Evaluation of failed implants and re-implantation at a previously dental implant failed site: survival rate and risk factors

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The Doctoral Dissertation
submitted to the Department of Dentistry
and the Graduate School of Yonsei University
in partial fulfillment of the requirements for the degree of
Ph.D. in Dental Science

Yu-Seon Park

This certifies that the Doctoral Dissertation
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The Graduate School
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December 2021

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Abstract

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While many studies have reported that the survival rate of implants is high, implant failure is still a matter of concern. Re-implantation is the first treatment option for a failed implant. However, various factors including patient oriented factors and implant-oriented factors may affect the failure and re-failure of implantation. The purpose of this study was to evaluate failed implants and reimplantation survival. The relative risk factors of implant re-failure were also identified.

A total of 91 dental implants were extracted between 2006 and 2020 at the National Health Insurance Service Ilsan Hospital, including 56 implants in the maxilla and 35 implants in

the mandible that were removed from 77 patients. Patient information (such as age, gender, and systemic diseases) and surgical information (such as the date of surgery and location of the implants and bone grafts) were recorded. If an implant prosthesis was used, prosthesis information was also recorded.

A total of 91 first-time failed dental implants in 77 patients were analyzed in this study. Of them, 69 implants in 61 patients received reimplantation after failure. Sixteen patients (22 implants) refused reimplantation or received reimplantation at a different site. Eight of the 69 reimplants failed again. The one-year survival rate of the 69 reimplants was 89.4%. Of the related factors, age at reimplantation and a smoking habit significantly increased the risk for reimplantation failure. However, a history of taking anti-thrombotic agents showed a statistically negative association with reimplantation failure. Of the failed implants, 66% showed early failure and 34% showed late failure of the initial implantation. Of the eight with re-failed implants, all reimplants showed early failure. Only three of these eight failed reimplants were re-tried and all the second reimplants survived.

The total survival rate of implants, which included reimplants and second reimplants was 99.2%, although the survival rate of the initial implantations was 96.3%. A previous failure did not affect the success of the next trial. Reimplantation failure was more strongly affected by patient factors than by implant factors. Therefore, each patient's specific factors need to be meticulously controlled to achieve successful reimplantation.

Keywords: Dental implants, risk factors, survival rate

I. Introduction

Dental implants are increasingly used as restorative therapy for partially or completely edentulous patients. Various studies have shown that implants are predictable substitutes for missing teeth, with the 5-year survival rate of implant-supported prostheses reported to be 97.1% by Pjetursson et al. [1]. Furthermore, a systematic review [2] reported that the survival rate in 12–74 months of follow-up was 91.5%. Although the overall survival rate is high, implant failure remains a concern for clinicians.

Multiple etiological factors contribute to implant failure, which can be divided into early and late according to the timing of implant loss. Early implant failure refers to implant loss before occlusal loading [3]. It occurs mainly due to the lack of osseointegration [4]. Late implant failure occurs after functional loading, and it is caused by biological or mechanical complications [4, 5].

Systematic reviews have reported that dental implant survival is associated with smoking, systemic disease, and a history of periodontitis [6, 7]. The size, length, and surface of the dental implant can also affect implant failure [8, 9]. Peri-implantitis is a major biological complication that can lead to implant failure with symptoms of marginal bone loss, suppuration, and implant mobility [7]. Timely identification of peri-implantitis can provide an opportunity to treat and save implants using non-surgical or surgical methods [10-12]. Nevertheless, if the treatment outcomes are not predictable, the clinician and the patient

may consider removing the implant.

Mechanical complications are associated with bruxism, heavy occlusal force, and cantilever-type prostheses [13]. Off-axis forces and mechanical overloading contribute to implant fixture fractures or de-osseointegration [13], which can also lead to implant removal.

In most cases of dental implant failure, reimplantation is the first choice. If the cause of failure is that the first implant was not assessed properly, the reimplant could fail again for similar reasons. However, few studies have investigated reimplantation outcomes with consideration of factors that can increase the survival rate of reimplants [14, 15].

Thus, the purpose of this study was to evaluate failed implants and the survival of reimplants. In addition, the relative risk factors for implant re-failure were identified.

II. Materials & Methods

1. Subjects

A total of 91 failed dental implants in 77 patients of 2,442 dental implants placed in 1,751 patients between June 2006 and March 2020 at the Department of Periodontology at National Health Insurance Service Ilsan Hospital (Korea) were evaluated. The data were collected through clinical chart reviews.

The inclusion criteria for reimplantation were:

1. Patients aged 20 to 80 years who received reimplantation.
2. No implant was previously placed into the site where the initial implant was placed.
3. Both the initial implantation and the reimplantation had been performed at the Department of Periodontology at National Health Insurance Service Ilsan Hospital.

The exclusion criteria for reimplantation were:

1. Patient refused reimplantation.
2. The implantation site was changed at the time of reimplantation.
3. Insufficient surgical details were recorded in the chart.

The study protocol was reviewed and approved by the Institutional Review Board of National Health Insurance Service Ilsan Hospital (approval number: NHIMC 2019-07-021).

2. Retrospective data collection

Data such as patient factors, surgical information, and other factors were recorded retrospectively.

The patient factors were:

- Sex
- Age at reimplantation
- Hypertension (HTN)
- Diabetes mellitus (DM)
- History of taking an anti-thrombotic agent
- Smoking habit
- Single site failure or multiple site failure

The surgical information collected included:

- Surgery date (for the initial implantation, reimplantation and second reimplantation)
- Site (maxilla or mandible, anterior or posterior)
- Submerged implant (for the initial implantation, reimplantation and second reimplantation)
- Use of bone graft (for the initial implantation, reimplantation and second reimplantation)

Other factors collected included:

- Failure time (early or late failure)
- Time of reimplantation (immediate, early, or late)
- Fixture change between the first implantation and second implantation (design, diameter, and length)

- Prosthodontic details (single or splinted, or bridge, cement or screw)

In the category of other factors, early failure referred to implant failure before connection of the prosthesis and late failure referred to failure after connection of the prosthesis to the implant. The timing of reimplantation was divided into immediate, early, and late because each reimplantation case had a different interval after the initial implant removal. Immediate reimplantation referred to reimplantation immediately after removal of the initial implant. Early reimplantation was performed within 16 weeks after the removal of the initial implant, and late reimplantation referred to reimplantation after 16 weeks. All fixtures in this study had moderately rough surfaces (Straumann [Basel, Switzerland], Dentium [Suwon, Korea], Osstem [Busan, Korea], Zimmer Biomet [Palm Beach Gardens, FL, USA] and Shinhung [Seoul, Korea]) and it was recorded whether there was a change in the fixture design (tissue level type or bone level type), diameter, or length.

Sixteen patients refused reimplantation. Thus, 69 reimplants were placed for 91 failed implants. The characteristics of the reimplants were recorded. Of the 69 reimplants in 61 patients, 8 reimplants failed again in 7 patients. These failed reimplants were evaluated and compared with the previously failed implants.

3. Statistical analysis

Statistical analyses were performed using SPSS version 23 (IBM ., Armonk, NY, USA) with a significance level of 5%. Survival analysis was performed using the Kaplan-Meier method. Different cross-analysis statistical methods for failure rates were used due to differences in the number of subjects between the groups. Failure rates were compared

between initial implantation and reimplantation using the Fisher exact test. Separately, the failure rate of implants placed with a bone graft was compared using the chi-square test. Factors affecting implant failure were determined using Cox regression analysisaffecting implant failures were determined using Cox regression analysis.

III. Result

1. Study population

Patient-related information for the study is summarized in Table 1. The mean age of the patients at the first failure was 60 years (range, 20–85 years). Of 77 patients who lost implants, 21 (27%) had HTN and 7 (9%) had DM. Fifteen (19%) patients were smokers, 7 patients were taking anti-thrombotic agents, and 13 patients had implant failures at multiple sites. After the removal of the failed implants, only 61 patients received reimplantation at the same site. Of them, 7 patients had reimplant failures. Of these 7 patients, 1 patient had failures of the reimplants at multiple sites.

The associations between the first reimplantation failure and patient factors (age, systemic disease, and smoking status) were analyzed using a univariate Cox regression model (Table 2). The age at reimplantation and a history of taking antithrombotic agents showed statistically significant associations with reimplant failure, although reimplant failure showed no statistically significant association with sex, HTN, DM, or smoking status. However, in multiple regression analysis (Table 2), smoking significantly increased the risk for reimplant failure.

2. Survival rate and failure rate

Figure 1 demonstrates the overall failure rate. Implant failure was observed in 3.7% of the implants and 4.4% of the patients, while 11.6% of reimplants in 11.5% of the patients failed again. The difference in failure rates between the initial implants and the reimplants

was statistically significant (P< 0.05, Fisher exact test). However, the failure rate of reimplantation at the previously failed site was 11.6% due to spontaneous falling out or explantation, with 8 instances of implant re-failure. Three of them received a second reimplantation, and all of the second reimplants survived.

The cumulative survival rate of reimplants was calculated using Kaplan-Meier curve analysis. The 1-year survival rate of the 69 reimplants was 89.4% (Figure 2).

3. Failure time and reasons for failure

The early failure rate was 66% and the late failure rate was 34% for failed implants. The reasons for the 91 failed implants were analyzed separately for early and late failures (Table 3). Most early failures had an unspecified cause (35%). Inflammation and infection accounted for 32% and 22%, respectively, of the early failures. Other causes included iatrogenic problems (malposition and nerve damage) and fixture problems. The reasons for late failures included biological problems (i.e., peri-implantitis) in 19 (61%) of a total of 31 cases, accounting for more than half of the late failures. The other causes of late failures included unspecified reasons, overloading, infections, and fixture problems.

Eight reimplantation failures were seen in 0–5 months after the reimplant was placed and they were all early failures (Table 3). In the univariate Cox regression model, the failure time of the initial implantation was not significantly associated with reimplant failure (Table 2). There were no cases of second reimplant failure by the last follow-up date.

4. Surgical site

Of the 91 failed implants included in this study, 56 were in the maxilla (11 anterior and 45 posterior) and 35 were in the mandible (2 anterior and 33 posterior) (Table 4). Thirty-one initial implants failed at the maxillary first-molar area, which was the most common failure site (34%). Regarding the site of the 8 reimplantation failures, there were 7 reimplants in the maxilla (1 anterior and 6 posterior) and 1 reimplant in the posterior mandible. In the univariate Cox regression model, the surgical site (anterior or posterior, maxilla or mandible) was not significantly associated with reimplant failure (Table 2).

5. Bone grafting

Among the 91 implants, 74.7% underwent simultaneous bone grafting with the initial implantation (Table 4). Bone grafting was categorized based on the method, as simple bone graft, guided bone regeneration (GBR), osteotome sinus floor elevation, bone-added osteotome sinus floor elevation, sinus elevation by the lateral approach, and 2 or more of the above. Sixty-nine reimplants were placed at the previously failed site and only 28 cases were reimplanted with a bone graft. Of the 8 failed reimplants, 6 (75%) sites received bone grafting with the reimplantation. Bone grafting in the initial implantation and reimplantation was not significantly associated with reimplantation failure in the Cox regression analysis (Table 2). However, the log-rank test in the Kaplan-Meier curve analysis showed that bone grafting with spontaneous reimplantation at the failed site had a statistically significant negative effect on the survival rate of the reimplant (P=0.035).

6. Nonsubmerged and submerged implants

Among 91 failed implants, 47 implants were nonsubmerged and 44 implants were submerged (Table 4). At the reimplantation, 25 implants were nonsubmerged and 44 implants were submerged. Among the 69 reimplants, two nonsubmerged reimplants and 6 submerged reimplants failed. There were no significant differences in reimplantation failure between nonsubmerged or submerged initial implantations and reimplantations by Cox regression analysis (Table 2).

7. Timing of reimplantation

The interval from the intitial failure to the reimplantation ranged from 0 and 12 months. The timing of reimplantation was divided into immediate, early, and late. Fourteen cases were immediately reimplanted among 69 reimplants. Twenty-eight cases were early reimplantations and 26 cases were late reimplantations. In the Cox regression analysis, there was no significant association between the timing of the reimplantation and reimplantation failure (Table 2).

8. Fixture change and prosthodontic details

There were 20 cases of fixture design changes, 19 cases of fixture diameter changes, and 36 fixture length changes. Also, 27 cases (17 single crowns and 10 multiple crowns) had prostheses at the initial implantation. However, due to the lack of cases for analysis, the statistical result was derived only with fixture length change and there was no significant association with reimplantation failure (Table 2).

9. Multivariate Cox regression analysis

The multivariate Cox regression model included age at reimplantation, HTN, DM,

taking an antithrombotic agent, smoking, use of a bone graft at the first implantation, the surgical site (maxilla or mandible), time of the first implant failure (early or late), fixture length, and use of a bone graft at the implantation, which were thought to be relevant. Finally, three variables (DM, smoking, and age at reimplantation) remained (Table 2). Age at reimplantation and smoking significantly increased the risk of reimplant failure.

IV. Discussion

There was a clear discrepancy in the failure rate between the initial implantation and reimplantation at the failed site in the present study. Several studies have reported lower survival rates for reimplants, similar to this study. Systematic reviews have also reported survival rates of reimplantation from 71% to 100% [16] and 88.7% [17]. A higher failure rate was observed for reimplants than for the initial implants. Thus, additional precautions are required during reimplantation at a previously failed site. The purpose of the present study was to determine the outcomes of reimplantation and to identify the factors influencing survival.

Patient-related factors such as age, sex, HTN, DM, and smoking status were evaluated. Among these factors, age at reimplantation was positively associated with the failure rate of the reimplants. Aging jeopardizes proper bone healing because it negatively impacts the inflammatory phase [18]. Increasing age could be associated with an increased risk of tissue damage because of a dysregulated immune response and the persistence of inflammatory cells in the periodontal tissue [19]. There was also less plaque accumulation on implants, and the peri-implant mucosa showed a stronger response than the gingiva around the teeth in elderly patients [20]. For reimplant survival, oral hygiene, poor local bone quality, poor bone quantity, and the biological mechanism of bone remodeling, which leads to osseointegration, are more important risk factors than age [21]. Therefore, age should be considered a risk factor, not a contraindication.

Multiple researchers [22, 23] have observed that smoking history did not affect the failure rate of reimplantation. However, Alsaadi et al. [24] reported a higher failure rate of implants in patients who smoked more than 20 cigarettes a day. A systematic review reported that smoking negatively influenced bone healing [25]. Smoking history was statistically significant in the multivariate analysis in the present study. In particular, reimplantation failure more frequently occurred in smokers (HR=4.79) (Table 2). Exposure to nicotine has been reported to affect osteogenesis and angiogenesis and to be associated with an increased risk of implant failure [26]. The smokers who experienced reimplant failure did not quit smoking in the present study and showed a higher failure rate. Therefore, smoking could be a potent risk factor for reimplantation failure, especially heavy smoking.

HTN was observed to be unrelated to reimplant failure. However, taking an antithrombotic agent had a significantly negative correlation with reimplantation failure in the univariate Cox regression analysis. Chrcanovic et al. [27] reported that reimplant failure was not related to HTN, although a higher implant failure rate was observed in patients taking antithrombotic agents. Conversely, Agari et al. [14] reported that patients taking antithrombotic agents had lower failure rates of reimplantation. They explained that these agents could protect bone regeneration and osseointegration during implant placement [14]. In addition, some studies reported that the use of an antithrombotic agent such as aspirin contributed to better bone healing by regulating bone remodeling factors [28, 29].

Several studies reported that well-controlled DM was not a risk factor for dental implant survival [27, 30, 31]. However, DM still showed a tendency to affect the rate of reimplant

failure in this study,, although the relationship was not statistically significant. Hyperglycemia can inhibit osteoblastic differentiation and affect proper bone remodeling [32]. Patients with poorly controlled DM tended to have delayed osseointegration compared to healthy patients [31]. In animal studies, rats with uncontrolled DM showed decreasing bone-to-implant contact with time [30]. Moreover, Alberto et al. [33] reported that DM was a high-risk factor for peri-implantitis, which can lead to implant failure. Thus, clinicians should be aware that DM could be a risk factor for reimplantation failure. If it is not controlled, this risk can become more serious.

In this study, the reimplant failures were all early failures, before the implant prosthesis was connected. There was no statistically significant difference in reimplant failure according to the time of the previous failure (early or late), indicating that a previous failure did not affect the success of the next trial. A higher implant failure rate was observed when a bone graft was used at reimplantation than when a bone graft was not used. This may not be a problem inherently related to bone grafts; rather, once a dental implant fails, it may form a larger defect and create poorer bone quality, with a lack of bone volume, which increases the failure rate of reimplants [34]. The implant removal site is usually made to form a 3-wall defect [35]. For subsequent implant placement, GBR can give good results when the implant is removed [35]. Similar to this study, other studies have also observed a tendency for early failure in reimplants [14, 23, 36]. Some studies have suggested that site-specific conditions of the failed site can interfere with the osseointegration of reimplants and lead to early failure [14, 27].

The second reimplantation (third trial) was observed to succeed in 3 out of 3 cases, with a failure rate of 0% as of the final follow-up in this study. The main focus of the second reimplantation was to eliminate the risk factors of previous trials. Patients with DM needed to control their glucose levels and smokers were advised to quit smoking. If the patient was unable to quit smoking, the third trial was abandoned based on a consideration of various site factors. Moreover, patients waited for a longer period than in previous attempts to compensate for the compromised bone quality and quantity of the re-failed site. The average waiting time for these 3 second reimplants for occlusal loading with a prosthesis after the second reimplant placement was 13 months, which was longer than the general waiting time [37]. Vayron et al. [38] performed animal studies and found that a longer waiting period after implantation was associated with a higher bone-to-implant contact ratio. As in this study, for implants placed in poor-quality bone, a higher bone-to-implant contact ratio was associated with better stress distribution for the contacted bone when masticatory pressure was applied to the implant [39]. Accordingly, the possibility of implant failure may decrease.

This study had some limitations. First, failed implants performed by 3 or more clinicians were collected and analyzed. There might have been differences in the technique of each clinician. Further analysis was also difficult due to the lack of implantation site information, such as bone quality and quantity. Moreover, some statistical analyses could not be performed because there were not many failed implants.

V. Conclusion

The 1-year survival rate of reimplantation was 89.4%. The failure rate of the reimplants was higher than that of the initial implants. To decrease the failure rate of reimplants, clinicians should make efforts to find and analyze the factors affecting previous failures and extend the submerged period after implantation. At the same site, the total survival rate of implants (including reimplants and second reimplants) was 99.2%, although the survival rate of the initial implants was 96.3%. A previous failure did not affect the success of the next trial. Failure of reimplantation was more strongly affected by patient factors than by implant factors. Therefore, each patient's specific factors need to be meticulously controlled to achieve successful reimplantation.

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Figure legends

Figure 1. Overall failure rate.

Figure 2. Cumulative survival rate of reimplantation (Kaplan-Meier curve analysis).

The blue line indicates cumulative survival of reimplantation and the green line indicates cumulative survival of the second reimplantation.

Table

Table 1. Demographics of patients with failed implants and failed reimplants

Variables		**1st failure (%)** ***N*** **= 77**	**2nd failure (%)** ***N*** **= 7**
Sex	Male	43 (55.8%)	4 (57.1%)
	Female	34 (44.2%)	3 (42.9%)
Age at reimplantation		60(yr; range 20-80)	61(yr; range 40-76)
Systemic disease	Hypertension	21 (27.2%)	4 (57.1%)
	Diabetes mellitus	7 (9.1%)	1 (14.3%)
	Taking anti-thrombotic agent	7 (9.1%)	2 (25.0%)
Smoking		15 (19.4%)	3 (42.8%)
Multiple site failure		13 (16.9%)	1 (14.3%)

Table 2. Cox regression model of relative factors for reimplant failure

		Survival (N=61)	Fail (N=8)	Univariate		Multivariate	
				HR	***P*-value**	**HR**	***P*-value**
Sex	Male (ref.)	34	5	1.329	0.697		
	Female	27	3				
Age at reimplantation	26 (younger, ref.) to 76			1.083	0.020[a)]	1.097	0.008 *
Hypertension	No (ref.)	42	4	0.502	0.330		
	Yes	19	4				
Diabetes mellitus	No (ref.)	58	7	0.380	0.366	8.134	0.083
	Yes	3	1				
Antithrombotic agents taking	No (ref.)	58	6	0.172	0.032[a)]		
	Yes	3	2				
Smoking habit	No (ref.)	48	4	0.297	0.087	4.789	0.042 *
	Yes	13	4				
Anterior-posterior	Anterior (ref.)	10	1	0.701	0.739		
	Posterior	51	7				
Maxilla-mandible	Maxilla (ref.)	38	7	3.842	0.208		
	Mandible	23	1				
Bone graft at initial implantation	No (ref.)	16	1	0.456	0.463		
	Yes	45	7				
Nonsubmerged or submerged at initial implantation	Nonsubmerge (ref.)	31	2	0.646	0.550		
	Submerged	30	6				
Early-late failure of initial implantation	Early (ref.)	18	7	3.967	0.197		
	Late	43	1				
Timing of reimplantation	Immediate (ref.)	12	2				
	Early	24	4	1.041	0.963		
	Late	25	2	0.521	0.515		
Fixture length change	No (ref.)	31	5	2.007	0.340		
	Yes	30	3				
Bone graft at	No (ref.)	39	2	0.211	0.057		

reimplantation	Yes	22	6		
Nonsubmerged or submerged at reimplantation	Nonsubmerge (ref.)	23	2	1.684	0.523
	Submerged	38	6		

All HRs listed are with respect to the reference categories. The multivariate analysis of this model included age at reimplantation, hypertension, diabetes mellitus (DM), taking an antithrombotic agent, smoking, a bone graft at initial implantation, the implantation site (maxilla or mandible), failure time of initial implantation (early or late), and a bone graft at reimplantation, which were thought to be highly relevant. Finally, 3 variables (DM, smoking, and age at reimplantation) remained.

HR, hazard ratio; ref., reference.

A hazard ratio > 1 suggests an increased risk for reimplantation failure.

a) Statistically significant difference compared to the reference, $P<0.05$.

Table 3. Reasons for early and late failures of the initial implantation, reimplantation and second reimplantation

Reasons	Failures					
	Initial implantation *N*(%)		Reimplantation *N*(%)		Second reimplantation *N*(%)	
	Early	Late	Early	Late	Early	Late
Unspecified	21(35%)	4(12.9%)	6(75%)	0	0	0
Inflammation	19(31.7%)	19(61.3%)	1(12.5%)	0	0	0
Infection	13(21.7%)	1(3.2%)	1(12.5%)	0	0	0
Iatrogenic	6(10%)	0	0	0	0	0
Fixture problem	1(1.7%)	3(9.7%)	0	0	0	0
Overloading	0	4(12.9%)	0	0	0	0
Total *N*	60(66%)	31(33%)	8(100%)	0	0	0

Table 4. Characteristics of failed implant and failed reimplant sites

Variables		1st fail (%) $N = 91$	2nd fail (%) $N = 8$
Site	Maxilla	56 (61.5%)	7 (87.5%)
	Mandible	35 (38.5%)	1 (12.5%)
	Anterior	13 (14.2%)	1 (12.5%)
	Posterior	78 (85.7%)	7 (87.5%)
Submerged	Nonsubmerged	47 (51.6%)	2 (25.0%)
	Submerged	44 (48.4%)	6 (75.0%)
Bone graft	Yes	23 (25.3%)	6 (75.0%)
	No	68 (74.7%)	2 (25.0%)

Figures

Figure 1

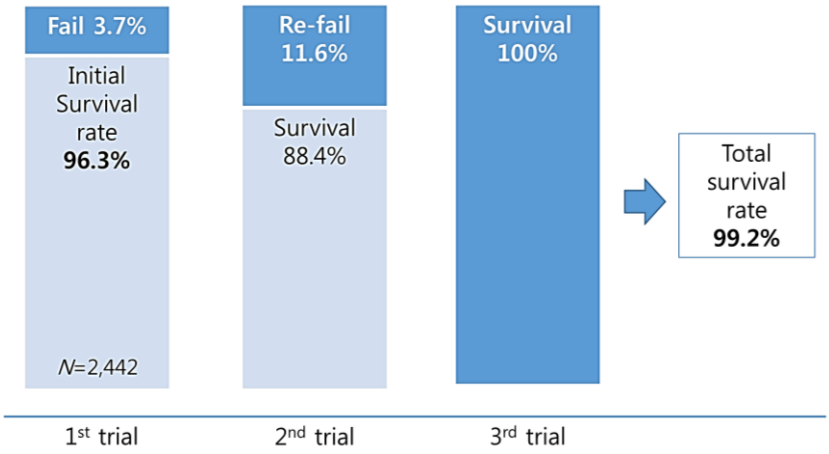
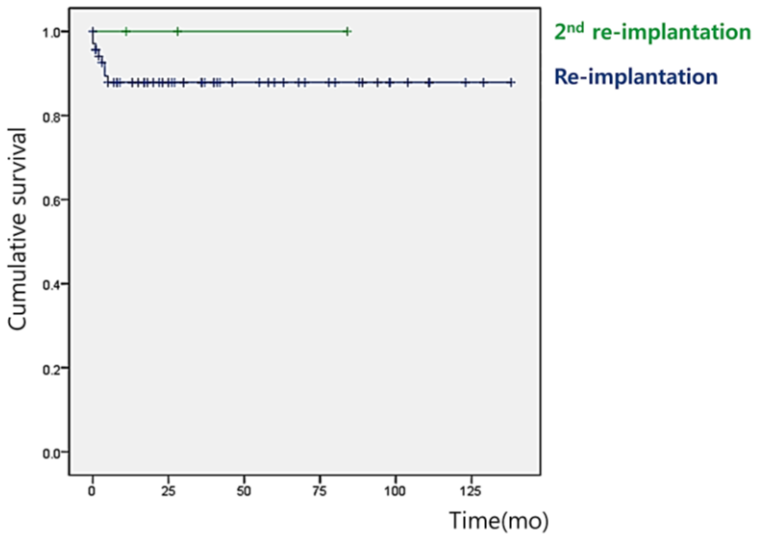


Figure 2



국문요약

실패한 임플란트와 이전에 실패한 부위에 재식립된 임플란트에 대한 평가: 생존율과 위험요소

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박 유 선

다수의 논문에서 임플란트의 높은 생존율이 보고 되고 있지만, 여전히 임플란트의 실패는 문제가 되고 있다. 이전에 실패한 부위에서 임플란트의 재식립은 치료의 첫 번째 선택지가 될 수 있다. 그러나 임플란트 재식립 시, 이전에 발거한 임플란트가 실패했던 이유를 분석하고 고려하지 않는다면 재식립된 임플란트도 실패할 가능성이 높다. 본 연구에서는 실패한 임플란트와 그 환자들을 통해 임플란트 실패에 영향을 미치는 요인들을 분석하고 재식립된 임플란트의 실패를 막기 위한 요인들을 알아보고자 한다.

국민건강보험 일산병원에서 2006년에서 2020년 사이 발거된 91개의 임플

란트 (상악 56개, 하악 35개), 77명의 환자 (남성 43명, 여성 34명)를 대상으로 연구하였다. 나이, 성별, 전신질환 등 환자 정보 및 수술 일자, 임플란트 식립 위치, 골이식 여부, 임플란트 보철 여부 및 합병증 여부 등이 기록되었다.

61명의 환자에서 69개의 임플란트만 실패 후 동일 부위에 재식립 되었다. 16명의 환자 (22개의 임플란트)는 임플란트 재식립을 원치 않았거나 식립 부위를 옮겨서 임플란트를 진행하였다. 69개의 재식립된 임플란트 중 8개가 실패하였으며 69개의 재식립된 임플란트의 1년 생존율은 89.4%로 분석되었다. 분석된 관련 요소 중에 임플란트 재식립 시의 나이와 흡연력이 재식립된 임플란트의 실패를 증가시키는 위험 요소로 관찰되었다. 그러나 항응고제를 복용하는 환자들에서 재식립된 임플란트의 실패 위험이 유의하게 낮은 것으로 관찰되었다. 실패한 임플란트의 시기는 첫 번째 식립 시에는 66%가 조기에 실패하였으나, 재식립 시에는 실패한 8개 임플란트 모두 조기에 실패하였다. 재식립에 실패한 임플란트 중 3개의 임플란트가 세 번째로 식립이 시도되었으며, 모두 생존하였다. 한 부위에서 최초로 식립된 임플란트의 생존율은 96.3%였고, 재식립된 임플란트를 포함한 최종 생존율은 99.2%였다.

동일 부위에서 임플란트 재식립 시에 이전의 실패가 다음 임플란트의 생존에 영향을 주지 않으며, 임플란트의 반복되는 실패는 임플란트 자체 요인보다는 환자 요인에 더 영향을 받는다. 따라서, 실패한 부위에서의 성공적인 임플란

트 식립을 위해서는 각 환자의 관련 요소들을 파악하고 세심하게 조절해야 할 필요가 있다.

핵심되는 말 : 생존율, 위험 요소, 치과 임플란트