

## FORENSIC PHOTOGRAPHY: A REVIEW

Vinod Sargaiyan, \* Deepti Bharddwaj, \*\* Pooja Singh, \*\*\*  
Rahul Sharma, † Sana Noor Siddiqui, †† Sateesh Bhatele †††

\* Senior Lecture, Department of Oral Pathology, Maharana Pratap College of Dentistry & RC, Gwalior, India

\*\* Senior Lecture, Department of Oral Medicine and Radiology, Maharana Pratap College of Dentistry & RC, Gwalior, India

\*\*\* Senior Lecture, Department of Oral Medicine and Radiology, Maharana Pratap College of Dentistry & RC, Gwalior, India

† Post Graduate Student, Department of Oral Medicine and Radiology, Maharana Pratap College of Dentistry & RC, Gwalior, India

†† Senior Lecture, Department of Oral Medicine and Radiology, Peoples College of Dental Sciences and Rc, Bhopal, Madhya Pradesh, India

††† Post Graduate Student, Department of Oral and Maxillofacial Surgery, SGT Dental College and Hospital & RC, Gurgaon, Haryana, India

### ABSTRACT

Forensic photography is the art of producing an accurate reproduction of the scene of a crime or an accident to aid in investigation and presentation of evidence during the legal process. It provides investigators with photos of victims, places and items involved in a crime or accident. Forensic photography often represents the best method to collect and preserve evidence in forensic odontology cases and is especially utilized for measurement of craniofacial dimensions, teeth arch morphology which include bite marks and dental restorations. Photography of this kind involves choosing correct lighting, accurate angling of lenses, and a collection of different viewpoints. Scale-like items for length measurement. Advances in photographic equipments and aids and especially digital photography along with photo softwares have enabled more accurate presentation and utilization of data in a crime or accident scene. This article discusses the types of photographic evidence and the specific techniques utilized in full spectrum forensic digital photography.

**KEYWORDS:** Forensic photography; forensic sciences; bite marks

### INTRODUCTION

Forensic photography regularly represents the paramount method to collect and preserve evidence in forensic cases including forensic odontology. Modern technology enables the investigator to obtain photographs using wavelengths of the light spectrum that are normally obscured from vision. The use of ALI,

UV, normal, and IR light source photography for the documentation of the examination, latent fingerprinting processing, detection of semen and bloodstains, trace wound pattern detection, teeth restorations, and bite mark documentation has opened a new frontier for forensic science.<sup>[1]</sup>

#### Need for the Forensic Photography

The need to photographically record injury patterns as they appear on skin is paramount to the odontologist and pathologist. Since vast amounts of time often elapse between the commission of a crime and the trial of the perpetrator, photographs frequently are the only permanent record of the injuries to the victims. Therefore, it is imperative that the forensic investigator be able to properly photograph injury patterns as a means of preserving such evidence. Photography is one of the most important applied protocols of forensic dentistry. The demands on the photographer can be great, especially in situations where an injury is the only evidence tying a suspect to the crime. Time, patience and preparation in forensic photography are requirements for successful pattern injury documentation. While often frustrating and time consuming, when done properly the results yield good evidence, bringing with it a sense of accomplishment and satisfaction that the forensic dentist has made a significant contribution to the case. Developing the skills necessary to competently document these injuries with visible and non visible light is one of the great challenges in forensic dentistry.<sup>[1]</sup>

#### Different Types of Techniques:

When presented with an injury, the forensic dentist or investigator must decide

1. What information the injury may contain.

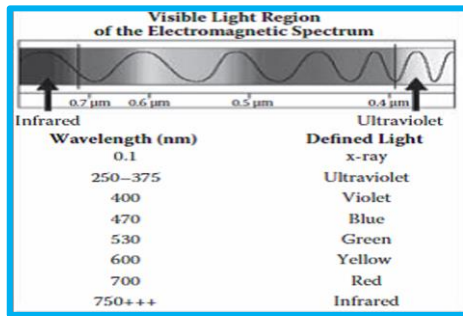


Fig. 1: Spectrum of Electromagnetic Radiation

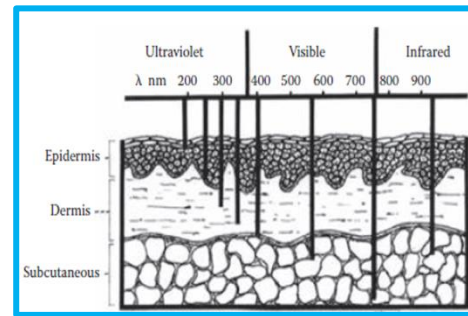


Fig. 2: Levels of light penetration into skin when illuminated by varying wavelength

- 2.The extent of the injury, and
  - 3.How best to photographically record it.
- Preserving the detail of the injury with photographs may involve a combination of color and black & white visible photographs as well as the use of the non-visible ultraviolet and infrared photographs.

#### The Standard Technique

The photographer should develop a standard technique which includes orientation photographs showing where the injury occurred on the body. Additionally, this protocol should include close-up photographs, placing the lighting source at different angles in relation to the injury. Photographs should be taken with and without a scale. The use of a scale serves as a reference to record the relative size of the injuries in the photographs. While there are a number of acceptable scales, including coins, when unavailability of appropriate scales occurs, many forensic investigators use the ABFO No.2 scale in their photographs. This right-angled scale was developed by a photogrammetrist (Mr. William Hyzer) and a forensic dentist (Dr. Thomas Krauss) for the purpose of minimizing photographic distortion and assuring accuracy in measurement. It has a black, white, and gray scale for color correctness, as well as three perfect circles and metric scales. The photographer should retain the original scale used in the photograph in the event enlargement to life-sized reproductions becomes necessary. It is essential that the standard technique developed by the forensic photographer includes exposing many photographs for each case. One should not be hesitant about using several rolls of film for a photo shoot.<sup>[2]</sup>

#### Forensic Dental Photography: Types & Technique

Various types of photographic technique are available today in order to cater the different need arising out of different situations. Some of these technique are used routinely, easier to perform and a mere more standardized adaptation to what we use in our day to day life, while others are more complex, requiring a thorough knowledge of optics and its principles, along with the advanced knowledge of various kind of camera systems, lens properties, and the processing techniques. In this part of the chapter, described first will be the simpler technique followed by the more complex other techniques. Following is the list of various techniques that are used in forensic photography:

##### I. Visible light photography

1. Digital photography
2. Visible light color photography
3. Visible light black and white photography.

##### II. Alternate light imaging (ALI) and fluorescent techniques

##### III. Non-visible light photography.

1. Reflective long-wavelength ultraviolet (UVA) photography
2. Infrared photography.

##### I. Visible light photography

By far, the most common type of photography utilized today is photography using visible light, both in color and black and white. Manufacturers of photographic equipment and films develop and market equipment and supplies that are specifically designed to have an optimal performance in the 400- to 760-nm range of the electromagnetic spectrum. For the photographer wishing to take pictures in this range of light energy, there is relatively little practice required to ensure highly detailed and sharply focused photographs.<sup>[2]</sup>

## 2. Visible Light Color Photography

Advancements in design and manufacture of modern 35-mm cameras have greatly simplified color photography. These cameras have the capability to photograph objects with great accuracy and precise color detail. As discussed previously, the lenses have coatings and the flash units are filtered to direct only visible light to the film. Modern films record the images in brilliant colors and sharp detail. The most critical variables to consider when taking still photographs in color are (1) the type of the film and (2) the intensity of the light present when the film is exposed. Color visible light photography is by far the most common type of photography used today. Modern cameras readily available today are manufactured and configured to take photographs using visible light. There are generally no special requirements or equipment needs assuming there is enough visible light energy available to properly record the image on the film. When choosing the type of film, use the lowest speed film possible for the lighting available and proceed to take orientation exposures, gradually moving to the specific site of the injury. With routine color slide or print film illuminated by flash, a film of ASA 100 is generally adequate for close-up photography. Use the standard technique to completely record all aspects of the injury on color film. To insure color accuracy, it would be helpful to include a color correction guide in one or more of the exposures. One popular color correction guide is the Macbeth Color Chart, which is available in camera shops. Use of this guide will allow the film processing lab to correct the color temperature of the negative to the real color composition of the image before printing the photograph. Present the color guide used in the photographic session to the processing lab when dropping off the film for developing and ask that they verify the color composition of the image photographed before printing.<sup>[3]</sup>

## 3. Visible Light Black and White Photography

Changing from color film to black and white film, the forensic photographer proceeds to re-photograph the injury. Use the same orientation and standard technique that was used when the color photographs were taken. In order to simplify this process, many photographers maintain two complete camera systems, with

interchangeable bodies; one loaded with color film, the other with black and white. It may seem redundant to rerecord the injury with black and white photographs when color photographs of the same injury were just taken or is it? Remember that the human eye is very adept at seeing images in color. Because of the color information processed optically by the retina, other important details of the injury may be overlooked. When the injury is photographed in black and white, the eye is not distracted by the color composition of the injury and the normal surrounding areas. Consequently, this absence of color allows the viewer to see more detail in the injury. When exposing film for black and white photographs, the same criteria for exposing color photographs are followed. These include film selection, bracketing, lighting, orientation, and close-up exposures, both with and without a scale. One cannot take too many photographs. In many situations there may only be one chance for photographs. If that is the case, take a minimum of three or four rolls of black and white and color photographs, bracketed widely, and illuminated from different angles.<sup>[3]</sup>

## II. Alternate Light Imaging (ALI) and Fluorescent Techniques

The field of forensic investigation has seen a tremendous growth in the utilization of alternate light imaging for both locating and photographing latent evidence. Fingerprints, serological fluids left behind at a crime scene (blood, semen, saliva), types of ink used to counterfeit or falsify documents, and bruises or other pattern injuries left on human skin that were sustained during violent crimes can now be more easily detected and also transformed into exciting and important exhibits with the utilization of fluorescence. The application of this new technique has numerous titles. For simplicity, here it will be referred to as Alternate Light Imaging (ALI). The technique of photographing evidence with alternate light is called fluorescent photography.

**Fluorescence:** It is the stimulation and emission of radiation from a subject by the impact of higher energy radiation upon it.

**Luminescence:** It is a general term for the emission of radiation that incorporates both fluorescence and phosphorescence, as well as other electro-chemical phenomena like bioluminescence.

### III. Non-visible Light Photography

The photographic requirements for recording injuries on film using non visible light become somewhat more complex. The appearance of the injury using non visible light illumination cannot be seen by the naked eye. Therefore, special techniques must be employed to record the injury on film and then print the image on photographic paper for viewing in visible light. Just as in ALI, these techniques require that band-pass filters be used. They are placed between the injury and the film, usually in front of the lens of the camera. The filters allow *only* the selected wavelengths of light to pass to the film. It is important that several factors be considered when attempting to photograph injuries in non visible light: First, one must consider the type of film being used. The film's photo emulsion must be sensitive to the light wavelength the filter is allowing it to "see". Additionally, the light source must be strong enough to expose the film. The camera's exposure settings (*f*-stop and shutter speeds) must be set to properly bracket for the type of light being used. The camera's ASA/ISO value must be correctly set for the film being used, and the lens must be focused correctly for the type of nonvisible radiation being used. It will take some experimentation with any camera to find the optimal settings. The forensic photographer, as a rule, will practice using his/her camera and establishing techniques before photographing actual cases. Suggestions of basic starting points are given. Keep in mind that each camera is slightly different and these starting points may not work for every camera. There are two major problems encountered with non-visible light photography. First, it is difficult to acquire a predictable light source that emits enough of the desired wavelength to adequately illuminate the injury being photographed. Second, the exact amount of focal shift to produce a sharp photograph must be determined. Developing confidence and getting predictable results in non visible light photography will require some trial and error. Bite mark located on deceased victim's abdomen using normal full-flash photography experimentation. Available and predictable sources of non visible lighting are listed below for both ultraviolet and infrared photography. This list is by no means totally inclusive and is intended to be a potential resource list. It is

possible to find other sources of adequate non visible light than those listed here.

#### Ultraviolet (UV) light sources

- **Sun Light:** A good source of long UV light but not practical for situations requiring indoor or nighttime exposures.

- **Fluorescent tubes:** Routinely used for indoor lighting; some useful UV emission. The best of these types of lights is known as a "black light", which emits good UV radiation; the brighter the better. Black-and-white view of abdominal bite mark exposed with full spectrum room light. Same bite mark using forensic light source at low-angle incident lighting. Note improved visualization of separations (striations) between teeth.

- **Mercury vapor lights:** Particularly useful in lighting small areas with intense UV light. Problems include long warm-up time for the light and limited availability.

- **Flash units:** Many older units provide adequate UV light emission. Some newer units emit a measurable amount of UV but will require experimentation to determine the correct output.

- **Combination fluorescent/black light:** This light combines the emission of the two light sources in one light fixture; commonly known as a Wood's lamp.

#### Infrared (IR) Light Sources

- **Flash Units:** Most commercial flash units emit sufficient IR light to be adequate, but require experimentation to determine their acceptability in infrared photography. Same bite mark with forensic light source at a 90° angle to surface of the injury. Note measurable and visible dimensions of lower incisors.

- **Tungsten Lamps:** Used routinely in forensic investigations. The brighter the Kelvin value, generally the more IR output.

- **Quartz-halogen lamps:** Good source of IR radiation if unfiltered; more readily available and easy to use.

#### 1. Reflective Long-Wavelength Ultraviolet (UVA) Photography

Ultraviolet photography is used by the forensic photographer primarily for two reasons: the first is to increase the observed detail of the surface of the injury. The second reason is to recapture an injury on film after the injury has "healed" and is no longer visible to the human eye. This second use occurs because ultraviolet light is strongly

absorbed by pigment in the skin. Any area of the injury having excess pigmentation when compared to the surrounding normal tissue will be recorded with excellent results using reflective ultraviolet photography. The techniques for photography using reflective ultraviolet photography work to enhance surface detail. Ultraviolet light does not appreciably penetrate the surface of skin, so photographs are taken using lower numbered *f*-stops that do not have too much depth of field at the focused distance. Bracketing exposures sequentially from *f*-4.5 to *f*-11, at shutter speeds of 1/125 to 2 s for each *f*-stop with the Kodak Wratten 18A band-pass filter in front of the lens should be included in the standard.<sup>[4]</sup>

## 2. Infrared Photography

Just as in reflective UV photography, infrared photography also requires special techniques. The infrared band of light is at the opposite end of the light spectrum from the ultraviolet band. Ultraviolet light is about one half of the wave length of infrared light. Because infrared is longer it penetrates up to 3 mm below the surface of the skin. Since the depth of the injury recorded with the infrared technique is below the surface, the infrared focus point will not be the same as the visible focus point. Just as in UV photography, some allowance must be made for the differences in these focus points. After obtaining a through-the-lens focus, the lens must be moved slightly away from the injury.

### Handling of Photographic Evidence

The photographs documenting a victim's injuries may become part of the legal system and, as such, are subject to chain of evidence rules. This requires an accountability as to what individuals had possession of the evidence from the time it was collected until it is marked and introduced into the legal system. As part of the standard technique, the forensic photographer should routinely mark each photograph with a categorizing system, usually consisting of numbers or letters which include the case number, as well as an identifying mark of the forensic photographer. This can be his or her initials or a signature, so that the photographs can be identified as originals and the chain of evidence maintained. It is strongly suggested that the forensic photographer not part with the original negatives. Under no circumstances should both

the negatives and prints be out of the possession of the photographer. If through carelessness they became "lost", there could potentially be no photographic evidence of the injuries and no way to recover from the mistake.

## CONCLUSION

Photography is one of the most important applied protocols of forensic dentistry. The demands on the photographer can be great, especially in situations where an injury is the only evidence tying a suspect to the crime. Time, patience, and preparation in forensic photography are requirements for successful pattern injury documentation. While often frustrating and time consuming, when done properly the results yield good evidence, bringing with it a sense of accomplishment and satisfaction that the forensic dentist has made a significant contribution to the case. Developing the skills necessary to competently document these injuries with visible and non-visible light is one of the great challenges in forensic dentistry.

## CONFLICT OF INTEREST & SOURCE OF FUNDING

The author declares that there is no source of funding and there is no conflict of interest among all authors.

## BIBLIOGRAPHY

1. Wright FD, Golden GS. The use of full spectrum digital photography for evidence collection and preservation in cases involving Forensic odontology. *For Sci Int* 2010;201(1-3):59-67.
2. Friar JA, West MH, Davies JE. A new film for ultraviolet photography. *J Forensic Sci* 1989;34(1):234-8.
3. Williams A.R, Williams GF. The invisible image - a tutorial on photography with invisible radiation. Introduction and reflected ultraviolet techniques. *J Biol Photogr* 1993;61(4):119.
4. Williams AR, Williams GF. The invisible image - a tutorial on photography with invisible radiation II. Fluorescence photography. *J Biol Photogr* 1994;62(1):4.
5. Ultraviolet & Fluorescence Photography, Kodak Publ. M-27; Eastman Kodak Co. Rochester, NY, 1972, pgs. 6-7.
6. Golden G. Use of alternative light source illumination in bite mark photography. *J Forensic Sci* 1994;39(3).

7. Medical Infrared Photography; Kodak Publ. N-1, Eastman Kodak Co., Rochester, NY, 1973;p. 26-27.
8. Ray B. Use of Alternate Light Sources for Detection of Body Fluids, South western Assoc. Forensic Sci J 1992;(14):30.
9. Nieuwenhuis G. Lens focus shift for reflected ultraviolet and infrared photography. J Biol Photogr 1991:19.
10. Robbins SL, Angell M, Kumar V. Inflammation and repair; Basic Pathology 3rd ed.; W.B. Saunders, Philadelphia, 1981; 28.