Efficacy and Clinical Utilization of UV Activated Implant

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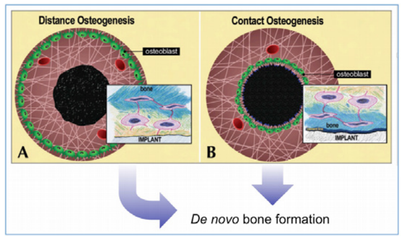
III . Theoretical base for ISQ measurement for determination of the early stage implant load and the effects of UV Activation on the time of loading

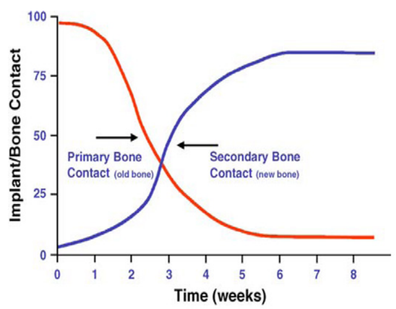
Until now, opinion that activation of UV onto the implant surface in appropriate method will be beneficial for early stage osteogenesis has been presented and was verified through the thesis by Professor T. Ogawa of UCLA in 2014 and results of other animal experiments. Benefits of UV Activated implant surface including increased protein absorption, increased contact of osteoblastic cells, increased retention of cells, promoted proliferation of cells, promotion of osteoblast differentiation, increase in the speed of synostosis, marked increase in bone-implant binding, prevention of the loss of Stability Dip that occurs in the 3rd ~ 4th week after placement, and removal of surface hydrocarbon, etc. were reported in laboratory researches along with the disclosure that these phenomenon do not occur independently but through close interaction with each other. Such theoretical advantages of UV surface treatment are being verified through clinical experiments. According to Ueno et al., if the embedded implant is healed without the support of cortical bone, strength of synostosis was reduced by 60% in the ordinary implant while the UV treated implant displayed the extent of synostosis that is similar to the ordinary implant healed with the support of cortical bone. At the same time, there was presence of aspect of contact osteogenesis in which the osteogenesis that began at the implant surface continues onto the surrounding bones (Fig. 1-1).



(Fig. 1-1) Drawings from Davies JE (1998 and 2003) that show the initiation of distance osteogenesis (A) and contact osteogenesis (B)

1. Theoretical grounds for ISQ measurement for determination of early stage load

Implant is fixated by mechanical retention force due to the friction with the existing bones after placement. Such mechanical fixation force decreases as the existing bones are absorbed and it takes relatively long time for remodeling of bone or in order for new bone to be generated and matured on the implant surface to support the implant (secondary implant stability). Therefore, there is a temporary period of degraded stability after implant placement due to such temporal difference (implant stability dip). It is recommended that application of load to the implant be avoided as much as possible during this period of stability dip (critical period) and this has become the reason for clinical surgeons in hesitating early stage or immediate loading after the implant placement (Fig. 1-2).

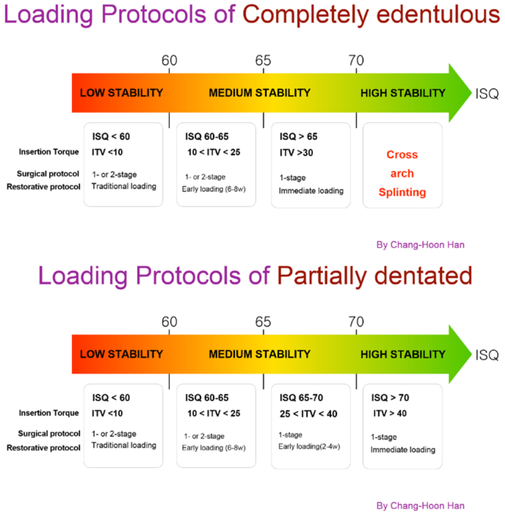


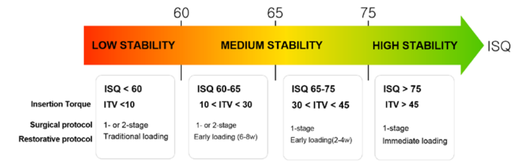
(Fig. 1-2) Red line- Initial stability (Perio test, ISQ values), Blue line- 2nd stability(Contact osteogenesis and distance osteogenesis). From surgery to 2 or 3 week is most critical period in osseointegration

Measurement of Implant Stability Quotient (ISQ) value based on Resonance Frequency Analysis (RFA) among various methods of measuring the implant stability has been reported as a non-destructive method with high reliability and efficacy. Although electronic device (Osstell®; Integration Diagnostics AB, Göteborg, Sweden) to which L-shaped transducer is connected was used for RFA in the initial stage, Osstell Mentor® (Integration Diagnostics AB) or Osstell ISQ® (Integration Diagnostics AB) with contact-free probe using magnetic receptor, SmartPeg® (Integration Diagnostics AB), is used at the moment. Although there are differing opinion in various theses on the correlation between the measured ISQ value and synostosis, follow-up observation by measuring the ISQ values at prescribed interval after the implant placement will provide highly useful ground for estimation and determination of whether synostosis is being carried out successfully for each implant.Currently, Osstell IDX, which is capable of accumulating data by storing dental formula, supports color screen and has the function for linkage with electronic chart in comparison to Osstell mentor, is commercially available (Fig. 1-3).

(Fig. 1-3) ISQ measurement method using Osstell (left), Osstell mentor (center) and Osstell IDX(DIO) (right)

As the results of evaluation of the extent of implant fixation for which load can be imparted on the basis of large number of clinical studies, ISQ value in the range of 70~75 has been proposed. I also determined the time of Immediate loading or delayed loading through ISQ measurement over the last 10 years. ISQ value that I recommend for loading is more than 75 for single moral case and more than 70 for anterior tooth, which, however can differ depending on the size of the defective area. C.H Han (2016) presented the standards at the time of immediate and delayed loading in the cases of edentulous and partially edentulous jaw, and at the time of single implant placement (Fig. 1-4).

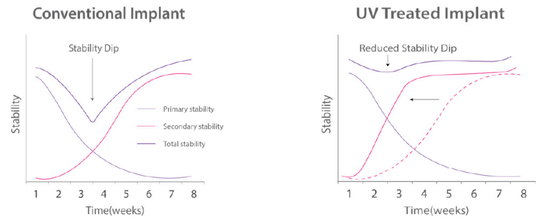




(Fig. 1-4) Appropriate time of loading by using ISQ value (By Han, Chang Hoon)

2. Effect of photoactivation (UV Activation) on the time of loading

In 2013, Professors A. Funato and T. Ogawa confirmed in 2013 that UV surface treatment enables shortening of the implant treatment time through quicker loading without decreasing the success rate of implant. This has also been proven in Korea on the basis of extensive clinical results (Fig. 1-5).



(Fig.1-5))UV treated titanium surface enduce faster bone healing around the implant. Fast increase of secondary stability reduce stability dip during 2 to 4weeks after implant placement.

Makato Hirota (2016) made comparison of the speed of improvement in the stability of photoactivated dental implant for both ordinary and difficult cases through the use of ISQ values and reported that photoactivation in particular accelerates the speed of osseointegration onto implants in cases of bones with poor osseous tissues and other difficult cases, improves stability level in comparison to ordinary implant, which acted as decisive factor from the perspective of implant stability in comparison to other host related factors that had already been tested.

Akiyoshi Funato (2013) reported that all implants were maintained functionally and in good health after 1 year in spite of early stage loading for all implants (2.1 ~ 4.5 months) including immediate placement after tooth extraction, vertical bone graft, maxillary sinus lifting case and placement in failed implant area. ISQ increased from 48~75 at the time of implant placement to 68~81 at the time of loading. In particular, ISQ of the implant with low early stage stability (early stage ISQ 〈70) increased markedly. It was found that the use of photoactivated dental implant in clinically difficult case induces synostosis in shorter period of time than that presented in the ordinary procedure and existing literatures. In addition, the stability of the implant and increase in the speed of synostosis were substantially higher in the case of photoactivated implant in comparison to the similar cases reported in literatures. While the quantity of bones around all implants increased in the cases with low marginal bone level (MBL) in comparison to the upper part of the implant at the time of final prosthesis during the 1 year of follow up period, implant for which sufficient bone around the implant was secured at the time of the final prosthesis maintained its level (Table 1-1).

Table 1 Case Description and Clinical Outcome Parameters

			ISQ			MBL		
Patient	Surgical procedure	Time before loading (mo)	At implant placement	At loading	Increase per month	At definitive restoration	After 1 y	Change
Patient 1	Immediate replacement of failing implant	2.1				−0.8 (M) −1.4 (D)	−0.2 −0.7	+0.6 +0.7
Patient 2	Simultaneous sinus elevation	3.8	48	76	7.36	0.4 (M) 1.0 (D)	0.4 1.0	0.0 0.0
			49	80	8.16	1.0 (M) −0.6 (D)	1.0 −0.4	0.0 +0.2
Patient 3	Fresh extraction socket	2.1	67	72	2.38	−0.3 (M) −1.1 (D)	0.5 −0.6	+0.8 +0.5
Patient 4	Staged approach: Vertical GBR and sinus elevation	4.5	67	80	2.89	−0.8 (M) −0.7 (D)	−0.2 0.0	+0.6 +0.7
			75	81	1.33	−0.2 (M) −0.6 (D)	0.5 0.2	+0.7 +0.8
			73	68	−1.11	−0.7 (M) −0.2 (D)	0.5 0.2	+1.2 +0.4
Mean		3.6	63.2	76.2	3.5	−0.35	0.16	0.51
SD		1.0	11.8	5.2	3.5	0.71	0.53	0.35

GBR = guided bone regeneration; M = mesial; D = distal.

(Table 1-1)

As illustrated above, it can be seen that UV Activated implant enables early stage loading with display of quick osteosynthesis in areas such as the area of bone graft, area of maxillary sinus lifting with inadequate residual bone and area of tooth extraction, and determination of such timing can obtain good results by utilizing ISQ values properly.In the next issue, I will introduce the effects of UV Activated implant in actual clinically difficult cases on the basis of such possibilities and cases that verified such effects by using ISQ values (continued in the next issue).

(REFERENCE)

Ueno T, Yamada M, Suzuki T., Enhancement of bone-titanium integration pro file with UVphotofunctionalized titanium in a gap healing model. Biomaterials. 2010; 31:1546-1557.

Han, Chang-Hun., Immediate Loading of Tapered Implants Placed in Postextr action Sockets and Healed Sites Journal of Craniofacial Surgery: July 2016-Vol ume 27-Issue 5-p 1220-1227

M. Hirota., Implant Stability Development of Photofunctionalized Implants Plac ed in Regular and Complex Cases:A Case-Control Study Quintessence Publishi ng co, Inc. volume 31, Number 3, 2016

A.i Funato., Photofunctionalized Dental Implants:A Case Series in Compromis ed Bone research

The International Journal of Oral & Maxillofacial Implants/Quintessence Publis hing co, Inc. 2013

Hyon-Woo Seol., Resonance Frequency Analysis and Early Loading of Implants with Sealed UV Treatment System: Case Reports. Implantology 2017

Cochran D.,.The evidence for immediate loading of implants. J Evid Base Dent Pract 2006;6:155〈63