Veinfinder® System: An Alternative to Vascular Mapping Pre Filler Injections and its Doppler, Dupplex Ultrasound Correlation

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Abstract: Dermal filler procedures are popular but demand a deep understanding of facial anatomy to prevent serious risks such as necrosis, ischemia, blindness, or paralysis. Errors in placement are common, and while ultrasound helps, it's expensive and requires expertise. An accessible, user-friendly tool for pre-injection assessment and guidance is needed. Our comparative study of Veinfinder® and Doppler ultrasound showed a strong correlation. Veinfinder® was designed for veins but shows promise in detecting superficial arteries. Challenges arose in detecting certain vessels due to their small size or anatomical features. Further studies are needed for sensitivity refinement. Implementing tools like Veinfinder® could significantly improve the safety and precision of dermal filler procedures.

Keywords: Veinfinder®, Ultrasonography, Fillers, Fillers Complications, Skin Ultrasound, Doppler Duplex.

INTRODUCTION

In the field of aesthetic dermatology, dermal filler treatments have experienced a significant increase in popularity as a non-surgical alternative for facial rejuvenation and enhancement (1). While these procedures are accessible and generally safe, the possibility of serious complications remains in the absence of proper precautions (2). One of the most critical complications is vascular occlusion, with the potential to induce skin necrosis and even blindness (3). Therefore, a precise understanding of facial vascular anatomy is crucial.

The demand lies in the availability of an easily accessible and user-friendly device capable of providing pre-injection assessment and guidance during the procedure. In this regard, we propose the implementation of the Veinfinder® system. This device utilizes infrared light for vein visualization during venipuncture procedures, leveraging the absorption of light by blood to create shadows and enhance their identification (2,4). In the context of this review, we seek to apply this technique to determine the location of facial vasculature and establish a correlation with the gold standard, Doppler ultrasound. The high concordance between these two imaging techniques could result in an accessible, cost-effective, and straightforward approach to enhancing the safety and precision of facial dermal filler injections.

METHODS

A prospective study was conducted, involving the selection of three patients to participate. During this study, the Veinfinder® device was used to perform a hemifacial vascular mapping (**Figure 1**), focusing on identifying and highlighting larger-caliber blood vessels at higher risk of occlusion. These identified vessels were marked using a permanent marker (**Figure 2**). Subsequently, directed Doppler ultrasound was performed on the vascular marks previously made , the ultrasound study was performed with a GE Venue System Ultrasound scanner with a high-resolution multifrequency hockey stick linear array. The ultrasound transducer was positioned directly over the previously traced marks (**Figure 3**). This ultrasound assessment allowed for the analysis of both the visualized image and blood flow, with the aim of determining the arterial or venous nature of the vessel in question with the spectral curve. The concordance, whether present or absent, was recorded in an Excel table (**Table 1**).

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Figure 1: Vascular visualization with Veinfinder®.

Figure 2: Marking of the visualized vessels.

Figure 3: Positioning of the ultrasound transducer immediately above the trace.

Table 1: Correlation between the Veinfinder® findings and Doppler ultrasound.

Artery	Patient 1	Patient 2	Patient 3
Facial	X	X	X
Inferior Labial	X	X	X
Superior Labial	X	X	X
Angular	X	X	X
Dorsal Nasal	Corresponds to a Venous Vessel.	Corresponds to a Venous Vessel.	Corresponds to a Venous Vessel.
Supratrochlear	X	X	No Correlation
Supraorbital	X	No Visible with the VF but Identified with DU	X
Temporal	X	X	X
Supralabial Anastomosis	X	X	X

X: Adequate correlation between Veinfinder® findings and Doppler ultrasound (arterial location and flow)
VF: Veinfinder®
DU: Doppler ultrasound

RESULTS:

In all three cases, the Veinfinder® device proved to be useful for the preliminary identification of large-caliber vessels on the skin surface. The marks made with the Veinfinder® showed a positive correlation with most of the arterial blood vessels identified in the Doppler ultrasound performed by the radiologist. There were difficulties in locating the dorsal nasal artery; the trace was consistently over a venous vessel. However, by moving the transducer a few millimeters, the artery could be easily located. The same occurred with the supra trochlear artery in the third patient. There was initial difficulty in locating the supraorbital artery with the Veinfinder®, but it was subsequently found in the Doppler ultrasound.

DISCUSSION

Despite injectable procedures being one of the most common practices for rejuvenation and volume enhancement, acquiring a thorough knowledge of facial anatomy becomes imperative to minimize inherent risks (5)(6). These complications can be categorized as ischemic and non-ischemic (3). Within the spectrum of non-ischemic complications, a variety of adverse effects occur at the injection site, including erythema, swelling, itching, bruising, and induration, most commonly manifesting within the first 72 hours after the procedure (3)(6).

Among the most serious early complications associated with the use of dermal fillers, arterial or venous occlusion stands out, leading to ischemia, followed by skin necrosis and/or vision loss (3). The incidence of vascular occlusion can reach up to 3 out of every 1000 injections and varies depending on the technique used (3)(5). Necrosis can be attributed to two factors: vascular supply interruption due to direct compression or obstruction of blood vessels from the product being injected directly into the vessel, or external compression of the blood supply caused by the filler material or surrounding volume increase, including secondary edema (3).

The areas at the highest risk include the glabella and nasal area, but it can also affect the lip, nasolabial fold, and temple (3). Vascular thrombosis is more common in facial arteries such as the supraorbital arteries and angular arteries, which can lead to skin necrosis in the area between the eyebrows and the nose. Additionally, ocular arteries and intracranial arteries can also be affected, leading to blindness and paralysis (3).

Common technical errors leading to complications with fillers include the administration of an inadequate volume (both excessive and insufficient), improper depth (either too superficial or too deep), incorrect placement (either in an unfavorable anatomical location or simply wrong), and the use of inappropriate materials (7). Although it is possible to avoid adverse events like hematomas or thrombosis through Dopler, Duplex color ultrasound visualization of vessels before and during the injection process, this approach often requires expensive equipment, a steep learning curve(7). As a result, many physicians choose to perform these procedures "blindly."

The need revolves around having an accessible and user-friendly device that can perform pre-injection assessment and provide guidance during the procedure. With this in mind, we propose the suggestion of incorporating the Veinfinder® system.

Veinfinder® is a device that utilizes infrared light for vein detection. It is an affordable, portable, and contactless tool used to locate veins for phlebotomy without requiring assistance from a radiologist (7). Its mechanism of action relies on infrared light-emitting diodes being absorbed by blood hemoglobin, creating a shadow on the skin's surface. In the electromagnetic spectrum range of 740 nm to 940 nm, the light can penetrate to approximately 5 mm deep into the skin tissue (4).

Venous blood contains a higher proportion of deoxyhemoglobin (53%), while arterial blood is dominated by oxyhemoglobin (90% - 95%) (8). Both types of hemoglobin have distinctive light absorption characteristics, with more pronounced absorption in the case of venous blood, resulting in a more prominent shadow during infrared visualization (8).

While Veinfinder® was primarily designed to improve venipuncture, this device has proven to be versatile in various contexts in the literature. For example, it has been used to assess pneumothorax in neonatal care units (8) and also to prevent venous puncture in dermal filler injection procedures, aiming to avoid hematomas in the post-procedure stage (6).

In our research, we conducted a comparative assessment between vascular findings obtained through Veinfinder® and the results obtained through Doppler ultrasound. The results revealed an almost perfect correlation between both techniques. (Figure 4)For all three patients, we were able to quickly locate the vessel of interest by placing the transducer directly over the previously made marks. Furthermore, the arterial nature of the vessel was confirmed through the analysis of the spectral curve. This suggests that, although Veinfinder was designed with a focus on detecting venous vessels, in the facial context, it represents a valuable strategy for identifying arterial vessels due to their superficial location. This correlation can be attributed to the possibility that both veins and arteries may follow parallel pathways in this region, meaning that finding a vein can also provide information about the artery's location, offering safety margins in the injection process.

However, difficulties arose in detecting certain vessels. In particular, the dorsal nasal artery posed challenges, as initially, the vein was located, and then slight transducer adjustments were needed to locate the artery.(Figure5) The supratrochlear and supraorbital arteries also presented difficulties in their initial detection through Veinfinder®, unlike Doppler ultrasound, which confirmed their location in all patients.

Figure 4A: After marking the facial artery on the patient's face, the high-resolution transducer is located at the exact point where the vascular structure was visualized with the Veinfinder.

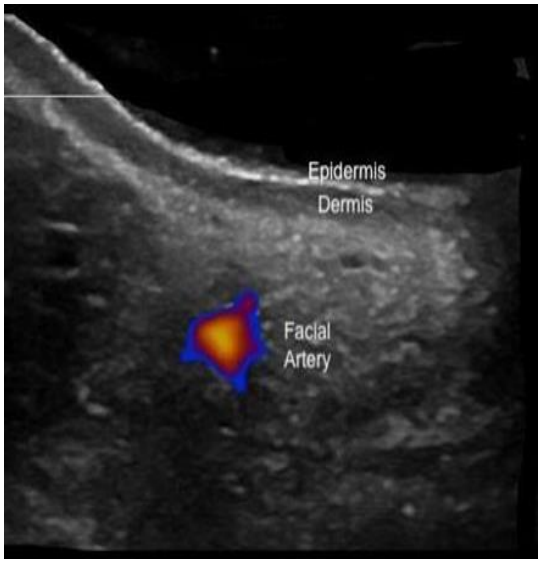

Figure 4B: The high-resolution ultrasound image in the axial plane confirms the presence of a pulsatile, non-compressible vascular structure corresponding to the facial artery.

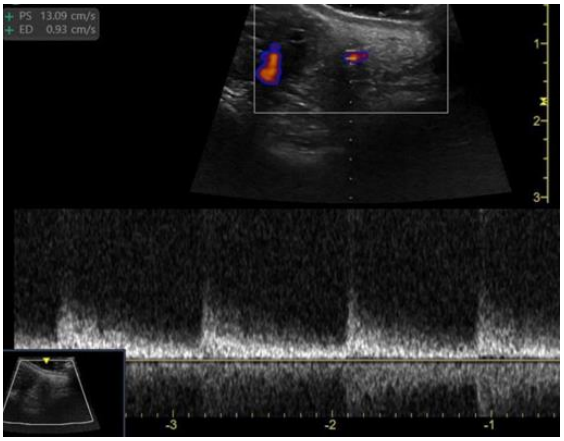

Figure 4C: The spectral curve with Doppler analysis, Duplex color confirms the classic triphasic pattern of the facial artery

These difficulties can be attributed to the small caliber of the vessels or anatomical characteristics of the region, such as the presence of minimal adipose tissue that affects light dispersion.

In all patients, we identified various anastomoses during the initial assessment with Veinfinder®, which were also marked for verification of their presence through Doppler ultrasound. The confirmation of these features in all patients is a significant finding, as some necrosis complications can arise due to the involvement of these anatomical variations, propagating vascular damage to distant facial areas from the injection site due to the contiguity of their vascular supply (5)(9).

It is essential to highlight that Veinfinder® relies on the operator's skill, and therefore, its consistent use in conjunction with solid facial anatomical knowledge would enhance the correlation. Given its good level of agreement with the gold standard, Doppler ultrasound, Veinfinder® could play a significant role in daily practice to reduce complications associated with injectable procedures and at a better cost. However, further studies with a larger number of patients and other brands of infrared light equipment are needed to calculate more precise sensitivity measures for the test.

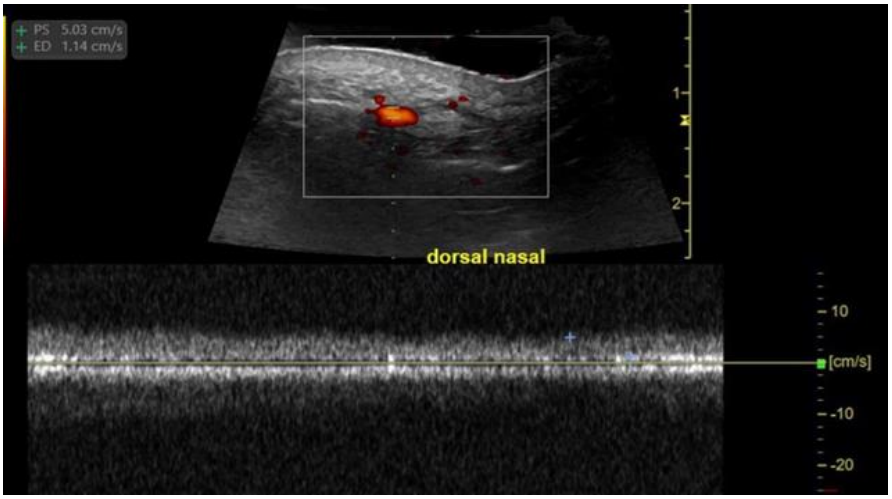

Figure 5A: The location of the transducer on the vascular structure suggestive of corresponding to the dorsal nasal artery corresponded to the dorsal nasal vein, with its classic venous spectral curve.

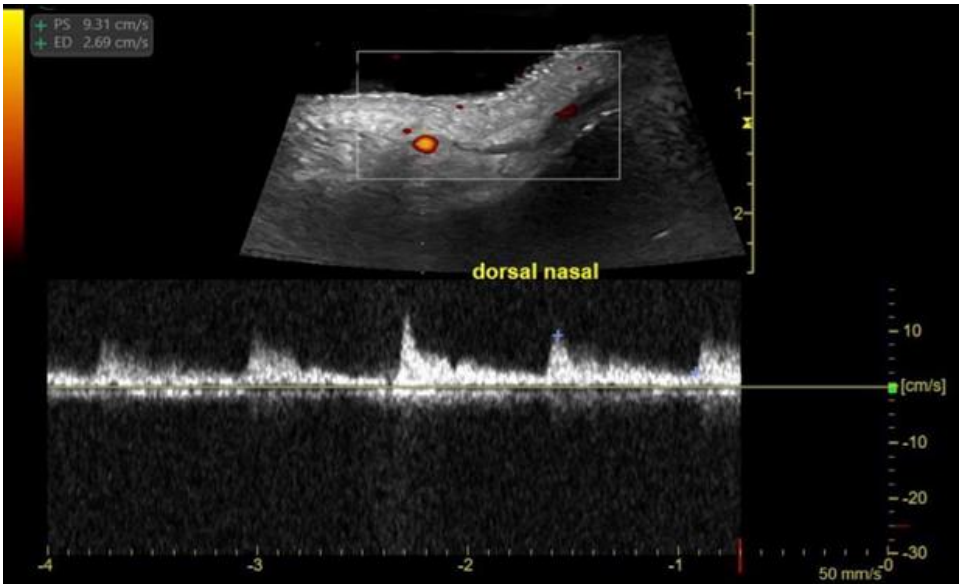

Figure 5B: The transducer is moved slightly externally and the normal arterial spectral curve of the nasal dorsal artery is obtained.

CONCLUSIONS

Dermal filler procedures, although popular, demand a profound understanding of facial anatomy to mitigate serious risks such as necrosis, ischemia, blindness, or paralysis. Among the common technical errors when using fillers is incorrect placement, and although ultrasound has proven effective in preventing complications, its implementation is costly and requires specialized skills. There arises a need for an easy-to-use device that enables pre-injection assessment and guidance during the procedure.

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