

Frequency of Iatrogenic Errors through Root Canal Treatment Procedure in 1335 Charts of Dental Patients

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Abstract:

Background: Endodontic procedures such as root canal treatment would be at the risk of failure like other medical interventions due to any unsuitable conditions. This has a causative effect in making the procedure more complicated to resulting in weak prognosis finally. Technical errors such as ledge, perforation, obstruction, broken instrument, etc. make infection control too hard or impossible. The aims of this study are common errors frequency and types of root canal treatments focusing on defined groups of dental students in Qazvin, Iran.

Materials and Methods: All the errors were divided into three major kinds of: (1) During providing access cavity, (2) cleaning and preparation and (3) canal obturation.

Results: A total number of 1335 charts of the cases were studied in the field of root canal treatment. The whole number of charts, which reported errors was 880 (66%) while 455 (34%) error-free ones. The most frequent error in upper incisors was void with the rate of 50.9%, followed by overfilling (apical perforation) in 18.2%. The same errors were also most common for lower incisors in addition to imperfect cleaning.

Conclusions: The current study identified the least mistakes through the process of providing access cavity and instrumentation phase comparing obturation phase, which had the most frequent errors including void, overfilling and imperfect cleaning.

Key Words: Endodontics, frequency, iatrogenic errors, root canal treatment

Introduction

Root canal treatment is a rather new branch of endodontic dentistry in recent years through, which chemical and mechanical remedies are used to limit pulpal and peri-apical diseases. This biologically approved technique has helped

peri-apical tissues in the process of healing significantly. The above technique is strongly depended upon the access to the area and identification of all roots as well as the possibility of a perfect chemo-mechanical tooth cleaning to be successful. Three directional shaping and filling of the root canals with neutral materials are important as well.¹ The success rate would even be 90-95% in controlled conditions in this regard,² although it usually succeeds in 35-60% when no peri-apical problems exist.^{3,4}

Relevant errors are usually evaluated in three different areas, which are explained more in methodology^{1,5-15} (Figure 1) Mukhaimer's work is probably the last research on the errors in the studied field of the current performance, which evaluated 612 radiographies of peri-apical trials by senior dentistry students in 2013.⁹ Out of the total records, 65% had acceptable obturation length and more than 75% had acceptable density of obturation substance in the treated teeth. Through a self-report design at the King Saud University in Riyadh in 2013, Alhekeir *et al.* identified 68% error rate in the procedure of root canal treatment by senior students.¹⁵

In Malaysia in the same year, the results of a 2 years study were reported to introduce void as the most common error in this matter like almost the rest of studies.¹⁶ A rate of 65.5% for void was highlighted by Moradi and Gharechahi in Mashhad, Iran, which was higher in mandible when compared with the maxilla.¹⁷



Figure 1: Some kinds of iatrogenic errors in root canal treatment. (a) Ledge (b) Apical perforation (c) Underfilling (d) Overfilling.

Materials and Methods

Study design

This study used a retrospective chart review design to just get descriptive information on the frequency and kinds of the errors, which usually occurred in the field of root canal procedure. We focused on senior students at the dentistry school clinic who had worked at the general ward of endodontics at the Medical University of Qazvin, Iran between October 2011 and October 2012. Patients' charts were participated in the study by census, and all of them were evaluated by the research dentists. Two endodontists were responsible to interpret radiographic clichés from the first X-ray studies to the last images of checking through the process of filling the teeth.

All the errors were divided into three major kinds of:

- Errors during providing access cavity:
 - Gouging
 - Furcal perforation
- Errors during cleaning and preparation:
 - Ledge
 - Transportation
 - Strip perforation
 - Broken instruments
 - Apical perforation
- Errors during canal obturation:
 - Void
 - Overfilling
 - Under filling

“Figure 1” explains some of the consequences and errors that were focused by the current work. After identification of the occurred errors throughout the whole process of canal obturation seen in the charts, findings were entered and analyzed statistically.

Statistics analyses

Regarding 95% confidence interval and type I error of $\alpha = 0.05$, Chi-square test was utilized to find the prevalence of errors by the students using SPSS 21 for windows. Ethics: No demographic data were recorded by the investigators, and only the students functions were evaluated by the interpreted X-ray radiographies. Hence, there were no ethical issues to prevent.

Results

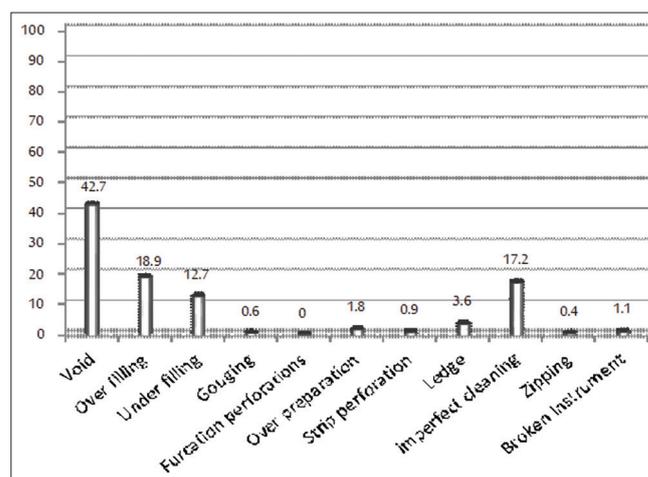
A total number of 1335 charts of the cases were studied in the field of root canal treatment in a general ward of endodontics at the medical University of Qazvin, Iran between 2011 through 2012. The whole number of charts, which reported errors was 880 (66%) while 455 (34%) error-free ones. Details of the reported errors are illustrated in Table 1. Regarding the table, the most frequent error in upper incisors was void with the rate of 50.9%, followed by overfilling (apical perforation) in 18.2%. The same errors were also most common for lower incisors in addition to imperfect cleaning, (Table 1). Canine teeth showed higher rates of iatrogenic errors including void and overfilling when compared with incisors. Overall, 5.4% out

of all errors occurred in upper canines while the rate was 1.8 in lower ones. In terms of premolar teeth of the total 41.5%, void was again the most common error with 48% and 51.6% in maxilla and mandible, respectively. Errors in maxilla were as three times as what in mandible. Overfilling was the second common error in the latter but imperfect cleaning in maxilla, and both of the errors were at the same rate of just more than 17%. Upper and lower molars owned 38.1% of the total errors including void followed by overfilling as the most common mistakes, which are visible (Table 1).

As a comparison, upper molars had a lower rate of the total errors (15.7%) while lower molars were responsible for 22.4% of the total mistakes in root canal treatment procedure. When consider all the patients' teeth in three groups, premolars with 86.11% had the most occurrences of errors followed by molars (63.2%). Otherwise, anterior group of teeth showed errors at the rate of 47.1%. As a whole, void had the most rates of 42.7% followed by overfilling (18.9%) and imperfect cleaning (17.2%). Maxilla had 64.2% of the total errors whilst mandible with 35.8% as can be checked (Table 2). Graph 1 illustrates the incidence of errors considering the total maxilla and mandible.

Discussion

A therapist would face a range of undesired and unexpected events and challenges, which could affect obviously on diseases prognosis. Knowledge and skill of doing the procedure are absolutely important to prevent these kinds of problems or to solve them when occurred.⁵ The current chart review showed that 34% of 1335 cases of dental root canal manipulations were done error-free while the rest had at least one of the evaluated errors such as void, overfilling and imperfect cleaning. Maxilla was more involved by the iatrogenic (provider-related) mistakes among which premolars had the most rates. Void-related problems were 42.7% followed by overfilling (18.9%) with a rather huge interval as can be seen by the percentages. Other errors like imperfect cleaning and under filling were frequent



Graph 1: Frequency of iatrogenic errors in the study considering both jaws.

Table 1: Kinds of errors occurred in root canal treatments considering all the teeth and their frequencies.

Errors	n (%)							
	Upper incisors	Lower incisors	Upper canines	Lower canines	Upper premolar	Lower premolar	Upper molar	Lower molar
Void	53 (50.9)	6 (54.5)	25 (52)	10 (62.5)	132 (48)	47 (51.6)	43 (31.1)	60 (30.4)
Over filling apical perforation	19 (18.2)	2 (18.2)	9 (18.7)	2 (12.5)	41 (14.9)	16 (17.6)	31 (22.5)	46 (23.4)
Under filling	14 (13.6)	0 (0)	4 (8.3)	1 (6.25)	34 (12.4)	9 (9.9)	21 (15.2)	29 (14.7)
Gouging	0 (0)	1 (9.1)	0 (0)	0 (0)	2 (0.7)	0 (0)	1 (0.7)	1 (0.5)
Furcal perforations	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Over preparation	1 (0.9)	0 (0)	1 (2.1)	1 (6.25)	5 (1.8)	1 (1.1)	4 (2.9)	3 (1.5)
Strip perforation	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.7)	0 (0)	3 (2.2)	3 (1.5)
Ledge	0 (0)	0 (0)	0 (0)	1 (6.25)	7 (2.6)	3 (3.3)	6 (4.3)	15 (7.7)
Imperfect cleaning	16 (15.5)	2 (18.2)	7 (14.7)	0 (0)	48 (17.4)	13 (14.3)	27 (19.7)	38 (19.3)
Zippering	0 (0)	0 (0)	1 (2.1)	0 (0)	2 (0.7)	1 (1.1)	0 (0)	0 (0)
Broken instrument	1 (0.9)	0 (0)	1 (2.1)	1 (6.25)	2 (0.7)	1 (1.1)	2 (1.4)	2 (1)
Total	104 (11.8)	11 (1.2)	48 (5.4)	16 (1.8)	275 (31.2)	91 (10.3)	138 (15.7)	197 (22.4)

Table 2: The incidence of errors considering the total maxilla and mandible.

Errors	n (%)		
	Both jaws	Mandible	Maxilla
Void	376 (42.7)	123 (39)	253 (44.8)
Over filling (Apical perforation)	166 (18.9)	66 (21)	100 (17.8)
Under filling	112 (12.7)	39 (12.5)	73 (12.9)
Gouging	5 (0.6)	2 (0.6)	3 (0.5)
Furcal perforations	0	0	0
Over preparation	16 (1.8)	5 (1.5)	11 (1.9)
Strip perforation	8 (0.9)	3 (0.9)	5 (0.9)
Ledge	32 (3.6)	19 (6)	13 (2.3)
Imperfect cleaning	151 (17.2)	53 (16.9)	98 (17.3)
Zippering	4 (0.4)	1 (0.3)	3 (0.5)
Broken instrument	10 (1.1)	4 (1.3)	6 (1.1)
Total	880 (100)	315 (35.8)	565 (64.2)

P=0.000

not too different from overfilling. This is while zipping and gouging were too scarce and no case of furcal perforation was found. Mukhaimer named under filling as the most frequent procedure-induced error, particularly in maxillary molars. Void was the second error in their study and ledge as well as perforation had higher rates in comparison to our findings.⁹

Like our results, Alhekeir *et al.* showed that the posterior parts of the maxilla were more frequently involved.¹⁵ Hard access and imperfect vision, as well as students' unskillfulness, help the situation occurred. Anatomical complex affairs in that area are a risk factor as well.^{15,18} Blaming both void and under filling, Rasheed *et al.* showed that, like our study, errors occurred in obturation phase through which much more technical care and strict professional supervision¹⁹ is needed. Obturation phase was the most frequent part of errors in another study by Khabbaz too. They reported under filling followed by overfilling and void, respectively, on the contrast side of our work while ledge and other mistake were too rare that would be explained by referring complicated cases to subspecialists in dentistry school.²⁰ The most frequent error in Ahmed's study was void, like the current research, but imperfect cleaning was unlikely at the second

place.²¹ However, posterior teeth were more involved like other reports. Perforation had no place of occurrence in our study like Ahmed's that would be an example of perfect supervision too. Broken instrument is another kind of errors which was condonative through our study, but did not occurred in Ahmed's and Mozayani's conductance.^{18,21} Void, as a very common error in a vast number of researches could be resulted from loss of skills, sealer overuse, and imperfect usage of spreader in packing gutta-percha, displaced accessory gutta-percha in root canals as well as mismatched size of spreaders and accessory gutta-percha 18.

Conclusion

The current study identified the least mistakes through the process of providing access cavity and instrumentation phase comparing obturation phase, which had the most frequent errors including void, overfilling and imperfect cleaning. Regarding the high rates of errors in root canal treatment, this study advises more practical learning and more strict supervision on students' tasks in this matter.

Furthermore, radiovisiography would be useful in terms of estimating the frequency of zipping and stripping as endodontic errors in order to get more details during root canal treatment in later trials. On the other hand, computerized tomography's of extracted teeth or microscopic studies are advised ways to evaluate the job.

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