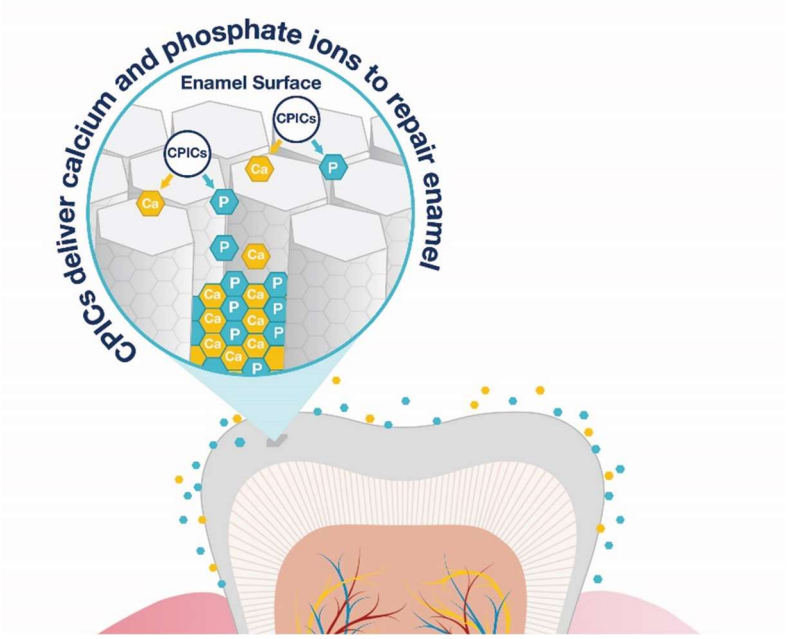
Calcium Phosphate Ion Clusters (CPICs)

An Exclusive Pac-Dent Calcium Technology



Features of Calcium Phosphate Ion Clusters

- Precisely replicates the structure of human tooth enamel
- Optimized to release a concentrated source of calcium and phosphate ions at the tooth surface
- Restores the mechanical properties of existing enamel
- Small size allows ions to penetrate deep into demineralized enamel

Introduction

Dental caries, or tooth decay, is widely recognized as the most prevalent dental problem globally. To combat this issue, numerous products have been developed to prevent further enamel degradation. However, the challenge of how to effectively regenerate lost enamel remains unsolved.

While enamel regrowth products are available, their effectiveness varies significantly. Replicating the unique structure and mechanical properties of human enamel is a complex task. Enamel's exceptional hardness and resilience stem its intricate, interwoven hydroxyapatite crystal rods, which form a distinctive "fish scale" pattern - an architecture that is challenging to fully replicate.

However, Pac-Dent has introduced an advanced solution for precise enamel regeneration and replication, spanning from the nanoscale to the macroscale: Calcium Phosphate Ion Clusters (CPICs).

An Innovative Solution: CPICs

CPICs are engineered to mimic the body's natural mineralization processes, providing a more bioavailable and efficient source of minerals compared to traditional technologies.

CPICs are nanoscale clusters of calcium and phosphate ions that are specifically designed to penetrate the microscopic pores and defects in demineralized enamel, making them highly effective in repairing and strengthening teeth.

When introduced into the oral environment, CPICs release calcium and phosphate ions upon contact with the tooth surface. This controlled release ensures that the ions are available precisely where they are required for remineralization.

The calcium and phosphate ions contribute to the formation of hydroxyapatite crystals, the primary mineral component of enamel.

Added fluoride works synergistically with CPICs to accelerate the uptake of calcium and phosphate ions into the tooth structure for more efficient enamel repair and the formation of fluorapatite, a more acid-resistant form of hydroxyapatite.

Supported by Scientific Research

A 2019 study by Zhejiang University compared Calcium Ion Clusters (CPICs) to Amorphous Calcium Phosphate (ACP) nanoparticles in their effectiveness at regenerating human tooth enamel. Within 48 hours, CPICS successfully replicated the intricate structure of enamel, confirmed through Scanning Electron Microscopy, with the regenerated enamel appearing indistinguishable from natural enamel[1]. This study demonstrated CPICs' capability for precise reconstruction of human enamel from the nanoscale to the macroscale, a structural fidelity that ACP nanoparticles were unable to achieve.

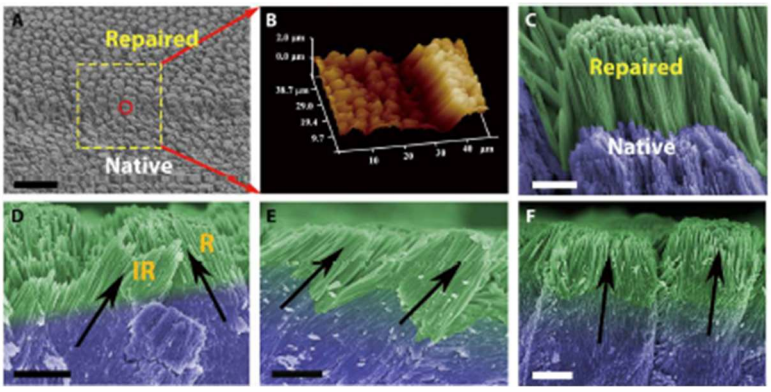


Figure 1. Replication of the complicated structure of enamel. (A) SEM image of both acid-etched and repaired enamel. (B) A 3D AFM image of repaired enamel. (C) High-magnification SEM image of the red circle in (A). (D) Cross-sectional view of final repaired enamel, where both enamel rods and inter-rods were repaired. R and IR represent for enamel rod and inter-rod, respectively. (E and F) Enamel rods with different orientations can be repaired.[1]

A 2022 study conducted a similar experiment to evaluate enamel hardness before and after treatment with a CPIC solution. Following CPIC application, the enamel hardness significantly increased, reaching levels comparable to that of natural tooth enamel[2]. In contrast, treatment with ACP nanoparticles was shown to reduce the mechanical strength of the repaired enamel[3].

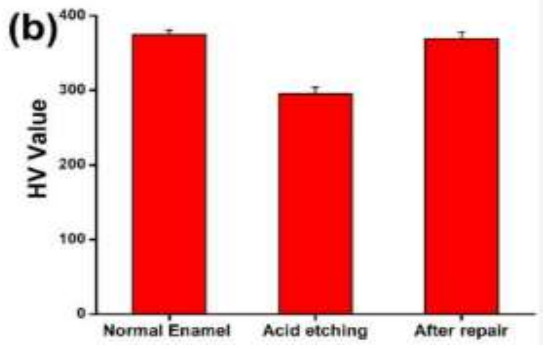


Fig 2. Vickers hardness values of normal enamel, enamel after acid etching for 10 min, and enamel after acid etching and repair with CaP Nanoclusters.[3]

Preventive Products with CPIC Technology

Inspired by CPIC technology, Pac-Dent introduces ProMin and ProMin F, cutting-edge remineralizing and desensitizing tooth crèmes. ProMin combines the nanotechnology of CPICs with potassium nitrate, xylitol, and fluoride to enhance enamel strength and reduce sensitivity. Potassium nitrate serves as a natural desensitizer, while xylitol inhibits bacterial growth, aiding in caries prevention.

ProMin and **ProMin F** are safe for children and adults and are effective for enamel remineralization, as well as managing hypersensitivity after professional cleanings or whitening treatments. Ideal for individuals with braces, **ProMin** prevents demineralization around orthodontic appliances, safeguarding against white spot lesions and decay. The crème is easy to apply with a toothbrush, fingertip, or custom dental tray, offering versatility for both professional and at-home use. With regular application, **ProMin** strengthens and preserves enamel, supporting long-term dental health.

ProMin is available in both fluoride (**ProMin F**) and fluoride-free versions. For convenience on the go, **ProMin F** is available in a travel-friendly pen for quick, targeted remineralization and desensitization.

References:

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2. Wang C-H, Mutalik C, Yougbaré S, Teng N-C, Kuo T-R. Calcium Phosphate Nanoclusters for the Repair of Tooth Enamel Erosion. Nanomaterials. 2022; 12(12):1997. https://doi.org/10.3390/nano12121997
3. Tang, S., Dong, Z., Ke, X. et al. Advances in biomineralization-inspired materials for hard tissue repair. Int J Oral Sci 13, 42 (2021). https://doi.org/10.1038/s41368-021-00147-z