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Retrospective study of radiological evaluation in 4 to 5 years loading of INNO® dental implant

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Abstract

Introduction: The marginal bone change of the 4 to 5 years panoramic x-rays were evaluated in the platform switching structured INNO® dental implant of which the surface is treated with sandblasting hydroxyapatite (HA), hyper-thermal acid etching and alkali solution cleaning process (SLA + Alkali solution Cleaning).

Materials and Methods: A total 435 dental implants were evaluated on 141 patients. Patient data was evaluated to acquire implant survival rates, gender, implant diameter, length, extraction socket, loading time, adjacent tooth, opposing tooth and kind of prosthesis. Marginal bone loss was measured from 4 to 5 years post-operative radiographs on the basis of known implant landmarks. Statistical analyses were performed using generalized estimating equations.

Results: 4 to 5 years survival rate was 99.2% (3 implants lost). A average marginal bone loss was 0.27± 0.13 mm in total 432 implants. The marginal bone loss of arches was 0.18 ± 0.07 mm in maxilla and 0.34 ± 0.32 mm in mandible (P>0.05). The bone loss of 8 mm length implant (0. 25 ± 0.009 mm) was lower than 10 mm length implant (0. 33 ± 0. 31 mm) without significant difference(P>0.05). Immediate implant placement (0. 14 ± 0. 09 mm) was lower than late placement (0. 36 ± 0. 24mm) in marginal bone loss without significant difference(P>0.05). The site of periodontitis with periapical lesion (0.027 ± 0.017 mm) was the same as the other site (0. 27 ± 0.19 mm) in marginal bone loss.

Conclusion: Within the limitations of this study, we conclude that INNO® dental implant have equal survival rates to the others of platform switched implants. Marginal bone loss was low even in the short length implant, immediate implant placement and the socket of periodontitis with periapical lesion, compared to the other clinical results.

Forty years ago, the first dental implant to replace a missing tooth in human oral cavity was reported.[1] It was a sensational break thorough in dentistry as it marked a new era to restore chewing function and aesthetics. The technique of placing titanium oral implants in healed edentulous sites and subsequently restoring the implant with prosthesis has been recognized to be a high predictive treatment for fully and partially edentulous patients. Previously, practitioners allowed a socket healing time of 12 months or longer before placing dental implants to restore an edentulous space.[2] The lag time brought the patient the compromised comfort, function, and aesthetics. In 1978, the first report of a situation, in which the extraction followed by the placement of an implant into the fresh socket at the same appointment, was described as the “Tübingen immediate implant”.[3] This method reduced the number of dental appointments, the time of treatment and the number of surgeries required. Short implants (10 mm) are another interesting alternative to avoid difficult tilted implant placement and advanced surgical bone augmentation in atrophic jaws.[4]

The implant-abutment configuration itself is also thought to affect peri-implant remodeling of bone. In so-called platform-switched implants, the diameter of the abutment is less than the diameter of the implant, resulting in a horizontal offset at the top of the implant that separates the crestal bone and the connective tissue from the interface. Early results of these platform switched implants showed no changes in peri-implant bone levels, contrary to standard platform-matched implants.[5] Atieh et al. concluded that marginal bone loss around platform-switched implants was significantly less compared to platform-matched implants (0.021–0.99 mm for platform-switched and 0.101–1.67 mm for platform-matched implants).[6]

Non-microthread collar structure was compared with microthread collar structure in the stress values at the cortical bone and implant-abutment complex in 3D FEA.[7] In this analysis, the stress value in the vertical and horizontal force except to the oblique force was not significant difference between microthread and non-microthread structures at cortical bone in which the highest bone stresses have been reported to be concentrated.[8] In this study, Panoramic X-rays for the marginal bone change of 1 year loading was evaluated in the non-microthread collar and platform switching structured INNO® dental implant of which the surface is treated with the sandblasting hydroxyapatite (HA), hyper-thermal acid etching and alkali solution cleaning process (SLA+Alkali solution Cleaning) for hydrophilic macro- and micro-porosity.

Materials and Methods

A retrospective clinical study was made in the Seoul Implant Clinic, Seoul, Korea between June 2010 and January 2016. The patient inclusion criteria were: 1) patients with single missing teeth programmed for restoration with dental implants; 2) partially edentulous patients with free extremities programmed for restoration with dental implants; 3) patients requiring dental implant restoration of the entire dental arch; and 4) patients with sufficient bone width (minimum 6.75 mm)and height (minimum 8.5 mm). The exclusion criteria were: 1) patients with systemic diseases contraindicating any type of surgery; 2) patients receiving or who have received bisphosphonates; 3) patients with active disease of the implant bed (e.g., residual cysts); and 4) patients with bone atrophy requiring bone regeneration in both width and height.

Figure 1. Panoramic X-ray view after first loading and last visit.

The mean age of the patients was 61.5 years with a range from 22 to 82 years. The average loading time was 4 years 5 months and the shortest time period was 4 years 2 months with 8 patients.

A total 432 of 435 (3 implants fail) dental implants were evaluated in 141 patients (63 females with 162 implants and 75 males with 270 implants) in 1st Molar (108 implants), 2nd premolar (48 implants), 1st premolar (39 implants), 2nd molar (27implants) and the anterior tooth site (9 implants) of the maxilla (228 implants) and the mandible (204 implants). The short 8 mm implant (192 implants) and the longer 10 mm (198 implants) and 12 mm implants (42 implants) of diameter 4 mm (366 implants), 4.5 mm (30 implants), 5 mm (24 implants), 6 mm (6 implants) and 3.5 mm(6 implants) was placed in the healed ridge (336 implants) and the extraction socket (96 implants) which were positioned in the site of adjacent tooth (231 implants) and the teeth (273 implant) and the implant (159 implants) opposed with fixed prosthetics (81 crowns, 123 splinted crown, 9 bridges and 6 full anchorage bridge). The immediate implant placement (138 implants) was done in the sockets of periodontitis with periapical lesion (72 implants). The immediate loading (24 implants) was done in anterior teeth (21 implants) and 1st premolar (3 implant) (Table 1).

Table 1.Baseline Characteristics of the patients

Variables	Value
Mean age (years)	61.5
Implant position:	
Maxillary	
Ant./P1/P2/M1/M2	12/21/45/84/66
Mandibular	
Ant./P1/P2/M1/M2	18/12/30/90/54
Implant Diameter(mm):	
3.5/4.0/4.5/5.0/6.0	6/366/30/24/6
Implant length(mm):	
8/10/12/14	192/198/42/0
Immediate implant placement position (site of periodontitis and peiapical lesion):	
Maxillary	
Ant./P1/P2/M1/M2	15(6)/3(0)/6(0)/27(12)/12(0)
Mandibular	
Ant./P1/P2/M1/M2	0(0)/3(3)/15(6)/42(33)/21(12)
Site	
With adjacent tooth	231
/*Without*	/201
Immediate loading	
Maxillary	
Ant./P1	3/0
Mandibular	
Ant./P1	18/3
Prosthesis	
Crown/Splinted Crown/ Bridge/ Full anchorage bridge	81/123/9/6
Opposing to site	
Tooth/Implant	273/159

Surgical techniques

The INNO® dental implant (Cowellmedi, Pusan, Korea) were placed using the same surgical protocol in all cases. Anesthesia was provided in the form of 2% lidocaine with epinephrine 1:100,000.A crestal incision was made with the raising of a full thickness mucoperiosteal flap. The surgical zone was subjected to curettage before the drilling phase, according to the recommendations of the manufacturer. The drill speed was reduced from 1200 to 60 rpm as the drill diameter was increased in order to reduce heating of the bone at the implant site. Drilling was carried out under irrigation with saline solution, and the implant was placed with a 25 rpm and 45N of torque. The space between extraction socket wall and implant was filled with CowellBMP® bone graft (Cowellmedi, Busan, Korea) which are composed of the rhBMP-2 and HA/TCP biphasic particles. Suturing was carried out with 4/0 silk. All surgeries were completed in two staged surgery, except to immediate loading. A standard non-submerged healing abutment was used. All implants were loaded in the conventional healing period after implant placement. Panoramic X-rays (Vatec, Anseong, Korea) were made at the appointment of before surgery, after surgery and 3, 6, 12 months after loading (Figure 1).

Image analysis

Panoramic X-rays were analyzed with Easydent viewer version 4.5 software (Vatec, Anseong, Korea). Two reference points were marked on the top of implant surface and the first contact point with bone at the mesial and distal side of implant. The measurement between two points was calculated to a average value. The differences between the values of the first measurement (after loading) and those of the second (last visiting) were used to establish marginal bone loss (Figures 2). The vertical bone increase of the bone graft in extraction socket is measured to 0 mm change value (Figures 3).

Figure 2. Reference point of measurement

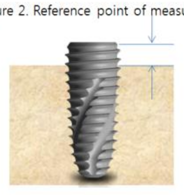
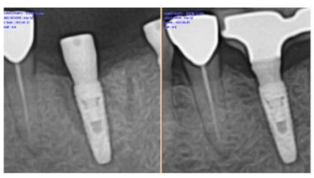


Figure 3. Vertical bone increase in socket



Statistical analysis

The data were processed using the SPSS version 17.0 statistical package (SPSS Inc., Chicago, IL, USA) for Microsoft Windows. The Student t-test was used for the comparative analysis.

Results

Implant survival

Three of 432 INNO® dental implants were lost at 2nd molar, resulting in a survival rate of 99.2%. All 3 implants were lost after loading, two in the maxilla and one in the mandible.

Marginal bone change

A average marginal bone loss was 0.27± 0.138 mm in total 432 implants. The marginal bone loss of arches was 0.18 ± 0.07 mm in maxilla and 0.34 ± 0.32 mm in mandible (P>0.05). The marginal bone loss of tooth position was 0.8 ± 0.78 mm in 2nd premolar, 0.29 ± 0.12 mm in 1st molar and 0.07± 0.01mm in 2nd molar(P>0.05). The bone loss of 8 mm length implant (0.25 ± 0.009 mm) was lower than 10 mm length implant (0.33 ± 0.31 mm) without significant difference(P>0.05). Immediate implant placement (0.14 ± 0.09 mm) was lower than late placement (0.36 ± 0.24mm) in marginal bone loss without significant difference(P>0.05). The site of periodontitis with periapical lesion (0.27 ± 0.17 mm) was the same as the other site (0.27 ± 0.19 mm) in bone loss. Teeth adjacent to Implant did not affect bone loss (implant adjacent to tooth: 0.20 ± 0.11 mm vs. implant without tooth: 0.33 ± 0.28 mm). Immediate loading (0.18 ± 0.01 mm) in anterior teeth was not a factor of bone loss, compared with conventional loading in the other site

Table 2.marginal bone loss in baseline characteristics

Variable	Marginal bone loss (mm)	*P* value
Implant position		
Maxillary/ mandibular	0.18±0.07/ 0.34±0.32	0.24
P2/M1/M2	0.8±0.78/ 0.29±0.12/ 0.07±0.01	0.15
Implant length(mm)		
8/10	0.25±0.09/ 0.33±0.31	0.38
Implant placement		
Immediate / Late	0.14±0.009/ 0.36±0.24	0.19
Site of periodontitis		
With periapical lesion / the others	0.27±0.17/ 0.27±0.19	0.49
Adjacent tooth		
With/ Without	0.20±0.11/ 0.33±0.28	0.28
Loading		
Immediate / conventional	0.18±0.01/ 0.26±0.19	0.43
Opposing		
Tooth / Implant	0.17±0.18/ 0.42±0.19	0.14

(0.26 ± 0.19mm). Implant supported prosthesis opposed implant (0.42 ± 0.19 mm) was not good, compared with tooth opposed implant (0.17 ± 0.18 mm), but there was not a significant difference. (Table 2)

Discussion

Implant survival

Survival was defined as implants remaining in site at the follow-up examinations, irrespective of their conditions. Failure was defined as implants that were lost after immediate implant placement. The survival rate of one year follow-up in 73 implants with platform switching connection was reported to 98.3 %.[9] Two of 144The INNO® dental implants were lost at 2nd molar, resulting in a survival rate of 98.2%. The survival rate of two studies was the same. One of two failed implants were placed in the soft bone of maxillary tuberosity, the other one in extraction socket of mandibular 2nd molar with the limited vertical bone due to the periodontitis with apical lesion. These implants were not supported by the proper bone quality and bone quantity.

Implant survival of immediate implantation in extraction socket

Clementini et al. (2013) concluded that Success rates for implants placed using a simultaneous approach ranged from 61.5% to 100%; success rates for implants placed using a staged approach ranged from 75% to 98% in 13 studies.[10] Lang et al. (2012) concluded that the annual failure rate of immediate implants was 0.82% (95% CI: 0.48–1.39%), translating into the 5-year survival rate of 96.4% (97.0–97.8%) after implant placement in a total of 46 prospective studies.[11] In this study, three of 432 implant was failed in the average 4 years 5 months after implant loading and the survival rate was 99.2 % which is higher survival rate than Lang et al. study.

Marginal bone change

Literature reports have recommended the radiographic evaluation of marginal bone change at regular intervals and the calculation of mean bone loss over time as a criterion for success of an individual implant (Alberktsson et al. 1986). Marginal bone change is an early manifestation of implant healing, and the stability of the implant and implant–abutment interface play an important role in marginal bone change. When applying such annual bone loss values to the current study, they would result in a total average marginal bone change of approximately 1.5 mm for the period of 5–6 years. In this study, the marginal bone loss was 0.27± 0.013 mm in total 432 implants in 4 to 5 year follow-up. This result was better than the result of study of Alberktsson et al. which recorded the minimal bone loss in all clinical studies.

Marginal bone change of short 8 mm length implant

Draenert et al. concluded that short implants with a length of 9 mm or less have equal survival rates compared with longer implants in mandibular arch over the observation period of 4-5 years.[13] In our study, the bone loss of 8 mm length implant (0.25 ± 0.009 mm) was lower than 10 mm length implant (0.33 ± 0.31 mm) without significant difference (P>0.05). These two studies coincided in the marginal bone loss.

The marginal bone loss, according to arches was 0.18 ± 0.07 mm in maxilla and 0.34 ± 0.32 mm in mandible (P>0.05). Mandible was higher than mandible without significant difference. Marginal bone loss might to be increased in dense cortical bone of mandible.

The marginal bone loss of tooth position was 0.8 ± 0.78 mm in 2nd premolar, 0.29 ± 0.12 mm in 1st molar and 0.07 ± 0.01mm in 2nd molar (P>0.05). The narrow ridge in premolar could be lost in thin buccal wall of ridge. But there were not the significant difference in implant position.

Immediate implant placement (0.14 ± 0.09 mm) was lower than late placement (0.36 ± 0.24 mm) in marginal bone loss without significant difference (P>0.05). The regenerated bone of space between socket wall and implant with rhBMP-2 bone graft could support the implant without difference of natural bone.

The periodontitis with periapical lesion (0.27 ± 0.17 mm) was not the handicapped site for support implant compared to the other site (0.27 ± 0.19 mm) in bone loss. Teeth adjacent Implant did not effect on bone loss (implant adjacent to tooth: 0.20 ± 0.11 mm vs. implant without tooth: 0.33 ± 0.28 mm). Immediate loading (0.18 ± 0.01 mm) in anterior teeth was not a factor of bone loss, compared with conventional loading in the other site (0.26 ± 0.19 mm). Implant supported prosthesis opposed implant (0.42 ± 0.19 mm) was not good, compared with tooth opposed implant (0.17 ± 0.18 mm), but there was not a significant difference.

Conclusion

Within the limitations of this study, we conclude that INNO® dental implant have equal survival rates to the others implants. Marginal bone loss was low even in the short length implant, immediate implant placement and the socket of periodontitis with periapical lesion, compared to the other clinical results.

Reference

1.Branemark, P.I., Adell, R., Breine, U., Hansson, B.O., Lindstrom, J. & Ohlsson, A. (1969) Intra-osseous anchorag of dental prostheses I. Experimental studies. Scandinavian Journal of Plastic Reconstructive Surgery, 3: 81–100.

2.Adell, R., Lekholm, U., Rockler, B. & Branemark,P.I. (1981) A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. International Journal of Oral Surgery 10: 387–416.

3.Schulte, W., Kleineiken scheidt, H., Lindner, K. & Schareyka, R. (1978) [The Tu¨bingen immediate implant in clinical studies]. Deutsche Zahnarztliche Zeitschrift 33: 348–359.

4.Menchero-Cantalejo, E., Barona-Dorado, C., Cantero-Alvarez, M., Fernandez-Caliz, F. & Martinez-Gonzalez, J.M. (2011) Meta-analysis on the survivalof short implants. Medicin a oral, patologı´a oral y cirugı´abucal16: e546–e551.

5.Wagenberg B, Froum SJ. Prospective study of 94 platforms witched implants observed from 1992 to 2006. Int J Periodontics Restorative Dent 2010; 30:9–17.

6.Atieh MA, Ibrahim HM, Atieh AH. Platform switching formarginal bone preservation around dental implants: asystematic review and met-analysis. J Periodontol 2010; 81: 1350–1366.

7.GÖKÇE M, ERKAN E, AHMET K, ATILIM E , AHMET UÖ. Biomechanical comparison of two different collar structured implant ssupporting 3-unit fixed partial denture: A 3-D FEM study. Acta Odontologica Scandinavica, 2012; 70: 61–71

8.Meijer HJ, Kuiper JH, Starmans FJ, Bosman F. Stress distribution around dental implants: influence of superstructure,length of implants, and height of mandible. J Prosthet Dent1992; 68:96–102.

9.Cappiello M, Luongo R, Di Iorio D, Bugea C, CocchettoR, Celletti R. Evaluation of peri-implant bone loss around platform-switched implants. Int J Periodontics Restorative Dent 2008;28:347-355.

10.M. Clementini, A. Morlupi,C. Agrestini, A. Barlattani, Immediate versus delayed positioning of dental implants inguided bone regeneration or onlay graft regenerated areas: asystematic review, Int. J. Oral Maxillofac. Surg. 2013; 42: 643–650

11.Lang NP, Lui P, Lau KY, Li KY, Wong MCM. A systematicreview on survival and success rates of implants placedimmediately into fresh extraction sockets after at least 1 year. Clin. Oral. Impl. Res. 23 (Suppl. 5), 2012, 39–66

12. Alberktsson, T., Zarb, G., Worthington, P. & Eriksson, A.R. (1986) The long-term efficacy of currently used dental implants: a review and proposed criteria of success. International Journal of Oral & Maxillofacial Implants 1: 11 –25.

13.Draenert FG, Sagheb K, Baumgardt K, Ka¨mmerer PW. Retrospective analysis of survival rates and marginal boneloss on short implants in the mandible. Clin.Oral Impl. Res 0, 2011, 1–7.