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Determination of Correlation Among 9-Hole Peg Test Scores and Preclinical Performances of Second-Year Students of a Faculty of Dentistry

Bir Diş Hekimliği Fakültesi 2. Sınıf Öğrencilerinin 9-Delikli Peg Testi Skorları ile Preklinik Performansları Arasındaki Korelasyonun Belirlenmesi

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ABSTRACT

Purpose: This study aims to evaluate the relationship between the scores obtained by the 9-hole peg manual dexterity test of the second-year students of the Faculty of Dentistry at Süleyman Demirel University and the grade point averages that they received from the preclinical practical course tasks.

Material and Methods: The study involved 121 dentistry students (46 males and 75 females). A 9-hole peg test (BASELINE Evaluation Instruments, LOT: 120536) was applied to each student twice for dominant and non-dominant hands, and the obtained average scores were recorded in seconds. At the beginning of the education period, Black II. cavity preparation assignments were given for model teeth numbered 15, 26, and 46. The assessment and evaluation criteria of the students' weekly preclinical practice tasks were shared before each assignment, and the same instructor evaluated the tasks given to the students for three weeks. The relationship between 9-hole peg test scores and preclinical course grades was analyzed with Pearson correlation analysis and the change in 9-hole peg test compared to grade point average with one-way ANOVA.

Results: Both the 9-hole peg test scores and grade point averages of female students participating in the study were significantly higher than male students ($p<0.05$). It was determined that there was a negative and high-level correlation between the nine-hole peg test scores and grade point averages ($p<0.05$, r:-0.712).

Conclusion: Although the nine-hole peg test is not used to assess student skills and predict success, it can validate and calibrate educators' grades.

Keywords: Dentistry, education, restorative dentistry, psychomotor skills

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ÖZET

Amaç: Bu çalışmanın amacı, Süleyman Demirel Üniversitesi, Diş Hekimliği Fakültesi 2. sınıf öğrencilerinin bir el beceri testi olan 9 delikli peg testi ile elde ettikleri skorlar ile preklinik uygulama dersi ödevlerinden aldıkları notlar arasındaki ilişkinin değerlendirilmesidir.

Materyal Metot: Çalışmaya 121 diş hekimliği öğrencisi (46 erkek, 75 kadın) katıldı. Her öğrencinin dominant ve non-dominant elleri için ikişer kez 9 delikli peg testi (BASELINE Evaluation Instruments, LOT: 120536) uygulandı ve elde edilen skorlar ortalama olarak saniye cinsinden kaydedildi. Eğitim yılının başında, uygulamalı eğitim dersinde 15, 26 ve 46 numaralı dişler için Black II kavite hazırlama ödevi verildi. Öğrencilerin tüm preklinik ödevlerine ilişkin ölçme değerlendirme kriterleri ödev öncesinde paylaşıldı. Uygulamanın sürdüğü bu üç hafta boyunca öğrencilere verilen ödevler aynı eğitmen tarafından değerlendirildi. Dokuz delikli peg testi skorları ve uygulama ödevlerinden aldıkları notlar arasındaki ilişki Pearson korelasyon analizi ile not ortalamasına göre 9 delikli peg testi değişimi Tek yönlü varyans analizi ile analiz edildi.

Bulgular: Çalışmaya katılan kadın öğrencilerin hem 9 delikli peg testi ortalama skorları hem de not ortalamaları erkek öğrencilere göre anlamlı düzeyde yüksek bulundu ($p<0,05$). Dokuz delikli peg testi skorları ve not ortalamaları arasında negatif yönlü ve yüksek düzeyde ilişki olduğu tespit edildi ($p<0,05$, r:-0,712).

Sonuç: Dokuz delikli peg testi, öğrenci becerilerini değerlendirmek ve başarının tahmini için kullanılmasa da eğitimcilerin notlarının geçerliliği ve kalibrasyonu için kullanılabilir.

Anahtar Kelimeler: Diş hekimliği, eğitim, restoratif diş tedavisi, pisikomotor beceriler

1. Introduction

In dentistry education, the use of success criteria to predict the future professional performance of students who will start education remains an important issue for educators [1]. The main reason is that dentistry education includes a complex curriculum requiring motor skills, hand-eye coordination, spatial abilities, and theoretical knowledge [2,3]. Additionally, a dental student acquires academic biomedical knowledge and a broad-based general practitioner's professional skills and attitudes [2-4]. However, many European countries, including Turkey, accept high school grade point averages (GPA) and university exam results as sufficient and final criteria for admission to dental faculties [5].

The dentistry program includes theoretical, practical, and clinical training modules, and the results of some studies examining the correlation between students' performance in these courses were conflicting [6-10]. In many dental curricula, students' psychomotor skill development potential is not assessed until the preclinical course period [5]. However, early evaluation of psychomotor competencies gives dentistry educators the idea that they can first reduce the number of students dropping out of school and train well-motivated dentistry students who can be successful in their studies [11].

Various studies have been conducted over the past 80 years to examine the relationship between dental students' fine motor skills and the performance they must demonstrate to complete their preclinical education successfully [12]. Block carving [13], tremometer test [14], two-handed

coordination machine [14], O'Connor Tweezer Skill Test [15], and Purdue Pegboard Test [16] are among the tests used in these studies. However, no consensus on which tests applied to students is more reliable regarding psychometric and predictive aspects [5, 12]. For example, Lundergan et al. [15] reported that the O'Connor test was insufficient to predict the motor skills of dental students, while Andrés et al. [17] advocated that the same test could be a good test in determining the performance of students with poor motor skills. In another study, it was reported that a stainless steel frame that simulates the mouth and contains two 32-hole plastic arcs is more comparable to dental practices and that this test can be used as an additional screening tool for dental students [18]. The University of Hamburg in Germany has shown that the wire bending test is an additional and valuable screening tool for those applying to the faculty of dentistry [19].

The 9-hole peg test, which is another tool used to evaluate dentistry students' hand skills, is a simple and rapid skill test that measures hand dexterity according to performance time (seconds) and is sensitive to changes in upper extremity performance, with proven validity and reliability [5, 20]. This test is generally used in physical therapy and rehabilitation centers to evaluate professional development or to determine the pre-occupational status [20]. However, some studies show that this test and students' performance in preclinical courses may be related [5]. However, these limited studies may not be sufficient to prove that this test is a valid method for dental education. This study aims to evaluate the relationship between the scores of Süleyman Demirel University, Faculty of Dentistry, 2nd-year students in the 9-hole peg test, and the grades they received from the Restorative Dentistry preclinical practice course.

2. Material and Method

An interview was held with the 2nd-grade students of Suleyman Demirel University Faculty of Dentistry in the 2022-2023 academic year. One hundred forty-four sophomore students who attended the meeting were informed about the content of the study. A statement was made that their participation or non-participation in this study would not provide any disadvantage or advantage. The study was approved by the Ethics Committee of Süleyman Demirel University Faculty of Medicine, with the decision numbered 2018:189. The research was conducted with 121 students who agreed to volunteer. All volunteers underwent the 9-hole peg test.

The 9-hole peg test used in the research consists of a wooden block with nine holes and nine plastic sticks that fit perfectly into these holes (BASELINE Evaluation Instruments, USA / LOT: 120536). The wooden block was placed in front of the participants in such a way as to coincide with their midline. A container with plastic sticks was placed next to the wooden block. Care was taken to keep the table at the chest level of the participants. For this reason, a height-adjustable chair was preferred. During the test, the participants were asked to take the sticks from the container individually, insert them into the holes in the wooden block as soon as possible, and then put them back into the plastic container one by one. The time from the beginning to the end of the test was recorded as a score. The test protocol was initiated in the dominant hand. After two consecutive tests with the dominant hand, the protocol was completed with two consecutive tests with the non-dominant hand. The mean of two consecutive tests was recorded on behalf of the participant as the dominant and non-dominant hand score [21].

Following the 9-HPT protocol, students were given a class II cavity assignment for three consecutive weeks during the preclinical class hour. Cavities were applied to teeth 15, 26, and 46. It was explained to the students that the following criteria would be taken as a basis for evaluation.

- Evaluation of the continuity of the occlusal contours of the cavity
- Evaluation of the cavo-surface angle
- Evaluation of cavity localization in the occlusal area
- Evaluation of whether the occlusal cavity borders are prepared in accordance with the anatomical structure of the tooth.
- Evaluation of the smoothness and the parallelism of the pulpal wall with the occlusal plane
- Evaluation of junction angles of pulpal wall and cavity walls
- Evaluation of axial wall and pulpal wall angle
- Evaluation of the localization and depth of the gingival step in the mesiodistal direction and in the buccolingual direction

The same lecturer evaluated weekly assignments. The students were divided into three groups according to their grade point averages (1st group: 40-59, 2nd group: 60-79, 3rd group: 80-100),

The student's grades during the three weeks were recorded, and the averages of these grades were taken. Data analysis was performed using the Statistical Package for Social Sciences statistical software (version 20; SPSS Inc.). Students' grade point averages and 9-hole peg test scores were defined by mean, standard deviation, minimum and maximum values. According to the results of the Kolmogorov-Smirnov normality analysis, it was seen that the data showed normal distribution ($p>0.05$). Whether the students' restorative dental treatment applications' grade point averages and 9-hole peg test scores differed according to gender was analyzed by t-test. Pearson correlation analysis was used to determine the relationship between these two parameters. The variation of the 9-hole peg test scores according to the grade point average groups was analyzed with the one-way ANOVA test. The statistical significance level was accepted as $p<0.05$.

3. Results

One hundred twenty-one students, 46 (38%) male and 75 (62%) female, studying in the 2nd year of Süleyman Demirel University Faculty of Dentistry, participated in this study. The students' 9-hole peg test average scores and restorative dental treatment applications' grade point averages are given in Table 1.

Table 1: Students' 9-hole peg test mean scores and grade point means

	N	Minimum	Maximum	Mean	Standard Deviation
9 Hole Peg Test Scores	121	14.44	23.02	18.90	1.54
Restorative Dentistry Course Grade Points	121	45.00	93.00	67.34	10.98

When the 9-hole peg test average scores and grade point averages of female and male students were compared, both the 9-hole peg test average scores and grade point averages of female students were found to be significantly higher than male students ($p<0.05$) (Table 2).

Table 2: Comparison of 9-hole peg test mean scores and grade points of female and male students

	Gender	N	Mean	t	p
9 Hole Peg Test Scores	Female	75	18.32±1.33	-5.92	**p<0.001**
	Male	46	19.84±1.39		
Restorative Dentistry Course Grade Point Means	Female	75	70.22±10.92	3.89	**p<0.001**
	Male	46	62.65±9.44		

When the relationship between the students' 9-hole peg test scores and their grade point averages was examined, it was found that there was a negative and high-level correlation between the 9-hole peg test scores and their grade point averages ($p<0.05$, r:-0.712) (Table 3).

Table 3: The relationship between 9-hole peg test mean scores and grade point means

		9 Hole Peg Test Scores	Restorative Dentistry Practice Grade Point Means
9 Hole Peg Test Scores	r	1	-.712**
	p		.000
Restorative Dentistry Practice Grade Point Means	r	-.712**	1
	p	.000	

** It is significant at the $p<0.001$ level.

The students were divided into three groups according to their grade point averages (1st group: 40-59, 2nd group: 60-79, 3rd group: 80-100), and their 9-hole peg test scores were analyzed. The test scores of the third group were from the first and second groups; The results of the 2nd group were found to be significantly lower than the 1st group ($p<0.05$) (Table 4).

Table 4: 9-hole peg test scores by grade point average groups

Groups	N	Mean	Standard deviation	p
1. Group	32	20.30[a]	1.40	**p<0.001**
2. Group	71	18.69[b]	1.07	
3. Group	18	17.21[c]	1.27	

p: OneWay Anova test. a, b, c: Groups with different letters were found to be statistically different.

4. Discussion and Conclusion

One of the main problems of dentistry education is the inability to determine a selective aptitude test that evaluates the manual skills of dentistry students. Gillet et al. reported that the main problem was determining the compositions that reflect these skills and including the organization's characteristics to accurately predict the students' dexterity [22]. Although many countries and faculties try to identify test methods that assess these skills for admission to dental education, there is no validated psychomotor test [5]. Studies have shown no substantial evidence that prediction tests can predict the practical course skills of students starting dentistry [15, 23-27]. For this reason, it was considered that it would not be appropriate to distinguish between students based on the scores they received from these estimation tests [11]. According to Gray et al., the differences in these results can be explained by Ackerman's theory of skilled performance ability predictors [27, 28]. To acquire complex skills such as dentistry, a person must go through three stages. The first of these is the cognitive stage, in which the student must understand the theoretical knowledge and develop strategies for the objectives of the given task. Dentistry is a complex task requiring the processing of new information that constantly challenges specific mental abilities. The secondary stage is also called the associative stage. It concerns the speed and efficiency (perceptual speed capabilities) at which a task can be accomplished by reinforcing the relationships between stimuli and responses. Finally, the autonomous stage of skill acquisition is linked to demands on psychomotor abilities [27]. The complexity of acquiring the necessary skills for a dental practice is evident to both educators and dentists. However, the lack of a specific test that uses both cognitive and non-cognitive abilities may explain the conflicting results in studies on this subject or our inadequacy in studies to predict students' future success [26, 27].

When the relationship between the 9-hole peg test scores and grade point averages of the students participating in our study was examined, the negative and high-level relationship between them showed that the students' success in this test was related to their grades received. However, in other similar studies in the literature, conflicting results were shown regarding the relationship between the tests performed and the success of the students [20]. The different results in these similar studies may be because the tests used in the research are not clearly defined, and different education systems are applied in each country and even in the faculties [4].

In Turkey, the applied course of Restorative Dentistry starts in the second year in many faculties. This course is the first and only practical course that the faculty of dentistry students take after the first year, after the dental anatomy course, which is considered professional skills and abilities. Following the Süleyman Demirel University Faculty of Dentistry education program, students apply the principles of cavity preparation, which they learned in Restorative Dentistry theoretical courses during their second year, to plastic jaws and teeth. Then, they learn how cement, amalgam, and composite restorations are applied to these cavities. The instructor of the course grades the assignments given in each course. The grading criteria for this grading process and on which criteria the grading is based are found in the course brochure distributed to the students at the beginning of the year. Before the lecturers enter the course, they enter the course as calibrated among themselves for these criteria and perform the grading process. In addition, each student is informed in detail about their grade and why they got it.

Until this time, researchers wanted to use tests that they thought were measuring student skill performance for several purposes. The first of these is the admission process to the faculty of dentistry; second, to determine the effect of the applied curriculum on students' psychomotor skills; finally, to show psychomotor skills as professional competence.

Our study aimed to observe the relationship between the students' initial levels in this course and their psychomotor skill levels. Therefore, our research was carried out at the beginning of the semester. The students had finished their class I cavity preparation tasks and only completed their class II preparation tasks for only one week. In other words, although they knew this assignment, they did not have the chance to practice it to gain sufficient manual dexterity. The class II cavity preparation assignment was applied to different teeth for the next three consecutive weeks, and the grade averages were taken. At this time, it was thought that the students received the necessary theoretical training to open a cavity, but they could not make enough practical applications for the practical skill requirement of dentistry. In this case, the students were considered to be at the same level for the practical application course of Restorative Dentistry.

The nine-hole peg test is a skill-based test to diagnose diseases such as stroke, multiple sclerosis, and Parkinson's. It was applied to students with equal knowledge and practical education level for the restorative dental treatment course to determine the students' psychomotor skill level. Determining the correlation between the grades given by the educator and these results can show how aware the dentistry educator is of the student's abilities and skills. The evaluation of a cavity applied according to the determined rules by an academician who has been an educator for more than 20 years and the correlation of the results with the 9-hole peg test gives rise to the idea that this test can be used to analyze the validity of the trainer's grades, if not to evaluate student skills. When these data are evaluated, the nine-hole peg test can also calibrate academicians who evaluate the same assignments in different classes, with different students at the same faculty. In addition, the results of our study show that a scaled assessment method can constitute an objective parameter in evaluating the student's skill.

Coy et al. investigated the effectiveness of the perceptual abilities test (PAT) in predicting future clinical performance. The results showed a gender bias favoring male candidates. However, male and female students admitted to dentistry have shown similar improvement in technical skills over the years. In our study, female students' test scores were significantly better than male students. The reason for this may be that students of different genders who are new to education are not physically and psychologically at the same starting point. At the same time, the diversity of dental students' backgrounds and previous experiences may have contributed to these different results [4, 29].

In light of the data obtained from the study and the knowledge of the relevant literature, although the 9-hole peg test is not yet used to predict students' abilities and clinical success, it can be used to validate the accuracy of the grades and calibration with other educators when evaluating students who have just started practical training.

Declaration of Ethical Code

In this study, we undertake that all the rules required to be followed within the scope of the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with, and that none of the actions stated under the heading "Actions Against Scientific Research and Publication Ethics" are not carried out.

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