

• • •

I.

pore filter

가

expanded polytetrafluoroethylene(e-PTFE)

, Gottlow

(1986)¹⁹⁾ e-PTFE

1-3),

, Pontoriero (1988)²⁰⁾ Caffesse

4-5),

6-8),

9-11),

(1990)²¹⁾

2

12-13),

e-PTFE

14)

e-PTFE

가

가

가

, e-PTFE

2

2

17-21). Nyman

(1982)¹⁷⁾ millipore filter

가

22).

가

, Magnusson

가

(1985)¹⁸⁾ millipore filter

가

type I collagen²³⁻²⁵⁾, oxidized cellulose²⁶⁾,

, milli-

polylactic acid, polylactic acid polyglycolic

acid (27-28)
glycolide lactide

BMP

(36, 40)

가

BMP

가

가

BMP - 2/ - 4

(29-32), glycolide lactide

(36)

BMP - 2/ - 4

8

alkaline phosphatase

가,

, cAMP

가,

, DNA

24

가,

(33), 2

가

(36-41)

가

BMP

, BMP

가

BMP

(34), fibronectin

BMP

(35)

(12-16, 36)

(76)

BMP

(Bone Morphogenetic

Protein)

, 가

가 (37-41), BMP 1965

Urist가

가

TGF -

가

가

BMP - 2/ - 4 , BMP - 5/ - 6/ - 7/ - 8 ,

BMP - 3/ - 12/ - 13 3

II.

dimeric, glycosylated protein

(37-38, 40-41)

1.

14 - 16kg 1 6 3 sodium (pH=1) 3
pentobarbital(Tokyo chemical Co., Japan) BMP - 4(R&D Systems Inc., USA) 0.05M acetic acid 10 μℓ 20μg 5μℓ (Biomesh , ,) BMP - 4
(, ,) 7
2. 3) 7
1) sodium pentobarbital Cleocin 300mg(,)
(1:80,000 epinephrine , 2% , 0.2% Chlorhexidine , 1
3, 4 2, 4, 8
1/2 round bur, 3 0.1M phos -
3, 4 4.5 phate buffer 2.5% glutaraldehyde
mm, 5.5mm가 1 가
2mm
4 Rapid - Decal(Calci - Clear Rapid™, National Diagnostics, Georgia, USA)
2) 4 - 5μm Hematoxylin - Eosin Goldner modi -
1 fied Masson's Trichrome

III.

(Figure 3c).

1. 2

(Figure 3c).

1)

2) BMP - 4

가
(Figure 4a).

(Figure 1, 1a, 1T, 1Ta).

가 (Figure

1a),

가 (Figure 1c).

(Figure 4),

(Figure 1b).

가
가 (Figure 4c, 4Tb).

2) BMP - 4

1/3

가
(Figure 4c, 4Tb).

(Figure 2, 2a, 2T),

가 (Figure 2a).

(Figure 4).

(Figure 2b, 2Ta),

(Figure 2Ta).

3. 8

가

1)

4

(Figure 2c).

(Figure 5, 5a).

2. 4

가

4

1)

(Figure 5b).

, 4

(Figure 3, 3a).

가

1/2
(Figure 5Tc).

(Figure 3b, 3Tc).

2) BMP - 4

4

(Figure 6, 6a).
(Figure 6a).
(Figure 6).
(Figure 6c),
가
가
6b).
(Figure 6).
IV.
e - PTFE 가
44 - 48). e - PTFE
2
가
polylactic acid
가
Calgut 48) Magnusson (1988)³¹⁾
polylactic acid가 e - PTFE
millipore filter
(1988)³⁰⁾ polylactic acid
acid
e - PTFE
가
(1991)⁷⁴⁾
가
Blumenthal (1993)⁴⁴⁾
2
가
48 - 62).
가 가
polyglycolic acid
3
, BMP - 4
, Fleisher
가 가
(1997)⁷⁵⁾
Bouchard

(PLA/PGA) 1 가 63,64).
 , Laurell (1994)⁵¹⁾ PLA
 6 - 8 가 ,
 PLA/PLGA 3 가 ,
 pH 가
 59).
 Tonetti (1993)⁶⁰⁾, Matchtei
 (1995)⁶¹⁾ 42).
 , Becker (1996)⁵⁸⁾ 가가
 , Selvig (1992)⁶²⁾ 가
 가 10).
 가 가
 45). , 가 66 - 67).
 , citric acid ,
 47). 66 -
 67).
 45 - 47). 가 BMP , BMP

40). BMP , , 가 ,
 , 40). , ,
 BMP - 4 pH
 . BMP - 4 , .
 , , , BMP

36,68,69,70). BMP 가 .
 . V.
 가 BMP

Cho (1995)⁴²⁾ PDGF - BB 1 6
 PDGF - BB 14 - 16kg
 3
 PDGF - BB 3, 4 3

Choi (1997) BMP - 4
 . alkaline . 2, 4, 8 1
 phosphatase

BMP 73). 1. 2 BMP - 4
 , ,
 2. 4
 ,
 BMP 4 가 4 BMP -
 BMP 가

3. 8

BMP - 4

4.

5.

BMP - 4

가

가

, BMP - 4

가

BMP - 4

VI.

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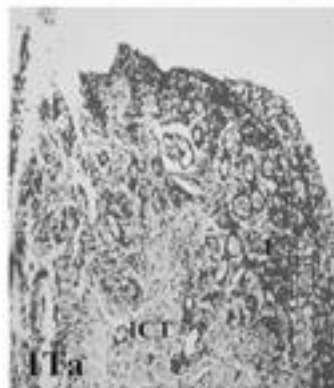
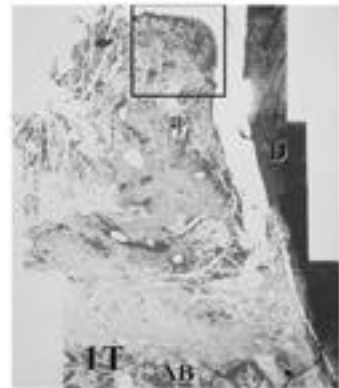
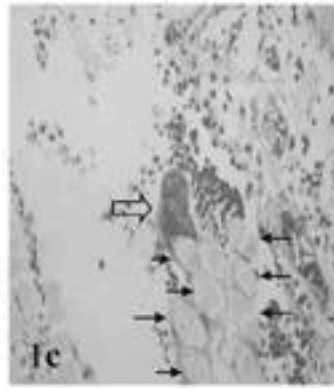
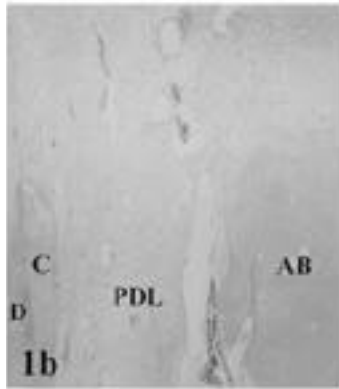
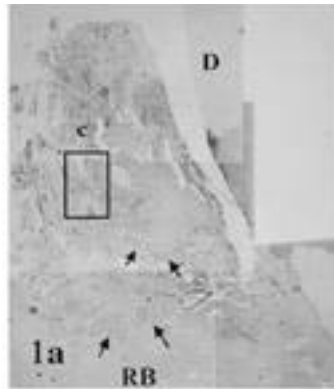
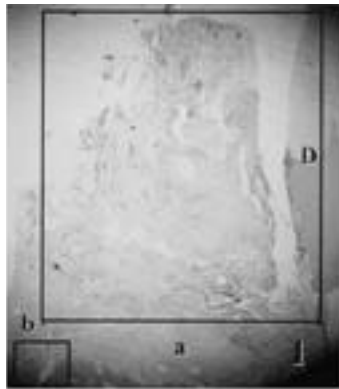
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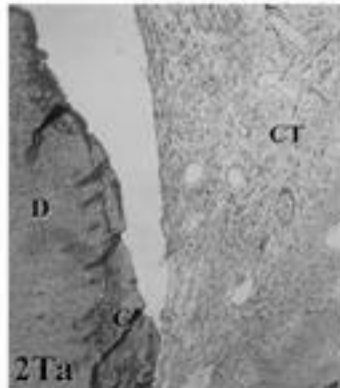
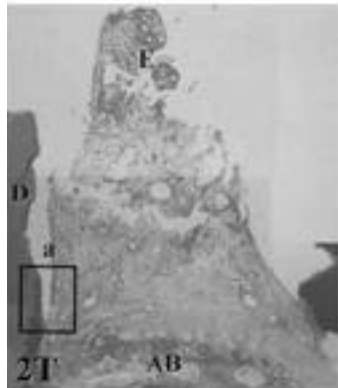
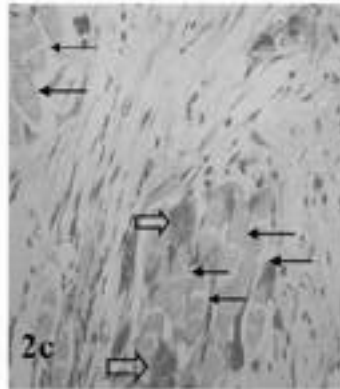
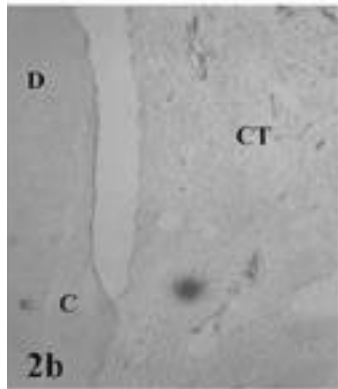
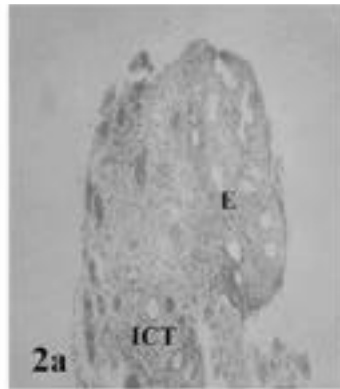
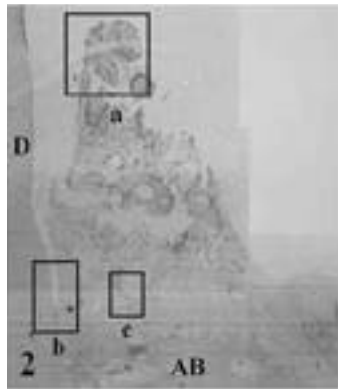
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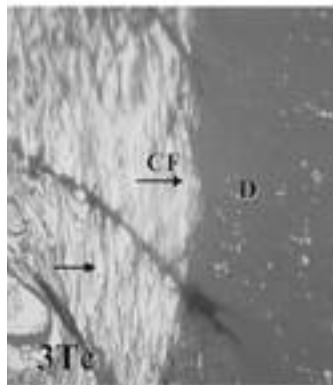
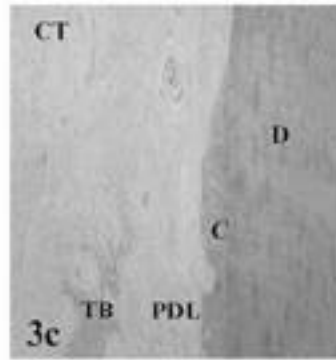
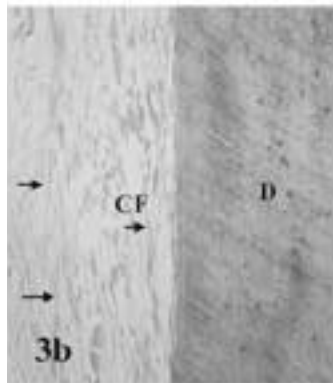
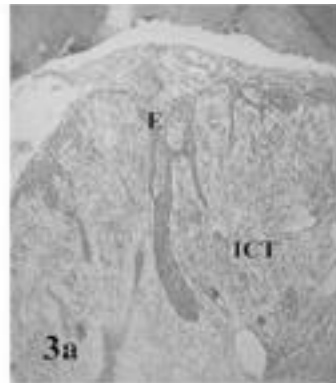
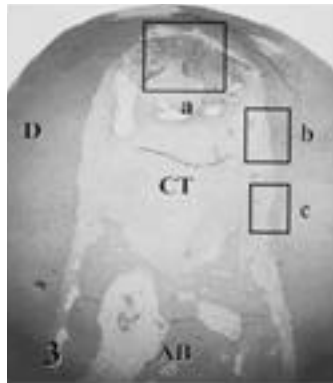
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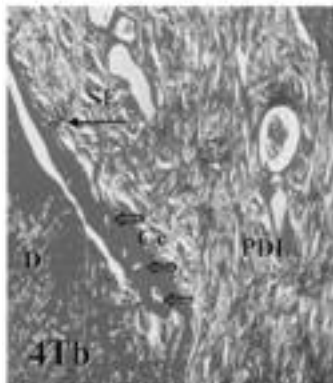
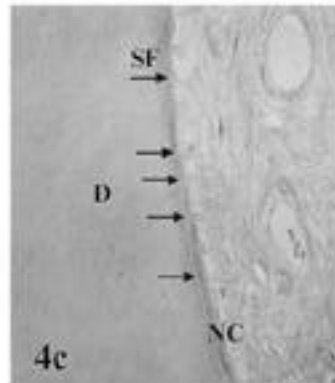
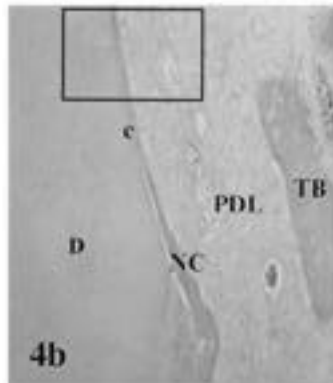
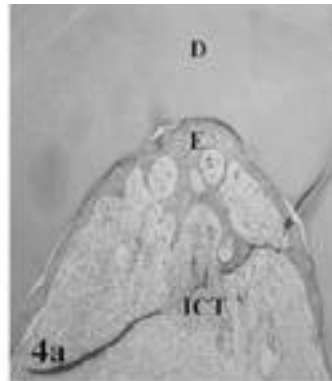
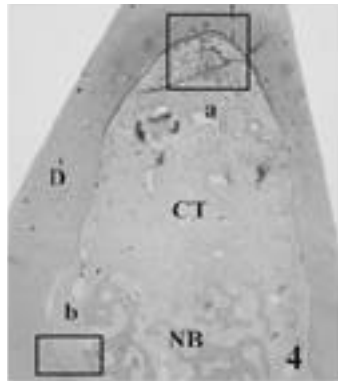
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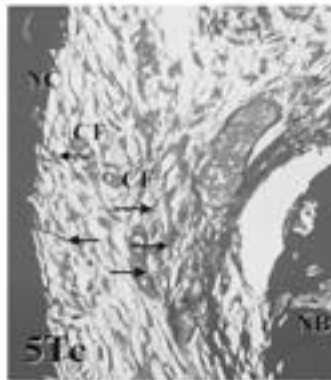
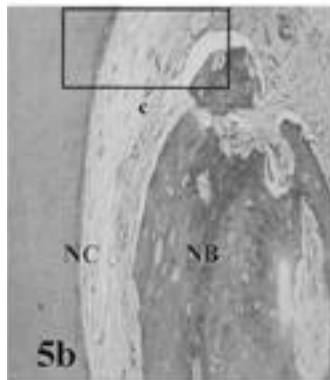
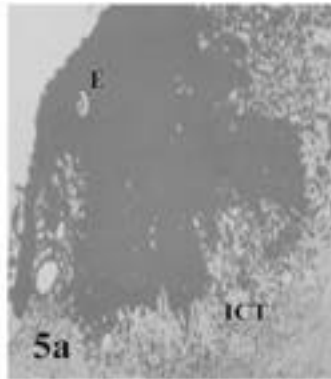
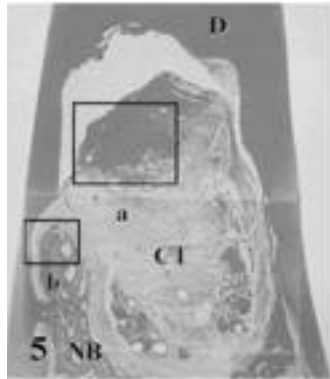
(III)



(IV)



(V)



(VI)

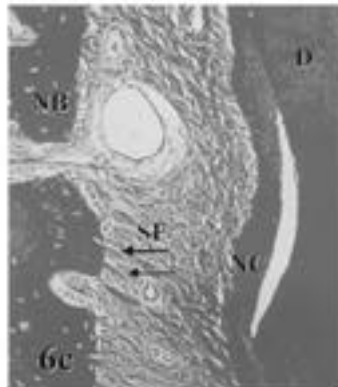
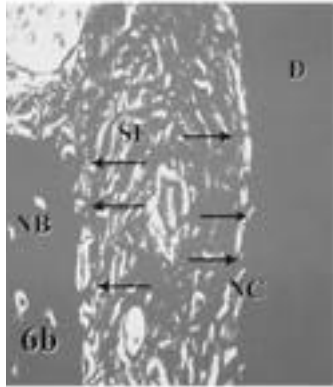
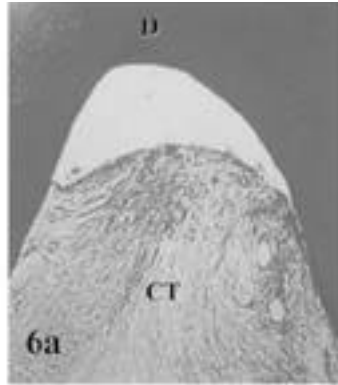
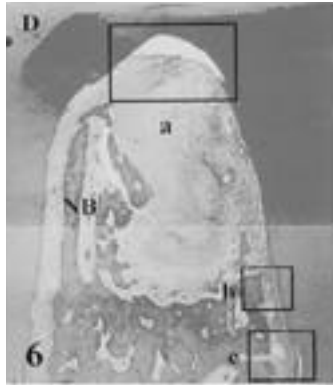


Figure 1 : Resorbable membrane - applied site

(2 weeks after regenerative surgery)

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

1a : Higher magnification of the area "a" shown in Figure 1.

Note the remnant of resorbable membrane. × 40, H&E.

1b : Higher magnification of the area "b" shown in Figure 1.

Note cementum, periodontal ligament, and alveolar bone. × 100, H&E.

1c : Higher magnification of the area "c" shown in Figure 1a.

Note the remnant of resorbable membrane (arrow) and multinucleated giant cell (open arrow). × 400, H&E.

1T : Bone defect filled with granulation tissue. × 40, Trichrome.

1Ta : Higher magnification of the area "a" shown in Fig. 1T.

Note epithelial downgrowth. × 100, Trichrome.

(D : dentin, RB : remaining bone, PDL : periodontal ligament, AB : alveolar bone, ICT : infiltrated connective tissue)

Figure 2 : BMP - 4 - and - resorbable membrane - applied site

(2 weeks after regenerative surgery)

2 : Bony defect filled with granulation tissue. × 40, H&E.

2a : Higher magnification of the area "a" shown in Fig. 2.

Note the epithelial downgrowth and infiltration of inflammatory cells. × 100, H&E.

2b : Higher magnification of the area "b" shown in Figure 2.

Note slight new cementum. × 100, H&E.

2c : Higher magnification of the area "c" shown in Figure 2.

Note remnant of resorbable membrane (arrow) and multinucleated giant cell (open arrow). × 400, H&E.

2T : Granulation tissue × 40, Trichrome.

2Ta : Note slight new cementum. × 100, Trichrome.

(AB : alveolar bone, ICT : infiltrated connective tissue, CT : connective tissue)

Figure 3 : Resorbable membrane - applied site

(4 weeks after regenerative surgery)

3 : Note the epithelium and connective tissue. × 40, H &E.

3a : Higher magnification of the area "a" shown in Figure 3.

Note the epithelial downgrowth. × 100, H &E.

3b : Higher magnification of the area "b" shown in Figure 3.

Note collagen fiber parallel to root surface. × 400, H &E.

3c : Higher magnification of the area "c" shown in Figure 3.

Note trabecular bone. × 100, H&E.

3Tc : Note direction of collagen fiber. × 400, Trichrome.

Figure 4 : BMP - 4 - and - resorbable membrane - applied site

(4 weeks after regenerative surgery)

4 : Note newly formed bone, connective tissue, and epithelium. × 40, H&E.

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

Note epithelial downgrowth. × 100, H&E.

4b : Higher magnification of the area "b" shown in Figure 4.

Note new cementum and trabecular bone. × 200, H&E.

4c : Higher magnification of the area "c" shown in Figure 4b.

Note new cementum and Sharpey's fiber. × 400, H&E.

4Tb : Note cementocyte(cc), Sharpey's fiber. × 400, Trichrome.

Figure 5 : Resorbable membrane - applied site

(8 weeks after regenerative surgery)

5 : Note epithelial downgrowth and new bone formation near the defect base. × 40, H&E.

5a : Higher magnification of the area "a" shown in Figure 5.

Note the epithelial proliferation and infiltrated connective tissue. × 200, H&E.

5b : Higher magnification of the area "b" shown in Figure 5.

Note new cementum and bone

formation. × 200, H&E.

5Tc : Higher magnification of the area "c" shown in Figure 5b.

Note orientation of collagen fiber(arrow). × 400, Trichrome.

(D : dentin, NB : new bone, CT : connective tissue, NC : new cementum, CF : collagen fiber, ICT : infiltrated connective tissue)

Figure 6 : BMP - 4 and - resorbable membrane - applied site

(8 weeks after regenerative surgery)

6 : Note no epithelial downgrowth and new bone formation along the root surface. × 40, H&E.

6a : Higher magnification of the area "a" shown in Figure 6. Note no epithelial downgrowth and loose connective tissue. × 100, H&E.

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

Note new bone and cementum formation and Sharpey's fiber(arrow). × 400, Trichrome.

6c : Higher magnification of the area "c" shown in Figure 6.

Note remarkable new cementum formation and Sharpey's fiber. × 200, H&E.

(D : dentin, NB : new bone, CT : connective tissue, SF : Sharpey's fiber)

- Abstract -

The Effects of Bone Morphogenetic Protein - 4 and Resorbable Membrane on the Regeneration of Periodontal Tissues

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The aim of our study is to achieve complete periodontal tissue regeneration by the application of BMP and resorbable membrane. Three beagle dogs aged over one and half years and weighed 14 to 16 kg were used in this study. Mandibular 1st, 2nd premolars were extracted bilaterally.

Horizontal furcation defects were induced around 3rd, 4th premolars bilaterally. BMP - 4 were applied in the right side with resorbable membranes and only resorbable membranes were applied in the left side respectively. Each animal was sacrificed at 2, 4, and 8 weeks, after regenerative surgery.

Specimens were prepared with Hematoxylin - Eosin stain and Goldner's modified Masson Trichrome stain for light microscopic evaluation.

The results were as follows:

1. At 2 weeks after regenerative surgery,

downgrowth of junctional epithelium was observed both in the membrane - applied site and BMP - 4 - and - membrane - applied site.

2. At 4 weeks after regenerative surgery, resorbable membranes were completely resolved, therefore would not prevent downgrowth of junctional epithelium. New bone formation, new cementum formation and Sharpey's fiber were observed in BMP - 4 - and - membrane - applied site.
3. At 8 weeks after regenerative surgery, downgrowth of junctional epithelium was observed in the membrane - applied site. But, new cementum formation was observed in the same site. The extensive regeneration of new bone, new cementum and remarkable formation of Sharpey's fiber were showed in BMP - 4 - and - membrane - applied site.
4. Resorbable membranes were resolved via the cell - mediated processes.
5. Periodontal tissue regeneration were better achieved in the BMP - 4 - and - membrane - applied site than in the membrane - applied site.

Within the above results, BMP - 4 may have the strong capability to form the new bone and resorbable membrane may be able to prevent the bony ankylosis. However, resolution rate of resorbable membrane may not be enough to protect rapid epithelial downgrowth for ideal periodontal regeneration. In conclusion, I suggest BMP - 4 may have the strong possibility to be utilized in the clinical periodontal treat -