

UV/IR Contusion Enhancement

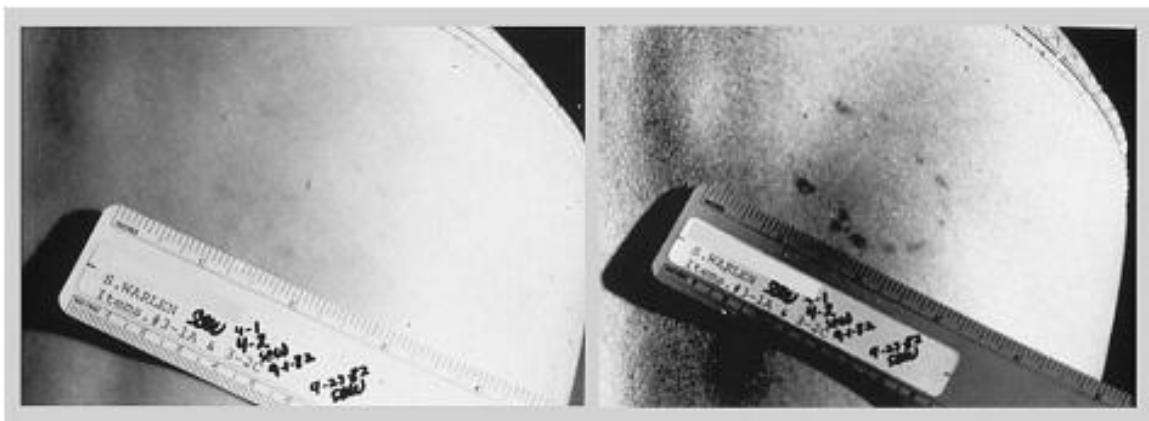
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Take this material for whatever you think it might be worth.

I've followed the progress of several recent surgeries leaving significant post-op bruises and a bruising fall from a ladder that collapsed under me. While I occasionally spotted small unexpected bruises acquired from over-enthusiastic encounters with a playful poodle, I never once managed to detect an expected latent bruise after the visible discoloration faded.

The absence of UV/IR enhanced contusions does not prove that abuse did not occur. The presence of latent discolorations suggestive of bruising does not prove that abuse did occur, absent supporting medical testimony and statements from credible witnesses who can tell their story on the stand when confronted on cross by an experienced trial lawyer.

See <http://www.crime-scene-investigator.net/uvchildphoto.html>. Although written during the film era, Detective Cochran's advice is still relevant during the digital era.



These pictures, courtesy Stephen Warlen from an article on *Reflected UV for Forensic Imaging Applications* by Dr. Austin Richards, were taken on September 1st, 1982, using B&W film.

The bite mark appears to be completely healed in the white light photo on the left. The photo on the right taken with reflected ultraviolet clearly shows the bite mark left by the assailant *after an interval of five months*.

Photographing visible injuries is not difficult. A good point and shoot will probably suffice. The newer cameras are usually pretty good, be the subject friends and family members or victims of domestic violence.

For critical work, I suggest a DSLR with an external flash and a diffusion dome tilted at 45° to minimize reflections.

A prosecutor of my acquaintance suggests that victims of alleged past domestic violence, a term encompassing child, spouse and elder abuse, should be examined and the injuries documented by a board-certified forensic pathologist or forensic orthodontist. Her logic is impeccable:

- Domestic violence cases frequently involve a long list of agencies from social services to prosecutors and defense attorneys, each with their own opinions and agenda.
- Healed and partially healed fractures may be more revealing than latent contusions, requiring x-rays taken under medical supervision.
- The average cop might have a two year associate degree in criminal justice and X weeks of P.O.S.T. training.
- The average forensic pathologist has a four year undergraduate degree, a four year post-graduate degree, four years of residency in pathology, a final year of residency in forensic pathology and membership the National Association of Medical Examiners.
- Using UV and IR photography to reveal injuries that cannot be seen under white light or in x-rays will likely require opinion testimony from witnesses who can be certified as experts.
- If the defendant can afford to hire competent counsel and their experts, a police photographer might have credibility problems.

Read Dr. Ed Friedlander's article on False Allegations of Child Abuse at <http://www.pathguy.com/abuse.htm>.

However, having first satisfied all administrative, medical and legal requirements, let's assume that you are assigned to photograph a victim of alleged

domestic violence with injuries from past incidents that have faded to the point that they are not distinct enough to demonstrate the severity of the original injuries to skeptical jurors, that being the object of the drill.

You'll want a DSLR with Live View and good ultraviolet sensitivity, a Tiffen 15 barrier filter, a lens for white light views, a manual focus macro (telephoto preferred) with good UV characteristics and an IR focusing mark, 365, 395 and 420 nm light sources, a tripod, a pair of yellow goggles for yourself, a pair of protective UV goggles for the subject and any witnesses who might be present, and a flash for white light photographs.

If you wish to be thorough, you'll need a second camera modified for infrared such as a full spectrum conversion on a high quality DSLR modified by an outfit like <http://www.lifepixel.com>. Your IR camera should be similar to your main camera, accepting the same lenses and accessories.

You will need a suitable room, preferably in a clinical setting, with a juvenile's parents and/or a victim's rights representative from the prosecutor's office in attendance. You will be shooting with the lights either dimmed or completely out so a curtained cubicle is not the best choice.

You will also need a selection of scales, including six inch and #2 ABFO. You might want them in various colors as required to enhance contrast against the subject's skin. Scales can be affixed to the skin by doubling a small length of surgical tape.

A 395 nm light source works well on Caucasians. Robert Cheeseman suggests a 420 nm light source for African Americans. 420 nm is not a common option. The closest match on a portable light might be the 405 nm filter from aelight.com for their Xenide HID lights.

A high intensity lamp might be too much of a good thing for medical imaging. Ultraviolet is the component in sunlight responsible for sunburns. Powerful UV lights can give you a nasty burn, hence the need for protective goggles for the subject and extra care when infants are involved.

The Xenide AEX-25 has most of the filters that you'll need but this is a very powerful light, as are multi-wavelength laboratory instruments. If in doubt, test on a fair-skinned volunteer ahead of time.

You would be well-advised to conduct a series of exposure tests on Caucasian, African-Americans and Hispanics. Conducting exposure tests will avoid the need for a series of test shots in front of the victim and assorted witnesses, all impatient if not emotional and/or hyper-critical.

You may find that flash with good output in the UV portion of the spectrum works better than a continuous light source. Unfortunately, many of today's flash units have flash tubes with an anti-UV coating.

Try the camera that you've got. If it doesn't work, you may be obliged to have a camera converted to UV/IR Plus Visible at Life Pixel or invest in a lens with better UV transmission characteristics. This might be an older manual focus lens with a simple optical design and minimal UV coatings.

If you resort to an older manual focus lens, you need a camera such as one of the newer Nikons, D7000 or better, that will let you focus and meter with a manual focus lens.

If your flash doesn't work, consider Quantum. Quantum sells replacement flash tubes without UV coatings.

Your standard zoom will suffice for overall views to establish the subject's general condition. An f/2.8 macro, 60 mm for APS-C cameras and 105 mm for full frame cameras will make it easier to focus in subdued light and provide sharp pictures without intruding on the subject's personal space. Consider a manual focus macro, available new from Nikon and Zeiss.

Once you've sorted out your hardware, examine the site of the suspected injury under a strong white light such as 6,500K LED tactical flashlight or a Solux lamp with a high color rendering index. See <http://www.solux.net> for details.

Injuries that are not visible in room light might show up under a strong white light. If you don't have a Solux lamp, you can always buy a Solux bulb with an Edison screw base and stick it in a clamp-on reflector.

I've seen Solux floor lamps in doctor's examination rooms but I would not trust the Woods lights that you might find in a dermatologist's office.

The spec sheet for Woods lights that I've checked merely state that the output is UVA - near ultraviolet - without specifying the exact wavelength in nanometers or the bell curve above and below the midpoint.

You have no way to know the color temperature or the color rendering index of room fluorescents. Many fluorescents are deficient in certain portions of the spectrum. Thus, you may not be seeing all of the detail that is there to be seen if you take existing room lights for granted.

After completing a white light examination, take overall views of the subject to show his or her general condition and closeups of the area of the suspected injuries with the flash positioned to avoid reflections. Flash will ensure more accurate color than ambient room light. Take one photo with a gray card so that a Photoshop operator to dial in accurate color balance, if necessary.

Next, examine the site of the suspected injury with a 395 nm source and again with a 420 nm source in subdued light. Melanin and hemoglobin do not fluoresce. Rather, they absorb ultraviolet.

If you see something that you couldn't see with white light, you're seeing reflected ultraviolet at the very edge of the visible spectrum. This is easy to see and easy to photograph with a standard camera. Try it with and without yellow safety glasses and a Tiffen 15 filter.

The final step, if you have a 365 nm light source, is to photograph the suspected site of the injuries through a Peca 900 or a B&W 403 bandpass filter blocking all visible light. The exact setup will depend on the power of your UV light versus the sensitivity of your camera and the performance of your lens.

Some sources recommend reflected infrared if UV results are unsatisfactory. This requires an IR-modified camera, a Peca 904 or a B&W 093 filter, an 850 nm light source and a lens with an IR focusing mark.

You may have to focus in white light and transfer the setting to the IR focusing mark, found only on fixed focal length lenses.

If you're fortunate enough to have a newer IR-modified camera with Live View, you may be able to save time using Live View to focus.

Take a test shot or two and use your LCD to see what you've got and verify focus and composition. Use your thumbnails and histogram to verify exposure. Look for injuries beyond the expected site. Keep shooting until you get it right.

Go to <http://gbforensicservices.com/bitemarks.html>. Read the ABFO bite mark guidelines. You may not be ready to deal with medical imaging if this document is confusing.

Using UV and IR imaging to document evidence of violence invisible to the naked eye is pretty much a self-taught proposition, if only because it would be rare to find two practitioners using the same equipment. Unless you can find players in one of the rougher contact sports to practice on, you have no way of finding subject likely to have latent contusions on which to practice.

You can try slapping your own forearm but, even if you manage to do it hard enough, this is a fresh injury, not a latent bruise old enough to be construed as a sign of past violence.

Needless to say, do not ask the victim to remove any articles of clothing that are not required to expose the site of an possible injury.

Also needless to say, make sure that all required releases are signed in advance in front of credible witnesses.

Caveat: It seems that there is never a board-certified forensic pathologist or a board-certified forensic orthodontist around when you want one. Consequently, despite advice to the contrary, you might find yourself confronted with the need to examine an alleged victim of domestic violence for latent bruises and bite marks. To accomplish this, you're going to need an IR-modified camera, barrier filters and light sources rarely carried by the average CSI.