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Reconstructive

A Novel Doppler Flowmetry Shaft for Postoperative Monitoring after Head and Neck Reconstructive Surgery

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Summary: Doppler flowmetry is one of the most popular methods of monitoring Doppler signals during reconstructive surgery of the body surface. However, because of the thick and straight structure of the shaft, it is difficult to perform in areas with limited space, such as the oral cavity. We used a new type of Doppler flowmetry shaft to postoperatively monitor the flap in the oral cavity. Compared with conventional Doppler flowmetry, the new type uses a thinner metal probe shaft that can easily be inserted in narrow and limited spaces, such as the oral cavity. Additionally, the tip of the metal probe is gently bent, thereby allowing the Doppler tip to be placed perpendicular to the surface of the skin flap. We used this new type of Doppler flowmetry shaft for 30 patients after head and neck reconstruction using free flap transfer because Doppler signals were difficult to hear using conventional Doppler flowmetry. For all 30 patients, the new Doppler flowmetry shaft was able to monitor free flaps. Vascular thrombosis or vascular spasm occurred in three patients; two patients had inadequate arterial flow caused by vasospasm and arterial thrombus, and one patient had a venous thrombus. These three patients required re-exploration, and all flaps survived. This new type of Doppler flowmetry is simple and noninvasive. Furthermore, it can easily be performed by nonphysician medical personnel, and is useful for monitoring patients after head and neck reconstructive surgery. *(Plast Reconstr Surg Glob Open 2023; 11:e5312; doi: 10.1097/GOX.0000000000005312; Published online 4 October 2023.)*

INTRODUCTION

The failure of free flaps because of a blood flow disorder is the most serious complication of free flap transfer. Although this is unlikely, it cannot be avoided completely.[1,2] In particular, in the head and neck region, complications of free flap necrosis can sometimes be fatal and can lead to fundamental changes in treatment plans, such as additional surgery and associated delays in postoperative chemotherapy or radiation therapy.[3,4]

Reports of monitoring methods for detecting impaired blood flow after free flap transfer include temperature measurement using a thermometer,[5] transcutaneous oxygen pressure, Doppler flowmetry at free flaps,[6] intravenous pressure measurements,[7] the general color and tension of the flap, and the presence and rate of bleeding using the pinprick test. Doppler flowmetry is one of the most popular methods of postoperatively monitoring Doppler signal during reconstructive surgery of the body surface, such as breast reconstruction. In this study, we used a new type of Doppler flowmetry shaft to perform postoperative monitoring of the flap in the oral cavity, which is typically challenging. This probe was created by Hadeco, and similar products have been commercialized (Fig. 1). We report the indications for and usefulness of this new type of shaft for Doppler flowmetry as well as the procedures involved.

Participants included 30 consecutive patients who underwent head and neck reconstruction using free flap transfer in the oral cavity or other areas where Doppler signals were difficult to hear using conventional Doppler flowmetry. There were 19 anterolateral thigh flaps, eight fibular osteocutaneous flaps, two rectus abdominis myocutaneous flaps, and one scapular osteocutaneous flap. The reconstruction sites were the mandible (12 patients),

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tongue (10 patients), floor of the mouth (four patients), oral palate (three patients), and buccal mucosa (one patient). The average numbers of vascular anastomoses in these 30 patients were 1.03 for arteries (range, 1–2) and 1.90 for veins (range, 1–3). Doppler flowmetry was used to monitor the blood flow after head and neck reconstruction. Compared with the conventional Doppler echocardiography probe, the new type of probe has a thinner metal probe shaft that can easily be inserted in narrow and limited spaces, such as the oral cavity. Additionally, the tip of the metal probe is gently bent (Fig. 2), thereby allowing the Doppler tip to be placed perpendicular to the surface of the skin flap. This metal probe was connected to the main body of a conventional Doppler flowmetry device to detect Doppler signals and evaluate blood flow in the free flaps (Fig. 3). (**See Video [online],** which displays listening for Doppler signals using a new Doppler shaft after fibular osteocutaneous flap transfer.)

For all 30 patients, the new Doppler flowmetry shaft could be used to monitor the free flaps. Vascular thrombosis or vascular spasm occurred in three patients; one patient had inadequate arterial flow because of vasospasm, one patient had an arterial thrombus, and one had a venous thrombus. These three patients required re-exploration, and all flaps survived (Table 1). However, in about 20% of the patients, monitor sounds were difficult to hear immediately after admission to the intensive care unit following the completion of surgery. These became audible after several minutes, after fluctuations in vital signs owing to the effects of postoperative mobility had subsided.

Takeaways

Question: What is the most ideal monitoring method after head and neck reconstruction?

Findings: The new shaft is useful for postoperative monitoring of head and neck reconstruction.

Meaning: We used a new type of Doppler flowmetry shaft to perform postoperative monitoring of the flap in the oral cavity.

DISCUSSION

Recently, a simple smartphone-based monitoring method has been described.[8] There have been few reports of the use of Doppler flowmetry in closed spaces, such as the oral cavity. In the present study, Doppler signals could be heard in only 20% of patients with the most commonly used pencil-type probes. The new probe is especially useful for free flaps transferred at the base of the tongue or lateral portion of the mandible. Postoperative flap monitoring should be easy, accurate, and objective, and medical personnel other than surgeons should be able to perform this procedure.[9,10] The new type of Doppler flowmetry probe was created in response to the input of surgeons, and it can be used to observe the complex morphology of intraoral flaps. This made it possible to monitor the flap at the restricted transfer site. Additionally, Doppler sound monitoring using the new type of probe can be performed by nonexpert medical staff. Therefore, this method meets most of the requirements for a good flap monitoring system.

When arterial insufficiency occurs in the flap, blood flow to the free flaps is interrupted and a Doppler sound is not detected. In cases of venous insufficiency, arterial Doppler signals can be heard during early stages. However, when venous insufficiency occurs, early flap color changes caused by congestion are relatively easy to identify using visual examination. In addition to the aforementioned cases of inadequate Doppler signals, there have been cases in which Doppler signals are heard, but the nature of the vascular sound changes or the location of the sound is shifted. These findings may be related to the effects of swelling caused by impaired circulation in the flap or changes in blood flow in the vessel, and require immediate attention. The most important aspect of flap monitoring is confirming that there is no change in the audible sound over time; furthermore, the results should not be judged at a single time point.

LIMITATIONS

The present study involved the use of a variety of flaps in the head and neck region. The differences in the types of flaps may have affected auscultation. Additionally, individual differences in the flap thickness may have affected auscultation. There may also be an effect of high re-exploration rates.

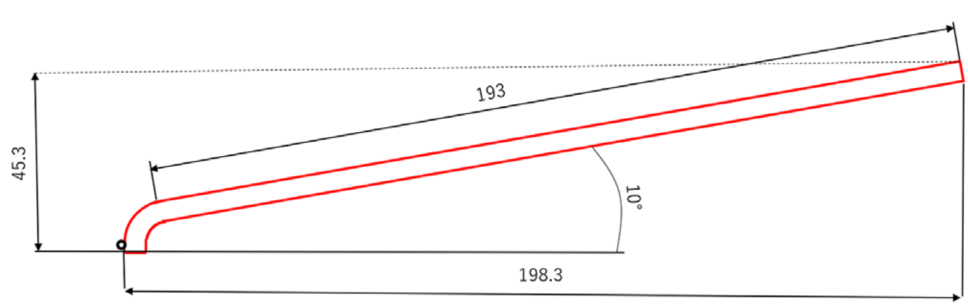

Fig. 1. Schematic diagram of the probes. The red line is the outline of the probe. Numbers are in millimeters.

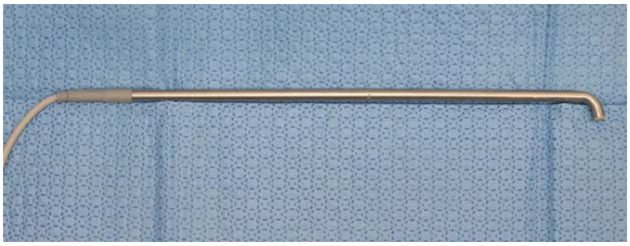

Fig. 2. Novel shaft for Doppler flowmetry. The shaft is thin and suitable for insertion in a limited space, such as the oral cavity. The tip of the shaft is gently bent, and the intersection angle with the shaft is close to 90 degrees. This allows the shaft to be pressed perpendicular to the flaps in the oral cavity.

Fig. 3. Connection of the probe. The novel shaft can be attached to the Doppler flowmetry body and used in the same manner as a conventional Doppler shaft.

CONCLUSIONS

Using the new type of shaft for Doppler flowmetry, we postoperatively monitored flaps that were transferred to the oral cavity, which is usually difficult because of the restricted nature of the transfer site. Blood flow disorder occurred in two postoperative cases, but both were salvageable. Doppler flowmetry is simple and noninvasive, and it can easily be performed by nonphysician medical personnel. Furthermore, it is considered a useful monitoring method after head and neck reconstructive surgery.

Table 1. Patient Characteristics

No.	Age/ Gender	Primary Disease	Type of Flaps	No. Anastomosis	Doppler Sound	Additional Operation	Flap Survival
1	65/M	Tongue ca.	RAMC	1A2V	Abnormal	Re-operation at 15 hours postoperatively (arterial spasm)	Survived
2	70/M	Floor of mouth ca.	ALT	1A2V	n.p	None	Survived
3	70/M	Mucosal ca.	ALT	1A2V	n.p	None	Survived
4	71/M	Tongue ca.	ALT	1A1V	Abnormal	Re-anastomosis at 13 hours postoperatively (Venous thrombus)	Survived
5	67/M	Mandible ca.	Fibula	1A2V	n.p	None	Survived
6	73/M	Floor of mouth ca.	ALT	2A3V	n.p	None	Survived
7	52/M	Mandible ca.	Fibula	1A2V	n.p	None	Survived
8	78/M	Tongue ca.	ALT	1A2V	n.p	None	Survived
9	61/F	Floor of mouth ca.	RAMC	1A2V	n.p	None	Survived
10	40/M	Mandible ca.	Fibula	1A2V	n.p	None	Survived
11	79/M	Floor of mouth ca.	ALT	1A2V	n.p	None	Survived
12	57/F	Mandible ca. rec.	Fibula	1A2V	n.p	None	Survived
13	70/F	Mandible ca. rec.	Scapula	1A1V	n.p	None	Survived
14	55/M	Tongue ca.	ALT	1A2V	n.p	None	Survived
15	39/M	Tongue ca.	ALT	1A2V	n.p	None	Survived
16	81/M	Upper gingival ca.	ALT	1A2V	n.p	None	Survived
17	78/F	Mandible ca.	ALT	1A1V	n.p	None	Survived
18	47/M	Tongue ca.	ALT	1A2V	n.p	None	Survived
19	72/M	Maxillary ca.	ALT	1A2V	n.p	None	Survived
20	63/F	Mandible ca.	ALT	1A1V	n.p	None	Survived
21	65/M	Tongue ca.	ALT	1A2V	n.p	None	Survived
22	71/F	Mandible ca.	Fibula	1A2V	n.p	None	Survived
23	50/F	Tongue ca.	ALT	1A2V	n.p	None	Survived
24	63/M	Tongue ca.	ALT	1A2V	n.p	Re-operation at 9 hours postoperatively (arterial thrombus)	Survived
25	71/F	Mandible ca.	Fibula	1A2V	n.p	None	Survived
26	55/M	Mandible ca.	Fibula	1A2V	n.p	None	Survived
27	63/M	Mandible ca.	Fibula	1A2V	n.p	None	Survived
28	78/F	Mandible ca.	ALT	1A1V	n.p	None	Survived
29	64/M	Upper gingival ca.	ALT	1A2V	n.p	None	Survived
30	75/M	Tongue ca.	ALT	1A2V	n.p	None	Survived

M, masculine; F, feminine; ca., carcinoma; rec, recurrence; ALT, anterolateral thigh flap; Fibula, fibula osteocutaneous flap; RAMC, rectus abdominis myocutaneous flap; Scapula, scapula osteocutaneous flap; A, arterial anastomosis; V, venous anastomosis; n.p, no problem.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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