

Etiologies of Complications during Endodontic Treatment: A Survey among Dentists of the Town of Abidjan

Marie-Chantal Avoaka-Boni^{1,*}, Wendpoulomé Aimé Désiré Kaboré²,
Stéphane X Djolé¹, Kouakou Florent Kouadio¹, Koffi TD Kouadio¹

¹Department of Conservative Dentistry and Endodontics, Félix Houphouët Boigny University,
Abidjan, 22 BP: 612 Abidjan 22, Ivory Coast

²Department of Conservative Dentistry and Endodontics/Research Center of Health Sciences,
Joseph KI-ZERBO University, 03 BP 7021 Ouagadougou 03, Burkina Faso

*Corresponding author: mchavoaka@gmail.com

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Abstract Objective: This study aimed to identify the etiologies of complications linked with the various stages of the operating procedure for endodontic treatment by means of a survey among dentists in the town of Abidjan so as to better understand and prevent such complications. **Materials and Methods:** This was a prospective and descriptive study. A data collection form was devised for this purpose. The following variables were collected: the type of practice, the number of years in practice, the frequency of root canal treatments performed, the complications encountered and identification of the etiological factors. **Results:** The questionnaire was completed by 135 dentists. Among them, 65.9% performed up to 10 endodontic treatments per month. The majority (92.7%) stated that they encountered between 1 and 4 cases of complications per month in the course of endodontic treatment. The absence of preoperative radiography was the most often cited reason (64.44%) followed by erroneous diagnoses (14.07%). **Conclusion:** Altogether, the results show non-adherence to the procedures for performing endodontic treatments, which is the source of most complications. There is an urgent need to realign practitioners with the rules of good practice during endodontic procedures.

Keywords: root canal treatment, complication, etiologies, dental surgeons of Abidjan

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1. Introduction

Many epidemiological studies report a strong association between apical periodontitis and inadequate technical quality of root filling. Furthermore, they show unsatisfactory quality of root canal treatment carried out in general practice and in dental teaching hospitals [1,2]. On the contrary when the endodontic therapy is performed "*lege et artis*" the success rate for endodontic therapy is very high, between 73% and 98% [1,3,4]. In Ivory Coast, like in a lot of others African and European countries, endodontics isn't a specialty, and the majority of endodontic procedures are carried out by general practitioners (GP). They rarely respect the basic principles to correctly perform an endodontic therapy, probably due to low standard of undergraduate training [3].

It is crucial that GP may get benefit from the teaching of endodontic specialists in order to improve the quality standards of root canal treatment. New technologies

should be used in order to train and allow them to be able to perform regularly and correctly an endodontic therapy, as the ESE undergraduate curriculum guidelines recommend [3].

A lengthy series of procedural errors have been associated with endodontic treatment failures, the main ones being persistence of the bacteria, inadequate shaping, inadequate filling, missed anatomy, errors in making the access cavity preparation (ECA), iatrogenic root perforations, and instrument fractures [5]. They arise when the endodontic treatment does not rigorously adhere to the established clinical principles. Indeed, endodontic treatment is meticulous and difficult, due to the anatomical variations, the complexity of the network to be cleaned, and the lack of visibility during the operating process, the practitioner often only being able to rely on an image in two dimensions. Despite scientific and technological advances in endodontics, accidents and complications during canal treatment can occur at any stage of the endodontic therapy. The professionals performing the treatment, need to adopt all the means to not compromise the success of the treatment [6]. In Ivory Coast, a study has reported that endodontic

treatment represents the most common procedure performed on a daily basis [7]. In light of this, we sought to identify the etiologies of complications linked with the various stages of the operating procedure for endodontic treatment by means of a survey among dentists in the town of Abidjan so as to better understand and prevent such complications.

2. Methodology

2.1. Ethical Considerations

The research protocol of this study was approved by the National Ethics Committee for Life Sciences and Health (US DPT OF REGISTRATION #2: IRB000111917 N°090-15/CNESVS).

2.2. Sampling and Execution of the Survey

This was a cross-sectional, prospective, descriptive study. A data collection form was devised for this purpose. The information collected comprised the following variables: information of a general nature (the type of practice, the number of years in practice), the frequency with which canal treatments are performed, the complications encountered, and identification of the implicated etiological factors. A pre-survey was carried out among 10 dentists in order to see how well the questions of the survey were understood and the level difficulty for filling out the form. Analysis of the questionnaires collected during this pre-survey allowed correction and reorganization of paragraphs that could give rise to confusion so as to eliminate all ambiguity. The survey was then carried out by self-administration of the questionnaires. The dentists stated their answers directly on the survey form which was either collected immediately or at another appointment. The survey took place over a period of six months from January to June of 2016. One hundred and fifty dentists were selected based on the official list of the National Guild of Dentists in Ivory Coast. This selection was by a random draw using the formula of Schwartz [8]. This sample included dentists practicing in the private sector as well as in the public sector of the 10 municipalities of the town of Abidjan and its suburbs. The information collected was analyzed by means of EPI-INFO version 06.01 software (Centers for Disease Control and Prevention, Atlanta, Georgia, United States of America). The results obtained are presented as tables, using Excel and Word 2013 software in Windows XP professional.

3. Results

Of the 150 dentists who were contacted, 135 completed the questionnaire, thus amounting to a response rate of 90%. The results derived from the 135 practitioners who ultimately participated in the survey are presented in the tables below.

3.1. Characteristics of the Sample

The distribution according to the type of practice allowed us to determine that a full range of experiences was represented, with a sex ratio of 2.5. The majority of

the practitioners (61.19%) were in the private sector and 39.25% in the public sector. They were mostly trained in Ivory Coast (88.89%), in France (11.90%), and in Senegal (2.80%).

3.2. The Number of Endodontic Treatments Performed Per Month

Among the dentists who were surveyed, 65.9% performed up to 10 endodontic treatments per month and 30.4% between 11 and 20. Some (3.7%) performed 21 endodontic treatments or more per month.

3.3. Frequency of Complications

The majority of the practitioners, or 92.7%, stated that they encountered between 1 and 4 cases of complications per month in the course of endodontic treatment and 4.1% encountered fewer than 5 cases per month. Some practitioners (3.2%) indicated that they did not encounter any cases involving complications.

3.4. Procedural Errors

The practitioners encountered different types of procedural errors, during each step of root canal treatment. Perioperatively, this comprised weakening of the wall, as indicated by 54.68% of them; fracturing of an instrument in the canal, as indicated by 55.47%; extension of the gutta cone and or the obturation cement, as indicated by 55.47%. Postoperatively, flare-ups were encountered by 81.49% of the dentists, paresthesia by 4.83% of them, and subcutaneous emphysema by 1.61%.

3.5. Etiologies of the Preoperative Complications

According to the surveyed practitioners, the complications during endodontic treatment have different etiologies. The absence of preoperative radiography was the most often cited reason (64.44%) followed by erroneous diagnoses (14.07%). An inadequate technical capacity (2.22%) and the complexity of the root anatomy (0.75%) were other reasons provided as etiologies of preoperative complications.

3.6. Etiologies of the Perioperative Complications

Overall, for 82.96% of the practitioners, the complexity of the canal anatomy was the main etiology of perioperative complications. The lack of ergonomics and asepsis (absence of an operating field), an inadequate technical capacity, and a lack of skill represented 35.55%, 40.74%, and 1.48% of the cases, respectively. The use of unsuitable canal instruments was the main etiology (58.52%) during the access cavity preparation [Table 1], and the use of obsolete instruments (56.30%) was the etiology of complications most often indicated by the practitioners during the shaping procedure [Table 2]. Fracturing of the paste filler (54.77%) was the etiology most often reported by the practitioners during canal obturation [Table 3].

Table 1. Etiologies of the complications upon gaining the access cavity

Etiologies	N	Percentage (%)
Lack of knowledge of crown anatomy	25/135	18.51%
Use of unsuitable instruments	79/135	58.52%
Absence of dam	1/135	0.74%
Limited mouth opening	1/135	0.74%

Table 2. Etiologies of the complications during preparation of the canal

Etiologies	N	Percentage (%)
Outdated instruments	76/135	56.30%
Lack of knowledge of canal anatomy	66/135	48.89%
Use of arsenic as a between sessions dressing	12/135	8.89%
Allergy to sodium hypochlorite	14/135	10.37%
Limited mouth opening	1/135	0.74%

Table 3. Etiologies of the complications during canal filling

Etiologies	N	Percentage (%)
Over instrumentation	22/135	16.29%
Failure to adhere to the working length	64/135	47.41%
Drying of the canal with air spray	38/135	28.14%
Fracture of the paste carrier	78/135	54.77%

4. Discussion

This study showed that 65.9% of the practitioners performed an average of 10 endodontic treatments per month. This reflects the frequency with which endodontic treatments are performed [9]. Most often, the technique for manual preparation is by alternating use of a K-file and an H-file [9,10]. However, nowadays, the technique of mechanized canal preparation by continuous rotation or by reciprocating motion allows for greater efficacy and earnings (time savings) [11]. This new technique is indispensable for improving the procedures for canal preparation and to thereby reduce complications. In our study 64.44% of endodontic treatment was performed without pre-operative radiograph that confirms clinicians often underestimate the importance of diagnostic radiographs and pre-access analysis to plane the access cavity preparation and the shaping sequence [12].

An inadequate technical set-up and a lack of ergonomics were noted. The ergonomics for the operator are a major benefit, as they attenuate fatigue, thereby allowing complex procedures to be carried out under more favorable conditions [13].

Indeed, the etiology of perforations is based on poor evaluation by the operator of the shape, the dimensions, and the direction of the crown and of the root due to a failure to analyze the preoperative retroalveolar images and of the clinical examination.

They represent the second most common cause of endodontic treatment failure [14]. Perforation of the tooth with a burr is a common occurrence during preparation of the access cavity. These are complications derived from iatrogenic errors during canal treatment, and they often

lead to extraction of the tooth. Root perforation is the iatrogenic consequence of inadequate instrumental preparation of a canal aberration. The instrument then crosses the root dentin as well as the cement, creating an artificial connection between the canal network and the desmodontium or with the oral cavity [15].

No doubt, the best way to manage perforations is to prevent them. The perfect knowledge of endodontic anatomy, a painstaking pre-access analysis of the pre-operative radiographs, the systematic identification of the cemento-enamel junction, using a periodontal probe, the use of magnification coupled with the use of specific endodontic ultrasonic tips to perform the access cavity preparation, the methodical creation of a previous glide path before the shaping step and the use of patency file can help to prevent perforations.

Similarly, the complexity of the canal anatomy mentioned by the surveyed practitioners was the source of numerous complications including instrument fracture. The study showed that 35.55% of the practitioners did not use an appropriate operating field, which could lead to complications. Thus, in the absence of a dam, which constitutes a key component of the operating field in endodontics, the patient is exposed to several potential issues: (1) discomfort of the patient, (2) septic inoculation of the tooth to be treated, (3) inhalation of the irrigation products, or more seriously (4) inhalation of the burr or the endodontic instrument. These latter situations were also noted in prior studies, where the issue was remedied by extraction of the inhaled instruments by endoscopy in a hospital setting [7,16]. Whence the relevance of this tool that, in addition to allowing for better visibility of the intervention site, ensures the safety of the patient [16,17,18]. Fracturing of an instrument is, however, not a rare event. The risk of instrument fracture increases with the root complexity [19]. Indeed, Wu et al. (2011) reported a high number of fracturing in particular with mesial canals of the lower molars [19]. The experience and carefulness of the practitioners allow the frequency of instrument fracture to be reduced considerably. Nonetheless, nothing is immune to this type of incident, and the practitioner needs to know how to deal with it [20,21]. As reported by the study, the etiology of the instrument fractures can also lie with the use of outdated instruments. Numerous studies have also revealed that weakening linked with numerous cycles of sterilization, as well as the instruments used, and overuse can be the cause [19]. Fracturing can be due to torsion and/or bending [22]. Moreover, a study in Burkina Faso reported that treating patients with dilapidated equipment and insufficient provision of care services can also be the source of complications. Indeed, dilapidation equates to non-functional chairs and a nearly normal shortage of consumables forcing practitioners to overuse endodontic instruments or to devise alternatives [23]. Performing endodontic treatments requires a minimum in terms of equipment, and it is essential to have these and to strictly abide with the various stages of the process. In order to increase the success rate of treatments, health authorities should preferentially focus on ensuring that dental practices have equipment that is adequate for endodontic treatments.

Despite progress with new canal obturation techniques, some practitioners (54.77%) encountered fracture of the

paste filler used in the single-cone obturation technique. But the sealer represents the weak link in the chain of root canal filling because of its setting reaction with subsequent shrinkage, the presence of intrinsic porosities, and its possible resorption over time [24,25]. As a result, the root canal volume filled by the sealer is more vulnerable because of their dimensional instability over time.

These factors constitute a relevant problem in terms of sealing ability.

Hence, the sealer thickness should be as smaller as possible. In this respect on the one hand warm gutta-percha obturation techniques have been developed to perform tridimensional root canal filling with a smaller sealer thickness and with a minimum presence of void areas [24,26]. On the other hand cold hydraulic condensation, using premixed bioceramic sealers (with intra canal tip), have been developed to perform tridimensional root canal too.

Hence increased awareness and continuous training in the use of warm gutta-percha obturation techniques or cold hydraulic condensation technique are indispensable in order to perform a correct root canal filling. Moreover, the etiology of complications in endodontics can be human, the majority being iatrogenic in nature. The stress linked with the professional burden of the practitioner can lead to operative technical errors and thus result in the occurrence of complications [27]. This again highlights the importance of preparing for the procedure in terms of the ergonomic set-up of the technical platform and of adhering to the steps involved in carrying out the procedure.

5. Conclusion

Altogether, the results show non-adherence to the procedures for performing endodontic treatments, which is the source of most complications. Considering health and economical repercussions of inadequate root canal treatment, we can conclude that there is an urgent need to realign practitioners with the rules of good practice during the performance of endodontic treatments. The main objective of endodontic therapy is not to “manage” complications, but to know how to avoid “generating” them in the first place. A strategy of continued training of practitioners appears to be required in order to prevent what are mostly avoidable complications. Therefore, it is crucial for each university to be able to give students clinical skills to perform a good standard endodontic therapy on routine root canal treatment. To face this challenge, it is imperative to recruit endodontic specialists to teach in the pre-clinical training and in undergraduate clinic.

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