

Home tooth bleaching slightly reduces enamel strength

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New research shows that human teeth lost some enamel hardness after the application of several different products used in the home to whiten teeth. The study suggests that future generations of such products might be reformulated in an effort to reduce these side effects.

The researchers noted that [teeth](#) typically can restore their previous hardness after losing small amounts of enamel calcification. But this is the first study to show at a nanometer scale - measuring in billionths of a meter - how human teeth are affected by the popular home whiteners.

"There is some significant reduction in nano-hardness of enamel, but we are talking on a very minute scale. So even though it may not be visible to the human eye, it's important for research because that's how we improve products," said Shereen Azer, assistant professor of restorative and prosthetic dentistry at Ohio State University and lead author of the study.

Azer and colleagues applied the recommended treatments of five name-brand home whiteners to samples of human teeth and compared the effects to tooth samples that received no treatment. In all cases, the products reduced the hardness of the enamel as well as what is called the elastic modulus or stiffness, a measure of the ability of the tooth surface to bounce back in response to applied force.

Many studies have sought to determine how tooth whitening affects [tooth enamel](#) hardness, but results have been inconclusive. Azer said that

previous studies measured the loss of enamel hardness in microns, or millionths of a meter, rather than on the nanometer scale used in his study.

"So this just gives us a better understanding of precisely how these products affect human teeth," he said.

The research is published in a recent issue of the *Journal of Dentistry*.

Tooth bleaching products contain solutions of various strengths of either hydrogen peroxide or carbamide peroxide, which provide the whitening effect. They bleach teeth by producing unstable [free radicals](#) that attack pigment molecules in the organic parts of enamel. The reduction in pigment means the molecules no longer reflect light, so the teeth appear whiter.

Enamel, which is almost entirely inorganic and translucent, appears yellow in most teeth because it reflects the color of the dentin underneath, which is naturally yellow.

"Especially nowadays, people tend to see beauty in white teeth," Azer said. "And bleaching does have a beautiful effect, but not without side effects."

The study did not test for two other common side effects of tooth whitening, gum irritation and tooth sensitivity. Azer said these side effects have been addressed by other products, such as toothpastes and treatment gels designed to lessen sensitivity and irritation.

He and colleagues used extracted molars to assemble 65 human tooth samples measuring 4 millimeters square and 2 millimeters deep for the study. Ten samples were used in a pilot study that determined they could achieve accurate results for the research under dry conditions rather than

wet conditions simulating the presence of saliva.

Of the remaining samples, five were left untreated, and 50 were divided into five groups of 10 each to undergo treatment.

The researchers used whitening strips on two groups of samples and trays filled with whitening gel on three groups. The treatment times included up to 60 minutes once per day or 60 minutes twice per day according to manufacturer recommendations. All treatments lasted for three weeks except for one tray method, which lasted 10 days.

The treatments included both over-the-counter and professionally provided products to be used in the home.

The scientists used a specialized tool to apply force to test the enamel hardness and stiffness (the surface ability to bounce back), and an atomic force microscope to observe the tiny nanometer-scale effects on the teeth.

The average loss of enamel ranged from 1.2 to 2 nanometers on the treated teeth. The control teeth, on average, actually gained 0.4 nanometers of hardness in comparison over the treatment time frame. The surface ability to bounce back from applied force was reduced by an average of between 6 percent and 18.8 percent among the treated teeth, depending on the type of treatment.

Among the different products, most of the reductions in hardness and elastic modulus were similar. However, there was a significant difference between one strip treatment method and one tray method, with the tray method reducing enamel hardness more dramatically than the strip treatment.

Enamel is the hardest structure in the human body. It protects teeth and

maintains the integrity of the bite. But enamel is subject to abrasion by certain products and even too-vigorous brushing, which is why it is important to figure out ways to reduce damage to this part of the tooth, Azer said.

"In the case of these products, manufacturers might be able to alter the concentrations of the materials and the vehicles used to apply the bleach," he said.

The study did not address how to restore hardness to bleached teeth, but Azer noted that extensive research has indicated that fluoride treatments, including the use of fluoride toothpaste, can promote enamel remineralization.

The products used in the study were Crest Whitestrips Premium Plus, Crest Whitestrips Supreme, Nite White ACP, Oral B Rembrandt and Treswhite Opalescence. The final three are tray treatments.

Azer conducted the research with Camilo Machado and Robert Rashid of the Division of Restorative and Prosthetic Dentistry and Eliana Sanchez of the Division of Primary Care, all in Ohio State's College of Dentistry.

Source: The Ohio State University ([news](#) : [web](#))

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