

Reconstructive Microsurgery in the COVID-19 Environment

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Summary: The COVID-19 pandemic has presented unique challenges to the plastic surgery field. Substantial changes have been incorporated in hospital and practice protocols in all branches of medicine. Organic medical teams were placed on scheduled shifts to prevent cross-infection, and some working teams were discontinued. Remote technology consultations and deliberations were instituted in hospitals and community medical services to maintain the flow of information on patient status. Several mitigation strategies were implemented during these times throughout medical facilities. We present those implemented in our facility to ensure adequate labor, resources, and facilities along with proper protocols for patient selection and management according to predetermined risk assessment criteria with the hope to assist the healthcare staff to minimize mortality risks. (*Plast Reconstr Surg Glob Open* 2021;9:e3691; doi: [10.1097/GOX.0000000000003691](https://doi.org/10.1097/GOX.0000000000003691); Published online 29 June 2021.)

The outbreak of the COVID-19 pandemic in December 2019 mandated the incorporation of substantial changes in hospital and practice protocols in all branches of medicine.¹ To avoid straining essential resources, hospitals had to free up healthcare staff to provide medical care for infected patients, resulting in fewer professional physicians on hospital wards.² Some working teams were dismantled and reorganized as self-contained medical teams and placed on scheduled shifts to prevent cross-infection,³ and remote technology consultations and deliberations were instituted to maintain the flow of information on patient status.⁴

Amid all these adjustments, optimizing patient care posed novel challenges to the health care system. Several mitigation strategies were implemented, including non-pharmaceutical interventions such as decontamination of surfaces and equipment, minimizing patient and surface contact, and waste management to limit exposure of patients and staff⁵ albeit at the risk of hampering medical follow-up and postoperative management. As in the

influenza pandemic of 1918, social distancing and quarantine remained the main focus for reducing viral spread.⁶ Although modern technology undoubtedly assisted in managing patients with COVID-19, the sparsity of knowledge on patient outcomes in previous pandemics⁷ precluded comparisons of strategies to resist viral spread.

Studies have described the important modifications instituted specifically in surgery departments in response to the pandemic. All aspects of surgical procedures were affected,⁸ from testing patients for COVID-19 before interventions to patient prioritization and the introduction of stringent safety measures and guidelines for postoperative care.³ Surgical teams carefully adhered to consensus recommendations for operating room (OR) behavior during the pandemic and the use of personal protective equipment (PPE) (goggles, N95 face mask, blood-repelling gown, gloves).⁹ In some institutes, ORs were fitted with negative-pressure laminar flow systems with frequent air exchange, and rooms adjacent to the OR were set aside (or even constructed) exclusively for donning and removing protective equipment. General anesthesia was achieved by rapid-sequence induction if possible and carried out by a minimal number of staff members,¹⁰ with close and continuous monitoring for optimal outcome. Additionally, in patients after resection of head and neck cancer, wounds were covered with local flaps instead of free flaps (the preferred method) to both shorten operative time and minimize the need for follow-up.⁶ After surgery, patients were

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transferred directly from the OR to the ward, bypassing the recovery room.⁹ Importantly, before surgery, patients were counseled regarding possible prolonged anesthesia time and the potential repercussions of newly instituted measures on postoperative management.⁷

As the COVID-19 pandemic largely impacted medical centers, attention was directed mainly at the availability and use of protective gear and facility preparedness.^{5,9} However, categorizing procedures by urgency and feasibility remained problematic.¹¹ The main purpose of this special topic article was to help the staff adapt to the new conditions to ensure quality patient care even under pandemic conditions. We present a protocol that focuses on patient medical status and procedure urgency, down to the level of the individual, which was based on the strategies and techniques instituted at the Department of Plastic Surgery and Burns of Rabin Medical Center, one of the largest such departments in Israel. The importance of taking preliminary measures to guarantee preparedness for future medical emergencies is emphasized.

DEPARTMENTAL PROTOCOL FOR MITIGATING RISK DURING THE COVID-19 PANDEMIC (FIG. 1)

Preoperative Measures

Patient Prioritization

1. At the regular weekly departmental conference for review and assessment of preoperative patients, cases are to be reclassified by urgency. Only patients whose operative procedure cannot be delayed (cancer, major trauma, etc) will be admitted, and elective/nonurgent surgeries should be postponed on a case-by-case basis. Delayed breast reconstruction procedures using autologous tissues will be rescheduled, in addition to secondary procedures such as correction of postablation facial anomalies.

2. To maintain adequate staffing levels and adherence to the modified working schedule, the medical staff will be divided into teams, each with the capabilities to handle all types of plastic surgery. The teams will meet only via virtual platforms such as Zoom (Zoom Video Communications, Inc., San Jose, Calif.) or Teams (Microsoft, Inc., Redmond, Wash.). The latter is the preferred institutional platform because it allows for data encryption at rest and during transit.

Patient Testing and Allocation

1. All patients who require urgent surgery must undergo a COVID-19 test. Those found to be positive will be transferred primarily to the medical center’s multidisciplinary satellite hospital, where added safety measures are taken. (See document, **Supplemental Digital Content 1**, which displays the protocol for surgical management of COVID-19-positive patients. <http://links.lww.com/PRSGO/B708>.) The satellite hospital is designed for the performance of all tasks and procedures in all fields for patients diagnosed with COVID-19. Patients are considered contagious for the first 10 days.
2. If surgery cannot be performed in the satellite hospital or is delayed, patients will be transferred to a COVID-19 multidisciplinary department in the main hospital. (This item was added at later stages of the pandemic.)
3. Patients testing negative for COVID-19 may undergo surgery at the department following verification of the urgency of the procedure. No added personal protective equipment is required.
4. In addition to routine preoperative evaluations, anesthesiologists must perform a thorough preoperative assessment of respiratory and cardiovascular status.¹² [This item was added as more information on post-COVID-19 functional compromise became available.]

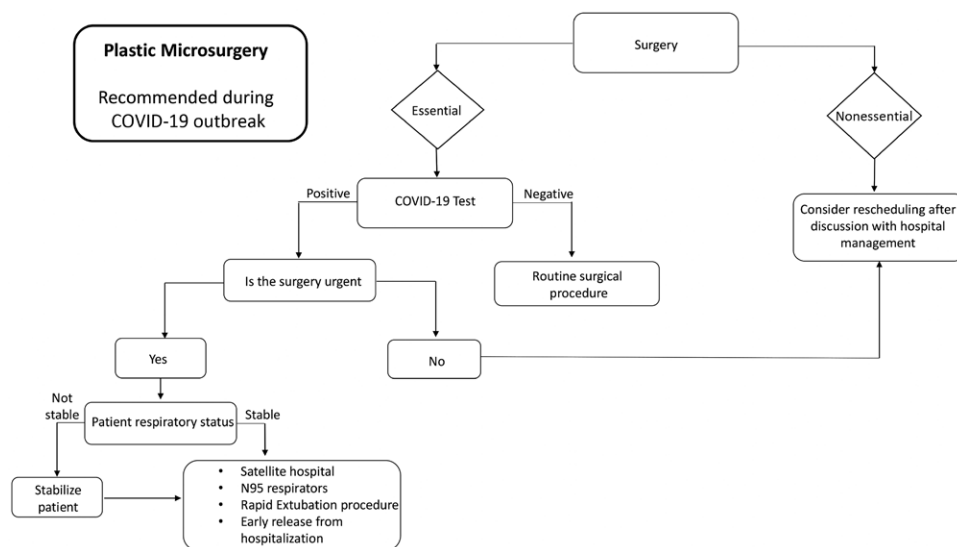


Fig. 1. Mitigation strategies implemented at the Department of Plastic Surgery during the COVID-19 pandemic.

Anesthesia

1. All medical personnel at the department who are involved in interventions requiring close contact with patients (including intubation, induction of regional anesthesia, cannulation or catheterization, and surgery) are required to wear an N95 face mask and protective eye gear.
2. Anesthesia is to be initiated already in the preoperative stage. If possible, the positive pressure will be turned off and the negative pressure will be turned on.

Intraoperative Measures

1. After satisfactory preoxygenation, induction and paralysis agents should be applied in rapid succession to avoid the generation of high concentrations of infectious respiratory aerosols associated with tracheal intubation.⁷
2. In the event of a significant shortage of medical resources and personnel, nonoperative approaches should be considered if medically acceptable, such as the use of advanced dressings for poorly healing wounds until they can be closed by free flaps.

Postoperative Measures

1. Rapid extubation is to be performed in the OR, if possible, when the patient's condition is stable. Before extubation, two layers of wet gauze should be placed over the patient's nose and mouth to prevent staff exposure to aerosolized secretions.¹⁴ Nurses and anesthesiologists must wear personal protective equipment outside of the OR, and patients are transported in a special elevator. One person should be assigned to clear the transfer channel in advance to reduce possible exposure of unrelated personnel.
2. As microsurgery operations are often prolonged compared with minor surgery, patients may require up to 24 hours of respiratory ventilator use. Thus, postoperative respiratory problems are not uncommon, and as required in routine procedures, during the pandemic, patients are to be followed by a multidisciplinary team, including an anesthesiologist and pulmonologist.
3. COVID-19 tests are mandatory at regular intervals throughout hospitalization. If findings in a patient underwent an operation are negative, no treatment for COVID-19 is necessary, and some postoperative tasks may be transferred to nonoperating personnel.
4. Multiple COVID-19 infections have been reported following visits by family and friends. Therefore, visitors will be limited to one per patient.
5. Patients are to be discharged home early if considered capable.

The protocol for COVID-19-positive patients treated in the satellite hospital is outlined in Supplemental Digital Content 1 (See document, Supplemental Digital Content 1,

which displays the protocol for surgical management of COVID-19-positive patients. <http://links.lww.com/PRSGO/B708>).

At the time this article was written, 39 patients had undergone microsurgical reconstruction in our department according to our COVID-19 protocol: 17 head and neck, 16 orthopedic, and six neurosurgical procedures. None of the patients were positive for COVID-19 before surgery, and six tested positive during in-hospital follow-up and recovery.

DISCUSSION

Microsurgery practice has undergone several major adjustments during the COVID-19 pandemic to reduce potential risks of viral exposure to medical staff and patients. Mitigation strategies applied in our facility included staffing-based working schedules, prioritization of patients with postponement of nonurgent surgeries, changes in anesthesia induction and certain surgical procedures, and rapid patient discharge. These proved highly efficient as evidenced by the absence of positive COVID-19 test results among the staff despite their continuous interactions with patients, including airway and oral procedures.

The algorithm for patient care that we recommend is linked to the status of the individual patient. In the event that surgery is essential, a COVID-19 examination is performed, followed by a second assessment of surgical urgency. If respiration is stable, surgery is performed under the protective measures described.

To the best of our knowledge, and as stated in previous publications,¹⁵ no protocol for microsurgery has fully included all aspects of management during pandemics. The information provided here on the formation of self-contained medical teams, shift-work schedules alongside medical staff testing, medical equipment, and OR anesthesia and surgical procedures will be of great assistance to medical teams. Although such measures may also aid in improving patient care under routine conditions, a tailored protocol is needed in critical times to guarantee the correct response of hospital medical staff. Additionally, changes in healthcare capacity should be taken into consideration when interventions are implemented.¹²

CONCLUSIONS

The probability, timing, and repercussions of future waves of COVID-19 remain unclear, and the healthcare system will doubtless face severe burdens. Ensuring adequate labor, resources, and facilities along with proper protocols for patient selection and management according to predetermined risk assessment criteria will assist the healthcare staff to minimize mortality risks.

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