Breast reconstruction during the COVID-19 pandemic
A systematic review

Pengfei Sun, MD\textsuperscript{a}, Fang Luan, MD\textsuperscript{b}, Di Xu, MD\textsuperscript{c}, Rui Cao, MD\textsuperscript{d}, Xia Cai, MD\textsuperscript{a,}\textsuperscript{c}.

Abstract

Background: The novel coronavirus disease 2019 (COVID-19) has changed people’s way of life and posed great challenges to plastic surgery. Most of plastic surgeries are considered elective surgeries and are recommended to be delayed. But breast reconstruction in plastic surgery is special. Doctors’ associations from different countries have different rules on whether breast reconstruction surgery should be delayed. For the controversial topic of immediate breast reconstruction in the COVID-19 pandemic, we conducted this study.

Methods: We searched English databases such as PubMed, Cochrane Library, and Embase. The publication time of papers was set to be from the establishment of the databases to February 2021. All studies on immediate breast reconstruction in the COVID-19 pandemic were included in our study.

Results: A total of 6 studies were included in this study. Four studies recommended the use of breast implants or tissue expansion for breast reconstruction surgery and had good results in their clinical practice. In addition, 1 study planned to use autologous free tissue transfer for breast reconstruction, and 1 study planned to use microsurgical techniques for breast reconstruction. But these 2 technologies are still in the planning stage and have not yet been implemented.

Conclusions: In our opinion, breast cancer surgery belongs to confine operation, and breast reconstruction surgery should be performed immediately after the completion of breast cancer surgery. We recommend the use of breast implants for breast reconstruction surgery during the COVID-19 epidemic. Due to the limitations of the study, our proposed protocol for breast reconstruction surgery during the COVID-19 epidemic needs to be further validated in clinical studies.

Abbreviations: COVID-19 = coronavirus disease 2019, SARS-CoV-2 = severe acute respiratory syndrome coronavirus-2.

Keywords: breast reconstruction, COVID-19, plastic surgery, SARS-CoV-2

1. Introduction

The novel coronavirus disease 2019 (COVID-19), which broke out in December 2019, has spread around the world.\textsuperscript{[1]} It has changed people’s way of life and posed great challenges to plastic surgery.\textsuperscript{[2–4]} Most of plastic surgeries are considered elective surgeries and are recommended to be delayed.\textsuperscript{[5]} But breast reconstruction in plastic surgery is special. It is important for the confidence and quality of life of breast cancer patients.\textsuperscript{[6]} Doctors’ associations from different countries have different rules on whether breast reconstruction surgery should be delayed. American Society of Breast Surgeons had proposed a priority group for breast cancer surgery and suggested immediate breast reconstruction. They recommended that it is best to use a tissue expander or breast prosthesis and postpone breast reconstruction surgery with an autograft. But the Argentine Society of Breastology had recommended postponing all immediate breast reconstruction.\textsuperscript{[7]} For the controversial topic of immediate breast reconstruction in the COVID-19 pandemic, we conducted this study. It is hoped that the results of our study can provide a reference for plastic surgeons to conduct immediate breast reconstruction surgery in the COVID-19 pandemic.

2. Methods

2.1. Search strategy

We searched English databases such as PubMed, Cochrane Library, and Embase. The publication time of papers was set to
be from the establishment of the databases to February 2021. Keywords retrieved were “Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), “COVID-19”, “Mammoplasty”, “Breast Reconstruction”, “Plastic Surgery”. There was no language restriction for this search.

2.2. Study selection

2.2.1. Inclusive criteria. Studies on immediate breast reconstruction in the COVID-19 pandemic. The subjects were patients undergoing immediate breast reconstruction, not animals or cells. Specific measures for immediate breast reconstruction were found in studies.

2.2.2. Exclusive criteria. The following were the exclusion criteria: duplicate publications in the databases; no specific measures for immediate breast reconstruction were found in studies; the subjects were not patients undergoing immediate breast reconstruction.

2.3. Ethical review

This study is a secondary analysis of published articles, and therefore does not require the approval of the Medical Ethics Committee. This article does not contain any studies with human participants or animals performed by any of the authors. For this type of study informed consent is not required.

2.4. Data extraction and data synthesis

Two researchers independently extracted the author’s name, publication time, study area, and specific measures for immediate breast reconstruction. The types of articles included in this study made it impossible to perform a quantitative analysis, and so the findings were pooled and presented in a narrative form and in tables.

3. Results

After searching databases, a total of 86 related articles were retrieved. Two researchers screened the studies by reading abstracts and full texts, and a total of 6 articles[6–13] were included in this study. The study selection flow is shown in Figure 1. We summarized the 6 included studies, as shown in Table 1.

In Sanchez et al’s protocol[8] physicians assessed patients’ risk of COVID-19 infection by phone prior to admission. Upon arrival to the hospital, patients underwent severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) blood quick testing. Patients with a negative test received a nasopharyngeal swab (real-time reverse transcription-polymerase chain reaction assay). Patients infected with SARS-CoV-2 were treated in isolation. Patients who were not infected with SARS-CoV-2 were observed for at least 4 days and swabs were repeated every 48 hours. If 2 consecutive swabs resulted negative with the patient asymptomatic, surgical treatment was delivered. Reconstruction was preferentially performed with a pre-pectoral implant or a tissue expander. After the patients were discharged from hospital, they continued to restrict contact with their families. Postoperative visits were scheduled in a special area of the hospital with direct external access, to limit risk of COVID-19 exposure. An emergency helpline was established that patients could promptly access for any postoperative need.

Lisa et al[9] and Perez-Alvarez et al’s protocols[10] were for physicians to examine patients pre-operatively for SARS-CoV-2 infection. Reconstructive breast surgery was performed for patients who met the surgical requirements. Patients were subjected to strict anesthesia and pain control during the operation. Reconstruction was performed with a pre-pectoral implant. Postoperative remote medical guidance was given to every patient. They called this protocol the same-day surgery program.

Specht et al’s protocol[11] involved patients communicating with oncologists and plastic surgeons via video conferencing before surgery. Doctors used the Internet to make specific treatment plans for their patients. Patients were treated with a strict total intravenous anesthesia regimen during the operation to maximize patient comfort and avoid postoperative nausea and vomiting. Reconstructions were performed with pre-pectoral implants. After all patients were discharged from hospital, the plastic surgeons kept in touch with the patients through the network and dealt with the patients’ problems. Patients’ travel should be minimized and nosocomial exposure to SARS-CoV-2 should be limited.

Masud et al’s protocol[12] involved low-risk patients attending pre-operative virtual forum consultations with surgeons, specialist nurses, and physical therapists. The diagnosis and treatment plans can be formulated through virtual forum consultation to shorten the time of face-to-face consultation. Patients who met the surgical requirements were operated on by autologous free tissue transfer for breast reconstruction. After breast reconstruction surgery, the virtual breast reconstruction forum can be fully played to provide follow-up services for patients.

Ali et al’s protocol[13] was for patients to discuss via the Internet with a multidisciplinary breast team consisting of oncologists, breast teams, and radiologists. After 2 weeks of self-isolation, the patient was admitted to the hospital for COVID-19 screening, and the patient underwent breast reconstruction surgery after 2 days of hospital isolation observation. The procedure was immediate microsurgical breast reconstruction. All drainage tubes were removed on the second day after surgery and discharged on the third day after surgery. Postoperative guidance was conducted by telephone.

4. Discussion

The COVID-19 has lasted for more than a year, and more than 100 million people worldwide have been SARS-CoV-2 infected. Medical systems in many countries and regions have been severely affected.[14] In order to treat COVID-19 patients, many plastic surgery procedures have been postponed. However, breast reconstruction surgery is carried out immediately after radical breast cancer surgery, which has an important impact on the quality of life and mental health of breast cancer patients.[15] Doctors around the world have debated the safety of breast reconstruction surgery during the COVID-19 pandemic. In our opinion, breast cancer surgery belongs to con...

Through the review of the included literature, we found that the similarities of the breast reconstruction surgery plans developed by the authors during the COVID-19 epidemic were as follows: Pre-operative consultations of patients were conducted through the Internet, and comprehensive treatment plans
were developed for patients through multidisciplinary cooperation. Patients were rigorously screened for COVID-19 preoperatively to ensure that they were not infected with SARS-CoV-2. Breast reconstruction should be performed with implants as far as possible to reduce the operative time and postoperative recovery time. Strict anesthesia and pain control should be carried out to make the patients recover from the anesthesia as soon as possible, and the pain should be the minimum level to ensure the patients’ early discharge from hospital. Postoperative medical services should be carried out through the Internet or telephone to reduce the face-to-face contact between medical staff and patients. In conclusion, 3 key points should be noted in breast reconstruction surgery during the COVID-19 epidemic: Strict screening to ensure that patients were not infected with SARS-CoV-2 before admission; Minimize contact time between medical staff and patients; Minimize the length of hospital stay and recovery time of patients.

Of the 6 included studies, 4 studies\(^{[8–11]}\) recommended the use of breast implants or tissue expansion for breast reconstruction surgery and had good results in their clinical practice. In addition, 1 study\(^{[12]}\) planned to use autologous free tissue transfer for breast reconstruction, and 1 study\(^{[13]}\) planned to use microsurgical techniques for breast reconstruction. But these 2 technologies are still in the planning stage and have not yet been implemented. Therefore, the specific effects of these 2 technologies need to be observed and studied. After a systematic review of the included articles, we recommend the use of breast implants for breast reconstruction surgery during the COVID-19 epidemic. This
| Study                  | Year | Country | Surgical method                                | Specific measures                                                                                                                                                                                                                                                                                                                                 |
|-----------------------|------|---------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sanchez et al[8]     | 2020 | Italy   | Reconstruction was preferentially performed with a pre-pectoral implant or a tissue expander | 1. Prior to hospitalization surgical candidates were contacted by phone to assess if they had experienced any symptom related to a COVID-19 infection or had contacts with anyone known or suspected to have COVID-19 in the last 14 days.  
2. Upon arrival to the hospital, patients underwent SARS-CoV-2 blood quick testing. Patients with a negative test received a nasopharyngeal swab (real-time RT-PCR assay). If the swab resulted negative, patients were admitted to the ward to complete pre-operative routine assessments.  
3. If SARS-CoV-2 quick testing was positive, patients were confined in a dedicated unit. An initial swab was performed and if SARS-CoV-2 disease was confirmed, surgical treatment for breast cancer was temporarily suspended.  
4. If the initial swab was negative, the patient remained in observation for at least 4 days, repeating swabs every 48 hours. If 2 consecutive swabs resulted negative with the patient asymptomatic, surgical treatment was delivered.  
5. Patients were discharged with drainages still in place, properly instructed on how to manage them at home. They were also instructed to limit contacts with relatives at home, wear surgical face masks, wash hands frequently, and measure body temperature daily. Postoperative visits were scheduled in a special area of the hospital with direct external access, to limit risk of COVID-19 exposure. An emergency helpline was established that patients could promptly access for any postoperative need. |
| Lisa et al[9]         | 2020 | Italy   | Implant breast reconstruction using implants, either 2-stage expander/implant or direct to implant | 1. Pre-operative recommendations: subdivision of plastic surgery team in subgroups; double-step screening for detection of any positive case before surgery.  
2. Anesthesia and pain control: proper protection of anesthesiology team and nurses; videolaryngoscopy instead of classical tracheal intubation, which adopts laryngoscope; intercostal blocks, thoracic paravertebral blocks, and the interfascial blocks of the pectoral region to reduce postoperative pain and help fast dismiss.  
3. Intraoperative recommendations: proper protection of the operators; immediate breast reconstruction adopting implants (tissue expanders or breast prosthesis); symmetrization of contralateral healthy breast postponed; pedicled flaps or microsurgical flaps postponed.  
4. Postoperative recommendations: reduction of postoperative consultations; tutoring patients with telemedicine to avoid access to the hospital. |
| Perez-Alvarez et al[10] | 2020 | America | Pre-pectoral implant reconstruction             | 1. The protocol incorporates both enhanced recovery after anesthesia pathway and intraoperative liposomal bupivacaine field blocks. The majority of patients receive pre-pectoral implant reconstruction, which is associated with significantly less pain than when the pectoralis muscle is manipulated.  
2. Initiating a standard sameday surgery program where patients have the opportunity to safely recover at home with a direct point of contact for issues has the potential for improved outcomes on many aspects. Notably, patients have improved psychological well-being, avoid exposure to nosocomial infections, alleviate health care system burden, and provide cost savings. |
| Specht et al[11]      | 2020 | America | Tissue expander or direct-to-implant breast reconstruction | 1. Pre-operative: many patients underwent surgical oncology and plastic surgery consultation via video conferencing with patient pictures viewed by the plastic surgeon. Patients were provided educational materials newly created by the multidisciplinary team to limit the need for in-person postoperative visits, including access to online videos to review wound and drain care.  
2. Intraoperative: once in the operating room, the planned surgical procedures were performed by the surgical oncologist and plastic surgery teams. Anesthetic was administered using a strict total intravenous anesthesia protocol along with administration of at least 2 anti-emetics in order to maximize patient comfort and avoid postoperative nausea and vomiting. |

(continued)
surgical approach is more conducive to patient recovery, is less prone to postoperative complications, and can ensure the safety of patients during the COVID-19 epidemic as much as possible.

This systematic review included 6 studies, from Italy, the United States, and the United Kingdom. Most of the studies included in this study were experience introductions and lack of relatively objective clinical data, so data combination and meta-analysis cannot be carried out. This study conducted a systematic review of the relevant treatment options of breast reconstruction surgery performed by various research teams during the COVID-19 epidemic, and the conclusions were limited. Since the COVID-19 epidemic situation was different in different countries and regions, the conclusion of this study only provided a certain reference for doctors in different countries to perform breast reconstruction surgery during the COVID-19 epidemic. Our proposed protocol for breast reconstruction surgery during the COVID-19 epidemic needs to be further validated in clinical studies.

Author contributions
Conceptualization: Pengfei Sun, Xia Cai.
Data curation: Fang Luan.
Formal analysis: Pengfei Sun, Rui Cao.

Investigation: Xia Cai.
Methodology: Pengfei Sun, Fang Luan.
Supervision: Xia Cai.
Validation: Fang Luan, Di Xu.
Writing – original draft: Pengfei Sun, Di Xu, Rui Cao.
Writing – review & editing: Pengfei Sun, Di Xu, Xia Cai.

References
[1] Sun P, Lu X, Xu C, Sun W, Pan B. Understanding of COVID-19 based on current evidence. J Med Virol 2020;92:548–51.
[2] Bregman DE, Cook T, Thorne C. Estimated national and regional impact of COVID-19 on elective case volume in aesthetic plastic surgery. Aesthet Surg J 2021;41:358–69.
[3] Steele TN, Hemal K, Browne DT, Balumuka D, Hansen JE, David LR. Academics in the pandemic: early impact of COVID-19 on plastic surgery training programs. Plast Reconstr Surg Glob Open 2020;8:e3320.
[4] Duggan RP, Tran JP, Phillips LG. Interest in plastic surgery during COVID-19 pandemic: a google trends analysis. Plast Reconstr Surg Glob Open 2020;8:e3268.
[5] Sarac BA, Schoenbrunner AR, Wilson SC, Chiu ES, Janis JE. The impact of COVID-19-based suspension of surgeries on plastic surgery practices: a survey of ACAPS members. Plast Reconstr Surg Glob Open 2020;8:e3119.
Commentary on “Delayed, two-staged autologous breast reconstruction: an approach to improving delayed reconstructive outcomes” by AA Patel, L Cai, S Moshrefi, IC Sando, GK Lee & RS Nazerali. Eur J Plast Surg 2021;1–2.

Vidya R, Rubio IT, Paulinelli RR, et al. Should breast reconstruction and breast oncoplastic procedures be performed during the coronavirus pandemic. E Cancer Medical Science 2020;14:1041.

Sanchez AM, Scardina L, Franceschini G, et al. Treatment protocol to allow reconstructive breast surgery during COVID-19 pandemic. Br J Surg 2020;107:e573–4.

Lisa A, Battistini A, Giannasi S, et al. Breast reconstruction in a coronavirus disease 2019 hub. Plast Reconstr Surg Glob Open 2020;8:e3043.

Perez-Alvarez IM, Bartholomew AJ, King CA, et al. Breast surgery in the time of global pandemic: benefits of same-day surgery for breast cancer patients undergoing mastectomy with immediate reconstruction during COVID-19. Plast Reconstr Surg 2020;146:522e–3e.

Specht M, Sobti N, Rosado N, et al. High-efficiency same-day approach to breast reconstruction during the COVID-19 crisis. Breast Cancer Res Treat 2020;182:679–88.

Masud D, Sharp OL, Rosich-Medina A, Köhler G, Haywood RM. Resuming autologous free tissue transfer for breast reconstruction in the COVID-19 era. J Plast Reconstr Aesthet Surg 2021;74:407–47.

Ali S, Ibrahim N, Warwick J, Boyce D, Ghattaura A. COVID-19 microsurgical breast reconstruction national practise survey: a survey of BAPRAS members and proposal of COVID-19 specific perioperative and ERAS pathways. J Plast Reconstr Aesthet Surg 2020;1748-6815(20)30512-X.

Vigneswaran P, Clancy R, Jackson PC, Wilson SM, Patel N. Restitution of the NHS breast reconstruction service during the recovery phase of the Covid 19 pandemic. J Plast Reconstr Aesthet Surg 2020;1748-6815(20)30525-8.

Quilichini O, Barrou J, Bannier M, et al. Mastectomy with immediate breast reconstruction: results of a mono-centric 4-years cohort. Ann Med Surg (Lond) 2021;61:172–9.