B125 The Forensic Analysis of Temporary Tattoos

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Learning Overview: After attending this presentation, attendees will better understand the physical and chemical characteristics of temporary tattoos, including transferable picture tattoos and freehand inks marketed toward both children and adults.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing examiners with information that will help them distinguish a temporary tattoo from a permanent tattoo, which may prove useful in investigations and identifications.

For thousands of years, cultures worldwide have used permanent tattoos for social identification and artistic expression. More recently, temporary tattoos have become more common and can potentially be used to identify individuals when biometric traits are unavailable. Transferrable picture tattoos are available for both children and adults, and inks to produce freehand, temporary tattoos are being marketed toward adults. The different types of temporary tattoos can be analyzed and distinguished from permanent tattoos and further distinguished from one another utilizing a variety of analytical methods.

Visual, microscopic, chemical, and spectroscopic methods were used to analyze the temporary tattoos. Visual examination consisted of evaluating the package ingredients listed and comparing them to alternate data sources made available by the manufacturer, such as MSDS, and observation of the tattoos/inks with an alternate light source at various wavelengths of radiation to assess fluorescence properties. Microscopic examination was conducted utilizing stereomicroscopy and brightfield microscopy in an effort to evaluate the dye distribution and printing patterns. Chemical extractions were performed in an attempt to isolate the dyes in the temporary tattoos and remove the colorless adhesive present. Spectroscopy, specifically Ultraviolet/Visible (UV/Vis) light spectroscopy and Fourier Transform Infrared (FTIR) spectroscopy, was employed in an attempt to identify the chemical composition of both the freehand inks and layers of the transferable picture tattoos. IR spectroscopy was used to analyze and compare different sections of temporary tattoo samples through the use of Attenuated Total Reflection (ATR) and Reflection-Absorption (RA) spectroscopy.

Some temporary tattoo companies do not openly disclose the ingredients present in their products, making it difficult to assess the composition of the temporary tattoos from packaging alone. Of the many temporary tattoo samples viewed with an alternate light source, only a handful of samples exhibited fluorescence, albeit weakly. The optimal conditions for fluorescence were found to be with a red filter and light with a wavelength of 555nm. Brightfield microscopy revealed that different printing patterns can be observed within one temporary tattoo sample and between samples from different brands. UV/Vis spectroscopy revealed that for the transferrable picture tattoos, the wavelengths of maximum absorption did mostly correspond with what would be expected for each color, with the exception of the secondary colors orange and purple. Seven out of ten henna samples shared an absorption band at 670nm, but there were otherwise few notable similarities in their spectra. ATR provided valuable information about the similarities and differences between the temporary tattoo samples. In general, temporary tattoos of the same type (such as henna or jagua) or same brand of transferrable picture tattoo had similar spectra, while transferrable picture tattoos from different brands had noticeably different spectra. IR spectral data was overwhelmingly characteristic of the adhesive layer, with individual dyes being undetected. RA results were consistent with the ATR data, with differences observed in spectral resolution.

The most effective ways to distinguish temporary tattoos from permanent tattoos and to differentiate between temporary tattoos are microscopy and IR spectroscopy. Specifically, the discriminating characteristics found in this study were the printing pattern of the transferable picture tattoos and the chemical composition of the adhesive layer of transferable picture tattoos. If a printing pattern is observed, the tattoo is likely temporary. IR spectroscopy can distinguish between henna or jagua, two common types of freehand temporary tattoos. IR spectroscopy can also yield results consistent with an adhesive, another indicator of a temporary tattoo. As a preliminary study, this research sets the stage for future studies in evaluating children's and adult temporary tattoos for forensic purposes.

Tattoo, Microscopy, Spectroscopy

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