

1 .      1 .      2 .      3 .      1 .      1

1

2 ,      3

I.

가      HA

1)      가      HA      -

가      ,      calcium

가      .      phosphate      HA

hydroxyapatite(HA)가 가      HA      3,7,8) .

HA      가      ,

2-5) .      HA      HA      50 - 100 $\mu$ m      6,7) .

De Groot      6)      HA      HA      , Klein      9)      Cook      10)

HA      600 - 700 MPa      , 200 - 250 MPa

dense HA      , Jansen      11)      Van Blitterswijk      12)

가      HA      가      Bagambisa      13)      HA

. HA  
 calcium phosphate  
 phase <sup>14)</sup>,  
 crystalline HA가

<sup>15)</sup>, amor -  
 phous calcium phosphate tricalcium  
 phosphate(TCP) 가 가 HA  
<sup>14,16)</sup>. 가

, HA TCP  
 biphasic calcium phosphate ceramics  
 가

TCP 가 85 : 15 biphasic calcium  
 phosphate ceramic  
 가

<sup>17)</sup>.  
 HA

<sup>18,19)</sup>,  
 가

<sup>20)</sup>. 5 - 8 가  
 , HA

가 가 <sup>21)</sup>, HA

<sup>21,22)</sup>,

HA HA

HA  
<sup>23-29)</sup>.

가

HA

, 가 .

II.

1.

8 9 12kg  
 5 가 1

. 가 8mm  
 3.8mm, 5.0mm, 6.0mm hexed  
 thread HA (STERI -  
 OSS , BASUSH & LOMB Co, U.S.A)  
 7 21 ,

(Teflon ,  
 Gore - Tex, W.L.Gore, Flagstaff, U.S.A)

2.

(1)

xylazine(Rompun , Bayer Vetchem  
 Korea Co.) 2cc ketamine(Ketara ,  
 ) 2cc

가 .

,  
 2% lido -  
 caine .

12cm

3 3 6mm 6mm  
 3 1cm가 6.0mm  
 6mm, 10mm hole , 5.0mm 5.0mm ( 2 )  
 hole 3.8mm, 3.8mm 3.8mm ( 1 )  
 5.0mm, 6.0mm 4  
 3.8mm, 5.0mm hole , 8 , 12 .  
 punch (2) 4  
 4-0 Terramycin (Pfizer) , 8  
 Terramycin (Pfizer) Arizarin Red  
 (Sigma) , 12 Terramycin  
 (Pfizer), Arizarin Red (Sigma) Calcein  
 (Sigma) 20mg/Kg 2  
 (Table 1).  
 3.8mm,  
 5.0mm 6.0mm 2 (3)  
 4, 8, 12  
 Lincomycine(Lincocin , ) 3 70% alcohol  
 2cc 2 1cc .

Table 1. Time schedule for intramuscular injections of fluorescent dyes

	Surgery	2 - week	4 - week	6 - week	8 - week	10 - week	12 - week
4 - week group	Tm	Tm	Sacrifice				
8 - week group	Tm	Tm	Ar	Ar	Sacrifice		
12 - week group	Tm	Tm	Ar	Ar	Cal	Cal	Sacrifice

Tm : Terramycin, Ar : Arizarine Red, Cal : Calcein.

Table 2. Miller's periotest value

Miller	Periotestvalue		
	0	-8	+9
	I	+10	+19
( 1mm )	II	+20	+29
( 1mm )	III	+30	+50

alcohol 6  
 . Villanueva bone stain 3  
 . 70%, 90%,  
 95%, 100% I, 100% II, 100% III, 100% IV  
 12 , Aceton Spurr  
 resin 1cm 가  
 Spurr resin 가  
 2 , 70 1

(AUTOGRAPH AGS -  
 1000D SERIES , JAPAN) 100kg  
 , 3 mm

III.

diamond wheel saw(South Bay  
 Technology inc.) 80 - 100 $\mu$ m 1.  
 , Omnilap 2000(South  
 Bay Technology inc.) 20 (1) 4  
 $\mu$ m

(confocal laser scanning microscope)

(3.8mm, 5.0mm, 6.0mm)  
 가

(4)

가

8 12

(Figure 1, 2, 3).

3.8mm

Periotest (Simens AG, Bensheim,  
 Germany)

2mm  
 2 가 Miller  
 가 (Table 2).

(Figure 1).

5.0mm

(5)

20cm

(Figure 2).

가

6.0mm

가

3.8mm 5.0mm

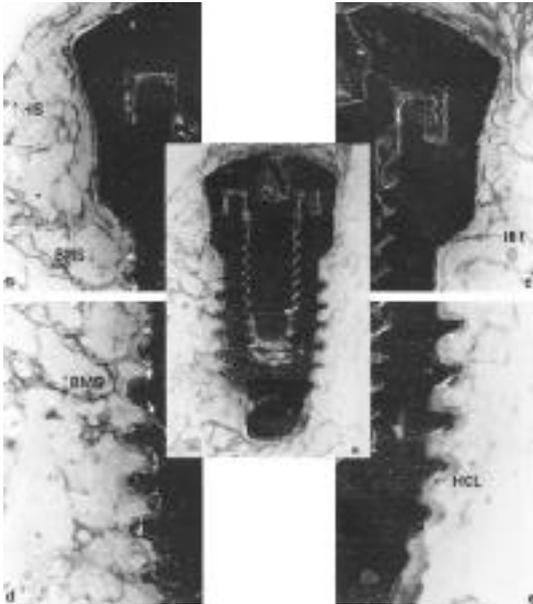


Figure 1. Micrographs of 3.8mm HA - coated implant after 4 weeks(Villanueva stain, a: x 10, b,c,d,e: x40)  
 1b, 1c : cortical portion, 1d, 1e : medullary portion, IBT : immature bone trabeculae, HCL : HA coating

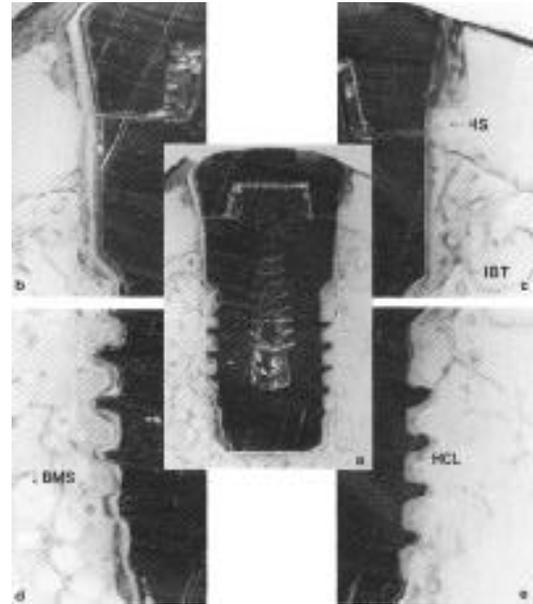


Figure 2. Micrographs of 5.0mm HA - coated implant after 4 weeks(Villanueva stain, a: x 10, b,c,d,e: x40).  
 2b, 2c : cortical portion, 2d, 2e : medullary portion, IBT : immature bone trabeculae, HCL : HA coating

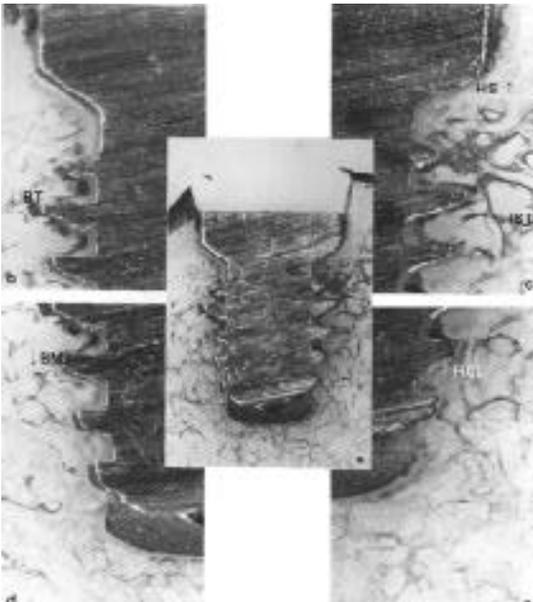


Figure 3. Micrographs of 6.0mm HA - coated implant after 4 weeks(Villanueva stain, a: x 10, b,c,d,e: x40)  
 3b, 3c : cortical portion, 3d, 3e : medullary portion, IBT : immature bone trabeculae, HCL : HA coating

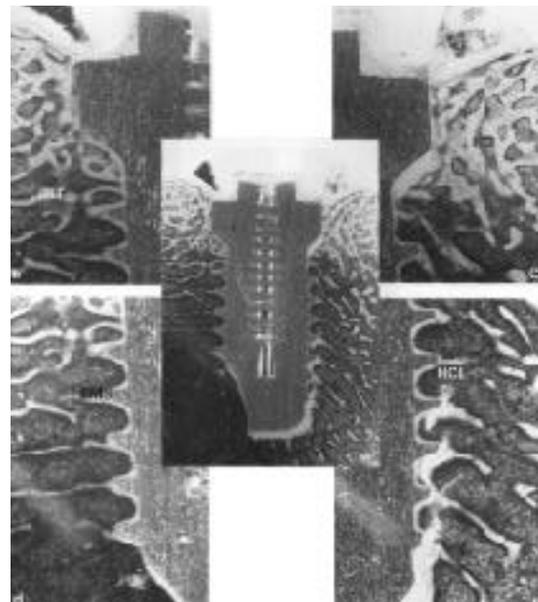


Figure 4. Micrographs of 3.8mm HA - coated implant after 8 weeks(Villanueva stain, a: x 10, b,c,d,e: x40)  
 4b, 4c : cortical portion, 4d, 4e : medullary portion, IBT : immature bone trabeculae, HCL : HA coating

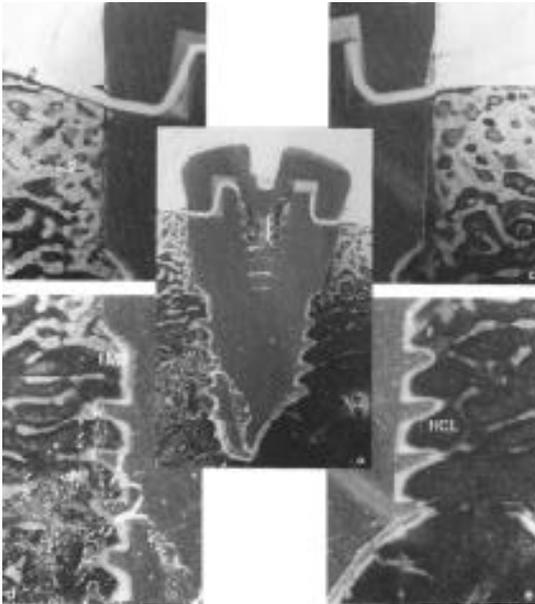


Figure 5. Micrographs of 5.0mm HA - coated implant after 8 weeks(Villanueva stain, a: x 10, b,c,d,e: x 40)  
5b, 5c : cortical portion, 5d, 5e : medullary portion, IBT : immature bone trabeculae, HCL : HA coating

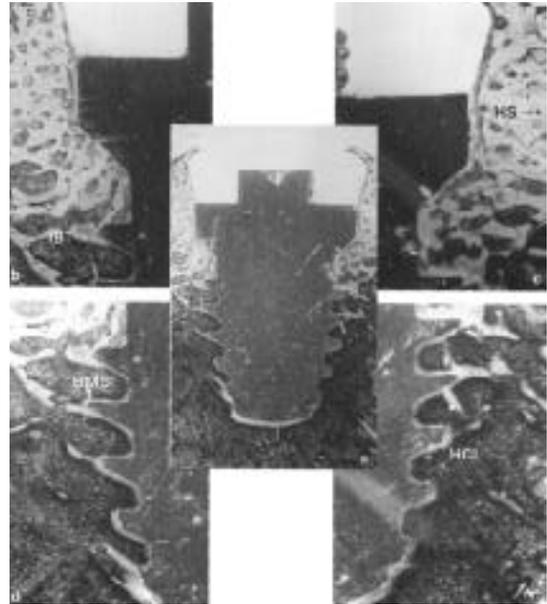


Figure 6. Micrographs of 6.0mm HA - coated implant after 8 weeks(Villanueva stain, a: x 10, b,c,d,e: x 40)  
6b, 6c : cortical portion, 6d, 6e : medullary portion, IBT : immature bone trabeculae, HCL : HA coating

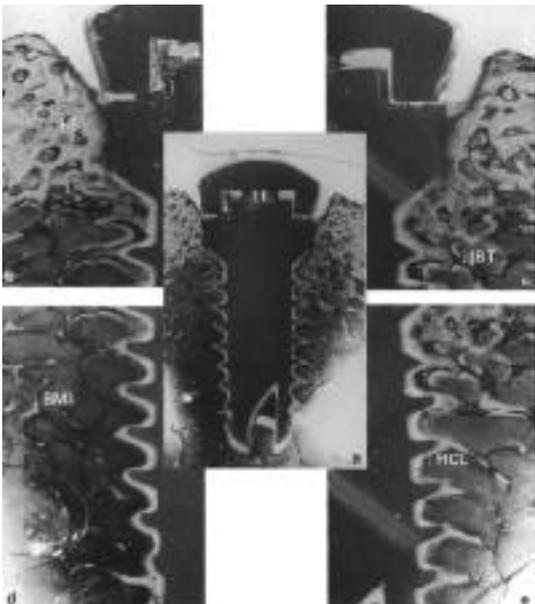


Figure 7. Micrographs of 3.8mm HA - coated implant after 12 weeks(Villanueva stain,a: x 10, b,c,d,e: x 40)  
7b, 7c : cortical portion, 7d, 7e : medullary portion, IBT : immature bone trabeculae, HCL : HA coating

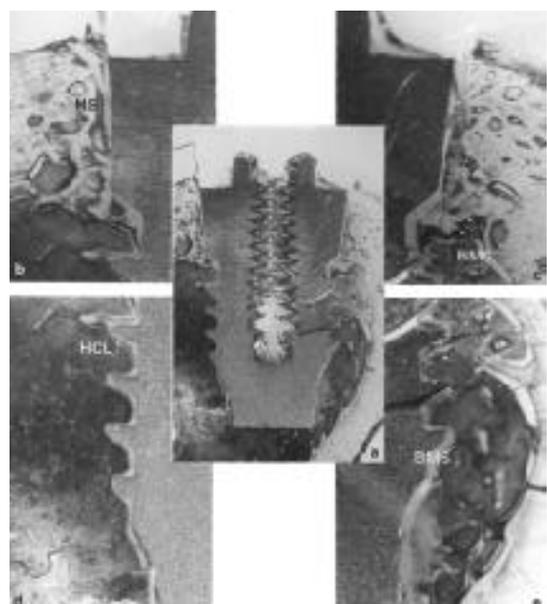


Figure 8. Micrographs of 5.0mm HA - coated implant after 12 weeks(Villanueva stain, a: x 10, b,c,d,e: x 40)  
8b, 8c : cortical portion, 8d, 8e : medullary portion, IBT : immature bone trabeculae, HCL : HA coating

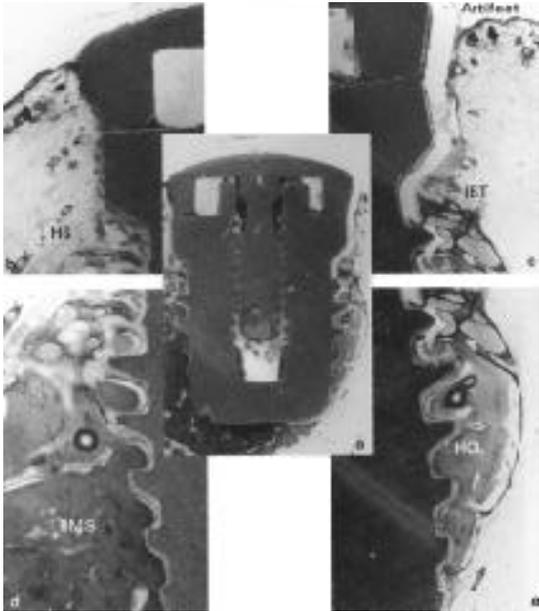


Figure 9. Micrographs of 6.0mm HA - coated implant after 12 weeks(Villanueva stain, a: x 10, b,c,d,e: x 40)  
 9b, 9c : cortical portion, 9d, 9e : medullary portion,  
 IBT : immature bone trabeculae, HCL : HA coating

(Figure 3).

(2) 8

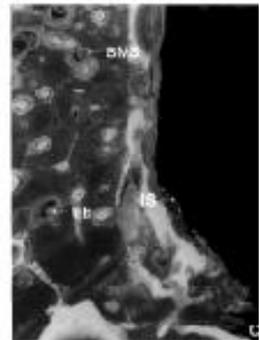
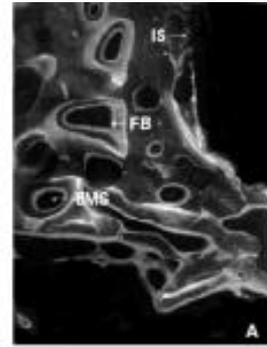


Figure 10. Confocal laser scanning micrograph of HA - coated implant after 12weeks(A : 3.8mm, B : 5.0mm, C : 6.0mm. x 40)

IS : implant surface, FB : fluorescent bands, BMS : bone marrow space.

(Figure 4).

5.0mm

3.8mm

6.0mm  
5.0mm

3.8mm

(Figure 4, 5, 6).

, 4

3.8mm

가

4

가 가

(Figure 5, 6).

4

(3) 12

8

(Figure 7, 8, 9).

3.8mm

Table 4. Removal torque test value(Unit:Ncm)

group	8 - week(n=2)		12 - week(n=2)	
6.0mm	22.06	19.84	102.46	96.52
5.0mm	10.74	10.24	53.52	50.86
3.8mm	5.68	6.12	23.65	25.94

(n) : number

8

가 3.8mm ,

(Figure 7).

5.0mm , 6.0mm

5.0mm 6.0mm

3.8mm

, 6.0mm

3.8mm

5.0mm

6.0mm

12

가

(Figure 8, 9).

5.0mm, 6.0mm

, 가 3.8mm,

, 6.0mm

2.

(Figure 10).

Table 3. Periotest value

group	8 - week(n=2)		12 - week(n=2)	
6.0mm	-6	-7	-8	-8
5.0mm	-5	-6	-7	-8
3.8mm	-5	-5	-6	-7

(n) : number

3.

가 8

12

6.0mm , 5.0mm , 3.8mm 8

(Table 3).

4

3.8mm

5.0mm

4.

가

가 8

12

, 6.0mm

가

, 6.0mm , 5.0mm 3.8mm

가 , Block 8)  
, 6.0mm , 5.0mm , 3.8mm 10 HA  
(Table 82.6%, grit - blasted titani -  
4). um 50.2% ,  
IV. Gottlander 25) TPS  
HA 6  
HA 75.9%,  
59.9%  
Weinlander 35)  
3 3  
tita -  
2-5). niun screw 45.66%, titanium  
Hartman 30) Kay 31) cylinder 54.96%, HA  
cylinder 71.35% .  
HA HA  
32), dense HA  
HA sandblaster 15), HA  
, HA  
HA  
plasma - 가 , HA  
spraying , sputter coating , vapor HA  
deposition , glow discharge , 20  
33) , HA 50 nm  
, 3 36).  
HA 가 3,000m/s 1. HA  
ma - spraying HA coating plas -  
HA 가 6).  
HA HA coating 4  
, Kim 34)  
4 HA 가  
(Integral, Calcitec ; Bio - Vent, Dentsply ;  
Denar Steri - Oss, Steri - Oss ; Sustain,  
Lifecore Biomedical) crys- 6.0mm Jansen<sup>11)</sup>, 37),  
talline HA, tricalcium phosphate, amorphous 38) 4  
calcium phosphate가 30% 66%  
. 5.0mm 6.0mm  
HA .

8

12 가

HA

, Block <sup>8)</sup>

, 6.0mm

HA

grit -

Jansen <sup>11)</sup> 8

2

blasted titanium cylinder

, HA

<sup>39)</sup>,

<sup>38)</sup>

8

가 1

4

, Weinlander <sup>35)</sup>

12

8

, Gottlander <sup>25)</sup>

HA

3.8mm

가

<sup>38)</sup>

HA

, 5.0 6.0mm

2. HA

Han Han<sup>40)</sup>, Schenk<sup>41)</sup>,

<sup>38)</sup>

가

, <sup>44)</sup>  
Periotest

<sup>45-48)</sup>,

가

<sup>49-52)</sup>,

(cutting resistance)

<sup>53)</sup>

Periotest value(PTV)

<sup>42,43)</sup>,

Teerlinck <sup>54)</sup>

PTV +1.5 +7

가

6 - 42

, 3.8mm 6.0mm

PTV가 - 1.74

, Chavez

<sup>45)</sup>

2 -

0.5mm

24

PTV가 - 6 +2

(5.0mm )

12 가

Chavez <sup>45)</sup>

1.1mm

(3.8mm )

PTV가 +6

, Olive



가 Sennerby<sup>53)</sup>  
 가  
 HA  
 Type bone(low  
 density, cancellous bone), 10mm

Oss ) 6.0mm  
 , 5.0mm 3.8mm  
 5 3  
 2  
 Terramycin , Arizarin Red , Calcein  
 4 , 8 12  
 Villanueva  
 , 2 8 12  
 (Periotest : Simens AG,  
 Bensheim, Germany)  
 (Autograph AGS - 1000D series , Japan)

34,59)

HA

5.0mm

, 3.8mm

2.

( 8 , 12 )

가

가

3.

가

, HA

가

V.

가

가

5

6mm,

10mm

VI.

3

3

, 2

6

6.0mm, 5.0mm 3.8mm

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8.0mm

HA

(Steri -

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- Abstract -

## Healing of the Bone around Hydroxyapatite - Coated Implants without Primary Bone Contact

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Implant stability is the key to long - term successful outcome for osseointegrated implants. To evaluate the initial healing response of bone around HA - coated implants without primary bone contact. 21 HA - coated thread type implants(STERI - OSS?) were placed in the femurs of 5 mongrel dogs, about 1 - year old.

Implants, 8 mm in length and 3.8mm(experimental 1group), 5.0mm(experimental 2group) and 6.0mm(control group) in diameter, were inserted after 3 holes of 6.0mm in diameter and 10mm in depth were prepared in the surgical sites each dog.

Implants were supported by only non - resorbable membrane(Teflon ), in order to prevent the ingrowth of upper soft tissue into the gap between bone and implant, and to maintain each implant to be positioned in

the center of the drilled hole.

9 implants with different diameters were inserted in 3 dogs for histologic observation, and 12 implants were inserted in 2 dogs for mobility test and removal torque test.

Fluorescent dyes were injected for the observation of new bone formation in order of Terramycin , Arizarin Red , and Calcein at an interval of 2 weeks.

3 dogs were sacrificed for histologic observation at 4, 8, and 12 - week after placement. Light microscopy and confocal laser scanning microscopy were used to qualitatively characterize the bone around HA - coated implant.

2 dogs were sacrificed for mobility test(Periotest , Simens AG, Bensheim, Germany) and removal torque test (Autograph AGS - 1000D series, Japan) at 8 and 12 - week after placement

The results were as follows:

1. Histologic observation showed that osseointegration occurred to both control and experimental groups as time lapse, but delayed bone healing was revealed in 3.8mm group (experimental 1group), compared to control group and 5.0mm group (experimental 2group).
2. The mobility test showed that the experimental groups had no distinguishable movement during experimental periods of 8 and 12 - week, and there was no difference in mobility depending on the gap between bone and implant, and time lapse.
3. The removal torque forces were

increased depended on the gaps decreasing between bone and implant, and time lapse.

The results suggest that HA - coated implant without primary bone contact, based on guided bone regeneration could obtain its stability in all experimental groups as time lapse, but bone healing was delayed in experimental group of 3.8mm. And the results suggested that studies on correlation between mobility test and removal torque test for implant stability would be necessary.