

Examination of the Validity and Reliability of the Preclinical Endodontics Assessment Rubric by Comparing Student and Academic Staff Scores

Fatma Selenay UÇAŞ YILDIZ^{1*}  Arslan TERLEMEZ² 

¹ Res. Ass., Necmettin Erbakan University, Faculty of Dentistry, Department of Endodontics, Konya, Türkiye, selenay.ucas@gmail.com

² Prof. Dr., Necmettin Erbakan University, Faculty of Dentistry, Department of Endodontics, Konya, Türkiye, arslanterlemez@gmail.com

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ABSTRACT

Aim: The aim of this study was to evaluate the applicability of a technical assessment rubric used in preclinical endodontic education by clinically experienced students and to investigate its level of agreement with academic staff assessments.

Material and Methods: This cross-sectional observational study included forty volunteer fourth-year dental students who had successfully completed their endodontic clinical education. Forty maxillary premolar cases prepared on extracted human teeth during third-year preclinical endodontic education were randomly selected for evaluation. All cases had previously been assessed by academic staff using a structured assessment rubric. The volunteer students independently evaluated anonymized and numbered cases using the same rubric, based solely on their own knowledge and clinical experience. Behavioral competency parameters were excluded from the analysis because they could not be objectively assessed retrospectively. The relationship between student and academic staff technical scores was analyzed using Pearson and Spearman correlation analyses, and group differences were compared using a paired-sample t-test. The level of statistical significance was set at $\alpha = 0.05$.

Results: A statistically significant positive correlation was found between student and academic staff technical scores ($r = 0.625$; $p < 0.001$). Paired-sample t-test analysis revealed no statistically significant difference between the two groups' technical scores ($p = 0.79$).

Conclusion: Clinically experienced students are able to apply a preclinical endodontic technical assessment rubric in a manner consistent with academic staff evaluations. These findings support the use of structured rubrics as reliable tools for assessing technical competence in endodontic education.

Endodonti Preklinik Değerlendirme Rubriğinin Öğrenci ve Öğretim Üyesi Puanlamaları Kıyaslanarak Geçerlilik ve Güvenirliliğinin İncelenmesi

Makale Bilgisi

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ÖZET

Amaç: Bu çalışmanın amacı, preklinik endodonti eğitiminde kullanılan teknik değerlendirme rubriğinin, klinik deneyim kazanmış öğrenciler tarafından uygulanabilirliğini ve akademisyen değerlendirmeleriyle olan uyumunu değerlendirmektir.

Gereç ve Yöntemler: Bu kesitsel ve gözlemsel metodolojik çalışmaya, endodonti klinik stajını başarıyla tamamlamış dördüncü sınıf diş hekimliği öğrencileri arasından gönüllülük esasına göre seçilen kırk öğrenci dâhil edilmiştir. Değerlendirme için, üçüncü sınıf preklinik endodonti uygulamaları kapsamında hazırlanmış çekilmiş insan dişlerine ait kırk üst premolar vakası kullanılmıştır. Tüm vakalar daha önce akademisyenler tarafından yapılandırılmış bir değerlendirme rubriği ile puanlanmıştır. Gönüllü öğrenciler, kimlik bilgileri gizlenmiş ve numaralandırılmış vakaları aynı rubriği kullanarak bağımsız şekilde değerlendirmiştir. Davranış yeterlilik parametreleri, retrospektif olarak objektif biçimde değerlendirilemeyeceği için analiz kapsamı dışında bırakılmıştır. Öğrenci ve akademisyen teknik puanları arasındaki ilişki korelasyon analizleri ile değerlendirilmiş, grup farkları ise eşleştirilmiş örneklem t-testi ile incelenmiştir. İstatistiksel anlamlılık düzeyi $\alpha = 0,05$ olarak kabul edilmiştir.

Bulgular: Akademisyen ve öğrenci teknik puanları arasında orta-iyi düzeyde ve istatistiksel olarak anlamlı pozitif korelasyon saptanmıştır ($r = 0,625$; $p < 0,001$). Eşleştirilmiş örneklem t-testi sonuçlarına göre iki grup arasında teknik puanlar açısından anlamlı bir fark bulunmamıştır ($p = 0,79$).

Sonuç: Klinik deneyim kazanmış öğrenciler, preklinik endodonti eğitiminde kullanılan teknik değerlendirme rubriğini akademisyenlerle uyumlu biçimde uygulayabilmektedir. Bu bulgular, yapılandırılmış rubriklerin teknik yeterlilik değerlendirmesinde güvenilir bir eğitimsel araç olduğunu göstermektedir..

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***Corresponding Author:** Fatma Selenay UÇAŞ YILDIZ, selenay.ucas@gmail.com



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INTRODUCTION

Endodontic training is a fundamental component of undergraduate dental education that requires both comprehensive theoretical knowledge and advanced psychomotor skills.¹ To perform safe and effective root canal treatments in clinical practice, students are expected to acquire adequate technical competence during the preclinical training period prior to their transition to clinical education.² In this process, assessment methods that provide objective, consistent, and educational feedback play a crucial role in ensuring and sustaining the quality of dental education.³

Assessment in preclinical endodontic education is often performed using global or semi-structured grading systems that are largely dependent on the instructor's experience.⁴ However, such approaches may result in inter-rater variability and provide limited educational feedback to students. Consequently, the use of structured assessment tools based on analytical rubrics for evaluating technical skills has become increasingly common in dental education in recent years.⁵ Analytical rubrics aim to standardize the scoring process by enabling endodontic procedures to be assessed according to clearly defined and specific technical criteria.

During the preclinical period, students predominantly adopt a rule-based learning approach. Due to their limited clinical experience and restricted radiographic interpretation skills, they may have difficulty identifying technical errors in assignments for which they receive low scores.⁶ In particular, anatomical variations of extracted teeth make it challenging for students to apply the rules they have learned to different cases, and the interpretation of assessment outcomes often relies on the instructor's explanations. As a result, preclinical assessments may fail to provide sufficient and effective educational feedback for students.⁶

Following preclinical training, students begin their endodontic clinical placement in the fourth year, during which they perform root canal treatments on patients and gain clinical experience.⁷ This clinical training process contributes to the development of students' radiographic assessment skills, enabling them to better identify technical errors and complications and to develop an awareness of anatomical variations among teeth. Such experience is also considered to have a positive impact on students' ability to evaluate technical quality.⁸

In this context, it is important to investigate whether the technical assessment rubrics used during the preclinical period can be consistently applied by students with clinical experience, and to what extent these assessments align with academic staff evaluations.⁹ Although previous studies have demonstrated that rubrics improve assessment consistency among teaching staff, evidence regarding the agreement between student assessments and academic staff scores following clinical training remains limited.¹⁰

Therefore, the aim of this study was to examine the level of agreement between academic staff evaluations and the application of a technical assessment rubric used in preclinical endodontic education by students who had completed their endodontic clinical internship, based on extracted teeth and analogue periapical radiographs.¹¹

MATERIALS AND METHODS

This study was designed as a cross-sectional observational study to evaluate the applicability of a technical assessment rubric used in preclinical endodontic education by students with clinical experience, as well as its consistency with academic staff evaluations. The research was conducted exclusively on educational materials and did not involve any patient data or clinical interventions.

The study was approved by the Ethics Committee of Necmettin Erbakan University,

Faculty of Dentistry (Approval No: 2025t717; Year: 2025). Forty fourth-year dental students who had successfully completed their endodontic clinical internship were included in the study on a voluntary basis.

The sample size was determined using G*Power software (v3.1.9.7) based on a correlation analysis model, with an expected effect size of 0.4, a statistical power of 80%, and a significance level of $\alpha = 0.05$. Taking potential data loss into account, a total of forty participants were included in the study. All participants had been assessed using the same evaluation rubric during their third-year preclinical endodontics training and had subsequently gained clinical experience by performing root canal treatments on patients.

Participants' identity information was kept confidential, and the evaluation process was conducted entirely anonymously.

For evaluation, forty maxillary premolar cases treated by students were randomly selected from endodontic assignments prepared on extracted human teeth within the scope of third-year preclinical endodontic education. During case selection, particular attention was paid to the preservation of anatomical integrity, the suitability of cavity preparations for technical assessment, and the adequacy of analogue periapical radiograph image quality.

All selected cases were required to have undergone complete cavity preparation, canal shaping, root canal obturation, and gutta-percha trimming procedures. The structured evaluation rubric used in the study is presented in Appendix 1. The rubric was originally developed and routinely used by the Department of Endodontics during third-year preclinical training for the standardized assessment of technical performance. To our knowledge, the rubric had not undergone a formal validation study prior to the present investigation; however, it had been routinely used in institutional preclinical assessments. It was designed based on fundamental endodontic

treatment steps and educational objectives and has been consistently applied in institutional preclinical evaluations.

The assessment was based on the structured evaluation rubric routinely used in third-year preclinical endodontic practice. The rubric's technical proficiency parameters encompassed the fundamental steps of endodontic treatment, including the adequacy of cavity form, preparation of the pulp chamber, apical termination level, canal taper, quality of obturation, and gutta-percha trimming.

All cases included in the study had previously been assessed by academic staff using the same evaluation rubric, and these scores were considered reference values. All academic evaluations were performed by experienced endodontic instructors using the same rubric as part of routine educational practice. No additional calibration session was performed prior to these routine assessments. Volunteer students who had completed their clinical placements were asked to evaluate the cases using the same rubric.

The cases were fully anonymized and presented in a numbered format, and students performed the assessments based solely on their own knowledge and clinical experience, without receiving any additional guidance. Prior to the evaluation, students were briefly reminded of the rubric items; however, no sample scoring, reference cases, or calibration exercises were provided.

During the assessment process, when major endodontic complications, such as perforation or instrument fracture, were present, the total technical score for the relevant case was reduced by half in accordance with the predefined rubric rules. This scoring criterion was known to both academic staff and students prior to the evaluation.

Potential score discrepancies resulting from students' failure to identify complications in certain cases were considered an inherent aspect of the study design and were therefore retained for analysis.

The data obtained were prepared for statistical analysis, and the distributions of academic staff and student technical scores were summarized using descriptive statistics. The normality of the data distribution was assessed using the Shapiro–Wilk test. The relationship between student and academic staff evaluations was examined using Pearson correlation analysis, and Spearman’s rank correlation analysis was additionally performed to assess consistency in case ranking. Differences between student and academic staff scores were analyzed using a paired-sample t-test. Statistical significance was set at $\alpha = 0.05$. All statistical analyses were performed using SPSS software (version 25.0; IBM Corp., Armonk, NY, USA).

The study was conducted in accordance with the principles of scientific research and publication ethics.

RESULTS

A total of forty preclinical endodontic cases were evaluated in the study. Descriptive analysis showed that the mean academic staff technical score was 42.15 ± 10.97 , while the mean student technical score was 42.55 ± 11.14 (Table 1). The score distributions of both groups were similar, with closely aligned measures of central tendency.

Table 1: Descriptive statistics of academic staff and student technical scores

Variable	Mean $\pm$ SD	Median (IQR)	Min–Max
Academic staff technical score	42.15 ± 10.97	44 (34–50.5)	20–60
Student technical score	42.55 ± 11.14	46 (36–50.5)	20–58

Pearson correlation analysis revealed a moderate-to-good and statistically significant positive correlation between student and academic staff technical scores ($r = 0.625$; $p < 0.001$). Consistently, Spearman’s rank

correlation analysis demonstrated that student and academic staff evaluations ranked cases in a similar manner ($\rho = 0.614$; $p < 0.001$).

The presence of a systematic difference between student and academic staff technical scores was examined using a paired-sample t-test. The analysis revealed no statistically significant difference between the two groups in terms of technical scores ($p = 0.79$). The mean difference between scores was minimal, indicating that students did not exhibit a systematic tendency to assign higher or lower scores than academic staff.

In case-by-case comparisons, noticeable differences between student and academic staff scores were observed in some individual cases; however, these differences were bidirectional and did not influence the overall score distribution. Greater discrepancies were particularly noted in cases where score reductions were applied due to the presence of complications. Complications such as perforation or instrument separation were observed in a limited number of cases, and these cases contributed to increased variability between student and academic scores due to the predefined scoring reduction rule. Nevertheless, when the entire dataset was considered, these variations did not affect the overall pattern of agreement between student and academic staff evaluations.

Overall, the findings indicate that students with clinical experience were able to apply the preclinical technical assessment rubric with a moderate to good level of agreement with academic staff evaluations.

DISCUSSION

In this study, preclinical technical competency scores were compared between clinically experienced students and academic staff, and a moderate to good level of agreement was observed between the two groups. This finding highlights the potential of structured rubrics to enhance objectivity and inter-rater reliability in the assessment of technical skills.¹²

Previous studies have similarly reported that the use of rubrics in dental education improves scoring consistency and provides a standardised framework for assessment by reducing inter-rater variability.^{3,5} By enabling detailed evaluation based on predefined criteria, rubrics contribute to decreased uncertainty and more predictable scoring outcomes¹³, which is consistent with the findings of the present study.

Furthermore, the present study demonstrates that the use of structured rubrics is also applicable from the students' perspective.¹⁴ Students' tendency to assign scores comparable to those of academic staff suggests a positive influence of clinical placement experience on technical assessment skills.

Previous studies have similarly shown that rubric-based approaches enhance inter-rater reliability and contribute to more objective evaluation of technical performance.^{14,15} However, the literature also reports inconsistent findings regarding agreement between student and faculty assessments, indicating that students' self-assessment scores do not always align closely with academic staff evaluations and may demonstrate lower reliability. Therefore, the careful design and structured implementation of rubrics within the educational process can be considered an important educational tool for improving students' assessment competencies.¹⁶

Throughout the study, noticeable differences between student and academic staff evaluations were observed in some individual cases. In particular, in cases involving technical complications, students appeared to have difficulty recognising these complications and consequently assigned higher scores. Such case-specific discrepancies suggest that, although students' technical assessment skills improve following clinical training, certain diagnostic and interpretative competencies may still be insufficiently developed.

Previous educational studies have similarly reported that students may overlook specific technical details when evaluating clinical outcomes, highlighting the need for greater emphasis on diagnostic awareness and critical evaluation skills within the educational process.

The impact of rubric design on assessment outcomes has been widely discussed in the literature. Detailed analytical rubrics used for complex tasks have been shown to contribute to higher levels of rater agreement, while the number of assessment categories and the clarity of criterion definitions play a critical role in determining scoring consistency.¹⁷ In this context, the rubric used in the present study may have facilitated similar assessment outcomes between students and academic staff by providing clearly defined technical criteria.¹⁴

Nevertheless, rubrics also have inherent limitations. Repeated training of assessors and continued exposure to rubric-based evaluation can enhance assessment skills; in the absence of such calibration, subjective interpretations may still influence scoring outcomes.⁵ In addition, as the present assessment was conducted within a single educational context, the generalisability of the findings may be limited and should be supported by future studies involving larger case series or diverse educational settings.

In addition, although behavioral parameters were part of the original rubric, they were excluded from the present analysis due to their retrospective nature. This exclusion may limit the comprehensive evaluation of the rubric's overall validity; however, it allowed a more objective comparison focused solely on technical performance.

In addition, the absence of a calibration session prior to evaluation may be considered a limitation of the study. Although this design allowed the assessment of students' independent evaluation abilities based on their clinical experience, it may have contributed to variability in scoring. Future studies

incorporating calibration procedures may provide further insight into inter-rater agreement and improve the reliability of student-based assessments.

In conclusion, this study demonstrates that clinically experienced students can apply a preclinical endodontic assessment rubric with moderate to good agreement with academic staff evaluations. These findings support the use of rubric-based assessment tools as an effective approach in dental education and highlight their role in objectifying the evaluation of students' technical competence. Future research may focus on optimising rubric design and implementation strategies to further enhance their educational impact and reliability.

CONCLUSION

This study demonstrates that students with clinical experience are able to apply the technical assessment rubric used in preclinical endodontic education with a moderate to good level of agreement with academic staff evaluations.

The findings suggest that experience gained during the clinical internship enhances students' ability to differentiate radiographic assessment from overall technical quality, which in turn contributes positively to assessment consistency. However, the inability of students to recognise certain complications in some cases indicates that diagnostic awareness in this area should be further emphasised within the educational process.

In conclusion, structured technical assessment rubrics can serve as reliable evaluation tools not only for teaching staff but also for clinically experienced students. The integration of such rubrics into both preclinical and clinical education may contribute to improved assessment standardisation and support the development of students' self-assessment skills. However, further studies with larger sample sizes and different educational settings are needed to confirm these findings and enhance generalizability.

Ethical Approval

Ethical approval for this study was received by Necmettin Erbakan University Non-Drug and Medical Device Ethics Committee (2025/717)

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Conflict of Interest

The authors deny any conflicts of interest related to this study.

Author Contributions

Design: FSUY, Data collection or access: FSUY, Analysis and comments: FSUY, AT, Literature search: FSUY, Writing: FSUY, AT.

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Supplementary File 1:

Endodontic Preclinical Assessment Rubric: Technical Competency Parameters						
		5	4	3	2	1
1	Timely submission of the assignment					
2	Adequacy of cavity preparation					
3	Removal of the pulp chamber roof and pulp horns					
4	Apical termination level of the root canal filling					
5	Canal taper and conical form					
6	Quality of lateral condensation					
7	Gutta-percha cutting and cleanliness of the pulp chamber					
Perforation:						
Instrument Separation:						
Other complications (please specify):						
• The total score obtained from all parameters is summed and multiplied by two to calculate the preclinical assignment score for each case. • In the presence of complications such as perforation or instrument separation, 50% of the total score is recorded as the final score. • The student’s preclinical grade is determined by calculating the average of all preclinical assignment scores.						