



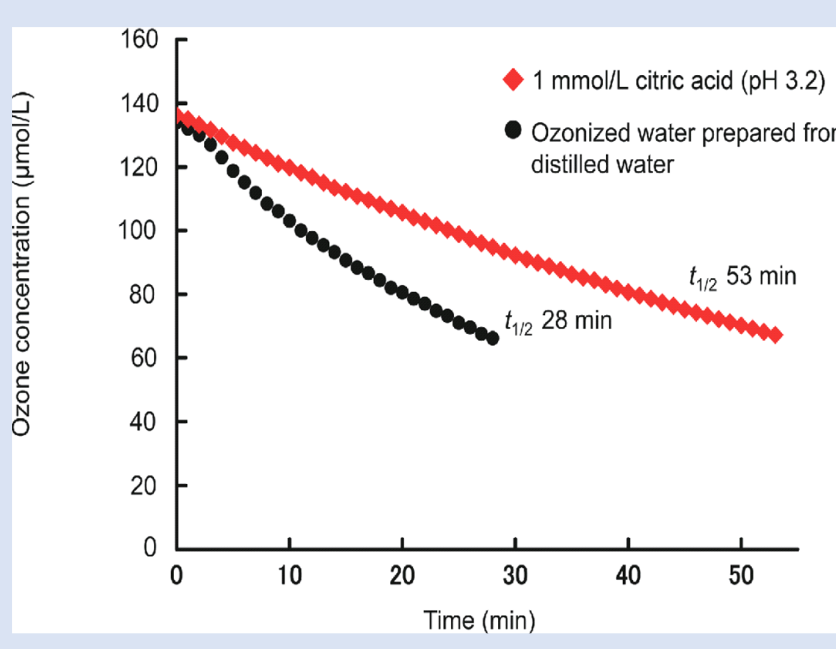
Ozone features and stability problems



- Ozone consists of 3 oxygen atoms
- Quickly converting into oxygen
- High concentrations of ozone gas are harmful to humans and animals and have been shown to impair the respiratory
- However, low concentrations of ozone gas are not toxic, and ozone and oxygen gas mixture has been used therapeutically.

Poor stability, equipment required

This makes practical application difficult.



The half-life of ozone water is about 30 minutes.

Why glycerin and ozonation?

Oil + Ozonation

Famous ozonation is decomposition of unsaturated fatty acids (Oil)

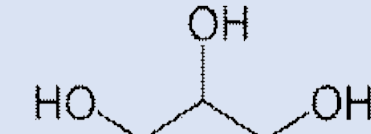
- Harmful ozone odor
- Ozonide is unstable
- Reports of irritancy

Glycerin + Ozonation

No reports of ozonation due to a lack of unsaturated fatty acids

- New discovery
- Glycerin is resistant to oxidation
- Odorless and stable

Glycerin (Glycerol)

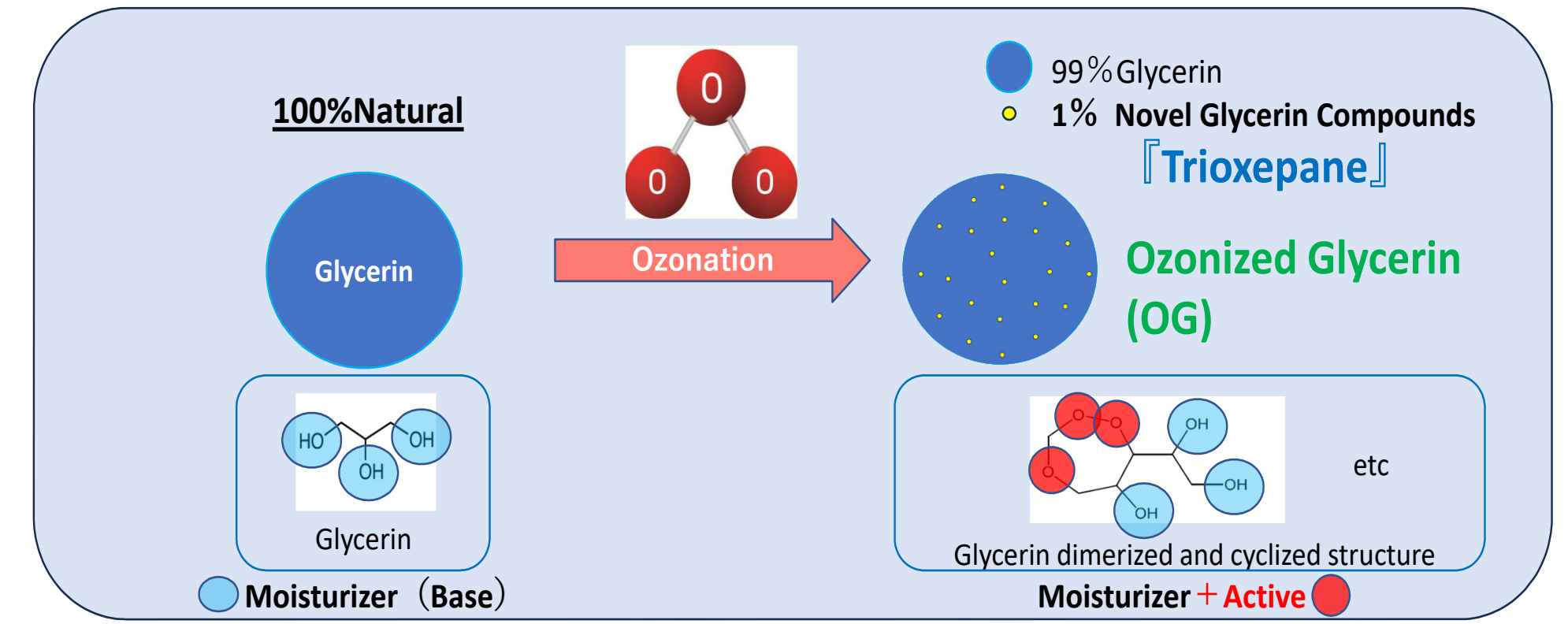


Glycerin has a very simple structure with three hydroxyl groups. It is a colorless, odorless, viscous liquid. It is known to have a sweet taste and is non-toxic. Therefore, it is widely used in pharmaceuticals and cosmetics and is especially well known as a moisturizer.



How to make ozonized glycerin

Using the patented ozonation process, 99% glycerin remains pure glycerin, only 1% made into a novel glycerin compound.



Multi-functionality of Novel Glycerin Compounds

We will evaluate the efficacy of a novel glycerin compound, a highly sustainable ingredient whose raw material is only naturally glycerin and whose manufacturing process uses only ozone treatment without chemicals, and find its application as a biomaterial.

1. Antibacterial
2. Cell proliferation
3. Collagen production
4. Anti-inflammation
5. Wound healing
6. Hemostatic

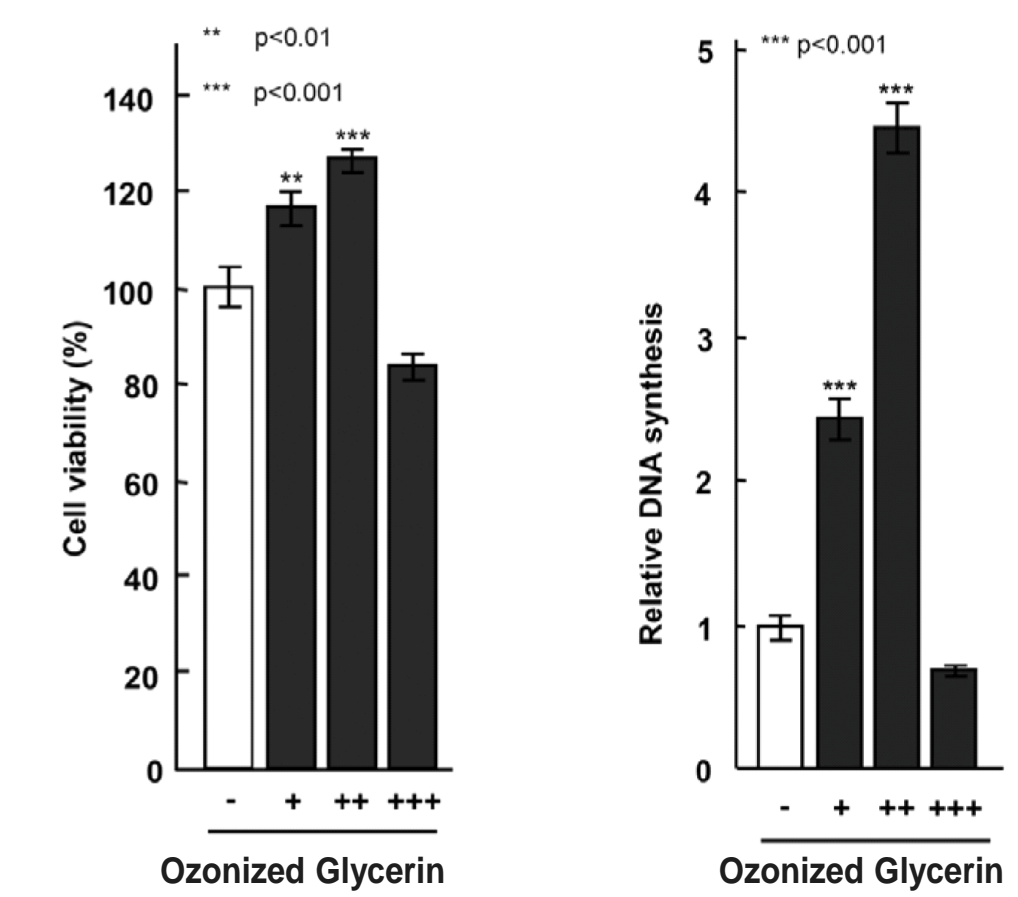


Antibacterial Effect

Ozonized glycerin showed efficacy against bacteria

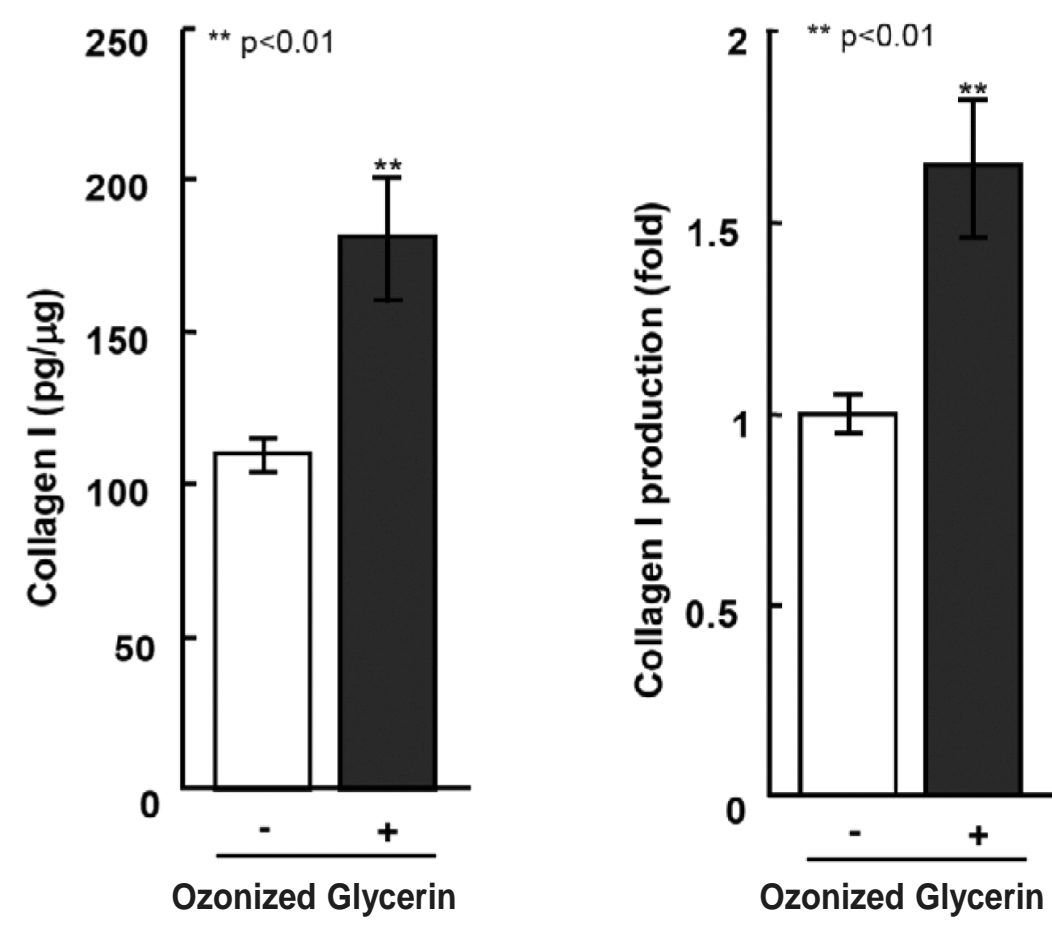
		Ozonized Glycerin(ppm)						control	MIC(ppm)
		1000	500	250	100	10	1		
1	<i>Escherichia coli</i>	-	-	+	+	+	+	+	500
2	<i>Staphylococcus aureus</i>	-	-	+	+	+	+	+	500
3	<i>Staphylococcus epidermidis</i>	-	-	+	+	+	+	+	500
4	<i>Streptococcus agalactiae</i>	-	+	+	+	+	+	+	1000
5	<i>Streptococcus uberis</i>	-	-	+	+	+	+	+	250
6	<i>Enterococcus faecalis</i>	-	-	+	+	+	+	+	500
7	<i>Corynebacterium bovis</i>	-	-	+	+	+	+	+	500
8	<i>Pseudomonas aeruginosa</i>	-	-	+	+	+	+	+	250

Cell Proliferation Effect of Human Gingival Fibroblasts(HGFs)



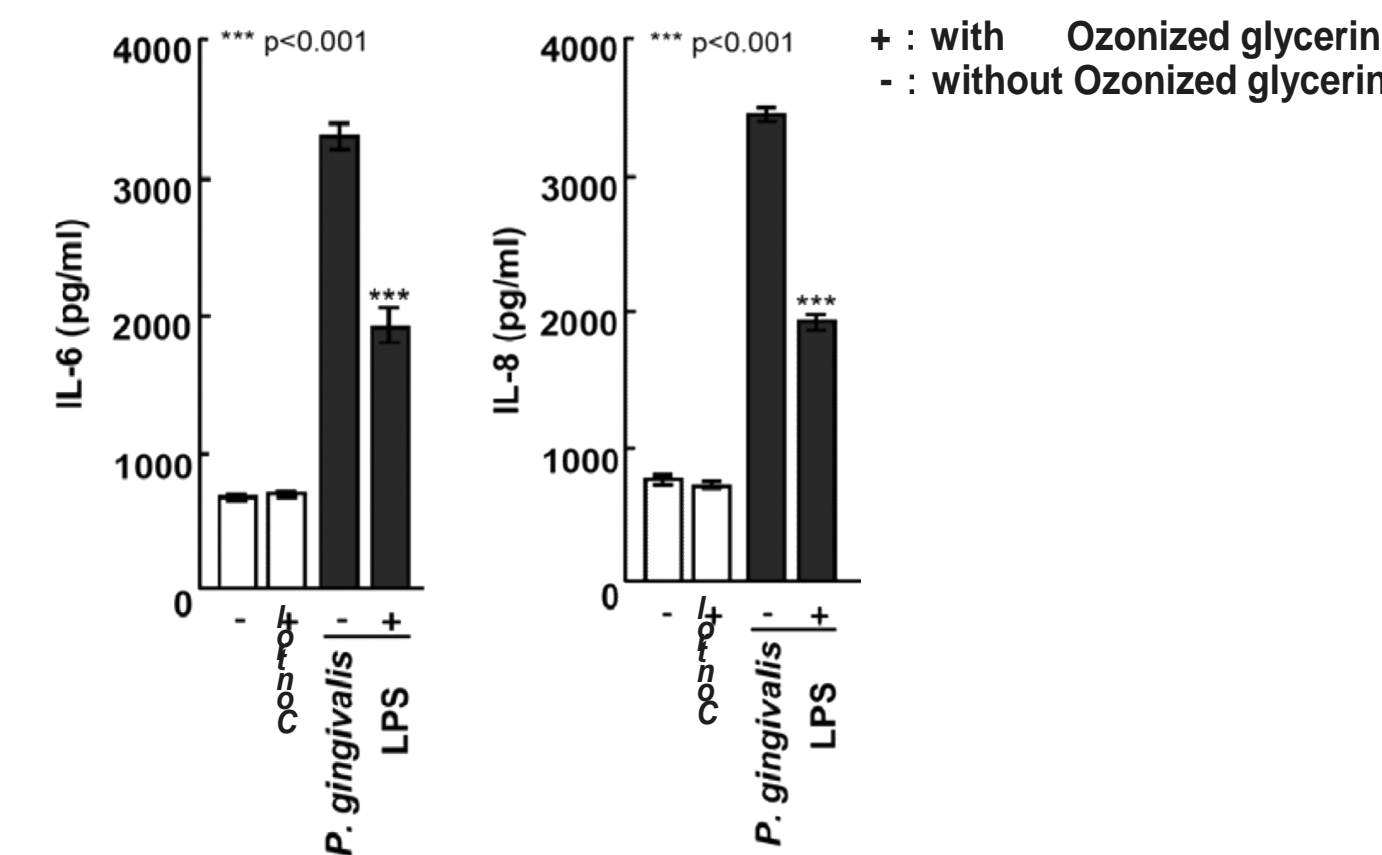
Collagen Proliferation Effect of Human Gingival Fibroblasts

We studied the effect of OG on HGFs' ability to produce type-I collagen, which is vital for periodontal tissue regeneration. OG increased cell proliferation and type-I collagen production by HGFs by around 1.6 times compared to the control group.



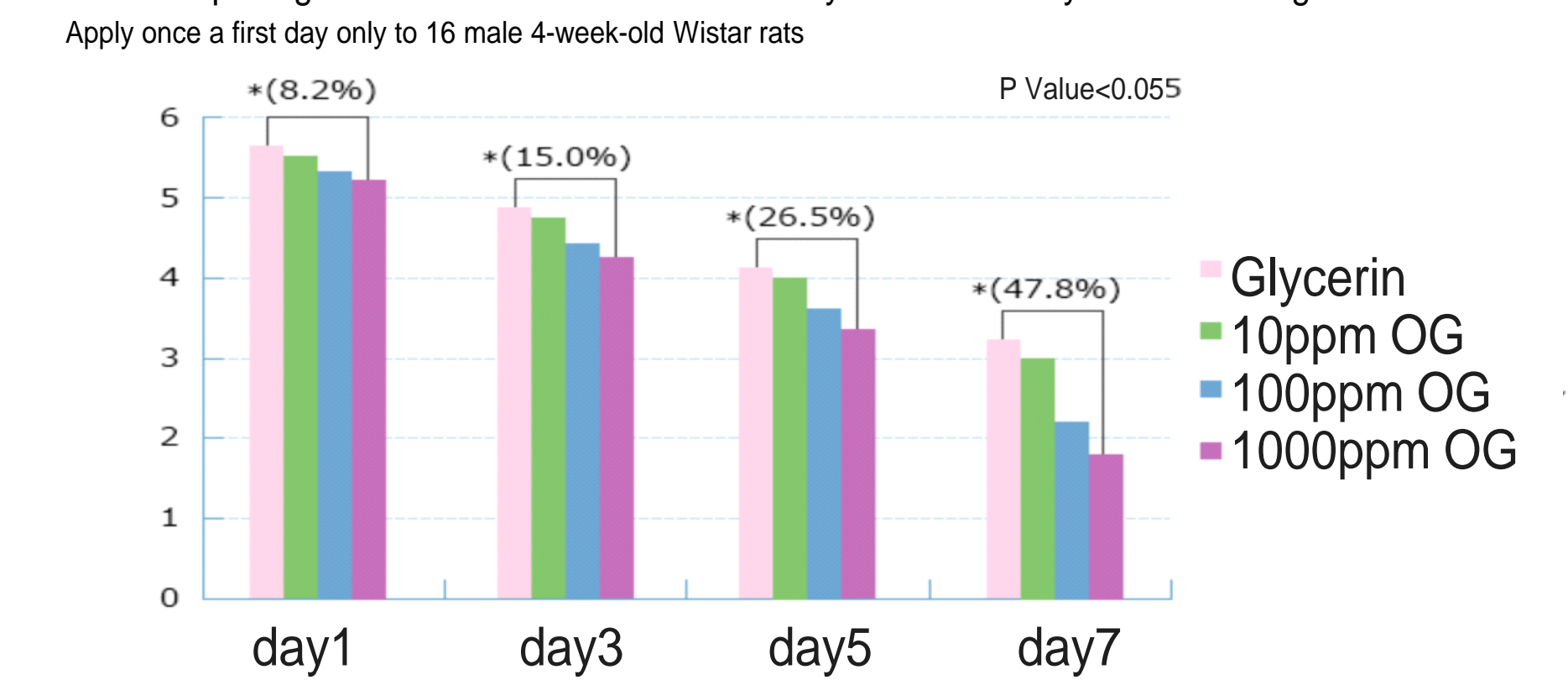
Anti-inflammatory Effect of Human Gingival Fibroblasts

The anti-inflammatory effect of human gingival fibroblasts. When stimulated by LPS from the periodontal pathogenic bacterium *P. gingivalis*, HGFs produced amount of IL-6 and IL-8, which are known to cause inflammation. On the other hand, the presence of ozonized glycerin during stimulation resulted in a significant suppression of interleukin production.



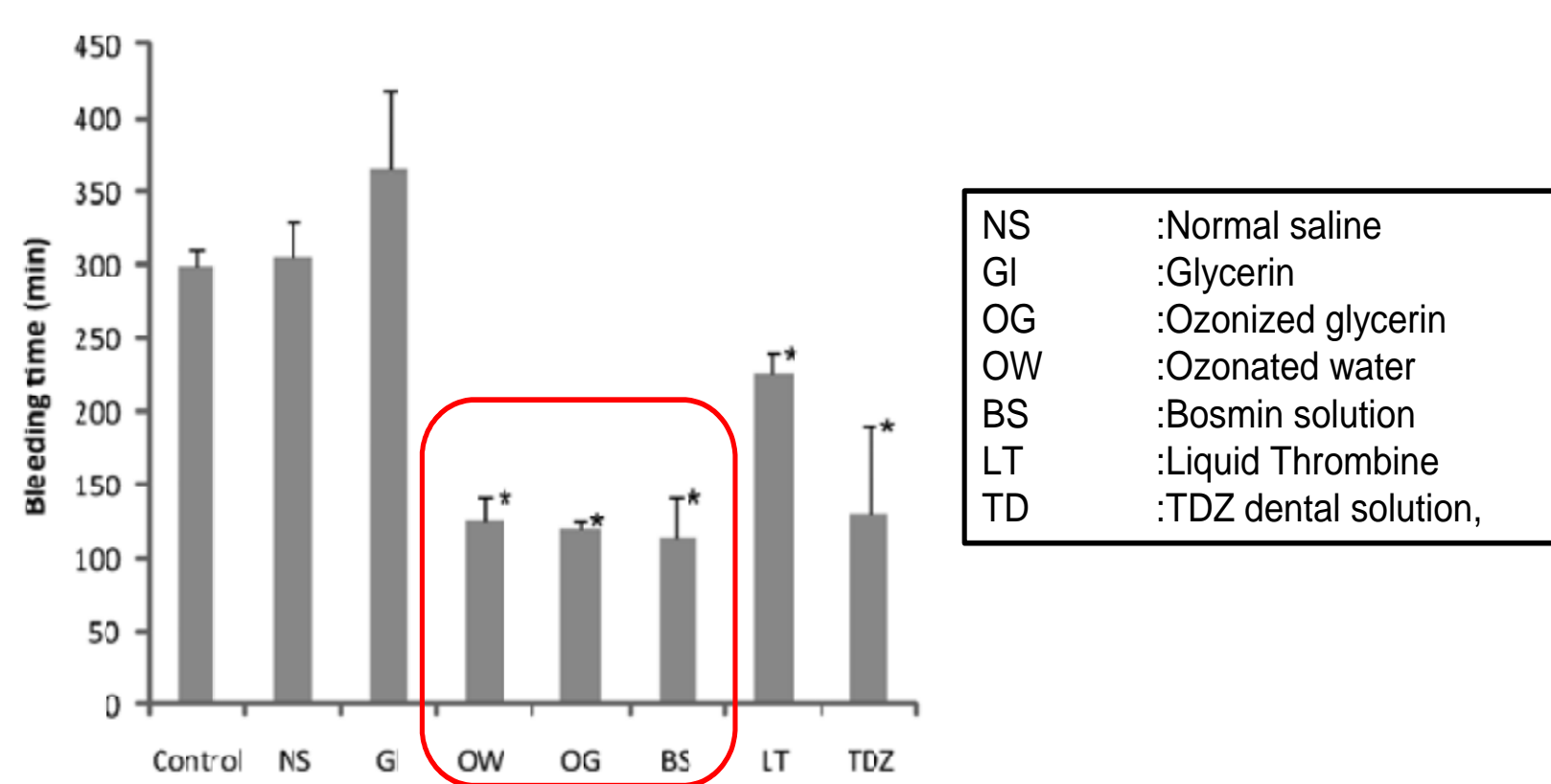
Wound Healing Effect of Ozonized Glycerin

Glycerin and OG were applied once daily to rat wounds, and the wound area was measured 1week. Our findings revealed that OG accelerates wound healing compared to glycerin on the seventh day. Although higher concentrations showed a bactericidal effect, it did not hinder wound healing, but instead promoted it by facilitating the formation of collagen and hyaluronic acid. This is surprising as the bactericidal effect is usually known to delay wound healing.



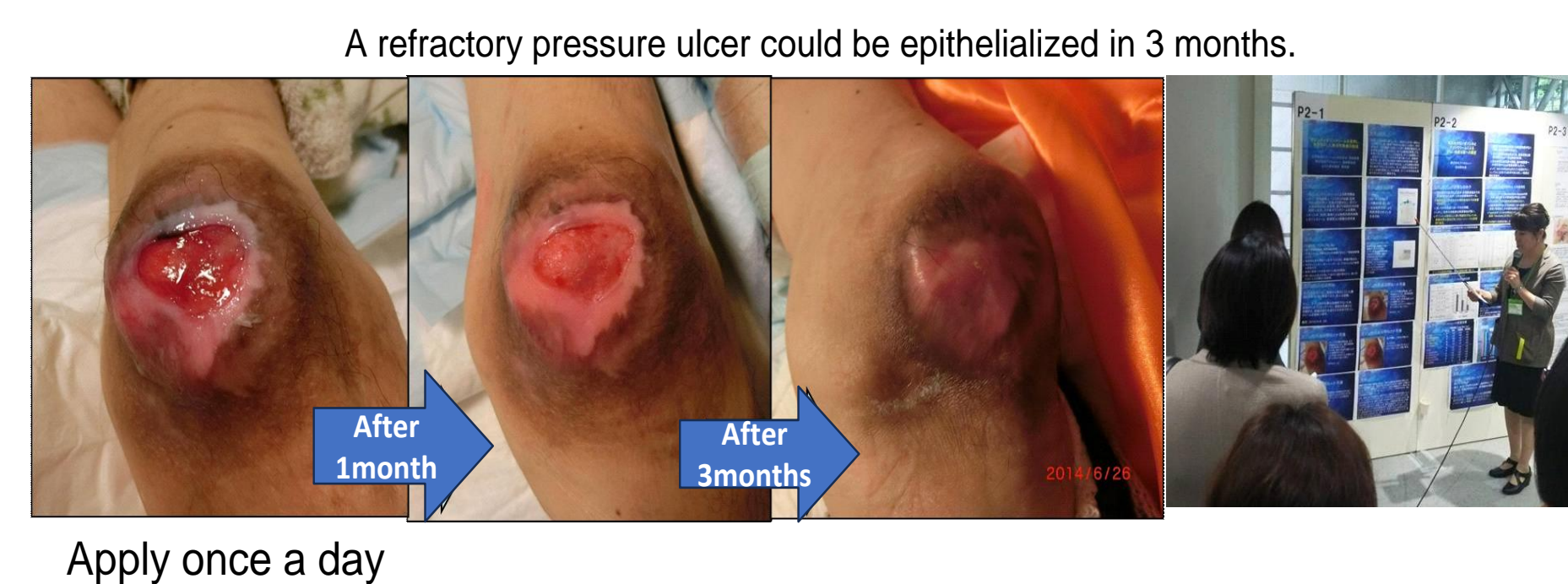
Hemostatic Effect of Ozonized Glycerin

OG has been reported to have hemostatic effects for clinical surgeons. The effectiveness of the hemostatic effect was confirmed through tests on rats. Compared to bosmin, a commonly used pharmaceutical, OG, OW, and bosmin all showed similar hemostatic effects in a short period of time.



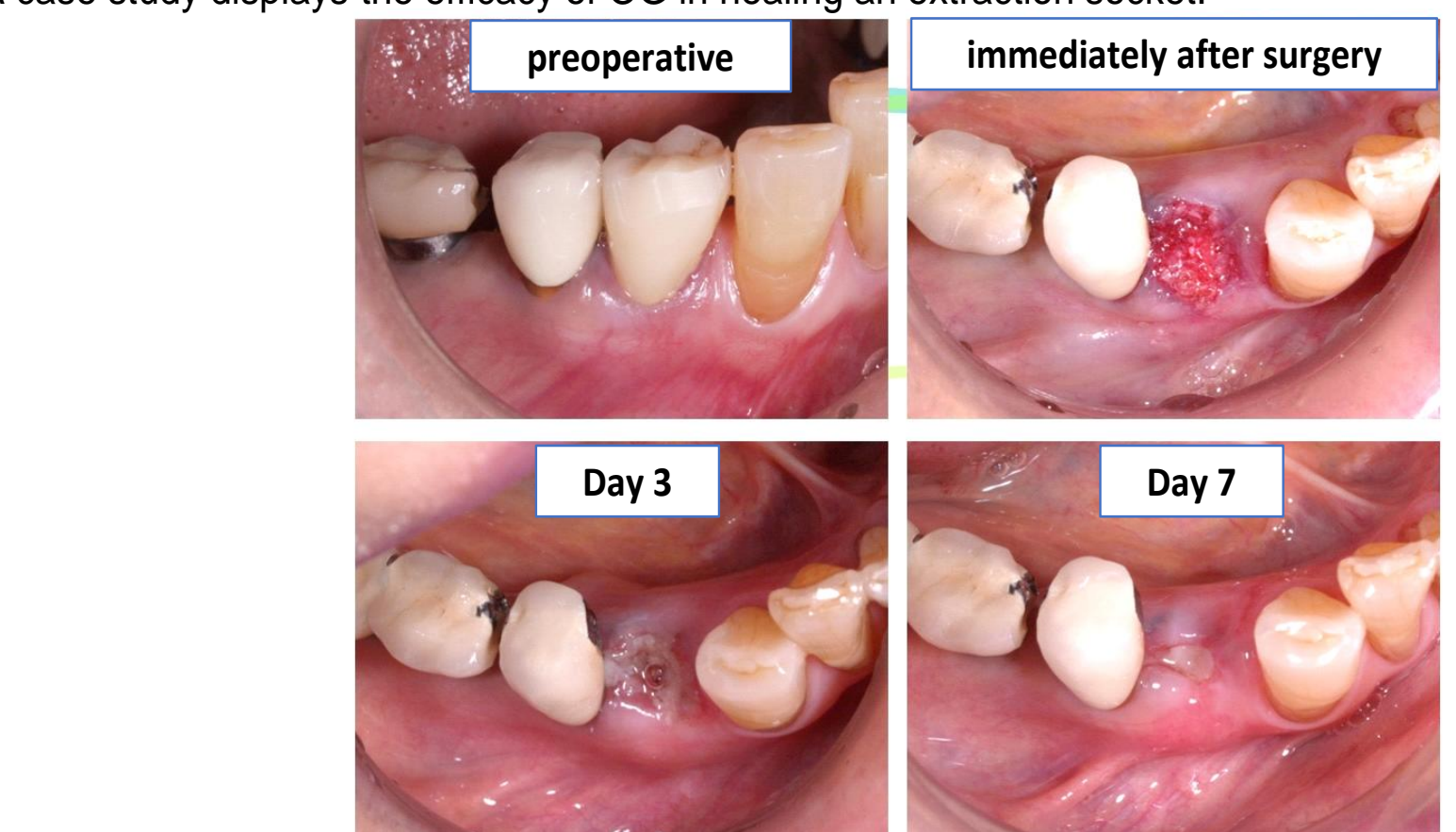
Effects of Ozonized Glycerin on Pressure Ulcers

We observed that demonstrate the impact of pressure ulcers. To our surprise, we learned that OG is an effective treatment for pressure ulcers, and pharmaceutical companies are still researching its potential. When the OG was applied to the wound, it turned red and the granulation started to grow. Over time, the wound steadily filled and epithelialized without any defective granulation. This particular case had an initial odor but showed that OG can eliminate infection and promote favorable wound healing.

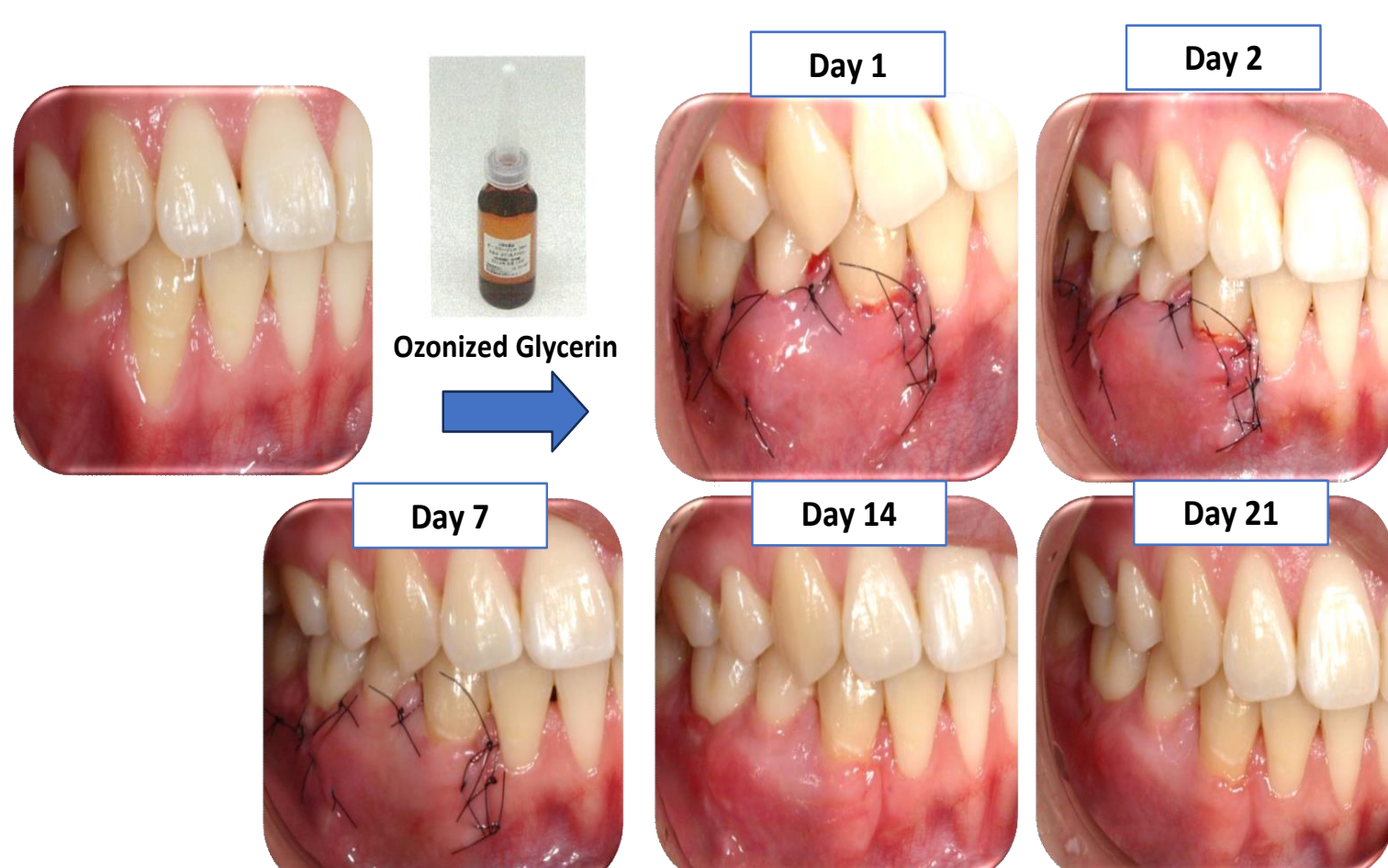


Case of surgical in dentistry for Tooth extraction

Surgical procedures carry risks. Prevention of postoperative infection and early wound closure are crucial. OG can help prevent infection, promote hemostasis, and clot retention. OG also reduces discomfort symptoms such as pain and swelling, and promotes early wound closure. A case study displays the efficacy of OG in healing an extraction socket.

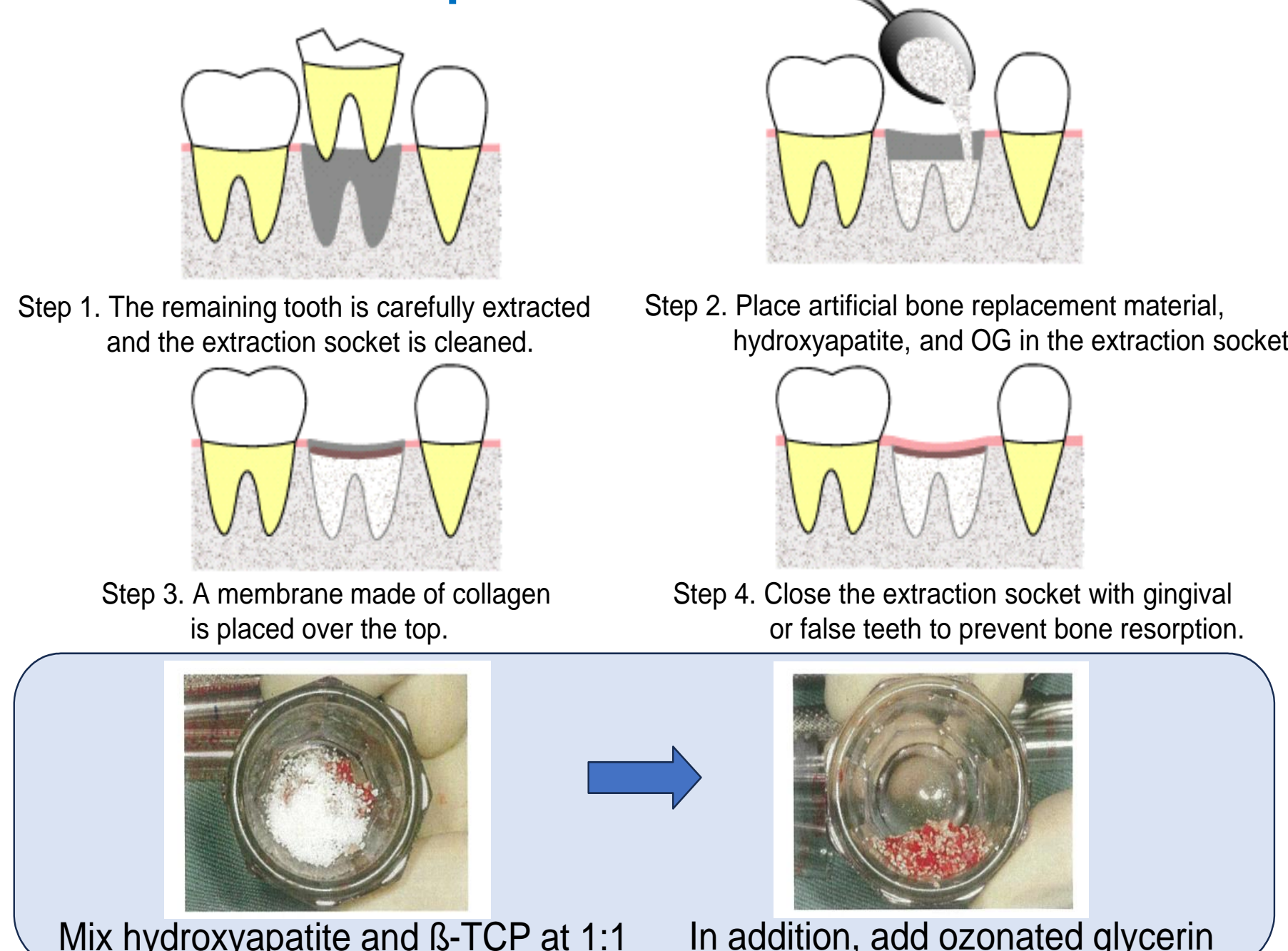


Case of Free Gingival Graft with Ozonized Glycerin



Ozonized glycerin was also used under surgical operation of the flap during free gingival grafting, leading to favorable wound healing without any inflammation or swelling.

Procedure of Socket preservation



Case of Socket Preservation



After cleaning, the extraction socket was filled with hydroxyapatite, artificial bone filler β -TCP, and ozonized glycerin. These fillings were carefully placed inside the extraction socket and covered with a membrane to keep the clots in place. After one month and three months of observation, it was found that the socket preservation with ozonized glycerin had resulted in good wound healing and gingival formation, without any infection and inflammation.

Conclusion

Ozonized Glycerin has been researched for its non-inhibitory effect on wound healing and antimicrobial properties. It can be used topically for skin diseases and as a biomaterial for controlling infection in implants. Its multifunctionality is expected to lead to the development of many more biomaterial applications.