Assessment of dental implant stability during healing period and determination of the factors that affect implant stability by means of resonance frequency analysis (Clinical study)

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ABSTRACT

Background: Implant stability is considered one of the most important factors affecting healing and successful osseointegration of dental implants. The aims of the study were to measure the implant stability quotient (ISQ) values during the healing period and to determine the factors that affect implant stability.

Materials and methods: Thirty patients enrolled in the study (17 female, 13 male). They received 44 Implantium® Dental Implants located as the following: 22 implants in maxillary jaw, 22 implants in mandibular jaw from them 17 implants in anterior segment and 27 in posterior segment. The bone density determined using interactive CT scan and classified according to the Misch bone density classification (29 implants in (D3), 15 implants in (D4)). Resonance frequency analysis was used for direct measurement of implant stability on the day of implant placement and 8, 16 and 24 weeks after implant placement.

Results: The lowest mean of average ISQ was at the 8th week (69.5) and then the mean increased to reach at the 24th week (76.8). Mandibular implants showed significantly higher ISQ values than maxillary implants. Implants placed in the posterior segment of the jaw had significantly higher ISQ values than implants in the anterior segment. A significant, positive linear correlation was observed between the implant diameter and the implant stability ($r=0.343$ $p<0.001$).

Conclusion: Resonance frequency analysis was non-invasive diagnostic tool for detecting changes in implant stability during the healing period. The factors that affect implant stability were implant diameter and implant location (maxilla\ mandible, anterior\ posterior).

Keywords: Dental implant, implant stability, implant stability quotient (ISQ), resonance frequency analysis. (J Bagh Coll Dentistry 2015; 27(3):109-115).

INTRODUCTION

Dental implants have recently become a reliable and predictable tool for oral rehabilitation. Even though the clinical outcome of an implant is influenced by many factors, including the implant body, skill of the surgeon, and the oral environment, the key factor for success is implant stability [(1)].

Dental implant stability is a measure of the anchorage quality of an implant in the alveolar bone. Dental implant stability divided into primary stability at placement which is a mechanical phenomenon and secondary stability which is the increase in stability attributable to bone formation and remodeling at the implant-bone interface [(2)].

Different diagnostic methods aimed to assess implant stability have been suggested: histology and histomorphometry, insertion torque, removal torque, push-through and pull-through, radiographic assessment, Periotest ultrasonic method, and resonance frequency analysis (RFA) [(2)]. Among these test methods, RFA offers a clinical, noninvasive measure of stability and presumed osseointegration of implants [(2-8)].

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RFA technique is a bending test of the implant– bone complex where a transducer applies an extremely small bending force. The bending force applies a fixed lateral force to the implant and measures the displacement, thus mimicking the clinical loading [(9)].

Osstell devices have been designed to measure implant stability using RFA since 1999 by the Integration Diagnostics Ltd. Company (Sävedalen, Sweden). Within the last decade, several generations of this device have been developed. The latest generation is the Osstell® ISQ. The RFA values are represented by a quantitative unit called the Implant Stability Quotient (ISQ) on a scale from 0 to 100 (100 being maximum implant stability) [(10)]. Several studies demonstrated a good correlation between the obtained ISQ values and the degree of stiffness between the implant and the bone [(2, 9-12)].

Achievement and maintenance of dental implant stability is the most important requirement for successful dental implant treatment [(13)]. So it is important to determine the factors that influence implant stability. There are several factors affecting primary and secondary stability. Primary implant stability is affected by factors related to bone properties (i.e. bone density), implant design (i.e. diameter, length, shape and surface) and surgical technique.

Secondary implant stability is affected by bone response to the surgery and implant material [14].

From these factors bone density needs preoperative assessment as it considered a key factor to take into account when predicting implant stability [15]. Several methods for bone density assessment have been reported: conventional radiography, drilling resistance, insertion torque force, digital image analysis, and computed tomography (CT) [16]. Of these methods computed tomography (CT) provide more accurate determination of bone density before surgery [17].

MATERIALS AND METHODS

Thirty patients were drawn from patients attending the dental implant clinic in the Department of Oral and Maxillofacial Surgery/ College of Dentistry/ University of Baghdad participated in this clinical prospective study including 13 male and 17 female with age range (20-59) year's old.

The inclusion criteria were as follows: healthy patients with No signs and symptoms of any systemic diseases with age ranges from 20 to 60, non-smoker Patients, implant site does not need any bone augmentation or sinus lift and without any fenestrations or dehiscence and all the patients treated according to traditional protocol (delayed implant placement) six months or longer after tooth extraction.

The patients received 44 dental implants (Implantium® (Dentium, seoul, korea)), 22 implants in the maxillary jaw and 22 implants in the mandibular jaw from them 17 implants in anterior segment and 27 in the posterior segment. According to interactive CT scan measurements, bone density at the implant sites ranged from 150 to 784 Hounsfield units. This means that the bone density of the implant sites of the sample is either D3 or D4 according to the Misch bone density classification [17].

Preoperative standardized digital orthopantograph (OPG) and interactive CT scan were taken for each patient (OPG will give an overview of the anatomical structures of the jaw while the CT scan offers more specific data such as length, width and bone density in the proposed implant site). Prior to the surgical procedure, a case sheet was filled with all the required information about the patient and every patient signed an informed consent.

Patient preparation

Just right before the surgery, the patient rinsed his mouth with Chlorhexidine mouthwash for 1 minute to minimize the number of oral microorganisms. Then local anesthesia was given using infiltration technique for the maxillary and mandibular arches.

Surgery

After soft tissue incision, the flap was raised and the implant site was prepared by using high torque handpiece at low speed 800 rpm, with sharp drills and copious external irrigation to prevent excess thermal injury to the recipient bone. The implant osteotomy site was sequentially enlarged to the desired length and diameter. No countersink drills was used for all the patients.

After reaching the desired length and diameter of the implant bony bed, the implant was placed with external irrigation to prevent heat generation due to friction of the implant and the bone. The cover screw was placed and then the wound edges were brought together and sutured. Verbal postoperative instructions were given to the patient. The patients provided with prescription of antibiotics and analgesics.

Implant stability measurements

Implant stability measurements were taken at surgery (primary stability) and at 8, 16, 24 weeks after surgery. The values were measured using Osstell® ISQ (Integration Diagnostics AB, Gothenburg, Sweden). Screw the SmartPeg® of Osstell® ISQ to the implant by using the SmartPeg Mount then hold the instrument probe close to the top of the SmartPeg® without touching it.

An audible sound will be emitted when the instrument senses the SmartPeg® and an ISQ value is generated and shown on the display. The measurements were taken first from the mesio-distal direction (MD) (along the jaw line), then from the bucco-palatal direction (BP) (perpendicular to the jaw line). The measurements reflect the level of stability on the universal ISQ scale – from 1 to 100 (the higher the ISQ value, the more stable is the implant). Then unscrew the SmartPeg® using the SmartPeg Mount. All measurements were taken by another colleague.

After the 24th week, the data were translated into a computerized database structure and statistical analyses were done using SPSS version 21 computer software (Statistical Package for Social Sciences) in association with Microsoft Excel 2010.

RESULTS AND DISCUSSION

The effect of healing time on Implant Stability Quotient (ISQ)

By calculating the average ISQ of the two perpendicular measurements (Bucco-Palatal direction (BP) and Mesio-Distal direction (MD)) as shown in table (1), we found that the mean of average ISQ reduced by (3.7) units at the 8th week compared to the primary stability value. This mean reduction was statistically significant and rated as moderate effect.

At the 16th week after surgery, the mean of average ISQ was increased by very small amount (0.3) compared to the primary stability value. This minor change was not significant statistically and rated as very week or almost no effect. At the 24th week (the end of the follow up period), the mean of average ISQ was increased by (3.6) units compared to the primary stability value. This increase was statistically significant and rated as moderate effect.

Table 1: The changes in average ISQ of 2 perpendicular measurements (BP and MD) after 3 successive time intervals following surgery compared to primary stability achieved at surgery

Time	At surgery (primary stability)	After 8 weeks	Changes after 8 weeks compared to primary stability	After 16 weeks	Changes after 16 weeks compared to primary stability	After 24 weeks	Changes after 24 weeks compared to primary stability
Range	(56 to 85)	(51 to 80)	(-31 to 18)	(62.5 to 82)	(-14.5 to 20.5)	(69.5 to 84)	(-10 to 24)
Mean	73.2	69.5	-3.7	73.5	0.3	76.8	3.6
SD	6.3	6.4	8.1	5	6.9	4.2	6.5
SE	0.96	0.96	1.22	0.75	1.04	0.63	0.97
N	44	44	44	44	44	44	44
Cohen's d (Effect size compared to primary stability)			-0.46		0.04		0.55
Paired t-test			**0.004**		0.8[NS]		**<0.001**

Rate of implants achieving high stability (ISQ≥70) at surgery and after 3 successive time intervals following surgery

The threshold level in this study was set to 70 ISQ. At surgery, almost three quarters (72.7%) of the studied implants attained high mean ISQ (ISQ≥70). This rate decreased to (59.1%) after 8 weeks then increased to (72.7%) at the 16th week after surgery. At the end of the study period at the 24th week after surgery, almost all the studied implants attained high mean ISQ (97.7%) as shown in figure (1).

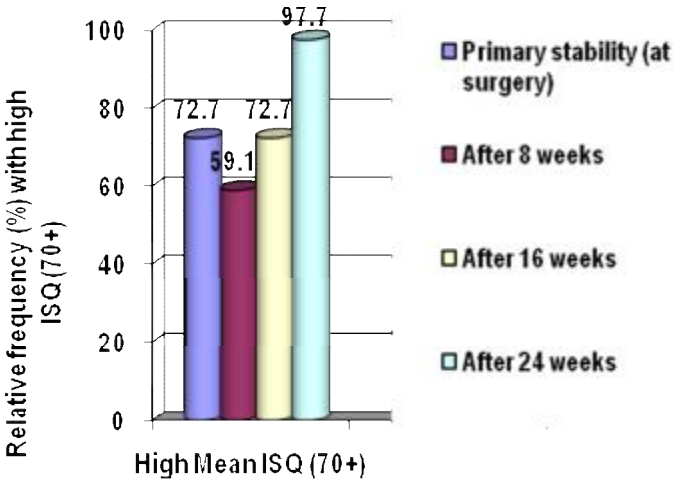

Figure 1: Bar chart showing the rate of implants achieving high stability (ISQ≥70) at surgery and after 3 successive time intervals following surgery.

The effect of each factor (gender, age, maxilla\mandible, anterior\posterior, bone density) on Implant Stability Quotient (ISQ) during the healing period

The effect of the *gender* Implant Stability Quotient (ISQ) during the healing period

As shown in table (2), we found that the mean of average of ISQ in male were higher than female with a difference in mean of (3.6) units at the time of surgery but this was not significant statistically and rated as moderate effect.

At the 8th week after surgery, the difference in mean reduced to (1.9) units and male still higher than female but this was not significant statistically and rated as week effect. At the 16th week after surgery, the difference in mean reduced again to (1) unit and male still higher than female but this was not significant statistically and rated as weak effect.

At the 24th week after surgery (the end of follow up period), the difference in mean were slightly raised by (1.3) units being higher in male than female but this was not significant statistically and rated as weak effect.

Table 2: The mean of average ISQ of 2 perpendicular measurements (BP and MD) showing the female/ male difference in mean at surgery and after 3 successive time intervals following surgery

Time	Gender	Range	Mean	SD	SE	N	P	Difference in mean	Cohn's d
At surgery	**Female**	(56 - 82)	71.9	7	1.33	28	0.07[NS]	**3.6**	0.59
	Male	(66 - 85)	75.5	4.2	1.06	16			
8th week	**Female**	(51 - 80)	68.8	6.7	1.26	28	0.34[NS]	**1.9**	0.3
	Male	(59 - 76)	70.7	5.8	1.45	16			
16th week	**Female**	(65.5 - 82)	73.1	4.8	0.91	28	0.52[NS]	**1**	0.2
	Male	(62.5 - 79)	74.1	5.3	1.33	16			
24th week	**Female**	(69.5 - 84)	76.4	4.3	0.81	28	0.31[NS]	**1.3**	0.31
	Male	(70.5 - 83.5)	77.7	3.9	0.97	16			

The effect of the *age* Implant Stability Quotient (ISQ) during the healing period:

As shown in table (3), there was no statistically significant difference between age groups during the healing period.

Table 3: The mean of average ISQ of 2 perpendicular measurements (BP and MD) showing the age group difference in mean at surgery and after 3 successive time intervals following surgery

Time	Age group (years)	Range	Mean	SD	SE	N	P
At surgery	<= 29	(66 - 81)	74	4.7	1.22	15	0.51[NS]
	30 - 39	(72 - 80)	76	2.9	1.29	5	
	40 - 49	(56 - 82)	71.1	9	2.73	11	
	50+	(65 - 85)	72.9	6.3	1.73	13	
At 8th week	<= 29	(59 - 80)	67.9	7.2	1.85	15	0.37[NS]
	30 - 39	(66 - 76)	72.6	3.9	1.74	5	
	40 - 49	(63 - 80)	71.2	5.7	1.72	11	
	50+	(51 - 75)	68.5	6.6	1.82	13	
At 16th week	<= 29	(62.5 - 82)	72.2	6.1	1.57	15	0.56[NS]
	30 - 39	(70.5 - 78)	75.5	2.9	1.31	5	
	40 - 49	(65.5 - 80)	74.3	5.5	1.65	11	
	50+	(67 - 79.5)	73.4	3.6	0.99	13	
At 24th week	<= 29	(70.5 - 83)	76	4.1	1.07	15	0.29[NS]
	30 - 39	(76 - 83.5)	79.7	2.8	1.23	5	
	40 - 49	(69.5 - 84)	77.6	5.4	1.62	11	
	50+	(72 - 82)	76	3.1	0.87	13	

The effect of the *jaw* on Implant Stability Quotient (ISQ) during the healing period

As shown in table (4), mandibular jaw showed higher mean average ISQ compared to maxillary jaw, with a difference in mean of (3.2) units at the time of surgery but this was not significant statistically and rated as moderate effect.

Mandibular jaw showed higher mean average ISQ compared to maxillary jaw, with a difference in mean of (2.5) units at the 8th week after surgery but this was not significant statistically and rated as moderate effect. Mandibular jaw compared to maxillary jaw showed statistically significant difference (p 0.012) being higher in mandibular jaw than in maxillary jaw, with a difference in mean of (3.7) at the 16th week after surgery and rated as strong effect. Mandibular jaw compared to maxillary jaw showed statistically significant difference (p 0.012) being higher in mandibular jaw than in maxillary jaw with a difference in mean of (3.1) at the 24th week after surgery and rated as strong effect.

Table 4: The mean of average ISQ of 2 perpendicular measurements (BP and MD) showing the maxilla/mandible difference in mean at surgery and after 3 successive time intervals following surgery

Time	Jaw	Range	Mean	SD	SE	N	P	Difference in mean	Cohn's d
At surgery	**Maxilla**	(56 - 80)	71.6	6.4	1.36	22	0.09[NS]	3.2	0.52
	Mandible	(65 - 85)	74.8	6	1.29	22			
8th week	**Maxilla**	(59 - 75)	68.2	5.6	1.2	22	0.2[NS]	2.5	0.39
	Mandible	(51 - 80)	70.7	7	1.48	22			
16th week	**Maxilla**	(62.5 - 78)	71.6	4.8	1.02	22	**0.012**	3.7	0.8
	Mandible	(66.5 - 82)	75.3	4.5	0.97	22			
24th week	**Maxilla**	(69.5 - 80.5)	75.3	3.7	0.78	22	**0.012**	3.1	0.79
	Mandible	(72 - 84)	78.4	4.1	0.87	22			

The effect of the *arch location* on Implant Stability Quotient (ISQ) during the healing period

As shown in table (5), implant arch location significantly affected implant stability (p<0.001), being lower in the anterior segment than the posterior segment, with a difference with a difference in mean of (-6.5) at the time of surgery and rated as strong effect. At the 8th week after surgery, we found that the mean of average of ISQ was lower in the anterior segment than the posterior, with a difference with a difference in mean of (-3.8) but this was not significant statistically and rated as moderate effect. At the 16th week after surgery, we found that the mean of average of ISQ was lower in the anterior segment than the posterior, with a difference in mean of (-4.5) and this was significant statistically (p 0.003) and rated as strong effect.

At the 24th week after surgery, we found that the mean of average of ISQ was lower in the anterior segment than the posterior, with a difference in mean of (-4.1) and this was significant statistically (p<0.001) and rated as strong effect.

Table 5: The mean of average ISQ of 2 perpendicular measurements (BP and MD) showing the anterior/posterior difference in mean at surgery and after 3 successive time intervals following surgery

Time	Arch location	Range	Mean	SD	SE	N	P	Difference in mean	Cohn's d
At surgery	Anterior	(59 - 76.5)	69.2	5	1.2	17	**<0.001**	-6.5	-1.17
	Posterior	(56 - 85)	75.7	5.9	1.13	27			
8th week	Anterior	(59 - 75)	67.1	5	1.22	17	0.05[NS]	-3.8	-0.61
	Posterior	(51 - 80)	70.9	6.8	1.31	27			
16th week	Anterior	(62.5 - 78)	70.7	4.5	1.09	17	**0.003**	-4.5	-1
	Posterior	(66.5 - 82)	75.2	4.5	0.87	27			
24th week	Anterior	(69.5 - 80.5)	74.3	3.4	0.82	17	**<0.001**	-4.1	-1.12
	Posterior	(71.5 - 84)	78.4	3.8	0.74	27			

The effect of the *bone density* on Implant Stability Quotient (ISQ) during the healing period

As shown in table (6), we found that the mean of average of ISQ was slightly higher in very low bone density (D4) than low bone density (D3) at surgery, with a difference with a difference in mean of (0.6) but this was not significant statistically and rated as very week effect. At the 8th week, we found that the mean of average of ISQ was lower in very low bone density (D4) than low bone density (D3), with a difference with a

difference in mean of (-5.2) this was significant statistically (p 0.008) and rated as strong effect.

At the 16th week, we found that the mean of average of ISQ was lower in very low bone density (D4) than low bone density (D3), with a difference with a difference in mean of (-2.4) but this was not significant statistically and rated as moderate effect. At the 24th week, we found that the mean of average of ISQ was lower in very low bone density (D4) than low bone density (D3), with a difference with a difference in mean of (-2.3) but this was not significant statistically and rated as moderate effect.

Table 6: The mean of average ISQ of 2 perpendicular measurements (BP and MD) showing the low (D3)/very low (D4) bone density difference in mean at surgery and after 3 successive time intervals following surgery

Time	Bone density	Range	Mean	SD	SE	N	P	Difference in mean	Cohn's d
At surgery	(D3)	(59 - 85)	73	6.2	1.16	29	0.74[NS]	0.6	0.09
	(D4)	(56 - 82)	73.6	6.7	1.74	15			
At 8th week	(D3)	(59 - 80)	71.2	5.3	0.98	29	**0.008**	-5.2	-0.88
	(D4)	(51 - 80)	66	7	1.82	15			
At 16th week	(D3)	(62.5 - 80)	74.3	4.9	0.9	29	0.13[NS]	-2.4	-0.49
	(D4)	(66.5 - 82)	71.9	4.9	1.27	15			
At 24th week	(D3)	(70.5 - 84)	77.6	3.9	0.73	29	0.08[NS]	-2.3	-0.57
	(D4)	(69.5 - 83)	75.3	4.3	1.1	15			

The effect of implant dimensions (diameter and length) on Implant Stability Quotient (ISQ) during the healing period

As shown in table (7), there was weak positive correlation but statistically significant between implant diameter and mean ISQ during the healing period. There was very weak negative correlation and not significant statistically between implant length and mean ISQ during the healing period.

Table 7: Linear correlation coefficient

Implant dimensions	Mean ISQ
Implant diameter (mm)	r=0.343 P<0.001
Implant length (mm)	r=-0.117 P=0.12[NS]

The net effect of time on Implant Stability Quotient (ISQ) after adjusting the effect of (gender, age, maxilla\mandible, anterior\posterior, bone density, implant diameter and length)

As shown in table (8), a multiple linear regression model was used to show the net and independent effect of healing time after surgery after adjusting for a set of explanatory variables on the average ISQ measured.

The follow up period (weeks after surgery) was the strongest predictor for the magnitude of implant stability assessed by average ISQ, followed by Implant diameter (mm) and bone and implant arch location (Anterior compared to posterior). Implant length, age and jaw location ranked 5th 6th and 7th in order of importance as predictors of implant stability. Only gender had no important effect on magnitude of implant stability.

REFERENCES

1. Fuh LJ, Huang HL, Chen CS, Fu KL, Shen YW, Tu MG, Shen WC, Hsu JT. Variations in bone density at dental implant sites in different regions of the jawbone. J Oral Rehabilit 2010; 37(5): 346-51.
2. Meredith N. Assessment of implant stability as a prognostic determinant. Int J Prosthodont 1998; 11: 491-01.
3. Balleri P, Cozzolino A, Ghelli L, Momicchioli G, Varriale A. Stability measurements of osseointegrated implants using Osstell in partially edentulous jaws after 1 year of loading: a pilot study. Clin Implant Dent Relat Res 2002; 4(3): 128-32.
4. Barewal RM, Oates TW, Meredith N, Cochran DL. Resonance frequency measurement of implant stability in vivo on implants with a sandblasted and acid-etched surface. Int J Oral Maxillofac Implants 2003; 18(5): 641-51.
5. Bischof M, Nedir R, Szmukler-Moncler S, Bernard JP, Samson J. Implant stability measurement of delayed and immediately loaded implants during healing. Clin Oral Implants Res 2004; 15(5): 529-39.
6. Huwiler MA, Pjetursson BE, Bosshardt DD, Salvi GE, Lang NP. Resonance frequency analysis in relation to jawbone characteristics and during early healing of implant installation. Clin Oral Implants Res 2007; 18: 275-80.
7. Kessler-Liechti G, Zix J, Mericske-Stern R. Stability measurment of 1-stage implants in the edentulous mandible by means of resonance frequency analysis. Int J Oral Maxillofac Implants 2008; 23: 353-8.

8. Sim CPC and Lang NP. Factors influencing resonance frequency analysis (RFA) assessed by Osstell mentor during implant tissue integration. I.: Instrument positioning, bone structure, implant length. Clin Oral Impl Res 2010; 21: 598-04.
9. Sennerby L, Meredith N. Implant stability measurements using resonance frequency analysis: biological and biomechanical aspects and clinical implications. Periodont 2000 2008; 47: 51-66.
10. Herrero-Climent M, Santos-García R, Jaramillo-Santos R, Romero-Ruiz MM, Fernández-Palacin A, Lázaro-Calvo P, Bullón P, Ríos-Santos JV. Assessment of Osstell ISQ's reliability for implant stability measurement: A cross-sectional clinical study. Med Oral Patol Oral Cir Bucal 2013; 18 (6): e877-82.
11. Becker W, Sennerby L, Bedrossian E, Becker BE, Lucchini JP. Implant stability measurements for implants placed at the time of extraction: a cohort, prospective clinical trial. J Periodont 2005; 76: 391-7.
12. Zix J, Hug S, Kessler-Liechti G, Mericske-Stern R. Measurement of dental implant stability by resonance frequency analysis and damping capacity assessment: comparison of both techniques in a clinical trial. Int J Oral Maxillofac Implants 2008; 23(3): 525-30.
13. Meredith N, Alleyne D, Cawley P. Quantitative determination of the stability of the implant-tissue interface using resonance frequency analysis. Clin Oral Implants Res 1996; 7: 261-7.
14. Östman PO, Hellman M, Wendelhag I, Sennerby L. Resonance frequency analysis measurements of implants at placement surgery. Int J Prosthodont 2006; 19(1): 77-83.
15. Farré-Pagés N, Augé-Castro ML, Alaejos-Algarra F, Mareque-Bueno J, Ferrés-Padró E, Hernández-Alfaro F. Relation between bone density and primary implant stability. Med Oral Patol Oral Cir Bucal 2011; 16 (1): e62-7.
16. Iezzi G, Scarano A, Di Stefano D, Arosio P, Ricci L, Piattelli A, Perrotti V. Correlation between the bone density recorded by a computerized implant motor and by a histomorphometric analysis: a preliminary in vitro study on bovine ribs. Clin Implant Dent Relat Res 2013; doi: 10.1111/cid.12121.
17. Misch CE. Contemporary implant dentistry. 3rd ed. St. Louis: Elsevier Health Sciences; 2008. p.137.

Table 8: Multiple linear regression with average ISQ (of the two perpendicular measurements, namely BP and MD) as the dependent (response) variable and duration of follow up (after 8 weeks of surgery) in addition to age, gender, bone density, implant dimensions and location as explanatory (independent) variables

Explanatory (independent) variables	Partial regression coefficient	P	Standardized coefficient
(Constant)	41.5	**<0.001**	
Follow up period (weeks after surgery)	0.5	**<0.001**	0.502
Implant diameter (mm)	5.0	**<0.001**	0.349
Bone density (D4 compared to D3)	-3.7	**<0.001**	0.295
Implant arch location (Anterior compared to posterior)	-3.2	**0.003**	0.258
Implant length (mm)	0.9	**0.002**	0.237
Age (years)	-0.1	**0.032**	0.142
Mandibular jaw compared to maxillary jaw	1.6	0.06[NS]	0.137

الخلاصة

الخلفية: يعتبر ثبات الزرعة واحد من أهم العوامل المؤثرة على الشفاء ونجاح عملية الاندماج العظمي للزرعات السنية. كان الهدف من هذه الدراسة هو قياس قيم حاصل ثبات الزرعة ISQ على فترات خلال فترة الشفاء بوصفه عاملا تنبؤيا للاندماج العظمي، وتحديد العوامل التي تؤثر على ثبات الزرعة.

المواد وطرق العمل: ثلاثون مريضا تم ادخالهم في الدراسة (17 انثى، 13 ذكر). تلقى المرضى 44 زرعة سنية من نوع Implantium وتقع على النحو التالي: 22 زرعة في الفك العلوي، 22 زرعة في الفك السفلي منها 17 زرعة في الجزء الامامي و27 زرعة في الجزء الخلفي. تم تحديد كثافة العظم باستخدام الاشعة المقطعية التفاعلية وتم تصنفيفها وفقا لتصنيف Mish لكثافة العظم (29 زرعة وضعت في D3 ، و 15 زرعة وضعت في D4). تم استخدام تحليل الترددات الرنينية للقياس المباشر لثبات الزرعة في يوم الزراعة وفي 8، 16 و 24 اسبوع بعد عملية وضع الزرعة السنية.

النتائج: كان متوسط معدل ISQ عند الجراحة (73.2). كان أدنى متوسط لمعدل ISQ عند الاسبوع الثامن (69.5)، ثم زاد المتوسط ليصل في الاسبوع الرابع والعشرون (76.8). الزرعات الموضوعة في الفك السفلي أظهرت قيم ISQ أعلى معنويا بالمقارنة مع الزرعات الموضوعة في الفك العلوي. بالنسبة للزرعات الموضوعة في الجزء الخلفي من الفك كانت قيم ISQ أعلى معنويا بالمقارنة مع الزرعات الموضوعة في الجز الامامي. وقد لوحظت علاقة خطية ايجابية ومعنوية بين قطر الزرعة وثبات الزرعة (r=0.343 p<0.001).

الاستنتاجات: كان تحليل الترددات الرنينية أداة تشخيصية بدون ادخال ادوات الى انسجة الجسم للكشف عن التغيرات في ثبات الزرعة خلال فترة الشفاء. وكانت العوامل التي أثرت على ثبات الزرعة هي قطر الزرعة وموضع الزرعة (الفك العلوي \ الفك السفلي، الأمامي \ الخلفي).