Evaluation of Implants Stability and Measuring Devices Reliability According to Dental Implant Placement Sites and Elapsed Time for Elderly Patients

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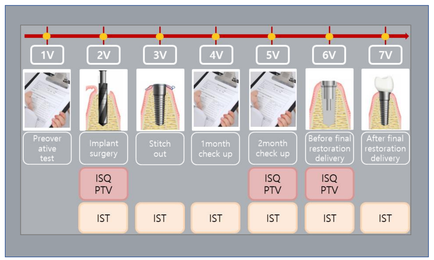
01 Introduction

- ✓ Recently, As the implementation of dental implant health insurance for elderly patients aged 65 years or older in Korea, the number of patients receiving treatment is increasing. As the differentiation rate of osteoblasts slows down with age, the time for implant osseointegration can be relatively increased. Depending on the implantation site, it has various alveolar bone conditions, so it is stable through a reliable diagnostic device to evaluate the appropriate degree of osseointegration. It is assumed that measurements are necessary.[1] However, there is currently a lack of prospective clinical studies on the evaluation of implant stability and measurement device reliability according to the implantation site and elapsed time in elderly patients.
- ✓ As a diagnostic device for implant stability evaluation, Osstell™ ISQ Mentor operates in the RFA measurement method, and measures resonance through a magnetic field by connecting a transducer called SmartPeg to a fixture to indicate a stability value. It is reported that the numerical value indicates high stability.
- ✓ Periotest™ M is a DCA-type device that operates on the principle of percussion. It measures the time for a metal rod to come back after contacting the surface of the target and converts it to the implant mobility. It percussions 16 times in 4 seconds, and the PTV value is - It ranges from 8 to +50, and the lower the number, the higher the stability of the implant. Anycheck™ operates on the DCA principle, but it is reported that it is more accurate by measuring in the contact state and applies minimal stimulation to the implant by reducing the strength during percussion. More than that means high stability.[2]
- ✓ The purpose of this study was to measure implant stability according to the implant placement site and elapsed time in elderly patients aged over 65 years and evaluate the accuracy and reliability of various diagnostic devices to help evaluate implant osseointegration in elderly patients.

02 Materials & Methods

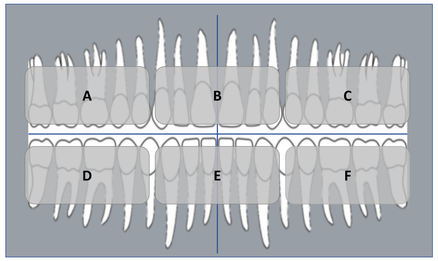
Study Abstract

- ❖ Subjects: Selected 60 patients over 65 years of age
- ❖ IRB No. DKUDH IRB 2020-11-001
- ❖ CMI IS-II active (Neobiotech, Seoul, Korea) implantation
- ❖ Insertion torque value(ITV): 30Ncm
- ❖ Diagnostic device used for implant stability evaluation
  - Osstell™ ISQ Mentor, Periotest™ M, Anycheck™
- ❖ Implantation and stability evaluation: performed by one experienced dentist



Group of placement site

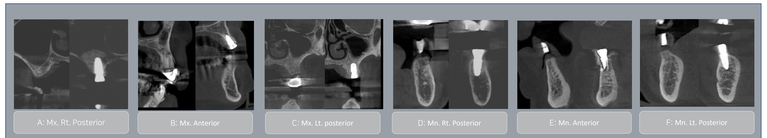
Implant placement Site	Group	Number
Mx. Rt. Posterior	A	10
Mx. Anterior	B	10
Mx. Lt. Posterior	C	10
Mn. Rt. Posterior	D	10
Mn. Anterior	E	10
Mn. Lt. Posterior	F	10



Treatment procedure and timing of stability evaluation

Visit (V)	Measurement	Measuring methods
1V	Preoperative test	Form of study agreement, adequacy evaluation, research number, CBCT taking
2V	Implant surgery	Implant stability measurement : ISQ, PTV, IST
3V	Stitch out	Implant stability measurement : IST
4V	1month check up	Implant stability measurement : IST
5V	2month check up	Implant stability measurement : ISQ, PTV, IST
6V	Before final restoration delivery	Implant stability measurement : ISQ, PTV, IST
7V	After final restoration delivery	Implant stability measurement : IST

CBCT analysis of implant placement (example)



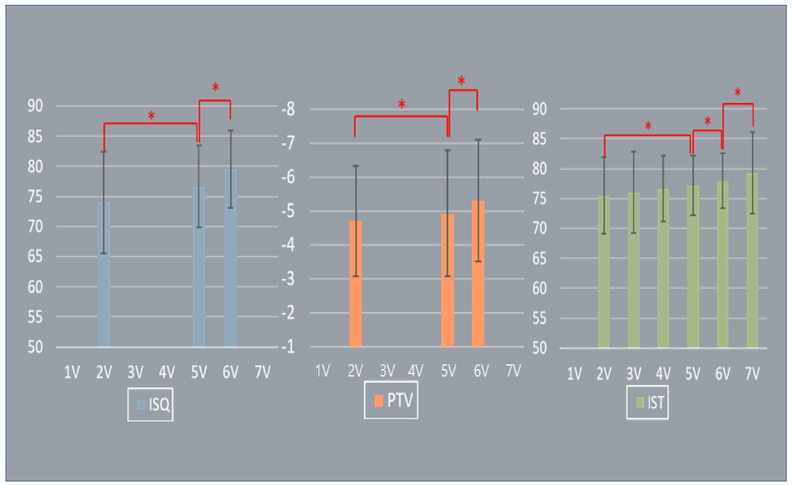
Statistical analysis

- ❖ SPSS Statistics for Windows V25.0
  - IBM SPSS Inc., Chicago, IL, USA
- ❖ Test of normality: One-sample Kolmogorov Smirnov test
- ❖ Implant stability according to dental implant placement sites
  - One-way ANOVA with Tukey HSD post hoc test
- ❖ Implant stability according to elapsed time
  - Paired samples t-test (α = .05)
- ❖ Correlation of ISQ, PTV, IST
  - Pearson's correlation test
- ❖ Correlation between arch position implant placement site and arch position
  - Two-way ANOVA with Tukey HSD post hoc test

03 Results

Evaluation and analysis of implant stability according to elapsed time

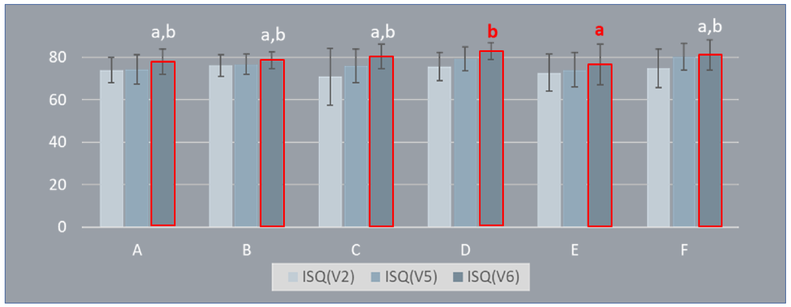
Value	1V	2V	3V	4V	5V	6V	7V
ISQ	-	73.98 (8.41)	-	-	76.68 (6.79)	79.53 (6.42)	-
PTV	-	-4.70 (1.62)	-	-	-4.93 (1.87)	-5.31 (1.80)	-
IST	-	75.50 (6.43)	76.02 (6.86)	76.64 (5.51)	77.21 (4.95)	78.00 (4.59)	79.27 (6.79)



✓In all measuring devices(ISQ, PTV, IST), implant stability values before final prosthesis placement(6V) were significantly higher than during implant surgery(2V).

Evaluation and analysis of implant stability according to placement sites - ISQ

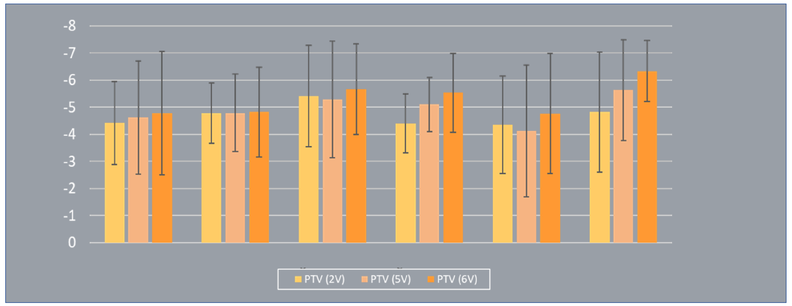
Location	1V	2V	3V	4V	5V	6V	7V
A	-	73.85 (5.89)^{a}	-	-	74.25 (6.94)^{a}	77.95 (6.00)^{a,b}	-
B	-	76.15 (5.14)^{a}	-	-	76.70 (4.73)^{a,b}	78.65 (4.01)^{a,b}	-
C	-	70.90 (13.40)^{a}	-	-	75.75 (7.91)^{a,b}	80.45 (5.74)^{a,b}	-
D	-	75.55 (6.61)^{a}	-	-	79.10 (5.55)^{a,b}	82.75 (3.90)^{a}	-
E	-	72.65 (8.80)^{a}	-	-	74.05 (7.98)^{a}	76.45 (9.61)^{b}	-
F	-	74.75 (8.95)^{a}	-	-	80.25 (6.20)^{b}	80.95 (7.01)^{a,b}	-



✓Before the final prosthesis was placed (6V), D (mandibular right posterior region) showed the highest ISQ value and E (mandibular anterior region) showed the lowest ISQ value.

Evaluation and analysis of implant stability according to placement sites - PTV

Location	1V	2V	3V	4V	5V	6V	7V
A	-	-4.42 (1.53)^{a}	-	-	-4.62 (2.09)^{a}	-4.78 (2.28)^{a}	-
B	-	-4.78 (1.11)^{a}	-	-	-4.79 (1.43)^{a}	-4.82 (1.66)^{a}	-
C	-	-5.41 (1.87)^{a}	-	-	-5.29 (2.16)^{a}	-5.67 (1.67)^{a}	-
D	-	-4.40 (1.10)^{a}	-	-	-5.10 (0.99)^{a}	-5.53 (1.46)^{a}	-
E	-	-4.35 (1.79)^{a}	-	-	-4.13 (2.43)^{a}	-4.76 (2.22)^{a}	-
F	-	-4.83 (2.22)^{a}	-	-	-5.64 (1.86)^{a}	-6.34 (1.12)^{a}	-

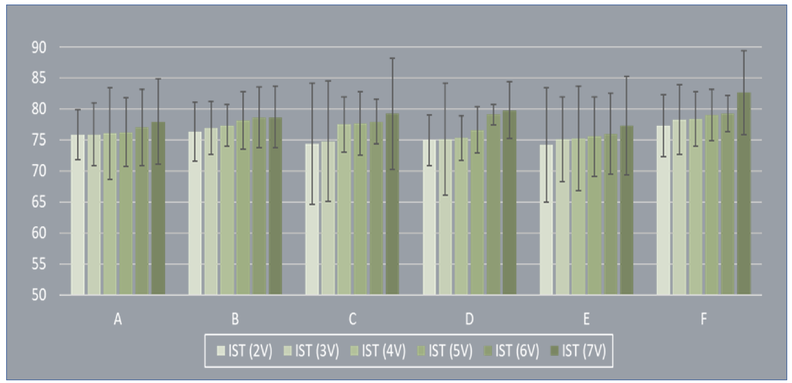


✓There was no significant difference in PTV levels according to the elapsed time by implantation site.

03 Results

Evaluation and analysis of implant stability according to placement sites - IST

Location	1V	2V	3V	4V	5V	6V	7V
A	-	75.85 (4.04)[a]	75.90 (5.03)[a]	76.05 (7.40)[a]	76.25 (5.52)[a]	77.00 (6.15)[a]	77.95 (6.91)[a]
B	-	76.35 (4.80)[a]	76.90 (4.27)[a]	77.35 (3.34)[a]	78.15 (4.67)[a]	78.65 (4.86)[a]	78.70 (4.99)[a]
C	-	74.35 (9.81)[a]	74.80 (9.73)[a]	77.50 (4.42)[a]	77.65 (5.15)[a]	77.95 (3.59)[a]	79.20 (9.01)[a]
D	-	74.95 (4.06)[a]	75.15 (9.04)[a]	75.30 (3.63)[a]	76.60 (3.75)[a]	79.10 (1.63)[a]	79.80 (4.57)[a]
E	-	74.20 (9.24)[a]	75.10 (6.86)[a]	75.25 (8.42)[a]	75.55 (6.44)[a]	76.00 (6.57)[a]	77.30 (7.89)[a]
F	-	77.30 (4.99)[a]	78.25 (5.61)[a]	78.40 (4.45)[a]	79.05 (4.14)[a]	79.30 (2.95)[a]	82.65 (6.76)[a]



✓There was no significant difference in IST values according to the elapsed time by implantation site.

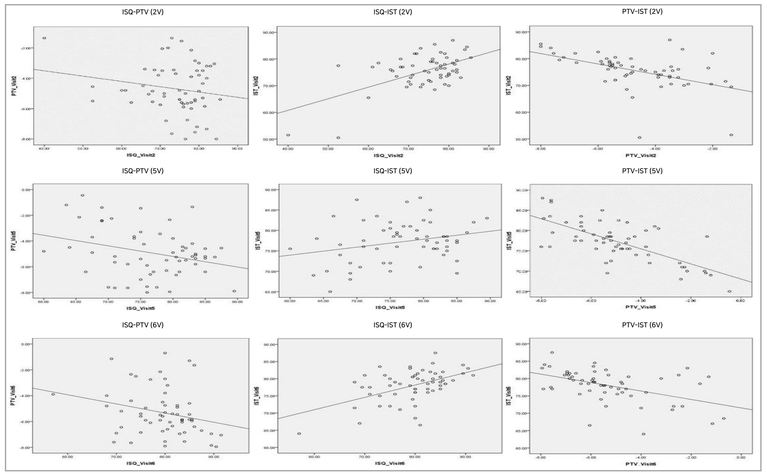
Correlation analysis between implant placement site and arch position

Value		1V	2V	3V	4V	5V	6V	7V
ISQ	Location	-	.561	-	-	.198	.048*	-
	Arch	-	.655	-	-	.062	.362	-
	Location *Arch	-	.134	-	-	.016*	.042*	-
PTV	Location	-	.119	-	-	.052	.007*	-
	Arch	-	.250	-	-	.870	.157	-
	Location *Arch	-	.720	-	-	.321	.520	-
IST	Location	-	.923	.809	.162	.185	.436	.137
	Arch	-	.977	.811	.516	.752	.747	.289
	Location *Arch	-	.186	.199	.472	.170	.044*	.259

✓ISQ and IST values before final prosthesis placement (6V) showed a significant correlation between implant placement site and arch position.(P<.05).

Correlation analysis of ISQ, PTV, IST

	2V		5V		6V	
	Correlation coefficient	P-Value	Correlation coefficient	P-Value	Correlation coefficient	P-Value
ISQ-PTV	-.180	.049*	-.298	.001*	-.252	.005*
ISQ-IST	.567	<.001*	.267	.003*	.503	<.001*
PTV-IST	-.490	<.001*	-.701	<.001*	-.479	<.001*



✓ISQ values at 2V, 5V, and 6V showed a negative correlation with PTV values, and a positive correlation with IST values.
✓PTV values at 2V, 5V, and 6V were negatively correlated with IST values.

Correlation analysis between IST placement site and prosthesis

Value	Effect	Type III Sum of Squares	*df*	Mean Square	*F*	*P*	$_{\eta}P^2$
IST	Location	457.233	5	91.447	2.816	.017*	.058
	Materials	96.267	1	96.267	2.965	.086	.013
	Location *Materials	62.433	5	12.487	.385	.859	.008

✓There was no significant difference in the correlation between the IST values measured in the healing abutment state and the values measured in the prosthetic state. (P>.05).

04 Discussion

✓In this prospective study, measurements of implant stability devices were performed in a clinical environment, and significant differences were found in implant stability according to implant placement site and elapsed time in elderly patients.

✓Although RFA shows high reliability, the process of additionally installing a transducer after removing the healing abutment may adversely affect osseointegration between the implant and the alveolar bone.[3] Previous studies have reported that ISQ is affected by factors such as exposed implant threads, bone quality and quantity, marginal mucosa, bone-implant contact, and transducer connection.[4] The DCA device can control more factors during measurement compared to the RFA device because it allows measurements without additional procedures when a healing abutment is attached.[5] According to previous studies, it has been reported that PTV is affected by the length of the implant fixture and healing abutment, the location and direction of percussion, and the angle of the handpiece.[4]

✓Unlike laboratory studies, which are conducted under certain conditions, measurements in real clinical settings may depend on variables such as accessibility, space, and patient cooperation. Therefore, studies in a clinical setting are subject to additional errors, which may change the accuracy of measurements.[6] In this study, it was confirmed that there was a weak or moderate statistically significant correlation between the three types of diagnostic devices. This study investigated the correlation between the values measured by different devices, but there were limitations in establishing absolute standards for implant prostheses. There were factors (soft tissue, bone quality, bone density, patient's mouth opening, saliva, etc.) that could affect the measured values in the clinical environment, and it is thought that follow-up studies considering these factors are needed.

05 Conclusion

✓As a result of this prospective clinical study, implant stability in elderly patients aged over 65 years showed a pattern of increasing with time after placement..

✓In the evaluation of osseointegration status, the implant placed in mandibular the anterior showed relatively low stability, but clinically, the implant stability was evaluated at an appropriate level in all areas and evaluation period.

✓In all implant stability diagnosis devices(Osstell ISQ™ Mentor, Periotest™ M, Anycheck™), the implant stability before the final prosthesis was installed was significantly higher than during implant surgery, and All diagnostic devices are judged to be clinically useful in evaluating changes in implant stability through osseointegration.

✓Based on the reliability of Osstell ISQ™ Mentor and Periotest™ M as a diagnostic device for implant stability for evaluation of osseointegration in elderly patients, Anycheck™ was also able to prove its relative reliability.

✓Based on the results of this study, the implant stability was evaluated according to the implant placement site and the elapsed time using the implant stability diagnostic device in elderly patients aged over 65 years, and by considering various factors that affect it, the appropriate implant load application time was determined and more Furthermore, it is considered that it can help increase the implant success rate.

06 References

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