

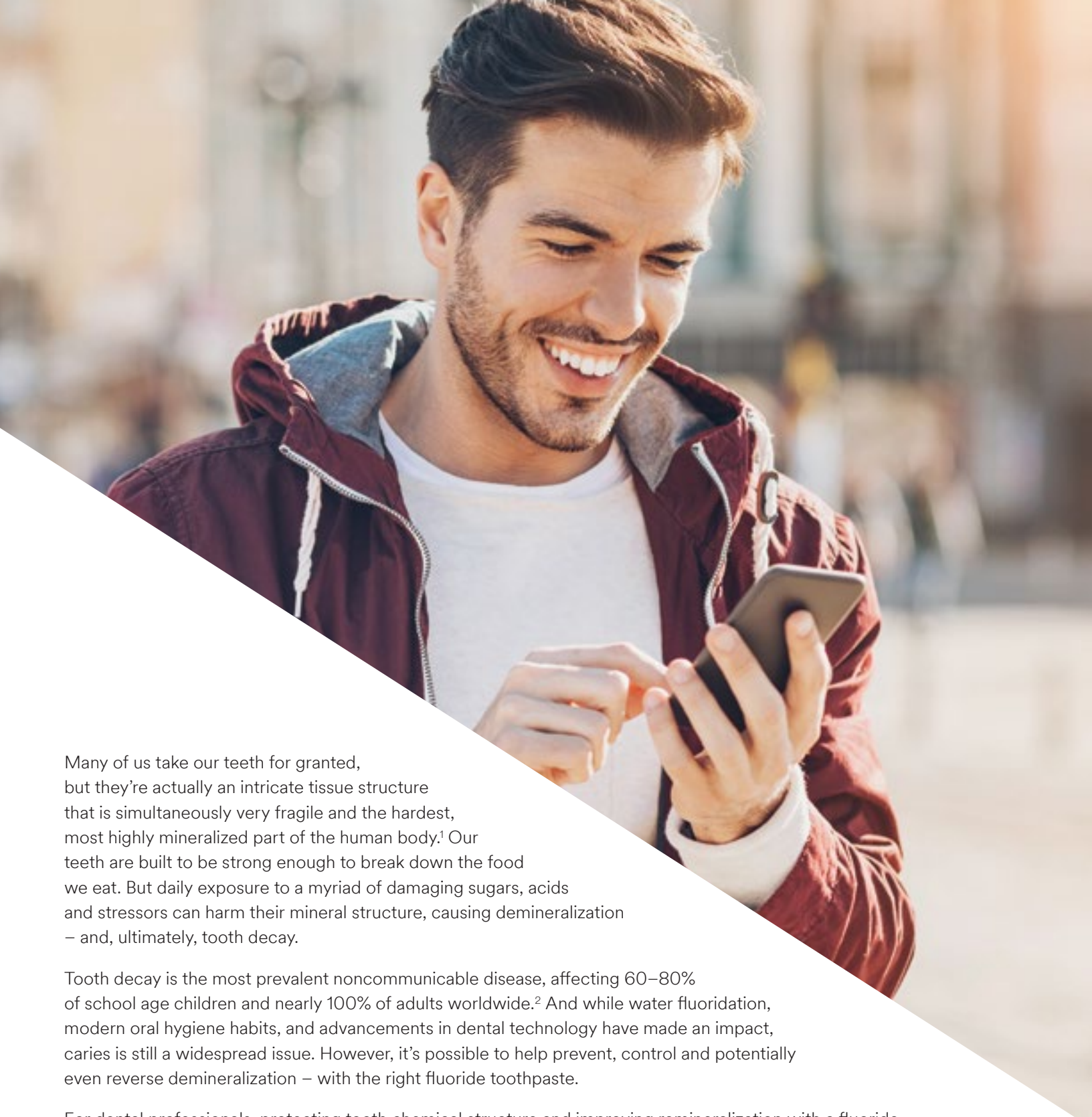


Science.
Applied to Life.™

Remineralization,
toothpaste and
the tooth – from
root to crown.

See how your toothpaste choices
can make a world of difference.





Many of us take our teeth for granted, but they're actually an intricate tissue structure that is simultaneously very fragile and the hardest, most highly mineralized part of the human body.¹ Our teeth are built to be strong enough to break down the food we eat. But daily exposure to a myriad of damaging sugars, acids and stressors can harm their mineral structure, causing demineralization – and, ultimately, tooth decay.

Tooth decay is the most prevalent noncommunicable disease, affecting 60–80% of school age children and nearly 100% of adults worldwide.² And while water fluoridation, modern oral hygiene habits, and advancements in dental technology have made an impact, caries is still a widespread issue. However, it's possible to help prevent, control and potentially even reverse demineralization – with the right fluoride toothpaste.

For dental professionals, protecting tooth chemical structure and improving remineralization with a fluoride toothpaste is a no-brainer, but not all methods are equally effective. A wide range of variables make a big difference – not only patient diet and habits, but also how toothpaste ingredients are delivered, how they react to one another and the tooth, and when reactions occur. The question is:

► **When it comes to remineralization, is your toothpaste doing everything it can?**

Tooth composition

The human tooth is far more extraordinary than we give it credit for, in both mineral composition and structure, and patients may not fully understand how big an impact their care choices can have. The small calcified structure has a unique tissue composition that is only found in the oral cavity and is limited to dental structures – and isn't bone like many patients believe.^{3,4} Bones are designed to be flexible to resist fracture and contain living proteins to repair themselves fairly quickly if broken. Teeth, on the other hand, consist mainly of hydroxyapatite ($\text{Ca}_5(\text{PO}_4)_3(\text{OH})$ or HA), a hard, white inorganic crystalline mineral made up of calcium and phosphate, that is easily broken down by acids, sugars and other factors.⁴

On a basic level, the human tooth is made up of **four distinct tissue layers**, each designed to protect one another:

1

Dentin makes up the bulk of the tooth structure. This yellowish, calcified tissue is harder than bone but softer than enamel and keeps brittle enamel from breaking when put under pressure.⁸ It has a limited ability to regenerate that is wholly dependent on the health of the pulp.⁹ Due to its lower mineral content, dentin can be overwhelmed by acid or erosion when exposed – particularly without vital pulp.⁹ It contains microscopic tubules, or canals, that extend from surface to the pulp, and serve as an early warning system in the event of trauma or exposure.¹⁰

2

Enamel is likely a familiar term for patients, although they may not know much about it. The hardest substance in the human body, enamel is also the most highly mineralized (96%). It is designed to protect the soft inner layers of the tooth from constant daily wear. Unlike the rest of the tooth, it contains no living tissue. When a tooth is demineralized, worn down or broken, it will stay that way – or get worse – without intervention.^{1,4}

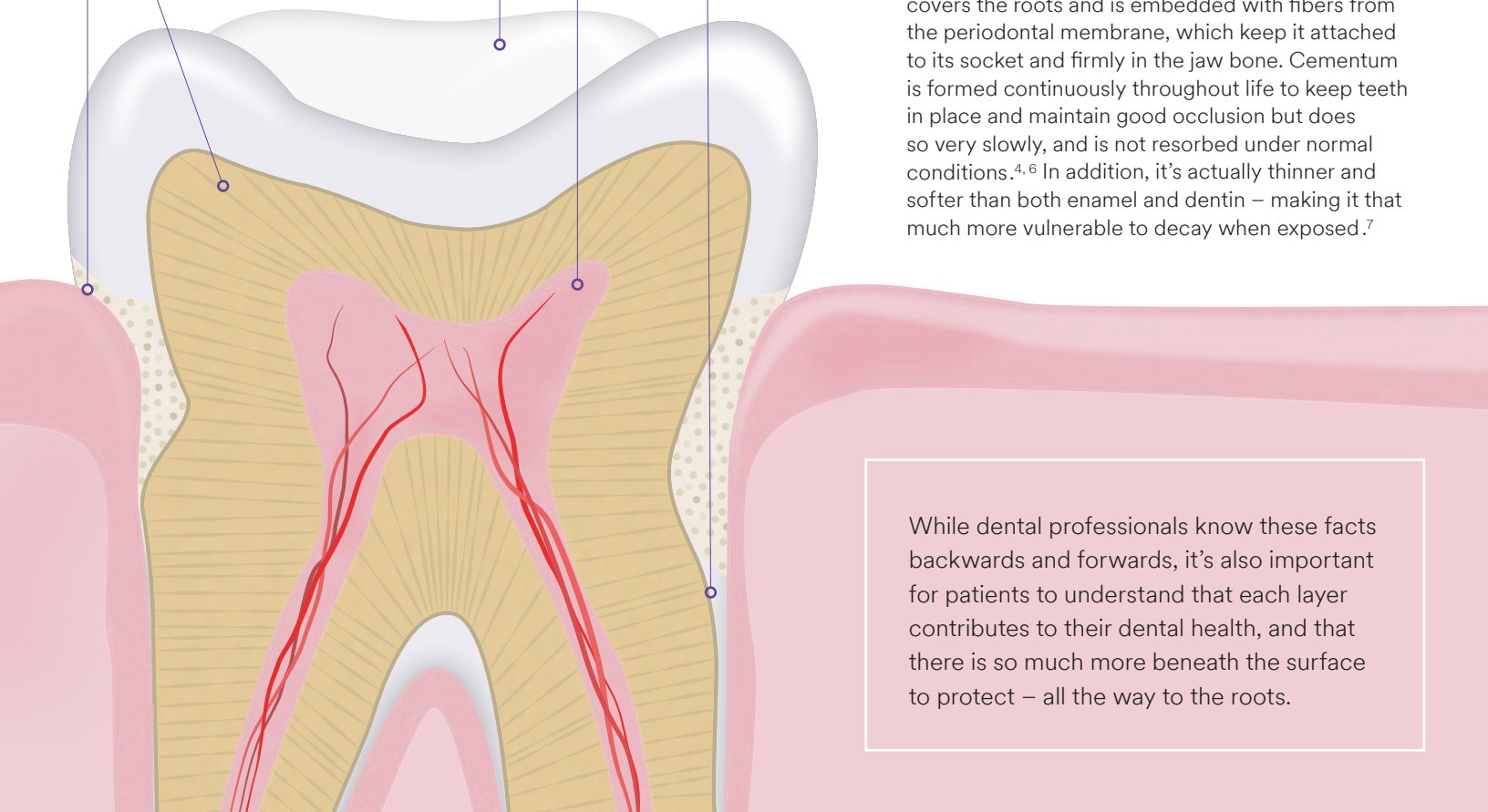
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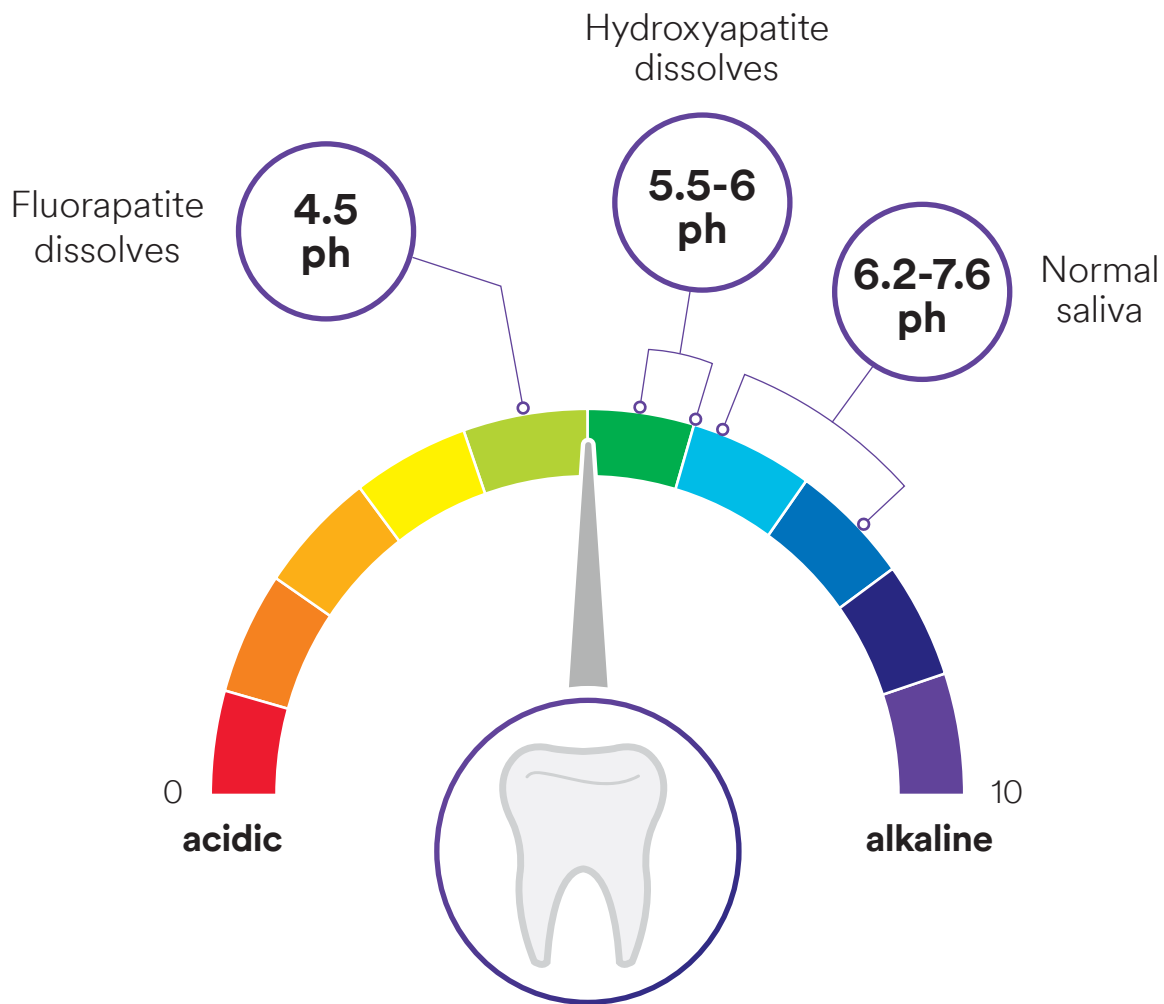
Pulp is the soft, innermost layer of the tooth. It contains blood vessels, connective tissue and nerves – and if exposed to temperature, pressure or trauma, will cause pain. And while preventing pain and infection seems like reason enough to protect it, the pulp actually serves several critical purposes in the mineralization process: it's responsible for forming and repairing damaged dentin, and provides moisture and nutrients to the tooth.⁵

4

Cementum is part of the anchoring system of the tooth. This mineralized connective tissue covers the roots and is embedded with fibers from the periodontal membrane, which keep it attached to its socket and firmly in the jaw bone. Cementum is formed continuously throughout life to keep teeth in place and maintain good occlusion but does so very slowly, and is not resorbed under normal conditions.^{4,6} In addition, it's actually thinner and softer than both enamel and dentin – making it that much more vulnerable to decay when exposed.⁷

While dental professionals know these facts backwards and forwards, it's also important for patients to understand that each layer contributes to their dental health, and that there is so much more beneath the surface to protect – all the way to the roots.





Demineralization and remineralization

Demineralization and remineralization are lifelong processes that occur constantly and simultaneously in the mouth whether patients pay attention to oral health or not. As discussed above, the tooth is an intricate mineral structure that reacts to external stimuli to trigger these processes. Its health is heavily dependent on saliva (a natural source of calcium and phosphate) and the mouth's overall pH level.

The mouth is at its healthiest when there is equilibrium between the mineral content of the tooth and the saliva, and it's constantly working to maintain this balance.¹⁴ In a neutral pH environment, hydroxyapatite dissolves minimally and supersaturates the calcium and phosphate-rich neutral saliva, resulting in the minerals resorbing into the teeth – i.e. remineralization.¹¹ This perpetual give-and-take is healthy and, if kept stable, ensures strong teeth.

However, achieving this balance is far more difficult than it sounds. Demineralization occurs when the pH level of the mouth drops below neutral and creates an acidic environment. Hydroxyapatite crystals begin to dissolve at approximately 5.5–6 pH, disintegrating enamel.^{12, 13} This reaction resaturates the oral fluid with calcium and phosphate, buffers the acidity and neutralizes the pH of saliva – but at the expense of the tooth structure.¹¹ Many factors including diet, age, genetics, medication, medical conditions and more can change the pH level of saliva. While the oral fluid will eventually neutralize on its own, it may not do so efficiently or quickly enough to avoid damage. This is where fluoride and fluoride toothpaste come into play.

Fluoride

While remineralization happens naturally, it requires outside intervention to happen effectively – and this means introducing fluoride. Fluoride, the ionic form of the element fluorine, is scientifically proven to prevent tooth decay and is the only substance recognized by the American Dental Association (ADA) and the Food and Drug Administration (FDA) for caries prevention.¹⁴ It works by holding on to calcium and phosphate in the mouth, increasing the remineralization of enamel. It prevents further decay by replacing the normal enamel crystalline composition hydroxyapatite with stronger fluorapatite ($\text{Ca}_5(\text{PO}_4)_3\text{F}$ or FA). FA begins demineralizing at 4.5pH, significantly lower pH than hydroxyapatite, giving teeth a stronger shield from decay.¹¹

Fluoride has a long history when it comes to dental health – it was first recognized for its caries-prevention properties in drinking water in the early 20th century, and water fluoridation has continued as a very effective measure ever since.¹⁵ Today, topical fluoride is delivered via three main mechanisms: community-based sources like salt, milk and fluoridated water; self-applied sources, such as toothpaste; and professionally applied treatments such as fluoride varnish. Self- and professionally-applied options, like toothpaste, are not intended to be ingested – reducing the risk of potential adverse effects.¹⁶

Fluoride toothpastes also have the ability to “recharge” fluoride-releasing materials such as glass ionomer restorations and sealants. This allows the materials to absorb and release another round of fluoride into the mouth every time a patient brushes, for both immediate and long-term fluoride delivery. The ADA recommends that most individuals brush twice a day with a certified fluoride toothpaste for general maintenance.¹⁷ However, finding the best toothpaste for each patient’s needs can be a challenge.

How well a fluoride toothpaste works is dependent on a number of factors, including patient age, diet, hygiene habits and caries risk – as well as the toothpaste formulation itself. Fluoride delivery and ingredient interactions both in the tube and on the teeth all play a role in how well a toothpaste will help remineralize and strengthen the smile. Patients may choose a toothpaste based on habit or advertising, but their best choice is to ask a dental professional for a recommendation that meets their needs. For example, some highly-abrasive toothpastes can do as much harm as good to those with weak enamel, or could contain ingredients that require an acidic pH to function, which can limit benefits to the tooth.¹⁸ And in some toothpaste formulations, calcium and fluoride can interact prematurely in storage, rendering both less effective.¹⁹ Particularly for high-risk patients who may need higher-concentration prescription toothpaste – such as those with xerostomia, active caries or cariogenic diets – knowing how they’re getting their fluoride is just as important as how much.²⁰



3M™ Clinpro™ Toothpastes

So how do you ensure your toothpaste recommendations are doing enough? By making a choice that's designed to do more than just trigger the remineralization process. 3M™ Clinpro™ Toothpastes were engineered to enhance remineralization through superior mineral delivery. They take the chemical structure of teeth, the pH levels of the mouth and the composition of toothpaste into account – giving patients the minerals they need efficiently, effectively, gently and without premature reactions.

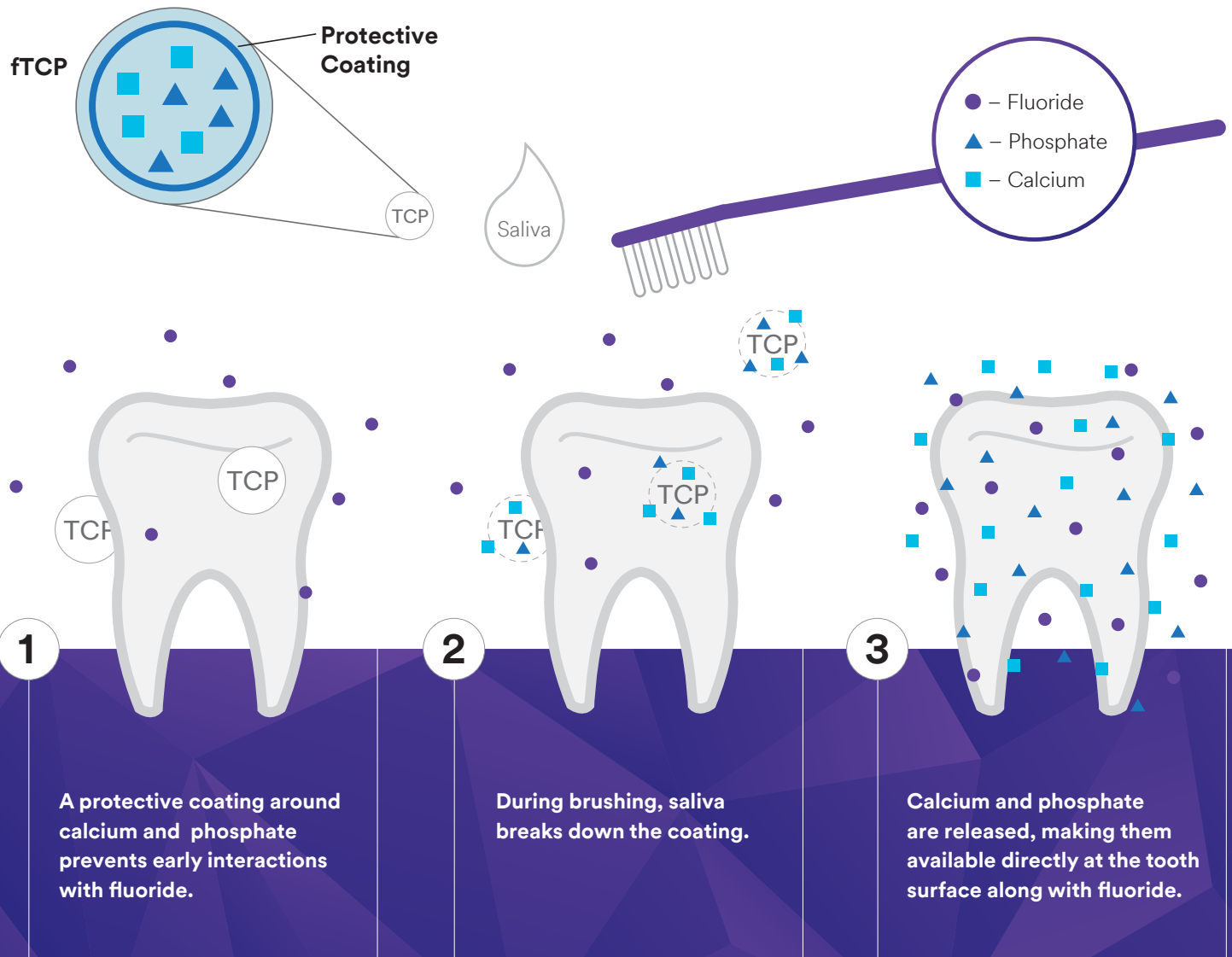
Clinpro toothpastes contain sodium fluoride as well as innovative functionalized tri-calcium phosphate (fTCP), an exclusive ingredient from 3M. These ingredients in concert ensure that moderate to high-risk patients

actually receive the fluoride and calcium listed on the tube. fTCP is a “smart” ingredient that control calcium and phosphate delivery by surrounding them with a protective coating, isolating them from fluoride until brushed on the tooth. This prevents unwanted interactions during storage and allows all three minerals to be delivered directly to the tooth surface. There, brushing and saliva break down the coating and release the calcium and phosphate where they're needed most on the tooth structure – throughout lesions, in vulnerable dentin tubules and on exposed root surfaces.

Backed by ten years of clinically-proven performance, Clinpro toothpastes are designed to prevent, repair and reverse white spot lesions while gently cleaning the tooth. They feature a low-abrasive formula and create acid-resistant mineral in dentin tubules, for a pleasant and effective experience with every brush. In addition, Clinpro toothpastes are prepared at an optimized neutral pH to help balance the mouth's environment. As with any fluoride toothpaste, they also have the ability to recharge fluoride-releasing sealants and restorations – further enhancing their remineralizing effects to create stronger, healthier smiles.



Innovative caries protection – as easy as fTCP.



When you recommend or prescribe a toothpaste to your patients, you're not just giving them a treatment: you're giving them a specific chemical and mineral reaction that helps build stronger, healthier teeth. The more you know about what the minerals in toothpaste do along every step of the journey – in storage, on the brush and for the tooth structure – the better choices you can make for your patients. Regardless of which fluoride concentration your patient needs, Clinpro toothpastes are uniquely formulated to promote remineralization – and overall oral health.

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