



A137 The Effects of Household Corrosive Acids on Restored and Non-Restored Teeth

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The goals of this presentation are to: (1) better understand how various types of household products affect restored and non-restored human dentition; and, (2) better understand how positive identification utilizing radiography is possible after exposure to certain acids and acid concentrations.

This presentation will impact the forensic science community by identifying the various changes to restored and non-restored teeth after exposure to acids, including changes to mass, crown width and length, color, and overall qualitative features. Additionally, this presentation will provide statistical analyses that identify the significant changes to dentition exposed to different household acidic solutions and concentrations.

A gap in the literature exists regarding the chemical effects of household acids at different concentrations on restored and non-restored dentition. While previous studies have focused primarily on how bone, hair, and teeth are affected by acids through quantitative and qualitative changes over 24-hour time periods, few studies utilize radiographic imaging for identification purposes subsequent to acid exposure or extend the acid exposure beyond 24 hours.^{1,2} The paucity of information on acid effects is problematic in forensic contexts, as human remains are frequently exposed to acids for concealment purposes, thereby potentially complicating the identification process.

This study utilizes 105 adult human premolars ($n=46$) and molars ($n=59$) consisting of restorations composed of silver amalgam ($n=62$), porcelain fused-to-metal restorations ($n=25$), and teeth with no restorative material ($n=18$). All samples were collected from the Body Donation program cadavers at Boston University's Division of Graduate Medical Sciences. The household corrosive chemical agents consisted of hydrochloric acid (Clorox® Bleach Cleaner and The Works®) and sulfuric acid (Drano® Drain Opener and Watchdog® Battery Acid), in addition to one base (Biz® Detergent) as a control. The teeth were radiographed before and after exposure to the various household products to mimic antemortem and postmortem radiographs. Twenty-one teeth were placed in 20mL of each solution and were removed from the solutions throughout the experimental process after 1, 2, 4, 8, 24, 72, 120, and 264 hours. Documentation included mass, Mesiodistal (MD) and Buccolingual (BL) crown measurements, and photography. Additionally, an ordinal scoring system was developed to assess the visual changes after exposure to the acids.

The results indicate that 86 (82%) of the teeth could be positively identified by radiographs after exposure to the acids. The Works®, which is 20% concentrated hydrochloric acid, resulted in the most destruction and deteriorated 68% of the teeth (mainly the silver amalgam and non-restored dentition). The enamel, dentin, and pulp cavity of these teeth suffered liquefaction. The only dentition that was positively identified after exposure to the Works® were those of porcelain fused-to-metal. Only 28% of this sample were positively identified by radiographs. The Watchdog® Battery Acid, which is 51% concentrated sulfuric acid, was the next most-destructive solution and deteriorated 8% of the teeth (mainly silver amalgam and non-restored dentition). Most of the enamel and parts of the dentin were affected, while the pulp cavity remained intact. Further, 75% of the teeth were positively identified after exposure to the battery acid. The mass, MD, and BL measurements all decreased dramatically for the teeth that were exposed to hydrochloric and sulfuric products. Exposure to Clorox® Bleach Cleaner, which is 8.25% concentrated hydrochloric acid, and Drano® Drain Opener, which is 93.2% sulfuric acid, resulted in minimal damage to the teeth, with 100% of the teeth positively identified by radiographs after exposure. Only the outermost enamel was affected by these two solutions. The mass, MD, and BL lengths slightly decreased in size after exposure to Clorox® and Drano®. Exposure to Biz® Detergent, which is commonly used in maceration, had no effect on the teeth, with 100% positively identified by radiographs, and minimal mass, BL, and MD size decreases.

The results of this study demonstrate that various household corrosive substances can affect the morphology of teeth, and in some cases, destroy teeth, which could mask the identification of an individual; however, the restorations were minimally affected by corrosive agents and can therefore be used for positive identifications. Thus, the quantitative and qualitative data produced from this study can aid forensic cases that display evidence of acidic modification.

Reference(s):

1. Cope D., Dupras T. 2009. The Effects of Household Corrosive Chemicals on Human Dentition. *J Forensic Sci.* 54:1238-1246.
2. Hartnett K., Fulginiti L., Di Modica F. 2011. The Effects of Corrosive Substances on Human Bone, Teeth, Hair, Nails, and Soft Tissue. *J Forensic Sci.* 56:954-959

Dentition, Household Acid Exposure, Identity Concealment