Experience and Confidence Level of Senior Dental Students in Performing Endodontic Treatment: A Pilot Study

By

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Department of Oral Science
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(2019)
Dedication

My thesis is dedicated to my beloved father Bakheet Alsharif. Thank you for giving me the best life. Thank you for your unconditional love, support, guidance, and constant faith on me. You always push me to be better. I love you.

To my dear sister Shahad, my best friend. We shared the ups and downs together through this journey. I was not being able to make it without your support. I love you.

To my brother Fahad and my sister Layan. You are always able to put a smile on my face no matter what. I’m grateful to have you in my life. I love you.

To my mother Basma Abu Nejim, I’m sure you would be proud of me. May your soul rest in peace.
Acknowledgements

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I would also like to thank Dr. Lucila Piasecki and Dr. Patrick Battista, my committee members, for their valuable contribution. Thank you for helping me and supporting me as well.

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Abstract

Aim: To assess senior dental students’ experience and confidence level in performing root canal treatment and to determine their perceptions of the nature and adequacy of their endodontic educational experience. Methodology: An online questionnaire was sent to participating senior dental students at four schools (N=374). The questionnaire consists of demographic questions, questions focusing on students’ experiences and confidence related to endodontic treatment, and open-ended items asked for comments and suggestions. A pilot test was done and provided a feedback that the questions were clear. Confidence was assessed on a four-point Likert-type scale from not at all confident to highly confident. Mann–Whitney, Wilcoxon Signed Ranks, and McNemar nonparametric tests were performed using IBM SPSS Statistics software with a significance level of .05. Results: Seventy-three senior dental students completed the questionnaire. The responding students were 48% male and 52% female with a mean age of 26.74 years (SD ± 2.18). The median number of teeth successfully completed during preclinical laboratory courses was 10. Fifty-six percent of the students felt moderately to highly confident to start clinical endodontic treatment after their preclinical training. No significant difference was found between number of teeth completed in preclinical training and confidence to start clinical practice as a result of their preclinical training. The median number of successfully completed teeth during clinical training was two. Thirty-eight percent of the students felt moderately to highly confident to practice endodontics after graduation as a result of the clinical experience provided by their school. A statistically significant difference was observed between number of teeth completed clinically and confidence to practice endodontics after graduation with more
confidence related to more successfully completed teeth. Among the students who were not confident to practice after graduation, they indicated that, on average, they would need to complete approximately 9 more teeth in clinic in order to feel confident. Students’ mean confidence in performing endodontic procedures was 2.1 (SD ± 0.38) (moderately confident). According to treating different tooth types, students’ mean confidence was 2.1 (SD ± 0.67) (moderately confident) for anterior teeth, and 1.3 (SD ± 0.62) (slightly confident) for posterior teeth. Conclusion: Senior dental students demonstrated high confidence to start practicing clinical endodontics as a result of their preclinical training. However, they reported not being as confident to practice endodontics after graduation due to insufficient clinical training provided by their schools. Those with greater clinical experience report higher confidence levels.
Introduction

Root canal treatment is aimed toward saving the tooth, after it becomes infected, through repairing the periradicular area to normal state. This treatment is being taught at dental schools to ensure that their graduates are able to successfully evaluate and administer suitable treatment of the diseased dental pulp and periradicular tissue in uncomplicated cases.

Although graduating students should be able to perform suitable root canal treatment, research suggests that most root canal treatment performed by undergraduate students is considered inadequate\(^1\). This is a worldwide observation, having been reported in several countries\(^2\)\(^-\)\(^4\).

Dental students often consider endodontics to be a challenging and stressful treatment due to the possibility of having various anatomical variations of the root canal system\(^5\). A previous study found that 43 percent of senior dental students considered endodontics to be the third most difficult specialty in dentistry; an additional 12 percent considered it to be the most difficult\(^6\).

It has been reported that a majority of students are not confident performing root canal treatment for both anterior and posterior teeth as a result of insufficient clinical practice\(^7\). In a survey of predoctoral endodontic directors in the United States and Canada, 36 percent stated that their graduates were not competent to perform root canal treatment in molar teeth as a result of insufficient clinical practice\(^8\). Insufficient clinical practice for undergraduate students will result in general practitioners who might not be able to perform proper decision-making and adequate treatment\(^9\).
With increasing clinical practice, students’ confidence levels will likely increase; Murray and Chandler found that senior dental students were more confident toward performing root canal treatment than junior students. This finding was also supported by a study which reported that, with additional cases completed during their undergraduate education, graduates would be ready to perform root canal treatment individually as general practitioners.

It has been suggested that dental students perform fewer root canal treatment procedures than in previous years, which in turn results in limited clinical experience. Therefore, methods of increasing both preclinical and clinical experience should be considered to enhance their experience and performance. In addition, students should be surveyed for their opinions and recommendations for improving the current curriculum, and such surveys should be conducted on a regular basis.

Surveying students regarding their undergraduate endodontic experience as well as their confidence levels in performing root canal treatments is considered an important first step in assessing the existing educational model.

The aim of this study is to assess senior dental students’ experience and confidence level in performing root canal treatment. A second aim is to determine their perceptions of the nature and adequacy of their endodontic educational experience. Results may provide important information for possible improvement of endodontic education through curricular change to address concerns of students in this clinical discipline, and ultimately to affect the outcome of endodontic treatment.
The main hypothesis is that there is a positive association between experience and confidence level among senior dental students, that is, that students with more experience will report greater confidence regarding performance of endodontic treatment. It is also hypothesized that the majority of respondents will report inadequate levels of endodontic clinical experience.

**Materials and Methods**

Twenty US dental schools were contacted to see if they were willing to participate in the research. Each school’s associate dean for research was contacted via email to request approval to include their senior dental students in the research and to determine if we needed IRB approval from their sites. The list of contacted schools appears in Appendix x.

Four schools agreed to allow their students to participate: Stony Brook University, University of Michigan, and University of North Carolina at Chapel Hill, and the University at Buffalo. Contacts at all three external participating schools confirmed that no IRB approval was needed from their site as long we had IRB approval from our institution.

The questionnaire was created by the investigators, and consists of demographic questions, including age, gender, school, and previous dental-related education, as well as questions focusing on students’ experiences and confidence related to endodontic treatment. Additional open-ended items asked for comments and suggestions. After finalizing the questionnaire, 20 senior dental student volunteers from the University at Buffalo Class of 2018, who were
not our study subjects, were asked to complete the questionnaire as a pilot test and to provide feedback regarding the clarity of the questions. Their feedback indicated that the questionnaire was easy to understand. A copy of the survey appears in appendix y.

The survey asked respondents for the number of cases they had successfully completed during their preclinical and clinical years and the number of anterior, premolar and molar teeth completed.

Confidence was assessed on a four-point Likert-type scale from not at all confident to highly confident. Students were asked to rate their confidence in performing each step of endodontic treatment starting from evaluation and case diagnosis through canal obturation. Students were also asked to rate their confidence in treating different tooth types and managing different steps usually associated with endodontic treatment such as taking radiographs, restoration of endodontically treated teeth and management of pain between appointments.

Finally, students were asked about their plan as general practitioners, whether they planned to perform endodontic treatment, and whether they planned to use the same instrumentation and obturation technique that they were taught at the dental school.

The questionnaire was sent in an online format using Survey Monkey via email to senior dental students at the four participating dental institutions (total N=374). Our anticipated response rate was 33 percent, based on typical online survey response rates. We therefore expected to enroll a total of 123 subjects. A recruitment email was sent at the beginning of March 2019 with the link to the
online questionnaire. The text of the email appears in appendix z. A weekly email reminder was sent through April 2019, for a total of eight emails being sent. Students at the University at Buffalo received the emails forwarded to the student class listserv by the web administrator. Students at the University of North Carolina received the emails directly from the co-investigator, through a listserv created for this purpose, based on a list of official email addresses for the class provided by the school’s associate dean of research. Students at Stony Brook University and the University of Michigan received the emails forwarded from the co-investigator to the student listservs by the schools’ associate deans of research.

The protocol was approved by University at Buffalo Institutional Review Board, (STUDY2829).

IBM SPSS Statistics software was used to generate descriptive statistics and to analyze the data using Mann–Whitney, Wilcoxon Signed Ranks, and McNemar nonparametric tests, with a significance level of .05. For statistical tests involving student confidence, confidence variables were collapsed to a two-point scale (not at all to slightly confident vs moderately to highly confident).

Results

Seventy-three senior dental students completed the questionnaire (response rate 19.5%). The responding students were 48% male and 52% female with a mean age of 26.74 years (SD ± 2.18) (range 24 – 33).
Only five students had previous dental related education: dental hygiene (n=1), dental assistant (n=1), and dental degrees from another country (n=3). The number of successfully completed clinical teeth by the three students who had a dental degree from another country was notably higher than others. Since it was possible that they counted the teeth that they completed during their previous degree programs, these responses were excluded from statistical analysis. Most respondents (67%) reported having one year or less of endodontic clinical practice at their school.

The median number of teeth successfully completed during preclinical laboratory courses was 10 (4 anterior, 3 premolar, and 3 molar teeth). Fifty-six percent of the students felt moderately to highly confident to start clinical endodontic treatment after their preclinical training. No significant difference was found between number of teeth completed in preclinical training and confidence to start clinical practice as a result of their preclinical training ($Z = .101, P = 0.92$).

Most students (81%) stated that the didactic part of their endodontic training, including lectures, was sufficient. Eighty-nine percent reported using social media as a source of information to help improve their endodontic knowledge and skills. The most commonly used applications were YouTube (83.6%), Instagram (46.6%) and Facebook (35.6%). Among students who use social media, 84 percent reported that it was helpful.

The median number of successfully completed teeth during clinical training was two. Median number of completed teeth clinically by tooth type (anterior, premolar, and molar) was one tooth. Thirty-eight percent of the students felt
moderately to highly confident to practice endodontics after graduation as a result of the clinical experience provided by their school. A statistically significant difference was observed between number of teeth completed clinically and confidence to practice endodontics after graduation ($Z=2.91, P = 0.004$), with more confidence related to more successfully completed teeth. Additionally, there was a statistically significant difference between students’ confidence in entering the clinic to start clinical endodontics and their confidence in practicing endodontics after graduation ($Z=6.26, P < 0.0001$). Among the students who were not confident to practice endodontics after graduation (62%), the median minimum number of teeth they felt were needed to be completed clinically to be confident was 12 teeth. Descriptive statistics for minimum number of teeth needed to be confident by tooth type is shown in table 1.

Table 1 Students’ perception about minimum number of teeth needed to be clinically completed to be confident practicing endodontics after graduation

<table>
<thead>
<tr>
<th>Tooth Type</th>
<th>Mean</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior teeth</td>
<td>3.63</td>
<td>3</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Premolar</td>
<td>3.61</td>
<td>3</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Molar</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Total teeth</td>
<td>12.14</td>
<td>12</td>
<td>3</td>
<td>37</td>
</tr>
</tbody>
</table>

A statistically significant difference was found between number of teeth clinically completed and number needed to feel confident ($t_{47} = 13.26, P < 0.001$). Students indicated that, on average, they would need to complete approximately 9 more teeth in clinic in order to feel confident practicing endodontics after graduation. The mean number perceived to be needed by tooth type was 2.5
more each for anterior and premolar teeth, and 4.3 more molar teeth. Students’ mean confidence in performing endodontic procedures was 2.1 (SD ± 0.38), or moderately confident. The percentage of students who reported feeling moderately to highly confident in performing various steps in endodontic treatment is shown in table 2. While most respondents reported feeling confident about rubber dam isolation, restoration of endodontically treated teeth, and dental anesthesia, only two-thirds felt confident about access cavity preparation and instrumentation and canal shaping, and a little more than half felt confident about canal obturation.

<table>
<thead>
<tr>
<th>Endodontic treatment step</th>
<th>Percentage of students feeling moderately to highly confident</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary steps</strong></td>
<td></td>
</tr>
<tr>
<td>Rubber dam isolation</td>
<td>100.0</td>
</tr>
<tr>
<td>Dental anesthesia</td>
<td>94.5</td>
</tr>
<tr>
<td>Endodontic diagnosis</td>
<td>91.8</td>
</tr>
<tr>
<td>Working length measurement</td>
<td>89.0</td>
</tr>
<tr>
<td>Canal irrigation</td>
<td>89.0</td>
</tr>
<tr>
<td>Evaluation of patient’s history</td>
<td>87.7</td>
</tr>
<tr>
<td>Access cavity preparation</td>
<td>67.1</td>
</tr>
<tr>
<td>Instrumentation and canal shaping</td>
<td>61.6</td>
</tr>
<tr>
<td>Canal obturation</td>
<td>53.4</td>
</tr>
<tr>
<td><strong>Adjunctive steps</strong></td>
<td></td>
</tr>
<tr>
<td>Restoration of endodontically treated teeth</td>
<td>98.6</td>
</tr>
<tr>
<td>Taking endodontic radiographs</td>
<td>83.6</td>
</tr>
<tr>
<td>Management of pain between appointments and flare up</td>
<td>24.7</td>
</tr>
</tbody>
</table>
Students’ mean confidence in performing endodontic treatment was 2.1 (SD ± 0.67) for anterior teeth (moderately confident), and 1.3 (SD ± 0.62) for posterior teeth (slightly confident). The percentage of students who reported feeling moderately to highly confident in performing endodontic treatment by tooth type is shown in figure 1. While most respondents reported feeling confident about maxillary anterior teeth, only two-thirds felt confident about mandibular anterior teeth and maxillary premolar teeth. Reported confidence in performing endodontic treatment on molar teeth was much lower (23% for mandibular molars; 7% for maxillary molars).

![Graph showing confidence in performing endodontic treatment by tooth type](image)

**Figure 1** Students’ confidence in performing endodontic treatment by tooth type (%)

The various endodontic errors that students experienced during clinical training are shown in figure 2. Ledge formation in root canal was the most frequently reported error (28%).
Rotary file instrumentation was the most commonly used instrumentation technique (94.5%). Only eight percent reported use of reciprocating file instrumentation. Most students reported using warm vertical compaction as obturation technique (71%); 34 percent use cold lateral compaction technique.

![Endodontic errors reported (%)](image)

**Figure 2** Endodontic errors reported (%)

Seventy-nine percent of the students who are going into general practice plan to perform uncomplicated initial non-surgical root canal treatment. Forty-four percent plan to use the same instrumentation and obturation technique that they used during dental school. Over two-thirds of the students (68.5%) reported that they are not considering endodontics as a specialty, 22 percent reported that they might consider endodontics, and only 9.5 percent indicated that they have considered endodontics as a specialty to pursue after graduation.
Discussion

Root canal treatment is an important procedure that general practitioners usually encounter. In fact, it has been reported that the majority of root canal treatment is performed by dental students and general practitioners (63%)\(^\text{15}\). Hence, general dentists should have the ability to evaluate and diagnose properly based on their understanding of dynamics of pulpal and periapical diseases, and to perform adequate root canal treatment, especially uncomplicated cases.

Surveys are considered an important method to assess students' perceptions and to gather their feedback in a way that allows us, as educators, to address the limitations of the educational experience\(^\text{13, 16, 17, 18}\).

In this study, the median number of successfully completed teeth during preclinical laboratory courses was 10, with no significant difference between number of teeth completed in preclinical training and confidence to start clinical practice.

The relatively high number of teeth completed could be due to the availability of plastic teeth to practice preclinically. Synthetic plastic teeth are considered an adequate substitute for natural teeth for preclinical training, due to their availability and cleanliness, which reduces the chance of infection\(^\text{19, 20}\). Adequate preclinical training allows students to gain necessary skills in order to start clinical practice\(^\text{19}\).

Most students in this study (81%) stated that the didactic part, including lectures, was sufficient and that the use of social media as a source of
information was helpful in improving their endodontic knowledge and skills. This finding contradicts a study by Davey et. al. conducted in the UK, where 79 percent of the students stated that the quality of the lecture was not adequate.

The median number of successfully completed teeth during clinical training was two teeth. This is consistent with a study in the UK that reported that senior dental students performed a mean of 2.81 root fillings clinically. However, a higher number of cases was reported in a study of students in Saudi Arabia. Studies have various methods of reporting number of cases completed by the students. Some reported number of teeth completed, while others reported number of canals completed, as was the case in a study by Murray and Chandler, who reported a mean number of root canals completed by fifth year students of 10. Another study reported that students in European Union completed a mean number of 17 canals.

All schools included in the present study were public institutions. However, there is diversity in number of required endodontic cases to be completed between different schools. This diversity in number can be attributed to multiple factors, such as patient flow and number of students enrolled in the school.

Students reported that the median number of teeth needed to be completed clinically in order to be confident was within a range from three to 37 teeth, compared to Murray and Chandler’s study, where fifth year students reported the need for performing between four and 22 canals to achieve clinical competence.
Irrespective of variations in methods of reporting, students commonly reported the need for a higher number of cases than what they actually performed in order to be confident \(^{10,21}\). This finding is supported by the European Society of Endodontology guidelines for undergraduate curriculum, which states that a student needs to complete 20 teeth, including both preclinical and clinical training, to achieve competency \(^{22}\). Consequently, in terms of number of canals, more than 20 canals are needed \(^{22}\).

Applying this recommendation might not be practical, as it is difficult to obtain an adequate number of cases suitable to be performed by dental students. Thus, one of the major impediments to endodontic clinical training is an insufficient patient pool for all students to complete endodontic requirements. In addition, the patient may also decide to proceed with other treatment options such as tooth extraction and replacement. One student in the present study suggested reducing the cost of endodontic procedures to encourage more patients to pursue it rather than extraction.

Rubber dam placement is a fundamental step in endodontic treatment. One study found that over half of senior dental students in Wales and Ireland reported difficulties in dental rubber dam placement \(^{23}\). However, in our study, all respondents reported confidence in this procedure.

Most respondents in this study (84%) reported confidence in taking endodontic radiographs, an essential step during endodontic treatment. This is higher than another study that found a little over half of students reporting confidence in this procedure \(^{12}\). Low confidence may be attributed to insufficient training in
endodontic radiography, or to the use of radiology technicians, which also results in insufficient endodontic radiography experience among students. Another possible factor contributing to insufficient experience, noted by one respondent in this study, is an insufficient number of available radiographical machines, which results in wait time.

As regards confidence in performing endodontic treatment on different tooth types, students reported lowest confidence in treating mandibular and maxillary molar teeth, a finding consistent with other studies. Low levels of confidence can be attributed to the variation and complexity of canal anatomy in molar teeth, the presence of multiple canals that necessitate special management, and inadequate experience treating molar teeth. The majority of students indicated that they plan to refer molar endodontic treatment to a specialist.

Thirty-three percent of respondents reported endodontic errors during their clinical training. This may be due to the willingness of senior dental students to take risks during endodontic treatment, especially with difficult cases such as canal curvature, a possibility that finds with some support in the finding that root canal ledging was reported as the most frequent endodontic error (28%). Perforation, which was reported by only 4 percent of respondents, has been reported in other studies as the most frequently occurring endodontic error. Endodontic errors can be attributed to multiple factors, such as difficulty of the case, students not following proper treatment technique, and lack of supervising faculty members. Another reason might be the lack of supervising specialists.
in most dental schools in the US and Canada, endodontic residents and general dentists supervise undergraduate students. Supervision by endodontists was found to be associated with higher competence among students in Amsterdam-Netherlands.

The majority of students (68.5%) reported that they are not considering endodontics as a specialty. This might be due to the exposure to difficult cases that reflect the difficulty of endodontics as a specialty or, more likely, to a lack of sufficient exposure during dental school. It is generally acknowledged that students feel deficient in clinical skills due to limited clinical exposure during dental school. Student suggestions for improvement included more clinical experience, observation of endodontic residents during endodontic diagnosis, step-by-step practical demonstration, using different techniques rather than following just one technique, and having well-trained professors who are eager to teach.

In summary, our hypothesis that there is a positive association between experience and confidence level among senior dental students was accepted, that is, students with more experience reported greater confidence regarding performance of endodontic treatment. In addition, the majority of respondents reported inadequate levels of endodontic clinical experience. By increasing the amount of clinical endodontic experience, confidence levels should also increase as students are able to master necessary skills and accordingly perform better quality root canal treatment.
Limitations

Our survey's response rate was 19.5 percent, which is lower than what we anticipated based on typical online survey response rates of 33 percent\(^4\). The response rate may have been higher if students had been offered an incentive, such as a prize drawing. In addition, students at two schools received the emails as forwarded messages by the schools' associate deans of research rather than directly from the co-investigator, which may have affected response rate. Based on the relatively low response rate, these results should be considered preliminary in nature.

Future research should include more dental schools in order to determine whether these results are replicable, and to allow for a better understanding of students' endodontic experience in order to make improvements in the educational setting.

Conclusion

- Within the limitations of the study, senior dental students demonstrated high confidence to start practicing clinical endodontics as a result of their preclinical training. However, they reported not being as confident to practice endodontics after graduation due to insufficient clinical training provided by their schools.
- Those with greater clinical experience report higher confidence levels.
- The majority of respondents plan to refer cases to an endodontist, and less than 10 percent are considering pursuing endodontics as a specialty after graduation.
Further research is needed to determine whether these results can be generalized, and to provide more information for the evaluation and improvement of undergraduate endodontic education.
## Appendix X: List of Contacted Schools and Disposition

<table>
<thead>
<tr>
<th>School</th>
<th>Disposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>Case Western Reserve University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>Columbia University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>Harvard University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>New York University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>Nova Southeastern University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>Declined to Participate</td>
</tr>
<tr>
<td>Oregon Health &amp; Science University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>Rutgers University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>Stony Brook University</td>
<td>Agreed to Participate</td>
</tr>
<tr>
<td>Temple University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>Tufts University</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>University of California at Los Angeles</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>University of Connecticut</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>University of Illinois at Chicago</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>University of Iowa</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>University of Michigan</td>
<td>Agreed to Participate</td>
</tr>
<tr>
<td>University of North Carolina at Chapel Hill</td>
<td>Agreed to Participate</td>
</tr>
<tr>
<td>University of Pennsylvania</td>
<td>Did Not Respond</td>
</tr>
<tr>
<td>University of Pittsburgh</td>
<td>Did Not Respond</td>
</tr>
</tbody>
</table>
Appendix Y: Survey

1. What is your age? ______

2. What is your gender?
   Male
   Female

3. Dental school you are attending:
   University at Buffalo
   Stony Brook University
   University of Michigan
   University of North Carolina at Chapel Hill

4. Do you have any previous dental-related degree(s)?
   Yes
   No

5. If yes, what kind of degree(s)? (You can choose more than one answer)
   Dental Hygiene
   Dental Assisting
   Lab Technician
   Dental degree from another country

6. How many clinical years of practicing endodontics have you had during dental school?
   Less than 1 year
   1 year
   More than 1 year but less than 2 years
2 years
More than 2 years

7. How many successfully completed teeth did you treat endodontically during your preclinical laboratory course(s)?

Anterior teeth
Anterior teeth # of cases menu

Premolar
Premolar # of cases menu

Molar
Molar # of cases menu

8. How confident you feel to start clinical endodontic treatment on your patients as a result of your preclinical preparation?

0 = Not at all confident
1 = Slightly confident
2 = Moderately confident
3 = Highly confident

9. In your opinion, do you think that the didactic part (lectures) of your endodontic education was sufficient?

Yes
No

10. If you answered no to the previous question, what kind of improvements do you think should be made: _____
11. Do you use social media (YouTube or other applications) as a source of information to help you to improve your endodontic knowledge and skills?

   Yes
   No

12. If you answered yes to the use of social media, please specify which application(s) you use (You can choose more than one answer)

   Youtube
   Facebook
   Endolit
   Instagram
   Twitter
   Snapchat
   Other (please specify)

13. If you answered yes to the use of social media, how helpful have these applications been?

   0 = Not at all helpful
   1 = Slightly helpful
   2 = Moderately helpful
   3 = Very helpful

14. How many successfully completed teeth did you treat endodontically during your clinical course(s)?

   Anterior teeth

   Anterior teeth # of cases menu
15. How confident you feel practicing endodontics after graduation as a result of this clinical experience provided by your school?

0 = Not at all confident
1 = Slightly confident
2 = Moderately confident
3 = Highly confident

Comments: _____

16. If you answered "Not at all" or "Slightly confident" to the previous question, what is the minimum number of required successfully completed cases that you think would allow you to be confident?

Anterior teeth

17. Please indicate how confident you are performing the following procedures, on a scale from 0-3 (0= Not at all confident, 1= Slightly confident, 2= Moderately confident, 3= Very confident)
Endodontic evaluation of the patient and patient history
Diagnosis of endodontic treatment
Achievement of anesthesia for endodontic treatment
Placement of the rubber dam for endodontic treatment
Endodontic access cavity preparation
Measurement of the working length
Root canal instrumentation and shaping
Root canal irrigation
Root canal obturation
Management of inter-appointment flare up and/or pain
Taking radiographs for endodontic treatment
Restoration of endodontically treated teeth

18. Please indicate how confident you are in performing root canal treatment to the following different types of teeth, on a scale from 0-3 (0= Not at all confident, 1= Slightly confident, 2= Moderately confident, 3= Very confident)
Maxillary anterior teeth
Maxillary premolars
Maxillary molars
Mandibular anterior teeth
Mandibular premolars
Mandibular molars
19. How many times have you experienced any endodontic errors during treatment of your patients (e.g., perforation, broken instrument, ledge, missed canal)?

**Perforation**

Perforation How many times? menu

**Broken instrument**

Broken instrument How many times? menu

**Ledge**

Ledge How many times? menu

**Missed canal**

Missed canal How many times? menu

**Other** (please specify)

20. After graduation, if you are going into general practice, are you planning to perform uncomplicated initial non-surgical root canal treatment?

Yes

No

Comments: ____

21. What kind of instrumentation do you use at your school? (You can choose more than one answer)

- Manual files instrumentation
- Rotary files instrumentation
- Reciprocating files instrumentation
22. What kind of obturation technique do you use at your school? (You can choose more than one answer)

Cold lateral compaction
Warm vertical compaction
Other (please specify)

23. After graduation, would you use the same instrumentation and obturation technique that you used during dental school?

Yes
No, will try different techniques
No, not planning to perform endodontic treatment

24. Have you considered Endodontics as a specialty?

Yes
No
Maybe

25. Please provide any additional comments regarding your endodontic education and practice.
Appendix Z: Text of the recruitment email to students

Dear senior dental student,

My name is Majd Alsharif and I am an endodontic resident at the University at Buffalo School of Dental Medicine. As part of my Master’s thesis, I am conducting a research study of graduating dental students’ experiences and confidence in completing endodontic procedures.

The purpose of the study is to determine whether there is a relationship between experience and confidence levels and to identify any potential areas of the dental education curriculum in endodontics that may need to be reviewed and/or revised.

Senior students at four different institutions are being asked to participate in the study. By completing the questionnaire, you are giving your consent to participate. The entire survey will take no more than 8 to 10 minutes to complete. Your responses are confidential and anonymous, and will be combined with those of your classmates, and senior dental students at other dental schools, to provide information about dental students’ experiences and confidence in completing endodontic procedures.

Your participation is strictly voluntary. Refusal to participate will not affect your grades or your status as a student in any way. You may also choose to discontinue participation at any time without penalty or loss of benefits to which you would otherwise be entitled.

There are no known risks and no direct benefits to you for completing the survey. However, a potential indirect benefit is a better understanding of the
dynamics involved in students’ experiences and confidence related to endodontic procedures and, ultimately, responsive curricular change to address concerns in the education of students in this clinical discipline.

To contact the research team about any questions, concerns, or complaints about the research, please email or call one of the following team members:

Dr. Elaine Davis, principal investigator

Email: eldavis@buffalo.edu
Phone: (716) 829-3726

Dr. Majd Alsharif, co-investigator

Email: majdbakh@buffalo.edu
Phone: (716) 829-6224

To contact someone independent of the research team for questions, concerns, or complaints, or questions about subjects’ right to obtain information or offer input, you may contact the research participant advocate at 716-888-4845 or researchadvocate@buffalo.edu.

This research has been reviewed and approved by an Institutional Review Board (protocol #STUDY00002829). You may talk to them at (716) 888-4888 or email ub-irb@buffalo.edu.

To complete the survey, please click on this link:

https://www.surveymonkey.com/r/TN8CGTP
References


2 Rafeek RN, Smith WA, Mankee MS, Coldero LG. Radiographic evaluation of the technical quality of root canal fillings performed by dental students. Aust Endod J 2012; 38: 64–69


9 Dummer PM. Comparison of undergraduate endodontic teaching programmes in the United Kingdom and in some dental schools in Europe and the United States. Int Endod J 1991; 24(4): 169-177


11 Archer R. How can the decreased number of cases at the predoctoral level and its impact on competencies be addressed. Eye on Education: AAE’s Monthly Update for Educators, Sept. 2014:2


14 Nulty DD. The adequacy of response rates to online and paper surveys: what can be done?. Assess & Eval in Higher Educ, 2008, 33, 301-314


20 Qualtrough AJE. Undergraduate endodontic education: what are the challenges? Br Dent J 2014; 216: 361–4


