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Breast Reconstruction during the COVID-19 Pandemic: A Systematic Review

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Introduction: The COVID-19 pandemic posed unique challenges for breast reconstruction. Many professional organizations initially placed restrictions on breast reconstruction, leading surgeons to conceive innovative protocols for offering breast reconstruction. This study reviewed the current evidence on breast reconstruction during the COVID-19 pandemic to provide guidance for surgeons facing future crises.

Methods: The MEDLINE, EMBASE, and Cochrane Database of Systematic Reviews were searched for studies (1) describing implant and autologous breast reconstruction following mastectomy and (2) occurring during or pertaining to the COVID-19 pandemic.

Results: Of the 1347 studies identified, 26 were included. Studies discussed type of reconstruction (18, 69%), complications (11, 42%), timing of reconstruction (10, 38%), protocols (10, 38%), COVID-19 screening (7, 27%), and length of hospital stay (7, 27%). The type of reconstruction varied depending on the stage of the pandemic: early on, autologous breast reconstruction was halted to preserve resources, but was later resumed. Within implant-based reconstruction, direct-to-implant was favored over serial tissue expansion. Several protocols were developed, with many emphasizing multidisciplinary collaborations for patient selection, use of specialized measures to reduce risk of COVID-19 transmission, and optimization of same-day discharge. Complication rates following breast reconstruction were similar to pre-pandemic rates.

Conclusions: The COVID-19 pandemic has forever changed the landscape of breast reconstruction by raising important questions about delivery of care, cost, and resource utilization. The findings of this review may inform surgeons as they plan for similar future crises or strive for improved patient care and efficacy even during nonpandemic times. *(Plast Reconstr Surg Glob Open 2021;9:e3852; doi: 10.1097/GOX.0000000000003852; Published online 22 September 2021.)*

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic dramatically changed the landscape of plastic surgery across the globe.[1–3] Breast reconstruction in particular has faced many challenges during the pandemic, including accommodating reconstructive surgery in an extremely strained healthcare setting and ensuring the safety of both patients and healthcare providers during the pre-, intra-, and postoperative course.[4,5] In response to the pandemic, many professional organizations placed restrictions on breast reconstruction in an effort to conserve resources and divert them to COVID-19 patients.[6] These policies range from recommending mastectomy with no immediate breast reconstruction to allowing for immediate breast reconstruction, but deferring autologous reconstruction.[6]

In such times of uncertainty, reconstructive surgeons conceived innovative protocols and mechanisms for offering breast reconstruction to cancer patients desiring it. Furthermore, pressures from the pandemic may engender potential gains such as improved efficiency, reduced length of hospital stay, and higher value care for patients. Although the state of the COVID-19 pandemic appears to be improving in the face of burgeoning vaccination efforts, the possibility of future pandemics in the coming

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months and years demands careful consideration of the delivery of breast reconstruction care in times of crisis.[7]

The COVID-19 pandemic raised important questions about the necessity and efficiency of breast reconstruction. It is known that patients with cancer are more vulnerable to COVID-19, and that cancer patients who undergo surgery in the 30 days before contracting COVID-19 have less favorable outcomes than individuals who forgo surgery.[8–10] Given the heterogeneity in recommendations from governing bodies for breast reconstruction, it was unclear how providers should counsel their patients about these risks. Furthermore, it is not yet known whether data from breast cancer patients corroborates the aforementioned trend.[4]

Although no part of the globe has been untouched by COVID-19, many countries have fared worse than others. The nature of a country's health services infrastructure and the degree to which it was impacted by COVID-19 may have also played a role in the way breast reconstruction was offered during the pandemic.[11,12] It remains to be seen which reconstructive protocols succeeded in various healthcare settings, and it is unknown how these policies impacted cost or resource conservation.

The purpose of this study was to review the current evidence on the provision of breast reconstruction during the COVID-19 pandemic and suggest mechanisms by which institutions may develop protocols best suited to their environment to provide care in future crises. Secondarily, it is our aim to synthesize best practices that emerged during these trying times as they may improve efficiency, standards of care, and reduce the cost of breast reconstruction.

METHODS

A systematic review aligning with the principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines was performed.

Search Strategy

The MEDLINE, EMBASE, and Cochrane Database of Systematic Reviews were searched for publications describing breast reconstruction during the COVID-19 pandemic that were published on or before January 17, 2021. (**See appendix, Supplemental Digital Content 1**, which displays the search terms. **http://links.lww.com/PRSGO/B798**.)

Peer-reviewed articles written in English were reviewed. Articles were included if they met the following criteria: (1) describing implant and autologous breast reconstruction (ABR) following mastectomy and (2) occurring during or pertaining to the COVID-19 pandemic. The references of manuscripts identified were also reviewed to identify additional articles of interest. Articles were excluded if they exclusively described male patients, cosmetic augmentation, and breast-conserving surgery in the absence of mastectomy.

Data Collection and Analysis

Data on type of breast reconstruction, population, and primary outcomes were extracted from all studies by two authors (KH, CJB). Due to significant heterogeneity in the population, setting, and outcomes measured, meta-analytical techniques were not deemed feasible. Therefore, results were summarized by describing the type of breast reconstruction considered and the outcomes studied.

Studies were grouped by type of breast reconstruction and population studied, and the overall outcomes were assessed by two authors (KH, CJB). Intervention type was categorized as one of the following: (1) immediate, (2) delayed, (3) implant-based, (4) autologous, and (5) other. Population refers both to the country and its setting as well as the COVID-19 status of the patients. Emerging themes or treatment recommendations were subsequently identified and discussed.

RESULTS

Search Outcomes

After removing duplicates, 1347 studies remained. Of these, an additional 1316 studies were excluded following screening of the title and abstract. A comprehensive full-text review led to the exclusion of another five studies (Fig. 1). Twenty-six studies were subsequently included in the review (Table 1).

The main characteristics of the included studies are outlined in Figure 2. We identified eight commentaries and 18 original articles, composed of retrospective studies (n = 5, 28%), surveys (5, 28%), prospective studies (4, 22%), case series (3, 17%), and a review article (1, 5%). The majority of the articles originated in the United Kingdom (7, 27%), followed by the United States (5, 19%), and Italy (5, 19%). Three articles (12%) originated from multiple countries, 3 (12%) from Brazil, and the remaining three originated from Canada, France, and Spain, respectively.

As studies were assessed, six common themes emerged: COVID-19 screening and safety, institutional protocols, complications following breast reconstruction in COVID-19 patients, strategies for reducing hospital stay, timing of breast reconstruction, and type of breast reconstruction (Table 2). Most studies discussed type of reconstruction (18, 69%), while other categories were less commonly mentioned: complication (11, 42%), timing of reconstruction (10, 38%), protocols (10, 38%), COVID-19 screening and safety (7, 27%), and reducing length of hospital stay (7, 27%).

Type of Reconstruction

Eighteen studies included in this review discussed the type of breast reconstruction.[4,6,13–28] Surgeons performing ABR were affected worldwide, with many being forced to halt ABR altogether.[16,20] When surveyed, plastic surgeons across the world agreed that delaying ABR was important to conserve resources.[19,28]

In the place of ABR, several studies detailed exclusive use of implant-based reconstruction (in particular, direct-to-implant reconstruction), breast conservation surgery, or mastectomy alone.[6,13,14,17,18,21–23,26,27] Many authors cautioned the dangers of overlooking ABR and relying

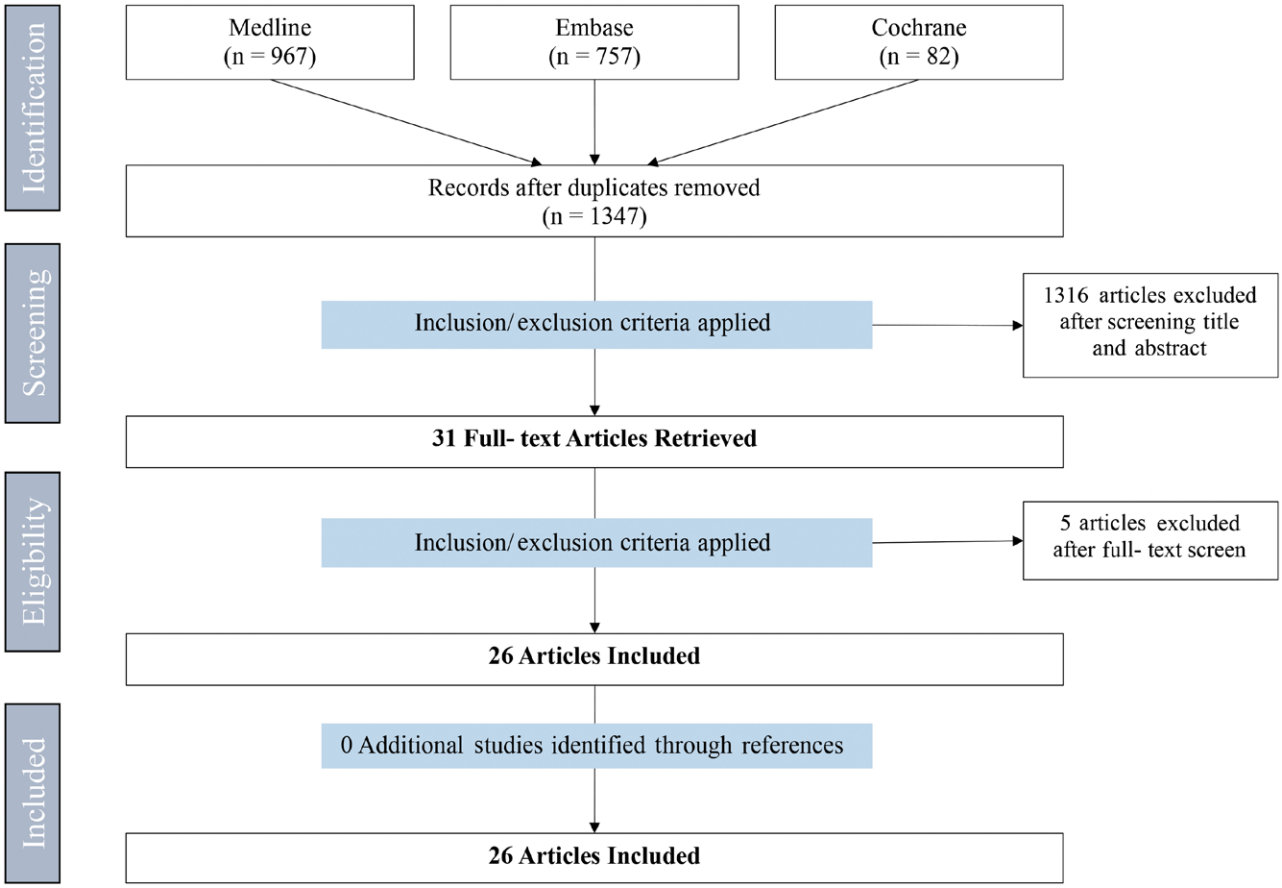

Fig. 1. Preferred Reporting Items for Systematic Review and Meta-Analyses diagram for the selection of literature for review. This describes the process by which articles were screened and included in the systematic review.

Table 1. Presence of Major Themes Pertaining to Breast Reconstruction during the COVID-19 Pandemic

Study	Timing of Reconstruction	Type of Reconstruction	Reducing Hospital Length of Stay	COVID-19 Screening and Safety	Protocol	Complications
Romics	✓	✓	✓	✓		✓
Lisa		✓	✓	✓	✓	✓
Specht	✓		✓		✓	✓
Vigneswaran		✓				
Sharp			✓			✓
Siotos						✓
Challoner						✓
Jallali	✓	✓		✓		✓
Cadilli		✓	✓		✓	✓
Fancellu	✓	✓	✓			
Brenes Sánchez		✓	✓	✓	✓	
Sanchez	✓			✓	✓	
Franceschini	✓			✓		✓
Pendola		✓				
Ali		✓		✓	✓	
Regis	✓				✓	
Cavalcante (*Breast Cancer Res Treat*, 8/2020)		✓				
Di Pace (*JPRAS*, 7/2020)		✓				
Cavalcante (*JPRAS*, 8/2020)		✓				
Di Pace (*JPRAS*, 9/2020)		✓				
Masud		✓			✓	
Kumar	✓	✓				✓
Chetta	✓					✓
Vidya		✓				
Perez-Alvarez	✓	✓			✓	
Salgarello		✓			✓	

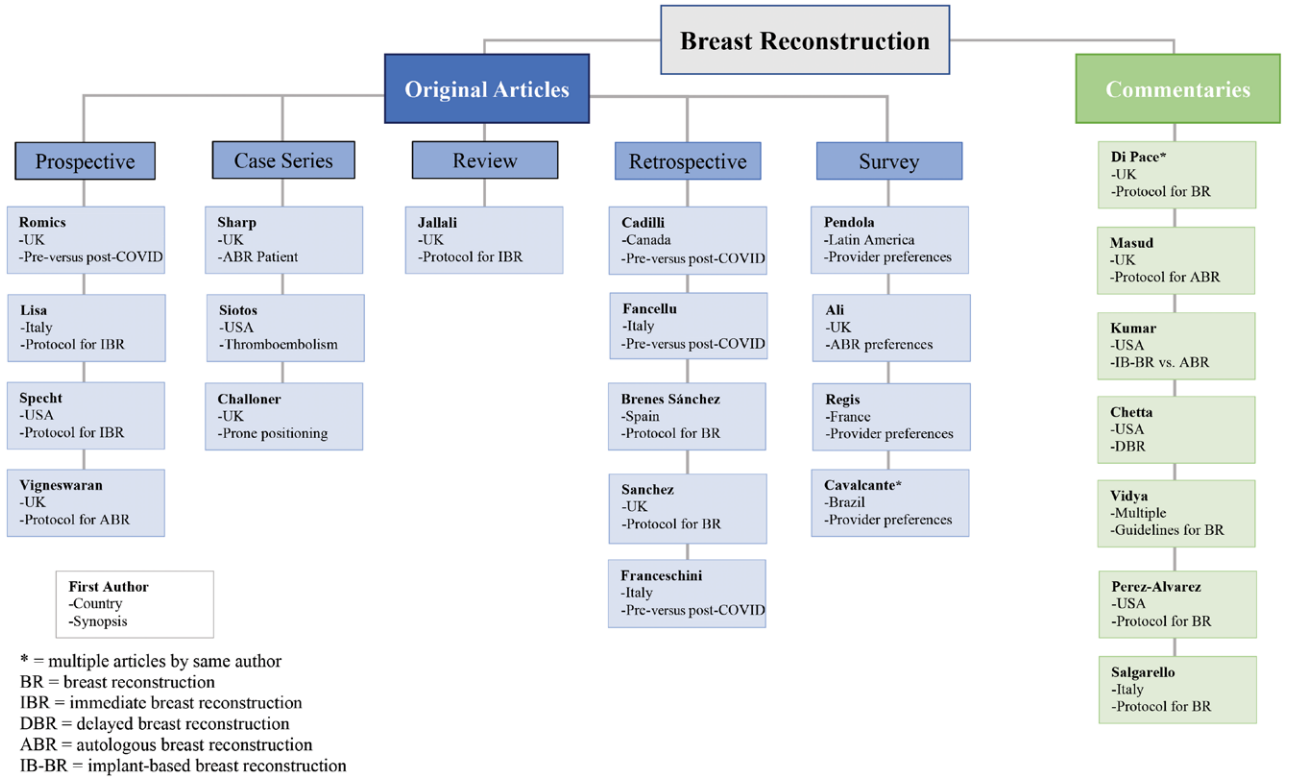

Fig. 2. Summary characteristics of included articles.

Table 2. Takeaways for Major Themes Identified During Systematic Review

Major Themes	Conclusions
Type of reconstruction	• At the beginning of the pandemic, ABR was halted due to concern for resource conservation. In the later stages of the pandemic, as the personal protective equipment shortages subsided, several authors argued in favor of ABR and demonstrated its safety and efficacy during the pandemic. • Within implant-based breast reconstruction, many institutions adopted protocols for direct-to-implant procedures in place of serial tissue expansion to reduce patient exposure to the healthcare setting.
Complications	• Several studies reported a complication rate between 0% and 8% for breast reconstruction during the pandemic. There was no difference in the rate of complications before the pandemic. • There are several unique considerations for breast reconstruction during the COVID-19 pandemic such as increased susceptibility to thromboembolism, respiratory compromise, and pressure injury to reconstructed breasts during prone positioning.
Timing of reconstruction	• The debate regarding immediate versus DBR persisted during the COVID-19 pandemic. • Proponents of immediate breast reconstruction argued that it reduced exposure to COVID-19, conserved resources, and improved psychosocial outcomes for patients. Others cautioned that immediate implant reconstruction had higher complication rates and more subsequent revision operations.
Protocols	• Several studies discussed their institution's protocol for managing breast reconstruction during the COVID-19 pandemic. Four studies described protocols for implant-based breast reconstruction, two addressed ABR only, and the remaining four described breast reconstruction as a whole. • Key themes that emerged among all protocols were the need for: ◦ Multidisciplinary collaboration in the creation of a standardized patient selection protocol ◦ Reducing risk of COVID-19 transmission by specialized techniques such as intubation using a video laryngoscope and use of regional or peripheral nerve blocks ◦ Reducing length of hospital stay using same-day discharge protocols, modified ERAS pathways, and providing follow-up using telehealth or a visiting nurse provider
COVID-19 screening and safety	• COVID-19 screening protocols for patients varied widely by location and stage of pandemic. Most studies that described a protocol required two consecutive negative RT-PCR tests before admission and surgery.
Reducing length of hospital stay	• The majority of studies reported a length of stay (LOS) of <24 hours following breast reconstruction during the COVID-19 pandemic. The use of regional anesthesia and telehealth aided in reducing LOS; however, not all institutions had access to these services.

DBR, Delayed Breast Reconstruction; ERAS, Enhanced Recovery After Surgery; RT-PCR, Reverse Transcription Polymerase Chain Reaction; LOS, Length of Stay.

too heavily on implant-based breast reconstruction, and three studies described the successful resumption of ABR and established its safety during the COVID-19 pandemic.[4,15,24,25] One commentary described successful ABR in an asymptomatic carrier of COVID-19 in March 2020, the early stage of the pandemic before COVID-19 guidelines had been established.[29]

Complications

Eleven studies discussed complications of breast reconstruction.[4,5,13,14,16,25,29–33] Many studies reported their complication rate after breast reconstruction during the pandemic, with rates ranging from 0% to 8%,[13,14,30] and two compared these rates with those during pre-pandemic times.[16,33] Others reported on COVID-19 related complications, such as thromboembolism, respiratory compromise, and pressure injury to implants due to prone positioning.[4,31,32] A single study described the postoperative care of a COVID-19 patient who had undergone ABR in the early days of the pandemic.[29] Two studies grappled with the complication profile of mastectomy alone, mastectomy with immediate reconstruction, and ABR.[5,25]

Timing of Reconstruction

Ten studies commented on the timing of reconstruction.[4,5,13,17,25,26,30,33–35] Two studies described halting or reducing immediate breast reconstruction at the height of the pandemic.[13,17] Delayed breast reconstruction was halted in an effort to conserve resources and prevent exposure to COVID-19.[34] As the peak of the pandemic passed, many advocated for restarting immediate breast reconstruction, citing reasons for its superiority over delayed breast reconstruction, such as, less risk of exposure to COVID-19, conservation of healthcare resources, a smaller backlog of patients post-pandemic, and improved psychosocial outcomes for the patient.[4,25,33] Many institutions optimized their protocols for same-day mastectomy and immediate, implant-based breast reconstruction.[26,30,35] However, others cautioned against relying too heavily on immediate breast reconstruction during the pandemic, citing high complication and reoperation rates among patients receiving mastectomy and immediate reconstruction when compared with those with mastectomy alone or with ABR.[5,25]

Protocols

Nearly all studies offered guidance on how to perform breast reconstruction during the pandemic; however, only 10 studies discussed the development of specific protocols.[14,16,18,20,24,26,27,30,34,35]

Six studies emphasized the importance of multidisciplinary collaboration and the creation of a standardized patient selection protocol, which would identify the patients most apt for reconstruction during the COVID-19 pandemic. These protocols involved assessment of patient variables such as age, breast cancer characteristics, need for adjuvant therapy, and other comorbidities.[16,18,24,27,30,34]

Four studies addressed implant-based breast reconstruction specifically, and outlined mechanisms to reduce the risk of infection for patients and staff, such as, careful patient selection, intubation using a video laryngoscope, peripheral nerve blocks, same-day discharge, and follow-up using telehealth or a visiting nurse provider.[14,26,30,35]

Two studies discussed protocols for re-introducing ABR during the pandemic, and strategies included reducing operating room workforce, adoption of patient selection pathways, a modified enhanced recovery after surgery pathway, and involvement of legal teams to help providers discuss risks with patients.[20,24]

COVID-19 Screening and Safety

Seven studies discussed COVID-19 screening and safety.[4,13,14,18,20,33,35] Techniques used to test for COVID-19 varied based on location and the phase of the pandemic. For example, before the use of RT-PCR tests, a low-dose computed tomographic scan was used to assess for COVID-19 pulmonary disease preoperatively. After the widespread use of nasopharyngeal swabs, institutions adopted a variety of different testing protocols, and most required two consecutive negative RT-PCR tests before admission and surgery.

Reducing Hospital Length of Stay

Seven studies discussed strategies for reducing length of hospital stay following breast reconstruction.[13,14,16–18,29,30] Several studies reported their length of stay for breast reconstructions performed during the COVID-19 pandemic with the majority being under 24 hours, significantly lower than pre-pandemic breast reconstruction.[13,14,16,30] One study from Spain reported median length of stay by type of surgery, with breast-conserving surgery being the lowest at 1 day, and mastectomy with immediate implant reconstruction being the highest at 4 days.[18] Follow-up was done virtually, in-person at clinic, or using a visiting nurse provider.[14,29,30] The use of regional or local anesthesia was also adopted to avoid general anesthesia, and this occurred at significantly higher rates when compared with pre-pandemic reconstruction in one study.[16] However, another study reported significantly less use of regional and local anesthesia compared with prior due to reassignment of specialized anesthesiologists to other wards.[17] Evidence suggested patients who received regional blocks had a longer duration of surgery compared with those who received general anesthesia.[17]

DISCUSSION

This systematic review assembles the collection of literature published on breast reconstruction during the COVID-19 pandemic. Women at risk for breast cancer faced unprecedented circumstances during the pandemic: screening programs were halted in many countries, which led to delayed diagnoses and worse cancer at the time of presentation.[36,37] Women already diagnosed with cancer faced delays in scheduling mastectomies, due to institutional policies to avoid COVID-19 surges and conserve resources.[38,39]

Given the novelty and disruptive nature of the pandemic, authors quickly voiced their concerns for performing breast reconstruction during a time of limited healthcare resources. Simultaneously, however, the

creativity and resourcefulness of plastic surgeons was readily apparent and evidenced by their efforts to continually offer breast reconstruction to patients during the COVID-19 pandemic in unprecedented ways. Periods of adversity often demand unique adaptations that contribute to improvements in both outcomes and efficiency. The value of this review is to synthesize these themes and identify best practices that emerged during the course of the pandemic so plastic surgeons can perpetually strive for quality improvement with or without a global pandemic.

With 26 articles, breast reconstruction was the topic of over 10% of articles related to the COVID-19 pandemic published in the plastic surgery literature.[40] Countries that reported some of the highest numbers of COVID-19 cases throughout the pandemic published the majority of articles. After review of the article cohort, it was clear that there were pertinent topics important to plastic surgeons regarding breast reconstruction. The unifying principle from the six themes emerging in the review of the literature was that plastic surgeons strove to provide breast reconstructive options to patients in the safest manner possible. From the studies that provided detail on their complication rates, the data suggest that breast reconstruction during the pandemic had similar complication rates and profiles in comparison with pre-pandemic reconstruction.[13,14,16,30,33] There was limited complication data available, and long-term assessment of both oncologic and reconstructive outcomes is merited.

Given the various breast reconstructive options in the plastic surgeon's armamentarium, there has always been ample discussion about the relative merits of these techniques even before the COVID-19 pandemic. These discussions were only heightened during the pandemic as surgeons sought to identify safe and effective ways of providing breast reconstruction to their patients, while balancing the needs of a resource-constrained healthcare system. The majority of authors felt that immediate ABR should be halted secondary to its prolonged operative time and longer length of stay for postoperative monitoring.[6,13,14,17,18,21–23,26,27] While pausing immediate ABR was widely agreed upon, some valid concerns were voiced. One author discussed the long-term effects of decreased access to immediate ABR, as it has been shown to have higher levels of patient satisfaction.[25,41] Proponents of limiting immediate ABR cited longer length of stay postoperatively for ABR compared with implant reconstruction.[42] Despite this, patients with implant reconstruction have been shown to require more subsequent operations in the 2 years following initial reconstruction, are at risk of readmission secondary to infection, and—in the case of tissue expanders—need multiple office visits for serial expansion.[25,42] Thus, while implant reconstruction may have provided immediate reduction in utilization of hospital resources, these same institutions may be facing higher rates of reoperation and readmission secondary to shifting their practice more toward implant reconstruction during the pandemic.[25] Others suggested not offering prophylactic mastectomies and reconstruction during the pandemic to reduce volume to those with oncologic diagnoses and avoiding procedures for contralateral symmetry to reduce operative time and subsequent postoperative risk.[6,21,34]

In conjunction with the type of reconstruction, timing of reconstruction was a commonly encountered theme among the included studies. Given the severity of the COVID-19 pandemic, some authors called for the cessation of breast reconstruction.[13,17] As the pandemic progressed, plastic surgeons carefully weighed the risks and benefits of resuming breast reconstruction during a global pandemic versus the health and psychological concerns of not offering breast reconstruction.[23,25] Immediate breast reconstruction was initially advocated for because, as discussed previously, many purported less theoretical risk of exposure to COVID-19 with this methodology and preservation of healthcare resources.[4,25,33] Recommending some type of breast reconstruction was deemed imperative to reduce post-pandemic queue of patients requiring breast reconstruction and to mitigate the adverse psychosocial impact of delaying breast reconstruction on patients.[4,25,33] Several groups published a protocol for accelerated outpatient immediate implant reconstruction.[26,30,35] Reviewing the protocols and experiences from these groups may offer benefits including, but not limited to, curtailed costs, reduced hospital utilization, improved psychosocial outcomes, and reduced infectious risk.[43,44] Unifying features for implementation of same-day mastectomy and reconstruction were grounded in patient education and establishing clear, direct, accessible points of contact in the postoperative setting.[26,30,35]

In addition to protocols for same-day mastectomy and breast reconstruction, others published general protocols for managing patients presenting for breast reconstruction. An emerging theme was the importance of developing standardized patient selection protocols. Factors influencing these decisions included assessment of patient demographic factors and specifics of breast cancer pathologies so that patients could be prioritized for mastectomy and subsequent reconstruction. Multidisciplinary teams involving breast surgeons, plastic surgeons, anesthesiologists, nurses, hospital administrators, and legal representatives were employed when devising these protocols to ensure appropriate allocation of limited resources in a manner that optimized safety for both the patient and the healthcare team.[16,18,24,27,30,34] Two groups shared their protocols for performing ABR during the pandemic. In both cases, these focused on streamlining preoperative workup while balancing limited contact between patient and the healthcare team. Furthermore, postoperative pathways were adjusted with similar intent to permit for discharge on postoperative day two. Goals included early mobilization and early nutrition coupled with targeted pain control.[20,24]

Protocols also highlighted specific mechanisms for reducing risk of COVID-19 spread in the perioperative period. These ranged from intraoperative alterations in intubation and anesthesia to reduced length of stay in the hospital with modified enhanced recovery after surgery protocols.[14,20,26,30,35] Several groups protocolized the use of telehealth for follow-up or visiting nurse services in lieu of office visits.[14,20,26,30,35] Observation is required to determine if virtual postoperative appointments will continue

to persist at such high levels, as vaccination levels increase and the severity of the pandemic abates. Although telehealth offers convenience for the patient, it may limit adequate physical examination and delay procedures for management of common complications such as seromas or impaired wound healing.

There are several limitations to our study. Although the COVID-19 pandemic impacted the practice of breast reconstruction globally, Europe and North America were overrepresented in our review as the majority of articles originated from these regions. At the time of writing, second and third waves of the pandemic are severely affecting other parts of the world, including Asia and South America. Thus, future studies are needed to observe impact of COVID-19 on breast reconstruction in these regions. The studies included in this review are heterogenous in their design and limited by small sample sizes; this precluded a meta-analysis of the data. Most studies were implemented at a single institution over a few months and as such, were not generalizable or able to comment on long-term impact. Finally, most studies did not report on the nature of their hospital's healthcare system or cost, which precluded a policy- and cost-analysis.

CONCLUSIONS

After systematic review of the literature, determining the optimum mechanism to offer breast reconstruction during the COVID-19 pandemic was a challenge for the plastic surgery community. Although ABR was initially halted by most surgeons to conserve resources, it was resumed in later stages of the pandemic by many who touted its safety and efficacy. Implant-based breast reconstruction rose in popularity, with many surgeons favoring direct-to-implant approaches instead of implant reconstruction with tissue expansion.

Many published their experiences and protocols for providing breast reconstruction while maintaining safety. Key changes included multidisciplinary collaboration to aid in careful patient selection, use of regional anesthesia or intubation using a laryngoscope to limit staff exposure to COVID-19, and the use of same-day discharge protocols and telehealth to reduce length of hospital stay. When reported, complication rates following breast reconstruction were similar to the same during pre-pandemic rates. Review of breast reconstruction patients who went on to develop COVID-19 also revealed important insights into how to care for this population. The changes implemented during the COVID-19 pandemic should be considered for adaptation by plastic surgeons to improve efficiency, reduce costs, and provider higher quality care for patients with breast cancer.

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