Novel Bio-Adhesive Gels for Hemostatics and Adhesion Barrier

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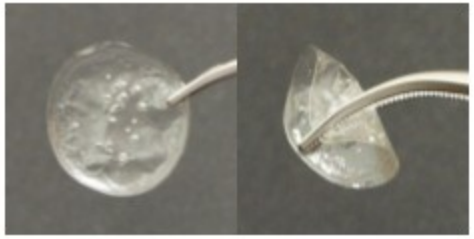
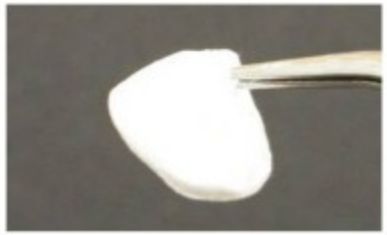
- Golden Orchid Brothers, Inc.; Adviser
- Obara Hospital; Adviser

Bioadhesive Gels Containing Poly(acrylic Acid) for Hemostatics and Adhesion Barrier Devices

- **Flexible Film**



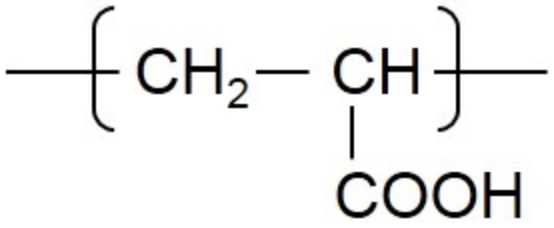
- **Sponge**



Highly Safe!!

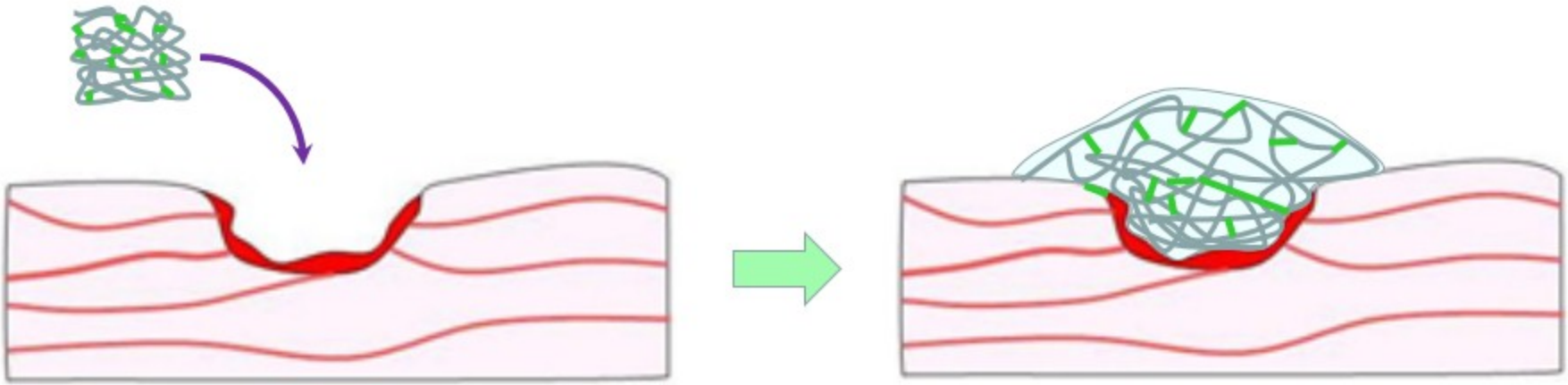
- All the materials used are approved as pharmaceutical additives
- Spontaneously dissolved at pH 7.4

Poly(acrylic acid) (PAA) gel has been known to form a bioadhesive gel



Poly(acrylic acid) (PAA)

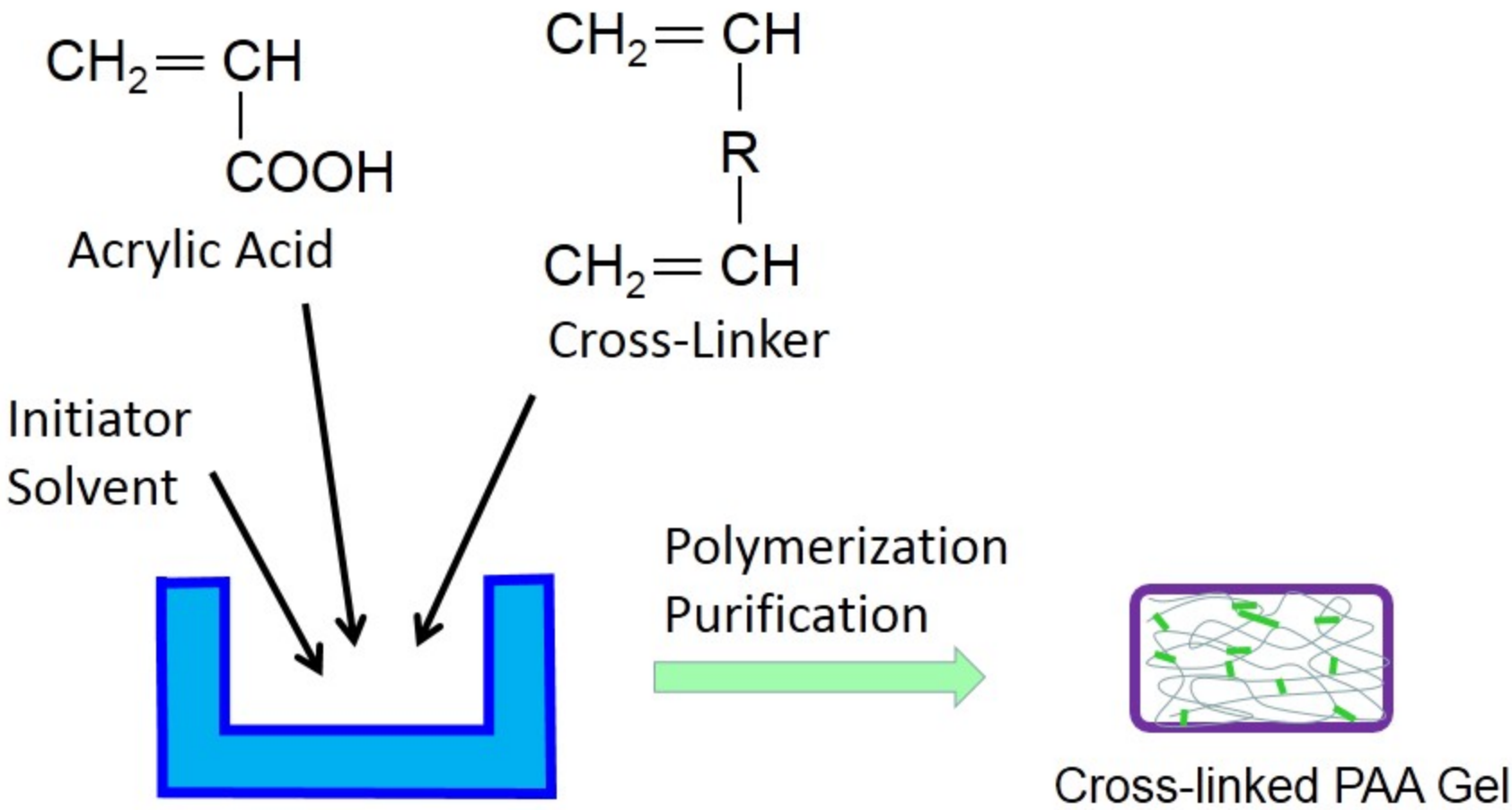
Cross-linked PAA Gel



Cross-linked PAA gel could be used as a hemostatic device.

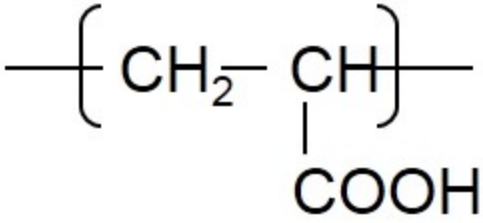
However,

Large Cross-linked PAA Gel is Difficult to be Prepared and Molded.



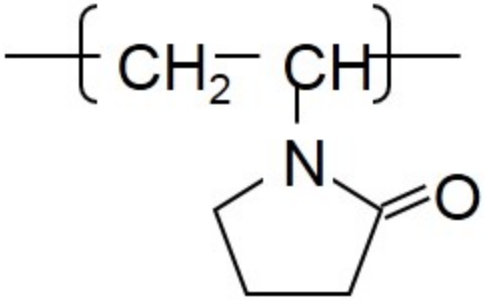
Hydrogen Bonding Complex Gel

Poly(acrylic acid)



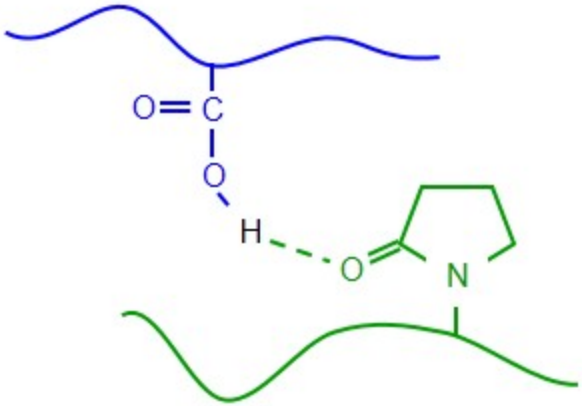
+

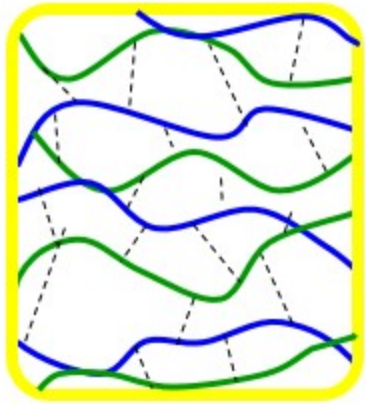
Poly(vinylpyrrolidone)



Mixed

(Not Reacted)



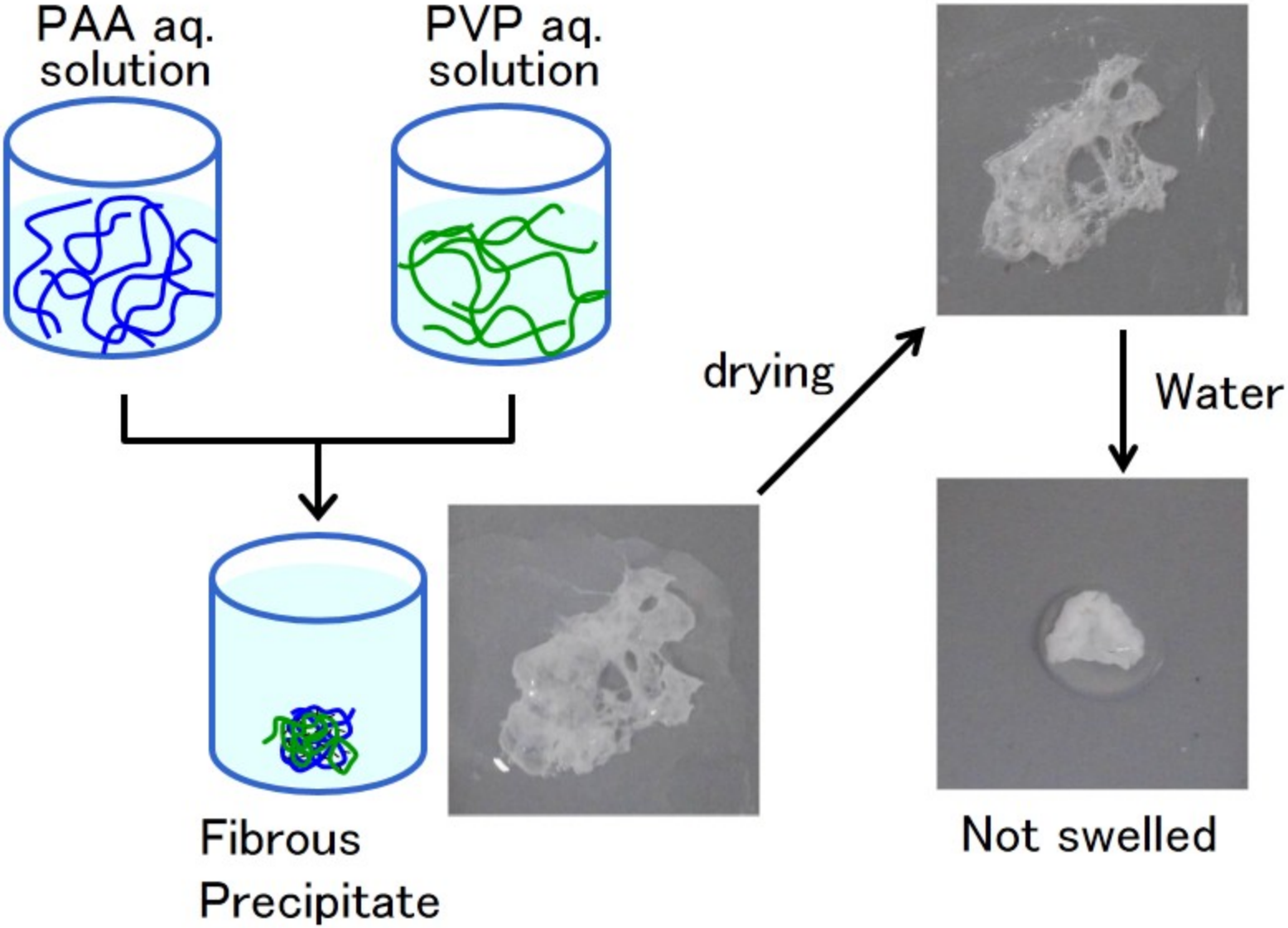


Not Chemically Bound
Just Physically Attracted

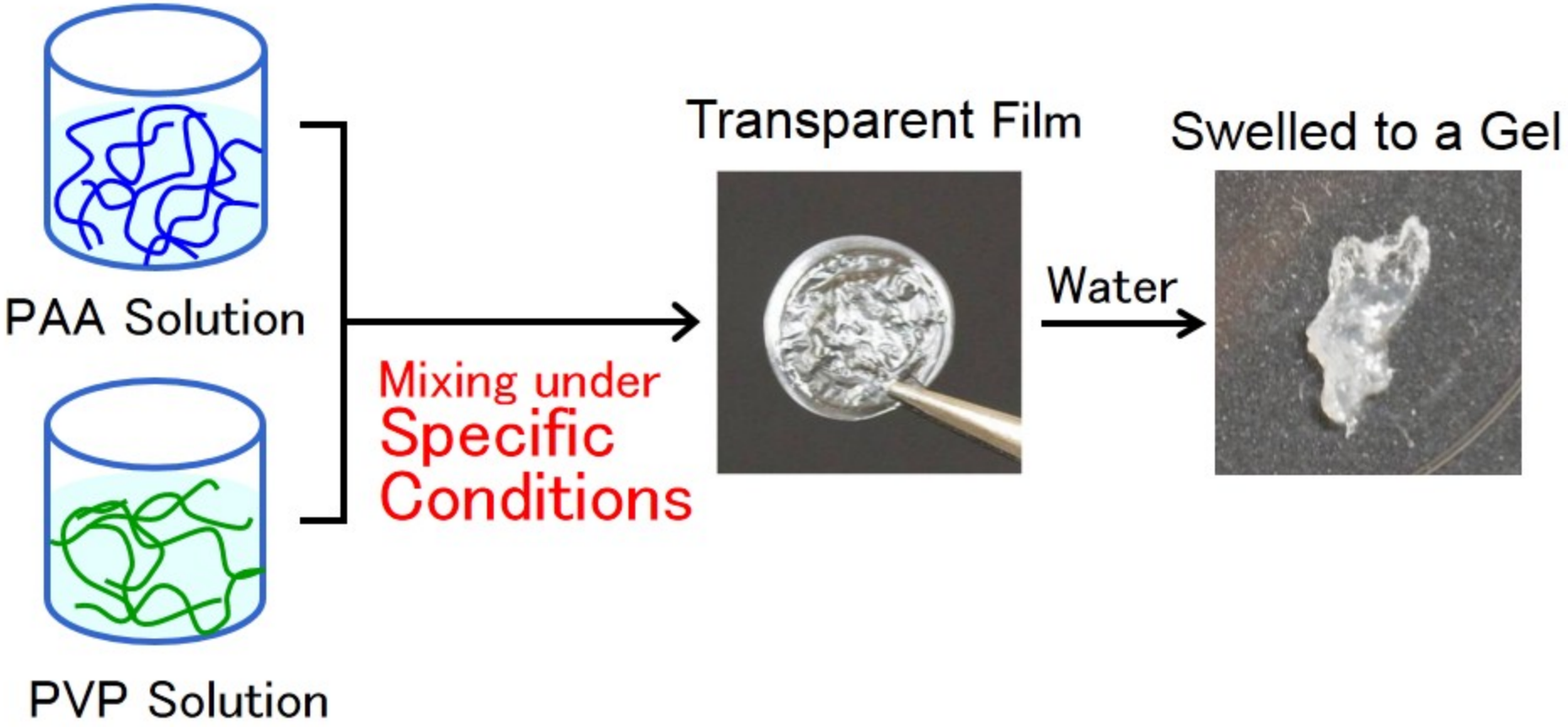
Could be Prepared by Mixing the Solutions

But, , ,

mixing of the solutions results in precipitating

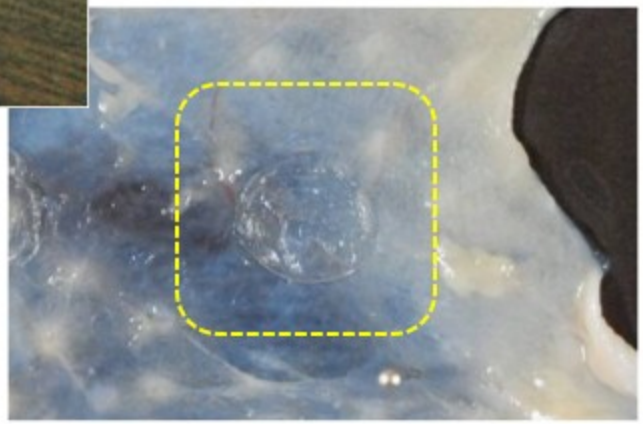


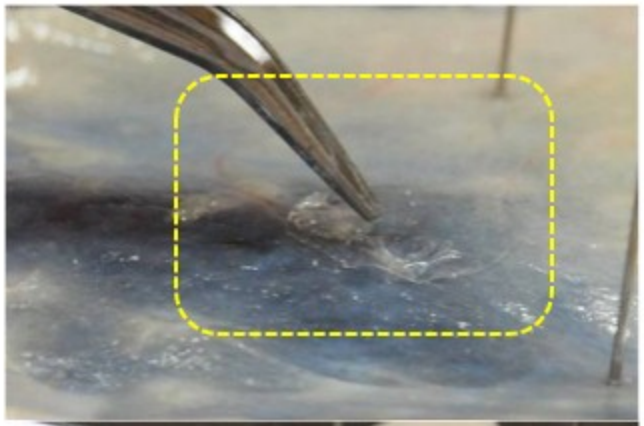
We Have Succeeded in Preparation of the PAA/PVP Complex Film Which is Swellable in Water

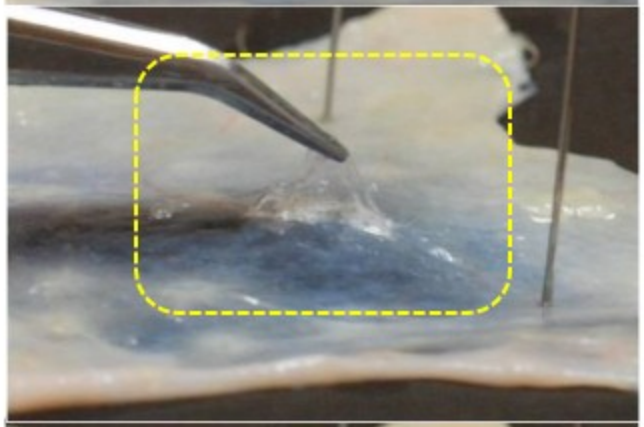


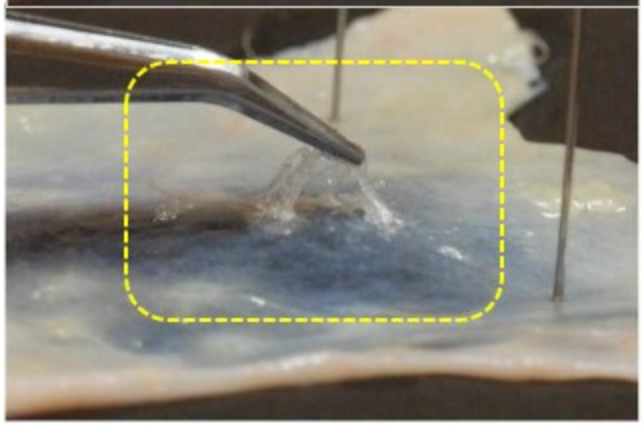
Swelled in Water to a Soft Gel

Adhesion to Tissue



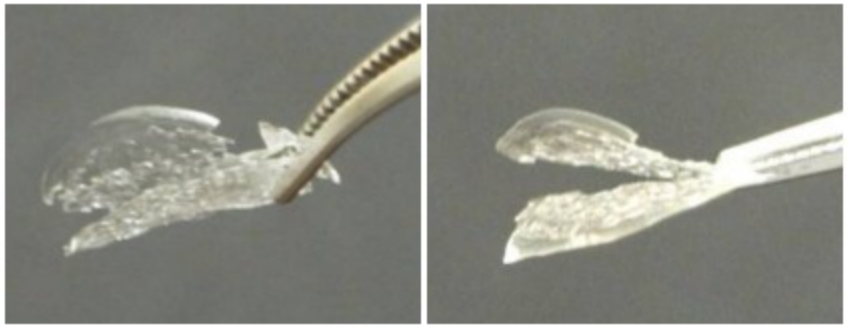






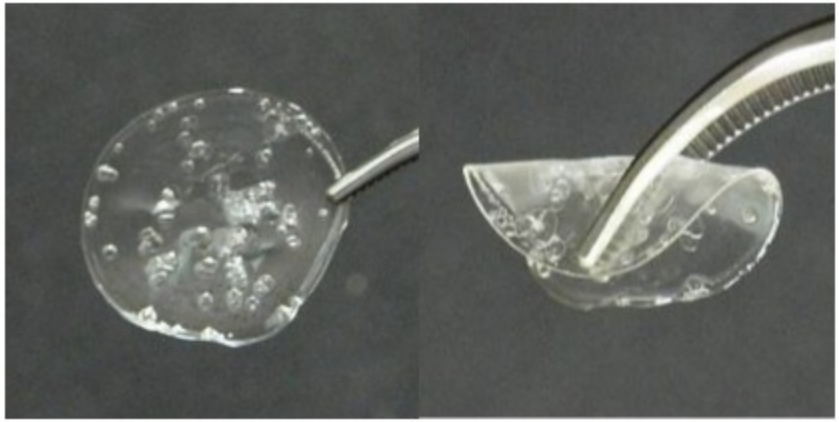
Improvement of the Film (1)

PAA + PVP



Brittle Film

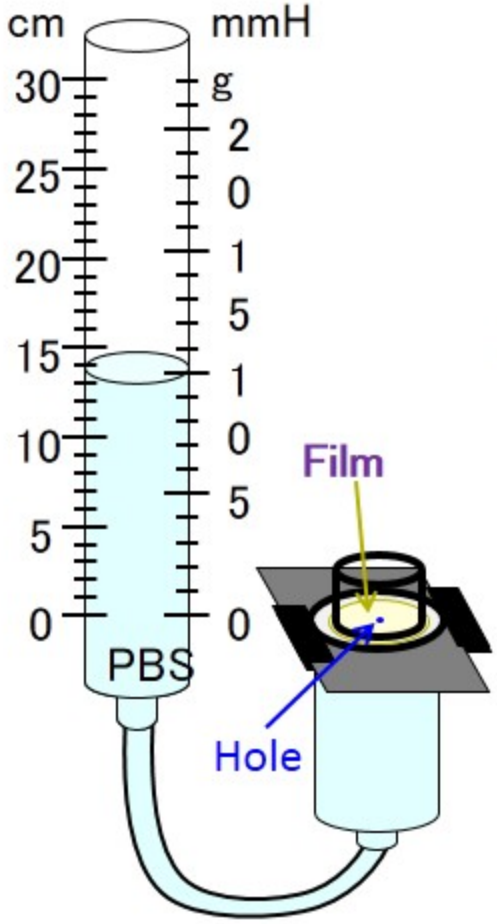
Addition of Polymer-A

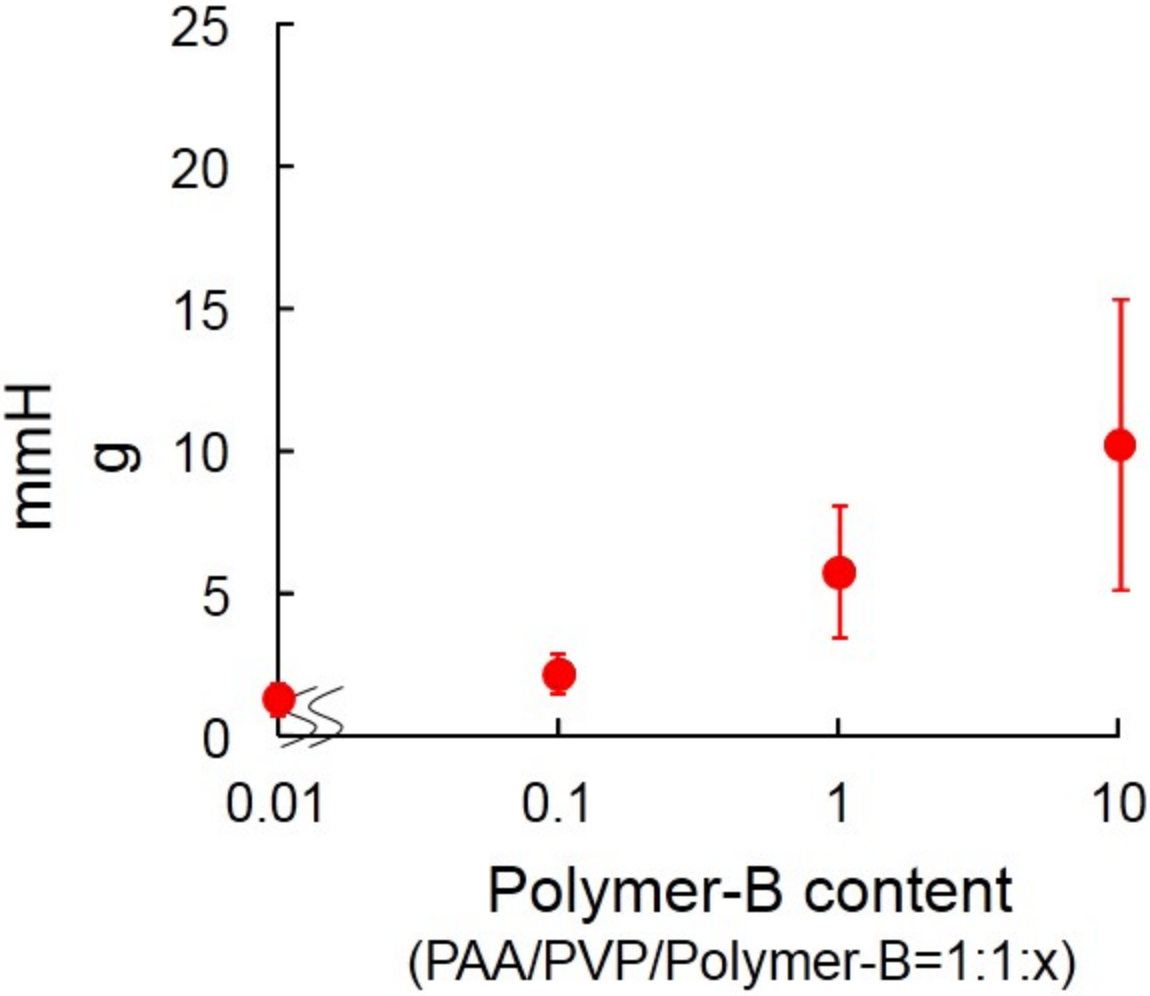


Flexible Film

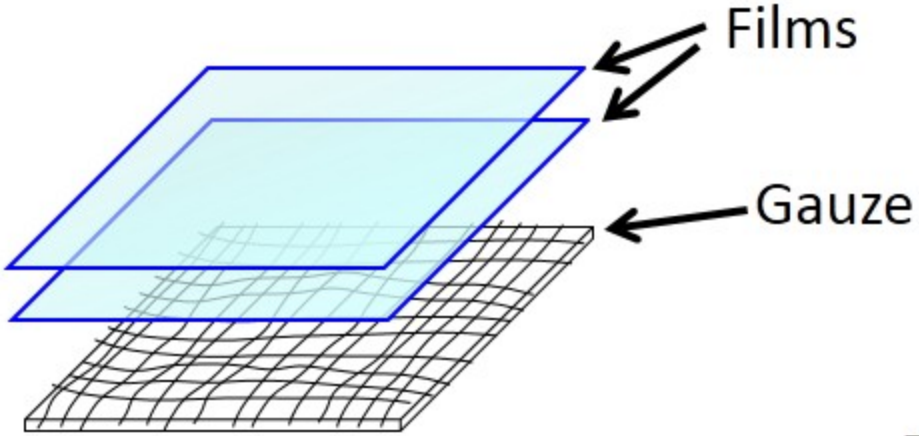
Improvement of the Film (2)

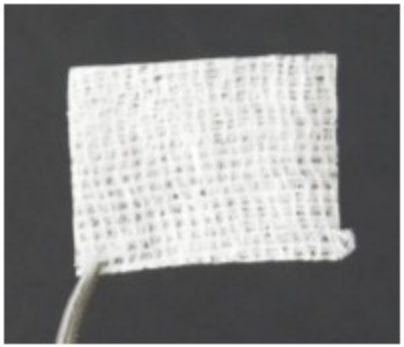
Polymer-B Enhanced the Pressure Resistance

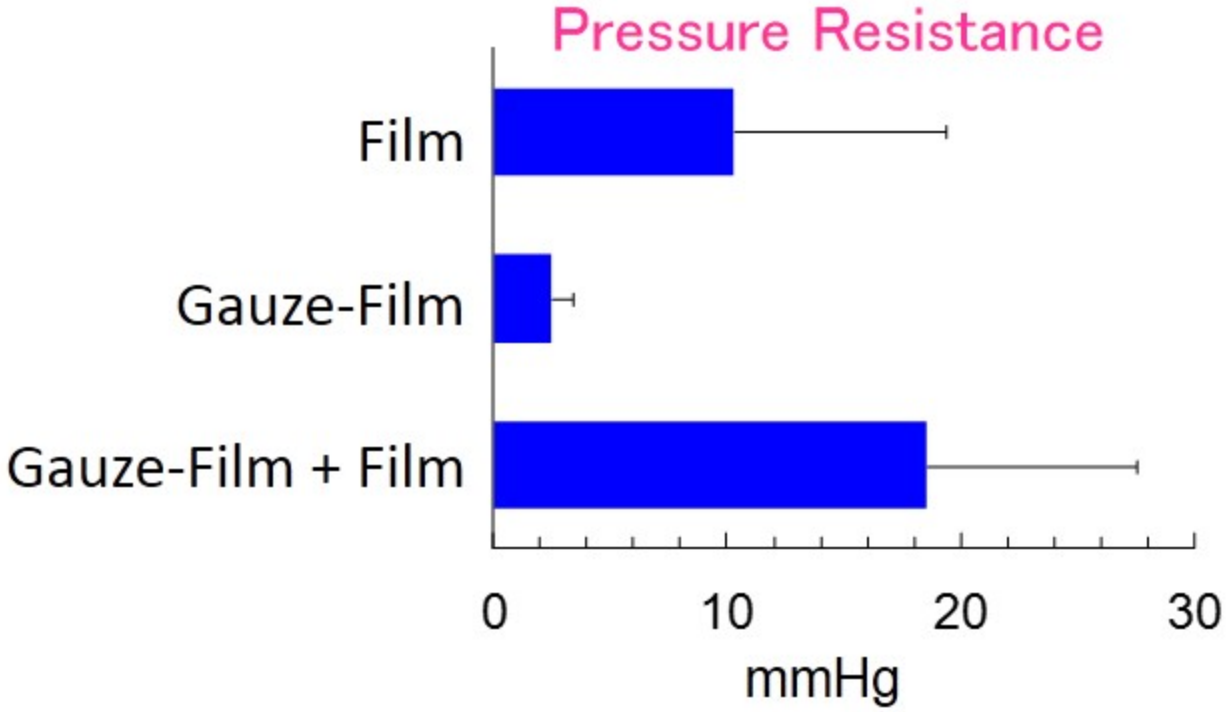




Improvement of the Film (3)
Multilayer Gauze-including Film



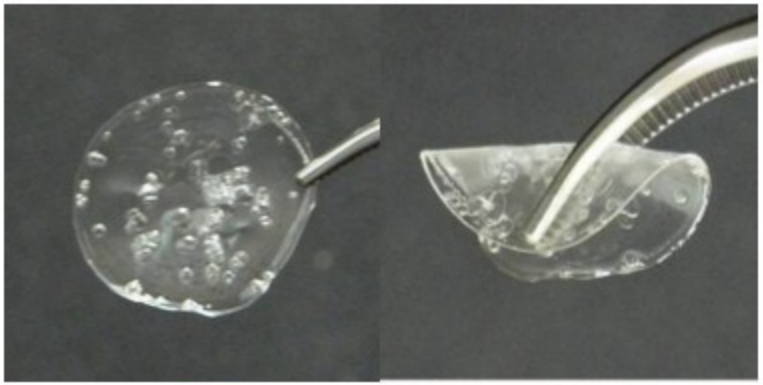




Improvement of the Film (4)

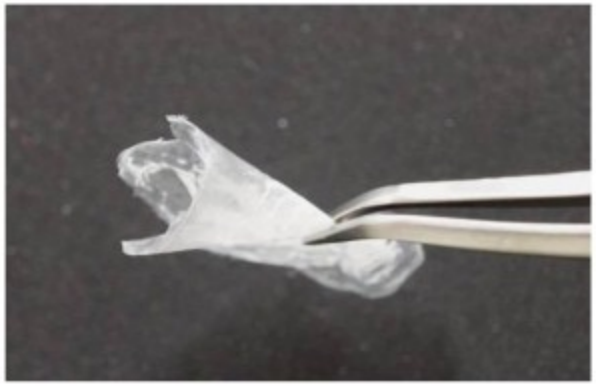
Softness and Fast Attachment

PAA + PVP + Polymer-A



Flexible Film

Addition of Polymer-C

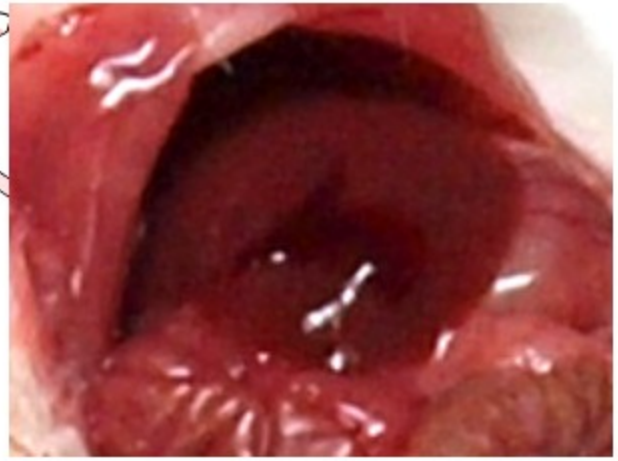


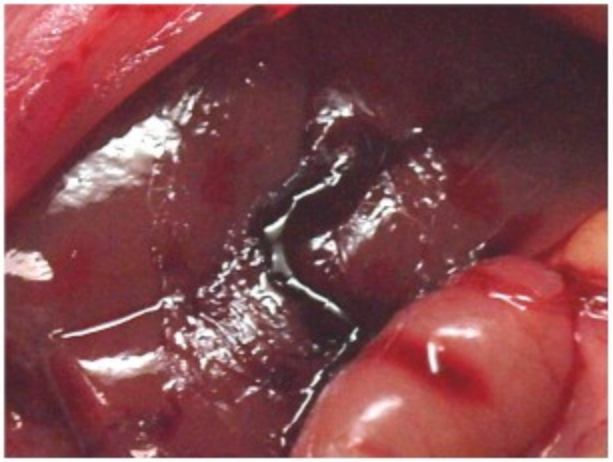
Highly Flexible Film
Fast Swelling and Attaching

Hemostatic Effect of the Film ①

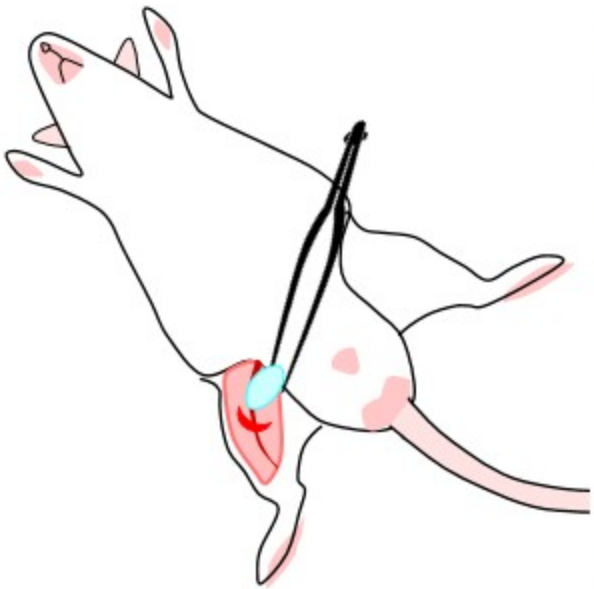
(on the Liver)

Liver was cut, and bleeding was stopped by the film





Hemostatic Effect of the Film ②
(on the Vein)

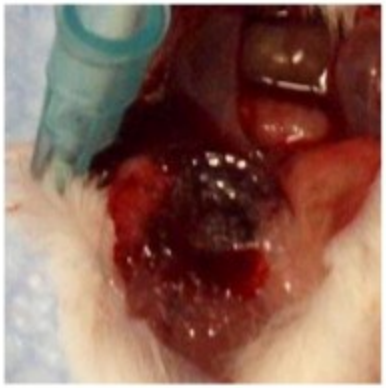


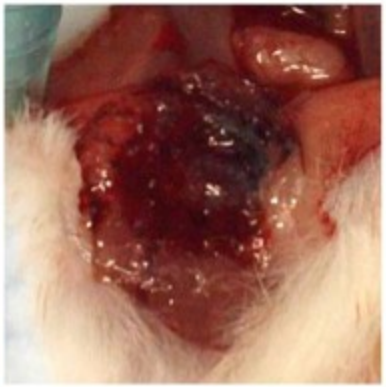
vein of lower extremity was cut, and treated with film

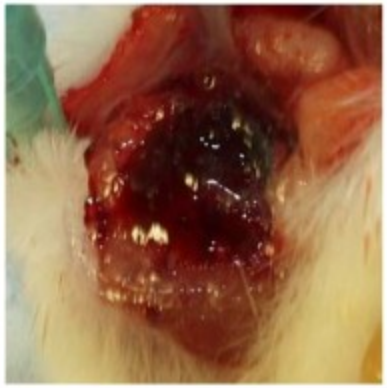
cut, and film was pasted

15 min.

60 min.

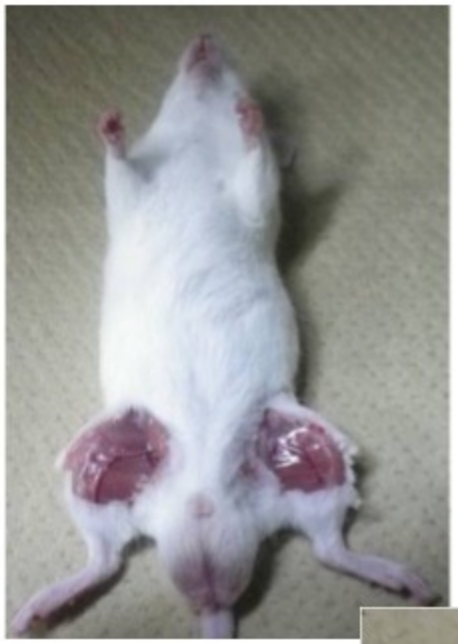






Hemostatic Effect of the Film ③

(on the Mouse treated with Heparin)



Mouse (ddY, ♂, 40 g) was injected with Fragmin (30 IU), and the 、lower extremity was cut, and treated with;

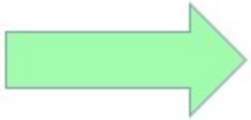
Right Leg: Film

Left Leg: Gauze

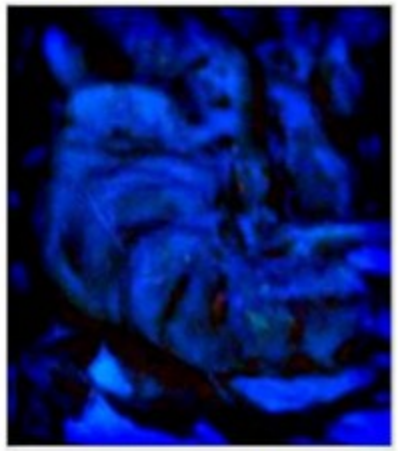
25 min

＜Degradation of the Film in body＞

（PAA was fuluorescence labelled by Texas Red）



1 d



4 d

Clinical Study

Male, 81 old, taking **Warfarin**

→

→

→

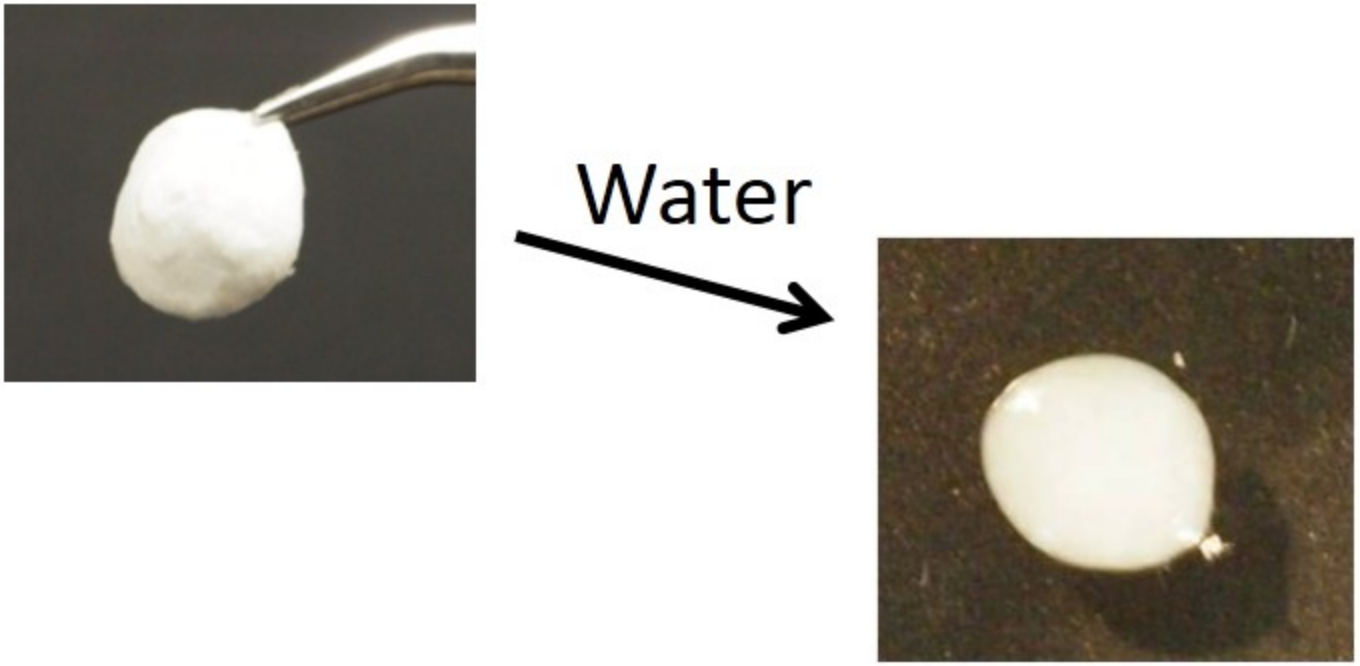
Bleeding was Soon Stopped

Female, 51 old, taking **Warfarin**

After Injection of CT-Contrast Media

Another Formulation

Swellable PAA/PVP Sponge



Traditional PAA/PVP Sponge

＜Mixing of Diluted Solutions＞

PAA aq. Solution　　PVP aq. Solution

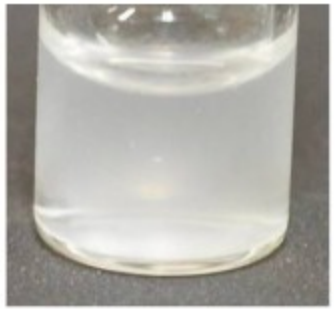
↓ Mixing

↓ Freeze-Drying

↓

Sponge

Not Swellable



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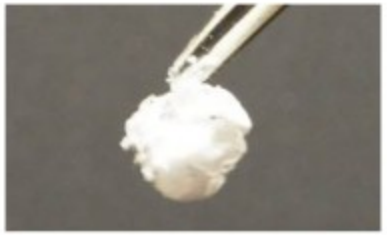


↓

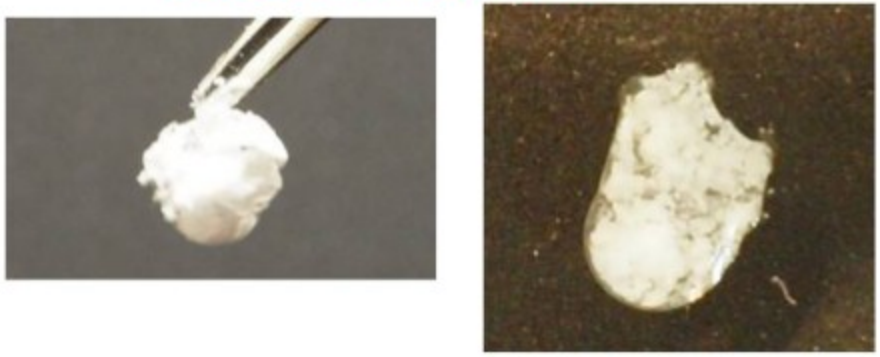
Swellable PAA/PVP Sponge

PAA Solution PVP Solution

Diluted Conditions

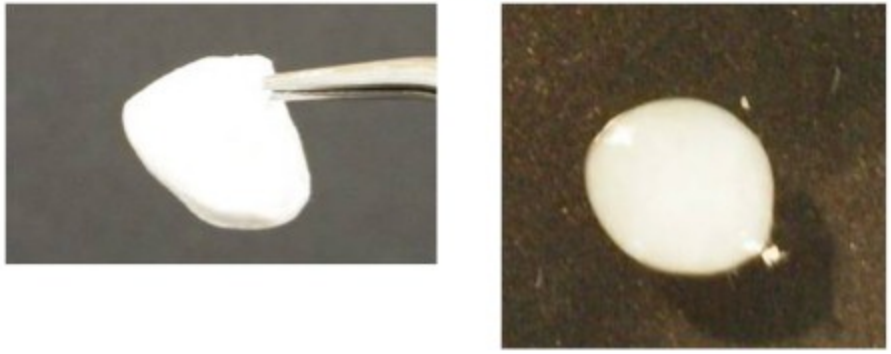
Conventional Freeze-Drying

Not Swellable

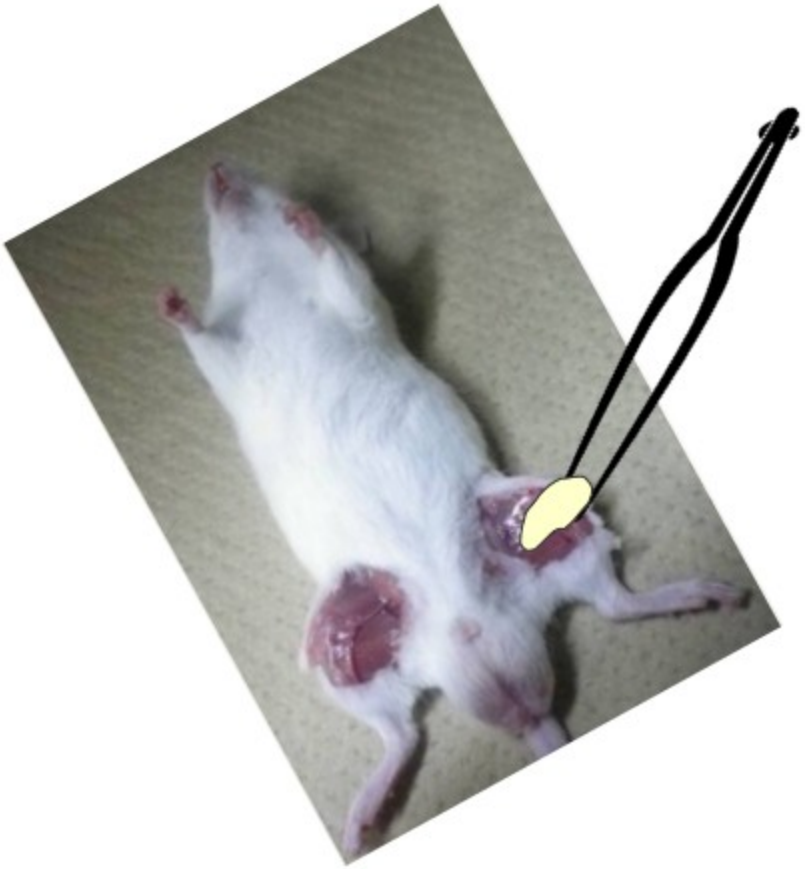


New Method

Swellable



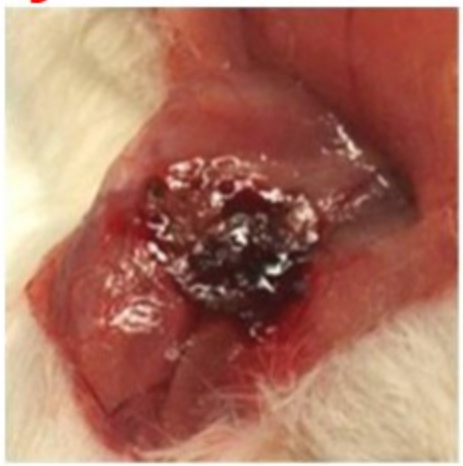
Hemostatic Effect of the Sponge



By Conventional Method

Could not Stopped

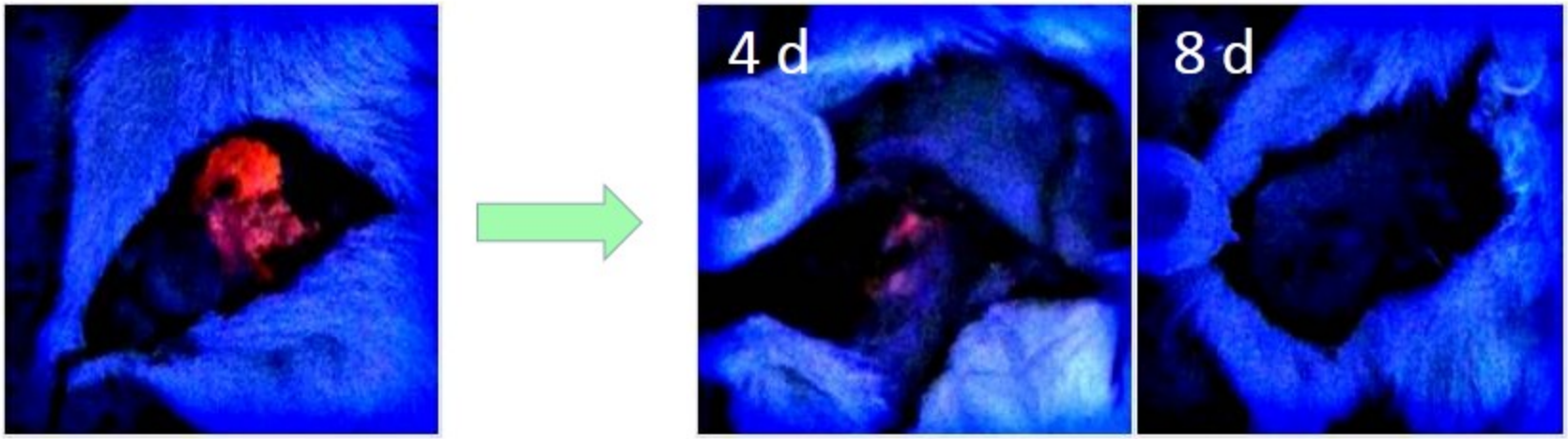
By New Method



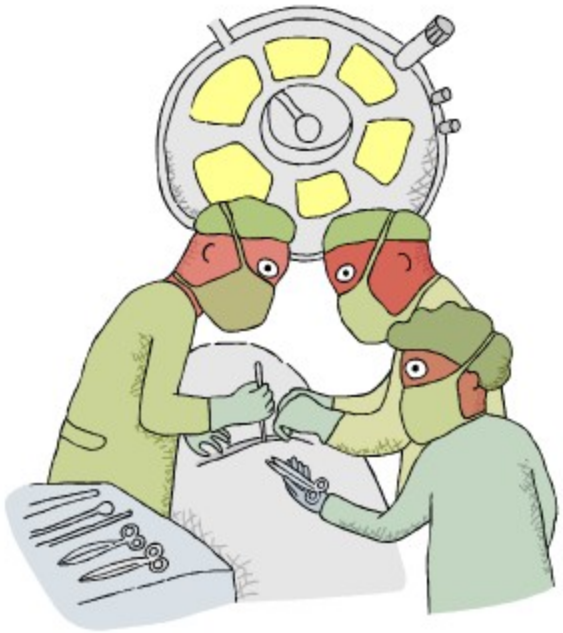
Stopped

Degradation of the Sponge

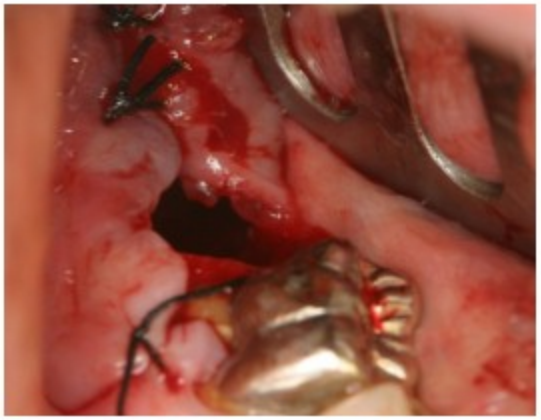
PAA was fuluorescence labelled by Texas Red)



Clinical Study

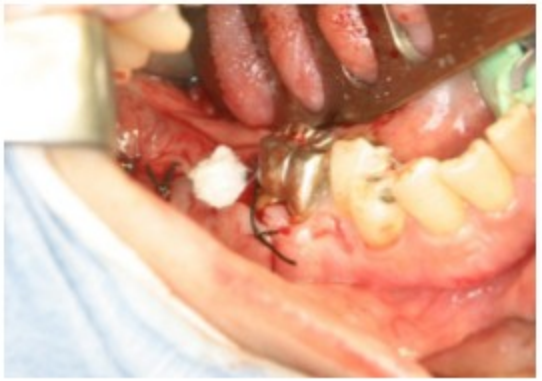


Female, 59 old

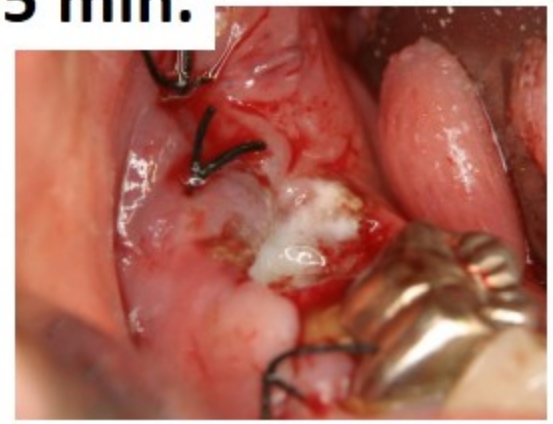


After Tooth Extraction

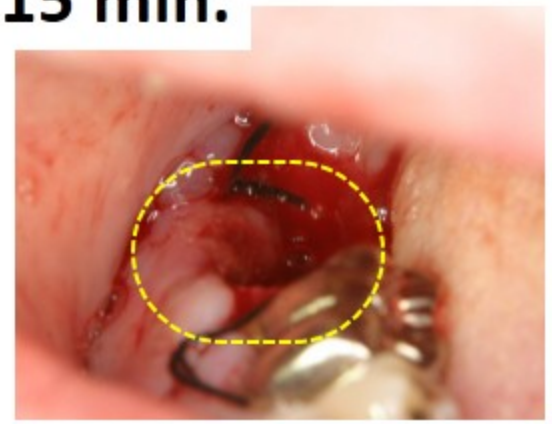
Sponge Insertion



5 min.



15 min.



Bleeding was Effectively Stopped

Male, 87 old, taking **Plavix**

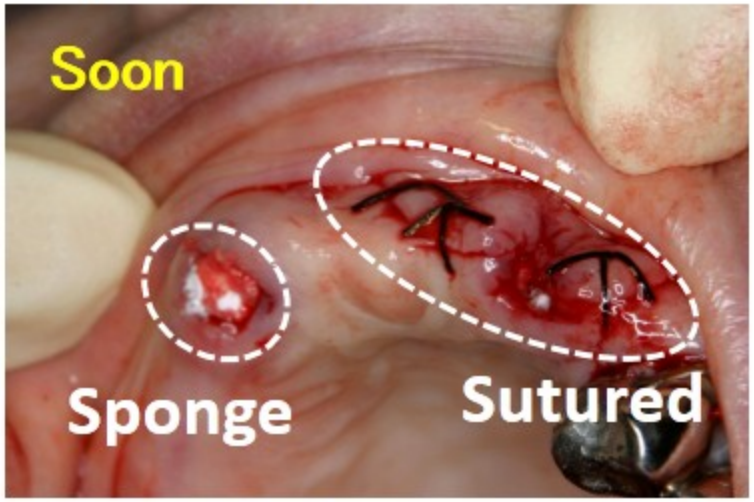
Female, 50 old, taking **Warfarin**

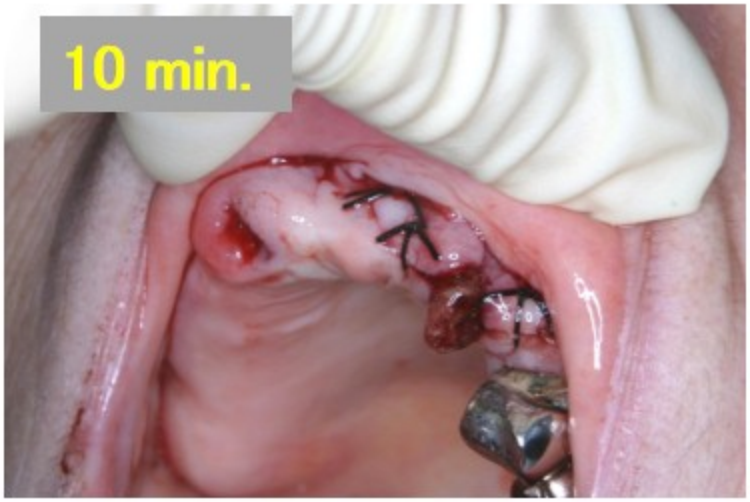
Female, 52 old, taking **Warfarin (High Dose)**

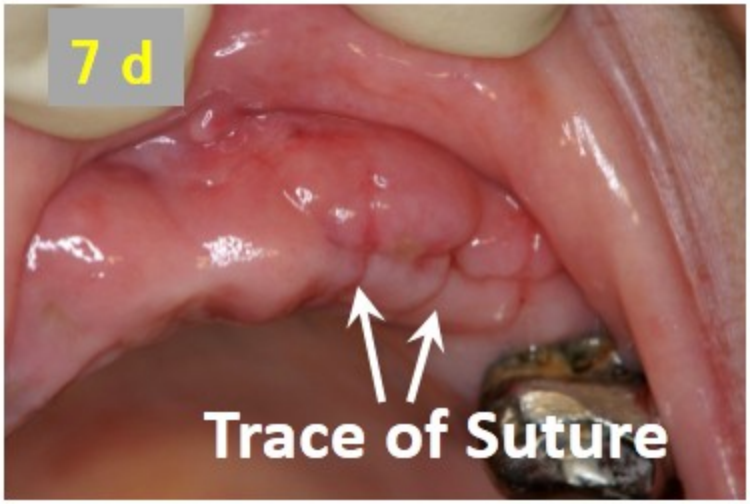
When she had her tooth extracted last year, bleeding lasted over 7 days.

Female, 81 old, taking **Bayaspirin**

Doctor had only one piece of the sponge.



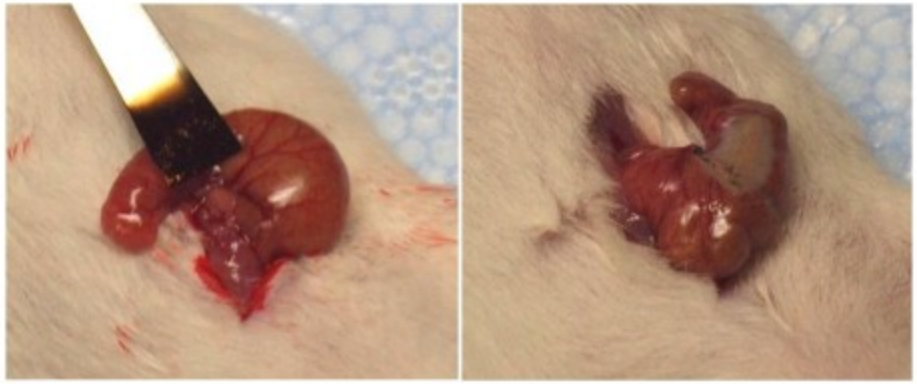




Another Application

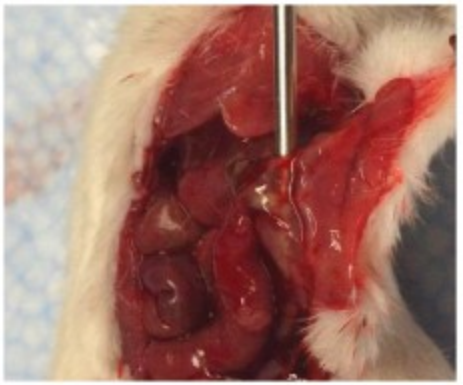
Adhesion Barrier

Adhesion Model Mouse : Cecum was heated

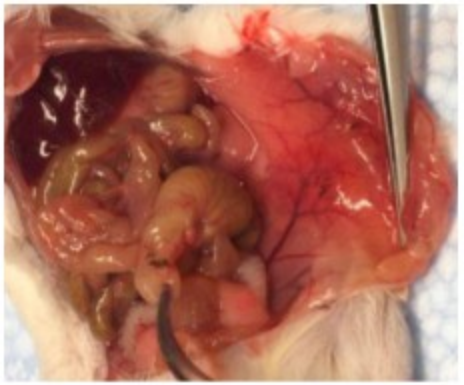


Without Film

7 d



With Film



They are novel devices with

No Risk of Infection!

No ingredients are from animals.

No Risk of Toxicity!

All the ingredients have already been approved as pharmaceutical additives.

No Risk of Inflammation!

Gel formed on the tissue would be slowly dissolved at pH 7.4, and no residue remains.

No Fear for Handling!

They would stick to the tissue by themselves.

No Fear for Material Supply and Cost!

All the ingredients are on market in a large amount at very low Price.

No Fear for Producibility!

They could be easily, and reproducibly prepared.

This technology would produce

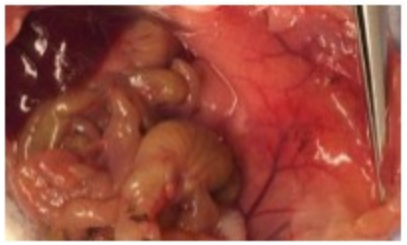
A hemostatic bandage for consumer

A hemostatic device for medical use
For Injection, Blood Sampling

For Dental Surgery Field

A hemostatic film for surgical use (internal use)

An adhesion barrier for surgery



Moreover,

This technology could be easily arranged to

☆ New composition to attain the appropriate property for individual requirements

soft, tough, thin, thick

☆ Compound with

Hemostatic agents

higher hemostatic efficacy

Antibacterial agents

to avoid infection

These Devices have

High Efficacy,
High Safety,
High Potential,
and
No Risk.

Thank you.