

# Video Tutorial for Clinical Flap-Monitoring in Plastic Surgery

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## INTRODUCTION

Free tissue transfer is a well-established technique in the field of plastic reconstructive surgery. Despite great progress being made in relation to technical issues and the anatomical understanding of free flap transfers, a loss rate of between 2% and 5% remains.<sup>1-5</sup> The main reasons for free flap failure are vascular problems, such as vascular thrombosis (venous and arterial), arterial insufficiency, active bleeding or hematoma, and venous congestion.<sup>1-4</sup> Many studies have demonstrated that the salvage rate for flaps is inversely related to the time between the onset of vascular compromise and surgical intervention.<sup>6,7</sup> To guarantee an immediate reaction in case of perfusion problems in free flap surgery, a continuous and sufficient flap monitoring is indispensable. Although there are numerous techniques to assess flap vitality, clinical examination remains the gold standard.<sup>8</sup> Besides this preferred method, a handheld and implantable Doppler, microdialysis, video-based application, real-time measurement of oxygen saturation, fluorescence angiography, spectroscopy, contrast-enhanced duplex, and activated clotting time have been proposed as alternative modalities for monitoring, though none of these has provided better results than clinical examination.<sup>9,10</sup>

The postoperative clinical examination and monitoring of flaps is frequently delegated to nurses and paramedics. Thus, there is often a high variation in skill level due to the lack of clinical experience needed to assess flap vitality.<sup>11</sup> When asked, even young plastic surgeons often admit uncertainty when it comes to assessing postoperative flap vitality. To guarantee a high level of monitoring quality, constant training is indispensable. As mentioned above, perfusion compromise—being of arterial or venous origin—emerges rarely and is hard to include consistently within a training program. Therefore, educational

material that clearly elucidates different qualities in vascular compromise in flaps is highly desirable.

## METHODS

In this training video, we want to provide the viewer with a reference for the clinical states of the various potential flap perfusion patterns (see video, **Supplemental Digital Content 1**, which details clinical free flap monitoring, <http://links.lww.com/PRSGO/A541>). The most common perfusion issues along with normal capillary refill time in healthy tissue are shown. In addition to the capillary refill time, the skin color must be considered. We used the handle of a pair of scissors to assess capillary refill time by pressing it for a few seconds on the transplanted



**Video Graphic 1.** See video, Supplemental Digital Content 1, which details clinical free flap monitoring. Sequence 1: Regular capillary refill time without vascular compromise. Sequence 2: Venous congestion with livid discoloration and short recapillarization. Sequence 3: Pronounced venous congestion with dark discoloration and fast capillary refill time. Sequence 4: Arterial compromised flap with pale flap skin without capillary refill. This video is available in the "Related Videos" section of the Full-Text article on PRSGlobalOpen.com or available at <http://links.lww.com/PRSGO/A541>.

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flap to cause a localized mechanical ischemia, followed by releasing it to observe the capillary refill time. The first sequence in the video shows the capillary refill of healthy tissue. The second sequence illustrates the clinical presentation of a light venous congestion. In the third sequence, we demonstrate a highly vulnerable venous congestion, and the last features an arterial perfusion problem. In any doubt of perfusion compromise, further diagnostic measures for validation or an immediate surgical intervention are required.

## DISCUSSION

This video tutorial was intended to serve as an educational tool in basic flap monitoring for young and inexperienced plastic surgeons as well as other health care professionals. Besides this clinical examination in postoperative flap monitoring, one has to keep in mind that there are many other additional techniques for flap monitoring such as the evaluation of flap bleeding—comprising slow bright versus dark fast bleeding with venous congestion to no bleeding with arterial inflow compromise, Doppler-analysis, oxygen saturation of the flap, or flap temperature, that should be considered. The videos have been taken intraoperatively with excellent lighting. In postoperative flap assessment, good light conditions should be guaranteed.

## CONCLUSIONS

Clinical examination still remains the gold standard in postoperative flap monitoring. Often, the personnel charged with this responsibility do not have the necessary experience to assess the state of the flap. Any paramedic personnel can access this video to establish a standard procedure for postoperative flap monitoring so as to simplify and guarantee a high-quality clinical assessment. To the best of our knowledge, no such video has previously been published.

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