ORIGINAL ARTICLE

Knowledge and practices of decontamination during root canal treatment by dentists in Jeddah

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Abstract  Background: The periapical area is healed through disinfection of root canal system and reduction of microbial infection after root canal.

Purpose: To assess the knowledge of dental practitioners about decontamination during root canal treatment and the techniques used in the government and private sectors of Jeddah, Saudi Arabia.

Methods: 103 dental practitioners and interns from private and governmental sectors performing root canal treatment were included. To extract information, a questionnaire assessing knowledge and preferred techniques used in decontamination during root canals treatment was distributed. The association of variables was investigated using chi-square tests.

Results: The findings reflected that 82.5% of subjects used rubber dam for isolation with significantly more practitioners in the governmental sector (95.2%) as compared to the private sector (27.8%). Chelating agents were used by 13.3% of the practitioners in government sector and 1% practitioners in private sector (1%). The most commonly used irrigant was sodium hypochlorite. Calcium hydroxide was used more frequently in the governmental sector (29.8%) than in the private sector (11.8%), as intracanal medicament. Mechanical irrigation devices were used by 2.4% of practitioners in the governmental sector only.

Conclusions: There is a significant difference in practicing root canal disinfection techniques among dentists in governmental and private sectors but no difference in degree of knowledge.

1. Introduction

Endodontic treatment prevents the development of microbial infection, as it involves successful entrance, cleaning, shaping, and obturation of root canal system. Periapical healing is carried out by the adjacent periodontium, once the microbial insult within the tooth has been controlled (Panuganti et al., 2016). All steps involved in the endodontic treatment are responsible for minimizing and eliminating the microbial contamination, following the aseptic sequence (Haapasalo et al.,...
Mechanical cleaning and shaping of the root canal result in removal of bacteria and debris. This is opened up and disinfected by using the chemical antibacterial and chelating agents. The long-term success of endodontic treatment depends on complete debridement and disinfection of pulpal space. However, the irregularities of root canal systems depend on residual pulpal tissue, dentin debris, and bacteria, even after meticulous mechanical preparation (Gomes et al., 2013).

The use of rubber dam provides significant patient production, clean operating field, retraction and protection of soft tissues, and improved access and visibility; therefore, it is considered as standard care provided during the root canal treatment (Hulsmann, 2016). Rubber dam is capable of protecting from aspiration of operative materials. It is also responsible for minimizing the contamination of accessed root canal space from oropharyngeal micro-organisms, either in aerosolized or in saliva. The absence of rubber dam is associated with poorer outcomes as the ability to disinfect the canal space is compromised (Kulild, 2013).

The treatment outcome is determined on the basis of disinfectant agents used during root canal treatment (Unal et al., 2012). The irrigating solutions possess a broad antimicrobial spectrum and high efficacy against anaerobic and facultative microorganisms organized in inactivate endotoxin, biofilms, and dissolve necrotic pulp tissue remnants. Endodontic irrigants coming in contact with the vital tissues need to be nontoxic, non-caustic to periodontal tissues, and also have decreased ability to cause anaphylactic reaction. Sodium Hypochlorite (NaOCl) is among the most effective irrigants for eliminating microbes. Its antibacterial effectiveness is a function of concentration and contact time (Baumgartner et al., 2007). The endodontic instrumentation produces a smear layer that is potentially contaminated and it delays or inhibits the penetration of microbial agents. This smear layer and superficial debris from the surfaces of instrumented root canals are effectively removed by flushing of the root canals with the chelating agent known as ethylenediaminetetraacetic acid (EDTA) (Baumgartner et al., 2007). Aqueous solution of 2% chlorhexidine gluconate is sometimes used to irrigate the root canals as it has a high kill rate against E. faecalis (Basrani, 2011). Chlorhexidine is unable to dissolve necrotic tissue remnants and is more effective on Gram-positive bacteria, as compared to Gram-negative bacteria. It cannot be advocated as the main irrigant in standard endodontic cases. Zehnder (2006) conducted a randomized trial to show that 0.2% chlorhexidine was less efficient compared to 2.5% hypochlorite to obtain negative cultures. Sodium Hypochlorite (NaOCl) is among the most effective irrigants for eliminating microbes. Its antibacterial effectiveness is a function of concentration and contact time (Baumgartner et al., 2007). The endodontic instrumentation produces a smear layer that is potentially contaminated and it delays or inhibits the penetration of microbial agents. This smear layer and superficial debris from the surfaces of instrumented root canals are effectively removed by flushing of the root canals with the chelating agent known as ethylenediaminetetraacetic acid (EDTA) (Baumgartner et al., 2007).

Aqueous solution of 2% chlorhexidine gluconate is sometimes used to irrigate the root canals as it has a high kill rate against E. faecalis (Basrani, 2011). Chlorhexidine is unable to dissolve necrotic tissue remnants and is more effective on Gram-positive bacteria, as compared to Gram-negative bacteria. It cannot be advocated as the main irrigant in standard endodontic cases. Zehnder (2006) conducted a randomized clinical trial to show that 0.2% chlorhexidine was less efficient as compared to 2.5% hypochlorite to obtain negative cultures (Zehnder, 2006). Therefore, chlorhexidine will be more efficacious if used after the NaOCl has dissolved as much tissue as possible (Basrani, 2011). However, it is not essential to use these two solutions consecutively in the same setting as their chemical interaction produces a toxic precipitate (Basrani, 2011).

The eradication of microorganisms from root canal is achieved by using Ca(OH)₂ that works as an interappointment medication. Complete eradication cannot be achieved in a single visit irrigation (Sjögren et al., 1997). The intra-canal medicament can be prevented from escaping into the oral cavity by preventing the entry of fluids, microorganism, and other debris into the root canal (Ciftci et al., 2009). The presence of a satisfactory permanent coronal restoration is considered major postoperative factor influencing periapical health that provides seal against bacterial contamination (Ng et al., 2011). Dentists have a vital role in minimizing decontamination (Natto, 2014). To identify the requirement of intervention and remediation to improve the general outcome of root canal treatment, it is essential for dentists to study the level of knowledge, attitudes and behavior of disinfection. This study aims to evaluate the knowledge of dental practitioners regarding decontamination methods, as well as their reported practices of materials and techniques used during root canal treatment in some governmental and private practice clinics in the city of Jeddah.

2. Material and methods

2.1. Study design and duration

Cross-sectional analysis was employed to assess the knowledge of dental practitioners regarding decontamination methods. The study was conducted from 2016 to 2017 among 103 dentists, who performed root canal treatment. Confidentiality was ensure among the recruited participants. Institutional Review Board committee at King Abdul-Aziz University, Faculty of Dentistry (KAUFD) approved this study. The study procedure was according to the World Medical Association Declaration of Helsinki.

2.2. Ethical approval

Dentists were selected randomly from different private and governmental hospitals in Jeddah. Random sampling was conducted in a way that every individual had equal chance to be selected among the targeted population. The inclusion criteria included dentists who performed root canal treatment. Incomplete or non-complied questionnaires were excluded.

2.3. Inclusion and exclusion criteria

Data was collected through questionnaires distributed to any dentist who performed root canal treatment in different types of clinical practice in Jeddah, Saudi Arabia (Table 1). The questionnaires were distributed via email, having two sections as below;

- First section gathered demographic details of the dentists including: gender, educational degree, place of work, number of years of practice, number of cases handled per month etc.
- Second section addressed the participant’s clinical practice such as: the use of rubber dam, different root canal irrigants, and intracanal medications used between appointments, mechanical irrigation devices and coronal seal after root canal treatment.

All questions required single answer choice except for a few questions about practices that allowed multiple answers.
Table 1: Demographic details of the respondents.

| Measure               | Items                  | No. | Percentage |
|-----------------------|------------------------|-----|------------|
| Name of government organization | King Abdul-Aziz University Dental Hospital | 43  | 51.1% |
|                       | Ministry of Health General Dental Clinics | 11  | 13.0% |
|                       | King Fahad Armed Forces Hospital | 19  | 22.6% |
|                       | National Guard Health Affairs | 11  | 13.0% |
| Type of private setting | Hospital setting | 8   | 25.0% |
|                       | Polyclinic setting   | 18  | 56.2% |
|                       | Independent setting  | 6   | 18.7% |
| Years of Experience   | <1 year               | 34  | 33.0% |
|                       | 1–5 years            | 48  | 46.6% |
|                       | 6–10 years           | 7   | 6.8%  |
|                       | >10 years            | 14  | 13.6% |

2.5. Statistical analysis

Data gathered through the questionnaire was coded and analyzed using SPSS version 20.0. Central tendency and dispersion were determined through descriptive analysis that helped in building understanding of the general characteristics of the study population. The association between different variables was established using chi-square test.

3. Results

The response rate was much higher from the governmental sector (81%) as compared to the private sector (17%). The demographic details of the respondents have been presented in Table 1. Majority of the respondents (51.1%) were from King Abdul-Aziz University Dental Hospital, followed by King Fahad Armed Forces Hospital (22.6%). The respondents were either from polyclinic setting (56.2%), hospital setting (25.0%), or independent setting (18.7%). Majority of the respondents (46.6%) had experience of 1–5 years; whereas, 33% had experience of <1 year. It was shown that sodium hypochlorite (NaOCl) was the best root canal irrigant for the majority of the dentists (66%); while, 58.3% knew the actions of this material. The action of chlorhexidine gluconate (CHX), chelating agents, and Ca(OH)2 were known by 71.8%, 63.1%, and 46.6% of the study population, respectively (Table 2).

Rubber dam was used by the majority of dentists (82.5%) for isolation; however, its routine use was reported by only 63.1% of them. The remaining 18.4% reported the use of partial isolation methods. Disapproval from the patient side (14.6%) and increased time consumption (15.5%) were considered as the most common reasons hindering the adoption of using rubber dam. More practitioners (95.2%) from governmental sector reported using rubber dam in their practice as compared to practitioners from private sector (27.8%) (p < 0.01). In both the sectors, sodium hypochlorite was the most commonly used irrigant. Chelating agents were used by 13.0% of practitioners in governmental sector and 11.0% of practitioners in private sector. Calcium hydroxide as intra-canal medicament was used more frequently in the governmental (29.8%) than in the private sector (11.8%) (p < 0.05). The mechanical irrigation devices were used by 2.4% of practitioners in the governmental sector only (Table 3).

Table 4 has shown significant difference in the level of knowledge about action and effective concentrations of certain irrigants such as EDTA, among the interns and dentists. There was no difference between interns and general dentists in practicing techniques like; using rubber dam, irrigation solutions, or intracanal medication. Table 5 illustrated the use of mechanical irrigation devices and educational degree were significantly associated (p < 0.01).

4. Discussion

The study employed a cross-sectional design based on questionnaire to demonstrate the level of differences between dental practice in both private and governmental sectors. Rubber dam is known as the standard of care during root canal treatment. In this study, 82.5% of the participants used rubber dam in both public and private sectors. These results were inconsistent with the study performed by Al-Fouzan (2010) showing that only 3% of the involved practitioners used rubber dam. More than 80% of the practitioners used sodium hypochlorite in their routine practice. Similar to this, a study conducted by Natto (2014) reported that 70% of the dentists use sodium hypochlorite. However, it contradicts Unal et al. (2012), who found that only 25% of practitioners used sodium hypochlorite during endodontic treatment.

Disinfection during root canal treatment is traditionally performed by introducing the solution into the root canals that allow it to flow and flush out of the access cavity, passively. It is difficult to remove the bacterial biofilms from all the aspects of root canal system because of the internal complexity of the system. Effective removal of smear layer and disinfecting root canals is possible through active irrigation and mechanical means as it favors further penetration of irrigating solutions into the root canal spaces. This sort of penetration develops contact between the irrigating solution and parts of the canal walls that were not possible to reach (Basrani, 2011). The frequency of use of active irrigation techniques by dental practitioners was not investigated in the current report. Active
Irrigation in the field of endodontics tends to initiate fluid hydrodynamics for improving the disinfection procedures. It plays an important role in the cleaning of well-shaped canals that include; lateral canals, anastomoses, dentinal tubules, webs, and fins.

Majority of the dentists reported that they placed temporary restorations, immediately after root canal therapy. This may be due to various reasons; for instance, referral to another dentist for placing restoration and lack of knowledge regarding the detrimental effect of not placing a final restoration immediately. The placement of temporary restoration after root canal increases the risk of developing tooth fracture and coronal leakage. Moreover, there is increase in the microbial penetration within the endodontic cavities with temporary filling materials, which has detrimental effect on the long-term prognosis of endodontic therapy (Cardoso et al., 2014). Previous studies were consistent with the results of the present study, which showed that there should not be long gap between root canal filling and final coronal sealing (Estrela et al., 2008; Kayahan et al., 2008; Cardoso et al., 2014).

Collagen depletion is experienced during the process of endodontic treatment, which decreases the dentine elasticity predisposing to fractures during the shearing forces (Eliyas et al., 2015). The present study showed significant difference in the level of knowledge about the action and effective concentrations of certain irrigants among the general dentists and interns. The results depicted that majority of the general practitioners did not follow the current recommended

| Practice | Private sector | Governmental sector | p-value |
|----------|----------------|---------------------|---------|
| Use of rubber dam | 5 (27.8%) | 80 (95.2%) | 0.000** |
| Use of Sodium hypochlorite, (NaOCl) | 14 (82.4%) | 72 (85.7%) | 0.263 |
| Chelating agent (like EDTA or MTAD) | 2 (11.1%) | 11 (13.3%) | 0.969 |
| Intra canal medication calcium hydroxide (Ca(OH)₂) | 2 (11.8%) | 25 (29.8%) | 0.018* |
| Use mechanical irrigation devices (like EndoVac system) | 0 (0%) | 2 (2.4%) | 0.744 |

| Practice | Measure | Educational Degree | p-value |
|----------|---------|-------------------|---------|
| The action of Sodium hypochlorite (NaOCl): Remove the organic material from root canal broad spectrum antimicrobial agent | 32 (59.3%) | 11 (57.9%) | 0.353 |
| The effective and safe concentration of Sodium hypochlorite (NaOCl): 1.5% – 2.5% 5% – 7% | 26 (48.1%) | 10 (52.6%) | 0.384 |
| The action of chlorhexidine (CHX): Broad spectrum antimicrobial agent | 36 (66.7%) | 10 (52.6%) | 0.189 |
| The effective and safe concentration of chlorhexidine (CHX): 10%-15% | 7 (14.0%) | 0 (0.0%) | 0.599 |
| The action of the chelating agent like (EDTA or MTAD) Remove the nonorganic part of smear layer | 30 (55.6%) | 11 (57.9%) | 0.345 |
| The effective concentration of EDTA 15% | 10 (18.5%) | 1 (5.3%) | 0.000** |
| Intra canal medication calcium hydroxide (Ca(OH)₂): Antimicrobial agent Obliterate the canal space to prevent bacterial growth | 39 (72.2%) | 17 (89.5%) | 0.421 |
| The duration of calcium hydroxide (Ca(OH)₂) to start its effect: 1 week | 32 (59.0%) | 4 (21.1%) | 0.322 |

* p < 0.05.
** p < 0.01
endodontic irrigation techniques in several areas. There is a need of upgrading and monitoring the irrigation techniques adopted by the dental practitioners as well as the interns to ensure high success rates of the endodontic treatment.

Rubber dam was used by majority of the practitioners (82.5%) for isolation; whereas, the remaining used partial isolation methods because rubber dam was time consuming and disapproved by the patients. Whereas, Unal et al. (2012) reported about the use of rubber dam in improving the quality and success of root canal therapy. A study similar to the present study showed that rubber dam isolation was applied by 56.3% of the dentists; whereas, still 24.2% used partial isolation for root canal therapy (Bogari et al., 2019). These results are in line with the conclusions drawn in the present study. However, previous studies conducted in Saudi Arabia have reported 9–14.7% use of rubber dam by dentists after root canal treatment (Iqbal et al., 2014; Mathew et al., 2015), 56.3% of the dentists; whereas, still 24.2% used partial isolation for root canal therapy (Bogari et al., 2019). These results are in line with the conclusions drawn in the present study. However, previous studies conducted in Saudi Arabia have reported 9–14.7% use of rubber dam by dentists after root canal treatment. The present study has reported that effective concentration of sodium hypochlorite that should be used. The dentists in governmental and private sectors. There is an insignificant difference in the canal disinfection techniques between dentists in governmental and private sectors. There is an insignificant difference in the degree of knowledge between both of them. These results recommend the implementation of improved techniques regarding decontamination methods by creating stricter clinical protocols and conducting continuing educational workshops. In future, the scope of the study can be expanded on a larger sample of dental practitioners to allow a greater understanding of the challenges they face in carrying out efficient decontamination practices during root canal treatment.

Table 5: Association between educational degree and years of experience with practicing technique.

| Practice | Measure | Educational degree | Years of experience | p-value |
|----------|---------|--------------------|---------------------|---------|
|          |         | General dentist    | Intern dentist      | (< 1 year) | (1–5 years) | (6–10 years) | (> 10) |
| Rubber dam use | No. % | 40 74.1 | 19 100 | 32 100 | 37 77.1 | 5 71.4 | 9 64.3 |
| Chelating agent (like EDTA or MTAD) | Always | 4 7.5 | 2 10.5 | 5 15 | 4 8.5 | 2 28.6 | 2 14.3 | 0.824 |
|          | Sometimes | 40 75.5 | 14 73.7 | 26 77 | 34 72.3 | 5 71.4 | 10 71.4 | 0.197 |
|          | Never | 9 17 | 3 15.8 | 3 8.8 | 9 19.1 | 0 0 | 2 14.3 |
| Intra canal medication calcium hydroxide (Ca(OH)2) | Always | 15 28.3 | 5 26.3 | 9 27 | 15 31.3 | 1 14.3 | 2 15.4 | 0.427 |
|          | Sometimes | 35 66 | 13 68.4 | 24 71 | 32 66.7 | 6 85.7 | 9 69.2 | 0.571 |
|          | Never | 3 5.7 | 1 5.3 | 1 2.9 | 1 2.1 | 0 0 | 2 15.4 |
| Use mechanical irrigation devices (EndoVac system) | Always | 1 1.9 | 0 0 | 0 0 | 1 2.1 | 0 0 | 1 7.1 | 0.754 |
|          | Sometimes | 4 7.4 | 1 5.3 | 3 8.8 | 4 12.5 | 3 42.9 | 2 14.3 | 0.334 |
|          | Never | 49 90.7 | 18 94.7 | 31 91 | 41 85.4 | 4 57.1 | 11 78.6 |

**p < 0.01

Adou-Assoumou et al. (2016) revealed that approximately 76% of practitioners were not aware of the recommended concentration of sodium hypochlorite that should be used. The present study has reported that effective concentration of sodium hypochlorite was not known by 43% of practitioners.

5. Conclusion

Results have depicted significant difference in practicing root canal disinfection techniques between dentists in governmental and private sectors. There is an insignificant difference in the degree of knowledge between both of them. These results recommend the implementation of improved techniques regarding decontamination methods by creating stricter clinical protocols and conducting continuing educational workshops. In future, the scope of the study can be expanded on a larger sample of dental practitioners to allow a greater understanding of the challenges they face in carrying out efficient decontamination practices during root canal treatment.

Ethical approval

The proposal of the article titled “Knowledge and Practices of Decontamination during Root Canal Treatment by Dentists in Jeddah” has been granted the ethical approval from Committee of Department of Endodontics Proposal Number 039-15, Faculty of Dentistry, King Abdul Aziz University, Jeddah, Saudi Arabia 04/10/2015.
Declaration of Competing Interest

The author declares no conflict of interest.

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