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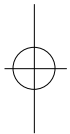
\* , \*\* , \* , \*  
 , \*  
 \*\*  
 < >  
 :  
 Sprague-Dawley  
 90 , ketamin  
 kg 1.36g , 1 kg 0.68g ,  
 1 , 2 4  
 1.5cm  
 hematoxylin-eosin alcian blue(pH 2.5)-PAS  
 : Anova test  
 1 가 (p = ns), 2  
 0.16 ± 0.01, 0.19 ± 0.01, 0.18 ± 0.01 가 (p = 0.035),  
 4 (p = 0.091).  
 2  
 가 , 2 가 PAS 1  
 , 2 가 PAS  
 , 4 , 1 가 , 2  
 가 , 4

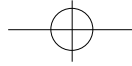
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17

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2  
가  
가

가 가

6,10)

14

가

. Teneff<sup>17)</sup>  
(vessel buds)

2-3

, McKibbin<sup>12)</sup>

(woven bone)

가 (primary callus)

가

1 10g,

5-10

1 5g

2-3

, Tang<sup>16)</sup>  
14

450

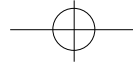
Sprague-Dawley

가

5

90

. Ketamin



0.05,  $0.19 \pm 0.01$ ,  $0.19 \pm 0.06$

( $p=0.091$ ) (Fig. 1-B,C,D).

2.

Kg 0.68g ,

8 Kg 1.36g

2

4

가

. 1 , 2

4

(Fig. 2-A,B,C).

3.

1.5cm

1

가

가

가

(Hologic QDR-4500A, Waltham, MA, USA)

blue

alcian

(B+)

(Fig.1-A) 1 , 2 4

(B++)

ANOVA test

1.8

(focal size 0.3mm).

alcian blue PAS

(BP)

PAS

(P+)

가

가

hematoxylin-eosin

가

가

(Fig. 3,4)

1

가

가

alcian

blue

(B+)

(BP)

alcian blue

(B++)

PAS

1.

1

,  $0.18 \pm 0.01$ ,  $0.17 \pm 0.01$ ,  $0.18 \pm 0.01$

( $p=ns$ ), 2

$0.16 \pm 0.01$ ,  $0.19 \pm$

$0.01$ ,  $0.18 \pm 0.01$

가

가 ( $p=0.035$ ). 4

$0.18 \pm$

1

(Fig. 5,6).

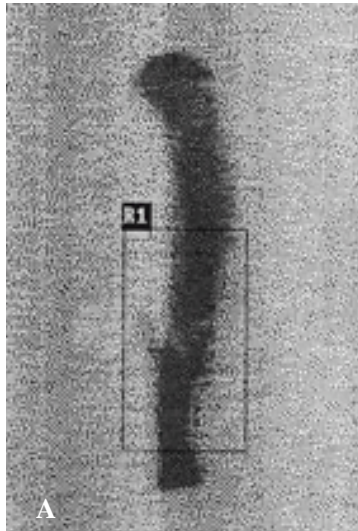
가

가

가

alcian blue

(B+)



**Fig 1-A.** BMD measurement was done from the rectangular ROI(region of interest) drawn over the fracture site.

**1-B.** There was no statistically significant difference of BMD values of control, low dose and high dose group after treatment for 1 week.

**1-C.** BMD values were significantly higher in the low and high dose group than the control group after treatment for 2 weeks.

**1-D.** BMD values did not show statistically significant difference between groups, but there was a tendency that the drug used groups showed higher value than the control group.

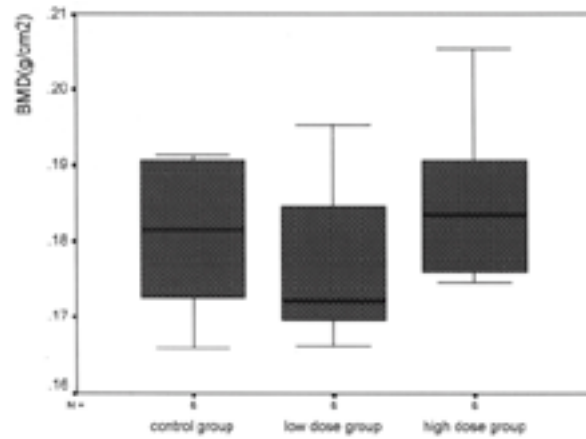


Fig. 1-B.

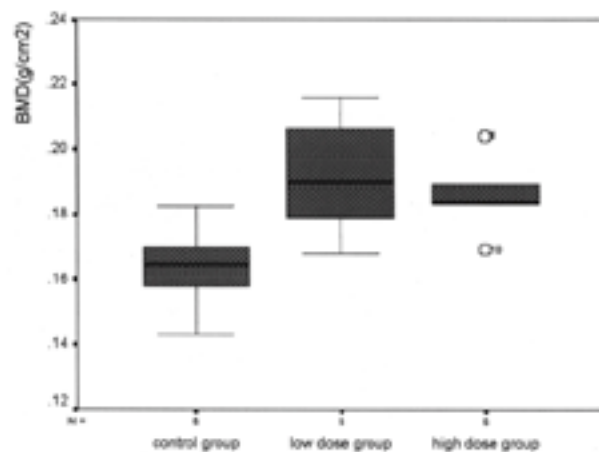


Fig. 1-C.

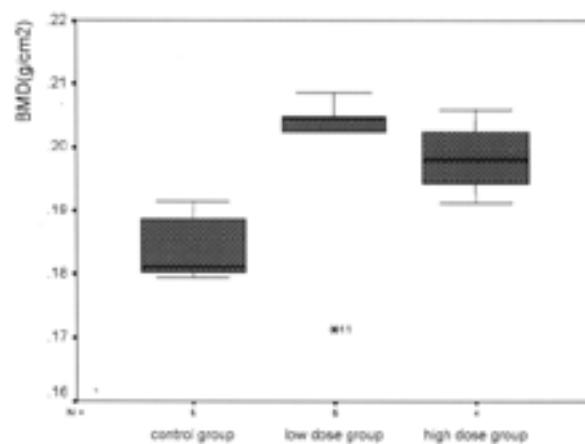
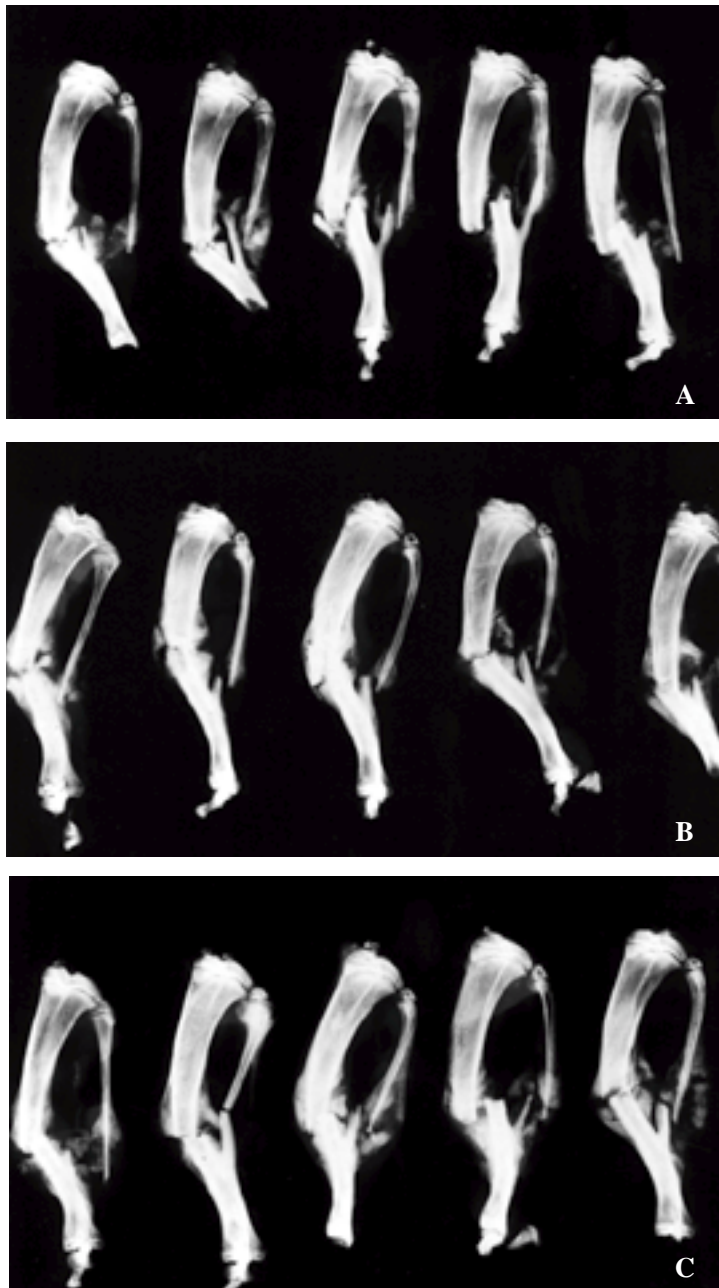
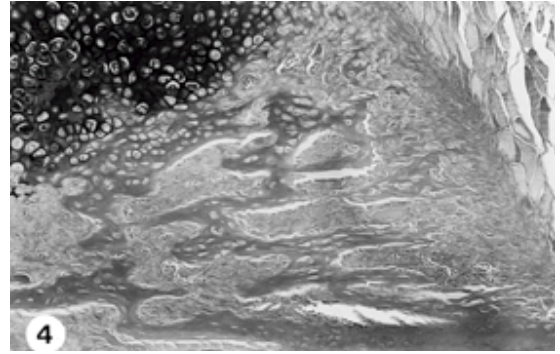
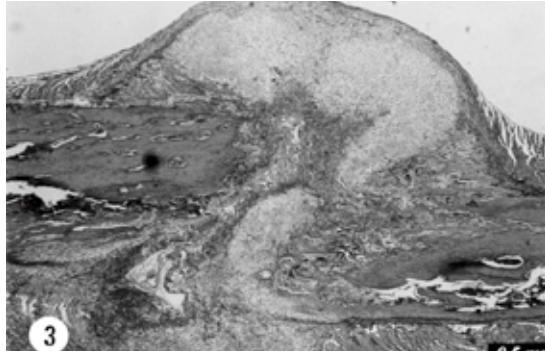
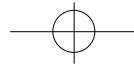


Fig. 1-D.

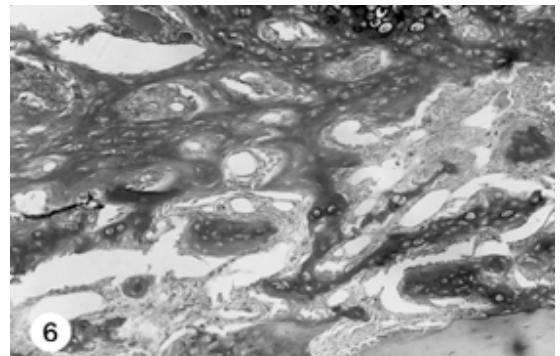
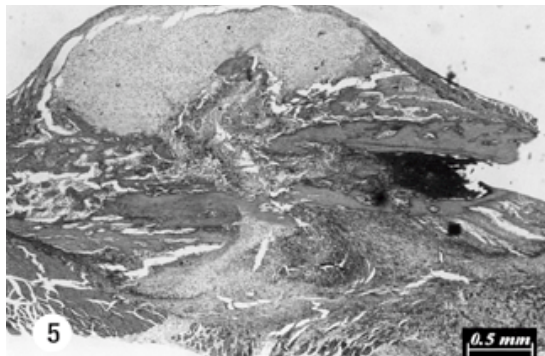


**Fig 2.** After treatment for 2 weeks, the low and high dose groups show more profuse callus formation than control group(2-A control group, 2-B. low dose group, 2-C. high dose group).

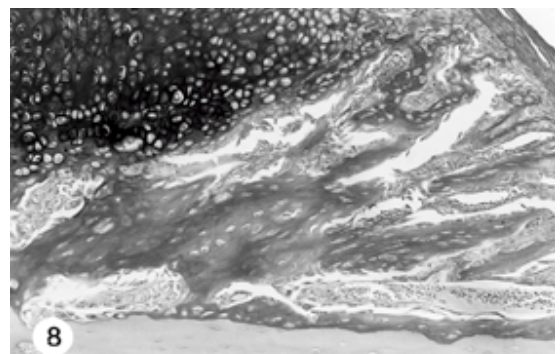
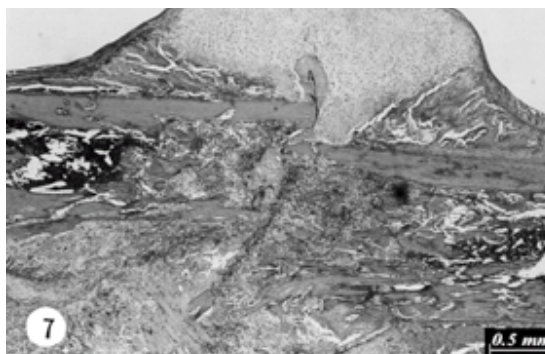
(B++)  
(B+++),  
(BP)  
PAS (P++)  
(P+++)  
(Fig. 7,8)  
2 가 가  
가  
가  
.  
,  
가  
PAS  
(P+) 가  
alcian blue (B+)  
(Fig. 9,10).  
2 가  
alcian blue PAS  
가  
alcian blue (B+)  
가  
alcian blue  
PAS  
alcian blue  
(Fig. 11,12).  
2  
가



**Fig 3, 4.** Light Microscopic findings of the osteotomized rib in the control rat at the 1st week after operation. Both osteotomized ends are connected with bulging cartilagenous callus. Hematoma is seen in the center of osteotomy site. Blood vessels in the near part of osteotomy site are well developed. HE stain and alcian blue(pH 2.5)-PAS stain. bar=0.5mm, X100, respectively.

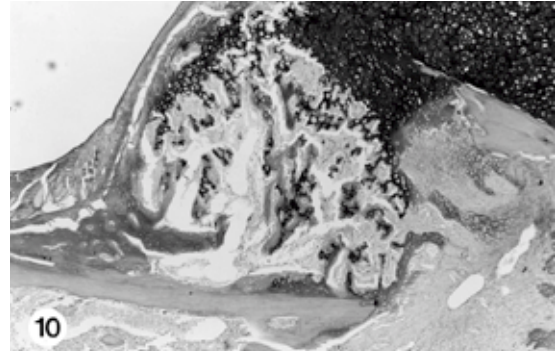
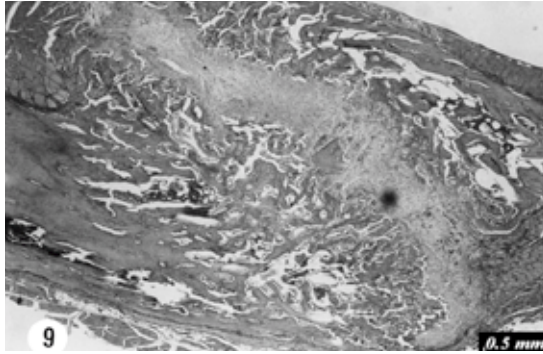
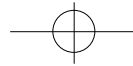


**Fig 5, 6.** Light Microscopic findings of the osteotomized rib in the low dosage treated experimental rat at the 1st week after operation. Hematoma and cartilagenous callus are seen. Numerous blood vessels adjacent relatively thick bony trabeculae are observed. HE stain and alcian blue(pH 2.5)-PAS stain. bar=0.5mm, X100, respectively.

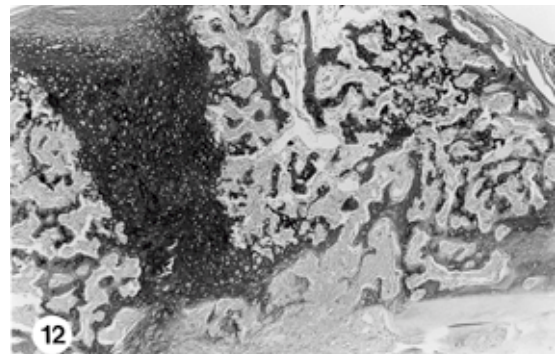
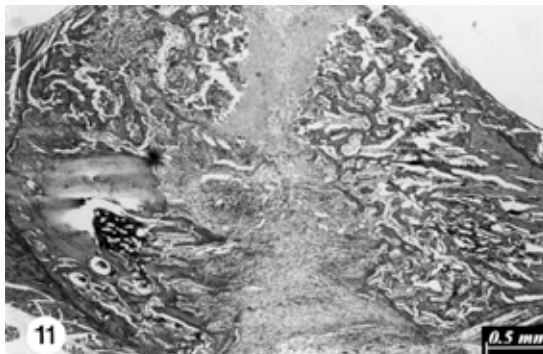


**Fig 7, 8.** Light microscopic findings of the osteotomized rib in the high dosage treated experimental rat at the 1st week after operation. Hematoma and osteotomized ends connected by cartilagenous callus are observed. Most of the cartilage matrix is reacted strongly with alcian blue except for region nearby periosteum. Dilated numerous blood vessels are seen in the periosteal thick bony trabeculae. HE stain and alcian blue(pH 2.5)-PAS stain. br=0.5mm, X100, respectively.

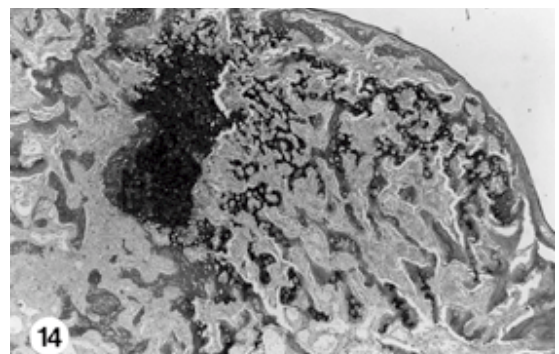
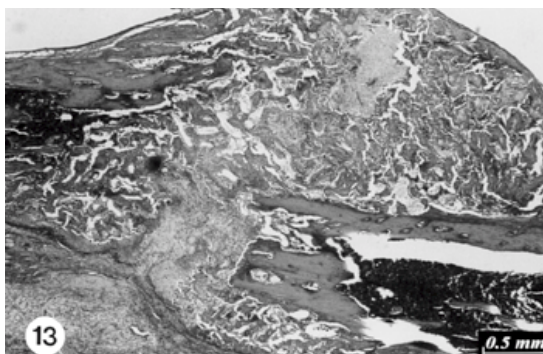




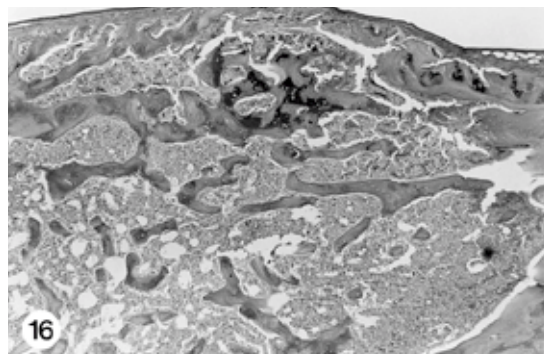
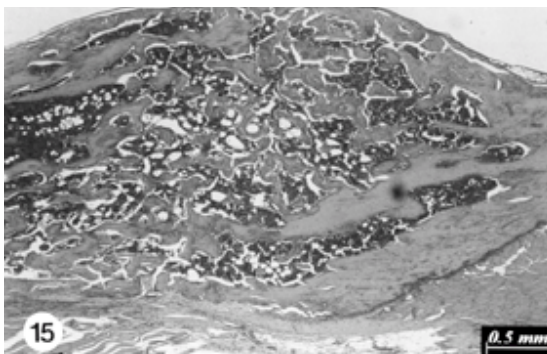
**Fig 9, 10.** Light microscopic findings of the osteotomized rib in the control rat at the 2nd week after operation. Hypertrophic chondroblast are seen in the cartilagenous callus. From the cartilagenous callus bony trabeculae are formed. HE stain and alcian blue(pH 2.5)-PAS stain. bar=0.5mm, X40, respectively.



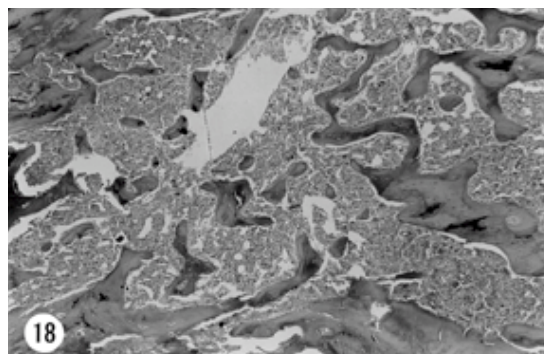
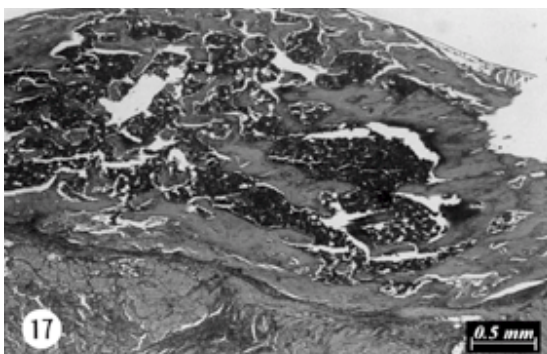
**Fig 11, 12.** Light microscopic findings of the osteotomized rib in the low dosage treated experimental rat at the 2nd week after operation. Numerous newly formed bony trabeculae containing hypertrophied chondrocyte are observed. Cartilage matrix is calcified to be reacted moderately or strongly with PAS. HE stain and alcian blue(pH 2.5)-PAS stain. bar=0.5mm, X40, respectively.



**Fig 13, 14.** Light microscopic findings of the osteotomized rib in the high dosage treated experimental rat at the 2nd week after operation. Numerous bony trabeculae are formed, so small portion of the cartilagenous callus is remained. HE stain and alcian blue(pH 2.5)-PAS stain, bar=0.5mm, X40, respectively.



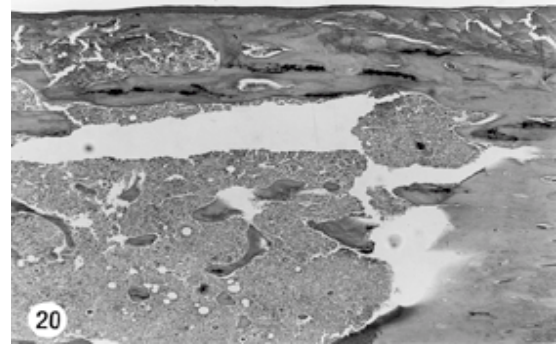
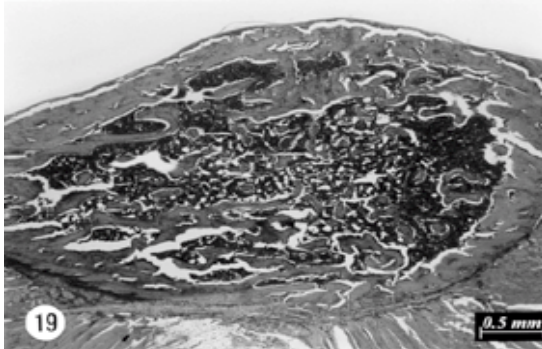
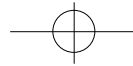
**Fig 15, 16.** Light microscopic findings of the osteotomized rib in the control rat at the 4th week after operation. Remodelling stage. Osteotomized both ends are connected by slender bony trabeculae. Some trabeculae possess cartilage matrix containing hypertrophied chondrocyte. In the medullary cavity thick bony matrices are seen. HE stain and alcian blue(pH 2.5)-PAS stain, bar=0.5mm, X40, respectively.



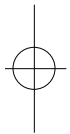
**Fig 17, 18.** Light microscopic findings of the osteotomized rib in the low dosage treated experimental rat at the 4th week after operation. Relatively thick bony trabeculae are connecting both osteotomized ends. HE stain and alcian blue(pH 2.5)-PAS stain, bar=0.5mm, X40, respectively.

가 (Fig. 17,18).  
 alcian blue (B+++)  
 가 (Fig. 13,14).  
 4  
 가 (Fig. 15,16).  
 4  
 가 (Fig. 19,20).





**Fig 19, 20.** Light microscopic findings of the osteotomized rib in the high dosage treated experimental rat at the 4th week after operation. Osteotomized both ends are completely connected by thick compact bone. Within medullary cavity tiny bony trabeculae are found. HE stain and alcian blue(pH 2.5)-PAS stain, bar=0.5mm, X40 respectively.



4) 14  
가  
, Tang 16) 450  
300 1 5g 1 PAS alcian blue(pH 2.5) alcian blue(pH 2.5)-  
2 28 1/3 Mowry<sup>13)</sup> PAS  
가 52%, 1/3-1/5 alcian blue  
가 45.6% 97.6% , Greco 8)  
alcian blue(pH 2.5)-PAS  
3 1) 60  
4 1 15g (purple) . PAS  
, 가 36 , 2/3 가 22 1/3 96.6%  
2) PAS alcian blue(pH 2.5)-  
40 1 10g PAS alcian blue  
5g 450 1 10g, 1 가 1 alcian blue  
2-3 가 5-10  
가  
(mucopolysaccharides)가  
가  
(calcium hydroxyapatite) 가 alcian blue  
가 alcian blue



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가 . 2 ,  
 가 ,  
 2 가 .  
 PAS ,  
 가 , Ham<sup>9)</sup> Girgis Pritchard<sup>7)</sup>  
 가 .  
 PAS 가 가 4  
 alcian blue . 가  
 가 가 가  
 , 가 5,11,18)  
 , 2  
 , Ham<sup>9)</sup> 가 , 가  
 가 , 가 1  
 가 가 가  
 Girgis Pritchard<sup>7)</sup> 가  
 . Rhinelande  
 Baragry<sup>15)</sup> 가 ,  
 가 (medullary arterial system)가 가 (uniting , 가  
 callus) 가 Rhinelande<sup>14)</sup> 가  
 가 1 , 2 , 4  
 , McKibbin<sup>12)</sup> 가 (external callus) .



alcian blue  
가  
2  
가  
4

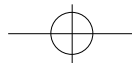
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가

가

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#### Abstract

### Effects of Yuhan Bone Connecting Powder on the Repair of Fractures in Rats

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*Department of Anatomy\**

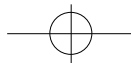
*Department of Nuclear Medicine\*\**

*Hanyang University College of Medicine*

**Objectives** : We have studied the effects of Yuhan bone connecting powder on the healing process of the frauture at the osteotomized bones in rat, using bone densitometer, X-ray and morphological studies after administration of Yuhan bone connecting powder which has been reported in China as enhancing the processes of the fracture healing.

**Materials and Methods** : 90 Sprague-Dawley male rats were divided into the rib and tibia osteotomy groups. Each group was subdivided into the control, low dosage and high dosage groups. Rib and tibia were osteotomized under the general anesthesia with ketamin. From the next day after operation, Yuhan bone connecting powder diluted with distilled water was administrated to low(0.68g/kg) and high(1.36g/kg) dosage groups per se. Same amount of the distilled water was used to the control group. 1.5cm long rib including the osteotomy site and whole tibia were excised. Bone densitometer using dual energy X-ray absorptiometry, radiological and morphological studies with HE stain and alcian blue(pH 2.5)-PAS stain were performed.

**Results** : BMD showed statistically significant difference between control group, low dose group and high dose group at 2weeks after treatment( $p=0.035$ ), but did not show such a good result at 1week( $p=ns$ ) and 4weeks( $p=0.091$ ) after treatment. Radiologically, after treatment for 2 weeks, the low and high dose groups showed more active callus formation than control group. Morphologically, dilated numerous blood vessels adjacent the bony trabeculae and well developed cartilagenous callus were



observed in the experimental group at the 1st week. At the 2nd week, many newly formed bony trabeculae were formed from the cartilagenous callus, and at the 4th week relatively thick compact bone and bony trabeculae were connecting the both osteotomy ends.

**Conclusion :** BMD at the osteotomy site seemed to be increased after administration with Yuhan bone connecting powder to rats, and this finding was supported radiologically at 2weeks after treatment. Morphologically, at the early stage of the fracture healing, numerous dilated blood vessels were distributed and many bony trabeculae were formed from the cartilagenous callus. At the remodelling stage relatively thick compact bone was connecting the both ends of the osteotomy site. So it is suggested that Yuhan bone connecting powder would induce enhancing the healing process of the osteotomized bone in rat through active vascularization, mineralization of the cartilage matrix, endochondral ossification and remodelling.

**key words :** Repair of fracture, Yuhan bone connecting powder, Rat

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