Introduction

(a) Imaging Veins

Superficial veins that are less than 3 mm deep can sometimes be seen as blue-green (often raised) areas of the skin.

Visualization of these veins is determined by the type of light used and the properties of the skin which reflects shorter wavelength light (blue and green) and absorbs longer wavelength light (orange and red). The light reflected by the surface of the skin is intense enough to overpower the light transmitted by the skin, thus limiting the visualization of superficial veins to less than one millimeter. Deeper veins are not visualized by the naked eye because of reflection from the stratum corneum.

There are two basic methods for reducing the reflected light and better visualizing deeper veins:

(b) Cross Polarization

The first method uses cross-polarization of the surface light to reduce the amount of light reflected by the skin surface, which permits better visualization of the deeper veins. In this method, the light source is linearly polarized in one axis and the viewing lenses are rotated in polarization by 90 degrees to cancel most of the reflected light. Not all the reflected light is cancelled so imaging of some deeper and smaller veins is limited.

Cross Polarization of Surface Light

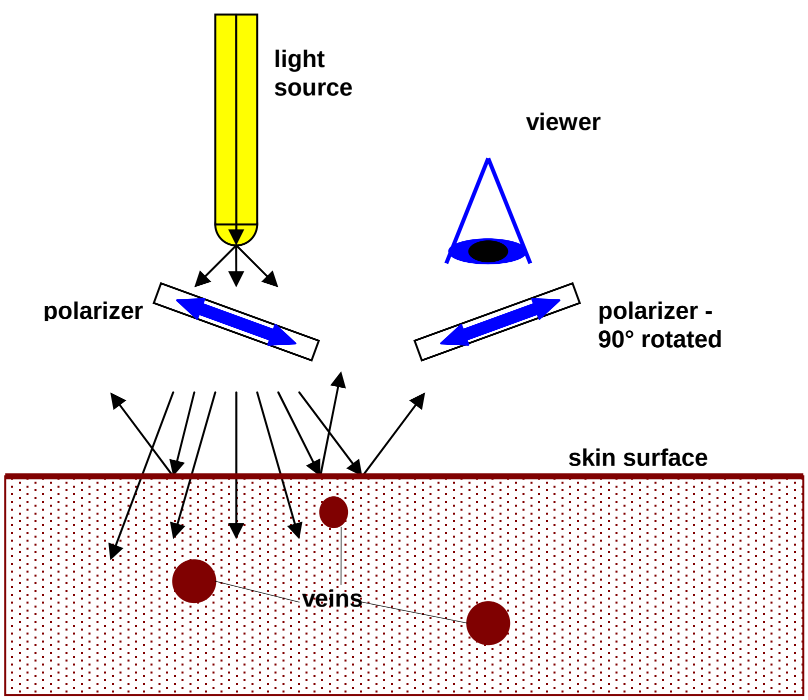


Figure 1

(c) Transillumination

The second method uses transillumination to eliminate surface reflected light and make the skin translucent. In the transillumination method, a light source is placed in contact with the skin and directed at it. The orange and red light enter the skin and are diffracted in the tissue. The depth of penetration of the light depends on its wavelength. Yellow light (which has a relatively short wavelength, compared to red light) travels a much shorter distance than the red light which penetrates deeper.

Transillumination techniques

There are three transillumination techniques:

a) Transmission Transillumination

In transmission transillumination, the light source is placed against one surface of an object and the transmitted light, i.e. the light which passes through the object, is viewed from the opposing surface.

Transmission Transillumination

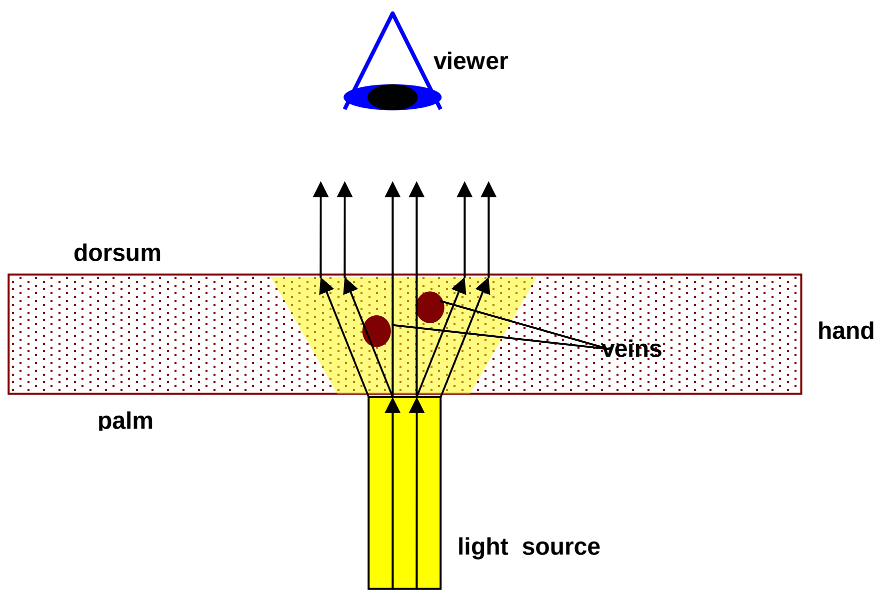


Figure 2

In vein imaging, the transmission transillumination technique can be used for locating veins in the hand: the light source is placed against the palm of the hand and the light is transmitted through to the dorsum, enabling the viewer to visualize veins below the dorsal surface.

This technique requires a very bright light source. Veinlite's patented ring illuminator can be used as a light source for the transmission transillumination technique.

b) Diffracted Light Transillumination

Diffracted light transillumination has been used for many years to image subsurface veins and some other structures. A bright light is directed into the skin and the area of interest is examined by viewing the translucent region around the light. In some cases, the transmitted light is used to view deeper structures.

Diffracted Light Transillumination

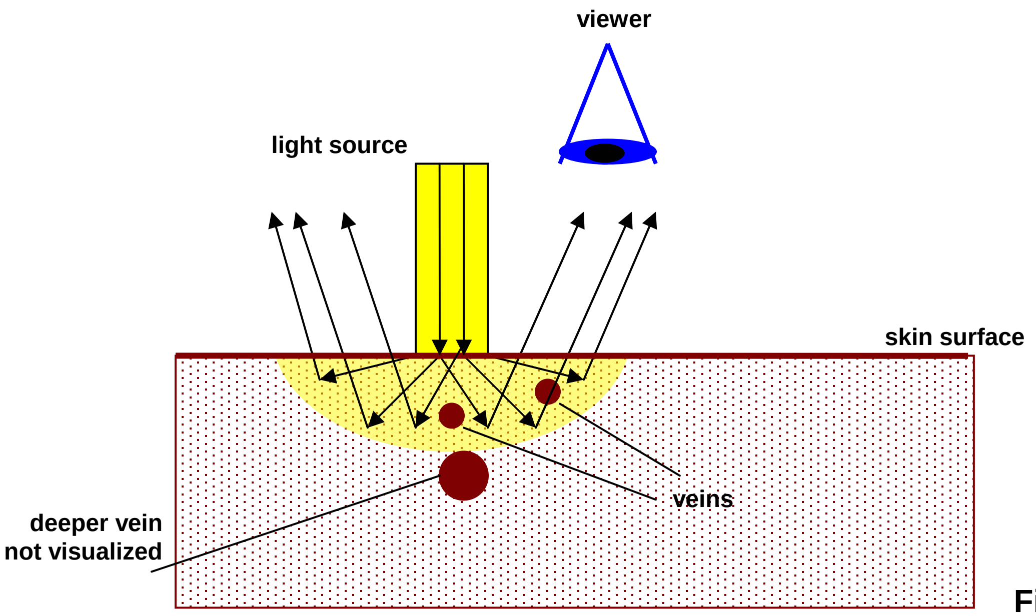


Figure 3

The Venoscope device, marketed for visualization of veins, uses two light sources to image the veins. While this device works better than a single light source, areas of shadow are created between the light sources, due to the non-uniform illumination. Moreover, the low light levels used in this device limit the visualization of veins to larger and more superficial veins.

c) Side-Transillumination

Veins can be better visualized using a new transillumination technique, called side-transillumination.

Side transillumination is a patented technique for transilluminating a small area. A circular array of bright fiber-optic lights is directed to the center of the circle and inclined at an angle such that the light is focused below the skin surface. The focused light creates a conical volume of illumination, with a central focus acting as a virtual light source under the skin.

This technique achieves uniform transillumination of a small region of skin, facilitating much better imaging of veins, without shadows.

Side-Transillumination

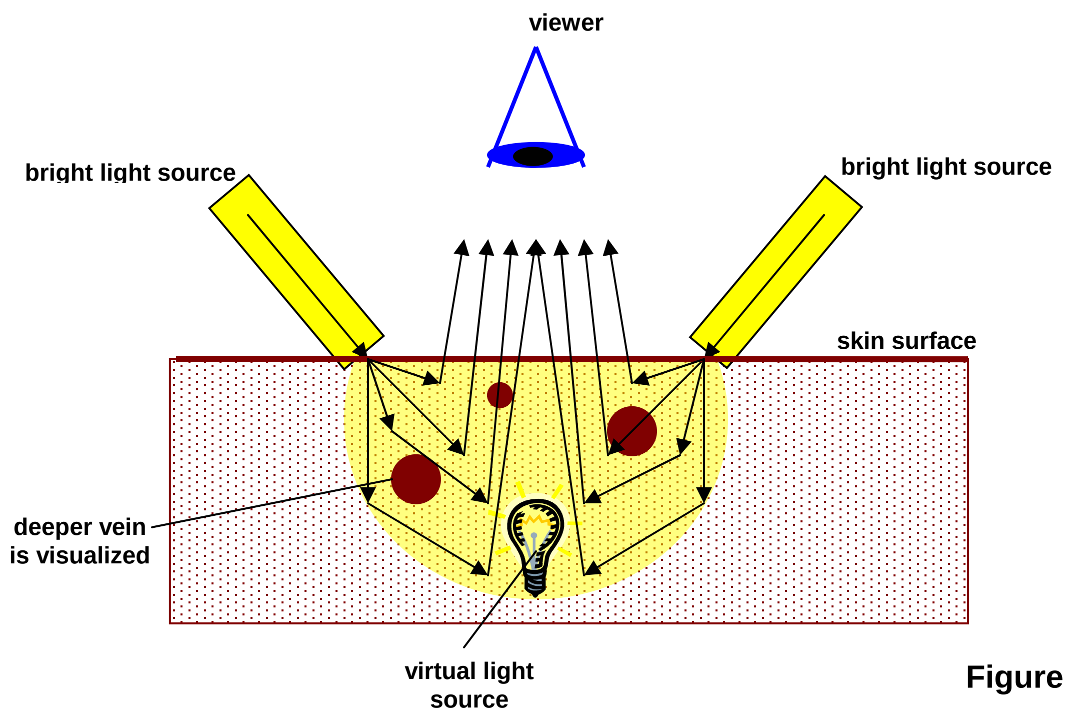


Figure 4

Veinlite uses a very bright ring light, known as a ring illuminator, to uniformly transilluminate the circular region contained within the ring opening. The ring illuminator forms a bright virtual light source at a depth of approximately 1 cm. Blood vessels are seen with much greater clarity to depths of more than 3mm.

Veinlite Components

a) Light Source

Veinlite comprises a powerful halogen light source with a variable intensity control, a flexible fiber-optic cable and a patented ring illuminator for side-transillumination.

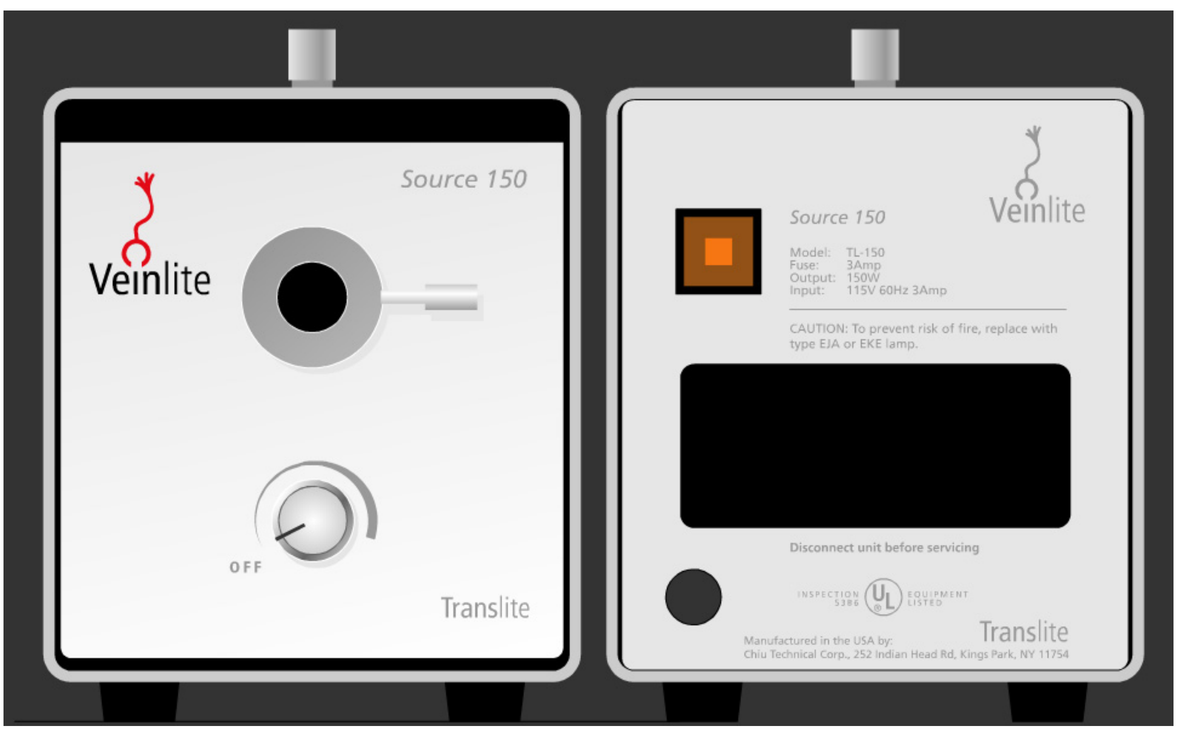
The light source uses a 150 watt halogen bulb and has a potentiometer for adjustment of illumination level. These are housed in a portable unit, known as a light box. A collapsible handle, for convenient carrying and storage, is attached to the top of the light box.

On the front of the light box is a circular dial for varying the light intensity and a port for the fiber-optic cable. This port comprises a metal ring into which the free end of the fiber-optic cable is inserted, and a screw for securing the end of the cable, once it has been inserted.

CAUTION: Do not switch on the light before inserting the fiberoptic cable.

On the top of the light box is a screw which holds the front cover in position. Removing this screw allows the front cover to be pulled forward to access the halogen bulb. Replace only with EKE or EJA type halogen bulb.

A 5 ft (1.5 m) power cable, with 3 pin plug, is attached to the back of the light box. Electrical information is printed on the back of the box, adjacent to the fuse cover.



Veinlite Light Source **Figure 5**

b) Fiberoptic Cable and Ring Illuminator

Light is channeled, through a 6ft flexible fiber optic cable, to the ring illuminator which is permanently attached to the cable.

The cable comprises a bundle containing in excess of 100 000 optic fibers, surrounded by an opaque vinyl cladding. Although the cable is flexible, it should not be wound into a tight coil or bent at a sharp angle. Over time, some fibers will break, even with careful handling. If the light intensity is set at maximum and the cable is viewed in a dark room, the broken ends may appear as tiny spots of light. Each spot of light represents just one fiber and it is expected that any bundle of 100 000 optic fibers will contain upwards of 100 broken fibers. The number of broken fibers is insignificant when compared with the total number of fibers and these spots of light in no way interfere with the cable's performance.

Figure 6 Fiber-optic Cable and Ring Illuminator

The ring illuminator is currently available in two sizes: one with an internal diameter of 18mm (small), the other with an internal diameter of 36mm (large).

The small ring illuminator has a focal spot that is approximately 6mm below the surface, providing very bright and uniform illumination of shallower veins. Its concentrated light provides a good source for transmission transillumination.

The large ring illuminator has a focal spot that is approximately 12mm below the surface. It is designed for visualization of larger and deeper veins, such as reticular veins.

The two different sizes of ring-illuminator can be used with the same light box.

CAUTION: Do not look directly at the ring illuminator when the light is on.