A SURVEY OF DENTAL SURGEONS IN GHANA ON THEIR UTILIZATION OF SUPPLEMENTAL LOCAL ANAESTHETIC METHODS DURING ROOT CANAL THERAPY

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Abstract

***Background*:** Teeth with irreversibly inflamed pulps can be preserved with endodontic or root canal treatment (RCT). The primary methods used to manage pain during RCT are local infiltration injections and nerve blocks. When infiltrations are used, it is reasonable that the acidic nature of inflamed tissues, can reduce the availability of the active form of the local anaesthetic agent. In the case of nerve blocks, the acidity of the inflamed tissue is unlikely to play a significant role in the failure to achieve anaesthesia. Supplemental anaesthesia methods including periodontal ligament injection (intraligamentary), intraosseous injection, and intra-pulpal injection have been suggested as adjuncts to obtaining complete anaesthesia of the symptomatic irreversibly inflamed dental pulp.

***Aim*:** This study was to ascertain the types of supplemental anaesthesia techniques, and their levels of utilization during lower molar RCT in Ghana.

***Materials and methods*:** An online survey was done by e-mailing questionnaires to practicing dental surgeons registered on the Ghana Dental Association(GDA), google's group platform. Data obtained was analyzed using SPSS version 21.

***Results*:** Eighty-five percent (34) of respondents indicated that they employ supplemental injections during RCT. Pulpal and intraligamentary techniques were the most commonly used, with 70.6% and 47.1% of dentists reporting utilization respectively.

Conclusion: There is the need for update courses in the utilization of intraosseous supplemental local anaesthesia. Other supplemental injection techniques like the inferior alveolar nerve block (IANB) plus nitrous oxide inhalation have to be introduced to dentists carrying out RCT, so they can add such techniques to their pain management portfolio.

Keywords : RCT pain control, supplemental anaesthesia in Ghana, supplemental anaesthesia survey.

Introduction

In RCT the pulp cavity is accessed through the crown, and the dental pulp completely removed so the root system of the tooth can be chemo-mechanically cleaned and shaped for subsequent placement of a three-dimensional root filling. The chemo-mechanical cleaning and shaping is done with files and chemical irrigants. RCT is the definitive treatment when the dental pulp is irreversibly inflamed (as in symptomatic irreversible pulpitis), or necrotic (as in non-vital teeth) resulting from trauma to the tooth. Symptomatic teeth (diagnosed with irreversible pulpitis) resulting from for example, deep dental caries, cracked tooth syndrome; are examples of teeth that usually require RCT in other to be saved. RCT may however be carried out as an elective procedure in healthy teeth with severe wear (having vital and non-inflamed pulps) as part of the restorative treatment plan.

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Conflict of Interest : none declared

Pain management during RCT, is generally more challenging in symptomatic teeth, as compared with healthy teeth or teeth with necrotic pulps.

Predictable and consistent pain control throughout root canal therapy (RCT) is essential not only for the comfort of the patient, but also for the dental practitioner since it contributes to the success of the RCT appointment(s).[1] Conventional local anaesthetic techniques involve nerve blocks or infiltration with local anaesthetic agents. The site of local anaesthetic action is the voltage-gated sodium channel.[2] It is especially challenging to anaesthetize mandibular posterior teeth with a history of pain and a diagnosis of irreversible pulpitis. Several explanations have been offered for this observation in these teeth, commonly referred to as 'hot' teeth.[1,3,4] These explanations include the following;

i. The failure of penetration by the anaesthetic agent into the nerve bundle to reach the sensory nerves that innervate the pulp, particularly during inferior alveolar nerve blocks (IANB)[1],
ii. Failure to reach the core of the nerve bundle to block the nerves that supply the anterior lower teeth leading to high failure rates in achieving anaesthesia for these teeth following the IANB (central core theory)[1],
iii. Sensitization of peripheral pain receptors leading to disproportionate and even spontaneous firing in

response to stimuli ie, allodynia and hyperalgesia respectively[1],

iv. Acidic nature of inflamed tissues leading to a decrease in the ionized form of anaesthetic solution inside the nerve.[1]

Rosenberg[5] also suggests that, apprehensive patients may be a cause of local anaesthetic failure. Odontalgia often leads to increased anxiety in patients, resulting in a lowered pain threshold. A cascade of negative events may then follow in such patients, with initial anxiety leading to a reduced pain threshold, followed by a complication with the anaesthesia and thus increased apprehension.[5]

During inflammation, there is a change in the type of sodium channel expressed in the nerves.[6] Sodium channel expression shifts from tetrodotoxin-sensitive (TTXs) to tetrodotoxin-resistant (TTXr), leading to hyperalgesia of C nerve fibers.[6] These TTXr sodium channels are relatively resistant to local anaesthetics compared with TTXs channels.[6] Scholz et al[6] found that bupivacaine (long acting local anaesthetic) may be the anaesthetic of choice when there is hyperalgesia, because it is found to be more potent than lidocaine (Intermediate acting local anaesthetic) in blocking TTXr channels.

Following IANB, patients may report numbness of the lower lip suggesting achievement of anaesthesia. Objective tests with provoking stimuli based on the presenting complaint returns a response of no pain, but when endodontic access is commenced, the patient may complain of acute pain. This sequence of events frequently encountered in teeth diagnosed with symptomatic irreversible pulpitis, can be addressed with the use of supplemental injection techniques. These supplemental injection techniques currently include intra-ligamentary, intraosseous, intra-pulpal injections, and nitrous oxide with IANB.[5]

Rosenberg[5] suggests that, nitrous oxide provides minimal sedation, an analgesic effect and decreases the pain of the initial IANB in the anxious patient. These coupled with the impressive safety record of nitrous oxide allows the dentist to combine it with the usual IANB, as a form of supplemental injection.

Intra-ligamentary injections are done by positioning the needle firmly into the periodontal membrane space and expressing anaesthesia under back pressure. Intra-pulpal injections are made directly into the pulp chamber of the tooth, once some access has been obtained into the pulp chamber (but there is pain when contact is made with the pulp). Intraosseous injection techniques allow the direct deposit of the anaesthesia into the medullary bone after perforating the cortical plate (of the lower jaw) with specially designed needle tips (eg. Stabident and S-Tip).[7] Supplemental injection techniques (ie, intrapulpal, intraligamentary, and intraossous) not involving IANB, should only be employed after a successful IANB, objectively confirmed by lower lip numbness[5].

It has been suggested variously that, when RCT is indicated for symptomatic lower molars diagnosed with irreversible pulpitis, the employment of supplemental injection techniques should be anticipated.[3,5,8] When supplemental injection techniques are anticipated and implemented as part of the process of anaesthetizing such teeth prior to initiating RCT, supplemental injection methods that do not require access to the pulp chamber are usually preferred.

This survey was carried out to ascertain the types of supplemental anaesthesia techniques, and their level of utilization during RCT in Ghana. Secondary investigations included finding out which teeth were most frequently root treated, treatment choices resorted to by respondents when they are unable to achieve pulpal anaesthesia at the initial RCT appointment, the teeth that were difficult to anaesthetize during RCT, the diagnosis of teeth undergoing RCT that were difficult to anaesthetize, and the type (based on the duration of action) of local anaesthetic drugs they regularly use during RCT.

It was also meant to identify knowledge gaps and provide information that will help with designing further training for dentists on the indications for supplemental injection techniques. Finally, the outcome of this survey will help dentists who carry out RCT, to better manage patients in whom there is incomplete anaesthesia.

Materials and Methods

A cross sectional online survey of dental surgeons who undertake RCT in Ghana was carried out between March and July 2016. The weblink to the questionnaire asking about years of practice/rank, what teeth RCT was frequently carried out on, the diagnosis and tooth type that were frequently difficult to completely anaesthetize, what they considered as supplemental injection techniques, what supplemental injection techniques were used by them during RCT, what group of local anaesthetic drugs (based on the duration of action) was regularly used during RCT, and what treatment options were employed when incomplete anaesthesia was encountered as a problem during the initial RCT appointment; was sent to all registered dental surgeons who are members of the Ghana Dental Association (GDA), practice in Ghana and subscribe to the GDA google's group.

Respondents were informed in the email that the survey was a postgraduate research project. To encourage unbiased responses, no identification was requested. The questionnaire was designed so that respondents were reminded to answer questions they had omitted before progressing to the next page. If respondents answered that they do not undertake RCT, their survey was ended.

The weblink to the questionnaire was piloted on restorative dentistry residents of the University of Ghana School of Medicine and Dentistry prior to being emailed to dentists on the GDA google groups platform. All

responses to the questionnaires were electronically recorded.

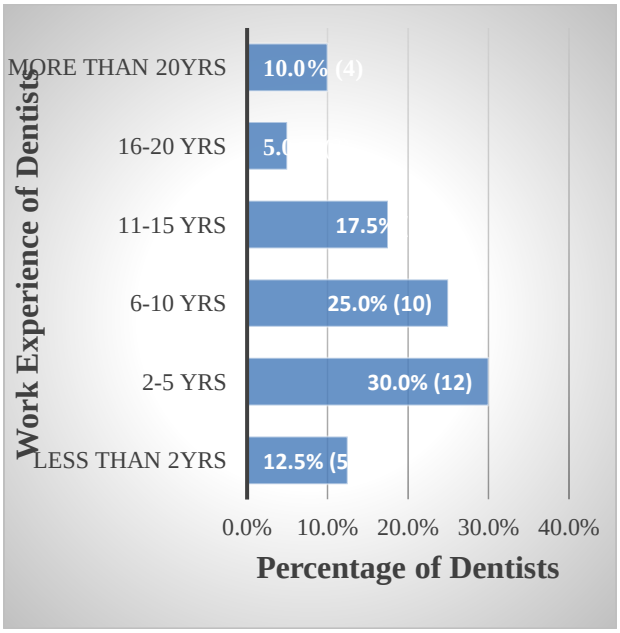
Descriptive statistics, including frequencies of responses and demographics of the respondents was analyzed using SPSS version 21. Data collected was used solely for purposes of research.

Results

Forty dentists completed the questionnaires (Response rate of 62%). Of the 40, (70.0%, 28) were males and (30.0%, 12) were females. Nine (22.5%) of the respondents had received postgraduate training involving endodontics. The distribution of working experience of the dentists is as shown in Figure 1.

77.5% of dentists indicated that they usually carryout RCT on mandibular molars **(Table 1a)**.
Lower molar RCT's were carried out by different ranks. Dentists with the rank of medical officer, carried out the most lower RCT's (Table 1b).

Figure 1. Distribution of working experience of the dentists



When asked for which teeth respondents experienced difficulties achieving anaesthesia during RCT? The responses in Table 2a were obtained.

In general, 57.5% (23) of the dentists reported ever having difficulty with achieving anaesthesia and maintaining anaesthesia during RCT. Specifically, 82.5% (33) of respondents mentioned lower molars in particular, as teeth that are frequently difficult to anaesthetize when RCT is indicated (Table 2a). The ranks of the 82.5% (33) dentists, is as shown in Table 2b. Thirty-one (77.5%) of the respondents reported further that, symptomatic irreversible pulpitis was the established diagnosis, of teeth that presented with difficulties in achieving complete anaesthesia.

Thirty-four dentists in this study (85.0%, p = 0.0000095) alluded to the use of some supplemental anaesthetic technique during lower molar RCT as opposed to 6 (15%) who had not. Figure 2 shows the supplemental methods as indicated by the 34 respondents. Table 3a and Table 3b breaks down the responses according to rank and years of practice of respondents respectively. In Figure 3, the preferred local anaesthetic agents (depending on the duration of action) used by dentists to anaesthetize the pulps prior to RCT is shown.

In situations where dentists were unable to achieve pulpal anaesthesia during the initial RCT appointment, the options shown in Figure 4 below were usually resorted to.

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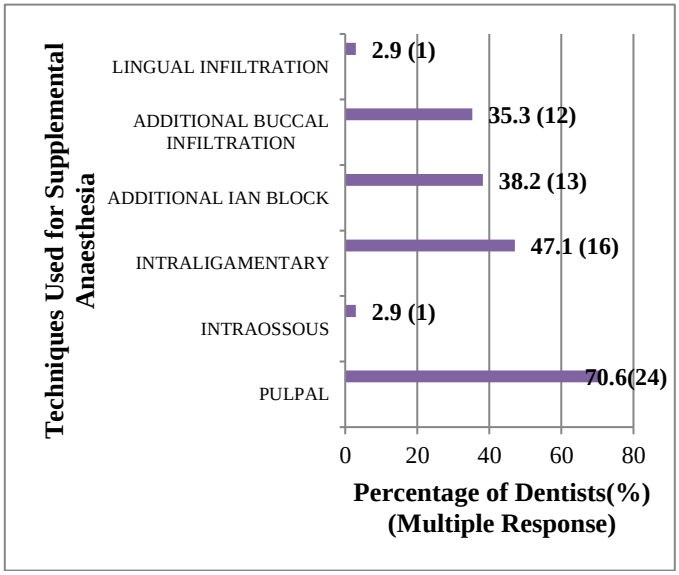

Figure 2. Supplemental anaesthetic Techniques

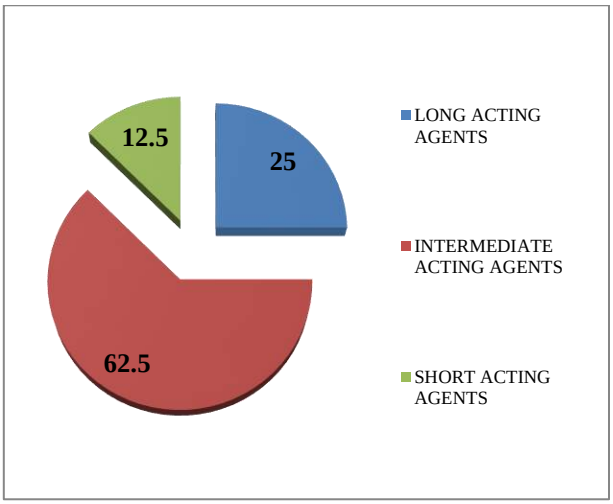

Figure 3. Local anaesthetic Used (%)

Table 1a. Teeth for which RCT is routinely carried out by respondents

Tooth type	Yes (Count/%)	No (Count/%)	Total responses (Count/%)
Upper anterior	21 (52.5)	19 (47.5)	40 (100.0)
Lower anterior	6 (15.0)	34 (85.0)	40 (100.0)
Upper premolar	25 (62.5)	15 (37.0)	40 (100.0)
Lower premolar	12 (30.0)	28 (70.0)	40 (100.0)
Upper molar	20 (50.0)	20 (50.0)	40 (100.0)
Lower molar	31 (77.5)	9 (22.5)	40 (100.0)

Table 1b. Work experience of surveyed dentists that perform lower molar RCT

Work experience	Number of dentists	Percentage (%)
< 2 years	4	12.9
2 - 5 years	9	29.0
6 - 10 years	7	22.6
11 - 15 years	5	16.1
16 - 20 years	2	6.5
> 20 years	4	12.9
Total	31	100.0

Table 2a. Teeth that respondents find difficulty in achieving and maintaining anaesthesia during RCT

Tooth type	Yes (Count/%)	No (Count/%)	Total responses (Count/%)
Upper anterior	2(5.0)	38 (95.0)	40 (100.0)
Lower anterior	2(5.0)	38 (95.0)	40 (100.0)
Upper premolar	4(10.0)	36 (90.0)	40 (100.0)
Lower premolar	4(10.0)	36 (90.0)	40 (100.0)
Upper molar	9(22.5)	31 (77.5)	40 (100.0)
Lower molar	33(82.5)	7 (17.5)	40 (100.0)

Table 2b. The rank/Position of dentists who selected lower molars in Table 2a

Rank/Position	Number of dentists	Percentage (%)
House Officer	3	9.1
Senior House Officer	5	15.2
Medical Officer	14	42.4
Senior Medical Officer	7	21.1
Specialist	4	12.1
Total	33	100.0

Table 3a. Supplementary anaesthesia techniques utilized based on rank

Rank/Position of Respondents	Pulpal	Intraosseous	Intraligamentary	Additional IAN	Additional Buccul Infiltration	Lingual Infiltration
House Officer (2)	1	0	0	0	1	1
Senior House Officer (5)	3	0	2	2	1	0
Medical Officer (13)	9	0	8	9	5	0
Senior Medical Officer (7)	5	1	2	1	1	0
Specialist (7)	6	0	4	1	4	0
Total Respondents/ %Respondents (34, 100%)	24 70.6%)	1(2.9%)	16 (47.1%)	13 (38.2%)	12 (35.3%)	1 (2.9%)

Table 3b. Supplementary anaesthesia techniques utilized based on years of practice of the respondents

Years of Practice (Number of Respondents)	Pulpal	Intraosseous	Intraligamentary	Additional IAN	Additional Buccul Infiltration	Lingual Infiltration
< 2yrs (4)	3	0	1	0	1	1
2 – 5yrs (12)	8	0	7	7	4	0
6 – 10yrs (9)	8	0	3	3	3	0
11 – 15yrs (4)	3	1	1	0	2	0
16 – 20yrs (2)	2	0	2	1	1	0
>20yrs (3)	0	0	2	2	1	0
Total Respondents/ Percentage of Respondents (34, 100%)	24 (70.6%)	1 (2.9%)	16 (47.1%)	13 (38.2%)	12 (35.3%)	1 (2.9%)

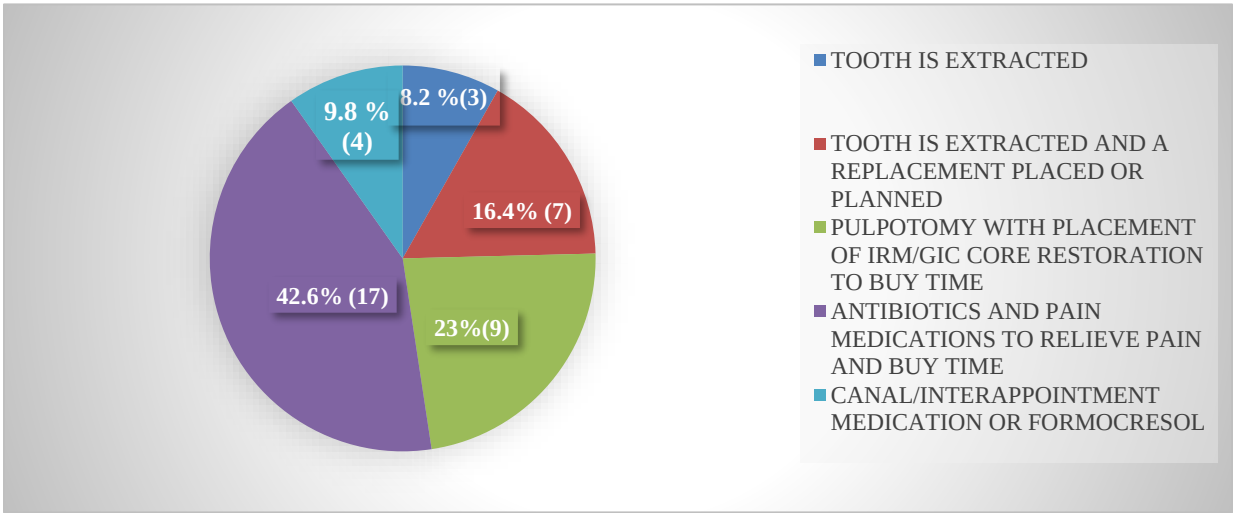

Figure 4. Treatment choices made by dentists when unable to achieve anaesthesia at initial RCT visit

Discussion

Most RCT's were carried out by general dental practitioners, with 9 (22.5%) of surveyed dentists having received postgraduate training involving endodontics.

Lower molar teeth had the greatest frequency of RCT undertaken on them (77.5%, 31). This was followed by upper premolar teeth (62.5%, 25), upper anterior teeth (52.5%, 21), upper molar teeth (50%, 20), and lower anterior teeth (15%, 6). Lower molars were also found in studies by Ismail and Ismail,[9] and Oglah et al[10] to be the teeth most frequently treated[9,10]. Al-Negrish[11] and Umanah et al[12] on the other hand reported that RCT's were more frequently undertaken in maxillary teeth than in mandibular teeth[11,12].

It has been observed that the leading pathology necessitating RCT is caries linked. This may imply that if the rate of uptake of RCT is high, the pattern of teeth treated may follow the reported order of susceptibility of teeth to caries in a population[13,14].

Success rates for pulpal anaesthesia with inferior alveolar nerve blocks (IANBs) have been found to range from 42% to 73% in noninflamed pulps[15,16] and 19% to 55% in teeth diagnosed with irreversible pulpitis[17–19]. All the patients in these studies[15–19] had expressed 100% lip numbness, an indication that their IANBs were successful. The findings in such clinical studies were confirmed by our surveyed dentists, with 77.5% (31) mentioning symptomatic irreversible pulpitis as the definitive diagnosis of teeth that are difficult to anaesthetize.

Considering the influence of tooth type, the reported difficulty in achieving anaesthesia is more in mandibular molars, followed by the mandibular premolars, the maxillary molars and premolars, and the mandibular anterior teeth. The maxillary anterior teeth present the least challenge[20]. In our survey, 82.5% (33) dentists also reported that lower molar teeth undergoing RCT are the most difficult to anaestheticize.

Eighty-five percent (85%, 34) of dentists reported having ever employed a supplemental anaesthetic method during RCT. The apparent utilization of supplemental anaesthetic methods by a significantly large portion of respondents (85%, p=0.00000955), may be explained by the fact that most of the dentists frequently treated lower molar teeth.

The most popular supplemental local anaesthetic injection method in our survey, was the intra pulpal (70.6%, 24), followed by the intraligamentary (47.1%, 16) and the intraosseous (2.9%, 1). The popularity of the intra pulpal method, may be because it is instinctive to resort to it once access has been secured to the pulp chamber. The intra-pulpal injection is however very technique-sensitive and requires the creation of adequate intra-pulpal pressure to ensure success[21]. A study by Birchfield and Rosenberg[22] highlighted the importance of getting the technique right.

Their study concluded that sterile saline or lidocaine 2% with 1:50,000 epinephrine were equally effective in producing pulpal anaesthesia when the intra-pulpal injection technique is used in the correct fashion[22]. To guarantee the generation of adequate intra-pulpal pressure during this injection, practitioners have to use the technique before widening the access cavity. It is possible that poor technique of intra pulpal injection technique may account for the difficulty in achieving anaesthesia during RCT of lower molars, despite the popularity of the intra pulpal injection method among the dentists we surveyed. In a survey done in the United States of America among Endodontic specialists, 94.77% of them used some form of intraosseous anaesthesia. The intraligamentary supplemental method was reported as the most popular (49.78%)[7] in that study. The fact that intraligamentary and intraosseous methods require special equipment may account for their low utilization by the dentists we surveyed.

The combination of IANB with inhalation of nitrous oxide as a form of supplemental anaesthesia during RCT, was not utilized by any of our surveyed dentists. This method requires equipment to deliver the nitrous oxide to the patient, whiles the rubber dam is still in place to protect the airway during RCT. Lack of familiarity with this concept of combining the IANB and nitrous oxide as a supplemental injection technique coupled with the absence of equipment needed to deliver the nitrous oxide gas whiles ensuring that the rubber dam isolation of the treated tooth is in place, may account for its non-utilization during RCT.

Twenty-six (76.4%) of the dentists however wrongly carried out additional IANB (38.2%, 13), additional buccal infiltrations (35.3%, 12), and lingual infiltrations (2.9%, 1) as supplemental injection techniques during RCT on molar teeth.

Our study participants were not asked reasons for their choice of local anaesthetic during RCT. Some clinical studies have however shown bupivacaine anaesthetic agent, to be more effective when used as IANB in teeth with irreversible pulpitis[23–26]. Such findings may explain the choice of bupivacaine anaesthetic agent (a long acting local anaesthetic) by 25% (10) of dentists during RCT.

In the case where time constraints or difficulties in achieving anaesthesia prevent pulp extirpation from been carried out, research has shown that the ideal treatment is pulpotomy followed by the placement of intermediate restorative material (IRM)[27]. The prescription of antibiotics as part of the management in this situation, has been shown not to be beneficial to the patient[28,29]. Seventeen (42.6%) of the survey respondents wrongly included prescription of antibiotics as part of their pain management modality, in situations where there had been failure to achieve anaesthesia at the initial RCT visit.

CONCLUSION

Even though there was wide adoption of supplemental local anaesthesia methods by 85% (34) of dentists, only (2.9%, 1) used the intraosseous supplemental anaesthetic method.

There is the need for update courses in the utilization of intraosseous supplemental local anaesthesia methods. Such update courses can also correct the misapplication

of additional IANB, lingual and buccul infiltrations as supplemental local anaesthesia methods. Supplemental injection techniques like the IANB plus nitrous oxide have to be introduced to dentists carrying out RCT, so they can add such techniques to their pain management portfolio.

The addition of new supplemental injection techniques, correction of practices like the prescription of antibiotics as part of endodontic pain management, and the bridging of knowledge gaps in the use and place of supplemental injection techniques during RCT will lead to greater success of endodontic practice in Ghana.

References

1. Rosenberg PA. Endodontic pain: Endodontic pain. *Endod Top* 2014; 30: 75–98.
2. Catterall WA. From ionic currents to molecular mechanisms: the structure and function of voltage-gated sodium channels. *Neuron* 2000; 26: 13–25.
3. Reader A, Nusstein J. Local anaesthesia for endodontic pain. *Endod Top* 2002; 3: 14–30.
4. Hargreaves KM. Management of pain in endodontic patients. *Oral Health* 2000; 90: 35.
5. Rosenberg PA. Local anaesthesia in endodontics. *Clin Dent Rev* 2017; 1: 2.
6. Scholz A, Kuboyama N, Hempelmann G, Vogel W. Complex blockade of TTX-resistant Na+ currents by lidocaine and bupivacaine reduce firing frequency in DRG neurons. *J Neurophysiol* 1998; 79: 1746–1754.
7. Bangerter C, Mines P, Sweet M. The use of intraosseous anaesthesia among endodontists: results of a questionnaire. *J Endod* 2009; 35: 15–18.
8. Reader A, Nusstein J, Drum M. *Successful Local Anaesthesia for Restorative Dentistry and Endodontics*. 1 edition. Quintessence Pub Co: Chicago, 2011.
9. Ismail NM, Ismail. Root canal treatment in Hospital Universiti Sains Malaysia Dental Clinic : a 5-year retrospective study /. 2008.
10. Oglah F, Zeidan B, Gholam M. Evaluation of endodontic treatment in three specialized private clinics in Baghdad (retrospective study). *MUSTANSIRIA Dent J* 2011; 8: 233–236.
11. Al-Negrish ARS. Incidence and distribution of root canal treatment in the dentition among a Jordanian sub population. *Int Dent J* 2002; 52: 125–129.
12. Umanah A, Osagbemiro B, Arigbede A. Pattern of demand for endodontic treatment by adult patients in Port-Harcourt, South-South Nigeria. *J West Afr Coll Surg* 2012; 2: 12–23.
13. Hopcraft MS, Morgan MV. Pattern of dental caries experience on tooth surfaces in an adult population. *Community Dent Oral Epidemiol* 2006; 34: 174–183.
14. Macek MD, Beltrán-Aguilar ED, Lockwood SA, Malvitz DM. Updated comparison of the caries susceptibility of various morphological types of permanent teeth. *J Public Health Dent* 2003; 63: 174–182.
15. Dunbar D, Reader A, Nist R, Beck M, Meyers WJ. Anaesthetic efficacy of the intraosseous injection after an inferior alveolar nerve block. *J Endod* 1996; 22: 481–486.
16. Childers M, Reader A, Nist R, Beck M, Meyers WJ. Anaesthetic efficacy of the periodontal ligament injection after an inferior alveolar nerve block. *J Endod* 1996; 22: 317–320.
17. Nusstein J, Reader A, Nist R, Beck M, Meyers WJ. Anaesthetic efficacy of the supplemental intraosseous injection of 2% lidocaine with 1:100,000 epinephrine in irreversible pulpitis. *J Endod* 1998; 24: 487–491.
18. Reisman D, Reader A, Nist R, Beck M, Weaver J. Anaesthetic efficacy of the supplemental intraosseous injection of 3% mepivacaine in irreversible pulpitis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1997; 84: 676–682.
19. Cohen HP, Cha BY, Spångberg LS. Endodontic anaesthesia in mandibular molars: a clinical study. *J Endod* 1993; 19: 370–373.
20. Hargreaves KM, Cohen S, Berman LH. *Cohen's pathways of the pulp*. 10th ed. Mosby Elsevier: St Louis, 2011.
21. VanGheluwe J, Walton R. Intrapulpal injection: factors related to effectiveness. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1997; 83: 38–40.
22. Birchfield J, Rosenberg PA. Role of the anaesthetic solution in intrapulpal anaesthesia. *J Endod* 1975; 1: 26–27.
23. Moore PA, Dunsky JL. Bupivacaine anaesthesia—A clinical trial for endodontic therapy. *Oral Surg Oral Med Oral Pathol* 1983; 55: 176–179.
24. Parirokh M, Yosefi MH, Nakhaee N, Abbott PV, Manochehrifar H. The success rate of bupivacaine and lidocaine as anaesthetic agents in inferior alveolar nerve block in teeth with irreversible pulpitis without spontaneous pain. *Restor Dent Endod* 2015; 40: 155–160.
25. Moradi S, Naghavi N. Comparison of Bupivacaine and Lidocaine Use for Postoperative Pain Control in Endodontics. *Iran Endod J* 2010; 5: 31–35.
26. Al-Kahtani A. Effect of long acting local anaesthetic on postoperative pain in teeth with irreversible pulpitis: Randomized clinical trial. *Saudi Pharm J* 2014; 22: 39–42.
27. Hasselgren G, Reit C. Emergency pulpotomy: pain relieving effect with and without the use of sedative dressings. *J Endod* 1989; 15: 254–256.
28. Keenan JV, Farman AG, Fedorowicz Z, Newton JT. A Cochrane systematic review finds no evidence to support the use of antibiotics for pain relief in irreversible pulpitis. *J Endod* 2006; 32: 87–92.
29. Aggarwal A, Luthra V. Role of Pharmacological Agents in Endodontic Therapy- a Mini Review. *J Adv Med Dent Sci Res* 2015; 3: 96–98.