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2

DENTIS 내부연결형 서브머지드 임플란트에서 지대주 선택에 따른 성공률의 후향적 연구

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ABSTRACT

A retrospective randomized study of success rates according to abutment selection in DENTIS submerged implant with an internal hex connection

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PURPOSE. The purpose of this study is to determine the efficacy of the DENTIS submerged-type implant with an internal hex connection and to build corresponding abutment-selection criteria.

MATERIAL AND METHODS. A total of 204 patients received submerged implant fixtures with an internal hex connection at the Dong-A University Hospital Dental clinic in Busan from January 2013 and May 2016. Three specific abutments, UCLA abutments, customized abutments, ready-made abutments, were randomly selected. Implant success was defined as the basis of the International Congress of Oral Implantologists(ICOI, 2007) criteria. The relationship between the implant success rate and the abutment factor was analyzed using the Kruskal-Wallis test(P<.05).

RESULTS. A total of 508 implants were placed in 204 patients. After a mean observation period of 38.6 months, 493 out of 508 implants were in normal function, yielding an overall success rate of 97.05%. A total of 15 implants failed: 10 in the maxillary molar area, 4 in the mandibular molar area, and 1 in the mandibular incisal area. All of the implant failures occurred in a single-implant prosthesis, especially high in the maxillary molar area. The Kruskal-Wallis analysis showed that abutment selection has no significant correlation with implant failure(P>.05).

CONCLUSION. DENTIS submerged implants with an internal hex connection showed predictable results with a success rate of 97.05%. It is no influence on the success rate in the selection of submerged implant abutment with an internal hex connection.

Key words : Dental implants; Survival rate; Dental implant-abutment design;

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Ⅰ. Introduction

There were two methods of connecting an implant fixture and an abutment: an external hex connection[1] and an internal hex connection[2] (Figs. 1a and b). With an external hex connec tion, excessive loading at the initial stage could lead to loss of crestal bone and could cause peri-implantitis as a result of bacterial infection arising in the micro-gap between the fixture and the abutment[3]. Whereas with an internal, tissue-level hex connection, exposure of the metal collar at the thin gingiva could show poor esthetics and make it more difficult to obtain emergency profile. In order to overcome these limitations, the submerged-type implant fixture with an internal hex connection has been designed and developed. In this case, the hexagon is positioned in the fixture, and the fixture platform is located at the alveolar bone level (Fig. 1c)[4].

Nevertheless, clinicians do not always choose the submerged implant type with an internal hex connection. And they fall into confusion in their choice, either external hex or internal hex. Practitioners lacking in clinical experience could be particularly uncertain of the proper implant fixture to select. After the implant insertion, the selection of the most appropriate superstructure for the prosthesis also could be confusing the dentists.

The abutments introduced for utilization in dental implant superstructures were as follows: casting abutment[5~7], which used a metal alloy, customized abutment, which milled the abutment according to its gingival shape and depth of the fixture, and ready-made abutment, which manufacturers produced in fixed sizes(Fig. 2). For the selection of abutment, there are no clear guidelines. Most clinicians rather are obliged to base their judgments only on esthetics, material, the convenience of their treatment, or the

Fig. 1. a. Branemark, external hexagonal connection(Branemark system MKIII, Nobel Biocare AB, Goteborg, Sweden), b. ITI, internal hexagonal connection(Straumann standard implant, Institute Straumann AG, Waldenberg, Switzerland) and c. Submerged internal hexagonal connection(s-Clean tapered II, Dentis, Dae-Gu, Republic of Korea).

Fig. 2. A. Gold UCLA abutment(s-Clean Gold UCLA Abutment, Dentis, Dae-Gu, Republic of Korea), B. Customized abutment(MyPLANT abutment, RaphaBio, Seoul, Republic of Korea), and C. Ready-made abutment(s-Clean Couple Abutment, Dentis, Dae-Gu, Republic of Korea).

practitioner's personal.

Establishment of abutment-selection criteria to help ensure the success of long-term treatment is controversial. For example, the type of gingiva and thickness could be varied in the submerged implant, depending on its located alveolar bone level. This is one of the reasons why abutment selection should be made very carefully.

The purpose of this research is to determine the efficacy of the DENTIS submerged-type implant with an internal hex connection and to build corresponding abutment-selection criteria. To those ends, the comparison of success rates was conducted according to both implant placement and abutment selection.

Ⅱ. Materials and Methods

Patients who had undergone insertion of DENTIS submerged implant fixture with an internal hex connection between January 2013 and May 2016 at the Dong-A University Hospital Dental Clinic in Busan, Republic of Korea, and who had experienced more than six months of normal function, were selected for inclusion in this study. Patients suffering from early failure prior to prosthesis insertion or from poor oral hygiene after implantation, implant overdenture, or systemic diseases such as uncontrolled osteoporosis or diabetes mellitus, were excluded. The investigation focused on patient data including gender, age, implant placement site, abutment type, and post-prosthetic complication, which information had been obtained from the relevant charts and radiographic film.

Three specific abutments of the three general types - casting abutment, customized abutment, and ready-made abutment - were adopted for use in this study: UCLA abutment(screw-retained prosthesis/ s-Clean Gold UCLA Abutment, Dentis, Daegu, Republic of Korea), Customized abutment(screw-cement-retained or cement-retained prosthesis/MyPLANT, RaphaBio, Seoul, Republic of Korea), and ready-made abutment(screw-cement-retained or cement-retained prosthesis/s-Clean Couple Abutment, Dentis, Seoul, Republic of Korea), respectively. The abutments used in this study were randomly assigned to the inserted implants. In this research, implant success was defined as the basis of the International Congress of Oral Implantologists(ICOI)[8] criteria(2007): I. Suc cess, and II. Satisfactory survival(Table I). Analysis of statistical difference between the implant success rate and the abutment factor in this study was assessed using the Kruskal-Wallis test($P<.05$).

Ⅲ. Results

A total of 508 implants of 204 patients (males: 111, females: 93, age: 16-79, average age: 50.1) were selected for this investigation. The time duration from an insertion of the implant fixture to the delivery of prosthesis was an average of 6.6 months. The time duration following prosthesis insertion, which indicated the average maintenance period, was 38.6 months(minimum:

25 months, maximum: 55 months).

A total of 261 implants were inserted into the maxilla: 56 (25 UCLA, 28 MyPLANT, 3 ready-made) into the incisal area: 82 (38 UCLA, 37 MyPLANT, 7 ready-made) into the premolar area, and 123 (75 UCLA, 34 MyPLANT, 14 ready-made) into the molar area(Table II).

A total of 247 implants were inserted into the mandible: 31(8 UCLA, 16 MyPLANT, 7 ready-made) into the incisal area: 64(27 UCLA, 30 MyPLANT, 7 ready-made) into the premolar area, and 152(109 UCLA, 36 MyPLANT, 7 ready-made) into the molar area(Table III).

After prosthesis delivery, 493 implants of 508 were in normal function intraorally, which represented an overall success rate of 97.05%. A total of 15 implants failed: 10 in the maxillary molar area, 4 in the mandibular molar area, and 1 in the mandibular incisal area. Most of the failures involved the UCLA abutment in the maxillary molar area(Table IV, V).

Seven of the failures occurred within an average of 7 months of prosthesis delivery, 2 within 1 year, and the remaining 6 within 18.5 months. They all were functioning as a single-implant prosthesis.

Regarding the comparison of the three abutments by Kruskal-Wallis test, there was no significant association between implant success rates and the three different abutment types(P=.420) (Table VI).

Table Ⅰ. The International Congress of Oral Implantologists (ICOI) (2007) classifications: success, survival, failure

Implant Quality Scale Group	Clinical Conditions
I. Success(optimum health)	a) No pain or tenderness upon function b) 0 mobility c) 〈2mm radiographic bone loss from initial surgery d) No exudates history
II. Satisfactory survival	a) No pain on function b) 0 mobility c) 2-4mm radiographic bone loss d) No exudates history
III. Compromised survival	a) May have sensitivity on function b) No mobility c) Radiographic bone loss 〉4mm(less than 1/2 of implant body) d) Probing depth 〉7mm e) May have exudates history
IV. Failure (clinical or absolute failure)	Any of following: a) Pain on function b) Mobility c) Radiographic bone loss 〉1/2 length of implant d) Uncontrolled exudate e) No longer in mouth

Table Ⅱ. Abutment-type selection according to the maxillary area

	Incisor(n=56)	Premolar(n=82)	Molar(n=123)
UCLA abutment(n=138)	25(44.6%)	38(46.3%)	75(61.0%)
MyPLANT abutment(n=99)	28(50.0%)	37(45.1%)	34(27.6%)
Ready-made abutment(n=24)	3(5.36%)	7(8.34%)	14(11.4%)

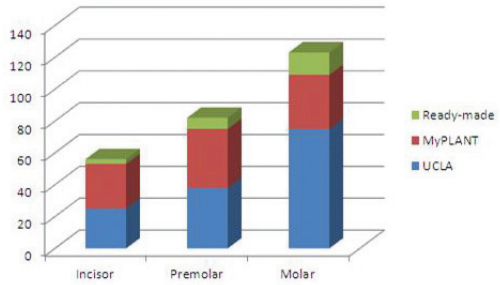

Table Ⅲ. Abutment-type selection according to the mandibular area

	Incisor(n=31)	Premolar(n=64)	Molar(n=152)
UCLA abutment(n=144)	8(25.8%)	27(42.2%)	109(71.7%)
MyPLANT abutment(n=82)	16(51.6%)	30(46.9%)	36(23.7%)
Ready-made abutment(n=21)	7(22.6%)	7(10.9%)	7(4.61%)

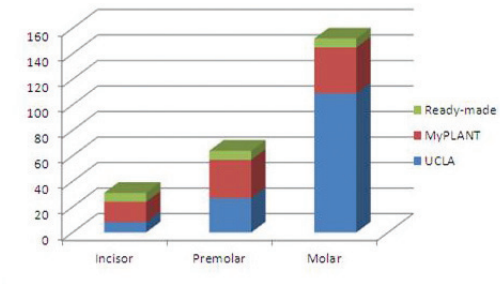

Table Ⅳ. Implantation failure according to the abutment selection

	UCLA abutment	MyPLANT abutment	Ready-made abutment
Failure No. / Total No. (Failure No. on the insertion sites)	10 / 282 (Mn. incisor: 1, Mx. / Mn. molar: 7 / 2)	5 / 181 (Mx. / Mn. molar: 3 / 2)	0 / 45
Failure rate(%)	3.54%	2.7%	-

Table Ⅴ. Implantation failure according to the implantation area

	Incisor	Premolar	Maxilla molar	Mandible molar
Failure No.	1	0	10	4

Table Ⅵ. Comparison of three abutments using Kruskal-Wallis test

	UCLA abutment	MyPLANT abutment	Ready-made abutment
N	282	181	45
median	256.01	254.02	247.00
Kruskal-Wallis Test, H Value		1.735	
P-value		.420	

Ⅳ. Discussions

When Branemark introduced implantation to dentistry, connection to the abutment was achieved by means of an external hex implant fixture. Adell et al[1]. estimated that alveolar bone resorption had advanced an average of 1.2 mm over the course of 1 year following implant fixture insertion and prosthesis delivery. As a resorption prevention, the concept of platform switching was introduced. Becker et al[9]. demonstrated that platform switching might increase the distance between the abutment margin and the alveolar crest, thus decreasing its bone-resorptive effect.

Balfour et al.[10] reported, concerning the evaluation of torsional loading and compressive bending, that increased force is necessary in order to remove a single abutment under internal as opposed to external hex connection. Chang et al[11]. performed a three-dimensional finite element analysis, the results of which revealed that implants with an external hex connection were subjected to greater stress than submerged implants with an internal hex connection.

Khraisat et al[12]. and Steinebrunner et al[13]. reported in vitro research findings indicating that internal connection was superior to the external connection in terms of resistance against fatigue, fracture strength, and the failure mode. This suggested that submerged implant with an internal hex connection could be more effective both in the anterior area, where there was significant lateral loading and in the posterior area, where there was substantial occlusal force.

In this study, 508 DENTIS implants were placed in 204 patients, and an overall implantation success rate was 97.05% at 38.6month follow up period. A total of 15 implants failed:10 in the maxillary molar area, 4 in the mandibular molar area, and 1 in the mandibular incisal area. This result could be compared favorably with other cases, where a 5-year implant survival rate under an external hex connection was 84~92% for the maxilla and 91~99% for the mandible[14]. Furthermore, the result in this study compared

favorably also within which the 5-year implant survival rate under an internal hex connection did not exceed 90%[15].

All failed implants were functioning as a single-implant prosthesis in this study. Isidor[16]emphasized, based on research on monkeys, that excessive occlusal loading could aggravate loss of osseointegration and occur peri-implantitis. Rangert et al[17]. reported that single- or two-implant arrangement in posterior teeth increased the risk of bending overload, resultantly, all single implants in the first-molar area fractured. Goodacre et al[18]. conducted a literature review and found that 12 of 332 single implants had to be removed, the majority of which failures were post-prosthetic. Among the other prosthesis types(i.e., implant overdentures, implant fixed partial/complete dentures), pre-prosthetic failure was the most.

There are other important factors that affect the success of the implant. For example, patient's age, gender, systemic condition, implant size, additional surgery, opposing dentition, smoking and splinting were not considered in this study because our study focused on randomly comparing the success rates of implant abutment types over a period of time. In addition, studies of various local and systemic factors affecting the success rate of implant have already proved a number of results, so we assumed that including the evaluation of these factors would cause confusion in our results. Despite of high implant success rates in this research, implant success rate influenced by local and systemic risk factors such as osteoporosis, Crohn's disease, smoking habits, implant (length, diameter and location) and vicinity with the natural dentition, are still inevitable and showed contradictory results[19]. Moy et al[20]. reported that patients who were over age 60, smoked, had a history of diabetes or radiation treatment, or hormone therapy significantly increased implant failure compared with healthy patients. Chrcanvic et al[21]. assessed the influence of local and systemic factors on the occurrence of dental implant failures up to the second-stage surgery(abutment connection). The distribution of implants in sites of different bone quantities and qualities was quite similar between implants lost up to and after abutment connection. Therefore, relevant factors affecting the implant success rate should be considered with caution.

For use of the submerged implant with an internal hex connection, the abutments selected were casting abutment, customized abutment, and ready-made abutment. The gold UCLA casting prosthesis offered excellent biocompatibility and fracture resistance even when used in reduced crown-height space. Additionally, it allowed convenient condition for insertion or removal of the prosthesis on account of which ease access for repairing was available in the event of encountering troubles[22]. Moreover, as it leaves no excess intraoral cement from its retrievability, it could effectively prevent peri-implantitis[23].

However, in cases of UCLA abutment, screw fracture possibly could occur due to screw loosening in a final prosthesis. Indeed, among the disadvantages of the UCLA abutment type were

the complexity and difficulty of prosthesis production, the problematic acquisition of passive fit, and an unaesthetic appearance[24, 25]. Furthermore, there was the possibility of micro-leakage from screw holes on the occlusal surfaces, which could lead to occlusion problems or poor hygiene if such restorations were not in suitable positions[26, 27].

Byrne et al[28]. emphasized that when using casting abutment, there were, relative to the cases for pre-machined abutment or customized abutment(the shape of which was modified at a laboratory), more serious interfacial and vertical discrepancies. Hebel et al[23]. reported the results of tests showing that when non-passive castings were formed for a multi-unit implant prosthesis of the screw-retained type, these misfits between the implant fixture and the abutment left micro gaps.

As confirmed by this research, reduced crown height space, patient preference, the difficulty of porcelain reduction for occlusal adjustment, and repair convenience were the main reasons UCLA was the most commonly used abutment type. The implant failure in this investigation was significantly not affected by abutment design. However, most of the failed implants were those with a single-unit UCLA abutment, in which case the fixing screw made a direct connection between the abutment and the fixture. With this kind of arrangement, there could be a direct occlusal load on the fixture. In looking at implant failure according to the insertion sites, it occurred mostly in the maxillary molar area. It was thought that implant site's bone quality was one of the factors in the implant failure, and this was supported by the previous research[29, 30].

A customized abutment is fabricated by milling it according to its gingival shape and the location of the inserted fixture platform. This could facilitate both the reproducing of an emergency profile and overall laboratory processes. It is important for preventing plaque deposition, ease of oral hygiene and esthetics to make natural emergence profile of prosthesis in the clinical situation. The round ready-made abutment in the occlusal plane did not match an anatomic gingival configuration, therefore customized abutments had efficacy by solving the difference between the ready-made abutment and the cross-sectional form of natural teeth. Especially in the anterior area, where an excellent esthetic was required, irregular gingival level, and deeply inserted site, customized abutments could be useful for an anatomically ideal prosthesis[31]. By contrast, if the ready-made abutment was used in those case, with fixed angulation it might be adjusted excessively, therefore it could lead to reducing the retention of the prosthesis. Moreover, it might result in less than ideal crown contours and insufficient support for optimum soft tissue esthetics because its size of the collar height and the the cross section were fixed[32~34]. Thus, a customized abutment could make the thickness of the final prosthesis ideal, and enable easy to retrieve splinting prosthesis without loss of retention[32, 35, 36]. This research indicated that in incisor and premolar placement cases, where esthetics is considered to be important, customized abutment is preferable to the ready-made abutment.

Within the limitation of this study, DENTIS submerged implant with an internal hex connection showed predictable results with a success rate of 97.05% at the maxillary and mandibular incisor, premolar and molar sites. There was no significant association between implant success rate and the three different abutment types. However, many relative factors affecting implant success rates should be considered, and a long-term follow-up period will be needed to assess implant prognosis.

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