ORIGINAL ARTICLE

J Korean Dent Sci. 2020;13(1):1-10
https://doi.org/10.5856/JKDS.2020.13.1.1
pISSN 2005-4742 • eISSN 2713-7651

Retrospective Clinical Study on the Survival Rate and the Evaluation of Marginal Bone Resorption on SNUCONE AF+II® Implants

Panjun Kim*, Myungjin Jung*, Jihye Jeong, Sungyu Choi, Sunghwi Hur, Seulki Lee

Department of Oral and Maxillofacial Surgery, Hankook General Hospital, Cheongju, Korea

Purpose: This study analyzes the clinical results of SNUCONE AF+II® (SNUCONE Implant) implants placed in the edentulous region to determine the implant survival rate and the marginal bone healing pattern in the healing process.
Materials and Methods: Two hundred forty implants placed in 131 patients with SNUCONE AF+II® implant system from January 1, 2014 to December 31, 2014 at Cheongju Hankook General Hospital were followed up for 5 years.
Result: We evaluated 240 SNUCONE AF+II® implants of 131 patients from January 1, 2014 to December 31, 2014 at Cheongju Hankook General Hospital, and the results are as following: 1) Three implants were failed out of 240 implants of 131 patients and the survival rate was 98.75%. 2) The marginal bone resorption was 0.95±1.84 mm for 4 years after prosthesis placement, showing favorable result.
Conclusion: Although long-term cumulative evaluations and studies should be performed in the future, SNUCONE AF+II® implants show high cumulative survival and low marginal bone resorption according to the results of this study, which believed to give outstanding result in various dental implant procedure.

Key Words: Marginal bone resorption; Sunucone implant; Survival rate

Introduction

The restoration of missing teeth using dental implants was first attempted in the 1960s by Branemark et al.[1] as permanently stabilized dentures in edentulous patients, based on the concept of bone-to-titanium osteointegration. The treatment of the edentulous region using implants is non-invasive

Corresponding Authors:
Myungjin Jung, https://orcid.org/0000-0003-3493-578X
Department of Oral and Maxillofacial Surgery, Hankook General Hospital, 106 Danjae-ro, Sangdang-gu, Cheongju 28713, Korea
TEL : +82-43-222-6175, FAX : +82-43-255-7007, E-mail : bearooh@naver.com
Panjun Kim, https://orcid.org/0000-0002-4420-0149
Department of Oral and Maxillofacial Surgery, Hankook General Hospital, 106 Danjae-ro, Sangdang-gu, Cheongju 28713, Korea
TEL : +82-43-222-6175, FAX : +82-43-255-7007, E-mail : kpj0407@naver.com

*These two authors equally contributed to this work as the corresponding author.

Received for publication April 30, 2020; Returned after revision June 3, 2020; Accepted for publication June 12, 2020

to adjacent teeth compared to treatment with fixed prosthetics and has advantages in terms of patient satisfaction, superior chewing ability, and reduced discomfort with denture base compared to treatment with removable dentures. Consequently, dental implant has become one of the primary choices for the restoration of edentulous sites. Accordingly, dental implant placement procedures have been diversified. Clinicians primarily consider reliable quality of implants for predictable implant placement surgery, and this reliability can be measured by success rate of implants. Since the report on the criteria for implant success by Schnitman and Shulman[2] several criteria have been proposed[3-5]. Among those, the one proposed by Albrektsson et al.[6] is generally used.

At the 1986 Toronto conference, Albrektsson et al.[6] claimed that there should be no mobility, no radiolucency around implant, gradual bone loss of less than 0.2 mm of bone loss per year, and absence of infection with pain or purulent exudates *in vivo* for a successful implant, and that 5-year success rate should be 85% and 80% for 10-year. In 1998, Zarb and Albrektsson[7] further proposed success criteria that implant-supported prostheses should be functionally and aesthetically satisfying to patients and clinicians, and also must be free of pain, discomfort, paresthesia in clinical examinations.

Based on these criteria, the literature on implant success rates published in the 2000s indicated success rates higher than 95%. In 2002, Krennmair et al.[8] reported that the success rate of implants was 97.3%. In 2004, Romeo et al.[9] reported 96.2%, and in 2005, Wennström et al.[10] reported 97.7% success rate.

The implant used in this study was SNUCONE AF+II® (SNUCONE Implant, Daegu, Korea) implant, of which surface was treated with sandblasting with large grit and acid etching (SLA) favorable to osteointegration and self-tapping is possible because of the 2-bladed cutting at the bottom of fixture body. It has an internal connection with the abutment and tapered ends, so it gives an excellent initial fixation force, and can apply appropriate strength to marginal cortical bone and increase the bone density.

This study analyzes the clinical results of SNUCONE AF+II® implants placed in the edentulous sites to determine the implant survival rate and the marginal bone healing pattern during the healing process.

Materials and Methods

1. Subjects and Implants Distribution

This study examined a total of 261 dental implants placed in 142 patients with SNUCONE AF+II® implant system from January 1, 2014 to December 31, 2014 at Cheongju Hankook General Hospital. Among those, the patients recalled for regular 1-year check after implant placement and 6 months after final prosthesis installation were included in this study. Subsequently 21 implants in 11 patients that did not meet these criteria were excluded and 240 implants in 131 patients were finally included in the study.

1) Age and sex distribution of patients

The group of patients consisted of 80 males and 51

Table 1. Patient distribution according to sex

Sex	Patient	Implant
Male	80 (61.07)	139 (57.92)
Female	51 (38.93)	101 (42.08)
Total	131	240

Values are presented as number (%).

Table 2. Patient distribution according to age

Age (yr)	Patient	Implant
21~30	8 (6.11)	9 (3.75)
31~40	4 (3.05)	5 (2.08)
41~50	15 (11.45)	26 (10.83)
51~60	44 (33.59)	90 (37.50)
61~70	43 (32.82)	79 (32.92)
71~80	17 (12.98)	31 (12.92)
Total	131	240

Values are presented as number (%).

females with a total of 240 implants. The age ranged from 24 to 77 years, with 8 subjects in 20s, 4 in 30s, 15 in 40s, 44 in 50s, 43 in 60s, and 17 in 70s, respectively (Tables 1, 2).

2) Implant location and distribution

Of the total 240 implants, 145 implants were placed in the maxilla and 95 in the mandible. In terms of implant region, 26 were in the anterior region, 43 in the premolar region and 171 in the molar region. A subtotal of 106 implants placed in the maxillary molar regions were the greatest subgroup (Table 3).

3) Implant lengths and diameters

The greatest subtotal of 120 implants was 8 mm in length, followed by 101 of 10 mm and 19 of 12 mm. The largest portion of 97 implants were 4.8 mm in diameter, followed by 62 implants with 5.3 mm, 46 with 4.3 mm, 13 with 5.8 mm and 3.5 mm, and 9 with 3.8 mm (Table 4).

2. Methods

1) Surgical and prosthetic procedure

Implant surgery was performed under local anesthesia according to usual surgical technique, and the implant placement period was determined as the time point when implant fixture was placed in the bone. Secondary surgery timing was determined by the clinician according to the implant fixture stability. All implants used in this study were AF+II® implants from SNUCONE and were placed according to the manufacturer's guideline.

Prostheses were installed after the healing period and all the abutments used for prosthetic restoration were SNUCONE system. Patients were recalled at the time of the final prosthesis installation, 6 months after installation and 1 year after installation, and plaque control, clinical and radiographic examination were conducted at each appointment.

2) Assessment of survival rate

(1) Criteria for implant survival and failure

Implant survival rate was evaluated according to criteria for success suggested by Rosen et al.[11]

a. No persistent pain, infection or paresthesia

b. No implant mobility

c. No continuous radiolucency around the implant

d. Less than 0.2 mm of bone loss every year after 1 year of implant placement

The implant failure were evaluated based on the clinical guideline suggested by Albrektsson et al.[6] in 1986 and the qualitative evaluation criteria of implant failure classification into 5 groups suggested by Misch[12] in 1993.

a. When there is radiolucency around the implant during healing process after implantation suspicious of thermal damage during implant placement

b. When there is a mobility in fixture during secondary surgery or rotation of fixture when the healing abutment is connected, implicating failure of osteointegration

c. Having paresthesia or uncontrolled infection

d. Progressive bone loss around the implant by more than 50%

e. Complaints of pain when functioning or percussion test after completion of the final prosthesis

f. Fixture breakage

Such cases were considered failed and implants

Table 3. Numbers of implants placed according to location in arch

Site	Maxilla	Mandible	Total
Anterior	13	13	26
Premolar	26	17	43
Molar	106	65	171
Total	145	95	240

Table 4. Numbers of implants placed according to implant lengths and diameters

Length	Diameter (mm)						Total
(mm)	3.5	3.8	4.3	4.8	5.3	5.8	
8	4	2	18	60	32	4	120
10	5	3	24	32	29	8	101
12	4	4	4	5	1	1	19
Total	13	9	46	97	62	13	240

Table 5. Cumulative survival rate of implants placed

Time	Implant at interval start	Failed implant during interval	Survived implant	Cumulative survival rate (%)
Placement to loading	240	0	240	100
Loading to 1 yr	240	0	240	100
1 to 2 yr	240	0	240	100
2 to 3 yr	240	3	237	98.75
3 to 4 yr	237	0	237	98.75

were removed from the oral cavity.

(2) Implant failure period

The classification by implant failure period was made based on the proposal by Rosenberg et al.[13] in 2004.

Stage 1: Interval from implant placement to secondary surgery

Stage 2: Interval between secondary surgery and final prosthesis

Stage 3: Within 1 year after final prosthesis completion

Stage 4: 1 to 5 years after completion of final prosthesis

Stage 5: Five years after completion of final prosthesis

3) Evaluation factor

Clinical factors such as sex and age distribution of patients, along with location, diameter and length of implants, were examined using medical records and radiographic images.

The implant location was classified into 6 subgroups; maxillary anterior, premolar and molar area, and mandibular anterior, premolar and molar area. The diameters were categorized into 6 groups; 3.5 mm, 3.8 mm, 4.3 mm, 4.8 mm, 5.3 mm, and 5.8 mm. The lengths of implant were divided into 3 categories of 8 mm, 10 mm, and 12 mm to determined the survival rate of the corresponding groups. Additionally, the use of alveolar bone graft and the amount of marginal bone resorption were evaluated as well.

Table 6. Survival rate of implant according to sex

Sex	State		Survival rate (%)
	Placed	Failed	
Male	139	3	97.84
Female	101	0	100

Results

1. Overall Survival Rate

Among the 240 implants in 131 patients investigated, three implants were removed during the follow-up period, showing a survival rate of 98.75% (Table 5).

2. Survival Rate by Sex and Age of Patient

Implant survival rate was 97.84% in males and 100% in females and there were no statistical difference in sex. Stronger masticatory force in male is thought to have some effect on three failed implants in 2~3 years after loading (Table 6).

The survival rates according to patients' age were 96.15% for age group 41~50 years, 98.89% for 51~60 years, 98.65% for 61~70 years old group with one implant failure in each group (Table 7).

3. Survival Rate according to Location, Diameter and Length of Implant Placed

The survival rates were 98.11% in the maxillary molar and 98.46% in the mandibular molar with no statistical significance between the locations (Table 8).

The survival rate according to the diameter of the implant, all three failed implants were 4.8 mm in diameter within 97 implants group with a survival rate

Table 7. Survival rate of implant according to age

Age (yr)	State		Survival rate (%)
	Placed	Failed	
21~30	9	0	100
31~40	5	0	100
41~50	26	1	96.15
51~60	90	1	98.89
61~70	74	1	98.65
71~80	31	0	100

Table 8. Survival rate of implant according to implant location

Site		State		Survival rate (%)
		Placed	Failed	
Maxilla	Anterior	13	0	100
	Premolar	26	0	100
	Molar	106	2	98.11
Mandible	Anterior	13	0	100
	Premolar	17	0	100
	Molar	65	1	98.46

of 96.91% (Table 9). The 2 implants were failed in 120 implants with 8 mm in length, and 1 implant was failed in 101 implants with 10 mm in length; indicating 98.33% and 99.01% of survival rate according to the implant length, respectively (Table 10). However, there were no significant difference.

4. Survival Rate according to Alveolar Bone Graft

In this study, 3 implants failed in 170 implants with alveolar bone graft due to lack of residual bone, showing a survival rate of 98.23% (Table 11).

5. The Amount of Marginal Bone Resorption

The mean resorption of marginal bone analyzed by radiographic examination in this study was 0.95±1.84 mm for 4 years after prosthesis placement.

6. Clinical Factors of Failed Implants

Three implants did not meet the survival criteria. Two were placed at #16 site and one at #47 site. All three patients were male who revisited the clinic with the implant mobility as a chief complaint. All three implants showed marginal bone loss of more than 3 mm from radiographic examination.

Table 9. Survival rate of implant according to implant fixture diameter

Fixture diameter (mm)	State		Survival rate (%)
	Placed	Failed	
3.5	13	0	100
3.8	9	0	100
4.3	46	0	100
4.8	97	3	96.91
5.3	62	0	100
5.8	13	0	100

Table 10. Survival rate of implant according to implant fixture length

Fixture length (mm)	State		Survival rate (%)
	Placed	Failed	
8	120	2	98.33
10	101	1	99.01
12	19	0	100

Table 11. Survival rate of implant according to native bone and augmented bone

Bone graft	State		Survival rate (%)
	Placed	Failed	
Native bone	70	0	100
Augmented bone	170	3	98.23

All failed implants were 4.8 mm in diameter and placed in secondary surgery 6 months after the alveolar bone augmentation due to insufficient residual alveolar ridge. All three implants were removed between two and three years after the functional load, and all opposing teeth were natural teeth. Although there is no statistical significance due to the small number of samples, it is considered that the implants failed as the bone loss occurred in the posterior region where the occlusal force could be relatively high in the alveolar bone with insufficient residual bone.

Discussion

The dental implant based on the concept of osteointegration of titanium is regarded as a highly predict-

able treatment method for satisfaction of both the patients and the clinicians. A number of researches on dental implants have been published so far for the establishment of clinical protocol, making them as the primary option for the replacement of missing teeth. Implants are able to play major oral functions such as mastication, pronunciation, and aesthetics, similar to the natural teeth.

Due to the popularity of implant procedure, implant products have been diversified, and recent researches reported latest products with improved quality in such as surface treatment and shape compared to the early products[14,15]. Among them, dentists may have to identify the pros and cons of each implant product and select appropriate type according to the treatment plan. Various clinical factors such as the skill of the clinician and the amount and density of the bone are considered as the primary determinants of the successful implant treatment.

In order to achieve success under the same operator condition and the patient's bone condition, the quality of implant is crucial.

Changes in surface treatment and design of implants have been proposed numerously. Several studies related to implant surface treatment have shown that implants with rough surfaces have a higher success rate in areas with poor bone quality than those with machine-polished smooth surfaces[16]. Rosenberg et al.[13] reported that early failures in the stage of osteointegration appeared higher in smooth surface implants and later failures appeared higher in hydroxyapatite (HA)-coated surfaces after the completion of prosthesis. The HA-coated surface has a rough surface, which increases the area of surface contact with the bone, which is advantageous for initial fixation. However, the functional load may lead to resorption of HA or loss of contact with implant surface, which reduce the bone contact. Accumulation of the plaque and exposure of rough implant surface due to bone resorption by the inflammation around the implant and soft tissue recession may occur. For this reason, the initial HA coated implants have disappeared from the market. Recently, however, improved interface binding between the implant and HA which enables uniform surface coating due to the development of manufacturing process is gaining attention. Recent studies have reported that HA-coated implants show excellent initial fixation and stability, and that HA coating does not delaminate under prolonged loading, and similar implant stability is reported compared to SLA surface treatment[17].

In a recent study on different surface treatment, Jang et al. categorized the treatments into acid etching, HA coating, resorbable blast media blasting, SLA, and titanium plasma spray group and examined the survival rate. The SLA surface treatment method showed the best results compared to other surface treatment methods[18].

Recent studies on implant macrostructures have shown that bone density was improved by condensation within the bone when placing implant using tapered implants at low bone density sites[19]. Tapered type implant are easier to place when there are anatomical limitations such as narrow or recessed alveolar ridge compared to straight walled type implant, and the applied occlusal force can be more evenly distributed to surrounding bone[20].

The microstructure of SNUCONE AF+II® implant is a product which surface treated with sandblasting and acid etching with large grit, showing excellent osteointegration. The macrostructure of the implant used in this study has a similar appearance to that of most companies' implant products. It has a tapered shape and the lower end of the implant is composed of 2-bladed cutting edges similar to those of other companies, enabling self-tapping. The blades are widely distributed, so that the alveolar bone around the implant covers a larger area compared to the implant consisting of a cutting edge of 3 blades. These features give excellent the initial fixation force and the strength marginal cortical bone and increase the

bone density (Fig. 1, 2). This type of implant-abutment connection is frequently used in South Korea, and is very similar to the Astra-implant abutment connection which the abutment is connected to the inside of the implant fixture.

Although it is difficult to clearly define the success and survival of the implant, the success rate is the percentage of implants that meet the success criteria after a certain period of time, and it is not possible to report that implant is successful until this time has elapsed. On the other hand, the survival rate is defined as the percentage of implants remaining in the oral cavity until the implant is removed or determined to be removed at some time point. Therefore, a failing implant can also be considered alive if it remains in the oral cavity, so the survival rate is not as strict as the success rate and more convenient for clinicians to use, and generally survival rate is higher than the success rate. It is clinically difficult to examine all the test categories necessary to meet the conditions of success rate, so the survival rate with less stringent standard is widely used. In this study, the implant survival rate was evaluated according to the criteria for success suggested by Rosen et al.[11] and the implant failure criteria were clinically evaluated based on the criteria suggested by Albrektsson et al.[6] in 1986 and the part of the five groups that Misch[12] categorized on qualitative implant evaluation on implant failure in 1993. In addition to the factors mentioned above, Misch also explained the implant's life expectancy, patients' pain, initial fixation, percussion test, bone loss measurement, radiological evaluation, peri-implantitis, probing depth, bone quality at the site of implantation, and the crown to fixture ratio, and the bleeding index[21].

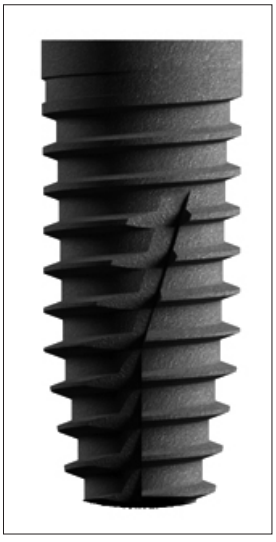

Fig. 1. SNUCONE AF+II® implant.

According to the studies on success rate, the Branemark system reported maxillary 78% and mandible 86% of success rate for 15~24 years, and other studies for 5-year success rate reported 98% for maxilla and 97% for mandible. In the case of the survey only in the maxilla, the success rate was 94.4% for 5 to 6

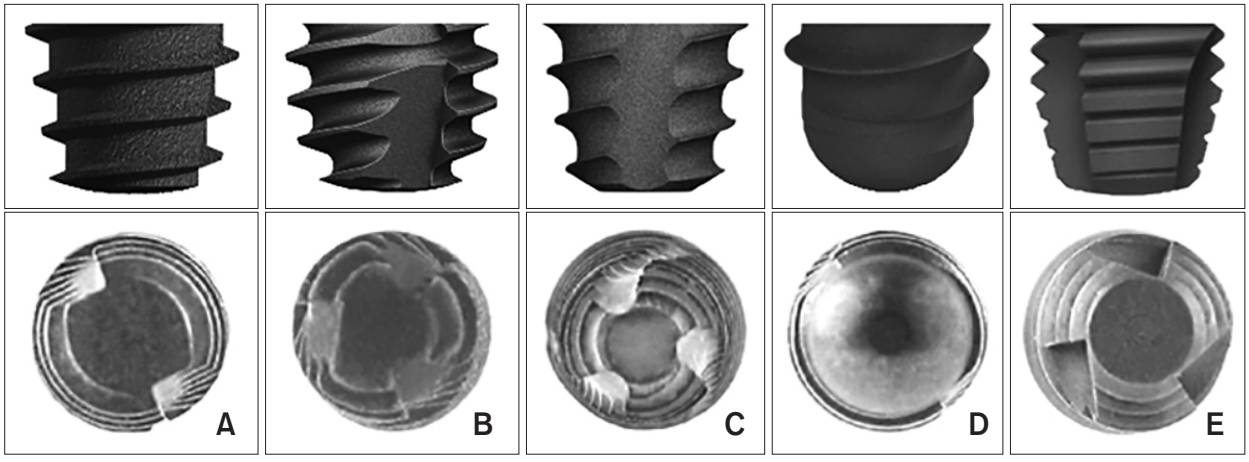

Fig. 2. Implant fixture and bottom design for each company. (A) SNUCONE AF+II® implant. (B-E) Implants mainly used in worldwide.

years and 93.4% for 10 years[22]. In the 5-year follow-up studies of International Team for Impantology system, the success rate was 87% for maxilla and 95% for mandible[23]. The success rate was high in most studies. This is because of the poorer bone quality of maxilla and not enough amount of bone due to severe alveolar ridge resorption after loss of teeth compared to the mandible. Moreover, the longer the period of edentulous state, the amount of bone is reduced because of the maxillary sinus pneumatization.

In this study, a total of 240 implants were investigated and three failed implants were encountered, resulting in a 98.75% of overall survival rate. There was no statistically significant difference between the maxilla (98.62%) and the mandible (98.94%).

Different lengths of implants, 8 mm, 10 mm, and 12 mm, were placed depending on the condition of the implant placement site and anatomical limitations. The 12 mm implant was not placed in the mandibular molar area because of inferior alveolar nerve. Six different diameters were used in this study, 3.5 mm, 3.8 mm, 4.3 mm, 4.8 mm, 5.3 mm, and 5.8 mm. Most of the 3.5 mm and 3.8 mm fixtures were placed in the upper and lower anterior region. The premolar area had fixtures with 3.8 mm to 4.8 mm diameter according to the bone width of the patient. The wide-diameter implants of 5.3 mm or wider were placed only in the molar area where alveolar bone width is wide. The premolar area had the diameter of 3.8 mm to 4.8 mm according to the bone width of the patient.

The mean resorption of marginal bone analyzed by radiographic examination in this study was 0.95±1.84 mm for 4 years after prosthesis placement. In a similar study, Astrand et al.[24] reported that in a five-year study using Branemark implants and Astra Tech implants 14 months after the abutment connection, the bone loss for Branemark implants were 1.97±0.18 mm in maxilla, and 1.73±0.20 mm in mandible, and for Astra Tech implants 1.74±0.36 mm in maxilla and 1.26±0.20 mm in mandible. This desirable result is thought to be related to the design of the SLA surface-treated implant with the removed machined surface on entire fixture surface up to the top. Cho et al.[25] examined two types of implants with different surface treatments for immediate replacement of premolars in the minipigs. More osteointegration was observed in the group with rough surface group compared to machined surface on cervical area. Davies[26] also noted that implants with rough surfaces show better osteointegration, especially in the early healing period, as they have a favorable contact surface between the implant and blood clots.

Three implants placed in three male patients had mobility on prosthesis. Two were placed at upper first molar site and one at lower second molar site. All three implants were found to have a marginal bone loss of more than 3 mm and were removed sine they are determined to be an implant failure. All failed implants were 4.8 mm in diameter and placed in secondary surgery 6 months after the alveolar bone augmentation due to insufficient residual alveolar ridge. All three implants were removed between two and three years after the functional load, and opposing teeth were all natural. The time of failure of the failed implant was in stage 4, which corresponds to range from one to five years after completion of the final prosthesis. Due to the small amount of remaining bone, the implant was placed in a site consisting mainly of the augmented bone, and the augmented bone could not adequately mature to withstand occlusal pressure, causing the failure. Implant success rate and the amount of marginal bone resorption have no significant difference in site with or without bone augmentation[27,28], but this study showed more marginal bone resorption on the group with ridge augmentation.

In this study, the survival rate and marginal bone resorption of SNUCONE AF+II® implants were satisfactory when compared with previous studies. However, there is a limitation that the factors that determine the success rate are limited to several clinical

and radiological factors. Further research is needed to supplement these limitations.

Conclusion

We evaluated 240 SNUCONE AF+II® implants of 131 patients from January 1, 2014 to December 31, 2014 at Cheongju General Hankook Hospital, and the results are as following:

1) Three implants were failed out of 240 implants of 131 patients and the survival rate was 98.75%.

2) The marginal bone resorption was 0.95±1.84 mm for 4 years after prosthesis placement, showing favorable result.

3) Three failures were encountered in 240 implants of 131 patients.

4) The locations of the failed implants were 2 in right maxillary first molar regions and 1 in right mandibular second molar region.

5) All of the failed implants occurred at the site where bone graft was performed due to the ridge atrophy and are all in males.

Although long-term cumulative evaluations and studies should be performed in the future, SNUCONE AF+II® implants show high cumulative survival and low marginal bone resorption according to the results of this study, which believed to give outstanding result in various dental implant procedure.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

References

1. Brånemark PI, Adell R, Breine U, Hansson BO, Lindström J, Ohlsson A. Intra-osseous anchorage of dental prostheses. I. Experimental studies. Scand J Plast Reconstr Surg. 1969; 3: 81-100.
2. Schnitman PA, Shulman LB. Recommendations of the consensus development conference on dental implants. J Am Dent Assoc. 1979; 98: 373-7.
3. Smith DE, Zarb GA. Criteria for success of osseointegrated endosseous implants. J Prosthet Dent. 1989; 62: 567-72.
4. Misch CE. The implant quality scale: a clinical assessment of the health--disease continuum. Oral Health. 1998; 88:15-20, 23-5; quiz 25-6.
5. Buser D, Mericske-Stern R, Dula K, Lang NP. Clinical experience with one-stage, non-submerged dental implants. Adv Dent Res. 1999; 13: 153-61.
6. Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: a review and proposed criteria of success. Int J Oral Maxillofac Implants. 1986; 1: 11-25.
7. Zarb GA, Albrektsson T. Consensus report: towards optimized treatment outcomes for dental implants. J Prosthet Dent. 1998; 80: 641.
8. Krennmair G, Schmidinger S, Waldenberger O. Single-tooth replacement with the Frialit-2 system: a retrospective clinical analysis of 146 implants. Int J Oral Maxillofac Implants. 2002; 17: 78-85.
9. Romeo E, Lops D, Margutti E, Ghisolfi M, Chiapasco M, Vogel G. Long-term survival and success of oral implants in the treatment of full and partial arches: a 7-year prospective study with the ITI dental implant system. Int J Oral Maxillofac Implants. 2004; 19: 247-59.
10. Wennström JL, Ekestubbe A, Gröndahl K, Karlsson S, Lindhe J. Implant-supported single-tooth restorations: a 5-year prospective study. J Clin Periodontol. 2005; 32: 567-74.
11. Rosen PS, Summers R, Mellado JR, Salkin LM, Shanaman RH, Marks MH, Fugazzotto PA. The bone-added osteotome sinus floor elevation technique: multicenter retrospective report of consecutively treated patients. Int J Oral Maxillofac Implants. 1999; 14: 853-8.
12. Misch CE. Contemporary implant dentistry. 2nd ed. St. Louis: Mosby; 1998. p. 91-123.
13. Rosenberg ES, Cho SC, Elian N, Jalbout ZN, Froum

S, Evian CI. A comparison of characteristics of implant failure and survival in periodontally compromised and periodontally healthy patients: a clinical report. Int J Oral Maxillofac Implants. 2004; 19: 873-9.
14. Esposito M, Grusovin MG, Coulthard P, Thomsen P, Worthington HV. A 5-year follow-up comparative analysis of the efficacy of various osseointegrated dental implant systems: a systematic review of randomized controlled clinical trials. Int J Oral Maxillofac Implants. 2005; 20: 557-68.
15. Hong JY, Chae GJ, Jung UW, Kim CS, Cho KS, Chae JK, Kim CK, Choi SH. Retrospective studies of dental implant placement at each intraoral site and situation. J Korean Acad Periodontol. 2007; 37: 805-24.
16. Cochran DL. A comparison of endosseous dental implant surfaces. J Periodontol. 1999; 70: 1523-39.
17. Park HC, Kim SG, Oh JS, Jeong MC, Lee SK, Jeong MA, Kim JS, Kim SH. A study of stability of hydroxy-apatite coated implants and sandblasted, large-grit and acid-etched implants. Oral Biol Res. 2012; 36: 19-23.
18. Jang JW, Ryoo GH, Chung HJ. Survival analysis of dental implants in maxillary and mandibular molar regions; A 4~5 year report. J Korean Acad Periodontol. 2007; 37: 165-80.
19. Summers RB. A new concept in maxillary implant surgery: the osteotome technique. Compendium. 1994; 15: 152, 154-6, 158 passim; quiz 162.
20. Rosenquist B, Grenthe B. Immediate placement of implants into extraction sockets: implant survival. Int J Oral Maxillofac Implants. 1996; 11: 205-9.
21. Misch CE. Contemporary implant dentistry. 2nd ed. St. Louis: Mosby; 1999. p. 21-32.
22. Nevins M, Langer B. The successful use of osseointegrated implants for the treatment of the recalcitrant periodontal patient. J Periodontol. 1995; 66: 150-7.
23. Buser D, Mericske-Stern R, Bernard JP, Behneke A, Behneke N, Hirt HP, Belser UC, Lang NP. Long-term evaluation of non-submerged ITI implants. Part 1: 8-year life table analysis of a prospective multi-center study with 2359 implants. Clin Oral Implants Res. 1997; 8: 161-72.
24. Astrand P, Engquist B, Dahlgren S, Gröndahl K, Engquist E, Feldmann H. Astra Tech and Brånemark system implants: a 5-year prospective study of marginal bone reactions. Clin Oral Implants Res. 2004; 15: 413-20.
25. Cho JY, Kim YJ, Yu MG, Kook MS, Oh HK, Park HJ. The effect of surface treatment of the cervical area of implant on bone regeneration in mini-pig. J Korean Assoc Oral Maxillofac Surg. 2008; 34: 285-92.
26. Davies JE. Mechanisms of endosseous integration. Int J Prosthodont. 1998; 11: 391-401.
27. Finne K, Rompen E, Toljanic J. Clinical evaluation of a prospective multicenter study on 1-piece implants. part 1: marginal bone level evaluation after 1 year of follow-up. Int J Oral Maxillofac Implants. 2007; 22: 226-34.
28. Schliephake H, Neukam FW, Wichmann M. Survival analysis of endosseous implants in bone grafts used for the treatment of severe alveolar ridge atrophy. J Oral Maxillofac Surg. 1997; 55: 1227-33; discussion 1233-4.