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Review Article,

The Potential of Hydroxyapatite Toothpaste towards the Hypersensitive Tooth

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Abstract:

Dental hypersensitivity is a communal problem that we may often encounter in the daily life of both men and women, especially in the elderly who can unconsciously affect every daily activity. Dentin hypersensitivity is defined as sharp pain caused by stimulation of exposed dentin and unprotected dentin by enamel which can be caused by attrition, abrasion, crown fracture, gingival recession, and orthodontic trauma. Aim: The aim of this study was to analyse the potential of hydroxyapatite toothpaste towards the hypersensitive tooth through literature review. Method: This study analyzed 35 journals from each database PubMed, Ebsco, Google Scholar, ResearchGate, Wiley Online Library, and other international journal websites with keywords hydroxyapatite, hypersensitive dentin, remineralization. Conclusion: Toothpaste containing hydroxyapatite was more effective than toothpaste without hydroxyapatite in inducing tooth remineralization process. The use of toothpaste containing hydroxyapatite in the long term and routine for 15 days is more effective in reducing dental hypersensitivity.

Key Words: Hydroxyapatite, Toothpaste, Hypersensitive tooth.

Introduction:

Dental hypersensitivity cases in Indonesia are a common problem that can be encountered every day, both in men and in women, especially those who have entered old age. In addition, according to research data from the Indonesian Ministry of Health, 20% of Indonesians have experienced sensitive teeth, 62.1% have cavities (caries), and 36.5% have active caries (not treated). WHO also has data that 50% of the Indonesian population suffer from sensitive teeth and without realizing this condition affects their daily productivity.[2]

Dentin is the largest and most calcified hard tissue in the teeth. Dentin has a composition of 70% inorganic material, 20% organic material, and 10% water.[3] According to Mulya (2016), dentinal hypersensitivity is defined as pain that lasts for a short time and is sharp due to stimulation of exposed dentin and dentin that is not protected by enamel due to friction irritation, abrasion, crown fracture, gingival recession, and orthodontic trauma.[4]When exposed dentin is exposed to external stimuli, the fluid in the dentinal tubules undergoes inward and outward mechanical movement that triggers pain.[5]Stimuli that trigger dentin hypersensitivity can be tactile or tactile, steam, chemicals and hot or cold stimuli.[6]Dentin hypersensitivity occurs due to reduced cementum protection, smear layer and hydrodynamic movement of fluid in the dentinal tubules. Symptoms of pulp inflammation in this case are not specific but in the case of exposed dentin, the complaint can be considered as localized reversible inflammation.[7]The occurrence of individual dentin hypersensitivity can be determined using the Visual Analog Scale (VAS) index. The VAS index is an index that is used to determine a person's level of pain visually

Dentin hypersensitive can be reduced or eliminated by using a direct desensitizing agents such as tooth pasted enriched with strontium chloride, strontium acetate, potassium nitrate, and potassium citrate. The mechanismofaction of most desensitization treatments is based on the closureoftubular dentin by salt deposition,avoiding fluidmovement and stimulation of nerveprocesses.[10,11] Professional to othpastescanprovidemechanicalimbricationofnano-sizedhydroxyapatiteintothedentinaltubules, which is resistanttothe oral environment for up to three months.[12] Gintu et al. (2020) stated that toothpaste is an ingredient for dental care to clean, adds aesthetics and replaces minerals that are lost from the tooth surface. To prevent damage to the mineral layer on the teeth, remineralization components are added to toothpaste in the form of calcium carbonate, calcium phosphate, and even nano calcium such as Hydroxyapatite (HA).[7] Hydroxyapatite which has the chemical formula of Ca10(PO4)6(OH)2 is synthesized from rich components.[9]

The hydroxyapatite synthesis method can be classified into the precipitation method and the sol gel method.[13] The precipitation method is part of the most well-known wet chemical method and the most widely used technique for the synthesis of hydroxyapatite.[14] The precipitation method can synthesize large amounts of hydroxyapatite without the use of organic solvents. and at a very low cost. To produce hydroxyapatite through the precipitation method, various precursors containing calcium and phosphate can be used, such as calcium hydroxide (Ca(OH)2) and phosphoric acid (H3PO4). The by-product produced by the reaction of Ca(OH)2 and H3PO4 in the synthesis of HA is only water and the reaction does not involve foreign elements.[15] The sol gel method provides convenience for adjusting the composition and synthesis that can be carried out at low temperatures, can produce a homogeneous layer , pure, and stoichiometric resulting from mixing with modern scales. Small particle size and large surface area so that the combustion temperature is low and it is possible to obtain homogeneous nano-sized particles, using relatively simple equipment.[16]

One of the ways that patients can treat hypersensitive dentin is by using commercial desensitizing toothpaste.[4] Toothpaste is a semi-aqueous material that is used with a toothbrush to clean the entire surface of the teeth and provide a comfortable feeling in the oral cavity.[17]The ingredients of the toothpaste are expected to react with calcium ions and form crystals that can seal the dentinal tubules and prevent the flow of fluid through the tubules. Desensitization toothpaste containing hydroxyapatite is used to relieve tooth hypersensitivity by closing the dentinal tubules through the remineralization process of dentin that has undergone a demineralization process.[18] According to Aulia (2018), hydroxyapatite-based toothpaste has an effect and works optimally to reduce dental hypersensitivity in long-term use, namely routine use for 6-15 days.[19]Saadah et al. (2018) stated that administration of nano-hydroxyapatite paste for 7 days resulted in lower enamel microporosity after bleaching treatment than those who were not treated with nano-hydroxyapatite paste. For tooth remineralization, nano-hydroxyapatite has been shown to be a material that can infiltrate dentinal tubules and induce regeneration of the mineralized layer which in turn can prolong the desensitizing effect of hypersensitivity teeth. The exposed dentinal tubules in hypersensitive teeth can be closed by adhering this material to their surface.[20,21]According to Ebadifar et al. (2017) stated that toothpaste containing nano-hydroxyapatite was more effective thantoothpaste not containing nano-hydroxyapatite for tooth remineralization.[22]Kulal et al. (2016) stated that toothpaste with nano-hydroxyapatite was effective against dentinal tubular occlusion. The effectiveness of nano-hydroxyapatite toothpaste is higher than novamin and proargin. This can be attributed to the occlusion of the dentinal tubules by nano-hydroxyapatite crystals and the formation of a protective biomimetic layer that is resistant to acid attack. This new biomaterial is a potential treatment modality for dentin hypersensitivity.[23] From this statement the authors would like to discuss the topic of the potential of hydroxyapatite-based toothpaste on dental hypersensitivity.

Method:

This study was conducted based on reference sources/references obtained from journals, textbooks and websites accessed through databases, ResearchGate, Ebsco, Google scholar, Wiley Online Library, NCBI (National Center for Biotechnology Information), Pubmed and searched for with the keywords "Hydroxyapatite, Hypersensitivity, and Remineralization". The types of journals taken are research and descriptive published from 2010-2020

Result:

A. Toothpaste

Toothpaste is defined as a semi-aqueous material that is used with a toothbrush to clean the entire surface of the teeth and provide a comfortable feeling in the oral cavity. The addition of aroma will provide a comfortable and refreshing feeling in the oral cavity.[17] Toothpaste used when brushing teeth serves to reduce the formation of plaque or stains, strengthens the protection of teeth against caries, cleans and polishes the tooth surface, eliminates or reduces bad breath, provides a fresh taste in the mouth and maintain dental health.[24] The main working principle of toothpaste focuses on two parameters, the first is to reduce plaque and dental caries produced by microbial activity, and the second is to help remineralize tooth enamel because many of the protective minerals of tooth enamel are reduced due to the activity of oral microorganisme. [25]

B. Model of toothpaste

Toothpaste is divided into two types:

1. *Non Herbal Toothpaste.*

Non-herbal toothpaste is toothpaste without any additional ingredients derived from herbal ingredients. Non-herbal toothpastes are composed of ingredients, such as abrasives, water, therapeutic ingredients and much more. These materials become a unified composition so that it can be used as a means to help maintain oral hygiene.[26]

2. *Herbal Toothpaste*

Herbal toothpaste is toothpaste that contains herbal ingredients as additives that are beneficial for dental health. Herbal ingredients that may be added to toothpaste can be green tea leaves, betel leaves, and lime which are expected to inhibit the formation of dental plaque. Green tea (Camellia Sinensis) has an active component, namely polyphenol catechins that function in preventing plaque formation. Betel leaf (Piper Betel Linn) contains many essential oils, catechins and tannins which are polyphenolic compounds and can act as antiseptics and can inhibit the biological activity of bacteria that cause dental caries. Lime (Citrus aurantifolia) contains useful chemical compounds including citric acid, fatty resins, glycosides, minerals, vitamin B1, essential oils. Lime fruit extract provides the highest antibacterial activity against the main bacteria in plaque formation.[27]

C. Content of Toothpaste

Most toothpaste available contain more than one active ingredient and are promoted with several advantages for users. Generally, toothpaste on the market today is a combination of abrasive, detergent and one or more therapeutic ingredients. The general composition and content of active ingredients commonly contained in toothpaste are as follows: Abrasive materials (20-50%), for example: silica or silica hydrate, sodium bicarbonate, aluminum oxide, dicalcium phosphate and calcium carbonate. water (20-40%), humectants or moisturizers (20-35%) namely sorbitol, mannitol, glycerin, propylene glycol, alpha hydroxy acids (AHA), propylene glycol, lactic acid and surfactants, adhesives (1-2%), water-soluble materials such as carragcenates, alginates, and sodium carboxyl metal cellulose, and water-insoluble materials such as magnesium, aluminum silicates, and colloidal silica. The materials commonly used are carboxyl metal cellulose, amylose, alginate, synthetic derivatives of cellulose, sorbitol and polyethylene glycol (PEG), surfactant or detergent (1-2%), flavor enhancer (0-2%), therapeutic agent (0-2%) namely: fluoride, desensitizing agent, anti-tartar agent and antimicrobial agent. Fluoride compounds are salts of fluoride compounds that occur in nature in the form of sodium fluoride, calcium fluoride, ammonium fluoride, aluminum fluoride, ammonium fluorosilicate, ammonium fluorophosphate, hexadecyl ammonium fluoride, magnesium fluoride and others.[28]

D. Hydroxyapatite

Hydroxyapatite is a highly biocompatible bio-ceramic and has a composition and crystal structure similar to that of apatite in human teeth and bones.[29] Hydroxyapatite is the most thermodynamically stable crystalline phase of CaP with the chemical formula Ca10(PO4)6(OH)2.[30] The crystal structure of HA can be either monoclinic or hexagonal. The monoclinic HA structure was obtained only under pure conditions with a stoichiometric composition, with a Ca/P ratio of 1.67. The hexagonal structure is generally obtained from HA synthesis which is not stoichiometric. The lower the value of the Ca/P molate ratio, the more acidic it is and the more soluble the calcium orthophosphate compound.[10]

E. Content of Hydroxiapatite

Dental mineral tissue consists of hydroxyapatite [Ca10 (PO4)6(OH)2] crystals. Minerals in teeth that have the highest percentage are calcium as

much as 35.8% and phosphorus as much as 17.4%. Calcium is the main component in tooth structure and demineralization of enamel occurs due to the release of calcium ions from tooth enamel. Phosphorus has an important role in the calcification of bones and teeth, formation of energy, absorption and transport of nutrients, acid-base balance, and as part of essential body tissues. Calcium and phosphorus combine to form hydroxyapatite crystals (Crystals of hydroxyapatite) [Ca10(PO4)6(OH)2].[31] Apatite crystals contain many carbon groups in the form of carbonates. In the hydroxyapatite structure, carbonate can replace OH- ions to form type A carbonate apatite crystals, and when replacing PO43- ions form type B apatite crystals. In general, precipitation at low temperatures will form type B apatite carbonates, whereas apatite is precipitated from the reaction at low temperatures. High levels will produce type A apatite carbonate. Apatite compound is a type of ceramic that can be synthesized and implanted into the human body. HA is a very stable apatite crystal that is commonly implanted as a bone substitute or dental filler.[32]

F. Benefit of Hydroxiapatite

Hydroxyapatite is proven to be biocompatible and very well tolerated by human oral tissues, has osteoconductive ability and has been shown to stimulate osteoblast differentiation and bone formation. Therefore, hydroxyapatite is widely used in dentistry, including bone tissue regeneration, dental implant coatings, fillers in root canal filling cements, fillers in GIC restoration materials, and active ingredients for sensitive toothpastes.[13]Hydroxyapatite meets the main basic criteria as a bone transplant material, namely osteoconduction, osteoinduction and osteogenesis. According to research Kattimani et al. (2014) stated that hydroxyapatite processed from egg shells has excellent properties as a bone substitute, because it is biocompatible, hydrophilic, can absorb fluids and bones, making it easier to handle. Eight months after transplantation, the bone defects grafted using hydroxyapatite in the study showed complete bone formation, with bone density equal to or greater than the surrounding normal bone.[33]

Management of pathological conditions in the bone may involve the placement of implants. The ideal criteria for dental implants include biocompatibility and good mechanical properties, which can facilitate osteogenesis at the alveolar bone interface and the implant. There is a new coating method with a biomimetic approach by depositing calcium phosphate apatite crystals in Simulated Body Fluids (SBF) at room temperature. Based on the research of De Wilde et al. (2015) stated that implant coating using nanostructured hydroxyapatite did not cause inflammation as happened with plasma spray hydroxyapatite coating.[34] Hydroxyapatite may use a root canal sealers that must be biologically inert and bioactive with body tissues, and exhibit good radiopacity and wetting. In addition, the cytotoxicity of this material is an important consideration because it will be in direct contact with dentin and periapical tissue. Collares et al. (2012) stated that nano-hydroxyapatite is suspected to be a filler material that can lead to crystal growth and biomimetic mineralization in the surrounding tissue, because synthetic apatite has a biological composition and configuration that resembles teeth.[35]Hydroxyapatite is thought to be involved in the chemical changes that occur during the initial setting of cement. HA is soluble in acidic solutions, its solubility increases rapidly at pH below 2.05 when in contact with polyacrylic acid. Under these conditions, Ca ions can be released from the HA surface, which acts as additional calcium which is first available for the GIC hardening reaction to occur. This causes an increase in the degree of acid-base reaction in the GIC structure and forms stronger cement. In addition, HA increases the density of the GIC because HA fills the gap between the glass particles in the empty Glass Ionomer Cement GIC.[13]

According to research Gopinath et al. (2015) stated that the use of toothpaste containing nano-hydroxyapatite was associated with a statistically significant decrease in tooth sensitivity. Nano-hydroxyapatite is thought to be effective in closing dentinal tubules, because this material consists of calcium and phosphate, and saliva in the oral cavity has been supersaturated by hydroxyapatite. Thus the possibility of dissolving these compounds by saliva is relatively small. At the end of the fourth week of this clinical trial, complaints of dentin hypersensitivity were significantly reduced.[15]

G.Advantage and Disadvantage of Hydroxyapatie

Hydroxyapatite has the ability to harden itself after reacting with a solvent without an exothermic reaction, and without a shrinkage process

occurring in the cavity during the hardening process, is osteoconductive which can integrate with bone tissue, biocompatible which can be accepted by the body without negative reactions, injectable, biosorbable and malleable. The biocompatible properties of hydroxyapatite are useful when used as osteoconductive filler in traumatized bone tissue. Hydroxyapatite is biocompatible because it can be accepted by body tissues without negative reactions, and its osteoconductive ability results in good integration of bone structure with hydroxyapatite. Ability to interact in the process of synthesizing nanoparticles with the sol-gel method with water (H2O), resulting in metal hydroxide compounds. The condensation process is a process in which metal hydroxides that have been formed in the hydrolysis process bind to each other to form oxide chains and produce metal oxide compounds. Shows the bioactive properties of a material, because bioactive properties are one of the important properties that biomaterials must possess in order to have good biocompatibility in the body.[16]

Disadvantages of hydroxyapatite are brittle, not osteoinductive, low mechanical properties and structural instability when mixed with body fluids or patient blood. Bone healing in the case of bone defects (bone defects) is a complex process where osteosis is required, namely osteoconduction and osteoinduction. Therefore, to improve the process of osteosis in the treatment of bone damage, a material that has osteoinduction properties on synthetic HA is needed. HA has a disadvantage when used as a bone implant, which is brittle.[36]

H. Hypersensitive Dentin

Dentinal hypersensitivity can be described as a short, sharp pain that occurs suddenly due to stimulation of the dentin. Stimuli that can trigger dentin hypersensitivity can be tactile, steam, chemical, hot or cold stimuli. Basically normal dentin is protected by enamel so that it is not affected by external stimuli, but in conditions where enamel and cementum are lost due to attrition, abrasion, and erosion, the dentin becomes responsive. Pain in dentin occurs due to the movement of dentinal tubular fluid which will cause a stimulus to the pulp nerve which then sends stimuli to the brain and causes the perception of pain.[8]

I. Cause of Hypersensitive Dentin

Dentin hypersensitivity is said to be pain or tenderness in the tooth that causes an exaggerated response of the vital pulp to various stimuli. This happens because the dentin is exposed to the oral environment which causes discomfort for a person. In this case there was no cavity as was the case with a carious or non-carious lesion. Dentin hypersensitivity is generally caused by gingival recession in the root area, exposed root surfaces as a result of scaling and root planning treatments or after bleaching treatments.[1]Dentin hypersensitivity is mainly found in cases of gingival recession which causes the root surface to be exposed to various stimuli of heat, cold, sour, sweet and air. The root surfaces of the facial aspect of the canines, premolars and molars are the most common areas for periodontal attachment loss and may increase after undergoing scaling and root planning. Dentin hypersensitivity occurs due to reduced cementum protection, smear layer and hydrodynamic movement of fluid in the dentinal tubules. Symptoms of deep pulp inflammation in cases of exposed dentin can be considered as localized reversible inflammation.[1]

Gingival recession is a condition where the root surface is exposed due to loss or pulling or retraction of the gingiva towards the root resulting in an unprotected root surface. Bleaching is an action to whiten teeth that experience discoloration that can be caused by extrinsic or intrinsic teeth. Bleaching treatments on vital teeth have the potential to irritate the pulp, causing hypersensitivity to the dentin. Scaling and root planning are actions to remove calculus both supra and sub gingiva. As a result, it can cause pain after treatment due to loss of cementum that protects the root of the tooth.[1]

J. Mechanism of Hydroxypatite of Hypersensitive Dentin

Hydroxyapatite is an inorganic compound that makes up the hard tissues of the human body such as bone, dentin, and teeth. HA has a mechanism to reduce dental hypersensitivity by inducing tooth remineralization. According to previous studies, hydroxyapatite has been shown to be a material that can infiltrate dentinal tubules. Dentinal tubules that have been exposed in hypersensitivity teeth can be covered by hydroxyapatite by adhering to its surface. HA can also induce regeneration of the mineralized layer which can prolong the desensitizing effect in tooth hypersensitivity conditions.[20]

HA is able to close the dentinal tubules by remineralizing the collagen matrix in a process called an "organic-mediated process". HA will

form nucleation and growth centers in the dentinal tubules. The process of nucleation begins with the addition of ions called epitaxial growth; this process promotes the formation of minerals in the dentin.

K. Research on the Potential of Hydroxyapatie toothpaste on Dental Hypersensitivity

There are researches on the potential of toothpaste made from hydroxyapatite on dental hypersensitivity, including: Aulia (2018) stated that toothpaste made from hydroxyapatite has an effect and works optimally to reduce dental hypersensitivity in long-term use, namely routine use for 6-15 days.[19]Saadah et al. (2018) stated that administration of nano-hydroxyapatite paste for 7 days resulted in lower enamel microporosity after bleaching treatment than those who were not treated with nano-hydroxyapatite paste. The dentinal tubules can contract or expand in response to a temperature stimulus imposed on the tooth surface. There is a mechanism that can reduce tooth hypersensitivity by inducing remineralization in teeth, nano-hydroxyapatite has been shown to be a material that can infiltrate dentinal tubules and can induce regeneration of the mineralized layer which can prolong the desensitizing effect in hypersensitivity conditions. The dentinal tubules that have been exposed in hypersensitivity teeth can be closed by attaching to their surface.[20] According to Ebadifar et al. (2017) stated that toothpaste containing nano-hydroxyapatite was more effective than toothpaste not containing nano-hydroxyapatite for tooth remineralization.[22]Kulal et al. (2016) stated that toothpaste with nano-hydroxyapatite was effective against dentinal tubular occlusion. The effectiveness of nano-hydroxyapatite toothpaste is higher than novamin and proargin. This can be attributed to the occlusion of the dentinal tubules by nano-hydroxyapatite crystals and the formation of a protective biomimetic layer that is resistant to acid attack. This new biomaterial is a potential treatment modality for dentin hypersensitivity.[23]

Discusion:

Gopinath et al. (2015) stated that the use of toothpaste containing nanohydroxyapatite was associated with a decrease in tooth sensitivity.Nano-hydroxyapatite is thought to be effective in closing dentinal tubules, because this material consists of calcium and phosphate, and saliva in the oral cavity has been supersaturated by hydroxyapatite. Thus the possibility of dissolving these compounds by saliva is relatively small. At the end of the fourth week of this clinical trial, complaints of dentin hypersensitivity were significantly reduced.[15]The research conducted by Aulia (2018) proved that hydroxyapatite-based toothpaste has an effect and works optimally to reduce dental hypersensitivity in long-term use, namely routine use for 6-15 days.[19]Brannstrom, et al. in his book entitled Hydroxiapatite (Hap) for Biomedical Application (2015) wrote the theory that closure of exposed dentinal tubules using production technology and isolation of 2 and 8 mm thick hydroxyapatite sheets was proven to be able to cover the surface of dentinal tubules on day 6 after adhesion.[37]

According to Maesaroh and Silviani (2019), toothpaste is defined as a semi-aqueous material that is used with a toothbrush to clean the entire surface of the teeth and provide a comfortable feeling in the oral cavity. The addition of aroma will provide a comfortable and refreshing feeling in the oral cavity. Cahyanti (2014) stated that toothpaste used when brushing teeth serves to reduce plaque or stain formation, strengthen dental protection against caries, clean and polish tooth surfaces, eliminate or reduce bad breath, provide a fresh taste in the mouth and maintain dental health.[24] The main working principle of toothpaste is focused on two parameters, the first is to reduce plaque and dental caries produced by microbial activity, and the second is to help remineralize tooth enamel because many of the minerals that protect tooth enamel are reduced due to the activity of oral bacteria.[25]

Gintu et al (2020) stated that toothpaste is an ingredient for dental care that is clean, adds aesthetics and replaces minerals that are lost from the tooth surface. To prevent damage to the mineral layer on the teeth, remineralization components were added to toothpaste in the form of calcium carbonate, calcium phosphate, and even nano calcium such as Hydroxyapatite (HA).[7]Ebadifar et al. (2017) added that toothpaste containing nano-hydroxyapatite was more effective than toothpaste that did not contain nano-hydroxyapatite for tooth remineralization, excellent and highly compatible with bones and teeth.Hydroxyapatite is a ceramic material composed of calcium phosphate which has high biocompatibility and is non-toxic and is an integral part of bone and tooth tissue.[38] Kulal et al (2016) stated that toothpaste with nano-hydroxyapatite was effective against dentinal tubular occlusion.

The effectiveness of nano-hydroxyapatite toothpaste is higher than novamin and proargin.[23]

Bansal et al. (2014) used hydroxyapatite nanopowder which was synthesized using calcium nitrate tetrahydrate and ammonium phosphate as precursors. The results of the synthesis were characterized using EDAX and it was found that the stoichiometric ratio of Ca/P was close to the theoretical value of 1.67, and from the XRD test it was found that the crystal particles were 20nm in size and there was no other crystalline phase other than hydroxyapatite. The hydroxyapatite nanopowder was used to fill periodontal defects in moderate to advanced chronic patients with intraboniangular defects. At the control visit 6 months after therapy, the probing depth showed a significant decrease.[39]

Wadu et al. (2017) stated that the need for active ingredients with dual performance led to the initiation of hydroxyapatite as an abrasive in toothpaste, the content of hydroxyapatite is also expected to be a remineralizing agent and also an active ingredient for caries antibacterial.[41] Hydroxyapatite was chosen as a remineralizing agent because it is thought to have a similar structure to the calcium structure that makes up bones and teeth and is also expected to be able to close micro-sized holes on the tooth enamel surface. Calcium phosphates such as hydroxyapatite show good biocompatibility for bone.[42]

Conclusion:

This studyconcluds that toothpaste made from hydroxyapatite has an effect on reducing dental hypersensitivity. There is a mechanism that can reduce tooth hypersensitivity by inducing remineralization in teeth, nano-hydroxyapatite has been shown to be a material that can infiltrate dentinal tubules and can induce regeneration of the mineralized layer which can prolong the desensitizing effect in hypersensitivity conditions. Toothpaste made from hydroxyapatite has an effect and works optimally to reduce dental hypersensitivity in long-term use, namely routine use for 6-15 days.

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