

# Experience With Wood Lamp Illumination and Digital Photography in the Documentation of Bruises on Human Skin

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**B**ruising is very common in children. Examination of bruising can guide the clinician in ordering radiographic imaging studies of children who have suffered trauma. Additionally, bruising in infants and patterns of bruising that do not match the injury scenario offered by caretakers can raise the suspicion of abuse. This article reports preliminary experience with Wood lamp enhancement of faint bruises and visualization of bruises that are not visible. It describes the method for digital photography of bruises visualized in this way. Finally, it suggests future applications and areas of further study.

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Although bruising in children is common,<sup>1</sup> bruises in unusual locations or in infants who do not yet cruise can be a physical finding that alerts clinicians to possible child abuse.<sup>1-3</sup> Additionally, in children involved in other types of trauma, such as falls down stairs and motor vehicle collisions, the presence of bruises can guide the clinician in choosing appropriate imaging studies.

The use of an alternative light source to delineate skin lesions is an established technique in forensic pathology<sup>4-8</sup> and forensic odontology.<sup>9-11</sup> Generally, these techniques use specialized film and filters that permit the recording on 35-mm black-and-white film—reflected light in the infrared or UV range. The infrared spectrum, which consists of wavelengths that are longer than the human eye can detect (>700 nm), has the deepest penetration and has the theoretical possibility of visualizing early bruising through the ability to detect the pooling of subcutaneous blood.<sup>12</sup> In contrast, UV light, which consists of wavelengths that are shorter than the visible spectrum (<400 nm), has the least penetration, entering only minimally into epidermal tissue, where it is either reflected or absorbed by various biochemical compounds (hemoglobin, carot-

enoids, or bilirubin) that are part of the healing process of skin.

Reflective UV and infrared photography have limitations that decrease their practical application in pediatrics. The required specialized filters, lenses, and films are unavailable in most emergency departments and outpatient facilities. Exposure times are prolonged that require a child to hold still for several minutes. Additionally, a tripod is required to hold the camera still, making applicability in clinical settings cumbersome. Since the camera is photographing light that is beyond the visible spectrum, detailed photographs of the entire body must be taken as the location of faded bruises becomes known only after the film is developed.

Ultraviolet illumination is an alternative to reflective UV and infrared photography that is more easily adapted for use in pediatrics. Most pediatric facilities have access to a Wood lamp that is an adequate source of UV light. If photographs are required, commercially available digital still and video cameras permit brief exposure times (<1 second) even under low-light conditions so that the child need not be still for extended periods. Additionally, these short exposure times permit the camera to be handheld. As UV illumination allows subclinical bruising to be seen, photographs need only be taken on specifically identified areas of the body.

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## SUBJECTS AND METHODS

This study was approved by the Human Rights Committee (institutional review board) of the Children's Hospital of Pittsburgh, Pittsburgh, Pa. We studied 4 children who had trauma. In children who had a history of trauma, the entire skin surface was examined using a Wood lamp. This examination was conducted under low-light conditions with the Wood lamp held approximately 10 cm from the skin surface. The camera used was a Sony Digital Mavica (model MVC FD95; Sony Electronics Inc, Park Ridge, NJ). The resulting digital images were imported into Adobe Photoshop (version 5; Adobe Systems Inc, San Jose, Calif). The only manipulations of the photographs prior to printing and storing consisted of resizing the images and adjusting contrast and brightness. Bruises were most easily seen after contrast boosts of 10% to 40%.

Our interest in the use of UV illumination was stimulated when one of us (E.V.) noted the visualization under Wood lamp illumination of a healed bruise on the wrist. The bruise had resulted from closing the skin in the clasp of a watchband 10 days earlier (**Figure 1**). Our study was undertaken to develop experience with the use of Wood lamp illumination in conjunction with digital imaging to permit photographic documentation of subtle and subclinical bruises in children.

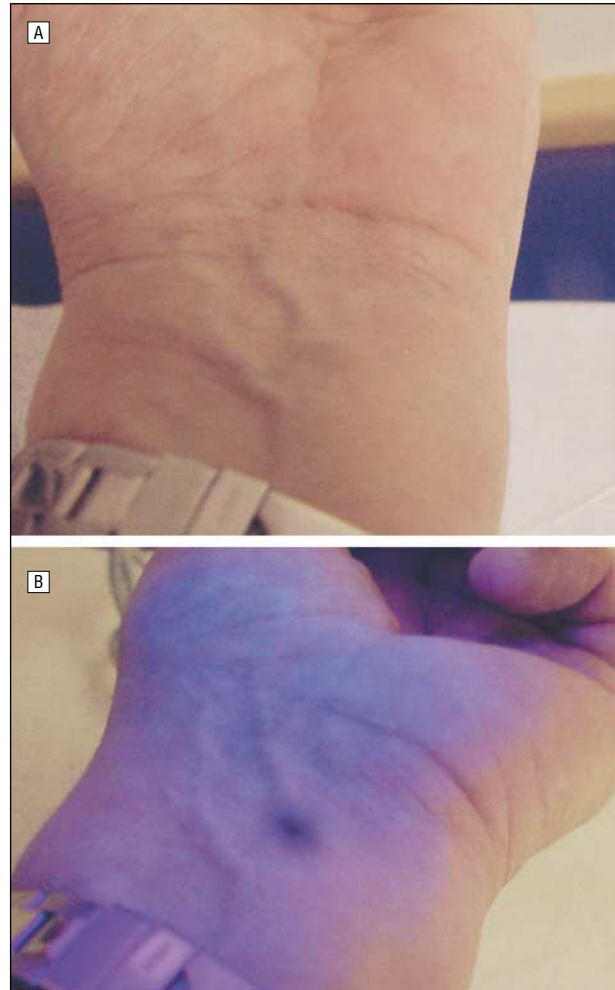
### RESULTS

#### Patient 1

A 6-month-old female infant rolled out of her grandmother's arms and struck her forehead on the beveled edge of a glass-topped table. The injury occurred approximately 1 hour prior to her presentation to the emergency department. Physical examination revealed a superficial laceration on the forehead with a small amount of surrounding ecchymosis (**Figure 2A**). More extensive bruising was demonstrated with digitally photographed Wood lamp illumination (**Figure 2B**).

#### Patient 2

A 7-month-old female infant was being carried down a flight of carpeted stairs by her 9-year-old sibling. The infant was facing her sibling, being supported by her buttocks, with her legs wrapped around the sibling's waist. At the third stair from the bottom, the older sibling slipped and fell backwards landing on her buttocks. After an intense bout of crying, the infant was noted to be fussier than usual with refusal to move her left leg. Radiographic examination revealed a nondisplaced buckle fracture of the left distal femur. Physical examination of the knee under normal lighting did not reveal any bruising (**Figure 3A**). A digitally photographed Wood lamp il-



**Figure 1.** View without (A) and with (B) Wood lamp illumination of a child's wrist showing a healed bruise resulting from closing the skin in the clasp of a watchband 10 days earlier.

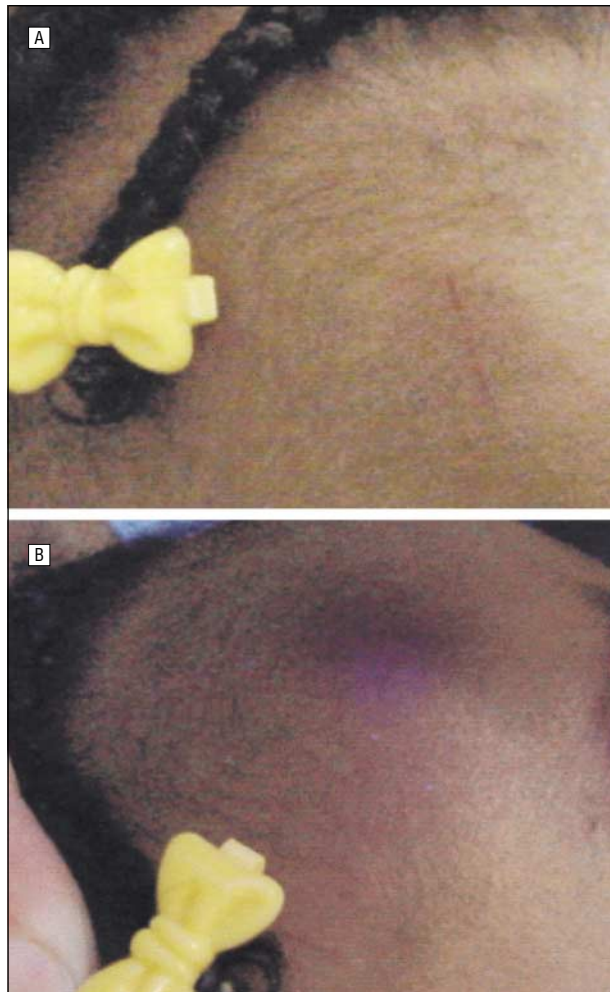
lumination demonstrated a linear bruise consistent with the described mechanism of injury (**Figure 3B**).

#### Patient 3

A 14-year-old boy was admitted to the hospital because of new-onset insulin-dependent diabetes mellitus. On physical examination, he was noted to have a very faint, yellow-brown ecchymosis overlying his left scapula (**Figure 4A**). He revealed that while attending military school approximately 2 weeks before, he had been bitten on the left part of his upper back. Wood lamp illumination revealed a pattern of bruises consistent with a human bite (**Figure 4B**).

### COMMENT

The evaluation of any injured child requires a thorough examination to define the extent of injury. Although preliminary, the aforementioned cases suggest that the use of digital imaging combined with Wood lamp illumination may provide clinicians with important information regarding the location and extent of subclinical bruising. For example, the demonstration of abdominal bruising

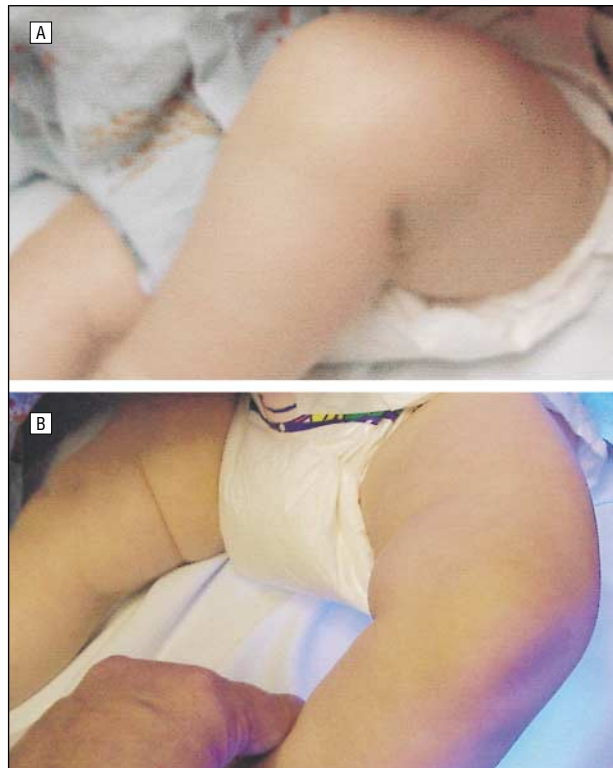


**Figure 2.** Patient 1. A, View without Wood lamp illumination of a superficial laceration on the forehead of a 6-month-old infant showing a small amount of surrounding ecchymosis. B, Under the illumination of a Wood lamp the same forehead laceration shows surrounding bruising.

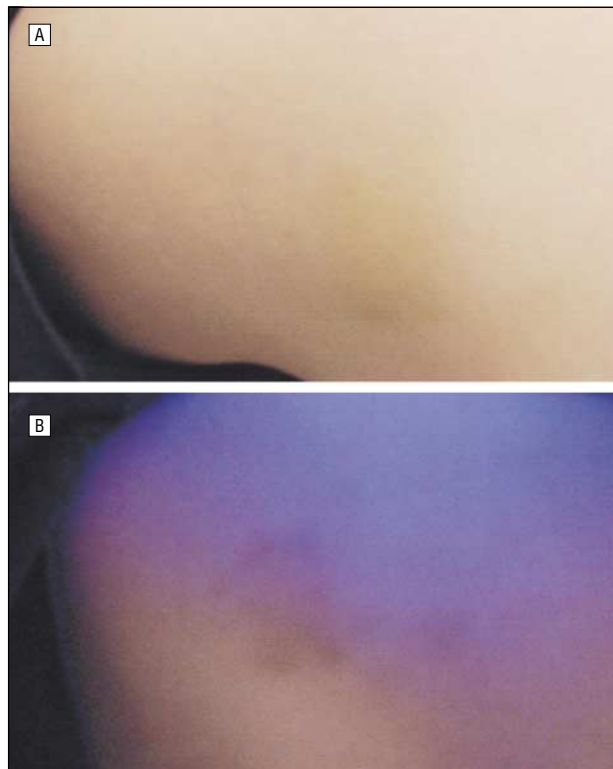
ing in a child presenting with head injury would guide the physician to order appropriate radiographic imaging studies to define the extent of injury to the intestine or solid organs.

Decisions about whether a given constellation of injuries is consistent with the explanation offered by caretakers is essential in determining the likelihood of inflicted vs noninflicted trauma. If the injury scenario described by a caretaker indicates that injuries occurred in a single plane, the demonstration of multiple points of contact in multiple planes raises the suspicion of abusive trauma. Just as important is the visualization of occult bruising that can add credence to the explanation of injury offered by caretakers allowing a more objective assessment of the injury event.

Further studies suggested by our preliminary work include histological correlations and serial Wood lamp illumination with reflective 35-mm UV photography. There is also the possibility that Wood lamp examination of infants who have suffered sudden unexplained death or an apparent life-threatening event may provide important clinical information.



**Figure 3.** Patient 2. View without (A) and with (B) Wood lamp illumination of the knee of a 7-month-old infant who sustained a nondisplaced buckle fracture of the left distal femur.



**Figure 4.** Patient 3. A, View without Wood lamp illumination of the left part of the upper back of a 14-year-old boy who had been bitten by another human. B, View of the same area under Wood lamp illumination showed a pattern of bruises consistent with a human bite.

### What This Study Adds

Forensic scientists have used alternative light sources to elucidate skin wounds that are not visible. Many of these techniques are limited in their application to pediatrics because of the requirement for specialized equipment and the need for subjects to remain still for prolonged periods. Our work describes the use of the ubiquitously available Wood lamp combined with digital photography so as to demonstrate subtle and subclinical bruises in children.

### CONCLUSIONS

Our brief experience demonstrates that the examination of the skin surface of injured children with Wood lamp illumination can permit enhanced visualization of soft tissue injury. The technique described permits visualization of bruises that are not otherwise visible and identification of faint bruises that were not noticed prior to the Wood lamp examination. The identification of these subclinical bruises may help guide clinicians in selecting laboratory evaluations and imaging studies in injured children. It may allow more complete comparison of the caretaker's accounts of injury scenarios with the child's clinical presentation. Further studies suggested by our preliminary work include histological correlations, observation of bruises over time, and correlation with techniques such as reflective UV and infrared photographic techniques

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### IN OTHER AMA JOURNALS

#### ARCHIVES OF OPHTHALMOLOGY

#### A Randomized Trial of Atropine vs Patching for Treatment of Moderate Amblyopia in Children

*The Pediatric Eye Disease Investigator Group*

**Objective:** To compare patching and atropine as treatments for moderate amblyopia in children younger than 7 years.

**Methods:** In a randomized clinical trial, 419 children younger than 7 years with amblyopia and visual acuity in the range of 20/40 to 20/100 were assigned to receive either patching or atropine at 47 clinical sites.

**Main Outcome Measure:** Visual acuity in the amblyopic eye and sound eye after 6 months.

**Results:** Visual acuity in the amblyopic eye improved in both groups (improvement from baseline to 6 months was 3.16 lines in the patching group and 2.84 lines in the atropine group). Improvement was initially faster in the patching group, but after 6 months, the difference in visual acuity between treatment groups was small and clinically inconsequential (mean difference at 6 months, 0.034 logMAR units; 95% confidence interval, 0.005-0.064 logMAR units). The 6-month acuity was 20/30 or better in the amblyopic eye and/or improved from baseline by 3 or more lines in 79% of the patching group and 74% of the atropine group. Both treatments were well tolerated, although atropine had a slightly higher degree of acceptability on a parental questionnaire. More patients in the atropine group than in the patching group had reduced acuity in the sound eye at 6 months, but this did not persist with further follow-up.

**Conclusion:** Atropine and patching produce improvement of similar magnitude, and both are appropriate modalities for the initial treatment of moderate amblyopia in children aged 3 to less than 7 years. (2002;120:268-278)

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