

“R”

가

“R”

가

2001 12

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	.....	
I.	.....	1
II.	.....	4
1.	.....	4
2.	.....	4
III.	.....	9
1.	.....	9
2.	가 .....	9
IV.	.....	13
V.	.....	16
	.....	19
	.....	23

Fig 1. Drawing of enamel specimen . . . . .	.4
Fig 2. Removable oral appliance attached with demineralized enamel specimen . . . . .	.7
Fig 3. Quantitative mineral volume change(%) of enamel . . . . .	10
Fig 4. Average mineral volume change of enamel specimen with remineralization solution "R" . . . . .	11
Fig 5. Average mineral volume change of enamel specimen with saline . . . . .	11
Fig 6. Average mineral volume change of enamel specimen with Senstime® . . . . .	12
Table 1. Initial composition of demineralization solution . . . . .	.6
Table 2. Initial composition of remineralization solution . . . . .	.6
Table 3. Experimental solution . . . . .	.8
Table 4. Remineralization peak depth from the surface . . . . .	10

가

가

가

가

"R"

microradiography

가

30

가

15

3 5

"R"

saline, (Senstime<sup>®</sup>)

. 15

microradiography

, 가 .

1. "R" Senstime<sup>®</sup> Saline

.(P<0.05)

2. "R"

.(P<0.05)

"R"

가

가

:

,

,

,

“R”

가

( : )

I.

가

<sup>18)</sup>

가

가

가

가

<sup>4,7)</sup>

가

. Moreno<sup>19)</sup>



pH 가 ,  
가 가 가  
dihydrate(DCPD) dicalcium phosphate .<sup>41)</sup>

, Chow<sup>4)</sup>

. 가  
가 .

.<sup>2)</sup>

가  
Ten Cate<sup>26)</sup> .  
Koulourdes<sup>12)</sup> 가  
가 가 가

Silverstone<sup>21)</sup>

. Ten Cate<sup>27)</sup>

crystallite

, lesion ,  
가

Ten Cate<sup>28)</sup>

1ppm

가 가 .<sup>42)</sup>

2ppm

가

. ,

가

.

가

가

36,39)

가

microradiograph

.

## II.

1.

가 30 , ,  
30 .  
, 가 (Senstime<sup>®</sup>, Ildong  
Co., Korea)

2.

가  
curette 가 pumice  
, 가 2-3mm window  
, Gold grid  
nail vanish  
bonding resin (Scotchbond MP, 3M ,U.S.A) 가



Fig 1. Drawing of enamel specimen

3.

1 )Stock

30% lactic acid (Sigma Co.U.S.A, 90.08, 1.080) 1M  
lactic acid , (Sigma Co.U.S.A, 147.0)  
0.3M (Sigma Co., 136.1)  
0.9M 100

(790PersonalIC.Metrohm.Ion analysis.Switzerland)

2)

Stock 15mM, 9.5mM, NaN<sub>3</sub> 3.08mM, lactic acid  
100mM 0.155<sup>29)</sup>가 , 8M KOH  
pH meter(Advanced Ion Selective Meter 920. Orion  
Research, U.S.A) pH 4.3 . 100  
(790PersonalIC.Metrohm.Ion analysis.Switzerland)

3)

10ppm (100ppm NaF Standard solution, Orion  
Research Inc., U.S.A.) 2ppm ,  
stock Table 2 protocol

Table 1. Initial composition of demineralization solution

Composition	Concentration (mM)
Lactic acid(mM)	100
Calcium (mM)	15.1
Phosphate(mM)	9.6
Sodium azide(mM)	3.08
pH	4.3
Degree of saturation	0.155

Table 2. Initial composition of remineralization solution

Composition	Concentration (mM)
Lactic acid(mM)	10
Calcium (mM)	31.2
Phosphate(mM)	12.0
Sodium azide(mM)	3.08
Fluoride(ppm)	2
pH	4.3
Degree of saturation	0.339

4.

50cc

30cc

37

. 2

가

microradigraph

.

5.



Fig 2. Removable oral appliance attached with demineralized enamel specimen

6.

15

1 3 가 ( , )

( , , ) 5 가

15

Table 3. Experimental solution

Group	Treatment solution
	“R”
	Saline
	Senstime <sup>®</sup>

7.  
 15  
 5mA, 37Kvp      1      30      microradiograph  
 microradiograph      100      Coolpix950  
 (Nikon corporation.Japan)      Image  
 analysis program  
 Excel(MS Office 2000,Microsoft U.S.A)  
 가      가  
 Mineral intensity가 가  
 Kruscal-Wallis test      Duncan

### III.

1.

Microradiography

erosion

가 . 30

$198 \pm 95\mu\text{m}$

가

2.

가

가

“R”  $34.53 \pm 14.08\%$ ,

$22.06 \pm 13.67\%$ , Senstime<sup>®</sup>

$28.97 \pm 9.18\%$

가

(Table 4, Fig 3)

가

mineral intensity가 ,

가

$97 \pm 15.08\mu\text{m}$ ,

$37 \pm 8.72\mu\text{m}$ , Senstime<sup>®</sup>

$73 \pm$

$17.01\mu\text{m}$

(Table 4)



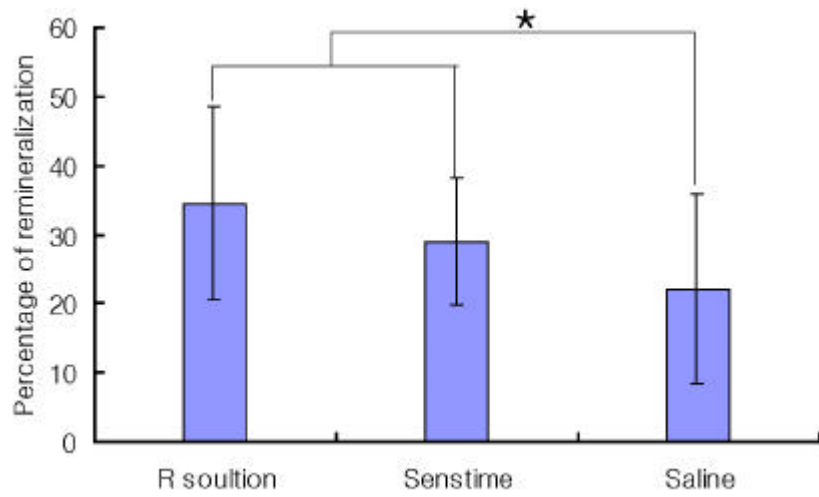


Fig 3. Quantitative mineral volume change(%) of enamel

Table4. Remineralization peak depth from the surface

Group	Remineralization peak depth( $\mu m$ )
R solution	$97 \pm 15.08$ *
Saline	$37 \pm 8.72$
Senstime <sup>®</sup>	$73 \pm 17.01$

\* significantly different ( $p < 0.05$ )

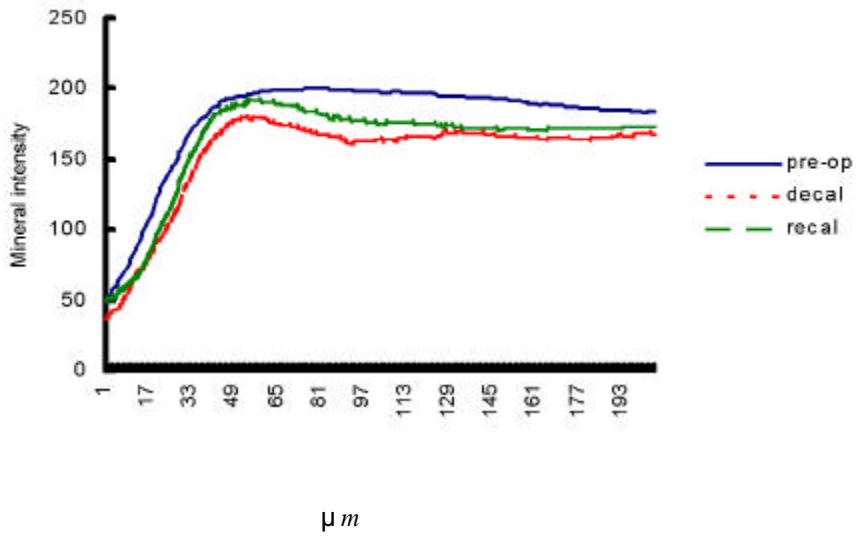


Fig 4. Average mineral volume change of enamel specimen with remineralization solution "R"

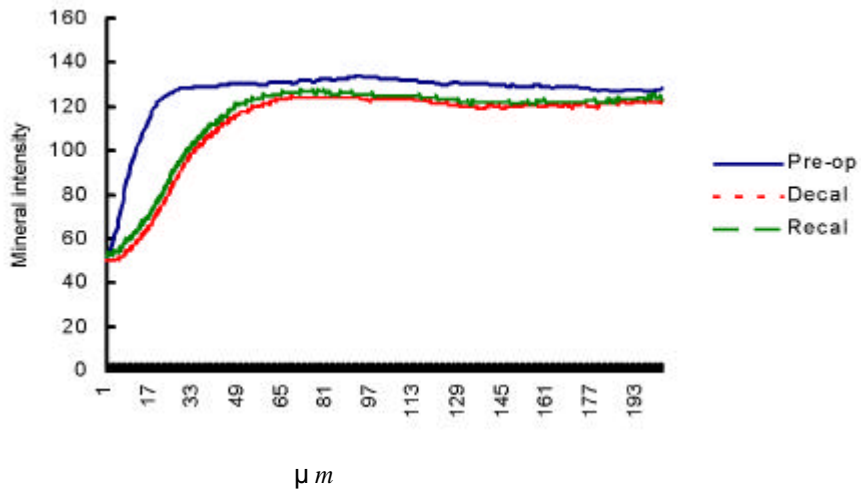


Fig 5. Average mineral volume change of enamel specimen with saline



#### IV.

가 가  
pH, pH<sup>29,34,35,38,40</sup> 가  
(supersaturated) 가  
(undersaturated) 가<sup>31)</sup>  
(Degree of saturation) pH , ,  
Brudevold<sup>3)</sup> 가  
가 Bunnocore<sup>24)</sup>  
Moreno<sup>19)</sup> ,  
가 가  
dicalcium phosphate dihydrate(DCPD)  
가 , 가  
가

DCPD 가 가

가

1974 Larsen<sup>13)</sup> 가 (undersaturated)

가

가

Ca-P crystal 가 ,

가

artificial gel

<sup>9,22)</sup>, partially saturated buffer <sup>15)</sup>, plaque bacteria<sup>5)</sup> gel

, partially saturated buffer

가

pH <sup>38)</sup> 4.3 <sup>41)</sup> <sup>38)</sup>

가

pH <sup>35)</sup> pH 4.0

5.5 pH

pH가  
 . Margolis<sup>16)</sup> 1ppm 가  
 가 , 1ppm  
 가  
 . 가  
 39) 가 가  
 가 가 0.339  
 36) 가 가  
 가 . 가 가  
 microhardness <sup>1)</sup>microradiograph<sup>10)</sup>, <sup>23)</sup>  
 light scattering<sup>25)</sup> .  
 가  
 . Microradigraphy  
 . gold grid  
 grid window .  
 17,33,37)  
 plaque fluid  
 30)

<sup>20)</sup>, *in vitro* 가  
*In vivo* pH, <sup>6)</sup>,  
 가 <sup>32)</sup>,  
 가  
 Senstime<sup>®</sup> saline 가  
 Senstime<sup>®</sup> ,  
 가 90.48 ppm <sup>36)</sup> 가  
 Senstime<sup>®</sup> 가  
 가  
 0.001ppm Larsen<sup>14)</sup>  
 1ppm <sup>42)</sup> 가  
 flouroaptite가  
 , Senstime<sup>®</sup>  
 가  
 가 , bicarbonate ,  
 가 macromolecule  
 pellicle

8.11)

Senstime®

가



V.

15  
Senstime<sup>®</sup> microradiograph  
가 . Saline  
1. Senstime<sup>®</sup> Saline  
. (P<0.05)  
2. . (P<0.05)  
가 "R"  
가

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**Abstract**

***In vivo* Quantitative Analysis of  
Remineralization effect of remineralization  
solution "R" of incipient enamel dental caries**

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Dental caries is a chronic disease that causes the destruction of tooth structure by the interaction of plaque bacteria, food debris, and saliva.

There has been attempts to induce remineralization by supersaturating the intra-oral environment around the surface enamel, where there is incipient caries.

In this study, supersaturated remineralized solution "R" was applied to specimens with incipient enamel caries, and the quantitative analysis of remineralization was evaluated using microradiography. Thirty subjects volunteered to participate in this study. Removable appliances were constructed for the subjects, and the enamel specimen with incipient caries were embedded in the appliances. The subjects wore the intra-oral appliance for 15 days except while eating and sleeping.

The removable appliance were soaked in supersaturated solution "R", saline, or Senstime<sup>®</sup> to expose the specimen to those solutions three times a day, 5 minutes each time. After 15 days, microradiography was retaken to compare and evaluate remineralization.

The results were as the following:

1. The ratio of remineralized area to demineralized area was significantly higher in the supersaturated solution "R" and Senstime<sup>®</sup> than in the saline ( $p < 0.05$ )
2. Remineralization in the supersaturated buffer solution "R" occurred in the significantly deeper parts of the tooth, compared to the Senstime<sup>®</sup> group containing high concentration of fluoride. ( $p < 0.05$ )

As in the above results, the remineralization effect of remineralized buffer solution "R" on incipient enamel caries has been proven. For clinical utilization, further studies on soft tissue reaction and the effect on dentin and cementum are necessary.

In conclusion compared to commercially available fluoride solution, remineralization solution "R" showed better remineralization effect on early enamel caries lesion, so it is considered as effecient solution for clinical application

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Key words : enamel caries ,remineralization solution, remineralization,  
removable oral appliance,microradiography