

Illustrated Fundamentals of Forensic Photographic Documentation

A guide to avoiding the most common photographic errors

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Introduction

Only photographic documentation makes it possible to form one's own picture, in the truest sense of the word, of findings that one has not seen personally.

"As an expert, one can render valuable services even with the simplest equipment, if one applies oneself in this direction with some skill and diligence." As early as 1930, Anton Werkgartner used this statement to point out that it is not solely the technical quality of the available photographic equipment that is decisive for the correct documentation of findings. To be able to document findings exactly and comprehensibly in high technical quality, the acquisition of basic photographic knowledge in combination with familiarization with the operating structure of one's own camera and, above all, the implementation of the existing procedural guidelines is crucial.

For the autopsy setting, Otto Busse demanded in 1917, "One must ensure the greatest possible cleanliness, and make sure that the table, the body, and also the hands are always clean." Particular attention should therefore be paid to aesthetic image composition, especially when documenting findings obtained during autopsy. In contrast to the "crime scene photograph," the choice of subject and the image composition for autopsy findings can be actively shaped by the photographer and the pathologist to depict the finding to be presented as optimally as possible.

The Most Important Technical Fundamentals of Photography

Correct exposure results from the mutually influencing interaction of aperture, exposure time, and the sensitivity of the image sensor.

If one of the parameters mentioned is changed by one full unit, this means a doubling or halving of the light value and requires a corresponding adjustment of one of the other two parameters.

The aperture controls the amount of light that can fall on the image sensor. A large aperture opening, meaning a small aperture number, allows a large amount of light to fall on the image sensor and provides only a shallow depth of field. A small aperture opening, meaning a large aperture number, allows little light to fall on the image sensor but provides a large depth of field.



Large aperture opening (e.g. f/2.8) with shallow depth of field



Small aperture opening (e.g. f/22) with large depth of field

As a general rule, the depth of field extends one third in front of and two thirds behind the plane that has been brought into focus.

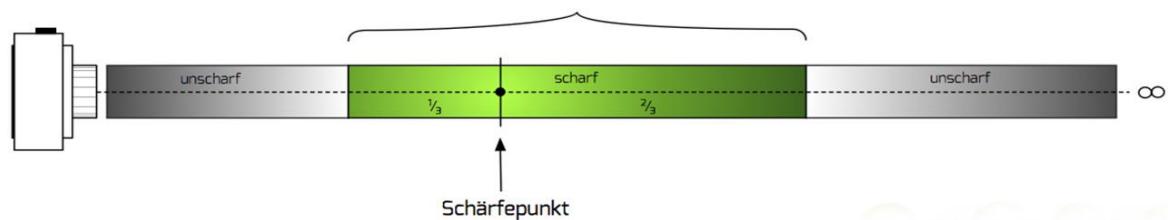


Image Translation:

- unscharf = unsharp
- scharf = sharp
- Schärfepunkt = focal point

The exposure time controls the period during which light can fall on the sensor. As a rough rule of thumb for blur-free handheld shots, the exposure time should be shorter than the reciprocal of the focal length used.

For example: Wide-angle focal length 24 mm = max. 1/30s exposure time

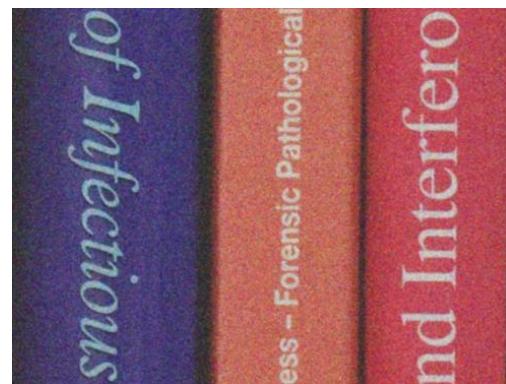
Standard focal length 50 mm = max. 1/60s exposure time

Attention: Image stabilizers that allow longer exposure times for handheld photography in some camera models and lenses are only suitable for static subjects.

The light sensitivity of the image sensor, which is specified in ISO values, determines how much light is required by the sensor at all to produce a correctly exposed image.



ISO 100



e.g. ISO 25.600

With increasing light sensitivity of the image sensor (setting higher ISO values), image quality decreases, as can be seen in the example images. Increasing image noise is accompanied by a loss of detail, contrast, and sharpness. Therefore, the lowest possible ISO values should be used.

Camera Technology, Accessories and Settings

Since image quality with regard to detail resolution and noise behavior is, among other things, significantly determined by the size and structure of the camera sensor, currently only system cameras equipped with correspondingly large sensors (APS-C and full-frame) should be used. Compact cameras, which are limited in this respect by their design alone, or cameras integrated into mobile phones, should preferably only be used in exceptional cases.

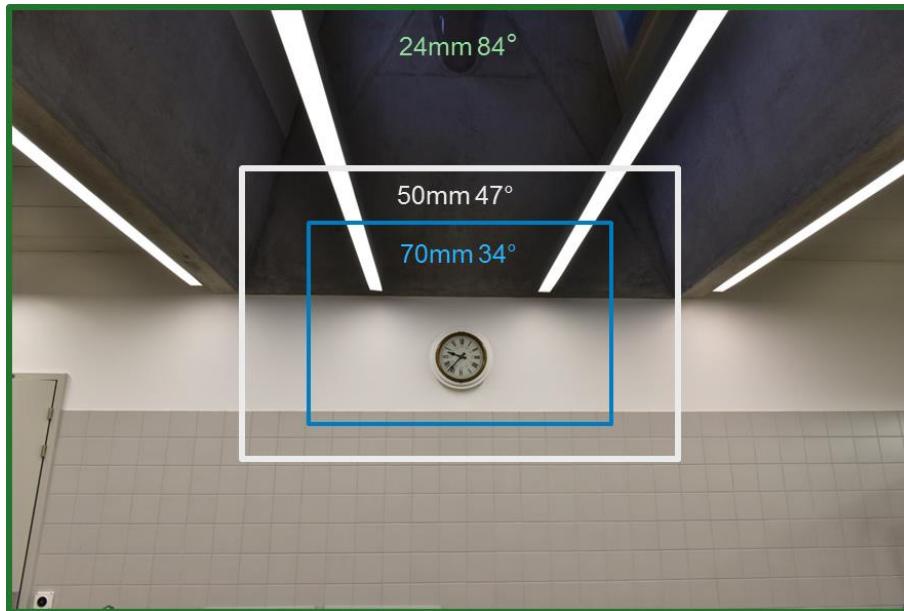


Resolution and detail rendering with a relatively large image sensor (23.6 x 15.7 mm) at 100% view



Resolution and detailed rendering with a relatively small image sensor (7,6 x 5,7 mm) at 100% view

The lens or lenses should cover the wide-angle range for overview shots (< 40 mm), the standard range (40–60 mm), and the macro focal lengths for close-up shots.

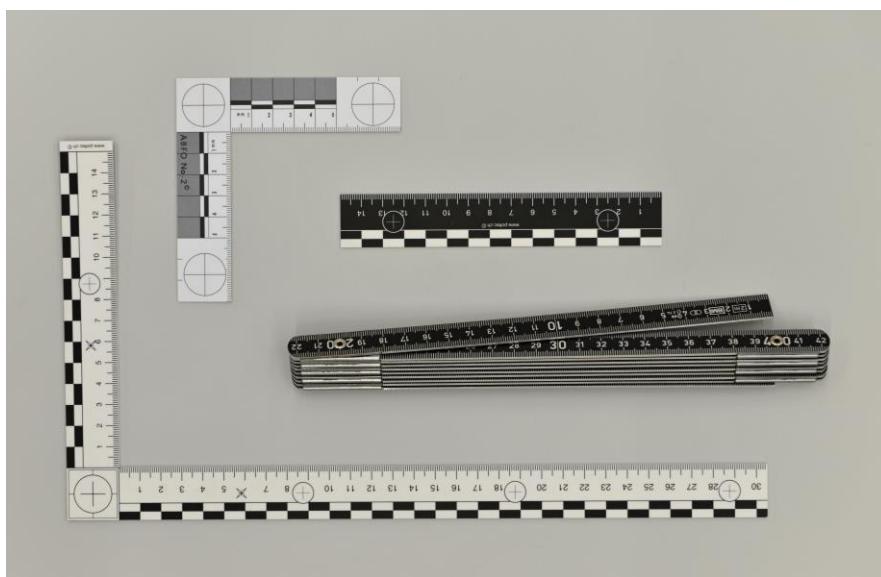


Example illustration of the different image sections and angles of view: a wide-angle focal length with 24 mm and 84°, a standard focal length with 50 mm and 47°, and a short telephoto focal length with 70 mm and 34°

For the use of different flash techniques, a compatible external flash unit with a swivel and tilt reflector is recommended.

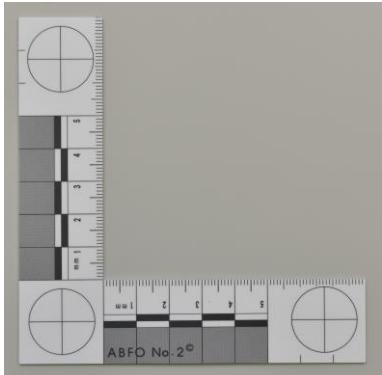
Due to the wide variety of available cameras and optics, no further statement or recommendation regarding camera technology can be made at this point.

Regardless of the available camera or photographic equipment, carrying and using a scale and/or an angle gauge for the exact determination of the size of a finding is essential. A version with a low-reflective matte surface is advisable.

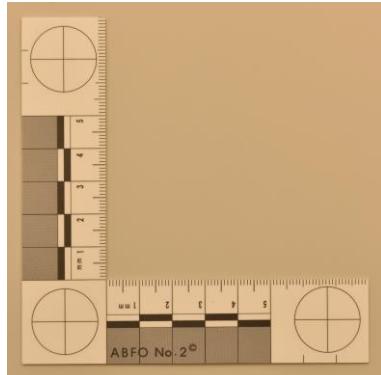


Example of scales and angle gauges

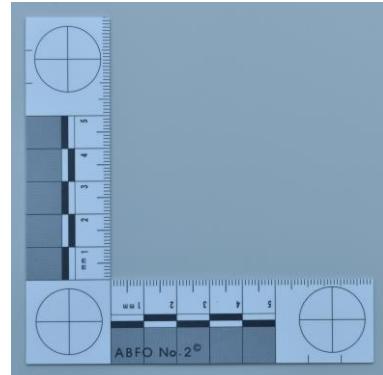
A distinct white area and/or a color control scale allows a quick check of the accuracy of the automatic white balance (WB) and thus the color fidelity of the images.



*Correct white balance (WB)
correct color temperature*



*WB error with yellow tint
too warm color temperature*



*WB error with blue tint
too cool color temperature*

In most image shooting situations, automatic white balance will provide sufficiently correct results.

Remedies if the colors appear unnatural:

- Use or activate the flash unit
- Consciously select white balance presets, e.g. for daylight or artificial light
- Manually set the white balance and use your own measured value

Image Quality, Composition, and the Avoidance of the Most Common Imaging Errors

1. Perspective und camera position

To avoid perspective-related imaging errors, such as image distortion, it is essential, as far as possible, to align the camera perpendicular to the finding. A fold-out or tiltable camera display is helpful for this purpose.



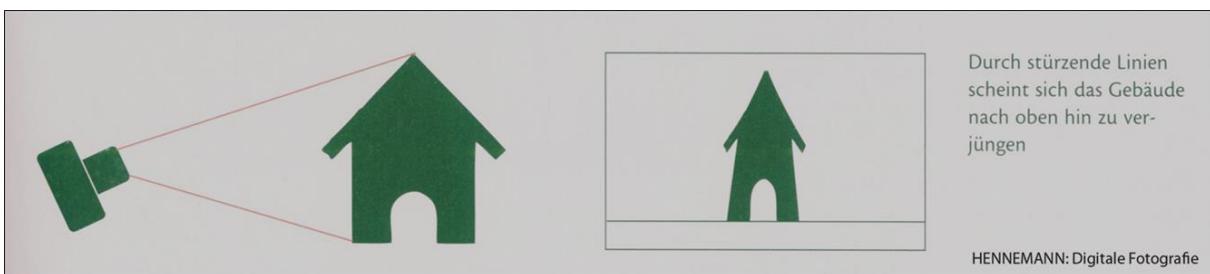
Worm's Eye View



Central Perspective

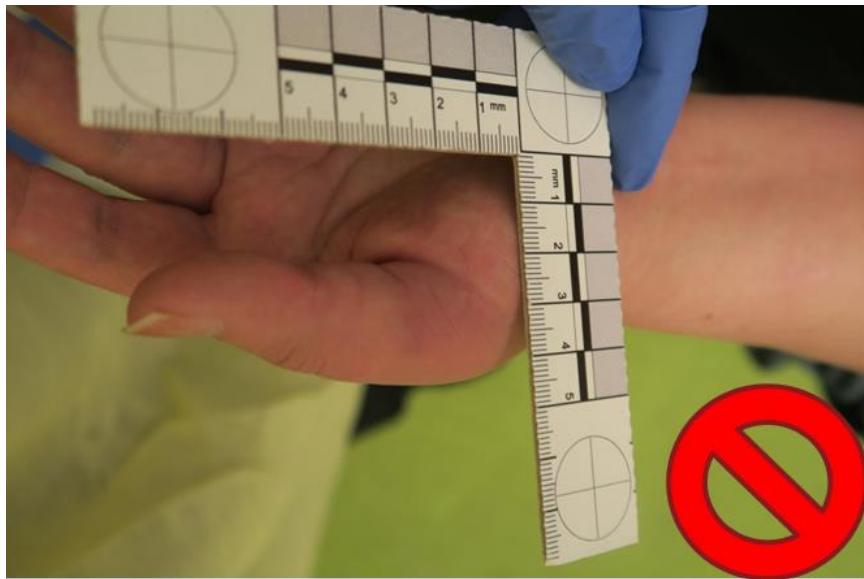
In the image on the left, there is a clear over-proportioning of the lower extremities with a tapering of the upper body due to an oblique, foot-level camera position. This is called a worm's-eye view. In addition, the choice of subject is disturbed, particularly by the person in the background, who most likely also did not give consent for the photograph.

In the image on the right, the depiction is correct due to a perpendicular camera position aimed at the center of the body. This is called a central perspective.



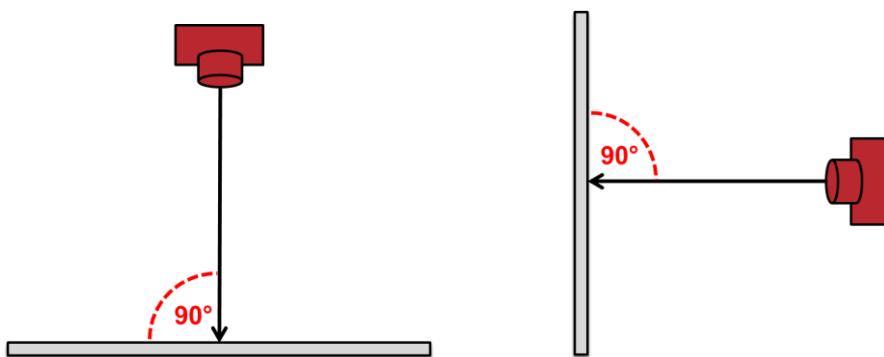
The effect of an oblique camera position in a schematic illustration

Image Translation: "Due to converging lines, the building appears to taper toward the top"

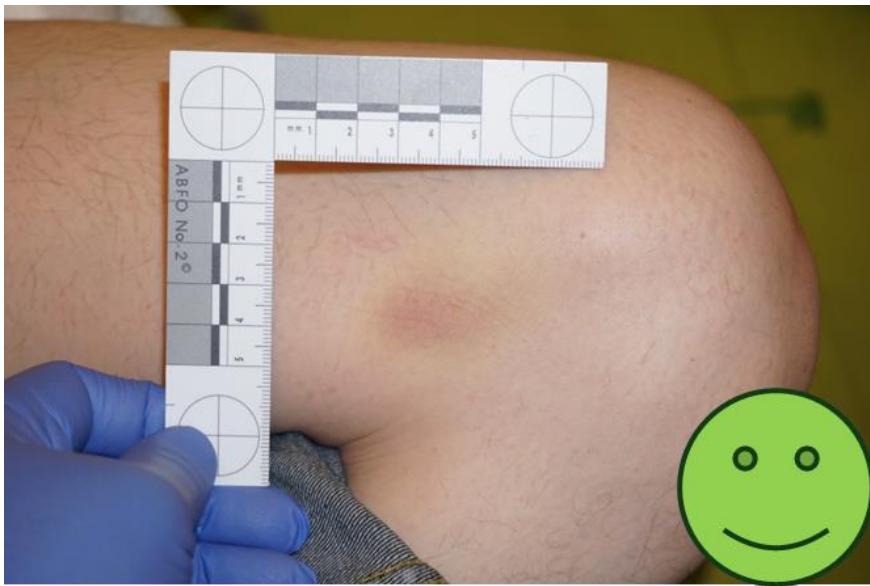


Negative example

An oblique camera position can make accurate measurement of a finding impossible. Comparative image overlays (superimpositions) can no longer be performed in this way. Therefore, as already mentioned, a perpendicular camera position relative to the finding is of essential importance.



Perpendicular camera alignment to the finding



Positive example of a nearly perfect, perpendicular camera alignment

From this positive example, it can be readily seen that the hematoma can also be determined and measured precisely in terms of its size at a later stage.

2. Filling the frame

The images should be taken filling the frame, with a safety margin to the edges. This prevents the viewer's eye from being distracted by extraneous elements, and the resolving power as well as the possibilities for magnification and isolation of the image are not unnecessarily limited.



The black dashed frame marks the desired image format

As can be readily seen, approximately three quarters of the image content were wasted in this picture

3. Portrait images, close-up images, and the problem with wide-angle focal lengths



Negative examples

Naturally proportioned portraits are of great importance, especially for the purpose of identification.

The most common mistake is to simply press the trigger while standing very close to the face using a wide-angle focal length.

In 2007, Verhoff described the so-called wide-angle effect. He showed that, particularly in frame-filling shots, the object distance has a significant influence on facial shape.



*24mm wide-angle focal length
at a distance of 30 cm
Pronounced distortion of facial proportions*



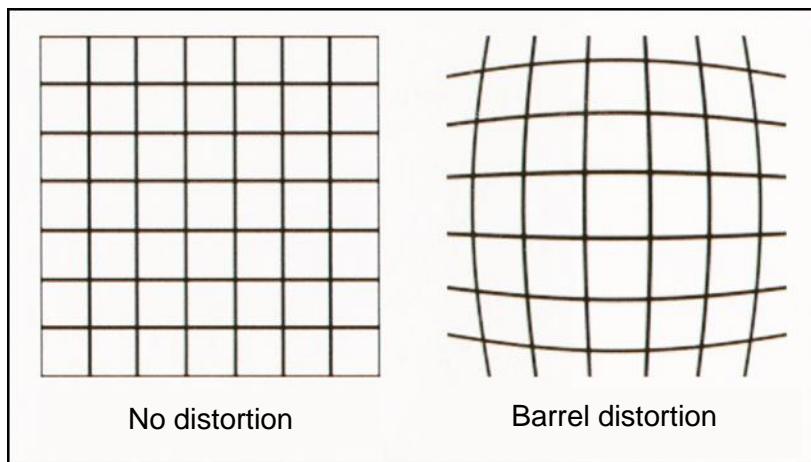
*70mm telephoto focal length
at a distance of 2 m
Natural representation of facial proportions*

In order to avoid grotesque distortions and to depict facial proportions realistically, a working distance of at least 1.5 m should be maintained for frame-filling portraits, and a short telephoto focal length of 70 mm or longer should be used.

Even though the short minimum focusing distance of wide-angle lenses makes it more convenient to take frame-filling close-up shots, maintaining some distance from the object generally has a positive effect not only on image fidelity but also on lighting.

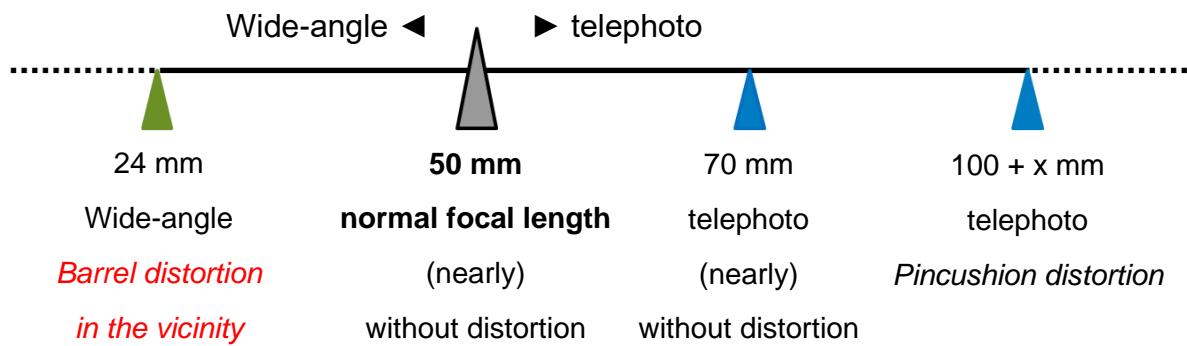


Barrel distortion of the angle ruler in a frame-filling close-up image taken with a wide-angle focal length



Schematic illustration of barrel distortion in a close-up image with a wide-angle focal length

For image fidelity, only wide-angle focal lengths are problematic.



Schematic illustration

Therefore, wide-angle lenses should only be used for overview shots.

For everything else, such as portraits, detail, or close-up shots, focal lengths of 50 mm and above should be used. It is better to keep some distance and zoom in. By the way, the term "standard focal length" comes from its relationship to our natural field of view.

If only wide-angle focal lengths are available for photographic documentation (e.g., often with smartphones), a digital focal length adjustment (digital zoom function) should be used whenever possible. With a digital zoom, only a portion of the sensor area is used for the shot, at the expense of resolution. If a digital zoom is not available, photos should be taken from some distance (approximately 50–60 cm) and the missing zoom function can then be compensated by cropping afterwards.



Example of an upper body image in landscape format. In the previously shown image, the white frame indicates the required image section. The black dashed frame shows the frame-filling upper body image in portrait format after cropping.

4. Challenging lighting conditions

Challenging lighting situations, such as insufficient ambient light, backlighting, and shadows, make photographic documentation of findings more difficult. A finding that is not sufficiently illuminated or evenly lit naturally makes its recognition and assessment more difficult.



The finding on the neck of the living person is poorly visible because the available light (ceiling light) is blocked by the person's head.

Remedies:

- Activate the flash or use a flash unit
- Use additional light source(s)
- Change the position so that the available light falls on the finding.
- Targeted overexposure as an emergency measure



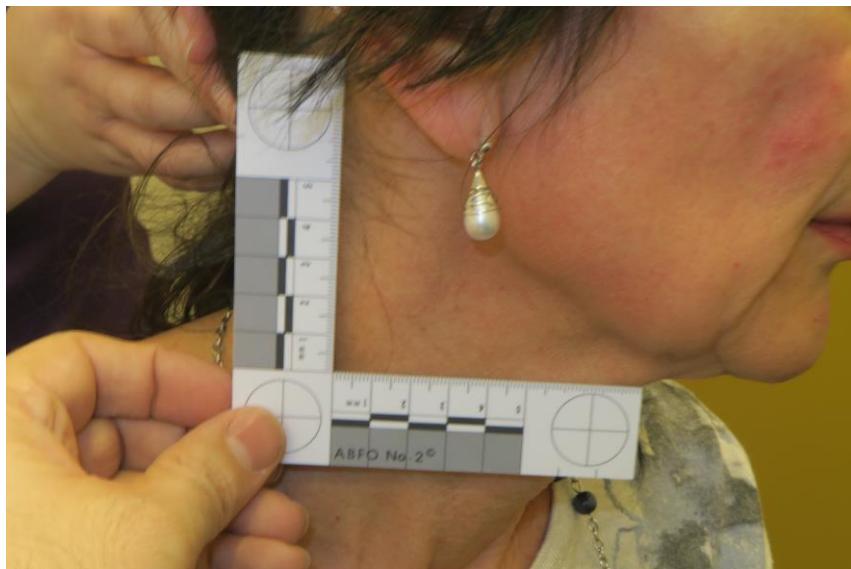
The back of the body is in shadow due to a backlighting situation



Activated flash illuminates the back of the body

5. Image blur and finding blur

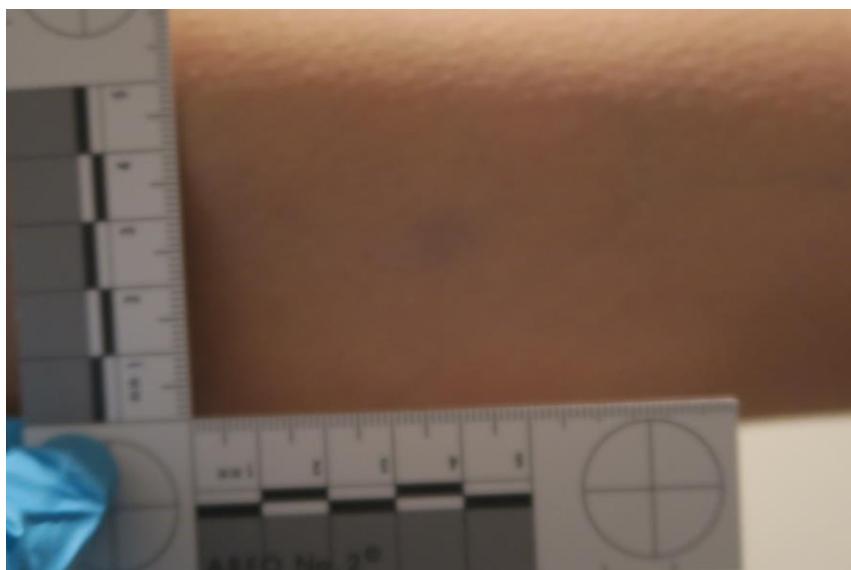
One of the most common causes of overall image blur is camera shake due to excessively long exposure times in handheld shots..



Exposure time 1/8 s at 30 mm focal length

The above example serves as a reminder that the exposure time should be shorter than the reciprocal of the focal length used. In this specific case, with a 30 mm focal length, the maximum exposure time (without image stabilization) should have been only 1/30 s. If, under unfavorable lighting conditions, a shortening of the exposure time cannot be compensated by further opening the aperture and increasing the sensitivity (ISO), the flash should be activated.

Image blur can also occur if the minimum focusing distance is not observed.



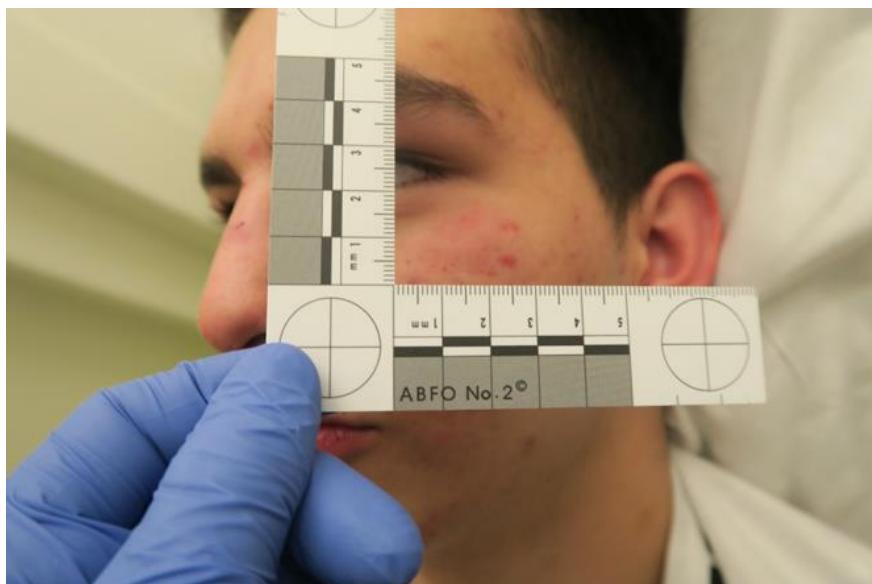
Minimum focusing distance exceeded

If this limit is exceeded, it is simply not possible to achieve sharp focus, whether automatically or manually.

Every lens and focal length has a minimum focusing distance. Wide-angle lenses have only about 25–30 cm as a minimum focusing distance (deceptive, because convenient), a standard focal length about 50 cm, and a telephoto, e.g., 70 mm, about 60–70 cm.

Remedy: Increase the distance

The finding and the scale must be in the same plane so that both can be sharply depicted. Especially at close shooting distances, even a small deviation can cause one-sided blur.



*Due to the short distance, only the scale is depicted sharply
(In addition, the camera is not aligned perpendicular)*



The finding and the scale are in the same plane (with an exactly perpendicular camera alignment) and are therefore depicted equally sharply

Remedies:

- Use the scale on the same plane as the finding
- Stop down or choose a smaller aperture for greater depth of field

Finding blur caused by incorrect focusing of the autofocus system.



Finding blur caused by incorrect autofocus on the office chair's swivel base

An image can always only be focused sharply on a specific area, either by manual focusing or with the help of an autofocus system.

Autofocus systems cannot know which area should be in focus and prefer clear and high-contrast structures for focusing. Simple autofocus systems have only a single focus sensor, usually using a small, central measuring area within the camera's field of view for automatic focus. More advanced systems have an entire grid of sensors, which can generally be individually selected to focus on the desired object.

For this reason, the focus result of the autofocus system should at least be checked via image review..

Remedies (if technically possible):

- Align the camera so that the focus area is on the main subject
- Move the focus area to the main subject, if possible
- Focus on high-contrast aids, such as a scale
- Press the shutter release to the first stop (about halfway) to allow the camera to measure and lock focus. While keeping it half-pressed, adjust the framing as desired, then fully press the shutter release to take the picture.

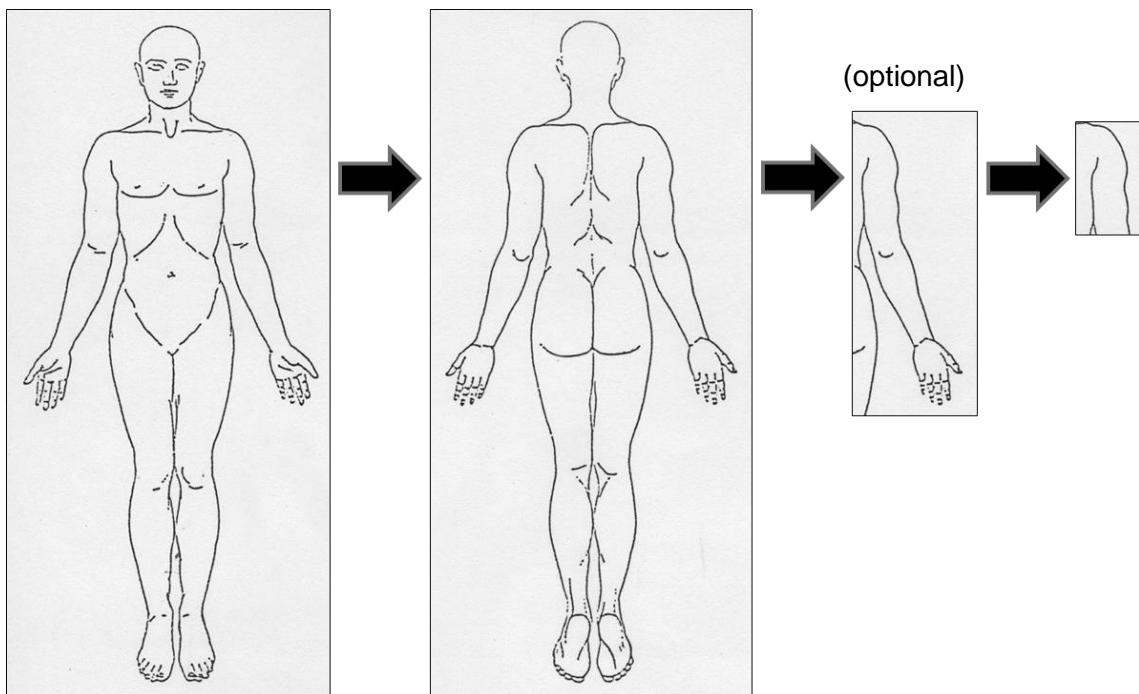
6. Sequence of images

A photographic documentation should be understandable even without text or explanation.



Negative example of an image sequence. Due to the lack of an overview, the viewer cannot determine the location of the hematoma.

Before taking close-up shots, it is useful to guide the viewer to the finding with overview and, if necessary, detail images, so that the documentation can be self-explanatory.



Schematic illustration of a correct image sequence

Otherwise, a situation or finding should, of course, always be recorded in its original form first, before anything is altered or cleaned.

7. Aesthetic image composition

Particularly when documenting findings obtained during autopsy, attention should be paid to aesthetic image composition. Dirt and an inhomogeneous background can distract the viewer from the subject and even repel them from the entire image. Therefore, the greatest possible cleanliness is of decisive importance. After the initial native documentation, cleanliness applies not only to the dissection table and the body but also to organ findings and all auxiliary tools. A homogeneous and neutral photographic background, which does not allow light reflections and does not create excessively harsh contrast, is also helpful.



Negative example



Positive example with homogeneous background

Practical summary:

- Check camera settings
- Perpendicular camera position relative to the finding
- Scale and finding in the same plane
- Frame-filling shots with a safety margin to the edges
- No close-ups with wide-angle focal length
 - Keep distance and zoom in
 - If necessary, maintain a «certain» distance and crop the object afterwards
- Activate flash in case of insufficient lighting of the finding
- Observe handheld/blur limits
- Respect the lens's minimum focusing distance
- Use autofocus deliberately and check the result
- Aesthetic image composition for attachments and scientific publications, especially for photographic documentation in the autopsy room