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Evaluation of Implant Stability According to Implant Placement Site and Duration in Elderly Patients

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KEYWORDS
implant stability; implant stability quotient; Periotest value; implant stability test; prospective study; elderly patient

ABSTRACT:

The research examined sixty implants in sixty patients who were 65 years old or older, with diameters of 3.5/4.0/4.5/5.0 mm and lengths of 8.5/10.0/11.5 mm. A, maxillary right-posterior; B, maxillary left-posterior; C, mandibular right-posterior; D, mandibular anterior; E, mandibular left-posterior; F, and a total of ten sections were used to split the implant placement locations. After the implant procedure, participants had to return to the hospital six times: once for stitch removal, twice for one month's follow-up, four times for two months' follow-up, five times before the final restoration was delivered, and six times after it was delivered. The Osstell Mentor, Periotest M, and Anycheck were used to assess the stability of the implants (IST). A significance level of 0.05 was used to assess the mean values of ISQ, PTV, and IST. Compared to 1V, 4V and 5V showed considerably greater ISQ, PTV, and IST findings ($p < 0.05$). In the E location, at 4V and 5V, the ISQ readings were the lowest ($p < 0.05$). The IST findings of 6V were noticeably greater than those of 1V, 2V, 3V, and 4V in all mandibular sites ($p < 0.05$). The findings of the ISQ showed a negative correlation with PTV and a positive correlation with IST, whereas the results of PTV showed a negative correlation with IST.

Introduction

It takes a combination of scientific knowledge and artistic skill to perform implant dental procedures such as planning, surgery, and tooth replacement. Patients' desire for dental implant therapy is on the rise. In the last ten years, dental implantology has grown in importance and helped dentists greatly enhance their patients' quality of life. Crowns, bridges, dentures, and other facial prostheses may be securely attached to and supported by dental implants, also known as end osseous implants or fixtures, which are surgical components that connect with the jaw or skull bone. Dental implant success or failure is mostly dependent on the skills of the surgeon, the patient, any drugs that influence Osseo-integration, the anticipated stress on the implant, and the patient's overall tissue health. Surgical risks (such as excessive bleeding or nerve injury) are one category of implant therapy complications. Another category includes risks that may occur within the first three to six months (such as infection and failure to Osseo integrate). Finally, there is a third category of risks that may occur in the longer term (such as peri-implantitis and mechanical failures). Consequently, dentists who specialize in dental implantology need to have a solid foundation in both the science and art of implant surgery as well as the clinical and post-operative care of their patients' prosthetic teeth. There should be a focus on both biology and dental restoration while placing dental

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implants. A thorough evaluation and correct diagnosis are prerequisites for the placement of dental implants.

Literature Review

SHIM (2023) Implant therapy for the elderly is on the rise globally as medical care focuses on preserving their quality of life. We set out to determine if there was a correlation between the length of time after implant placement and the reliability of various measurement equipment in patients over the age of 65. The research looked at 60 implants in 60 individuals who were 65 years old or older. A, maxillary anterior; B, maxillary left-posterior; C, mandibular right-posterior; D, mandibular anterior; E, mandibular left-posterior; and F make up the six equally dispersed parts of the ten implant implantation locations. Each participant had seven separate hospital visits: 1 before surgery, 2 during implant surgery, 3 after stitch removal, 4 for a follow-up at 1 month, 5 for a follow-up at 2 months, 6 before final restoration delivery, and 7 after final restoration delivery. The Osstell Mentor, Periotest M, and Anycheck were used to assess the stability of the implants (IST). We evaluated the mean values of ISQ, PTV, and IST with a significance level of =.05. The values for ISQ, PTV, and IST at 5V and 6V were noticeably greater than those at 2V (P<.05). At 5V and 6V, the E position had the lowest ISQ findings (P<.05). Seven-volt IST outcomes were noticeably better than two-volt, three-volt, four volts, and five-volt responses in every mandibular site (P<.05). There was a negative correlation between ISQ and PTV, a positive correlation between PTV and IST, and a negative correlation between IST and PTV. The optimal implant load application time was calculated by taking into account many aspects that impact implant stability. A higher percentage of successful implant placement in older individuals may result from this. Anycheck also shown its relative dependability when compared to Periotest M and Osstell ISQ Mentor, two other diagnostic devices for implant stability and osseointegration assessment in older patients.

Choi (2023) Examining how implant stability varies with time after installation in relation to aging was the primary goal of this research. Content and procedures: The study comprised 104 patients across four age categories: those under 60 years old, those between 61 and 70 years old, those between 71 and 80 years old, and those above 80 years old. Without performing any kind of bone augmentation operation, level-tapered implants were surgically implanted into the patient's bone. While inserting the implant, we made note of the ultimate torque value shown on the implant engine. Immediate post-operative cone-beam computed tomography (CBCT) was used to assess the implant-related bone quality. Immediate postoperatively, 2, 4, and 8 weeks postoperatively, the stability of the implants was assessed. The outcomes are: The CBCT picture showed that groups 3/4, group 1, and group 2 had significantly greater grayscale values ($p<0.05$). The insertion torque levels did not vary significantly ($p\geq0.05$) among the various age groups. Compared to immediately and 8 weeks after surgery, groups 1 and 2 had poorer implant stability values after 2 and 4 weeks ($p<0.05$). On the other hand, groups 3 and 4 did not exhibit a significant difference in findings assessed at various timepoints ($p\geq0.05$). Findings: When the implant is properly embedded in the alveolar bone without the use of bone augmentation, implant therapy in older patients is effective, demonstrating stable implant stability over time after implant placement.

Huang (2023) From immediately placing the implants the day after extraction to delaying installation for at least six months after full healing, a wide range of loading procedures was discovered. An important part of the implantation process is the evaluation technique for the placement and loading of the implants. Several parameters, including the implant's macroscopic design, surgical technique, and the amount and quality of local bone in touch with the implant, would be detailed in depth; these, in turn, greatly influence the anticipated clinical results. The goal of this literature study was to identify the elements that affect implant design and how they relate to implant placement stability. It is believed that future research may better serve dentists and patients if they have a better grasp of the first look of implant design as well as the stability requirements of implant placement.

Andreotti (2016) The purpose of this review is to compare and contrast two approaches that are used to determine whether an implant is stable enough to utilize in a given clinical situation, and if so, which one is more accurate. Methods: Searches were made in the Scopus and MEDLINE-PubMed databases for articles published up to November 2015 without regard to publication date limitations. These terms were used, along with their associations: "dental implant," "dental implants," "Osstell," "resonance frequency analysis," "implant stability quotient," "ISQ," "Periotest," "Periotest value," and "PTV." Clinical studies that assessed implant stability using resonance frequency analysis (RFA) and damping capacity analysis (DCA) and were conducted in English were eligible for inclusion. If the analysis had been conducted in different locations, the research should have discriminated the outcomes for each region; RFA and DCA should have been given to the same implants and times; and the study should have assessed implant stability in a particular region for all patients. Data of interest were compiled after carefully selecting studies. The inclusion criteria were satisfied by six studies. Despite a strong numerical connection between the two sets of results, data revealed that 46% of instances were identical when it came to classifying implant stability. In conclusion, it seems that the values acquired by RFA and DCA devices do not always provide a universally accepted criterion for classifying implant stability. This lack of uniformity has the potential to cause misunderstandings and conflicts among dental practitioners.

Lim (2022) Through the use of an improved number of blows and strength determined by a prospective clinical trial, we aim to evaluate the stability of dental implants and the usefulness of a newly constructed damping capacity measurement device. Approach and Materials: Measurements were taken to determine the stability of dental implants in 50 implants belonging to 38 individuals. The Anycheck and Periotest M devices were used for two sets of measurements, one each in the buccal and lingual directions. Also, there were a total of five measures taken: the day of surgery, two weeks, one month, two months, and three months following the procedure. Differences and variations over time for each device were detected after the measured values were standardized. Findings: At any given moment, there was no discernible disparity in the standardized data recorded by the two devices. Initially, stability in both devices was lower two weeks after surgery, but it steadily rose after that. The readings did not vary in relation to the direction of measurement. Results: Any check's damping capacity was comparable to Periotest M. Implant stability improved with time after a temporary dip in the first two weeks following insertion.

Research Methodology

Between 2020 and 2022, researchers at Korea University Guro Hospital and Dankook University Dental Hospital followed 60 patients—30 males and 30 females—who were 65 and older and in need of dental implant therapy. Prior to the start of the investigation, this prospective research was entered into the public clinical trials database (KCT0005721 — Clinical Research Information Service of the National Research Institute of Health in the Republic of Korea). Two dental clinics served as study sites, and after receiving green lights from their respective local medical ethics committees (2020GR0580 and DKUDH 2020-11-001), researchers followed all applicable protocols. When a tooth extraction was necessary, it was done in accordance with the delayed implant criteria, and then the patient was given three to four months to recuperate before the implants were placed. "Dropouts" were defined as participants who either did not complete the implant procedure or who voluntarily withdrew their permission. Previous research comparing implant stability diagnostic equipment served as the basis for the sample size calculation, with a correlation coefficient of 0.777 serving as the benchmark. The findings of a paired t-test ($\alpha = 0.05$, $\beta = 0.8$, two-tailed) were used to determine the sample size in a software for calculating sample numbers (G power ver 3.1; Heinrich-Heine-Universität, Düsseldorf, Germany). At least seven days prior to implant surgery, all patients had read, comprehended, and signed an informed consent form in writing. After getting the participant's written agreement, the clinical staff made sure they met all of the inclusion and exclusion criteria. We did not exclude any patients. The participant's hospital visit count was six times: once for implant surgery, twice for stitch removal, once for a month's follow-up, twice for two months' follow-up, five times before the final restoration delivery, and six times following the final restoration delivery. Osstell ISQ Mentor and Periotest M were used to assess implant stability at 1V, 4V, and 5V, while the Anycheck was used at 1V, 2V, 3V, 4V, 5V, and 6V. The purpose of this research was to compare groups depending on post-implantation length and implant site to determine the accuracy and reliability of IST using the ISQ and PTV values. Statistical Package for the Social Sciences, Version 25.0 (IBM SPSS Inc., Chicago, IL, USA) was used to analyze all the data. To ensure that the data was normally distributed, we ran

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one-sample Kolmogorov-Smirnov tests. If the tests came out normal, we moved on to statistical analysis. Tukey's post hoc comparisons were performed after one-way analysis of variance (ANOVA) tests compared differences between the groups according to the implantation site.

DATA ANALYSIS

The stability of the implants was assessed using a variety of instruments. Figure 3 shows the groups' average values and standard deviations for ISQ, PTV, and IST according to the period of post-implantation. At the 2-month follow-up and prior to the final restoration delivery, the implant stability findings for all ISQ, PTV, and IST were noticeably greater than those recorded during implant surgery. As indicated in Table 1, there are notable variations in ISQ, PTV, and IST across the groups when categorized by the length after implantation. It was found that there were significant changes ($p < 0.05$) in the ISQ and PTV between the first and fourth visits, the first and fifth visits, and the fourth and fifth visits. There were notable variations at every stage for the IST, with the exception of the visits between the first and second, third, and fourth visits ($p < 0.05$).

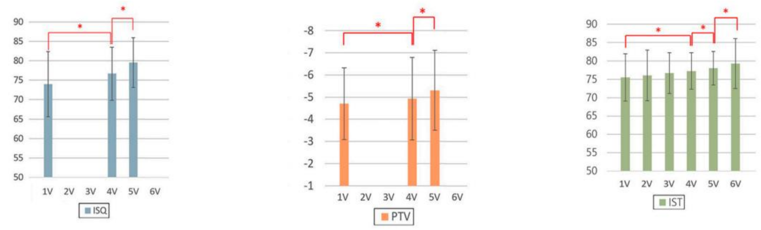

Figure 3. Analysis of implant stability measurements made with different devices according to the duration. (A) ISQ, (B) PTV, and (C) IST. ISQ, implant stability quotient; PTV, Periotest value; IST, implant stability tester value. 1V, first visit; 2V, second visit; 3V, third visit; 4V, fourth visit; 5V, fifth visit; 6V, sixth visit. * Denotes a significant difference, with $p < 0.05$.

Table 1. Statistical analysis of implant stability measurements made with different devices according to the duration.

Value	1V:2V	1V:3V	1V:4V	1V:5V	1V:6V	2V:3V	2V:4V	2V:5V	2V:6V	3V:4V	3V:5V	3V:6V	4V:5V	4V:6V	5V:6V
ISQ	-	-	0.001 *	<0.001 *	-	-	-	-	-	-	-	-	<0.001 *	-	-
PTV	-	-	0.049 *	<0.001 *	-	-	-	-	-	-	-	-	0.001 *	-	-
IST	0.488	0.096	0.012 *	<0.001 *	<0.001 *	0.215	0.048 *	0.005 *	<0.001 *	0.127	0.007 *	<0.001 *	0.043 *	<0.001 *	0.032 *

Figure 4 displays the mean values and standard deviations of implant stability measures taken with various instruments, categorized by dental implant insertion location and duration. Between the first and fourth visits, the first and fifth visits, and the fourth and fifth visits, there were statistically significant changes for the ISQ according to the post implantation length for each site of the placed implants (Table 2).

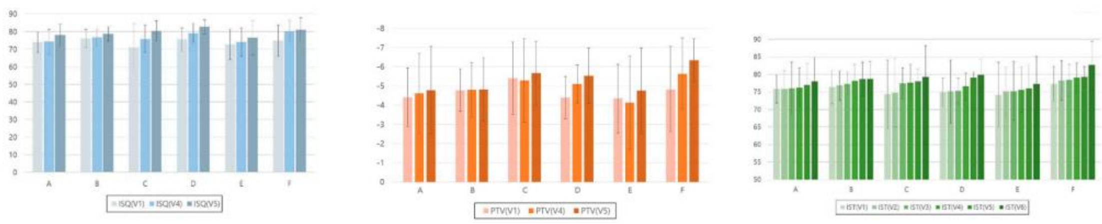

Figure 4. Analysis of implant stability measurements made with different devices according to dental implant placement site and duration. (A) ISQ, (B) PTV, and (C) IST. ISQ, implant stability quotient; PTV, Periotest value; IST, implant stability tester value. A, maxillary right-posterior; B, maxillary anterior; C, maxillary left-posterior; D, mandibular right-posterior; E, mandibular anterior; F, mandibular left-posterior. 1V, first visit; 2V, second visit; 3V, third visit; 4V, fourth visit; 5V, fifth visit; 6V, sixth visit. Figure 4. Analysis of implant stability measurements made with different devices according to dental implant placement site and duration. (A) ISQ, (B) PTV, and (C) IST. ISQ, implant stability quotient; PTV, Periotest value; IST, implant stability tester value. A, maxillary right-posterior; B, maxillary anterior; C, maxillary

left-posterior; D, mandibular right-posterior; E, mandibular anterior; F, mandibular left-posterior. 1V, first visit; 2V, second visit; 3V, third visit; 4V, fourth visit; 5V, fifth visit; 6V, sixth visit.

Table 2. Statistical analysis of implant stability measurements made with different devices according to dental implant placement site and duration.

Location	Value	1V:2V	1V:3V	1V:4V	1V:5V	1V:6V	2V:3V	2V:4V	2V:5V	2V:6V	3V:4V	3V:5V	3V:6V	4V:5V	4V:6V	5V:6V
A	ISQ	-	-	0.728	0.002 *	-	-	-	-	-	-	-	-	0.003 *	-	-
	PTV	-	-	0.596	0.305	-	-	-	-	-	-	-	-	0.719	-	-
	IST	0.937	0.857	0.744	0.499	0.172	0.910	0.788	0.583	0.249	0.883	0.594	0.093	0.485	0.267	0.503
B	ISQ	-	-	0.703	0.149	-	-	-	-	-	-	-	-	0.046 *	-	-
	PTV	-	-	0.961	0.932	-	-	-	-	-	-	-	-	0.934	-	-
	IST	0.500	0.334	0.139	0.071	0.176	0.507	0.196	0.080	0.147	0.072	0.018	0.150	0.268	0.600	0.954
C	ISQ	-	-	0.078	0.002 *	-	-	-	-	-	-	-	-	0.001 *	-	-
	PTV	-	-	0.847	0.654	-	-	-	-	-	-	-	-	0.136	-	-
	IST	0.882	0.136	0.185	0.104	0.141	0.059	0.174	0.176	0.181	0.906	0.704	0.498	0.772	0.451	0.529
D	ISQ	-	-	0.031 *	<0.001 *	-	-	-	-	-	-	-	-	0.009 *	-	-
	PTV	-	-	0.006 *	<0.001 *	-	-	-	-	-	-	-	-	0.086	-	-
	IST	0.903	0.474	0.023 *	<0.001 *	0.001 *	0.929	0.449	0.056	0.048 *	0.085	<0.001 *	0.001 *	<0.001 *	0.002 *	0.458
E	ISQ	-	-	0.561	0.159	-	-	-	-	-	-	-	-	0.152	-	-
	PTV	-	-	0.615	0.329	-	-	-	-	-	-	-	-	0.005 *	-	-
	IST	0.729	0.743	0.612	0.383	0.048 *	0.902	0.676	0.619	0.046 *	0.718	0.635	0.012 *	0.729	0.017 *	0.434
F	ISQ	-	-	0.047 *	0.019 *	-	-	-	-	-	-	-	-	0.669	-	-
	PTV	-	-	0.005 *	<0.001 *	-	-	-	-	-	-	-	-	0.021 *	-	-
	IST	0.454	0.177	0.073	0.109	0.007 *	0.885	0.564	0.333	0.049 *	0.266	0.408	0.023 *	0.815	0.033 *	0.052

Table 3 displays the findings of the Pearson's correlation tested between the mean ISQ, mean PTV, and mean IST. Upon first examination, the modest negative correlation (p = 0.049) was confirmed by an R-value of −0.208 between the ISQ and PTV findings. The moderate positive correlation (p < 0.001) was confirmed by the R-value of 0.567 between the ISQ and IST findings. Furthermore, the negative correlation between the PTV and IST values was considerable (r = -0.490, p < 0.001). On the fourth visit, the modest negative association (p = 0.001) was confirmed by an R-value of -0.298 between the ISQ and PTV data. A slight positive association (p = 0.003) was confirmed by an R-value of 0.367 between the ISQ and IST data. Furthermore, the correlation coefficient (r) of -0.701 between the PTV and IST data confirmed the significant negative connection (p < 0.001). On the fifth visit, the modest negative association (p = 0.005) was confirmed by an R-value of -0.252 between the ISQ and PTV data. A moderate positive correlation (p < 0.001) was confirmed by the R-value of 0.503 between the ISQ and IST findings. Furthermore, there was a moderate negative correlation (p < 0.001) as shown by the R-value of -0.479 between the PTV and IST values.

Table 3 Results of Pearson's correlation between the mean ISQ, PTV, and IST values.

Value	1V			4V			5V		
	Correlation Coefficient	Size of Correlation	*p*-Value	Correlation Coefficient	Size of Correlation	*p*-Value	Correlation coefficient	Size of Correlation	*p*-Value
ISQ-PTV	−0.208	weak	0.049 *	-0.298	weak	0.001 *	−0.252	weak	0.005 *
ISQ-IST	0.567	moderate	<0.001 *	0.367	weak	0.003 *	0.503	moderate	<0.001 *
PTV-IST	−0.490	moderate	<0.001 *	-0.701	strong	<0.001 *	−0.479	moderate	<0.001 *

Table 4 displays the groups' findings for the implant stability values between the arch positions and implant sites in Osstell ISQ Mentor, Periotest M, and Any check. Differences in ISQ scores were statistically significant at both the fourth and fifth visits (p = 0.016 and p = 0.042, respectively). The PTV findings showed that the relationships between the implant sites at each visit were statistically insignificant (p > 0.05). Only at the fifth visit (p = 0.044) did the correlations between implant sites show a statistically significant difference in the IST outcomes.

Table 4. Results of the two-way ANOVA of all groups for the implant stability values between the locations of the implants and the positions of arch with the mean ISQ, PTV, and IST values.

Value		1V	2V	3V	4V	5V	6V
ISQ	Location	0.561	-	-	0.198	0.048 *	-
	Arch	0.655	-	-	0.062	0.362	-
	Location × Arch	0.134	-	-	0.016 *	0.042 *	-
PTV	Location	0.119	-	-	0.052	0.007 *	-
	Arch	0.250	-	-	0.870	0.157	-
	Location × Arch	0.720	-	-	0.321	0.520	-
IST	Location	0.923	0.809	0.162	0.185	0.436	0.137
	Arch	0.977	0.811	0.516	0.752	0.747	0.289
	Location × Arch	0.186	0.199	0.472	0.170	0.044 *	0.259

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Conclusion

Finding the optimal implant load application time within the constraints of our research requires taking into account a number of variables impacting implant stability. A higher percentage of successful implant placement in older individuals may result from this. Anycheck also shown its relative dependability when compared to Periotest M and Osstell ISQ Mentor, two other diagnostic devices for implant stability and osseointegration assessment in older patients.

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