



## Correlation between Handwriting, Drawing Skills and Dental Skills of Junior Dental Students

Sulieyman Al-Johany, Maan AlShaafi, Mohammed Bin-Shuwaish, Faleh Alshahrani, Abdulfatah Alazmah  
Sami Aldhuwayhi, Nassr AlMaflehi

### ABSTRACT

Learning fine motor skills is a pre-requisite for succeeding in dental practice and it is sometimes challenging for dental students. Most of the methods used in the selection process depend on evaluation of intellectual ability or structured interview while manual competence is not. However, no test on aptitude or manual dexterity is used as criteria.

**Objective:** The purpose of the present study intended to evaluate the fine motor skills of beginning dental students which could in turn be used as a method of selection of students for the dental degree admission process.

**Materials and methods:** A study was conducted among 71 second year dental students at College of Dentistry, King Saud University in Riyadh. A test composed of three parts, writing an answer for a question in four lines, drawing a picture of a smile and doing a class 1 amalgam preparation on a plastic molar tooth. The students were evaluated based on their handwriting, basic drawing skills and their skills in performing the tooth preparation by experts in each fields following certain criteria.

**Results:** The results showed a significant correlation between writing and drawing skills and dental skills of the student with  $p < 0.001$ .

**Conclusions:** The results of the current study support the use of the writing or drawing test as one of the test used for the applicants for dental school admission. However, the value given to such test in the selection of students needs further investigations and consensus.

**Keywords:** Hand writing skills, Drawing skills, Dental skills, Dental admission, Dental students, Dental education.

**How to cite this article:** Al-Johany S, AlShaafi M, Bin-Shuwaish M, Alshahrani F, Alazmah A, Aldhuwayhi S, AlMaflehi N. Correlation between Handwriting, Drawing Skills and Dental Skills of Junior Dental Students. *J Contemp Dent Pract* 2011; 12(5):327-332.

**Source of support:** Nil

**Conflict of interest:** None declared

### INTRODUCTION

One of the most debated issues among the parameters used for selecting dental students is basic manual skill.<sup>1</sup> Manual skill form only a part of capabilities of future dentist, but it is a very important component. No objective practical solution has been found up to now to measure it.<sup>2</sup> Tests, such as perceptual motor ability, chalk carving, paper and pencil, have been used in dental admission test in US and Europe.<sup>1</sup> In a study done in UK at King's College Hospital, wire bending tests were used to analyze the dental skills of the student which was found to be positively correlated.<sup>3</sup> In a previous study, positive correlations have been noted between student performance in manual skills assessment and dental school performance.<sup>4</sup> Walcott et al<sup>5</sup> showed that the waxing test administered during the first week of classes in the dental school is a valid predictor of psychomotor performance for the first 2 years of the dental training. Manual skills form only a part of the capabilities required of future dentists, but they are a very important component, which should be tested.<sup>6</sup> However, studies have shown controversial results with regards to the professional success of the dental students.

Predictive admission procedures reduce dropout rates, improve average academic performance and selectively exclude applicants who are unlikely to be successful later on.<sup>2,7</sup> Suitable students have a higher chance of performing satisfactorily and graduating within the anticipated time frame. Despite numerous admission procedures being developed, no adequate practical solution has been found that could be applied to the students who opt for dental studies. Various publications state that manual skills have predictive value as a screening instrument for selecting dental school students.<sup>8-11</sup>

The selection of the dental students at most of the universities in the Kingdom of Saudi Arabia is mainly based on the GPA they acquired from high school. The dental school admission is based on their knowledge about science, mathematics and languages. An interview is conducted before the final selection process. However, no test on aptitude or manual skills is used as criteria. The purpose of the present study intended to evaluate the fine motor skills of beginning dental students which could in turn be used as a method of selection of students for the dental degree admission process.

## MATERIALS AND METHODS

The second year undergraduate dental male students at College of Dentistry, King Saud University were selected for the study. The class student number was 75 students with only 71 students agreed to participate in the study with their age range from 19 to 21 years. The second year dental student group was selected for this study because they just have been exposed to the use of dental handpiece in the pre-clinical laboratory for tooth preparation in the operative course. The time of the study was set-up 4 weeks after the student started their operative course. By that time, they are almost done with their first tooth preparation project (class I tooth preparation for amalgam restoration). The goal is to do the test while they are in their initial training period. So, it is expected they have not yet develop hand dental skills from the continuous training throughout the courses as well as they know the basic principles of doing a class I amalgam preparation.

No training sessions or hints were given to the students prior to performing any of the three tests. The students were informed to participate in the three tests to show the best skills they can produce. Each student should undergo the three tests to be included in the study. The subjects spent 4 weeks of their operative course and had been exposed to the use of handpiece and the preparation in ivory plastic teeth. Same knowledge and close supervision were given to the entire students in the previous sections during their operative course.

### Dental Laboratory Test

A well-equipped laboratory was prepared to accommodate the students at a particular time and had multiple cubicles

with well-equipped dental armamentarium. The dental test was conducted by asking the student to do a class I amalgam cavity preparation on the lower right first molar ivory plastic tooth (No. #46) in a jaw model (Bensons Typodont, New Delhi, India) under the following guidelines: All the cavity walls should be prepared with high-speed handpieces using new #330 carbide bur with water and air coolant. Maximum time given for cavity preparation was 20 minutes. The prepared cavity should follow the original anatomy of the prepared tooth according to the evaluators' criteria as shown in Table 1.

### Evaluation

The evaluation was made by three faculties who are American Board Certified in Restorative Dentistry. The criteria considered for the evaluation of the tooth preparation test depended on the features used in class I amalgam preparation (Table 1).

### Handwriting and Drawing Test

A well-accommodated classroom for the students with uniformed seats was prepared for the study. New tapering pencils type HB 2 (Staedtler, Nuernberg, Germany) and test paper size A4 (Roco, Johannesburg, South Africa) which consisted of two parts to test the quality of handwriting and drawing skills. The first part had well written Arabic question, "Why did you choose dentistry as a future career?" This question and the possible response were approved by the evaluators from the College of Education, Artistic Education Department. Students were asked to write the answer for the question in the four lines provided. The smooth, continuous and clear way of writing, including the beauty aspects of the handwriting, were the main criteria for the evaluation (Table 2). It was graded out of 10 marks.

The second section had a smile picture which was approved by the evaluators from the College of Education, Artistic Education Department which can represent the artistic drawing skills of a student. The quality of students' drawing and the ability of balancing the pen during the drawing of lines without zigzagging are the main criteria for evaluation (Table 3). It was graded out of 10 marks.

**Table 1:** Criteria used for the evaluation of the dental laboratory test

Value (marks)	Feature	Description
2 marks	Isthmus width	1-1.5 mm
2 marks	Pulpal depth	1.5-2.0 mm
1.5 marks	B & L walls convergence	Parallel or lightly converged
1 mark	M & D walls divergence	Lightly diverged
2 marks	Smoothness of walls, margins and line angles	Regular, flat and round
1.5 marks	Marginal ridge thickness	1.8-2.0 mm

**Table 2:** The criteria used for the evaluation of handwriting

Value	Features
2 marks	Smoothness and continuity of the hand writing
2 marks	Continuity in the writing line without deviation
2 marks	Presenting the beauty aspects of Arabic writing
2 marks	Writing esthetics straight configuration on the same level of writing
2 marks	Size consistency and similarity between letters

**Table 3:** The criteria used for the evaluation of handdrawing

Value	Features
2 marks	The clearly of the borders with minor details
2 marks	Symmetry of the drawing features
2 marks	Size of the student drawing comparing to the original picture
2 marks	Using same pencil to differentiate saturation between the colors saturation in the original picture
2 marks	Conversion of 2 dimensions rowing to 3 dimensions using shadow and other drawing skills

**Evaluation**

Three faculty members from the College of Education, Artistic Education Department were involved in the writing evaluation for the handwriting section according to the criteria out of 10 marks.

The grades for both handwriting and drawing tests will be out of 10 marks. Depending on the previously mentioned criteria, the students were classified into five categories as shown in Table 4.

**RESULTS**

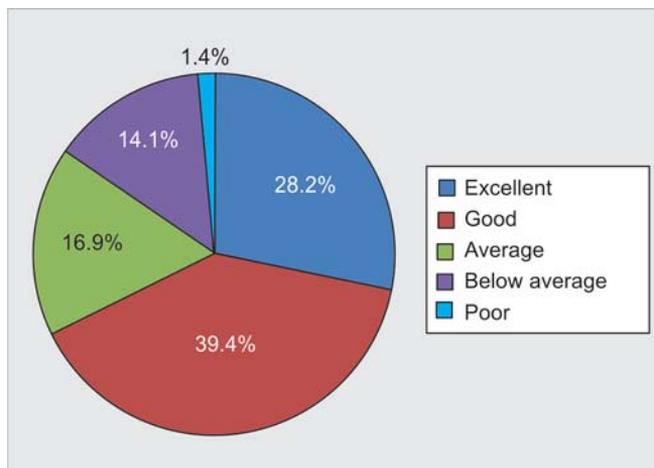
All the 71 students were included in all the three tests of the study and their results were analyzed (Figs 1 to 3). Table 5 shows the frequency distribution of the descriptive measurements of the three tests. Majority of the students had above average scores for the three tests of the three skills.

Cross-tabulation was found to be statistically significant ( $p < 0.001$ ) to compare writing and drawing skills with dental skills (Tables 6 and 7).

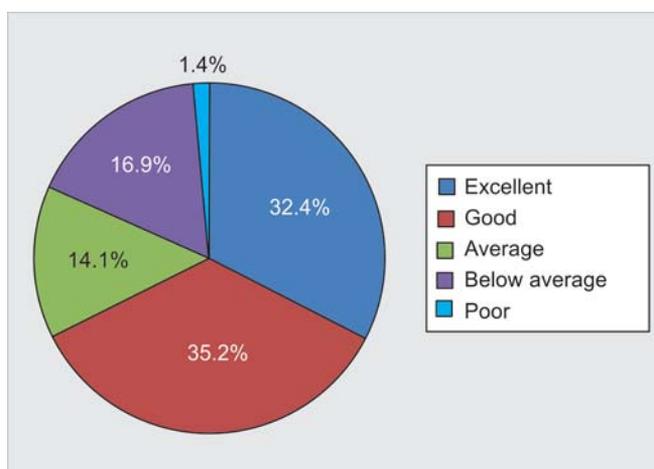
A total of 16 (69.6%) of the students who had excellent drawing skills also had excellent dental skills. Only 1 student who had excellent drawing skills had poor dental skills. The difference is statistically significant ( $p < 0.001$ ) as shown in Table 6. In general, students with excellent or good handwriting and drawing skills were found to have good dental skills as well.

**Table 4:** Categories distribution according to marks

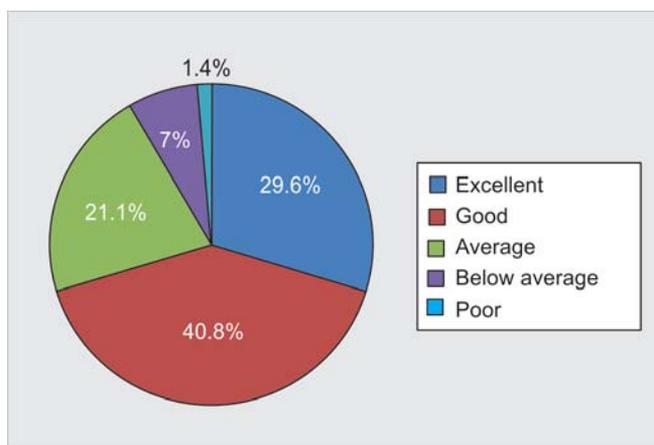
Category of student	Grades (marks)
Poor skills student	From 0.0 to 1.9
Below average skills student	From 2.0 to 3.9
Average skills student	From 4.0 to 5.9
Good skills student	From 6.0 to 7.9
Excellent skills student	From 8.0 to 10



**Fig. 1:** Frequency distribution of writing skills



**Fig. 2:** Frequency distribution of drawing skills



**Fig. 3:** Frequency distribution of dental skills

Spearman rank correlation showed that a significant correlation exists between the handwriting and drawing skills with dental skills.

**DISCUSSION**

The effectiveness of several selection measures for graduate school applicants has been previously evaluated including undergraduate and other predental school

**Table 5:** Frequency distribution of the students writing skills, drawing skills and dental skills

S.No.	Student classification (marks)	Writing skills N (%)	Drawing skills N (%)	Dental skills N (%)
1.	Excellent (8.00-10.00)	20 (28.2)	23 (32.4)	21 (29.6)
2.	Good (6.00-7.9)	28 (39.4)	25 (35.2)	29 (40.8)
3.	Average (4.00-5.9)	12 (16.9)	10 (14.1)	15 (21.1)
4.	Below average (2.00-3.9)	10 (14.1)	12 (16.9)	5 (7)
5.	Poor (0.00-1.9)	1 (1.4)	1 (1.4)	1 (1.4)
6.	Total	71 (100)	71 (100)	71 (100)

**Table 6:** Cross-tabulation between writing skills and dental skills

		Dental skill					
		Excellent (%)	Good (%)	Average (%)	Below average (%)	Poor (%)	Total (%)
Writing skill	Excellent	16 (80)	4 (20)	0 (0)	0 (0)	0 (0)	20 (100)
	Good	4 (14.3)	19 (67.9)	4 (14.3)	0 (0)	1 (3.6)	28 (100)
	Average	1 (8.3)	5 (41.7)	6 (50)	0 (0)	0 (0)	12 (100)
	Below average	0 (0)	1 (10)	5 (50)	4 (40)	0 (0)	10 (100)
	Poor	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)
	Total	21 (29.6)	29 (40.8)	15 (21.1)	5 (7)	1 (1.4)	71 (100)

**Table 7:** Cross tabulation between drawing skills and dental skills

		Dental Skill					
		Excellent (%)	Good (%)	Average (%)	Below average (%)	Poor (%)	Total (%)
Drawing skill	Excellent	16 (69.6)	6 (26.1)	0 (0)	0 (0)	1 (4.3)	23 (100)
	Good	5 (20)	18 (72)	2 (8)	0 (0)	0 (0)	25 (100)
	Average	0 (0)	4 (40)	5 (50)	1 (10)	0 (0)	10 (100)
	Below average	0 (0)	1 (8.3)	8 (66.7)	3 (25)	0 (0)	12 (100)
	Poor	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)
	Total	21 (29.6)	29 (40.8)	15 (21.1)	5 (7)	1 (1.4)	71 (100)

training<sup>12,13</sup> standardized tests including the Dental Admission Test and admission interviews.<sup>14</sup> It is acknowledged that dental competency involves more than achievement based on core knowledge. The profession of dentistry requires clinical practice competency as well, identified in part, by dexterity and other fine-motor skills. This need for motor skill assessment has resulted in the examination of suitable measures, including standardized and/or unstandardized dexterity tests. It is hypothesized that the dexterity tests, improve the prediction of clinical practice competency.<sup>5,11</sup>

In the present study, evaluation of the handwriting and drawing skills of the dental students showed a significant correlation with dental skills. The observation indicates that there is a clear relationship between noncognitive level, as measured by handwriting with drawing tests, and manual ability of the dental students. This differs from the majority of earlier studies which assessed the practical aspect and concluded that it is more difficult to predict motor skill performance than academic performance.<sup>15</sup> While, Manhold et al<sup>16</sup> concluded that the performance in academic subjects was highly predictive of clinical performance. A study conducted in King's College Hospital used wire bending

tests and found that a correlation between these tests and performance in the phantom head practical test exist.<sup>17</sup>

Phipps et al<sup>18</sup> concluded that it was impossible to predict clinical grades compared to the prediction of academic performance. Moore and Peel<sup>19</sup> in their investigation showed that it is unwise to rely entirely on a school examination for selecting dental students. Recently, in a published study by Deubert<sup>20</sup> used paper and pencil psychometric tests for predicting performance on operative courses and show some success.

On the other hand, in a study done by Stacey<sup>14</sup> showed that weak correlation between the various tests in the study confirm the difficulty in finding a reliable test that can predict the likelihood of a student becoming a good dentist. That is because of many uncontrolled variables such as stress, mood, anxiety, student interest and personality which can affect result outcomes.<sup>14</sup>

There is increasing interest in the use of ability and aptitude testing as a tool to aid in the selection and career development. Tests of general intelligence have been shown to predict educational success in most fields, as well as high occupational performance for work, in particular of a complex, high-level type.<sup>21</sup> The psychometric tests have

been used in dentistry, a profession which requires a combination of practical and intellectual ability. Dental Admission Test is mandatory for the selection process of North American dental students.<sup>7</sup> Assessment of the intellectual ability is done by the candidates' ability to visualize patterns and relationships and to use their hands and fingers dexterously. It has been validated in reducing student dropout rates, however, its value in assessing manual skills is questionable.<sup>22</sup>

Studies showed no clear relationship between secondary school grades and clinical competence in medicine or dentistry.<sup>17</sup> It was suggested that effectiveness and success in medical or dental studies requires not only sound academic ability but also a variety of noncognitive skills and qualities, along with a positive attitude toward the profession.<sup>23</sup> In both dental training and the practice of dentistry, a high degree of dental skills and the ability to perform exact and partly repetitive movements would appear to be advantageous.

The results of the current study support the use of the writing or drawing test as one of the test used for the applicants for dental school admission. However, the value given to such test in the selection of students needs further investigations and consensus.

One of the limitations of this study is the sample size and it includes only male students. Further investigation may be needed which include a larger sample size and to include both male and female dental students.

## CONCLUSION

The results this study suggest that it is wise to assess the dental skills along with academic ability in the selection criteria of students to dentistry courses. The strong correlation between the writing and drawing skills with dental skills support that such component may be added to the present examination system to identify the best candidates. However, these tests must be performed by well-trained testers and the characteristics of the ideal candidate must be defined in advance.

## ACKNOWLEDGMENTS

The authors would like to thank Dr Maha AlSenan, PhD from Harvard University; Dr Nadiah Alhumaid and Dr Ghadeer Albsaili from Princess Noura Bint AbdulRahman University for their invaluable assistance in the evaluation of the drawing skills of the students in this study.

The authors would also like to thank Dr Fahad Aljwair, Dr Abdullah Altwalah and Dr Sultan Alziad from King Saud University for their invaluable assistance in the evaluation of the writing skills of the students in this study.

Lastly, we all would like to thank the dental students who participated in this study.

## REFERENCES

1. Kirby TJ. Dexterity testing and residents' surgical performance. *Trans Am Ophthalmol Soc* 1979;77:294-307.
2. Hoad-Reddick G, Macfarlane TV. An analysis of an admission system: Can performance in the first year of the dental course be predicted? *Br Dent J* 1999;186(3):138-42.
3. Glyn-Jones JC. Dental student selection: The prediction of success. *J Dent* 1979;7(4):329-38.
4. Heintze U, Radeborg K, Bengtsson H, Stenlås A. Assessment and evaluation of individual prerequisites for dental education. *Eur J Dent Educ* 2004;8(4):152-60.
5. Walcott AM, Knight GW, Charlick RE. Waxing tests as predictors of students' performance in preclinical dentistry. *J Dent Educ* 1986;50(12):716-21.
6. Luck O, Reitemeier B, Scheuch K. Testing of fine motor skills in dental students. *Eur J Dent Educ* 2000;4(1):10-14.
7. Kreit LH. The prediction of student success in dental schools. In: Richards NO, Cohen LS (Eds). *Social sciences in dentistry: A critical biography*. The Hague: A. Sighthoff 1971:97-119.
8. Boyle AM, Santelli JC. Assessing psychomotor skills: The role of the Crawford Small Parts Dexterity Test as a screening instrument. *J Dent Educ* 1986;50(3):176-79.
9. Spratley MH. Regression analysis of dexterity tests and dental students' practical examination results. *Aust Dent J* 1992; 37(6):461-66.
10. Oudshoorn WC. The utility of Canadian DAT Perceptual Ability and Carving Dexterity scores as predictors of psychomotor performance in first-year operative dentistry. *J Dent Educ* 2003; 67(11):1201-08.
11. Gansky SA, Pritchard H, Kahl E, Mendoza D, Bird W, Miller AJ, Graham D. Reliability and validity of a manual dexterity test to predict preclinical grades. *J Dent Educ* 2004; 68(9): 985-94.
12. Potter RH, McDonald RE. Use and application of structural models in dental education research. *J Dent Educ* 1985; 49(3):145-53.
13. Scheetz AJ, Markham JA, Fifková E. The effect of chronic ethanol consumption on the fine structure of the CA1 stratum oriens in short-sleep and long-sleep mice: Short-term and long-term exposure. *Brain Res* 1987; 409(2):329-34.
14. Stacey DG, Whittaker JM. Predicting academic performance and clinical competency for international dental students: Seeking the most efficient and effective measures. *J Dent Educ* 2005; 69(2):270-80.
15. Heller DB, Carson RL, Douglas BL. Selection of students for dental school. *J Dent Educ* 1965;29:202-07.
16. Manhold JH Jr, Manhold BS. Final report of an 8-year study of the efficacy of the dental aptitude test in predicting 4-year performance in a new dental school. *J Dent Educ* 1965;29:41-45.
17. Suddick RP, Yancey JM, Devine S, Wilson S. Field dependence-independence and dental students' clinical performance. *J Dent Educ* 1982;46(4):227-32.
18. Phipps GT, Fishman R, Scott RH. Prediction of success in a dental school. *J Dent Educ* 1968; 32(2):161-70.
19. Moore BCR, Peel EA. Predicting aptitude for dentistry. *Occup Psychol* 1951;25:192.

20. Deubert LW, Smith MC, Downs S, Jenkins CG, Berry DC. The selection of dental students. A pilot study of an assessment of manual ability by practical tests. *Br Dent J* 1975;139(9): 357-61.
21. Salvatori P. Reliability and validity of admissions tools used to select students for the health professions. *Adv Health Sci Educ Theory Pract* 2001;6(2):159-75.
22. Spratley MH. Aptitude testing and the selection of dental students. *Aust Dent J* 1990;35(2):159-68.
23. Powis D. Select medical students. *BMJ* 1998; 317(7166): 1149-50.

## ABOUT THE AUTHORS

### Suliemman Al-Johany (Corresponding Author)

Assistant Professor, Department of Prosthetic Dental Sciences, College of Dentistry King Saud University, PO Box 60169, Riyadh 11545 Saudi Arabia, e-mail: saljohany@hotmail.com

### Maan AlShaafi

Assistant Professor, Department of Restorative Dental Sciences College of Dentistry, King Saud University, Riyadh, Saudi Arabia

### Mohammed Bin-Shuwaish

Assistant Professor, Department of Restorative Dental Sciences College of Dentistry, King Saud University, Riyadh, Saudi Arabia

### Faleh Alshahrani

Intern, College of Dentistry, King Saud University, Riyadh, Saudi Arabia

### Abdulfatah Alazmah

Intern, College of Dentistry, King Saud University, Riyadh, Saudi Arabia

### Sami Aldhuwayhi

Intern, College of Dentistry, King Saud University, Riyadh, Saudi Arabia

### Nassr AlMaflehi

Lecturer, Department of Periodontics and Community Dentistry, College of Dentistry, King Saud University, Riyadh, Saudi Arabia