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GENERAL UROLOGY

Original Article

Analysis of the learning curve for transurethral resection of the prostate. Is there any influence of musical instrument and video game skills on surgical performance?

Transüretral prostat rezeksiyona ilişkin öğrenme eğrisinin analizi: cerrahi performans üzerine müzik ve video oyunlarındaki becerinin herhangi bir etkisi var mı?

Kleiton Gabriel Ribeiro Yamaçake, Elcio Tadashi Nakano, Iva Barbosa Soares, Paulo Cordeiro, Miguel Srougi, Alberto Azoubel Antunes

ABSTRACT

Objective: To evaluate the learning curve for transurethral resection of the prostate (TURP) among urology residents and study the impact of video game and musical instrument playing abilities on its performance.

Material and methods: A prospective study was performed from July 2009 to January 2013 with patients submitted to TURP for benign prostatic hyperplasia. Fourteen residents operated on 324 patients. The following parameters were analyzed: age, prostate-specific antigen levels, prostate weight on ultrasound, pre- and postoperative serum sodium and hemoglobin levels, weight of resected tissue, operation time, speed of resection, and incidence of capsular lesions. Gender, handedness, and prior musical instrument and video game playing experience were recorded using survey responses.

Results: The mean resection speed in the first 10 procedures was 0.36 g/min and reached a mean of 0.51 g/min after the 20th procedure. The incidence of capsular lesions decreased progressively. The operation time decreased progressively for each subgroup regardless of the difference in the weight of tissue resected. Those experienced in playing video games presented superior resection speed (0.45 g/min) when compared with the novice (0.35 g/min) and intermediate (0.38 g/min) groups (p=0.112). Musical instrument playing abilities did not affect the surgical performance.

Conclusion: Speed of resection, weight of resected tissue, and percentage of resected tissue improve significantly and the incidence of capsular lesions reduces after the performance of 10 TURP procedures. Experience in playing video games or musical instruments does not have a significant effect on outcomes.

Keywords: Learning curve; music; prostate; surgery; video games.

ÖZ

Amaç: Üroloji asistanlarının arasında transüretral prostat rezeksiyonunu (TURP) öğrenme eğrisini değerlendirmek ve performans üzerine video oyunları oynama ve bir müzik aleti çalma yetilerinin etkisini incelemek.

Gereç ve yöntemler: Benign prostat hiperplazisilerinin tedavisi için Temmuz 2009-Ocak 2013 arasında TURP olan hastalarda bir prospektif çalışma yürütülmüştür. On dört asistan 324 hastayı ameliyat etmiştir. Yaş, prostat spesifik antijen düzeyleri, ultrasonda prostat ağırlığı, pre- ve postoperative serum sodyum ve hemoglobin düzeyleri, rezeke edilmiş dokunun ağırlığı, ameliyat süresi, rezeksiyon hızı ve kapsül lezyonu gibi parametreler incelenmiştir. Tarama sonuçlarına göre asistanların cinsiyeti, dominant eli, önceki müzik ve video oyun becerileri kaydedilmiştir

Bulgular: İlk 10 TURP operasyonunda ortalama rezeksiyon hızı 0,36 g/dk iken 20. TURP sonrası ortalama 0,51 g/dk'ya ulaşmıştır. Kapsül lezyonlarının yüzdesi giderek azalmıştır. Her bir grup için ameliyat süresi rezeke edilen dokuların ağırlıkları arasında farklılığa bakılmaksızın giderek azalmıştır. Video oyunlarında çok deneyimli (0,45 g/dk)olanlar acemi (0,35 g/dk) ve orta derecede (0,38 g/dk) deneyimli olan gruplara göre daha hızlı rezeksiyon yapmıştır (p=0,112). Müzik aleti çalma yetileri performansı etkilememiştir.

Sonuç: On adet TURP operasyonu yapıldıktan sonra rezeksiyon hızı, rezeke edilmiş dokunun ağırlığı ve rezeke edilmiş dokunun yüzdesi önemli derecede iyileşmeye başlamakta ve kapsül lezyon oranları düşmektedir. Video oyunlar veya müzik aletleriyle deneyim sonuçlarda istatistiksel açıdan önemli bir rol oynamamıştır.

Anahtar kelimeler: Öğrenme eğrisi; müzik; prostat; cerrahi; video oyunları.

Department of Urology, University of Sao Paulo, Sao Paulo, Brazil

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Correspondence: Kleiton Gabriel Ribeiro Yamaçake, E-mail: kleiton_med91@yahoo.com.br

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Introduction

Benign prostatic hyperplasia (BPH) is one of the most common conditions in aging male and the most frequent cause of lower urinary tract symptoms (LUTS). Moderate or severe LUTS occurs in about one-quarter of men in their 50s and in about half of all men aged 80 years or older.[1] Surgical management is an appropriate treatment for men with LUTS secondary to bladder outlet obstruction who do not improve after medical therapy, those who do not want to undergo medical therapy yet request active intervention, and those who present complications.[2]

Because of its long-term treatment efficacy, transurethral resection of the prostate (TURP) has been considered the gold standard surgical management for BPH since 80 years.[3] However, with the introduction of medical treatment and, more recently, with the development of laser procedures, TURP rates have been declining over time.[4-6]

Data from the Accreditation Council for Graduate Medical Education has shown that the number of TURP procedures performed by graduating chief residents has also steadily decreased during the last decade, whereas the number of laser procedures has started to increase since 2004.[7] The rate of procedures for adverse events as a percentage of TURP procedures has also increased since 2004. These data suggest that the decrease in TURP procedures may be impacting the resident's surgical learning curve.

To date, only a few studies have analyzed the learning curve for TURP.[8] A better understanding of this process and of some individual characteristics that may influence it would improve the learning process and make it widely available to teaching centers. The aim of the present study was to evaluate the learning curve for TURP among urology residents in a high-volume tertiary referral center and study the impact of video game and musical instrument playing abilities on its performance.

Materials and methods

We conducted a prospective study from July 2009 to January 2013 in the Division of Urology, University of São Paulo Medical School. Patients submitted to TURP for BPH were evaluated. Fourteen residents operated on 324 patients (mean 23 procedures per resident) during a 60-75-days rotation period in the prostate section of the urology division. All urology residents consented to be enrolled in the study and the Institutional Review Board and Human Subjects Committee approved it.

For the surgical procedures, epidural anesthesia was preferred and 1 g of cefazolin was administered intravenously. All procedures were mentored by a staff surgeon with extensive experience in TURP procedures and performed by a second-year urology resident. Conventional monopolar TURP was performed with a 24-French resectoscope (Storz, Germany) and a loop electrode for TURP (5-mm diameter, Storz). Mannitol 3.0% was used as the irrigation fluid.

We analyzed the following parameters: preoperative: age, prostate-specific antigen (PSA) levels, prostate weight on ultrasound (US), and serum sodium and hemoglobin levels; intraoperative and perioperative: weight of resected tissue, operation time, speed of resection, incidence of capsular lesions (perforation reported by the surgeon); and postoperative: serum sodium and hemoglobin levels. Sodium and hemoglobin levels were measured on the first postoperative day.

All urology residents had previous experience with rigid cystoscopy. Analysis of the learning curve was performed by comparing the 10 initial TURP procedures with the following 10 TURP procedures and the remaining surgeries for those who performed 21 surgeries or more. Moreover, gender, handedness, and prior experience in playing video games and musical instruments were recorded for each resident using survey responses. The questionnaire related to video games asked questions regarding the length of playing time and types of games played, such as conventional gaming consoles with button-push and joystick controllers or video games that involved interaction with virtual reality situations. Considering that all urology residents had previous video game playing experience, they were categorized as follows: novice (those who had played video games at some point in the past), intermediate (those who were still playing video games but not frequently), and experienced (those who played video games frequently and reported themselves as skillful). With regard to experience in playing musical instruments, the residents were grouped as follows on the basis of self-reported responses: none (those who had never played an instrument), novice (those who had a brief contact in the past), and experienced (those who played an instrument in the past and still practiced frequently or sometimes). There was no distinction in terms of the type of musical instrument played. The groups were compared in relation to performance in monopolar TURP (Figure 1).

Statistical analyses were performed using the Excel program (Microsoft Inc., Redmond, WA). Comparison of continuous variables between groups was carried out using Student's t-test (two tailed), with a p value of <0.05 considered statistically significant. Comparison of categorical variables was performed using the chi-square test, with a p value of <0.05 considered statistically significant.

Results

The mean patient age at surgery was 67.4±8.6 years (range: 45-95 years), and the mean estimated prostate volume by US was 57.5±18.4 g (range: 15-127 g). We observed a mean drop of 2.6 mmol/mL and 1.4 g/dL in sodium and hemoglobin levels,

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respectively. Patient demographics and surgery data are summarized in Table 1. Distribution of the number of surgeries performed by each of the 14 residents and comparison regarding prostate size and intraoperative data are summarized in Table 2. Thirteen urology residents were right-handed and 1 urology resident was left-handed. The group included 13 men and 1 woman.

Data from the first 10 TURP procedures for each resident were compared with the next 10 TURP procedures and the remaining surgeries for those who had performed 21 or more surgeries. Table 3 summarizes the comparison between groups. Improvements were noted in the majority of the parameters examined, including speed of resection, weight of resected tissue, percentage of resected tissue, incidence of capsular lesions, and operation time. Figure 2 shows the evolution of resection speed according to the number of surgeries performed. Moreover, the incidence of capsular lesions decreased progressively (21.4% in group 1 and 12.7% in group 3), although the deacrease in capsulare lesions were not statistically significant. The chi-square test for this categorical variable was performed

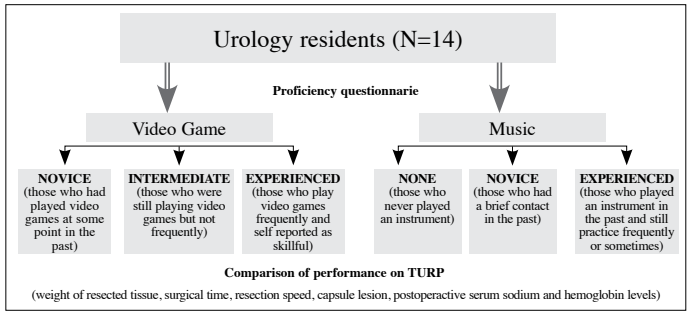

Figure 1. Flowchart for comparing performance of TURP according to experience in playing musical instruments and video games

Table 1. Patient demographics and surgery data

Patient demographics and surgery data	Median±SD (range)
Age, years	67.4±8.6 (45–95)
PSA, ng/mL	5.4±5.1 (0.26–42.8)
TRUS prostate weight, g	57.5±18.4 (15–127)
Speed of resection, g/min	0.4±0.1 (0.08–0.93)
Operation time, min	59.5±21.7 (10–120)
Weight of resected tissue, g	24.1±13.4 (4–80)
Preoperative serum Na^+, mmol/mL	141.6±4.4 (106–162)
Postoperative serum Na^+, mmol/mL	139.0±5.3 (102–156)
Preoperative hemoglobin, g/dL	14.3±1.5 (7.2–18.2)
Postoperative hemoglobin, g/dL	12.9±1.8 (6.7–17.9)

SD: standard deviation; Min: minutes; PSA: prostate-specific antigen; TRUS: transrectal ultrasound

Table 2. Distribution of the number of surgeries performed by each resident and comparison in terms of prostate size and intraoperative data

	TRUS prostate size, g. Mean±SD (range)	Speed of resection, g/min. Mean±SD (range)	Operation time, min. Mean±SD (range)	Weight of resected tissue, g. Mean (range)	Percentage of resected tissue	Capsule lesion (%)	Mean Serum Na^+ drop, mmol/mL	Mean Hemoglobin drop, g/dL	Number of procedures
1	49.2±18.40 (15-76)	0.23±0.09 (0.09-0.44)	67.2 (30-120)	15.92 (4-40)	43.85	12	1.8	0.8	25
2	57.5±20.44 (28-110)	0.28±0.12 (0.08-0.57)	76.4 (45-110)	22.5 (6-60)	38.22	35.71	3.21	2.27	14
3	53.1±13.10 (24-74)	0.39±0.13 (0.2-0.70)	51.92 (20-90)	21.04 (5-46)	38.97	28	4.8	0.93	25
4	60.1+-19.34 (37-117)	0.42±0.10 (0.22-0.67)	62.2 (30-120)	26 (10-50)	44.58	20	5.94	1.05	25
5	63±12.26 (40-80)	0.48±0.11(0.29-0.75)	55.26 (30-80)	26.84 (10-45)	44.38	0	5.31	1.28	19
6	60±17.21 (24-92)	0.3±0.11 (0.11-0.53)	60 (30-90)	18.38 (5-40)	30.7	14.28	3.71	1.43	21
7	60.9±17.75 (28-86)	0.41±0.14 (0.08-0.71)	59.52 (30-80)	24.35 (6.4 - 50)	41.37	21.05	3.78	0.69	19
8	50.1±17.93 (28-105)	0.42±0.16 (0.10-0.72)	49 (30-95)	20.83 (4-57)	41.74	16.66	2.36	1.04	30
9	65.9±23.62 (30-127)	0.57±0.14 (0.33-0.78)	62.63 (20-120)	36.28 (10-80)	55.87	12.12	3.39	1.39	33
10	58.2±9.83 (36-78)	0.42±0.16 (0.16-0.87)	52.9 (15-90)	21.25 (4-50)	35.63	45	2	1.46	20
11	58.4±22.03 (25-114)	0.48±0.14 (0.18-0.75)	60.37 (20-100)	28.66 (9-57)	49.73	7.4	2.29	1.62	27
12	55.5±16.22 (25-84)	0.38±0.11 (0.22-0.64)	65.45 (40-105)	24.95 (10-67)	47.62	30	1.65	1.87	20
13	63.2±15.07 (40-90)	0.43±0.17 (0.25-0.93)	58.72 (10-90)	25.82 (10-70)	41.22	13.79	4.1	1.37	29
14	50.2±13.95 (30-75)	0.31±0.13 (0.15-0.63)	59.52 (23-110)	18.94 (5-44)	36.82	5.88	4.82	0.86	17

SD: standard deviation; Min: minutes; PSA: prostate specific antigen; TRUS: transrectal ultrasound

Table 3. Surgical results and clinical data of TURP: comparison between groups

	Group I (1-10)	Group II (11-20)	Group III ≥21	p value
Speed of resection, g/min	0.36	0.4	0.51	G-I vs G-II, G-III: <0.005, G-II vs G-III: <0.005
Operation time, min	60	58.46	60.92	G-I vs G-II, G-III: 0.744 , G-II vs G-III: 0.438
Weight of resected tissue, r,g	21.81	23.57	31.71	G-I vs G-II, G-III: <0.005, G-II vs G-III: <0.005
Capsule lesion (%)	21.42	16.27	12.72	*0.298
Mean Na drop, mmol	3.65	3.44	3.14	G-I vs G-II, G-III: 0.604, G-II vs G-III: 0.651
Mean Hb drop, g/dL	1.38	1.21	1.09	G-I vs G-II, G-III: 0.149, G-II vs G-III: 0.523
US Size, g	56.66	56.82	61.72	
Percentage of resected tissue	38.89	41.91	50.74	G-I vs G-II, G-III: <0.05, G-II vs G-III: <0.05
Number of procedures	140	129	55	
Number of residents	14	14	8	

Min: minutes; US: ultrasound; g: grams; p value: student´s t test; G-I: Group I; G-2: Group II; G-3: Group III. *p value: Chi Square test

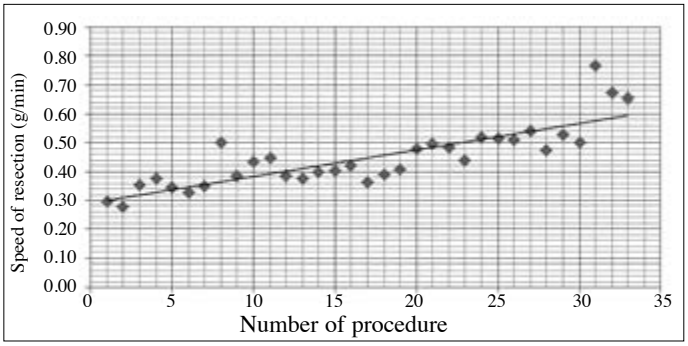

Figure 2. Learning curve for TURP. Relationship between the number of TURP procedures and speed of resection; min: minutes, g: gram

with a p value of 0.298. The operation time and mean drop in sodium levels was not different between the groups.

A comparison between weight of resected tissue and operation time was performed. The operation time decreased progressively for each subgroup regardless of the difference in the weight of tissue resected, as showed in Table 4. Of note, residents in group 3 (after 20 procedures) were able to resect more than 50 g of prostatic tissue in about 1 h. Despite these numbers, the decrease in operation time was not statistically significant.

In relation to musical instrument playing experience, 5 residents had never played an instrument, 4 were considered novice, and 5 were experienced. Regarding video game playing experience, 5 were categorized as novice, 5 as intermediate, and 4 as experienced. Urology residents experienced in playing video games presented superior speed of resection when compared with the novice and intermediate groups but without statistical difference (p=0.112). On the other hand, musical instrument playing abilities did not affect TURP performance. In addition, video game and musical instrument playing experience had no effect on the percentage of tissue resected, incidence of capsular lesions, and drop in sodium and hemoglobin levels. A box plot of comparison between the groups is summarized Figures 3a, b. The median resection speed according to the video game groups was 0.38 g/min (novice), 0.39 g/min (intermediate), and 0.42 g/min (experienced). In relation to the music groups, the median resection speed was 0.42 g/min (novice), 0.4 g/min (intermediate), and 0.31 g/min (experienced).

Discussion

In the present study, we demonstrated that speed of resection, weight of resected tissue, and percentage of resected tissue significantly improved with experience. The incidence of capsular lesions decreased by about 50%, although the results did not reach statistical significance. Regarding the individual abilities, despite the increase in the resection speed with greater video game playing experience, we did not find statistical differences between the groups. Furthermore, musical instrument playing experience does not seem to influence the TURP learning curve.

The learning curve in surgery can be defined as the number of cases needed to perform the procedure with reasonable operation time and an acceptable rate of complications, resulting in an adequate postoperative clinical outcome and a shorter hospital stay.[9] In this sense, several factors may play an important role in the learning curve, including those related to the surgeon, such as confidence and experience with other surgical procedures, as well as those related to the team members involved in the procedures. The number of cases performed by the surgeon and the volume of surgeries in a given center may undoubtedly delineate the course of surgical outcomes.

Skills development is strongly correlated with the gain in experience through repetition. In this learning process, the surgeon shows a relatively permanent improvement in operative ability.

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Table 4. Relationship between weight of tissue resected and operation time. Data presented are mean±standard deviation

	Operation time (minutes)			
Weight of tissue resected	**Group 1**	**Group 2**	**Group 3**	**p value**
<9g	43.3±19.1 (n=15)	39.8±15.0 (n=10)	30±0 (n=2)	G-I vs G-II, G-III: 0.445, G-II vs G-III: 0.082
10-29g	56.3±18.2 (n=94)	52.7±17.8 (n=82)	48.4±17.1 (n=28)	G-I vs G-II, G-III: 0.066, G-II vs G-III: 0.261
30-49g	78.2±20.6 (n=30)	73.1±15.9 (n=30)	67.5±15.7 (n=14)	G-I vs G-II, G-III: 0.135, G-II vs G-III: 0.293
>50 g	105±0 (n=1)	88.5±17.0 (n=7)	61.4±11.2 (n=11)	G-II vs G-III: 0.859

n: number; p value: Student´s t test; G-I: Group I; G-2: Group II; G-3: Group III

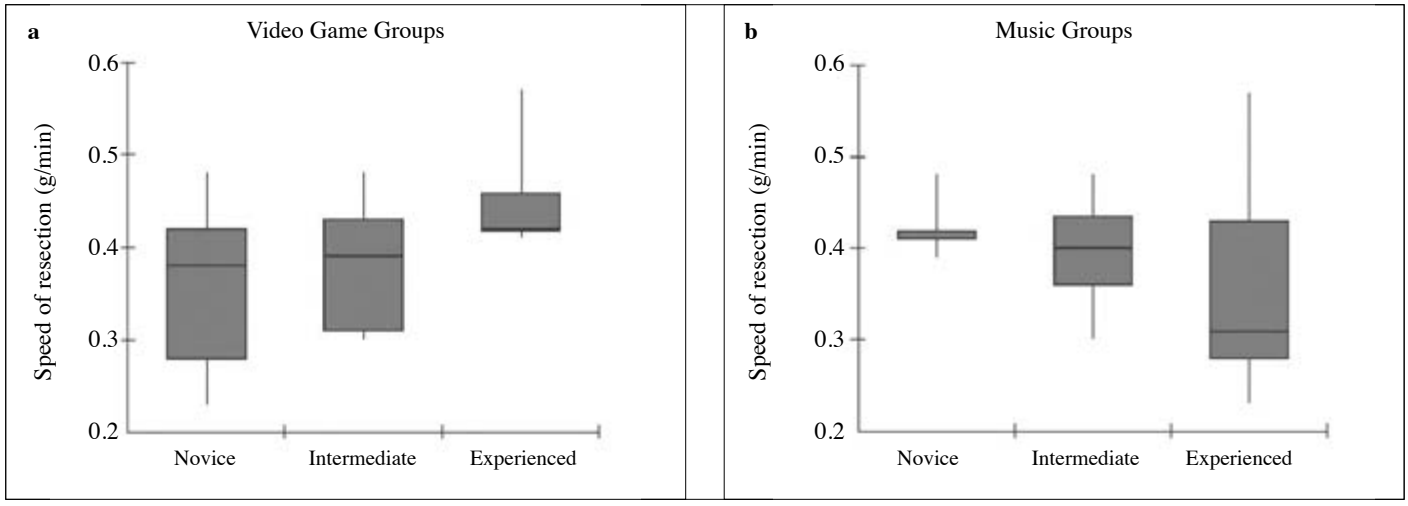

Figure 3. a, b. Box plot of comparison between groups according to experience in playing musical instruments and video games (Median, Q1-Q3)

Evaluation of the learning curve for monopolar TURP has been rarely addressed in the literature. Moreover, no study published till date has specifically addressed the learning curve for monopolar TURP among urology residents and the influence of video game and musical instrument playing on TURP performance.

The main goals during the learning process for TURP include recognizing the transition between the adenoma and prostate capsule as well as performing resection with reasonable speed without complications such as bleeding and capsular lesions. Furthermore, the learning curve and better results are mainly related to the number of the procedures performed and experience, although we believe that other factors may play an important role on surgeon performance.

It has been postulated that the positive benefits of playing video games include increased performance on eye–hand coordination tasks and neuropsychological tests and better reaction time, spatial visualization, and mental rotation.[10,11] Recent studies have shown that subjects with previous regular experience in playing video games tend to be more skillful at videoendoscopic surgical tasks.[12]

Some studies have shown that experience in playing video games is correlated with better performance of laparoscopic skills both in simulators and in the surgical environment.[13,14] In our study, those with extensive video game playing experience had faster resection times than those with intermediate or limited video game playing experience; however, this difference was not statistically significant. We believe that the relative small number of procedures analyzed may have precluded adequate analysis about the effect of video game playing experience on surgical performance.

Musical instrument playing experience has already been proved to influence math skills and visuospatial abilities. Boyd et al tested the laparoscopic skills of medical students according to their skills with musical instruments. The most significant effect was observed among men, where those with musical instrument playing experience showed improvement of more than 2 min in the average time for completion of tests compared with novices in music.[15]

Some limitations of the present study should be pointed out. We did not evaluate which instrument a participant played or had played in the past nor did we assess proficiency in video

game or musical instrument playing. We relied on self-reported video game and musical instrument playing experience. In our analysis, musical instrument playing experience had no impact on TURP performance. In addition, late postoperative complications, such as late bleeding hematuria, bladder neck contracture, urethral stricture, meatal stenosis, urinary incontinence, were not evaluated in the study.

On the other hand, some positive features of the study may be highlighted, such as the prospective design, the group homogeneity of the residents, use of the same surgical technique and equipment, and the sample size recruited. Furthermore, we can assume that these results may provide important information on surgical training in TURP.

Speed of resection, weight of resected tissue, and percentage of resected tissue start to improve significantly and the incidence of capsular lesions starts to reduce significantly after performance of 10 TURP procedures. Video game and musical instrument playing experience does not seem to influence surgical performance. Studies with a larger number of residents are necessary to confirm these results and find out other personal abilities that may influence surgical performance.

Ethics Committee Approval: Ethics committee approval was obtained.

Informed consent: Written informed consent was obtained from patient/patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - A.A.A.; Supervision - A.A.A., M.S.; Data Collection and/or Processing - I.B.S.; Analysis and/or Interpretation - K.G.R.Y, E.T.N.; Literature Review - K.G.R.Y., E.T.N.; Writer - K.G.R.Y.; Critical Review - P.C., M.S., A.A.A.

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Hakem Değerlendirmesi: Dış bağımsız.

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