

TELEDENTISTRY: KNOWLEDGE, AWARENESS, AND ATTITUDE AMONG UNDERGRADUATE, GRADUATE AND POSTGRADUATE DENTAL STUDENTS

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ABSTRACT

Background: The usage of information technology and telecommunications for dental care is known as Teledentistry. This study aimed to assess the knowledge, awareness, and attitude of teledentistry among undergraduate, graduate, and postgraduate dental students in Riyadh City, Saudi Arabia.

Materials and Methods: This cross-sectional study was conducted among undergraduates, graduates, and postgraduate dental students. A Structured, self-administered, and close-ended questionnaire was administered to dental students (n=240). The knowledge, awareness, and attitude towards teledentistry were assessed using a 19 items questionnaire with yes/no responses. Descriptive statistics and Chi-square tests were applied to the data. Statistical significance was determined at p-value <0.05.

Results: A total of 240 dental students completed the survey. About 92.3% of postgraduates, 44.5% of undergraduates, and 69.2% of graduates responded to the statement "Can teledentistry be applied in any branch of dentistry? This was statistically significant (P<0.001). About 33.3% of dental students were aware that "teledentistry is practiced in Saudi Arabia; however, 66.6% of the participants disagreed, and the majority (74.5%) of them were undergraduates. About 84.6% of postgraduates and 76.9% of graduates showed interest in teledentistry training (P=0.001).

Conclusion: Postgraduate and graduate dental students demonstrated higher knowledge, awareness, and attitudes towards teledentistry than undergraduate dental students.

Key words: Teledentistry, dental students, graduates, postgraduates, Saudi Arabia.

Introduction

The health care sector has been changing with the advent of new technology and telecommunication in medicine and dentistry. The introduction of teledentistry in dentistry is an exciting new era that serves the rural and underserved populations ¹⁻⁴. Similar to telehealth and telemedicine, teledentistry uses information technology and telecommunications for dental care, consultation, education, and public awareness. It uses electronic health records, digital imaging, and the Internet to link health care providers in rural or remote communities to enhance communication, the exchange of health information, and access to care for underserved patients, including socially disadvantaged people, and those who live in remote or rural areas ^{5,6}.

Teledentistry has the potential to eliminate the disparities in oral healthcare between rural and urban communities. Teleconsultation through teledentistry can occur in either the following ways – "Real-Time Consultation" and "Store-and-Forward Method." In Real-Time consultation, a

videoconference helps dental professionals and their patients communicate with one another at different locations. In the Store-and-Forward Method, clinical information is exchanged, static images are collected and stored by the dental practitioner. Afterwards, they are sent by the practitioner for consultation and treatment planning. During the "consultation", the patient is not present. ⁷

Teledentistry has more benefits for patients, which includes reduced costs of dental care, specialist support, decrease in travel time for patients and their families, reduced inappropriate referrals to specialists, fastness and efficiency, dental education and dental hygiene instructions, suitable during emergencies, useful for dental hygiene instructions comfort and convenient for the patient's who are at farthest distances, where there is no skilled person available. ⁸

Many studies on teledentistry were conducted in more than fifteen countries, and the most massive numbers were from the USA and India. ⁹⁻¹³ In contrast, minimal studies were published about teledentistry in Saudi Arabia. In one study

in Saudi Arabia, which was conducted on the perceptions of teledentistry among dental professionals, it was reported that the majority (71.2 percent) of the dental students displayed a strong interest in teledentistry instruction. However, the total awareness regarding teledentistry was stated quite limited.¹⁴

To integrate the expertise and practice of teledentistry into dentists' future generation, it is essential to determine current dental students' knowledge, understanding, and attitudes. Therefore, the present study aimed to assess the knowledge, awareness, and attitude of undergraduates, graduates, and postgraduate about teledentistry in Riyadh, Kingdom of Saudi Arabia.

Material and Methods:

Study design

A cross-sectional study was conducted among 240 undergraduates, graduates, and postgraduate dental students from Riyadh Elm University, Riyadh, Saudi Arabia, between January to June 2020.

Inclusion and exclusion criteria

The study included those dental students who were willing to participate and excluded those students not willing to participate and with incomplete data.

Ethical statement

The study participants were informed about the research's purpose and objective, and informed consent was obtained. The study was registered with the research center of Riyadh Elm University with registration number "FUGRP/2020/139/76". The ethical clearance was obtained from the Institutional Review Board of REU with IRB approval number "FUGRP/2020139/76/78".

Validity and reliability

All the questionnaire items were derived after a careful literature review on the topic. A pilot study was conducted to test the validity and reliability of the questionnaire. The study instrument was designed in Arabic and English languages distributed to the thirty dental students willing to participate. The face validity of the questionnaire was established by taking an expert's opinion. Simultaneously, the Cronbach's coefficient was 0.80, which showed the adequate reliability of the questionnaire.

Data collection

A structured, self-administered, and close-ended questionnaire written in English and Arabic was distributed

to 240 dental students from Riyadh Elm University. The questionnaire comprised of 19 closed-ended questions with yes/no responses divided into four sections. The first section included details of the socio-demographic data of the participants. The second section included nine items that assess the knowledge-based questions about teledentistry. The third section included seven items that assess awareness-based questions, and section four included three items for attitude-based questions (Table 1).

Data Analysis

The collected data was analyzed using SPSS version 23.0 (IBM Inc., Chicago, IL, USA). Descriptive frequencies and Chi-square test was used for intergroup comparisons. The confidence interval was set at 95%, and statistical significance was set at p-value <0.05.

Results

In the present study, a total of 270 questionnaires were distributed to the study participants. However, 30 students did not complete the questionnaire due to time constraints, and thereby a final response rate of 90.5% was obtained.

A total of 240 dental students completed the questionnaire, including 110 undergraduates, 65 graduates, and 65 postgraduates. Demographic data showed that most of the participants were females 121 [50.4%) than males 119 (49.6%). The age groups of participants were between 18-38 years. About 55.8 % were aged 18-24 years, 27.5 % were aged between 25-31 years, and 16.3% were aged 32 to 38 years. The majority of the dental students were undergraduates 110 (45.8%), compared to 65 (27.1%) graduates and 65(27.1%) postgraduates (**Table 2**).

Knowledge of teledentistry among undergraduate, graduate, and postgraduate dental students

About 96.9% of postgraduates, 79.1% undergraduates, and 92.3% of graduates heard about teledentistry. The Internet was the primary source of knowledge to 52.7 % of undergraduates and 43.1% of postgraduates. About 92% of the participants agreed that the practice of teledentistry could be done using computers, videoconferences, smartphones, and telecommunications. About 92.3% of postgraduates, 44.5% of undergraduates, and 69.2% of graduates agreed that teledentistry could be applied to any dentistry branch, and this was found statistically significant (p<0.001). Around 96.9% of postgraduates, 80.9% undergraduates, and 92.3% of graduates agreed that teledentistry could be used for patient oral hygiene education and early caries prevention (p=0.033) (**Table 3**).

Awareness of teledentistry among undergraduate, graduate, and postgraduate dental students

Nearly 60.9% of undergraduates, 78.5% of graduates, and 87.7% of postgraduates were aware that teledentistry could provide dental advice and treatment to patients living in rural and urban areas with a statistically significant difference ($p < 0.001$). About 90.8% of postgraduates, 73.8% of graduates, and 65.5% of undergraduates were aware that teledentistry is not a direct face-to-face interaction of patients ($p = 0.001$). Almost 70.9% of undergraduates, 84.6% of graduates, and 89.2% of postgraduates agreed that teledentistry saves time for the dentist & the patient ($p = 0.007$). Moreover, 67.3% of undergraduates, 69.2% of graduates, and 84.6% of postgraduates were aware that teledentistry could be cost-effective for the patient ($p = 0.036$). When enquired about the practice of teledentistry in Saudi Arabia, 25.5% of undergraduates, 40% of graduates, and 40% of postgraduates responded positively with no statistically significant difference ($p = 0.059$). However, no significant difference was observed among the study participants regarding the item that the dentist should have good knowledge of computers, smartphones to use teledentistry ($p = 0.196$), and insufficient equipment as a barrier for teledentistry ($p = 0.483$) (**Table 4**).

The attitude of teledentistry among undergraduate, graduate, and postgraduate dental students

More than half, 60.9% of undergraduates, 72.3% of graduates, and 76.9% of postgraduates were agreed to practice teledentistry in the future ($p = 0.063$). While 82.7% of undergraduates, 86.2% of graduates, and 95.4% of postgraduates agreed that teledentistry should be made aware to all dental students and dentists through CDE programs and workshops ($p = 0.053$). Almost 60% of undergraduates, 76.9% of graduates, and 84.6% of postgraduates were interested in participating in teledentistry training in the future ($p = 0.001$) (**Table 5**).

Discussion

The 1994 military project of the United States Army (US Army's Total Dental Access Project) can be linked to the origin of teledentistry as a subspecialist field of telemedicine. This aimed to improve patient care, dental education, and effective communication between dentists and dental laboratories. In Teledentistry, it's seen that dental professionals could consult each other even at large distances and in remote rural areas.¹⁰ Minimal data were available about the field of teledentistry in Saudi Arabia. Hence, the present study was undertaken to fill this gap. This particular study explored and assessed the knowledge,

attitude, and practice of teledentistry among undergraduate, graduate, and postgraduate dental students at Saudi University.

The present study revealed that 87.5% of the participants agreed that they heard about teledentistry, which is in line with a study reported by Balsaraf SV et al. (2015)¹¹, who showed around 85% of practicing dentists were aware of teledentistry. However, another study showed that 33% of dentists were aware of teledentistry.¹²

The Internet is the basis for the modern system of teledentistry, being up-to-date and fast, and transporting large amounts of data. All new systems of teledentistry are Internet-based, with all kinds of distant consultation.¹⁰ In the present study internet was the primary source of knowledge about teledentistry to 50.8% of the participants. However, 27.91% of the participants had reported that they heard of teledentistry through their doctors.

In the current study, 64.1% of the participants agreed that teledentistry could be applied in any dentistry branch, which is in line with the previously reported study.¹¹ Majority of the postgraduates (92.3%) compared to undergraduates (44.5%) and graduates (69.2%) agreed that teledentistry could be applied in any branch of dentistry, which is a contrary finding to another study,¹³ Which showed a lesser number of postgraduates (46.8%) agreed to it.

Alabdullah et al. (2018)¹⁴ reported that teledentistry provides oral care, consultation, education, and public awareness by using electronic medical records, videoconferences, and digital images of patients living in isolated and distant places. Knowledge of technology application is an essential aspect of teledentistry, which will become a barrier for dentists if not trained in it. The present study showed that most (92.08%) of the participants agreed that teledentistry uses computers, the Internet, and smartphones to diagnose and advise treatment without the patient's presence in the clinic. Almost 95.4% of postgraduates and 89.1% of undergraduates agreed to use computers, the Internet, and smartphones to diagnose and advise treatment through teledentistry. This finding is similar to the study reported by Pradhan et al. in 2019¹⁵ which was agreed by 96.2% of postgraduates but contradictory to an Indian study¹⁶ in which only 88.6% of the dentists responded positively.

Tele-education instructs rural patients about oral health and oral hygiene.¹⁷ In the present study, it was found that 88.3% of the participants agreed that teledentistry helps to educate the patient about oral hygiene and prevention of early

carious lesions. The majority of the postgraduates (96.9%), graduates (92.3%), and undergraduates (80.9%) agreed with the statement, which is in line with a study reported by Boring et al. (2015),¹⁸ however it contradicts the studies reported from India,¹⁹ where only 70% of the postgraduates expressed their concern.

In the present study, the knowledge of teledentistry was low among undergraduates (79.1%) compared to both the postgraduates (96.9%) and graduates (92.3%). This finding is similar to the previously reported studies by various authors.^{13, 15, 16} However, our study findings contradict the studies reported by Boring et al.¹⁷ and Sen et al.¹⁹ in which postgraduates demonstrated a lower level of knowledge than the undergraduates.

In a study by Singh et al., 2017¹⁹ 43% of postgraduates and 40% of undergraduates were aware of the fact that teledentistry is not a face to face interview with patients, which is in contrast to the present study, in which 90.8% of postgraduates and 65.5% undergraduates were aware of it. About 33.3% of dental students agreed that teledentistry is practiced in Saudi Arabia, and 66.6% of respondents negatively. Amongst the students, 74.5% of undergraduates and 60% of postgraduates were unaware of teledentistry.

Nagarajappa et al., 2013,¹⁶ pointed out that 60% and 38% of the study participants disagreed that teledentistry saves time and is cost-effective. This report contradicts our study, where 79.5% and 72.2% of the participants agreed that teledentistry saves time and is cost-effective. The current finding is almost in line with the previously reported study in which 79.6% and 69% of the participants agreed that teledentistry saves time and is cost-effective.²⁰

About 68.3% of dental students in our study agreed to practice teledentistry in the future. While only 39.3% of the dentists agreed to practice teledentistry in a study reported by Latif et al. in 2016.²¹

Teledentistry training of oral health professionals has increased the knowledge of the subject. Dental schools can play an essential role in preparing health professionals in the use of teledentistry. In this study, most dental students (71.2%) showed interest in the teledentistry training program. However, about (40%) of undergraduates were least interested in teledentistry training in the future.²²

In this study, postgraduates and graduates compared to the undergraduates demonstrated good knowledge, awareness,

and attitude about teledentistry. Our results are in line with previously reported studies by various authors.^{13, 15, 16, 18, 19}

Strengths and Limitations

Many studies were carried out on teledentistry in other parts of the world, but minimal studies were reported in Saudi Arabia among dental students. Therefore, this study was the first of its kind in Saudi Arabia, which targeted the undergraduates, graduates, and postgraduate dental students to assess their knowledge, awareness, and attitude toward teledentistry. This study is an institution-based study targeted at a single private university and is not representative of the whole dental professionals in Saudi Arabia. Therefore, further studies should be carried out in multiple universities and locations involving many dental students and practitioners of Saudi Arabia.

Conclusion

Overall, the knowledge and awareness of dental students were fair. However, the attitude of undergraduates is low, compared to postgraduates and graduates. In the present study, postgraduate and graduate dental students have more knowledge, awareness, and a positive attitude towards teledentistry than undergraduate dental students. The lack of knowledge, awareness, and poor attitude among undergraduate dental students is due to a lack of formal training programs and unwillingness to adapt to the new dental practice strategies. Hence there is a need to implement teledentistry-related continuous dental education programs and workshops in the dental schools of Saudi Arabia.

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Table 1: Questionnaire items and their responses

Item. No	Questions	Response
Item 1	Have you heard about Teledentistry?	Yes, No
Item 2	From where you heard about Teledentistry?	Yes, No
Item 3	Do you think Teledentistry is the practice of using computers, internet telecommunication, and smartphones to diagnose and advise treatment without the patient's presence in the clinic?	Yes, No
Item 4	Can Teledentistry be applied to any branches of dentistry?	Yes, No
Item 5	Can Teledentistry help to educate patients about oral hygiene?	Yes, No
Item 6	Can Teledentistry prevent early carious lesions by instructions through videoconferences smartphones and telecommunications?	Yes, No
Item 7	Do you think Teledentistry can help to consult patient's problems with specialists or dentists without the patient?	Yes, No
Item 8	Can Teledentistry increase the accessibility of specialists to rural, underserved communities?	Yes, No
Item 9	Do you think Teledentistry is a good tool for patient emergencies in distant places?	Yes, No
Item 10	Are you aware that Teledentistry provides diagnosis and advice about dental treatment to the patient in rural and urban areas?	Yes, No
Item 11	Are you aware that Teledentistry is not a direct face to face dental treatment of the patient?	Yes, No
Item 12	Teledentistry can save time for the dentist & the patient	Yes, No
Item 13	Are you aware that Teledentistry can be cost-effective for the patient?	Yes, No
Item 14	Are you aware of whether Teledentistry is practiced in Saudi Arabia or not?	Yes, No
Item 15	Are you aware that the dentist should have good knowledge of computers, smartphones to use Teledentistry?	Yes, No
Item 16	Are you aware that not having sufficient equipment is a barrier to Teledentistry?	Yes, No
Item 17	In the future, will you practice Teledentistry?	Yes, No
Item 18	Do you think that Teledentistry should be made aware of all dental students and dentists through CDE programs and workshops?	Yes, No
Item 19	Are you interested in participating in teledentistry training in the future?	Yes, No

Table 2. Demographic details of study participants (n=240)

Category		n	%
Age (years)	18-24	134	55.8
	25-31	66	27.5
	32-38	39	16.3
	> 38	1	.4
	Total	240	100.0
Gender	Male	119	49.6
	Female	121	50.4
	Total	240	100.0
Education level	Under Graduate	110	45.8
	Intern / Graduate	65	27.1
	Post Graduate	65	27.1
	Total	240	100.0

Table 3. Knowledge of Teledentistry among undergraduate, graduate, and postgraduate dental students

Items	Responses	UG		I/G		PG		χ^2	p-value
		N	%	N	%	N	%		
Item 1	Yes	87	79.1	60	92.3	63	96.9	13.762	<0.001**
	No	23	20.9	5	7.7	2	3.1		
	Total	110	100	65	100	65	100		
Item 2	Doctors	32	29.1	15	23.1	20	30.8	9.376	0.154 NS
	Internet	58	52.7	36	55.4	28	43.1		
	Friends	18	16.4	13	20	11	16.9		
	TV	2	1.8	1	1.5	6	9.2		
	Total	110	100	65	100	65	100		
Item 3	Yes	98	89.1	61	93.8	62	95.4	2.6	0.273 NS
	No	12	10.9	4	6.2	3	4.6		
	Total	110	100	65	100	65	100		
Item 4	Yes	49	44.5	45	69.2	60	92.3	41.502	<0.001**
	No	61	55.5	20	30.8	5	7.7		
	Total	110	100	65	100	65	100		
Item 5	Yes	89	80.9	60	92.3	63	96.9	11.533	0.033*
	No	21	19.1	5	7.7	2	3.1		
	Total	110	100	65	100	65	100		
Item 6	Yes	78	70.9	52	80	61	93.8	13.239	0.001*
	No	32	29.1	13	20	4	6.2		
	Total	110	100	65	100	65	100		
Item 7	Yes	65	59.1	48	73.8	58	89.2	18.412	<0.001**
	No	45	40.9	17	26.2	7	10.8		
	Total	110	100	65	100	65	100		
Item 8	Yes	72	65.5	50	76.9	60	92.3	16.134	<0.001**
	No	38	34.5	15	23.1	5	7.7		
	Total	110	100	65	100	65	100		
Item 9	Yes	62	56.4	44	67.7	56	86.2	16.53	<0.001**
	No	48	43.6	21	32.3	9	13.8		
	Total	110	100	65	100	65	100		

UG=Under Graduates, I/G=Interns/Graduates, PG= Postgraduates
*Significant (p<0.05),** -Highly significant (p<0.001), NS – Not significant (p>0.05)

Table 4. Assessment of Awareness of Teledentistry among undergraduate, graduate and postgraduate dental students

Items	Responses	UG		I/G		PG		χ^2	p-value
		N	%	N	%	N	%		
Item 10	Yes	67	60.9	51	78.5	57	87.7	16.229	<0.001**
	No	43	39.1	14	21.5	8	12.3		

	Total	110	100	65	100	65	100		
Item 11	Yes	72	65.5	48	73.8	59	90.8	13.837	0.001*
	No	38	34.5	17	26.2	6	9.2		
	Total	110	100	65	100	65	100		
Item 12	Yes	78	70.9	55	84.6	58	89.2	9.83	0.007*
	No	32	29.1	10	15.4	7	10.8		
	Total	110	100	65	100	65	100		
Item 13	Yes	74	67.3	45	69.2	55	84.6	6.641	0.036*
	No	36	32.7	20	30.8	10	15.4		
	Total	110	100	65	100	65	100		
Item 14	Yes	28	25.5	26	40	26	40	5.673	0.059 NS
	No	82	74.5	39	60	39	60		
	Total	110	100	65	100	65	100		
Item 15	Yes	82	74.5	56	86.2	55	84.6	4.494	0.196 NS
	No	28	25.5	9	13.8	10	15.4		
	Total	110	100	65	100	65	100		
Item 16	Yes	79	71.8	50	76.9	52	80	1.584	0.483 NS
	No	31	28.2	15	23.1	13	20		
	Total	110	100	65	100	65	100		
UG=Under Graduates, I/G=Interns/Graduates, PG= Postgraduates *Significant (p<0.05),**-Highly significant (p<0.001), NS – Not significant (p>0.05)									

Table 5. Assessment of Attitude of Teledentistry among undergraduate, graduate and postgraduate dental students

Items	Responses	UG		I/G		PG		χ^2	P-value
		N	%	N	%	N	%		
Item 17	Yes	67	60.9	47	72.3	50	76.9	5.493	0.063 NS
	No	43	39.1	18	27.7	15	23.1		
	Total	110	100	65	100	65	100		
Item 18	Yes	91	82.7	56	86.2	62	95.4	5.888	0.053 NS
	No	19	17.3	9	13.8	3	4.6		
	Total	110	100	65	100	65	100		
Item 19	Yes	66	60	50	76.9	55	84.6	13.486	0.001*
	No	44	40	15	23.1	10	15.4		
	Total	110	100	65	100	65	100		
UG=Under Graduates, I/G=Interns/Graduates, PG= Postgraduates *Significant (p<0.05),**-Highly significant (p<0.001), NS – Not significant (p>0.05)									