# Validation of Assessment-of-Clinical-Exodontia-Skill (ACES) Rating Scale for Assessment of Exodontia in Undergraduate Dental Students

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## ABSTRACT

*Objective:* To validate assessment-of-clinical-exodontia-skill (ACES) rating scale for formative and summative assessment of undergraduate dental students' exodontia skill.

*Study Design:* Validation study.

*Place and Duration of Study:* Department of Oral and Maxillofacial Surgery, Faisalabad Medical University, Faisalabad, Pakistan, from Feb to Sep 2022.

*Methodology:* Two forms were used for data collection: ACES form and feedback form. Two consultant oral and maxillofacial surgeons assessed each student simultaneously while extraction on live patients was performed and scores were recorded. This was done after one month and after completion (2 months) of oral surgery rotation. Both students and consultants filled in a feedback form and results were analyzed.

*Results:* Fifty (n=50) students participated in study and validity was measured in terms of construct validity where all variables of ACES rating scale had a *p*-value of >0.05 for both observers while reliability was measured in terms of internal consistency and inter-rater reliability. Internal consistency was 0.88±0.01 and 0.83±0.08 for Observer 1 and 2 respectively. Inter-rater reliability of overall score was 0.69 and 0.75 for formative and summative assessment respectively. ACES rating scale was a fair instrument (48.10%) and it provided adequate feedback to the students regarding their competence level (59.60%). Overall students and examiners thought that ACES rating scale should be used for assessment of exodontia skills (61.50%).

*Conclusion:* ACES was found to be acceptable and feasible by students and assessors as a validated tool for formative and summative assessment of exodontia skills in terms of construct validity, internal consistency and inter-rater reliability.

**Keywords:** Assessment, Dental students, Educational measurements, Tooth extraction, Validation.

## INTRODUCTION

Dental Undergraduates require knowledge, skill and attitude to attain the core competence of exodontia,[1] due to which dental institutions across the world have their own way to assess this competence.[2,3] In the United Kingdom, checklist based formative assessment tools like structured clinical operative test (SCOT) or checklist assessment of operative skill (CAOS) are used 1,3 as these assessment tools are valid and reliable in assessing exodontia with some limitations which include inter-examiner variability.[1,4,5,6] In dental institutions across Pakistan, students maintain a log book, signed by faculty, as a record source for the procedures they perform and no checklist-based assessment system is present. Tools currently available to assess exodontia only evaluate quantity and fail to evaluate quality.[7] To overcome this problem, ACES rating scale was developed by consensus of oral surgery faculty across Pakistan for assessment of exodontia (Delphi technique).[8] This rating scale has not been validated for its validity, reliability, acceptability and feasibility, thus, the rationale of this study was to find validation of ACES rating scale, so it could be used uniformly for formative and summative assessment of exodontia. By using valid, reliable, acceptable and feasible ACES rating scale, competence of students can be assessed, and proper feedback provided, helping the students in improving deficient areas. The objective of this study was to validate assessment-of-clinical-exodontia-skill (ACES) rating scale for formative and summative assessment of undergraduate dental student's exodontia skill.

## METHODOLOGY

This validation study was carried out in Department of Oral and Maxillofacial Surgery, Faisalabad Medical University, Faisalabad, Pakistan,

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from February to September 2022 over 8 months, after approval from Ethics Review Committee (Letter No.48.ERC/FMU/2020-21/184). Non-probability consecutive sampling was used among final year dental students of this institute as it was a naturally formed group of research participants. Sample size was calculated assuming success of students after two attempts being 86%1, confidence level of 95% and precision of 10% and it came about to be 50.

**Inclusion Criteria:** Final-year dental students, belonging to either gender, enrolled at Faisalabad Medical University, who were rotating through the Department of Oral Surgery during the data collection period from February to September 2022. Data provided by students was only included in the final paired analysis if they had completed both assessment points: the first after one month of their rotation and the second after the full two-month rotation as the study's validity measures relied on comparing these two sets of scores.

**Exclusion Criteria:** Students who were not in Final-year and who did not complete both sets of scores were excluded from the final analysis.

Two forms were used for data collection: ACES and feedback form. ACES form was developed by consensus of oral and maxillofacial surgeons across Pakistan (Delphi technique) while feedback form was developed after literature search and it was a modification of a form used in a study carried by Balkany T et al similar to the objectives of our study.[9] Both forms used Likert's scale and results of the ACES form were used to calculate construct validity, internal consistency and interrater reliability. Acceptability and feasibility were measured using the results of feedback form. Data was collected from final year dental students when they came for rotation in the Department of Oral Surgery. A brief description of the study was given to the students followed taking their by informed consent. Two consultants from Department of Oral and Maxillofacial Surgery assessed each student simultaneously while they performed extraction on live patients and scores were recorded on ACES form. This was done twice: once, after one month of oral surgery rotation and second, after completion of two-month oral surgery rotation. A copy of ACES form filled by each examiner was given to students so that they could assess their own performance. After completion of the task, both student and the consultants filled a feedback form and results of ACES form and feedback form were

compiled. The data was analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Mean and standard deviation were calculated for individual responses while construct validity was measured by paired student t-test and internal consistency was measured using Cronbach's alpha. Interrater reliability was measured using intraclass correlation coefficient (ICC) and acceptability and feasibility were measured in percentages and compared by chi-square test between students and observers where a $p$-value $<0.05$ was taken to be significant.

## RESULTS

All of the 50 students enrolled in the study participated in both rounds of the study. Scores of ACES rating scale, achieved after completion of first month of rotation were used for formative assessments and scores after two months, for summative assessment. Validity was measured in terms of construct validity as shown in Table-I. For all variables of ACES rating scale $p$-value was $>0.05$ for both observers. This insignificant p-value showed that indicators used to measure each variable were developed correctly and this scale is a valid tool for measurement of exodontia skills.

**Table-I: Construct Validity (n=50)**

| Observer | Variable | Formative Assessment (n=50) | Summative Assessment (n=50) | p-value |
|----------|----------|------------------------------|------------------------------|---------|
| 1 | Pre-Op Patient Assessment | 9.70±2.63 | 10.23±2.86 | 0.36 |
| | Local Anesthesia | 16.74±4.92 | 17.46±4.84 | 0.36 |
| | Extraction Technique | 21.04±5.34 | 22.46±5.51 | 0.07 |
| | Overall Score | 60.92±13.67 | 64.08±13.37 | 0.13 |
| 2 | Pre-Op Patient Assessment | 10.45±2.56 | 10.20±2.84 | 0.63 |
| | Local Anesthesia | 17.34±4.62 | 17.46±4.82 | 0.88 |
| | Extraction Technique | 22.24±5.30 | 22.24±5.16 | 0.60 |
| | Overall Score | 64.22±14.29 | 63.57±14.05 | 0.80 |

Reliability was measured in terms of internal consistency, as shown in Table-II, and inter-rater reliability is shown in Table-III. Mean values of Cronbach`s Alpha for both observers show that internal consistency of ACES rating scale was in good criteria (0.80-0.89) and Inter-rater reliability for most of the variables was in moderate reliability category (0.5-0.75), however, it was in poor category (<0.5) for

extraction technique in formative assessment and for post operative management in both formative as well as summative assessment. Based on these results, ACES rating scale is a reliable tool for evaluation of exodontia skills.

**Table-II: Internal Consistency (n=50)**

| Observer | Formative Assessment (n=50) | Summative Assessment (n=50) | Mean±SD |
|---|---|---|---|
| 1 | 0.88 | 0.87 | 0.88±0.01 |
| 2 | 0.77 | 0.88 | 0.83±0.08 |

**Table-III: Inter-rater Reliability (n=50)**

| Variable | Formative assessment (n=50) | | Summative assessment (n=50) | |
|---|---|---|---|---|
| | r-value | *p*-value | r-value | *p*-value |
| Pre-Op Patient Assessment | 0.53 | < 0.001 | 0.52 | 0.01 |
| Local Anesthesia | 0.56 | < 0.001 | 0.68 | < 0.001 |
| Extraction Technique | 0.45 | 0.02 | 0.62 | <0.001 |
| Cross Infection Control | 0.55 | < 0.001 | 0.62 | <0.001 |
| Post-Op Management and Care | 0.48 | 0.01 | 0.45 | 0.02 |
| Overall | 0.70 | <0.001 | 0.75 | <0.001 |

skills (Strongly Agree=48.10%), it provides adequate feedback to the students regarding their competence level (Strongly Agree=59.60%) and patients' management was not compromised (Strongly Agree =57.70%). However, 28.00% of students and 1 observer were unable to answer whether little time was spent or not while running ACES rating scale. Overall students and examiners think that ACES rating scale should be used for assessment of exodontia skills (Strongly Agree=61.50%).

## DISCUSSION

Exodontia is an important component of undergraduate dental education1-10 and the rationale of this study was to find validation of ACES rating scale, so that it can be used uniformly in all dental institutions across Pakistan for formative and summative assessment of exodontia as no such scale is currently in use and current instruments available for assessment in Pakistan do not measure quality of exodontia skill. The content validity of ACES rating scale is high as it is developed by consensus of oral and maxillofacial surgeons across Pakistan,[8] while construct validity was measured by running ACES rating scale on final year dental students, both for formative and summative assessment. A similar study used an analogous rating scale and found it to be highly valid.[11] Internal consistency of ACES rating

**Table-IV Acceptability and Feasibility of ACES Rating Scale (n=52)**

| | | Students (n=50) | Observers (n=2) | Total (n=52) | *p*-value |
|---|---|---|---|---|---|
| Fair Instrument | Neither Agree Nor Disagree | 8(16.00%) | 0(0.00%) | 8(15.40%) | 0.80 |
| | Agree | 18(36.00%) | 1(50.00%) | 19(36.50%) | |
| | Strongly Agree | 24(48.00%) | 1(50.00%) | 25(48.10%) | |
| Adequate Feedback to Students | Neither Agree Nor Disagree | 4(8.00%) | 0(0.00%) | 4(7.70%) | 0.49 |
| | Agree | 17(34.00%) | 0(0.00%) | 17(32.70%) | |
| | Strongly Agree | 29(58.00%) | 2(100.00%) | 31(59.60%) | |
| Patient Management Not Compromised | Disagree | 4(8.00%) | 0(0.00%) | 4(7.70%) | 0.67 |
| | Neither Agree Nor Disagree | 8(16.00%) | 0(0.00%) | 8(15.40%) | |
| | Agree | 10(20.00%) | 0(0. 00%) | 10(19.20%) | |
| | Strongly Agree | 28(56. 00%) | 2(100. 00%) | 30(57.70%) | |
| Consumes Little Time | Disagree | 8(16.00%) | 0(0.00%) | 8(15.40%) | 0.72 |
| | Neither Agree Nor Disagree | 14(28. 00%) | 1(50. 00%) | 15(28.80%) | |
| | Agree | 12(24.00%) | 0 (0.00%) | 12(23.10%) | |
| | Strongly Agree | 16(32.00%) | 1(50.00%) | 17(32.70%) | |
| Personal Opinion Regarding ACES Scale | Neither Agree Nor Disagree | 9(18.00%) | 0(0.00%) | 9(17.30%) | 0.52 |
| | Agree | 11(22.00%) | 0(0.00%) | 11(21.20%) | |
| | Strongly Agree | 30(60.00%) | 2(100.00%) | 32(61.50%) | |

Acceptability and feasibility were measured using a feedback form in percentages as shown in Table-IV. Majority of students as well as both observers were of the opinion that the ACES rating scale is a fair instrument for assessment of exodontia

scale was good and it could will give similar results in future while inter-rater reliability for some variables was in poor category which could be a "halo effect" for students who were "liked" by examiners scoring higher.[11] Practically, avoiding this phenomenon is

hard but number of examiners can be increased to nullify this. The findings of this study match studies carried out worldwide,[12-18] however one author reported a significant difference in inter-rater reliability while another study found no significant difference in inter-rater reliability.[1,11] Majority of students as well as evaluators in this study were of the opinion that it is a fair instrument to access exodontia skills as it provides adequate feedback to the students regarding the level of skill they learned while other rating scales used internationally have similar acceptability as this scale.[1,3] Results of our study showed that ACES rating scale took no extra time to run and matched with the values of SCOT and COAS.[1,3] Students and assessors were of the opinion that ACES rating scale can be used for assessment of exodontia skills as results of this scale provides detailed information regarding different components of exodontia which can help the students to improve their shortcomings and allow examiners to justify their result over a wide range of variables.

## LIMITATIONS OF STUDY

As this study was carried out in one public sector dental college so its result cannot be generalized to all public and private sector dental colleges of Pakistan. While single-institution limitations call for multicenter validation, ACES integration into dental curricula promises standardized training, improved outcomes, and adaptation to advanced simulation environments.

## CONCLUSION

The ACES rating scale is a validated, reliable tool for formative and summative assessment of exodontia skills, exhibiting strong construct validity, internal consistency, and inter-rater reliability. It was deemed acceptable and feasible by both students and assessors, positioning it as an effective alternative to traditional methods for precise proficiency evaluation.

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**Authors' Contribution**

Following authors have made substantial contributions to the manuscript as under:

MUK & AA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

TK: Conception, data analysis, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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