ANGIE SEGATTO
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SMART POWDER FOR DENTINE DESENSITIZATION THE KEY TO SUCCESS

Dentine hypersensitivity is a frequent problem in cases involving dentine exposition. The problem affects all ages, and its prevalence is the highest in the canines and premolars. Precise diagnosis and differential diagnosis are of the utmost importance. A frequently occurring mistake is that instead of concentrating on the cause, only the symptoms are treated, which, naturally, yields only temporary success.

Today, several modern devices and techniques are available, both for home and clinical use, that make it possible to reach a long-lasting solution, provided that the indication was correctly determined. This article offers the clinician an up-to-date overview of the characteristics and importance of bioglasses, concentrating especially on Sylc (NovaMin).

THE STRUCTURE OF DENTINE

Dentine is a vital tissue, an organic matrix with a permeable, tubular structure embedded in crystalline apatite. Dentine is normally covered with hard tissue: enamel in the coronal region and cementum on the roots. Dentine is characteristically a sensitive tissue type. This is because of the odontoblast endings in the dentinal tubuli, and also because dentine is part of the dentine-pulp complex. Given that the pulp and dentine are so closely associated, harm to one will also affect the other. Odontoblasts located in the dentinal tubuli are the major cells of the dentine-pulp complex. The endings of odontoblasts are surrounded with fluid inside the tubuli. Dentinal fluid adds up to 22% of the entire volume of the dentine. The fluid itself is an ultrafiltrate of blood, which serves as a medium between the pulp and dentine along the odontoblasts. This anatomical fact led Gysi to hypothesise that it was the movement of this fluid that stimulated the odontoblast-associated nerve endings, causing pain this way. Decades later, Brannström revisited the hydrodynamic theory of dentine hypersensitivity and proved that removal of the fluid from the tubuli can alleviate the pain or stop it completely. The work of Brannström made the hydrodynamic theory the accepted explanation for dentine hypersensitivity.

DENTINE HYPERSENSITIVITY

CLINICAL PRESENTATION

Dentine sensitivity and hypersensitivity are well known and frequent problems. It is characterised by brief, sharp pain triggered by thermal, tactile, osmotic and chemical stimuli. The pain originates in the exposed dentine, and it is not similar to any other kind of dental pain.

EPIDEMIOLOGY

The prevalence of the condition has been reported between 4% and 74%, which reflects a large standard deviation due to methodological differences. The most affected are between 20 and 50 years of age, but there is another surge between 30 and 40 years. The canines and premolars are the most frequently affected, especially at their labial cervical area.

AETIOLOGY AND PATHOGENESIS:

Dentine hypersensitivity develops in two phases, lesion localisation and lesion initiation. Localisation means the loss of the supradentinal protective layer (enamel or cementum) in a circumscribed area, whereby dentine becomes exposed to the external environment. The mechanisms include attrition, abrasion, erosion, abfraction or gingival recession. The latter may be the result of toothbrush abrasion or excessive flossing, but it can also be secondary to periodontal surgery (e.g. pocket reduction surgery) or tooth preparation for crown. However, localisation itself does not necessarily result in the development of hypersensitivity. For this, initiation has to happen, which means the removal of the protective smear layer, by which the dentinal tubules open up.

In the oral cavity, demineralisation and remineralisation of the dental tissues are in a physiological balance, but organic acids produced in the dental plaque can shift this balance toward demineralisation. The resulting loss of minerals leads to damage to the dental tissues.

MECHANISM

There are three plausible theories regarding how sensitivity/pain develops, the most accepted of which, as said above, is the hydrodynamic theory. The three theories are:

the direct innervation theory

the odontoblast receptor theory

the fluid movement (hydrodynamic) theory

The first two of these, however, have fundamental weaknesses:

Ad 1. There is no proof that the external layer of dentine (which can become sensitive) is innervated at all.

Ad 2. Most of the studies conducted in this matter prove that odontoblasts are matrix forming cells, they are not sensitive to stimulation and they have no synaptic connection with the terminal nerves.

Most of the evidence we have support Brannström's 1964 hydrodynamic theory (see "The structure of dentine"). Scanning electron microscopic studies observed wide dentinal tubule openings on hypersensitive surfaces, which supports the hydrodynamic pain theory. The movement of fluid can be triggered by thermal, tactile, osmotic and chemical stimuli, and then it is the movement that activates the nerve endings in the dentinal tubuli or the dentine-pulp complex. The degree of pain depends on the intensity of stimulation. Stimuli that move the fluid away from the dentine-pulp complex cause more intensive pain (e.g. exhaustor).

DIAGNOSIS

A correct diagnosis based on a thorough diagnostic process is of key importance here. All other potential pain triggers must be excluded. The degree of pain must also be correctly determined (from mild to strong). It cannot be overemphasised how important it is to determine the cause of hypersensitivity, so that the trap of symptomatic treatment can be avoided. If we suspect increased acidity, it has to be determined if it stems from a systemic disease or some external factor is at play. It also has to be examined if there are any erosive agents that can damage the enamel or cementum, potentially leading to the loss of dentine protection.

TREATMENT

It has been attempted to treat dentine hypersensitivity in several ways. Based on the mechanism of action, these can be divided into 6 groups: nerve desensitisation, protein precipitation, plugging the dentinal tubules, dentine adhesive sealers, laser and homeopathic medication.

Temporary success may be expected from the following:

- chemical agents that penetrate the dentinal tubuli and block the depolarisation of the nerve endings (toothpastes that contain potassium nitrate).

- forming a protective layer by chemical or physical agents so that the flow of fluid in the tubuli is blocked (potassium/iron oxalate). This, however, is only a short-term solution, as the protective layer can be damaged, and after some time it disappears, and the hypersensitivity reoccurs.

Brannström's results made it clear that any material capable of sealing the dentinal tubuli and preventing liquid movement can be used to reduce the sensitivity.

A long-term effect, however, can be only expected from a material that binds to the dental tissues not only physically, but also chemically, so that the chance of reopening is minimized. Based on the bioglass technology, researchers of OSspray (UK) developed a cleaning and desensitising powder that, by the emission of calcium phosphate ions, forms a surface layer and closes the dentinal tubuli.

A multitude of in vitro studies proved that when used for air-polishing, this powder remineralises the demineralised dentine, while the calcium phosphate ions attach to the surface. Remineralisation can occur because the biomaterial is capable of reacting with the dentinal tubular fluid and/or saliva. As a result, carbonated hydroxyapatite is deposited along the demineralised collagen fibres and the tubuli are closed at the same time.

BIOGLASS

Bioactive glass (Calcium sodium phosphosilicate – CSPS) was developed by Prof. Larry Hench at the end of the 1960s at the University of Florida. CSPS belongs to the large group of bioactive ceramics, which were developed to replace, enhance and repair hard tissues. The material was originally meant to play a role in bone regeneration, considering its excellent bioactive capability in forming hydroxicarbonate apatite, resultant in adhesion of cells to the glass when submerged in stimulated body fluid solutions. Later, in the mid-1990s, Leonard Litkowski, Gary Hack and David Greenspan further enhanced the material so that it became capable of remineralization by releasing calcium and phosphate ions from itself. The use of bioactive glass yields a longer desensitizing effect, and also more effective whitening results.

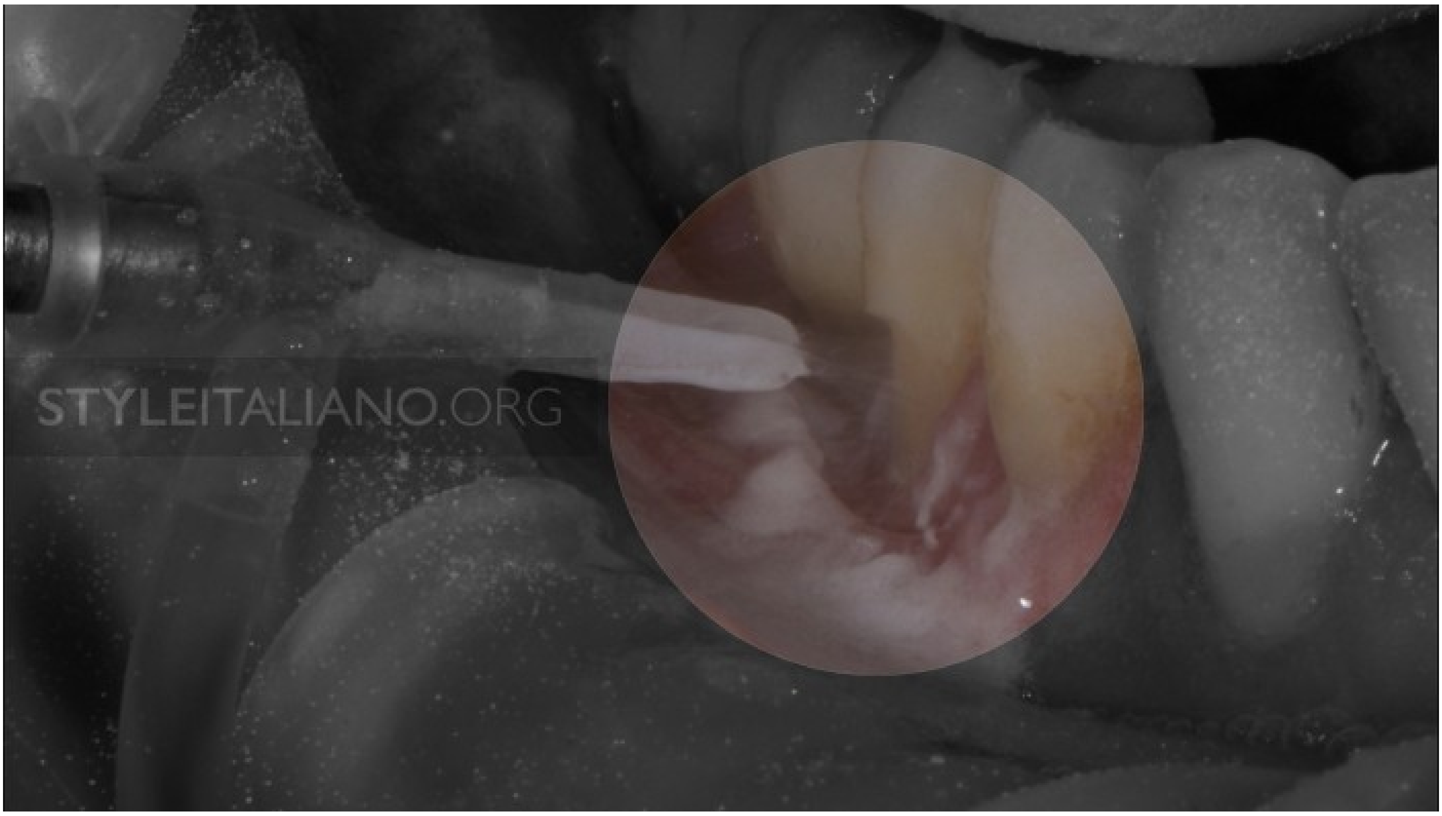
NOVAMIN

Bioactive glass capable of desensitizing dentine entered the market in 2003, under the brand name NovaMin. NovaMin is an inorganic, amorphous melt-derived glass compound that contains only calcium, sodium, phosphate, and silica. NovaMin offers immediate and long-lasting relief. Today various toothpastes and desensitizing pastes contain this material.

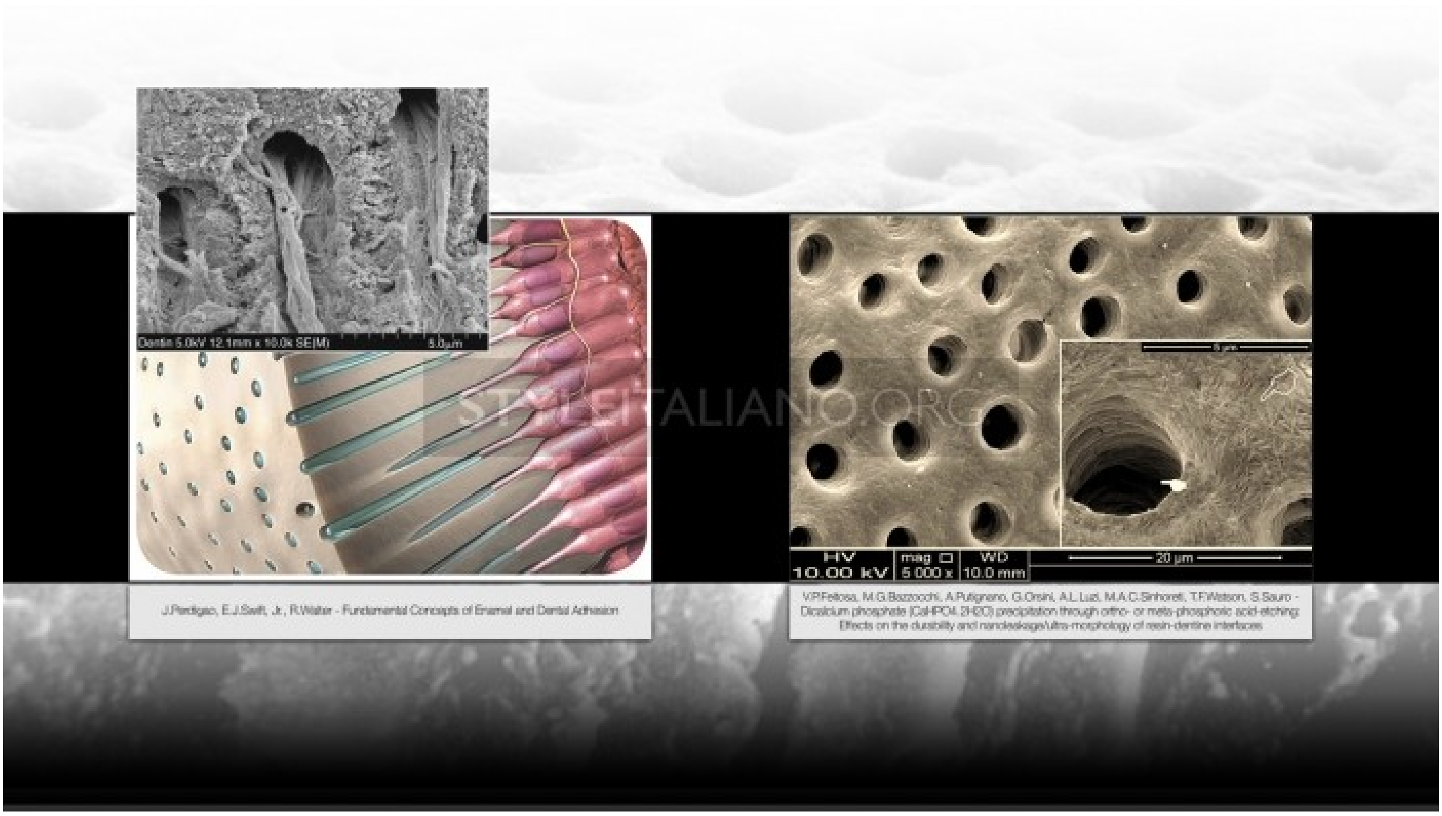
The active ingredient of the prophylactic powder (Sylc) for the air-flow-based AquaCare is also NovaMin. Reacting with a salivary environment, the Sylc (NovaMin) releases calcium and phosphate ions. Sylc applied with air-flow forms a biologically stable, acid-resistant mineral layer (HCA), which is strong and resilient. The continuous release of calcium ions promotes both constant protection and a lasting sealing of the tubuli.

It was proven in in vitro studies that the deposited smear layer allows mineralization in a calcium-rich fluid environment (such as saliva or the dentinal tubular fluid).

It must be mentioned that NovaMin is also capable of remineralising enamel, and its antimicrobial and anti-inflammatory properties make it a promising candidate for gingivitis treatment.



Img. 1 - Desensitizing powder (pro Sylc) applied with AquaCare iTip.



Img. 2 - Structure of dentine.

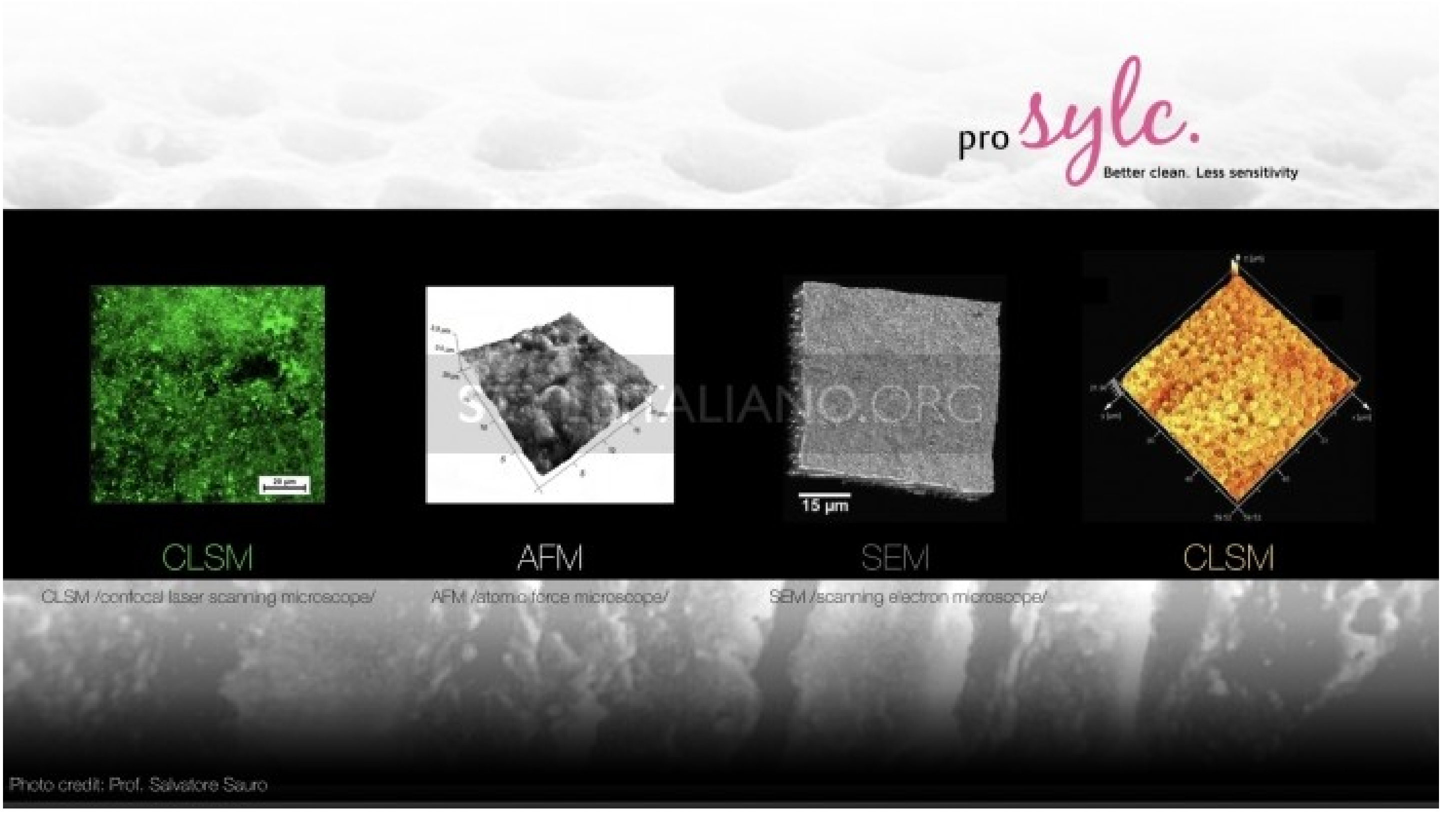
Img. 3 - Initial situation - dentine exposition.

Img. 4 - Surface treatment.

Img. 5 - Before & after.

Img. 6 - The "smart powder".

Img. 7 - Air-polishing procedure: before - after.



Img. 8 - Treated dentinal surfaces; different microscopic images (courtesy of Prof. Salvatore Sauro) of bioactive smear layer.

Img. 9 - AquaCare units.

Air-flow applied Sylc (NovaMin) does not only remove discolouration, but it also offers a rapid, efficient and long-lasting solution for dentine hypersensitivity. The smart unit of Aqua-Care allows the clinician to apply Sylc (NovaMin) with ease, which makes it an indispensable instrument of the modern dental office.

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