3M™ ESPE™ Clinpro™ 5000
1.1% Sodium Fluoride Anti-Cavity Toothpaste

Technical Product Profile
Table of Contents

INTRODUCTION .............................................................................................................................3
  Caries Development................................................................................................................3
  Caries Prevention..................................................................................................................3

PRODUCT DESCRIPTION ...............................................................................................................4

INDICATIONS ...............................................................................................................................4

COMPOSITION ..............................................................................................................................4

EVALUATIONS ...............................................................................................................................4
  Fluoride Uptake.......................................................................................................................5
  Fluoride Bioavailability ..........................................................................................................6
  Extrinsic Stain Removal ...........................................................................................................7
  Abrasivity ................................................................................................................................8

DIRECTIONS FOR USE .................................................................................................................10

STORAGE ....................................................................................................................................10

QUESTIONS AND ANSWERS ....................................................................................................10

SUMMARY ..................................................................................................................................11

WARRANTY .................................................................................................................................11

LIMITATION OF LIABILITY .......................................................................................................11

REFERENCES ..............................................................................................................................12
INTRODUCTION

Caries Development

Teeth are naturally covered by dental plaque that contains bacteria. Some of the bacteria, including mutans streptococci and lactobacilli, produce acids when they metabolize fermentable carbohydrates such as glucose, sucrose, fructose, or cooked starch. The acids produced by this metabolism enter into the pores of sound tooth enamel or exposed dentin and dissolve minerals in the tooth structure. This causes a loss of calcium and phosphate from the tooth, resulting in demineralization.1-4

Plaque bacteria + Fermentable carbohydrates => Acids
Acids + Tooth enamel and dentin => Demineralization

Demineralization is first visible as a “white spot lesion” on the surface of the tooth enamel. Left untreated, this process can continue, eventually leading to cavitation.

Caries Prevention

Saliva serves as the body’s natural defense against tooth decay by both physical and chemical means. Saliva protects the tooth by clearing carbohydrates and acids from the tooth surface and buffering the acids generated by carbohydrate metabolism. Saliva contains minerals such as calcium and phosphate that replace the minerals dissolved from the tooth during demineralization.5

Saliva is also a carrier of fluoride. Fluoride in sufficient quantities combines with the demineralized hydroxyapatite of tooth structure to form fluorapatite in a process known as remineralization. Fluorapatite is more resistant to acid challenge than naturally occurring hydroxyapatite. This minimizes the formation of dental caries.

Unfortunately, the amount of fluoride in saliva is low. Fluoride in whole saliva is approximately 0.32 μmol/l in areas with low fluoride concentration in drinking water.6 Because of the known beneficial effects of fluoride on teeth, fluoride is added to drinking water and to toothpaste, rinses, gels and other topically-applied products. Topical application of fluoride can raise the concentration of fluoride in saliva up to 1000-fold.7

Caries rates have decreased dramatically in the USA, Canada, and in Western Europe over the past 40 years due to community water fluoridation, increased oral hygiene awareness and the use of fluoride-containing toothpaste.8-12 Fluoride delivered through community water fluoridation and fluoridated toothpaste has been shown to be a cost-effective public health measure for preventing tooth decay.11,12
There is evidence of a positive dose response for concentrations of sodium fluoride in toothpaste ranging from fluoride-free to 5000 ppm F. Large-scale clinical trials have demonstrated that higher concentrations of sodium fluoride in toothpaste deliver greater caries effectiveness.\textsuperscript{13-18} Likewise, higher concentrations of sodium fluoride in toothpaste exhibit greater anticaries effectiveness on root surfaces.\textsuperscript{19,20}

\textit{3M™ ESPE™ Clinpro™ 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste} was developed specifically for patients who need the benefits of higher concentration fluoride toothpaste. This toothpaste can be applied to enamel and exposed dentin through daily tooth brushing. The product provides a high concentration of fluoride during brushing to help remineralize demineralized enamel and to aid in the prevention of tooth decay.

\textbf{PRODUCT DESCRIPTION}

\textit{Clinpro™ 5000 Toothpaste} is a white toothpaste that contains 5000 ppm fluoride and an innovative Tri-Calcium Phosphate ingredient with a vanilla mint flavor. The product is intended to be used in place of conventional toothpaste, allowing it to be incorporated easily into daily oral care routines.

\textit{Clinpro™ 5000 Toothpaste} is packaged in a 4oz (113g) tube with an accompanying professional package insert containing instructions for proper use of the product.

\textbf{INDICATIONS}

\textit{Clinpro™ 5000 Toothpaste} is indicated for use as part of a professional program for the prevention and control of dental caries. It helps reverse tooth decay before it becomes a cavity, protects the teeth from acid wear and erosion, and remineralize tooth enamel.

\textbf{COMPOSITION}

\textit{Clinpro™ 5000 Toothpaste} contains 1.1% sodium fluoride and an innovative tri-calcium phosphate ingredient which is sold exclusively through 3M ESPE. Each gram of \textit{Clinpro™ 5000 Toothpaste} contains 5mg of fluoride ion in a neutral pH base consisting of water, sorbitol, hydrated silica, glycerin, polyethylene-polypropylene glycol, flavor, polyethylene glycol, sodium laureyl sulfate, titanium dioxide, carboxymethyl cellulose, sodium saccharin and Tri-Calcium Phosphate.

\textbf{EVALUATIONS}

Fluoride has been shown to reduce the incidence of caries.\textsuperscript{21} Studies have shown that higher concentrations of sodium fluoride in toothpaste deliver statistically significantly greater caries efficacy.\textsuperscript{13-20} Over-the-counter toothpastes typically contain 1100 ppm fluoride ion or less; \textit{Clinpro™ 5000 Toothpaste} contains 5000 ppm fluoride ion.
Fluoride Uptake

While the concentration of fluoride in toothpaste is important, the amount of fluoride that is delivered to demineralized tooth structure is equally, if not more, important. *In vitro* laboratory testing was conducted to determine the fluoridating efficiency of 3M™ ESPE™ Clinpro™ 5000 Toothpaste compared to that of other fluoride-containing preparations.

**Methodology**

Enamel chips were prepared from bovine incisors. The tooth surfaces were ground flat and then polished. The indigenous fluoride level of each chip was determined. The chips were demineralized using a solution of 0.1M lactic acid and 0.2% carbopol. Following demineralization, the chips were treated for 30 minutes by soaking in a slurry of fluoride preparation and water. The fluoride preparations consisted of the following:

- fluoride-free deionized water
- GC MI Paste Plus™ (900 ppm F-)
- PreviDent® 5000 Booster (5000 ppm F-)
- Clinpro™ 5000 Toothpaste (5000 ppm F-)

Following treatment, chips were re-analyzed using the same technique used to determine indigenous fluoride level. The fluoride level after treatment was compared to fluoride level before treatment to determine fluoride uptake.

**Results**

Clinpro™ 5000 Toothpaste and PreviDent® 5000 Booster exhibited statistically significantly greater fluoride uptake than GC MI Paste Plus™. This is reflective of the dose response relationship observed clinically.

Clinpro™ 5000 Toothpaste exhibited greater fluoride uptake than PreviDent® 5000 Booster, suggesting that the anticaries potential of Clinpro™ 5000 Toothpaste is at least as good as PreviDent® 5000 Booster.

### Fluoride Uptake into Demineralized Enamel [Mean +/- SD]

![Fluoride Uptake Graph](Image)

Source: 3M ESPE internal data
Fluoride Bioavailability

“white spot lesions” are an early sign of tooth decay that, if left untreated, will progress to frank caries lesions. Treatment of these demineralized areas with fluoride can stop progression and reverse the decay process through remineralization. An *in vitro* pH cycling experiment was conducted to assess the fluoridating and remineralizing efficiency of 3M™ ESPE™ Clinpro™ 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste and other fluoride toothpaste formulations. The pH cycling model is a widely accepted and validated method to evaluate the anticaries potential of toothpaste formulations. The results from the pH cycling experiment are often used to fulfill the fluoride uptake into demineralized enamel requirement of the American Dental Association's Acceptance Program Guidelines for Fluoride-Containing Toothpaste.

In this experiment, specimens were subjected to 20 days of pH cycling. The purpose of this *in vitro* laboratory experiment was to determine the ability of Clinpro™ 5000 Toothpaste and several other preparations to:

- promote fluoride uptake
- promote remineralization

**Methodology**

Enamel specimens were cut from bovine incisors. Each specimen was soaked in a solution of 0.1M lactic acid and 0.2% carbopol to produce artificial caries lesions. Baseline surface microhardness measurements were made. Eighteen specimens were then randomized to each of the following treatment groups:

- fluoride-free deionized water
- GC MI Paste Plus™ (900 ppm F-)
- PreviDent® 5000 Booster (5000 ppm F-)
- Clinpro™ 5000 Toothpaste (5000 ppm F-)

Each group of specimens was subjected to 20 days of pH cycling with each day consisting of a series of soaking in demineralizing solution, artificial saliva and toothpaste/fluoride preparation treatments (a slurry of one part fluoride preparation and three parts water). A 1:3 dilution of the toothpaste represents normal tooth brushing.

Following 20 days of pH cycling, the specimens were subjected to microdrill biopsy and surface microhardness analysis to determine fluoride uptake and remineralization ability, respectively.

**Results**

Clinpro™ 5000 Toothpaste was significantly more effective than the other toothpastes/fluoride-containing preparations in this study on all measures tested.

- Clinpro™ 5000 Toothpaste exhibited statistically significantly greater fluoride uptake into demineralized enamel than GC MI Paste Plus™ and PreviDent® 5000 Booster.
- Clinpro™ 5000 Toothpaste exhibited statistically significantly greater remineralization than GC MI Paste Plus™ and PreviDent® 5000 Booster.
Extrinsic Stain Removal

The cleaning efficiency of toothpaste is determined using the Pellicle Cleaning Ratio (PCR) test. This *in vitro* test evaluates a toothpaste formulation’s ability to remove stained pellicle compared to that of the American Dental Association (ADA) reference standard, calcium pyrophosphate. Higher PCR scores are reflective of better cleaning and whitening. In this experiment, over-the-counter toothpastes typically exhibit PCR scores between 65 and 115.22

**Methodology**

Specimens of enamel were prepared from bovine teeth. The specimens were stained by alternatively submerging and air drying in a solution of soy broth, tea, coffee, mucin, and *Sarcina lutea* for a period of four days. Following staining, the colour of each specimen was measured using a spectrophotometer.

Stained specimens were placed on a V-8 cross-brushing machine equipped with soft-bristled
toothbrushes. One hundred and fifty grams of force was applied to the toothbrushes. Specimens were brushed with slurries (25 grams of fluoride-containing preparation and 40 grams of deionized water) for a total of 800 strokes. One slurry contained 3M™ ESPE™ Clinpro™ 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste while the others contained GC MI Paste Plus™ or a conventional 1100 ppm fluoride toothpaste. Following brushing, the colour of each specimen was measured. The change in colour observed for each slurry was compared to that observed for the ADA Reference Standard of calcium pyrophosphate to determine the PCR score.

**Results**

Clinpro™ 5000 Toothpaste exhibited a PCR value of 73.9 which indicates effective stain removal. This value is statistically greater than the 33.8 PCR value achieved with GC MI Paste Plus™. Clinpro™ 5000 Toothpaste effectively cleans and whitens teeth.

![Graph showing Pellicle Cleaning Ratio](source: 3M ESPE internal data)

**Abrasivity**

Toothpaste needs to strike a balance between effective cleaning and abrasivity. Toothpastes that are highly abrasive can damage enamel and dentin over time. ISO 11609 Dentistry -- Toothpastes -- Requirements, Test Methods and Marking contains an abrasivity requirement and provides appropriate test methods for determining abrasivity. Two tests, relative dentin abrasion (rDA) and relative enamel abrasion (REA), were performed to determine if the abrasive system used in this formulation is safe for twice daily, unsupervised tooth brushing.

**Methodology**

The RDA and REA tests are similar. Irradiated dentin or enamel was brushed with slurries (25 grams of fluoride-containing preparation with 40 grams of deionized water). One slurry contained Clinpro™ 5000 Toothpaste while the others contained PreviDent® 5000 Booster (5000 ppm F-) or GC MI Paste Plus (900 ppm F-). Abrasivity was reported relative to a reference standard abrasive, calcium pyrophosphate. When evaluating dentin, the test formulation must not exceed 2.5 times that of the reference standard abrasive (that is assigned a value of 100) and when evaluating enamel, the test formulation must not exceed 4 times that of the reference standard abrasive (that is assigned a value of 10). Because dentin is considered approximately 10 fold more susceptible to abrasion than enamel (the
reason for the assignment of 100 and 10 for the reference standard), dentin abrasivity is often viewed as a more appropriate measure of abrasivity to ensure the preparation is not overly aggressive.

Results
The RDA value observed for 3M™ ESPE™ Clinpro™ 5000 Toothpaste was 62.15, well under the limit of 250. The RDA value for PreviDent® 5000 Booster was 112.03, statistically higher than that for Clinpro™ 5000 Toothpaste. This indicates that Clinpro™ 5000 Toothpaste is less abrasive on dentin.

The REA value for Clinpro™ 5000 Toothpaste was 3.49, well under the limit of 40. The REA value for the PreviDent® 5000 Booster was 3.39, statistically the same as that for Clinpro™ 5000 Toothpaste. Clinpro™ 5000 Toothpaste provides gentle, effective cleaning of enamel and dentin.

![Relative Dentin Abrasion](image1.png)

![Relative Enamel Abrasion](image2.png)
DIRECTIONS FOR USE
For patient information, refer to package insert which is available at www.3MESPE.ca/preventivecare.

STORAGE
Refer to packaging of 3M™ ESPE™ Clinpro™ 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste for storage information.

QUESTIONS AND ANSWERS
Are my patients at risk for tooth decay?
While the prevalence of dental caries in permanent teeth of US adolescents aged 12-19 years old decreased from 1994 to 2004, the figure still remains above 50%. (68% in 1988-1994 to 59% in 1999-2004). The mean number of decayed and filled permanent teeth in this age group was 2.55 in 1999-2004.

The prevalence of coronal and root caries in the adult population (20-64 years old) has declined from 95% and 19%, respectively (1988-1994), to 92% and 14%, respectively (1999-2004). The number of decayed, missing, or filled permanent teeth has decreased in this group in the decade from 1994 to 2004.

Why do my patients need 5000 ppm sodium fluoride toothpaste?
Studies have shown that toothpastes with a higher concentration of fluoride deliver greater anticaries efficacy than those with lower concentrations. A similar dose response has been observed when studying the anticaries efficacy of fluoride-containing toothpaste in the control of root caries. These results support a correlation between the fluoride concentration in toothpaste and clinical anticaries efficacy.

What advantages does Clinpro™ 5000 Toothpaste offer over other toothpastes?
In laboratory studies, Clinpro™ 5000 Toothpaste has provided greater fluoride uptake and remineralization effects than that of its competitors. In addition, Clinpro™ 5000 Toothpaste has been shown in laboratory studies to reverse white spot lesions greater than regular toothpaste.

What advantages does Clinpro™ 5000 Toothpaste offer over other fluoride containing toothpastes?
Clinpro™ 5000 Toothpaste contains an innovative tri-calcium phosphate ingredient, available exclusively from 3M ESPE. Due to this innovative technology, Clinpro™ 5000 Toothpaste is more effective at reversing white spot lesions in laboratory studies when compared to other toothpaste products. In vitro studies have shown that Clinpro™ 5000 toothpaste exhibits greater fluoride uptake and remineralization than select fluoride containing toothpastes yet is less abrasive than other types included in the testing.

How long can my patients continue to use Clinpro™ 5000 Toothpaste? Is there a time limit for treatment with Clinpro™ 5000 Toothpaste?
With Clinpro™ 5000 Toothpaste your patients can receive the benefit of 5000 ppm fluoride in a gentle toothpaste that is less abrasive to enamel and dentin. Your patients can use Clinpro™ 5000 Toothpaste in place of their conventional toothpaste for the time necessary to control and prevent dental caries.
SUMMARY
3M™ ESPE™ Clinpro™ 5000 Toothpaste:

- is used for the prevention of dental caries
- helps to prevent and reverse root caries
- is more effective than conventional toothpastes in preventing caries
- contains 5000 ppm fluoride ion
- contains an innovative Tri-Calcium Phosphate ingredient
- cleans and whitens teeth
- exhibits greater fluoride uptake than GC MI Paste Plus™ and PreviDent® 5000 Booster
- provides greater remineralization than GC MI Paste Plus™ and PreviDent® 5000 Booster
- helps reverse white spot lesions greater than GC MI Paste™ Plus and PreviDent® 5000 Booster

WARRANTY
3M ESPE warrants this product will be free from defects in material and manufacture. 3M ESPE MAKES NO OTHER WARRANTIES OR CONDITIONS INCLUDING ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. User is responsible for determining the suitability of the product for user's application. If this product is defective within the warranty period, your exclusive remedy and 3M ESPE's sole obligation shall be repair or replacement of the 3M ESPE product.

LIMITATION OF LIABILITY
Except where prohibited by law, 3M ESPE will not be liable for any loss or damage arising from this product, whether direct, indirect, special, incidental or consequential, regardless of the theory asserted, including warranty, contract, negligence or strict liability.
REFERENCES


21. CDC MMWR Recommendations and Reports;August 17, 2001;50(RR14):1-42.

