Index

- **Refraction artifact**: occurs when the ultrasound beam is bent from its original direction when passing through an interface of two tissues with significantly different propagation speeds. The ultrasound machine assumes that the ultrasound has traveled in a straight line, leading to a misplacement of structures (**Fig. 9**)[8, 10].

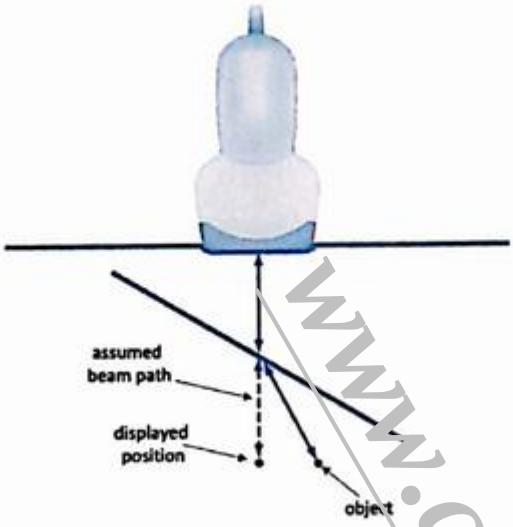
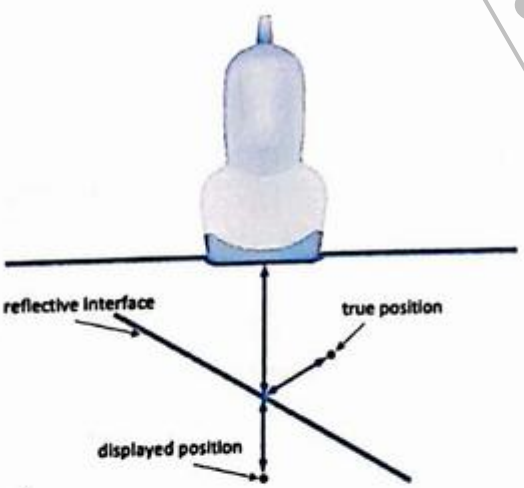
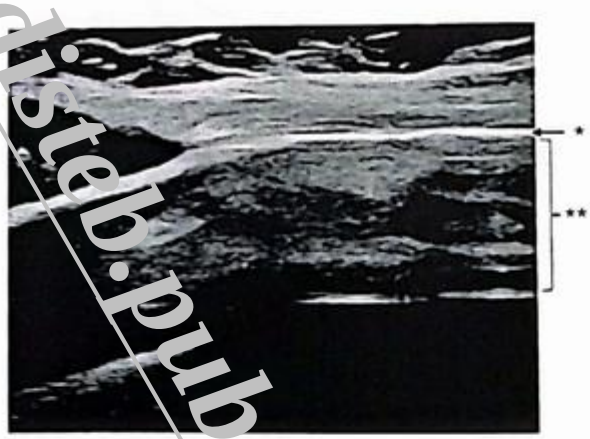


Figure 9: Refraction artifact: occurs when the ultrasound beam is bent from its original direction when passing through an interface of two tissues with significantly different propagation speeds and causes this object to be displaced on the screen.

- **Mirror artifact**: occurs when structures located on one side of a strong reflector, such as a bone, appear to duplicate on the opposite side of the reflector (**Fig. 10**).



A



* Mandible bone

** Mirror artifact

Figure 10: Mirror artifact: a) occurs when structures located on one side of a strong reflector, such as a bone, appear to duplicate on the opposite side of the reflector, b) Jawline, Mandible bone acting as a mirror.

When an artifact is suspected, minor adjustments to the transducer's position, such as tilting, applying pressure, or changing the imaging plane with rotation while assessing whether the suspected artifact moves in conjunction with the surrounding tissues, can be helpful. Changing the angle of incidence often proves effective in eliminating many artifacts. Furthermore, advanced ultrasound modes like harmonics and compound imaging can also be utilized to reduce artifacts significantly[8, 10, 15, 16].

Color Doppler Imaging Artifacts

Color Doppler Imaging is also susceptible to artifacts like B-mode imaging, and many of the artifacts described in B-mode, such as shadowing (**Fig. 11**), mirror image, and refraction, also affect Color Doppler Imaging[7, 8, 17].

- **Flash Artifact**: the flash artifact appears as short flashes of large areas of color that are due to motion between the probe and the tissue. It can be eliminated by increasing the wall filter or slowing the transducer's movements.
- **Twinkling Artifact**: the twinkling artifact is a mixture of fluctuating red and blue colors generated by small, strongly reflecting structures, like calcifications.
- **Color bleed**: appears as color overflowing outside the blood vessel (**Fig. 20**). It can be eliminated by reducing the color gain, adjusting the pulse repetition frequency (PRF), or increasing the wall filter.
- **Aliasing**: aliasing is an artifact seen in Doppler and color Doppler ultrasound when the Doppler-shift frequency is too high (**Fig. 19a**), exceeding the Nyquist limit (1/2 PRF), and can be corrected by increasing the flow speed (which increases the PRF) (**Fig. 13**) or baseline shifting[7, 17-19].

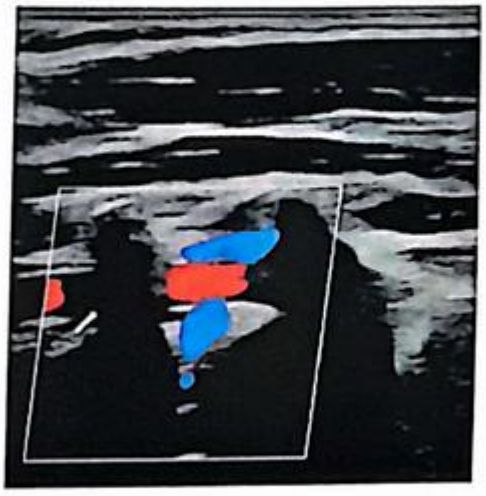


Figure 11: Vertebral artery – Color Doppler Mode imaging. Transverse processes of vertebrae causing posterior shadowing (white arrow).

PRACTICAL CONSIDERATIONS FOR OPTIMIZING ULTRASOUND IMAGING

Room Setup and Patient Position

Performing the ultrasound examination in a well-lit room with adjustable lighting, e.g., dimmable lights and blackout curtains, enables enough light for the history taking and clinical exam, subsequently allowing for the adjustment of the light to accommodate the ultrasound. The light should be dimmed during the examination to diminish possible screen reflections and optimize the image visualization. Before starting the examination, the patient should be positioned comfortably. For the ultrasound examination of the face, the patient will be supine, as this helps minimize any potential motion artifacts by ensuring a relaxed and stable posture[4, 17].

Coupling agent

The coupling agent, often a thick amount of ultrasound gel or stand-off pads, eliminates air gaps, ensuring efficient sound wave transmission between the transducer and the patient's skin and positions the examined structure closer to the focal point, enhancing resolution (**Fig. 12**)[20]. Gel stand-off pads, if used correctly, may increase the detection of peri- and intra-lesional flow signals of superficial lesions on Doppler imaging[4, 21].

Figure 12: The transducer is placed over a thick amount of gel.

- **Power Output**: Controls the strength of the ultrasound beam emitted by the transducer, improving penetration and enhancing image quality. However, transmission power changes also impact the mechanical and thermal effects on the tissue, so the ALARA principle ("as low as reasonably achievable") should be followed[2, 23-28].

Then, the vessels are displayed longitudinally, and **Color Doppler or Power Doppler** is performed.

- **Color Doppler box**: The size of the sampling box is adjusted to be as small as possible to increase temporal resolution and frame rate. Then, the sampling box should be steered to demonstrate flow in the whole vessel (**Fig. 17**).
- **Velocity scale (pulse repetition frequency)**: The velocity scale should be adjusted according to the examined vessels. If it is set too low, aliasing will occur; if it is too high, ultrasound will not depict low flow (**Fig. 18**).
- **Gain**: The Doppler gain is appropriately set by turning it up until extravascular noise is seen (**Fig. 19**) and then lowering it until it disappears[27-31].
- **Wall filter**: The wall filter removes noise from tissue movement, especially vessel wall movement. It can be set to low, medium, or high (**Fig. 20**). In dermatologic ultrasound, a low wall filter is used[4, 32].

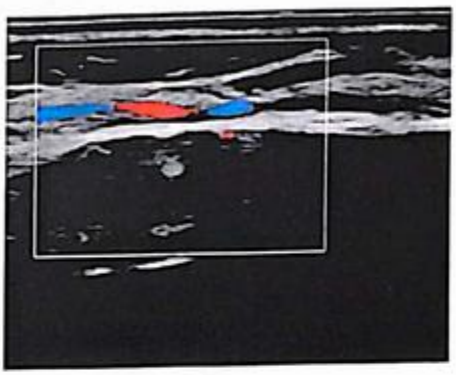


Figure 17: Color box: a) too big color box with wrong angle.

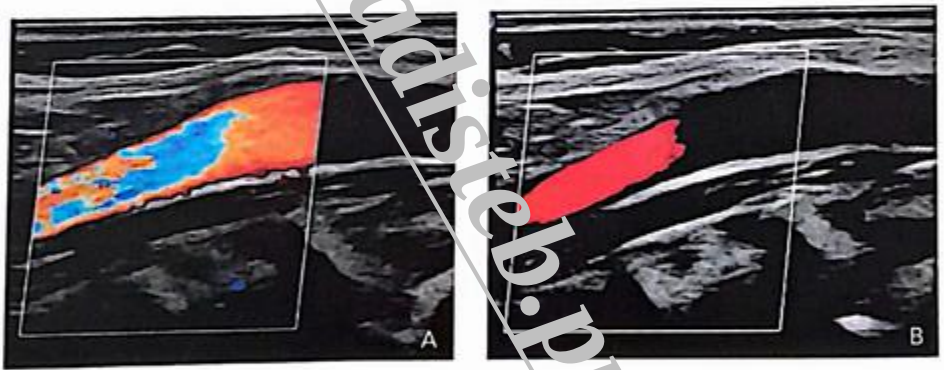


Figure 18: Velocity scale (PRF) adjustment: a) set too low (Aliasing), b) set too high, flow is not correctly depicted.

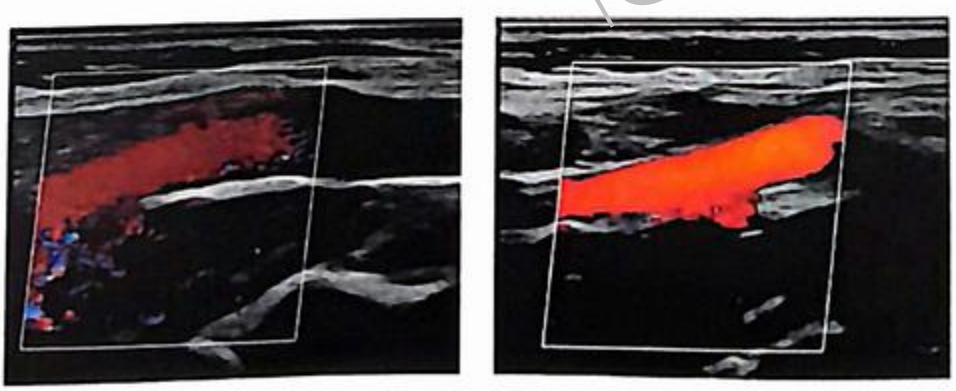


Figure 19: Wall filter set too low: color gain is too high causing color bleed artifact.

Figure 20: The artifact is removed.