Confidence of undergraduate students and new graduates in performing tooth extractions - An exploratory study

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Abstract

Aim: To evaluate pre-extraction assessment skills of dental students and interns and explore their self-perceived confidence in performing these tooth extractions.

Methods: A cross-sectional survey investigated the self-perceived confidence to perform the extraction for a set of eight expert-rated cases. The participants were dental students in years 4, and 5 of the Bachelor of Dental Surgery (BDS) program and interns. The participants were asked to rate the difficulty level of each of the eight tooth extraction cases. The self-perceived confidence of the participants to perform extraction of each was also explored. Finally, the participants were asked to identify the main reason for the perceived lack of confidence.

Results: A total of 199 responded to the survey, yielding a response rate of 94.7%. The effect of Grade of Extraction (the expert rating of cases), and Stage on difficulty ratings was assessed using a mixed 3 Stage x 4 Grades ANOVA, with response (Difficult=1, Easy=0) as the dependent variable. The results showed that there was a main effect of Stage, a main effect of Grade of extraction and a significant interaction between the two. Gender showed a significant impact with females categorizing significantly more cases as difficult. A three-way contingency table (counts of each confidence-level response by Stage by Expert rating of cases) suggests a statistically significant association between the three factors. Most participants identified limited clinical exposure as the main reason for their perceived lack of confidence.

Conclusions: The findings of this study show that a majority of the participants were able to recognize tooth extraction cases which were beyond the scope of their training stage with females reporting lower confidence. Increased clinical exposure to a wider range of tooth extraction cases with varying levels of difficulty may contribute to improving the self-confidence of undergraduate dental students and interns.

Introduction

The goal of undergraduate dental programmes is to prepare the students for independent dental practice and equip them with underpinning scientific knowledge, clinical skills, and behavioral attributes required to serve the community in a safe and effective manner. Dental students are expected to demonstrate competence in range of clinical operative procedures as well as skills in communication, team-working, management, leadership and professionalism.

Competence of a new dental graduate may be viewed as the ability to perform a clinical procedure independently in a safe and effective manner. Competence in uncomplicated tooth extractions is a core clinical skill in undergraduate dental education globally. Dental schools provide clinical training in tooth extractions through structured exposure of students to appropriate patients allowing them repeated opportunities to consolidate their clinical skills under supervision of clinical faculty. However, considerable variations in the teaching and training of undergraduate students in oral surgery are
reported across dental schools beyond within and outside Europe\textsuperscript{6–8} A key variation relates to the number of tooth extractions which dental students are required to perform at a satisfactory level prior to graduation. Given that most contemporary dental curricula are based on a competency-based framework, numerical targets may not be the most critical factor in assessing competence of students. It has also been reported that the relationship between the total number of tooth extractions and the successful completion of the final assessment does not always follow a linear relationship.\textsuperscript{3,7,9} Nevertheless, minimal targets are still prescribed widely in undergraduate dental curricula.

There are remarkable variations in the difficulty level of tooth extractions encountered in clinical practice, more so than many other clinical procedures and may be related to both local factors as well as patient-related systemic factors.\textsuperscript{10} Local factors which may complicate tooth extractions include but not limited to: mouth opening and access; position and orientation of the tooth; residual crown structure; bone thickness; root morphology especially if showing dilaceration, hypercementosis, ankylosis, or accessory roots, concrescence etc. Patient-related factors which may complicate tooth extractions include medical conditions and drugs associated with increased risk of bleeding and delayed healing.

Given the variations in the difficulty-level of tooth extractions, it is important for the students to develop pre-extraction assessment skills to identify cases suitable to their stage of training and the “grain-size” of their competence.\textsuperscript{9} This is important not only to minimize the risk of complications, but also to ensure that students have a positive learning experience, and their confidence is not impacted by repeated unsuccessful attempts at tooth extractions and/or negative feedback from their clinical supervisors.

This study was undertaken to evaluate the pre-extraction assessment skills of undergraduate dental students and their self-perceived confidence in undertaking tooth extractions with a range of difficulty.

The conceptual framework of this study was underpinned by the theory of situated learning which views learning as a transformative process linked closely to the context, and social interactions in a learning environment.\textsuperscript{11} Dental students begin their professional journey through legitimate peripheral participation first by observing and then performing basic tasks. Participation and professional interactions in the learning environment enable the novice students to demonstrate responsibility and allow them to take a more active role in the community of practice.

**Methods**

**Ethical Considerations**

**Ethical approval**

was obtained from the University of Sharjah Research Ethics Committee (approval number REC-21-10-17-1). Participation in the survey was voluntary, and individuals could not be identified using the obtained. No personal information was requested except for gender, and course study year (Stage). The potential
candidates gave their consent to participate in the study after reading written information on the aims and methods of the study data. Neither participation nor questionnaire findings affected academic progress. Student perceptions of competence were not linked to grades or academic performance. All research data were processed and stored according to the university’s data protection regulations.

**Study Design**

This was a cross-sectional analytical study and reported in accordance with STROBE guidelines.

**Settings**

The study was conducted at the college of dental medicine at the University of Sharjah, United Arab Emirates.

**Participants**

A purposive sampling technique was used to target undergraduate dental students in the BDS years 4 and 5, and also new graduates doing their dental internship.

**Research Instrument**

The data collection instrument was based on an electronic questionnaire. The first part of the questionnaire included eight clinical cases of tooth extractions with high-resolution radiographic images. The difficulty-level of each case was rated by four senior oral surgery faculty instructors to determine the suitability for students and interns at various stages of training. The eight cases of tooth extractions were rated as follows by the experts:

- Grade I Suitable for BDS4, BDS5, and interns (2 cases)
- Grade II Suitable for BDS5, and interns (2 cases)
- Grade III Suitable for interns only (2 cases)
- Grade IV Complicated, beyond the scope of students and interns (2 cases)

The inter-examiner agreement was evaluated via the Kappa test with a value of 0.6. Subsequently, the participants were asked to rate the difficulty-level of each tooth extraction case. The second part of the questionnaire explored self-perceived confidence of the participants to perform extraction of each on a five-point scale ranging from “able to perform independently” to “unable to perform”. Finally, the participants were asked to identify the main reason for their perceived inability to perform tooth extraction on one or more cases.

**Data Collection**

The questionnaire was administered face-to-face using electronic tablets during the second semester of the academic year. The participants were asked to review the cases and provide their responses.
independently. The participants were allowed up to 30 minutes to submit their responses.

**Data analysis:**

The analyses reported here were conducted using the R statistical environment (R Core Team 2020). Ratings of case difficulty were recoded to allow a comparison, using a mixed analysis of variance, of the proportions of students within each Stage who identified each Grade of extraction (expert rating) as difficult, and how these factors interacted. The same analysis was repeated with the inclusion of Gender as a factor to investigate differences in difficulty ratings between male and female participants.

Ratings of whether students would feel confident performing the extractions independently, with help, or not at all, were collated into a three-way contingency table and analyzed to assess any association between Stage, Grade of extraction, and self-perceived Confidence. Follow-up analyses using two-way contingency tables and Chi-Square test of association explored these relationships between each combination of factors, as well as considering gender differences.

Descriptive summaries were analyzed for sample composition and reasons given for reluctance to perform the extractions.

**Results**

**Sample**

The estimated size of the sample was 210 candidates. Of this number, 199 responded to the survey, with an overall response rate of 94.7%. Mean age and number of respondents by Stage of Education and Gender are shown in Table 1.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Number (N)</th>
<th>Gender</th>
<th>Mean Age (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDS4</td>
<td>54</td>
<td>Female</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>Male</td>
<td>22</td>
</tr>
<tr>
<td>BDS5</td>
<td>51</td>
<td>Female</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>Male</td>
<td>23</td>
</tr>
<tr>
<td>Intern</td>
<td>40</td>
<td>Female</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Male</td>
<td>24</td>
</tr>
</tbody>
</table>

**Difficulty Ratings of Tooth Extraction Cases**
The percentage of each group reporting the extraction in each case as easy or difficult, are shown in Table 2.

<table>
<thead>
<tr>
<th>Case</th>
<th>Grade of Extraction</th>
<th>BDS4 Difficult</th>
<th>BDS4 Easy</th>
<th>BDS5 Difficult</th>
<th>BDS5 Easy</th>
<th>Intern Difficult</th>
<th>Intern Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case1</td>
<td>I</td>
<td>20.25</td>
<td>79.75</td>
<td>8.82</td>
<td>91.18</td>
<td>3.85</td>
<td>96.15</td>
</tr>
<tr>
<td>Case2</td>
<td>II</td>
<td>41.77</td>
<td>58.23</td>
<td>16.11</td>
<td>83.82</td>
<td>7.69</td>
<td>92.31</td>
</tr>
<tr>
<td>Case3</td>
<td>I</td>
<td>69.62</td>
<td>30.38</td>
<td>73.53</td>
<td>26.47</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Case4</td>
<td>II</td>
<td>55.70</td>
<td>44.30</td>
<td>41.18</td>
<td>58.82</td>
<td>36.54</td>
<td>63.46</td>
</tr>
<tr>
<td>Case5</td>
<td>IV</td>
<td>94.94</td>
<td>5.06</td>
<td>97.06</td>
<td>2.94</td>
<td>94.23</td>
<td>5.77</td>
</tr>
<tr>
<td>Case6</td>
<td>III</td>
<td>54.43</td>
<td>45.57</td>
<td>60.29</td>
<td>39.71</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Case7</td>
<td>III</td>
<td>49.37</td>
<td>50.63</td>
<td>57.35</td>
<td>42.65</td>
<td>48.08</td>
<td>51.92</td>
</tr>
<tr>
<td>Case8</td>
<td>IV</td>
<td>70.89</td>
<td>29.11</td>
<td>80.88</td>
<td>19.12</td>
<td>84.62</td>
<td>15.38</td>
</tr>
</tbody>
</table>

The effect of Grade of Extraction (the expert rating of cases), and Stage on difficulty ratings was assessed using a mixed 3 Stage (BDS4, BDS5, Intern) x 4 (Grades I-IV) ANOVA, with response (Difficult = 1, Easy = 0) as the dependent variable. The resultant mean for each cell of the design represents the percentage of respondents who perceived the cases as difficult in that category, and the ANOVA compares the differences in these means between groups.

The results showed that there was a main effect of Stage ($F_{2,196}=4.31$, $p=0.015$, $\eta^2_p=0.015$), a main effect of Grade of extraction ($F_{2.72, 533.84}=115.57$, $p<0.001$, $\eta^2_p=0.279$), and a significant interaction between the two ($F_{5.45, 533.84}=4.76$, $p<0.001$, $\eta^2_p=0.031$); as depicted in Fig. 1.

Pairwise comparisons (Tukey HSD) showed that Grade 1 extractions, only the BDS4 and Intern years differ significantly ($p=0.030$); for Grade II extractions, only the BDS4 and Intern years differ significantly ($p=0.004$); and on Grade III and IV extractions, no differences were seen by stage.

BDS4 respondents' judgements of the difficulty of cases suitable for Grade I, II and III extractions are comparable, but all of these judgements are significantly lower than their judgements of Grade IV extractions.

BDS5 respondents' judgements of the difficulty of cases suitable for Grade I, II and III extractions are all significantly lower than their judgements of Grade IV extractions, and in addition, Grade III extractions were reported as more difficult than cases suitable for Grade II.
Intern respondents’ judgements show the same pattern as BDS5 respondents; judgements of the difficulty of Grade I, II, and III extractions are all significantly lower than their judgements of complicated cases, and in addition, Grade III extractions were seen as more difficult than Grade II extractions.

These patterns are found across both male and female respondents. Side-by-side plots are shown in Fig. 2. Statistically, the ANOVA described above, with gender factored in, showed a significant main effect of Gender ($F_{1,193}=4.08$, $p = 0.045$, $\eta^2=0.007$), with females categorizing significantly more cases (54.60%) as difficult on average than males (48.00%), but no significant interaction effects with either Stage ($p = .601$), Grade of extraction ($p = 0.065$), or the two in combination ($p = 0.186$), i.e. the patterns shown in Fig. 1 and both of those shown in Fig. 2 are statistically comparable.

**Self-reported Confidence Ratings**

The percentage of each group reporting the perceived confidence for performing each extraction, by Stage, are depicted graphically in Fig. 3.

Correspondence analysis of a three-way contingency table (counts of each confidence-level response by Stage by Expert rating of cases) suggests a statistically significant association between the three factors ($\chi^2_{df=28} = 853.725$, $p < 0.001$).

Chi-Squared tests of association between stage and response are significant for Grade I ($\chi^2_{df=4} = 17.497$, $p = 0.002$), Grade II ($\chi^2_{df=4} = 16.517$, $p = 0.002$), Grade III ($\chi^2_{df=4} = 14.916$, $p = 0.005$), and Grade IV ($\chi^2_{df=4} = 22.703$, $p < 0.001$) extractions.

Similarly, collapsing across stage and testing for associations between responses and expert rating of cases showed a significant relationship between the two ($\chi^2_{df=6} = 761.33$, $p < 0.001$), and these are found within all permutations of the contingency tables, e.g., whether comparing responses between Grade I and II extractions, Grade II and III extractions, Grade I and IV extractions etc. All of these relationships hold across male and female respondents; a summary of responses for each are shown in Fig. 4.

**Factors underlying lack of confidence**

Table 3 shows the percentage by stage of each response given to the question of why students were reluctant to perform the extractions.
Table 3
Reasons for lack of confidence: percentage of participants in each stage by gender

<table>
<thead>
<tr>
<th>Reason</th>
<th>Males BDS4</th>
<th>Males BDS5</th>
<th>Males Intern</th>
<th>Females BDS4</th>
<th>Females BDS5</th>
<th>Females Intern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always nervous or anxious</td>
<td>4.00</td>
<td>0.00</td>
<td>8.33</td>
<td>7.41</td>
<td>1.96</td>
<td>2.50</td>
</tr>
<tr>
<td>Fear of complications</td>
<td>16.00</td>
<td>11.76</td>
<td>0.00</td>
<td>11.11</td>
<td>11.76</td>
<td>15.00</td>
</tr>
<tr>
<td>Limited exposure to such cases</td>
<td>20.00</td>
<td>23.53</td>
<td>33.33</td>
<td>48.15</td>
<td>33.33</td>
<td>35.00</td>
</tr>
<tr>
<td>No exposure to such cases</td>
<td>32.00</td>
<td>47.06</td>
<td>58.33</td>
<td>24.07</td>
<td>29.41</td>
<td>35.00</td>
</tr>
<tr>
<td>Feel underprepared</td>
<td>28.00</td>
<td>17.65</td>
<td>0.00</td>
<td>9.26</td>
<td>23.53</td>
<td>12.50</td>
</tr>
</tbody>
</table>

Discussion

Competence in clinical dentistry requires several years of experience and for clinical operative skills in dentistry it often extends beyond the temporal confines of a university environment\textsuperscript{12}. Given that dental students get limited clinical exposure during their undergraduate education, stakeholders need to moderate their expectations regarding the “grain-size” of competence that may be achieved realistically by new dental graduates\textsuperscript{9,13–15}. Although dental schools mandate the undergraduate students to achieve clinical targets for various procedures, evidence from the literature suggests that numbers alone are not a reliable predictor of competency\textsuperscript{16,17}. In addition to numerical targets, dental educators need to consider the context and complexity of clinical tasks and monitor student performance longitudinally for a more comprehensive evaluation of students’ clinical competence.

The results of this study show that increased clinical exposure improves the confidence of students and new graduates in dealing with increasingly complex cases of tooth extractions. These findings are consistent with a recent study on foundation dentists in the United Kingdom\textsuperscript{18}. However, the confidence tends to plateau indicating that further experience as an independent practitioner is required to deal with complicated cases. These observations are in accord with the theoretical framework of this study. Dental students begin their professional journey as novice learners and through legitimate peripheral participation, progress through the stages of advanced beginners, aiming to be clinically competent by the time they graduate from the university. Further professional development and experience facilitate transformation of dental graduates into skilled, and ultimately an expert professional.

The findings of this study reiterate that dental educators must ensure that students get appropriate experience in performing tooth extractions with a range of difficulty level. It is also important to ensure that students gain experience performing extractions of all types of single and multi-rooted teeth in both arches so they proficient in dealing with for variations in access, crown/ root morphology, bone thickness, and relationship to teeth adjacent anatomical structures. Therefore, decisions regarding signing off the students for their finals must not rest purely on numbers. For example, extraction of periodontally
involved teeth and mobile, retained roots localized to the soft tissues may fulfill the numerical requirements but such experience does not provide adequate evidence of competence in tooth extraction skills.\textsuperscript{19}

Some inconsistencies in the assessment of difficulty level of tooth extractions cases were noted amongst a small percentage of participants in each of the three groups. While overestimation of difficulty level of tooth extractions is not ideal, it primarily reflects limited confidence but does not pose risks to patients as such. However, a small percentage of participants appeared to be over-confident in their abilities to extract teeth which were over and above the difficulty level appropriate to their stage. This reflects “unconscious incompetence” and is certainly a source of concern. It is widely accepted that one of the key attributes of dental graduates is their ability to recognize their own limitations and refer complex cases appropriately.\textsuperscript{20} The findings of this study are in accord with previous studies which reiterate the need to improve the training of dental students and new graduates to improve their competence and confidence in tooth extractions.\textsuperscript{18,21}

Dental educators must support the students and trainees to reflect on their skill set and prioritize patients’ interests and safety at all times. Individualized and immediate feedback on student performance in simulated and clinical settings was identified as a key factor in enhancing student competence in tooth extractions and this was endorsed by all participants uniformly as reported previously.\textsuperscript{22} Students should be provided timely and constructive feedback to support self-reflection. Feedback should not be restricted to assessments and ideally should follow all patient encounters involving invasive and irreversible clinical procedures such as, tooth extractions. A log of students’ performance such patient encounters can help populate sufficient data points required for longitudinal monitoring of student and trainee performance. Although more challenging, dental educators must also try to prioritize providing timely support to underperforming students and offer appropriate remediation to ensure continuity in their clinical training.\textsuperscript{23}

Some limitations of this study need to be mentioned. Firstly, this study was done at a single institution which limits the generalizability of these findings. Secondly, the results are based on a questionnaire and further engagement with the participants using qualitative methods could have allowed a deeper insight into the factors which impact on the learning experiences of the students and new graduates in oral surgery. Finally, it might be helpful to follow the participants longitudinally to evaluate how further experience contributes to shaping their competency profile in tooth extractions.

**Conclusions**

The findings of this study show that a majority of the participants were able to recognize tooth extraction cases which were beyond the scope of their training stage with females reporting lower confidence. Increased clinical exposure to a wider range of tooth extraction cases with varying levels of difficulty may contribute to improving the self-confidence of undergraduate dental students and interns.
Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the University of Sharjah Research Ethics Committee (approval number REC-21-10-17-1). All methods were carried out in accordance with relevant guidelines and regulations. Informed consent was obtained from all subjects to participate in the study.

Consent for publication

Not applicable

Availability of data and materials

Detailed survey data are available from the corresponding author upon request.

Competing interests

The authors declare no competing interests for this review.

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Authors' contributions (This statement must exactly match on Editorial submission system and in the manuscript)

KG conceptualized the study and contributed to data analysis
KA provided advice on study design and contributed to drafting the manuscript
DZ analysed the data
EI contributed to data collection
EN contributed to data collection
All authors reviewed the manuscript

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References
Figures

Figure 1

Mean cases rated by participants as 'Difficult' (%) by Grade of Extraction and Stage. Error bars reflect 95% confidence intervals.
Figure 2

Mean cases rated by participants as 'Difficult' (%) by Grade of Extraction and Gender. Error bars reflect 95% confidence intervals.

Figure 3

Self perceived confidence of participants by grade of extraction and stage. Labels for values of <5% omitted.
Figure 4

Self perceived confidence of participants by grade of extraction, stage and gender. Labels for values of <5% omitted.