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SUPPLEMENT ARTICLE OPEN ACCESS

Paediatric Root Canal Treatment With General Anaesthetic: A Multi-Centre Evaluation

Lucy Simpson[1] | Claudia Heggie[1] | Sascha Scutt[2] | Clare Hutchison[3] | Nathalie Gallichan[2] | Katherine O'Donnell[1]

[1]Leeds Dental Institute, Leeds, UK | [2]Alder Hey Children's Hospital, Liverpool, UK | [3]Newcastle Dental Hospital, Newcastle, UK

Correspondence: Lucy Simpson (lucy.simpson30@nhs.net)

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1 | Introduction

Historically, root canal treatment (RCT) has relied on a multiple visit approach due to the necessitated disinfection time by intra-canal medicaments between visits [1, 2]. A multiple visit approach may also be used in children and young people (CYP) to reduce individual appointment times in order to support co-operation. However, a recent systematic review found no significant difference in clinical and radiographic outcomes for patients receiving single visit RCT, when compared to multiple visit RCT, in closed apex teeth [3].

The European Society of Endodontology (ESE) advises a minimum clinical and radiographic follow-up of RCT of 1 year following obturation but protracted recall of up to 4 years may be required where there is incomplete healing or a traumatic dental injury (TDI) [2].

RCT with general anaesthetic (GA) may be required for CYP unable to tolerate treatment with other modalities. A multiple visit RCT approach with GA carries additional risk, cost and increases service demand. A retrospective study of adults with additional needs receiving single visit RCT with GA found periapical pathology to have resolved in 81.5% ($n = 221$) of teeth at 1-year follow-up and reduced in lesion size in a further 15.9% ($n = 43$) [4]. However, there is limited evidence regarding RCT approaches with GA for CYP, without consideration for apical maturity. There is currently no local or national standard for this, with preferences for delivering RCT with GA varying between individual operators or units.

2 | Aim

The aim of this study was to evaluate approaches and outcomes of RCT with GA at three tertiary centres in the United Kingdom.

2.1 | Objectives

To evaluate service delivery in relation to:

1. Endodontic approach (single or multiple visits);
2. Demographics and clinical history;
3. Procedural details;
4. Treatment outcomes.

3 | Materials & Methods

Participation in the service evaluation was advertised through the Child Oral health NatioNal rEsearch CollaboraTive (CONNECT) through regional representatives across the United Kingdom. The service evaluation was registered at each included tertiary centre. Pilot data were initially collected at Leeds Dental Institute and a data collection template finalised for use at further sites: Alder Hey Children's and Newcastle Dental Hospitals.

Retrospective data collection occurred for all CYP receiving RCT with GA between 2015 and 2017, to allow analysis of ESE recommended follow-up [2]. Data pertaining to demographic, clinical history, procedural details and treatment outcomes were collected (see Table 1) and extracted directly into Microsoft Excel (Microsoft Corporation). Descriptive statistics were completed at patient level for demographic details and tooth level for procedural and outcome details.

Absolute failures were considered when teeth required extraction. Relative failures included known treatment risks such as the need for further treatment (e.g., re-endodontics, restoration replacement) and clinically significant ankylosis.

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TABLE 1 | Data extracted from patient records.

Demographics	Age at time of GA
	Date of GA
	Medical comorbidities
Clinical history	Number of teeth root treated
	Indication for GA (TDI/Caries)
	Presence of hard tissue or periodontal ligament injury
	Presence of pre-operative symptoms
	Pathology at time of GA
	Endodontic treatment prior to GA
	Follow-up
	Post-operative problems
Procedural details	Other treatment completed at time of GA
	Number of endodontic visits
	Number of dental GA visits
	Use of rubber dam
	Irrigant used
	Obturation technique
	Sealer used
Outcome	Symptoms or failure at review
	Nature of treatment failure

4 | Results

Expressions of interest were received from eight centres, including one Community Dental Service. Representatives from three centres reported logistical difficulties in obtaining data, and two centres withdrew their interest, leaving three included units.

4.1 | Demographics and Clinical History

Twenty-two CYP had 32 RCTs across 26 GAs and 21 teeth were obturated. Most treated teeth, 78.1% ($n = 25/32$), were upper central incisors. The median age was 12 years (range 7–15 years); seven patients were aged between 7 and 9 and were determined to have had open apex central incisors when correlated with procedural details. Over half of patients, 59.1% ($n = 13/22$) had medical comorbidities including autism, attention deficit hyperactivity disorder, learning disabilities, epilepsy, cleft lip and/or palate, congenital heart disease and chromosomal syndromes. TDI was the indication for RCT in 81.3% ($n = 26/32$) of teeth, with caries in the remaining 18.8% ($n = 6/32$). Patients at half of the GAs ($n = 13/26$) were pre-operatively symptomatic and one child had received an RCT stage prior to GA. RCT was the sole indication for 46.2% ($n = 12/26$) of GAs, with three of these children receiving opportunistic fissure sealants or scaling.

4.2 | Procedural Details

Endodontic approaches and techniques utilised were diverse, with a wide range of dental materials used (Table 2). Record keeping of procedural details was often incomplete, with use of rubber dam, irrigant details and sealer type frequently not documented.

4.3 | RCT Outcome

Completion of RCT was recorded except for three cases where subsequent treatment fell outside of the evaluation period. One CYP received initial extirpation in the dental chair and a repeat intra-canal dressing with GA but was not brought for obturation under local anaesthetic.

Two teeth had documented absolute failures, due to fracture. Four teeth had relative failures; two teeth had clinically significant ankylosis (in the same patient) and two teeth had documented restoration failures requiring further GA. Notably, these teeth were restored without rubber dam.

5 | Discussion

Although delivered in small volumes at individual centres, RCT with GA presents a substantial demand on services and was the sole indication for 46.2% of GAs. There was wide variation in procedural approach. Notably, rubber dam and sodium hypochlorite use were only documented in 37.5% and 43.8% of cases, respectively. Additionally, Vitapex (a non-setting calcium hydroxide and iodoform paste) was used in one case despite not being a recommended obturation material for permanent teeth due to its properties [2]. Due to the historic nature of this evaluation, it may be that some procedural elements were not documented or that change in clinical practice has since occurred. The proportion of open apex teeth was not formally captured, which is a limitation to evaluation, and explicit recording of this is recommended in future.

A retrospective approach enabled evaluation of outcome data in the post-operative period recommended by the ESE. No observed failures related to the primary RCT. The details of the failures highlight the importance of case selection, use of rubber dam and ensuring adequate time for definitive restoration in a single-visit GA approach. Pragmatically, it was considered that subsequent failure was unlikely in the absence of further communication from families or referring general dental practitioner after discharge. It is acknowledged that asymptomatic RCT failure may have occurred in some CYP who may not tolerate radiographic monitoring or who failed to attend for review in primary care. Additionally, it may fail to capture CYP who transition out of paediatric services within this postoperative period.

Given the significant impact of multi-visit GA to patients and to services [5], although this was not a prospective study and cannot demonstrate causality, findings of this evaluation remain of clinical significance. Given the relatively small number of CYP receiving RCT with GA each year, with this mostly occurring

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TABLE 2 | Procedural details.

Procedural detail	Recorded outcome	Result
Number of visits ($n = 22$ children and young people)	Single visit RCT	45.5% ($n = 10$)
	Multiple visit RCT	54.5% ($n = 12$) Of these children: • RCT completed with GA over two visits ($n = 6$) • Initial access in dental chair, GA for obturation ($n = 1$) • Initial access with GA, obturation planned in dental chair ($n = 2$) • GA for first stage RCT, treatment incomplete ($n = 3$)
Rubber dam ($n = 32$ teeth)	Used	37.5% ($n = 12$)
	Not used	40.6% ($n = 13$)
	Not documented	21.9% ($n = 7$)
Irrigant ($n = 32$ teeth)	Sodium hypochlorite	46.8% ($n = 15$)
	Not documented	53.1% ($n = 17$)
Sealer ($n = 21$ obturated teeth)	Tubliseal	47.6% ($n = 10$)
	Resin sealer	23.8% ($n = 5$)
	Vitapex	4.8% ($n = 1$)
	PolyF	4.8% ($n = 1$)
	TempBond	9.5% ($n = 2$)
	Not documented	9.5% ($n = 2$)
Obturation technique ($n = 21$ obturated teeth)	Cold lateral condensation	47.6% ($n = 10$)
	Thermal obturation	38.1% ($n = 8$)
	Bioceramic plug and gutta percha backfill	9.5% ($n = 2$)
	Vitapex	4.8% ($n = 1$)

in secondary and tertiary centres, the present evaluation represents the largest reported sample to date. Retrospective data collection precluded evaluation of procedural aim at the outset, that is, whether a multiple visit RCT was planned or necessitated intra-operatively by the absence of a clean and dry canal. Any future evaluation could explore differences between treatment planned and treatment delivered through prospective evaluation. Alternatively, conducting a research project to prospectively identify patients would enable direct follow-up and collection of patient-level outcome data that could inform changes to practice.

6 | Action Plan

To enable the identification of current practice and reduce the limitations of historic documentation, a contemporary national multi-centre evaluation is planned to determine endodontic practices across a wider variety of settings including community dental services. This is planned through the British Society of Paediatric Dentistry's Quality Improvement and Research Committee's national audit programme within the next 12 months.

7 | Conclusion

This service evaluation presents the largest reported dataset on CYP receiving RCT with GA. The data highlight notable diversity in clinical practice and analysis was limited by suboptimal record keeping. Failures were associated with restoration failure, root fracture or ankylosis, rather than primary endodontic treatment. Further planned collaborative evaluation will provide a broader view of RCT practices with GA in the United Kingdom, in a wider variety of settings, to gain greater insight into the impacts on patients, families and services.

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Conflicts of Interest

The authors declare no conflicts of interest.

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