Let There Be Light! Using Alternate Light Sources to Detect and Improve Cutaneous Bruise Visibility

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Abstract

Background

Over six million violent victimizations occur in the United States each year. Forensic nurses provide care to patients following non-accidental trauma, including child and elder abuse, sexual assault, and intimate partner violence. Bruising is one of the most common types of injury resulting from violence and are caused by blunt, compressive, or squeezing force mechanisms which produce extravasation of blood from damaged blood vessels and localized inflammation. However, bruises are sometimes difficult to visualize due to age of the bruise, amount of extravasated blood, depth, and victim’s age, body mass, and skin color. The escaped blood may or may not be visible or barely visible to the naked eye under normal (ambient/white) room lighting in some skin colors. This may result in health care treatment disparities and decreased investigation and prosecution of violent crimes. To note for significance and research implications, recent studies have determined that non-Hispanic Black and Native American/Alaska Native women reported higher prevalence rates of lifetime interpersonal violence, compared to Hispanic and non-Hispanic White women.

Alternate light sources (ALS) with short narrowband visible (NBV) or long ultraviolet (UV) spectrums have been used clinically for several years in select forensic nurse examiner programs to improve visibility and detection of cutaneous bruises. However, there has been limited prospective research to support its use, and little is known regarding how skin color affects bruise visibility comparing normal light and ALS.

Purpose

The goal of the parent study, Analysis of Alternate Light in the Detection and Visibility of Cutaneous Bruises, is to generate new knowledge and improved understanding necessary to determine whether ALS is an effective technology to address a recognized and specific evidentiary need in clinical forensic science.

We induced bruises via the controlled application of a paintball pellet to a randomly assigned left or right upper arm to 78 participants and examined them over four weeks under normal and alternate lights. This purpose of this poster is to present cross-sectional data comparing bruise visibility using normal light and 415 nanometer (nm) wavelength of alternate light 1-week post bruise induction in six participants -one from each of six skin color categories.

Methods

This study was conducted at Texas A&M University’s College of Nursing in Bryan, TX. A convenience sample (ages 18-65) was recruited to include 13 healthy adults within six known skin colors. To objectively measure skin color and its difference from bruise color, colorimetry measures were calculated.
with the Minolta® CM-600D spectrophotometer chosen. for its intra-rater, inter-rater, inter-instrument, and
day-to-day reliability of skin color. These categories include: Very Light (ITA° > 55), Light (ITA° > 41),
Intermediate (ITA° > 28), Tan (ITA° > 10), Brown (ITA° > -30), and Dark (ITA° < -30). Following IRB
approval, health screening measures and informed consent were obtained to rule out participants with
bleeding disorders, pregnancy, medications that increased bleeding, tattoos on the upper arms, recent
febrile illness, tanning, blood product donation, and non-bruise absorptions on the upper arms found with
the alternative light source.

We used a Handscope® Xenon HSX-5000 (SPEX Forensics, Edison, NJ) ALS unit. The light produced
uses a xenon arc lamp with filters controlling the bandwidth of the emitted light. At each study visit, we
randomized the order of light type (ALS or white light) we used first to assess the bruise site.

Bruised and non-bruised arms were assessed for visibility under white and alternate light 9-times during
the first 72 hours post-bruise induction and 21-times over four weeks. Bruise visibility using wavelength
peaks within UV (365nm) and visible (415nm, 450nm, 475nm, 495nm, 515nm, 535nm) spectrums and
filters (yellow, orange, red) were examined. In the current analysis, we visualized bruises using 415nm
wavelength with SPEX yellow googles.

The principal investigator of the parent study developed and validated a Bruise Visibility Scale (BVS) to
systematically measure bruise visibility for this study. The BVS uses visual cues to rate bruise visibility on
a 1-5 scale from “barely” to “clearly” visible. Research nurses were trained to use the BVS using inter-
rater reliability to calibrate ratings until raters were using the scale consistently. Raters entered BVS
scores using a visual analog slider programmed in Qualtrics that generated a corresponding rating.
Bruise areas were measured in millimeters, taking the longest distance of bruise vertical (length)
multiplied by horizontal (width). Spectrophotometric measures of skin and bruise color were obtained
along with digital photographs under each light source.

For this analysis, we will calculate descriptive statistics for one participant from each of the six skin tones
at one week post bruise induction and compare BVS scores for normal and 415 nm wavelength (yellow
goggles) visits between participants. We will compare BVS scores between bruises visualized with normal
vs. 415 nm ALS using paired t-tests for all participants together and for each participant separately. If
differences are found between normal vs. ALS, we will compare strength of the difference between the
participants in the very light vs. the dark skin category (most extreme two groups). We will also present
photographs of the bruises in ambient and ALS for visual comparison.

*We hypothesize the light wave of 415nm with yellow filtered goggles will improve bruise visibility
compared with normal light, and the effects will be greater in persons with darker skin colors.*

**Results**

The full parent study results will be calculated after data collection is complete in January 2019.

**Clinical Implications**

This study will increase our understanding of using ALS to improve bruise visibility with broad forensic
applications for non-fatal victims of violence in various clinical settings and potential future application in
deceased populations. Translational research is needed to explore the efficacy of using ALS in various
clinical settings.

**Title:**
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References:


Abstract Summary:
Victims of violence have latent cutaneous bruises due to skin color, injury age, or depth. A randomized controlled trial measured the effectiveness of alternate light sources in improving visibility over white light, while exploring effects of skin color, gender, localized fat/muscles, bruise size and color on specific wavelengths over time.

Content Outline:
Abstract

Background

Purpose

Methods

Results
Clinical Implications

References

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