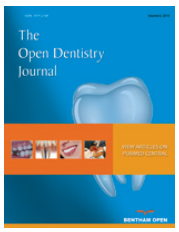

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RESEARCH ARTICLE

Conventional *vs*. Digital Impression: Comfort Level, Preferences, and Acceptance of Treatment Time among Orthodontic Patients

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Abstract:

Background:

The escalated technological development and the emergence of computer-aided manufacturing have improved dental restoration accuracy and the accurate manufacturing of prosthetic models.

Objective:

The study aims to assess patients' comfort level, preferences, and acceptance of treatment time for conventional impression technique *vs*. digital impression among orthodontic patients treated with clear aligners.

Methods:

A cross-sectional survey study was conducted between February 2019 and April 2019 by recruiting 50 patients from the orthodontic clinics at multiple centers. A self-administered questionnaire was designed to evaluate patients' perceptions in each impression technique group. Descriptive statistics and paired sample t-test were applied with statistical significance set at $P<0.05$.

Results:

The results showed that the impression technique bothered patients as they experienced helplessness during treatment. There was a significant impact on patients' perception of the treatment, whereas there was an insignificant association between comfort level and treatment of the patients.

Conclusion:

The technicalities of conventional impression were not applied to the intraoral scanners, making these scanners superior and more user-friendly. Digital impression techniques were also preferred by the participants regarding their time, taste/smell, and sensitivity.

Keywords: Conventional impression, Dentistry, Orthodontics, Time, Treatment process, Comfort.

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1. INTRODUCTION

The escalated technological development and the emergence of computer-aided manufacturing have improved dental restoration accuracy and the accurate manufacturing of prosthetic models [1]. Its growth has continued to propel since the 1980s when novel study models, such as intraoral scanners, have drastically increased among orthodontists. There is a considerable increase in intraoral scanners to obtain study models among orthodontists [2]. This technological breakthrough in dentistry has increased the digital impression efficiency, information storage capacity, and digital image transfer from the dental office to the laboratory [3].

Despite the increasing accuracy of digital impression technology, its full integration has not yet been achieved, given the conventional impression endurance [4, 5]. The conventional impression techniques encompass hydrocolloid and elastomeric materials, such as polyvinyl siloxane and polyether. The main factors that lead to the sustainment of the conventional impression technique are its accuracy, acceptance, and inexpensiveness [6]. Reflecting upon both techniques' execution time, the impression time using contemporary technology is shorter than the conventional impression approach [6]. Mangano *et al*. [7] stated that digital

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impression reduces the patients' discomfort and saves storage and time as no pouring of the stone cast is required.

Further advantages of the digital scanning systems are the option to easily transfer digital data to the dental technician *via* email, avoiding impression shipping to the laboratory, which results in better communication with the laboratory [8]. Impression in adolescents is obtained for diagnosis and treatment processes in orthodontics and pediatric dentistry through habit breaker fabrication, space maintainer, *etc* [9]. In impression taking, a digital revolution is now apparent in dentistry. As systems in this sector advance, a total transformation of the impression-taking method, regarded as the worst experience by patients and children, may be predicted [10].

Various studies have been conducted on the accuracy of the digital models for the scanner, while very few have addressed the patients' perception of it [11]. Moreover, these studies have reported divergent results regarding the patients' preference for conventional or digital impression techniques [10, 12, 13]. Furthermore, those studies did not consider other important factors, such as patient comfort, performance, efficiency, and cost, which disrupted the preference for digital and conventional impression techniques [1, 13]. The impression material used in previous studies was used for prosthetic and implant restorations, not for orthodontic treatment.

Digital impressions provide efficiency, attain captured information indefinitely, speed, and transfer digital images between the laboratory and dental office techniques [1, 13]. Also, most patients prefer digital impressions due to their efficiency in providing a comfortable experience [14]. Several studies on the accuracy of digital impressions and intraoral scanners have been published, which give discussions on full arch scans, several teeth in a row, quadrants, and single-unit restorations [15 - 17]. In their research, Burzynski *et al*. [18] compared and contrasted patient satisfaction and time required with two intraoral scanners and traditional alginate impressions. The findings revealed that respondents who received intraoral scans preferred digital impressions, whereas those who received alginate impressions were neutral, and that efficiency differed depending on the impression method. Yilmaz *et al*. [19] conducted a study to determine the impact of impression technique (conventional preliminary alginate and digital scan) and operator experience (experienced in digital and conventional, experienced in conventional and inexperienced in digital, and inexperienced in conventional and digital) on impression time, satisfaction, stress levels, and operator preference. The findings demonstrated a significant interaction between the operator's impression-making experience and the impression technique on time for maxillary and mandibular arch impressions and overall time (p 0.002). The combination between operator experience and impression method significantly impacted comfort and average VAS values (p 0.016). On the other hand, this interaction did not substantially affect stress (p 0.195).

A network meta-analysis was used to find statistical evidence on overall patient preferences for digital *vs*. traditional impression processes and the time it took to make these impressions. The time taken for 589 patients was reported in 11 trials (278-digital; 311 conventional). The 95 percent confidence range for the pooled estimate (2.72 [0.08, 5.32]) revealed a statistically significant increase in the time required to generate digital imprints. The overall time taken in minutes for the interventions in the digital group in decreasing order was as follows: LAVA Cos (8.14[3.64,12,26] (statistically significant); I tero (4.11[-1.02,9.24]; CEREC (0.34[-4.14,4.82]) [20]. A systematic review of the validity and reliability of intraoral scanners was conducted by Aragón *et al*. [21] in their study; they included four articles for qualitative synthesis and found that among them, only one of the studies evaluated the time required to complete the clinical procedures as well as taking patients' opinion about the treatment procedures. Thus, the study intended to assess patients' comfort level, preferences, and acceptance of treatment time for conventional impression technique *vs*. digital impressions among orthodontic patients. They have been receiving clear aligner treatment. Only a few studies have compared patient preference and comfort with both impression techniques, particularly among adult patients [22 - 25].

1.1. Hypothesis

H1: There is a significant difference in patients' comfort level, preferences, and acceptance of treatment time between the conventional and digital impression techniques.

H0: There is no significant difference in patients' comfort level, preferences, and acceptance of treatment time between the conventional and digital impression techniques.

2. MATERIALS AND METHODS

2.1. Study Design

The study adopted a cross-sectional survey design to compare patients' comfort level, preferences, and acceptance of treatment time with conventional impressions (group 1) and digital impressions (group 2). The study was conducted between February and April 2019.

2.2. Study Population and Sample

A total of 50 patients were recruited for the study using a convenience sampling technique from multiple centers, but the same operators performed the procedures. The sample consisted of adult orthodontic patients who attended clinics for the treatment with clear aligners. The sample size was calculated using the “Raosoft” sample size calculator. Initially, 60 patients were recruited. However, the questionnaire was returned only by 50 patients, which makes a response rate of 83.3%. Each group comprised equal sample size (*i.e*., 25 in each group).

2.3. Inclusion Criteria

The patients who had good oral health, oral hygiene, and no periodontal disease were included in the study. Patients who underwent impression for both impression techniques of group 1 and group 2 were included. Patients with previous impression experience or orthodontic treatment were excluded. Prosthetic restorations' presence also led to the exclusion of the patients.

2.4. Ethical Considerations

Before the commencement of the project, the study was approved by the Ethical committee at King Abdulaziz University, Faculty of Dentistry, Jeddah, Saudi Arabia [Ethical

No. 085-09-18]. Each participant signed the written consent, and the study was conducted following the principles of the Declaration of Helsinki.

2.5. Procedure

The appointment for digital impressions was scheduled for the same patients for 14-21 days while following the conventional impressions. The iTero Element® 2 system was used to perform the digital impressions (Align Technology, Inc., San Jose, CA, USA). The virtual models for bite registration and arches were recorded through intraoral digital scanning within the digital impression electronic data.

All digital scanning procedures were conducted following the guidelines of manufacturers. Moreover, these procedures were performed by the principal operator with experience of 7 years. The digital impression technique's clinical outcomes and effectiveness were assessed by measuring the total treatment time, which includes the following steps: upper/lower scan, laboratory prescription, entering patient information, and bite scan. A second operator with five years of experience recorded each step based on the treatment time calculated in seconds. The perceptions and attitudes of the subjects were evaluated immediately after the impressions were made using a standardized questionnaire towards the digital impression technique.

2.6. Study Instrument

The study used an anonymous, structured, and self-administered questionnaire to evaluate the patients' perception under the two impression techniques assessed, conventional polyvinyl siloxane impression and the digital impression iTero Element® 2 system with a scanner. The questionnaire constituted 31 questions, which were categorized into four primary sections. The first part of the questionnaire collected information about the patients' demographics. The second part concentrated on patients' comfort level with their treatment. It was further subdivided into two sections to assess their perception during the impression of the lower and upper jaw impression. The questions were based on a 5-point Likert scale (from 1 strongly agree to 5 strongly disagree) [22]. The third section of the questionnaire inquired about the patients' preference for the used impression technique. The fourth section was designed to assess the patients' acceptance of the treatment time, which was utilized to take the impression.

Subsequently, the questionnaire was piloted on ten patients to determine the time required and readability. For appropriate wording and validity of the study instrument, it was reviewed by two experienced orthodontists. Along with it, the Cronbach Alpha value was also calculated to determine the reliability of the items that were included in the questionnaire.

2.7. Data Collection

Before the investigation, a brief explanation of the project and its main objectives were provided to the participants. Participants were then asked to complete the three parts of the questionnaire. In case of any ambiguity, the participants were guided by the researcher.

2.8. Data Analysis

Data were entered into the Statistical Package for the Social Sciences (SPSS) 22.00 for Windows (I.B.M. Corporation, Armonk, NY, USA). Descriptive statistics and Paired sample tests were applied with a statistical significance set at $P< 0.05$. Cross-tabulation or contingency tables were prepared to evaluate comfort level and preference for an upper jaw impression. Chi-square statistics were used to determine the p-values for contingency tables.

3. RESULTS

Before the questionnaire dissemination, its items were assessed for reliability through Cronbach Alpha coefficients. The value achieved for the 31 items was 0.967, indicating its increased reliability (Table **1**).

The baseline characteristics of the participants are demonstrated in Table **2**. Based on the table, it was found that the majority of the participants, 48(96%), were Saudi, whereas only 2(4%) participants were non-Saudi. The residing city for most of the participants was Riyadh 47(94%), while the remaining 3(6%) participants belonged to other cities in the country. Responses also indicate that most of the patients, 17(34%), were aged between 23- 27 years and 28-32 years 12(24%).

Table 1. Questionnaire reliability.

Cronbach's Alpha	No. of Items
0.967	31

Table 2. Baseline characteristics.

-	Variables	N (%)
Nationality	Saudi	48 (96)
	Non-Saudi	2 (4)
City	Riyadh	47 (94)
	Other	3 (6)
Age	18-22 years	5 (10)
	23-27 years	17 (34)
	28-32 years	12 (24)
	33-37 years	9 (18)
	38 and above	7 (14)
Gender	Male	21 (42)
	Female	29 (58)

(Table 2) contd.....

-	Variables	N (%)
Marital status	Single	12 (24)
	Married	33 (66)
	Divorced	4 (8)
	Widow	1 (2)
Education	High school and below	6 (12)
	University	37 (74)
	Bachelor and above	7 (14)
Employment	Employed	35 (70)
	Not employed	15 (30)
Impression technique	Conventional Polyvinyl Siloxane impression (Group 1)	25 (50)
	Digital impression with scanner (Group 2)	25 (50)

Concerning the gender of the participants, females constituted 29 (58%) of the sample while males were 21(42%). Most of the patients were married, 33 (66%), while only 1 (2%) was a widow. Most of the participants, 37(74%), were university students, and 35 (70%) of the participants were employed.

Table **3** presents the patients' responses regarding the treatment level based on their impression method. 17(34%) of the group 2 participants indicated that the treatment method bothered patients, whereas 12(24%) of group 1 participants agreed with the following statement (P-value: 0.426). Both groups firmly decided on the shortness of breath, respectively, with 21(42%) participants in each (P-value: 0.442) (Table **3**). The feeling of being anxious was reported by 19(38%) of the group 2 participants and 21(42%) participants from group 1 (P-value: 0.274). Both groups agreed that they experienced a feeling of helplessness during their treatment, with the values of 15(26%) in patients in group 2 and 19(38%) in patients from group 1 (P-value: 0.983).

Table **3** also presents the patients' perceptions of their impression of the lower jaw. It exhibits that gag reflex was experienced majorly by group 1 participants, 20(40%), and only 17(34%) participants from group 2 had a similar experience; however, no difference in gag reflex experience was found among the two groups, which was found to be statistically non-significant (P-value: 0.088). The effect of the impression technique on breathing was neutrally reported by participants in both groups, while the comfort level was neutral for both groups. Unbiased answers were written for queasiness, where most of group 2 reported its occurrence.

Perception of the impression of the upper jaw is also depicted in Table **3**. Based on the results, it was found that gag reflex was almost neutral for the participants in both the groups, 17(34%) in group 1 and 15(30%) in group 2 (P-value: 0.729). 25(50%) participants from group 2 and 18(36%) participants from group 1 did not feel queasiness (P-value: 0.106). During the upper jaw impression, participants of both groups experienced difficulty in breathing. Only 16(32%) from group 2 and 20(40%) from group 1 reported ease in breathing (P-value: 0.319). The comfort level during the treatment was found to be higher in digital impression patients 23(46%) than patients in group 119(38%) (P-value: 0.436).

Table 3. Comfort level.

Survey Question	Options	Group 1 n=25(%)	Group 2 n=25(%)	P-value
General				
The impression-making procedure bothered me	Strongly Agree - Agree	12 (24)	17 (34)	0.426
	Neutral	29 (58)	25 (50)	
	Disagree - Strongly Disagree	9 (18)	8 (16)	
Impression making made me feel unpleasantly short of breath	Strongly Agree - Agree	21 (42)	21 (42)	0.442
	Neutral	23 (46)	23 (46)	
	Disagree - Strongly Disagree	6 (12)	6 (12)	
I am anxious about having to undergo the impression procedure again	Strongly Agree - Agree	21 (42)	19 (38)	0.274
	Neutral	23 (46)	24 (48)	
	Disagree - Strongly Disagree	6 (12)	7 (14)	
During the impression procedure, I experienced a feeling of helplessness	Strongly Agree - Agree	19 (38)	15 (26)	0.983
	Neutral	21 (42)	26 (52)	
	Disagree - Strongly Disagree	10 (20)	9 (18)	
I had no stress about the appointment	Strongly Agree - Agree	18 (36)	21 (42)	0.232
	Neutral	25 (50)	21 (42)	
	Disagree - Strongly Disagree	7 (14)	8 (16)	

(Table 3) contd.....

Survey Question	Options	Group 1 n=25(%)	Group 2 n=25(%)	P-value
The appointment for the impression did not last long	Strongly Agree - Agree	19 (38)	15 (28)	0.980
	Neutral	28 (56)	28 (56)	
	Disagree - Strongly Disagree	7 (14)	7 (14)	
For the upper jaw impression procedure				
I did not have a gag reflex	Strongly Agree - Agree	15 (30)	17 (34)	0.729
	Neutral	30 (60)	26 (52)	
	Disagree - Strongly Disagree	5 (10)	7 (14)	
I did not feel any queasiness	Strongly Agree - Agree	18 (36)	25 (50)	0.106
	Neutral	25 (50)	17 (34)	
	Disagree - Strongly Disagree	7 (14)	8 (16)	
I could easily breathe	Strongly Agree - Agree	20 (40)	16 (32)	0.319
	Neutral	19 (38)	24 (48)	
	Disagree - Strongly Disagree	11 (22)	10 (20)	
I had a comfortable feeling	Strongly Agree - Agree	19 (38)	23 (46)	0.436
	Neutral	26 (52)	20 (40)	
	Disagree - Strongly Disagree	5 (10)	7 (14)	
For the lower jaw impression procedure				
I did not have a gag reflex	Strongly Agree - Agree	20 (40)	17 (34)	0.088
	Neutral	19 (38)	25 (50)	
	Disagree - Strongly Disagree	11 (22)	8 (16)	
I did not feel any queasiness	Strongly Agree - Agree	17 (34)	11 (22)	0.516
	Neutral	25 (50)	27 (54)	
	Disagree - Strongly Disagree	8 (16)	12 (24)	
I could easily breathe	Strongly Agree - Agree	14 (28)	17 (34)	0.198
	Neutral	30 (60)	20 (40)	
	Disagree - Strongly Disagree	6 (12)	13 (26)	
I had a comfortable feeling	Strongly Agree - Agree	16 (32)	19 (38)	0.847
	Neutral	28 (56)	24 (48)	
	Disagree - Strongly Disagree	6 (12)	7 (14)	

3.1. Differences in Comfort Level and Perception of Impression of Upper Jaw between Groups 1 and 2

Table **4** presents the differences between the groups concerning treatment-based comfort levels through T-test statistics. It exhibits that the association between the two was statistically non-significant (P-value: 0.145), indicating no effective treatment for the patients. The mean comfort level for group 1 was 1.784, whereas for group 2, it was 1.79. The standard deviation was the same for both the groups, with SD being 0.687 for group 1 and SD being 0.686 for group 2.

Table 4. T-test of comfort level with regard to the treatment of the patient.

	Mean	Standard Deviation	P-value
Group 1	1.784	0.687	0.145
Group 2	1.79	0.686	

Table 5. T-test of perception of the impression of the upper jaw.

	Mean	Standard Deviation	P-value
Group 1	1.78	0.674	0.556
Group 2	1.75	0.711	

Table **5** presents the differences in perception of the impression of the upper jaw between group 1 and group 2. The mean for upper-level impression for group 1 was 1.78. Whereas for group 2, it was found to be 1.75. The significant results were not attained (P-value 0.556), which indicated the differences in patients' perception or impression of the upper jaw between groups 1 and 2.

3.2. Differences in Perception of Impression of Lower Jaw between Group 1 and 2

Table **6** presents the differences in perception of the impression of lower jaw treatment between conventional and digital impressions. The mean of 1.84 was found for group 1, while it was 1.86 for group 2 (P-value: 0.765), pointing towards its insignificant impact on the treatment of the patients.

Table 6. T-test of perception of the impression of the lower jaw.

-	Mean	Standard Deviation	P-value
Conventional group	1.84	0.720	0.765
Digital group	1.86	0.670	

3.3. Differences in Comfort Level between Group 1 and 2

Table **7** shows the preference of the patients concerning the two impression methods. The comparison among the two groups was made with respect to the preference of impression

method for treatment purposes. The study found that in both groups, a statistically significant difference was found (P-value: <0.05). Similarly, an increased number of participants, 16(64%), were more comfortable with treatment through digital impression techniques than the conventional method 8(32%) from the conventional group. However, considering group 2, 19(76%) preferred digital impression techniques, and only 6(24%) were comfortable with conventional polyvinyl siloxane impression; therefore, statistically significant difference was observed in the two groups (P-value: <0.001).

Considering referral to a friend in need of impression taking, from group 1, 18(72%) participants stated they suggested the digital impression technique, whereas 19(76%) participants in the digital impression group suggested digital impression with a scanner in comparison to 7(28%) from group 1 and 5(20%) from group 2 who recommended impression with polyvinyl siloxane impression (polyvinyl siloxane, 3M ESPE, Dental Products, St. Paul, MN, USA) (P-value: >0.001). When asked about their suggestion for treatment in case of treatment repetition, 22(88%) from group 2 showed an inclination toward the digital impression (iTero Element 2 system with a scanner (Align Technology, Inc., San Jose, CA, USA)) and 20(80%) from group 1 preferred next time impression scanning through a digital scanner with highly significant P-value <0.001.

The study compared the preference of impression technique for some conditions, including tooth/gingival sensitivity, difficulty in breathing during treatment, or experience of gagging reflex during treatment, and again the statistically significant difference was observed between the two groups (P-value: <0.001).

Considering the time significance involved in the impression technique, both groups were convinced to opt for the digital impression technique, with 19(76%) from group 2 and 17(68%) from group 1 being inclined towards the digital impression technique (P-value: <0.001). To attain a better feeling of taste/smell, voice/heat during the treatment, and get a better intraoral scanner/impression on a tray, again when two groups were compared, the study found a significant difference in both the groups (P-value: <0.001).

Table 7. Preference for impression method.

Items	Impression Technique	Group 1 n=25 N (%)	Group 2 n=25 N (%)	P-value
Which impression method do you prefer?	Conventional Polyvinyl Siloxane	10 (40)	7 (28)	>0.001
	Digital impression with a scanner	13 (52)	17 (68)	
	No preference	2 (8)	1 (4)	
Which impression technique is more comfortable?	Conventional Polyvinyl Siloxane	8 (32)	6 (24)	<0.001
	Digital impression with a scanner	16 (64)	19 (76)	
	No preference	1 (4)	0 (0)	
Which impression technique do you suggest to a friend who needs impression taking?	Conventional Polyvinyl Siloxane	7 (28)	5 (20)	>0.001
	Digital impression with a scanner	18 (72)	19 (76)	
	No preference	0 (0)	1 (4)	
Which impression technique do you prefer if repetition of the impression procedure is required?	Conventional Polyvinyl Siloxane	4 (16)	3 (12)	<0.001
	Digital impression with a scanner	20 (80)	22 (88)	
	No preference	1 (4)	0 (0)	
Which impression technique do you prefer if having tooth/ gingival sensitivity during impression procedure?	Conventional Polyvinyl Siloxane	3 (12)	2 (8)	<0.001
	Digital impression with a scanner	21 (84)	23 (92)	
	No preference	1 (4)	0 (0)	
Which impression technique do you prefer if having difficulty in breathing during the impression procedure?	Conventional Polyvinyl Siloxane	6 (24)	5 (20)	<0.001
	Digital impression with a scanner	19 (76)	20 (80)	
	No preference	0 (0)	0 (0)	
Which impression technique do you prefer if having gagging reflex during the impression procedure?	Conventional Polyvinyl Siloxane	8 (32)	6 (24)	<0.001
	Digital impression with a scanner	15 (60)	17 (68)	
	No preference	2 (8)	2 (8)	
Which impression technique do you prefer for having better time involved with impression procedure	Conventional Polyvinyl Siloxane	5 (20)	4 (26)	<0.001
	Digital impression with a scanner	17 (68)	19 (76)	
	No preference	3 (12)	2 (8)	
Which impression technique do you prefer for having better feeling taste/smell or voice/heat during the impression procedure?	Conventional Polyvinyl Siloxane	6 (24)	5 (20)	<0.001
	Digital impression with a scanner	16 (64)	19 (76)	
	No preference	3 (12)	1 (4)	
Which impression technique do you prefer for having better the size of the intraoral scanner/impression tray used in your mouth during the impression procedure?	Conventional Polyvinyl Siloxane	7 (28)	6 (24)	<0.001

4. DISCUSSION

The baseline characteristics concerning orthodontic care have depicted that most of the patients were in their early teenage [23]. A study has shown that 41% of dental clinicians use digital models as diagnostic records [26]. Simultaneously, their research emphasized the significance of "CAD/CAM – computer-aided design/computer-aided manufacturing" technology, as it gives enhanced results and abridged functioning time, from impression to framework. It serves as an opportunity for dentists to design, milling, and do ceramics restoration in a single sitting, which ultimately improves patient acceptance, attains patient satisfaction through positive feedback, and eventually augments clinical outcome and reliability. This technology has enumerated a persistent increase in practice in many fields of dentistry, such as pediatric dentistry, prosthodontics, conservative dentistry, orthodontics, *etc*. The ultimate bond strength to CAD/CAM material for both resin cements is eventually dependent on the method used for surface treatment, constituents of CAD/CAM or resin cements, structure of different CAD/CAM blocks and impact of surface treatment on other materials due to material based special effects [24].

However, six years have been recorded for the downward trend in casts made from conventional impressions [26]. Contemporary orthodontics are interested in knowing the patients' perceptions of conventional and digital impression procedures. The technicalities of the conventional impression are not likely to be applied to the intraoral scanners, which makes these scanners superior and more user-friendly. Results of the present study have shown that digital impression techniques are preferred by the participants in terms of their time, taste/smell, and sensitivity. These findings were consistent with the previous studies where participants preferred the digital scan and reported minor inconvenience [1, 16, 27 - 29].

The carryover effects occurred when the impressions were taken at the first visit. For this purpose, a washout period is needed between the appointments for at least four weeks. A similar study conducted by Burhardt *et al*. [23] showed an insignificant difference between the conventional and digital impressions; however, the digital methods were more favored. A study conducted by Syrek *et al*. [15] stated that most patients preferred alginate impression methods because it was faster and much easier. Similarly, an intraoral scanner was selected by 27% of the respondents because it was more comfortable. This aspect can be explained by the time required for average chairside time for the alginate impressions [23]. However, the present study has used polyvinyl siloxane impression (polyvinyl siloxane, 3M ESPE, Dental Products, St. Paul, MN, USA) as a conventional impression and not with alginate. The participants preferred the conventional impression procedure rather than the digital one, which was based on the patients' perceptions.

The conventional impression procedure is preferred over the digital one, for instance, Lava C.O.S. "Lava C.O.S., 3M ESPE, St. Paul, MN, USA", being a digital impression procedure, which would require three separate scans to determine the interocclusal relationship. On the contrary, the conventional procedure would only require a single scan [23]. The heterogeneity of the involved factors makes it difficult to compare the registered chairside times with similar studies. These factors include variation in digital processing methods of acquired impression, operator's experience, and different impression methods [17, 29]. In most cases, 3-dimensional models are acquired, such as the placement of cheek extractors or patient tutorials. The Likert scores were distributed in both directions in each impression technique, regardless of the real chairside time in minutes.

The increased level of expectation among the patients is associated with a decreased tolerance level for the time required for the conventional method rather than a new impression method. The present study has a limitation as it has not reported any relationship between larger mouth opening and better accessibility of the handpieces within the oral cavity. However, the present study has compared the conventional and digital impression methods requiring scanning power to obtain the shortest intraoral scanning time. Previous studies have contradicted the claims made by the manufacturer regarding the superiority of no-powder scanning based on arbitrary assumptions [17, 20 - 30]. The polyvinyl siloxane scores were high compared to the digital impressions after summing the total perceptions scores for breathing difficulty, gag reflex, uncomfortable feeling, and queasiness. However, the study has failed to directly compare its results with the previous studies due to the differentiation in the perception results by the jaw. CAD/CAM technology allows a completely digital workflow, from impression to final framework for interceptive and multi-brackets orthodontic treatments [31 - 33].

This study only collected data from 50 adult orthodontic patients using a convenience sampling method. The inclusion of the purposive sampling method can help recruit patients to obtain pre-clinical and didactic instructions related to conventional and digital impressions. The current study has a limitation in that it only tested patient's perceptions and preferences over a short period with a limited sample size; however, future studies are needed to evaluate further mechanical characteristics to analyze and estimate tested materials' behavior thoroughly and can be helpful if future studies extend the period to understand the comfort level, preferences, and acceptance of treatment time on a larger sample. Moreover, patient counseling over the adopted technique by the clinician could also play a significant role in selecting an appropriate technique that could be more beneficial to the patient.

CONCLUSION

The present study has compared the perceptions and patient preferences for conventional impressions *vs*. digital impressions among the orthodontic patients receiving polyvinyl siloxane and digital impressions. It has been shown that treatment methods bothered patients as they experienced helplessness during their treatment. An insignificant association between comfort level and treatment of the patients was found. At the same time, there was a significant impact on patients' perception of the treatment provided. It has been concluded that the digital impression technique was accepted

as the preferred and effective technique, according to the subjects' perception, as compared to the conventional impression technique, and irreversible materials like “polyvinyl siloxane impressions” can be altered through a paradigm shift toward digital intraoral scanners. However, future studies need to conduct well-designed research to depict patients' experiences with digital impressions.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Ethical committee at King Abdulaziz University, Faculty of Dentistry, Jeddah, Saudi Arabia (Ethical No. 085-09-18).

HUMAN AND ANIMAL RIGHTS

No animals were used that are the basis of this study. The study was conducted following the principles of the Declaration of Helsinki.

CONSENT FOR PUBLICATION

Each participant signed the written consent.

STANDARDS OF REPORTING

STROBE guidelines have been followed.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated and/or analyzed during the current study are not publicly available due to limitations of ethical approval involving the patient data and anonymity. Still, they are available from the corresponding author on [H.A.B] reasonable request.

FUNDING

Any resource did not fund this research.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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