Retrospective Multicenter Cohort Study of the Clinical Performance of 2-stage Implants in South Korean Populations

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Purpose: *To evaluate long-term follow-up clinical performance of dental implants in use in South Korean populations.* ***Materials and Methods:*** *A retrospective multicenter cohort study design was used to collect long-term follow-up clinical data from dental records of 224 patients treated with 767 2-stage endosseous implants at Ajou University Medical Center and Bundang Jesaeng Hospital in South Korea from June 1996 through December 2003. Exposure variables such as gender, systemic disease, location, implant length, implant diameter, prosthesis type, opposing occlusion type, and date of implant placement were collected. Outcome variables such as date of implant failure were measured.* ***Results:*** *Patient ages ranged from 17 to 71.7 years old (mean age, 45.6 years old). Implants were more frequently placed in men than in women (61% versus 39%, or 471 men versus 296 women). Systemic disease was described by 9% of the patients. All implants had hydroxyapatite-blasted surfaces. Most of the implants were 3.75 mm in diameter. Implant lengths 10 mm, 11.5 mm, 13 mm, and 15 mm were used most often. Differences of implant survival among different implant locations were observed. Implants were used to support fixed partial dentures for the majority of the restorations. The opposing dentition was natural teeth for about 50% of the implants. A survival rate of 97.9% (751 of 767) was observed after 4.5 years (mean, 1.95 ± 1.2 years).* ***Conclusion:*** *Clinical performance of 2-stage dental implants demonstrated a high level of predictability. The results achieved with a South Korean population did not differ from results achieved with diverse ethnic groups.* (Cohort Study) INT J ORAL MAXILLOFAC IMPLANTS 2006;21:785–788

Key words: *dental implants, implant survival, implants in Korean populations, implant-supported prostheses*

In South Korea, dental prostheses supported and retained by endosseous implants have become one of the most predictable prosthodontic modalities, and the number of dentists practicing implant prosthodontics has increased very rapidly since 2001. Although the use of dental implants is expanding, as documented by several laboratory studies and a survey,[1–11] few clinical studies have demonstrated the clinical performance of dental implants among South Korean populations.[12] Lack of long-term follow-up data in this specific population diminishes clinicians' confidence when there is a strong desire to practice evidence-based dentistry.[13] Therefore, this study was intended to evaluate long-term follow-up of dental implant usage in South Korean populations.

MATERIALS AND METHODS

A retrospective multicenter cohort study design was used to collect data on clinical performance of implants and implant-supported prostheses. The dental records of all patients treated with 2-stage dental implants (Osstem, Seoul, South Korea) at Ajou University Medical Center and Bundang Jesaeng Hospital in South Korea from June 1996 through December 2003 were reviewed.

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Table 1 Patient Characteristics

Characteristics	Women	Men
No. of implants	296	471
No. of patients	103	121
No. of patients having systemic diseases	8	13
Mean age (SD)	43.8 (12.8)	46.7 (12.7)
Range of age	18.8 to 70.7	17.1 to 71.7

Table 2 Implant Characteristics

	n	%
Length*		
7 mm	2	0.3
8.5 mm	24	3.6
10 mm	91	13.6
11.5 mm	130	19.4
13 mm	232	34.7
15 mm	157	23.5
18 mm	33	4.9
Diameter†		
3.3 mm	23	2.9
3.75 mm	604	84.0
4.0 mm	64	9.0
5.0 mm	26	4.0
5.5 mm	1	0.1
Location		
Maxilla		
Anterior	105	13.7
Premolar	58	7.6
Molar	81	10.6
Mandible		
Anterior	67	8.7
Premolar	116	15.2
Molar	338	44.2

*Unspecified for 99 implants.
†Unspecified for 49 implants.

Table 3 Implant Failure by Anatomic Location

Implant location	No. of failures	Total no. of implants	%
Maxilla			
Anterior	3	105	2.85
Premolar	1	58	1.72
Molar	5	81	6.17
Mandible			
Anterior	0	67	0
Premolar	4	116	3.45
Molar	3	338	0.89

Data collection was performed by a clinical research assistant unaware of the specific aims of this study. Exposure variables, such as gender, systemic disease, location, implant length, implant diameter, prosthesis type, opposing occlusion type, and date of implant placement were collected. Outcome variables, such as date of implant failure, were measured.

RESULTS

A total of 224 South Korean patients were treated using 767 implants to support or retain dental prostheses. Patient ages ranged from 17 to 71.7 years old (mean, 45.6 years old) (Table 1). Implants were more frequently placed in men, with 61% (471) placed in men and 39% (296) placed in women. Systemic disease was described by 9% of the patients.

All of the implants had hydroxyapatite-blasted surfaces. Most of the implants were 3.75 mm in diameter (Table 2). The most frequently used implant lengths were 10 mm, 11.5 mm, 13 mm, and 15 mm. Differences in implant survival were observed among different implant locations (Table 3). Implants placed in maxillary molar sites were at the highest risk for failure. Implants placed in mandibular anterior locations demonstrated the lowest risk for failure. Implants were used to support fixed partial dentures for the majority of the restorations (Table 4). The opposing occlusion was natural dentition for almost 50% of the implants. As shown in Table 5, a survival rate of 97.9% (751 of 767) was observed after a maximum of 4.5 years of observation (mean, 1.95 ± 1.2 years). Among the 16 failed implants, 13 implants failed in the first year of clinical use; these implants constituted 81.3% of failed implants.

DISCUSSION

To determine the clinical performance of an implant system, a retrospective review of the dental records was required. Since the desired clinical data have been recorded completely and consistently at the hospital settings, the quality of data was not a concern.[13] Records of age, gender, systemic disease, implant diameter, implant length, and implant failure are objective data and are retrievable completely due to consistent use of an electronic medical record.

Table 4 Prosthesis Characteristics

	n	%
Prosthesis		
Single	149	20.6
Fixed partial denture	530	73.3
Overdenture	44	6.1
Opposing occlusion		
Partial/Fixed partial denture	248	33.7
Crown	56	7.6
Edentulous	23	3.0
Natural tooth	363	49.3
Removable denture	47	6.4

Table 5 Implant Failure and Survival by Year

Year	Implants at start of interval	Implants lost to follow-up	Failures	% of total failures	Cumulative survival (%)
1	767	754	13	81.3	98.3
2	754	752	2	12.5	98.0
3	752	751	1	6.2	97.9
4	751	751	0	0	97.9
4.5	751	751	0	0	97.9

The records of all patients who received this implant system within the time period studied were analyzed. Therefore, concerns that patient selection resulted in underrepresentation of certain characteristics or in artificially positive results than more complete data collection provides do not apply to this study.[14] Data collection was performed by a clinical research assistant blinded to the specific aims of this study. This method was employed to control the possibility of bias resulting in differential misclassification of exposure and outcome variables.

The American Dental Association (ADA) certification program defines implant systems as "acceptable" or "provisionally acceptable" on the basis of follow-up period and success rate. The criteria of this program describe an overall success rate of 85% after a period of 5 years for full acceptance or 3 years for provisional acceptance.[15,16] The follow-up period and success rate of the implant system in this study fulfill ADA criteria for provisional acceptance. Longer follow-up is required to establish more confidence in this implant system.

This 4.5-year retrospective multicenter cohort study demonstrated clinical outcomes related to implant survival that were equivalent to other implant systems.[17–23] Diversity of bone density, dental arch anatomy, masticatory force, and dietary pattern have been reported on by other authors using different population groups.[24–33] The current study was limited to patients within Korea of a specific ethnic group. Since clinical outcomes of the implant system in this study were very similar to those observed for other implant systems, in spite of the diversity of their study populations, this study showed that there is no difference in implant survival between South Korean people and other ethnic groups. Further study is required for extrapolation of the results of this study and confirmation of their generalizability.

CONCLUSION

The implant survival rate was 97.9% at 4.5 years. This clinical performance of the 2-stage dental implants placed suggests a favorable clinical outcome during the follow-up period for the South Korean populations treated at the 2 dental care facilities. Therefore, ethnic group had no effect on implant survival in the present study.

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REFERENCES

1. Yoo JH, Lee JW, Baek SH, Jeong WG, Kim JB. Comparative study about jaw biocompatibility of national AVANA and international ITI implant. J Korean Acad Maxillofacial Plast Surg 2002;24:464–469.
2. Lee JB, Hwang BN, Yoo SH, Byoen CJ, Choi SK. Comparison of mechanical stability of self tapping fixture and double threaded fixture using finite element analysis. Korean Acad Gen Dent 1999;1(1):113–117.
3. Park IK, Hwang BN, Lee JB, Lim JH, Kim JH, Choi SK. Surface treatment of AVANA implant. Korean Acad Gen Dent 2000;2(1):215–219.
4. Jang KS, Kim DS. Surface roughness analysis of the AVANA dental implant. J Korean Dent Assoc 2000;38:1129–1135.
5. Ko SM, Hwang BN. Selection criteria of abutment of AVANA implant system and prosthetic design. In: Kim YK, Park HS, Cho YS, Choi YG, Eom TG (eds). Osstem Implant System. Seoul: Cheongwonsa, 2005:518–526.
6. Hwang BN, Ko SM. Good manufacturing practices of AVANA implant system. In: Kim YK, Park HS, Cho YS, Choi YG, Eom TG (eds). Osstem Implant System. Seoul: Cheongwonsa, 2005: 510–517.
7. Han DH, Jeon YS, Kim J, Kim SJ. A histomorphometric study of two different threaded CP titanium implants. J Korean Acad Prosthodont 1999;37:56–65.

8. Kim YK, Hwang JW, Yun PY, et al. Multicenter prospective clinical study of implant system: Early stability measured by Periotest. J Korean Dent Assoc 2005;12:873–881.
9. Kim TI, Choi KO, Eom TG, Byun TH, Kim JH. Elemental analysis of the surface residues on dental implants. In: Kim YK, Park HS, Cho YS, Choi YG, Eom TG (eds). Osstem Implant System. Seoul: Cheongwonsa, 2005:527–535.
10. Lee H, Kim SG. An animal study on calcium metaphosphate coated implants in rabbits. In: Kim YK, Park HS, Cho YS, Choi YG, Eom TG (eds). Osstem Implant System. Seoul: Cheongwonsa, 2005;536–542.
11. Lee JB, Wang YS, Shin KH, Hwang BN. Survey of use of endosseous dental implant. J Korean Dent Assoc 2000;38:1054–1062.
12. Nam KY, Cho LR, Yi YJ, Um HS, Chang BS. A two-year retrospective study on the clinical survival of the neoplant implant systems. J Korean Dent Assoc 2003;41:558–565.
13. Eckert SE, Choi YG, Koka S. Methods for comparing the results of different studies. Int J Oral Maxillofac Implants 2003;18: 697–705.
14. Jacob RF, Carr AB. Hierarchy of research design used to categorize the "strength of evidence" in answering dental questions. J Prosthet Dent 2000;83:137–152.
15. Gerstman BB. Epidemiology Kept Simple: An Introduction to Classic and Modern Epidemiology. New York: Wiley-Liss, 1998;183–225.
16. American Dental Association Council on Dental Materials, Instruments, and Equipment. Acceptance Program for Endosseous Implants. Chicago: American Dental Association, July 1993.
17. Eckert SE. Food and Drug Administration requirements for dental implants. J Prosthet Dent 1995;74:162–168.
18. Carr AB, Choi YG, Eckert SE, Desjardins RP. Retrospective cohort study of the clinical performance of 1-stage dental implants. Int J Oral Maxillofac Implants 2003;18:399–405.
19. Adell R, Lekholm U, Rockler B, Brånemark P-I. A 15-year study of osseointegrated implants in the treatments of the edentulous jaw. Int J Oral Surg 1981;10:387–416.
20. Cox JF, Zarb GA. The longitudinal clinical efficacy of osseointegrated dental implants: A 3-year report. Int J Oral Maxillofac Implants 1987;2:91–100.
21. Tolman DE, Laney WR. Tissue-integrated dental prostheses. The first 78 months of experience at the Mayo Clinic. Mayo Clin Proc 1993;68:323–331.
22. Lekholm U, van Steenberghe D, Herrmann I, et al. Osseointegrated implants in the treatment of partially edentulous jaws: A prospective 5-year multicenter study. Int J Oral Maxillofac Implants 1994;9:627–635.
23. Eckert SE, Wollan PC. Retrospective review of 1,170 endosseous implants placed in partially edentulous jaws. J Prosthet Dent 1998;79:415–421.
24. Kook YA, Nojima K, Moon HB, McLaughlin RP, Sinclair PM. Comparison of arch forms between Korean and North American white populations. Am J Orthod Dentofacial Orthop 2004;126: 680–686.
25. Will MJ, Ester MS, Ramirez SG, Tiner BD, McAnear JT, Epstein L. Comparison of cephalometric analysis with ethnicity in obstructive sleep apnea syndrome. Sleep 1995;18:873–875.
26. Lam B, Ip MS, Tench E, Ryan CF. Craniofacial profile in Asian and white subjects with obstructive sleep apnoea. Thorax 2005;60:504–510.
27. Barrett-Connor E, Siris ES, Wehren LE. Osteoporosis and fracture risk in women of different ethnic groups. J Bone Miner Res 2005;20:185–194.
28. Fernandes CL. Forensic ethnic identification of crania: The role of the maxillary sinus—A new approach. Am J Forensic Med Pathol 2004;25:302–313.
29. Morton DJ, Barrett-Connor E, Kritz-Silverstein D, Wingard DL, Schneider DL. Bone mineral density in postmenopausal Caucasian, Filipina, and Hispanic women. Int J Epidemiol 2003;32: 150–156.
30. Yang EJ, Kerver JM, Song WO. Dietary patterns of Korean Americans described by factor analysis. J Am Coll Nutr 2005; 24:115–121.
31. Wahlqvist ML. Diversification in indigenous and ethnic food culture. Forum Nutr 2005;57:52–61.
32. Shinogaya T, Bakke M, Thomsen CE, Vilmann A, Sodeyama A, Mstsumoto M. Effects of ethnicity, gender and age on clenching force and load distribution. Clin Oral Investig 2001;5: 63–68.
33. Tsunori M, Mashita M, Kasai K. Relationship between facial types and tooth and bone characteristics of the mandible obtained by CT scanning. Angle Orthod 1998;68:557–562.