



A survey of the satisfaction of patients who have undergone implant surgery with and without employing a computer-guided implant surgical template

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PURPOSE. This study aims to investigate the degree of subjective pain and the satisfaction of patients who have undergone an implant treatment using a computer-guided template. **MATERIALS AND METHODS.** A survey was conducted for 135 patients who have undergone implant surgery with and without the use of the computer-guided template during the period of 2012 and 2013 in university hospitals, dental hospitals and dental clinics that practiced implant surgery using the computer-guided template. Likert scale and VAS score were used in the survey questions, and the independent t-test and One-Way ANOVA were performed ($\alpha=.05$). **RESULTS.** The route that the subjects were introduced to the computer-guided implant surgery using a surgical template was mostly advices by dentists, and the most common reason for which they chose to undergo such surgery was that it was accurate and safe. Most of them gave an answer that they were willing to recommend it to others. The patients who have undergone the computer-guided implant surgery felt less pain during the operation and showed higher satisfaction than those who have undergone conventional implant surgery. Among the patients who have undergone computer-guided implant surgery, those who also had prior experience of surgery without a computer-guided template expressed higher satisfaction with the former ($P<.05$). **CONCLUSION.** In this study, it could be seen that the patients who have undergone computer-guided implant surgery employing a surgical template felt less pain and had higher satisfaction than those with the conventional one, and the dentist's description could provide the confidence about the safety of surgery. [J Adv Prosthodont 2014;6:395-405]

KEY WORDS: Dental implant; Computer-guided template; Patient satisfaction; Pain

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Received 12 February, 2014 / Last Revision 21 July, 2014 / Accepted 28 July, 2014

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This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Planning (2013R1A1A1076022).

INTRODUCTION

Implant treatment that makes a restoration from an edentulous state by installing an artificial tooth has been rapidly made available to the extent that approximately more than one million cases of implant surgery are carried out every year in the US and more than 30 types of implants are installed in over 50,000 cases in Korea.^{1,2} In the 1970s when dental implant surgery was carried out by a Brånemark system, it was performed by elevating a flap and even to date, the implant is installed by lifting a flap in many cases.³ However, if implant surgery is carried out with the flap lifting, dehiscence and inflammation in the incision site can

occur and the bone loss, pain or edema around the implant may be caused.^{4,8}

Recently, flapless implant surgery that installs an implant without lifting a flap has been introduced and available.⁹ It has been suggested that by eliminating incision and suturing, this technique could achieve rapid healing of mucosa, shallower gingival sulcus, less bone loss and higher stability of the implant.^{10,11} However, since surgery is carried out without considering the shape of alveolar bone in flapless implant surgery, it is difficult to install the implant to an appropriate bone position. A computer-guided template is fabricated using a dental cone beam tomography and a treatment planning program in order to assist in determining the location and direction of the implant, which is to be installed accordingly.¹² Therefore, the shape of a patient's jawbone can be evaluated three-dimensionally before surgery, which subsequently enables the evaluation of relevant important anatomical structures, and bone mass and density. In addition, it can help installing the implant in the desirable location where prosthesis can function properly. Accordingly, by using a computer-guided template, advantages of flapless implant surgery can be exploited while its disadvantages as a blind technique are complemented to a certain degree.¹³

As implant surgery employing the computer-guided template have been increasingly available, studies on the accuracy of the guide system such as the comparison of the accuracy of computer-guided template,¹⁴⁻¹⁷ the impact of drilling for the implant on the heat generation in alveolar bone when using the computer-guided template^{18,19} and the complications due to the low accuracy of guide system²⁰ have been carried out.

Recently, interests in conceptualizing the quantification of the recovery from the symptoms and the patients' quality of life have been increasing.²¹ In 1998 Toronto Symposium, a consensus that the satisfaction of patients with the treatment had to be included in scales to measure the success of the implant treatment was reached and the subjective evaluation by patients has been included as one of the important factors for the successful implant surgery.^{22,23} McGrath *et al.*²⁴ reported the increasing trend of patient-reported outcome measures (PROMS) through a systematic review of relevant previous studies, and Erkapers *et al.*²⁵ investigated the satisfaction of patients with the immediate implant at 24 hours after surgery through a questionnaire. In a study on the relationship of the intravenous sedation with the anxiety of patients before surgery and the satisfaction of surgeons, it was suggested that the satisfaction of patients was lower if the anxiety of patients was higher before surgery, and it was not related to the satisfaction of surgeons.²⁶ In a survey of the satisfaction with implant surgery itself, willingness of recommendations, pain and cost for the comparison of the pre- and post-surgery satisfactions of patients who have undergone implant surgery, the satisfaction with implant surgery itself was shown to be the highest among them.²⁷ In a survey of the overall satisfaction of 100 patients who visited a clinic with the cost of the implant treatment, com-

fort, esthetics, chewing, gingival health, food impaction, phonetics, screw loosening and the implant itself, the lowest satisfaction was shown with the cost, and the food impaction and esthetics also displayed the low satisfaction.²⁸ These earlier studies compared either the satisfaction with implant surgery and other surgery, or pre- and post-surgery satisfactions, and investigated the satisfaction with implant surgery itself, willingness of recommendation, pain and other factors.

Most of studies on the computer-guided template to date have been performed on the safety through the analysis of the accuracy with which implant could be installed at a planned site by determining anatomical structures such as the inferior alveolar nerve, and there have been very few studies that analyzed the satisfaction from the perspective of patients who have undergone implant surgery using the computer-guided template. This study aims to investigate the degree of subjective pain and the satisfaction of patients who have undergone implant surgery using the computer-guided template.

MATERIALS AND METHODS

The subjects for this study consisted of adults between the ages of 20 and 69 years, who have undergone implant surgery in dental hospitals or dental clinics in Seoul, where implant surgery was performed using the computer-guided template, and voluntarily agreed on the purpose of this clinical study. Patients with mental illness or alcoholism, or those with clinical conditions considered being unsuitable for this test under the medical judgment of investigators or personnel responsible for the test were excluded. A survey was conducted on 135 people who had undergone implant surgery irrespective of using the computer-guided template during the period of 2012 and the first half of 2013. The study protocol was approved by Institutional Review Board (IRB) in Ewha Womans University (IRB No. ECT 13-13-04).

The questionnaire was composed of 4 main sections containing a total of 25 questions; 5 questions for general characteristics such as gender, age, education level, and occupations, 5 questions for monthly incomes, 6 questions for general health such as current physical condition, disease status and reasons for the choice of the hospital, and dental history, 12 questions for implant surgery such as implant sites, the number of implants and the number of hospital visits, and 2 questions for measuring the degree of pain and satisfaction.

Questions associated with the implant included which site they had implants installed in, whether the number of implants would act as a factor in choosing implant surgery, how often they visited hospital, and also whether they thought it was a right choice to have implant surgery. The first question was whether they were aware of the computer-guided template, and then depending on whether they had an experience of it, questions were varied. Patients who had experienced implant surgery with the computer-guided

Table 1. Major components of the questionnaire and its contents

Classification	Content	Number of questions
General characteristics	Gender, Age, Education level, Income level	5
General health and dental history	Current physical condition, Disease status, Reasons for the choice of the hospital	6
Experience of conventional or computer-guided implant surgery	Number of implant, Surgery site, Number of hospital visits, etc.	12
Degree of pain during implant surgery and satisfaction	Filled up directly	2
	Total	25

template were asked to fill in a questionnaire about reasons for choosing it, the satisfaction with choosing it, concerns about the cost, whether they would recommend it to others and whether they would get the help of it again in next implant treatment. At the end of the questionnaire, the degree of pain during implant surgery and the satisfaction were asked irrespective of using the computer-guided template, and thereby it was attempted to compare patients who have undergone implant surgery with the computer-guided template with those who have without it.

Questions were scored by 5-point scale (strongly agree=5 point, agree=4 point, neutral=3 point, disagree=2 point, strongly disagree=1 point). For questions asking the degree of pain during implant surgery and the satisfaction, investigators directly measured the area marked on the Visual Analogue Scale (VAS) with a ruler and recorded it to one decimal place (Table 1).

Among subjects who agreed to participate, those who complied with the clinical research plan were included in the final analysis. The collected data were analyzed by a statistical program, IBM SPSS 19.0 according to the purpose of data analysis, and the independent t-test and one-way ANOVA were performed to determine VAS Score and the relationship between the satisfaction and variables. The maximum level of statistical significance was set at .05.

RESULTS

Demographic analysis of the patients enrolled in this study is shown in the Table 2. The general health and dental history of research subjects is described in the Table 3.

The overall information of implant surgery, descriptions of implant surgery and the satisfaction, and the recognition and experience of the computer-guided template is shown in Table 4. Question about the sites and number of implants showed that the most common implant site was a lower molar (mandibular molar region) for 80 (50.3%) and the average number of teeth treated with implant surgery was 2.82. Also for the number of hospital visits during implant surgery, the answer from 61 participants (45.2%) was 11 - 16 times and 5 - 10 times from 47 participants

Table 2. General characteristics

Variables		n (%) or mean (SD)	
Gender	Male	79 (58.5)	
	Female	56 (41.5)	
Age		42.68 (10.98)	
Occupations	Agriculture, forestry, fishery or self-employed	13 (9.6)	
	Professional	42 (31.1)	
	Professor, teacher, civil servant	13 (9.0)	
	Technician, sales and service worker	12 (8.9)	
	Office worker	22 (16.3)	
	Housewife	21 (15.6)	
	Student (high school, college, graduate school)	8 (5.9)	
Unemployed	Unemployed	0 (0.0)	
	No answer	4 (3.0)	
	Education levels	Up to high school graduation	12 (18.5)
		University students	9 (6.7)
		University graduates	90 (66.7)
Graduate students and in possession of a graduate degree	Graduate students and in possession of a graduate degree	10 (7.4)	
	No answer	1 (0.7)	
Average monthly income	Less than 2 million won	38 (28.1)	
	2-3 million won	42 (31.1)	
	3-4 million won	32 (23.7)	
	4-5 million won	8 (5.9)	
	More than 5 million won	7 (5.2)	
	No answer	8 (5.9)	

Table 3. General health and dental history (n=135)

	Variables	n (%) or mean (SD)
Health condition	Normal	128 (94.1)
	Abnormal	6 (4.4)
	No answer	1 (0.7)
General health	Heart disease	3 (2.2)
	Cerebrovascular disease	1 (0.7)
	Liver disease	1 (0.7)
	Hypertension	21 (15.5)
	Diabetes	7 (5.2)
	chronic lower airway disease	0 (0.0)
	Gastric ulcer and duodenal ulcer	1 (0.7)
	Etc	4 (3.0)
	No answer	99 (73.3)
	The reason for choice of the hospital	Mass media such as advertisements or newspapers
Recommendation by family or acquaintances		2 (15.6)
State-of-the-art facilities		5 (3.7)
Reliable medical staffs		41 (30.4)
Others		4 (3.0)
No answer		1 (0.7)
Number of previous dental visit		4.19 (4.07)
Whether to have fear of dental treatment	Yes	77 (57.0)
	No	57 (42.2)
	No answer	1 (0.7)
Reasons for fear of dental treatment	Mechanical sound	17 (12.6)
	The smell of dental materials	1 (0.7)
	Anesthetic injection	39 (28.9)
	Bad experiences in the past	18 (13.3)
	The use of sharp instruments	6 (4.4)
	Others	0 (0.0)
Reasons of not undergoing timely dental care	No answer	54 (40.0)
	Aversion to the treatment	28 (20.7)
	Lack of time	47 (34.8)
	Expensive cost	51 (37.0)
	The absence of hospitals nearby	0 (0.0)
	Others	3 (2.2)
	No answer	6 (4.4)

(34.8%). A question of whether they thought it was a right choice to take implant surgery showed that the answer 'agree' from 86 people (63.7%), and 'strongly agree' from 34 people (25.2%). As for a question of whether they were given a full description of implant surgery by dentists before surgery, 52 respondents (38.5%) were 'neutral', and

Table 4. Implant surgery and computer-guided template

	Variables	n (%) or mean (SD)
Implant surgery site	Maxillary molar	53 (33.3)
	Maxillary anterior	12 (7.5)
	Mandibular molar	80 (50.3)
	Mandibular anterior	14 (8.8)
	No answer	2 (1.2)
Average number of placed implants per patient		2.82 (2.54)
Number of hospital visits	Less than 5 times	14 (10.4)
	5-10 times	47 (34.8)
	11-16 times	61 (45.2)
	16-20 times	8 (5.9)
	More than 20 times	3 (2.2)
Implant satisfaction	No answer	2 (1.5)
	Strongly disagree	0 (0.0)
	Disagree	0 (0.0)
	Neutral	13 (9.6)
	Agree	86 (63.7)
Description of implants	Strongly agree	34 (25.2)
	No answer	2 (1.5)
	Strongly disagree	0 (0.0)
	Disagree	0 (0.0)
	Neutral	52 (38.5)
Awareness of the computer-guided template	Agree	63 (46.7)
	Strongly agree	18 (13.3)
	No answer	2 (1.5)
Experience of a computer-guided template	Yes	39 (28.8)
	No	92 (68.1)
	No answer	4 (3.0)
	Yes	37 (27.4)
	No	90 (66.7)
	No answer	8 (5.9)

63 (46.7%) 'agree'. Results of questions regarding the recognition, experience, and satisfaction of the computer-guided template were as follows. To the question of whether they were aware of it, answers from 39 participants (28.8%) were 'yes' and those from 92 (68.1%) were 'no', which indicated that there were more people who were not aware of it yet. To a question of whether they have undergone surgery with a computer-guided template, 37 participants gave an answer 'yes' and 90 (66.7%) gave 'no', which showed that the number of people who were aware of the computer-guided template was similar to those who have undergone surgery using it.

Introduction route to the computer-guided template, reasons for the choice of it, and willingness of recommendation is shown in Table 5. Questions regarding the intro-

duction route to the computer-guided template, the reasons for choosing it, and willingness of recommendation gave following results. As for the route through which participants were introduced to implant surgery using the computer-guided template, 11 respondents (29.7%) pointed out the internet search, 16 (43.2%) the dentist's suggestion, 1 (2.7%) recommendations by acquaintances, and 9 (24.3%) mass media. The most frequently answered reason for choosing it was 'accurate and safe', followed by 'flapless' and 'multiple implants possible in one surgery'. As for a question whether they were willing to recommend implant surgery using the computer-guided template to others, 3 respondents (8.1%) gave an answer 'neutral', 17 (45.9%) gave 'agree', 16 (43.2%) gave 'strongly agree', and 1 (2.7%) gave no answer.

The degree of satisfaction at the time of undergoing implant surgery employing the computer-guided template was represented in the order of the average value of the Likert scale, as shown in Table 6. The reliability (Cronbach's α) of 8 questions about the satisfaction of patients who had undergone computer-guided implant surgery was 0.530. As for the response to the question of whether they felt less discomfort during implant surgery using the computer-guided template, 19 patients (52.8%) gave an answer 'agree', which was the highest rate, followed by 'strongly agree' with 16 patients (44.4%). The highest number of patients, 22 (61.1%), 'agreed' to the question of whether they felt relaxed during computer-guided implant surgery, followed by 'strongly agree' with 13 patients (36.1%). Responses to the question of whether they were satisfied with computer-guided implant surgery showed that 20 patients (55.6%) gave 'agree', which was the highest rate followed by 'strongly agree' with 14 patients (38.9%). Responses to the question of whether they were satisfied with their decision to undergo computer-guided surgery

Table 5. Introduction route to the computer-guided template, reasons of choosing it, and willingness of recommendation (n=37*)

Variables		n (%)
Introduction route	Internet search	11 (29.7)
	Dentist suggestion	16 (43.2)
	Acquaintances' recommendation	1 (2.7)
	via mass media	9 (24.3)
	Others	0 (0.0)
Reasons for choosing the computer-guided template	Multiple implants possible in one surgery	7 (18.9)
	Flapless	11 (29.7)
	Minimization of pain	1 (2.7)
	Accurate and safe	15 (40.5)
	The state-of-the-art technology	1 (2.7)
	Short operation time	1 (2.7)
	No answer	1 (2.7)
Willing to recommend the computer-guided template	Strongly Disagree	0 (0.0)
	Disagree	0 (0.0)
	Neutral	3 (8.1)
	Agree	17 (45.9)
	Strongly agree	16 (43.2)
	No answer	1 (2.7)

* Survey for 37 participants who have experienced the computer-guided template among a total of 135.

Table 6. Questions about the satisfaction with the computer-guided template in the order of Likert's scale score

Question	Mean (SD)	n (%)					(P-value)
		Strongly do not agree	Do not agree	Neutral	Agree	Strongly agree	
6	4.417 (0.554)	0 (0.0)	0 (0.0)	1 (2.8)	19 (52.8)	16 (44.4)	15.5 (0.000)*
5	4.333 (0.535)	0 (0.0)	0 (0.0)	1 (2.8)	22 (61.1)	13 (36.1)	18.5 (0.000)*
7	4.333 (0.586)	0 (0.0)	0 (0.0)	2 (5.6)	20 (55.6)	14 (38.9)	14 (0.001)*
1	4.200 (0.473)	0 (0.0)	0 (0.0)	1 (2.9)	26 (74.3)	8 (22.9)	28.514 (0.000)*
4	4.167 (0.507)	0 (0.0)	0 (0.0)	2 (5.6)	26 (72.2)	8 (22.2)	26 (0.000)*
2	4.139 (1.018)	0 (0.0)	3 (8.3)	7 (19.4)	8 (22.2)	18 (50.0)	13.556 (0.004)*
8	3.778 (0.832)	2 (5.6)	1 (2.8)	2 (5.6)	29 (80.6)	2 (5.6)	82.611 (0.000)*
3	3.694 (0.577)	0 (0.0)	0 (0.0)	13 (36.1)	21 (58.3)	2 (5.6)	15.167 (0.001)*

* : Statistically significant with $P < .05$

6: It was more comfortable when I underwent surgery with the computer-guided template, 5: I was relaxed during computer-guided implant surgery, 7: Implant surgery using the computer-guided template was satisfactory, 1: Before computer-guided implant surgery, I was satisfied with the decision, 4: After computer-guided implant surgery, I was less anxious, 2: The cost of implant surgery employing the computer-guided template was more expensive, 8: For the next chance, I would like to undergo computer-guided implant surgery again, 3: I fully understand the process of implant surgery employing the computer-guided template.

showed that 'agree' was the highest rate answer with 26 patients (74.3%), followed by 'strongly agree' with 8 patients (22.9%). To the question of whether they felt less anxiety about surgery after undergoing computer-guided implant, 'agree' was the highest rate answer with 26 patients (72.2%), followed by 'strongly agree' with 8 patients (22.2%). To the question of whether they were concerned about the cost for implant surgery using the computer-guided template, 18 patients (50.0%) gave the answer 'strongly agree', which was the highest rate, followed by 'agree' with 8 patients (22.2%). To the question of whether they would use the computer-guided template at next implant treatment, the highest rate answer was 'agree' with 29 patients (80.6%). Finally, to the question of whether

they chose the implant surgical methods after fully understanding it, 21 patients (58.3%) answered 'agree', which was the highest rate, followed by 'neutral' with 13 patients (36.1%).

The degree of pain with implant surgery according to the general characteristics of research subjects is shown in Table 7. In relation to the pain felt during implant surgery, there was statistically significant difference in the average VAS scores within the age groups, occupations, and the monthly incomes. Results according to the age groups showed that patients in their 50s or older felt less pain than those in their 20s-40s, with the scores shown to be 3.04 for 20s, 3.09 for 30s, 3.17 for 40s, 2.01 for 50s, and 2.08 for 60s or older ($P < .05$). Scores depending on occupations are as

Table 7. VAS scores of the degree of pain during surgery according to general characteristics (n=135)

Variable		Mean (SD)	t (P-value) or F (P-value)
Sex	Male	2.73 (1.15)	-1.185 [†] (0.238)
	Female	3.00 (1.40)	
	No answer	-	
Age	20 ¹⁾	3.04 (1.49)	5.306 [‡] (0.001)*
	30 ²⁾	3.09 (0.99)	
	40 ³⁾	3.17 (1.14)	
	50 ⁴⁾	2.01 (1.39)	
	60 or more ⁵⁾	2.08 (1.26)	
	No answer	-	
Occupations	Agriculture, forestry, fishery or self-employed ¹⁾	1.92 (1.16)	2.573 [‡] (0.022)*
	Professional ²⁾	2.95 (1.20)	
	Professors, teachers, civil servant ³⁾	2.88 (1.09)	
	Technicians, sales and service worker ⁴⁾	3.34 (1.35)	
	Office worker ⁵⁾	3.18 (1.05)	
	Housewife ⁶⁾	2.32 (1.22)	
	Students (High school, college, graduate school) ⁷⁾	2.88 (1.63)	
	No answer	-	
Education levels	Up to high school graduation	2.66 (1.55)	1.555 [‡] (0.204)
	University student	2.97 (1.43)	
	University graduate	2.94 (1.14)	
	Graduate student or in possession of a graduate degree	2.10 (1.19)	
	No answer	-	
Monthly income	Less than two million ¹⁾	2.92 (1.33)	4.413 [‡] (0.002)*
	Less than two million to three million won ²⁾	3.19 (1.17)	
	Less than three million to four million won ³⁾	2.72 (1.18)	
	Less than four million to five million won ⁴⁾	1.68 (0.80)	
	More than five million won ⁵⁾	1.74 (0.80)	
	No answer	-	

* : Statistically significant with $P < .05$.

† : Result of two sample t-test.

‡ : Result of one way ANOVA.

§ : Result of multiple comparison by Tukey.

Superscript numbers in parenthesis mean the references for post hoc analysis.

follows; 1.92 for occupations in agricultural, forestry and fishery sectors or self-employed, 2.95 for professionals, 2.28 for professors, teachers and civil servants, 3.34 for technicians, sales and service workers, 3.18 for office workers, 2.32 for housewives and 2.88 for students (high school, university, graduate school). It was shown that employees in agricultural, forestry and fishery sectors or self-employed persons felt less pain than technicians, sales, service and office workers ($P<.05$). Scores depending on the monthly incomes are as follows; 2.92 for less than 2 million won, 3.19 for 2-3 million won, 2.72 for 3-4 million won, 1.68 for 4-5 million won and 1.74 for more than 5 million won. It was shown that patients earning more than 4 million won of the monthly income felt less pain than those earning less

than 2-4 million won ($P<.05$).

Analysis associated with the satisfaction with the implant showed that there was statistically significant difference in the average VAS scores in the age groups, the education levels, and the monthly incomes (Table 8). Scores according to the age groups were 7.99 for 20s, 7.81 for 30s, 7.77 for 40s, 8.58 for 50s and 8.19 for 60s or older, which indicated that patients in their 50s or older felt higher satisfaction with implant surgery than those in their 20s-40s. As for the education levels, scores were 7.91 for high school graduation or lower, 7.68 for university students, 7.94 for university graduates and 9.00 for graduate school students or persons with a graduate degree, which showed that patients who were in graduate school or possessed a gradu-

Table 8. VAS scores of the satisfaction with the implant according to general characteristics (n=135)

Variable		Mean (SD)	t (P-value) or F (P-value)
Sex	Male	8.04 (1.14)	0.768† (0.444)
	Female	7.88 (1.12)	
Age	20 ¹⁾	7.99 (1.40)	5.306‡ (0.001)* 1,2,3 < 4,5§
	30 ²⁾	7.81 (1.06)	
	40 ³⁾	7.77 (1.08)	
	50 ⁴⁾	8.58 (0.99)	
	60 ⁵⁾	8.19 (1.27)	
	No answer	-	
Occupation	Agriculture, forestry, fishery or self-employed	8.50 (1.17)	1.400† (0.220)
	Professional	7.78 (1.19)	
	Professors, teachers, civil servant	8.11 (0.99)	
	Technicians, sales and service worker	7.59 (0.93)	
	Office worker	8.21 (1.00)	
	Housewife	8.27 (0.65)	
	Student (High school, college, graduate school)	7.86 (1.60)	
	No answer	-	
Education levels	High school graduation or lower ¹⁾	7.91 (1.20)	3.276‡ (0.023)* 1,2,3 < 4§
	University student ²⁾	7.68 (1.48)	
	University graduate ³⁾	7.94 (1.02)	
	Graduate student or in possession of graduate degree ⁴⁾	9.00 (9.24)	
	No answer	-	
Monthly income	Less than two million ¹⁾	7.79 (1.12)	4.098‡ (0.004)* 1,2,3,4 < 5§
	Less than two million to three million won ²⁾	7.82 (1.00)	
	Less than three million to four million won ³⁾	8.22 (0.88)	
	Less than four million to five million won ⁴⁾	8.35 (1.51)	
	More than five million won ⁵⁾	9.33 (0.86)	
	No answer	-	

* : Statistically significant with $P<.05$.

† : Result of two sample t-test.

‡ : Result of one way ANOVA.

§ : Result of multiple comparison by Tukey.

Superscript numbers in parenthesis mean the references for post hoc analysis.

ate degree felt higher satisfaction than those who had lower levels of education. Scores according to the monthly incomes were 7.79 for less than 2 million won, 7.82 for 2-3 million won, 8.22 for 3-4million won, 8.35 for 4-5 million won and 9.33 for more than 5 million won, which indicated that patients who earned more than 5 million won felt higher satisfaction than those earning 2-5 million won.

The comparison of VAS scores that represent the degree of subjective pain from the perspectives of patients with or without the experience of computer-guided surgery was done (Fig. 1). In the visual analogue scale (VAS) with the maximum value of 10, patients who have undergone implant surgery without the computer-guided template gave a score of 3.34 on average, and those who have undergone computer-guided implant surgery gave a score of 1.14 on average, which indicated that patients who have had implant surgery with the computer-guided template felt less pain ($P<.05$). The average satisfaction that patients felt subjectively according to the experience of computer-guided template was evaluated (Fig. 2). Patients who have under-

gone implant surgery without it scored 7.66, while those with it scored 8.95, which showed higher level of satisfaction of patients who have undergone computer-guided implant surgery. The analysis showed that there were statistically significant differences in the degree of pain and the satisfaction between the computer-guided surgery group and the conventional surgery group ($P<.05$).

Satisfaction of patients who have experienced both conventional implant surgery and computer-guided surgery is shown in Table 9. Among 37 patients who have undergone computer-guided implant surgery, there were 16 patients who also had prior experience of traditional implant surgery before that with the computer-guided template. A survey was conducted on 16 patients who have experienced both surgeries, and 15 patients (93.8%) gave 'yes' while 1 patient (6.2%) gave 'no' to the question of whether they had higher satisfaction with computer-guided surgery than conventional surgery (Table 10). Average values of the degree of pain and the satisfaction of 16 patients who have experienced both surgeries were 1.2 and 8.9, respectively.

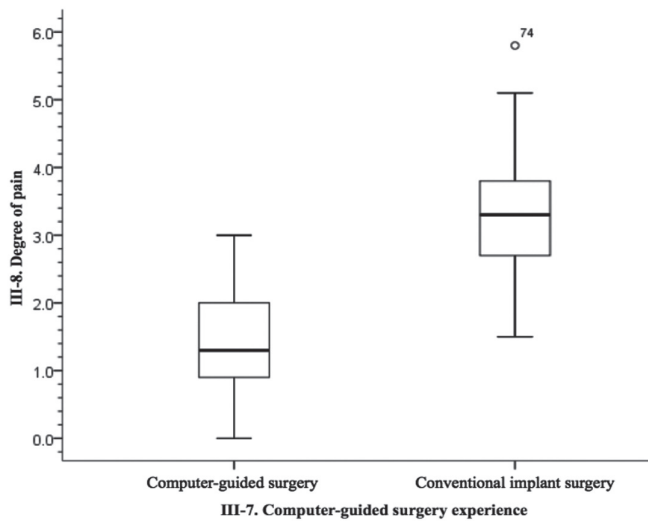


Fig. 1. Boxplot showing the relationship between the experience of computer-guided surgery and the degree of pain in VAS score. The patients who chose computer-guided surgery felt less pain than those who had surgery without a computer-guided template.

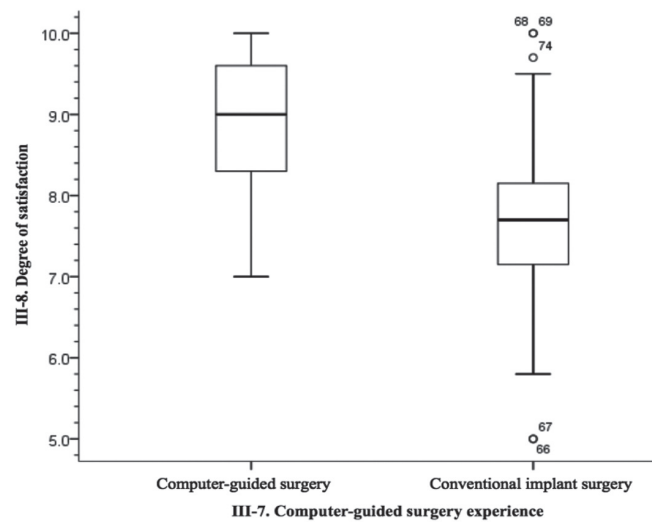


Fig. 2. Boxplot showing the relationship between the experience of computer-guided surgery and the satisfaction in VAS score. The patients who chose computer-guided surgery were more satisfied than those who had surgery without a computer-guided template.

Table 9. The degree of pain and the satisfaction of patients who have experienced both computer-guided surgery and conventional surgery in VAS score (n=16)

Variable	Mean (SD)
Degree of pain	1.244 (0.812)
Satisfaction	8.919 (0.854)

Table 10. The survey of the satisfaction of patients who have experienced both computer-guided surgery and conventional surgery (n=16)

Variables	n (%)
Satisfaction	Yes 15 (93.8)
	No 1 (6.2)

DISCUSSION

The computer-guided implant surgical template is used in order to determine the site where an implant is installed within the mouth during surgery. As mentioned earlier, since the use of the computer-guided template results in faster healing of the mucous membrane and does not require the lifting of the periosteum, the depth of the gingival sulcus around the implant is reduced and the less bone loss occur. Subsequently, the implant stability is guaranteed.^{10,11} Therefore, cases of computer-guided implant surgery have been increasing in recent years.²⁹⁻³¹ In this study, the level of subjective pain during implant surgery and the satisfaction of patients according to the implant site, the number of implants, willingness of recommendations, the satisfaction with the computer-guided template and the use of it were assessed through the survey. VAS has been mainly used in the pain research and has advantages of the easy application to patients, the easy statistical process compared to the subjectively classified survey responses, little or no communication failure and comparability with other studies.³²

The mandibular molar accounted for 50.3% of implant sites, which was the highest rate, followed by the maxillary molar with 33.3%. Most of implants were installed in the mandibular molar region since the tooth loss occurs more frequently in the mandible than other regions.³³ As for the number of hospital visits, 11-16 times was the most common with 45.3%. Most of patients were satisfied with the description by dentists before implant surgery and the post-surgery progress.

28.8% of patients were aware of the computer-guided implant surgery while 68.1% of patients were not, which showed that more patients did not know it. However, the number of people who were aware of it and the number of people who received computer-guided implant surgery were almost identical, as 27.4% of patients have undergone surgery with it and 66.7% of patients have not. It is considered that most of patients who had prior knowledge of the computer-guided template felt the need for a guide and subsequently chose computer-guided implant surgery. If patients recognize the computer-guided template through the full explanation, it will become one of the most important factors for choice of a treatment.

The highest rated answer for the introduction route to the computer-guided template was “the advice from the dentist”, accounting for 11.9%. Therefore, it is considered that dentists who frequently practice the computer-guided implant surgery provide patients with the information about the implant operation guide. As for the reasons to choose the computer-guided template, ‘accurate and safe’ practice was the most common reason, followed by ‘flapless surgery that does not require an incision in the gum’. On the contrary, ‘installation of multiple implants at a time’, ‘state-of-the-art technology’, and ‘short operation time’ were not considered to be reasons, and it is considered that the safety and postoperative pain are more important factors for consideration from the perspective of

patients undergoing implant surgery. It is considered that patients who have experienced the computer-guided implant surgery have a good impression of the guide, as it was shown that 11.9% and 12.6% gave the responses ‘Strongly Agree’ and ‘Agree’, respectively for the question of whether they would recommend the implant surgery using a guide to their acquaintances.

The question that received the highest score among the 8 questions about the satisfaction with the computer-guided template according to the average score in Likert scale was ‘less discomfort during surgery’, followed by ‘comfortable during surgery’, ‘satisfied with computer-guided surgery immediately after the operation’ and ‘satisfied with a decision of computer-guided surgery’. It can be inferred from the results that computer-guided surgery caused actually less discomfort compared to traditional surgery from the perspective of patients. It is considered that emotional distress was also reduced during surgery. On the contrary, the question about the cost of computer-guided surgery scored 4.13, which indicated that patients felt the economic burden. However, the question about the willingness of using the computer-guided template again in the future implant treatments scored 3.8, which clearly showed that patients were generally satisfied with computer-guided surgery despite the economic burden.

Regarding the degree of pain in implant surgery according to variables, significant results were obtained only in the age and the monthly incomes. For the degree of pain, patients in their 50-60s or older were shown to feel less pain than patients in their 20-40s. Since the age group in which periodontal diseases begin to occur is mainly 40s due to many tooth losses,³⁴ it is considered that the age groups who can experience more improvement of masticatory function after restoring the missing tooth are likely to have greater expectations for implant surgery and thus feel less pain. As for the monthly income, the group earning more than five million won of the monthly income showed higher satisfaction than the group earning less than five million won. Shin *et al.*³⁵ noted that dental care is considered expensive due to many treatments not covered by insurance, and patient who received treatments covered by insurance showed higher satisfaction with the cost than those who received non-covered treatments. Likewise in this study, it is considered that patients earning more than five million won of the monthly income could have higher satisfaction than those earning less than five million won, since the former can afford the treatment. The degree of subjective pain shown as VAS score suggested that patients who received computer-guided implant surgery felt less pain with the score of 1.41, while those who underwent conventional surgery without the computer-guided template scored 3.34. The fear of treatment was identified as the most important factor of making patients not visit the dentistry,³⁶ and one of the most important reasons for delaying or cancelling the appointment of dental care.³⁷ In addition, a study also suggested that the fear of pain was considered to be the most uncomfortable aspect in visiting the dentist.³⁸ The

results of this study imply that the computer-guided template may play a role in motivating patients who do not want to receive dental treatments due to the fear of pain to have a treatment, and become an alternative way that enables dentists to recommend the implant to patients with dental phobia.

Scores in the visual analog scale of the satisfaction with implant surgery were 7.66 from patients who have undergone traditional implant surgery and 8.95 from those who have received computer-guided implant surgery, indicating that the latter showed higher satisfaction. In previous studies on the satisfaction with overall implant surgery, Ganzberg *et al.*³⁹ suggested that patient satisfaction was 84.1% through VAS, Garip *et al.*⁴⁰ reported 95% of the satisfaction through 3-point Likert scale of 'excellent, good, and poor', and 52.2% of the satisfaction through 4-point scale was reported in another study.²⁶ While the satisfaction with overall implant surgery appeared to be high in these studies, there was big difference between the studies depending on the design of the questionnaire.

Unlike previous studies on overall implant surgery that showed higher satisfaction, this study attempted to investigate the difference in the satisfaction depending on the different implant surgical methods: the one with or without a computer-guided template. As a result, patients' satisfaction with computer-guided implant surgery was shown to be higher and accordingly, it is recommended to suggest the use of the computer-guided template along with pre-surgical description in order to enhance patients' satisfaction with implant surgery.

Among 37 patients who have undergone computer-guided implant surgery, 16 patients have also had prior experience of traditional implant surgery without the guide, and 15 of them revealed that they had higher satisfaction with computer-guided surgery than with the traditional surgery. Although there is a limitation in comparing the two implant surgical methods as implants were not installed during the same period and in the identical sites, it is very suggestive since the results were based on patients who have experienced both ways of surgery. Through these results, it can be considered that the satisfaction with implant surgery through a guide can be higher with the experience.

Since this study was carried out only with patients who visited dental hospitals or dental clinics in limited areas, and subsequently samples were not collected by a statistical sampling method, this study has a certain limitation that the results cannot be generalized. In addition, since the computer-guided template is still not in general use, there are not many patients who have undergone computer-guided implant surgery, which limited the number of available research subjects and subsequently the sample size was small. There was a limitation in the comparative analysis due to the substantially small ratio of these research subjects compared to that of patients who have undergone conventional implant surgery without the computer-guided template. In the future research, factors that may affect data

need to be controlled by choosing target institutions through a statistical sampling method, and the data that could complement and generalize the previous studies by enlarging the sample size with increased number of research subjects should be acquired. Finally, if the clinically measurable objective testing method is additionally combined with the patients' subjective judgments, more objective results can be derived.

CONCLUSION

From this study, 'dentist's suggestion' was the most frequently answered introduction route to computer-guided surgery and 'accurate and safe' was the most frequently answered reason for choosing computer-guided implant surgery. Also, patients who had experienced both computer-guided and conventional treatments revealed that they felt less pain and higher satisfaction with computer-guided surgery.

It is considered that the quality of treatment can be enhanced in implant surgery and a wide range of options may be provided to patients, if sufficient information of the computer-guided implant surgery is provided to patients prior to surgery.

ACKNOWLEDGEMENTS

We thank to Prof. Shin for providing statistical analysis in this study.

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