F12 A Comparison of the Quality of Color Produced by Photographic Film and Digital Imaging Exposed Under Ultra-Violet Light and Measured as a Function of Degrees Kelvin

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The forensic odontologist relies on the faithful reproduction of film and/or digital photographs exposed under various light sources for investigative and evidentiary purposes. After attending this presentation, attendees will be briefed on the evaluation of the differences in color reproduction from these two modalities when exposed to ultra-violet light.

This presentation will impact the forensic community and/or humanity by demonstrating how if one should present evidence based on film or digital reproduction, the possibility exists that the defense might posture this as exculpatory evidence due to the inherent differences in color imaging.

The development of digital imaging has empowered the forensic scientist with a multifaceted investigative instrument. Digital imaging offers instantaneous recording of evidentiary material and a wider range of storage and reproduction modalities. The forensic odontologist relies on image recording and reproduction under various light sources to evaluate the evidence obtained on the initial investigation and to document the conclusions achieved from the painstaking processes of bite mark analysis and/or victim identification. It is vital to all investigators that accurate reproducibility of evidence imaging must be unquestionably accurate. While there has been much documentation on the comparison between photographic and digital imaging with respect to resolution vs. graininess, the literature is notably sparse on comparing the ability of the two media to faithfully reproduce evidence quality color documentation. In a previous presentation the Author evaluated some of the preliminary findings from a project designed to measure the temperature in degrees Kelvin of color images produced by the two media after exposure utilizing 4,800^{o} and 3,200^{o} Kelvin light sources while maintaining the inherent variables as constants. This presentation will deal with a comparison of the color differences between the two modalities when exposed to ultraviolet light.

The objects to be imaged consisted of three plastic report binders: a red, a blue, and a green. Because of the inherent ability of certain polymers to fluoresce, all binders were manufactured by the same company and of the same material to ensure consistency thereby removing this variable from the equation. Two cameras from the same manufacturer were used: a Nikon F4 35mm film camera and a Nikon D-100 digital camera. The same lens, a Nikon 35-70mm macro zoom, was used on both cameras. The lens were used in the macro mode with a lens to object length of approximately 40 centimeters and secured in a Quadrapod copy stand and a LabJax was used to aid in focusing the image. Three portable Ultraviolet handheld light sources were affixed to the legs of the Quadrapod and their light beams were centered on the focal plane of the image. Kodak Gold 35mm 200/ISO film was used and the digital camera was set to the same ISO setting. Because the film chosen was balanced for daylight, the digital camera's "white balance" setting was adjusted for "daylight." Setting the resolution of the digital image was not considered a factor in this experiment.

Each object, the red, blue, and green binders, was imaged according to the following protocol: Ultraviolet on film and then ultraviolet on Digital. A total of three exposures for each parameter per binder were made.

The film was developed by a commercial laboratory utilizing a C-41 process with instructions to not make any color corrections to the final 4x6 prints. The negatives of these images were scanned on an Olympus ES- 10s 35mm scanner and stored on a CD. The digital images were printed on 4x6 photographic paper without color correction by direct placement of the compact flash card from the camera into a Hewlett-Packard #7550 printer. These digital images were also stored on a CD.

A Spectra #4143 Color Temperature Meter was used to measure the color temperature of the various images in degrees Kelvin. Measurements were taken of:

1. The 4x6 film & 4x6 digital prints from reflected light.
2. The CD stored film & digital images from an LCD computer monitor projected by Photoshop.

All measurements were taken in a darkroom environment.

An initial analysis of the measurements showed that all of the images taken in triplicate produced the same measurement. Because the measurement for each parameter would have been universally tripled, it was decided to reduce the statistical evaluation to one measurement for every triplicate image analyzed.

A total of four parameters were considered for each color. The resultant measurements were entered into a spreadsheet, average differences were calculated, and graphs were promulgated and analyzed. While empirically one could say there may not have been any visual differences, the

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measurements clearly illustrates a difference in color temperatures of 500°, 450°, and 600° for red, blue and green respectively. No conclusions should be made on the results of this preliminary report. What the Forensic Odontologist should be aware of is the possibility that any judgment made on the basis of the color film or digital record may be different from the actual color seen with the naked eye. Further investigation is encouraged.

Ultraviolet, Variation, Imaging

