치의학석사 학위논문

Risk Factors of Early Implant Failure: A Retrospective Study

임플란트 초기실패의 위험요소: 후향적 연구

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서울대학교 대학원
치의과학과 치주과학 전공

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ABSTRACT

Risk Factors of Early Implant Failure: A Retrospective Study

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Objective

The aim of this retrospective study was to assess the potential risk factors that lead to early implant failure.

Materials and methods

The medical records of patients who received implant (Bränemark System, Nobel Biocare, Gothenburg, Sweden) surgery within the period 2008–2014 at the Department of Dentistry, Asan Medical Center, were carefully reviewed. Data collection and analysis

mainly focused on systemic, anatomic, implant, and operative factors. The outcome variable was early implant failure.

Results

In 321 patients, including 150 women and 171 men, whose mean age was 54.4 years (range, 18-81 years), 1014 implants were installed. Thirty-four implants in 29 patients failed to osseointegrate, corresponding to an early implant failure rate of 3.4%. The early implant failures were significantly associated with smoking habit ($p < 0.05$), implant site ($p < 0.05$), bone quality ($p < 0.05$), timing of implant surgery ($p < 0.01$), and horizontal ridge augmentation ($p < 0.05$). Multivariate logistic regression analysis established the significance of smoking habit (Odds ratio (OR) = 2.7, $p < 0.05$), bone quality (OR = 2.0, $p < 0.05$), timing of implant surgery (OR = 3.9, $p < 0.01$), and horizontal ridge augmentation (OR = 2.3, $p < 0.05$).

Conclusions

The risk factors of early implant failure were smoking habit, bone quality, timing of implant surgery, and horizontal ridge augmentation. Therefore, such systemic and local factors should be considered in planning implant installation in order to prevent early implant failure.

Key words: early implant failure, risk factors, osseointegration failure

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임플란트 초기실패의 위험요소:

후향적 연구

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I. INTRODUCTION

Placement of an endosseous implant is considered as a predictable treatment of lost teeth, but the number of implant failure has increased along with a concomitant increase in the number of implant success. Implant failure can be subdivided into early or delayed failure, occurring before or after installment of the prosthesis, respectively. Early implant failure results from ‘‘an inability to establish an intimate bone-to-implant contact’’ and a subsequent failure of osseointegration.[1,2] Late failure is referred to as a breakdown of osseointegration by prosthesis overloading. This subdivision is relevant because the failures in these two periods are associated with different risk factors. Most failures occur early, so the recognition of potential risk factors of early implant failure is important.[3]

Previous studies assessed potential risk factors such as systemic and local factors.[4-7] Systemic factors included subject sex, age, systemic diseases, and smoking habit.[6] Systemic diseases and smoking affected osseous wound healing negatively and interfered with the osseointegration of endosseous implants.[6] Local factors were related with the alveolar bone, implant dimension and surgical methods.[7] Small bone volume is unfavorable for osseointegration because short and/or narrow implants should be installed within the limited size of the alveolar bone. Poor bone quality is also disadvantageous to gain primary stability. Methods or timing of implant surgery may affect early implant failure.[7]

The risk factors and predictors of early implant failure should be identified in order to reduce the probability of failure. However, only few studies have been conducted on early implant failure and risk factors. Therefore, the aim of this retrospective study was to calculate the early implant failure rate and assess the potential risk factors that lead to early implant failure.

II. MATERIALS AND METHODS

Study Design

This retrospective study included patients who received implant installation in the Department of Dentistry, Asan Medical Center, in Seoul, South Korea, between January 2008 and December 2014. We reviewed 1,014 implants (327 MK III TiUnite® and 687 MK III Groovy®, Bränemark System, Nobel Biocare, Gothenburg, Sweden) in 321 patients. The protocol was approved by the institutional review board (IRB) of Asan Medical Center (S2015-1626-0001) and was conducted in accordance with the Declaration of Helsinki.

Data collection

The medical records of the enrolled patients were thoroughly and completely reviewed. Data were collected on a form designed for this study, and then entered in a spreadsheet (Microsoft Excel 2007, Microsoft Inc., Redmond, WA, USA).

The outcome variable was early implant failure due to lack of osseointegration before abutment connection.

Risk factors were categorized into four divisions, including the independent variables listed in Table 1. The systemic factors were assessed by checking medical records, including data from other departments in the hospital. Smoking habit was divided into non-smoker, light smoker (< 20 cigarettes/day), and heavy smoker (≥ 20 cigarettes/day). Physical health was categorized into healthy status for class I and chronic morbidity for class II according to categories established by the American Society of Anesthesiologists (ASA).

The anatomic factors included implant site and bone quality. Implant site was composed of upper anterior, upper posterior, lower anterior, and lower posterior. Bone quality at implant placement was evaluated by the surgeon. Tactile evaluation during drilling and assessment of the alveolar crest both radiographically and clinically allowed classification according to the Lekholm-Zarb (1985) index.

The implant factors were diameter and length of implant. Implant diameter was classified as narrow (< 3.5 mm), regular (3.5-4.5 mm), and wide (> 4.5 mm); and implant length, as short (< 10 mm), medium (10-12 mm), and long (> 12 mm).

The operative factors included: timing of implant surgery (immediate/delayed), insertion method (submerged/non-submerged), horizontal ridge augmentation (no/yes), sinus elevation (no/yes), insertion torque (low/moderate/high), and surgeon experience (professor/resident). All the factors were considered as independent variables.

Statistical analysis

Statistical analyses were performed by using the SPSS software for Windows (version 16, SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to analyze the patients and implants in this study group. The χ^2-test and Fisher's exact test for bivariate analyses were used to assess the significance of differences between the risk factors and outcome. A p value of < 0.05 was considered statistically significant. The multivariate logistic regression model was used to control for potential confounders and to calculate the odds ratios (ORs) and 95% confidence intervals (CIs) for potential independent predictors of outcome.

Forward stepwise multivariate logistic regression analysis was then used to control for potential confounding variables and to calculate the ORs and 95% CIs for potential

independent predictors of outcome. Biologically relevant variables (age and sex) and variables that had probabilities of < 0.20 in the initial analyses were entered in the logistic regression model as independent variables.

III. RESULTS

In this study, 321 patients aged between 18 and 81 years (mean ± SD, 54.4 ±12.3 years) at the time of fixture installation were enrolled. Of the patients, 171 were men (53.3%) and 150 were women (46.7%). These patients received 1,014 implants, with an approximate average of 3.2 implants per patient. Of the 1,014 implants placed in the 321 patients, 34 in 29 patients failed to osseointegrate, corresponding to an early implant failure rate of 3.4%.

The distributions of the predictable variables among the patients and their relationship to the outcome are shown in Tables 2–5 (univariate analysis). Early implant failure related significantly to smoking habit as a systemic factor ($p = 0.040$). Moreover, sex or physical health had no significant effect (Table 2). Implant site ($p = 0.032$) and bone quality ($p = 0.043$) as anatomical factors affected early implant failure significantly (Table 3). No significant correlation was found between early failure and implant factors (Table 4). Early implant failure related significantly to the following operative factors: timing of implant surgery ($p = 0.003$) and horizontal ridge augmentation ($p = 0.030$; Table 5).

The multivariate logistic regression analysis (Table 6) revealed that smoking habit, bone quality, timing of implant surgery, and horizontal ridge augmentation were independent predictors of early implant failure. A significant difference was detected between the heavy smokers and the non-smokers ($p = 0.022$, OR [95% CI], 2.73 [1.16–6.40]). Significantly more failures were detected in bone quality type 4 (soft bone with little cortical bone) than in type 1 ($p = 0.010$, OR [95% CI], 2.03 [0.39-11.50]), and in type 1 than in type 3 ($p = 0.019$, OR [95% CI], 0.58 [0.14–2.86]). Immediate implant placement had nearly four times the risk of early failure ($p = 0.002$, OR [95% CI], 3.92 [1.66-9.28]) when compared with delayed placement, and the horizontal ridge augmentation was associated with a two times higher risk of early failure ($p = 0.028$, OR [95% CI], 2.31 [1.10-4.86]).

IV. DISCUSSION

Implant loss is divided into early or delayed failure, occurring before or after installment of the prosthesis, respectively.[8-11] Most (90%) of the initial implant failures occurred early.[12,13] Early failure of dental implants results from ‘‘an inability to establish an intimate bone-to-implant contact’’ and subsequent failure of osseointegration.[1,2] The several previous studies reported that the early implant failure rate ranges from 1.5% to 3.8%.[3,6,7,14-16] In this study, the incidence of early implant failure was 3.4%, which is compatible with the results of the previous studies.

It is widely accepted that smoking has an adverse effect on survival and success of implants.[3,17] Nicotine has been shown to reduce blood flow, increase platelet aggregation, and inhibit the function of polymorphonuclear leukocytes.[18] Smoking has been determined to adversely affect bone mineral density, lumbar disc health, the relative risk of sustaining wrist and hip fractures, low back pain and the dynamics of bone and wound healing.[19] A study reported that the number of type IV bone in moderate and heavy smokers was twice as much as that in non-smokers and light smokers.[20] In this study, the heavy smokers had nearly three times higher risk of early failure compared to non-smokers (Table 6). Several studies revealed the negative effect of smoking on osseointegration, and its dose-related effect.[18] This is in accordance with the present findings.

The reported co-existing medical conditions seem to have a variable effect on the success of implants. We found that early loss was more common among patients with such conditions, but not significantly. Despite the suggestion that type 2 diabetes has a possible adverse effect on implant survival,[17] the evidence available is inconclusive. A recent review showed that cardiovascular diseases did not contribute to early implant

failure.[14] However, a recent study reported that osteoporosis and Crohn's disease were significantly associated with a high rate of early implant failures.[6]

In the univariate analysis, implant site and bone quality had significant effects on early implant failure (Table 3). However, the multivariate logistic regression analysis revealed that bone quality, not implant site, was an independent predictor of the early implant failure (Table 6). This means that implant site correlated significantly with bone quality. Type 4 and 1 bones have been suggested to be more likely to result in implant failure,[6] concurring with our results. Too high and low bone densities, as assessed clinically or radiologically, have also been pointed out as two possible reasons for non-integration.[21-23] One speculation is that the inability to establish intimate bone-implant contact compromises bone healing, which in turn leads to fibrous union and failure.[6,8]

Small dimension of implants showed a higher rate of early implant failure than the large dimension of implants.[16] Similarly in this study, the narrow (< 3.5 mm) or short (< 10 mm) implants had a higher failure rate than the wide (> 4.5 mm) or long (> 12 mm) implants, but the difference was not significant (Table 4). It might be due to the small sample size of narrow and short implants.

The present study shows that implant placement in an extraction socket had nearly four times the risk of early failure, than delayed placement in mature bone (Table 6). An intimate bone-to-implant contact was speculated to be more difficult to be established in immediate implant placement than in conventional placement. The marginal gap between the implant surface and surrounding bone after implant placement in an extraction socket can be filled partially with a fibrous scar tissue. However, only few studies have been conducted on early failure of immediate implant placement, because most studies focused on implant function after immediate placement.

Horizontal ridge augmentation was revealed as a strong predictor of early implant failure (Table 6). This surgical procedure is used in unfavorable conditions such as insufficient bone volume for the required implant diameter. Therefore, this finding implies that poor bone quantity has a negative effect on implant osseointegration, in accordance with the finding of a previous study.[6] However, sinus elevation was not a significant risk factor of early implant failure (Table 5), which is in accordance with the result of a previous study.[7] Sinus augmentation has been suggested to be a reliable technique because it leads to new bone formation and then implant osseointegration.[24]

No significant correlation was found between early implant failure and insertion torque value (Table 5). A previous study reported that torque measurement is not a useful method to predict early failure, whereas the use of Periotest® (Siemens AG, Bensheim, Germany) at implant placement seems to be relevant, as more early failures occur, with implants demonstrating higher Periotest values (PTV) at implant installation.[6]

V. CONCLUSIONS

This study shows an early implant failure rate of 3.4%. The risk factors of early implant failure were smoking habit, bone quality, timing of implant surgery, and horizontal ridge augmentation. Therefore, such systemic and local factors should be considered in planning implant installation in order to prevent early implant failure.

VI. REFERENCES

1. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants. (II). Etiopathogenesis. Eur J Oral Sci. 1998;3:721–64.
2. Quirynen M, De Soete M, van Steenberghe D. Infectious risks for oral implants: a review of the literature. Clin Oral Implants Res. 2002;13:1–19.
3. Koldsland OC, Scheie AA, Aass AM. Prevalence of implant loss and the influence of associated factors. J Periodontol. 2009;80:1069–75.
4. Kronström M, Svensson B, Erickson E, Houston L, Braham P, Persson GR. Humoral immunity host factors in subjects with failing or successful titanium dental implants. J Clin Periodontol. 2000;27:875–82.
5. Kronström M, Svenson B, Hellman M, Persson GR. Early implant failures in patients treated with Bränemark System titanium dental implants: a retrospective study. Int J Oral Maxillofac Implants. 2001;16:201–7.
6. Alsaadi G, Quirynen M, Komárek A, van Steenberghe D. Impact of local and systemic factors on the incidence of oral implant failures, up to abutment connection. J Clin Periodontol. 2007;34:610–7.
7. Zaid H. Baqain, Wael Yousef Moqbel, Faleh A. Sawair. Early dental implant failure: risk factors. British J Oral Maxillofac Surg. 2012;50:239-43
8. Esposito M, Hirsch J, Lekholm U, et al. Differential diagnosis and treatment strategies for biologic complications and failing oral implants: A review of the literature. Int J Oral Maxillofac Implants. 1999;14:473-90.
9. Santos MC, Campos MI, Line SR. Early dental implant failure: A review of the literature. Braz J Oral Sci. 2002;1:103-11.

10. Esposito M, Worthington HV, Thomsen P, et al. Interventions for replacing missing teeth: Different times for loading dental implants. Cochrane Database Syst Rev. 2004;3:CD003878.
11. Snauwaert K, Duyck J, van Steenberghe D, et al. Time dependent failure rate and marginal bone loss of implant supported prostheses: A 15-year follow-up study. Clin Oral Investig. 2000;4:13-20.
12. Machtei EE, Mahler D, Oettinger-Barak O, Zuabi O, Horowitz J. Dental Implants placed in previously failed sites: survival rate and factors affecting the outcome. Clin Oral Implants Res. 2008;19:259-64.
13. Grossman Y, Levin L. Success and survival of single dental implants placed in sites of previously failed implants. J Periodontol. 2007;78:1670-4.
14. Bornstein MM, Cionca N, Mombelli A. Systemic conditions and treatments as risks for implant therapy. Int J Oral Maxillofac Implants. 2009;24(Suppl.):12–27.
15. Huynh-Ba G, Friedberg JR, Vogiatzi D, Ioannidou E. Implant failure predictors in the posterior maxilla: a retrospective study of 273 consecutive implants. J Periodontol. 2008;79:2256–61.
16. Olate S, Lyrio MC, deMoraes M, Mazzonetto R, Moreira RW. Influence of diameter and length of implant on early dental implant failure. J Oral Maxillofac Surg. 2010;68:414–9.
17. Klokkevold PR, Han TJ. How do smoking, diabetes, and periodontitis affect outcomes of implant treatment? Int J Oral Maxillofac Implants. 2007;22(Suppl.):173–202.
18. Bain CA. Smoking and implant failure – benefits of a smoking cessation protocol. Int J Oral Maxillofac Implants. 1996;11:756–9.
19. Porter SE, Hanley EN. The musculoskeletal effects of smoking. J Am Acad Orthop Surg. 2001;9:9–17.

20. Bain CA, Moy PK. The influence of smoking on bone quality and implant failure. Int J Oral Maxillofac Implants. 1994;9:123.
21. Engquist B, Bergendal T, Kallus T, Linden U. A retrospective multicenter evaluation of osseointegrated implants supporting overdentures. Int J Oral Maxillofac Implants. 1988;3:129–34.
22. Friberg B, Jemt T, Lekholm U. Early failures in 4641 consecutively placed Bränemark dental implants, a study from stage 1 surgery to the connection of completed prostheses. Int J Oral Maxillofac Implants. 1991;6:142–6.
23. Jaffin RA, Berman CL. The excessive loss of Bränemark fixtures in type IV bone, a 5-year analysis. J Periodontol. 1991;62:2–4.
24. Lie N, Merten HA, Meyns J, Lethaus B, Wiltfang J, Kessler P. Elevation of the maxillary sinus membrane for de-novo bone formation: First results of a prospective study in humans. J Craniomaxillofac Surg. 2015;43:1670-7.

Table 1. Potential risk factors

Risk factors	Variables
Systemic factors	Age
	Sex
	Physical health
	Smoking habit
Anatomic factors	Implant site
	Bone quality
Implant factors	Implant diameter
	Implant length
Operative factors	Timing of implant surgery
	Insertion method
	Horizontal ridge augmentation
	Sinus elevation
	Insertion torque
	Surgeon experience

Table 2. Systemic factors and their relation to early implant failure

Variables	Outcome of implant			
	Total (n = 321) n (%)	Success (n = 292) n (%)	Failure (n = 29) n (%)	p-value
Sex				0.076
Female	150 (46.7)	141 (94.0)	9 (6.0)	
Male	171 (53.3)	151 (88.3)	20 (11.7)	
Smoking habit (cigarettes/day)				0.040 *
Non-smoker	263 (81.9)	244 (92.8)	19 (7.2)	
Light smoker (< 20)	25 (7.8)	21 (84.0)	4 (16.0)	
Heavy smoker (≥ 20)	33 (10.3)	27 (81.8)	6 (18.2)	
Physical health				0.075
Healthy status	183 (57.0)	171 (93.4)	12 (6.6)	
Chronic morbidity	138 (43.0)	121 (87.7)	17 (12.3)	

*, $p < 0.05$; n represents the number of patients.

Variables	Outcome of implant		
	Total (n = 321)	Success (n = 292)	Failure (n = 29)
Age (years)			
Mean	54.4	54.2	56.5
SD	12.3	12.5	9.6
Range	18-81	18-81	30-75

n represents the number of patients; SD, standard deviation.

Table 3. Anatomic factors and their relation to early implant failure

Variables	Outcome of implant			
	Total (*n* = 1014) *n* (%)	Success (*n* = 980) *n* (%)	Failure (*n* = 34) *n* (%)	*p*-value
Implant site				0.032 *
Upper anterior	72 (7.1)	66 (91.7)	6 (8.3)	
Upper posterior	470 (46.4)	455 (96.8)	15 (3.2)	
Lower anterior	43 (4.2)	40 (93.0)	3 (7.0)	
Lower posterior	429 (42.3)	419 (97.7)	10 (2.3)	
Bone quality				0.043 *
Type 1	46 (4.5)	44 (95.7)	2 (4.4)	
Type 2	205 (20.2)	201 (98.1)	4 (2.0)	
Type 3	682 (67.3)	661 (96.9)	21 (3.1)	
Type 4	81 (8.0)	74 (91.4)	7 (8.6)	

*, $p < 0.05$

n represents the number of implants.

Table 4. Implant factors and their relation to early implant failure

Variables	Outcome of implant			
	Total (*n* = 1014) *n* (%)	Success (*n* = 980) *n* (%)	Failure (*n* = 34) *n* (%)	*p*-value
Implant diameter (mm)				0.409
Narrow (< 3.5)	25 (2.5)	23 (92.0)	2 (8.0)	
Regular (3.5-4.5)	611 (60.3)	592 (96.9)	19 (3.1)	
Wide (> 4.5)	378 (37.3)	365 (96.6)	13 (3.4)	
Implant length (mm)				0.279
Short (< 10)	67 (6.6)	63 (94.0)	4 (6.0)	
Medium (10-12)	825 (81.4)	797 (96.6)	28 (3.4)	
Long (> 12)	122 (12.0)	120 (98.4)	2 (1.6)	

n represents the number of implants.

Table 5. Operative factors and their relation to early implant failure

Variables	Outcome of implant			
	Total (n = 1014) n (%)	Success (n = 980) n (%)	Failure (n = 34) n (%)	p-value
Timing of implant surgery				0.003 **
Delayed	937 (92.4)	911 (97.2)	26 (2.8)	
Immediate	77 (7.6)	69 (89.6)	8 (10.4)	
Insertion method				0.435
Submerged	454 (44.8)	441 (97.1)	13 (2.9)	
Non-submerged	560 (55.2)	539 (96.3)	21 (3.8)	
Horizontal ridge augmentation				0.030 *
No	806 (79.5)	784 (97.3)	22 (2.7)	
Yes	208 (20.5)	196 (94.2)	12 (5.8)	
Sinus elevation				0.269
No	856 (84.4)	825 (96.4)	31 (3.6)	
Yes	158 (11.9)	155 (98.1)	3 (1.9)	
Insertion torque (cN)				0.277
Low (≤ 20)	339 (33.4)	325 (95.8)	14 (4.1)	
Moderate (25-45)	620 (66.6)	600 (96.8)	20 (3.2)	
High (≥ 50)	55 (5.4)	55 (100)	0 (0)	
Surgeon experience				0.599
Professor	889 (87.7)	860 (96.7)	29 (3.3)	
Resident	125 (12.3)	120 (96.0)	5 (4.0)	

*, $p < 0.05$; **, $p < 0.01$
n represents the number of implants.

Table 6. Multivariate logistic regression model for early implant failure

Variables	OR	95% CI	*p*-value
Sex			0.346
Male	1		
Female	1.53	(0.63, 3.72)	0.346
Age	1.01	(0.98, 1.05)	0.586
Physical health			0.842
Healthy status	1		
Chronic morbidity	0.84	(0.39, 1.83)	0.842
Smoking habit (cigarettes/day)			0.040 *
Non-smoker	1		
Light smoker (< 20)	2.35	(0.76, 7.26)	0.168
Heavy smoker (≥ 20)	2.73	(1.16, 6.40)	0.022 *
Implant site			0.156
Upper anterior	1		
Upper posterior	3.06	(0.97, 9.38)	0.051
Lower anterior	1.17	(0.48, 2.85)	0.729
Lower posterior	2.34	(0.54, 10.06)	0.255
Bone quality			0.049 *
Type 1	1		
Type 2	0.44	(0.08, 2.56)	0.388
Type 3	0.58	(0.14, 2.86)	0.019 *
Type 4	2.03	(0.39, 11.50)	0.010 *
Timing of implant surgery			0.002 **
Delayed	1		
Immediate	3.92	(1.66, 9.28)	0.002 **
Horizontal ridge augmentation			0.028 *
No	1		
Yes	2.31	(1.10, 4.86)	0.028 *

*, $p < 0.05$; **, $p < 0.01$

OR represents the odds ratio; CI, the confidence interval.

국문 초록

임플란트 초기실패의 위험요소: 후향적 연구

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연구목적

임플란트의 실패는 보철 여부에 따라, 크게 초기실패와 후기실패로 분류하고 있다. 그 중 임플란트의 초기실패는 임플란트가 골유착을 이루는데 실패한 것으로, 이번 연구는 초기실패의 잠재적인 위험요소를 후향적으로 분석하고자 하였다.

연구재료 및 방법

2008년부터 2014년까지 서울아산병원 치과에 내원하여 Brånemark 임플란트를 식립한 환자를 대상으로 하여, 위험요소를 다음 4가지의 범주로 나누어 조사하였다.

- 전신적 요소: 성별, 나이, 흡연, 전신적 건강
- 해부학적 요소: 임플란트 식립부위, 골질

• 임플란트 요소: 임플란트 직경, 임플란트 길이

• 수술적 요소: 임플란트 식립시기, 식립방법, 수평적 골이식술 여부, 상악동 거상술 여부, 임플란트 식립토크, 술자의 숙련도

종속변수를 임플란트의 초기실패로 하였고, 단변량 분석을 위해 카이제곱 분석과 Fisher의 정확한 검정을 시행하였다. 그리고 잠재적인 confounder를 조절하기 위해 다변량 로지스틱 회귀분석을 사용하였다.

연구결과

총 321 명의 환자 (남자 171 명, 여자 150 명, 평균나이: 54.4 세)를 대상으로 1014 개의 임플란트가 식립되었다. 그 중 29 명의 환자에서 총 34 개의 임플란트가 골유착에 실패하여, 초기실패율은 3.4% 였다. 단변량 분석결과 임플란트의 초기실패는 흡연 ($p < 0.05$), 임플란트 식립부위 ($p < 0.05$), 골질 ($p < 0.05$), 임플란트 식립시기 ($p < 0.01$), 수평적 골이식술 ($p < 0.05$)에 유의한 상관관계를 보였다. 다변량 로지스틱 회귀분석 결과, 임플란트 초기실패는 흡연 (OR = 2.7, $p < 0.05$), 골질 (OR = 2.0, $p < 0.05$), 임플란트 식립시기 (OR = 3.9, $p < 0.01$), 수평적 골이식술 (OR = 2.3, $p < 0.05$)과 유의한 상관관계를 보였다. 결론적으로 임플란트의 초기실패는 환자의 전신적인 요소와 국소적 요소와 관련이 있으므로, 임플란트 식립 시 초기실패의 위험요소를 고려하여 신중하게 식립하여야 한다.

주요어: 임플란트 초기실패, 위험요소, 골유착 실패

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