

가

• • •

I. 2,3), ,

, , 가 .

1), , ,

가

, ,

가

12,13),

가

2,3), 4,5),
, 6-8) 9-11)

.14)

가

(IGF), (EGF)
 14 - 20), 42 - 45),
 1983 Scott⁴⁶⁾ EGF가
 ,
 21,22), , EGF prostaglandin
 alkaline
 , phosphatase
 47 - 49),
 . 1976 Melcher²³⁾ 가
 가 가 50,51),
 24 - 35), 1971 Urist⁵²⁾
 (BMP)
 . BMP 9가
 , BMP - 1 BMP cDNA
 clone
 36,37) 가 3 cys -
 teine 가 53 - 56),
 가 가 BMP 가
 38,39) BMP
 . BMP - 2
 가 BMP - 4 , ,
 , 54),
 BMP
 .40) , ,
 . , BMP
 41), ,
 ,
 . 54,55), , BMP
 (PDGF),

bital(Tokyo Chemical Co., Japan)

56,57)

BMP

2

1

58,59)

가

BMP

2.

BMP

(1)

sodium pentobarbital

60 - 69),

2%

(1:80,000 epinephrine,

63,64) BMP

BMP

3

4

3

(Hamp)⁷⁰

3

4

BMP

4.5mm

alkaline phosphatase

5.5mm가

EGF

4

가

(2)

II.

1

1.

1 6

14 - 16(14.5)Kg

(Marshall Farms USA Inc., USA) 3

1

sodium pentobar -

(pH=1)

3

	Hematoxylin - Eosin	Trichrome
0.05M acetic acid 10 $\mu\ell$		
BMP - 4 (R & D System Inc., USA) 20 μg		
	III.	
5 μg micropipette		
, 1/2 0.05M acetic acid 6 $\mu\ell$	1.	2
EGF (Collaborative Biomedical Products, Bedford, USA) 2 μg	(1) BMP	
3 $\mu\ell$	(Figure 1)	가
0.05M acetic acid 10 $\mu\ell$		(Figure
BMP - 4 20 μg	1a).	
5 μg micropipette	(Figure 1b).	
		(Figure 1T)
		가
	(Figure 1Tc).	
(3)		
1	(2) BMP EGF	
300mg(,) 1		(Figure 2, 2a).
0.2% chlorhexidine	(Figure 2a)	
1		(Figure 2b,
(4)	2c).	
2, 4, 8 1	2.	4
sodium pentobarbital		
, 0.1M phosphate buffer	(1) BMP	
2.5% glutaraldehyde	(Figure 3)	1/3
0.1M phosphate buffer		(Figure 3a).
2.5% glu - taraldehyde 1 가 2mm		
Rapid - Decal (Calci - Clear Rapid™, National Diagnostics, Georgia, USA)	(Figure 3a, 3Tc).	
5 - 8 μm		(Figure 3b).

(2) BMP EGF

가

(Figure 4, 4a).

72).

(Figure 4b)

(Figure 4Tc).

3. 8

(1) BMP

4

1/3

(Figure 5, 5a).

(Figure 5a).

가

3

가

가

가

(Figure 5b).

38,39).

(2) BMP EGF

(Figure 6, 6T), 4

BMP

1/3

. BMP

(Figure 6, 6T, 6Ta).

(Figure 6a. 6Tb).

IV.

BMP - 4

가

3
EGF

BMP - 4

4

가

. Aspenberg (1992)⁵⁸⁾ BMP EGF
 rhBMP - 2 . 1962 Cohen
 Ripamonti EGF 53
 (1993)⁵⁹⁾ BMP - 3
 90 가 EGF 6045Da, EGF
 5400Da 가 37
 . Sigurdsson (1995a,b)^{63,64)} 가
 3 76,77), EGF
 rhBMP - 2 , ,
 Toriumi (1991)⁶⁰⁾, Bower (1991)⁶¹⁾, alkaline
 Ripamonti (1994)⁶²⁾ phosphatase
 BMP .
 BMP 46 - 49). Cho (1996)⁷⁸⁾ PDGF EGF가
 , BMP - 2 - 4 EGF가 PDGF
 가 alkaline phosphatase
 57,60,63,64). Choi
 (2000)⁷¹⁾ BMP - 2/ - 4
 BMP가 , EGF
 , alkaline phosphatase Buckley (1985)⁵⁰⁾ EGF
 가 가 ,
 BMP - 2/ - 4 RNA, glycosaminoglycans 가
 BMP - 2 - 4 EGF
 , , 51).
 alkaline phosphatase Choi (1997)⁷⁹⁾ 3
 가 PDGF
 57,73,74), , EGF
 가 BMP BMP - 4 가
 BMP 2 , EGF
 75), BMP

8 BMP 1/3 , 4 EGF PDGF EGF 4 EGF

8 12 EGF 가

1/3 8 , EGF 4 BMP EGF 4

가 3

BMP BMP 4 8 , EGF

가 BMP EGF

(1994)⁸⁰ EGF Cho 가 4

, 8 , 8 Choi (1997)⁷⁹ 1/3

(1995)⁸¹ PDGF pH=1 4 8 EGF , EGF

, 가

EGF 가

PDGF BMP EGF 3 , 2, 4, 8

3 pH1 BMP EGF BMP

micropipette EGF 가

BMP BMP

, EGF 가 BMP

1/2 Choi (1997)⁷⁹ PDGF

V.

BMP
BMP
alkaline phosphatase
EGF
6 14 - 16Kg
3,4 3
BMP - 4 EGF
micropipette
2, 4, 8 BMP - 4
1
1.
2.
3.
4.
1/3
8
1/3
4 8
가

, BMP - 4
EGF

가

가

VI.

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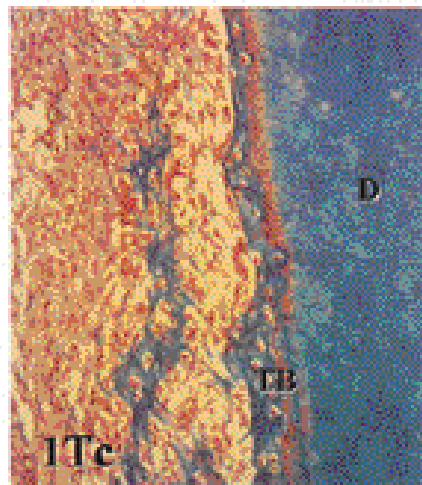
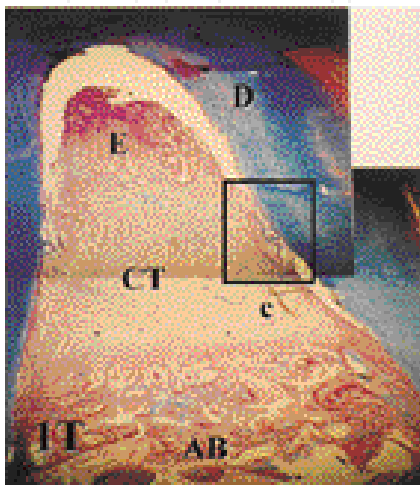
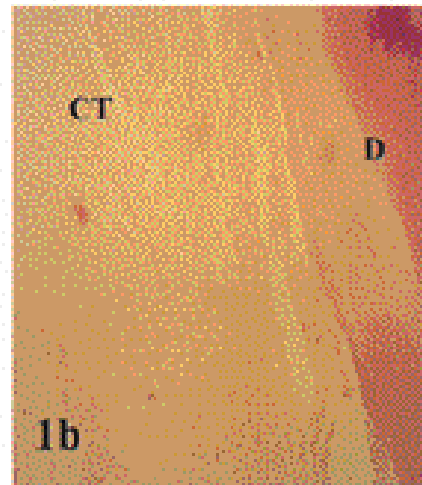
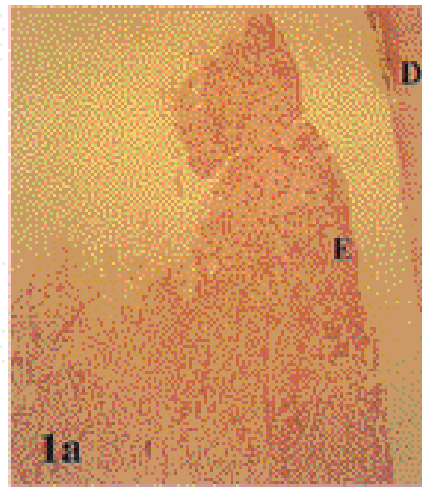
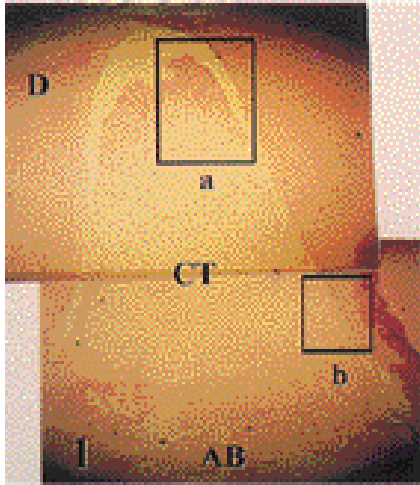
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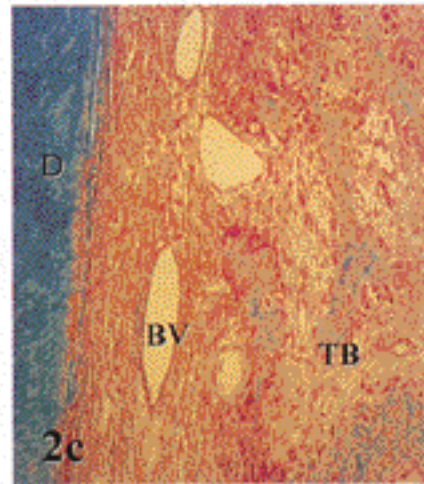
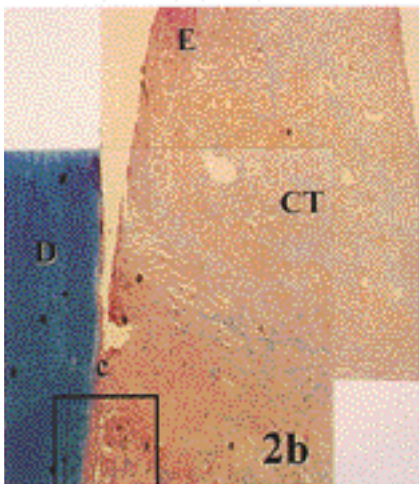
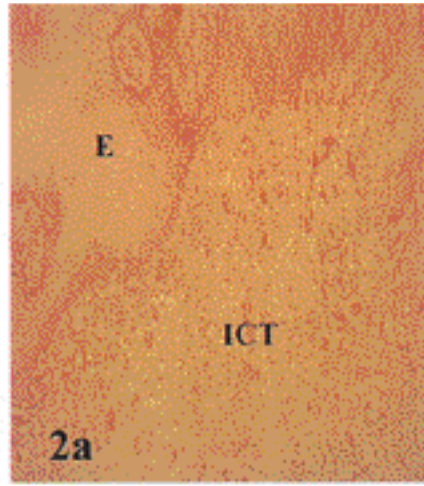
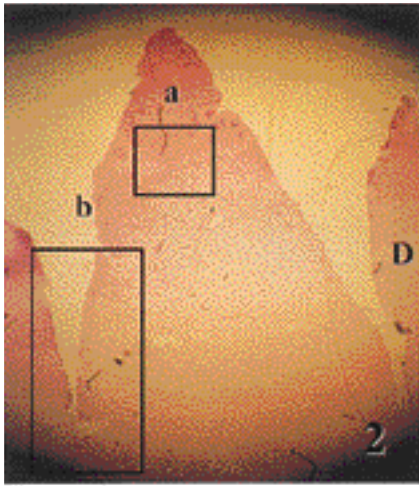
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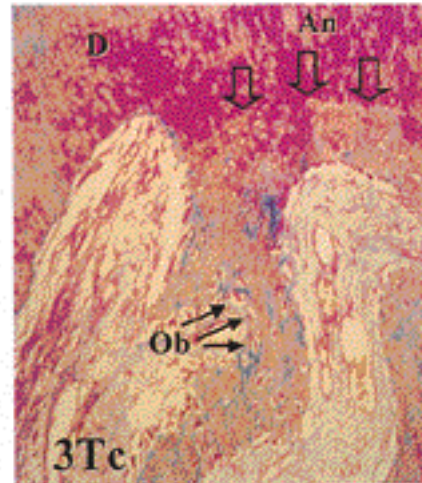
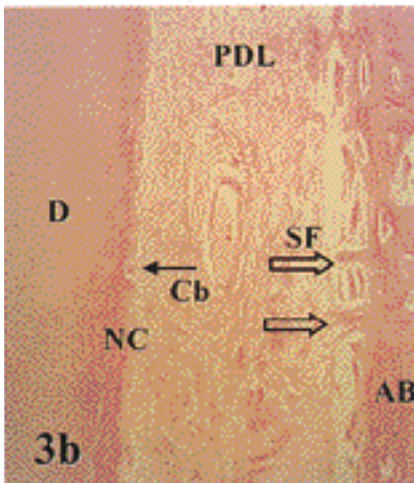
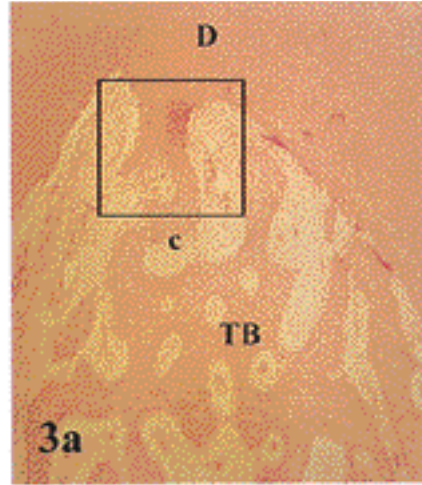
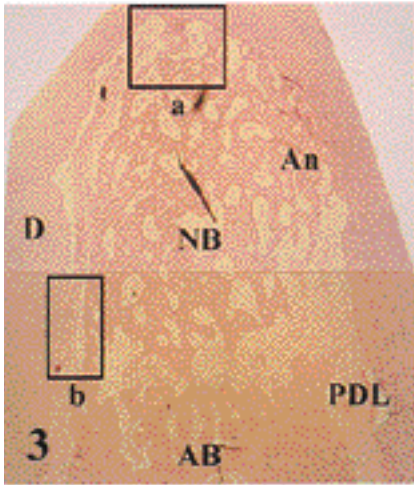
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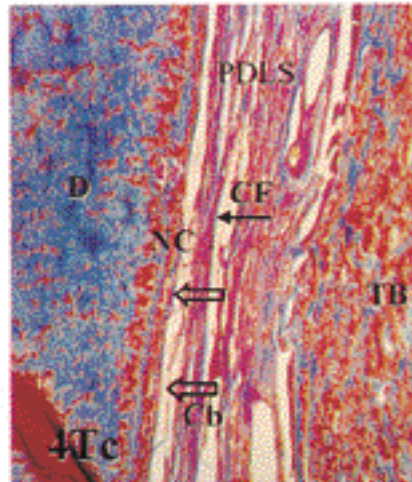
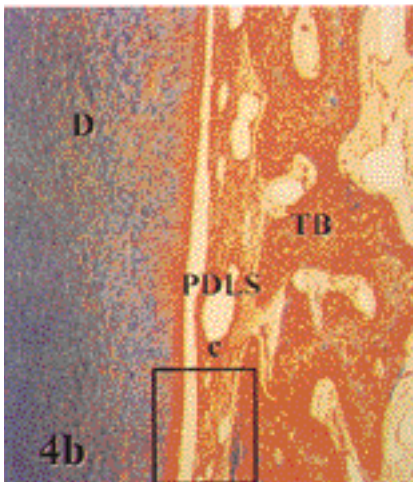
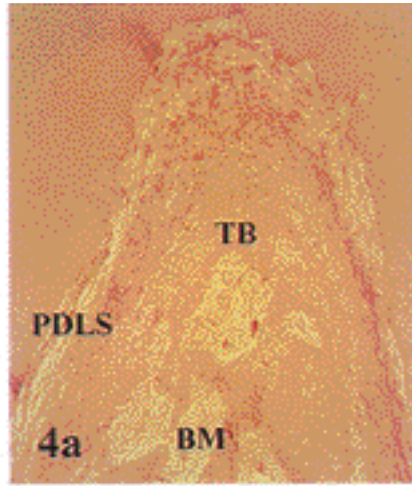
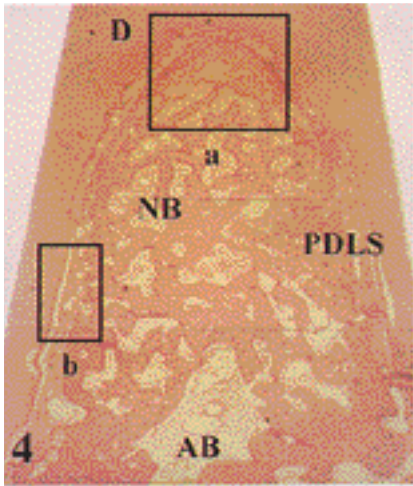
(II)



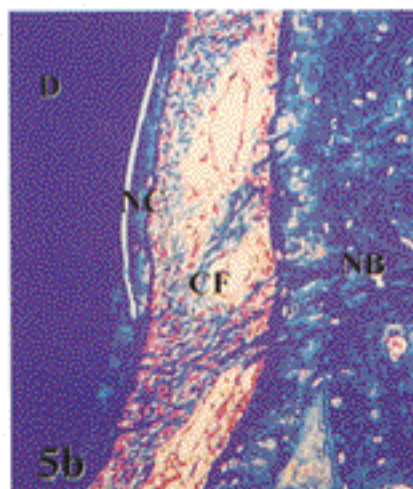
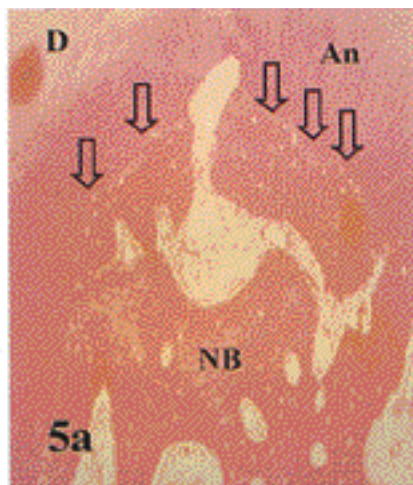
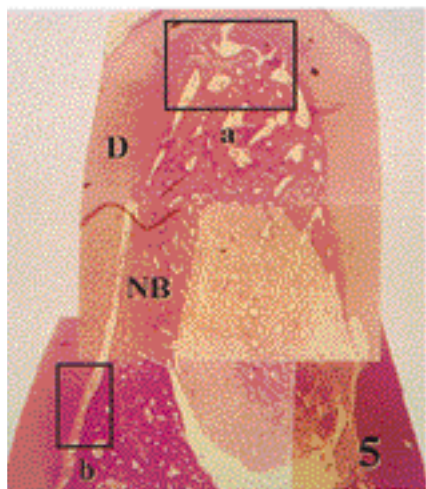
(III)



(IV)



(V)



(VI)

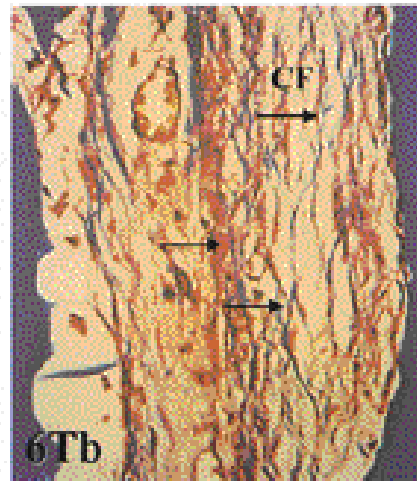
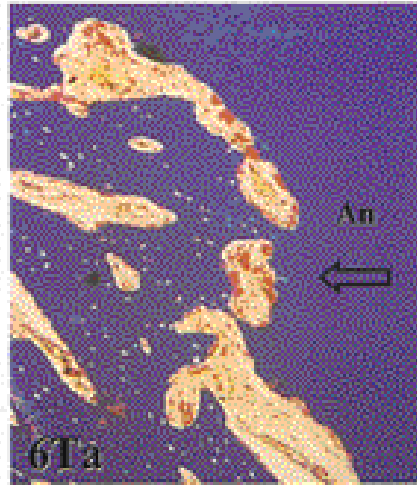
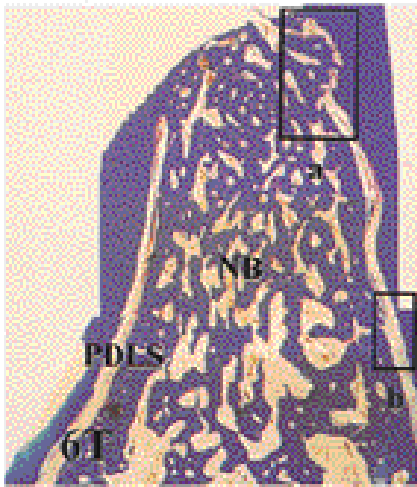
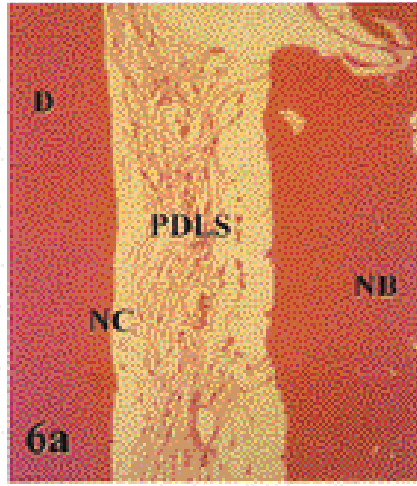
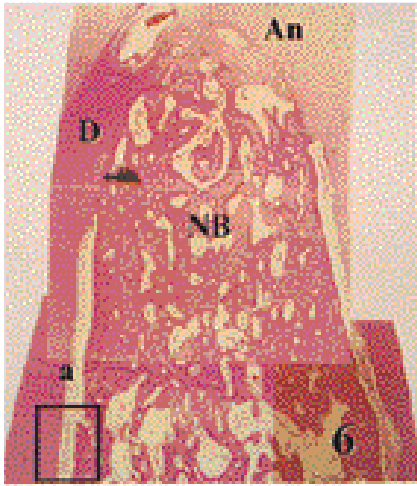


Figure1 : BMP - 4 applied site. (2 weeks after regenerative surgery)

1 : Horizontal furcation defect filled with granulation tissue. × 20. H & E stain

1a : Higher magnification of the area " a " shown in Fig1. Note the epithelial downgrowth in the root area. × 100. H & E stain

1b : Higher magnification of the area " b " shown in Figure 1. Note the collagen fiber parallel to the root surface. × 100. H & E stain

1T : Root ankylosis in the coronal 1/3 area. × 20. Trichrome stain

1Tc : Higher magnification of the area " c " shown in Figure 1T. Note the trabecular bone along the root surface. × 200. H & E stain

(CT:connective tissue, D:dentin, AB:alveolar bone, E:epithelium, TB:trabecular bone)

Figure2 : BMP - 4 and EGF applied site. (2 weeks after regenerative surgery)

2 : Horizontal furcation defect almost filled with granulation tissue. × 20. H & E stain

2a : Higher magnification of the area of " a " shown in Figure 2. Note the remarkable apical epithelial proliferation and inflammatory cells under the epithelium. × 100. H & E stain

2b : Higher magnification of the area of " b " shown in Figure 2. Note the dense connective tissue along the root surface. × 40. Trichrome stain

2c : Higher magnification of the area of " c " shown in Figure 2b. Note the immature trabecular bone. × 200. Trichrome stain

(D:dentin, E:epithelium, ICT:infiltrated connective tissue, BV:blood vessel, TB:trabecular bone)

Figure 3 : BMP - 4 applied site. (4 weeks after regenerative surgery)

3 : Horizontal furcation defect almost filled with immature newly - formed bone. × 40. H & E stain

3a : Higher magnification of the area of " a " shown in Figure 3. Note the root ankylosis in the roof area. × 100. H & E stain

3Tc : Higher magnification of the area of " c " shown in Figure 3a. Note the root ankylosis (open arrow) and osteoblast (arrow). × 200. Trichrome stain

3b : Higher magnification of the area of " b " shown in Figure 3. Note the newly - formed cementum containing cementoblast (arrow) and Sharpey's fiber (open arrow) embedding in the alveolar bone. × 400. H & E stain

(An: ankylosis, PDL:periodontal ligament, NB:newly - formed bone, AB:alveolar bone, TB:trabecular bone, SF:Sharpey's fiber, NC:new cementum)

Figure 4 : BMP - 4 and EGF applied siter (4 weeks after regenerative surgery)

4 : Bone defect almost filled with newly - formed bone and no root ankylosis in the roof area. × 40. H & E stain

4a : Higher magnification of the area of " a " shown in Figure 4. Note the trabecular bone

and no root ankylosis in the root area. x 100. H & E stain

4b : Higher magnification of the area of " b " shown in Figure 4. Note the connective tissue filled in the periodontal ligament space. x 100, Trichrome stain

4Tc : Higher magnification of the area of " c " shown in Figure 4b. Note the collagen fiber (arrow) parallel to the newly - formed cementum surface. x 400, Trichrome stain

(D: dentin, NB:newly - formed bone, AB:alveolar bone, PDLS:peri - odontal ligament space, TB:tra - becular bone, NC : new cementum, CF:collagen fiber, CB:cemento - blast)

Figure 5 : BMP - 4 applied site.(8weeks after regenerative surgery)

5 : Note new bone formation along the root surface to the fornix area. x 40, H & E stain

5a : Higher magnification of the area " a " shown in Figure 5. Note root ankylosis(open arrow). x 100, H & E stain

5b : Higher magnification of the area " b " shown in Figure 5. Note ori - entation of collagen fiber. x 200, Trichrome stain(D : dentin, NB : newly - formed bone,

An : ankylosis, NC: new cementum, CF : collagen fiber)

Figure6 : BMP - 4 and EGF applied site(8weeks after regenerative surgery)

6 : Note newly - formed bone filled in the defect area. x 40, H & E stain

6a : Higher magnification of the area

" a " shown in Figure 6. Note con - nective tissue filled in the peri - odontal ligament space. x 200, H & E stain

6T : Note newly - formed bone filled in the defect area and root ankylosis in the fornix area. x 40, Trichrome stain

6Ta : Higher magnification of the area " a " shown in Figure 6T. Note bony ankylosis. x 100, Trichrome stain

6Tb : Higher magnification of the area " b " shown in Figure 6T.

Note orientation of collagen fiber parallel to the root surface.

x 400, Trichrome stain

- Abstract -

The Effects of Bone Morphogenetic Protein and Epidermal Growth Factor on the Periodontal Tissue Regeneration

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Dentistry, Kyung Hee University

The 3 beagle dogs aged over one and half years and weighed 14 to 16 Kg were utilized in this study. Horizontal furcation defects were induced around 3rd, and 4th premolars bilaterally. BMP - 4 in conjunction with EGF and BMP - 4 only were applied in the right and left premolars respectively. 1 animal was sacrificed at 2nd week, 4th week, and 8th week, after regenerative surgery respectively. Semi - thin sections using glass - knife were stained with hematoxylin - eosin and trichrome for light microscopic study.

The results were as follows :

1. The long junctional epithelial down - growth was observed in both area

- applied with BMP - 4 and with BMP - 4 and EGF at 2nd week after the surgery.
2. The extensive regeneration of new bone and cementum was appeared at 4th week and the maturation of bone was observed at 8th week in both area applied with BMP - 4 and with BMP - 4 and EGF.
 3. The root ankylosis and resorption was presented along the exposed root surface at the coronal 1/3 of defect in the BMP - 4 applied site, but it was not shown in the site applied with BMP - 4 in conjunction with EGF at the 4th week. At 8th week, the root ankylosis was apparently appeared in the BMP - 4 and EGF applied site as well as in the BMP - 4 applied site.
 4. The periodontal ligament tissue including Sharpey's fiber inserted into cementum and alveolar bone, was formed along the exposed root surface in the area applied with BMP - 4 only, but in the site applied with BMP - 4 and EGF, the collagen fiber running parallel to the root surface without Sharpey's fiber, was observed in the periodontal ligament space at 4th and 8th week.

Within the above results, BMP - 4 had the remarkable capability to regenerate the periodontal tissue and EGF had possibility to prevent from the root ankylosis. Therefore, growth factors including BMP - 4 and EGF may have the strong possibility to be utilized in the clinical periodontal treatments.