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IDEAS AND INNOVATIONS

Reconstructive

Gemini Anastomosis for Dual Venous Anastomosis in Head and Neck Reconstruction

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Summary: Free tissue transfer has been frequently used in head and neck reconstruction. However, vascular problems still cause serious damage to patients when thromboses occur in microvascular anastomoses. In the Gemini anastomosis procedure, two flap pedicle veins are anastomosed adjacently to the internal jugular vein using the end-to-side anastomosis method. From April 2019 to March 2021, 12 patients whose free flaps had two pedicle veins underwent head and neck surgery in Saitama Cancer Center (Saitama, Japan). In six patients, the veins were anastomosed adjacently to the internal jugular vein using the Gemini procedure (Gemini group). In the other six patients, the veins were anastomosed to the internal jugular vein using the end-to-side anastomosis method at a distance from each other (control group). The anastomosis time was measured retrospectively by reviewing video from the operations and comparing them across groups. There were no reoperations in any patients, and all flaps survived without exhibiting any circulatory problems. The mean total anastomosis time in the Gemini group was 21 minutes 38 seconds ± 75 seconds. The mean total anastomosis time in the control group was 34 minutes 14 seconds ± 121 seconds. The mean flap ischemic time in the Gemini group was 124 minutes ± 3 minutes. The mean flap ischemic time in the control group was 135 minutes ± 6 minutes. The Gemini anastomosis procedure is effective and convenient when the pedicle has two veins and the recipient vein choice is only the internal jugular vein in head and neck reconstruction.
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INTRODUCTION

When the pedicle flap has more than two veins, there remains controversy whether a single venous anastomosis is sufficient or if a dual venous anastomosis should be performed for safety reasons. In our institution, the dual venous anastomosis is frequently performed when the pedicle flap has multiple veins. However, as other advocates of single venous anastomosis have described, the dual venous anastomosis procedure itself has some complications because an additional venous anastomosis is a time-consuming task. Therefore, to enhance efficiency of dual venous anastomosis, we invented a new dual venous anastomosis method called "Gemini anastomosis," in which the two veins are anastomosed adjacently at the same point of the internal jugular vein using the end-to-side anastomosis method. The new venous anastomosis method (dual-C: Gemini anastomosis) was compared with the traditional dual vein anastomosis method (dual-B) in the present study (Figs. 1 and 2).

MATERIALS AND METHODS

From April 2019 to March 2021, 12 patients in Saitama Cancer Center (Saitama, Japan) underwent head and neck surgery, in which their free flaps had two veins in the pedicles. In six patients, the veins were anastomosed adjacently to the internal jugular vein using the end-to-side anastomosis method at the same point via the Gemini anastomosis procedure described below (dual-C: Gemini group). In the other six patients, the veins were

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anastomosed to the internal jugular vein using the end-to-side anastomosis method at a distance from each other (dual-B: control group). In the dual-B procedure, an artery can be anastomosed after the first vein anastomosis, and then the second vein can be anastomosed after anastomosing one vein and artery. In the present study, only patients whose two veins were anastomosed consecutively and then underwent artery anastomosis were enrolled, in order to compare this method with the Gemini anastomosis (dual-C). The individual and total anastomosis time was measured retrospectively by reviewing operating room video and compared across groups.

Summary statistics of data are expressed as means ± standard error of the mean. Statistical comparison was performed by Mann Whitney test. Statistical significance was accepted at a *P* value less than 0.05. All statistical calculations were performed with the Prism software (GraphPad Software, Inc. San Diego, Calif.).

Takeaways

Question: Dual venous anastomosis seems superior to single venous anastomosis. In what ways can complications from dual venous anastomosis be further mitigated?

Findings: The two veins of the flap's pedicle can be anastomosed adjacently at the same point of the internal jugular vein using the end-to-side anastomosis method.

Meaning: The dual venous anastomosis can be performed quickly and easily using the Gemini anastomosis procedure.

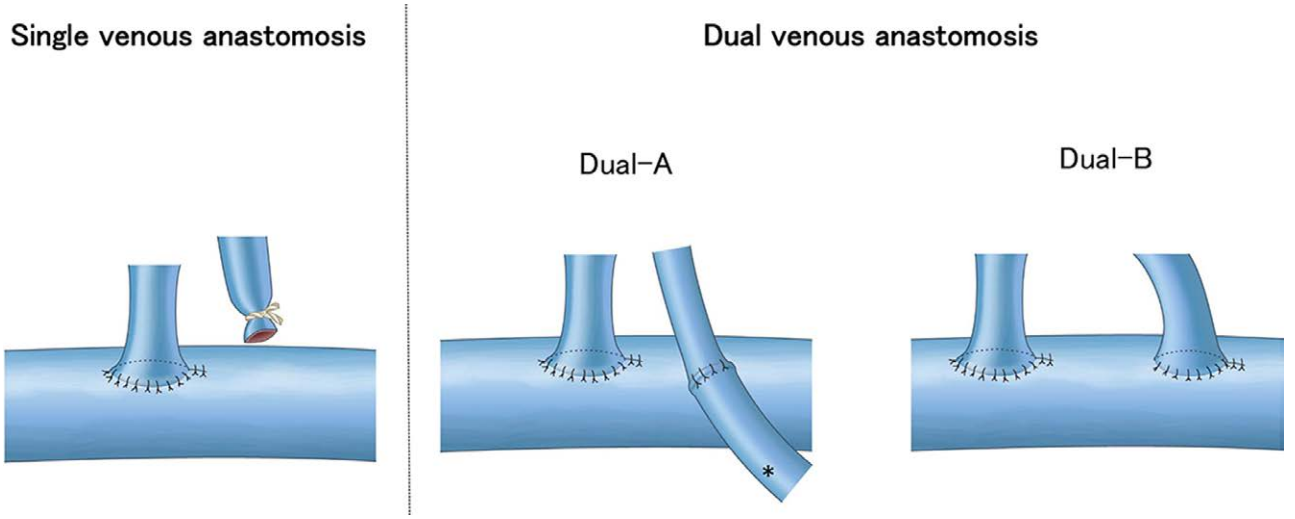

Fig. 1. The type of single venous anastomosis and dual venous anastomosis. Single venous anastomosis: one of the two veins is anastomosed to the internal jugular vein using the end-to-side method and another vein is ligated. Dual-A: one of the two veins is anastomosed to the internal jugular vein with the end-to-side method, and another vein is anastomosed to the internal jugular vein (*). Dual-B: the two veins are anastomosed to the internal jugular vein with the end-to-side anastomosis method at a distance from each other.

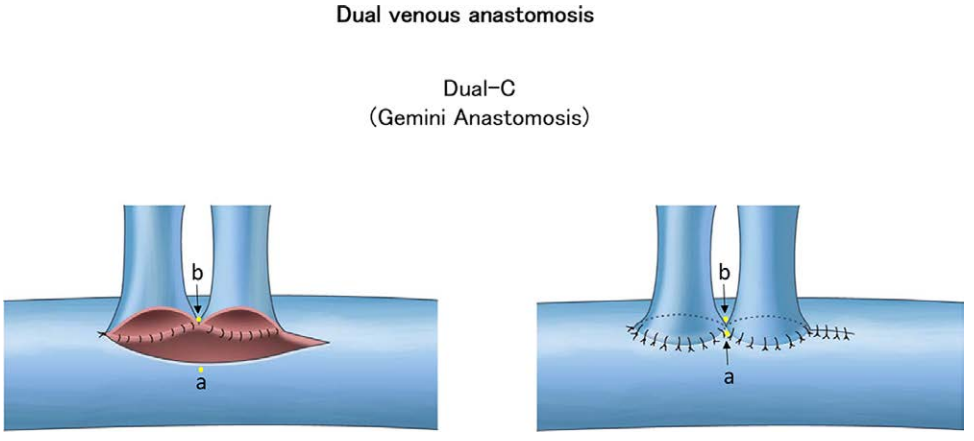

Fig. 2. Dual-C (Gemini anastomosis): the two veins are anastomosed adjacently to the internal jugular vein with the end-to-side anastomosis method at the same point. At this point, the wall of internal jugular vein is sutured between the first and second vein after suturing the first vein completely (points a and b).

GEMINI ANASTOMOSIS PROCEDURE

Under a surgical microscope, the internal jugular vein is clamped with a U-shaped clamp (BEAR Clip ES-150, BEAR Medic Corporation), and the vein's wall is partially resected with microscissors. The first vein of the flap pedicle is sutured to the internal jugular vein with 9-0 nylon (9-0 ETHILON, ETHICON) using a back wall technique until the back side wall is sutured completely to the internal jugular vein. The second vein of the flap pedicle is sutured immediately adjacent to the first vein until the back side wall is sutured completely to the internal jugular vein. Next, the front side wall of the first vein is sutured until the front side wall is sutured completely to the internal jugular vein. Next, the wall of the internal jugular vein is sutured between the first and second vein (Fig. 2 points a and b). Although the lumen would be larger without the suture, the lack of a suture would cause bleeding to emerge from the point between the first and second veins. Then the front side wall of the second vein is sutured until the front side wall is sutured completely to the internal jugular vein. If the opening of the internal jugular vein is larger than the two veins, the extra internal jugular wall is sutured to itself (Fig. 2). The two veins are anastomosed and nestled close to each other using a procedure we have named "Gemini anastomosis" (**See Video [online]**, which shows the Gemini anastomosis procedure.)

RESULTS

All flaps survived without any circulatory problems, and all patients were discharged without any wound problems. The summary of the mean anastomosis time is shown in Table 1.

The anastomosis time of the Gemini procedure itself was significantly longer than each anastomosis time (first anastomosis time and second anastomosis time) in the control group. However, total anastomosis time was significantly shorter in the Gemini group than in the control group (Table 1).

In one patient, the blood flow was examined with indocyanine green (ICG) fluorescence imaging technique, and the venous blood flow was confirmed as being appropriate (Fig. 3).

DISCUSSION

Although venous issues may arise in the circulatory flap compromise due to the poor choice of the recipient vein, poor surgical technique, or kinking/twisting of the vein when the flap is being inset, to prevent further venous issues, multiple venous anastomosis methods have been used and reported in several institutions; however, controversy remains about whether the dual venous anastomosis is superior to the single venous anastomosis. Hanasono et al reported that single venous anastomosis is sufficient and superior to the dual venous anastomosis in terms of flow velocity, time-efficiency, and simple pedicle geometry. Other authors have also supported the single venous anastomosis method.[1,2] On the other hand, dual venous anastomosis has been supported by several authors. For example,

Table 1. Summary of Anastomosis Time and Flap Ischemic Time

No	Age	Gender	Flap	Gemini Anastomosis Time	—	—	Total Anastomosis Time	Flap Ischemic Time
Gemini group (dual-C)								
1	52	M	Fibula	19:03	—	—	19:03	115 min
2	52	M	Fibula	22:23	—	—	22:23	140 min
3	69	M	ALT	23:40	—	—	23:40	119 min
4	66	M	ALT	26:25	—	—	26:25	128 min
5	73	M	Fibula	19:39	—	—	19:39	121 min
6	60	M	Fibula	18:39	—	—	18:39	122 min
Mean ± SE (min:sec ± sec)				21:38 ± 75*†	—	—	21:38 ± 75‡	124 ± 3 min
Control group (dual-B)								
No	**Age**	**Gender**	**Flap**	**First Anastomosis Time**	**Transit Time**	**Second Anastomosis Time**	**Total Anastomosis Time**	**Flap Ischemic Time**
1	47	M	ALT	15:38	8:50	13:47	38:15	122 min
2	70	F	FA	11:53	4:05	14:44	30:42	119 min
3	70	M	ALT	12:53	3:43	11:52	28:28	125 min
4	30	F	ALT	14:28	10:19	15:37	40:24	152 min
5	61	M	Fibula	16:36	7:09	13:24	37:09	152 min
6	65	F	Fibula	12:56	3:58	13:34	30:28	140 min
Mean ± SE (min:sec ± sec)				14:04 ± 44	6:21 ± 70	13:50 ± 75	34:14 ± 121	135 ± 6 min

*Significant difference versus control first anastomosis time ($P < 0.05$).
†Significant difference versus control second anastomosis time ($P < 0.05$).
‡Significant difference versus control total anastomosis time ($P < 0.05$).
Fibula, fibular flap; ALT, anterolateral thigh flap; FA, forearm flap; F, feminine; M, masculine.

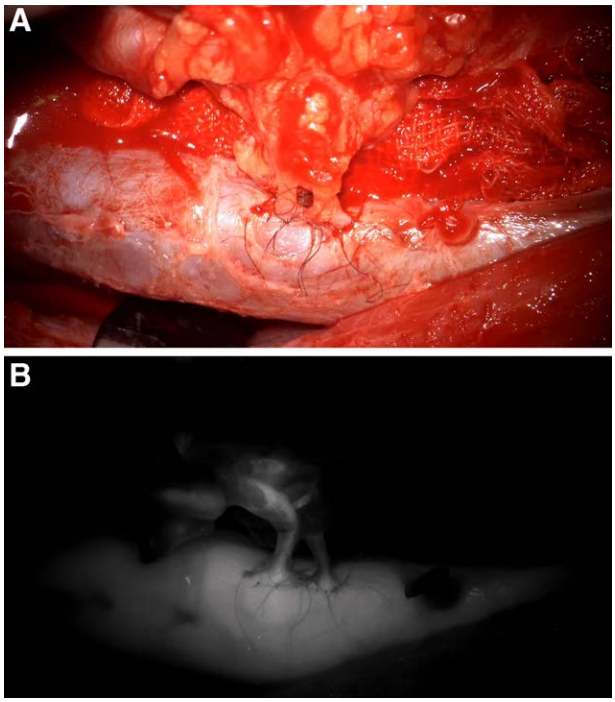

Fig. 3. The ICG blood flow examination. The two veins are anastomosed with the Geminin anastomosis procedure (A). The blood flow was examined with ICG fluorescence imaging technique (B).

Chaput et al and Riot et al used meta-analysis to describe superiority of dual venous anastomosis with regard to flap failure, venous thrombosis, and surgical revision, although the physiological mechanism is still poorly understood.[3,4]

Single versus dual anastomosis concerns aside, the ways in which the two veins are anastomosed in head and neck reconstruction when performing dual venous anastomosis has not been thoroughly discussed. The dual-A anastomosis (Fig. 1) was thought to be the ideal venous anastomosis because the flap veins can be anastomosed to both the internal and external jugular vein system. However, it is not feasible to use the external vein for anastomosis in all patients because of anatomical variation, intentional resection, and unintentional damage by oncological surgeons. Recently, it has been reported that end-to-side anastomosis to the internal jugular vein is better than end-to-end anastomosis to the extremal jugular vein.[5,6] When previously anastomosing two veins to the internal jugular vein, the two veins were anastomosed at our institution using the dual-B procedure. In the dual-B procedure, an artery can be anastomosed after the first vein anastomosis and then the second vein can be anastomosed after anastomosing one vein and artery. Similarly, the two veins can be anastomosed consecutively, and then an artery can be anastomosed as in the present study. We previously used both procedures in the dual-B method. However, after confirming the safety of the Gemini anastomosis procedure as shown in Figure 2 and the Supplemental Video, the Gemini anastomosis has been frequently used in our institution when the pedicle has multiple veins. The thrombus in one vein may easily affect another vein in Gemini anastomosis. Gemini anastomosis was successful in several dozen consecutive patients with no indication of any thrombus problem, to date. We believe that the blood flow area doubles in Gemini anastomosis, and the larger blood flow area decreases the risk of thrombus when compared with the single anastomosis.

By using Gemini anastomosis (dual-C), the extremely sensitive surgical task risk can be reduced, and the total anastomosis time significantly decreased in the Gemini group than in the control group, although the Gemini anastomosis takes a longer time than each single anastomosis in the control group. In addition, two veins are anastomosed adjoiningly at the same point in Gemini anastomosis, and unfavorable pedicle geometry can be avoided compared with dual-A and dual-B type anastomosis.

CONCLUSION

When a pedicle flap has two veins, and the only recipient vessel option is the internal jugular vein, the two veins can be safely anastomosed to the same point adjacently using end-to-side anastomosis.

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