



The Open Dentistry Journal

Content list available at: <https://opendentistryjournal.com>



RESEARCH ARTICLE

Knowledge and Attitudes of Dental Interns and Dentists on Implants and Implant-Retained Restorations in Jeddah, Saudi Arabia

Maryam Alghamdi^{1,*}, Khalid Aboalshamat², Doaa Alghamdi³, Shroug Abed⁴, Halah Almahlawi⁵, Sreen AlKathiri⁵, Amal Abu Thiraa⁵, Afaf Alsulami⁶ and Maha Alzughhaibi⁷

¹Department of Dentistry, Faculty of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia

²Department of Preventive Dentistry, Dental Public Health Division, Faculty of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia

³Department of Dentistry, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia.

⁴Department of Dentistry, General Dentist, Alfarabi College, Jeddah, Saudi Arabia

⁵Department of Dentistry, Alfarabi College, Jeddah, Saudi Arabia

⁶Department of Dentistry, General Dentist, Ministry of Health, Jeddah, Saudi Arabia.

⁷Department of Dentistry, General Dentist, Ibn Sina National College, Jeddah, Saudi Arabia

Abstract:

Objectives:

This cross-sectional study aimed to assess the knowledge and attitudes of dental interns and dentists in Jeddah, Saudi Arabia, about Cement-Retained Restoration (CRR), Screw Retained Restoration (SRR), and implant restoration.

Methods:

A total of 530 dentists and students participated in the study. Data were collected using a self-administrated questionnaire modified from previous studies. The collected data were analyzed using SPSS software for t-test, linear regression, and ANOVA.

Results:

Participants had a mean score of 5.01 (SD = 1.50) for a total of nine implant-retained restoration (IRR) knowledge questions (lowest score = 0, highest score = 9), and general implant knowledge had a mean score of 3.12 (SD = 1.25) for five questions with scores of 0 to 5. The participants' knowledge about implants significantly differed in relation to gender, place of work, and work status. Also, participant knowledge about IRR showed significant differences in relation to participants' knowledge, age, gender and place of work. The dental interns and dentists were in agreement in considering SRR to be better than CRR for six out of nine factors. Those factors were cost effectiveness, expertise required for provision, retrievability, retention, fracture resistance, and passivity of fit.

Conclusion:

The overall knowledge of dental interns and dentists regarding implants and IRR was fair and needs to be improved, given the tendency of general dentists to engage in implant dentistry. Both dentists and interns considered CRR to be aesthetically superior, easier to fabricate, and requiring comparatively less expertise in comparison to SRR.

Keywords: Knowledge, Attitudes, Dental intern, Dentist, Implants, Implant-retained restorations.

Article History

Received: March 14, 2020

Revised: May 04, 2020

Accepted: May 05, 2020

1. INTRODUCTION

Osseointegrated dental implants have become an increasingly popular choice for the treatment of missing teeth because these implants have been found to be comfortable, stable, and more natural-looking than alternatives [1 - 8]. Den-

tal implants have durability and a long-term life span of ≥ 10 years [9]. Implant-Retained Restorations (IRR) can be either Screw-Retained Restorations (SRR) or Cement-Retained Restorations (CRR), and choosing the correct one for individual patients is important because they are different in terms of aesthetic outcomes, mechanical complications, financial implications, and ease of maintenance [10]. In fact, the longevity of implants is influenced by systemic patient

* Address correspondence to this author at the Department of Dentistry, Faculty of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia;
E-mail: dr.maryamkg@gmail.com

health, type of supra-structure, implant site, occlusal loads, biomechanical considerations, and oral hygiene maintenance [11 - 14]. The CRR has better aesthetics and occlusion, is easy to fabricate, and offers passivity in fitting, while the SRR offers better retrieval ability, retention, and healthy surrounding tissues [15, 16].

Many studies have investigated levels of knowledge and attitudes about dental implants among dental students and dentists. For example, a recent study in Nepal [17] showed that 50.36% of dental interns are moderately knowledgeable about dental implants; however, 64.3% had difficulty in placing an implant. More importantly, 67.14% of their respondents stated that they had acquired enough knowledge about implant treatment during their bachelor studies.

Two studies investigated the attitudes and knowledge about CRR and SRR implants among dentists and dental students in Saudi Arabia (specifically, Riyadh) [10, 18]. One study indicated that specialists had significantly higher knowledge scores than general dentists, and both general dentists and specialists used the CRR method significantly more than SRR [18]. There was also a significant difference between general dentists and specialists in their reasons for choosing either CRR or SRR in terms of five out of the nine factors, including retention, aesthetics, retrievability, cost-effectiveness, required expertise, and ease of fabrication [18]. The other study found that 40% of the participants did not have sufficient knowledge, and 33% had low levels of experience with IRR [10]. In that study, the student participants preferred SRR for its better retention, retrievability, and the health of the soft tissues, whereas they preferred CRR for fracture resistance, aesthetics, and ease of fabrication. The authors of the two previous studies reported that around 50% of the students requested more information about IRR, and the authors recommended that dental professionals in general should have proper IRR education and training because implants are becoming increasingly important and are even used in primary care [10].

However, there are still too few studies to allow for assessing the level of knowledge and attitudes about IRR in Saudi Arabia, because these studies only investigated Riyadh city [10, 18]. Thus, the present study aimed to assess the knowledge and attitudes of dental students and dentists toward IRR in Jeddah, as the second largest city in Saudi Arabia with a population of dental students and dentists [19].

2. MATERIALS AND METHODS

This cross-sectional study investigated the knowledge and attitudes about implants and IRRs (screw and cement) among dental students and dentists. A convenience sampling technique was used in recruiting the participants from six dental centers: King Abdulaziz University, King Fahad Hospital, King Fahad Armed Forces Hospital, Alfarabi College, Ibn Sina College, and Primary Health Care of the Ministry of Health in Jeddah, Saudi Arabia. The inclusion criteria were currently working dental students (interns) and dentists. The exclusion criteria were any candidates who did not sign the consent form. Using a sample size calculation with a precision level of 5%, 50% as an estimated prevalence, and a confidence level of 90%, the

minimum number of participants needed for this study was 385. To overcome an estimated 40% non-response rate, the research team distributed 580 self-administered hard copy questionnaires in English among potential participants, who answered voluntarily and anonymously. Each participant signed the informed consent before answering the questionnaire, and completing the questionnaire took approximately four to six minutes. The questionnaire was given to each participant as hard copy by hand.

The questionnaire used in this study was derived from four validated questionnaires in previous studies [17, 18, 20, 21] with modifications, and a pilot testing was carried out among 10 participants to evaluate the questions in terms of syntax, organization, order, logical sequence, content, grammar, and clarity of meaning.

The questionnaire consisted of 31 questions organized in four sections: the first section included eight demographic questions regarding gender, age, affiliated college, work status, years of experience, place of current work, and place of undergraduate studies. This section also contained questions about participants' previous experience with implants. The second section asked five general knowledge questions regarding implants, with multiple choice answers on the topics of parts of dental implants, most important factors for implant success, and the ideal distance between an implant and adjacent structures. Correct answers were added to the total score for general implant knowledge. The third section asked about participants' knowledge of the best choice of SRR or CRR for outcomes in terms of nine factors: aesthetics, cost-effectiveness, ease of fabrication, expertise required for provision, retrievability, retention, passivity of fit, fracture resistance, and surrounding tissue health. Correct answers were derived from previous literature [10, 18, 22 - 27], and scores for the correct answers were also added to the overall knowledge score on IRR. The last section asked participant opinions regarding the importance of the previously mentioned nine factors. The answers for this section were scored on a five-point Likert scale ranging from very insignificant to very significant.

The data were collected and analyzed using SPSS version 21 (IBM Corp., Armonk, NY, USA). T-tests, linear regressions, and ANOVA were used for statistical analysis, and a probability value of less than 0.05 was set to be statistically significant. The continuous variables were normally distributed as Kolmogorov Smirnov test had P-value ranged between 0.089 to 0.74. Also, the difference between the mean and median was not larger than 10%, skewness and kurtosis values did not exceed 1 and was not less than -1.

Before conducting the study, ethical approval was obtained from the Institutional Review Board (IRB) of Umm Al-Qura University, Faculty of Dentistry, with number 152-19.

3. RESULTS

A total of 530 participants returned the questionnaire, yielding a 91.37% response rate. The mean age was 30.01, with a Standard Deviation (SD) of 7.68. The median number of years in dental practice after graduation was 1 year, with a minimum of 0 and a maximum of 30 years. There were 317

(59.8%) participants who worked in the governmental dental sector and 213 (40.2%) working in the private sector. In terms of the type of institution attended for their studies, 237 (44.7%) respondents graduated from governmental dental schools, while 293 (55.3%) graduated from private dental schools. Participant demographic variables are shown in Table 1.

The participants' answers to factors influencing the choice

of IRR (CRR or SRR) are shown in Table 3. The total score of IRR correct answers out of the nine questions had a mean of 5.01 and SD of 1.50.

The participants' answers to the implant general knowledge questions are shown in Table 2. After adding in the correct answers to the five items in the total implant general knowledge, the mean = 3.12, and the SD = 1.25.

Table 1. Participant demographical variables.

Variable	Number (N)	Percent (%)	
Gender	Male	247	46.6
	Female	283	53.4
Work status	Intern	250	47.17
-	General dentist	177	33.40
-	Specialist/consultant	103	19.43
Have you done implants surgically before?	Yes	111	20.9
	No	419	79.1
Center of current work/internship	King Abdulaziz University	105	19.8
-	King Fahad Armed Forces Hospital	93	17.5
-	King Fahad Hospital	55	10.4
-	Primary Health Care	64	12.1
-	AlfarabiCollege	202	38.1
-	Ibn Sina College	11	2.1
Center type, current work/internship	Governmental	317	59.80
	Private	213	40.20
Undergraduatecollege type	Governmental	237	44.70
	Private	293	55.20

Table 2. Participant answers to implant general knowledge questions.

Implant General Knowledge Questions	Number (N) (%)	
How many part/s are there to a dental implant?	One	4 (0.8%)
	Two	103 (19.4%)
	Three*	344 (64.9%)
	Four	79 (14.9%)
In surgical technique, what is the ideal distance between two implants?	1 mm	23 (4.3%)
	2 mm	139 (26.2%)
	3 mm*	281 (53.0%)
	4 mm	87 (16.4%)
In surgical technique, what is the ideal distance between an implant and natural teeth?	1–1.5 mm*	344 (64.9%)
	2–2.5 mm	122 (23.0%)
	3–3.5 mm	50 (9.4%)
	4.4.5 mm	14 (2.6%)
In surgical technique, what is the ideal distance of an implant from the maxillary sinus?	0–1 mm*	316 (59.6%)
	1.5–2 mm	147 (27.7%)
	2.5–3mm	41 (7.7%)
	3.5–4 mm	26 (4.9%)
What do you think is the most important factor for implant success?	Case selection*	372 (70.2%)
	Implant type and material	35 (6.6%)
	Patient compliance	29 (5.5%)
	Surgical technique	62 (11.7%)
	Experience of operator	32 (6.0%)

* The correct choice.

Table 3. Participants' answers regarding the desired factors of IRR.

Desired Factor	SRR N (%)	CRR N (%)
Aesthetic outcome	57 (10.8%)	473 (89.2%)*
Cost-effectiveness	318 (60.0%)	212 (40.0%)*
Ease of fabrication	183 (34.5%)	347 (65.5%)*
Expertise required for provision	324 (61.2%)*	205 (38.8%)
Retrievability	327 (61.7%)*	203 (38.3%)
Retention	341 (64.3%)	189 (35.7%)*
Passivity of fit	277 (52.3%)*	253 (47.7%)
Fracture resistance	299 (56.4%)	231 (43.6%)*
Surrounding tissue health	257 (48.5%)*	273 (51.5%)

* The correct choice.

A simple linear regression found that there was a significant relationship between total implant general knowledge scores and total scores for correct IRR choices, with $F(1,528) = 1014.78, p < 0.001$, and $R^2 = 0.658$. Total implant general knowledge scores were higher males ($t(528) = 2.502, p = 0.013$), and worked in the private sector, as compared to females experience and working in the governmental sector, with $t(528) = 5.88, p < 0.001$. Using ANOVA there was a significant relationship between work status and total knowledge score $F(2,527) = 10.467, p < 0.001$, and using Tukey post hoc test, both interns and specialist/consultants had significantly higher scores for general implant knowledge when compared to general dentists, as shown in Table 4. Age ($p = 0.355$), implant experience ($p = 0.72$), and undergraduate university ($p = 0.26$) were found to not be significantly related to total implant general knowledge scores.

There was a significant positive relationship between total correct IRR scores with age, at $F(1,528) = 4.801, p = 0.029, R^2 = 0.009$. Total correct IRR scores were significantly higher among males ($t(528) = 2.306, p = 0.022$) and participants in the private sector ($t(528) = 3.817, p < 0.001$) compared to females and governmental sector participants, shown in Table 4. Previous experience with implants ($p = 0.13$), undergraduate university ($p = 0.67$), and work status ($p = 0.11$) were found to

not be significantly related to total correct IRR scores.

Table 5 shows participants' opinions regarding the importance of the following nine factors related to IRR: aesthetic outcome, cost-effectiveness, ease of fabrication, expertise required for provision, retrievability, retention, passivity of fit, fracture resistance, and surrounding tissue health. Each factor was rated on a scale from very insignificant to very significant.

4. DISCUSSION

The present study aimed to identify the level of knowledge and attitudes about implants and IRR among dental interns and dentists in Jeddah, Saudi Arabia. The results showed that the overall total general implant and IRR knowledge was higher than the midpoint. Total implant general knowledge scores were higher among males and those who worked in the private sector, and interns and specialist/consultants. Total correct IRR choice scores increased significantly with age and were higher among males and participants working in the private sector. Aesthetic outcome and cost-effectiveness were rated as the most significant factors by participants, while ease of fabrication and expertise required for provision were rated as the least important factors in regard to IRR.

Table 4. Total implant general knowledge and correct IRR choices cores in relation to gender, previous history with implants, place of work, place of undergraduate studies, and work status.

		Total Implant General Knowledge			Total Score of Correct IRR		
		M	SD	pvalue	M	SD	pvalue
Gender	Male	8.38	2.16	0.013	5.17	1.55	0.02
	Female	7.92	2.05		4.87	1.45	
Have you done implants before?	Yes	8.20	1.91	0.72	4.83	1.38	0.13
	No	8.12	2.17		5.06	1.53	
Place of work	Governmental	7.71	2.07	<0.001	4.81	1.43	<0.001
	Private	8.77	2.02		5.31	1.57	
Undergraduate university	Governmental	8.17	2.06	0.26	4.98	1.43	0.67
	Private	8.11	2.16		5.03	1.56	
Work status	Intern*	8.49	1.96	<0.001	5.16	1.47	0.11
	General dentist	7.56	2.29		4.88	1.55	
	Specialist/ consultant	8.26	1.97		4.87	1.49	

*Both the intern and specialist/consultant categories had significantly higher scores for general implant knowledge compared to general dentists; there was no significant difference between the intern and specialist/consultant categories.

Table 5. Participant perceptions of nine desired IRR factors.

Desired Factors	Very Insignificant	Insignificant	Neutral	Significant	Very Significant
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Aesthetic outcome	24 (4.5%)	16 (3%)	79 (14.9%)	114 (21.5%)	297 (56.0%)
Cost-effectiveness	24 (4.5%)	16 (3.0%)	79 (14.9%)	114 (21.5%)	297 (56.0%)
Ease of fabrication	72 (13.6%)	58 (10.9%)	106 (20.0%)	167 (31.5%)	127 (24.0%)
Expertise required for provision	12 (2.3%)	38 (7.2%)	124 (23.4%)	224 (42.3%)	132 (24.9%)
Retrievability	2 (0.4%)	26 (4.9%)	134 (25.3%)	202 (38.1%)	166 (31.3%)
Retention	4 (0.8%)	18 (3.4%)	107 (20.2%)	190 (35.8%)	211 (39.8%)
Passivity of fit	4 (0.8%)	11 (2.1%)	92 (17.4%)	163 (30.8%)	260 (49.1%)
Fracture resistance	2 (0.4%)	10 (1.9%)	116 (21.9%)	174 (32.8%)	228 (43.0%)
Surrounding tissue health	3 (0.6%)	24 (4.5%)	63 (11.9%)	148 (27.9%)	292 (55.1%)

The high response rate for this study was higher than for similar studies [10, 18], which might be attributed to using a hard copy questionnaire rather than an electronic one, as in the previous studies [10, 18]. In fact, hard copy questionnaires have been reported to have higher response rates [28]. While previous studies focused on either basic knowledge about implants [20, 21] or knowledge related to IRR only [10, 18], this study covered both aspects. In fact, in terms of the study’s targeted population, most Saudi studies have focused mainly on public awareness [2, 29 - 31] about implants rather than on dentists’ knowledge, as was the focus of the present study.

Our results indicated that 65.8% of the knowledge about IRR is explained by general knowledge about implants. According to the mean of correct answers, participants had a moderate level of knowledge about implants in general and about IRR. The study found that general implant knowledge was better among dental specialist/consultants than general dentists but did not find this difference in IRR knowledge, which is contradictory to a previous study [18]. This might be due to the difference in the analysis; we assessed the total score, while the previous paper [18] compared each item individually.

When comparing the results for general implant knowledge with other studies, we found that the correct answers in our study to the five items ranged from 53% to 70.2%, which is similar to previous studies of Nepalese dentists, ranging from 51.7% to 78.2% for the same questions in two studies [17, 20]. To the best of our knowledge, there are no similar local studies assessing general implant knowledge. Furthermore, this level of knowledge might not be satisfactory and might be attributed to the required competencies of participants in this study. In fact, a study of five institutions in Saudi Arabia indicated variation in implant dentistry teaching [32]. Some of the institutions offered workshops or clinical training, while others taught only the theoretical aspects. Therefore, it might be important to standardize implant dentistry curricula in undergraduate programs and continuing education in Saudi Arabia, according to US and UK standards [33, 34], in order to improve dental implant practices, especially for general dentists, to facilitate their clinical dentistry practices.

The correct answers to IRR knowledge questions showed that the participants were aware of six out of the nine factors affecting the choice of implant restoration type, which means

that, in general, the participants were moderately knowledgeable about implants and IRR. The correct answers involved the superiority of CRR or SRR over the other and were based on several prior studies [10, 18, 22 - 27]. However, it should be noted that some studies found only slight or insignificant differences between CRR and SRR in some factors, such as passive fit [24].

When comparing IRR knowledge with previous studies among dentists [18], we noticed more similarities and few differences. In our study, the majority believed that CRR is more aesthetic and easier to fabricate than SRR, which was similar to a previous study [18]. In our results, more than half believed that SRR is better in five of the nine factors, including cost effectiveness, expertise required for provision, retention, retrieval, and fracture resistance. This is also similar to a previous study [18] except with regard to cost effectiveness, as the majority believed they were similar in that respect, and for fracture resistance, where the majority believed CRR is better [18].

Two factors had comparable results in our study, the passivity of fit and surrounding tissue health, which was different from a previous study [18], where the majority believed CRR has better passivity of fit and surrounding tissue health. The differences in these answers can be explained by differences in the experience of the participants in the two studies. It may also be due to the different educational content received by the participants, bearing in mind that our study included six different centers, whereas the previous study [18] included only one university. However, such an explanation needs further qualitative study to verify.

Despite most factors being found to be important when choosing CRR or SRR, our study agreed with a previous study in Riyadh [18] that aesthetic outcome was the most important factor, while ease of fabrication was one of the least important factors when choosing an IRR type. This might be influenced by patients’ common desire for better aesthetics [35, 36], and the fabrication of a prosthetic part is a dental technician’s responsibility [37]. Cost-effectiveness was the other most significant factor rated by our participants, while ease of fabrication and expertise required for provision were rated as the least important factors for IRR. What is interesting is that our study found the cost to be a very important factor, while the participants in the previous study in Riyadh [18] did not

rate it higher than other factors. The cause of this is not clear, and future qualitative studies might unveil the reason. However, an important point to be noted is that our study evaluated importance using a Likert scale, while the previous study in Riyadh [18] converted the questions into a continuous scale, and this might account for the difference.

This study is important because patients have become increasingly aware that the best option for replacing missing teeth is implants. Thus, assessing the current level of knowledge can highlight the ability of dentists to provide advice, consultation, and services regarding implants for patients in Jeddah, which is considered the second largest city in Saudi Arabia with a large population of dental students and dentists. Our results indicate that all aspects of implant dentistry should be an integral part of the undergrad curriculum and post-graduate continuing education.

It should be mentioned that retained sub-gingival cement and periimplantitis is one of the major problems for CRR [38]. Such an issue might shift dental professional preference to use SRR. However, such information was not assessed in the current study. Also, the current study focused on single tooth restoration, not full mouth rehabilitation. Furthermore, the difference of protheses' material used (metal-ceramic, full-ceramic, or resin), and different manufacturing techniques were not taken into consideration in this study. It might be valuable to address such issues for IRR in future studies.

Also, the current study investigated general knowledge about conventional IRR. However, recent technologies lead to new challenges in dental practice. For instance, the use of new CAD/CAM materials for implant-supported tooth-colored fixed dental prosthesis [39] have been recently tested. Such innovations allow a completely digital workflow, starting by impression to final framework, with clinical reliability [40], excellent optical characteristics [41] and good patients feedback [42]. The results of the present study would be deepened in the future with further studies also testing the knowledge of these new technologies.

Several limitations were encountered in this study, including the use of a self-reported questionnaire, lack of external validity (because it was conducted for only Jeddah), and the data being categorized and correlated on the basis of knowledge and attitudes of dentists and dental interns in relation to IRR (SRR and CRR). Further studies are needed to assess knowledge and attitudes to give these results more generalizability. In addition, educational curricula, workshops, and clinical training about dental implants and IRR should be provided for dentists and dental students in various areas in Saudi Arabia.

CONCLUSION

The results showed that the knowledge of dental interns and dentists about implants and IRRs in Jeddah, Saudi Arabia, was fair, but needs to be improved, especially given the trend toward general dentists providing implant dentistry. Both dentists and interns considered CRR to be aesthetically superior, easier to fabricate, and requiring comparatively less expertise than SRR. Conversely, SRR was considered to offer better retention, retrievability, and soft tissue health. Aesthetic

outcome and cost-effectiveness were rated as the most significant factors. It is recommended that dentist's knowledge regarding dental implant and IRR be boosted throughout Saudi Arabia both in undergraduate programs and continuing education in order to have a reliable standard of basic knowledge, which will provide better dental implant quality for Saudi Arabian patients seeking to replace missing teeth.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study received the approval of the Institutional Review Board (IRB) of Umm Al-Qura University, Faculty of Dentistry, with number 152-19.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

The participants signed a written informed consent to be involved in this study.

AVAILABILITY OF DATA AND MATERIALS

The data are available in unidentifiable format on request.

FUNDING

This project was self-funded.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

The authors would like to thank all the participants for answering the questionnaire.

REFERENCES

- [1] Al-Musawi AR, Sharma P, Maslamani M, Dashti M. Public awareness and perception of dental implants in randomly selected sample in Kuwait. *J Med Imp Surg* 2017; 2: 1-5.
- [2] Al Hashim H, Saleh F, AlEssa R, *et al.* Knowledge and awareness of dental implants: A survey done among Saudi general public. *Donnish J Dent Oral Hyg* 2017; 3(4): 19-26.
- [3] Alajlan A, Alhoumaidan A, Ettesh A, Doumani M. Assessing knowledge and attitude of dental patients regarding the use of dental implants: A survey-based research. *Int J Dent* 2019; 20195792072 [<http://dx.doi.org/10.1155/2019/5792072>] [PMID: 31467547]
- [4] Mayya A, D'Souza J, George AM, Shenoy K, Jodalli P, Mayya SS. Knowledge and awareness of dental implants as a treatment choice in adult population in South India: A hospital-based study. *Indian J Dent Res* 2018; 29(3): 263-7. [http://dx.doi.org/10.4103/ijdr.IJDR_92_17] [PMID: 29900906]
- [5] Renvert S, Persson GR, Piri FQ, Camargo PM. Peri-implant health, peri-implant mucositis, and peri-implantitis: Case definitions and diagnostic considerations. *J Periodontol* 2018; 89(Suppl. 1): S304-12. [<http://dx.doi.org/10.1002/JPER.17-0588>] [PMID: 29926953]
- [6] Shah R, John LE, Mitra D, *et al.* Awareness of dental implants as a treatment modality amongst patients having fixed prosthesis-A questionnaire survey based study. *J Indian Dent Assoc* 2018; 12(4)

- [7] Mgbeokwere U, Okoye L, Ekwueme O. A survey of the knowledge of dental implants as a choice in treatment of edentulous jaws among health workers in government dental clinics in Enugu. *Ann Med Health Sci Res* 2011; 1(1): 91-5. [PMID: 23209960]
- [8] Pjetursson BE, Lang NP. Prosthetic treatment planning on the basis of scientific evidence. *J Oral Rehabil* 2008; 35(Suppl. 1): 72-9. [http://dx.doi.org/10.1111/j.1365-2842.2007.01824.x] [PMID: 18181936]
- [9] Derks J, Schaller D, Håkansson J, Wennström JL, Tomasi C, Berglundh T. Effectiveness of implant therapy analyzed in a Swedish population: Prevalence of peri-implantitis. *J Dent Res* 2016; 95(1): 43-9. [http://dx.doi.org/10.1177/0022034515608832] [PMID: 26701919]
- [10] Vohra F, Shah AH, Zafar MS, Kola Z. Knowledge and practice of implant-retained restorations among dental students in Saudi Arabia. *Pak J Med Sci* 2015; 31(4): 848-53. [PMID: 26430416]
- [11] Diz P, Scully C, Sanz M. Dental implants in the medically compromised patient. *J Dent* 2013; 41(3): 195-206. [http://dx.doi.org/10.1016/j.jdent.2012.12.008] [PMID: 23313715]
- [12] Geckili O, Bilhan H, Geckili E, Cilingir A, Mumcu E, Bural C. Evaluation of possible prognostic factors for the success, survival, and failure of dental implants. *Implant Dent* 2014; 23(1): 44-50. [http://dx.doi.org/10.1097/ID.0b013e3182a5d430] [PMID: 24113554]
- [13] Misje K, Bjørnland T, Saxegaard E, Jensen JL. Treatment outcome of dental implants in the esthetic zone: a 12- to 15-year retrospective study. *Int J Prosthodont* 2013; 26(4): 365-9. [http://dx.doi.org/10.11607/ijp.3097] [PMID: 23837168]
- [14] Papaspyridakos P, Chen CJ, Chuang SK, Weber HP. Implant loading protocols for edentulous patients with fixed prostheses: a systematic review and meta-analysis. *Int J Oral Maxillofac Implants* 2014; 29(Suppl.): 256-70. [http://dx.doi.org/10.11607/jomi.2014suppl.g4.3] [PMID: 24660202]
- [15] Jung RE, Zembic A, Pjetursson BE, Zwahlen M, Thoma DS. Systematic review of the survival rate and the incidence of biological, technical, and aesthetic complications of single crowns on implants reported in longitudinal studies with a mean follow-up of 5 years. *Clin Oral Implants Res* 2012; 23(Suppl. 6): 2-21. [http://dx.doi.org/10.1111/j.1600-0501.2012.02547.x] [PMID: 23062124]
- [16] Vohra F, Al Fawaz A. Repair of a fractured implant overdenture gold bar: A clinical and laboratory technique report. *Eur J Dent* 2013; 7(3): 382-6. [http://dx.doi.org/10.4103/1305-7456.115428] [PMID: 24926222]
- [17] Sharma A, Shrestha B, Chaudhari BK, Suwal P, Singh RK. Knowledge, awareness, and attitude regarding dental implants among dental interns. *JNMA J Nepal Med Assoc* 2018; 56(210): 607-15. [http://dx.doi.org/10.31729/jnma.3440] [PMID: 30376006]
- [18] Vohra F, Habib R. Knowledge and attitude of dentists toward implant retained restorations in Saudi Arabia. *Niger J Clin Pract* 2015; 18(3): 312-7. [http://dx.doi.org/10.4103/1119-3077.151788] [PMID: 25772910]
- [19] AlBaker AA, Al-Ruthia YSH, AlShehri M, Alshuwairikh S. The characteristics and distribution of dentist workforce in Saudi Arabia: A descriptive cross-sectional study. *Saudi Pharm J* 2017; 25(8): 1208-16. [http://dx.doi.org/10.1016/j.jsps.2017.09.005] [PMID: 29204070]
- [20] Dhami B, Shrestha P, Lamichhane B, Sharma AK, Gupta S. Dental implants and general dental practitioners of Nepal: A study of existing knowledge and need for further education. *Journal of College of Medical Sciences-Nepal* 2017; 13(1): 212-5. [http://dx.doi.org/10.3126/jcmsn.v13i1.16668] [PMID: 29204070]
- [21] Nagpal D, Prakash S, Kalra DD, Singh G. Knowledge, attitude, and practice of dental implants among dental postgraduates and practitioners in Davangere City, Karnataka: A cross-sectional study. *Indian J Dent Res* 2018; 29(5): 575-82. [http://dx.doi.org/10.4103/ijdr.IJDR_500_15] [PMID: 30409935]
- [22] Chaar MS, Att W, Strub JR. Prosthetic outcome of cement-retained implant-supported fixed dental restorations: a systematic review. *J Oral Rehabil* 2011; 38(9): 697-711. [http://dx.doi.org/10.1111/j.1365-2842.2011.02209.x] [PMID: 21395638]
- [23] Duyck J, Naert I. Influence of prosthesis fit and the effect of a luting system on the prosthetic connection preload: an in vitro study. *Int J Prosthodont* 2002; 15(4): 389-96. [PMID: 12170855]
- [24] Heckmann SM, Karl M, Wichmann MG, Winter W, Graef F, Taylor TD. Cement fixation and screw retention: parameters of passive fit. An in vitro study of three-unit implant-supported fixed partial dentures. *Clin Oral Implants Res* 2004; 15(4): 466-73. [http://dx.doi.org/10.1111/j.1600-0501.2004.01027.x] [PMID: 15248882]
- [25] Michalakis KX, Hirayama H, Garefis PD. Cement-retained versus screw-retained implant restorations: a critical review. *Int J Oral Maxillofac Implants* 2003; 18(5): 719-28. [PMID: 14579961]
- [26] Wittneben JG, Millen C, Brägger U. Clinical performance of screw-versus cement-retained fixed implant-supported reconstructions--a systematic review. *Int J Oral Maxillofac Implants* 2014; 29(Suppl.): 84-98. [http://dx.doi.org/10.11607/jomi.2014suppl.g2.1] [PMID: 24660192]
- [27] Zarone F, Sorrentino R, Traini T, Di Iorio D, Caputi S. Fracture resistance of implant-supported screw- versus cement-retained porcelain fused to metal single crowns: SEM fractographic analysis. *Dent Mater* 2007; 23(3): 296-301. [http://dx.doi.org/10.1016/j.dental.2005.10.013] [PMID: 16564081]
- [28] Nulty DD. The adequacy of response rates to online and paper surveys: What can be done? *Assess Eval High Educ* 2008; 33(3): 301-14. [http://dx.doi.org/10.1080/02602930701293231] [PMID: 16564081]
- [29] Al-Johany S, Al Zoman HA, Al Juhaini M, Al Refeai M. Dental patients' awareness and knowledge in using dental implants as an option in replacing missing teeth: A survey in Riyadh, Saudi Arabia. *Saudi Dent J* 2010; 22(4): 183-8. [http://dx.doi.org/10.1016/j.sdentj.2010.07.006] [PMID: 23960495]
- [30] Areashi A, Algarni K, Alwadie M. Knowledge and attitude of patients toward dental implant in Asser region, Saudi Arabia: A cross-sectional comparative study among patients with and without implants. *EC Dental Science* 2017; 13(5): 222-7.
- [31] Kola MZ, Alasqah MN, Alharbi B, Alonazi A, Alhadyan FS. Public awareness, information sources and evaluation of oral implant treatment in Alkharj town (Kingdom of Saudi Arabia)—A survey based study. *Journal of Advanced Medical and Dental Sciences Research* 2016; 4(6): 114-20.
- [32] Alkindi M, Ramalingam S, Al-Johany SS, Almunif M, Abuhaimeed A, Alkharan H. Undergraduate implant dentistry education in Saudi Arabian universities. *J Int Oral Health* 2016; 8(6): 720-4.
- [33] Chin JS, Lynch CD, Rees J, Locke M, Thomas MBM, Addy LD. Teaching of implant dentistry in undergraduate dental schools in the UK and Ireland. *Br Dent J* 2018; 225(8): 763-8. [http://dx.doi.org/10.1038/sj.bdj.2018.867] [PMID: 30337728]
- [34] Petropoulos VC, Arbree NS, Tarnow D, et al. Teaching implant dentistry in the predoctoral curriculum: a report from the ADEA Implant Workshop's survey of deans. *J Dent Educ* 2006; 70(5): 580-8. [PMID: 16687644]
- [35] Maghaireh GA, Alzraikat H, Taha NA. Satisfaction with dental appearance and attitude toward improving dental esthetics among patients attending a dental teaching center. *J Contemp Dent Pract* 2016; 17(1): 16-21. [http://dx.doi.org/10.5005/jp-journals-10024-1796] [PMID: 27084857]
- [36] Samorodnitsky-Naveh GR, Geiger SB, Levin L. Patients' satisfaction with dental esthetics. *J Am Dent Assoc* 2007; 138(6): 805-8. [http://dx.doi.org/10.14219/jada.archive.2007.0269] [PMID: 17545270]
- [37] Tulbah H, AlHamdan E, AlQahtani A, AlShahrani A, AlShay M. Quality of communication between dentists and dental laboratory technicians for fixed prosthodontics in Riyadh, Saudi Arabia. *Saudi Dent J* 2017; 29(3): 111-6. [http://dx.doi.org/10.1016/j.sdentj.2017.05.002] [PMID: 28725128]
- [38] Chee WW, Duncan J, Afshar M, Moshaverinia A. Evaluation of the amount of excess cement around the margins of cement-retained dental implant restorations: the effect of the cement application method. *J Prosthet Dent* 2013; 109(4): 216-21. [http://dx.doi.org/10.1016/S0022-3913(13)60047-5] [PMID: 23566601]
- [39] Colombo M, Poggio C, Lasagna A, Chiesa M, Scribante A. Vickers micro-hardness of new restorative CAD/CAM dental materials: Evaluation and comparison after exposure to acidic drink. *Materials (Basel)* 2019; 12(8): 1246. [http://dx.doi.org/10.3390/ma12081246] [PMID: 31014032]
- [40] Alessandretti R, Borba M, Benetti P, Corazza PH, Ribeiro R, Della Bona A. Reliability and mode of failure of bonded monolithic and multilayer ceramics. *Dent Mater* 2017; 33(2): 191-7. [http://dx.doi.org/10.1016/j.dental.2016.11.014] [PMID: 27986280]

[41] Della Bona A, Pecho OE, Ghinea R, Cardona JC, Pérez MM. Colour parameters and shade correspondence of CAD-CAM ceramic systems. *J Dent* 2015; 43(6): 726-34. [<http://dx.doi.org/10.1016/j.jdent.2015.02.015>] [PMID: 25748670]

[42] Sfondrini MF, Gandini P, Malfatto M, Di Corato F, Trovati F, Scribante A. Computerized casts for orthodontic purpose using powder-free intraoral scanners: accuracy, execution time, and patient feedback. *BioMed Res Int* 2018; 2018: 4103232. [<http://dx.doi.org/10.1155/2018/4103232>] [PMID: 29850512]

© 2020 Alghamdi *et al.*

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International Public License (CC-BY 4.0), a copy of which is available at: (<https://creativecommons.org/licenses/by/4.0/legalcode>). This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.