

**Healing of surgically created circumferential
gap around non-submerged type implants in
dogs: a histomorphometric study**

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gap around non-submerged type implants in
dogs: a histomorphometric study**

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감사의 글

실험을 시작하기 전, 막연함에 막막해 하던 기억이 얼마 전인데, 초조함과 인고의 시간을 거쳐 논문을 탈고하게 되었습니다.

이 논문이 완성되기까지 부족한 저를 항상 격려해 주시고 사랑과 관심으로 이끌어 주신 김종관 교수님께 깊은 감사를 드립니다. 그리고, 더 나은 논문을 위해 많은 조언과 따뜻한 관심으로 지켜봐 주신 채중규 교수님, 조규성 교수님, 최성호 교수님, 김창성 교수님께 진심으로 감사 드립니다.

연구 내내 자기 일처럼 많은 도움을 준 김태균 선생님, 채경준 선생님, 그리고 치주과 수련의 선생님 여러분들께 고마움을 전합니다.

그리고, 제가 이 자리에 오기까지 항상 묵묵히 절 믿고 지켜봐 주신 부모님과 장인, 장모님에 대한 감사의 마음은 이루 말할 수 없이 큼니다. 제가 힘들고 지칠 때 많은 상담과 조언을 해주며 독려해 주신 형님, 누님, 매형, 형수님께도 감사의 마음을 전합니다.

마지막으로 누구보다 늘 아낌 없는 사랑과 헌신적인 도움으로 든든하고 따뜻한 버팀목이 되어준 사랑하는 나의 아내, Angie에게 진정으로 사랑과 고마움의 마음을 전합니다. 모든 분들께 진심으로 감사 드립니다.

아울러, 더 나은 과학 지식 발전을 위해 희생된 동물들에게, 그 희생이 헛되지 않도록 더욱 더 열심히 연구할 것을 다짐해 봅니다.

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Abstract

Healing of surgically created circumferential gap around non-submerged type implants in dogs: a histomorphometric study

Objectives: This study was to evaluate the healing of surgically created circumferential gaps around non-submerged type implants according to varying size and healing periods in dogs.

Material and Methods: In four mongrel dogs, all mandible premolars were extracted and after an 8-week of healing period, non-submerged type implants were placed. Circumferential coronal defects around the implants were performed surgically with a customized tapered step drill. Groups were divided according to width of the coronal gaps: 1.0 mm, 1.5 mm, or 2.0 mm. First the right side of the mandible was prepared, and after 8 weeks, the left side was prepared. The dogs were sacrificed following an 8-week healing period. Specimens were analyzed histologically and histomorphometrically.

Results: As the size of the coronal gap increased, the unfilled area tended to be greater. In terms of bone-to-implant contact and bone density, both the 1.0-mm and 1.5-mm groups showed a larger percentage of coronal defect than the apical side, while the 2.0-mm group showed contrary results in the 8-week groups. The general histologic features in the 16-week groups were similar to the findings of 8-week groups but were more matured, with a higher percentage of lamellar bone. A certain

amount of bone filling and osseointegration was observed in the defects of all the groups.

Conclusion: It can be concluded that the remaining defect, small enough to be clinically neglected, irrespective of gap size within 2 mm, does not need any kind of regenerating procedures.

Key Words: critical size defect, customized tapered drill, gap, non-submerged type implant

Healing of surgically created circumferential gap around non-submerged type implants in dogs: a histomorphometric study

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I. Introduction

In the rehabilitation of tooth loss, dental implants have replaced conventional prosthetic therapy. They have become the therapy of choice by overcoming the limitations. However, restoration by dental implants has some disadvantages, e.g. a long edentulous period from extraction to final restoration and the need for further surgical intervention, despite its many advantages.

The development and improvement of dental implant systems and surgical techniques have led to faster and easier restoration. Since the introduction of the ‘immediate implant’ by Schulte et al. (1978), many authors have studied and improved the clinical efficacy of immediate placement of dental implants into the extraction socket in human clinical studies (Lazzara 1989; Werbitt 1992; Gelb 1993; Lang et al. 1994; Becker et al. 1994, 1998; Watzek et al. 1995; Rosenquist & Grenthe 1996;

Schwartz-Arad & Chaushu 1997, 2000; Botticelli et al. 2004a). The advantages of immediate implantation are as follows: Total treatment time can be reduced; the preservation of the residual socket's horizontal and vertical level could be more easily achieved than in delayed implantation; implant positioning is optimized; the need for additional bone augmentation procedures is minimized; and the healing potential of residual periodontal ligament cells is helpful in successful osseointegration.

However, coronal gaps around the implants placed immediately into fresh extraction sockets are often a problem and the lack of soft tissue makes it difficult to maintain a primary closure of the surgical site (Becker & Becker 1990; Gotfredsen et al. 1993, Becker et al. 1994, Goldstein et al. 2002).

Although several clinical studies proved comparable, substantial bone fill and a high success rate with delayed implantation, animal experiments were carried out using various experimental models (Carlsson et al. 1988; Knox et al. 1991; Thomas et al. 1998; Akimoto et al. 1999; Botticelli et al. 2003a, b, 2004b, c, 2005), since clinical defect fill does not mean histological osseointegration.

Carlsson et al. (1988) studied titanium implants with initial gap widths of 0.00, 0.35, and 0.85 mm. When the initial gap between bone and implant was larger than 0.35 mm, histologic evaluation revealed no osseointegration. Knox et al. (1991) proved that gaps larger than 1 mm resulted in a smaller amount of direct bone to implant contact. Thomas et al. (1998) concluded in their clinical study that in a gap width of less than 0.5 mm there is no need for membrane use, but in a gap width of more than 4 mm, no integration of bone and implant was observed. Akimoto et al.

(1999) studied a smooth surface implant in surgically created bone defect sites after tooth extraction in a dog experimental model. Bone was regenerated in gap widths of more than 0.5 mm clinically, but histologically there was no direct contact of bone and implant.

The development of implant surface characteristics allowed osseointegration of implants in areas with larger gaps.

Botticelli et al. (2003a) studied a rough surface implant (SLA) in dogs by creating a bone defect with a 1 to 1.25-mm gap. A barrier membrane was used to cover the coronal defect. They suggested that the defect sites were healed by appositional bone growth from the lateral and apical bone walls of the defect. Botticelli et al. (2004c) performed a similar study in a bone defect of 5 mm depth and 1-1.25 mm width. In the test group, Bovine bone substitute was grafted and covered with absorbable membrane. The results after 4 months healing, there was good bonding between graft material and newly formed bone, but no significant improvements in bone formation or gap closure as compared to the control group. In a recent study, Botticelli et al. (2005) compared bone healing at implants with turned or rough surface topographies placed in self-contained defects using either a submerged or non-submerged installation technique. They suggested that healing of the bone defect around implants with a rough surface was superior to that with a turned surface, and there were no differences between submerged or non-submerged sites.

In the above studies, the coronal gap was treated with either a barrier membrane or bone grafting. Regenerative procedures could be affected by membrane exposure to

the oral cavity, presenting a risk for bacterial colonization. Celletti et al. (1994) reported that higher levels of bone formation were observed in sites with no membranes as compared to the barrier membrane-covered cases. Covani et al. (2003) reported that primary implant stability, integrity of bone walls maintaining a firm blood clot and primary flap closure are important factors that induce spontaneous bone healing in circumferential peri-implant bone defects not exceeding 2 mm. Botticelli et al. (2003b) suggested that during the healing of a 'self-contained' bone defect in the presence of a proper periosteum, the use of a barrier membrane might not be required.

The naturally controlled healing of various sized defects in non-submerged, rough-surfaced implants has not yet been observed.

The objectives of this study were to compare the healing of various sized circumferential gaps around non-submerged type implants in dogs. Additionally, we observed the healing status for two periods: 8 weeks and 16 weeks.

II. Materials & methods

1. Animals

Four male Mongrel dogs, 18 to 24 months old and weighing about 30 kg, were chosen. The animals had intact dentition and healthy periodontium. Animal selection, management, preparation and surgical protocol followed the routine procedure approved by the Animal Care and Use Committee, Yonsei Medical Center, Seoul, Korea.

2. Experimental Design

Groups were divided according to the size of coronal gap between the margin of defect and implant into 1.0-mm, 1.5-mm and 2.0-mm groups. They were also divided according to a healing time after surgery of 8 weeks or 16 weeks.

3. Surgical protocol

Teeth were extracted under general anesthesia under sterile conditions in an operating room using Atropine 0.05mg/kg SQ, xylazine (Rompun[®], Bayer Korea, Seoul, Korea.) 2mg/kg, ketamine hydrochloride (Ketalar[®], Yuhan Co., Seoul, Korea) and 10mg/kg IV. Dogs were placed on a heating pad, intubated, administered 2% enflurane, and monitored with an electrocardiogram. After disinfecting the surgical sites, 2% lidocaine HCl with epinephrine 1:100,000 (Kwangmyung Pharm., Seoul, Korea) was administered by infiltration at the surgical sites. Crevicular incisions were made and all premolars were carefully extracted. Prior to extraction, P2-P4 were

sectioned to avoid tooth fracture. Flaps were sutured with 5-0 resorbable suture material (Polyglactin 910, braided absorbable suture, Ethicon, Johnson & Johnson Int., Edinburgh, U.K.) by the vertical mattress suture technique. On the day of surgery the dogs received 10mg/kg IV of the antibiotic Cefazoline.

The implants (Stage-1[®], Lifecore, USA) were placed after a healing period of 8 weeks using the same surgical conditions as those for tooth extraction. A crestal incision was made to preserve keratinized tissue, and mucoperiosteal flaps were carefully reflected on the buccal and lingual aspects. The edentulous ridge was carefully flattened with a surgical bur and irrigated with sterile saline. Three non-submerged type implants (3.5 mm diameter, 10.0 mm length) were placed on the right side of the mandible (Fig. 1). Implant osteotomy was performed at 800 rpm under chilled saline irrigation and circumferential defects of 1.0 mm, 1.5 mm and 2.0 mm gaps were created surgically with a customized tapered step-drill (Fig. 2). Implant placement was made without tapping to obtain good initial stability.

Flaps were closed with 5-0 resorbable suture material and implants were maintained in the transmucosal status (Fig. 2). Post-operative care was similar as that for tooth extraction. Sutures were removed after 7 to 10 days and a soft diet was provided throughout the study period.

After a period of 8 weeks, the same procedures were repeated on the left side of the mandible. Dogs were sacrificed 8 weeks after surgery. Euthanasia was performed by anesthesia drug overdose. Block sections including segments with implants were preserved and fixed in 10% neutral buffered formalin.

The specimens were dehydrated in ethanol, embedded in methacrylate, and sectioned in the mesio-distal plane using a diamond saw (Exakt®, Apparatebau, Norderstedt, Germany). From each implant site, the central section was reduced to a final thickness of about 20 μ m by microgrinding and polishing with a cutting-grinding device (Exakt®). The sections were stained in hematoxiline-eosine.

4. Histologic analysis

General histological findings were observed with a stereoscope (LEICA MZFLIII, LEICA, WETZLAR, Germany) and microscope. After conventional microscopic examinations, computer-assisted histometric measurements were obtained using an automated image analysis system (Image-Pro Plus®, Media Cybernetics, Silver Spring, M.D.) coupled with a video camera mounted on a light microscope (LEICA DM-LB, LEICA, WETZLAR, Germany). The measuring points were as follows (Fig. 3):

- 1 The distance (C-B) from the most coronal point of osseointegration (C) to the rough surface border (B)
- 1 The distance (C-A) from the most coronal point of osseointegration (C) to the level of the alveolar crest (A)
- 1 The unfilled area within the defect
- 1 Bone-to-implant contact within the two most coronal threads and the two most apical
- 1 Bone density within the two most coronal threads and the two most apical

III. Results

1. Clinical findings

During the postoperative period, healing was uneventful and implants were well-maintained. Only four implants exhibited clinical mobility: one in each of the 1.0-mm and 2.0-mm gap groups at both the 8-week and 16-week period. There were no signs of inflammation observed in the mucosa adjacent to the implants.

2. Histologic findings

1) 8-week groups

The soft tissue around the implants was well organized and the collagen fibers of connective tissue were aligned in directions parallel to the implant.

Implants were in closer contact with thick dense bone than to nearby bone marrow (Figs. 4a, 5, 6a). Many primary and secondary osteons were observed within the coronal defect area (Fig. 4b). Bone marrow contained adipocytes, vessels, collagen fibers and some mononuclear leukocytes (Fig 4c). The larger the initial coronal gap around the implants, the larger the remaining unfilled area of the defects was. A thin rim of newly formed bone apparently covered most of the rough surface in the bone marrow compartment. However, each of the four implants in the 1.0-mm gap group and the 2.0-mm gap group was encapsulated with fibrous tissue.

The newly formed bone present at the lateral border of the cut bony bed appeared to be continuous with the parent bone (Fig. 6a, b).

In the apical portion of the implant, osseointegration was well established with active remodeling. A scallop-like reversal line was observed in the direction from the implant surface to the lateral side. In the bone marrow space, osteoblasts arranged in a row were observed and were followed by newly formed osteoid parallel to the woven bone (Fig. 6c).

2) 16-week groups

The general histologic features of the 16-week groups were similar to the findings of 8-week groups (Fig. 7a, 8, 9) but were more matured, with a higher percentage of lamellar bone (Fig. 7b). Reversal lines demarcating the margin of defects could be identified but not in all samples, and comparable resolution of surgically created defects was observed (Fig. 7c). Less osteoid was seen at the uppermost coronal part of the defect and many primary and secondary osteons surrounded the implants when compared with the 8-week groups. It was difficult to distinguish the pre-existing bone and newly formed bone since they were well integrated with the surrounding bone.

3. Histomorphometric analysis

1) 8-week groups

Data from the analysis are shown in Tables 1 and 2. With increasing size of coronal gap, the distance of C-A, C-B and the unfilled area tended to be greater. In bone-to-implant contact and bone density, both the 1.0-mm and 1.5-mm groups showed a larger percentage of the coronal defect area than the apical side, while the

2.0-mm group showed contrary results.

Table 1. 8-week groups. Distance of C-B (mm), C-A (mm), unfilled area (mm²).

	1.0-mm group	1.5-mm group	2.0-mm group
Distance of C-B (mm)	2.28±0.44	2.34±1.33	3.26±1.61
Distance of C-A (mm)	1.87±0.31	2.58±1.18	2.74±1.22
Unfilled area (mm ²)	1.10±0.23	1.53±0.91	1.31±0.54

Table 2. 8-week groups. BIC (%), bone density (%).

	1.0mm group		1.5mm group		2.0mm group	
	coronal	apical	coronal	apical	coronal	apical
BIC (%)	63.28±5.99	51.85±14.79	55.37±36.80	39.33±24.22	42.37±37.09	55.12±36.87
BD(%)	74.55±2.47	28.13±5.57	47.48±14.58	35.27±19.89	43.62±37.88	50.15±30.46

2) 16-week groups

Data from the analysis are presented in Tables 3 and 4. The distance of C-A, C-B and the unfilled area were similar to or slightly less than the values of 8-week groups, and the unfilled area also showed an increase in value with larger defects. The bone-to-implant contact and bone density were reduced slightly when compared with 8-week groups, but there was no difference among the groups.

Table 3. 16-week groups. Distance of C-B (mm), C-A (mm), unfilled area (mm²).

	1.0mm group	1.5mm group	2.0mm group
Distance of C-B (mm)	2.14±1.10	2.07±0.86	2.49±0.71
Distance of C-A (mm)	1.73±0.24	2.26±1.11	2.56±1.01
Unfilled area (mm ²)	1.08±0.12	1.47±0.77	1.40±0.75

Table 4. 16-week groups. BIC (%), bone density (%).

	1.0mm group		1.5mm group		2.0mm group	
	coronal	apical	coronal	apical	coronal	apical
BIC (%)	48.56±37.17	43.32±34.15	48.02±26.61	47.19±6.74	40.39±13.66	58.41±28.18
BD(%)	48.43±30.74	48.66±19.42	49.03±19.19	41.89±7.87	43.14±24.69	43.73±26.81

IV. Discussion

The immediate implant technique was introduced to allow patients to have shorter rehabilitation periods and researches were carried out to explore the theoretical background. Many methods have been introduced to overcome the coronal gap associated with immediate implants (Becker 1990, Becker 1994, Caudill 1991, Werbitt 1992, Gotfredsen 1993, Lang 1994, Kohal 1998, Alliot 1999, Cornelini 2000, Schwartz-Arad 2000, Goldstein 2002, Botticelli 2004, Cangini 2005), but the critical size of defect allowing spontaneous healing has yet to be determined. In addition, the previous studies were mainly on submerged type implants whereas studies on non-submerged type implants were rare. Therefore, if this critical defect size could be determined, the treatment procedure could be simplified and the treatment period shortened, benefiting both the patient and practitioner.

In the present study, non-submerged type implants with resorbable blast media (RBM) surface were used. In order to obtain RBM surface, a machined titanium implant was blasted with calcium phosphate ceramic and then passivated to completely remove the residual media. The surface roughness ranged from 3.09 ± 0.38 microns, and micro-pit diameter ranged from 5 to 10 microns.

Davies (1998) suggested that there are two different phenomena by which bone can become juxtaposed to an implant surface: distance and contact osteogenesis. Distance osteogenesis is that in which new bone is formed on the surfaces of bone in the peri-implant site through appositional growth and contact osteogenesis or

osteoconduction is that in which de novo bone formation occurs directly on the implant surface. Davies suggested that an implant with a roughened surface, as opposed to an implant with a smooth surface, may 'promote osteoconduction by both increasing available surface area for fibrin attachment and by providing surface features with which fibrin could become entangled'. In the present study, contact osteogenesis was observed on the rough surface of the apical portion (Figure 4C). Bone remodeling was continuously taking place around the implant, and wavy reversal lines were formed with bone formation from the rough surface of implants to the lateral wall. Appositional bone formation was observed along the lateral and apical wall of the coronal defect and this demonstrates that the cells derived from the pre-existing defect wall filled new bone.

Botticelli et al. (2003a) studied the healing of marginal defects adjacent to submerged implants for healing periods of one month and two months. They suggested that the healing of a wide marginal defect around an implant is characterized by appositional bone growth from the lateral and apical bone walls of the defect, and that bone-to-implant contact is first established in the apical portion of the gap. They reported this new bone tissue in the coronal direction to be continuous, with a dense, non-mineralized 'implant attached' soft tissue, which also became mineralized over time and hence, the height of the zone of bone-to-implant contact was increased. Injury to the bone marrow caused by the ostectomy procedure initiated a process of wound healing which resulted in hard tissue formation at the implant surface. The authors of that study assumed that a zone of dense connective tissue

lateral to the implant surface was under-mineralized and could be replaced by mineralized bone.

In a submerged type implant, the blood clot is well retained under the intact periosteum and can resist a certain amount of connective tissue integration. In case of natural teeth, downgrowth of epithelium into the periodontal lesion has most likely occurred during healing following flap surgery, and reduces the chance of attachment gain (Moskow 1964, Caton 1980, Proye & Polson 1982). In a non-submerged type implant with coronal defect, an epithelial downgrowth was considered to be postulated when healing of natural teeth, giving less chance for osseointegration. However, in the present study, appositional bone growth took place at the base of the defect, allowing for a certain amount of bone fill and osseointegration.

Cortical bone was an important portion for the initial stability of implantation, but in this study model, the presence of a coronal defect made it difficult to gain initial stability. In particular, the wider the coronal gap, the more vibration upon drilling there was, and the widened drilling socket led to instability of the implant. This micro-movement during the early healing phase attributed to the failure of osseointegration. In addition, the unstable apical stop was responsible for the varying level of installation depth and therefore the measuring point was unstable. Bone quality was highly varied among the individuals and this was especially noticed in dog no. 3. The four implants placed in this dog were encapsulated with fibrous tissue and therefore were not included in the histometric analysis. Since the number of individuals was

small, statistical analysis was not performed and hence, only the means and the standard deviations were listed in this study.

One of the objectives in this study was to develop a standardized experimental model of the extraction socket. However, this model may have some differences from the real extraction socket (Cardaropoli 2005). First, the presence of residual periodontal ligament (PDL) could enhance healing capacity through PDL cells which are not the only source of osteoblast that occur in the provisional matrix, but bone forming cells may also enter into the wound from the bone marrow lateral to the socket wall (McCulloch & Melcher 1983, Lin et al. 1994). In contrast, Cardaropoli et al. (2005) stated that sockets that following tooth removal had their PDL tissue removed exhibited similar features of healing after 3 months as sockets which had the PDL retained. In addition, they stated that the tissues present in an extraction site appeared to be more mature than those present in a surgically created defect of similar dimension. The cortical wall around the socket could initially enhance stability around the implants. In addition, using instruments such as osteotomes and spreaders allowed bone compaction, which also enhances initial stability. Nevertheless, this experimental model is considered competent in terms of morphological reproduction and standardization of the original extraction socket.

In the histometric analysis, we assessed the distance between the most coronal point of osseointegration and the borderline between the polished and rough surface (A-B), and measured the unfilled area within the defect. As predicted, the coronal gap healed in a manner where the measured value increased as the size of the gap

increased. However, this change was very small. The healing pattern according to healing period showed a difference in maturity of the surrounding bone and activity of the osteoblast, but measured values were similar.

The BIC between the two threads of the implant within the defect and the BIC between the two threads of the apical part were measured. This was done to compare the amount of osseointegration in the defect area and the parent bone area. In addition, bone density was measured in the same areas. BIC and bone density values in the defect area were higher than the apical area in the 8-week group but similar in the 16-week group. This may be due to good integration of the parent bone with the new bone as the bone matured with time.

V. Conclusion

It can be concluded that the remaining defect, small enough to be clinically neglected, irrespective of gap size within 2 mm, does not need any kind of regenerating procedures.

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Figure Legends

Figure 1. Clinical photograph representing the experimental design. From the left, 1.0-mm, 1.5-mm and 2.0-mm gaps were prepared, respectively.

Figure 2. Customized tapered step drill. From the left, a 5.5-mm diameter drill for the 1.0-mm gap defect, a 6.5-mm diameter drill for the 1.5-mm gap defect and a 7.5-mm diameter drill for the 2.0-mm gap defect are represented, respectively.

Figure 3. Schematic drawing illustrating measurement landmarks. **G**: gap; 1.0 mm, 1.5 mm, 2.0 mm, **A**: the level of alveolar crest, **B**: the border of rough surface, **C**: the most coronal point of osseointegration.

Figure 4. Histologic view of the 1.0-mm gap group at 8 weeks.

- a.** Overall view. Comparable resolution of surgically created defects is observed (magnification X8).
- b.** Many primary and secondary osteons are observed within the coronal defect area (magnification X100). Star: osteon.
- c.** A thin rim of newly formed bone covers most of the rough surface in the bone marrow compartment (magnification X100).

Figure 5. Histologic view of the 1.5-mm gap group at 8 weeks. Implants are in closer

contact with thick, dense bone as compared to nearby bone marrow (magnification X8).

Figure 6. Histologic view of the 2.0-mm gap group after an 8-week healing period.

a. Overall view (magnification X8).

b. Osteoblasts are arranged in a row around the implant surface followed by newly formed osteoid beside woven bone and parallel to osteoblasts in the coronal defect area (Distance osteogenesis). Arrow: osteocyte, Arrow head: osteoblast, Star: osteoid. (magnification X200).

c. In the apical area, bone apposition takes place from the surface of the implant in the lateral direction (Contact osteogenesis). Arrow head: osteoblast, Star: osteoid. (magnification X200).

Figure 7. Histologic view of the 1.0-mm gap group after a 16-week healing period.

a. overall view (magnification 8x).

b. The woven bone within the thread is replaced by mature lamellar bone and well organized osteons are observed (magnification X200). LB: lamellar bone, Arrow head: osteocyte.

c. Reversal lines demarcating the margin of defects can be identified (magnification X100).. Arrow head: reversal line.

Figure 8. Histologic view of the 1.5-mm gap group after a 16-week healing period

(magnification X8).

Figure 9. Histologic view of the 2.0-mm gap group after a 16-week healing period
(magnification X8).

Figures I

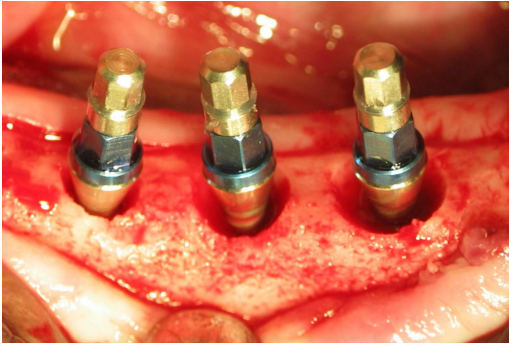


Figure 1.



Figure 2.

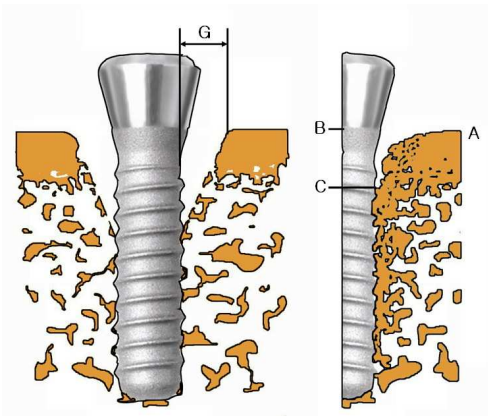


Figure 3.

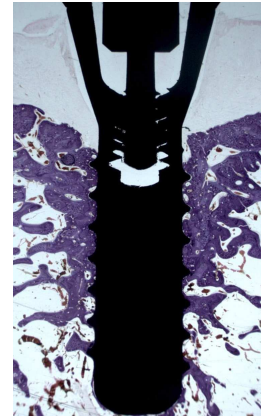


Figure 4a.

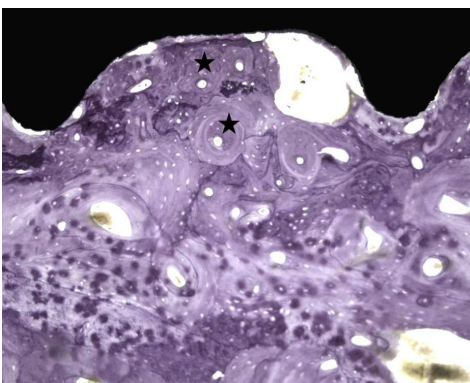


Figure 4b.

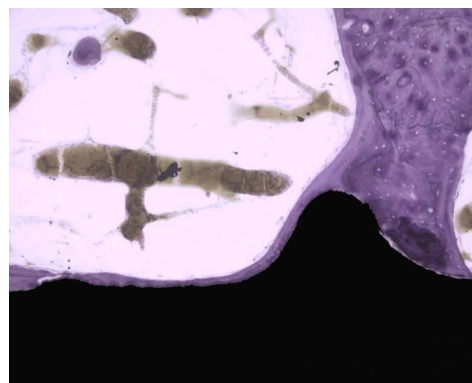


Figure 4c.

Figures II



Figure 5.

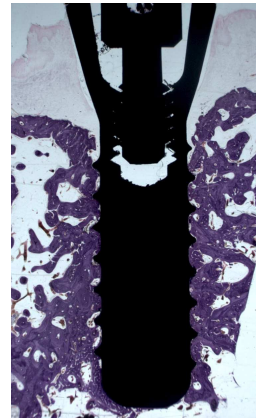


Figure 6a.

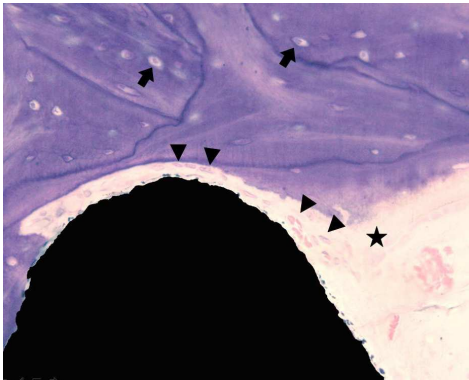


Figure 6b.

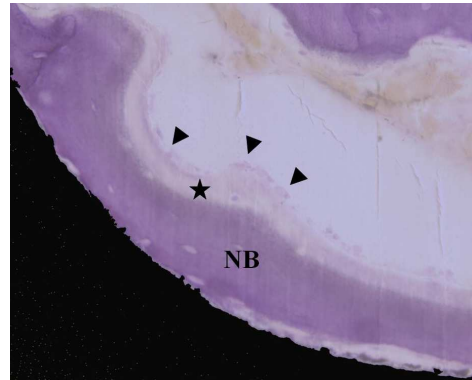


Figure 6c.

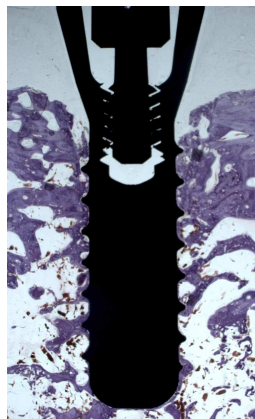


Figure 7a.

Figures III

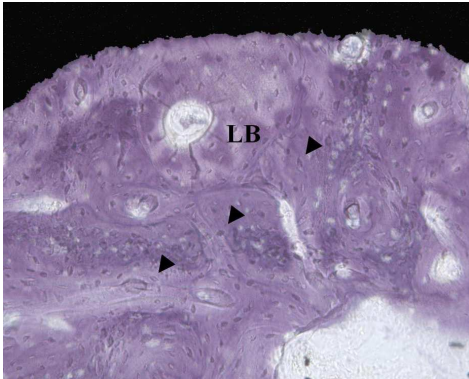


Figure 7b.

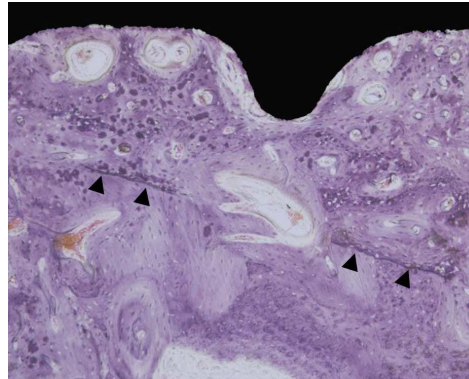


Figure 7c.



Figure 8.

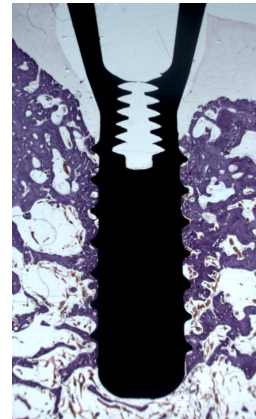


Figure 9.

국문요약

성견에서 비매물형 임프란트 주변에 수술적으로 형성한

환상 결손부의 치유에 대한 조직 계측학적 연구

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정 의 원

상실된 치아의 수복에 있어서, 임프란트가 기존의 전통적인 보철 수복을 대체하고 있다. 좀 더 빠르고 간편한 임프란트 치료를 위해 발치 즉시 식립하는 임프란트 술식이 소개 되었고, 그 이론적 배경이 되는 많은 임상 실험 및 동물 실험들이 보고 되어 왔다. 이 실험의 목적은 비매물형, 거친 표면 임프란트 주변에 수술적으로 다양한 크기의 환상형 결손부를 형성하고 자연 치유되는 양상을, 8주와 16주에 나누어 비교 분석하는 것이다.

총 4마리의 수컷 잡견에서, 모든 하악 소구치를 발거하고 8주동안 치유시킨 후, 비매물형 임프란트를 식립하고 치관부에 환상형 결손부를 주문 제작한 췌기형 드릴을 이용하여 수술적으로 형성하였다. 결손부의 폭에 따라 다음과 같이 군을 나누었다: 1.0mm, 1.5mm, 2.0mm. 처음에는 하악 우측에 각각을 식립하고, 8주 치유 후 좌측에 각각을 동일한 방법으로 시행하였다. 다시 8주의 치유기간 후에 희생하여 조직 절편을 얻었다. 이를 조직학 및 조직계측학적으로 관찰하였다.

실험 결과, 치관부 결손폭이 증가함에 따라, 채워지지 않은 면적이 넓어지는

양상을 보였다. 골-임프란트 접촉률과 골밀도에 있어서, 8주군 중 2.0mm 군만 제외하고, 1.0mm 군과 1.5mm 군 모두 근단부 보다 치관부에서 더 큰 계측치를 보였다. 16주군에서의 일반적인 조직학적인 소견은 8주군과 비슷했지만, 좀 더 성숙한 양상을 보였다. 모든 군에서 상당한 양의 신생골과 골유착이 관찰되었다.

이상의 결과를 통해, 2mm 이내의 치관부 결손부에서는, 특별한 골재생 술식 없이도 임상적으로 무시할 만큼 작은 잔존 결손부만을 남기고 자연 치유될 수 있다는 결론을 얻었다.

핵심되는 말: 임계 크기 결손부, 쉼기형 드릴, 치관부 결손부, 비매몰형 임프란트