

가

I.

(osteogenesis),

(osteoinductive graft material),

(creeping

substitution)

(osteoconductive
graft material) 7-11). 가

1).

가

osteoprogenitor cell

가

12).

2).

가

13-15).

가

가

가

enamel matrix proteins

3-6).

16,17),

가

platelet - derived growth factor(PDGF), insulins - like growth factor(IGF), basic fibroblast growth factor(bFGF) transforming growth factor(TGF) - , Lynch
18) PDGF IGF - 1

TGF - bone morphogenetic proteins(BMPs)

19,20), ,

가

가 .

가 .

, , , , , 가
가 ,
가

21 - 25),

, , 26 - 27), 28)

IL - 6

IL - 1 PGE₂
, collagenase
29 - 34),
(safflower seeds)
가

35,36),

linoleic acid
cholesterol

37 - 39), 40)

41), 42), 43)

가
44).

가

II.

1.

(1)

(safflower seeds) 100g 10 1, 4, 8

100 2, 10%

30g formic acid - sodium citrate, 4µm

(2) 250g 3 Hematoxyline - Eosin Goldner's
 Sprague - Dawly 24 Masson Trichrome

10mg (-),
 (±), (+), (++)
 (+++) 5

2.
 (1) ketamine HCl(Ketalar, Yuhan Co., Seoul, Korea) 1.5 - 2mg Goldner's Masson
 Trichrome (Media
 Image Pro II Cybernetics, USA)
 5

8mm trephine
 bur(3i, FL, USA) (4)

kanamycin sulfate(Kanamycin, Scientific Feed Co., Seoul Korea) (ANOVA) t - test
 p<0.05

(2) III.

Table 1. Histologic finding of inflammatory response

	Control			Experimental		
	1week	4week	8week	1week	4week	8week
Inflammatory cell	+++	±	±	++	±	±
Angiogenesis	+	+	±	+	±	±
Fibrosis in defect	+	++	+++	++	+	+

±; rare, +; mild, ++; moderate, +++; severe.
 Control; Non - application of safflower seeds extract.
 Experimental; Application of safflower seeds extract.

Table 2. Histologic finding of bone remodeling

	Control			Experimental		
	1week	4week	8week	1week	4week	8week
Osteoclastic activity	±	±	±	±	±	±
Osteoblastic activity	±	±	+	+	++	+
New bone formation	±	±	++	+	++	+++
Bone maturation	±	+	+	±	+	+++

±; rare, +; mild, ++; moderate, +++; severe.

Control; Non - application of safflower seeds extract.

Experimental; Application of safflower seeds extract.

Masson trichrome

1.

(1)

1

(Table 1, 2, Photo 5 - 1,

5 - 2).

(2)

1

(Table 1, 2, Photo 1 - 1, 1 - 2). 4

1

가

(Table

1, 2, Photo 2 - 1, 2 - 2). 4

(Table 1, 2, Photo 3 - 1, 3 - 2). 8

4 가

(Table 1, 2, Photo

Goldner's

4 - 1, 4 - 2). 8

4

Table 3. Histomorphometry of new bone formation(μm^2)

Group Duration	Control(Mean ± S.D.)	Experimental(Mean ± S.D.)
1week	14.06 ± 5.77	97.26 ± 30.48
4week	79.78 ± 15.26	222.85 ± 62.54
8week	380.27 ± 180.05	1349.64 ± 569.38*

* : Significant difference compared to control group ($p < 0.05$).

Control; Non - application of safflower seeds extract.

Experimental; Application of safflower seeds extract.

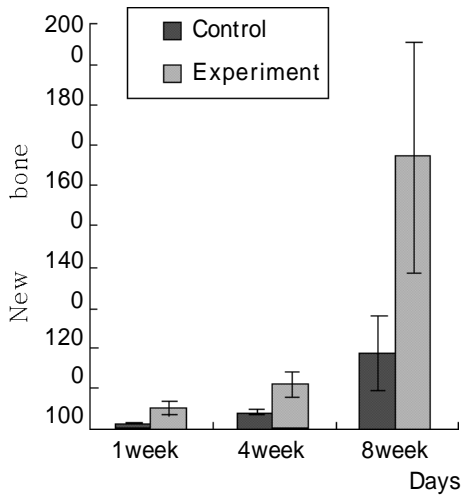


Figure 1. Effects of safflower seeds extract on new bone formation by histomorphometry(μm^2). Control; Non - application of safflower seeds extract. Experimental; Application of safflower seeds

가 ,
 가 (Table 1, 2,
 Photo 6 - 1, 6 - 2).

2.

1
 $14.06 \pm 5.77 \mu\text{m}^2$,
 $97.26 \pm 30.48 \mu\text{m}^2$,
 $79.78 \pm 15.26 \mu\text{m}^2$,
 $\pm 62.54 \mu\text{m}^2$,
 $380.27 \pm 180.05 \mu\text{m}^2$,
 $569.38 \mu\text{m}^2$

8
 (p<0.05).

가 45 -
 48). (osseous regeneration)
 (periodontal regeneration)
 가

(guided bone regeneration)
 가
 49). 1970
 가

12).

가

가

- carotene, adenosine bisphosphate, tocopherol, cystine, lysine, methionine, arginine, linoleic acid, Vitamine A, C, D

carotene 0.1 - 1 μ M alkaline phosphatase osteopontin 가 , adenosine bisphosphonate hydroxyapatite

49). BMP

53,54). 41),

42)

3

. Riley

10⁻³g/ml

50) human BMP - 2

가

가

55)

, Ekelund 51)

BMP

, BMP

가

(hetero -

topic sites)

bone - spe -

. TGF -

cific alkaline phosphatase

56). 44)

10⁻³g/ml

alkaline phosphatase

가

52).

가

TGF - osteonectin

가

가

가

Hosny Sharawy⁵⁷⁾ Goldner 's Masson

Trichrome

1

가 ,

, 4

4

1

가

8

3.5 가

가

, 4

가

가 4

. James

Jeffrey⁵⁸⁾ 10%

가

critical size defect(CSD)

CSD가 8mm

8

8mm

가

trephine bur

8mm

가 4

가

가

44)

1, 4

가

가

가

가가

가

1

4

가

가

8

가

가

가

가

V.

가

1. .

2. 1 , 4 , 8 , 8

가 4 , 8

3. 가 . 4

4. 가 , 8 가

(p<0.05).

가

가

VI.

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(1)

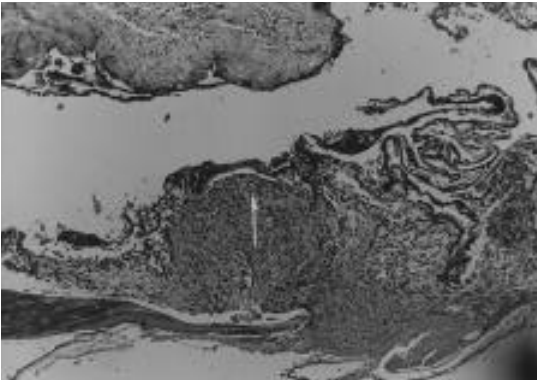


Photo 1 - 1

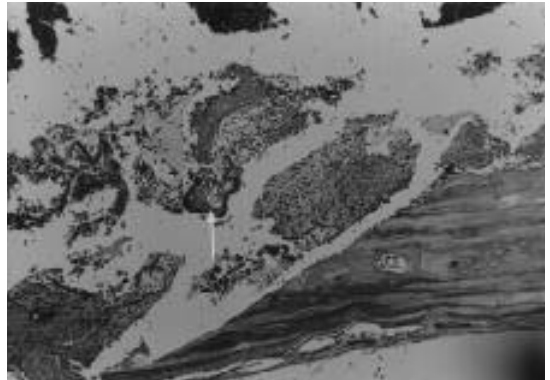


Photo 1 - 2



Photo 2 - 1



Photo 2 - 2

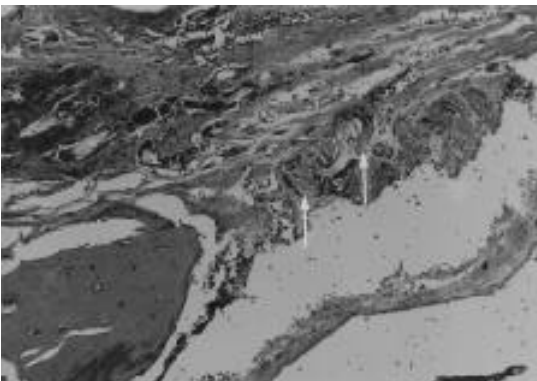


Photo 3 - 1



Photo 3 - 2

(II)



Photo 4 - 1

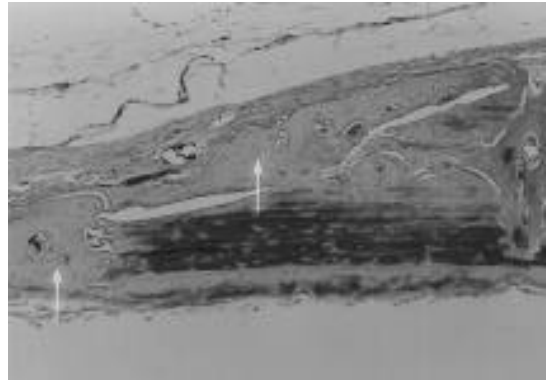


Photo 4 - 2

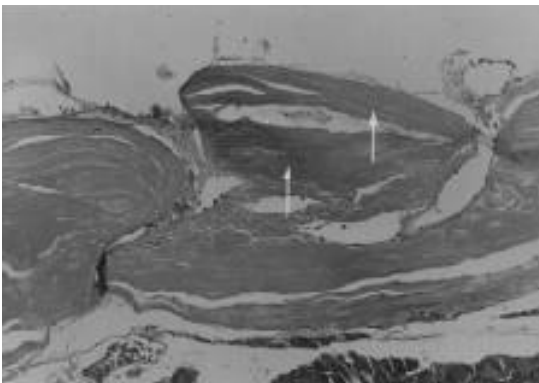


Photo 5 - 1

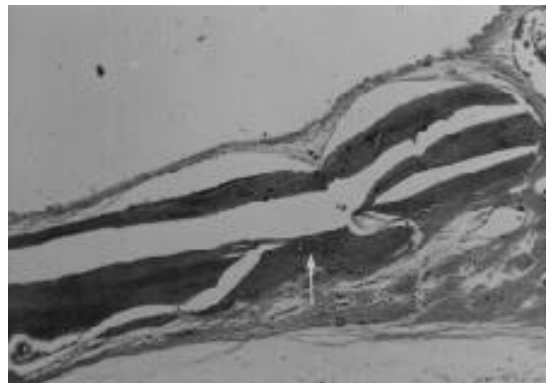


Photo 5 - 2



Photo 6 - 1



Photo 6 - 2

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Photo 1 - 1.

Microphotography of bone remodeling according to healing at 1 week on control groups (Goldner's Masson - Trichrome stain, x 100). Arrow indicates prominent fibrous inflammatory connective tissues.

Photo 1 - 2.

Microphotography of bone remodeling according to healing at 1 week on control groups (Goldner's Masson - Trichrome stain, x 100). Arrow indicates prominent fibrous inflammatory connective tissues.

Photo 2 - 1.

Microphotography of bone remodeling according to healing at 1 week on safflower seeds extract groups (Goldner's Masson - Trichrome stain, x 100). Arrow indicates slight osteoblastic activity.

Photo 2 - 2.

Microphotography of bone remodeling according to healing at 1 week on safflower seeds extract groups (Goldner's Masson - Trichrome stain, x 100). Arrow indicates new bone formation.

Photo 3 - 1.

Microphotography of bone remodeling according to healing at 4 week on control groups (Goldner's Masson - Trichrome stain, x 100). Arrows indicate dense connective tissues.

Photo 3 - 2.

Microphotography of bone remodeling according to healing at 4 week on control groups (Goldner's Masson - Trichrome stain, x 40). Arrows indicate dense connective tissues.

Photo 4 - 1.

Microphotography of bone remodeling according to healing at 4 week on safflower seeds extract groups (Goldner's Masson - Trichrome stain, x 40). Arrows indicate new bone formation.

Photo 4 - 2.

Microphotography of bone remodeling according to healing at 4 week on safflower seeds extract groups (Goldner's Masson - Trichrome stain, x 40). Arrows indicate new bone formation.

Photo 5 - 1.

Microphotography of bone remodeling according to healing at 8 week on control groups (Goldner's Masson - Trichrome stain, x 100). Arrows indicate hypo-maturated new bone formation.

Photo 5 - 2.

Microphotography of bone remodeling according to healing at 8 week on control groups (Goldner's Masson - Trichrome stain, x 40). Arrow indicates hypo-maturated new bone formation.

Photo 6 - 1.

Microphotography of bone remodeling according to healing at 8 week on safflower seeds extract groups (Goldner's Masson - Trichrome stain, $\times 100$). Arrows indicate matured new bone formation including bone marrow.

Photo 6 - 2.

Microphotography of bone remodeling according to healing at 8 week on safflower seeds extract groups (Goldner's Masson - Trichrome stain, $\times 100$). Arrows indicate matured new bone formation including dense bony tissues.

- Abstract -

Effects of Locally Applied Safflower Seeds Extract on Bone Regeneration of Rat Calvarial Defects

Doek - Kyu Kim, Sung - Woo Hong, Kyung - Tae You, Jae - Jin Seo, Heung - Shik Kim, Hyung - Keun You, Hyung - Shik Shin
Department of Periodontology, College of Dentistry, Wonkwang University

The ultimate goal of periodontal treatment is the regeneration of periodontal tissues which have been lost due to periodontal disease. Recently, many natural medicines have been studied for their potential of anti - bacterial, anti - inflammatory and regenerative effects in periodontal tissues. Safflower seeds have been traditionally used as a drug for treatment of fracture and blood stasis in oriental medicine. The objective of the present study is to examine the biologic effects of safflower seeds extract on bone formation and regeneration of rat calvarial defects. The calvarial defects were made with 8mm trephine bur and extract of safflower seeds were placed directly at these defects. 24 rats were divided into control and experimental groups, and each group was sacrificed at 1 week, 4 weeks and 8 weeks. To study a histopathology related to bone regeneration, Goldner's Masson Trichrome stain and his -

tomorphologic measuring was done at each weeks. In the early phase of bone healing, less inflammatory infiltration and capillary proliferation was found in experimental group compared to control. Dense bony tissues and matured bone structures in defect areas were found in experimental groups. And area of new bone formation was significantly increased at 8 weeks in experimental group. These results indicate that direct local application of safflower seeds extract reduces the early inflammatory response and promotes the regeneration of new bone in calvarial defects of rats.