

Management of Outpatient Elective Surgery for Arthroplasty and Sports Medicine During the COVID-19 Pandemic

A Scoping Review

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Background: The onset of the coronavirus disease 2019 (COVID-19) pandemic has presented unforeseeable challenges to the orthopaedic community, especially arthroplasty and sports medicine subspecialties, as many surgeries were deemed nonessential and delayed. Although there is a glimpse of hope with the approval and distribution of vaccines, daily case numbers and death tolls continue to rise at the time of this review.

Purpose: To summarize the available literature on the management of elective sports medicine and arthroplasty procedures in the outpatient setting to gather a consolidated source of information.

Study Design: Scoping review; Level of evidence, 5.

Methods: A scoping review of 3 databases (PubMed, Embase, and OVID Medline) was performed using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist. All retrospective and prospective analyses, systematic reviews and meta-analyses, expert opinions, and societal guidelines were included for review, with 29 articles meeting the inclusion criteria.

Results: Guidance for resumption of elective arthroplasty and sports medicine surgery and patient selection during the COVID-19 pandemic focuses on resource availability, patient fitness, and time sensitivity of the procedure, with patient and surgical team safety as the highest priority. Telemedicine and other innovative technology can be used to continue patient care during periods of delayed surgery through monitoring disease progression and offering nonoperative management options.

Conclusion: While the current societal recommendations provide guidance on safety protocols and patient prioritization, each orthopaedic practice must consider its unique situation and use evidence-based medicine when determining surgical timing and patient selection.

Keywords: arthroplasty; COVID-19; outpatient elective surgery; sports medicine

The World Health Organization declared the Chinese outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) to be a public health emergency of international concern at the end of January 2020.³³ At the time of writing, more than a year into the coronavirus disease 2019 (COVID-19) pandemic, there have been >99 million cases and 2.1 million deaths globally, with the United States leading in both case numbers and deaths by a large margin.¹¹ Furthermore, a new SARS-CoV-2 variant (VUI 202012/01) first identified in the United Kingdom in mid-December 2020 has been found in several other countries

and has an estimated increase of transmissibility of between 40% and 70% compared with previous circulating strains of the virus.³²

During the onset of the COVID-19 pandemic, elective orthopaedic surgery was quickly deemed nonessential and postponed, with the intent to mitigate risk to the patient and surgical team, conserve personal protective equipment (PPE), and remain cautious given the uncertain trajectory of COVID-19 transmission.^{2,31} Several reports showed a decrease of 74% in arthroplasty and 84% in sports medicine cases in the United States, with a similar reduction in arthroplasty and arthroscopy procedures globally, creating a backlog of patients awaiting surgery.^{3,7,9,16} One study predicted between 77,000 (best-case scenario) and 372,000 (worst-case scenario) primary total hip arthroplasty and

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total knee arthroplasty cases in the United States would require rescheduling, with projections of catch-up time ranging from 9.09 months (best-case scenario) to 34.75 months (worst-case scenario).³⁰

Whereas there have been articles published on general recommendations for the approach to elective orthopaedic surgery during the COVID-19 pandemic,^{3,6,14,19,20-22,28} there is an absence of literature specifically addressing elective orthopaedic surgery in the ambulatory setting. Outpatient surgery centers and clinics are the practice setting for a significant portion of arthroplasty and sports medicine specialists and present a different workflow, use of resources, and risk of virus exposure than the inpatient hospital setting.

The purpose of this scoping review was to summarize the available literature on the management of elective sports medicine and arthroplasty procedures in the ambulatory setting with the expectation of gathering a consolidated source of information if we were to potentially enter another period of delayed surgeries. We hypothesized that recommendations would focus on surgical timing, patient selection, and safety; however, there would be no consensus on how to proceed with outpatient elective orthopaedic surgery.

METHODS

Search Strategy and Evidence Review

Two reviewers (S.M.C., Y.M.) performed a search of 3 electronic databases (PubMed, Embase, OVID Medline) according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for scoping reviews using the search terms “COVID,” “orthopaedic,” “sports medicine,” and “elective surgery.” Articles published between January 1, 2020, and December 23, 2020, were retrieved and screened for duplicates. Titles, abstracts, and full texts were then reviewed based on the inclusion/exclusion criteria described herein. Reference lists from articles deemed to fit the inclusion criteria were reviewed to identify additional studies.

Articles were included if they were prospective or retrospective analyses, systematic reviews or meta-analyses, expert opinion, or societal guidelines written in English reporting on the management of elective arthroplasty or sports medicine procedures in the outpatient setting during the COVID-19 pandemic. A study was excluded from this review if it was an unpublished abstract; it focused on inpatient management; or its recommendations were not

orthopaedic-specific, were for nonelective surgeries, or concentrated on other subspecialties of orthopaedics (pediatrics, trauma/fractures, spine, hand, foot/ankle).

Pertinent information extracted included author, country, date and journal of publication, study design (and level of evidence), main subject, and conclusion on the management of orthopaedic elective surgery during the COVID-19 pandemic. The level of evidence was determined based on the guidelines of the Oxford Centre for Evidence-Based Medicine.

RESULTS

The literature search yielded 338 articles. After removing duplicates and screening abstracts and full-text articles, 25 articles met the inclusion criteria (Figure 1). Four additional articles were identified in the references, making a total of 29 articles for qualitative synthesis. Table 1 presents the characteristics of articles included in this review. All the included articles were published in 2020 or 2021. The articles represent the consolidation of recommendations from national and international orthopaedic societies and specialists in 24 countries, with 20 (69%) articles being collaborations among multiple countries. Among all the articles included, the most common country of origin of contributing authors was the United States (59%), followed by the United Kingdom (21%). The distribution in level of evidence was as follows: 14% (n = 4) of articles were level 3,^{8,10,12,30} 14% (n = 4) were level 4,^{13,16,18,31} and 72% (n = 21) of articles were level 5.^{1-7,14,15,17,19-29} The majority of studies were categorized as expert opinion/societal guidelines (55%). The most common theme among articles was general management recommendations on the resumption of elective arthroplasty and sports medicine surgery (n = 11 articles).^{3,6,14,15,19-24,28}

DISCUSSION

The 29 articles included in this review together represent the recommendations of experts globally and provide the current evidence-based data related to elective orthopaedic surgery during the COVID-19 pandemic. While there is no consensus on how to approach resuming elective arthroplasty and sports medicine procedures in the ambulatory setting, these articles demonstrate overlapping themes on nonoperative management, use of telemedicine, surgical timing, patient selection, and safety. With ethical considerations in mind, this information, combined with

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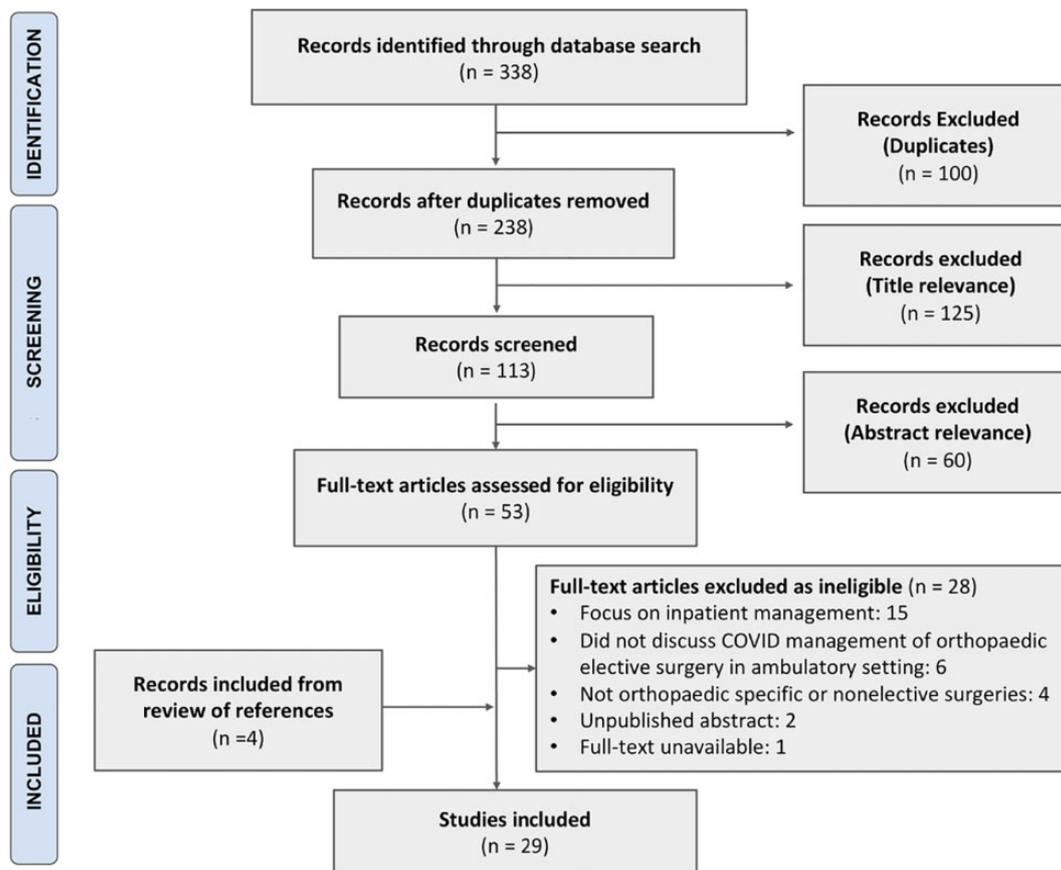


Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart of the article selection process. COVID-19, coronavirus disease 2019.

evidence-based medicine, can be used for individual orthopaedic institutions to develop a COVID-19 protocol based on its unique situation.

Nonoperative Management

Delay in elective procedures for the treatment of osteoarthritis and musculoskeletal injuries can have detrimental effects on many aspects of a patient's life and result in poorer outcomes and need for revision procedures.^{13,16} Uncontrolled pain leads to increased use of analgesics and opioids, placing patients at increased risk of opioid tolerance and addiction.^{12,13,16,29} One institution surveyed patients awaiting elective joint replacement during the COVID-19 pandemic and found that 23.4% of patients reported an increase in dose or frequency of pain medication consumption after being told surgery was delayed, with 21.6% of patients surveyed using opioids to manage their arthritis pain.³¹ Less mobility and functional limitations can cause lack of independence during a time of increased social isolation and lead to the development of flexion contractures and loss of muscle mass, making postoperative rehabilitation more difficult.^{13,14,28} When delay

in surgery is unavoidable, as in the case of the current COVID-19 pandemic, surgeons have an obligation to provide patients with resources to lessen the burden of the disease and prevent further damage that could worsen postoperative outcomes.

A stepwise approach should be used when prescribing medications during the interim period before surgery because of the risk of opioid abuse. Nonopioid agents such as acetaminophen, nonselective and cyclooxygenase 2—selective nonsteroidal anti-inflammatory drugs (NSAIDs), and topical NSAIDs and capsaicin can provide pain relief and reduce swelling.^{24,29} Pain relief after injections of corticosteroids or high molecular weight hyaluronic acid is variable and often temporary, which may manage symptoms successfully until surgery can be scheduled.^{24,29} The American Academy of Orthopaedic Surgeons has released a statement in regard to the use of corticosteroids for musculoskeletal care in the setting of COVID-19, reporting a lack of evidence demonstrating potential harm or increased risk of COVID-19 with intra-articular injections of corticosteroids.¹ However, caution is recommended, and robust discussion with patients regarding the potential risks and alternative treatments is critical.¹

TABLE 1
Characteristics of the Articles Included in the Scoping Review^a

First Author	Title	Country of Origin	Main Theme	LOE
AAOS Committee on Patient Safety ¹	Guidance summary: use of corticosteroids for musculoskeletal pain during the COVID-19 pandemic	US	Nonoperative management	5
Ding ²	Time-sensitive ambulatory orthopaedic soft-tissue surgery paradigms during the COVID-19 pandemic	Singapore	Surgical timing	5
Donell ³	Preparation for the next COVID-19 wave: the European Hip Society and European Knee Associates recommendations	UK, Austria, Indonesia, Argentina, US, Chile, Switzerland, Greece, Russia, New Zealand, China, Turkey, Italy, Netherlands	General management recommendations	5
Forlenza ⁴	Protecting surgical patient safety during the COVID-19 pandemic	US	Safety measures	5
Geevarughese ⁵	Aerosol generating procedures in orthopaedics and recommended protective gear	India	Safety measures	5
Gilat ⁶	Recommendations to optimize safety of elective surgical care while limiting the spread of COVID-19: primum non nocere	Israel, US	General management recommendations	5
Guy ⁷	AAOS guidelines for elective surgery during the COVID-19 pandemic	US	Surgical timing	5
Jaenisch ⁸	Evaluation of the feasibility of a telemedical examination of the hip and pelvis—early lessons from the COVID-19 pandemic	Germany	Telemedicine	3
Jella ¹⁰	Rapid decline in online search queries for hip and knee arthroplasties concurrent with the COVID-19 pandemic	US	Evidence-based medicine	3
Karasavvidis ¹²	Home-based management of knee osteoarthritis during COVID-19 pandemic: literature review and evidence-based recommendations	Greece	Nonoperative management	3
Kort ¹³	Recommendations for resuming elective hip and knee arthroplasty in the setting of the SARS-CoV-2 pandemic: the European Hip Society and European Knee Associates survey of members	Netherlands, Spain, Canada, UK, France, US, Switzerland, Austria, Greece, Belgium, Turkey, Italy	Survey of surgeons	4
Kort ¹⁴	Resuming hip and knee arthroplasty after COVID-19: ethical implications for wellbeing, safety and the economy	Netherlands, Italy, Spain, Turkey, Austria, UK, Greece	General management recommendations	5
Kunze ¹⁵	Perspectives on the impact of the COVID-19 pandemic on the sports medicine surgeon: implications for current and future care	US	General management recommendations	5
Liebensteiner ¹⁶	It is not “business as usual” for orthopaedic surgeons in May 2020—the Austrian-German-Swiss experience	Austria, Switzerland, Germany	Survey of surgeons	4
Loeb ¹⁷	Departmental experience and lessons learned with accelerated introduction of telemedicine during the COVID-19 crisis	US	Telemedicine	5
Morris ¹⁸	Waiting lists for symptomatic joint arthritis are not benign: prioritizing patients for surgery in the setting of COVID-19	UK	Survey of patients	4
Mouton ¹⁹	COVID-19—ESSKA guidelines and recommendations for resuming elective surgery	Switzerland, Luxembourg, France	General management recommendations	5
O'Connor ²⁰	Economic recovery after the COVID-19 pandemic: resuming elective orthopedic surgery and total joint arthroplasty	US	General management recommendations	5
Öztürk ²¹	Perioperative management recommendations to resume elective orthopaedic surgeries for post-COVID-19 “new normal”: current vision of the Turkish Society of Orthopaedics and Traumatology	Turkey	General management recommendations	5

(continued)

Table 1 (continued)

First Author	Title	Country of Origin	Main Theme	LOE
Parvizi ²²	Resuming elective orthopaedic surgery during the COVID-19 pandemic: guidelines developed by the International Consensus Group (ICM)	US, Germany, Australia	General management recommendations	5
Pelt ²³	The rapid response to the COVID-19 pandemic by the arthroplasty divisions at two academic referral centers	US	General management recommendations	5
Phillips ²⁴	Impact of COVID-19 on orthopaedic care: a call for nonoperative management	Canada, US, UK, Netherlands	General management recommendations	5
Rizkalla ²⁵	Triaging total hip arthroplasty during the COVID-19 pandemic	US	Surgical timing	5
Tan ²⁶	The long road to recovery: at six months since the first COVID-19 wave, elective orthopedic care has still not fully recovered in Belgium	Belgium	Survey of surgeons	5
Tanaka ²⁷	Telemedicine in the era of COVID-19: the virtual orthopaedic examination	US	Telemedicine	5
Vles ²⁸	Returning to elective orthopedic surgery during the COVID-19 pandemic: a multidisciplinary and pragmatic strategy for initial patient selection	Belgium, UK	General management recommendations	5
Wall ²⁹	Symptom management for patients awaiting joint replacement surgery	Australia	Nonoperative management	5
Wilson ³⁰	Quantifying the backlog of total hip and knee arthroplasty cases: predicting the impact of COVID-19	US	Evidence-based medicine	3
Wilson ³¹	Patient perceptions of COVID-19-related surgical delay: an analysis of patients awaiting total hip and knee arthroplasty	US	Survey of patients	4

^aAAOS, American Academy of Orthopaedic Surgeons; COVID-19, coronavirus disease 2019; ESSKA, European Society for Sports Traumatology, Knee Surgery and Arthroscopy; LOE, level of evidence.

Role of Telemedicine

The COVID-19 crisis has presented an opportunity to integrate virtual technology into daily orthopaedic practice to continue patient care while keeping the safety of patients and health care professionals as a top priority. In the United States, relaxation on requirements for HIPAA (Health Insurance Portability and Accountability Act)—compliant technology and governmental restrictions on interstate communication during the COVID-19 pandemic have allowed surgeons to communicate with patients who may have unequal access or inadequate understanding of available technologies and/or reside in states beyond the surgeon's license.^{15,17,20,23} To avoid clinical staff dedicating time on the telephone for redundant patient questions and updates, 1 orthopaedic institution reported use of its text message program to send alerts in regard to surgery scheduling, patient education content about COVID-19, words of empathy and encouragement from staff, and personalized video messages from the attending surgeons.²³ Sports medicine surgeons can also use virtual platforms to provide information on injury prevention and ways to remain physically active without compromising musculoskeletal function.⁴ Such innovation demonstrates good application of technology to add efficiency and value to orthopaedic practice.

Tanaka et al²⁷ shared the triumphs and pitfalls of the orthopaedic virtual examination based on their institution's experience thus far during the COVID-19 pandemic. Before the scheduled appointment, the patient should consent to the virtual visit and be sent a checklist with instructions on how to test connection to the telemedicine platform, guidelines on camera positioning and lighting, and demonstrative photos or videos of the examination maneuvers. Virtual rulers and web-based goniometers are compatible with many video communication platforms and can be used for measurements such as limb length or pelvic obliquity and range of motion, respectively.²⁷ Strength testing and provocative testing of the upper extremities can be performed against gravity or while holding objects of known weight (ie, 16-oz bottle of water [1 lb; .5 kg], 1-liter bottle of soda [2 lbs; .9 kg], full bottle of wine [4-5 lbs; 2 kg]).²⁷

Jaenisch et al⁸ recently studied the feasibility of performing a hip and pelvis examination via telemedicine during the COVID-19 pandemic by assessing the agreement between telemedicine and conventional examinations. The study found good agreement for inspection and function assessments, moderate agreement for evaluation of range of motion, and adequate correlation for palpation and provocation assessments between the 2 examination modalities. Furthermore, there was a positive correlation found

TABLE 2
Categorization by Degree of Emergency of Indications for Arthroplasty Procedures in the Pandemic Era^a

		Degree of Emergency	
		Urgent	Elective
Indication for Arthroplasty	Primary/Conversion	<ul style="list-style-type: none"> • Hip and long bone fractures (ie, femoral neck fracture) • Hip or knee dislocation • Rapid bone collapse due to AVN • Aggressive tumor infiltration • Progressive structural bone erosion • Nonunion or collapse of the fracture construct after internal fixation 	<ul style="list-style-type: none"> • Total joint arthroplasty for chronic conditions (ie, osteoarthritis, rheumatoid arthritis, noncollapsed AVN, developmental deformities, malunion) • Previous fracture constructs that have developed stable osteoarthritis • Failed hip or knee arthroscopy for treatment of intra-articular or periarticular pathology
	Revision	<ul style="list-style-type: none"> • Periprosthetic joint infections • Irreducible or reoccurring prosthetic dislocations • Periprosthetic fractures • Acute pain exacerbation in prior joint arthroplasty • Exposed implant 	<ul style="list-style-type: none"> • Stable, loose implants without progressive bone loss • Chronic problems (ie, head/liner exchange for polyethylene wear with minimal osteolysis)

^aAVN, avascular necrosis.

between rate of deviation between the 2 examinations and patient-specific factors, including age, body mass index, and American Society of Anesthesiologists (ASA) classification score, demonstrating the need to screen patients to improve the accuracy of the examination. While provocative testing, discrete palpation, and strength or stability testing can be limited in the virtual setting, providers can utilize imaging modalities to assist in evaluation and diagnosis.²⁷ Future directions in telemedicine for orthopaedic practice include standardization of the virtual examination, technological advancements to incorporate motion-capture imaging and remote dynamic testing, and research on the reliability of the testing maneuvers for each joint to optimize the quality and efficiency of the virtual encounter.^{23,27}

Elective Surgery Guidance

Patient Selection Tools. Several organizations (American Academy of Orthopaedic Surgeons; American Association of Hip and Knee Surgeons; American College of Surgeons; European Hip Society; European Knee Association; and European Society of Sports Traumatology, Knee Surgery, and Arthroscopy [ESSKA]) and individual institutions have released recommendations on the approaches to the resumption of elective sports medicine and arthroplasty surgery during the COVID-19 pandemic.^{3,7,13,19} Common themes addressed in these statements are resource availability, patient safety, and time sensitivity of the procedure. Several tools have been developed to combine risk factors to help with patient selection and to predict risks and complications of COVID-19 contraction for patients requiring surgery during the pandemic, with the Medically Needed Time-Sensitive Procedures score being most universally used.¹⁴ The Medically Needed Time-Sensitive Procedures score incorporates procedural factors, disease

factors, and patient factors, with each factor scored on a 1 to 5 scale, with higher scores associated with poorer perioperative patient outcomes, increased risk of SARS-CoV-2 transmission, and/or increased use of hospital resources.^{14,28} Another institution created its own tool to rank orthopaedic surgical patients based on resource availability, patient fitness, and time sensitivity of the procedure. Each domain functions as a standalone with no sum scores in order for surgeons to adjust the weight of items based on differences among subspecialties.²⁸

While many assessment tools focus on objective factors, quality of life is an important consideration that may not be detected easily by established prioritization tools. Two recent studies that surveyed patients who had their initial appointments for major joint arthritis deferred or elective joint arthroplasty surgery delayed during the COVID-19 pandemic found that patients reported further deterioration in their health and functional state as measured using the EuroQol 5-level 5-dimension assessment and Single Assessment Numeric Evaluation score, respectively.^{18,31} Either incorporating patient-reported scores or having a conversation with the patient can provide valuable insight into the patient's state of health and also appeal to patient autonomy by including them in the decision-making process.³¹

Surgical Timing. In the pre-COVID-19 era, there were no valid and widely accepted tools used to determine the time sensitivity of orthopaedic procedures.^{13,28} Therefore, a major component of the guidelines released attempts to distinguish priority indications of sports medicine and arthroplasty procedures to create a systematic approach to patient selection. Attention is given to time on a waiting list and effect of further delay on surgical difficulty, outcome, quality of life, return to work/school, and/or return to sports.²⁸ Risk of clinical deterioration, immobility, and frequent falls should be considered in conjunction with the

TABLE 3

Recommended Time to Surgery for Sports Medicine Conditions Requires Time-Sensitive Orthopaedic Ambulatory Surgery^a

Condition	Recommended Time of Surgery	LOE
Shoulder		
Unstable glenohumeral joints after dislocation	>2 dislocations	2
Acute types 3, 4, 5, and 6 acromioclavicular joint dislocations	<3 wk	4
Acute/severe rotator cuff tears	<3 wk	4
Elbow		
Unstable elbow subluxations or dislocations	<2 wk	3
Locked osteochondral defects of the elbow	<2 wk	5
Distal biceps tendon tears	<3 wk	3
Triceps tendon tears	<12 wk	3
Hand and wrist		
Acute flexor tendon tears	<3 d	3
Unstable carpal dislocations/fracture dislocations	<1 wk	3
Unstable phalangeal subluxations or dislocations	<4 wk	4
Foot and ankle		
Ankle fracture dislocations or subluxation with syndesmosis disruption	<1 d	5
Acute Achilles tendon rupture	<2 d	3
Acute ligament tears with ankle instability	<2 wk	2
Knee		
Acute tendon rupture (patellar or quadriceps)	<1 wk	3
Dislodged osteochondral fractures	<2 wk	2
Multiligament knee injury	2-4 wk	2
Anterior/posterior cruciate ligament avulsion injuries	<3 wk	2
Meniscal tears	<12 wk	5
Hip		
Hip subluxation or dislocation that is not reducible or is unstable after reduction	<6 h	5
Acute proximal hamstring ruptures	<4 wk	4
Locked hip secondary to intra-articular bodies or an incarcerated labrum	<6 mo	2

^aAdapted from Ding et al.² LOE, level of evidence.

underlying diagnosis.^{6,25} Furthermore, factors contributing to the complexity of the procedure (joint destruction/erosion, loose/failed implants compromising bone stock, etc) can affect the time and resources required.²³ Tables 2 and 3 summarize the time sensitivities of arthroplasty and musculoskeletal soft tissue disorders requiring surgery, respectively, based on the recommendations in the articles included in this scoping review.^{2,6,7,12,13,19,22,23,25}

Indications for primary, conversion, and revision total joint arthroplasty (TJA) need to be considered when triaging a patient and determining the degree of emergency. Interventions that warrant urgent primary arthroplasty surgery include hip or knee dislocations, femoral neck fractures, rapid bone collapse due to avascular necrosis, aggressive tumor infiltration, or progressive structural bone erosion.^{7,14,25} In respect to conversion to TJA, urgent reasons to consider are nonunion or collapse of the fracture construct after internal fixation.²⁵ Finally, arthroplasty specialists must be able to distinguish between elective and urgent indications for revision arthroplasty procedures. Chronic, stable issues with implants can be handled electively, while periprosthetic fractures or joint infections, irreducible or reoccurring prosthetic dislocations, acute pain exacerbation in previous joint arthroplasty, or exposed implants all require thorough investigation and warrant urgent intervention to avoid further complications requiring more complex procedures.^{2,7,12,13,22,23,25}

There is a wide range of indications for sports medicine procedures that requires a clear understanding of the underlying soft tissue musculoskeletal disorders to determine the urgency of treatment. Acute intra-articular or periarticular ligament injuries, acute tendon injuries, bucket-handle meniscal tears with a locked knee, intra-articular loose bodies causing acute symptoms, dislocated joints that cannot be closed or reduced, and rapid onset or worsening compression neuropathies with motor deficiency warrant urgent intervention.^{6,7,19,23} Ding et al² performed a systematic review further summarizing time-sensitive elective orthopaedic soft tissue surgery paradigms (Table 3). Timely surgery for the repair, reduction, or reconstruction of critical structures has the potential to improve outcomes and overall quality of life for patients.

Patient Prioritization. The success of orthopaedic surgery in the outpatient setting relies heavily on the patient's health, independence, and support structure.²³ The patient's sex, age, body mass index, medical comorbidities, ASA score, and history of exposure to COVID-19 should be considered.^{4,14,16,19,21,28} Several societies released recommendations on patient selection during the peak of the pandemic in the spring of 2021, with the focus on prioritizing patients who are at low risk of COVID-19 disease transmission and postoperative complications.^{3,21,22}

There were some discrepancies in the cutoff patient age for higher risk of COVID-19, with the American Association

of Hip and Knee Surgeons using >75 years old; the American College of Surgeons, European Hip Society, and European Knee Association using >65 years old; and ESSKA using equal to or greater than 60 years old.^{3,14,19,22} Comorbidities of concern include morbid obesity, uncontrolled hypertension, cardiopulmonary disease, kidney disease, liver disease, diabetes mellitus, autoimmune diseases, immunosuppression or immunodeficiency, active cancer, history of transfusion, obstructive sleep apnea, and smoking.^{4,14,19,21,25,28} Due to the potential catalytic effect surgical stress might have on the course of disease in case of concomitant COVID-19 infection during the perioperative period, it is crucial to evaluate the patient as a surgical candidate as a whole rather than solely by his or her orthopaedic condition.²⁸ With restrictions on admission for inpatient rehabilitation and at-home services, the surgeon and health care team have a responsibility to make sure patients can perform activities of daily living and have the resources necessary to access and complete rehabilitation.

Safety Measures

Safety of the patient and surgical team during the perioperative period is normally of the utmost importance and should be emphasized even more during the COVID-19 crisis. Preoperatively, patients undergoing surgery should have their temperature and pulse oximetry measured and be screened using a series of questions covering symptoms (cough, fever, loss of smell or taste, headache, etc) and travel to regions with a high prevalence of COVID-19, occupation with a high risk of COVID-19 infection, contact with people known to be infected with COVID-19, or close proximity with people known to have COVID-19.^{13,19,21,22} The threshold for requiring reverse transcription polymerase chain reaction testing for SARS-CoV-2 should be based on the disease prevalence and test availability in the area, with local guidelines as a valuable resource.^{13,25} Patients with high risk of being infected or whose SARS-CoV-2 test results are positive, should have surgery deferred and quarantine per local and national guidelines.

Regional anesthesia, whenever possible, should be considered strongly for patients undergoing elective orthopaedic surgery during the pandemic.^{13,19,21,22} General anesthesia requires airway manipulation, endotracheal intubation, and positive ventilation, which predisposes the surgical team to the transmission of SARS-CoV-2.^{13,22} Orthopaedic surgery involves aerosol-generating procedures (AGPs), defined as medical procedures that generate aerosols of <10 µm that can travel >2 m.⁵ The viral concentration of SARS-CoV-2 in articular, periarticular, and bony tissues and fluids of infected patients is currently unknown; however, it is reasonable to assume it is lower in these tissues than in respiratory or digestive tissues.¹⁹ Due to these uncertainties, several societal and institution guidelines recommend to decrease or proceed with caution with surgeries that generate a high number of aerosols.^{13,19,21,22} In particular, high-risk AGPs in arthroplasty or sports medicine include the use of power drills, reamers, high-speed saws, pulsed lavage, and electrocauterization in cutting and coagulation mode.^{5,13,21} Harmonic devices,

osteotomes, nibblers, gigli saw, and hand drills are considered moderate-risk AGPs.^{5,21,22} Risk can be reduced by using suction devices to clear surgical smoke, keeping the power setting on low when using high-power tools, and working with manual tools whenever possible.^{14,21,22} There is a theoretical risk of exposure during arthroscopic procedures; therefore, central aspirator systems should be used to drain smoke and prevent waterlogging.^{5,21}

The operating ventilation system should prevent the dissemination of airborne pathogens inside and outside the room, with consensus on having a ventilation system with a minimum of 20 air changes per hour and using high-efficiency particulate air filters that are able to remove aerosol and droplets as small as nanoparticles.^{4,5,13,21} Normal positive-pressure rooms can be used for elective procedures.^{21,22} The number of team members in the operating room should be minimized, and only the equipment and supplies required for the procedure should be present.^{4,5,13,22}

All patients undergoing elective orthopaedic surgery should wear a mask upon entering the facility, to and from the operating suite, and in postoperative recovery.^{4,13,19,22} In areas of high prevalence of COVID-19, PPE for the surgeon and whole team who scrub into the case should include a surgical gown, mask (preferably N95, filtering face piece P2 or P3), and face shield or protective eyewear.^{5,13,19,21,22} For high- and moderate-risk AGPs, it is also recommended for surgeons to wear knee-high shoe covers and to double glove.⁵ Surgical helmets should not be used as a primary protection against COVID-19 as they can harbor viruses and cannot be sterilized between procedures.²² For TJA, surgical helmets should continue to be used in addition to wearing a N95 mask (or equivalent) and with appropriate disinfection protocols for the helmets in place.^{19,22}

Recently, Tan et al²⁶ published a study that surveyed 56 members of the Belgian Knee Society to evaluate the implementation of ESSKA COVID-19 guidelines and recommendations for resuming elective surgery in the practice of Belgian knee surgeons. The study found good compliance with ESSKA COVID-19 guidelines for preoperative patient COVID-19 testing but observed lower compliance in terms of preoperative health care personnel testing, changes in use of PPE, technical adaptations to control AGPs, and preference for locoregional anesthesia; yet there were no COVID-19 infections that could be traced back to an elective surgery or outpatient visit among patients of these surgeons. While the effect of the additional safety measures to reduce COVID-19 transmission during elective orthopaedic surgery is debatable, these precautions should be strongly considered until more substantial evidence is available.

Ethical Considerations

An ethical dilemma exists between prioritizing patient safety and avoiding delay in procedures that can lead to progression of the condition, resulting in functional limitations and worse outcomes.²³ Furthermore, TJA and sports medicine subspecialties generate significant revenue for outpatient surgery centers, medical device companies,

orthopaedic practices, and health care systems in general.¹⁴ The projected value of the overall global joint market is \$20.2 billion by 2025.^{14,21} Because of the immense pressure to recoup missed case volumes and financial losses, there is risk of arthroplasty and sports medicine specialists incorporating these implications into their approach to treatment.^{14,15} Therefore, shared decision making between the surgeon and patient should be emphasized when discussing treatment options and choosing to proceed with surgery.

Equally important is the consent process during the pandemic to provide direct, succinct, and transparent information.^{3,14,22,28} Patients should understand that although preventative measures are being taken in the ambulatory setting, COVID-19 contraction and the associated risk of complication and death cannot be fully abolished.^{3,19} In addition, it must be clearly stated that arthroplasty and sports medicine procedures are considered elective, besides the selective cases deemed emergent, and may be postponed or cancelled depending on the COVID-19 case load and local guidelines.^{3,28}

Use of Evidence-Based Medicine

Reflection on what went well and what could have been done better during the initial wave and lockdown is crucial to create a sustainable approach to patient care that improves efficiency and prioritizes patient safety and well-being.^{3,28} Evidence-based medicine, including real-time data collection and analysis, is key for the planning and refining of the response to a new phase of SARS-CoV-2 and determining the pandemic's effect on current and future elective surgery.^{3,10,20,30} Jella et al¹⁰ quantified the effect of COVID-19 on the relative public interest in elective procedures by analyzing the Google search volume index values for key search terms related to TJA. The results demonstrated a drop in Google search volume index for each search term, approximating 3 standard deviations below the 5-year mean, during March 2020. Wilson et al³⁰ used population-level data to create a model to predict monthly total hip arthroplasty and total knee arthroplasty procedural volumes in the United States for 2020 to 2023 and projected catch-up time for the backlog of cases due to delays from the COVID-19 pandemic. Using real-time data can help policy makers and administrators anticipate excess volume and make provisions to accommodate patients forced to delay their care through expanding operative days or hours and increasing access to nonoperative management options.³⁰ Understanding demand for elective orthopaedic procedures leads to efficient utilization of surgical facilities to mitigate practice attrition, which will be critical to economic recovery and sustainability.^{20,30,31}

Study Limitations

This scoping review had several limitations. First, only recommendations from peer-review articles found during the literature search of the databases or societal guidelines found in the references were included. Updated guidelines posted on societal websites that have not been cited in the

literature may have been excluded. Second, there were more articles that directly addressed the management of elective arthroplasty procedures than sports medicine procedures. While many of the recommendations could be extrapolated to the care of patients undergoing sports medicine procedures, further guidance from sports medicine-specific societies or institutions would be beneficial.

CONCLUSION

The COVID-19 pandemic has challenged the medical community globally. With the cancellation of nonessential surgeries, arthroplasty and sports medicine specialists were forced to redesign and develop innovative approaches to patient care and treatment options. While the current societal recommendations provide guidance on safety protocols and patient prioritization, each orthopaedic practice must consider its unique situation when determining surgical timing and patient selection. Evidence-based medicine, including collection of real-time data, should be used to track outcomes and surgical demand to adjust guidelines as necessary to maximize patient safety and prevent further delay in care.

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