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ORIGINAL ARTICLE

Comparison of preparation errors among dental students in different study years in the endodontic department of dentistry faculty of Birjand, Iran, during 2014-2017

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Abstract

Introduction: Traumas to the teeth can damage the pulp that may require root canal treatment. In addition, the evaluation of trauma errors is very important in every educational system. Therefore, the aim of the present study was to investigate technical errors during root canal therapy and compare these errors among the students who were in their 4th, 5th, and 6th years of their education in Dental Faculty of Birjand, Iran.

Methods: A total of 428 documents of root canal therapy performed by dental students who were in the 4th, 5th, and 6th years of their education were randomly selected during 2014-2017. For each tooth, four radiographs, including the periapical images of the initial radiograph, master apical file, master cone, and final obturation radiographs, were reviewed under the supervision of an endodontist. Technical errors investigated included transport, ledge, perforation, underfilling, overfilling, and presence of void and broken instrument.

The data were entered into a relevant form and analyzed. The normality was investigated using the Shapiro-Wilk test in the SPSS commercial software (version 22). In the present analysis, because the normality of the data was not confirmed, the Kruskal-Wallis and Mann-Whitney U tests were used, and the Chi-Square test was also utilized at the α-level of 0.05 to compare the ratio.

Results: Technical errors were observed in 149 out of 428 documents (34.8%). Numbers of the documents containing technical errors were 60 (30.6%), 78 (40.6%), and 11 (27.5%) associated with the students of the 4th, 5th, and 6th years, respectively. Only one perforation error was observed by the students of the 5th year. In addition, there was no transport error by the students of the 4th year. Number of the ledge and overfilling errors presented significant differences by the students of various years (P_{ledge}=0.01 and $P_{overfill}$=0.002).

Conclusions: Results of this study showed that 65.2% of the students had acceptable performance; however, procedural errors were a fairly common finding among the students. Moreover, there were significant differences between students in different years. Pre-evaluation of radiographs and more accurate case selection could promote the quality of root canal therapy among students.

Key words: Dental students, Diagnostic error, Education, Endodontic

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Introduction

In addition to traumas to the tissues around the root, traumas to the teeth damage the pulp. Changes in the pulp can lead to the complete death of the pulp tissues and cause chronic pulpitis and sometimes acute pulpitis that may require root canal treatment (1). Root canal therapy is an important part of dentistry, including pulp removing, mechanical and chemical cleaning, and root canal filling (2). According to various investigations, the success rate of root canal therapy is reported as 84-90% (3).

Success rate of root canal therapy is dependent on several factors among which the skill of the dentist is the most important one. Lack of skill or careless treatment leads to developing different faults. Cleaning and forming the canal, especially in case of a root canal with a curvature, are not always easy, and the most complicated area of the canal in terms of cleaning is the apical zone (4). The faults, such as the creation of a new path in the canal, perforation, and broken instrument, also occur. Perforation of the roots may lead to a failure in root canal therapy (5). It was also demonstrated that there is a connection between the breakage of a file and insufficient cleaning in root canal therapy (6).

In filling root canals, keeping in mind that the length of filling of the root canal has a significant influence on the success of root canal therapy, and some faults, such as overfilling or underfilling could occur. In most investigations, it was indicated that periodontal health is related to the length of filling of the root canal (7). A distance up to 2 mm between the filling material and apex is associated with better results. Root canal therapy is usually evaluated using radiography (8).

Radiographic investigation of the quality of the root canal therapy is very easy because the filling material provides a good contrast. The radiographic measurements that are used to evaluate root canal therapy include the length, taper, and density of obturation. Quality of root canal treatment performed by dentistry students is different in various studies that may correspond to the different educational methods applied at different universities (9, 10). Dentistry Faculty of Birjand is a new faculty, and there is no documented study about the errors in root canal therapy.

However, considering the above-mentioned points, the students could be evaluated by investigating failure measures, and progressing trend of students in different educational years will confirm a good educational program. Therefore, the aim of the present study was to evaluate the preparation errors of the dentistry students at the Endodontic Department of the Dental Faculty of Birjand during treatment and compare the performance of the students in different years of education.

Methods

In the present cross-sectional and retrospective study, 650 documents of treatments performed by the students were investigated according to the permission of the Ethics Committee of Birjand University of Medical Sciences with the number of ir.bums.Rec.1397.236 in the Endodontic Department of Dentistry Faculty of Birjand during 2014-2017. In addition, 500 treatment documents were determined to be suitable for the present study.

The documents should contain the initial radiograph, measurements of the master apical file, master cone, as well as final obturation, and provide sufficient information about root forms and filling method. Documents with low-quality radiographic images or incomplete root canal treatment were excluded from the study. In addition, the standard strategy of root canal therapy used in the Dentistry Faculty of Birjand should be applied in the following cases:

Side density strategy should be applied.

The isolation should be provided by a rubber dam.

The canals should be prepared by a K-file.

All radiographic images should be prepared using the bisecting angle technique.

The teeth should also be treated temporarily using Cavit. Then, 428 documents were randomly selected and investigated. The selected documents included 196 documents of the students of the 4th year, 192 documents of the students of the 5th year, and 60 documents of the students of the 6th year. The radiographs were investigated and technical errors, including transport, ledge, perforation, length of filling, voids, and broken instrument, were recorded. In addition, whenever a problem was presented, the help of the corresponding professor was applied.

Some evaluated items on radiographic images are as follows:

Filling length (i.e., proper length: up to 2 mm distance from the apex; overfilling: filling beyond the apex; underfilling: more than 2 mm distance of filling material from the apex);

Voids (i.e., the presence of spaces within filling materials and between materials and canal wall);

Ledge (i.e., root filling at least 1 mm less than

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the primary measurement of filling length or deviation from the primary path of the canal in canals with a curvature);

Apical perforation (i.e., a difference between the apical end of the filled canal and primary canal or gutta-percha or sealer taken out from apical foramen);

Broken file (i.e., the presence of a part of a broken instrument in the canal space or in periapical zone);

Transport (i.e., a deviation from the main path of the canal) (3)

SPSS commercial software (version 22) was used to analyze the collected data. Firstly, the normality of the data was analyzed. Then, because the normality was not confirmed, the Kruskal-Wallis and Mann-Whitney U tests were used at the significant level of 0.05. The Chi-Square test was also used to compare the ratio of errors in various years of education.

Results

The investigated 428 documents included 196 (45.8%) documents of 36 students of the 4th year, 192 (44.9%) documents of 43 students of the 5th year, and 40 (9.3%) documents of 14 students of the 6th year. Out of 428 investigated ones, an error was detected in 149 (34.8%) documents (Table 1). Nonetheless, the ratios of the documents with an error for the students of the 4th, 5th, and 6th years reported as 30.6%, 40.6%, and 27.5%, respectively, did not present a significant statistical difference (P=0.07).

However, Table 2 tabulates a significant statistical difference in the mean number of errors of students in different years. In addition, the results of a post hoc analysis suggested that the number of errors of the students in the 6th year was significantly different from that of the students of the 4th and 5th years ($P_{4th\ and\ 6th\ years}$=0.034 and $P_{5th\ and\ 6th\ years}$=0.008).

Table 3 compares the frequency of different errors for the students of different years separately. The perforation error was omitted from the Table because there was only one case in the students of the 5th year, and there was no case in the students of the 4th and 6th years. In addition, there was no transport error in case of the students of the 4th year.

As it is observed in Table 3, the difference in the number of the ledge and overfilling errors for the students of different years is significant (P_{ledge}=0.01 and $P_{overfilling}$=0.001). Results of post hoc tests presented that the number of ledge error for the students of the 4th and 5th years was statistically significant (P=0.01). In case of overfilling, the presented difference was related to the difference in the number of errors for the students of the 4th year with that for the students of the 5th and 6th

Table 1: Relative frequency of errors among students of 4th, 5th, and 6th years

Year	n (%)	χ2 (P-value)
4th	60 (30.6%)	
5th	78 (40.6%)	5.33 (0.07)
6th	11 (27.5%)	
Total	149	

Table 2: Comparison of error numbers in students of various years

Error type	Students of 4th year Mean±standard deviation	Students of 5th year Mean±standard deviation	Students of 6th year Mean±standard deviation	Kruskal-Wallis test (P-value)
Number of errors	0.22±1.33	0.20±1.31	0.21±0.80	7.06*(0.03)

Shapiro-Wilk test for students of 4th year (p-value)=0.85 (<0.001)
Shapiro-Wilk test for students of 5th year (p-value)=0.90 (0.002)
Shapiro-Wilk test for students of 6th year (p-value)=0.80 (0.005)
* Significant level of P-value as 0.05

Table 3: Comparison of number of different errors in students of different years

Error type	Students of 4th year Mean±standard deviation	Students of 5th year Mean±standard deviation	Students of 6th year Mean±standard deviation	Kruskal-Wallis test (P-value)
Transport	-	0.12±0.39	0.07±0.27	3.41(0.18)
Ledge	0.03±0.17	0.30±0.51	0.21±0.43	8.85*(0.01)
Overfilling	1.06±0.96	0.49±0.77	0.29±0.47	12.27*(0.002)
Underfilling	0.22±0.49	0.58±0.82	0.36±0.50	4.97(0.08)
Void	0.47±0.65	0.42±0.73	0.21±0.43	1.61(0.45)
Broken file in canal	0.03±0.17	0.12±0.32	0.14±0.36	2.60 (0.27)

P-value of Shapiro–Wilk test lower than 0.001 in all groups leading to the use of nonparametric Kruskal-Wallis and Mann-Whitney U tests for comparison; significant level of P-value as 0.05

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years. Accordingly, in case of the students of the 4th year, the number of this error was significantly higher ($P_{4th \text{ and } 6th \text{ years}}$=0.013 and $P_{4th \text{ and } 5th \text{ years}}$=0.009).

Discussion

In the present study, there was no transport error in case of the students of the 4th year, and the mean values of the number of this error for the students of the 5th and 6th years were 0.12±0.39 and 0.07±0.27, respectively. This is maybe because the students of the 4th year generally work on anterior and simple teeth. On the other hand, the students of the 6th year have more experiences leading to a lower number of errors.

Ingel suggested that perforation with 61.9% is the second major reason for unsuccessful root canal therapy (11). In a study carried out by Walton and Torabinejad, it was demonstrated that a hole made in the root exposes the tooth to distortion of the tissue around the root resulting in periodontal attachment loss and finally loss of the tooth (1). Therefore, only one perforation error in case of the students of the 5th year and no such an error in case of the students of the 4th and 6th years confirmed the effectiveness of an educational program in the Birjand University of Medical Sciences in this regard.

Mean values of the number of ledge errors were 0.03±0.17, 0.30±0.51, and 0.21±0.43 for the students of the 4th, 5th, and 6th years, respectively, demonstrating significant statistical differences. This error was reported as 30% and 46% in the studies conducted by Himel et al. (12) and Green and Krell (13), respectively, which are higher, compared to those of the present study in general. In addition, in the present study, due to using stainless steel files, the number of ledge errors was reported even higher. Therefore, using the passive step back method by the dentistry students of the aforementioned university and step by step supervision by professors played an effective roll in decreasing the ledge errors in comparison to other studies.

On the other hand, the lower numbers of transport, ledge, and proration errors in the present study in comparison to those of other studies (9, 14) may be due to the patient selection method performed under the supervision of professors. In this way, students are not permitted to work on teeth with complicated anatomy or canals with a large curvature until they have enough skills.

Mean value of the number of overfilling errors was 1.06±0.96 in case of the students of the 4th year that decreased to 0.49±0.77 and 0.29±0.47 for the students of the 5th and 6th years, respectively. This finding indicated more experience and control on the length of filling for the students of the 5th and 6th years. The overfilling errors were reported as 12.6% and 19.5% in the studies carried out by Refeek et al. (15) and Dadresanfar et al. (16), respectively. Consequently, the overfilling errors had the lowest value in the present study due to the higher experience of students or different kind of treated teeth. Although, decreasing this error with an increase in the year of studying were indicated that the experiences of students increased with their educational year.

Mean values of underfilling errors were 0.22±0.49, 0.58±0.82, and 0.36±0.50 for the students of the 4th, 5th, and 6th years, respectively, with no significant difference. Barrieshi et al. (17) reported that the underfilling error is 30%; however, it is reported to be 18.5% by Dadresanfar et al. (16). The reasons for these differences are the educational method and low experience of students. In addition, due to using the bisecting angle technique providing radiographic images, it is possible that some mistakes occur in the determination of the precise length of filling. It could be more precise if the parallel technique is applied.

Due to more experiences that the students of the 5th and 6th years gain during their education, the mean value of the number of void errors also decreased from 0.47±0.65 for the students of the 4th year to 0.21±0.43 for the students of the 6th year. Mokhtary et al. reported that 65.4% of samples have sufficient density; however, it was reported to be 82.6% by Eleftheriadis et al. (18). The difference may be due to the difference in the method used to fill the root canal.

In case of broken file error, the mean value was 0.03±0.17 for the students of the 4th year that increased to 0.12±0.32 and 0.14±0.36 for the students of the 5th and 6th years, respectively. This happened because the students of the 6th year work on more difficult teeth in comparison to the students of the 4th and 5th years. It should be noticed that only the investigation of the stereotype of a patient could not determine the prognosis of treatment. Furthermore, important factors, including paying attention to the isolation, presence of periapical lesion, and material that is used, affect the prognosis of the treatment. In addition, although using a rubber dram is necessary, the saliva leakage should be avoided.

Another point that should be considered is that all errors could not be detected using radiographic images. Moreover, some cases, such as pushing of

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debris beyond the foramen apical, could not be detected using a radiographic image. Only moving of sealer or filling material through the canal is detectable. According to the obtained results, although the mean value of errors was low, it should decrease even more through more careful case selection and increase of the number of teeth required in the preclinic period that increases the skills of students before they start treatment on real patients.

Conclusions

In conclusion, the mean value of errors was lower in the present study in comparison to those of similar studies that may be the result of using numerous radiographic images and supervision of professors during the treatment. A very low percentage of perforation and transport was also observed in the present study that was the result of the step by step supervision of professors and using an apex locator device for length determination.

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The authors did not preregister the study with an analysis plan in an independent institutional registry. Manuscript of the present study was written by the authors and not submitted elsewhere for publication. In addition, the manuscript is not under concurrent consideration elsewhere.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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