

Head and neck free flap reconstruction under the COVID-19 pandemic

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ABSTRACT

High perioperative mortality and complication rates during the coronavirus disease 2019 (COVID-19) pandemic have been reported. In head and neck reconstruction, not only is patient safety important, but the prevention of infection introduced by the surgical team is also important because the procedure is performed in close proximity to the upper respiratory tract. In addition, recent studies have reported an increased risk for thrombus formation after infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) or COVID-19 vaccination, which is problematic for microsurgical reconstruction procedures. At the authors' institution, patients undergoing head and neck reconstruction are requested to stay home for 2 weeks and undergo screening tests for COVID-19 before admission. Surgeons use standard personal protective equipment during surgery. There was no significant difference in the rate of total flap necrosis between the COVID-19 and non-pandemic periods or large difference of perioperative complication rates between vaccinated and non-vaccinated patients. No surgery-related infections among the surgical staff were also found.

Keywords: COVID-19, microsurgical reconstruction, thrombus formation

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INTRODUCTION

Infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of coronavirus disease 2019 (COVID-19), has been attributed to the first case of infection in Wuhan, China, and began to spread in Japan with an outbreak in January 2020, and the number of infected patients increased dramatically after late March 2020. Elective surgery was postponed at many institutions, and radiation therapy was recommended for patients with radiosensitive malignancies. As measures to deal with COVID-19 were gradually explored and implemented, surgeries resumed as usual. As the perioperative risks of COVID-19 infection became clear, protocols were developed at various institutions regarding the wait period for surgery after infection. Vaccinations began in autumn of 2020, and reports of post-vaccination thrombus formation

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began to emerge. Thrombus formation has also been reported as one of several complications after infection with SARS-CoV-2. Given that using the free flap is now the gold standard for reconstruction(s) in the head and neck region,^{1,2} thrombus formation after infection or vaccination may affect reconstructive surgery. While many institutions have downgraded head and neck reconstruction from free flap to local flap, authors' institution has continued to utilize free flap without downgrading the surgical procedure.^{3,4} At our institution, all patients undergoing elective surgery were requested to stay home for 2 weeks before admission, and polymerase chain reaction (PCR) or antigen testing was performed immediately before admission. Reconstructive head and neck surgery was performed using standard protective measures including goggles, masks, and gowns. Head and neck reconstructions using the free flap performed between April 2020 and April 2023 were reviewed for safety of the microsurgical procedure, association(s) between vaccination and thrombus formation, and infection rates among the surgical staff.

MATERIALS AND METHODS

Data from microsurgical reconstructions of the head and neck region, performed at Nagoya University Hospital (Nagoya, Japan) between April 2020 and April 2023, were reviewed. The period covered was the period when the total number of COVID-19 patients in Japan was determined. Patients with head and neck cancer who required free-flap reconstruction were included in this study. Sex, age, medical history, vaccination status, SARS-CoV-2 infection, interval between infection and surgery, interval between vaccination and surgery, perioperative complications, perioperative mortality, and medical staff infections were examined.

As part of the hospital's infection control measures, all patients were asked to stay at home for 2 weeks before admission and were required to check their temperature and monitor upper respiratory tract symptoms daily. PCR testing was performed on admission in August 2020. Beginning in July 2021, antigen testing was used for screening instead of PCR. Vaccination was initiated in Japan in May 2021. Surgery was performed 3 weeks after vaccination. For patients with SARS-CoV-2 infection, the interval was 4 weeks for those who had no history of previous infection and were asymptomatic or experienced mild symptoms, 6 weeks for those who had moderate or severe symptoms and did not require hospitalization, 8 weeks for those who had diabetes or immunosuppressive status and required hospitalization, and 12 weeks for those who required intensive care unit (ICU) admission (Table 1).⁵ Otolaryngologists, oral surgeons, neurosurgeons, and plastic surgeons involved in the reconstruction(s) wore gowns, goggles, gloves, and masks as personal protective equipment to perform the surgeries.

Comparison was made between the COVID-19 pandemic period and the past 3 years before the pandemic. Postoperative complications related to the flap necrosis were evaluated using Clavien-Dindo grading system. Data were analyzed using Fisher's exact test, and differences with $P < 0.05$ were considered to be statically significant.

Table 1 Timing of elective surgery after COVID-19 infection at our institution

Asymptomatic or minor illness	4 weeks
Moderate disease	6 weeks
DM, immunosuppressive, hospitalize	8 weeks
ICU admission	12 weeks

DM: diabetes mellitus

ICU: intensive care unit

Ethics considerations

The present study was conducted in accordance with the principles of the Declaration of Helsinki. All study participants provided informed consent, which was approved by the Nagoya University Hospital Institutional Review Board (approval No. 2023-0247). Patient identity was protected.

RESULTS

During the study period, 132 free-flap reconstructions were performed at the authors' institution. Resection of the primary lesion was performed by an otolaryngologist or dental surgeon. Free-flap reconstruction was performed by plastic surgeons in all cases. Of the patients included in this study, 102 were male and 30 were female, with a mean age at surgery of 66.4 years. Indications for surgery in the 132 reconstructions included the following: hypopharyngeal cancer (n=44); oral cancer (n=43); nasal and paranasal sinus cancer (n=14); temporal bone tumors (n=10); oropharyngeal cancer (n=8); cervical esophageal cancer (n=5); laryngeal cancer (n=3); mandibular bone tumors (n=2); and parotid cancer, orbital tumor(s), and olfactory nerve tumor(s) (n=1, each). The following flaps were used: free jejunal flaps (n=49); free rectus abdominis flaps (n=35); free anterolateral thigh flaps (n=26); free greater omentum flaps (n=9); free peroneal osteocutaneous (n=5); free forearm flaps (n=4); free scapular flaps with scapular bone (n=1); and free peroneal osteocutaneous flaps with free anterolateral thigh flaps, free peroneal osteocutaneous flaps with free rectus abdominis flaps, and free greater omentum flaps with free jejunal flaps (n=1, each) (Table 2). The superior thyroid artery was the most commonly used recipient artery, followed by the transverse cervical artery. The external jugular vein was the most commonly used vein, followed by the internal jugular vein (Table 3). Total flap necrosis occurred in 2 cases. One patient was diagnosed with COVID-19 preoperatively, and surgery was performed after a four-week wait period. Seven patients experienced complications of Clavien-Dindo grade IIIa or higher, including 2 postoperative hemorrhage, 1 partial flap necrosis, 2 total flap necrosis and 2 perioperative deaths. In the past 3 years before the pandemic, 179 free-flap head and neck reconstructions were performed at the authors' institution. Of the patients included in the comparison period, 127 were male and 52 were female, with a mean age at surgery of 64.1 years. Fifteen patients experienced complications of Clavien-Dindo grade IIIa or higher, including 1 perioperative death and 5 total flap necrosis in the comparison period. There was no significant increase in flap necrosis, complications of Clavien-Dindo grade III or higher and mortality during the COVID-19 pandemic compared with reconstructions performed at the authors' institution during the past 3 years. Forty-four patients were vaccinated preoperatively and the mean wait period after vaccination was 15 weeks. There was no significant difference in complication rates between vaccinated and nonvaccinated patients (Table 4). No surgery-related SARS-CoV-2 infection(s) was observed among the surgical staff.

Table 2 Demographic and clinical characteristics

Male:Female	102:30		
Age	27–89 y.o (Average 66.4)		
Primary lesion	Hypopharynx	44	
	Oral	43	
	Nasal and paranasal sinus	14	
	Temporal bone	10	
	Oropharynx	8	
	Cervical esophagus	5	
	Larynx	3	
	Mandibular bone	2	
	Parotid gland	1	
	Orbit	1	
	Olfactory nerve	1	
	Flap	Jejunum	49
		RA	35
		ALT	26
OM		9	
Fibula		5	
Forearm		4	
Scapular with bone		1	
Fibula + ALT		1	
Fibula + RA		1	
OM + jejunum	1		

RA: rectus abdominis flap
 ALT: anterolateral thigh flap
 OM: omentum

Table 3 Recipient arteries and veins

Artery		Vein	
Superior thyroid	66	Eternal jugular	81
Transverse cervical	36	Internal jugular	47
Facial	12	Common facial	8
External carotid	8	Superficial temporal	3
Lingual	8	Superior thyroid	2
Superficial temporal	3	Transverse cervical	1
Internal thoracic	1	Internal thoracic	1

Table 4 Postoperative complication rate

	Number of cases	Complication	No statistical difference
Vaccinated patients	44	3 (7.3%)	(p=0.6855)
Unvaccinated patients	88	4 (4.5%)	

DISCUSSION

At the beginning of the COVID-19 pandemic, elective surgeries were postponed ensuring the safety of the medical staff. In patients infected or suspected to be infected with COVID-19, the use of N95 masks or highly protective masks during procedures that can generate aerosols was recommended.⁶ Although head and neck surgery is considered to be associated with a high risk of COVID infection due to the proximity of the airway, surgery was not performed on patients with suspected COVID-19 infection because the acuity of the surgery was low.

An analysis of the perioperative period in patients with COVID-19 worldwide has revealed a high mortality rate due to perioperative infection.⁷ Although it has been reported that perioperative mortality decreases 7 weeks after COVID-19 infection,⁸ patient background and severity of infection were not considered; therefore, our institution performed surgery according to the criteria recommended by the American Society of Anesthesiologists (ASA).⁵ Of the 132 patients, only one was found to have COVID-19 infection preoperatively. Because the symptoms were mild, and the patient had no preexisting medical history, and underwent reconstructive surgery after a four-week wait period from the time of infection, and the patient's postoperative course was uneventful. Setting a wait period based on ASA guidelines enables safe surgery.

The incubation period for COVID-19 is approximately 4–5 days.⁹ At our institution, all patients were requested to stay at home before admission to avoid perioperative infection as much as possible, and they underwent screening tests on hospital admission. Patients who underwent head and neck reconstructive surgery were tested for SARS-CoV-2 in 4 or 5 days before surgery. None of the patients failed the screening test or developed an infection postoperatively. One patient found to be infected preoperatively developed an infection on day 2 of hospitalization due to close contact with an infected patient. Although infection was not evident at that point, scheduled surgery was postponed, and the patient was discharged from hospital due to risk for of infection. Four days after close contact, the patient developed fever, and the antigen test was positive; therefore, surgery was scheduled 4 weeks after the infection.

Thrombus formation has also been reported as a complication of SARS-CoV-2 infection.¹⁰ To reduce patient invasiveness and decrease exposure time for the surgeon and surgical staff, a shift in flap selection for head and neck reconstruction from a free flap to a local flap has also been considered.¹¹ At our institution, there was only 1 case of preoperative COVID-19 and no cases of postoperative SARS-CoV-2 infection; therefore, it is unlikely that the infection occurred at the time of surgery. The reconstruction method was the same as that used for cases operated before the COVID-19 pandemic, and none of the cases required conversion to local flaps. There was no significant difference in flap survival rates compared with those 3 years before the COVID-19 pandemic. These results indicate that the same reconstruction methods could be used during the COVID-19 pandemic.

The risk for thrombus formation, even after vaccination, has been reported.^{12,13} The risk for thrombosis due to vaccination is known as vaccine-induced thrombotic thrombocytopenia (VITT), and increases for approximately 15 days after vaccination. Based on these results, anesthesiologists at authors institute recommend 3 weeks interval between surgery and vaccination. We followed this recommendation in 44 vaccinated patients except for 1, and surgery was performed without any effect of vaccination. Although some reports suggest that vaccination may protect against postoperative complications,¹⁴ we found no significant difference in postoperative complications between vaccinated and nonvaccinated patients at our institution. As such, it remains unclear whether vaccination has protective effects against postoperative complications.

Two postoperative deaths occurred in this study period. One patient with history of COVID-19 vaccination 21 weeks prior to the surgery developed subarachnoid hemorrhage on the second

postoperative day and died on 18th postoperative day. The other patient with no history of vaccination and COVID-19 infection died the 24th postoperative day. CT scan revealed no evidence of pulmonary embolism, deep vein thrombosis, or any other thrombosis. The cause of the death was unclear. In both cases, it was concluded that the deaths were not COVID-19 related.

Total flap necrosis occurred in 2 cases. One patient with no history of vaccination and COVID-19 infection developed total flap necrosis on 6th postoperative day. The other patient with history of COVID-19 vaccination 25 weeks prior to the surgery developed total flap necrosis on 13th postoperative day. CT scan showed the internal jugular vein thrombosis, which was considered an incidental complication of the surgical procedure. Blood test of the patient revealed platelet counts within normal range ($29.0 \times 10^4 \mu\text{L}$) and mild elevation of d-dimer (1.70 ng/mL). The possibility that the patient had developed VITT was negative because a long period of time had elapsed since vaccination.

In Japan, notifiable disease surveillance for the number of patients with COVID-19 was terminated in accordance with the Infectious Disease Control Law on May 8, 2023, and screening at admission was completed at our institution, conforming to the law. Patients who underwent head and neck reconstruction were admitted to the hospital 4 days before surgery since before the pandemic. The incubation period for SARS-CoV-2 is approximately 4–5 days, with some cases exhibiting an incubation period > 10 days. In addition, many cases of subclinical infection(s) have been reported. Therefore, the possibility of performing surgery in patients with infections was also considered. COVID-19 can lead to postoperative complications and exposure of surgical staff to infection; therefore, it is necessary to recommend the pre-admission self-isolation of surgical patients.

This study had some limitations, among which included its single-center, retrospective design and small sample size, with inherent susceptibility to bias and confounders.

CONCLUSION

We investigated cases of head and neck free-flap reconstruction during the COVID-19 pandemic. Results of analysis were similar to those from before the COVID-19 pandemic. Results revealed that a certain wait period after SARS-CoV-2 infection and COVID-19 vaccination enabled surgery to be performed without being affected by these factors. The use of standard precautions ensured the safety of the staff involved in the surgery.

CONFLICT OF INTEREST

The authors declare no conflicts of interest directly relevant to the content of this article.

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