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가

. \* . \* . . \* . \* . . †

, \* , †

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:가

가

: 가 52

20%

2

5%

1

30%

4

가 : 1 7.2 , 2 8.6 , 3 8.8 , 4 8.5 1  
 가 1 (p<0.05)  
 ±49.58 g/mm<sup>2</sup> 4 291.16±55.79 g/mm<sup>2</sup> 1 415.33± 137.18 N/mm, 4 310.45  
 (bending stiffness) (p<0.05)가  
 358.75 ± 107.32 N/mm (p<0.05)가

가

가

: , , , ,

:

가

가

가 6

1000g

가

62  
20%

가 5

1,2,3,4

가 5.9)

5

1 (16 )

가

(flavonoid),

(serotonin)

(lignan),

30%

2 (10 )

가

5%

3 (10 )

(estrogen)

5 microgram

4

4 (16 ) , 5 (10 )

16

1-4)

(genistein)

(xylazine) 5-10mg/kg

(Ketamin) 40-80mg/kg

(daidzein)

(isoflavone)

(flaxseed)

(matairesinol)

(secoisolariciresinol)

1.5 mm

2.3 mm

(half-

pin)

가

4

가

2

(air saw)

20%

가

1

(WI: width index=width of new bone formation on operated femur/width of contralateral femur)

1 4  
가

(Instron)

1cm

(Somastom Plus-S, Simens, Germany)

(destructive 3-point-bending test)

2cm

Instrument Ltd., U.K.)

가

10kN (load cell)  
(deflection speed) 5mm

가

X-Y

(load-deflection)

(ultimate load), (ultimate stress),  
(ultimate stiffness)

Student t- test

p<0.05

1.

(WI: width index)

1,2, 3,4

5  
1  
7.2 , 2 8.6 , 3 8.8 , 4 8.5  
1 가 1  
(p<0.05)

(Table 1).

2

**Table 1.** Union time and width index.

	Group I	Group II	Group III	Group IV
Union time (week)	7.19 ± 0.63	8.60 ± 0.54	8.83 ± 0.75	8.44 ± 0.96
Width index	145.14 ± 16.16	115.66 ± 17.38	114.46 ± 14.17	121.00 ± 15.72

Group I: Fed on safflower seed powder(30%) and normal diet(70%)

Group II: Fed on matairesinol(5%) and normal diet(95%)

Group III: Fed on normal diet(100%) and intravenous injection of matairesinol

Group IV(%) : Fed on normal diet(100%)

Width index(%): width of new bone formation at the center of bone defect divided by width of the contralateral femur

3

30% 70% 50%

5

100%

6

9

(Fig.1).

14

(WI)

1

145% 가

(Fig. 2) 2 115%,

3 114%, 4 121%

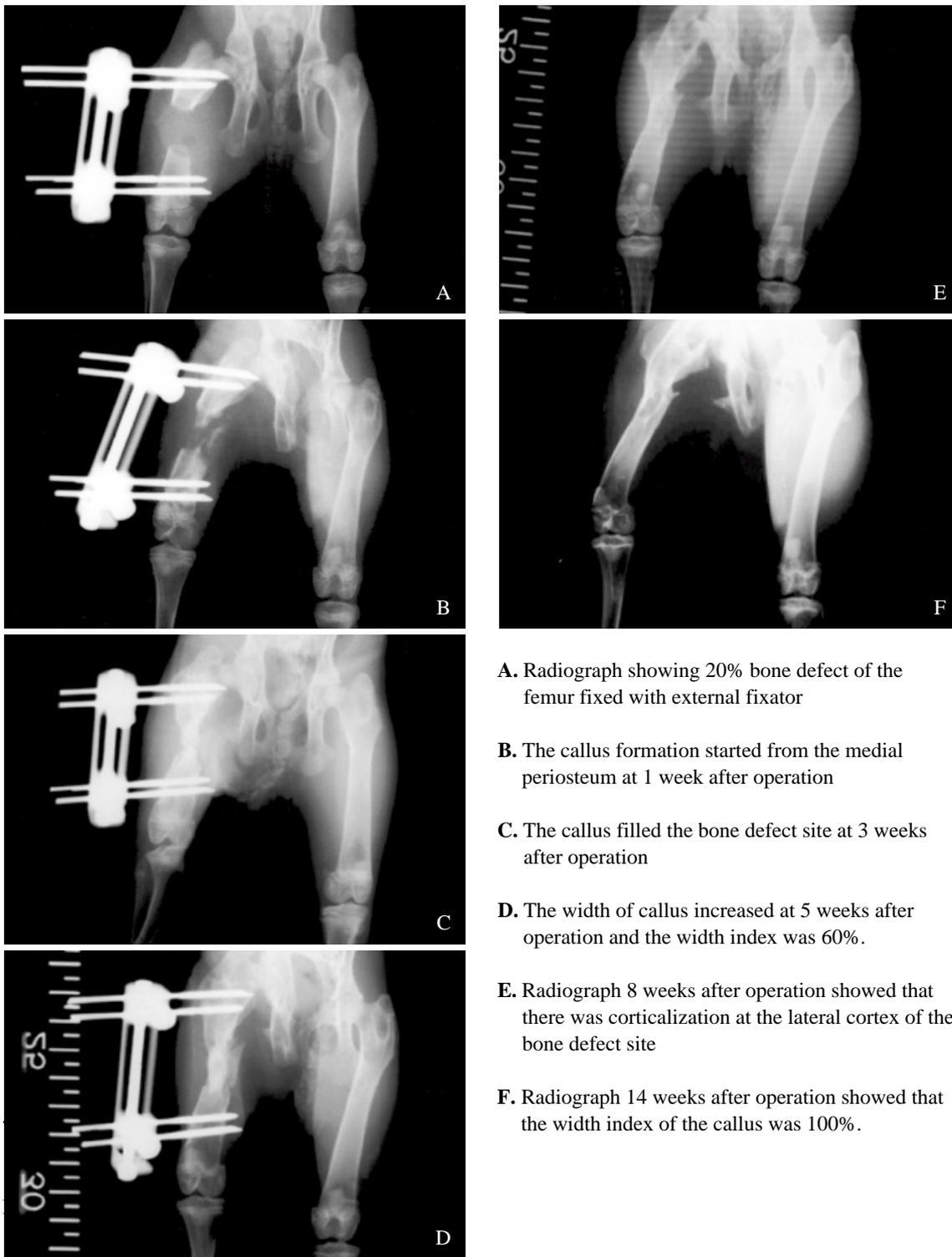
1

(p<0.05)

2,3,4

가

**Fig 1.** Group IV fed on normal diet(100%)



- A.** Radiograph showing 20% bone defect of the femur fixed with external fixator
- B.** The callus formation started from the medial periosteum at 1 week after operation
- C.** The callus filled the bone defect site at 3 weeks after operation
- D.** The width of callus increased at 5 weeks after operation and the width index was 60%.
- E.** Radiograph 8 weeks after operation showed that there was corticalization at the lateral cortex of the bone defect site
- F.** Radiograph 14 weeks after operation showed that the width index of the callus was 100%.

**Table 2.** Bone mineral density and bone strength in group I and group IV

	Group I (n = 10)	Nonop	Group IV (n = 10)	Nonop	<i>P</i> value <sup>I</sup>
BMD (g/mm <sup>2</sup> )	310.45 ± 49.58	492.01 ± 45.48	291.16 ± 55.79	480.47 ± 58.42	0.03 0.39
Failure load (N)	380.04 ± 83.27	346.25 ± 33.61	358.13 ± 76.80	339.23 ± 41.22	0.23 0.71
Stress (M Pa)	4.43 ± 1.19	8.79 ± 1.48	4.00 ± 0.77	8.51 ± 1.20	0.10 0.23
Stiffness (N/mm)	415.33 ± 137.18	480.81 ± 63.85	358.75 ± 107.32	433.04 ± 81.31	0.005 0.05

BMD, bone mineral density; Nonop, contralateral nonoperated side.

*P* values between group I and group IV were obtained using Student *t*-test.

1 4 가 (Table 2).

Draper <sup>4)</sup>

6,7) 10%

(high

(phytoestrogens) 가 1,4,12)

density lipoprotein cholesterol)

8)

가

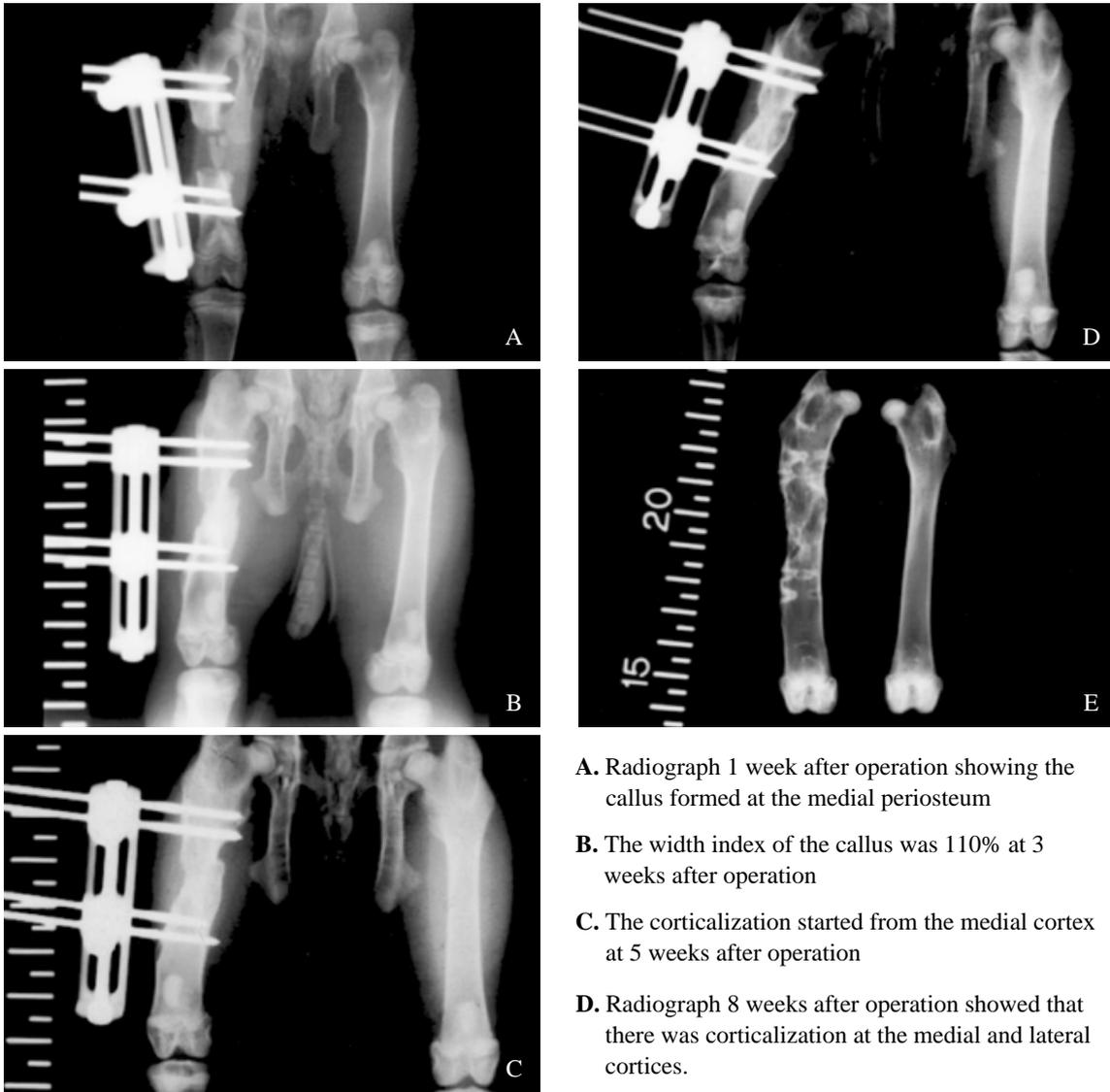
87%

55%

17%

8)

**Fig 2.** Group I fed on safflower seed powder(30%) and normal diet(70%)



- A. Radiograph 1 week after operation showing the callus formed at the medial periosteum
- B. The width index of the callus was 110% at 3 weeks after operation
- C. The corticalization started from the medial cortex at 5 weeks after operation
- D. Radiograph 8 weeks after operation showed that there was corticalization at the medial and lateral cortices.
- E. Radiograph 14 weeks after operation showing that the width index of the callus was 145%.

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## Abstract

## The Effect of Safflower Seed or Matairesinol on Spontaneous Bone Formation in Surgically Induced Bone Defect in Young Rabbit

Hae-Ryong Song, M.D., Do-Kyung Ra, D.V.M.\*, Gon-Sup Kim, D.V.M.\*, Ph.D.,  
Ki-Churl Chang, Ph.D. Jae-Min Hwang, D.V.M.\*, Seong-Chan Yeon, D.V.M.,  
Ph.D.\*, Hyung-Bin Park, M.D., and Sang-Won Choi, Ph.D.†

*Department of Orthopaedic Surgery, School of Medicine, and School of Veterinary  
Medicine, Institute of Health Science<sup>b</sup>, Gyeong-Sang National University\*, Chinju,  
Department of Food Science and Nutrition, Catholic University of Taegu-Hyosung, Taegu,  
Korea.†*

**Purpose:** To investigate the effect of defatted safflower seed or matairesinol on spontaneous bone formation in surgically induced bone defects in young rabbits

**Materials and Methods:** Bone defects(20% of original femoral length) were created at the midshaft of the femur in 52 young rabbits and stabilized with external fixation. The periosteum was preserved. Fifty-two rabbits were divided into four groups as follows; the group I fed on safflower seed powders(30%) and normal diet(70%), the group II on matairesinol (5%) and normal diet(95%), the group III on normal diet(100%) with intravenous injection of matairesinol, the group IV on normal diet(100%). Radiographs were taken weekly to evaluate the bone regeneration and union time. Biomechanical testing on the new bone formation area was performed to measure bending stiffness. The area of new bone formation was scanned by quantitative computed tomography to measure bone mineral density(BMD).

**Result:** The mean union time(weeks) was 7.2 in the group I, 8.6 in the group II, 8.8 in the group III, and 8.5 in the group IV and was significantly different between the group I and the other groups( $p<0.05$ ). The BMD and bone strength of the callus were compared between the group I and the group IV. The mean BMD was  $310.45 \pm 49.58$  g/mm<sup>2</sup> in the group I and  $291.16 \pm 55.79$  g/mm<sup>2</sup> in the group and there was significant difference( $p<0.05$ ). The mean bending stiffness was  $415.33 \pm 137.18$  N/mm in the group I and  $358.75 \pm 107.32$  N/mm in the group IV and there was significant difference( $p<0.05$ ).

**Conclusion:** The diet with safflower seed powder was effective for decreasing union time and increasing bone strength of the callus formed at the bone defect whereas the diet or injection with matairesinol was not effective. More experimental studies are necessary to prove the effect of matairesinol on the callus.

**Key Words:** Bone defect, Safflower seed powder, Matairesinol, Callus