The Biocompatibility and effects of Hydroxyapatite / Chitosan Block scaffold in One-wall Intrabony Defect of Beagle Dogs

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오늘이 있기까지 변함없는 믿음과 사랑으로 이해해 주시며, 물심양면으로 후원해 주신 어머님과 장인, 장모님께 감사의 마음을 드립니다.

모든 분들께 진심으로 감사 드립니다.

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Purpose of this study is to evaluate biocompatibility following implantation of Hydroxyapatite/chitosan block scaffold and HA/β-TCP particle on the regeneration of one-wall intrabony defects in beagle dogs and compare periodontal regeneration between block and particle graft. The surgical control groups received a flap operation only, while experimental groups were treated with the Hydroxyapatite/ chitosan block scaffold and HA/β-TCP particle. In surgical control group. Mean values were bone regeneration 0.33mm, cementum regeneration 0.80mm, connective tissue attachment 0.97mm, epithelium 1.54mm. In HA/β-TCP particle bone graft group. Mean values were bone regeneration 0.74mm, cementum regeneration 1.24mm, connective tissue attachment 0.60mm, epithelium 1.22mm. In HA/Chitosan block scaffold group. mean values were bone regeneration 0.42mm, cementurm regeneration 1.33mm, connective tissue attachment 0.78mm, epithelium 1.22mm.

In the aspect of biocompatibility, hydroxyapatite/chitosan block scaffold showed little inflammatory reaction, it showed good biocompatibility but was resorbed too rapidly for periodontal regeneration, bone regeneration to be enhanced.

In the aspect of periodontal regeneration, hydroxyapatite/chitosan block scaffold showed good cementum regeneration due to effect of chitosan but less effective in bone regeneration due to rapid resorption. HA/β-TCP particle showed good bone regeneration due to its slow resorption and good space maintenance effect but cementum regeneration was not effective as hydroxyapatite/chitosan block scaffold.

For evaluation of difference between block and particle type graft in periodontal regeneration. in this experiment, it was not possible to draw conclusion due to difference in its chemical difference.

KEY WORDS: periodontal regeneration, Hydroxyapatite/ β-TCP,

Hydroxyapatite/chitosan block bone

The Biocompatibility and effects of Hydroxyapatite/Chitosan Block scaffold in One-wall Intrabony Defect of Beagle Dogs

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I. INTRODUCTION

The ultimate goal of periodontal therapy for destructive periodontal disease is the regeneration of the attachment apparatus. In addition to the formation of new cementum and new alveolar bone on the surface of tissue damaged by periodontitis, regeneration requires a restructuring of the periodontal tissue following the functional insertion and arrangement of the new periodontal ligament fibers. Many procedures for regeneration, including guided tissue regeneration, bone grafts, and the use of a growth factor have been developed, but all have their limitations (Selvig et al., 1993;

Park et al., 2001). So recently tissue engineering strategies are tried to be applied for periodontal regeneration.

Bone grafts were widely investigated for periodontal regeneration. Autograft (Kim et al., 2005), allogenic material (Kim et al., 1998c), alloplastic materials like, calcium sulfate(Kim et al., 1998d, Kim et al., 2006b) , bioactive glass (Park et al., 2001), calcium phosphate (Lee et al., 2003), calcium carbonate (Kim et al., 2006a), xenogenic materials (Camelo et al., 1998; Richardson et al., 1999) has been widely studied and showed regeneration of periodontal attachment.

Both the application of bone grafts, synthetic implant materials or inorganic bone graft materials in combination with GTR have been reported to favor the formation of bone (Dahlin et al., 1991; Alberius et al., 1992). Different types of biocompatible materials such as hydroxyapatites, calcium phosphates and inorganic bone graft materials have been used alone or in combination with GTR with varying results in bone formation (Song et al., 2005; Song et al., 2007; Kim et al., 2005).

For tissue engineering, scaffold provides a solid framework for cell growth and differentiation allowing cell attachment and migration. Scaffolds should be biocompatible, be absorbable with rates of resorption comparable to rate of formation of new bone, provide a platform on which bone cells can proliferate, have sufficient

mechanical stability, and be easy to manufacture, sterilize, and handle in the operating room (Logeart-Avramoglou et al, 2005).

The scaffold should also have sufficient porosity to accommodate osteoblasts or osteoprogenitor cells, periodontal ligament cell and support cell proliferation and differentiation, and to enhance bone tissue formation , cementum and new attachment. High interconnectivity between pores are also desirable for uniform cell seeding and distribution and the diffusion of nutrients to and metabolites out from the cell/scaffold constructs (Liu X et al., 2004).

Various scaffold materials have been used with varying success to generate tissue-engineered bone formation *in vitro*. Ishaug et al. investigated bone formation *in vitro* by culturing stromal osteoblasts in a three dimensional, biodegradable poly (lactic-co-glycolic acid) foam (Ishaug et al., 1997).

Chitosan has been reported to enhance the healing of injured connective tissue (Muzzarelli et al., 1988). Recently, a tissue engineering strategy has been suggested as a possible alternative to conventional regenerative therapy. Chitin is a natural polymer of N-acetylglucosamine, and is a component of the exoskeleton of a great number of organisms such as shells and cuticles of arthropods including crustaceans and insects (Cabib, 1987). Chitosan has excellent potential as a structural base

material for a variety of engineered tissue system (Madihally et al., 1999). Chitosan has been reported to enhance peridontal tissue regeneration (Madihally et al., 1999; Mukherjee et al., 2003; Park et al., 2003). And also effective in membrane type (Min et al., 2005; Yeo et al., 2005; Han et al., 2007; Chae et al., 2007).

However, several inherent disadvantages have been observed with chitosan used as scaffold materials including weak structural integrity, variable degradation rates. chitosan has a low physical property leading to an improper use in the areas where it receives a lot of force.

Hydroxyapatite is widely investigated material for bone regeneration usually in particle type. As a block type, hydroxyapatite itself is too brittle to handle.

Hydroxyapatite-chitosan block scaffold is manufactured by combination of chitosan and hydroxyapatite to enhance physical properties as space provision and handling.

The aim of this study was to evaluate biocompatibility of a Hydroxyapatite/ Chitosan Block scaffold applied to preclinical one wall periodontal defects surgically created in beagle dogs and compare results with particulate type bone graft material to evaluate the effect of block type scaffold.

Ⅱ. MATERIAL AND METHODS

A. Materials

1. Animals

A total of six male beagle dogs, each weighing about 15 kg, were used in this study. The animals had intact dentition and a healthy periodontium. Animal selection and management, surgical protocol, and preparation followed routines approved by the Institutional Animal Care and Use Committee, Yonsei Medical Center, Seoul, Korea. The animals were fed a soft diet throughout study, in order to reduce chances of mechanical interference with the healing process during food intake.

2. Materials

1) Hydroxyapatite/chitosan block scaffold

Hydroxyapatite/chitosan block scaffold was manufactured by freeze-dried method. Chitosan solution was prepared by dissolving chitosan (2wt%) in 0.2 M acetic solution. Hydroxyapatite/chitosan solution was made by dissolving hydroxyapatite in

the chitosan solution (Chitosan : hydroxyapatites = 7:3). Hydroxyapatite/chitosan solution was poured in Φ 6 mm × 12 mm teflon mold. Above 5 hours, it was refrigerated in −70 ℃. It was freeze-dried under 6 mTorr by freezing dehydrator, above 3 days. The residual acetic acid was neutralized by 1 M NaOH solution, and then washed with the distilled water (above 3 times) and it was soaked in bovine serum albumin. The solvent was completely dried by freeze dry, during 3 days. Hydroxyapatite/chitosan hybrid scaffold was manufactured.

2) HA/β-TCP particle bone graft

HA/TCP particle bone graft[††] is a newly developed alloplastic material containing 70% HA and 30% β-TCP. The interconnected porous scaffold is comprised from biocompatible HA, while the surface is coated with bioresorbable β-TCP. Particle size is 0.5–1.0 mm (Kim et al., 2007).

[††] Osteon®, Dentium. Republic of Korea

B. Experimental Procedures

1. Surgical procedures

Six male beagle dogs were used. 4X4 mm one-wall intrabony periodontal defects were surgically created bilaterally at the distal sides of the mandibular second premolars and mesial sides of the fourth premolars under general anesthesia with sterile conditions in an operating room using atropine 0.05mg/kg SQ, xylazine (Rompuns, Bayer Korea,Seoul, Korea) 2mg/kg, ketamine hydrochloride (Ketalars, 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% lidocane HCl with epinephrine 1 : 100,000 (Kwangmyung Pharm., Seoul, Korea) was administered by infiltration at the surgical sites. Prepared defects were randomly assigned an experimental condition and treated as follows. Flaps were sutured with 5-0 resorbable suture material (Polyglactin910, braided absorbable suture, Ethicon, Johnson & Johnson Int., Edinburgh, UK). On the day of surgery, the dogs received 10mg/kg IV of the antibiotic cefazoline.

The dogs were sacrificed at 8 weeks after the experimental surgery.

2. Experimental group

1) Surgical control

created defects receive nothing, flaps were repositioned.

2) HA/β-TCP particle bone graft

Bone graft particles were hydrated with sterile saline and applied to defect.

3) Hydroxyapatite/Chitosan Block scaffold

Blocks were shaped with #15 scalpel and scissors to fit defect and applied to defect.

3. Evaluation method

1) Clinical Observation

Following surgical procedure, surgical sites were examined if there were any inflammatory reactions or uneventful healing.

2) Histologic analysis

Tissue blocks, which included teeth, bone, and tissue, were removed, rinsed in saline, then fixed in 10% buffered formalin for 10 days. After being rinsed in water, the block section were decalcified in 5 % formic acid for 14 days, and embedded in paraffin. Serial sections, 5 μm thick, were prepared at intervals of 80 μm. The four

most central sections from each block were stained with hematoxylin/eosin (H-E) and examined using a light microscope. The most central section from each block was selected to compare histologic findings between groups. Computer-assisted histometric measurements were obtained using an automated image analysis system[††] coupled with a video camera on a light microscope[‡‡]. Sections were examined at 20x magnification.

3) Histometric Analysis (Fig 1.)

For the histometric analysis, the cementoenamel junction (CEJ) and the notch were used as reference points. The alveolar crest (AC) point was gained by subtracting the distance between the AC and CEJ from the CEJ measured at the experiment. The histometric parameters were as follows:

· Defect height (DH): the distance from the alveolar crest to the base of the reference notch (BN).

· Junctional epithelium (JE) migration: the distance from the alveolar crest to the apical extension of the JE.

· Connective tissue (CT) adhesion: the distance from the apical extension of the junctional epithelium to the coronal extension of cementum regeneration.

[††] Image-Pro Plus®, Media Cybernetics, Silver Spring, MD, U.S.A

[‡‡] Olympus BX50, Olympus Optical Co., Tokyo, Japan

· New cementum (NC) regeneration: the distance from the base of the reference notch to the coronal extension of newly formed cementum on the root surface.

· New alveolar bone regeneration (NB): the distance from the base of the reference notch to the coronal extension of the newly formed alveolar bone along the root surface.

Ⅲ. RESULT

A. Clinical observations

Surgical procedures were uneventful and without complication in all dogs. Wound closure was successfully maintained throughout the experiment for all defects. Healing process was generally uneventful.

B. Histologic findings

1) Surgical control group

The apical migration of junctional epithelium was greatest. In some slides, a little amount of new cementum and bone had formed in notch region along the root surface. There was little or no sign of inflammatory cell infiltration. (Fig.2)

2) HA/β-TCP particle bone graft group

The apical migration was greater than HA/chitosan block scaffold group, bone regeneration was greatest and the coronal portion of regenerated bone was relatively distant from root surface. Cementum regeneration was observed which was greater

than surgical control group. There was little or no sign of inflammatory cell infiltration.

Remnants of bone graft particle were observed as hollow pores in decalcified histologic sections (Fig. 3,4).

3) Hydroxyapatite/Chitosan Block scaffold

Any remnants of Hydroxyapatite/chitosan block scaffold were not observed and little inflammatory cells were observed. Epithelial apical migration was least. Cementum regeneration were greatest among 3 groups. A little amount of bone was regenerated. (Fig 5,6)

In all groups, Any root resorption or ankyosis were observed. Under limited experimental condition, statistical analysis was not possible.

C. Histometric analysis

In surgical control group, Mean values were bone regeneration 0.33mm, cementum regeneration 0.80mm, connective tissue attachment 0.97mm, epithelium 1.54mm.

In HA/β-TCP particle bone graft group, Mean values were bone regeneration 0.74mm, cementum regeneration 1.24mm, connective tissue attachment 0.60mm, epithelium 1.22mm.

In Hydroxyapatite/Chitosan Block scaffold. mean values were bone regeneration 0.42mm, cementurm regeneration 1.33mm, connective tissue attachment 0.78mm, epithelium 1.22mm (Table 1).

Table 1. **Comparison between experimental groups (mean ± SE) (N=3)**

	Surgical control	HA/β-TCP particle	HA/Chitosan block
Defect height	3.56±0.50 mm	4.01±0.04 mm	3.54±0.15 mm
Junctional epithelium	1.55±0.12 mm	1.49±0.18 mm	1.22±0.72 mm
Connective tissue	0.97±0.35 mm	0.60±0.19 mm	0.78±0.99 mm
New Bone	0.33±0.34 mm	0.74±0.27 mm	0.42±0.00 mm
New cementum	0.80±0.41 mm	1.24±0.12 mm	1.33±0.53 mm

IV. DISCUSSION

The ultimate goal of periodontal therapy is to regenerate the supporting tissue that was destroyed. Although, various procedures such as guide tissue regeneration (Kim et al., 1996; Kim et al. 1998a; Moon et al., 1996; Trombelli et al., 1997), autografts (Schallhorn, 1972), other bone grafts (Mellonig et al., 1976; Mellonig, 1984; Kim et al., 1998a; Kim et al., 1998b), and the application of growth factor (Lynch et al., 1989; Becked et al., 1992; Wikesjö et al., 1999; Choi et al., 2002) have been already developed and used to help regeneration, each has its shortcomings.

Bone graft for periodontal regeneration has been widely investigated as graft itself, space provider and clot stabilizer for GTR. As a graft material, material of choice is autograft, but some limitations like donor site limitation, limited volume exist. Allografts and alloplasts have been used as alternatives, but in histologic studies some of these materials just function as biocompatible filler and encapsulated by connective tissue (Lee et al., 2000).

Based on the results of Wikesjo et al's study, which found that naturally or ligature induced loss of attachment and surgically induced loss of attachment showed no difference in healing (Wikesjö., 1991). In one-wall defect model, Moon et al. (1996) could not discern cementum regeneration until week 6 in a dog intra-bony

defect model using light microscopy suggesting that wound maturation must progress over several weeks until cementum formation may be appreciable by light microscopy. Moreover, Choi et al. (2002) observed no additional bone and cementum formation between an 8-and 24-week healing interval for sham-surgery controls in a dog intra-bony defect model suggesting longer observation intervals may not be necessary to capture the osteogenic potential and cementogenesis.

According to Kim et al (Kim et al., 2004), One-, 2-, and 3-wall intrabony periodontal defects were surgically produced at the proximal aspect of mandibular premolars in either right or left jaw quadrants in six beagle dogs. After 8 weeks, Bone and cementum regeneration was positively correlated to the number of bone walls limiting the intrabony periodontal defects. the number of bone walls is a critical factor determining treatment outcomes in intrabony periodontal defects. One- wall intrabony defect appear to be reproducible models to evaluate candidate technologies for periodontal regeneration.

Recently tissue engineering strategies are being tried to be applied into periodontal regenerative procedures. The scaffold for bone regeneration provides a solid framework for cell growth and differentiation at a local site, allowing cell attachment and migration. The scaffold may be implanted alone to induce host cell migration to the wound site and initiate tissue regeneration, or it may serve as a carrier for cells for the purpose of cell replacement therapy (Sharma B et al., 2004). Scaffolds for bone

regeneration should be biocompatible, be absorbable with rates of resorption comparable to rate of formation of new bone, provide a platform on which bone cells can proliferate, have sufficient mechanical stability, and be easy to manufacture, sterilize, and handle in the operating room (Logeart-Avramoglou D et al., 2005). The scaffold should also have sufficient porosity to accommodate osteoblasts or osteoprogenitor cells, to support cell proliferation and differentiation, and to enhance bone tissue formation. High interconnectivity between pores are also desirable for uniform cell seeding and distribution and the diffusion of nutrients to and metabolites out from the cell/scaffold constructs (Liu X et al., 2004).

Naturally derived or synthetic polymers are materials used commonly for bone tissue engineering scaffolds. Polymers have great design flexibility because the composition and structure can be tailored to specific needs (Liu x et al., 2004). Collagen, chitosan, and hyaluronic acid are some natural polymers that have been used in bone tissue engineering applications. Chitosan has excellent potential as a structural base material for a variety of engineered tissue system (Madihally et al., 1999). Chitosan has been reported to enhance peridontal tissue regeneration (Madihally et al., 1999; Mukherjee et al., 2003; Park et al., 2003). For application of chitosan for periodontal therapy, many researches were done *in vitro*, *in vivo*. in various forms i.e. mediator type, graft type, membrane type.

In *in vitro* studies, chitosan as mediator i.e. solution type has been reported to

induce proliferation of periodontal ligament cells, osteogenic cells and induce more bone formation (Pang et al., 2005) .

In *in vivo* studies, As a mediator type i.e. solution type chitosan. It induces bone regeneration and cementum regeneration in rat calvarial defect model (Kim et al., 2003; Jung et al., 2000; Jung et al., 2007), dog 1-wall defect model (Park et al., 2003).

As bone graft, chitosan has been tested in modified form with hydroxyapatite and calcium phosphate in order to enhance mechanical properties in dog 1-wall defect model (Kim et al., 2007). Bone regeneration (1.20±0.40mm) was more than surgical control group but less effective than mediator type(2.43±0.44mm). the same was for the cementum regeneration (graft type 1.46±1.58mm, mediator type 3.46±0.78mm) (Park et al., 2003).

As membrane. Chitosan alone fabricated in membrane form or chitosan blended with antibiotics and tested in rat calvarial model and dog 1-wall defect (Chae et al., 2005; Min et al., 2005; Yeo et al., 2005; Han et al., 2007; Chae et al., 2007). as a barrier membrane in guided tissue regeneration concept. Chitosan membrane functions acceptably. But space maintenance property appears inferior to e-PTFE membrane.

Scaffolds for bone formation may contain inorganic compounds to enhance proliferation. Examples include hydroxyapatite, calcium phosphate cements, metals, and calcium sulfate (Sharma B et al., 2004).

Hydroxyapatite is highly biocompatible and serves as the scaffold for the osteogenic precursor cells, promoting their differentiation into osteoblasts (Marei MK et al., 2003, 2005). However, there are some disadvantages with these materials. Particulate hydroxyapatite lacks shape and cohesive strength; therefore, it tends to be dislodged and to migrate under externally applied forces during the healing period (Letic-Gavrilovic A et al., 2003).

For periodontal regeneration, Space provision is one of key factor for successful result. Some researches were conducted to compare effectiveness of block type graft and particle type graft type in guided bone regeneration model. But few studies were done in periodontal defect. So in general agreement, Block type graft seems to better in space provision effect.

The purpose to fabricate Hydroxyapatite/Chitosan Block scaffold is combination of cementum regeneration of chitosan, high biocompatibility of hydroxyapatite and enhancement of space provision by block type.

The aim of this study was to evaluate the biocompatibility of Hydroxyapatite/ Chitosan Block scaffold into 1- wall intrabony defects in the beagle dogs and evaluate effect of block type graft by comparison with particle type graft.

At 8 weeks after implantation of Hydroxyapatite/Chitosan Block scaffold. Histologic section did not show any inflammatory infiltrates, any residual remnants of block scaffold. In histometric analysis, enhancement of cementum regeneration and

bone regeneration were observed. From these results, Hydroxyapatite/Chitosan Block scaffold showed good biocompatibility. For ideal scaffold for bone regeneration, Resorption rate should be similar to formation of bone. Although. Shirakata et al., 2002 mentioned that faster resorption of the material would be desirable to avoid the risk of any infection of the residual material during periodontal healing. the resorption rate of Hydroxyapatite/Chitosan Block scaffold was to high. prolonged space provision effect of block type was not observed.

In the aspect of bone regeneration, surgical control group, HA/β-TCP particle group and HA/chitosan block group showed 0.33±0.34mm, 0.74±0.27mm, 0.42±0.00mm. HA/β-TCP particle group showed the most bone regeneration. according to Sigurdsson et al. in periodontal regeneration by guide tissue regeneration. coronal thinning of new bone was apparent. (Sigurdsson et al., 1994) in HA/chitosan block group and surgical control group, coronal thinning of new bone was observed.

In cementum regeneration, surgical control group, HA/β-TCP particle group and HA/chitosan block group showed 0.80±0.41mm, 1.24±0.12mm, 1.33±0.53mm. HA/chitosan block group and HA/β-TCP particle group showed similar result, more than surgical control group.

In apical migration of junctional epithelium. surgical control group, HA/β-TCP particle group and HA/chitosan block group showed 1.55±0.12mm, 1.49±0.18mm, 1.22±0.72mm. Block type graft showed the least migration. Surgical control and

HA/β-TCP particle group showed similar results.

In connective tissue adhesion, surgical control group, HA/β-TCP particle group and HA/chitosan block group showed 0.97±0.35mm, 0.60±0.19mm, 0.78±0.99mm. surgical control was the most. No root resorption or ankylosis was observed. In the groups of hydroxyapatite/chitosan block scaffold, in a previous study as graft type (Kim et al., 2007), Bone regeneration was similar to surgical control but cementum regeneration was more than surgical control. Any remnants of hydroxyapatite/ chitosan block scaffold were not observed at 8 weeks specimens. hydroxyapatite/ chitosan block scaffold has not functioned as space provider long enough to promote bone regeneration. But chitosan has effected to enhance cementum regeneration. More recession was observed than surgical control.

In the groups of HA/β-TCP particle group. Bone regeneration and cementum regeneration were more than surgical control group. And remnants were observed at 8 weeks specimens. HA/β-TCP particle remains at 8 weeks, functions as space provider long enough to promote bone regeneration and this maintained space may contribute cementum regeneration but cementum regeneration was less than hydroxyapatite/ chitosan block scaffold group. Recession was similar to surgical control group.

hydroxyapatite/chitosan block scaffold functions initially to enhance cementum regeneration due to its chitosan portion but block was absorbed too soon for bone to grow in. so more recession was followed.

At initial healing period, chitosan may enhance cementum regeneration and bone regeneration, but in late healing period the block fails to maintain its space so a little bone regeneration enhancement was observed.

HA/β-TCP particle maintained its space long enough for bone to grow in. so bone regeneration was more than surgical control and hydroxyapatite/chitosan block scaffold. But less cementum regeneration was observed than hydroxyapatite/ chitosan block scaffold. Recession was little.

HA/β-TCP particle was superior at space maintenance so more bone regeneration was observed.

The difference in periodontal regenerative effect between block and particle type graft is difficult to draw conclusion in this experimental result.

V. CONCLUSION

Hydroxyapatite/chitosan block scaffold showed good biocompatibility and cementum regeneration due to effect of chitosan. but less effective in bone regeneration due to rapid resorption. Some modification is needed for scaffold to reduce reduction rate in order to be used as scaffold for periodontal regeneration.

For evaluation of difference between block and particle type graft in periodontal regeneration, in this experiment, it was not possible to draw conclusion due to difference in its chemical difference.

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FIGURE LEGENDS

Figure 1. A schematic diagram depicting the experimental design, the landmarks and the parameters used in histometric analysis.

Figure 2. surgical control (X 20)

Figure 3. HA/β-TCP particle graft (X 20)

Figure 4. HA/β-TCP particle graft (X 40)

Figure 5. HA/Chitosan block scaffold (X 20)

Figure 6. HA/Chitosan block scaffold (X 40)

FIGURES

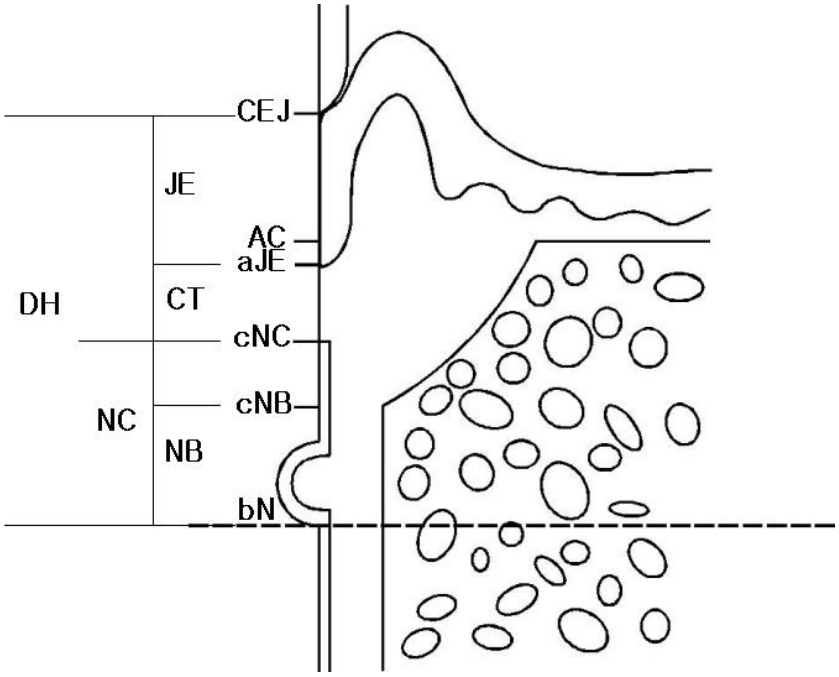
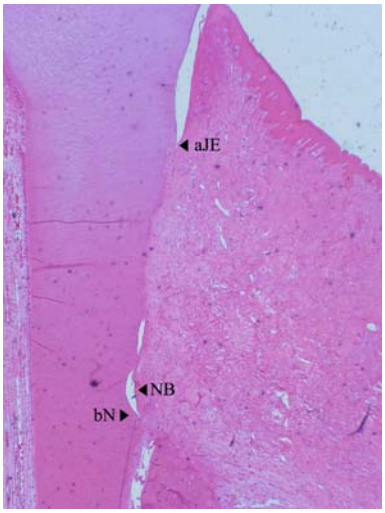


Figure 1. A schematic diagram depicting the experimental design, the landmarks and the parameters used in histometric analysis.

DH: defect height JE: junctional epithelium migration

CT: connective tissue adhesion NC: new cementum regeneration

NB: new bone regeneration



aJE : apical extent of junctional epithelium,

bN : the base of the reference notch

CT: connective tissue NB: new bone

Fig 2. surgical control (X 20)

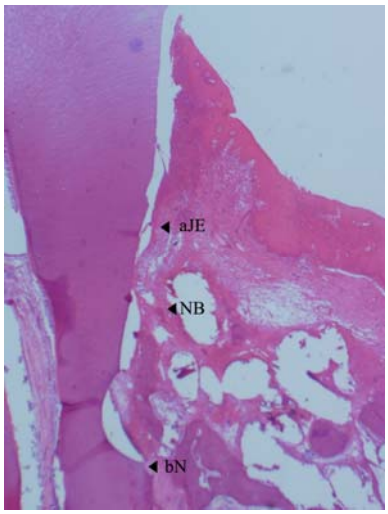


Fig 3. HA/β-TCP particle graft(X 20)

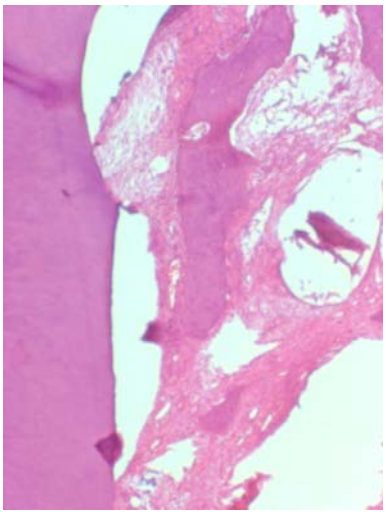
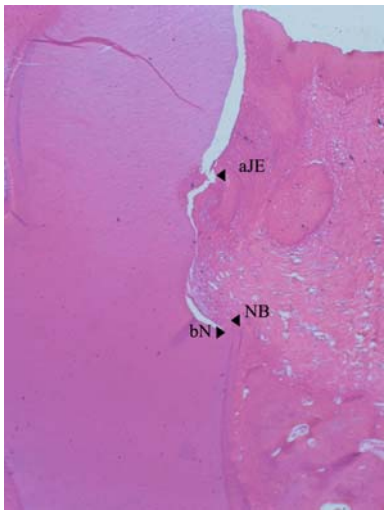


Fig4. HA/β-TCP particle graft(X 40)



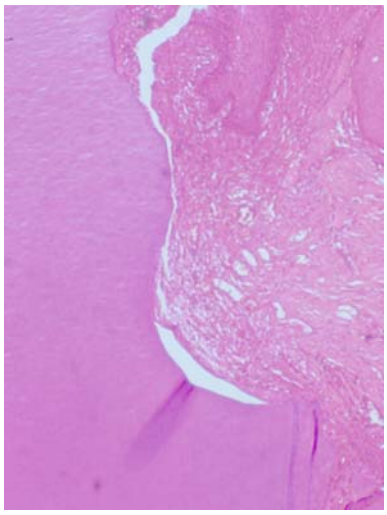


Fig 5. HA/Chitosan block scaffold(X 20) **Fig 6. HA/Chitosan block scaffold(X 40)**

국문요약

성견 1 면 골 결손부에서 하이드록시아파타이트-키토산 block scaffold 의 생체친화성과 영향

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김 동 진

이 연구는 새로 개발된 Hydroxyapatite/chitosan block scaffold 이 성견 1 면 골결손에서의 생체친화성과 치주조직재생에 미치는 영향과 block 형태와 입자 형태의 치주 1 면 골결손에서의 재생효과를 비교하기 위하여 hydroxyapatite/β-TCP particle 을 이용하여 비교하였다. 4X4mm 1 면 골 결손부에 Hydroxyapatite/chitosan block scaffold 를 이식한 군과 hydroxyapatite/β-TCP particle 를 이식한 군을 치은박리소파술만 시행한 군과 술후 8 주 뒤에 희생하여 다음과 같은 결과를 얻었다.

Hydroxyapatite/Chitosan Block scaffold 은 8 주후에 모두 흡수되었고 어떤 염증세포의 침윤도 관찰되지 않아 높은 생체친화성을 가지고 있는 것으로 관찰되었다. 치은박리소파술만을 시행한 군에서는 신생골 0.33mm, 신생백악질 0.80mm, 결합조직부착 0.97mm, 상피층 1.54mm 의 평균치를, hydroxyapatite/β-TCP particle 를 이식한 군에서는 신생골 0.74mm, 신생백악질 1.24mm, 결합조직부착 0.60mm, 상피층 1.22mm 의 평균치를, Hydroxyapatite/chitosan block

scaffold 에서는 신생골 0.42mm, 신생백악 질 1.33mm, 결합조직부착 0.78mm, 상피층 1.22mm 의 평균치를 얻었다.

Hydroxyapatite/chitosan block scaffold 은 백악질의 재생에서 좋은 결과를 나타내었지만 빠른 흡수로 인하여 골재생에서는 효과적이지 못하였다. hydroxyapatite/β-TCP particle 은 골재생의 효과가 높았는데 이는 흡수 속도가 낮고 좋은 공간유지능력을 보였기 때문이다. 그러나 백악질재생은 Hydroxyapatite/chitosan block scaffold 만큼 효과적이지는 못 했다.

Hydroxyapatite/Chitosan Block scaffold는 높은 생체친화성을 가지고 있는 것으로 관찰되었고, Block 형태와 입자형태의 이식재의 치주조직재생에서의 차이점을 비교하는 것은 이 연구에서는 사용된 재료의 화학적성분의 차이로 인하여 결론을 낼 수 없었다.

핵심되는 말: 치주조직재생, 하이드록시아파타이트 키토산 블록형 골, hydroxyapatite/β-TCP 입자형골