

Sensitivity during and after the whitening of vital teeth

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Today, gleaming white teeth have become a status symbol; people in the public eye, in particular, lead by example in having their teeth artificially whitened. Various methods of this whitening process exist, which, amongst other things, differ in type and strength of the whitening gel. There is a risk of individual hypersensitivity with all conventional whitening methods. How much these hypersensitivities can be influenced or prevented was thoroughly examined and discussed in a special edition of the journal *Inside Dentistry* from 2008. [1]

There are currently three main methods of whitening on the market, using either hydrogen peroxide or carbamide peroxide as a whitening agent. The patient has the option of choosing between the office method, the home method or the strip method. The office method is carried out by the dentist in his or her practice, ordinarily using a whitening gel based on approximately 35% hydrogen peroxide. The home method can be carried out by the patient at home without supervision, a prior instruction by the dentist, however, is necessary. An individual whitening tray is made for this, which the patient fills at home and wears either for two hours per day, or overnight. In home whitening, the active whitening agent is based on approximately 10–20 % carbamide peroxide. The strip method is not very common; this method uses whitening films containing a low concentration of carbamide peroxide. The strips are applied to the teeth by the patient and can thereby achieve their whitening effect over a specific period of time. A satisfactory and equivalent whitening result can be achieved with all three methods; apart from the active whitening agent the only differences are in the duration of the application, whereby the strips proved not entirely unproblematic in their application.

Origin and prevention of sensitivity during and after the whitening process

The mechanism of the whitening process is based on a chemical reaction that is analogous to the process of bleaching hair. In these chemical reactions, the active whitening agents hydrogen peroxide or carbamide peroxide make so-called radicals available, which are able to destroy the chromophores of the pigments deposited in the teeth (from coffee, nicotine, wine, etc.). The destruction of the chromophores leaves the pigments with no visible colour so that, after the whitening process, the teeth are lighter and appear gleaming white. In addition, the whitening process removes a proportion of water from the dental hard tissue, which also contributes to the gleaming white colour of the teeth.

The whitening effect of hydrogen peroxide is approximately three times as powerful as carbamide peroxide, i.e. the effect of a 30% carbamide peroxide whitening gel roughly corresponds to the effect of a 10% hydrogen peroxide gel. Peroxides, as used in the whitening process, are by no means harmless and caution is therefore advised when handling them. Contact with the skin causes an unpleasant burning sensation and the skin turns a whitish colour. Peroxides generally only attack the upper layers of the skin, however, longer exposure may allow them to penetrate further into the body and cause damage. If skin that has come into contact with peroxides is thoroughly rinsed with water only mild complaints will occur, which should completely subside after three days at most.

The irritating effects of peroxides can cause varying degrees of sensitivity in different whitening clients, which may cause sometimes substantial pain to occur within 5 to 15 minutes. The causes of dentine hypersensitivity may be, for example, exposed dentine, deep restorations or cracks in the dental hard tissue. The sensitivity that occurs during and after whitening is also due to hydrodynamic movements of the dentinal fluid, which are caused by the irritant whitening gel and thereby irritate the nerve.

In order to prevent the sensitivities described above, or even to stop them completely, almost all whitening agents currently on the market contain both fluorides (in the form of sodium or potassium fluoride), as well as potassium nitrate. The fluorides **in no way** disturb the actual whitening process. From a chemical perspective, fluorides are unable to have a negative effect on the peroxide-induced destruction of the chromophores of the pigments! In order to be able to prevent the whitening reaction, the fluorides would need to be able to intercept the peroxide radicals and thereby render them unreactive. This is impossible from a chemical perspective, so the whitening gel can take its full effect, despite the presence of fluorides. Fluorides prevent hypersensitivity by sealing the dentinal tubules, as well as strengthening the dental hard tissue via the incorporation of fluoride ions into the apatite frame of the tooth.

Potassium nitrate, on the other hand, exhibits an entirely different mechanism of action in the control of sensitivity. Analogous to fluorides, potassium nitrate does not hinder the whitening action of the peroxides either. Potassium nitrate penetrates through the enamel and dentine into the pulp chamber, where the potassium ions block the impulse transmission to the nerve, so that the patient only experiences a weak form of any sensitivity, if any at all. The suppressing process caused by potassium nitrate is reversible. Important in the blocking, which is limited to a period of only a few days, is the presence of pure potassium ions; the suppressing process could not be detected with similar ions, such as calcium, sodium or magnesium ions. Numerous *in vivo* studies in humans have shown that potassium nitrate is able to combat sensitivity in more than 90% of patients. The American Food and Drug Administration (FDA) even advises that, should sensitivity occur, potassium nitrate-containing toothpaste should be applied for 10 to 30 minutes using the whitening tray. It should however be noted that almost all potassium nitrate toothpastes also contain sodium lauryl sulphate, which can lead to gingival irritation in some patients. Many companies in the dental sector offer syringes with 3–5% potassium nitrate for such allergic clients, as well as providing single-use whitening trays that can be used if sensitivity occurs after office-whitening. However, the quantities of fluoride and potassium nitrate added to the whitening gel by the manufacturer are generally sufficient to combat any possible sensitivity.

Despite its anaesthetic action, potassium nitrate is not able to completely prevent sensitivity. A further study indicates that patients who wish to whiten their teeth should exchange their regular toothpaste for a toothpaste containing potassium nitrate to clean their teeth with around two weeks before whitening. The results showed that the experimental group, who had been using conventional toothpaste, suffered considerably stronger sensitivity after the whitening procedure.

Overall, we can conclude that the occurrence of sensitivity after whitening depends on numerous prior factors and thereby presents many options for counteractive measures. This includes the prior application of toothpaste containing potassium nitrate or the use of pure potassium nitrate in the whitening tray. The type and concentration of the whitening gel, as well as the duration of application on the teeth, also play a decisive role. This enables the conclusion that the factors described should be observed step-by-step, in order to avoid or prevent sensitivity as far as possible. Cleaning the teeth with a toothpaste containing potassium nitrate for two weeks, followed by whitening with low-concentration carbamide peroxide would be the gentlest way to start. As such, it would be preferable to power whitening carried out with high-concentration hydrogen peroxide and without prior treatment, in regard to the occurrence of painful sensitivity.

Conclusion: whitening gels are chemically sophisticated systems that assure the effective brightening of teeth. The addition of fluorides and potassium nitrate does not in any way hinder the whitening reaction, thus does not lead to failure of the whitening procedure for the patient. In order to effectively minimise sensitivity during and after whitening, almost all whitening gels currently on the market contain sodium fluoride and potassium nitrate, which work passively by sealing the dentinal tubules and strengthening the dental hard tissue, as well as actively anaesthetising the nerves in the pulp. This consequently assures the treating dentist that the risk of sensitivity associated with the whitening process is reduced to a minimum.

[1] Dentine hypersensitivity: Consensus-based recommendations for the diagnosis & management of dentine hypersensitivity; Inside Dentistry, Vol. 4, Special Issue 9, 2008.