



# Potential Application of Nano-Hydroxyapatite in Tooth Decay Prevention

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## Introduction

Tooth decay is a chronic disease present in children and around 26% of adults. In recent years, nano-hydroxyapatite has gained attention as a potential caries prevention treatment, as it makes up over 90% of our tooth enamel and can aid in tooth remineralization. This study will look at the clinical applications of nano-hydroxyapatite in dentistry. Specifically, this study will examine the ability of nano-hydroxyapatite to remineralize teeth, it's effectiveness as a preventative dental caries treatment, and it's possible side effects.

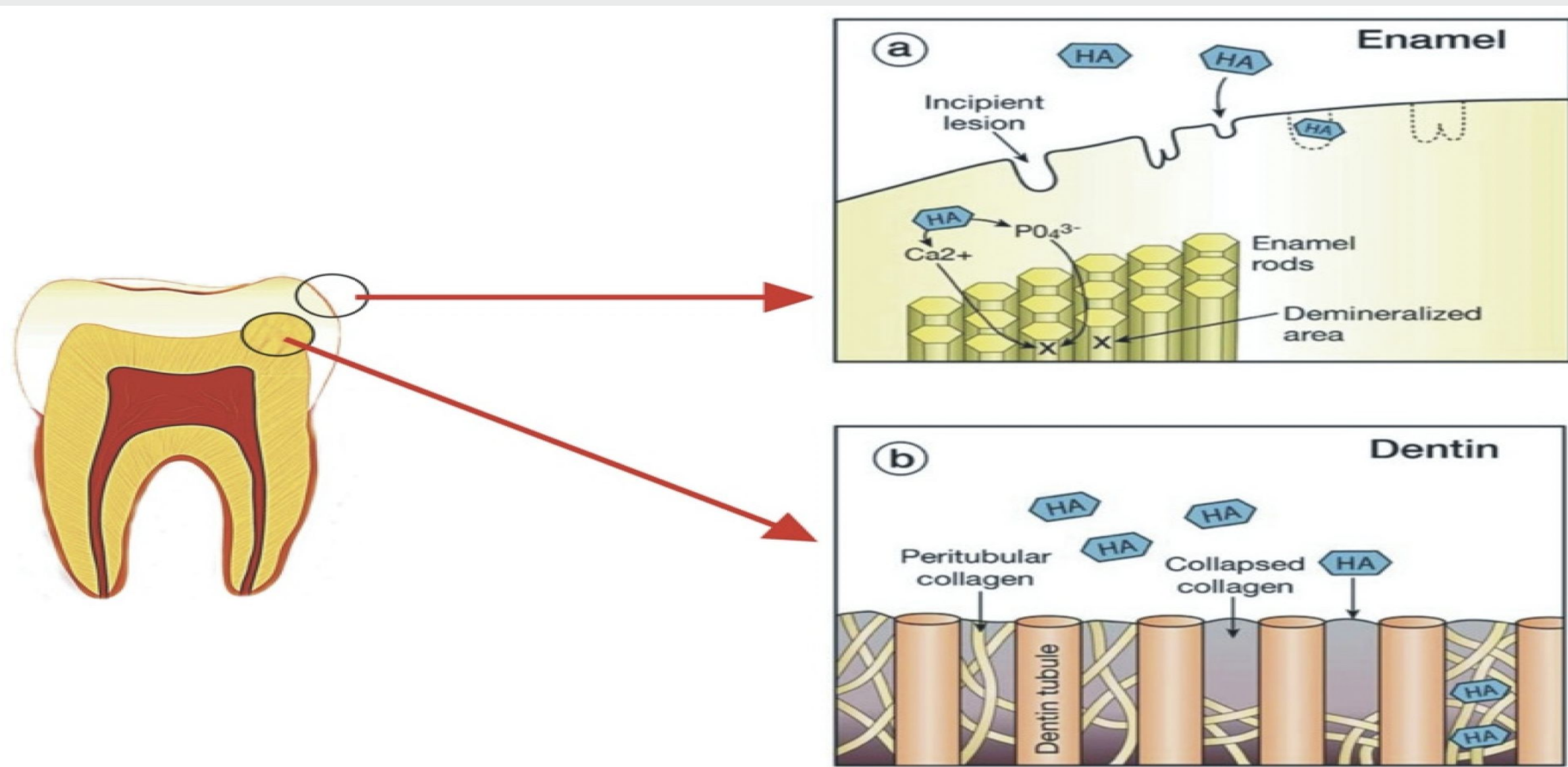


Figure 1. Displays nano-hydroxyapatite interacting with enamel & dentin. (Nano Medical Hydroxyapatite)

## Methods

A range of databases was used such as Google Search, Google Scholars, and PubMed. The search strategy used was a combination of terms such as Nano-hydroxyapatite, Toothpaste, tooth remineralization, side effect of nano-hydroxyapatite, Tooth decay and treatment, and dental caries. This search strategy collected and analysed ten different scholarly articles.

	Inclusion	Exclusion
<b>Time Period</b>	Literature published anytime after December 2022	Literature published before January 2014
<b>Language</b>	English	Non-English
<b>Remineralization component</b>	Nano-hydroxyapatite, Hydroxyapatite, Sodium Fluoride, Stannous Fluoride, Fluoride-Free, Sodium monofluorophosphate	N/A
<b>Article Type</b>	Journal Articles, Peer-Reviewed Articles, Systematic Reviews	All other Articles
<b>Article Criteria</b>	Nano-hydroxyapatite and tooth remineralization	Nano-hydroxyapatite and other diseases.

Table 1. Inclusion/Exclusion criteria for nano-hydroxyapatite & increased remineralization for dental caries.

## Results

Studies have shown that Nano-hydroxyapatite forms a protective layer over enamel. Nano-hydroxyapatite reduces biofilm adhesion on teeth. Studies showed nano-hydroxyapatite can homogeneously remineralize teeth. No possible side effects were observed in any of the research studies.

Study	Teeth (n=)	Effectiveness	Side Effects	Clinical Applications
(Nozari et al., 2017)	n = 80	Nano-hydroxyapatite was shown to have greater remineralization than NaF varnish	No side-effects were observed.	Gives a wide variety of preventative dentistry treatment options for individuals
(Haghgoo et al., 2014)	n = 60	Both nano-hydroxyapatite and NaF mouthwash greatly increased remineralization	No side effects were observed.	The use of NaF or nano-hydroxyapatite mouthwash can be used as effective remineralization option for tooth enamel.
(Grocholewicz et al., 2020)	n = 546	Nano-hydroxyapatite gel combined with ozone therapy provides remineralization to enamel and dentine.	No side effects were observed.	The combination of nano-hydroxyapatite gel with ozone therapy could be used as a nonrestorative treatment option for dental caries.
(Ebadifar et al., 2017)	n = 80	Nano-hydroxyapatite, fluoride, and the combination of both are effective at remineralizing carious lesions.	No side effects were observed.	The combination of using a 7% concentration of nano-hydroxyapatite with fluoride could be used as a potential treatment option for dental caries.
(Wang et al., 2016)	n = 137	Nano-hydroxyapatite was as effective as Pro-Argin and fluoride varnish at reducing dental hypersensitivity.	No side effects were observed.	Nano-hydroxyapatite can be used as an effective treatment option for individuals experiencing dental hypersensitivity.

Table 2. Analysing the effectiveness, side effects, and clinical applications of nano-hydroxyapatite.

Studies main findings:

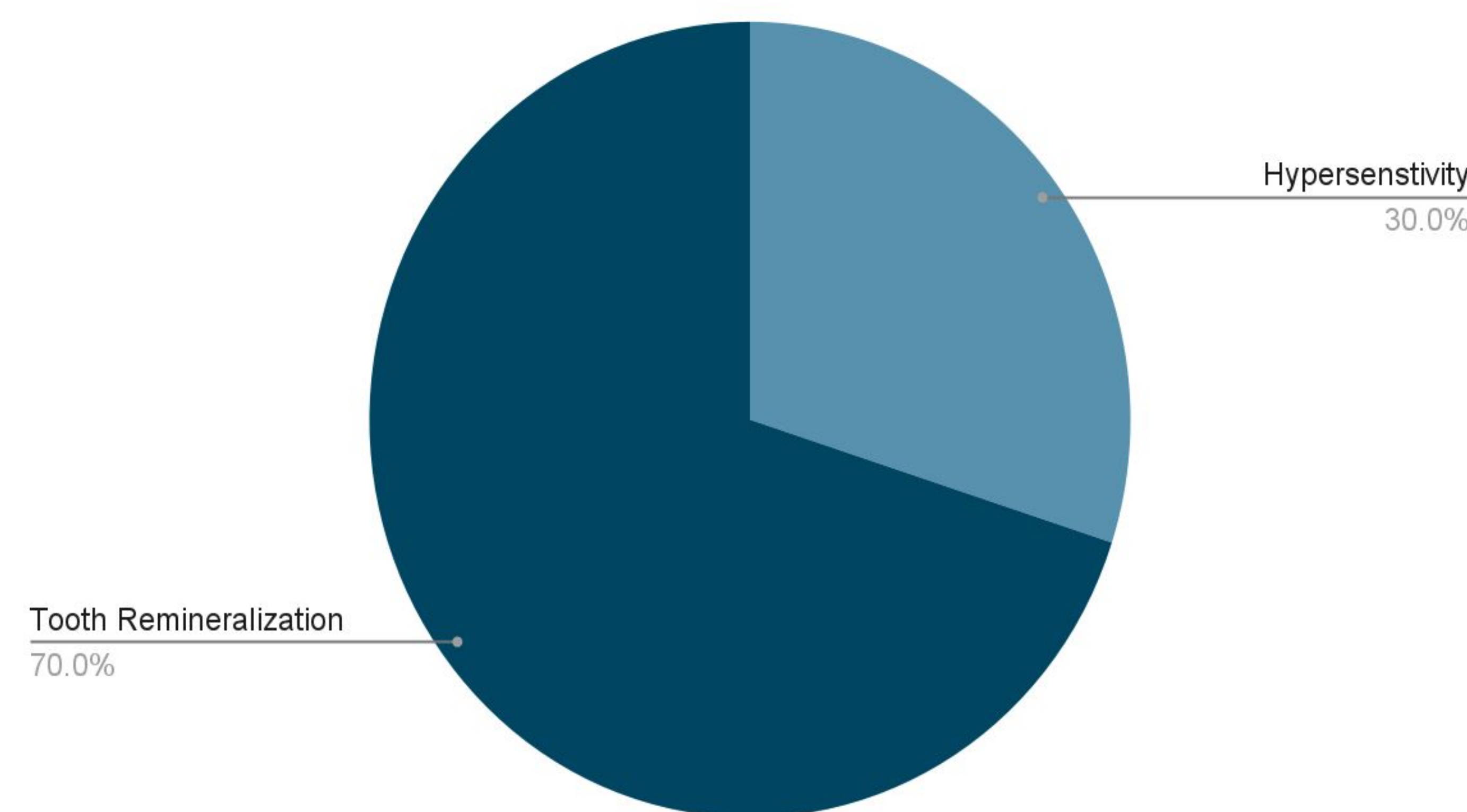


Figure 2. Displays the potential clinical applications and main findings for nano-hydroxyapatite of the studies analysed.

## Future Directions

Future directions should include *in vitro* & *in vivo* studies using the combination of nano-hydroxyapatite & sodium fluoride for the remineralization of teeth. Additionally, future studies should focus on the mechanism of action that are necessary for dentin morphological changes and permeability alteration following the nano-hydroxyapatite application.

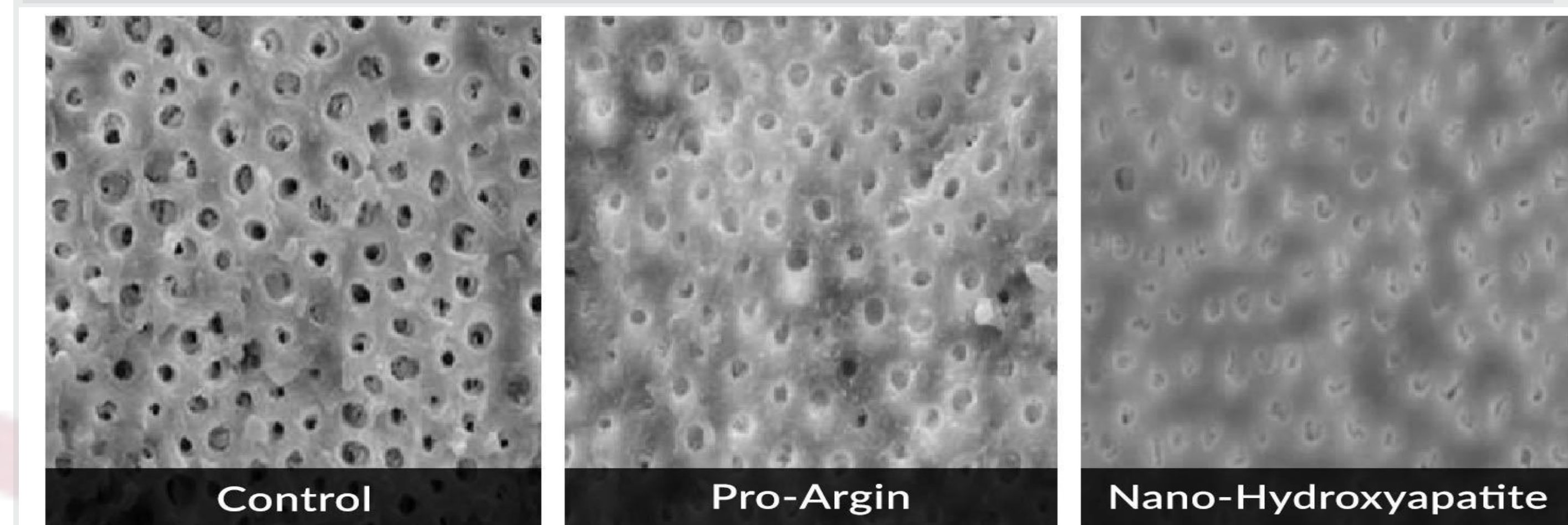


Figure 3. Displays the remineralization potential using Pro-Argin and Nano-Hydroxyapatite in dentin tubules. (Felgueiras, 2018)

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## Conclusion

At the root, nano-hydroxyapatite is effective at remineralizing tooth enamel & providing relief for hypersensitivity. Based on the current literature, nano-hydroxyapatite can provide individuals with an alternative remineralization option compared to fluoride. Additionally, the current literature determined hydroxyapatite nanoparticles to be non-toxic and biocompatible.

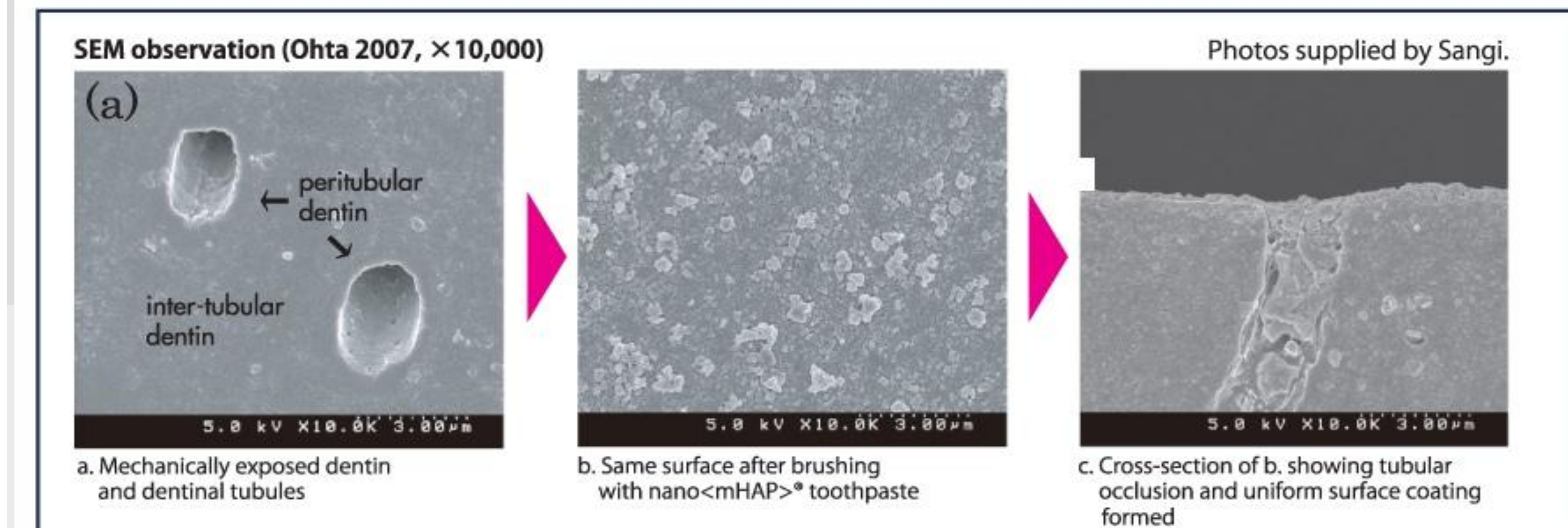


Figure 4. Displays dentin tubules remineralizing from nano-hydroxyapatite. (Nano Medical Hydroxyapatite)