

Factors Associated with Implant Recommendation for Single-Tooth Replacement

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Dental therapy aims primarily to maintain teeth in a state of health, function, and appropriate aesthetics.¹ However, tooth extraction is still needed when teeth cannot be saved by periodontal and restorative measures, and dentists are therefore faced with the decision of what replacement options to offer to their patients. Options given traditionally for single-tooth replacement have included the use of fixed or removable partial dentures or a resin-bonded prosthesis.²

The advent and widespread use of dental implants has expanded the available options for single-tooth replacement to include endosseous dental implants.³ In fact, implants have been proposed to be the most suitable option for single-tooth replacement in most situations, both in posterior⁴ and anterior regions of the mouth.⁵⁻⁷ The single-tooth implant has become a predictable treatment option, with survival rates reported to range between 94.4 and 99%, with a mean survival rate of 96.7%.^{4,8-11} Dentists therefore increasingly consider this option for single-tooth replacement in addition to traditional replacement methods.^{12,13}

The use of dental implants for single-tooth replacement has been established as a predictable treatment option; yet, limited data are available as to how frequently this option is recommended to patients. The aim of the present study was to examine the frequency of implant recommendation by general dental practitioners after single-tooth extraction and factors influencing their decision to recommend an implant. All single-tooth extractions performed in 26 general dental practice clinics in Kuwait over a 30-day period were examined. Dentists in these centers used the study form to record demographic data, the type of tooth extracted, reason for extraction, and replacement options presented to the patients. Univariate and logistic regression analyses were used to examine associations between background factors and decisions to recommend implant therapy. A total of 1367 patients (mean

age, 37.9 ± 11.8 years) had an extraction of one tooth during the study period. Forty-three patients were offered implants as a replacement option (3.3% of the total sample; 8.6% of patients who were offered tooth replacement options). Factors associated significantly with the recommendation of an implant by Kuwaiti dentists to their patients included younger age, regular dental maintenance visits, and adequate oral hygiene practices (P <0.05; binary logistic regression). Dental implant recommendation for single-tooth replacement in the present sample of dentists was low. Factors associated significantly with dentist recommendation of an implant for single-tooth replacement included age, history of dental maintenance, and oral hygiene practices. (Implant Dent 2005;14:201-208)

Key Words: dental implants, tooth replacement, tooth extraction

Several factors should be taken into consideration when deciding whether or not to use implants in patients in need of single-tooth replacement, including both systemic and local factors. Systemic factors include the stage of growth of the patient, the presence of certain medical conditions, such as diabetes, connective tissue and bone diseases, and autoimmune disorders, and smoking.¹⁴ Local factors include the quantity and quality of available bone, the condition of

the abutment teeth, and aesthetic considerations.^{14,15} Dentists must be able to evaluate the presence of these factors before recommending implants as replacement options.

Studies evaluating factors influencing dentists' choice of replacement options after single-tooth extractions are limited,¹⁶⁻¹⁸ and none has evaluated the frequency of implant recommendation by dentists after actual extraction of the tooth. The aim of the present study was therefore to evaluate

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the frequency of implant recommendation by general dentists for single-tooth replacement at the time of tooth extraction and investigate factors associated with such recommendation.

MATERIALS AND METHODS

The present study was a prospective, multicenter study of the frequency of implant recommendation for single-tooth replacement after tooth extraction. A list of all the government-operated general dental practice centers in Kuwait was obtained from the dental administration of the Ministry of Health, Kuwait. Thirty such centers from all six health district areas in the country were selected randomly, and dentists in those centers were contacted and invited to participate in the present study. Twenty-six of the 30 centers agreed, for a response rate of 86.7%.

Dentists in each participating center were asked to complete a specially designed study form on all single-tooth extractions they perform within a 30-day period. The study form recorded demographic information (e.g., age and sex), medical and dental histories, smoking history, the type and number of the extracted tooth, reasons for the extraction, and the planned replacement option offered to the patient before or after the extraction, if any.

The criteria for determining the reason for tooth extraction were given to all participating dentists and included extractions due to deep caries, periodontal disease, preprosthetic reasons, failed endodontic therapy, root fracture, aesthetic reasons, tooth malposition, patient refusal of alternative treatment, or other reasons. Options for replacement included an implant, fixed partial denture, removable partial denture, or option undecided/not discussed if no options were selected.

Inclusion criteria included all adult patients 18 years of age or older in need of extraction of a permanent tooth, posterior or anterior, within the 1-month study period. Exclusion criteria included growing patients (younger than 18 years); third molar extractions; extractions for orthodontic reasons, since no replacement options are usually offered for these situations; and multiple tooth extrac-

Table 1. Patient Demographics and Medical and Dental Histories

| Variable* | n (%) | Mean | Range |
|----------------------------|------------|--------------------|-------|
| Age | | 37.9 (\pm 11.8) | 18–80 |
| Sex | | | |
| Male | 756 (55.5) | | |
| Female | 607 (44.5) | | |
| Medical history conditions | | | |
| Diabetes | 212 (15.5) | | |
| Hypertension | 136 (9.9) | | |
| Cardiovascular disease | 30 (2.2) | | |
| Asthma | 19 (1.4) | | |
| Other | 18 (1.3) | | |
| Smoking | | | |
| Current smoker | 368 (27.7) | | |
| Past smoker | 37 (2.8) | | |
| Never smoked | 923 (69.5) | | |

*Numbers may not add up to the total of 1367 cases because of missing values.

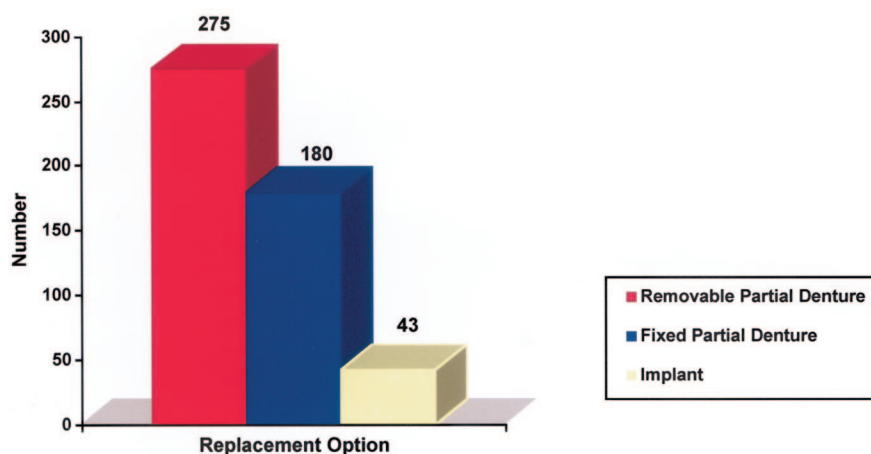


Fig. 1. Replacement options presented to patients. Most patients were given the option of a removable partial denture (55.2%), followed by a fixed partial denture (36.2%), then an implant (8.6%).

tions, since the aim was to investigate the presented options for single-tooth replacement only. The study protocol was submitted for review by the ethical review committee of the Faculty of Dentistry, Kuwait University before commencement of the project, and appropriate consent was obtained from all study participants. Study forms were collected by the principal investigator at the end of the study period for each center.

Statistical Analysis

Data were analyzed using SPSS software, version 12 (SPSS, Chicago, IL). Frequency distributions and descriptive statistics were generated for all study variables. Cross-tabulation of background and outcome study variables was performed, and χ -square

test was used to detect significant associations between variables. Multiple regression analysis was used to examine association of implant recommendation with patient background factors. Statistical significance was set at $P < 0.05$.

RESULTS

The patient demographic data and the medical and smoking history results are presented in Table 1. A total of 1367 patients had an extraction of one tooth during the 1-month study period. The mean age of the study patients was 37.9 ± 11.8 years (range, 18–80 years), and males comprised 55.5% of the sample. The number of patients with a positive, potentially significant finding in their medical

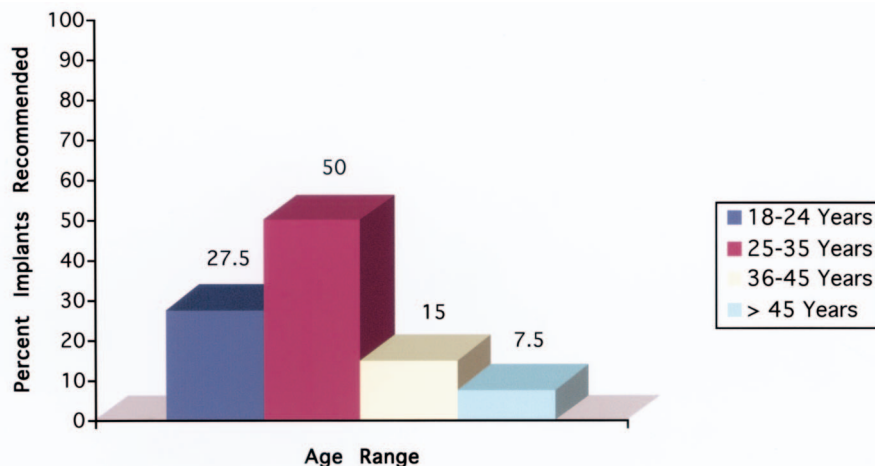


Fig. 2. Implant recommendation in different age groups. Most implants were recommended to patients between the ages of 25-35 years (50%), and the fewest were to patients older than 45 years.

history was 289 (21.1%). Diabetes mellitus was the most common medical problem reported by study patients (15.5%), followed by hypertension (9.9%) and cardiovascular disease (2.2%). The majority of the patients did not smoke (69.5%), whereas current and past smokers accounted for 27.7 and 2.8% of the sample, respectively.

For the majority of extracted teeth, no replacement options were planned or dentists did not decide which replacement options to recommend to their patients (62.4%; $n = 825$). Replacement options given to the remaining patients are presented in Figure 1. Implants were recommended for 43 patients (8.6%), whereas a removable or fixed partial denture was offered to 55.2 and 36.2% of patients, respectively.

Figure 2 presents the effects of patient age on implant recommendation. Implants were recommended most commonly if patients were between 25 and 35 years of age (50% of all patients receiving implants as an option), whereas only 7.5% of implants were presented as an option to patients older than 45 years.

Of the 43 implant recommendations, 20 (46%) were recommended after the extraction of mandibular molars, 11 (26%) for the replacement of maxillary molars, and 6 (14%) and 5 (12%) for maxillary and mandibular premolars, respectively. Only one implant was recommended for the re-

placement of maxillary anterior teeth, and none was recommended for the replacement of mandibular anterior teeth (Fig. 3).

Table 2 presents factors associated with dentist decisions to recommend implants in patients who were given a replacement option. The factors significantly associated with dentists being less likely to offer an implant as a replacement option were age, with no patients 50 years of age or older offered implants; having diabetes mellitus, hypertension, or any

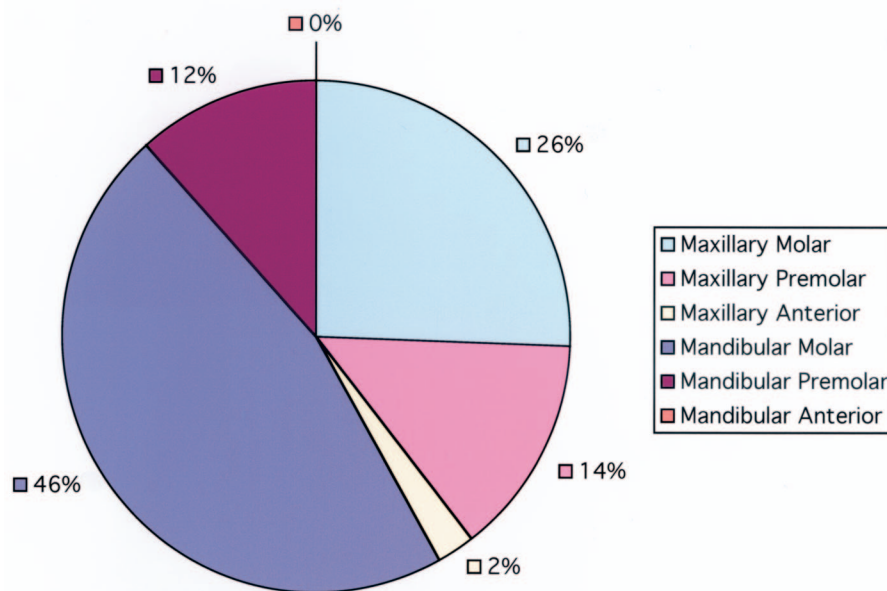


Fig. 3. Implant recommendation by tooth type. Most implants were recommended after the extraction of mandibular molars, while none were recommended after the extraction of mandibular anterior teeth.

history of medical problems; not having a maintenance visit for over 6 months; brushing less than twice per day; having the tooth extracted as a result of periodontal disease; or the tooth in question being an anterior tooth ($P < 0.05$; χ -square test). Sex, smoking status, and tooth position (*i.e.*, maxillary or mandibular tooth) did not influence dentist recommendations significantly.

Multiple logistic regression analysis was used to ascertain significance and eliminate confounding of the variables. A model was constructed dichotomizing implants being offered as an option (*i.e.*, yes or no), and all the factors found significant in univariate analysis were entered. Only age, last maintenance visit, and frequency of toothbrush use remained significant in this model (Table 3). Younger patients, patients having a maintenance visit within the previous 6 months, and those brushing their teeth at least twice daily were more likely to have implants recommended as replacement options.

DISCUSSION

Single-tooth implant treatment is a predictable treatment option substantiated by a number of clinical investigations.^{12,19-22} Despite its in-

Table 2. Factors Associated with Recommending an Implant for Patients Presented with a Replacement Option

| Variable* | n (%) | P Value |
|---|-----------|---------|
| Age group | | |
| <50 (n = 380) | 40 (10.5) | |
| ≥50 (n = 117) | 0 | <0.001 |
| Sex | | |
| Male (n = 260) | 21 (8.1) | |
| Female (n = 249) | 22 (8.8) | NS |
| Medical history conditions | | |
| Yes (n = 142) | 3 (2.1) | |
| No (n = 370) | 40 (10.8) | <0.001 |
| Diabetes mellitus | | |
| Yes (n = 103) | 2 (1.9) | |
| No (n = 409) | 41 (10) | 0.003 |
| Hypertension | | |
| Yes (n = 80) | 2 (2.5) | |
| No (n = 432) | 41 (9.5) | 0.022 |
| Last maintenance visit | | |
| ≤6 mo (n = 104) | 19 (18.3) | |
| >6 mo (n = 401) | 22 (5.5) | <0.001 |
| Toothbrush use | | |
| ≤2/day (n = 115) | 18 (15.7) | |
| <2/day (n = 383) | 22 (5.7) | 0.001 |
| Smoking status | | |
| Current/past smoker (n = 131) | 12 (9.2) | |
| Never smoked (n = 363) | 27 (7.4) | NS |
| Reason for tooth loss | | |
| Periodontal disease (n = 142) | 5 (3.5) | |
| Caries (n = 370) | 38 (10.3) | 0.014 |
| Tooth type | | |
| Posterior tooth (molar or premolar) (n = 459) | 42 (9.2) | |
| Anterior tooth (incisor or canine) (n = 370) | 1 (1.9) | 0.047 |
| Tooth position | | |
| Maxillary tooth (n = 256) | 18 (7) | |
| Mandibular tooth (n = 256) | 25 (9.8) | NS |

*Numbers may not add up to the total of 512 cases because of missing values.

P value, χ^2 -square test.

NS = not significant.

creasing use and established predictability, limited data are available on how frequently general dentists recommend this treatment modality.^{16,17} To the knowledge of the authors, the present study is the first to report the frequency of implant recommendation by general dentists after actual extraction of single teeth.

The majority of patients in the present study were not given a replacement option by their dentists (62.4%). This may have been because of dentist or patient choice not to have a replacement, lack of options presented to the patients, or possible lack of familiarity by some dentists with implants as replacement options. Factors associated with the decision to replace missing teeth are generally complex, and both

dentist- and patient-related variables are involved, including social differences, self-perceived importance of tooth replacement, and experience and treatment philosophy of the dentist.^{17,18,23,24} Another factor of possible relevance to the present study is the type of dental practice involved (*i.e.*, public or private).²³ The present study was performed in a public sector setting, where patients were treated free of

charge. It may be interesting to compare the results with a private, fee-for-service setting to see whether differences exist in the frequency of replacement option recommendations.

Of patients who were given a replacement option, only 43 (8.6%) were given recommendations for dental implants. Although it is difficult to compare this figure with other studies because of the lack of comparable investigations, it is still a somewhat low figure given the established benefits of dental implants. One reason for the low number of implant recommendations may be the public sector setting of the present study; other potential reasons may include the level of knowledge of participating dentists regarding the benefits and predictability of dental implants, since the knowledge and attitude of a dentist has been reported to influence prosthodontic, and especially implant, treatment decisions.¹⁷

The present results indicated that several factors were significantly associated with dentist decisions to recommend single-tooth implant replacement. These factors included age, with the majority of implants recommended to younger patients and no implants recommended to patients older than 50 years of age. Age has not been established to influence implant success, and success rates have been reported to be similar in both older and younger implant recipients.²⁵ The presence of any problems in the medical history, especially diabetes and hypertension, were also associated significantly with less likelihood of implant treatment recommendation in the present study. Similarly, the mere presence of problems in the medical history has not been shown to negatively influence implant success rates, provided that adequate control of these medical conditions is present.²⁶ In contrast, smoking was not associated significantly with the decision to recommend an implant by the partici-

Table 3. Logistic Regression Analysis of Factors Associated with Implant Recommendation as Replacement Options

| Factor | OR | CI | P Value |
|-------------------------|------|-----------|---------|
| Age | 1.08 | 1.03–1.13 | 0.003 |
| Last maintenance visit | 2.11 | 1.35–3.32 | 0.001 |
| Toothbrushing frequency | 1.70 | 1.01–2.89 | 0.05 |

OR = adjusted odds ratio; CI = 95% confidence interval.

pating dentists, although several studies have implicated smoking with increased failure rates for dental implants.²⁷⁻²⁹

On the other hand, both lack of regular maintenance and inadequate oral hygiene practices were associated significantly with less likelihood of dentists to recommend implants, and only a small proportion of patients who had not had a maintenance visit for over 6 months or those brushing their teeth less than twice daily received implant recommendations. This agrees with established guidelines for implant therapy in that adequate oral hygiene and professional maintenance are essential for successful treatment outcomes.^{14,30} Another factor associated with not recommending implants in the present study was tooth loss due to periodontal disease, which may be explained by the presence of uncontrolled periodontal disease in the judgment of the dentist, constituting a contraindication for implant placement.¹⁵ However, implant placement in stable patients with a history of controlled periodontal disease has been shown to be predictable.³¹

CONCLUSION

Within the limitations of the present study, which dealt only with public dentists and did not investigate the private sector, implant recommendation by this sample of general dental practitioners was low. Factors associated significantly with the recommendation by Kuwaiti dentists of an implant for single-tooth replacement included age, history of dental maintenance, and oral hygiene practices. The applicability of these findings to dentists in other regions of the world and other types of practices may warrant additional investigation.

Disclosure

The authors claim to have no financial interest in any company or any of the products mentioned in this article.

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Behandlungsempfehlung für Einzelzahnwiederherstellung und die damit in Verbindung stehenden Faktoren

ZUSAMMENFASSUNG: Die Verwendung von Zahnimplantaten zur Wiederherstellung von Einzelzähnen hat sich als Behandlungsvariante mit vorhersagbar guten Erfolgsaussichten etabliert. Bislang liegt allerdings nur wenig Datenmaterial darüber vor, inwieweit die behandelnden Ärzte den Patienten diese Methodik zur Behandlung empfehlen. In der vorliegenden Studie sollte untersucht werden, wie häufig behandelnde allgemeine Zahnärzte ihre Patienten nach der Extraktion eines Einzelzahns über eine Implantierungsmöglichkeit informieren und diese empfehlen, sowie welche Faktoren beeinflussend in ihre Entscheidung für die Empfehlung einer Implantationsbehandlung eingeflossen sind. Es wurden alle in 26 unterschiedlichen allgemeinen zahnärztlichen Kliniken in Kuwait durchgeführten Einzelzahnextraktionen innerhalb eines 30-tägigen Zeitraums einbezogen. Auf dem Untersuchungsformular der Studie nahmen die in diesen Kliniken behandelnden Ärzte Eintragungen bezüglich demographischer Daten, gezogenem Zahntyp, Extraktionsgrund sowie der dem Patienten vorgestellten Wiederherstellungsoptionen vor. Logistische Regressionsanalysen mit einer Variablen wurden angewendet, um die Zusammenhänge zwischen Hintergrundfaktoren und der zahnärztlichen Entscheidung für eine Implantationsempfehlung zu ermitteln. Im Studienverlauf unterzogen sich 1.367 Patienten mit einem durchschnittlichen Alter von $37,9 \pm 11,8$ Jahren einer Einzelzahnextraktion. 43 Patienten wurde hierbei eine Wiederherstellungsbehandlung mittels Implantatsetzung empfohlen (3,3% der gesamten Testgruppe und 8,6% der Patienten, denen eine Zahnwiederherstellungsbehandlung angeboten wurde). Für die Entscheidung der in den zahnärztlichen Kliniken von Kuwait arbeitenden Zahnärzte, eine Implantationsbehandlung für ihre Patienten zu befürworten, spielten als wesentliche Faktoren ein jüngeres Lebensalter, die regelmäßige Teilnahme an zahnärztlichen Vorsorgeuntersuchungen sowie angemessene Mund- und Zahnhygiene eine maßgebliche Rolle ($P < 0,05$, binäre logistische Regression). Nur wenige der in der Untersuchung eingeschlossenen Zahnärzte befürworteten eine Einzelzahnwiederherstellung mittels Implantationsbehandlung. Mitentscheidend für eine entsprechende Empfehlung und Befürwortung einer Einzelzahnwiederherstellung durch Implantatsetzung waren für die teilnehmenden Zahnärzte hauptsächlich das Alter, die Historie der zahnärztlichen Vorsorgebehandlungen sowie entsprechende Mund- und Zahnhygienepraktiken der Patienten.

SCHLÜSSELWÖRTER: Zahnimplantate, Zahnwiederherstellung, Zahnextraktion

Factores asociados con la recomendación de un implante para el reemplazo de un solo diente

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ABSTRACTO: El uso de implantes dentales para el reemplazo de un solo diente se ha establecido como una opción predecible de tratamiento a pesar de que los datos sobre con cuánta frecuencia se recomienda esta opción a los pacientes son limitados. El objetivo de este estudio fue examinar la frecuencia de la recomendación de un implante por los practicantes generales de la odontología, después de la extracción de un solo diente y los factores que influyen la decisión de recomendar un implante. Se evaluaron todas las extracciones de un solo diente realizadas por 26 clínicas de práctica general de la odontología en Kuwait durante un período de 30 días. Los dentistas de dichos centros usaron el formulario del estudio para registrar datos demográficos, el tipo de diente extraído, el motivo de la extracción y las opciones de reemplazo presentadas al paciente. Se utilizaron análisis de regresión monovariante y logística para examinar las asociaciones entre los factores de antecedentes y la decisión de los dentistas de recomendar la terapia de implantes. Un total de 1.367 pacientes (edad media $37,9 \pm 11,8$ años) recibieron una extracción de un diente durante el período del estudio. Cuarenta y tres pacientes recibieron la opción de implantes como reemplazo (3,3% de la muestra total; un 8,6% de los pacientes a quienes se ofrecieron una opción de reemplazo). Los factores asociados significativamente con la recomendación de los dentistas de Kuwait de un implante a sus pacientes incluyeron edad más joven, visitas periódicas de mantenimiento y prácticas adecuadas de higiene dental (regresión logística binaria $P < 0,05$). La recomendación de implantes dentales para el reemplazo de un solo diente en esta muestra de dentistas fue baja. Los factores asociados significativamente con la recomendación de los dentistas de un implante para el reemplazo de un solo diente incluyeron la edad, historia de mantenimiento dental, y prácticas de higiene oral.

PALABRAS CLAVES: implantes dentales, reemplazo de dientes, extracción de dientes

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Fatores Associados à Recomendação de Implante para Substituição de Dente Único

RESUMO: O uso de implantes dentários para substituição de dente único tem-se estabelecido como opção de tratamento previsível, contudo dados limitados estão disponíveis a respeito de quanto frequentemente esta opção é recomendada aos pacientes. O objetivo deste estudo foi examinar a frequência de recomendação de implante por clínicos odontológicos gerais após extração de dente único e fatores que influenciam sua decisão de recomendar um implante. Todas as extrações de dente único realizadas em 26 clínicas dentárias gerais no Kuwait pelo período de 30 dias foram examinadas. Os dentistas destes centros usaram o formulário de estudo para registrar dados demográficos, o tipo de dente extraído, o motivo da extração e as opções de substituição apresentadas aos pacientes. Análises de regressão univariadas e logísticas foram utilizadas para examinar associações entre fatores ambientais e decisão dos dentistas de recomendar terapia de implante. Um total de 1367 pacientes (idade média $37,9 \pm 11,8$ anos) teve a extração de um dente durante o período de estudo. Quarenta e três pacientes receberam implantes como opção de substituição (3,3% da amostra total; 8,6% de pacientes que receberam opções de substituição de dente). Fatores significativamente associados à recomendação dos dentistas kuaitianos de um implante em seus pacientes incluíam idade menor, ter visitas regulares de manutenção dentária e práticas adequadas de higiene oral ($P < 0,05$; regressão logística binária). A recomendação de implante dentário para substituição de dente único nesta amostra de dentistas foi baixa. Fatores significativamente associados à recomendação dos dentistas de um implante para substituição de dente único incluíam idade, histórico de manutenção dentária e prática de higiene oral.

PALAVRAS-CHAVE: Implantes Dentários, Substituição de Dente, Extração de Dente.

単独歯Replacementのためのインプラント推薦に関連する要因

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要約：

目的：単独歯replacementへのデンタルインプラント適用は予後予測の可能なoptionとして定着しつつある。しかしこのoptionがどのような場合に勧められるかについてのデータは限られている。この研究の目的は、一般歯科医によって単独歯抜歯後にインプラントが勧められる頻度と、インプラントを勧めるという決定に影響を与える要因について調べることであった。

方法：クウェートにおいて26人の一般歯科医によって30日の間に行われた単独歯抜歯の症例のすべてが調査の対象となった。これらのセンターの歯科医が一定の書面に従い、人口構成情報、抜歯歯のタイプ、抜歯理由、患者に提案されたreplacement optionについて回答した。インプラント・セラピーを選択した歯科医の決定と背景的要因との間の関係が、univariateとlogistic regression analysisによって調べられた。

結果：調査期間中に単独歯抜歯を受けた患者数は総計1367人（年齢平均37.9歳±11.8歳）であった。うちの43人にインプラントがreplacement optionとして勧められた（総サンプルの3.3%；replacement optionが与えられた患者総数の8.6%）。クウェートの歯科医がインプラントを勧めたことに有意に関連する要因としては、年齢の低さ、歯科メインテナンスを定期的に受けている、口腔衛生法の十分な実践が挙げられた（ $p<0.05$ ；binary logistic regression）。

結論：今回の調査対象となった歯科医において、単独歯replacementにおけるインプラントの推薦率は低かった。歯科医がインプラントを勧めることに関連する要因には、年齢、歯科メインテナンス、口腔衛生法の実践が数えられた。

キーワード：デンタルインプラント、tooth replacement、抜歯

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