxide used in n = 140 (97.9%) children and sevoflurane in n = 134 (93.7%) children. Forty-nine children had intravenous propofol in addition to the gas induction with nine children (6.3%) having propofol alone.

GA duration

The duration of the GA (from induction to leaving the operating theatre) was a mean time of 36 minutes. There was no association

between duration of the GA and post-operative pain at discharge/one week later or morbidity one week later.

Local analgesia (LA)

Nearly half of the children 68/143 (47.6%) were given 2.2 ml of LA (lidocaine 2% with adrenaline 1:80,000). Five children 5/143 (3.5%) did not receive any LA during GA, further details are given in Table 3. Logistic regression showed no significant correlation between self-reported pain post-operatively and the dose of LA that was administered.

Systemic analgesics regimens

Details of the peri-operative analgesics that the children received are shown in Table 3. There was a significant association between the analgesic regimen prescribed and post-operative pain at discharge. The 58 children who received fentanyl and paracetamol reported less pain at discharge compared to those who received paracetamol only (odds ratio 0.17, log regression, p = 0.006).

Post-operatively on the ward, two analgesic drugs were commonly administered, these were paracetamol and ibuprofen, and they were given orally, usually at the parents' request to almost all of the children 141/143 (99%), details are shown in Table 3. There was no association between the type of analgesic given on the ward and post-operative child-reported pain.

Children's pain

Forty-one children 41/143 (29%) reported pain before the GA event but 110/143 (77%) reported being in pain immediately afterwards. One week after the GA visit, 12/100 (12%) children reported 'mild' pain and two reported 'nagging' pain. Full details are shown in Table 4.

Results of logistic regression carried out for self-reported pain at discharge and one week later are summarised below in Table 5. The results showed that the type of systemic analgesic significantly predicted the post-op pain. Use of both paracetamol and fentanyl together significantly (p = 0.006) reduces the post-op pain with an odds ratio of 0.17. This indicates that patients who received both the analgesics had 0.17 times odds of not having post-op pain compared to patients who received paracetamol only. No other variables predicted the post-op pain.

However, one week later, there was no statistically significant correlation found and the results are found in Table 6.

Post-operative morbidity

One week after the GA event, 11/100 (11%) families reported that their child had suffered some form of post-operative morbidity. The most common psychological behavioural changes reported were: 'being fussy about eating', 'being upset when someone mentions doctors or hospitals', 'being shy or afraid around strangers' and 'having poor appetite'. There was no significant association using logistic regression between either the reported morbidity or the number of primary teeth extracted, or the number of sextants in which primary teeth were extracted.

Family satisfaction

Most families (99%) were completely satisfied with the service provided. A few parents were critical of the time waiting in the ward before being taken into theatre.

Discussion

In this service evaluation of one of the largest service providers in the UK, children reported pain following a day case hospital admission for extraction of only primary teeth under GA, as it is more likely in this age group, but about three-quarters of them had not experienced toothache pre-operatively. Other studies have also reported that before the GA, around 82% and 83% of children were pain free.^{6,19} Indeed, Atan *et al.*¹⁹ also reported pain in 74% of children at GA discharge compared to only 17% before the operation. This suggests that children who had undergone extraction arrived without pain but left in pain. Children who required extraction of primary teeth only were included in this study, and likely to be diagnosed as having early childhood caries.

Children who received a short-acting opioid (fentanyl), alone or in combination with paracetamol, had a 17% better odds of having no pain at discharge compared to those who didn't have fentanyl. National guidance on the use of systemic analgesics offers various prescribing options but does not include short-acting opioids, perhaps because these are thought to cause respiratory depression and as such are deemed unsuitable for short day surgery cases.²¹ The decision to use fentanyl is usually based on the anaesthetist's preference but the dentist may guide them if the procedure may involve for example extractions of first permanent molars or is deemed traumatic. The KCH anaesthetists who diverted from the national

Table 4 Child-reported pain scores at medical pre-assessment and before, during and after surgery. '0' is 'no pain'

Time points	Faces pain scale-revised						Total	Missing
	0	2	4	6	8	10		
Medical pre-assessment (2 weeks before DGA)	109 (76.2%)	14 (9.8%)	3 (2.1%)	3 (2.1%)	3 (2.1%)	11 (7.7%)	n = 143	n = 0
On ward	102 (71.3%)	18 (12.6%)	12 (8.4%)	4 (2.8%)	1 (0.7%)	6 (4.2%)		
At discharge	33 (23.1%)	37 (25.9%)	26 (18.2%)	13 (9.1%)	7 (4.9%)	27 (18.9%)		
One week later	86 (60.1%)	12 (8.4%)	2 (1.4%)	0 (0%)	0 (0%)	0 (0%)	n = 100	n = 43

Table 5 Logistic regression analysis for self-reported pain at discharge following dental extractions of primary teeth under GA

Predictor	Compared with	Odds ration (OR)	95% confidence interval	p-value
Extraction				
>7 teeth	<=7	1.46	0.34 to 6.26	0.61
LA				
>1.1 ml	≤1.1 ml	1.67	0.53 to 5.28	0.39
Analgesic				
Paracetamol				
	Fentanyl	0.57	0.05 to 6.99	0.66
	Both	0.17	0.05 to 0.61	0.006*
Sextant				
1				
	2	17.41	0.84 to 361.52	0.07
	3	11.15	0.85 to 146.35	0.07
	4	9.06	0.95 to 86.44	0.06
	5	7.90	0.64 to 97.30	0.11
	6	5.19	0.29 to 94.00	0.27

*For sextant, the estimates could not be computed as there were fewer cases.

recommendations in relation to using a low dose of fentanyl, provided better pain control for the children that they anaesthetised. Therefore, this suggests that use of an opioid (fentanyl) as part of the systemic analgesic regimen results in better pain control at discharge. The findings in this service evaluation suggest that further research is undertaken to explore the efficacy of short-acting opioids in children who need a GA for primary tooth extraction.

In the past anaesthetists and dentists believed that LA was sufficient for pain control alongside reducing tachycardia but now with the increased number of extractions and to ensure safe LA dosages it is more difficult to provide adequate pain relief. As such LA nowadays is considered to be largely to assist in haemostasis administered by the dentist. In this unit an intra-papillary technique is used. Also, children can be upset if they wake up feeling 'numb', especially when they

Table 6 Logistic regression analysis for self-reported pain one week later following dental extractions of primary teeth under GA

Predictor	Compared with	Odds ratio (OR)	95% confidence interval	p-value
Extraction				
>7 teeth	≤7	0.61	0.13 to 2.76	0.52
LA				
>1.1 ml	≤1.1 ml	0.74	0.20 to 2.67	0.65
Analgesic				
Paracetamol				
	Fentanyl	0.75	0.06 to 8.88	0.82
	Both	0.72	0.20 to 2.55	0.61

haven't experienced LA before. This may be a confounding factor resulting in patients reporting post-operative pain if LA has been given during the GA.

Unlike other studies this service evaluation did not find that children's pain at discharge increased when more teeth are removed.^{22,23,24} The reason why the association was weak might be because it was masked by the use of the opioid analgesics but further research is required.

Balancing extractions, which refers to the extraction of the contralateral tooth in cases with crowded dental arches with the aim to prevent midline shift, is common practice and it leads to an increase in the number of primary teeth removed under GA. These teeth may be healthy and caries free but are extracted specifically for orthodontic reasons and were not excluded or specifically investigated in this study.

Regarding morbidity, in the present service evaluation, there was less 'sore mouth' and 'dizziness' reported compared to previous studies, this might be because of the differences between the general anaesthetic or peri-operative analgesics regimens. Atan *et al.* reported dizziness, sleeplessness and weakness²⁵ and the few reports of nausea and vomiting was also similar to other studies.^{2,6,10} The 'lack of appetite' is likely due to the children being cautious eating while they have open and healing sockets. An interesting paper by Rodd *et al.* published in 2014 has revealed insights into experiences from ten children who had dental general anaesthetic and pain was not the main negative aspect but feeling hunger, scared/worried and having discomfort from the cannula were the main concerns.²⁶

Despite the children's self-reported pain and post-operative morbidity, parents were

generally satisfied with the treatment that their child had received although they didn't like their child to be kept waiting on the ward, this has also been reported in other studies that included children who were anxious.^{2,8} Other studies especially those interested in this patient group reported that dental treatment under GA had a positive impact on the children's families and that it had resulted in improved oral health quality of life, perhaps because the painful teeth had been removed.^{22,27,28} A strength of this service evaluation is that there was a 70% telephone follow-up response rate, this is very good in these 'hard-to-reach' families. In addition, well-validated measures were used throughout. However, these often socially deprived families are known to give positive feedback at follow-up, especially when they have met the researcher before.²⁹ Given that 30% of the parents did not take part in the follow-up interview despite having consented to do so, might suggest that some of these families were dissatisfied and perhaps their children had experienced greater pain and morbidity. This is a limitation of the design.

The findings from this service evaluation may not be generalisable as they reflect practice from one centre albeit one of the largest centres in the UK for extraction of primary teeth under GA. Data can be used to allow comparisons with other similar centres in the U.K.

Conclusion

Systemic use of fentanyl and paracetamol significantly reduced the post-op pain and the odds ratio is 0.17. Although this is not a randomised controlled trial and this data came from one centre there is a need for

future research to test the efficacy of low doses of fentanyl during dental GA. Families who responded one week after the procedure were highly satisfied with their child's treatment.

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Correction to: Interceptive extractions for first permanent molars: a clinical protocol

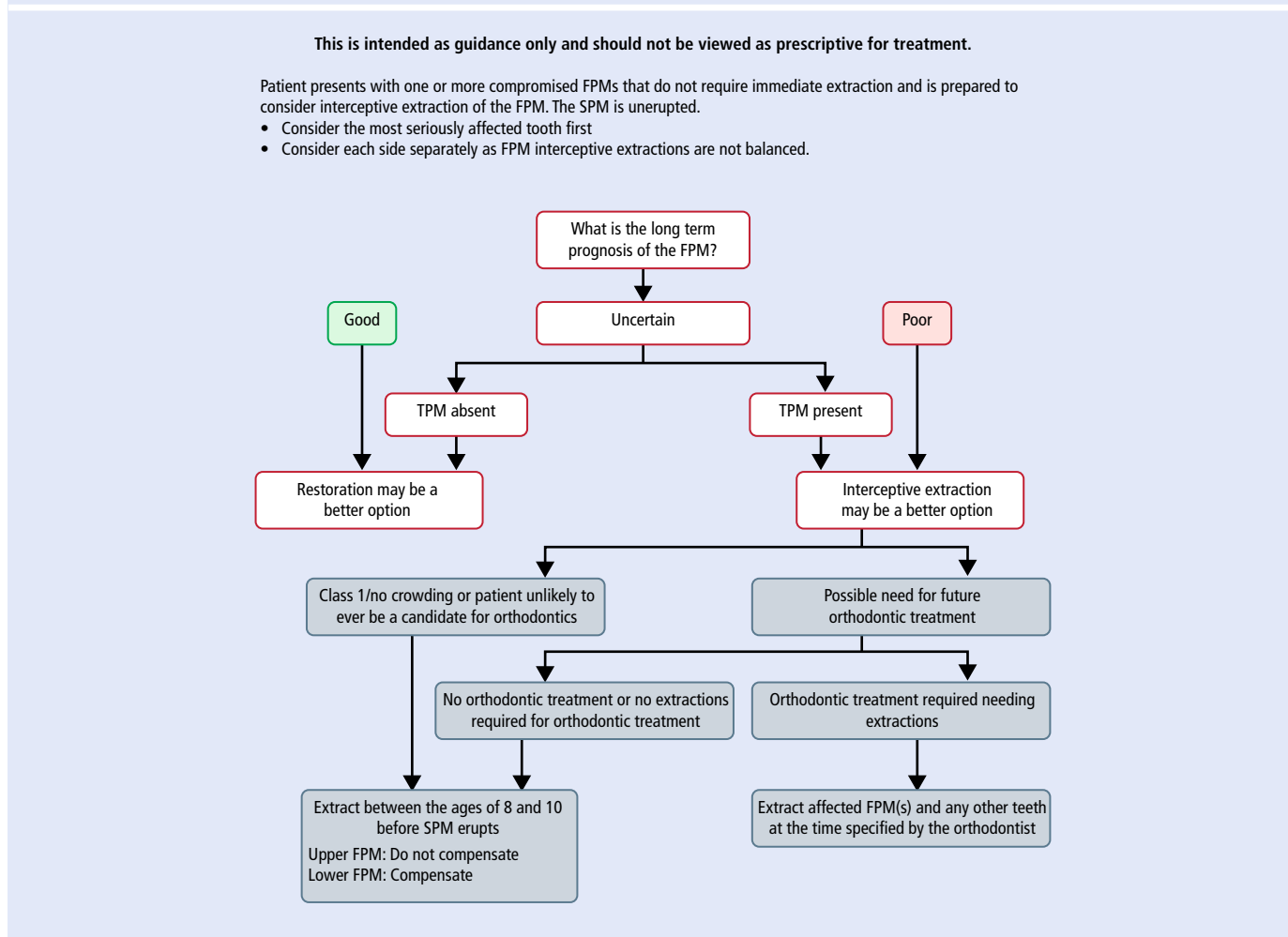
The original article can be found online at <https://doi.org/10.1038/s41415-019-0561-7>.

Author's correction note:

Clinical article *Br Dent J* 2019; **227**: 192–195.

When this article was initially published, one of the boxes in Figure 2 had been duplicated. The correct figure is shown below:

Fig 2 Flowchart of first permanent molar management



The journal apologises for any confusion caused by this error.