Original Research Article

Prevalence of Dental Implants in a Saudi Population

Authors

Rahaf Al-Safadi,[1,2*] Riham Al-Safadi, Reef Al-Safadi, Zahra Al-Abduljabbar,[2] Reem Al-Ghuneem,[2] Afnan Al-Kharisi,[2] Zhra Al-Musa,[2] Maha Al-Honazil,[2] Sarah Al-Ajlan[2]

[1]Department of Preventive Dentistry, College of Dentistry, Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia
[2]University Dental Hospital, College of Dentistry, Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia
*Corresponding Author
Rahaf Al-Safadi
Department of Preventive Dentistry, University Dental Hospital, College of Dentistry, Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia
Email: *dent.sci.research@gmail.com*

Abstract
Aim: *The aim of this study was to detect the prevalence of dental implants in a Saudi population in the Kingdom of Saudi Arabia and to describe the status of the health insurance covering dental implants in Saudi Arabia.*
Materials and Methods: *1831 Saudi patients aged ≥18 years with at least one missing permanent tooth and residing in the Kingdom of Saudi Arabia were randomly selected and clinically examined for implant prostheses types (single-tooth implant, implant-supported long or short span conventional fixed bridge, implant overdenture). Radiographs were used too. The health insurance covering dental implants was detected. The data obtained including age, gender, systemic disease, and tobacco smoking were documented in a patient examination form then statistically analyzed using Chi-Square Test or Fisher-Freeman-Halton Test and U-Test.*
Results: *The prevalence of dental implants among adults missing at least one tooth was 12.7%. Of those 12.7%, the majority of patients had 2-4 implants (5.4%). The majority of patients who had one implant were in the age group <40 years; patients who had >8 implants were seen in the age group ≥60. In addition, the prevalence of implant prostheses types was as the following: Single-tooth implant 75.5%, followed by implant-supported short span fixed bridge 17.1%, implant overdenture 3.9%, and implant-supported long span fixed bridge 3.5%. The majority of patients treated with single-tooth implants were in the age group <40 years. There was an insignificant difference in the median number of dental implants between males and females p>0.05.*
Conclusion: *The majority of patients were treated with single-tooth implants. Health insurance policy doesn't cover the cost of dental implants in Saudi Arabia.*
Keywords: *Implant, Patient, Prevalence, Prostheses/Prosthesis, Type*

Introduction

Since the introduction of the concept of osseointegration nearly 50 years ago, implant dentistry has evolved from an experimental treatment to a highly predictable option to replace missing teeth with implant-supported prostheses.[1-3] Dental implants have become in demand because modern implant therapy offers beneficial functional and biologic advantages for many patients when compared with conventional fixed or removable

prostheses. Also, implant therapy has excellent long-term results as documented by numerous 10-year studies with success and survival rates ≥ 95%,[4-7] while tooth-supported fixed partial dentures have an expected survival rate of 87% and 69% at 10 and 15 years.[8-10]　In addition, implant dentistry is a preservative therapy with respect to the adjacent tooth structure and bone on the contrary of tooth-supported conventional fixed bridges, tooth-mucosa-supported removable dentures or mucosa-supported removable dentures.[8]　Furthermore, implant reconstruction for patients who are edentulous and partially edentulous reportedly enhances masticatory function and quality of life.[11,12] Therefore, dental implants have become an essential treatment option for replacing missing teeth,[4,13,14] and public awareness and acceptance of dental implants are high.[15] There is a general impression that use of dental implants has been increasing, and market research indicates that the overall number of implants used has been increasing.[2,16] However, little is known about the prevalence of dental implants among different populations[2,17] including Saudi Arabia. Therefore, it's important to keep searching in order to find out the common global phenomena and in order to help implement effective health policies. The aim of this study was to detect the prevalence of dental implants and the health insurance covering them in a Saudi population in Saudi Arabia.

Materials and Methods
Ethical approval
The study was registered with the research center of Riyadh Elm University (FRP/2019/9) and received ethical approval from the institutional review board of the same institution (RC/IRB/2019/44).

Selection of the content for analysis and statistical analysis
1831 Saudi patients aged ≥18 years and residing in Saudi Arabia were randomly selected. The study was conducted from March 2019 to June 2019. After taking the patient consent on an informed consent statement form for clinical studies, each patient was clinically examined in both the maxilla and the mandible for the following implant prostheses types[18-20]:

1. Implant overdenture in fully edentulous arch (implant denture supported by implants and largely by mucosal edentulous ridge)
2. Implant-supported long span conventional fixed bridge in fully edentulous arch
3. Single-tooth implant
4. Implant-supported short span conventional fixed bridge in partially edentulous arch

Also, radiographic examination was used including panoramic and periapical radiographs. The health insurance covering the cost of dental implants was detected.

The inclusion criterion was: All patients missing at least one permanent tooth were included in the study.　Missing tooth means: tooth is absent (partially edentulous or fully edentulous).

The exclusion criterion was: All patients who had only one or more missing third molars were excluded from the study.

The term prevalence of dental implants was used in this study to indicate the number of patients who had at least 1 dental implant among all of those with at least 1 missing tooth.

The term prevalence of implant prostheses types was used in this study to indicate the number of patients treated with one or more implant prostheses types among all of those with at least 1 dental implant.

The data obtained including age, gender, systemic disease, and tobacco smoking were documented in a patient examination form then statistically analyzed using Chi-Square Test or Fisher-Freeman-Halton Test when appropriate to test the association between categorical variables (age, implant prosthesis type, dental implant) and Mann-Whitney-Wilcoxon Test (U-Test) to test the differences in the number of dental implants per patient by (gender, tobacco smoking, systemic disease). Also, Chi-Square Test was used to test the differences in the percentages of dental implants between the maxilla and the mandible. All statistical analyses were performed using the IBM SPSS Statistics version 20

data processing software. The significance level was set at p < 0.05.

Results

The sample of 1831 patients consisted of males 47.4% (n= 868) and females 52.6% (n=963), and the patients were of the following age groups: 18-39 years 31.9% (n=585), 40-49 years 24.8% (n=455), 50-59 years 22.8% (n=417), and ≥60 20.4% (n=374). The total number of patients with at least one dental implant was 232 patients. Those 232 patients with at least one dental implant ranged in age from 20 to 73 years with a median of 44 years. Of those 232 patients with at least one dental implant, 37.1% (n=86) were 18-39 years of age,

29.7% (n=69) were 40-49 years of age, 18.5% (n=43) were 50-59 years of age, and 14.7% (n=34) were ≥60 years of age. A total of 606 dental implants were placed in the 232 Saudi patients.

Prevalence of Dental Implants

Chi-Square Test showed that there was a significant difference between the percentage of patients who had at least one implant and that of patients who didn't have any implants p=0.000 <0.05. The prevalence of dental implants among adults missing at least 1 tooth was 12.7%. (Table 1).

Table 1: Prevalence of Dental Implants

Patients	Count (n)	Percent (%)
No Implants	1599	87.3
At least one implant	232	12.7
Total	1831	100

Prevalence of Implant Prostheses Types and Age Groups

Fisher's Exact Test showed that there was a statistically significant relationship between the prevalence of implant prostheses types and the age of the patient p=0.000<0.05. The Contingency Coefficient value was 42.5% with p=0.000 <0.05.

The prevalence of implant prostheses types was as the following: Single-tooth implant 75.5%, followed by implant-supported short span fixed bridge 17.1%, implant overdenture 3.9%, and implant-supported long span fixed bridge 3.5% (Table 2, Chart 1).

Table 2: Prevalence of Implant Prostheses Types and Age Groups

Age Group, Years		Patients Treated with Implant Prostheses Types				Total n (%)
		Implant overdenture	Long span conventional fixed bridge	Single-tooth implant	Short span conventional fixed bridge	
18-39	n (%)	0 (0)	0 (0)	81 (41.8)	8 (18.2)	89 (34.6)
40-49	n (%)	1 (10)	3 (33.3)	58 (29.9)	13 (29.5)	75 (29.2)
50-59	n (%)	1 (10)	1 (11.1)	36 (18.6)	13 (29.5)	51 (19.8)
≥60	n (%)	8 (80)	5 (55.6)	19 (9.8)	10 (22.7)	42 (16.3)
Total	n (%)	10 (3.9)	9 (3.5)	194 (75.5)	44 (17.1)	257 (100)

Implant overdenture: Of all age groups, the majority of patients treated with implant overdentures were in the age group ≥60 years (80%), while none of them were in the age group <40 years (0%).

Implant-supported long span conventional fixed bridge: Of all age groups, patients treated with implant-supported long span conventional fixed

bridges were seen in the age group ≥60 years (55.6%).

Single-tooth implant: Of all age groups, the majority of patients treated with single-tooth implants were in the age group <40 years (41.8%), while the minority of them were in the age group ≥60 years (9.8%).

Implant-supported short span conventional fixed bridge: Of all age groups, the minority of patients treated with implant-supported short span conventional fixed bridges were in the age group <40 years (18.2%) (Table 2).
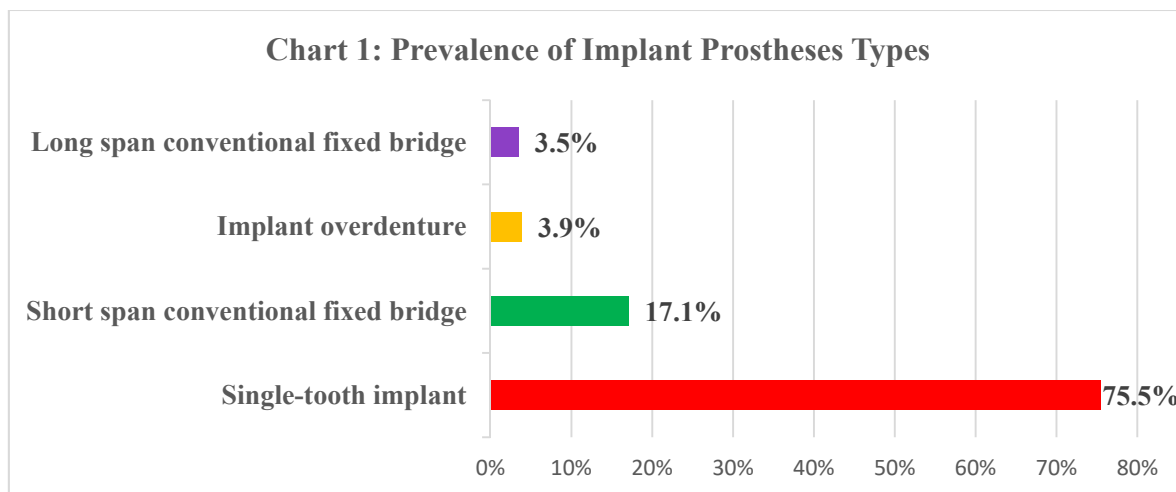
Chart 1: Prevalence of Implant Prostheses Types

Prosthesis Type	Percent
Long span conventional fixed bridge	3.5%
Implant overdenture	3.9%
Short span conventional fixed bridge	17.1%
Single-tooth implant	75.5%

Table 3 shows the frequency of patients treated with implant prostheses types.

Table 3: Distribution of Patients Treated with Implant Prostheses Types

Implant Prosthesis Type	Patients Treated with Dental Implants Count (n)/Percent (%)		Total Count(n)/Percent (%)
Implant overdenture	Yes	n=10 (4.3%)	Total n=232 (100%)
	No	n=222 (95.7%)	
Implant-supported long span fixed bridge	Yes	n=9 (3.9%)	Total n=232 (100%)
	No	n=223 (96.1%)	
Single-tooth implant	Yes	n=194 (83.6%)	Total n=232 (100%)
	No	n=38 (16.4%)	
Implant-supported short span fixed bridge	Yes	n=44 (19%)	Total n=232 (100%)
	No	n=188 (81%)	

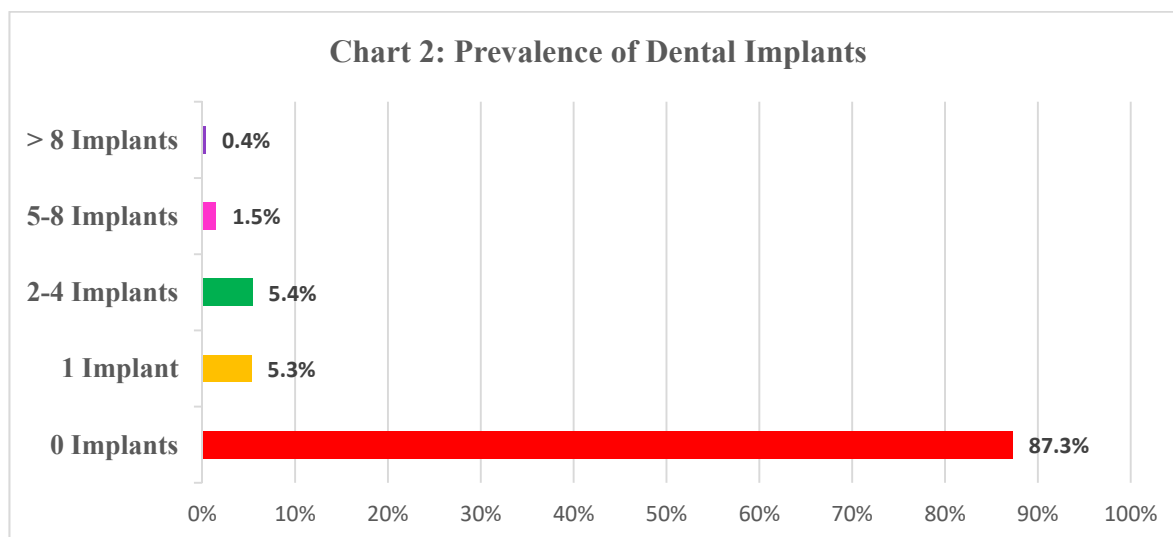**Prevalence of Dental Implants and Age Groups**

Fisher's Exact Test showed that there was a statistically significant relationship between the prevalence of dental implants and the age of the patient p=0.000<0.05. The Contingency Coefficient value was (14.9%) with p=0.000 <0.05.

Of the (12.7%) patients who had at least one dental implant, (5.3%) had one implant, (5.4%) had 2-4 implants, (1.5%) had 5-8 implants, and (0.4%) had >8 implants (Table 4, Chart 2). Of all age groups, the majority of patients who had 1 implant were in the age group <40 years (53.6%), while the minority of them were in the age group ≥60 years (6.2%). Also, of all age groups, patients who had 1 implant were seen in the age group 50-59 years (14.4%). In addition, of all age groups, patients who had 2-4 implant were seen in the age group 40-49 years (33.3%). Finally, of all age groups, patients who had >8 implants were seen in the age group ≥60 years (50%) (Table 4).

Table 4: Prevalence of Dental Implants and Age Groups

Age Group, Years		Dental Implants					Total
		0 Implants	1 implant	2-4 implants	5-8 implants	>8 implants	n (%)
18-39	n (%)	499 (31.2)	52 (53.6)	28 (28.3)	6 (21.4)	0 (0)	585 (31.9)
40-49	n (%)	386 (24.1)	25 (25.8)	33 (33.3)	10 (35.7)	1 (12.5)	455 (24.8)
50-59	n (%)	374 (23.4)	14 (14.4)	20 (20.2)	6 (21.4)	3 (37.5)	417 (22.8)
≥60	n (%)	340 (21.3)	6 (6.2)	18 (18.2)	6 (21.4)	4 (50)	374 (20.4)
Total	n (%)	1599 (87.3)	97 (5.3)	99 (5.4)	28 (1.5)	8 (0.4)	1831 (100)

Chart 2: Prevalence of Dental Implants

- > 8 Implants: 0.4%
- 5-8 Implants: 1.5%
- 2-4 Implants: 5.4%
- 1 Implant: 5.3%
- 0 Implants: 87.3%

Dental Implants and Jaws

Chi-Square Test showed that there was an insignificant difference in the percentages (number of observations) of the dental implants between the maxilla and the mandible p=0.935 > 0.05.

Dental Implants and Gender

U-Test showed that there was an insignificant difference in the median number of dental implants between males and females p=0.234>0.05.

Dental Implants and Tobacco Smoking

U-Test showed that there was an insignificant difference in the median number of dental implants between smokers and nonsmokers p=0.253>0.05.

Dental Implants and Systemic Diseases

U-Test showed that there was an insignificant difference in the median number of dental implants between healthy individuals and individuals with systemic diseases as the following: Diabetes mellitus p=0.072>0.05, osteoporosis p= 0.290>0.05, hypertension p= 0.281>0.05, asthma p= 0.388>0.05, and renal disease p= 0.290>0.05.

Discussion

According to the regulations of the Council of Cooperative Health Insurance in the Kingdom of Saudi Arabia, the health insurance policy does not cover the cost of dental implants.[21-24] Therefore, all the patients included in the study sample didn't have health insurance that covered dental implants.

In the United States of America, Elani et al. found that roughly half the implants were placed in the mandible (51%, 95% CI = 45% to 57%) and half in the maxilla (49%, 95% CI = 43% to 55%),[2] and the present study found an insignificant difference in the percentages of dental implants between the maxilla and the mandible. In addition, in the USA, Elani et al. found that 5.7% (95% CI = 4.1% to 7.7%) of patients had at least one dental implant from 2015 to 2016 among all of those with at least one missing tooth.[2]

Of 9422 patients who presented to the Dental School, University of Texas Health Science Center at San Antonio in the United States of America, Alkan et al. found that 1.98% of patients had at least one dental implant. Those patients with at least one implant ranged in age from 29 to 88 years with a

median of 64 years; in the present study, the patients with at least one implant ranged in age from 20 to73 years with a median of 44 years. Also, Alkan et al. found that, of those patients with implants, 43.9% had only one implant, 27.3% had two implants, 18.2% had three or four implants, and 10.7% of implant patients had five to eight implants.[17] In addition, Alkan et al. study and the present study were consistent and found that patients treated with single-tooth implants were the majority of all implant patients.[17]

The highest risk for implant failure was associated with periodontitis followed by tobacco smoking.[25] It has been proven in literature that tobacco smoking is a risk factor in periodontitis and that it affects healing. A few studies have shown that the overall mean failure rate of dental implants in smokers is approximately twice that in nonsmokers. Protocols recommending smokers to give up for at least two weeks prior to implant placement and for several weeks afterward have not been sufficiently tested in clinical trials neither smokers compliance. Significant marginal bone loss around implants has been noticed in smokers followed in longitudinal studies than in nonsmokers, and heavy smokers are very good candidates for implant failure.[18,19]

Diabetes mellitus is another risk factor for implant failure because it affects the vasculature, healing, and response to infection. In well-controlled diabetes, there is limited evidence to suggest higher failure of implants, but this factor should not be ignored in poorly controlled diabetic patients.[18,19]

Moy et al. found that diabetes and tobacco smoking were significant predictors to implant failure, and failure rates significantly increased in smokers and diabetic patients. However, asthma and hypertension were not correlated with a significant increase in failure of dental implants. For instance, in smokers, most implant failures occurred within the first year, with very few failing at later time points; diabetic patients had implant failures from the first few months, and the failures continued over the following 10 years. Also, more implants failed in diabetic patients than in smokers. In addition,

Moy et al. added that the location of the implant had a significant effect on the failure rate. For instance, implants in the maxilla had a greater probability of failing compared with implants in the mandible.[26]

Moreover, the results of the study of Wu et al. indicated that treatment with antihypertensive drugs may be associated with an increased survival rate of osseointegrated implants. This result could probably be the first study showing that the systemic use of a medication could be associated with higher survival rate of dental implants.[27]

In their cross-sectional study, Wagner et al. found no contraindication to place dental implants in osteoporotic patients.[28] In addition, Palmer et al. stated that the effect of osteoporosis on the maxilla and mandible may be of little significance in the majority of patients and justified this by the fact that many patients can have type four bone quality, particularly in the posterior maxilla, in the absence of any osteoporotic changes.[18] However, Plamer et al. mentioned that osteoporotic patients who have been treated with oral bisphosphonates for osteoporosis probably do not present a significant risk of osteonecrosis, while patients treated with IV bisphosphonates for tumors with bone metastases present significant complication of osteonecrosis.[19]

Renal disease is major concern to dental implant, and patients who have any chronic renal problems should receive additional steroids prescribed by an experienced physician.[29]

Conclusion

The results of this study showed that patients treated with single-tooth implants were the majority of all implant patients, followed by patients treated with implant-supported short span conventional fixed bridges. The majority of patients had 2-4 implants. According to the regulations of the Council of Cooperative Health Insurance in the Kingdom of Saudi Arabia, the health insurance policy does not cover the cost of dental implants.[21-24]

Conflict of Interest: None declared

References

1. Brånemark PI, Adell R, Breine U, Hansson BO, Lindström J, Ohlsson A. Intra-osseous anchorage of dental prostheses: I. Experimental studies. *Scand J Plast Reconstr Surg*. 1969;3(2):81–100.

2. Elani HW, Starr JR, Da Silva JD, Gallucci GO. Trends in dental implant use in the U.S., 1999–2016, and projections to 2026. *J Dent Res*. 2018;97(13):1424–1430.

3. Buser D, Sennerby L, De Bruyn H. Modern implant dentistry based on osseointegration: 50 years of progress, current trends and open questions. *Periodontol 2000*. 2017;73(1):7–21.

4. Buser D, Janner SF, Wittneben JG, Brägger U, Ramseier CA, Salvi GE. 10-year survival and success rates of 511 titanium implants with a sandblasted and acid-etched surface: a retrospective study in 303 partially edentulous patients. *Clin Implant Dent Relat Res*. 2012;14(6):839–851.

5. Degidi M, Nardi D, Piattelli A. 10-year follow-up of immediately loaded implants with TiUnite porous anodized surface. *Clin Implant Dent Relat Res*. 2012;14(6):828–838.

6. Fischer K, Stenberg T. Prospective 10-year cohort study based on a randomized controlled trial (RCT) on implant-supported full-arch maxillary prostheses. Part 1: sandblasted and acid-etched implants and mucosal tissue. *Clin Implant Dent Relat Res*. 2012;14(6):808–815.

7. Gotfredsen K. A 10-year prospective study of single tooth implants placed in the anterior maxilla. *Clin Implant Dent Relat Res*. 2012;14(1):80–87.

8. Jivraj S, Chee W. Rationale for dental implants. *Br Dent J*. 2006;200(12):661–665.

9. Scurria MS, Bader JD, Shugars DA. Meta-analysis of fixed partial denture survival: prostheses and abutments. *J Prosthet Dent*. 1998;79(4):459–464.

10. Walton TR. An up to 15-year longitudinal study of 515 metal-ceramic FPDs: Part 1. outcome. *Int J Prosthodont*. 2002;15(5):439-445.

11. Hartlev J, Kohberg P, Ahlmann S, Andersen NT, Schou S, Isidor F. Patient satisfaction and esthetic outcome after immediate placement and provisionalization of single-tooth implants involving a definitive individual abutment. *Clin Oral Implants Res*. 2014;25(11):1245–1250.

12. Jofre J, Castiglioni X, Lobos CA. Influence of minimally invasive implant-retained overdenture on patients' quality of life: a randomized clinical trial. *Clin Oral Implants Res*. 2013;24(10):1173–1177.

13. Tarnow DP. Commentary: replacing missing teeth with dental implants: a century of progress. *J Periodontol*. 2014;85(11):1475–1477.

14. Christensen GJ. Why are dental implants not used more in the United States?. *J Am Dent Assoc*. 2012;143(8):903–905.

15. Zimmer CM, Zimmer WM, Williams J, Liesener J. Public Awareness and acceptance of dental implants. *Int J oral Maxillofac Implants*. 1992;7(2):228-232.

16. Murray CM, Thomson WM, Leichter JW. Dental implant use in New Zealand: A 10-year update. *N Z dent J*. 2016;112(2):49-54.

17. Alkan EA, Mau LP, Schoolfield J, Guest GF, Cochran DL. Prevalence of dental implants and evaluation of peri-implant bone levels in patients presenting to a dental school: a radiographic cross-sectional 2-year study. *Int J Oral Maxillofac Implants*. 2018;33(1):145–151.

18. Palmer RM, Smith BJ, Howe LC, Palmer PJ, eds. *Implants in Clinical Dentistry*. London: Martin Dunitz; 2002.

19. Palmer RM, Howe LC, Palmer PJ, eds. *Implants in Clinical Dentistry*. 2nd ed. London: Informa Healthcare; 2012.

20. Sonis ST, ed. Dental Secrets. 4th ed. St. Louis, Missouri: Elsevier; 2015.

21. Help and Support / Frequently Asked Questions: Does the Cooperative Health Insurance Policy Cover Alternative Body Organs Transplants That Replace any Organ in Whole or in Part?. Council of Cooperative Health Insurance. https://www.cchi.gov.sa/en/Help/FAQ/Pages/default.aspx?PageIndex=4. Accessed May 26, 2019.

22. Frequently Asked Questions: Does the Cooperative Health Insurance Policy Cover Alternative Body Organs Transplants That Replace any Organ in Whole or in Part?. Council of Cooperative Health Insurance. https://www.cchi.gov.sa/en/Insureds/FAQ/Pages/FA

Q-38.aspx. Published July 23, 2018. Accessed May 26, 2019.

23. Qualified Insurance Companies List. The Council of Cooperative Health Insurance. https://eservices.cchi.gov.sa/Pages/ClientSystem/Company/SearchICs.aspx?lang=en. Accessed May 26, 2019.

24. Customer Care / Frequently Asked Questions: What are the Standard Exclusions Under Health Insurance Policy?. Bupa. https://bupa.com.sa/customer-care/faqs/page/8/. Accessed May 26, 2019.

25. Buhara O, Pehlivan S. Estimating the importance of significant risk factors for early dental implant failure: a Monte Carlo simulation. *Int J Oral Maxillofac Implants*. 2018;33(1):161-168.

26. Moy PK, Medina D, Shetty V, Aghaloo TL. Dental implant failure rates and associated risk factors. *Int J Oral Maxillofac Implants*. 2005;20(4):569-577.

27. Wu X, Al-Abedalla K, Eimar H, et al. Antihypertensive medications and the survival rate of osseointegrated dental implants: a cohort study. *Clin Implant Dent Relat Res*. 2016;18(6):1171-1182.

28. Wagner F, Schuder K, Hof M, Heuberer S, Seemann R, Dvorak G. Does osteoporosis influence the marginal peri-implant bone level in female patients? A cross-sectional study in a matched collective. *Clin Implant Dent Relat Res*. 2017;19:616–623.

29. El Askary A. Diagnostic considerations for esthetic implant therapy. In: El Askary A, editor. *Fundamentals of Esthetic Implant Dentistry*. Oxford: Blackwell Munksgaard; 2007:13-78.