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A Multicenter Clinical Study on the Survival and Success Rates of Two Commercial Implants of Korea according to Loading Period

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Purpose: The purpose of this study was to evaluate the survival and success rates of Korean Osstem implants US II Plus, GS II following loading period.

Materials and Methods: Dental records were obtained in total 201 patients who were treated with Korean Osstem implants US II Plus, GS II on both maxillary and mandibular anterior and posterior areas in six different clinics for 2 years from January 2007 to December 2008. Total 430 implants were evaluated clinically and radiographically using predefined success criteria prospectively and following results were obtained.

Result: US II Plus, GS II implants showed high survival rates of more than 99% and high success rates more than 90% independent of loading period. As a result of cross analysis to evaluate clinical significance between implant loading period and success rate, the P-value of US II Plus was 0.10 (P>0.05), and the P-value of GS II was 0.17 (P>0.05), which showed no statistical significance. Bone quality, smoking, and edentulous state are factors that can affect the survival and success rates following differently loaded implants, but did not significantly affect in this study.

Conclusion: These results suggest that selection of loading period of Korean Osstem implants US II Plus, GS II would be done carefully considering implant install area, the quality alveolar bone, the state of edentulous ridge and experience of operator, though they showed clinically good results on both maxillary and mandibular anterior and posterior areas.

Key Words: GS II; Immediate dental implant loading; Osstem implant; Success rate; Survival rate; US II plus

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Introduction

Thanks to the development of materials and surgical method, implant treatment has become a general method to recover the lost masticatory function and esthetics resulting from the loss of teeth. During the initial period when the surface treatment skills of implants were not developed, 2-stage surgery where the inserted implants were exposed and abutment posts were connected inside the mouth after having a healing period of 3 to 6 months without applying loading after implants were placed for osseointegration were recommended. Recently, however, numerous methods that can reduce treatment period from the time of placing implants to the use of final prosthesis, such as the one-stage surgery where abutment posts are connected immediately after placing implants to satisfy patients' desire to get fast treatment along with the development of the surface treatment skills, were introduced[1-4].

In the existing conventional loading, there were healing periods after implant placement for approximately 6 months in general in the case of maxilla or 3 months for mandible, and loading was applied to implants after verifying sufficient osseointegration of the periotic bone[5]. If success rate similar to existing methods can be obtained even after reducing or eliminating the healing period, patients' discomfort can be decreased by reducing overall treatment period. In 2003, Aparicio et al.[6] classified loading applied to implants by time and called immediate loading if loading is applied after connecting temporary prosthesis within 3 days to 1 week after implant placement, early loading is loading is applied after connecting temporary prosthesis earlier than 3 to 6 months, the normal healing period after implant placement and delayed loading if prosthesis are installed through the second procedure after healing for more than 3 to 6 months, the normal healing period. With the advent of the 2000s, there were many international agreement regarding the definition of such loading types[7], and recently, early loading is recognized as a case where loading is applied within 1 week to 2 months after placing implants[8].

Recently, researches were carried out on survival rate and success rate in case of early loading after implant placement; however, they are very controversial. This paper therefore has carried out clinical trials on factors that can affect the survival rate, success rate and the impacts of implants.

Materials and Methods

1. Objects of Researches

This study was carried out on a total of 201 patients who, for 2 years from January 2007 to December 2008, visited in six different clinics to have Osstem implants placed and they were followed up for at least 1 year after applying loading at many different time. The following patients were excluded from this study. 1) Patients who are younger than 18 years of age, 2) patients who are pregnant or suffering from severe systemic disease, 3) patients who require additional surgery on the implant placement area (such as bone augmentation), 4) patients who are less cooperative, 5) patients whose extraction areas are not fully healed, and 6) patients whose initial insertion torque is less than 15 Ncm during inserting implants.

2. Method of Study

This study is related to US II Plus (Osstem Co., Seoul, Korea) and GS II (Osstem Co.) implants and to enable comparison of the implant survival rate and success rate in each period prior to applying loading, the time for applying loading after implant placement was divided into 3 types considering the definition[6] of early loading. In other words, the period ranging from 1 week to 2 months for maxilla and from 1 week to 1 month for mandible were regarded as early loading, and period from 2 to 6 months for maxilla and from 1 to 3 months for

mandible were regarded as conventional loading which were again divided into 2 to 4 months and 4 to 6 months for maxilla and 1 to 2 months and 2 to 3 months for mandible. According to the order of time, in the case of US II Plus, early loading is called Group 1, conventional loading of short-term healing is called Group 2, and conventional loading of long-term healing is called Group 3. And in the case of GS II, early loading is called Group 4, conventional loading of short-term healing is called Group 5, and conventional loading of long-term healing is called Group 6. Based on the written records of implant patients prepared jointly with Osstem implant research center, diagnostic, clinical and radiological tests were conducted and the following items were investigated covering each group.

1) Distribution of Implant Placement Patients by Gender and Age

Distribution of installed implants were examined by patient's gender and age.

2) Survival Rate and Success Rate of Implants

The survival rate of implants was defined as a case according to the standards established by Buser et al.[9] in case, after placing implants up to now, the upper prosthesis function properly without any particular symptoms and even if there are some problems on the soft tissue around implants, such symptoms disappear after taking appropriate measures continuously maintaining functions. On the other hand, the success rate of implants was defined as a case based on the standards established by Albrektsson et al.[10] where there are no mobility, pains, parasthesia, radiolucent lesion or periiimplantitis at all, or there is no progressive bone resorption (less than 1.5 mm within 1 year after placing implants, and not exceeding 0.2 mm annually thereafter).

(1) Survival rate and success rate according to implant insertion area

The placement area was divided into mandibular anterior, mandibular posterior, maxillary anterior and maxillary posterior, and the survival rate and success rate of the implants placed in the vicinity were compared.

(2) Survival rate and success rate according to bone quality

Bone quality was defined as ① type 1: dense cortical bone, ② type 2: thick dense to porous cortical bone on crest and coarse trabecular bone within, ③ type 3: thin porous cortical bone on crest and fine trabecular bone within, and ④ type 4: fine trabecular bone based on the bone quality judgment criteria classified by Lekholm et al.[11] into 4 grades according to relationships between cortical bone and cancellous bone, and the quality of bone where implants were placed in each group was checked based on the findings of X-ray taken prior to surgery and the findings obtained during surgery, and the survival rate and success rate of implants were compared.

(3) Survival rate and success rate depending on whether patients smoke

Smoking patients and non-smoking patients divided in each group, and the survival rate and success rate of implants were compared.

(4) Survival rate and success rate relating to edentulous state

From each group, the edentulous states were divided into full edentulous, partial edentulous and single edentulous and the survival rate and success rate of implants were compared.

3) Clinical Significance between Implant Loading Period and Success Rate

Cross-analysis was conducted on the success rate of the 2 implants using IBM SPSS Statistics version 19.0 (IBM Co., Armonk, NY, USA), and the data statistically handled based on chi-squared tests. P-value was obtained and the data was considered statistically significant at $P<0.05$ from which clinical relationships between loading period and success rate of implants were evaluated.

Result

1. Distribution of Implant Placement Patients by Gender and Age

One hundred sixty-seven units of US II Plus implants were placed on 66 patients (38 males and 28 females), and 263 units of GS II implants were placed on 135 patients (73 males and 62 females). The average age of the implant placement patients were 47 (16 to 79 years old) in the case of US II Plus placement patients and 54 (18 to 86 years old) in the case of GS II placed patients.

2. Survival Rate and Success Rate of Implants

1) Survival Rate and Success Rate According to Placement Areas

While the survival rate according to implant placement area was 100% in the case of US II Plus, that of GS II was 98.8% and 96.6% respectively because one each case failed from Group 6 of mandibular posterior and Group 5 of the maxillary posterior. The success rate according to implant placement area in the case of US II Plus were 71.4% from Group 1 and Group 3 of the mandibular posterior, and 91.7% from Group 2 of maxillary posterior, and as for GS II, success rates were 83.3% from Group 4 of the mandibular posterior and 96.6% from Group 5 of the mandibular posterior (Tables 1, 2).

2) Survival Rate and Success Rate according to Bone Quality

In most cases, the bone quality of the area where implants were inserted were type 2 and type 3 bone quality based on the bond quality judgment criteria established by Lekholm et al.[11]. However, in the case of GS II, 10 implants were placed in type 1 and 95 implants in type 4. While the survival rate of implants related to bone quality was 100% in the case of US II Plus, GS II showed 66.7% and

Table 1. Influence of locations on US II plus implant survival and success rate

Location	Number of implant			Survival rate, n (%)			Success rate, n (%)		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Maxilla									
Anterior	8	10	1	8/8 (100)	10/10 (100)	1/1 (100)	8/8 (100)	10/10 (100)	1/1 (100)
Posterior	7	44	20	7/7 (100)	44/44 (100)	20/20 (100)	5/7 (71.4)	44/44 (100)	19/20 (95.0)
Mandible									
Anterior	4	1	7	4/4 (100)	1/1 (100)	7/7 (100)	4/4 (100)	1/1 (100)	7/7 (100)
Posterior	4	12	49	4/4 (100)	12/12 (100)	49/49 (100)	4/4 (100)	11/12 (91.7)	49/49 (100)
Total	23	67	77	23/23 (100)	67/67 (100)	77/77 (100)	21/23 (91.3)	66/67 (98.5)	76/77 (98.7)

Table 2. Influence of locations on GS II implant survival and success rate

Location	Number of implant			Survival rate, n (%)			Success rate, n (%)		
	Group 4	Group 5	Group 6	Group 4	Group 5	Group 6	Group 4	Group 5	Group 6
Maxilla									
Anterior	3	8	28	3/3 (100)	8/8 (100)	28/28 (100)	3/3 (100)	8/8 (100)	28/28 (100)
Posterior	6	59	83	6/6 (100)	59/59 (100)	82/83 (98.8)	5/6 (83.3)	57/59 (96.6)	82/83 (98.8)
Mandible									
Anterior	1	4	5	1/1 (100)	4/4 (100)	5/5 (100)	1/1 (100)	4/4 (100)	5/5 (100)
Posterior	5	29	32	5/5 (100)	28/29 (96.6)	32/32 (100)	5/5 (100)	28/29 (96.6)	32/32 (100)
Total	15	100	148	15/15 (100)	99/100 (99.0)	147/148 (99.3)	14/15 (93.3)	98/100 (98.0)	147/148 (99.3)

98.0% respectively from Group 5 of type 1 and from Group 6 of type 4. The success rate of implants according to bone quality, in the case of US II Plus, were 92.3%, 97.4%, and 97.3% respectively from Group 1 and Group 3 of type 2, and in Group 2 of type 3; however, GS II showed 66.7%, 85.7%, 95.2% and 98% respectively from Group 5 of type 1, Group 4 of type 2, and from Group 5 and Group 6 of type 4 (Table 3).

3) Survival Rate and Success Rate according to Whether Patients Smoke

The survival rate of implants in relation to smoking, in the case of US II Plus, was 100%, GS II showed 98.8% and 99.2% respectively from Group 5 and Group 6 of non-smoking patients. The success rate of implants related to smoking, in the case of US II Plus, were 99.4%, 98.4%, and 98.6% respectively from Group 1, 2, and 3 of non-smoking patients. However, GS II showed 66.7%, 97.6% respectively from Group 4 of smoking patients, and Group 5 of non-smoking patients (Table 4).

4) Survival Rate and Success Rate according to Edentulous state

The survival rate relating to the edentulous state, in the case of US II Plus, was 100%; however, GS II showed 98.7% and 99.0% respectively from Group 5

Table 3. Influence of bone quality on implant

Bone quality	US II plus			GS II		
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
			Survival rate, n (%)			
Type 1	0	0	0	0	2/3 (66.7)	7/7 (100)
Type 2	13/13 (100)	30/30 (100)	39/39 (100)	7/7 (100)	30/30 (100)	47/47 (100)
Type 3	10/10 (100)	37/37 (100)	38/38 (100)	4/4 (100)	25/25 (100)	45/45 (100)
Type 4	0	0	0	4/4 (100)	42/42 (100)	48/49 (98.0)
Total	23/23 (100)	67/67 (100)	77/77 (100)	15/15 (100)	99/100 (99.0)	147/148 (99.3)
			Success rate, n (%)			
Type 1	0	0	0	0	2/3 (66.7)	7/7 (100)
Type 2	12/13 (92.3)	30/30 (100)	38/39 (97.4)	6/7 (85.7)	30/30 (100)	47/47 (100)
Type 3	10/10 (100)	36/37 (97.3)	38/38 (100)	4/4 (100)	25/25 (100)	45/45 (100)
Type 4	0	0	0	4/4 (100)	40/42 (95.2)	48/49 (98.0)
Total	22/23 (95.7)	66/67 (98.5)	76/77 (98.7)	14/15 (93.3)	97/100 (97.0)	147/148 (99.3)

Table 4. Influence of smoking on implant success rate

Smoking	US II plus			GS II		
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
			Survival rate, n (%)			
Smoking	5/5 (100)	6/6 (100)	7/7 (100)	3/3 (100)	18/18 (100)	19/19 (100)
Non-smoking	18/18 (100)	61/61 (100)	70/70 (100)	12/12 (100)	81/82 (98.8)	128/129 (99.2)
Total	23/23 (100)	67/67 (100)	77/77 (100)	15/15 (100)	99/100 (99.0)	147/148 (99.3)
			Success rate, n (%)			
Smoking	5/5 (100)	6/6 (100)	7/7 (100)	2/3 (66.7)	18/18 (100)	19/19 (100)
Non-smoking	17/18 (94.4)	60/61 (98.4)	69/70 (98.6)	12/12 (100)	80/82 (97.6)	128/129 (99.2)
Total	22/23 (95.7)	66/67 (98.5)	76/77 (98.7)	14/15 (93.3)	98/100 (98.0)	147/148 (99.3)

Table 5. Influence of edentulous type on implant success rate

Type	US Ⅱ plus			GS Ⅱ		
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
			Survival rate, n (%)			
Full	6/6 (100)	11/11 (100)	12/12 (100)	3/3 (100)	5/5 (100)	26/26 (100)
Partial	11/11 (100)	29/29 (100)	38/38 (100)	8/8 (100)	78/79 (98.7)	98/99 (99.0)
Single	6/6 (100)	27/27 (100)	27/27 (100)	4/4 (100)	16/16 (100)	22/22 (100)
Total	23/23 (100)	67/67 (100)	77/77 (100)	15/15 (100)	99/100 (99.0)	147/148 (99.3)
			Success rate, n (%)			
Full	6/6 (100)	11/11 (100)	12/12 (100)	3/3 (100)	5/5 (100)	26/26 (100)
Partial	11/11 (100)	28/29 (96.6)	38/38 (100)	7/8 (87.5)	77/79 (97.5)	98/99 (99.0)
Single	5/6 (83.3)	27/27 (100)	26/27 (96.3)	4/4 (100)	16/16 (100)	22/22 (100)
Total	22/23 (95.7)	66/67 (98.5)	76/77 (98.7)	14/15 (93.3)	98/100 (98.0)	147/148 (99.3)

Table 6. Clinical significance between implant loading time & success rate

Statistical list	Value	df	Asymptotic Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
US Ⅱ plus					
Pearson chi-square	4.54	2	0.10	0.16	
Likelihood ratio	3.10	2	0.21	0.25	
Fisher's exact test	3.62				
Linear-by-linear association	2.71	1	0.10	0.15	0.10
Number of valid cases	167				
GS Ⅱ					
Pearson chi-square	3.51	2	0.17	0.15	
Likelihood ratio	2.48	2	0.29	0.37	
Fisher's exact test	3.74			0.15	0.11
Linear-by-linear association	2.84	1	0.09	0.11	
Number of valid cases	263				

df: degrees of freedom, Sig.: significance.

and Group 6 of partial edentulous state. The success rate of implants related to edentulous state, in the case of US II Plus, were 96.6%, 83.3%, and 96.3% respectively from Group 2 of partial edentulous state, Group 1 and 3 of single edentulous state. However, GS II showed 87.5%, 97.5%, and 99% respectively from Group 4, 5, and 6 of partial edentulous state (Table 5).

3. Clinical Significance between Implant Loading Period and Success Rate

A cross-analysis was carried out to examine the clinical significance between implant loading period and success rate. The results, in the case of US II Plus, showed 91.3% from Group 1, 98.5% from Group 2 and 98.7% from Group 3, and the P-value of the chi-squared tests was 0.10 (P>0.05), indicating there is no statistical significance between the loading period and success rate. GS II also showed success rate of 93.3% from Group 4, 98.0% from Group 5 and 99.3% from Group 6, and the P-value of the chi-squared tests was 0.17 (P>0.05) indicating no statistical significance between loading period and success rate (Table 6).

Discussion

Since implants began being used, many follow-up studies have been carried out regarding long-term prognosis, and numerous studies reported extremely high success rate of more than 90%[1-5,12,13]. Implant treatment may be evaluated based on mainly survival rate and success rate. The implant survival means a case where there are no particular pains, level of mobility or inflammation when implants are not removed and functions are maintained without any disorder, the implant success means a case where no radiographic image is shown in the vicinity implants, no pains are induced when functioning, adjacent anatomical structures are not affected, and the loss of upper alveolar bond is less than 1.5 mm within the first year after implants began functioning, and the annual bone loss thereafter is less than 0.2 mm[10].

In this study, US II Plus showed 100% survival rate where all implants functioned satisfactorily without having to remove any implants due to failure, while GS II also showed survival rate of 98% and 99.3% respectively from Group 5 and Group 6. During the process of using GS II, there was an implant which was removed due to abnormal reaction of the mandibular posterior; however, this is believed to be due to lack of healing period, and there was an implant reinsertion in the case of the maxillary posterior due to abnormal mobility seemingly resulting from overloading. Park et al.[14] stated that 100% success rate was shown in all implants of US II Plus and GS II. This study also showed extremely high survival rate in both US II Plus and GS II irrespective of loading period even though not 100%.

The success rate of implant, in the case of US II Plus were 71.4% from Group 1 and Group 3 of maxillary posterior area, 91.7% from Group 2 of mandibular posterior, and 100% from the groups in remaining areas, and the average success rate of US II Plus was 97.6%, an extremely high level. On the other hand, success rate, in the case of GS II, was 83.3% from Group 4 of maxillary posterior area, 96.6% from Group 5 of maxillary posterior area and 100% from the groups in the remaining area and the average success rate of GS II was also 98.9%, an extremely high level. Compared with 96.2%, the success rate of Avana implants reported by Lee et al.[15], the aforesaid average success rate is higher, while success rate was higher than even 93.8%, the upper jaw success rate of the Si implants reported by Lazzara et al.[16] and 97%, the success rate of the lower jaw. In particular, high success rate carries meaning in the sense that this study contains implants to which early loading is applied. Martínez-González et al.[17], in their researches carried out regarding the early loading of implants, reported that success rate was 95.7%. On the other hand, Chiapasco et al.[18] reported 98% success rate when early loading is applied after inserting implants. Even though the success rate of 91.3% from Group 1 of US II Plus and 93.3% from Group 4 of GS II to which early loading is applied in this study were somewhat less compared with the preceding studies, this is believed to be due to small number of implants within groups, and results similar to those of the preceding studies are expected to be shown once the number of implants increases.

Douglass and Merin[19] reported that, if implants are placed immediately after extraction, there should not be any bone loss resulting from paradental diseases, and implant should carry appropriate level of alveolar bone, and dense alveolar bone equivalent to type 2 and type 3 shown in the bone quality classification established by Lekholm et al.[11]. In addition, the bone quality is known to be an extremely important factor for success in general implant operation[20]. In this study, most implants were inserted in type 2 and 3 alveolar bone, and In case of GS II, 10 implants were inserted in type 1 and 95 implants in type 4. On the other hand, Jaffin and Berman[21] reported that while the success rate of Brånemark implants was 97% in type 1, 2, and 3 bone quality, but decreased to 65% in type 4. In

this study, 1 of 3 implants failed from Group 5 of type 1 numerically indicating low survival rate and success rate. In connection with this, however, it seems necessary to carry out additional researches on more implants, and high survival rate and success rate displayed irrespective of loading period from type 4 bone quality, which are similar to the results of researches conducted by Kim et al.[22] that reported high success rate 98.8% from type 4 bone quality.

Smoking, the general social habits, is known as a factor that hinders healing. In meta-analysis related to smoking and based on review of related literature, Strietzel et al.[23] stated that smoking is a factor that can adversely affect implant healing. In this study, the survival rate of implants related to smoking, in the case of GS II, showed slightly low numerical value in non-smoking patients, and the survival rate, in the case of US II Plus, were 94.4%, 98.4% and 98.6% respectively from Group 1, 2, and 3 of non-smoking patients, and while GS II showed 66.7% and 97.6% from Group 4 of smoking patients and from Group 5 of non-smoking patients. Based on such results, it was difficult to specially identify harmful impacts of smoking in relation to the success rate under each loading period. This conforms to the report submitted by Park et al.[14] that stated there was no implant failure resulting from smoking and that all patients who showed 3 mm alveolar bone resorption ad no relations with smoking.

In this study, while the survival rate of implants in relation to edentulous state showed 100% in case of US II Plus, GS II showed 98.7% and 99% respectively from Group 5 and Group 6 of partial edentulous state. In the case of US II Plus, success rate showed 96.6% from Group 2 of partial edentulous state, 83.3% and 96.3% respectively from Group 1 and Group 3 of single edentulous state. On the other hand, GS II showed 87.5% and 97.5% respectively from Group 4 and Group 5 of the partial edentulous state, indicating slightly higher survival rate and success rate compared with the partial or single edentulous state. This runs counter to the results of research carried out by Park et al.[14] who reported that approximately 90% success rate was shown from the full-mouth edentulous jaw while the success rate of all implants was 100% from partial and single edentulous jaw. There can be many impact factors such as the shape of prosthesis or the number of implants placed however, it seems necessary to perform long-term follow-up studies on more patients. All of the 2 implants showed high survival rate and success rate of more than 90% under each loading period.

Cross-analyses were carried out to examine clinical significance between implant loading period and success rate, and both US II Plus and GS II did not show any statistical significance between implant loading period and success rate. In the existing literature, variation in the success rate according to loading period was not observed. Turkyilmaz[24] reported that when he applied early loading starting from the 1st week after inserting Brånemark implants for the overdenture of mandible, and it did not affect the stability of implants, bone loss or the health of the soft tissue surrounding implants. In addition, Bornstein et al.[25] reported that when early loading is applied starting the 6th week after placing implants on the posterior areas of partial edentulous patients, successful osseointegration of implants was shown during at least 5-year observation period. Even in this study, implants to which early loading is applied showed somewhat low success rate compared with implants to which long-term conventional loading is applied. In particular, the success rate of the mandibular posterior area was 71.4% in the case of Group 1 of US II Plus, and 83.3% in the case of Group 4 of GS II, indicating comparatively low tendency compared with other part, however, it was not at a level where the loading period affects success rate. Furthermore, there were no US II Plus implants that inserted in type 1 and 4 bone quality, and even in the case of

GS II, early loading was not applied after placing implants, and for this reason, it seems additional researches are needed in future through more cases regarding the significance between loading period and success rate.

De Smet et al.[26] stated that loading during the initial stage of osseointegration plays extremely important roles and the tissue surrounding implants adjusts its configuration and tissue according to the applied functional loading. On the other hand, Goodman et al.[27] stated that physical stimulation affects the differentiation and the growth of the mesenchymal tissue at an extremely significant level, and implants are integrated with adjacent bone through such remodeling. Simmons et al.[28] stated that to maintain stability of implants to which loading is applied, it is necessary that the osteoblast that produces bone accelerate the extracellular matrix around implants, that the mature and mineralized base is sufficient to grant physical stability of implants even in the early osseointegration stage. Quirynen et al.[29] reported 100% success rate when conventional loading is applied after placing implants, and Chiapasco et al.[18] and Tawse-Smith et al.[30] reported 98% success rate when early and immediate loading is applied. As such, the success rate of implants was extremely high from studies related to early loading, however, it seems that there were almost no relevant complications generated.

This study has, for 1 year, followed up patients who underwent early, short-term conventional and long-term conventional loading after placing US II Plus and GS II implants after extraction during the period from 2007 to 2009. There was no significant difference in the success rate of implants according to loading period, however, it seems that long-term follow-up studies on prognosis are needed in future pursuant to standardized protocols covering more cases.

Conclusion

This study was carried out using implants placed from 6 hospitals to evaluate the survival rate and success rate of the domestic Osstem US II Plus and GS II implants according to loading period after placing implants in the maxillary and mandibular posterior and anterior area and related factors, and the following results were obtained.

1. US II Plus and GS II implants showed extremely high survival rate of more than 99% and the success rate of more than 90% irrespective of loading period.

2. The results of cross-analysis carried out to examine clinical significance between loading period and success rate of implants showed no statistical significance from both US II Plus and GS II (P=0.10 of US II Plus, and P=0.17 of GS II).

3. Even though bone quality, smoking and the edentulous state were the factors that affect the survival rate and success rate of implants according to loading period, they did not contribute much to this study.

The results described above showed clinically excellent results because there was no significant difference in the survival rate and success rate of the mandibular and maxillary anterior and posterior area in relation to the loading period after placing domestic Osstem US II Plus and GS II implants. However, since there might be other factors that might affect these results, it implies that loading period needs to be selected considering the implant placement areas, bone quality, edentulous state and the experience of operators. It is considered necessary to conduct additional researches in future on more cases considering other factors.

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