failure is a lack of blood being supplied to the flap tissue after the free flap is reattached at the recipient site. Things that commonly disturb circulation in a flap include vascular occlusion, hemorrhage, or infection. When not enough blood is supplied to the flap tissue, tissue necrosis results. However, if it can be recognized early enough that the flap is not receiving adequate circulation, it may be saved, or salvaged. The window of time for salvaging the flap after a lack of blood flow is recognized is very small. It is therefore critical that any lack of blood flow in a transferred flap be quickly recognized.

[0005] Handheld Doppler probes, which are typically permanently positioned on the distal tip of a pen-like device instead of being placed or left within the body, are helpful in blood flow monitoring, but they suffer from several drawbacks. One drawback with handheld probes is their inability to be reliably positioned about a vessel.

[0006] It is of great importance after microvascular surgery to monitor the region of the surgery in order to make sure that the blood flow is maintained at the desired level and that no problems, such as thromboses have occurred. Should thrombosis occur, the transferred tissue would die. Other indirect means of monitoring the functioning of blood flow through blood vessels, which have been subjected to microvascular surgery, are also often inadequate. For example, surface temperature measurements, transcutaneous PO_2 monitoring, photo plethysmography and laser Doppler flow meters have been employed. However, these approaches generally require an accessible exposed portion of the flap. Additionally, buried free tissue transfers and intraoral flaps cannot be monitored effectively by these methods.

SUMMARY

[0007] The present disclosure provides improved vascular monitoring straps and collars, which may be used with vascular monitoring systems, devices and methods to improve the accessibility, detection and/or reliability of detecting blood flow to confirm vessel patency at an anastomotic site.

[0008] Aspects of the subject matter described herein may be useful alone or in combination with one or more other aspects described herein. In a first exemplary aspect of the present disclosure a vascular monitoring system includes a collar configured to be

positioned about a patient's vessel and a transducer coupled to the collar. The transducer is configured to emit an ultrasonic signal that is transmitted through the patient's vessel.

[0009] In accordance with ~~another exemplary aspect~~an example of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar includes at least one eyelet that is adapted to be sutured to adjacent tissue to fixedly position the collar about the patient's vessel.

[0010] In accordance with another ~~exemplary aspect~~example of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar includes a probe holder sized and shaped to receive the transducer.

[0011] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is coupled to the collar through a friction fit with the probe holder.

[0012] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar is made of at least one of implant grade liquid-silicon rubber ("LSR") and high-consistency silicone rubber ("HCR") with a durometer between 40 and 80.

[0013] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar is configured to be positioned about an anastomosis site of the patient's vessel.

[0014] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar is configured to be positioned at a location that is one of upstream of an anastomosis site of the patient's vessel and downstream of the anastomosis site of the patient's vessel.

[0015] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is removably coupled to the collar.

[0016] Aspects of the subject matter described herein may be useful alone or in combination with one or more other aspects described herein. In an example ~~second exemplary aspect~~ of the present disclosure a vascular collar includes a cylindrical body portion with an opening, the opening having an inside diameter sized and shaped to be positioned about a

patient's vessel. The vascular collar also includes a probe holder and at least one mounting tab. The probe holder is configured to receive a transducer.

[0017] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the inside diameter is between 1.0mm and 4.0mm.

[0018] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is configured to emit an ultrasonic signal that is transmitted through the patient's vessel.

[0019] Aspects of the subject matter described herein may be useful alone or in combination with one or more other aspects described herein. In another ~~third exemplary~~ aspect of the present disclosure a vascular monitoring system includes a collar configured to be positioned about a patient's vessel. The collar is configured to transition from an open configuration to a closed configuration. The vascular monitoring system also includes a transducer coupled to the collar. The transducer is configured to emit an ultrasonic signal that is transmitted through the patient's vessel.

[0020] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar includes at least one closure structure configured to maintain the collar in the closed configuration.

[0021] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the at least one closure structure includes a first eyelet and a second eyelet.

[0022] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the at least one closure structure is adapted to be sutured to adjacent tissue to fixedly position the collar about the patient's vessel.

[0023] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar includes a probe holder sized and shaped to receive the transducer.

[0024] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is coupled to the collar through a friction fit with the probe holder.

[0025] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar is made of at least one of implant grade liquid-silicon rubber ("LSR") and high-consistency silicone rubber ("HCR") with a durometer between 40 and 80.

[0026] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar is configured to be positioned about an anastomosis site of the patient's vessel.

[0027] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar is configured to be positioned at a location that is one of upstream of an anastomosis site of the patient's vessel and downstream of the anastomosis site of the patient's vessel.

[0028] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is removably coupled to the collar.

[0029] Aspects of the subject matter described herein may be useful alone or in combination with one or more other aspects described herein. In an example ~~fourth exemplary aspect~~ of the present disclosure a vascular collar includes a body portion that is configured to transition from an open configuration to a closed configuration. The body portion has an opening in the closed configuration, and the opening has an inside diameter sized and shaped to be positioned about a patient's vessel. The vascular collar also includes a probe holder and at least one mounting tab. The probe holder is configured to receive a transducer.

[0030] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the mounting tab includes a closure feature that is adapted to retain the collar in the closed configuration after transitioned from the open configuration to the closed configuration.

[0031] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the body portion is made from a flexible/malleable material that allows the body portion to transition from

the open configuration to the closed configuration when a closure force is applied to the collar.

[0032] Aspects of the subject matter described herein may be useful alone or in combination with one or more other aspects described herein. In an example ~~fifth exemplary aspect~~ of the present disclosure a vascular monitoring system includes a strap configured to be positioned about a patient's vessel, a clasp configured to maintain the strap in a closed configuration about the patient's vessel, and a transducer coupled to the strap. The transducer is configured to emit an ultrasonic signal that is transmitted through the patient's vessel.

[0033] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the strap includes at least one eyelet that is adapted to be sutured to adjacent tissue to fixedly position the strap about the patient's vessel.

[0034] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the strap includes a probe holder sized and shaped to receive the transducer.

[0035] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is coupled to the strap through a friction fit with the probe holder.

[0036] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the strap is made of at least one of at least one of implant grade liquid-silicon rubber ("LSR"), high-consistency silicone rubber ("HCR"), high density polyethylene ("HDPE"), Nusil 4750, Nusil 4840, and a thermoplastic.

[0037] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the strap, in its closed configuration, is configured to be positioned about an anastomosis site of the patient's vessel.

[0038] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the strap, in its closed configuration, is configured to be positioned at a location that is one of upstream of

an anastomosis site of the patient's vessel and downstream of the anastomosis site of the patient's vessel.

[0039] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is removably coupled to the collar.

[0040] Aspects of the subject matter described herein may be useful alone or in combination with one or more other aspects described herein. In an example ~~sixth exemplary aspect~~ of the present disclosure a vascular strap includes an elongate strap body having a first end and second end, a plurality of sizing holes positioned along the strap body starting near the first end, and a closure prong positioned adjacent the second end of the strap body. The closure prong is sized and shaped to press-fit through a sizing hole of the plurality of sizing holes, and the closure prong is configured to maintain the vascular strap in a closed configuration when press-fit through the sizing hole. The closed configuration forms a cylindrical shape having an inside diameter sized and shaped to be positioned about a patient's vessel. Additionally, the vascular strap includes a probe holder and at least one mounting tab. The probe holder configured to receive a transducer.

[0041] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the inside diameter is between 1.0mm and 4.0mm.

[0042] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is configured to emit an ultrasonic signal that is transmitted through the patient's vessel.

[0043] Aspects of the subject matter described herein may be useful alone or in combination with one or more other aspects described herein. In another ~~seventh exemplary~~ aspect of the present disclosure a vascular monitoring system includes a strap configured to transition from an open configuration to a closed configuration. The strap forming a collar when placed in the closed configuration, the collar configured to be positioned about a patient's vessel. The vascular monitoring system also includes a transducer coupled to the collar. Additionally, the transducer is configured to emit an ultrasonic signal that is transmitted through the patient's vessel.

[0044] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the strap includes at least one closure structure configured to maintain the strap in the closed configuration.

[0045] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the at least one closure structure includes a clamp, clasp, and band.

[0046] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the at least one closure structure includes a prong and a sizing hole.

[0047] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the strap includes a probe holder sized and shaped to receive the transducer.

[0048] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is coupled to the strap through a friction fit with the probe holder.

[0049] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the strap is made of at least one of implant grade liquid-silicon rubber ("LSR"), high-consistency silicone rubber ("HCR"), high density polyethylene ("HDPE"), Nusil 4750, Nusil 4840, and a thermoplastic.

[0050] Aspects of the subject matter described herein may be useful alone or in combination with one or more other aspects described herein. In an example ~~eighth exemplary aspect~~ of the present disclosure a vascular strap includes a base portion and a saddle portion extending from the base portion. The saddle portion has a proximal end and two respective distal ends. The vascular strap also includes two respective band portions extending from the respective distal ends of the saddle portion. The saddle portion and the two respective band portions are sized and shaped to be positioned about a patient's vessel. Additionally, the vascular strap includes a probe holder formed within the base portion, the probe holder configured to receive a transducer.

[0051] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the transducer is configured to emit an ultrasonic signal that is transmitted through the patient's vessel.

[0052] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the vascular strap includes at least one eyelet that is adapted to be sutured to adjacent tissue to fixedly position the strap about the patient's vessel.

[0053] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the probe holder includes a receptacle that is sized and shaped such that the transducer is coupled to the strap through a friction fit with the receptacle of the probe holder.

[0054] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the collar is made of at least one of implant grade liquid-silicon rubber ("LSR") and high-consistency silicone rubber ("HCR") with a durometer between 40 and 80.

[0055] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the saddle portion and the two respective band portions are sized such that when the vascular strap is closed to form a collar about a vessel, the inside diameter of the collar is between 1.0mm and 4.0mm.

[0056] In accordance with another example ~~exemplary aspect~~ of the present disclosure, which may be used in combination with any one or more of the preceding aspects, the strap includes at least one closure structure configured to maintain the strap in the closed configuration.

[0057] It is accordingly an advantage of the present disclosure to improve accessibility of blood flow data.

[0058] It is another advantage of the present disclosure to improve the detection of blood flow to confirm vessel patency.

[0059] It is another advantage of the present disclosure to provide remote monitoring of blood flow at an anastomotic site.

[0060] It is yet a further advantage of the present disclosure to reduce the occurrence of free flap failure and serious adverse events due to insufficient blood flow in a free flap.