Elective Orthopaedic Surgery in the Era of COVID-19

Summary of Current Guidelines and Road Map to Resuming and Sustaining Safe Practice

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Abstract

» The COVID-19 pandemic has forced hospitals in the United States to postpone elective orthopaedic surgery, which has financially impacted health-care systems and left patients vulnerable to increased morbidity.

» In combination with the Centers for Medicare & Medicaid Services (CMS) and the Centers for Disease Control and Prevention (CDC) recommendations, the American Academy of Orthopaedic Surgeons (AAOS) guidelines should be utilized to stratify orthopaedic conditions into 4 tiers in order to properly define which surgeries are elective.

» Recommendations released by the American Association of Hip and Knee Surgeons (AAHKS) and the American College of Surgeons (ACS) have encouraged a checklist approach for implementing a safe return to elective orthopaedic surgery, and include both regional and facility-specific recommendations.

» When determining patient eligibility and priority for elective orthopaedic surgery, a standardized virtual orthopaedic examination via telemedicine can be used alongside the European Society of Sports Traumatology, Knee Surgery and Arthroscopy (ESSKA) guidelines, which detail a 4-phase strategy that is based on age, comorbidities, type of surgery, and expected length of hospital stay.

» To ensure a safe, sustainable return to surgery and sufficient patient safety, hospital administrators should be aware of preoperative, intraoperative, and postoperative considerations according to the current state of knowledge on COVID-19.

At the time of this article's acceptance for publication, the Centers for Disease Control and Prevention (CDC) had reported >25 million total cases of coronavirus disease 2019 (COVID-19) and 450,000 deaths in the United States[1]. The pandemic has overwhelmed intensive care units and forced hospitals to incur an unprecedented financial burden due to drug shortages, increasing wage and labor costs, inadequate personal protective equipment (PPE), the need for additional medical supplies, and loss of revenue from outpatient and elective services[2,3]. According to a report from the American Hospital Association, the total losses for hospital and health systems in the U.S. for the 2020 calendar year were estimated to be >$320 billion[3]. A large portion of these

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losses was due to cancelled or postponed elective orthopaedic procedures, which typically account for $5.5 to $5.9 billion in reimbursement and $1.3 to $1.8 billion in net income per month[4,5].

With the exceedingly high number of COVID-19 cases in the U.S., healthcare system administrators have been left with a difficult decision: continue to suffer the financial impact of lost revenue from missed elective orthopaedic surgeries or return to work amid the high incidence of COVID-19 infections and the potential for a resurgence. From April 2020 to June 2020, several orthopaedic societies and associations released guidelines and recommendations regarding the optimal strategy for safely resuming elective orthopaedic surgeries[6-11]. Nevertheless, these have thus far provided an inconsistent amount of detail and a lack of consensus. In this article, we aim to summarize the currently available guidelines that address the reinstitution of elective orthopaedic surgeries and provide a potential road map for implementing the safest environment to do so while awaiting a universally available vaccine.

Defining Elective Orthopaedic Surgery

On April 2, 2020, the American Academy of Orthopaedic Surgeons (AAOS) presented a 4-tier system to stratify orthopaedic conditions based on urgency[8]. Tier-1 conditions were defined as chronic problems in which surgery could be delayed without "significant" harm to the patient or the eventual outcome. Examples include total joint replacement, spine fusion, and chronic joint conditions, such as chronic rotator cuff tears, carpal tunnel surgery, and degenerative meniscal tears. Tier-2 conditions were defined as needing urgent elective surgery; they feature more acute pathology (e.g., anterior cruciate ligament tears, locked menisci, or acute traumatic rotator cuff tears). Tier-3 conditions require urgent surgical intervention to prevent impairment of function, such as fracture-dislocations and distal biceps ruptures. Lastly, tier-4 conditions require emergency surgery and are considered to pose a viable threat to life or limb.

Similarly, the Centers for Medicare & Medicaid Services (CMS) and the CDC stratified all elective surgeries into a 3-tiered system that is based on patient harm and degree of community transmission[10,11]. According to this classification, tier-1 conditions are unlikely to result in patient harm if surgery is delayed and, if possible, they should be managed exclusively through telemedicine. Tier-2 conditions have the potential for increased morbidity and mortality and should be triaged and followed via telemedicine. If the condition deteriorates, in-person appointments are advised prior to surgical intervention. Lastly, the CMS and the CDC define tier-3 conditions as those that will result in patient harm without in-person treatment and possible surgical intervention. These guidelines are very broad and do not directly address specific orthopaedic conditions.

Since the AAOS guidelines provide relevant examples and are, to our knowledge, the only recommendations in the current literature utilizing a tiered system to stratify the urgency of orthopaedic conditions, we recommend using this system when defining elective orthopaedic surgeries in the era of COVID-19 (Table I).

Determining When It Is Safe for a Return to Elective Surgery

The American Association of Hip and Knee Surgeons (AAHKS) has suggested a checklist approach for the reinstitution of elective orthopaedic surgery that is largely consistent with those proposed by other societies and organizations[7]. Once a regional lockdown for an area has been lifted, the AAHKS guidelines recommend that surgery should not take place until new COVID-19 cases have consistently been declining for ≥2 weeks. Additionally, the hospital or surgical facility should be able to admit patients without COVID-19 who are undergoing elective orthopaedic surgery to an area of the hospital or facility that is separate from patients with COVID-19. The facility should also institute social distancing policies, including minimal

TABLE I Summary of AAOS, CMS, and CDC Guidelines for Defining Conditions*

	AAOS[8]	CMS[10]/CDC[11]
Tier 1	Elective surgery: patients with chronic conditions whose surgery can certainly be delayed without significant harm to the patient or the eventual outcome	Unlikely to result in patient harm (low acuity): conditions in which deferral of in-person care is unlikely to result in patient harm
Tier 2	Urgent elective surgery: patients with more acute pathology necessitating outpatient surgery pending availability of resources	Less likely patient harm (intermediate acuity): conditions in which deferral of in-person care has the potential to increase patient morbidity and mortality
Tier 3	Urgent surgery: patients whose conditions require immediate surgical intervention when failure to repair will lead to significant impairment of function and increased morbidity	Highly likely patient harm (high acuity): conditions in which deferral of in-person care is highly likely to result in patient harm
Tier 4	Emergency surgery: patients with life or limb-threatening injuries	

*AAOS = American Academy of Orthopaedic Surgeons, CMS = Centers for Medicare & Medicaid Services, and CDC = Centers for Disease Control and Prevention.

patient-to-patient interaction, no visitors for patients who are ≥18 years of age, and, if possible, no time spent in the waiting room.

According to the guidelines that were released on April 17, 2020, by the American College of Surgeons (ACS), a facility should have at least a 30-day supply of PPE for airborne, aerosol, droplet, and contact precautions prior to relaxing restrictions on surgical activity[9]. A CDC calculator is available to determine supply needs based on a given hospital's parameters[12]. Moreover, the ACS guidelines recommend that health-care systems should enact local testing policies for patients and health-care workers and determine a threshold incidence rate to trigger activity restriction if local cases resurge. This should be a priority because epidemiologic models suggest that multiple waves of COVID-19 cases should be expected before a vaccine is universally available[13,14].

Local COVID-19 diagnostic capabilities, including the ability for mass testing, should be considered, and protocols should be developed with false-negative test rates in mind. Since median false-negative test rates on the day of symptom onset are estimated to be 38%[15], establishing local guidelines for potential retesting of negative patients and staff prior to return to work are encouraged, a task that can prove particularly complicated as testing continues to fluctuate[16]. Moreover, due to the substantial cost of mass testing[17], financially unstable health-care systems may consider taking a pragmatic approach by utilizing PPE and symptom tracking in lieu of mass testing for preoperative assessment visits.

The ACS guidelines also advise health-care systems to prioritize the utilization of surgical facilities over hospitals for elective surgery[9]. This ensures that hospital operating rooms remain available for possible patient overflow from overwhelmed intensive care units and emergency cases secondary to complications from COVID-19. Moreover, operating at an alternative site of care can help prevent the backlog of future elective cases from looming over the health-care system after the pandemic. One article estimated that 3 months without elective surgeries translates to a backlog of roughly 5 million surgical cases in the United States alone[18].

Finally, the ACS guidelines encourage creative staffing to mitigate physical and emotional exhaustion. Prior to the COVID-19 pandemic, burnout was reported in up to 53% of surgeons[19]. Medical personnel on the front lines have witnessed high mortality rates secondary to COVID-19, the lack of adequate PPE, and extended work hours. These psychologically challenging conditions have led to a 20% to 50% increase in levels of depression, anxiety, insomnia, and distress[20]. To prevent burnout in physicians and medical staff, hospitals can offer psychosocial assistance and implement creative staffing practices, such as having retired surgeons work as first assistants, granting chief residents who have met graduation requirements independent privileges, and expediting the training of nurses and surgical technicians (Table II).

Patient Evaluation and Prioritization

The COVID-19 pandemic has shifted a large portion of clinical care to telemedicine. In an attempt to standardize the virtual orthopaedic examination, Tanaka et al. proposed a standard approach to these visits[21]. To maximize efficiency, patients are given a standardized checklist in advance, including instructions on camera placement, lighting, clothing, and the proper use of household items (e.g., chairs and bottles of water for strength testing). Use of the screen-sharing function across all platforms allows for physicians to review imaging with patients and refer to prepared pictures when explaining the patient's condition. While telemedicine can be beneficial in the initial evaluation or follow-up of a patient's condition, it remains in its infancy. Future research regarding the reliability of virtual orthopaedic examinations and technological advancements will continue to hone telemedicine as it becomes a more crucial tool for orthopaedic surgeons[22].

In the era of COVID-19, when examining patients with conditions that may require potential elective orthopaedic surgery, the European Society of Sports Traumatology, Knee Surgery and Arthroscopy (ESSKA) guidelines recommend prioritizing procedures in COVID-19-negative patients according to patient age, comorbidities, type of procedure, and expected hospital stay[6]. To limit exposure for high-risk individuals, the ESSKA guidelines initiated a

TABLE II AAHKS[7] and ACS[9] Checklist for Safe Return of Operations*

Regional considerations
Local government lockdown removed
State COVID-19 cases declining for ≥2 weeks
Facility-specific recommendations
Surgical facility isolated from unit with COVID-19-positive patients
Policy for social distancing and minimal patient-to-patient interaction
Minimum 30-day supply of PPE for airborne, aerosol, droplet, and contact precautions
Appropriate testing policy and ability for mass testing
Policy in place for creative staffing amidst burnout and attrition

*AAHKS = American Association of Hip and Knee Surgeons, ACS = American College of Surgeons, and PPE = personal protective equipment.

4-phase proposal for determining the order in which patients should return to elective orthopaedic surgery. Upon re-institution of these procedures, precedence should be given to minimally invasive surgeries for patients without comorbidities who are <60 years of age, with an expected hospital stay of ≤3 days. For phase 2, invasive surgeries should be reinstituted for patients of all ages without comorbidities who are expected to remain in the hospital for ≤3 days. Phase 3 involves minimally and open invasive surgeries for patients with comorbidities who are <60 years of age, and phase 4 includes all elective orthopaedic surgeries for patients of all ages with comorbidities (Table III). Minimally invasive surgery is considered theoretically safer due to the hypothetical risk that COVID-19 viral particles may reside dormant in musculoskeletal tissue and be released as aerosols during open surgical approaches[23].

The ACS guidelines stress the importance of establishing a scoring system for COVID-19-negative patient prioritization for elective surgery, but ultimately defer to specialties to implement their own framework[9]. An established system based on input from surgeons, anesthesiologists, nurses, and other staff allows for cohesiveness in a time of chaos and reduces the ethical dilemma that is associated with deciding which patients to prioritize.

Preoperative Screening

Once patients are designated for elective orthopaedic surgery, the importance of preoperative COVID-19 screening is paramount[6-11]. Consensus recommendations consider the real-time reverse transcription-polymerase chain reaction (rRT-PCR) test for the qualitative detection of nucleic acid from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in upper respiratory system specimens to be ideal due its relatively high sensitivity and negative predictive value[24]. According to CDC guidelines, the upper respiratory system sample can be obtained via nasopharyngeal, oropharyngeal, nasal mid-turbinate, or anterior nares swab[25].

Despite the consensus regarding rRT-PCR diagnostic testing, the AAHKS and ESSKA guidelines differ in terms of the extent and details of testing[6,7]. The AAHKS guidelines suggest that patients should be tested 3 to 7 days prior to surgery and should be continually screened for symptoms until the day of surgery. If a patient produces a negative test but is displaying symptoms of infection such as fever, cough, fatigue, anorexia, shortness of breath, sputum production, loss of taste and smell, sore throat, diarrhea, or nasal congestion, the AAHKS guidelines suggest delaying surgery to repeat the rRT-PCR test. In addition to rRT-PCR testing, the ESSKA guidelines suggest the use of daily temperature checks until the day of surgery. For patients who have been exposed to COVID-19 or have experienced a past infection and have since recovered, ESSKA guidelines recommend lung computed tomography (CT) at 48 to 72 hours before surgery. According to a systematic review and meta-analysis conducted by Xu et al., the sensitivity of chest CT for detecting COVID-19 is estimated to be 92%[26]. Thus, combining the rRT-PCR test and chest CT in especially high-risk patients may be an optimal strategy.

If a patient tests positive for COVID-19, elective surgery should be deferred for ≥8 weeks—even if the patient is asymptomatic[6]. According to an update from the CDC on August 16, 2020, a patient who has recovered from COVID-19 may have low levels of SARS-CoV-2 virus in their body for up to 3 months after the diagnosis[27]. While it is unclear if these patients remain infective months after the diagnosis, there are no specific guidelines addressing elective orthopaedic surgery in asymptomatic patients who continue to shed viral particles after 8 weeks, but it may be prudent to defer the surgery as postoperative pulmonary complications occur in half of patients with perioperative COVID-19 infection and are associated with a 30-day mortality rate that is nearly 75% higher than those without COVID-19[28] (Fig. 1).

Intraoperative Considerations

Once patients are designated for surgery, operative conditions must be considered. Consensus recommendations suggest the use of regional rather than general anesthesia whenever possible, as this has been found to safely reduce transmission in patients with confirmed COVID-19 infection[29]. To prevent the aerosolization of SARS-CoV-2 particles in a potentially infected patient, if possible, the patient should wear an N95 respirator mask, and airway manipulation should be minimized[30]. Only select personnel should be present during intubation, and some facilities may

TABLE III Summary of ESSKA[6] 4-Phase Strategy for Resuming Elective Surgery*

	Age	Comorbidities	Type of Procedure	Expected Hospital Stay
Phase 1	<60 years	No	Minimally invasive	≤3 days
Phase 2	All ages	No	Open invasive	≤3 days
Phase 3	<60 years	Yes	Minimally and open invasive	All LOS
Phase 4	All ages	Yes	Minimally and open invasive	All LOS

*ESSKA = European Society of Sports Traumatology, Knee Surgery and Arthroscopy, and LOS = lengths of stay.

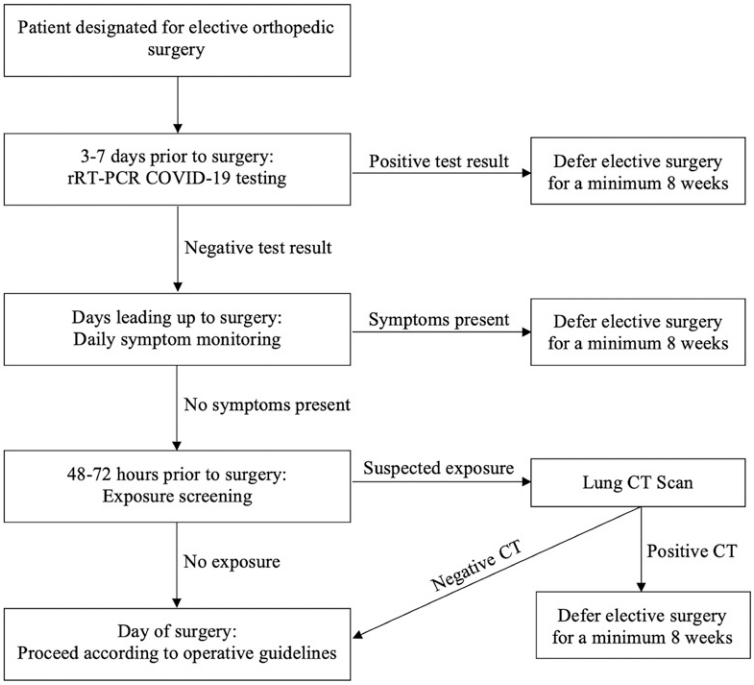

Fig. 1

Flowchart for preoperative screening for elective orthopaedic surgery based on the AAHKS and ESSKA guidelines.

consider a waiting period of up to 1 hour to allow for adequate air circulation before beginning the operation[9]. A recent study by van Doremalen et al. concluded that SARS-CoV-2 particles may remain viable in stagnant air for up to 3 hours[31]; however, most operating rooms can exchange and filter air at a rate that should eliminate 99.9% of the particles after 21 minutes[32]. Thus, the AAHKS guidelines recommend a turnover of 21 minutes, with minimal personnel in the operating room between surgeries. Ultraviolet light, which has been reported to kill up to 99.99% of coronavirus viral particles, can be utilized in operating rooms overnight to help eliminate any residual particles[33].

In addition to standard operating room protocol, orthopaedic surgeons should be aware that the presence of SARS-CoV-2 particles in bone, muscle, and fat remains largely unknown[34]. Thus, surgeons should implement heavy suction to remove smoke when using electrocautery, saws, drills, or other tools. If possible, the AAHKS guidelines recommend against the use of surgical helmets[7]. Although the helmets possess fans, the lack of air filtration within the helmet allows it to act as a reservoir that harbors active viral particles that hypothetically may have been released during an open procedure. If surgeons must wear surgical helmets to protect themselves against particulate or bodily fluids, surgeons should also wear an N95 respirator mask inside the surgical helmet and implement appropriate disinfection protocol of the helmet between cases to mitigate the risk.

Postoperative Considerations

Postoperatively, the ACS guidelines encourage the adherence to standardized care protocols[9]. With COVID-19 transmission in mind, surgical specialties have adopted new standardized care protocols to optimize the length of hospital stay and decrease complication rates. For orthopaedic surgeons, consensus guidelines have centered around the implementation of telemedicine[6]. Telemedicine during the perioperative to short-term follow-up period allows for more frequent visits and serves as a necessary screening tool to determine if a patient needs to be examined in person to evaluate for possible postoperative complications. For patients who are unable to take part in telemedicine due to technical limitations, in-person appointment protocols should be designed to include gaps between patient appointments and limit waiting room interaction.

Additionally, ACS guidelines encourage providers to consider postoperative discharge conditions prior to registering a patient for surgery[9]. If a patient is >60 years of age and requires postoperative rehabilitation, he or she is at significantly higher risk due to the semiconfined spaces and potential overcrowding of rehabilitation facilities[35]. If a patient wishes to be discharged to his or her home setting to mitigate this risk, the patient and the provider should have a thorough conversation to ensure that the patient's home environment is adequate for a safe recovery[36].

Overview

The COVID-19 pandemic has overwhelmed health-care systems in the U.S. and consequently caused a disruption to the existing infrastructure. To reduce the transmission of the virus, administrators have postponed elective

orthopaedic surgeries—a decision that costs hospitals $1.5 billion per month—forcing health-care systems to balance financial burden with patient safety. Without consensus guidelines for a safe return of elective orthopaedic surgery, already difficult decisions become nearly impossible. To ensure a safe return of procedures, hospital administrators should follow the aforementioned summarized consensus guidelines according to the current state of knowledge on COVID-19 until a vaccine becomes universally available.

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