Difficulties Encountered during Transition from Preclinical to Clinical Endodontics among Salman bin Abdul Aziz University Dental Students
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Abstract:
Background: The quality of academic training can best be analyzed by including the student’s perceptions. The aim of this study is to evaluate the short comings in preclinical endodontic training and also to find out key areas to stress upon for better student understanding and treatment outcome.

Materials and Methods: A total of 72 structured questionnaires were distributed to the dental students who have already entered or finished clinical endodontic training in 4th year after successfully completing the preclinical endodontic course in 3rd year. The questions were focused on the list of difficulties encountered during each step of endodontics including patient consideration, access related difficulties, difficulties during working length determination, cleaning and shaping and obturation. The difficulty level for each of the questions was also rated on a scale of 1-3. About 88% of the questionnaires were returned for evaluation. The obtained answers were analyzed generating a data showing the type and level of difficulty.

Results: Locating the apical constriction and controlling the length of the master cone has the highest percentage of difficulty among all the groups.

Conclusions: This study helped in highlighting key areas of difficulties faced by the students. The training for students in future needs to be amended so that they are better able to manage such difficulties.

Key Words: Education, dental students, difficulties, preclinical endodontics, Saudi Arabia

Introduction
The quality of training at any institution can best be analyzed by taking the students perceptions into consideration. Students can provide valuable feedback, which can be beneficial to review the curriculum and improve the overall standard of training, as well as patient care. Unfortunately, in many situations the students’ opinions are often overlooked, especially when considering the future planning of the program.

Dentistry is an extensive program that requires a lot of efforts, encouragement, and clinical exposure. A lot of factors play a role during the mental development of dental student, and the most important of them is stress. Few of the possible stress factors could be competition, frequent examinations, comparisons between students, teacher/student relationships, patient/student relationships, clinical application of theoretical knowledge. These factors can significantly affect the confidence of the student and influence the way students perceive and experience their education.

The anatomical diversity of root canals, the need to provide adequate care to the patients and the lack of self-confidence among students led many of them to consider endodontics to be difficult and stressful discipline, especially while performing the molar endodontic treatment. This uncertainty by the dental student may reflect on the unsatisfactory preclinical training, which affects the clinical treatment.

The present study aimed to identify the difficulties faced by the students based on their perceptions and to remove these shortcomings by laying more emphasis on these areas. The study also aims to create a better environment for training the students, who are able to remove fear, instill self-belief and create better skills among students to perform quality endodontic procedures.

Materials and Methods
A structured questionnaire was distributed to a total of 72 dental students in College of Dentistry, Salman bin Abdul Aziz University Al Kharj, Saudi Arabia. These students had previously attended and cleared the preclinical endodontics course in the 3rd year of their curriculum and had entered or already cleared the clinical endodontic program. The dental college has four functioning departments which are conservative dental sciences, preventive dental sciences, oral and maxillofacial surgery and diagnostic sciences and prosthetic dental sciences. The field of endodontics comes under the Department of Conservative Dental Sciences.

Time devoted to preclinical lab practice
The students first come across endodontics in 3rd year of their BDS program. The preclinical endodontic course is a four
credit hour, two semester program which has a total of 28 h of didactic and 84 h of laboratory training. On completion of the program, the students enter clinical endodontics in 4th year, which is a three credit hour program.

**Minimum requirement (quota)**
The students are assigned a quota of 12 completed root canals in freshly extracted human natural teeth. Three single canaled maxillary anterior, one two canaled mandibular anterior, two maxillary two canaled premolars, two single canaled mandibular premolars, two maxillary and two mandibular molars. These include the exercises as well as the assessment test for each category of teeth. In clinical endodontics three anterior teeth, three premolars, three molars and two retreatment cases which are a total of 12 completed cases.

**Clinical procedures**
During the course of both the laboratory and clinical program, the students are taught and are made to follow step back technique of root canal preparation as described by Mullaney in 1979.

A No. 2 Round bur and Endo Z bur are used for access opening. Gates Glidden drills are used for Orifice enlargement, and ISO standardized stainless steel K files are used for the shaping procedure. Niti instruments are not a part of student training and use. Irrigation is done by using 2.5% NaOCl, 2% chlorhexidine and normal saline is used to flush out the debris. Obturation is done by cold lateral condensation of gutta-percha using a resin based sealer.

**Assessment**
The student to staff ratio in both the courses is 5:1. At the end of each session, the endodontic envelope is filled according to the work done which is then approved, graded and signed by the concerned faculty member.

**Approval**
Approval for the study was received from the Human Research Ethics Committee at Salman bin Abdul Aziz University. Each student received an information sheet prior to distribution of the survey explaining the study’s confidentiality and the purpose of the study.

**Results**
The descriptive analysis of the percentage of subjects having difficulty in different root canal procedures is shown in Tables 1-5.

Locating the apical constriction and controlling the length of the master cone has the highest percentage of difficulty among all the groups.

### Discussion
Regular evaluation and feedback from students is necessary to improve and alter the curriculum and correct the mistakes. In the current study, out of the 72 distributed survey forms, six interns and two students did not return, a high response rate of 88% was achieved. This could depend on the way the questionnaire is presented. In this study, the questionnaire was distributed to the students during their lectures and was collected at the same time. However, great variability (63-100%) in return rates has been reported in other studies. The students were asked to grade a total number of 36 closed-ended questions on a difficulty grade ordinal scale of 0-3 as seen in Table 6.

In Table 1 Group I, difficulties encountered during the patient management, administration of local anesthesia and Rubber Dam application were the major concerns of the students.

Local anesthesia is not a part of both the didactic and laboratory training exercises in the preclinical endodontic curriculum. Although taught during oral surgery and periodontal sessions it seemed necessary to provide student’s additional chair side training in endodontic clinics as pulp is an entirely different substrate to anesthetize and handle. Obtaining anesthesia often is difficult in patients with endodontic pain who have pulpal pathosis. One possible explanation for this is that local anesthetics are unable to prevent impulse transmission because of lowered excitability thresholds.

Failure to successfully achieve an inferior alveolar nerve block is also at a higher side. Accessory innervation, accuracy of injection, needle deflection were thought to be possible reasons for failure, but were proved to be irrelevant in subsequent studies. Lower speed of injection has shown higher success in achieving profound anesthesia than rapid injection. With more clinical training and experience the students would be able to overcome this difficulty and use additional means to

### Table 1: Group I percentage of difficulties encountered by students during patient management in the clinics.

| Q no. | Question                                      | Difficulty grading (%) | Difficulty level                                      |
|-------|-----------------------------------------------|------------------------|------------------------------------------------------|
|       |                                               | Never      | Rare       | Sometimes  | Frequent  |                                              |
| 1     | Difficulty in correct diagnosis               | 24 (38.7)  | 23 (37.1)  | 12 (19.4)  | 3 (4.8)   | Maximum difficulty in administration of local anesthesia - 8.1% |
| 2     | Difficulty in administration of local anesthesia | 26 (41.9)  | 24 (38.7)  | 7 (11.3)   | 5 (8.1)   | Difficulty in Rubber Dam application – 8.1% |
| 3     | Difficulty in pain management                 | 14 (22.6)  | 35 (56.5)  | 10 (16.1)  | 3 (4.8)   | Any other – 6.5%                              |
| 4     | Difficulty in rubber dam application          | 20 (32.3)  | 22 (35.5)  | 15 (24.2)  | 5 (8.1)   | Difficulty in correct diagnosis – 4.8%         |
| 5     | Any other                                     | 51 (82.3)  | 6 (9.7)    | 1 (1.6)    | 4 (6.5)   | Difficulty in pain management – 4.8%           |
Table 2: Group II percentage of difficulties encountered by the students during access opening in the clinics.

| Q. no | Question                                                      | Difficulty grading (%) | Difficulty level                                                                 |
|-------|---------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------|
|       |                                                               | Never | Rare | Sometimes | Frequent |                                                                                     |
| 6     | Difficulty in reaching the pulp chamber                       | 28 (45.2) | 21 (33.9) | 10 (16.1) | 3 (4.8) | Maximum difficulty in gauging of the pulpal floor – 8.1%                               |
| 7     | Difficulty in adequately deeroofing the chamber               | 19 (30.6) | 25 (40.3) | 15 (24.2) | 3 (4.8) | >Difficulty in locating the orifices – 6.5%                                         |
| 8     | Difficulty in locating the orifices                           | 12 (19.4) | 29 (46.8) | 17 (27.4) | 4 (6.5) | >Difficulty in reaching the pulpal chamber – 4.8%                                      |
| 9     | Gauging of the pulpal floor                                  | 14 (22.6) | 33 (53.2) | 10 (16.1) | 5 (8.1) | >Difficulty in adequately deeroofing the chamber – 4.8%                               |
| 10    | Perforations                                                  | 22 (35.5) | 29 (46.8) | 9 (14.5)  | 2 (3.2)  | >Perforations – 3.2%                                                                |
| 11    | Any other                                                      | 56 (90.3) | 5 (8.1)   | 1 (1.6)   | 0 (0)    | >Any other (0%)                                                                    |

Table 3: Group III percentage of difficulties encountered by students during working length determination in the clinics.

| Q. no | Question                                                        | Difficulty grading (%) | Difficulty level                                                                 |
|-------|-----------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------|
|       |                                                               | Never | Rare | Sometimes | Frequent |                                                                                     |
| 12    | Difficulty in reaching the apex                                 | 12 (19.4) | 24 (38.7) | 19 (30.6) | 7 (11.3) | Maximum difficulty in feel the apical constriction – 43.5%                           |
| 13    | Difficulty in reading the radiograph                           | 21 (33.9) | 21 (33.9) | 15 (24.2) | 5 (8.1)  | >Difficulty in using apex locator – 19.4%                                          |
| 14    | Difficulty to feel the apical constriction                      | 10 (16.1) | 14 (22.6) | 11 (17.7) | 27 (43.5) | >Difficulty in reaching the apex – (11.3%)                                        |
| 15    | Difficulties in using apex locator                             | 16 (25.8) | 18 (29)   | 16 (25.8) | 12 (19.4) | >Difficulty in reading the radiograph – 8.1%                                      |
| 16    | Any other                                                       | 56 (90.3) | 5 (8.1)   | 1 (1.6)   | 0 (0)    | >Any other (0%)                                                                    |

Table 4: Group IV percentage of difficulties encountered by students during cleaning and shaping procedures in the clinics.

| Q. no | Question                                                      | Difficulty grading (%) | Difficulty level                                                                 |
|-------|-----------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------|
|       |                                                               | Never | Rare | Sometimes | Frequent |                                                                                     |
| 17    | Loss of working length during shaping                          | 15 (24.2) | 21 (33.9) | 17 (27.4) | 9 (14.5) | Maximum difficulty in flare up – 43.5%                                              |
| 18    | Canal blockage                                                 | 13 (21)   | 26 (41.9) | 17 (27.4) | 6 (9.7)  | >Ledge formation – 21%                                                             |
| 19    | Ledge formation                                                | 16 (25.8) | 27 (43.5) | 6 (9.7)   | 13 (21)  | >Chemical accident – 19.4%                                                      |
| 20    | Apical perforation                                             | 21 (33.9) | 17 (27.4) | 14 (22.6) | 10 (16.1) | >Apical perforation – 16.1%                                                      |
| 21    | Canal transportation                                           | 24 (38.7) | 23 (37.1) | 12 (19.4) | 3 (4.8)  | >Loss of working length during shaping - 14.5%                                     |
| 22    | Strip perforation                                              | 56 (90.3) | 5 (8.1)   | 1 (1.6)   | 0 (0)    | >File separation - 11.3%                                                       |
| 23    | File separation                                                | 12 (19.4) | 24 (38.7) | 19 (30.6) | 7 (11.3) | >Canal blockage – 9.7%                                                             |
| 24    | Difficulty in achieving continuous tapering preparation        | 21 (33.9) | 21 (33.9) | 15 (24.2) | 5 (8.1)  | >Difficulty in achieving continuous tapering preparation – 8.1%                  |
| 25    | File separation                                                | 10 (16.1) | 14 (22.6) | 11 (17.7) | 27 (43.5) | >File separation - 11.3%                                                       |
| 26    | Sodium hypochlorite/chemical accident                          | 16 (25.8) | 18 (29)   | 16 (25.8) | 12 (19.4) | >Canal transportation - 4.8%                                                      |
| 27    | Handling difficulties of chelating agent                       | 23 (37.1) | 29 (46.8) | 9 (14.5)  | 1 (1.6)  | >Handling difficulties of Chelating agent – 1.6%                                   |
| 28    | Any other                                                       | 57 (91.9) | 5 (8.1)   | 0 (0)     | 0 (0)    | >Strip perforation                                                             |

Table 5: Group V percentage of difficulties encountered by students during obturation in the clinics.

| Q. no | Question                                                      | Difficulty grading (%) | Difficulty level                                                                 |
|-------|-----------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------|
|       |                                                               | Never | Rare | Sometimes | Frequent |                                                                                     |
| 29    | Difficulty in placement of sealer                              | 13 (21)   | 24 (38.7) | 19 (30.6) | 6 (9.7)  | Maximum difficulty in master cone beyond apex - 41.9%                             |
| 30    | Master cone short of apex                                      | 22 (35.5) | 21 (33.9) | 15 (24.2) | 4 (6.5)  | >No tug back – 17.7%                                                            |
| 31    | Master cone beyond apex                                        | 11 (17.7) | 14 (22.6) | 11 (17.7) | 26 (41.9) | >Bending of accessory cones while placement - 14.5%                              |
| 32    | No tug back                                                    | 17 (27.4) | 18 (29)   | 16 (25.8) | 11 (17.7) | >Difficulty in placement of sealer – 9.7%                                        |
| 33    | Difficulty in taking spreader to 1-2 mm of WL                  | 57 (91.9) | 5 (8.1)   | 0 (0)     | 0 (0)    | >Voids in obturation - 8.1% master cone short of apex - 6.5%                     |
| 34    | Bending of accessory cones while placing                       | 11 (17.7) | 24 (38.7) | 18 (29)   | 9 (14.5)  | >Difficulty in taking spreader to 1-2 mm of WL. 14.5%                          |
| 35    | Voids in obturation                                            | 11 (17.7) | 28 (45.2) | 18 (29)   | 5 (8.1)  | >Any other                                                                     |
| 36    | Any other                                                      | 53 (85.5) | 8 (12.9)  | 1 (1.6)   | 0 (0)    | >Any other                                                                     |

achieve pulpal anesthesia like the use of intra ligamentary anesthesia and intraosseous anesthesia which was found to be effective.\(^{23,24}\)

Training and emphasis on the use of rubber dam from the first exercise in preclinical endodontics throughout their student are mandatory in College of Dentistry, Salman bin Abdul Aziz University. Possible reasons for the shortage of confidence and difficulty in clinics could be lack of patient cooperation, badly broken down teeth and maligned teeth. Lack of patient cooperation may be more strongly related to the dentist attitude as pointed out by Whitworth et al.\(^{25}\). The latter two reasons could be because the teeth selected for work during preclinical training are sound teeth and teeth with carious involvement with all or most of the walls intact. Selection and adaptation of clamps could become an issue in the clinic when the tooth is broken down due to caries/fracture or is malaligned.
In Table 3 Group III, difficulties encountered during working length determination, the maximum level of difficulty faced by the students was to detect the apical constriction. The apical constriction is the apical portion of the root canal having the narrowest diameter. This position may vary but is usually 0.5-1.0 mm short of the apical foramen.\textsuperscript{27,28} The exact location of this can become difficult when the apical constriction disappears completely in case of the apical disease or by resorption.

The use of apex locator would have helped to overcome this problem as it has been proved a success rate of 98%. A combination of the use of radiographs with electronic working length determination has been recommended for predictive endodontic treatment.\textsuperscript{29,30} The students had a problem with the use of the apex locator in the clinics. Its use was not part of the training in preclinical endodontics. Incorporation of the apex locators in the preclinical setting would help to overcome this problem as the students will have time to adapt to it and would be more at ease in the clinical setup.

In Table 4 Group IV, difficulties encountered during cleaning and shaping, ledges where the most common error encountered by the students. Although it has been proved that the use of step back preparation is advantageous as it helps to reduce procedural errors such as transportation and ledges.\textsuperscript{31}

A ledge is created when the working length can no longer be negotiated, and the original pathway of the canal has been lost. Failure to bypass the ledge and renegotiate the root canal space apical to it can result in unsuccessful treatment and ongoing periapical pathosis.\textsuperscript{32}

It commonly occurs due failure to follow proper instrument sequence and skipping instruments, failure to recapitulate, forcing the instrument, failure to precurve the instruments. A ledge can also occur because of failure to extend the access cavity sufficiently to allow adequate access to the apical part of the root canal.\textsuperscript{33}

In few studies, the use of Niti files and instruments with non-cutting tips proved beneficial in treating curved canals and helped in preventing ledge formation.\textsuperscript{34} However, it is been reported that the introduction of Niti instruments in undergraduate clinics has met with some resistance, despite several reports indicating low rates of complications.\textsuperscript{35} This could be because of the high cost of these instruments as compared to stainless steel files.\textsuperscript{36} Unfortunately, the use of Niti files was not a part of this program. A change in the training pattern with the use of Niti especially while shaping curved canals could be one possible recommendation to negate this iatrogenic error.

### Table 6: Questionnaire on the difficulties encountered in performing Endodontics in clinics.

| List of difficulties encountered | Difficulty grading |
|---------------------------------|--------------------|
| Patient considerations          |                    |
| Difficulty in correct diagnosis |                    |
| Difficulty in correct diagnosis |                    |
| Difficulty in pain management   |                    |
| Difficulty in rubber dam application |    |
| Any other                       |                    |
| Access opening related difficulties |                |
| Difficulty in reaching the pulp chamber |         |
| Difficulty in adequately deroofing the chamber |        |
| Difficulty in locating the orifices |               |
| Gauging of the pulpal floor     |                    |
| Perforations                    |                    |
| Any other                       |                    |
| Working length related difficulties |               |
| Difficulty in reaching the apex  |                    |
| Difficulty in reaching the apex  |                    |
| Difficulty to feel the apical constriction |          |
| Difficulties in using apex locator |               |
| Any other                       |                    |
| Chemico mechanical preparation related difficulties | |
| Loss of working length during shaping |                |
| Canal blockage                  |                    |
| Ledge formation                 |                    |
| Apical perforation              |                    |
| Canal transportation            |                    |
| Strip perforation               |                    |
| File separation                 |                    |
| Difficulty in achieving continuous tapering preparation | |
| Flare up                        |                    |
| Sodium hypochlorite/chemical accident |           |
| Handling difficulties of chelating agent |           |
| Any other                       |                    |
| Obturation related difficulties |                    |
| Difficulty in placement of sealer |                 |
| Master cone short of apex       |                    |
| Master cone beyond apex         |                    |
| No tug back                     |                    |
| Difficulty in taking spreader to 1-2 mm of WL |             |
| Bending of accessory cones while placing |          |
| Voids in obturation             |                    |
| Any other                       |                    |

**WL: Working length**

| Students difficulty grading criteria. | 0 | 1 | 2 | 3 |
|---------------------------------------|---|---|---|---|
| Never                                 |   |   |   |   |
| Rare                                  |   |   |   |   |
| Sometimes                             |   |   |   |   |
| Frequent                              |   |   |   |   |

### Additional training, including the use of rubber dam techniques like the use of the split dam technique while working on broken down teeth could be beneficial.

In Table 2 Group II, difficulties encountered during access opening, gauging of the pulpal floor was the most common error encountered by the students. Gauging of the dentinal walls weakens the remaining tooth structure and usually occurs as a result of the improper angulation. The use of too large a round bur should be avoided as it can cause indiscriminate gauging of the walls.\textsuperscript{26}
In Table 5 Group V, obturation related difficulties, unable to control the length of the master cone and subsequently over obturation was one of the major difficulty encountered by the students. It could also be directly related to the previous difficulty of unable to feel the apical constriction and instrumentation beyond the minor diameter could be one of the reasons for the master cone and obturation beyond the apex. Sjogren et al. classical study has shown that major causes for failed endodontic treatment is seen when obturation is beyond the apex. They showed a success rate of 50% for retreatment cases and 76% for primary endodontic treatment cases with pre-operative apical periodontitis.37

Conclusion
In conclusion, the survey helped to find out about several loop holes in the training program which if modified properly would be of immense benefit to both the student’s quality of work as well as the faculties amount of chair side time in trying to solve these issues. Some of the issues worth employing are:
1. Implementing the use of electronic apex locators in preclinical endodontics
2. Flexibility in the use of instruments like the use of Niti whenever deemed necessary
3. Encouraging the students to eventually overcome these errors and more predictable treatment.

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