

Scanning Time of a Digital Impression Technique: A Comparison Between Left- and Right-Handedness

Dijital Ölçü Tekniğinde Tarama Zamanı: Sağ ve Sol El Kullanımının Karşılaştırılması

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ABSTRACT Objective: There is not enough information about the effect of digital impression scanning using right/left hand on the scanning time. The purpose of this study was to evaluate whether the scanning time of digital impression with an intraoral scanner is dependent upon the handedness of the operator. **Material and Methods:** Two voluntary fourth-year students and 2 prosthodontists from the Yeditepe University, School of Dentistry were included. One of the students and prosthodontists were right-handed while the others were left-handed. For the experiments, 100 models containing 16 teeth on the maxillary arch were adapted in sequence to a phantom head that positioned uprightly. The participants were divided into 4 groups according to handedness of students and prosthodontists. Each group was divided into 2 subgroups according to right and left quadrants of scanned model. The scanning time was measured and recorded in seconds with a chronometer in all groups. Mann-Whitney U test was used to compare the groups, with a significance level established at $p < 0.05$. **Results:** There was a significant difference in scanning time between the students (24.37 sec) and prosthodontists (12.36 sec). The scanning time of right-handed student and right-handed prosthodontist was significantly higher than left-handed student's and left-handed prosthodontist's ($p = 0.001$; $p < 0.05$). **Conclusion:** The results of the study suggest that left-handed dentists may have better skills than right-handed dentists regardless of time of experience. Students may need more training and experience to achieve the same level of proficiency as prosthodontists.

ÖZET Amaç: Dijital ölçüde sağ/sol el kullanılarak tarama yapılmasının, tarama zamanı üzerindeki etkisi ile ilgili yeterli bilgi bulunmamaktadır. Bu çalışmanın amacı, dijital ölçü tarama zamanının, diş hekiminin sağ/sol el kullanmasına bağlı olup olmadığının değerlendirilmesidir. **Gereç ve Yöntemler:** Yeditepe Üniversitesi Diş Hekimliği Fakültesinden 2 gönüllü 4. sınıf öğrencisi ve 2 protez uzmanı çalışmaya dâhil edildi. Öğrencilerden biri ve bir protez uzmanı dijital ölçü taraması için sağ elini kullanırken, diğer 2 hekim sol elini kullandı. Çalışma için 100 adet üst çene modeli (16 diş) fantoma yerleştirildi. Çalışmaya katılanlar sağ/sol elini kullanan öğrenci ve protez uzmanı olarak 4 gruba ayrıldı ve sırasıyla modelleri taradı. Her grup, modelin sağ ve sol yarısı taramasına göre 2 alt gruba ayrıldı. Tarama süresi ölçüldü ve tüm modeller için kronometre yardımıyla sn bazında kaydedildi. Grupların karşılaştırılmasında Mann-Whitney U testi kullanıldı. Anlamlılık $p < 0,05$ düzeyinde değerlendirildi. **Bulgular:** Öğrenciler (24,37 sn) ve protez uzmanlarının (12,36 sn) tarama zamanları arasında istatistiksel olarak ileri düzeyde anlamlı farklılık bulundu. Sağ el kullanan protez uzmanı ve öğrenci için kaydedilen tarama zamanı, sol el kullanan protez uzmanı ve öğrenci için kaydedilen tarama zamanından yüksek bulundu ($p = 0,001$; $p < 0,05$). **Sonuç:** Çalışmamızın sonucunda, sol el kullanan diş hekimlerinin sağ el kullananlara göre el becerilerinin, tecrübe sürelerine bakılmaksızın daha iyi olduğu düşünülebilir. Öğrencilerin, uzmanların yeterlilik düzeyine ulaşmaları için daha fazla eğitim ve tecrübeye ihtiyaçları vardır.

Keywords: Computer-aided design; dental impression technique; functional laterality

Anahtar Kelimeler: Bilgisayar destekli tasarım; dental ölçü tekniği; fonksiyonel lateralite

Computer-aided design/computer-aided manufacturing (CAD/CAM) technology has been used in dentistry since 1980s.¹ The “Chairside Economical Restoration of Esthetics Ceramics (CEREC)” (Sirona

Dental Systems GmbH) was the first CAD/CAM system came on the dental market in 1987, which was initially designed to fabricate inlays and onlays chairside for immediate cementation.^{2,3} Over the years, the

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development of the system has allowed clinicians to manufacture the variety of restorations and materials such as inlays, onlays, crowns, laminate veneers, fixed dental prostheses, implant abutments and complete dentures.⁴⁻⁶ In this system, digital models are produced with the chairside devices, intraoral scanners, which scan the patient's dentition and capture a 3-dimensional impression.² The introduction of intraoral scanners is one of the latest innovations in digital dental technology.^{7,8}

The ease of communication with dental technician or patients, enhanced treatment planning and reduced storage requirements are the advantages of digital impressions over conventional impression techniques.⁹ Digital systems may increase the standardization of the impression by avoiding the operator depended factors. Left-handedness is one of these factors in professional practice in medicine and dentistry.¹⁰⁻¹⁷ Although there are many studies about CAD/CAM systems and/or materials, any differences in scanning times of digital impression due to operator handedness have not been addressed yet.¹⁸⁻²⁴ It was reported in the literature that there are better right- and left-hand skills of left-handers when compared with the right-handers.^{25,26} The working time of the intraoral scanner of CAD/CAM systems may be affected by the handedness of the operators. Therefore, the aim of this study was to determine whether the scanning time of digital impression with an intraoral scanner is dependent upon the handedness of the operator. The null hypothesis was that there is no difference in scanning time between right-handed (RH) and left-handed (LH) operators.

MATERIAL AND METHODS

All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional scientific committee (Yeditepe University Scientific Committee, 22.6.2018, No: 241) and with the 2008 Helsinki Declaration and its later amendments or comparable ethical standards. Written informed consent was obtained from all participants who were involved in the experiment. Two voluntary fourth-year students and two prosthodontists from Yeditepe University, School of Dentistry were included in this study. One

of the students and prosthodontists were RH, while the two others were LH. Despite the prosthodontists had more than 10 years of clinical experience with conventional impression; both students and prosthodontists had no experience with digital impression before. Following the basic education which the whole CEREC (Dentsply Sirona Dental Systems GmbH, USA) procedures from planning to insertion of the restoration, each participant had performed 20 training scans for the proficiency. The scanner (CEREC Omnicam, Sirona Dental Systems GmbH, USA) was used according to the manufacturer's recommendations. For the experiments, 100 maxillary arch models containing 16 teeth (Frasaco GmbH, Tettngang, Germany) on the jaw simulator (KaVo Dental GmbH, Biberach/Riß, Germany), were adapted in sequence to a phantom head that positioned uprightly. The participants were divided into 4 groups according to handedness of students and prosthodontists. The models were scanned with CEREC Omnicam by RH prosthodontist in Group 1, LH prosthodontist in Group 2, RH student in Group 3 and LH student in Group 4.

Each group were divided into 2 subgroups according to right and left quadrants of scanned model. The RH operators were positioned on the right side, and the left-sided operators were positioned on the left side of the phantom head. The scanning procedure, including buccal, palatal and occlusal/incisal surfaces of the teeth, were started from the third molar and ended in midline. Scanning time was defined as the time needed to achieve an impression meeting the acceptance criteria of the digital system, and it was measured and recorded in seconds with a chronometer in all models for each group. Once the accuracy of the digital impression of each model was checked and approved with the audible and visual warning of the system, the chronometer was stopped by the observer.

NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) was used for the statistical analysis of the data. Shapiro-Wilk test was used to evaluate the distribution of the data, in addition to descriptive statistical methods (median, frequency, minimum, maximum). Mann-Whitney U test was used to compare the two groups that did not show normal distribution of quantitative data. Significance was set at $p < 0.05$.

RESULTS

The median values for all scanning times obtained by the operators are presented in Table 1. It was found that there was a significant difference between the students (24.37 sec) and prosthodontists (12.36 sec) ($p=0.001$; $p<0.05$). Table 2 showed the median values for scanning times of both quadrants according to handedness of prosthodontists and students. The scanning time of RH student (25.18 sec) and the scanning time of RH prosthodontist (12.88 sec) was significantly higher than LH student's (23.07 sec) and LH prosthodontist's (11.68 sec) ($p=0.001$; $p<0.05$).

Comparisons of scanning times on right and left side of the arches according to handedness of the operators were given in Table 3. According to these results, RH prosthodontist showed higher scanning time for right quadrant than left quadrant ($p=0.001$; $p<0.05$). It was shown that there was no significant difference between left and right quadrant scanned by LH prosthodontist ($p>0.05$). RH student showed lower scanning time for right quadrant than the left quadrant ($p=0.001$; $p<0.05$). The LH student showed significantly higher time measurement on right quadrant than the left quadrant ($p=0.001$; $p<0.01$).

DISCUSSION

In this study, the effect of handedness on the scanning time of the digital impression was evaluated. According to the results of this study, there was a significant difference between the scanning time obtained by right and LH operators. Therefore, the null hypothesis was completely rejected. Although many

TABLE 1: Time comparisons between operators (second).

	n	Minimum-Maximum (Median)	p value
Prosthodontists	400	7.54-20.58 (12.36)	0.001**
Students	400	14.48-35.12 (24.37)	

n: Number of quadrants; Mann-Whitney U test was used; * $p<0.05$.

TABLE 2: Time comparisons according to handedness of operators (second).

	n	Minimum-Maximum (Median)	p value
RH prosthodontist	200	8.16-20.58 (12.88)	0.001**
LH prosthodontist	200	7.54-17.33 (11.68)	
RH student	200	18.85-34.22 (25.18)	0.001**
LH student	200	14.48-35.12 (23.07)	

RH: Right-handed; LH: Left-handed; Mann-Whitney U test was used; * $p<0.05$.

studies reported shorter working time for conventional impression when compared with digital systems, conventional impression can be affected by several conditions such as experience, manual dexterity and handedness of the operator or distortion of the impression material.^{18,19} Also, it was reported that the patients could feel uncomfortable and anxious because of the procedures of conventional impression, thus majority of them preferred digital impression.^{18,24}

According to the results of the present study, the models were scanned faster by prosthodontists than students, regardless of handedness. Ten years of experience of the prosthodontists may be the reason for the lower scanning times, and this may be attributed to the improvement of the skills by training and experience.²⁵ Joda et al. found no significant difference between the scanning time of the dentists and stu-

TABLE 3: The median values for scanning times (second) on right and left side of the arch according to handedness of the operators.

		n	Minimum-Maximum (Median)	p value
RH prosthodontist	Right side of the arch	100	12.14-20.58 (14.73)	0.001**
	Left side of the arch	100	8.16-14.84 (11.09)	
LH prosthodontist	Right side of the arch	100	7.54-17.33 (11.78)	0.098
	Left side of the arch	100	9.48-16.55 (11.64)	
RH student	Right side of the arch	100	18.85-26.86 (21.49)	0.001**
	Left side of the arch	100	24.12-34.22 (29.95)	
LH student	Right side of the arch	100	18.28-35.12 (25.86)	0.001**
	Left side of the arch	100	14.48-26.52 (19.81)	

RH: Right-handed; LH: Left-handed; Mann-Whitney U test was used; * $p<0.05$.

dents, where only one implant area was scanned.²³ The reason of the different findings between the studies may be due to the difference between the scanned areas. Scanning the entire arch as performed in the present study may require more experience than scanning a single implant or a tooth.

In this study, the scanning time for the LH student and prosthodontist was found to be lower than the RH student and prosthodontist. Similarly, it was reported that left-handers were faster than right handers in hand skills.²⁶ This may be explained by the better orientation of left-handers.^{10,14,26} Besides, it was pointed out that the right and left-hand skills of left-handers are better than the right and left-hand skills of right-handers.²⁵

In the present study, the scanning time for both the RH and LH student was higher on the left quadrant. Similar findings were reported by Kapoor et al. where left quadrant was the most difficult to work for the LH students.¹¹ Contrary, Silva et al. showed that the LH students felt discomfort on the right quadrant of the phantom head in preclinical conditions and added that these results may not reflect the real difficulties of the dental procedures.¹⁷ The scanning time for the RH prosthodontists was higher on the right quadrant than the left quadrant; however, there was no difference between the quadrants for the LH prosthodontist. This finding again reflects a better right-and left-hand skills of left-handers.²⁶

There are limited number of clinical assessments that evaluated the relationship between the handedness and the quadrant.^{13,14} Orbak et al. showed that RH dentists were less successful on the calculus removal on the distal surface of the teeth, while there was only a slight difference between calculus removal of LH dentists on the distal and mesial surfaces of the teeth.¹⁴ According to the present study, there was no difference depending on the side of the quadrant in LH prosthodontist, similar to the findings of Orbak et al.¹⁴ On the other hand, Khan et al. claimed that handedness did not affect the probing depth measurements in the right and left quadrants.¹³ The different results may be caused by the evaluation of the different dental procedures.

The operators had no clinical experience with digital impression before the experiments, thus, the participants involved in the study got the basic education

including the whole CEREC procedure, following 20 training scans for calibration at the same session. The positions of the operators were selected as they were used to in previous dental treatments. Maxillary models which were adapted to a phantom head were used to mimic the clinical conditions. The scanning was also performed on models for the standardization by eliminating the difficulties and variations of clinical condition present in other studies.^{20,21} Therefore; swallowing, saliva, soft-tissue conditions or behavior of the patient that may affect the scanning time could be avoided entirely. The limitation of this study was that there was a single operator for each group. In future studies, the scanning time of digital impression technique may be evaluated on patients in clinical conditions, all quadrants may be included, and increased number of operators may be assessed.

CONCLUSION

The results suggest that LH dentists may have better skills than RH dentists regardless of time of experience. Students may need more training and experience to achieve the same level of proficiency as prosthodontists.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Güher Barut; **Design:** Zeynep Özkurt Kayahan, Guher Barut; **Control/Supervision:** Zeynep Özkurt Kayahan; **Data Collection and/or Processing:** Zeynep Özkurt Kayahan, Guher Barut; **Analysis and/or Interpretation:** Zeynep Özkurt Kayahan, Guher Barut; **Literature Review:** Burcu Bal; **Writing the Article:** Güher Barut; **Critical Review:** Güher Barut, Burcu Bal; **References and Fundings:** Güher Barut, Burcu Bal; **Materials:** Zeynep Özkurt Kayahan, Guher Barut, Burcu Bal.

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