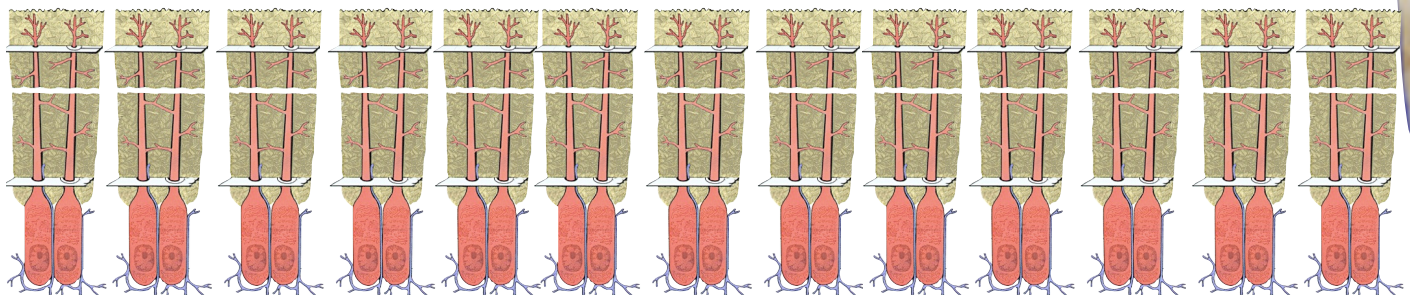
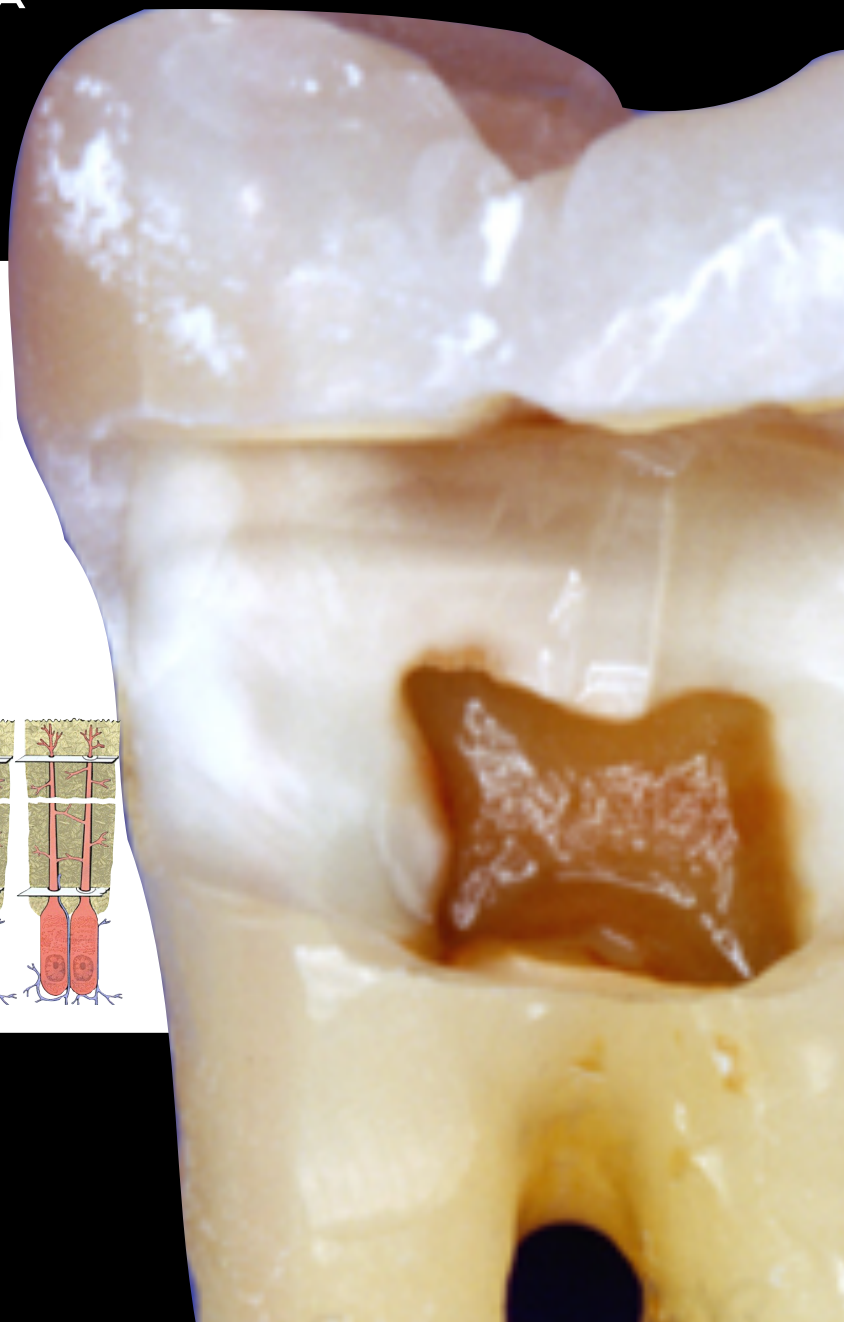
Universita' di Torino
Facolta' di Medicina e Chirurgia
Corso di Laurea in Igiene Dentale
Corso integrato - Conservativa

Sensibilità dentinale:

Meccanismi e soluzioni





Dott.ssa Comba Allegra

Dentin hypersensitivity:

Dentin hypersensitivity is characterized by short, sharp pain arising from exposed dentin in response to stimuli - typically thermal, evaporative, tactile, osmotic or chemical - that cannot be ascribed to any other dental defect or disease

Canadian Advisory Board on Dentin Hypersensitivity, 2003

Dott.ssa Comba Allegra

Epidemiology:

- Prevalence: 25% (range 3-57)
- Age Range: 15 - 70+
- Peak incidence: 30 - 40 years
- Gender: F>M
- Most commonly found:

  Teeth: canines and premolars

  Sites: buccal cervical regions

  Patients: adults (periodontitis), young (erosion), at risk for exposed cervical dentin (overenthusiastic brushers)

Splieth and Tachou, 2013

Epidemiology:

Data are scarce and contradictory

Population-based studies are needed

Potential increase in prevalence

- Increasing exposure to erosive food or drinks
- Intensified oral hygiene
- Increased number of dentate seniors
- Countries with a long-standing history of prevention dental care

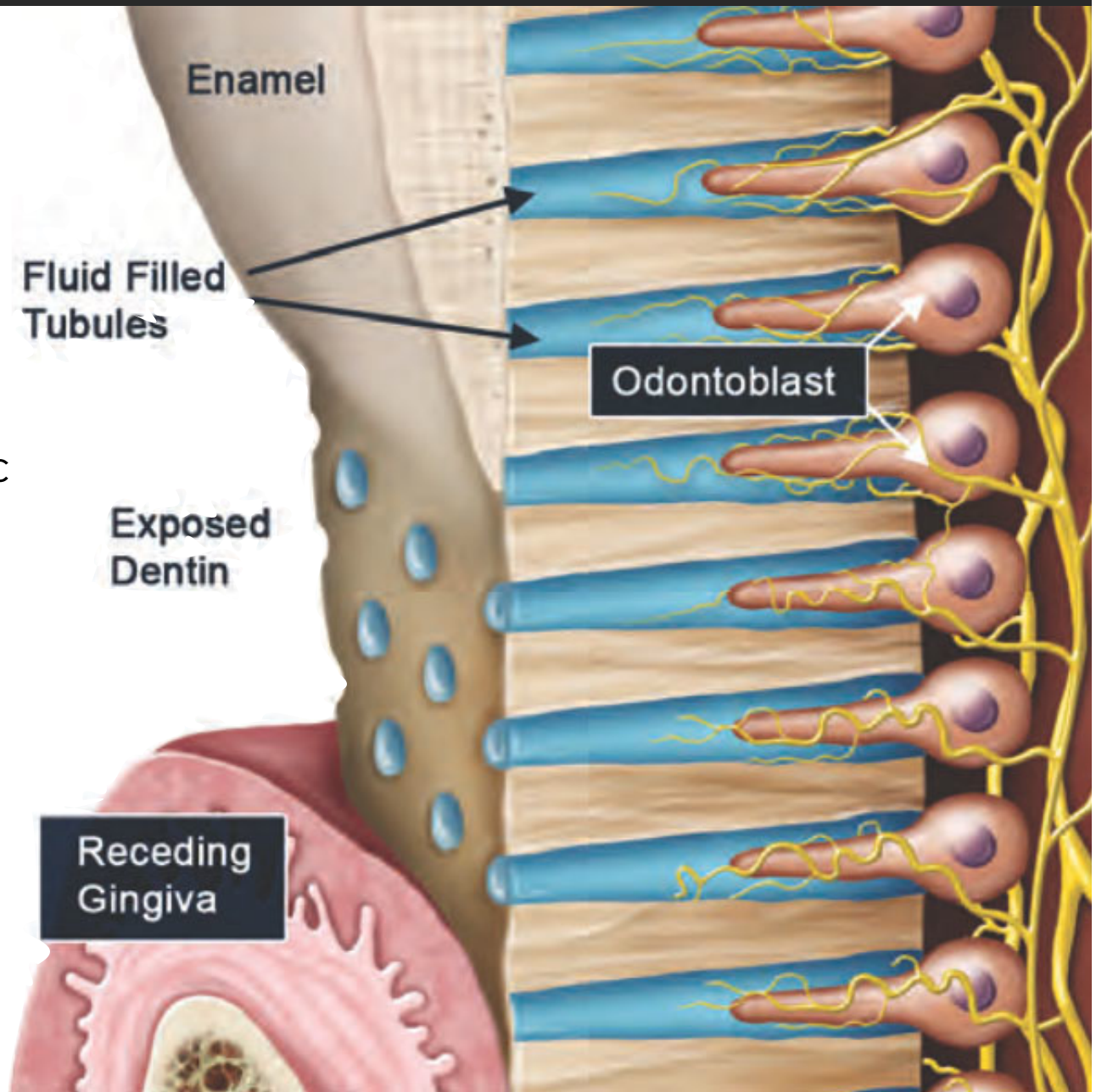
Aetiology and risk factors:

Gingival recession

- Traumatic toothbrushing
- Periodontal disease
- Other (self-inflicting gingival damage, piercing, orthodontic movement)

Loss of hard tissue

- Abrasion (physical wear)
- Erosion (chemical wear)
- Abfraction (fatigue wear)
- Attrition (physical wear)



Gengival recession:

Chronic Periodontitis

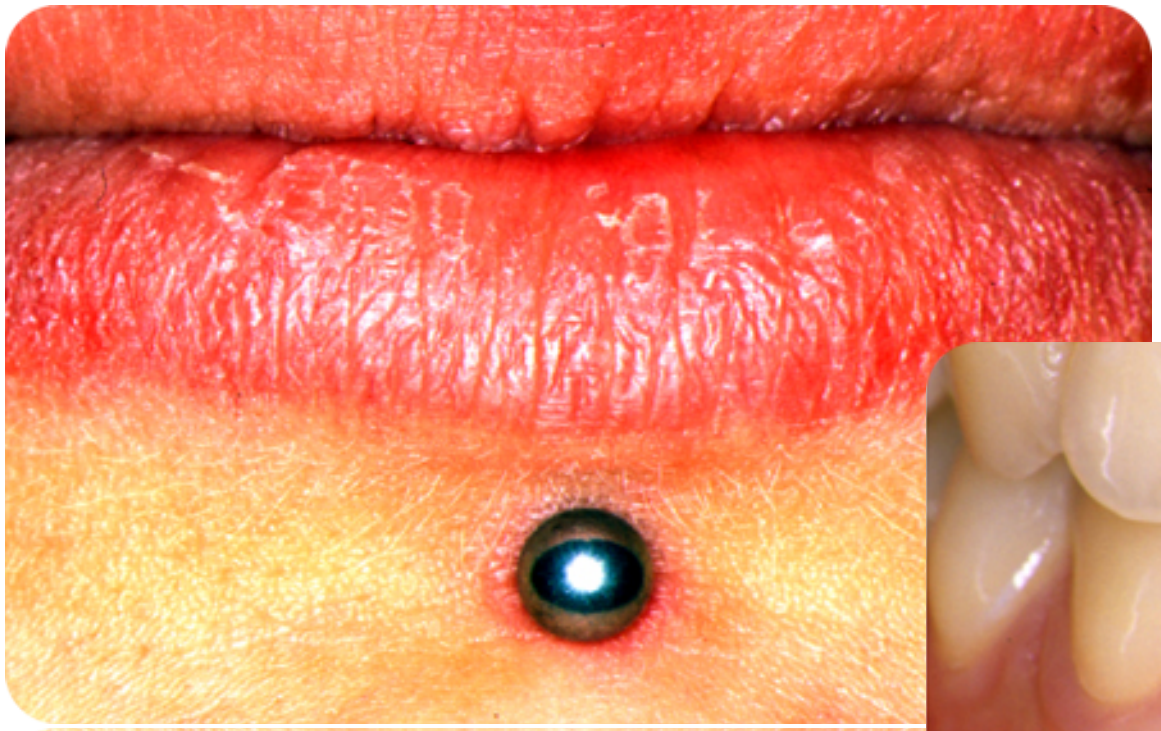
Gengival recession:

Traumatic toothbrushing

Gengival recession:

Orthodontic movement

Gengival recession:



Piercing

Loss of hard tissue:

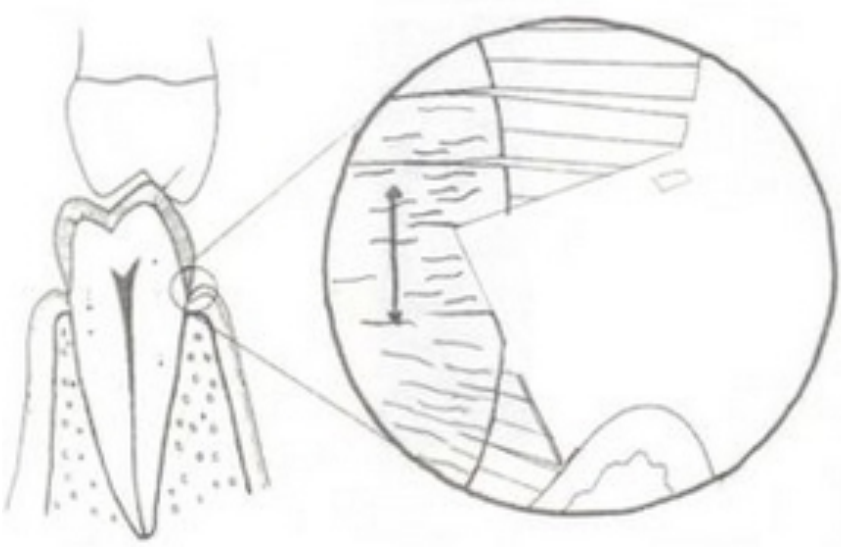
Definita come la perdita di sostanza dentaria per cause diverse dal contatto dentario. Sono lesioni causate dall'azione meccanica di agenti esterni.

Loss of hard tissue:

Erosion

L'erosione è la perdita di struttura dentaria causata da agenti o processi chimici non batterici.

Loss of hard tissue:



Abfraction

Si riferisce alla perdita di sostanza dovuta a carichi occlusali che determinano ripetute flessioni dentali che sgretolano lo smalto lontano dal punto di applicazione della forza.

Loss of hard tissue:

Attrition

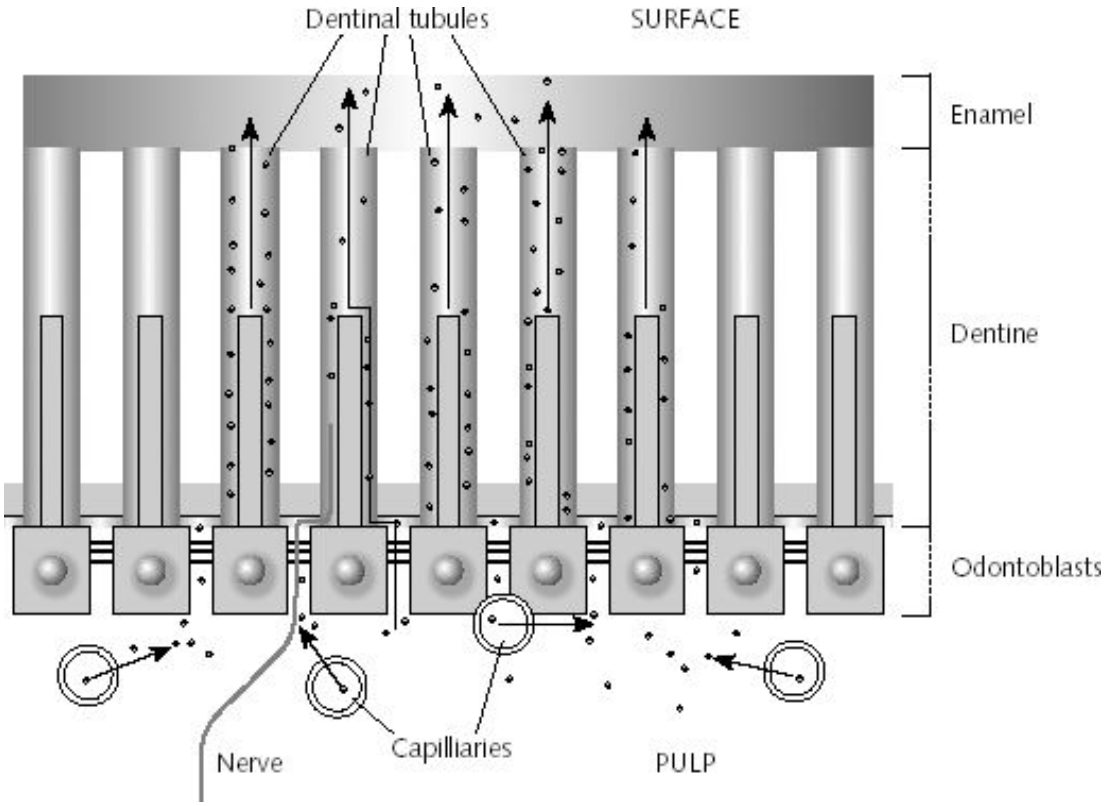
Definita come la perdita di smalto, dentina o restauro dovuto al contatto dente-dente durante l'occlusione o la masticazione.

Pain mechanism:

Hydrodynamic Theory (Brannstorm)

Sensitive dentin is based on the stimulus-induced fluid flow in the dentinal tubules and consequent nociceptor activation in the pulp/dentin border area.

Intradental myelinated A-β and some A-δ fibres are thought to respond to stimuli resulting in the characteristic short, sharp pain.



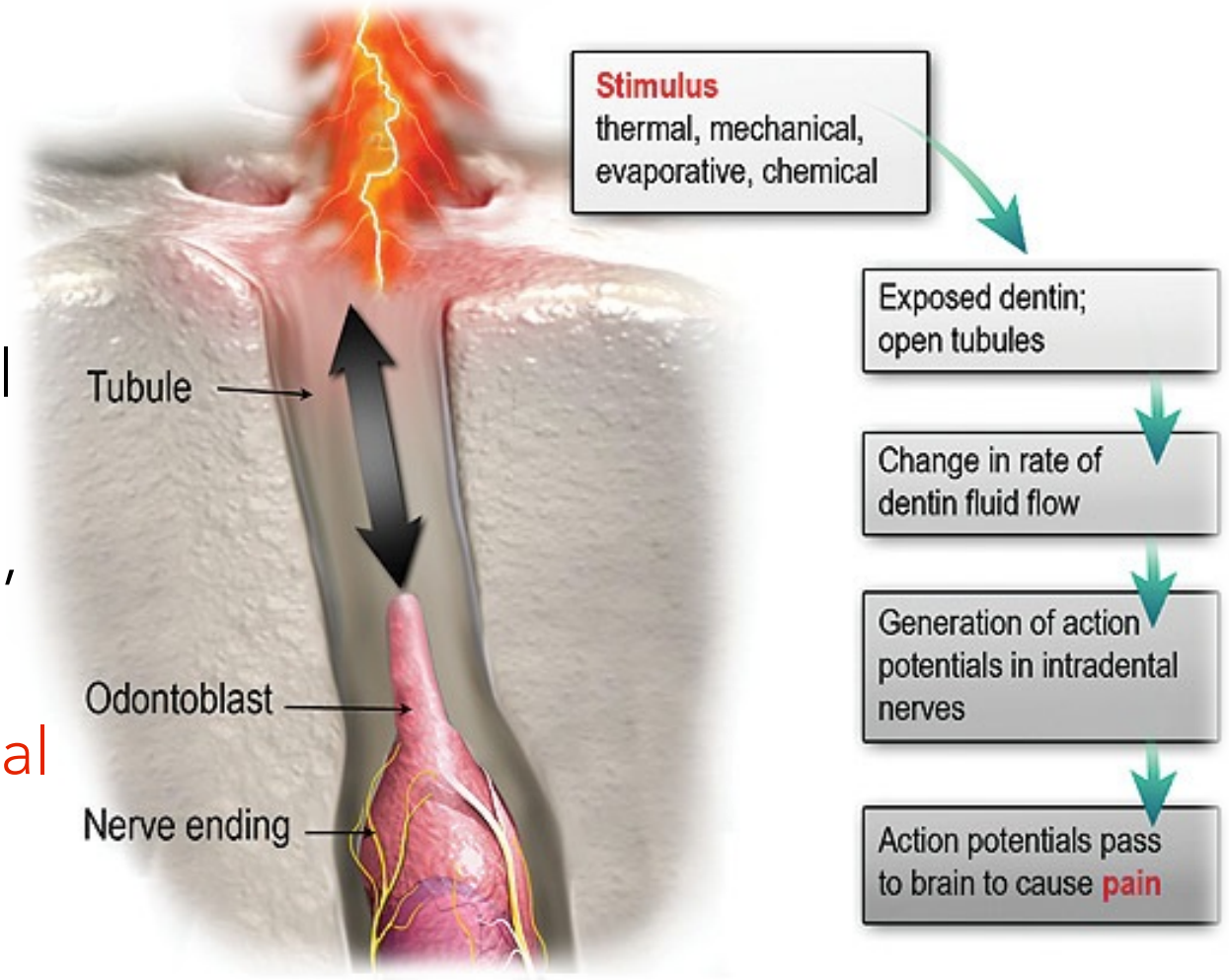
West et al , 2013

Pain mechanism:

Hydrodynamic Theory (Brannstorm)

Pressure change across the dentin activates intra-dental nerve fibres, via a mechanoreceptor response, to cause pain.

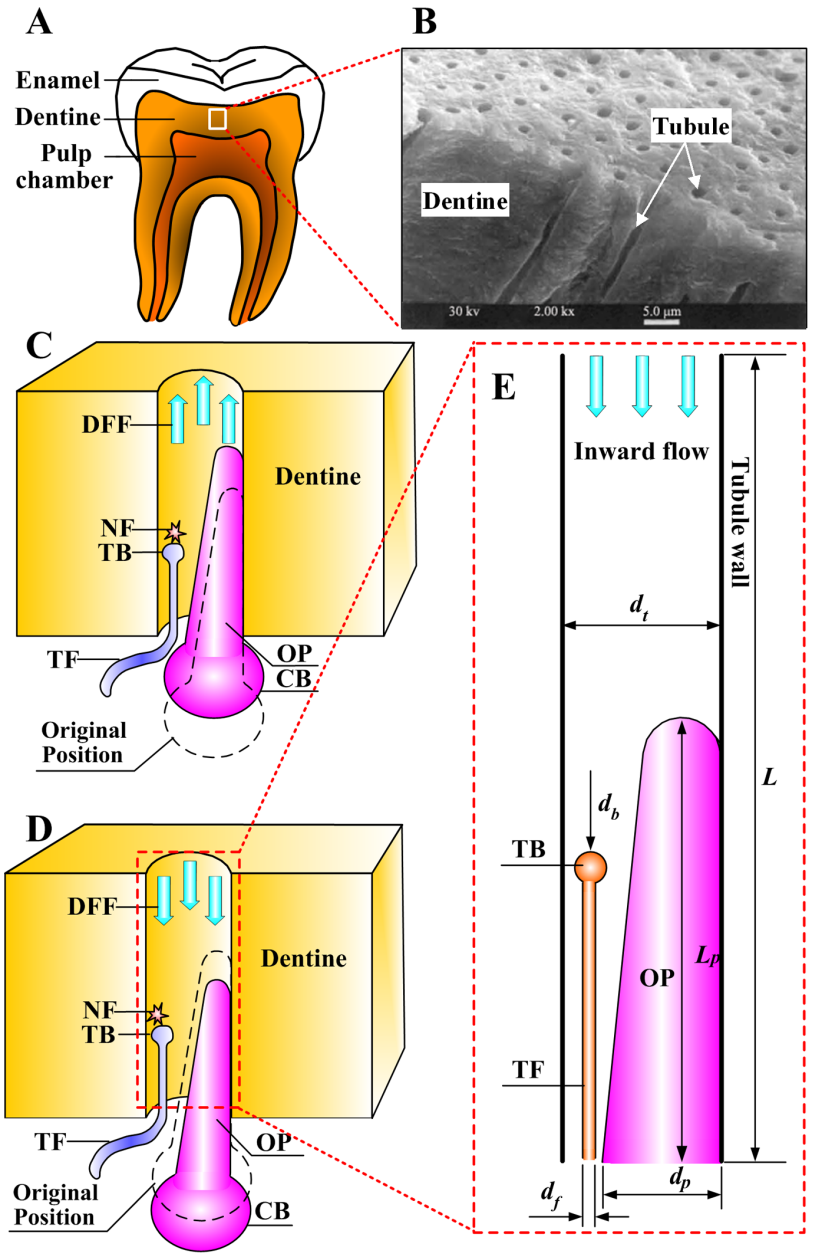
Electrical streaming potential may contribute to a nerve response



West et al , 2013

Pain mechanism:

- COLD
- HOT
- AIR
- OSMOTIC STIMULI



Diagnosis:

Different diagnosis of dental pain that may conflict with an accurate diagnosis of dentin hypersensitivity

- Cracked tooth syndrome
- Fractured restoration
- Fractured teeth
- Dental caries
- Post-operative sensitivity
- Acute hyper-function of teeth
- Atipical facial pain
- Palatal gingival groove
- Hypoplastic enamel
- Congenital open cementum-enamel junction
- Improperly insulated metallic restorations

Gillam, 2013

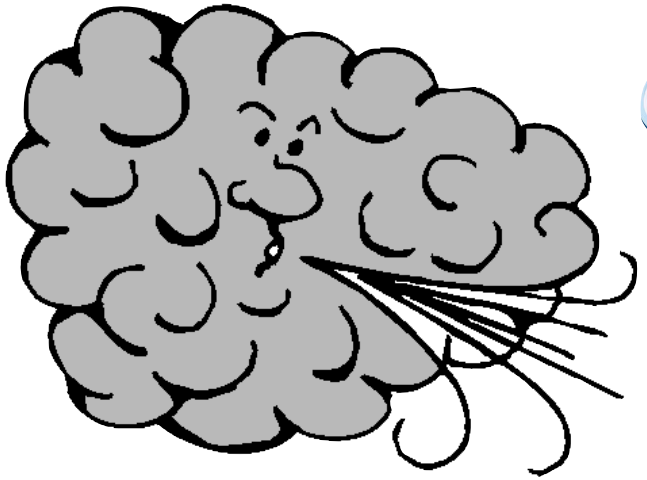
Hypersensitivity evaluation:

According to the recent recommendations by Holland et al(1997), dentin hypersensitivity may be evaluated both in terms of the stimulus intensity to evoke pain and in terms of response based methods.

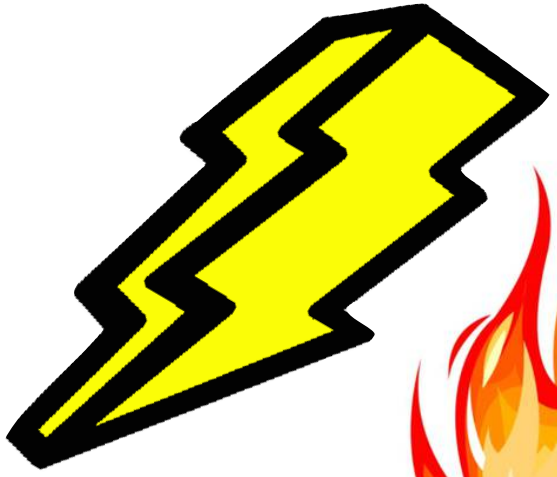
Stimulus based methods usually involve measurement of a pain threshold; response based methods involve the estimation of pain severity.

Hypersensitivity evaluation:

Stimuli can be divided into **5** categories:



- Thermal
- Chemical
- Mechanical
- Evaporative
- Electrical



Hypersensitivity evaluation:

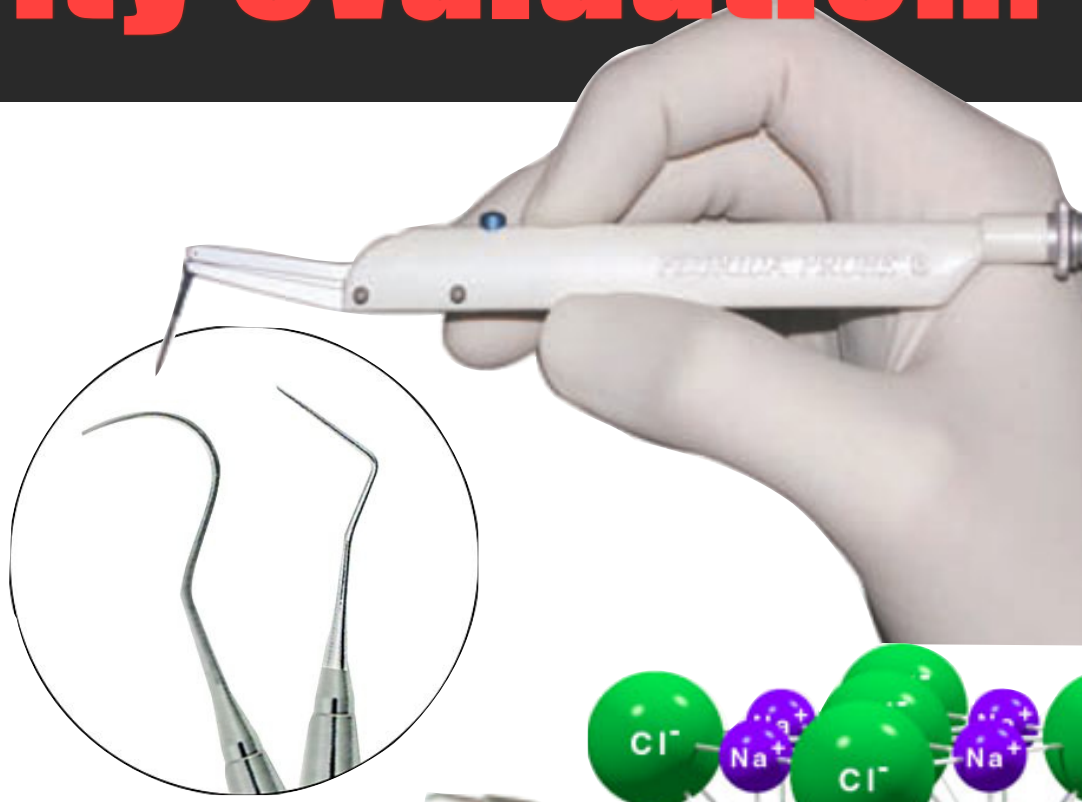
OBJECTIVE EVALUATION

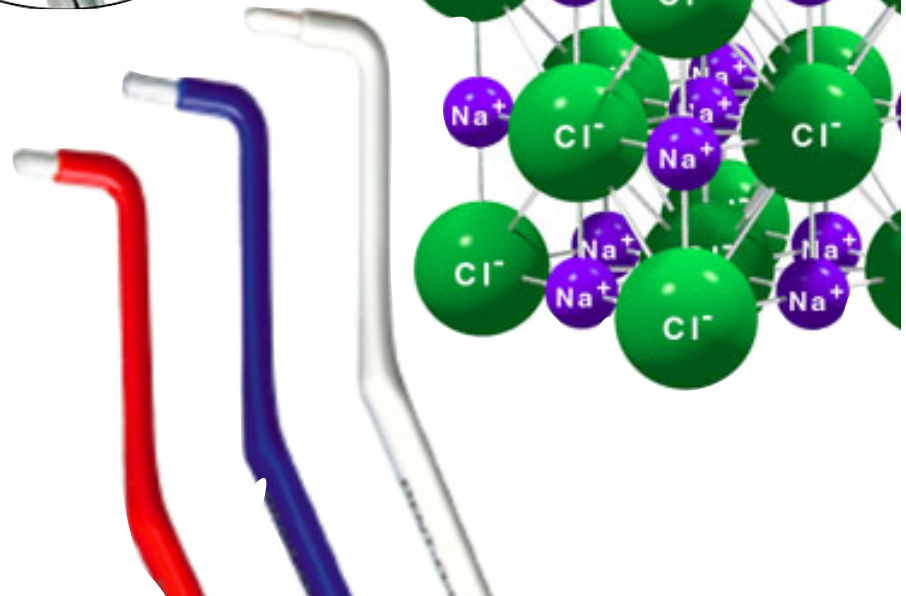
Mechanical (tactile) stimuli:

- explorer probe
- constant pressure probe (Yeaple)
- Mechanical pressure stimulators
- scaling procedures
- single-tufed brush

Chemical (osmotic) stimuli:

- hypertonic solutions (sodium chloride, glucose, sucrose, and calcium chloride)





Hypersensitivity evaluation:

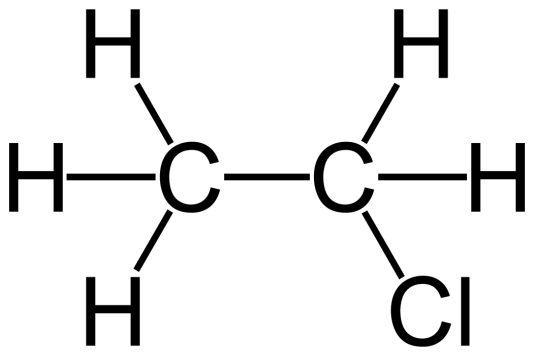
OBJECTIVE EVALUATION

Electrical stimulation:

- electrical pulp tester

Evaporative stimuli:

- cold air blast
- air thermal system
- air jet stimulator



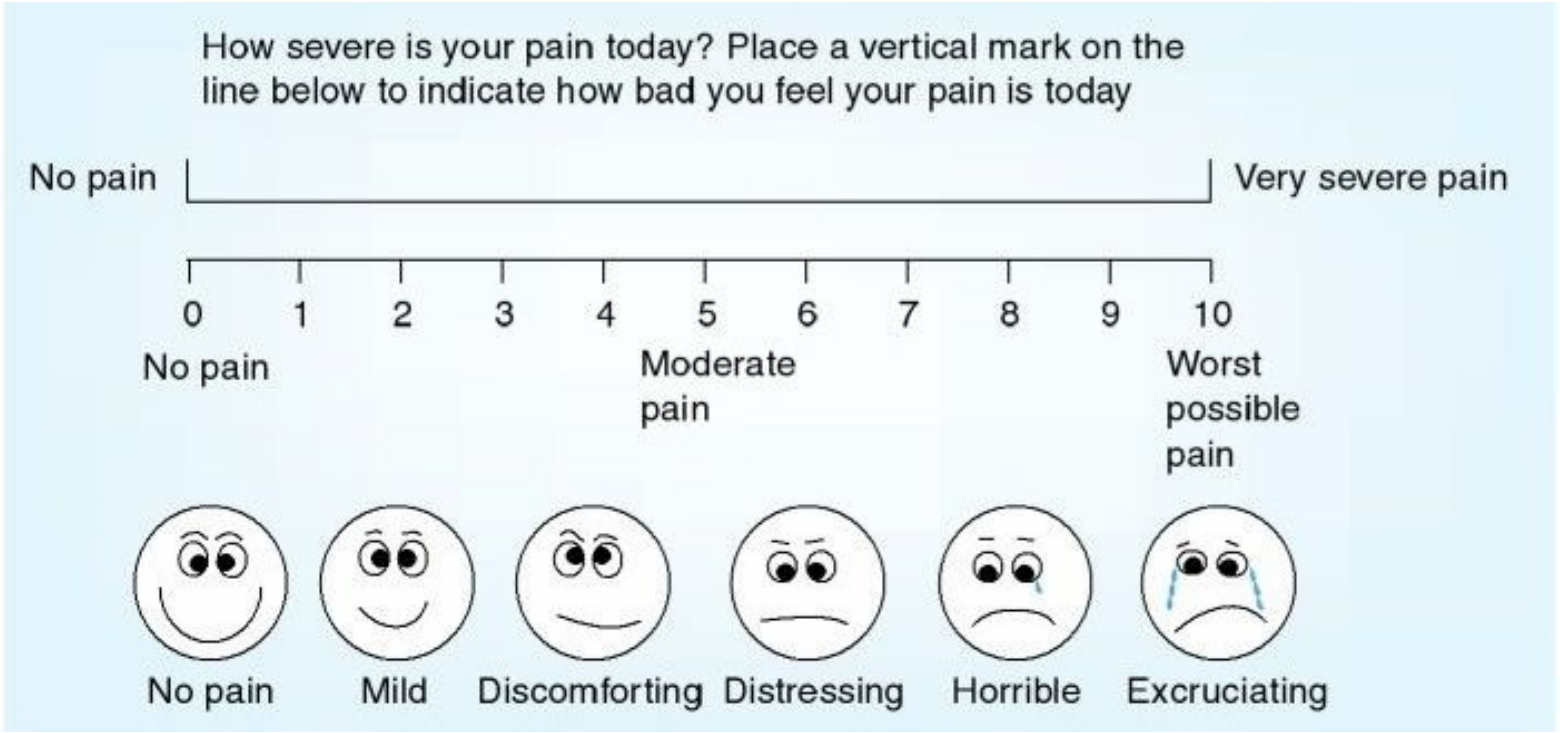
Thermal stimuli:

- electronic threshold measurement device
- cold water testing
- ice stick
- heat
- Ethyl chloride

Hypersensitivity evaluation:

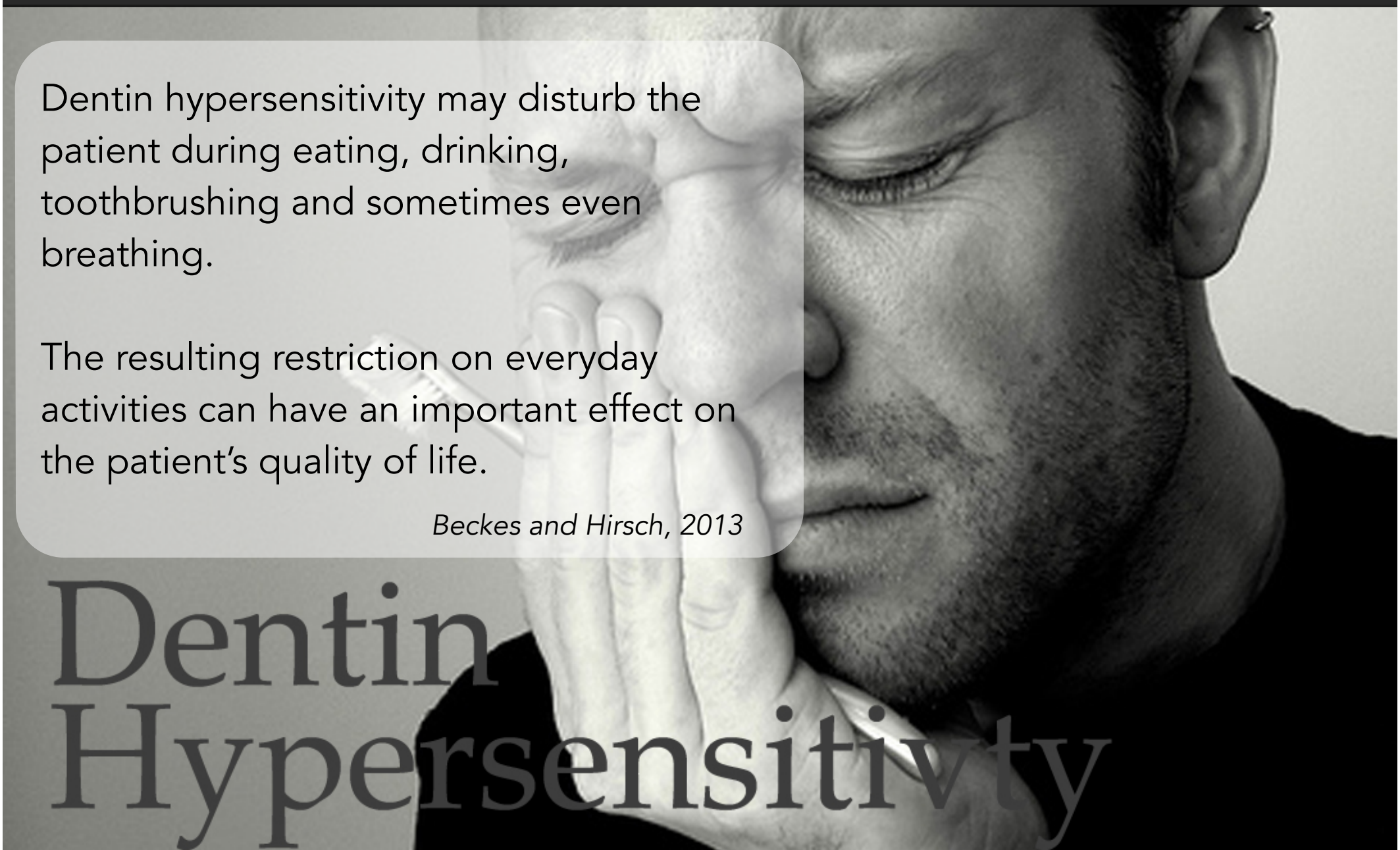
SUBJECTIVE EVALUATION

VAS scale:



Patients are asked to place a mark on the 10 cm line which indicates the intensity of their current level of sensitivity or discomfort following application of stimuli

Effect on quality of life:



Dentin hypersensitivity may disturb the patient during eating, drinking, toothbrushing and sometimes even breathing.

The resulting restriction on everyday activities can have an important effect on the patient's quality of life.

Beckes and Hirsch, 2013

Dentin Hypersensitivity

Management:

PREVENTION IS BETTER THAN CURE!!!!!

The primary prevention of dentine exposure as a result of recession formation, and/or dental hard tissue damage by any prophylactic measures is the best way to actually treat this phenomenon and its associated painful symptoms.

Schmidlin and Sharmann, 2013

Management:

The ideal treatment for dental hypersensitivity must act fast, not irritate the pulp not cause pain, not stain the teeth and be constantly effective.

Grossam, 1935

However, no treatment has been found so far, which could serve as a defined therapeutic gold standard, especially in long term.

Schmidlin and Sharmann, 2013

Management:

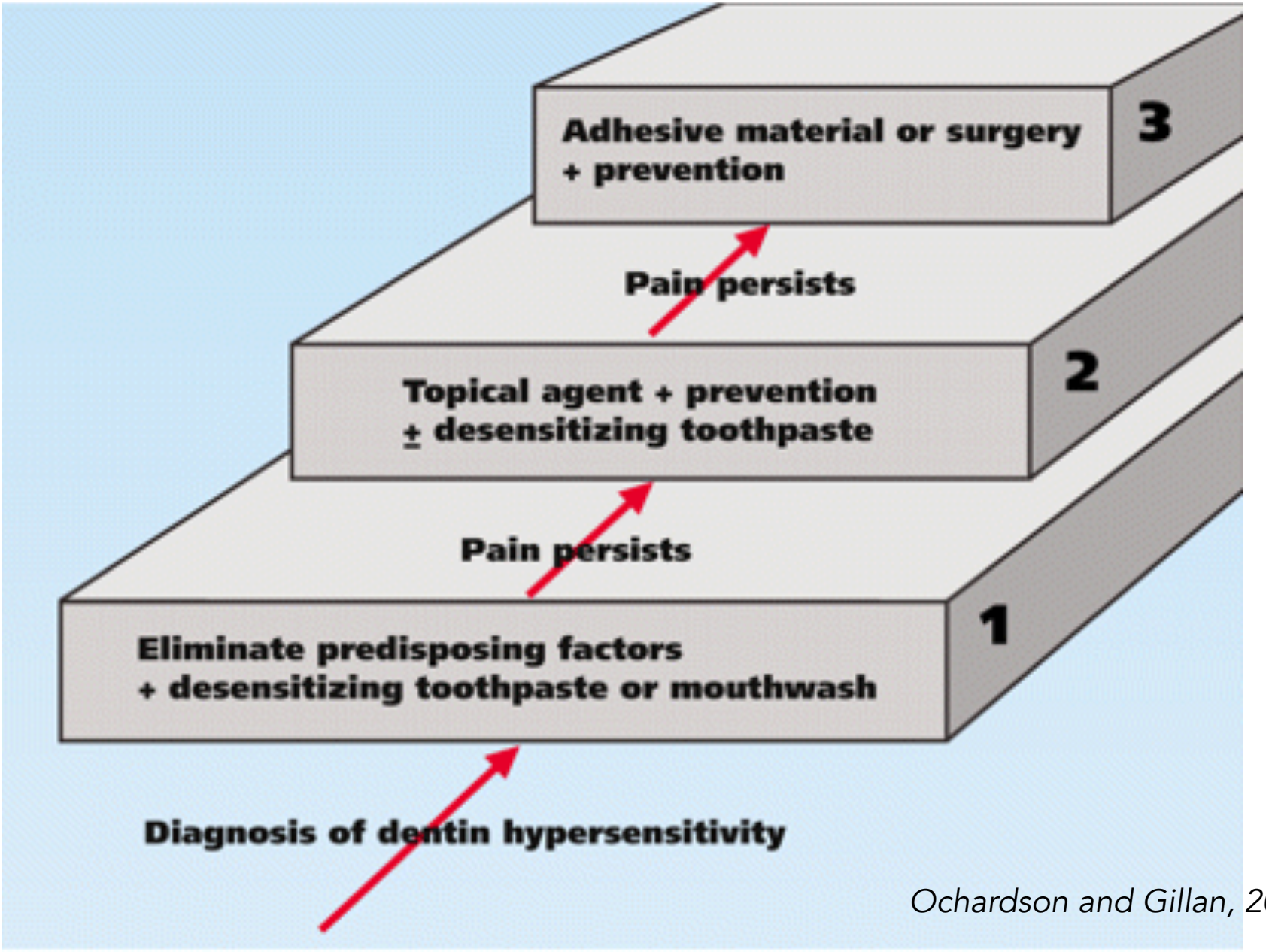
In general, all interventions should start with non-invasive, reversible, nonhazardous, easy to perform and non expensive options.

Only if they prove to be ineffective at revaluation, more invasive interventions should be considered.

Schmidlin and Sharmann, 2013

Tooth sensitivity can be real pain...

Management:

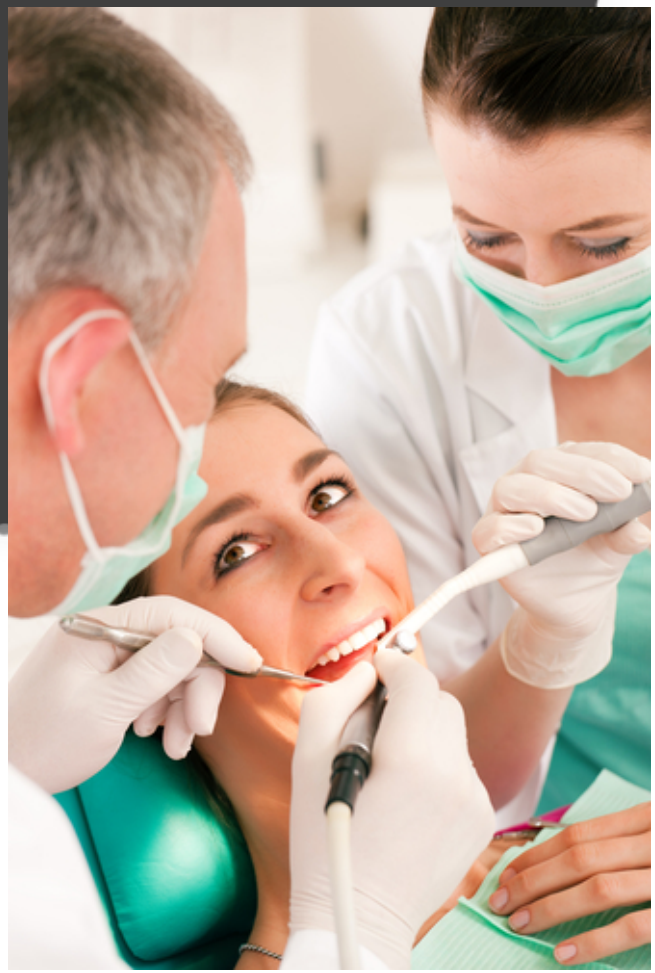


Ochardson and Gillan, 2006

Management:

The management of dental hypersensitivity can be generally divided in two different approaches:

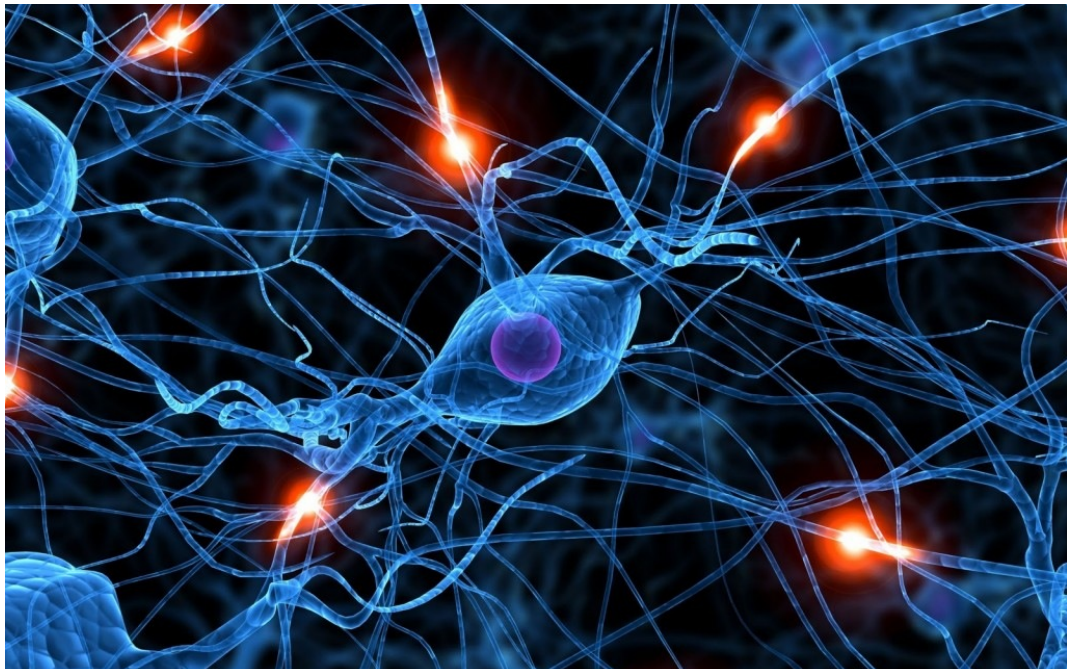
1. Self-performed therapy at home
2. In office treatment

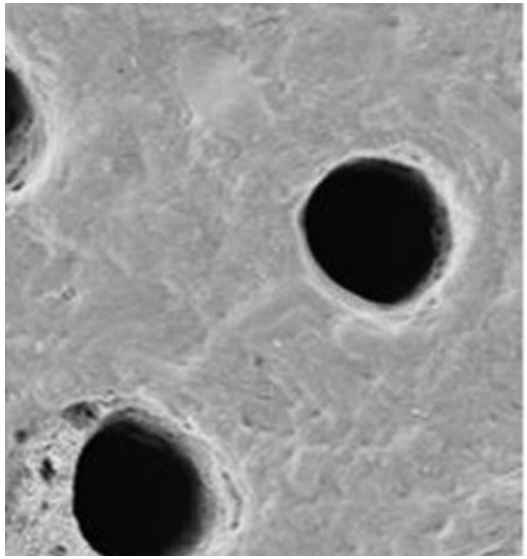


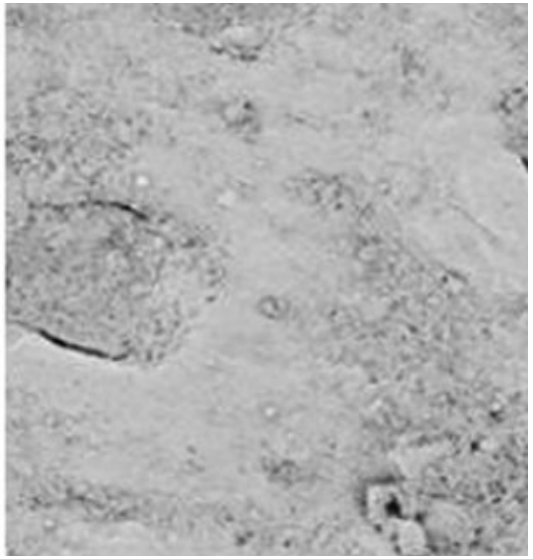
Management:

Two primary approaches to the development and validation of products to treat dentin hypersensitivity have been investigated:

1. Interruption of neural response to pain stimuli
2. Occlusion of exposed tubules to block the hydrodynamic mechanism of pain stimulation







Management:

Main toothpaste available for dentin hypersensitivity treatment:

Occluding agents

Amine fluoride

Strontium acetate

Calcium sodium phosphosilicate

Management:

Main toothpaste available for dentin hypersensitivity treatment:

Occluding agents

Arginine - Calcium carbonate (E.U. brand)

Arginine - Calcium carbonate (U.S. brand)

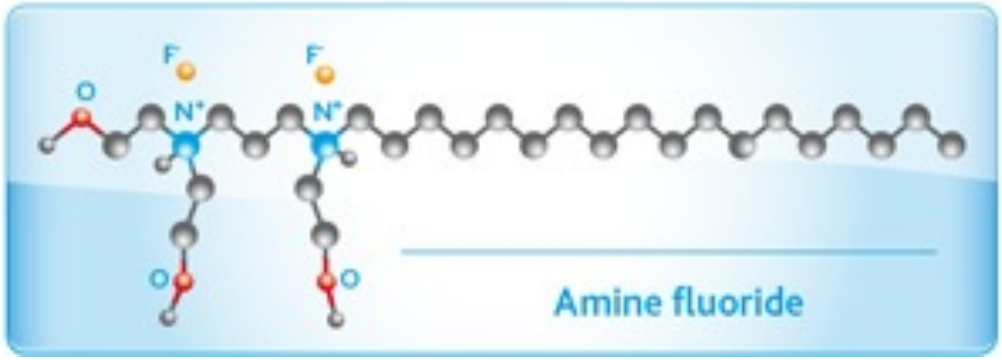
Occluding agents:

Fluoride

Chemical ability to reduce and block fluid movements through formation of calcium-phosphorous precipitants, calcium fluoride and fluoroapatite

Prevention and control of dentin hypersensitivity can modestly be realized by using toothpaste with concentration between 1,000 and 1,500 ppm F as NaF, MFP or AmF

Petersson, 2013



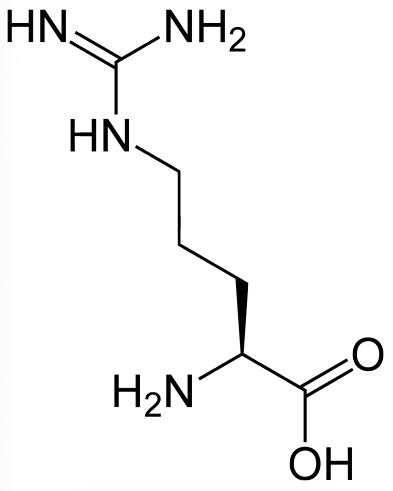
Occluding agents:

Pro Argin™

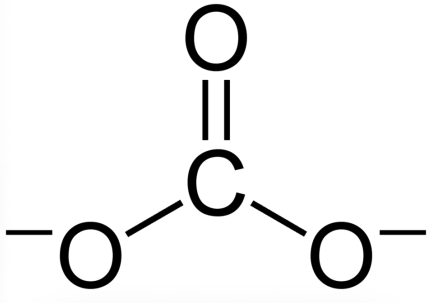
Arginine physically absorb onto the surface of the calcium carbonate, forming a positively charged agglomerate which binds to the negatively charged dentin. The pH of the agglomerate is also sufficiently alkaline to facilitate deposition of calcium and phosphate from saliva and dentin fluid.

A toothpaste containing 0,8% arginine, calcium carbonate and 1450 ppm fluoride, as MFP, has been clinically proven to provide instant and lasting relief of sensitivity.

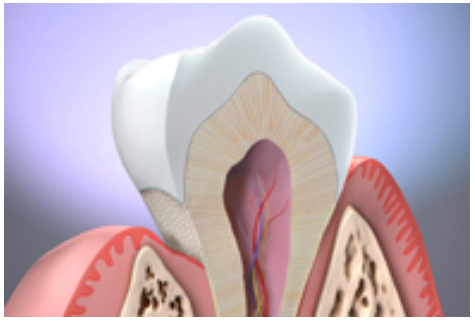
Cummins, 2010, 2011; Sharif et al 2013

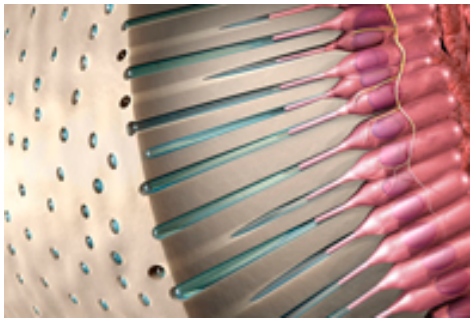


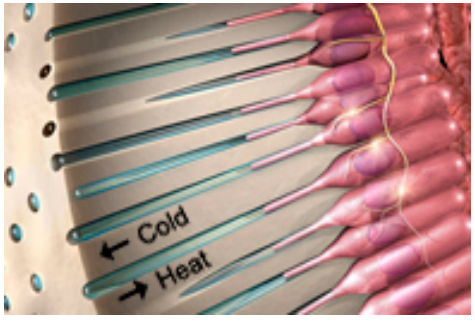
Arginine



Carbonate





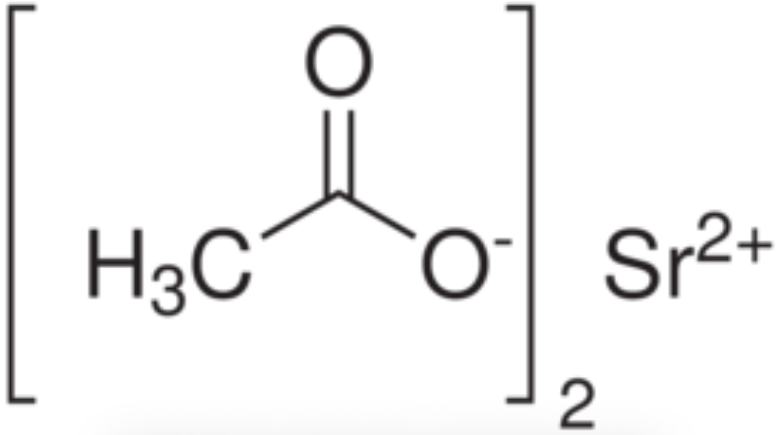


Occluding agents:

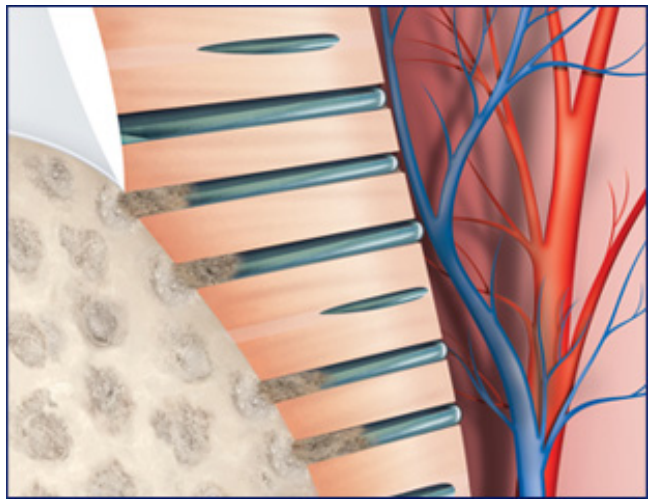
Strontium acetate

Two clinical studies support the provision of instant and lasting dental hypersensitivity relief from an 8% strontium acetate, 1040 ppm sodium fluoride-based toothpaste

Methodological flaws in study design and results from further comparative studies made clinical equivalence of strontium acetate and Pro-Argin questionable



Strontium acetate



Mason et al, 2010; Hughes, 2010; Cummins, 2011; West et al 2013

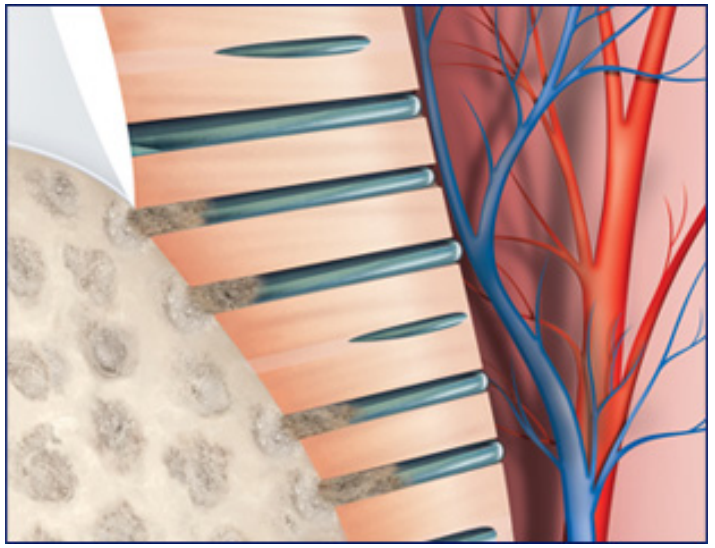
Occluding agents:

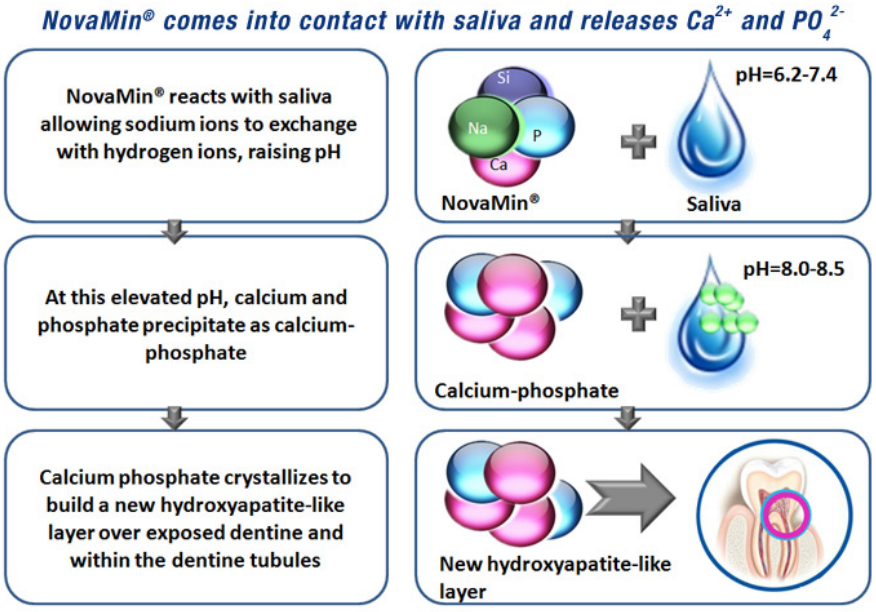
NovaMin®

Calcium sodium phosphosilicate particles bind to exposed dentin surfaces, and physically occlude patent tubules. The subsequent ionic release from the particles and surface reaction promotes formation of a protective hydroxiapatite-like layer

Controlled clinical trials support the efficacy of toothpaste formulations containing 5% NovaMin® for the relief of pain after 2 weeks of use

Gendreau et al, 2011





Occluding agents:

Bonding agents

All adhesive systems, independently from the kind of material employed, infiltrates dentinal substrate producing an hybrid layers that occludes patent tubules.

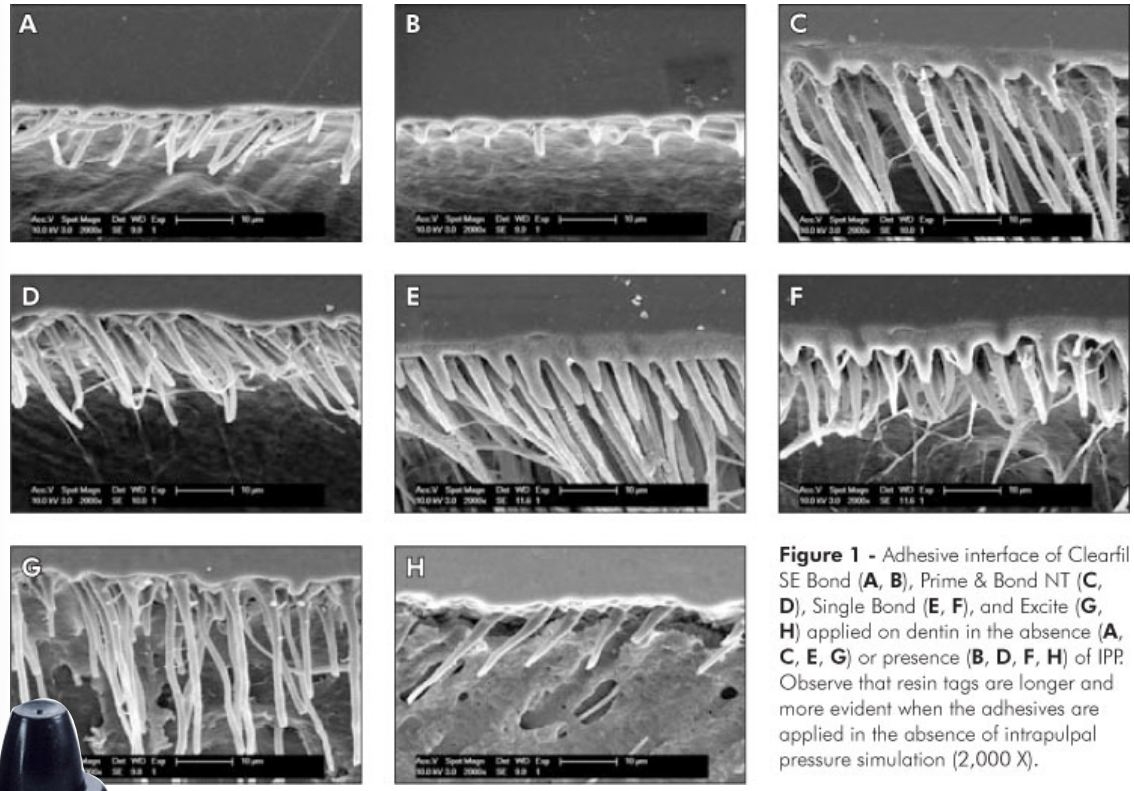


Figure 1 - Adhesive interface of Clearfil SE Bond (**A**, **B**), Prime & Bond NT (**C**, **D**), Single Bond (**E**, **F**), and Excite (**G**, **H**) applied on dentin in the absence (**A**, **C**, **E**, **G**) or presence (**B**, **D**, **F**, **H**) of IPP. Observe that resin tags are longer and more evident when the adhesives are applied in the absence of intrapulpal pressure simulation (2,000 X).

Hybrid layer: Nakabayashi,1982

LEGAME TRA ADESIVO E DENTINA

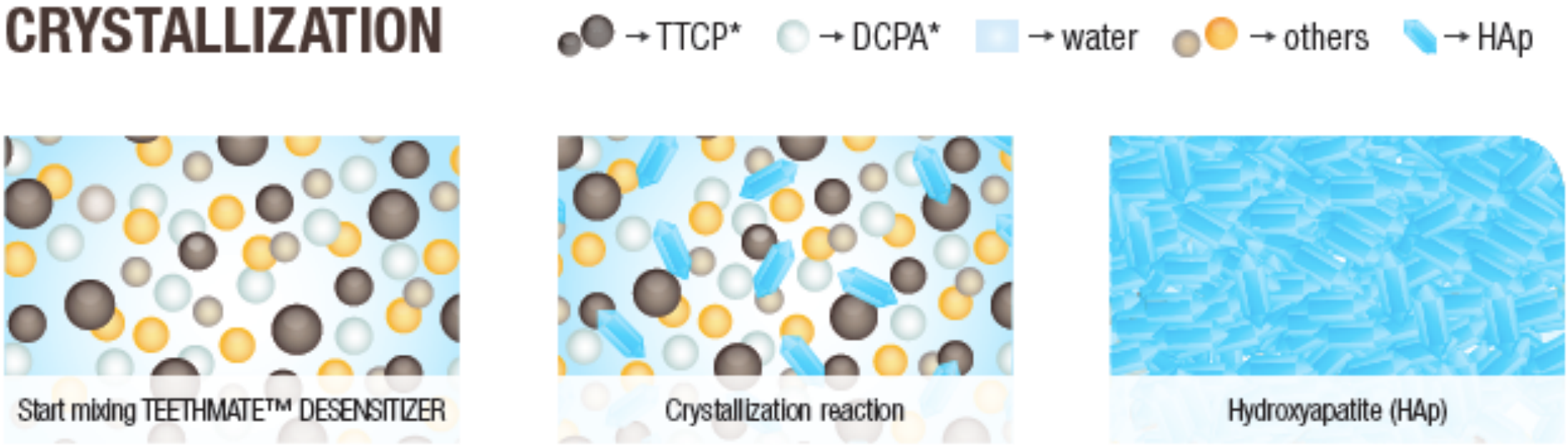
1- INTERDIGITAZIONI DELLA RESINA NEL SISTEMA TUBULARE
2- INTERDENTAZIONI DELLA RESINA NELLA DENTINA INTERTUBULARE DEMINERALIZZATA
3- AGGROVIGLIAMENTO DELLE CATENE RESINOSE ALLE CATENE DI COLLAGENE
4- LEGAMI SECONDARI
5- LEGAMI CHIMICI (MAI DIMOSTRATI)

Strato: comprende la superficie dentinale intertubulare e le pareti dei tubuli
Ibrido: combinazione di resine e collagene

Occluding agents:

TeethMate Desensitizer™

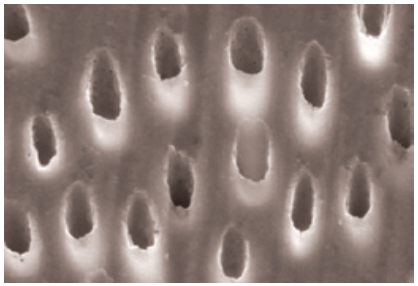
Tetracalcium phosphate (TTCP), dicalcium phosphate anhydrous (DCPA), water, others

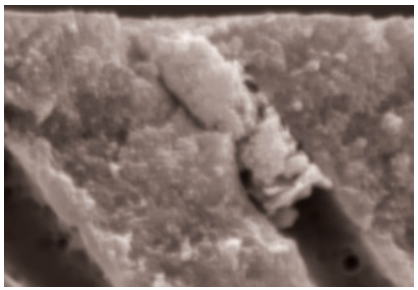


* TTCP; tetracalcium phosphate, DCPA; dicalcium phosphate anhydrous

Occluding agents:

TeethMate Desensitizer™





Tetracalcium phosphate (TTCP), dicalcium phosphate anhydrous (DCPA), water, others

Dr. Thanatvarakorn* et al.

"… Therefore, the calcium-phosphate-containing material is expected to be a new generation desensitizer promoting growth of the crystals, leading to long term stability in the oral environment."

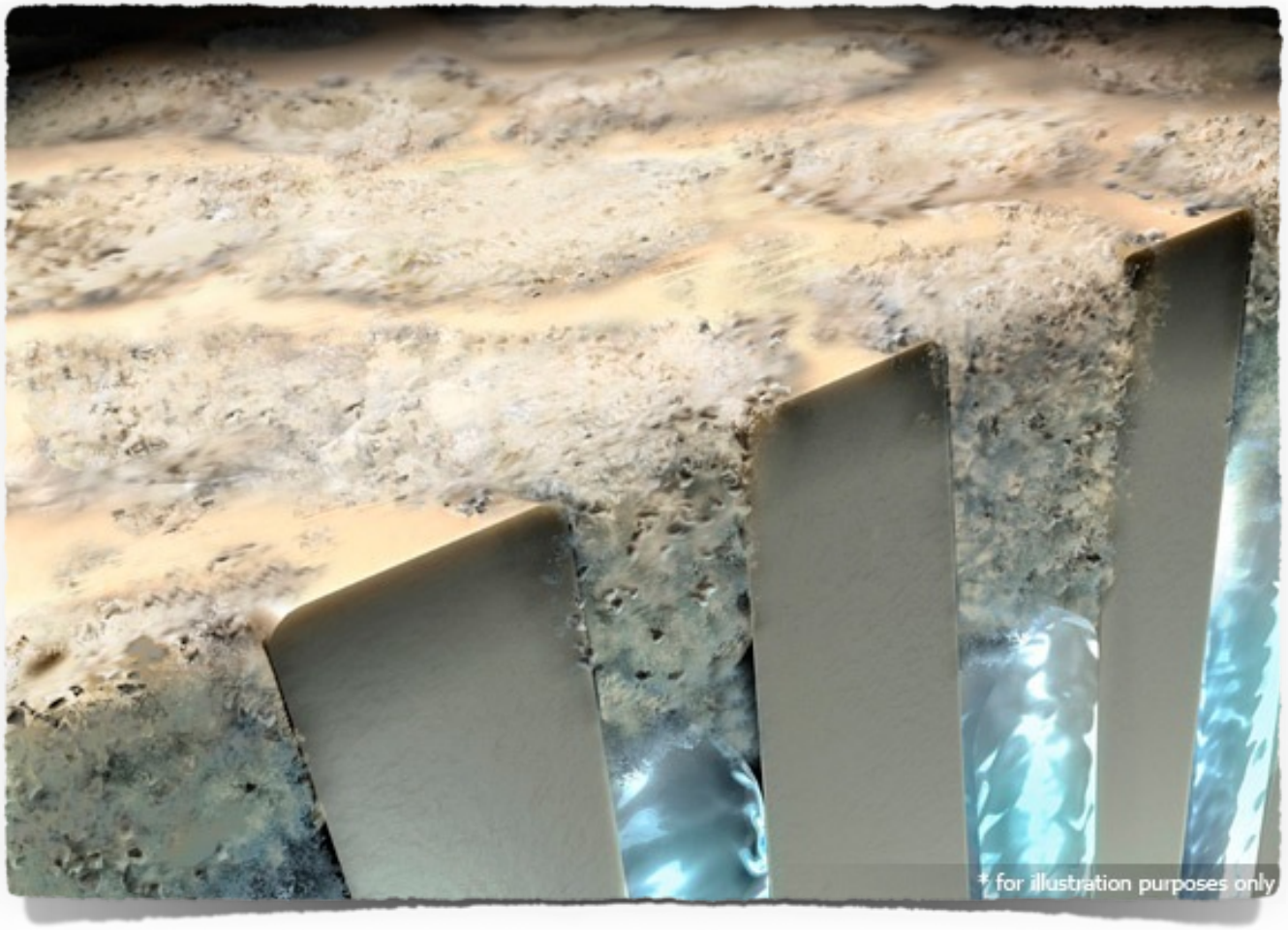
Dr. Endo** et al

"… The results suggested that the application of TEETHMATE™ DESENSITIZER within the tubules was effective on inhibition of dentin demineralization. The obliteration of dentinal tubules by repeated application of TEETHMATE™ DESENSITIZER prevents demineralization and the occluded dentinal tubules reduce dentinal fluid movement with consequent clinical improvement of dentin hypersensitivity."

* Thanatvarakorn, O., et al. In vitro evaluation of dentinal hydraulic conductance and tubule sealing by a novel calcium–phosphate desensitizer. J Biomed Mater Res, 101(2), 303-309, 2012.
** Endo, E., et al.: Evaluation of a calcium phosphate desensitizer using an ultrasonic device. Dent Mater J, 32(3), 456-461, 2013.

Occluding agents:

Recently, the principle of occluding patent tubules to block the hydrodynamic mechanism has been broadly applied to professional in office and home-use products



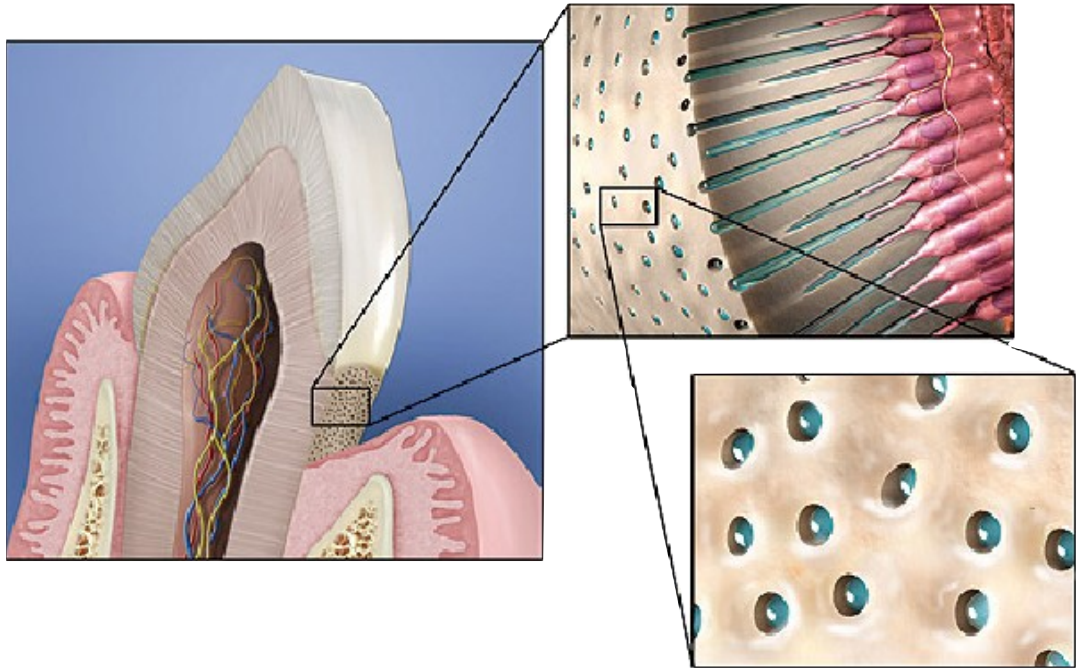
Desensitizing agents:

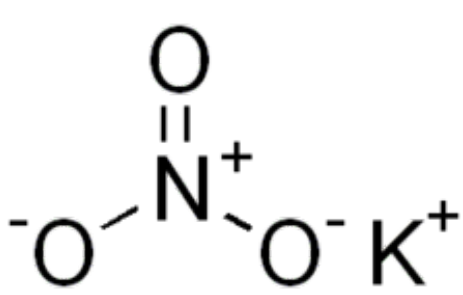
Potassium salts

Potassium ions can decrease the excitability of A fibers, thus resulting in a significant reduction in tooth sensitivity

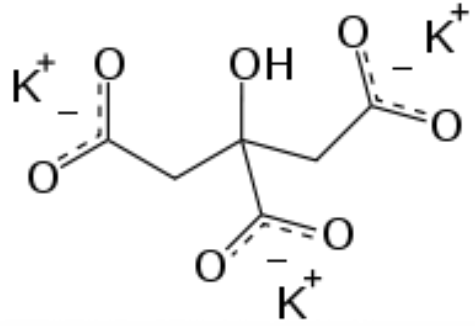
There is insufficient evidence to state categorically that potassium salts alone are effective in reducing dentin hypersensitivity

Karim and Gillam, 2013





Potassium nitrate



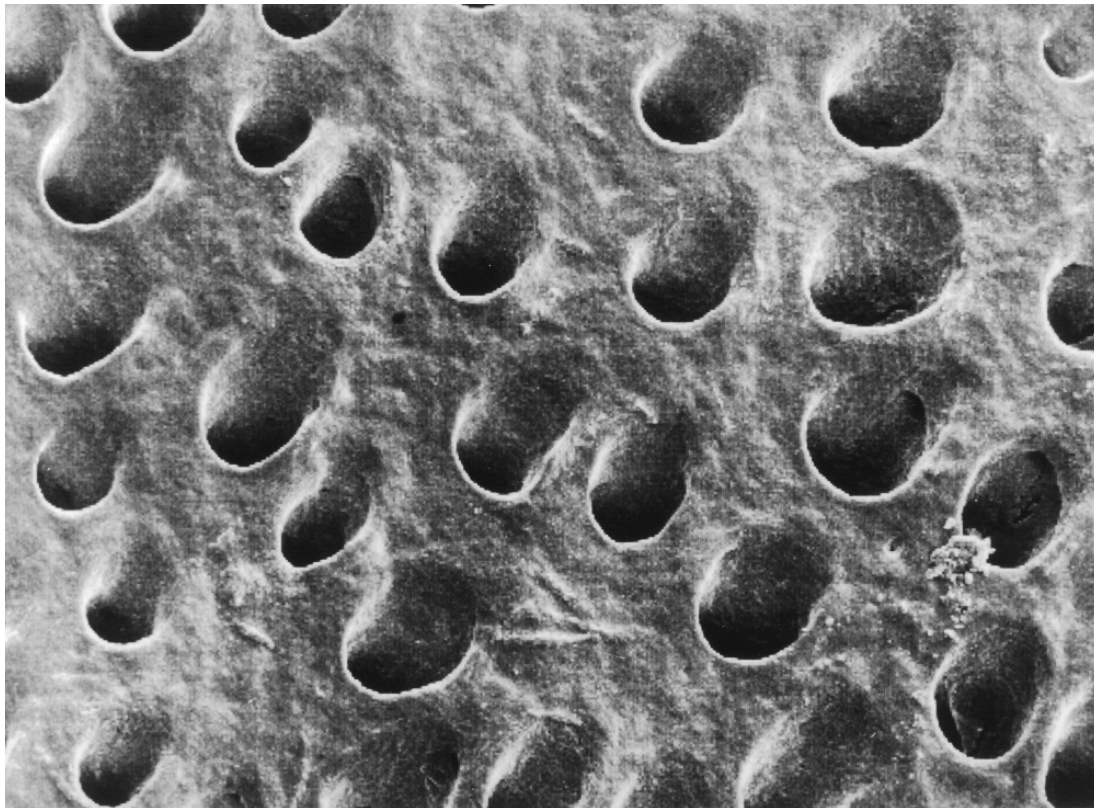
Potassium citrate

In-vitro and In-vivo study:

Methods of study:

In-vitro study

1. Surface analysis technique



2. Hydraulic conductance experiments

Methods of study:

In-vitro study

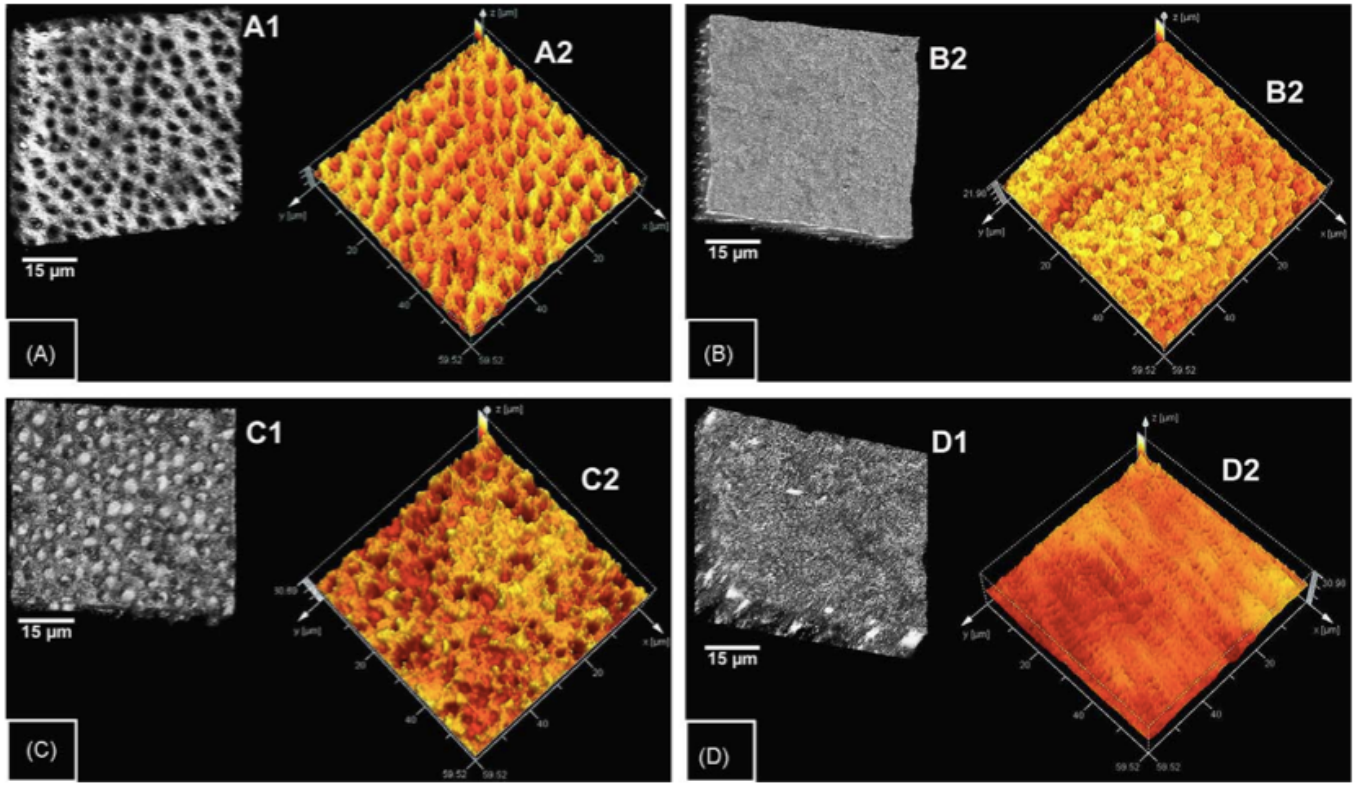


Fig. 2 – Confocal z-stack single projections and topographical reconstruction of dentine surfaces after application of the prophy-powders for air-polishing prophylactic procedures used in this study. Image A shows the effects of PA on the dentine surface. It is possible to observe a dentine surface characterized by completely open dentinal tubules (A1). In particular, A2 shows how PA induces many modifications in the intertubular and peritubular dentine. Image B shows the effects of bicarbonate powder used with the air-polishing system on the dentine surface. Images B1 and B2 show how this procedure creates a smear layer that covers the dentine surface and occludes the dentinal tubules. Image C shows the effects of EMS Perio powder on the dentine surface. Both in C1 and picture C2 is possible to observe a number of dentinal tubules completely or partially open showing how this procedure creates a smear layer that covers the dentine surface and occludes the dentinal tubules. Image D show the effects of Sylc-bioglass powder used with the air-polishing system on the dentine surface. Both D1 and D2 show how this procedure creates a multilayered smear layer that completely covers the dentine surface and occludes the dentinal tubules.

Methods of study:

In-vitro study

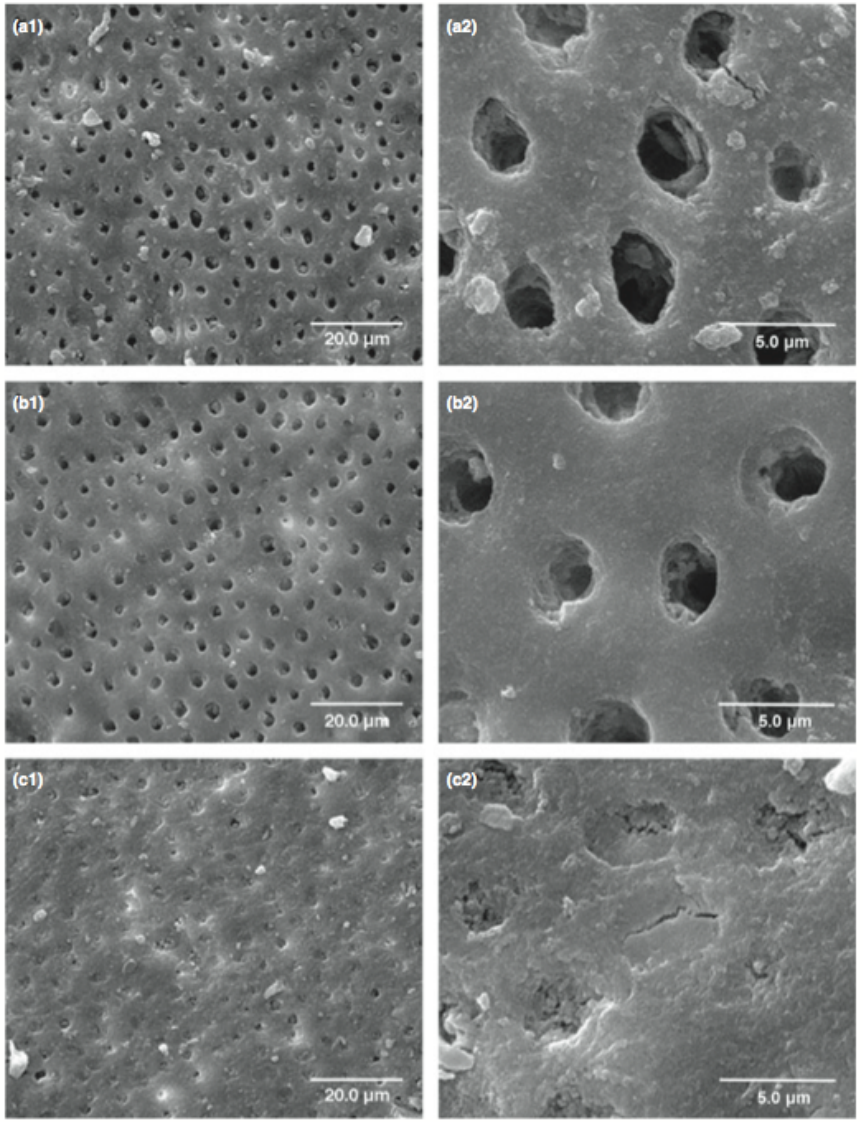
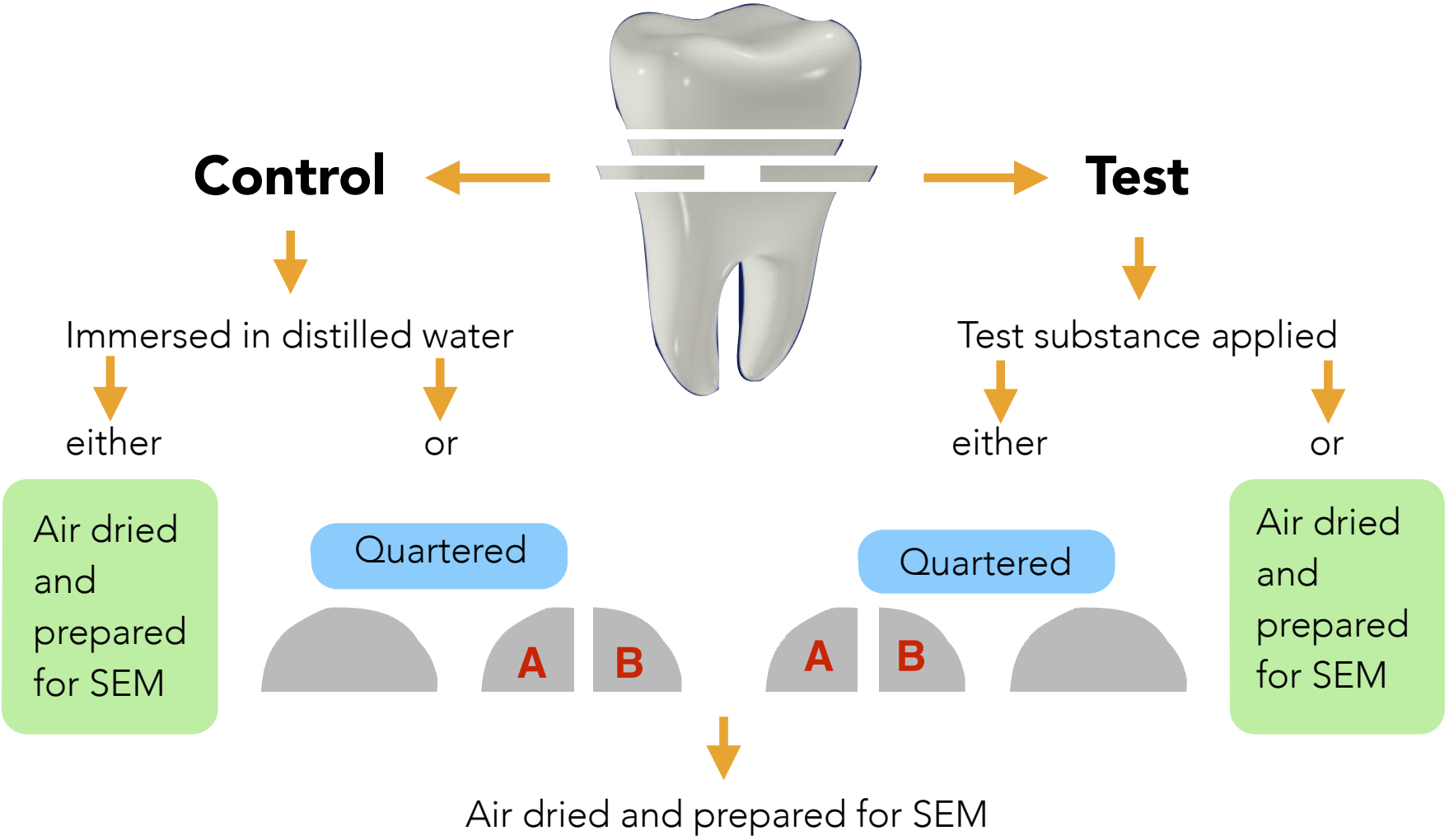


Fig 4. SEM micrographs of the dentine surface morphology following different brushing treatments for 7 days prior to acid challenge. (a1, a2) EDTA-etched dentine surface after AS immersion for 7 days. Most of the dentinal tubules were open. Note some irregular deposits on the surface or even in the tubules (a2). (b1, b2) Dentine surface appeared smooth after brushing with distilled water for 7 days but some debris in the tubules could still be noted (b2). (c1, c2) Dentine was covered by a smear layer, leaving very few open tubules following brushing with Novamin for 7 days. Dentinal tubules were occluded by debris which completely obliterated dentinal orifices.

Methods of study:

In-vitro study: dentin discs model

Gillam et al, 1997



Methods of study:

In-vitro study: hydraulic conductance

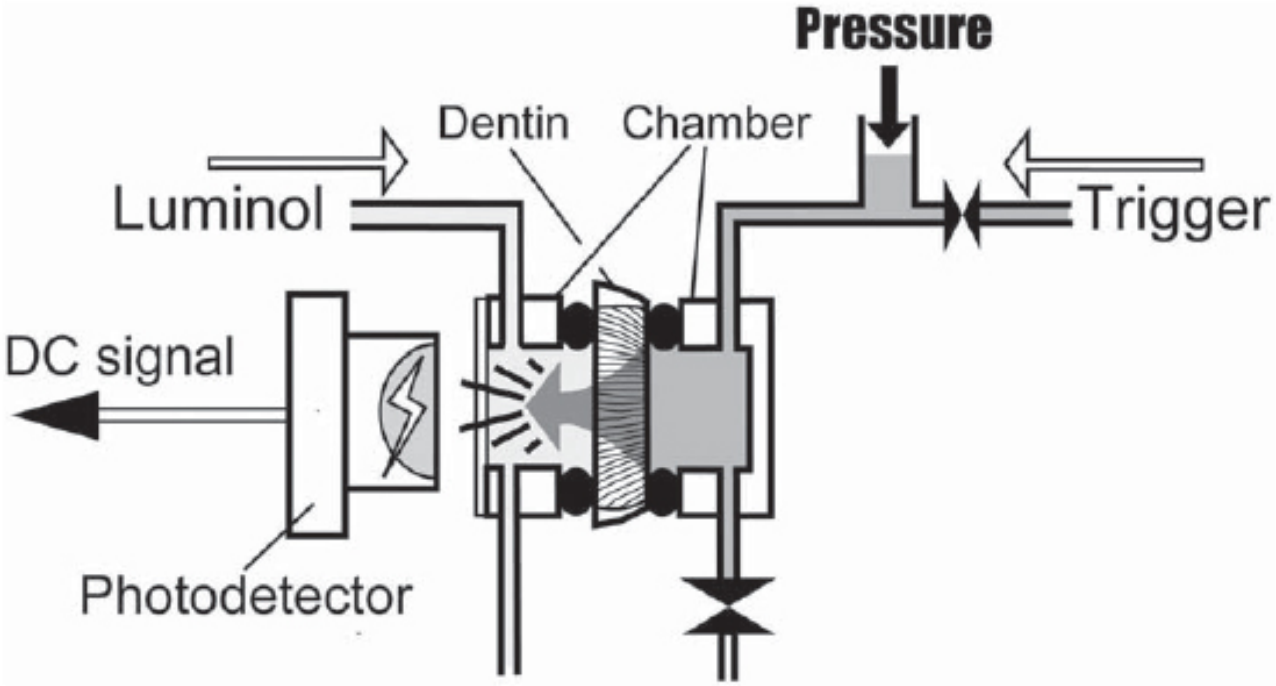


Figure 1- Measuring device for determination of dentin permeability. The activator solution (trigger) is enclosed in the chamber on the pulpal side of the specimen. Upon start of measurement, the trigger is pressurized to 2.5 and 13 kPa respectively, while the luminol remains at atmospheric pressure. The trigger penetrates through the dentin specimen, and a photochemical reaction is generated upon contact with the luminol. Light emission is detected with a photodetector through a window of the chamber on the occlusal side and outputted as DC signal

In-vitro study: what do they say?

In-vitro study allow to:

- Assess tubules occlusion
- Identify the composition of occlusion deposit
- Demonstrate the resistance of the occlusion to acid, brushing forces, and salivary flow
- Demonstrate the ability in arresting dentin fluid movements
- Evaluate the effect of pulpal pressure on the robustness of the occlusion
- Test new products and thecnologies

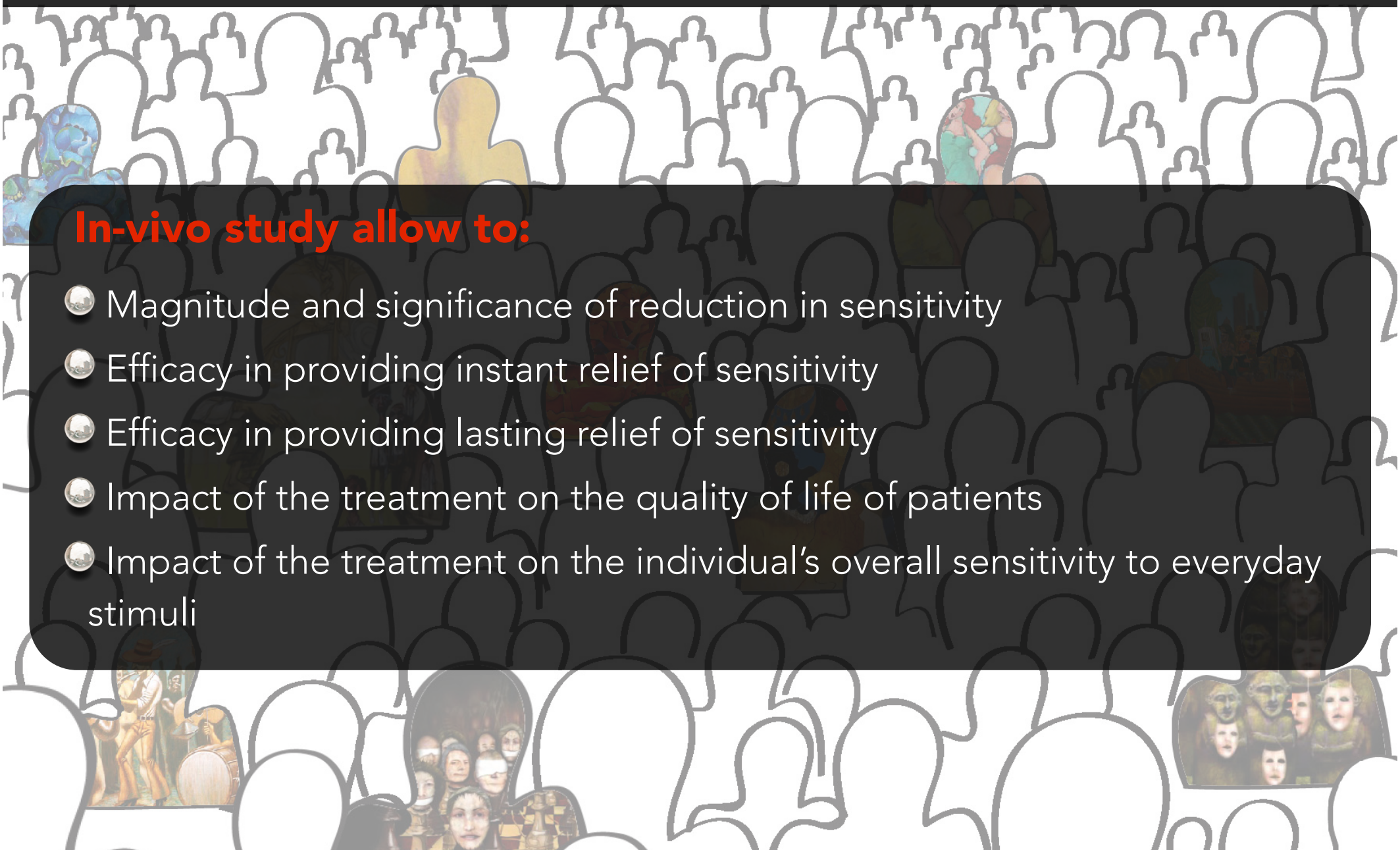
LIMITATIONS...

Methods of study:

In-vivo study:

- Experimental design
- Sample size
- Subject selection
- Randomization process

In-vivo study: what do they say?



In-vivo study allow to:

- Magnitude and significance of reduction in sensitivity
- Efficacy in providing instant relief of sensitivity
- Efficacy in providing lasting relief of sensitivity
- Impact of the treatment on the quality of life of patients
- Impact of the treatment on the individual's overall sensitivity to everyday stimuli

Therapy...

- Active management usually involve a combination of at-ome and in-office therapies.
- Active treatment may begin with an at-home method, such as desensitizing toothpaste.
- This alone may alleviate the condition, otherwise, an in office treatment may be used.