NEU PRESS

Diş Hekimliği Dergisi

Vol: 6 No: 2 Year: 2024 | Research Article | e-ISSN: 2687-5535

https://doi.org/10.51122/neudentj.2024.99

Evaluation of Orthodontic Wire-Bending Performance of Dental Students Between Two Consecutive Academic Years

Merve Nur EGLENEN[1*] Mehmet Ali YAVAN[2]

Yavuz Selim ASLAN[3] Nihal HAMAMCI[4]

[1] Assist. Prof., Yeditepe University, Faculty of Dentistry, Department of Orthodontics, İstanbul, Türkiye, nureglenen@yahoo.com

[2] Assoc. Prof., Adıyaman University, Faculty of Dentistry, Department of Orthodontics, Adıyaman, Türkiye, yavanmehmetali@gmail.com

[3] Dr., Private practice, Gaziantep, Türkiye, dt.yavuzselimaslan@gmail.com

[4] Prof., Adıyaman University, Faculty of Dentistry, Department of Orthodontics, Adıyaman, Türkiye, nhamamci@hotmail.com

Article Info

Article History

Received: 26.12.2023
Accepted: 10.03.2024
Published: 30.08.2024

Keywords:
Education,
Dental,
Continuing,
Orthodontics,
Time.

ABSTRACT

Aim: To compare orthodontic preclinical skills of same dental students that were trained using the same learning method in similar skills at an interval of one year

Material and Methods: The retrospective study evaluated the archived wire-bending and wax models that had been submitted by the same undergraduates who were fourth-year undergraduates (T0) in 2019-2020 and were promoted to the fifth year in 2020-2021 (T1). Orthodontic performances were taught to a total of 45 dental students (21 males and 24 females) using the live demonstration method prior to their internship in both academic years. Labial arch, Adams clasp, eyelet clasp bending and base plate wax modeling skills at the end of internship were compared between the two periods and between the two genders.

Results: A significant difference was found between the two genders with regard to T0 labial wire-bending (male: 9.90 ± 1.70, female: 10.66 ± 2.05) and T0 total skill score (male: 27.76 ± 2.94, female: 30.45 ± 3.00) ($p<0.01$). In female students, a significant increase was observed in the Adams clasp bending scores at T1 (11.33±1.27) compared to T0 (11.08±1.34), while in male students, a significant increase was detected in the eyelet clasp bending scores between T1 (3.28±0.56) and T0 (2.71±1.10) ($p<0.05$). However, no significant change was observed between T0 and T1 with regard to all parameters in the entire population ($p>0.05$).

Conclusion: The difference between the initial scores of both genders disappeared in the long term and there was no significant change in total skill scores between the two academic years.

Diş Hekimliği Öğrencilerine Canlı Demonstrasyon ile Öğretilen Ortodontik Preklinik Performanslarının Uzun Vadeli Karşılaştırması

Makale Bilgisi

Makale Geçmişi

Geliş Tarihi: 26.12.2023
Kabul Tarihi: 10.03.2024
Yayın Tarihi: 30.08.2024

Anahtar Kelimeler:
Eğitim,
Dental,
Sürekli,
Ortodonti,
Zaman.

ÖZET

Amaç: Bir yıl arayla benzer becerilerde aynı öğrenme yöntemi kullanılarak eğitilen aynı diş hekimliği öğrencilerinin ortodontik preklinik becerilerini karşılaştırmak

Gereç ve Yöntemler: Bu retrospektif çalışmanın verileri, Diş Hekimliği Fakültesi öğrencilerinin ortodonti staj dönemlerinde yaptıkları büküm ve modelasyondan oluşmaktadır. Geleneksel canlı demonstrasyon yöntemiyle 21 erkek ve 24 kadından oluşan toplam 45 (ortalama yaş: 22,4 ± 1,8) dental öğrenciye 4. (T0) ve 5. (T1) sınıflarında stajları öncesinde ortodontik büküm ve mum modelaj canlı demonstrasyonla öğretilmiştir. Bir yıl arayla 20 günlük staj sonunda teslim edilen vestibul ark, adams ve eyelet kroşeleri ile mum modelasyondaki beceriler cinsiyetler ve yıllar arasında karşılaştırılmıştır.

Bulgular: T0 da vestibul ark (erkek: 9,90 ± 1,70, kadın: 10,66 ± 2,05) ve total beceri skorlarında (erkek: 27,76 ± 2,94, kadın: 30,45 ± 3,00) cinsiyetler arasında anlamlı bir fark ($p <0,01$) mevcutken, diğer parametrelerde anlamlı bir fark ($p >0,05$) bulunamamıştır. T0 ve T1 arasında, kadınlarda adams kroşe büküm skorunda anlamlı bir artış (T0: 11,08±1,34, T1: 11,33±1,27) ($p <0,05$) gözlenirken, erkeklerde damla kroşe büküm skorunda (T0: 2,71±1,10, T1: 3,28±0,56) anlamlı bir artış ($p <0,05$) mevcuttur. Totalde ise kroşeler ve modelasyon skorları hiçbir parametrede anlamlı bir fark göstermemiştir ($p >0,05$).

Sonuç: Dental öğrencilerin beceri skorlarında, cinsiyet grupları arasındaki fark uzun dönemde ortadan kalkarken, totalde iki yıl arasında beceri skorları arasında anlamlı bir değişim olmamıştır.

To cite this article: Eglenen MN., Yavan MA., Aslan YS., Hamamcı N. Evaluation of Orthodontic Wire-Bending Performance of Dental Students Between Two Consecutive Academic Years. NEU Dent J, 2024;6:162-9. https://doi.org/10.51122/neudentj.2024.99

***Corresponding Author:** Merve Nur EGLENEN, *nureglenen@yahoo.com*

INTRODUCTION

Acquisition of psychomotor skills is a key to clinical success in many branches of medicine and dentistry.[1] Most procedures in dental practice require psychomotor skills with cognitive planning as well as hand-eye coordination.[2] Therefore, many dentistry schools use the conventional live demonstration method to develop the psychomotor skills of undergraduate students.[3, 4] Live demonstration can increase students' confidence and improve their communication skills and also provides a better understanding of the procedure compared to didactic teaching.[5]

In previous studies, orthodontic preclinical laboratory performances of dental students have been evaluated based on their wire-bending skills. In those studies, conventional live demonstration has been compared with other methods that have been developed to overcome the difficulties of this method, including video demonstration,[6] video-live demonstration,[7] and flipped classroom.[8] The results of these studies showed that all of these methods were equally effective as conventional live demonstration. Additionally, Corpus and Eisbach[9] demonstrated that the conventional the live demonstration method had self-reported cognitive and motivational benefits in child development in the long-term follow-up.

Removable orthodontic appliances have three main components including acrylic base plate, clasps, and active elements.[10] Of these, clasps are obtained via wire-bending and are used to increase the retention of the appliance.[10] Many dentistry school curricula in undergraduate orthodontic education include preclinical wire-bending to improve students' manual dexterity. In ## dental school, the orthodontic curriculum focuses on the practical training of various orthodontic wire-bending skills in preclinical training in addition to didactic and clinical observational training in both the fourth and fifth years of the five-year program. The wire-bending procedure involves numerous sequential steps, each of which requires careful monitoring.[10]

Nowadays, due to the increase in the number of students in the classes, each student may not have the opportunity to observe the wire-bendings equally. However, this study aims to show that this disadvantage can be eliminated by live demonstration. To our knowledge, there is no study evaluating the long-term results of orthodontic preclinical laboratory skills taught with the use of the live demonstration method. The aim of the present study was to compare the performances of fourth- and fifth-year dental students that were trained using the same learning method in similar skills. Our null hypothesis was that the live demonstration method will improve the orthodontic laboratory skill scores of undergraduate dental students in the long term.

MATERIAL AND METHODS

The retrospective study evaluated the orthodontic bends made by the fourth graders were scored and the scores obtained by the same students by making the same orthodontic bends in the fifth grade were compared during the academic year 2019-2020 and 2020-2021, respectively. The study was approved by Adıyaman University Non-Interventional Clinical Research Ethics Committee (Approval No 2021/07-10). The present study was conducted in accordance with the Principles of the Declaration of Helsinki.

In the country where the study was conducted, the academic year covers the months between September and June and orthodontic internship is performed once for 20 working days in both fourth and fifth years of education. The orthodontics curriculum of our school requires a certain level of success (60 out of 100 points) both in preclinical laboratory skills and in the oral exam conducted at the end of the internship in order for students to pass the class in the fourth and fifth years. Out of 50 students that began the fourth year in the academic year 2019-2020, 45 of them were able to pass to the fifth year in the academic year 2020-2021 and

completed their orthodontics internship, all of whom were included in the study. Inclusion criteria of students were as follows:

1. Having successfully completed the fourth year of education including orthodontics and other clinics and courses and having passed to the fifth year at the end of the academic year 2019-2020.
2. Having successfully completed all the assignments including labial arch, Adams clasp, eyelet clasp bending and base plate wax modeling at the end of the orthodontic internship in the academic year 2019-2020 and 2020-2021.
3. Having been instructed about every step of wire-bending and modeling procedures by the same instructor using the live demonstration method.
4. Having practiced the wire-bending procedure in preclinical training for one hour on each internship day by using the same brand of pliers, wire, and wax on the same orthodontic model replicated during the 20-day orthodontics internship in the fourth- and fifth-year internships and having submitted the models to the same lecturer on the following day.
5. Students who repeated the fourth year of education in 2019-2020 and those who were transferred from other universities in 2020-2021 were excluded from the study.

Live demonstration technique

During the academic year 2019-2021, when this study was conducted, our fourth- and fifth-year students were divided into 9 internship groups (with 6 students each) according to the academic calendar. In the orthodontics internship, laboratory skills were taught using the live demonstration method during the preclinical training. In the same orthodontic preclinical training, each student was instructed on how to perform each step of clasp bending and base plate wax modeling by the same lecturer (MAY). In these sessions, students were allowed to ask their questions as needed. After the demonstration, which lasted for an average of 40 minutes, the clasp and wax models were left in the classroom for students to reference. Afterwards, for one hour of each internship day, students were allowed to practice using those clasp and wax models under the supervision of the same lecturer (YSA), during which they were allowed to ask questions as needed. On the following day, the resultant clasps and wax models were submitted by each student. At the end of the internship, all the students submitted their most successful clasp and wax models for final evaluation.

Evaluation

In order to standardize the scoring of students' skill scores between two academic years and between two genders and to evaluate their comparability with the studies in the literature, similar articles [8, 11] were reviewed. The scoring process was conducted by another blinded and calibrated lecturer (NH). While Table 1 presents the evaluation criteria used for labial arches and eyelet clasps, Table 2 for Adams clasp bending and wax modeling skills. The rater (NH) performed the scoring on four performances using the criteria presented in Table 1 and 2 by assigning 1 point for each criterion. The total skill score was obtained by summing the scores obtained for labial arch, Adams clasp, and eyelet clasp bending and wax modeling. To confirm intra-rater reliability, the same investigator (NH) randomly re-evaluated 20 models after 15 days. To confirm inter-rater reliability, a calibrated second investigator (ME) randomly re-evaluated 20 models.

Statistical analysis

Data were analyzed using SPSS for Windows version 25.0 (Armonk, NY: IBM Corp.). Normal distribution of data was assessed using Shapiro-Wilk test. All the scores excluding the eyelet clasp bending scores showed a normal distribution. Gender-based differences were compared using Independent-Samples t-test and Mann-Whitney U test. Differences between two time points (fourth-

year, T0;fifth-year, T1) were compared using Paired-Samples t-test and Wilcoxon signed rank test. A *p* value of <0.05 was considered significant.

Table 1: Evaluation criteria for vestibular arch and eyelet clasp bending

	Evaluation criteria for vestibular arch and eyelet clasp bending	Point
1.	The wire's labial segment might be placed in the the incisors' middle 1/3.	**1**
2.	The wire's mesial vertical segment might be started from the canine's mesial 1/3.	**1/ R**
3.		**1/ L**
4.	Mesial vertical segment and the labial segment might be perpendicular (90°) to the each other.	**1/ R**
5.		**1/ L**
6.	Distal and mesial vertical segment might be parallel to the each other.	**1/ R**
7.		**1/ L**
8.	Vertical segment might be at a distance of 0.5-1.5 mm from the the alveolar mucosa's buccal side.	**1/ R**
9.		**1/ L**
10.	The ring's vertical margin the might be 2-3 mm above the gingival margin.	**1/ R**
11.		**1/ L**
12.	The retention arm might follow the occlusal embrasure.	**1/ R**
13.		**1/ L**
14.	The retentive arm might contact to the tooth on the occlusal embrasure between the canine and first premolar.	**1/ R**
15.		**1/ L**
16.	There might be about 0.5 mm to 1 mm clearance when the retentive arm passes through the palatal tissue.	**1/ R**
17.		**1/ L**
18.	The tag might be facing towards the palate.	**1/ R**
19.		**1/ L**
	Evaluation criteria for eyelet clasp bending	
1.	The tip of the eyelet clasp might engage the undercut.	**1**
2.	There might be 45° between the eyelet clasp and the arm.	**1**
3.	The retentive arm might follow the occlusal embrasure.	**1**
4.	The retentive arm might contact to the tooth on the occlusal embrasure.	**1**
5.	There might be about 0.5 mm to 1 mm clearance when the retentive arm passes through the palatal tissue.	**1**

R: 1 point for right side, L: 1 point for left side

Table 2: Evaluation criteria for Adams clasp bending and wax modeling

	Evaluation criteria for Adams clasp bending	Point
1.	The bridge might be straight.	**1**
2.	The bridge and the buccal plate might be parallel to the each other.	**1**
3.	Bridge might not contact the first molar's buccal surface.	**1**
4.	The bridge's height might be at halfway up to the molar's buccal surface.	**1**
5.	The arrowhead might be at 45°.	**1/ R**
6.		**1/ L**
7.	The arrowhead might engage the mesiobuccal undercut.	**1/ R**
8.		**1/ L**
9.	The arm might follow the occlusal embrasure.	**1/ R**
10.		**1/ L**
11.	The arm might contact the occlusal embrasure.	**1/ R**
12.		**1/ L**
13.	There might be about 0.5 mm to 1 mm clearance when the mesial arm passes through the palatal tissue.	**1**
14.	There might be about 0.5 to 1 mm clearance when the distal arm passes through the palatal tissue.	**1**
15.	The mesial arm might be bent towards palate in a mesial direction.	**1**
16.	The distal arm might be bent towards palate in a mesial direction.	**1**
17.	The tag might be facing towards the palate.	**1/ R**
18.		**1/ L**
	Evaluation criteria for wax modeling	
1.	The thickness of the model might not exceed 2 mm.	**1**
2.	The thickness might be equal throughout the model.	**1**
3.	The model might end in the embrasures of anterior teeth.	**1**
4.	Posteriorly, the model might end at a location 2 mm beyond the distal segment of the Adams clasp.	**1**
5.	The model might end in the palatal embrasures of premolar and molar teeth.	**1/ R**
6.		**1/ L**
7.	The surface of the model might be smooth.	**1**
8.	The model might completely cover the palatal parts of the clasp.	**1**

R: 1 point for right side, L: 1 point for left side

RESULTS

Intra-rater correlation coefficients ranged between 0.869 and 0.980 and inter-rater correlation coefficients ranged between 0.841 and 0.978. Table 3 presents a gender-based comparison of preclinical orthodontic performances during the two time points. In this comparison, a significant difference was found between the two genders only with regard to T0 labial wire-bending (male: 9.90 ± 1.70, female: 11.66 ± 2.05) and T0 total skill score (male: 27.76 ± 2.94, female: 30.45 ± 3.00) (p<0.01). Other variables did not show a significant difference between the genders (p>0.05).

Table 4 presents a comparison of preclinical orthodontic skill scores between the two time points and between the two genders. In female students, a significant increase was observed in the Adams clasp bending scores at T1 (11.33±1.27) compared to T0 (11.08±1.34), while no significant change was found with regard to other scores (p>0.05). In male students, a significant increase was detected in the eyelet clasp bending scores between T1 (3.28±0.56) and T0 (2.71±1.10) (p<0.05), whereas no significant change was found with regard to other scores (p>0.05). On the other hand, no significant change was observed between T0 and T1 with regard to all parameters in the entire population (p>0.05).

Table 4: Year-based comparison of scores

Parameters	Female			Male			Total		
	T0	T1	P	T0	T1	P	T0	T1	P
Vestibular arch	11.66±2.05	10.75±2.60	0.155	9.90±1.70	9.71±2.41	0.857	10.84±2.07	10.26±2.54	0.178
Adams	11.08±1.34	11.33±1.27	**0.045***	10.90±1.33	10.90±1.64	0.502	11.00±1.33	11.13±1.45	0.596
Eyelet	3.12±0.94	3.08±0.77	0.808	2.71±1.10	3.28±0.56	**0.029***	2.93±1.03	3.17±0.68	0.150
Wax modeling	4.58±0.71	4.62±0.82	0.261	4.23±.76	4.38±1.07	0.051	4.42 ± 0.75	4.51±0.94	0.543
Total skill	30.45±3.00	29.79±4.03	0.435	27.76±2.94	28.28±3.71	0.546	29.20±3.24	29.08±3.91	0.854

T0: Fourth-year, T1: Fifth-year, SD: Standard deviation, **: P< 0.05

DISCUSSION

Preclinical training, which is an integral component of dentistry undergraduate education, plays a pivotal role in improving students' manual dexterity. In this training, live demonstration is the most frequently used and researched method.[7] In the present study, long-term effects of this method and gender-based differences were investigated and our null hypothesis was partially accepted.

In this study, the clasp bending and modeling scores (labial arch: 10.84±2.07, Adams clasp: 11.00±1.33) obtained by our fourth-year students who received live demonstration for the first time were higher than those reported by Sivarajan et al. [11] (labial arch: 9.26, Adams clasp: 4.58) and Lau et al. [8]. Additionally, the number of students participating in the live demonstration in this study was remarkably lower, which might have allowed our students to observe the bending and modeling steps easier and at a closer distance to the instructor, and also the students had longer periods for practice when compared to those of other studies. Meaningfully, it has been shown that poor seating arrangement can affect students' learning.[12] Moreover, numerous studies have suggested that learning is maximized when students are seated near the instructor, albeit not always significantly.[13-15]

The results indicated no significant change between T0 and T1 with regard to all parameters in the entire population (p>0.05). This finding could be attributed to the fact that the students submitted their most successful clasp and wax models for final evaluation at the end of the internship (~20 hours) and that they were required to obtain a minimum total score of 60 out of 100 to pass the class, which may have caused them to avoid exerting extra effort in the fifth year.

In the comparison of preclinical orthodontic skill scores between the two time points and between the two genders, the female students in the fourth-year had significant higher total skill and labial arch scores compared to male students. To our knowledge, there has been no study evaluating the skills of undergraduate dental students between the two genders. Some studies examined medical students and, contrary to our findings, reported that male students performed better in acquiring surgical skills, with the biggest differences detected in visuospatial abilities and speed.[16-18] In contrast, some other studies, in a similar way to the teaching technique used in this study, reported that female students acquired surgical skills significantly better when they were adequately trained with one-to-one feedback sessions.[18-21] Labial arch bending is the procedure that requires the most skills and care compared to other bending procedures and also requires 19 criteria to be fulfilled.[10] Literature indicates that adolescent girls have better writing skills than boys.[22, 23] This difference may explain the significantly higher labial arch bending and total skill scores in our female students compared to male students. In addition, this difference, which emerged when students practiced orthodontic bending for the first time in the fourth year, might have been caused by the possible stress experienced by the students during their dentistry education, as emphasized in many studies in the literature.[24-27] Some researchers also reported that female dental students experience significantly greater stress compared to male students.[28-30] Nevertheless, the pressure induced by possible stress is likely to cause female students to work harder and achieve higher scores. In this study, no significant difference was found between the two genders with regard to total skill scores at T1 as well as the change that occurred in these scores between T0 and T1. This finding implicates that the difference between the two genders with regard to orthodontic preclinical laboratory skills disappears in the long term. This hypothesis could be supported by the disappearance of the pressure in the first preclinical experience in the fifth year of education.

Comparison of orthodontic preclinical skill scores between the two time points indicated a significant increase in Adams clasp bending skills in female students compared to male students. The Adams clasp bending procedure ranks the second among the bending procedures that require the most skills, following labial arch bending. In this study, female students improved their Adams clasp bending scores in the long term (T1: 11.33±1.27), which were already remarkably high in fourth year (T0: 11.08±1.34). This finding implicates that women can further improve complex skills in the long term when compared to men. Male students, on the other hand, showed a significant improvement in eyelet clasp bending skills. In these skills, which require relatively few criteria, male students approached the ideal at T1.

This study was limited in several ways. First, due to its retrospective nature, the present study compared the long-term effects of live demonstration on a particular population at a given time period. Accordingly, the long-term effects of this method in other populations can be investigated by comparing it with other methods. In addition, the study focused on the preclinical laboratory skills of university students, which are an integral part of their education and are required for passing the class, and did not examine the effect of factors such as stress. Further prospective studies are needed to explore novel educational methods to be used in the pass/fail grading system with no grading.

Conclusion

The authors of this study found that by using the live demonstration method, the difference between the starting points of both genders disappeared over a long period of time.

Acknowledgment

We thank the English language and education expert Dr. Emrullah DAĞTAN for evaluating the language of the article. With respect to the memory of dentistry students who lost their lives in the February 2023 earthquake.

Ethical Approval

Ethics approval was obtained from Adıyaman University Non-Interventional Clinical Research Ethics Committee (Approval No 2021/07-10).

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

All authors declare that they have no conflict of interest.

Author Contributions

Design: MAY, MNE, NH, Data collection: YSA, MAY, Analysis and interpretation: MAY, NH, Literature review: MNE, MAY, Writing: MNE, MAY.

REFERENCES

1. Tedesco LA. Issues in dental curriculum development and change. Eur J Dent Educ. 1995;59:97-147.
2. Afify AR, Zawawi KH, Othman HI, Al-Dharrab AA. Correlation of psychomotor skills and didactic performance among dental students in Saudi Arabia. Adv Med Educ Pract. 2013;4:223.
3. Nikzad S, Azari A, Mahgoli H, Akhoundi N. Effect of a procedural video CD and study guide on the practical fixed prosthodontic performance of Iranian dental students. J Dent Educ. 2012;76:354-9.
4. Packer M, Rogers J, Coward T, Newman P, Wakeley R. A comparison between videotaped and live demonstrations, for the teaching of removable partial denture procedures. Eur J Dent Educ. 2001;5:17-22.
5. Packer M, Scott B, Davis D. An assessment of the influence of clinical demonstrations on the confidence of undergraduate dental students, when treating patients requiring removable partial dentures. Eur J Dent Educ. 1999;3:133-9.
6. Alqahtani ND, Al-Jewair T, Khalid A-M, Albarakati SF, Alkofide EA. Live demonstration versus procedural video: a comparison of two methods for teaching an orthodontic laboratory procedure. BMC Med Educ. 2015;15:1-4.
7. Atik E, Gorucu-Coskuner H, Taner T. The effect of live-video demonstration on dental students' orthodontic bending performance. J Dent Educ. 2020;84:377-84.
8. Lau MN, Kamarudin Y, Zakaria NN, Sivarajan S, Mohd Tahir NNZ, Bahar AD et al. Comparing flipped classroom and conventional live demonstration for teaching orthodontic wire-bending skill. Plos One. 2021;16:e0254478.
9. Corpus JH, Eisbach AOD. A live demonstration to enhance interest and understanding in child development. J Educ Psychol. 2005;32:35-44.
10. Enacar A, Özgen M. Orthodontic application of proximal clasps. J Oral Sci. 1990;32:167-74.
11. Sivarajan S, Soh EX, Zakaria NN, Kamarudin Y, Lau MN, Bahar AD et al. The effect of live demonstration and flipped classroom with continuous formative assessment on dental students' orthodontic wire-bending performance. BMC Med Educ. 2021;21:1-12.
12. Black S. Achievement by design. ASBJ. 2007;194:39-41.
13. Meeks MD, Knotts TL, James KD, Williams F, Vassar JA, Wren AO. The impact of seating location and seating type on student performance. Educ Sci. 2013;3:375-86.
14. Bailenson JN, Yee N, Blascovich J, Beall AC, Lundblad N, Jin M. The use of immersive virtual reality in the learning

sciences: Digital transformations of teachers, students, and social context. J Learn Sci. 2008;17:102-41.

15. Perkins KK, Wieman CE. The surprising impact of seat location on student performance. Phys Teach. 2005;43:30-3.
16. Thorson CM, Kelly JP, Forse RA, Turaga KK. Can we continue to ignore gender differences in performance on simulation trainers? J Laparoendosc Adv Surg Tech. 2011;21:329-33.
17. Schlickum M, Felländer-Tsai L, Hedman L, Henningsohn L. Endourological simulator performance in female but not male medical students predicts written examination results in basic surgery. Scand J Urol. 2013;47:38-42.
18. Donnon T, DesCôteaux J-G, Violato C. Impact of cognitive imaging and sex differences on the development of laparoscopic suturing skills. Can J Sur. 2005;48:387.
19. Strandbygaard J, Bjerrum F, Maagaard M, Winkel P, Larsen CR, Ringsted C, et al. Instructor feedback versus no instructor feedback on performance in a laparoscopic virtual reality simulator: a randomized trial. Ann Sur. 2013;257:839-44.
20. White MT, Welch K. Does gender predict performance of novices undergoing Fundamentals of Laparoscopic Surgery (FLS) training? Am J Surg. 2012;203:397-400.
21. Van Hove C, Perry KA, Spight DH, Wheeler-Mcinvaille K, Diggs BS, Sheppard BC, et al. Predictors of technical skill acquisition among resident trainees in a laparoscopic skills education program. World J Sur. 2008;32:1917-21.
22. Cohen MR. Individual and sex differences in speed of handwriting among high school students. Percept Mot Skills. 1997;84:1428-30.
23. Ziviani J, Elkins J. An evaluation of handwriting performance. Educ Rev. 1984;36:249-61.
24. Muirhead V, Locker D. Canadian dental students' perceptions of stress and social support. Eur J Dent Educ. 2008;12:144-8.
25. Sofola O, Jeboda S. Perceived sources of stress in Nigerian dental students. Eur J Dent Educ. 2006;10:20-3.
26. Al-Omari WM. Perceived sources of stress within a dental educational environment. J Contemp Dent Pract. 2005;6:64-74.
27. Sanders AE, Lushington K. Effect of perceived stress on student performance in dental school. J Dent Educ. 2002;66:75-81.
28. Sugiura G, Shinada K, Kawaguchi Y. Psychological well-being and perceptions of stress amongst Japanese dental students. Eur J Dent Educ. 2005;9:17-25.
29. Heath J, Macfarlane T, Umar M. Perceived sources of stress in dental students. Dent Update. 1999;26:94-100.
30. Naidu RS, Adams JS, Simeon D, Persad S. Sources of stress and psychological disturbance among dental students in the West Indies. J Dent Educ. 2002;66:1021-30.