SCIENTIFIC INFORMATION

Bifluorid 10 - Fluoridation

VOCO GmbH, Department of Knowledge Communication

Anton-Flettner-Str. 1-3
Postfach 767
D-27472 Cuxhaven

Tel.: +49 (0)4721-719-0
Fax: +49 (0)4721-719-109

info@voco.de
www.voco.de

With Bifluorid and Profluorid Varnish, VOCO provides several different preparations that contain fluoride, yet they all have something in common: The formation of calcium fluoride deposits on the tooth surface as well as the formation of fluorapatite.

It is generally accepted that fluoride preparations protect the tooth from demineralisation. The mechanics of how this occurs is more closely examined below. There are two significant processes to be distinguished in this respect: The formation of calcium fluoride deposits and the development of fluorapatite. The formation of calcium fluoride deposits on the tooth surface is always the first step in the emergence of fluorapatite.

Precipitation of calcium fluoride

There are numerous fluoride preparations on the market, which have one thing in common - they all release fluoride ions. Whether they are introduced in the form of inorganic salts (e.g. sodium fluoride or sodium monofluorophosphate) or organic salts (e.g. amine fluoride) is totally irrelevant here. A high number of calcium ions are dissolved in saliva, which interact with the released fluoride ions. It becomes calcium fluoride. Calcium fluoride is a sparingly soluble salt and precipitated as solid matter. Since the teeth are always covered with saliva, this precipitation prefers to take place on the tooth surface. The precipitation of calcium fluoride is visualised in a scanning electron micrograph in the following figure.

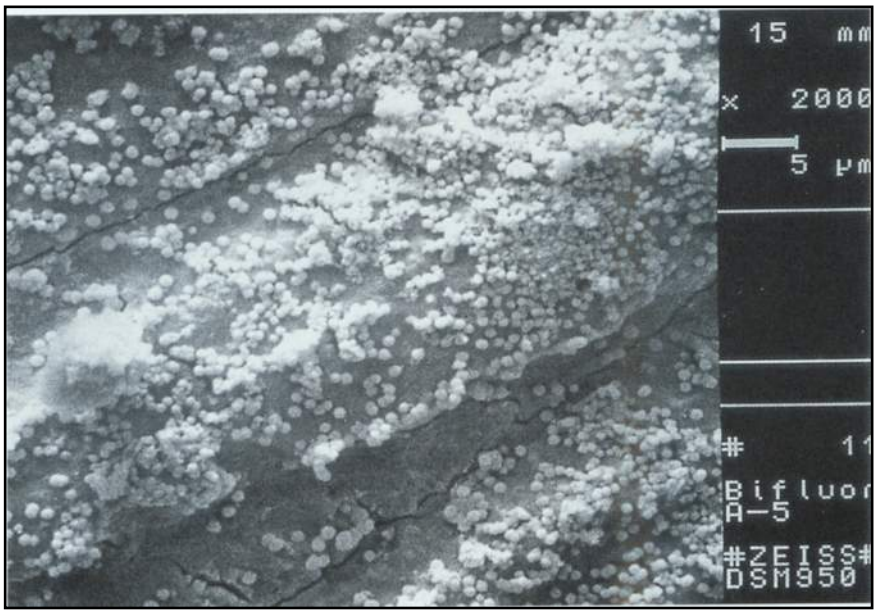

Figure 1: Calcium fluoride globules on the tooth surface (SEM micrograph, University of Freiburg)

The precipitated calcium fluoride has a protective function on the tooth surface in two respects. The precipitated salt first forms a physical barrier and alone protects the tooth substance from external influences. Calcium fluoride additionally fulfills yet another important function: the facilitation of the formation of fluorapatite.

Formation of fluorapatite

The tooth as well as hydroxyl apatite ($Ca_5(PO_4)_3OH$), its main component, demineralise under acidic conditions. Initially hydroxide ions (OH^-) are removed from the crystal by the attack from protons (H^+) under the formation of water (H_2O). The further degradation of the apatite structure is the result of this first reaction. In fluorapatite ($Ca_5(PO_4)_3F$), the places normally occupied by hydroxide ions are occupied by fluoride ions. One can see at first sight that the initial reaction in the fluorapatite can no longer take place. Fluorapatite is dissolved only with significantly stronger acid attacks (then following other mechanisms). With deep fluoridation, hydroxide ions should then deliberately be replaced through fluoride. Since the places in the crystal lattice must naturally first be "loosened", this preferably occurs in the presence of acids. These remove hydroxide ions; the arising interstice in the crystal can then be occupied by fluoride ions. Since calcium fluoride becomes more soluble with lower pH-values, they also are more soluble when attacked by acid. The calcium fluoride deposits thus release fluorides exactly in these situations, if they are needed for the formation of fluorapatite and are therefore an integral component in the formation of fluorapatite.

Conclusion

Calcium fluoride deposits on the tooth surface represent an important component of fortifying teeth against demineralisation caused by acid attacks. For this reason, this protective shield should always be maintained and then always rebuilt if damaged by a dental procedure. On the one hand, this applies to professional dental cleaning, where the calcium fluoride deposits are almost completely removed from the tooth surface. On the other hand, this also applies to restorative therapy, where the deposits are likewise removed in the area where the filling is being placed. A buildup through tooth brushing with fluoride toothpaste alone would take several weeks to a few months - a time period in which the teeth are insufficiently protected. Fluoridation should be carried out after every professional cleaning and, ideally, also after every treatment in which the tooth surface is exposed due to drilling or polishing.

The bottom line: The development of calcium fluoride deposits on the tooth surface is an integral component in protecting the tooth from demineralisation. A fluoridation procedure should thus be performed after every treatment that is accompanied by the loss of these deposits.