An Assessment of the Variance in Patient's Knowledge of Dental Implant Treatment for Replacement Missing Teeth in Riyadh, Saudi Arabia

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Abstract

Background: Little is known about the variance in patients' knowledge of dental implant for the replacement of missing teeth.

Materials and Methods: We obtained a representative random sample of 396 patients, drawn from a target population of 585 patients at three dental institutions in Riyadh, Saudi Arabia. Prior to dental implant treatment, we tested the patients' knowledge using the Dental Implant Knowledge Scale.

Results: The answers to the 10-point scale were normally distributed (range = 1 to 7; median = 4.00; mean = 4.09; 95% CI = 3.94, 4.24). Most (369, 84.9%) of the patients achieved poor scores (≤ 5). The patients who achieved lower than average scores tended to be male, more than 40 years old, reside in rural areas, be smokers, and have a high-school education. They also tended to be retired, not to suffer from a systemic disease, and not to acquire information from dentists.

Conclusion: The patient's low scores on the Dental Implant Knowledge Scale reflected misconceptions about the complications and risk factors associated with implant failure, and the relationships between oral hygiene, systemic disease, smoking, and overall health. We recommend that dental teams in Saudi Arabia and elsewhere should administer the Dental Implant Knowledge Scale in practice to identify those patients who exhibit the poorest knowledge of dental implant, and to target these specific groups of patients for appropriate educational interventions prior to treatment.

Keywords: Dental Implants; Oral Hygiene; Patient Reported Outcome Measures; Peri-Implantitis; Periodontal Disease; Patient Education

Introduction

Dental implant treatment is increasingly being prescribed for the aesthetic and functional rehabilitation of partially dentate or edentulous patients [1-3]. Successful dental implant treatment requires patients to know about the clinical procedures, outcomes, and associated health issues [4]. Several surveys have concluded, however, that the patients' knowledge of dental implant treatment in Asian countries is extremely variable [5-11]. In Mumbai, India. only 32.3% of 1000 participants were aware of dental implant as an option to replace missing teeth [5]. Only a small proportion (27.7%) of 527 subjects in Turkey knew about dental implants as a treatment option [6]. Elsewhere in Asia, the patients' knowledge of dental implant ranged from 52.6% of 192 patients in Nepal [7], 62.8% of 113 patients in Hong Kong, China [8], to 76.2% of 1013 patients in Malaysia [9]. One study in Saudi Arabia reported that 66.4% out of 379 patients treated at the Military Hospital and College of Dentistry at King Saud University in Riyadh knew about dental implant [10]. Another study revealed that 56.0% out of 747 respondents drawn from the general population in Riyadh were aware of dental implant treatment [11]. In comparison, a recent survey conducted in USA revealed that the vast majority of patients (94% of 76) treated at a dental school emergency department displayed adequate knowledge of dental implant prior to the replacement of missing teeth [4].

Little is known about why there is such a wide variance in patients' knowledge about dental implant treatment across Asia. Perhaps the generally poor levels of patient knowledge in Asia may be a reflection of the failure of Asian dentists to comply with appropriate guide-

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lines? In Saudi Arabia, for example, guidelines have been issued to prevent emergencies, and to control infections, by recommending the use of personal dialogue, and physical evaluation before the start of dental treatment [13,14]. However, no official guidelines have been issued by the Saudi Society of Periodontology, similar to those issued by the American Academy of Peridontology, recommending that "Treatment should include patient education, training in personal oral hygiene and counseling on control of risk factors (e.g., smoking, medical status)".

Previous studies have identified several sources of information used by Asian patient populations receiving dental implant treatment. In India, the main sources were dentists (67.5%); the internet (12.7%); and friends/family (8.7%) [5]. The main sources in Turkey were dentists (44.5%), followed by printed media (31.6%) and friends (17.3%) [6]. In China, the main sources were dentists and dental hygienists (42.0%); friends/family (25%); and the internet (14%) [8]. In Saudi Arabia the main sources of were dentists (34.4%), friends (29.9%), and social media (19.7%) [11]. No previous studies have identified other factors that may be associated with the variance in the knowledge of Asian patients regarding dental implant. This practice-gap provided a direction and rationale to explore the extent to which the variance in patients' knowledge of dental implant may be dependent not only on alternative sources of information, but also on the demographics of the patients, their experience of disease and treatment, and the characteristics of their dental specialists.

The theoretical framework underpinning our research was the Health Belief Model and the Process-Knowledge Model of Health Literacy [15,16]. The Health Belief Model posits that knowledge is a predictor of the healthy behavior of individuals and that knowledge of health issues is linked to demographic factors, as well as perceptions regarding the susceptibility to disease and the seriousness and risk of disease [15]. The Health Belief Model predicts that an individual's knowledge of health issues is promoted by information from various sources, including healthcare providers, friends, family, and the media. The Process-Knowledge Model posits that health literacy is dependent on the patient's level of knowledge, linked to demographic factors, as well at the patients' experience of disease [16].

We propose an extension to the knowledge dimension of the Health Belief Model and the Process-Knowledge Model of Health Literacy in the context of implant dentistry. We tested our model by devising an evidence-based measure of the patients' level of knowledge of dental implant and associated health issues called the Dental Implant Knowledge Scale. The content validity of this 10-point scale was ensured by reference to data extracted from dental journals [1-25]. We hypothesized that the variance in the Dental Implant Knowledge Scale will be dependent on the four factors outlined in Figure 1, specifically: the demographic characteristics of the patients, the patient's experience of disease and treatment, the patients' sources of information, and the characteristics of the dentists.
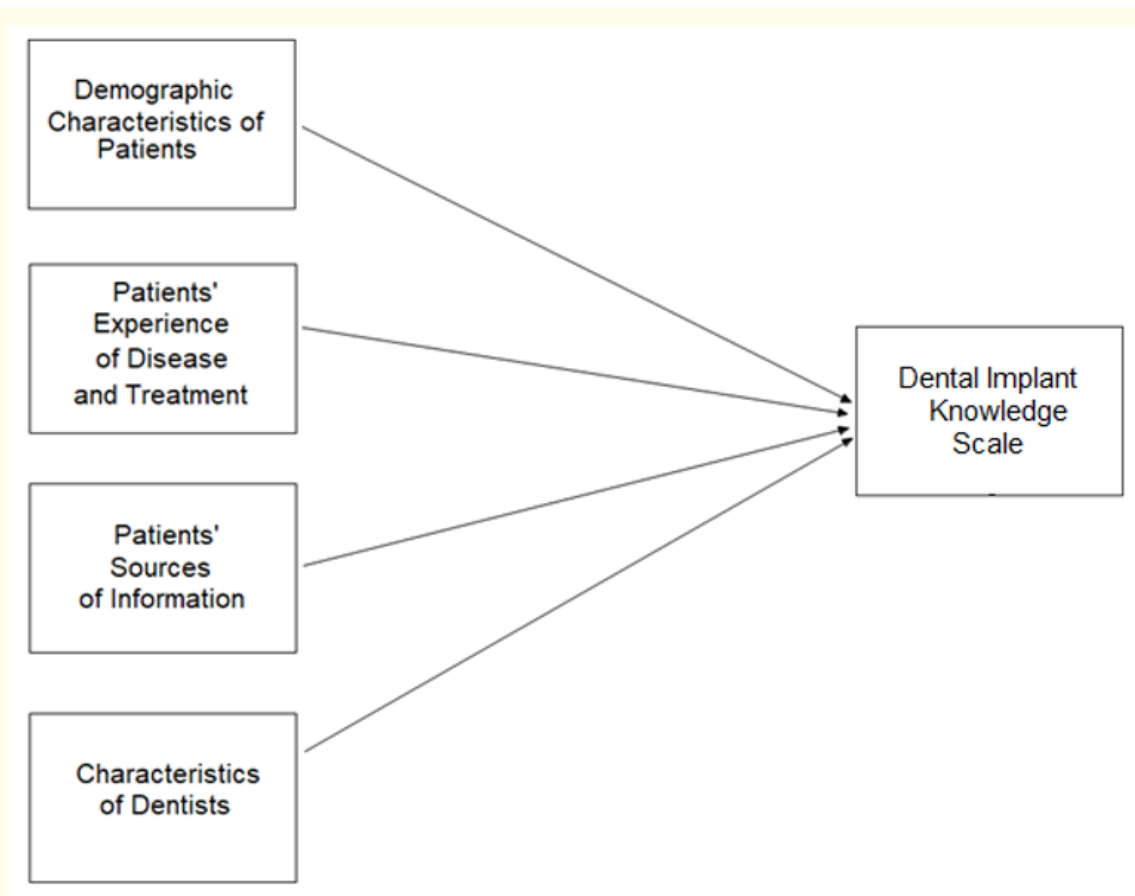

Figure 1: Theoretical Framework.

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The purpose of our study was not only to improve theoretical understanding, but also to promote changes in clinical practice. Our ultimate goal is to inform dental teams how they might improve the oral and general health of their patients by targeting their educational interventions specifically toward those patients who, because of their poor levels of knowledge regarding dental implant treatment, are in the greatest need of professional advice.

Materials and Methods

This study was approved by the Institutional Review Board at King Abdullah International Medical Research Centre (RC18/097/R); was conducted in compliance with ICH-GCP Ethical Standards and Research Protocol; and was approved by the Institution Review Board of the KSAU-HS International Medical Research Center.

Study population

Completed responses to a self-report questionnaire were received from a random sample of 396 patients, constituting 67.7% of the target population of 585 patients prescribed dental implant treatment at King Abdullah Medical City, King Saud bin Abdulaziz University for Health Sciences, and King Abdullah International Medical Research Centre in Riyadh, during the time period 4 March 2018 to 4 March 2019. A sample size calculation predicted that 396 patients provided 95% confidence that the data were representative of the target population, with a 5% margin of error [26].

Questionnaire

Table 1 lists the 10 items comprising the Dental Implant Knowledge Scale, whereby each patients' level of knowledge could potentially range from 0 (no correct answers) to 10 (all answers were correct). The 10 test items were adapted from a questionnaire developed by Pommer., *et al.* [27] with our modifications to test the patient's knowledge in more detail. Tables 2, 3, 4, and 5 lists the 16 other questions that we used to collect data on the demographic characteristics of the patients, the patient's experience of disease and treatment; the patient's sources of information, and the characteristics of their dentists.

Data analysis

We analyzed the quantitative data using IBM SPSS vs. 24.0, attempting not to commit statistical errors. One review revealed that out of 307 articles published in 10 dental journals, a total of 158 (51.5%) contained at least one misuse of statistics [28]. Another revealed that 81% of 928 articles in four dental journals relied mainly on p-values to interpret the results [29]. Many articles provide misleading conclusions, because p-values "are not as reliable as many scientists assume" [30], and "the fickle p value generates irreproducible results" [31]. More dental researchers should comply with the statement issued by the American Statistical Association asserting that "A p-value, or statistical significance, does not measure the size of an effect or the importance of a result"; and that "By itself, a p-value does not provide a good measure of evidence" [32].

To test our theoretical model, we conducted Multifactorial Analysis of Variance (ANOVA) and Scheffe's post hoc tests for multiple comparisons between mean scores. We identified the main effects of 16 independent variables on the Dental Implant Knowledge Scale. The effect sizes were interpreted to reflect the practical significance of the results. The values of eta squared (ES) indicated the proportions of the variance in the Dental Implant Knowledge Scale explained by each independent variable [33]. The minimum ES to indicate practical significance was 0.04 [34].

Results

Dental implant knowledge scale

Table 1 summarizes the responses to the Dental Implant Knowledge Scale. The majority of patients knew the correct answers six questions, including "Which tooth replacement has more advantages?" (87.9%); "Where do you think implants are anchored?" (72.7%);

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"From what material are implants made" (57.6%); and "What is an implant?" (51.5%). In response to "What could be the reason for failure of dental implant?" 45.5% of the respondents correctly answered "Dentist experience" whilst 30.3% answered "Poor oral hygiene". Both reasons were verified from one source [19]. The correct responses to "How long do you think an implant lasts?" were taken as "For a lifetime" (36.4%) and "Up to 20 years" (24.2%) based on commonly held perceptions. However, accurate data to predict the longevity of dental implants is difficult to obtain due to the heterogeneity between different studies [17-19].

Item	Options	Frequency		Correct Answer
		n	**%**	
Which tooth replacement has more advantages?	Non-removable	348	87.9	Non-removable [1,2]
	Removable	48	12.1	
Where do you think implants are anchored?	Jawbone	288	72.7	Jawbone [1,2]
	Gums	48	12.1	
	Neighbouring teeth	48	12.1	
	Do not know	12	3.0	
From what material are implants made?	Titanium	228	57.6	Titanium [3]
	Do not know	96	24.2	
	Steel	48	12.1	
	Plastic	24	6.1	
What is an implant?	Screw	204	51.5	Screw [3]
	Do not know	84	21.1	
	Nail	72	18.2	
	Pin	36	9.1	
What could be the reason for failure of dental implant?	Poor oral hygiene	180	45.5	Dentist experience and poor oral hygiene [19]
	Dentist experience	120	30.3	
	Allergy/incompatibility	96	24.2	
How long do you think an implant lasts?	For a lifetime	144	36.4	For a lifetime [17]
	Up to 10 years	96	24.2	Up to 20 years [18,19]
	Up to 20 years	96	24.2	
	Up to 5 years	60	15.2	
Systemic illness is associated with dental implants	Not sure	168	42.4	Agree [20,21]
	Agree	129	30.3	
	Disagree	108	27.3	
Smoking is a risk factor for peri-implantitis	Not sure	312	78.8	Agree [22,23]
	Agree	60	15.2	
	Disagree	24	6.1	
Smoking is a risk factor for periodontal disease	Not sure	372	93.9	Agree [24]
	Agree	12	3.0	
	Disagree	12	3.0	
Having dental problems can lead to general health problems	Not sure	168	42.4	Agree [25]
	Disagree	72	18.2	
	Agree	0	0.0	

Table 1: *Answers to the 10 Items in the Dental Implant Knowledge Scale.*

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Only 30.3% of the patients agreed correctly that "Systemic illness is associated with dental implants" and only 15.2% agreed correctly that "Smoking is a risk factor for peri-implantitis". Very few (3%) agreed correctly that "Smoking is a risk factor for periodontal disease". None of the patients knew that "Having dental problems can lead to general health problems".

The answers to the 10-point scale were normally distributed (range = 1 to 7; median = 4.00; mean = 4.09; 95% CI = 3.94, 4.24). Most (369, 84.9%) of the patients achieved scores at the lower end of the scale (≤ 5) implying that they exhibited a poor level of knowledge.

Demographic characteristics

Table 2 presents the evidence to assess the effects of the patients' demographic characteristics, reported in order of effect size (ES). The knowledge of male patients was less than female patients (ES = .22). The patients living in rural areas had less knowledge than those in urban areas (ES = .17). The knowledge of retired patients was lower than other patients (ES = .14). The knowledge of the patients educated at university was higher than those who were educated at high school or college (ES = .14). The patients who smoked had less knowledge than non-smokers (ES = .09). The older patients (> 40 years old) had less knowledge than younger patients (ES = .06).

Independent variable	Group	n	%	Multifactorial ANOVA		
				Mean	**p**	**ES**
Gender	Female	252	63.6	3.26	<.001	.22
	Male	132	33.3	1.66[a]		
Age (Years)	> 50	132	33.3	3.91[a]	<.001	.07
	41-50	108	27.3	3.89[a]		
	30-40	84	21.2	4.29		
	< 30	72	18.2	4.50		
Education level	University	228	57.6	4.58	.042	.05
	College	108	27.3	3.56[a]		
	High School	60	15.2	3.20[a]		
Occupation	Employed	204	51.5	4.56	<.001	.14
	Retired	84	21.2	3.20[a]		
	Housewife	60	15.2	3.71		
	Student	48	12.1	4.25		
Place of residence	Urban	360	90.9	4.30	<.001	.17
	Rural	36	9.1	1.09[a]		
Smoking status	No	312	78.8	3.14[a]	.001	.09
	Yes	84	21.2	4.35		

***Table 2**: Effects of Patients' Demographic Characteristics on the Dental Implant Knowledge Score.*
[a] Lowest in the group (p < .05).

Patients' experience of disease and treatment

Table 3 presents the evidence to assess the effects of the patients' experience of disease and treatment. The patients who had surgery less than 6 months ago had less knowledge than the patients who had surgery more than 6 months ago (ES = 0.30). The patients who waited a short time (less than 12 months) between diagnosis and surgery, had less knowledge than those who had waited for a longer

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time (ES = 0.23). Patients who were only aware of dentures as an option for the replacement of missing teeth had less knowledge than patients who were aware of dental implants (ES = 0.10). The patients who suffered from systemic disease, including Asthma (6.1%); Hyperthyroidism (6.1%); Diabetes (3.0%); Hypertension (3.0%); Liver cirrhosis (3.0%); or Sinusitis (3.0%) achieved higher knowledge scores than the patients who did not suffer from systemic disease (ES = 0.13). Although the patients with replacement of front teeth had lower knowledge than those with replacement of back teeth (ES = 0.13) awareness different types of treatment had a negligible effect on the patients' knowledge (ES = .03).

Independent variable	Group	n	%	Multifactorial ANOVA		
				Mean	**p**	**ES**
What alternatives for replacing teeth do you know?	Dental implant	216	54.5	4.44	.001	.10
	Fixed partial dentures	120	30.3	3.56[a]		
	Removable partial dentures	48	12.1	3.75[a]		
	Removable complete dentures	12	3.0	3.00[a]		
Do you suffer from a systemic disease?	No	324	81.8	3.22[a]	<.001	.13
	Yes	72	18.2	4.71		
Type of treatment?	Implant supported single tooth	228	57.6	4.37	.005	.03
	Implant supported prosthesis	108	27.3	4.00		
	Implant retained over denture	48	12.1	2.75		
Location of dental treatment?	Upper front	144	36.4	3.56[a]	<.001	.33
	Lower front	120	30.3	1.75[a]		
	Upper back	84	21.2	5.00		
	Lower back	48	12.1	4.67		
Length of time of diagnosis prior to surgery (months)?	< 3	204	51.5	4.41[a]	<.001	.23
	3-6	96	24.2	3.50[a]		
	6-12	48	12.1	2.33[a]		
	> 12	48	12.1	5.00		
Length of time after surgery (months)?	< 3	168	42.4	3.64[a]	<.001	.30
	> 12	84	21.2	5.57		
	3-6	60	18.2	3.40[a]		
	6-12	72	18.2	3.83		

Table 3: Effects of Patients' Experience of Disease and Treatment on the Dental Implant Knowledge Scale.
[a] Lowest in the group (p < .05).

Sources of information

Table 4 presents the evidence to assess the effects of different sources of information. The most frequent sources of information were dental specialists, reported by 48.5% of the sample. The patients who received information from dental specialists had the highest level of knowledge, whereas patients who obtained information from friends/relatives had the lowest knowledge (ES = .13). The patients who did not ask for more information had less knowledge than those who asked for more information (ES = .22).

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Independent variable	Group	n	%	Multifactorial ANOVA		
				Mean	p	ES
Where do you get information on dental implants?	Dental specialist	192	48.5	5.33	<.001	.13
	Advertisement	84	21.2	3.40		
	Friend/relative	60	15.2	3.14[a]		
	Social media	36	9.1	4.50		
	Physician	24	6.1	4.00		
Do you want more information?	Yes	324	81.8	4.44	<.001	.22
	No	72	18.2	2.45[a]		

Table 4: *Effects of Patients' Sources of Information on the Dental Implant Knowledge Scale.*
[a] Lowest in the group (p < .05).

Dentist's characteristics

Table 5 presents the evidence to evaluate the effects of the dentists' characteristics. The patients who reported that their dentist used up-to-date techniques achieved the highest scores (ES = .11). Patients treated by prosthodontists and periodontists had greater knowledge than those who were treated by others (ES = .04).

Independent variable	Group	n	%	Multifactorial ANOVA		
				Mean	p	ES
Speciality	Oral/Maxillofacial Surgeon	133	36.4	4.17	.038	.04
	Prosthodontist	84	21.2	4.71		
	Periodontist	36	9.1	4.33		
	Periodontal Resident	36	9.1	4.33		
	Other (Not specified)	95	24.2	3.25[a]		
Dentist uses up-to-date techniques	Yes	216	54.5	4.16	<.001	.11
	No	84	24.2	3.12[a]		

Table 5: *Effects of Dentists' Characteristics on the Dental Implant Knowledge Scale.*
[a] Lowest in the group (p < .05).

Discussion

Principal findings in the context of previous studies

We found that 54.5% of our patients were aware of dental implant as an option for replacing missing teeth. This proportion was lower than that reported in previous studies in Riyadh, where the dental implant awareness rate was 56.0% to 66.4% [10,11]. Our assessment using the Correct Total Knowledge Score indicated that the Saudi population displayed poor knowledge regarding dental implant and associated health issues. The most serious misconceptions were reflected by the patients' limited knowledge of risk factors such as smoking, treatment complications, and health issues. We are concerned that none of our patients agreed with the statement that "Having dental

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problems can lead to general health problems". This answer contradicted the statement of the World Health Organization that "Oral health is part of a person's health and general well-being and it is considered very important to a good and consistent quality of life [25]. Most of our patients believed that dental implants may last for a lifetime, or at least for up to 20 years. This finding was consistent with qualitative studies also revealing that patients' have a limited knowledge of implant failure, and unrealistic perceptions regarding implant longevity [35].

We found that the patients' knowledge was strongly dependent on the effects of demographic factors, which, in order of effect size, included gender, place of residence, occupation, and educational level. This finding supported the Health Belief Model [15], and the Process-Knowledge Model of Health Literacy [16], both of which posit that demographic factors are predictors of an individuals' knowledge of health issues. The effects of age and educational level were consistent with previous research in Asia concluding that younger patients, and those with a higher education level, have more realistic perceptions regarding dental implant treatment [8,9].

Male patients tended to be less well informed than female patients. This was a controversial finding in the context of discussions about gender inequity in Saudi Arabia and its role in public health, and justifies the need for more research on inconsistencies between the knowledge and healthcare practices of Saudi men and women [36]. Saudi patients in rural areas had lower Dental Impact Knowledge Scores than those in urban areas, possibly because dentists in Saudi Arabia are mainly concentrated in urban areas [37]. The access of patients to information from dentists in rural areas may be restricted. Smokers were less knowledgeable than smokers, consistent with the conclusion that smokers tend not to acknowledge the health risks of smoking [38].

The patients in Riyadh obtained information mainly from dental specialists, consistent with previous studies concluding that dental specialists are the primary sources of information on dental implant treatment [4-11]. It was salutary to record that the Saudi patients who obtained information from prosthodontists and periodontists had better knowledge than patients who obtained information from alternative sources. Furthermore, Saudi patients who suffered from a systemic disease had greater knowledge than patients who did not. These findings supported the Process-Knowledge Model of Health Literacy which posits that an individual's knowledge of health issues is promoted not only by healthcare professionals, but also by previous experience of disease and treatment.

The patients who had the best knowledge of dental implant treatment reported that their dentists used up-to-date techniques. This finding is consistent with the suggestion that the most professional dentists in Saudi Arabia are perceived by patients to be not only the providers of efficient and up-to-date diagnosis and treatment, but they are also perceived to be excellent advisers and communicators [39].

Clinical implications

Currently, Saudi dental specialists distribute brochures/leaflets to all patients prior to receiving dental implant treatment; however, we do not yet not specifically target patients who achieve low scores on the Dental Implant Knowledge Scale. We plan, in the future, to target certain groups of patients for more intensive educational interventions (e.g., those who are male, more than 40 years old, reside in rural areas, be smokers, have a high-school education, are retired, do not suffer from a systemic disease, and acquire information mainly from friends/family or social media). We suggest that guidelines should be developed recommending dental specialists in Saudi Arabia to focus their educational interventions on specific risk groups of patients. The guidelines should also recommend the requirements for the follow-up and maintenance recall of patients who are perceived to be at risk from implant failure. Such guidelines may be developed by the Saudi Society of Periodontology, similar to those developed by the American Academy of Peridontology [12].

Given that dental specialists in USA [4] and Asia [5-11] are reported to be the primary advisers of patients, we suggest that all dental specialists, irrespective of their nationality or location, should focus their attention on providing information to patients regarding the risk factors and complications associated with the longevity and failure of dental implants, including systemic diseases, peri-implantitis,

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periodontal disease, smoking, and general health. This evidence-based information must, however, be accurate, up-to-date, and be verified by research literature [40].

We suggest that all dental teams might economize their time and effort by focusing evidence-based information parsimoniously toward targeted groups of patients (who are known to be in the greatest need of help) rather than universally toward all patients (not all of whom need help). This suggestion is consistent with the recommendation of the American Academy of Periodontology that "Ultimately, judgments regarding the appropriateness of any specific procedure must be made by the practitioner in light of all the circumstances presented by the individual patient" [12]. This suggestion is also consistent with the recommendation that evidence-based health promotion programs in Asia should be targeted towards specific socio-demographic and socio-cultural groups at the community level [41].

A targeted approach to interventions raises the question of which groups of patients to target? We suggest that dental teams should apply the Dental Implant Knowledge Scale (or a similar tool) in practice to identify those patients who exhibit the poorest knowledge of dental implant, and to target those patients for educational interventions prior to treatment. Patients who exhibit low levels of knowledge should be targeted to receive interventions that are designed to correct their misconceptions about dental implant and associated health issues. Examples of appropriate types of intervention that are known to improve the oral health of patients include one-to-one personal counseling and community-based education, including dedicated brochures/leaflets, and/or motivation programs. However, there may be constraints to the delivery of certain types of educational intervention in some dental institutions, particularly in the developing countries of Asia, where limited financial resources, low workforce capacity, and inadequate infrastructure may act as serious obstacles [41,42].

Limitations and Recommendations for Future Research

Patient populations exhibiting different socio-demographic and socio-cultural characteristics probably exhibit different levels of knowledge about dental implant treatment. Consequently, our assessment using the Dental Implant Knowledge Scale, in the context of patients in Riyadh, is not generalizable to all patient populations in other parts of the world. We therefore recommend that more research should be conducted to measure the effects of different socio-demographic and socio-cultural contexts on the variance in the Dental Implant Knowledge Scale.

Conclusion

- An assessment of 396 patients in Riyadh, Saudi Arabia, using the 10-point Dental Implant Knowledge Scale, indicated that most (84.9%) of the patients achieved poor scores (≤ 5).

- The patients' knowledge was dependent on demographic factors, supporting the Health Belief Model and the Process-Knowledge Model of Health Literacy.

- We recommend the development of official guidelines, to focus the educational and follow-up interventions of Saudi dental specialists toward specific risk groups of patients.

- We encourage dental teams to apply the Dental Implant Knowledge Scale in practice, and to identify the demographic characteristics of those groups of patients who exhibit the poorest knowledge of dental implant treatment, in order to target those patients for educational interventions prior to treatment.

Summary

The administration of the Dental Implant Knowledge Scale identified patients who, due to their poor knowledge of dental implant treatment and associated health issues, should be targeted for appropriate educational interventions prior to treatment.

Conflicts of Interest

There were no perceived conflicts of interest.

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