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Endodontic 'Solutions' Part 2: An Audit Comparing Current Practice in Belfast with UK and Republic of Ireland Dental Schools

Abstract: Endodontic lubricants, irrigating solutions and medicaments help reduce the microbial load within root canals. Primary and secondary cases involve different microbes. Each 'solution' or combinations thereof could play a significant role but no detailed guidelines exist on their use. An audit was undertaken to compare current practice in Belfast Dental School to the others across the UK and Republic of Ireland (ROI). This audit highlighted three main differences between Belfast and other dental schools. Many other institutions utilized other irrigants besides sodium hypochlorite (NaOCl), different intracanal medicaments, including calcium hydroxide, and higher concentrations of NaOCl. Having gathered this information, we ask, 'Is there sufficient evidence to change the endodontic regime currently used at Belfast Dental School?'. Using the findings from the literature review (Part 1), we introduce new evidence-based protocols for primary and secondary cases for use in Belfast Dental School.

Clinical Relevance: In the absence of detailed clinical guidelines on the use of endodontic lubricants, irrigants and medicaments in primary and secondary cases, it is important to be aware of current practice in UK and ROI dental schools where dentists and specialists are trained.

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There are two types of endodontic case, those involving teeth that have never been root-treated, known as primary, and those where a previous root treatment has failed, known as secondary. All cases involve microbes which are organized into protective adhesive biofilms,[1] but the species of microbes differ in primary and secondary cases. Primary infections tend to include many species, involving mostly gram negative anaerobes plus fungi.[2] Secondary infections, however, involve fewer species and often include *E faecalis,*[3–5] which can be difficult to

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Endodontic Solution	% Dental Schools
Pre-op oral rinse	21
Canal lubricant(s)	100
Sodium hypochlorite	100
Other irrigant(s):	
■ Primary cases	86
■ Secondary cases	86
Intracanal medicament(s):	
■ Primary cases	93
■ Secondary cases	100

Table 1. The percentage of dental schools using various endodontic 'solutions'.

eliminate.[6]

The aim of endodontic treatment or retreatment is to reduce the infection of the root canal system (RCS) sufficiently to allow the host response to favour healing of the periapical tissues.

Following the literature review in Part 1 of this paper it is clear that there are many endodontic 'solutions' available which are claimed to help prepare and disinfect the RCS. There are, however, only a few that have evidence to support their use clinically, although no detailed guidelines exist on this topic from the British Endodontic Society (BES), the European Society of Endodontology (ESE) and the American Endodontic Society (AES). In the absence of such guidelines, and in order to formulate protocols for primary and secondary cases for use in Belfast Dental School, an audit was undertaken on the current use of endodontic 'solutions' across UK and Republic of Ireland dental schools.

The current practice in the Restorative Department, Belfast Dental School is as follows: routinely no pre-op oral rinse is given: having accessed the RCS canal lubricant 19% ethylenediaminetetraacetic acid (EDTA) paste (File-Eze®, Ultradent Products Inc, South Jordan, UT, USA) is used with files: 10–20 ml/canal of 0.5% sodium hypochlorite (NaOCl) at room temperature, is the only irrigant used for both primary and secondary infections. In multi-visit cases, calcium hydroxide ($Ca(OH)_2$) paste (Hypo-cal, Ellman Int'l Inc Oceanside, New York, USA) is the main intracanal medicament used for both primary and secondary infections; along with the occasional use of *Ledermix* paste (Blackwell Supplies, Henry Schein UK Holdings Ltd, Kent, UK) if hyperaemia or failed anaesthesia occurred.

Audit data collection

Data collection forms were e-mailed to Restorative Specialist Registrars from all 16 dental schools across the UK and Republic of Ireland asking for details of the institution's treatment regimes under the following headings:

- Pre-operative oral rinse used (if any);
- Canal lubricant(s) used;
- Sodium hypochlorite (NaOCl):
  - Percentage;
  - Estimated volume per canal;
  - Room temperature or warmed?;
- Other irrigants and sequence for:
  - Primary cases:
  - Secondary/Retreatment cases;
- Intracanal medicaments:
  - Primary cases:
  - Secondary/Retreatment cases;
- Any other relevant information.

Results

The response rate was 87.5%, with 14 of the 16 dental schools participating (including Belfast). The percentage of dental schools using the various 'solution' categories outlined is presented in Table 1.

All dental schools used sodium hypochlorite (NaOCl) but with a wide range of volume (1–40 ml/canal) and range of strength (Figure 1) and only one institution warmed the solution. Only one responder mentioned a volume less than 10 ml/canal.

Primary cases

The other irrigants reportedly used included sterile water (H_20), 0.2–2%

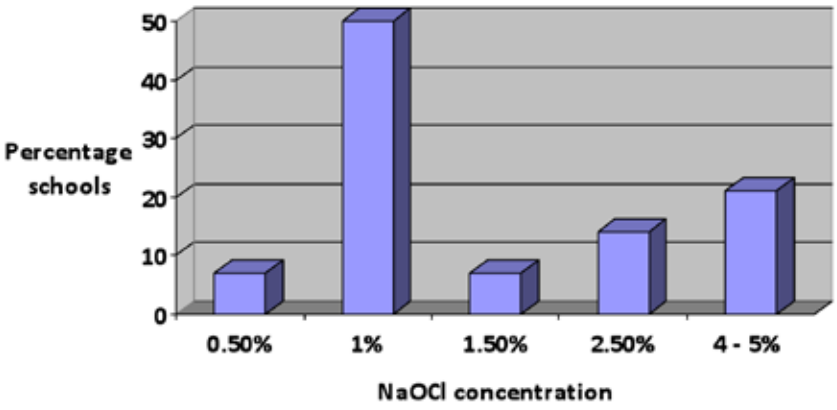

Figure 1. The percentage of dental schools using various concentrations of sodium hypochlorite.

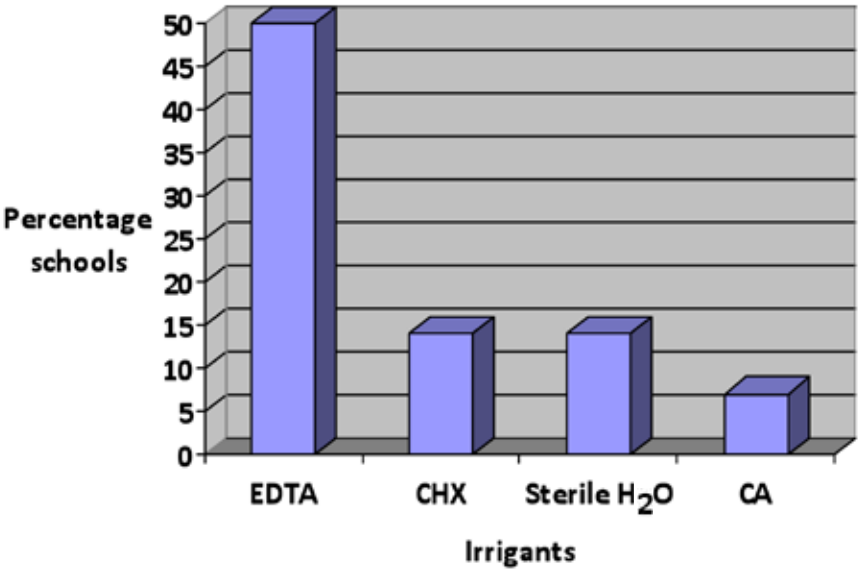

Figure 2. The percentage of dental schools using 'other irrigants' for primary cases.

chlorhexidine gluconate (CHX), 17% EDTA solution and 10% citric acid (CA) (Figure 2). The intracanal medicament used in most primary cases was non-setting $Ca(OH)_2$ paste (Figure 3).

There were 10 different protocols from the 14 dental schools for irrigant sequencing in primary cases:

- NaOCl;
- NaOCl; distilled H_2O;
- NaOCl; sterile H_2O; CHX occasionally; EDTA final flush;
- CHX & NaOCl (repeating); final flush NaOCl;
- NaOCl & CA (repeating); final flush NaOCl;
- EDTA; NaOCl; CHX;
- NaOCl; CHX; final flush EDTA;
- EDTA & NaOCl (repeating);
- NaOCl & EDTA (repeating); final flush EDTA;
- NaOCl (20 min); EDTA (3 min).

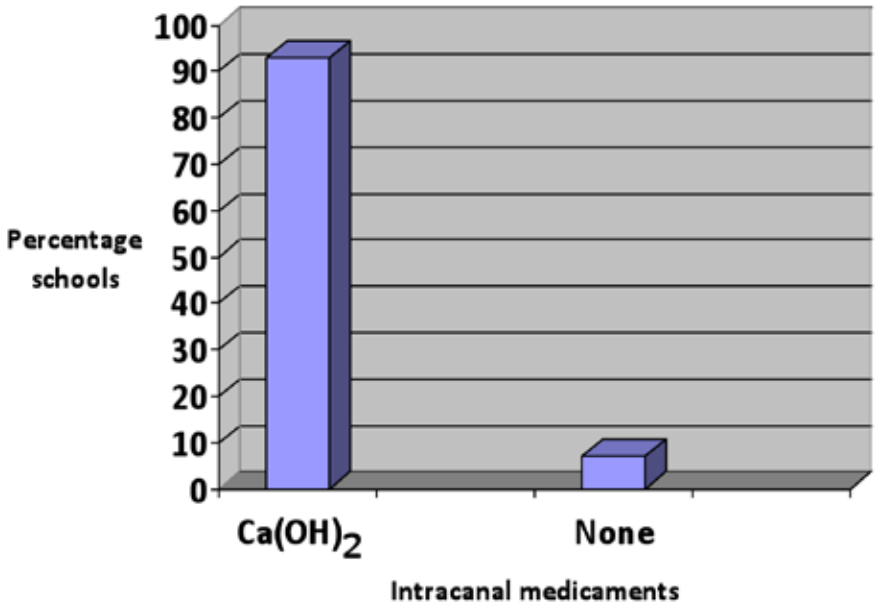

Figure 3. The percentage of dental schools using intracanal medicaments for primary cases.

Secondary cases

The 'other irrigants' used for secondary infections in some of the dental schools were the same as those for primary infections, apart from the inclusion of iodine (I) preparations (Figure 4). The intracanal medicaments used in retreatment cases included non-setting $Ca(OH)_2$ paste, 2% CHX gel, 10% povidone-iodine (I) or $Ca(OH)_2$ and I combined (Figure 5).

Of responders, 57% had the same irrigant sequence for primary and retreatment cases. There were 13 different protocols from the 14 dental schools for irrigant sequencing in secondary cases:

- NaOCl;
- NaOCl; CHX;
- NaOCl; sterile H_2O; occasionally CHX; EDTA final flush;
- NaOCl; distilled H_2O;
- CHX & NaOCl (repeating); final flush NaOCl;
- NaOCl & CA (repeating); penultimate rinse IKI (5–10 min); final flush NaOCl;
- EDTA; NaOCl; CHX;
- NaOCl; CHX or Povidone-Iodine;
- NaOCl; CHX; EDTA;
- EDTA & NaOCl (repeating);
- NaOCl; Povidone-Iodine; CHX; EDTA;
- NaOCl & EDTA (repeating); occasional Povidone-Iodine; final flush EDTA;
- NaOCl (20 min); EDTA (3 min); NaOCl (20 min); EDTA flush; CHX (3 min).

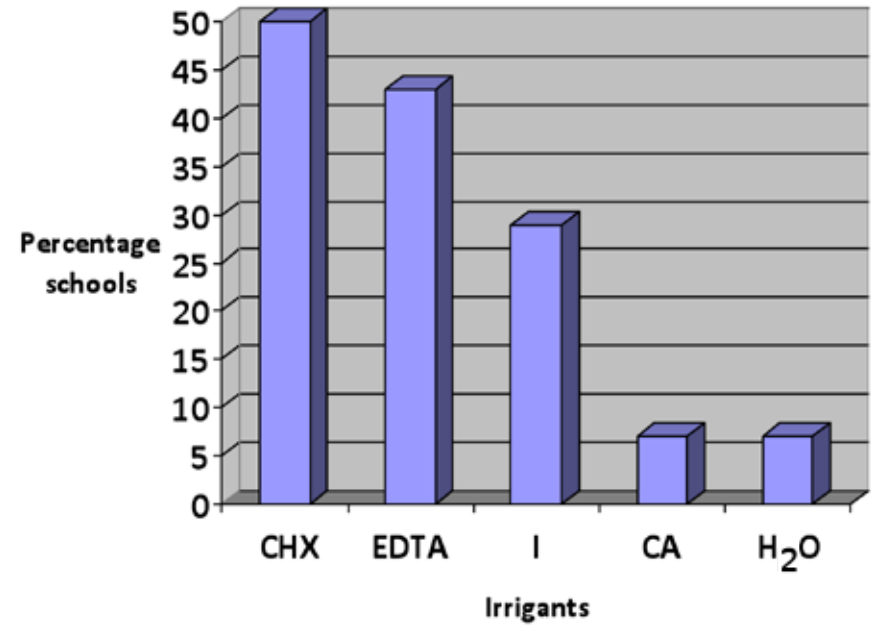

Figure 4. The percentage of dental schools using 'other irrigants' for secondary cases.

Reported comments included: use of 4% CHX (*Hibiscrub* Antiseptic Cleansing Solution, Regent Medical, Bedfordshire, UK) as an initial canal lubricant; use of freshly mixed $Ca(OH)_2$: $Ca(OH)_2$ was left *in situ* for 2–3 weeks; use of *Ledermix* paste (Lederle Pharmaceutical, Wolfrathausen, Germany) when hyperaemic vital tissue found within the RCS; use of Metapex™ (Meta Biomed Co Ltd, Chungbuk, Korea) (contains $Ca(OH)_2$ and iodoform) if symptoms were present; use of Sterilox® Solution (Ultradent Products, Inc, South

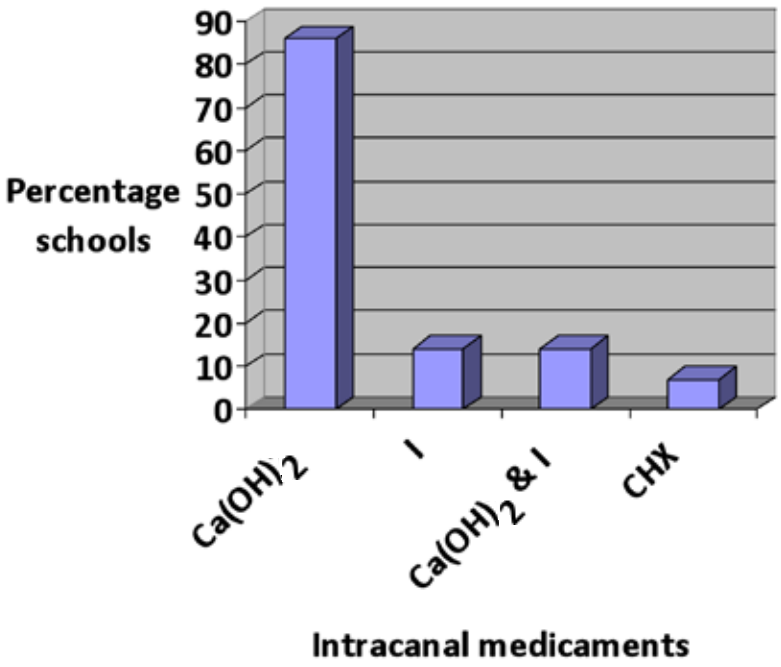

Figure 5. The percentage of dental schools using intracanal medicaments for secondary cases.

Sequence	Why?
Pre-op: CHX mouthwash	Reduce microbial load in saliva if incomplete isolation
Canal lubricant: EDTA paste	Removes inorganic blockage; file lubrication
Canal shaping: NaOCl (1%, 10–20 ml/canal, room temp, U/S*)	Removes organic tissue; antimicrobial; flushing action; file lubrication
Penultimate irrigant: EDTA soln (17%, 5 ml, 1 min, & U/S*)	Removes smear layer; first irrigant in multi-visit cases to remove calcium hydroxide medicament
Final irrigant: NaOCl (1%, 10–20 ml/canal, room temp, U/S*)	Washes out EDTA; removes organic tissue; antimicrobial; synergistic with $Ca(OH)_2$
Intracanal medicament: $Ca(OH)_2$	Antimicrobial

Table 2. Protocol for the endodontic 'solution' sequence in primary cases. *U/S = ultrasonics

Jordan), (super-oxidized water) and use of Bio Pure™ MTAD™ Cleanser (Dentsply International, York, PA, USA), a doxycycline, citric acid and detergent mix, which was reportedly used occasionally by one school.

Discussion and conclusion

Audits are designed to compare current practice with an accepted 'gold standard' but, as there are no detailed published guidelines on endodontic lubricant, irrigant and medicament use, this topic did not have one. Instead, it was decided to compare current practice in Belfast with the other dental teaching institutes across the UK and ROI where dental students and specialists are trained. These institutes are also influential on the clinical practices of general dental practitioners through the provision of postgraduate courses and lectures.

Restorative dentistry specialist registrars (SpRs) were chosen to complete the audit questionnaire as endodontics is a major component of their training and they ought to be familiar with their institute's recommendations on this topic. At the time of undertaking this audit project, one of the authors was a restorative dentistry SpR and had contacts with this group of trainees and, therefore, hoped that there would be a good response rate. Endodontic specialists or SpRs were not targeted as not every institute in the UK and ROI employs or trains this group.

This audit highlighted three main differences between current practice in Belfast and other dental schools across the UK and Republic of Ireland:

1. Most other dental schools were using a higher concentration of sodium hypochlorite;
2. Many other schools used a variety of 'other irrigants';
3. Alternative intracanal medicaments besides calcium hydroxide were in frequent use.

These results raised three important questions:

- What was the purpose of each endodontic irrigant and medicament?
- Do these 'solutions' used sequentially or concurrently interact favourably or otherwise?
- Was there sufficient evidence to change current practice at Belfast Dental School?
- The audit found that the dental schools did not have a unified approach. The Belfast 'endodontic solution' to this problem was to combine the findings from this audit with those from the literature review (Part 1) and develop evidence-based protocols for both primary and retreatment cases for use

Sequence	Why?
Pre-op: CHX mouthwash	Reduce microbial load in saliva if incomplete isolation
Canal lubricant: EDTA paste (if required)	Removes inorganic blockage; file lubrication
Canal shaping: NaOCl (1%, 10–20 ml/canal, room temp, U/S*)	Removes organic tissue; antimicrobial; flushing action; file lubrication
EDTA soln (17%, 5 ml, 1 min, & U/S*)	Removes smear layer; first irrigant in multi-visit cases to remove calcium hydroxide medicament
NaOCl (1%, 10–20 ml/canal, room temp, U/S*)	Washes out EDTA; removes organic tissue; antimicrobial
Sterile water flush or paper points	Prevents reaction between NaOCl & CHX
Final irrigant: CHX (2%, 10 ml, 5 min)	Antimicrobial (*E faecalis* & Candida)
Or penultimate irrigant: IKI (5%, 5–10 ml, 5–10 min) followed by NaOCl (1%, 10–20 ml/canal, room temp, U/S*)	If persistent signs/symptoms and not allergic; antimicrobial (*E faecalis*, Candida & viruses) To prevent discoloration of dentine by iodine; synergistic with $Ca(OH)_2$
Intracanal medicament: $Ca(OH)_2$	Antimicrobial (not *E faecalis*)

Table 3. Protocol for the endodontic 'solution' sequence in secondary cases. *U/S = ultrasonics.

in Belfast Dental School (Tables 2 and 3). These protocols need to evolve as research uncovers new knowledge on existing and new endodontic solutions, sequences and techniques.

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Book Review

Facial Aesthetics: Concepts and Clinical Diagnosis. Farhad B Naini. Oxford: John Wiley & Sons, 2011 (456pp, £86.95 h/b). ISBN 978-1-4051-8192-1.

The concept of facial aesthetics and, in particular, attractiveness is a fundamental one to dentistry in general and is also of special interest to the orthodontist. A desire to improve a perceived level of attractiveness is often a prime motivator in someone choosing to seek treatment. The subject matter of this book is therefore likely to be of some interest to clinicians from a wide range of dental specialties.

Although I found the front cover a little uninspiring, the book opens with a fascinating look at the historical background to this topic and demonstrates how the concept of beauty has occupied the minds of great thinkers and writers from Plato to Shakespeare. The author looks in some detail at how the classical canons in this area have evolved and been shaped by modern anthropometry and scientific advances to inform our current practice. The historical illustrations are superb and really help bring the subject matter to life.

The clinical diagnosis section of the book is logically organized and well presented, starting with general information gathering through the clinical interview and potential diagnostic record procedures. A detailed and regional descriptive approach is taken to cover evaluation of various areas of the face. The level of detail covered here is admirable, although it may also mean that the chapters are of most interest to those with a special interest in the field. The final two chapters, however, covering smile and dento-gingival aesthetics are likely to be of most interest to the non specialist.

Overall, this book is a thorough and well researched work which is a welcome and thoughtful addition to the dental literature. It is likely to be particularly valued by readers looking for a reliable and informative reference resource in this subject area.

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