Covid-19 and Orthopedic Surgery: Review of the Literature and Evidence

Covid-19 y cirugía ortopédica: Revisión de la literatura y evidencias

Karen A. Weissmann[1,2] Carlos Huaiquilaf[1] Marcelo Costa[3] Cristian Correa[4] Alan Bey[5,6] Luis Bahamonde M.[1]

[1] Orthopedics and Traumatology Department, Universidad de Chile, Santiago, Chile
[2] Orthopedics and Traumatology Department, Universidad Católica de Valencia San Vicente Mártir, Valencia, Spain
[3] Spine Team, Redsalud Santiago, Santiago, Chile
[4] Orthopedics and Traumatology Department, Universidad de la Frontera, Temuco, Chile
[5] Universidad Finis Terrae Región Metropolitana, Santiago, Chile
[6] Universidad Diego Portales, Región Metropolitana, Santiago, Chile

Address for correspondence Karen A. Weissmann, Departamento de Ortopedia y Traumatología, Universidad de Chile, avenida Libertador Bernardo O'Higgins 1.058, Santiago de Chile, Chile (e-mail: karenw9@gmail.com).

Rev Chil Ortop Traumatol 2021;62:57–65.

Abstract

A pandemic has been declared due to a new highly contagious virus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV2). The world has come to a halt due to the rapid expansion of this virus, whose lethality has reached 15% in some countries. In Chile, the government has taken decisive, aggressive measures in an attempt to control disease spread and provide healthcare to those who need it. These decisions include the suspension of elective surgeries and other ambulatorial procedures. As orthopedic surgeons, we have been affected by these measures, and there is doubt regarding the best course of action. We prepared this guide to summarize available evidence and orient our colleagues regarding this condition. This guide is meant to be dynamic, as new opinions, evidence and experiences arise every day. Therefore, we advise the reader to keep it as a reference, not an undisputable truth.

Keywords
- pandemic
- covid-19
- orthopedic surgery

Resumen

Se ha declarado una pandemia ante la propagación de un nuevo virus con alta contagiosidad, llamado síndrome respiratorio agudo severo coronavirus 2 (severe acute respiratory syndrome coronavirus 2, SARS-CoV2). El mundo ha quedado detenido ante la rápida expansión del virus, con una letalidad que en algunos países llega a 15%. En Chile, el gobierno ha tomado medidas rápidas y agresivas que han permitido mantener la curva de contagios a un nivel que permita atender de manera

received
April 27, 2020
accepted
January 21, 2021

DOI https://doi.org/10.1055/s-0041-1728739.
ISSN 0716-4548.

Thieme Revinter Publicações Ltda., Rua do Matoso 170, Rio de Janeiro, RJ, CEP 20270-135, Brazil

adecuada a la población. Dentro de estas medidas, se contempla la suspensión de cirugías y consultas ambulatorias. Como cirujanos ortopédicos, nos hemos visto afectados por estas medidas, y existe confusión respecto a cuál es la conducta más adecuada. Quisimos hacer esta guía para resumir parte de las evidencias disponibles y orientar a los cirujanos ortopédicos respecto a esta patología. El comportamiento de esta guía es dinámico, dadas las múltiples opiniones, experiencias y evidencias, que surgen diariamente, por lo que recomendamos mantenerlo como referencia, no como certeza.

Palabras clave
- pandemia
- covid-19
- cirugía ortopédica

Introduction

On March 12, 2020, the World Health Organization (WHO) declared a pandemic due to the spread of a new highly contagious virus from China, called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

We prepared the present guide to summarize part of the available evidence and offer guidance to orthopedic surgeons regarding this condition. This guide is meant to be dynamic, as new opinions, evidence and experiences arise every day. Therefore, we advise the reader to keep it as a reference, and not an undisputable truth. We hope to update it continuously as required.

What is Covid-19?

In December 2019, 41 cases of pneumonia of an unknown etiology appeared in Wuhan, China. As Wuhan is an important transport hub, most of these patients reported visiting a local fish and wildlife market during the month prior to the onset of the disease.

The virus is contracted through the respiratory tract, mainly through respiratory droplets and contact with contaminated surfaces.[1] The most frequent symptoms are fever and cough (►**Table 1**), but some patients may remain afebrile.

The diagnosis is made with real-time polymerase chain reaction (RT-PCR), which has a 61% to 70% sensitivity during the first week of symptoms. From days 8 to 14, the sensitivity of this test in oropharyngeal swab samples falls from 61% to 50% in patients with severe disease, and to 29% in those with mild symptoms.[2]

Multiple detection tests have become available worldwide up to the date of the present report, using either airway or blood samples; as such, Sociedad Chilena de Infectología has prepared a review on the usefulness of different tests (►**Table 2**).[2]

The highest mortality rates occur in patients with comorbid conditions (►**Table 3**). This virus causes two types of severe syndromes: one behaving as a cytokine storm, and the other, as an antiphospholipid syndrome. ►**Table 4** shows signs of poor prognosis.

Treatment

The only proven treatment against coronavirus disease 2019 (Covid-19) consists of supportive measures, ranging from keeping a patient with mild disease well hydrated at home to mechanical ventilation and general management for respiratory distress.

From the point of view of traumatology and orthopedics, increased morbidity and mortality rates have been previously described in patients with pneumonia and hip fracture.[3] Similarly, there is a 5% rate of postoperative pulmonary complications following the surgical treatment for hip fracture. In a series[4] of 10 Covid-19-positive patients with major fractures, 4 died 8 to 11 days after admission to the emergency room; among them, only 1 patient was operated on promptly, resulting in early death. These patients presented neutrophilia, lymphopenia, and increased D-dimer levels compared to patients without fractures, which is in line with the greater severity of the condition.[4]

Control Measures

All available measures are required to avoid these degrees of disease transmission (►**Table 5**). Persons who came in direct contact with Covid-19 patients must be quarantined for

Table 1 Covid-19 symptoms

Symptoms	Frequency (percentage)	Authors
Fever	83–100	[1,2]
Cough	61–90	[1,2]
Fatigue	27–100	[1,3]
Productive cough	21	[1]
Muscle/joint pain	14–50	[1,3](76)
Gastrointestinal symptoms (diarrhea)	10	[1](77)
Dyspnea	12–14	[1]
Odynophagia	8	[1]
Headache, dizziness, reduced mentation	9	[1](70)
Upper-respiratory-tract symptoms (rhinorrhea, anosmia)	5	[1](69)
Multiple organ failure	6	[1](75)
Hepatomegaly/Splenomegaly		[4](75)
Encephalitis		[5]

Table 2 Diagnostic tests for Covid-19

	Detection	Uses	Beneficiaries
Ribonucleic Acid (RNA) amplification techniques	Current infection. Respiratory sample From oropharyngeal swab	- Report individual infection status, help to anticipate spread and take measures to prevent it	- Patients - Health institutions - Public health
Antibody detection	Current or previous infection	- Detects previously infected and susceptible subjects - Identifies subjects with neutralizing antibodies - Allows contact tracing	- Potentially immune subjects - Health institutions - Public health
Antigen detection	Current infection	- May report current infection status. Lack of sufficient data	- Patients - Health institutions

Table 3 Comorbid conditions and their impact on Covid-19 mortality

Comorbid condition	Mortality risk (percentage)*	Author
Age over 60 years	80	[1]
Age over 50 years	90	[1,6]
Cardiovascular condition	10.5–13.2	[1,6]
Hypertension	8.3–65.9	[1,6,7]
Diabetes with glycated hemoglobin (A1c) level > 7.6%	7.3–9.2	[1,6]
Respiratory condition	8.0–10.3	[1,6]
Cancer	5.6–7.6	[1,6]
No comorbid conditions	0.9–1.4	[1]
Biological therapy**		[6](76)
Transplant or mesenchymal conditions**		[6](76)
HIV with CD4 cells < 200*		[6]

Notes: *From deceased patients, risk percentage. **Theoretical.

Table 4 Signs of poor prognosis[13]

Vital signs	Laboratory tests
Respiratory rate > 24/minute	D-dimer > 1,000 ng/mL
Heart rate > 125/minute	Creatine kinase level more than two-fold increased from normal values
SpO_2 < 93% with room FiO_2	C-reactive protein > 100
PaO_2/FiO_2 < 300 mmHg	Lactate dehydrogenase level > 245 U/L
	Increased troponin level
	Total lymphocyte count < 0.8
	Ferritin level > 500 U/L

Abbreviations: FiO_2, fraction of inspired oxygen; PaO_2, partial pressure of oxygen in arterial blood; SpO_2, oxygen saturation.

Table 5 Measures to avoid disease transmission

Measure	When	Author
Hand washing	Always	[1,13]
Mask use	Always	[1,13]
Social distancing (> 1 meter)	Always	[1,13]
Personal protective equipment (PPE) use	Healthcare personnel	[13]
Quarantine for 14 days	Contact	[1]
Gloves, face cover, change clothes	Always	[13]
Public places closures (malls, schools)	Case by case	[1]
Public transportation closure	Case by case	[1]
Workplace closure	Case by case	[1]
Total quarantine	Case by case	[1]
Border closure	Stage IV	[1]

14 days, since 98% of the patients are symptomatic at 12 days, as previously explained.

There are three key concepts:

1. Clinical urgency.
2. Protection of patients and the healthcare personnel.
3. Conservation of health resources.[5]

In a stage-IV pandemic, as orthopedic surgeons, we are exposed to different mechanisms of disease transmission. In Spain, 14% of infections occur in healthcare personnel. In Wuhan, China, from December 2019 to February 2020, traumatologists reported an average incidence rate of 5.6% of SARS-CoV-2 infections across their eight hospitals; the most frequent places of suspected transmission were waiting rooms (79%), public areas of the hospital (20.8%), and surgical wards (12.5%). One in four traumatologists was directly contaminated by another colleague.[6,7]

The mandatory use of personal protective equipment (PPE), including gowns, gloves, masks, N95, P100, and FFP2 respirators with goggles or powered air-purifying respirators

(PAPRs), is critical to minimize the risk of intra-hospital disease transmission and cross-infection. Meticulous hand washing and disinfection of personal items, such as stethoscopes, cell phones, and laptops, are also recommended (►**Table 6**).

Allocating Orthopedic Surgery Units

Teams must be created and absolutely isolated from each other.[8] Ideally, teams should be created at least 12 days[9] or 2 weeks apart to meet minimal service requirements. There must be teams to care for Covid-19-positive patients and teams to care for negative patients. Surgeons should not work more than 6 hours at a time to avoid exposure and fatigue.[6]

Management of Orthopedic Conditions at the Emergency Room

From a "viral" point of view, there are several alternatives for trauma patients requiring urgent care:

Types of "Viral" Patients in General Emergency Care Visits

1. Patient previously diagnosed as Covid-19-positive.
2. Patient under preventive quarantine due to direct contact with a Covid-19-positive subject.
3. Symptomatic patient under no quarantine.
4. Asymptomatic patient under no quarantine but within a total quarantine perimeter due to location at an epidemiologically dangerous area with untreated contacts.

Table 6 Recommended personal protective equipment for different activities and places with confirmed/suspected SARS-CoV-2-positive patients

Location	Mechanism	Study groups involved
Screening	Screening and initial examination	1. Surgical mask 2. AAMI level II regular gown 3. Goggles or face shields 4. Gloves 5. Hand hygiene before and after examining each patient
Outpatient medical visit 1	Examination of Covid-19-negative patients with no respiratory signs	1. Surgical mask 2. Gloves 3. Attention to environmental contamination (tools, work items) 4. Hand hygiene before and after examining each patient
Outpatient medical visit 2	Examination of Covid-19-positive patients or subjects with fever and/or respiratory signs	1. Tight-fitting NIOSH-certified N95 mask (if available) or surgical mask (consider double/multiple mask technique and ensure a perfect fit) 2. AAMI level II regular gown 3. Goggles or face shields 4. Gloves (consider double gloving) 5. Hand hygiene before and after examining each patient
Procedure room	Non-invasive care of Covid-19-positive patients or subject with fever and/or respiratory signs	1. Tight-fitting NIOSH-certified N95 mask (if available) or surgical mask (consider double/multiple mask technique and ensure a perfect fit) 2. AAMI level II regular gown 3. Goggles or face shields 4. Gloves (consider double gloving) 5. Hand hygiene before and after examining each patient
Preanesthesia room	Avoid unnecessary contact between orthopedists and patients. The anesthetist must be protected during aerosol-generating procedures	1. Powered air-purifying respirators (PAPRs) if available, or 2. Tight-fitting NIOSH-certified N95 mask 3. Eye protection: goggles (with lateral cover) or face shields 4. AAMI level III disposable surgical gown 5. Double surgical gloves with extended cuff (alternatively, vertical strips of tape can be used to keep gloves secured to gown) 6. Shoes must be fluid-resistant and easily decontaminated (disposable shoe covers may increase contamination risk) 7. Hand hygiene before and after putting on/taking off personal protective equipment (PPE) 8. Take a shower after procedures generating respiratory aerosols.
Operating Room 1	Urgent surgery, damage control, minimizing risk and surgical time in Covid-19-positive patients or subjects with fever and/or respiratory signs. (Operating room with no aerosol generation)	1. PAPRs if available or 2. Tight-fitting NIOSH-certified N95 mask 3. Eye protection: goggles (with lateral cover) or face shields 4. AAMI level III disposable surgical gown 5. Double surgical gloves with extended cuff (alternatively, vertical strips of tape can be used to keep gloves secured to gown) 6. Shoes must be fluid-resistant and easily decontaminated (disposable shoe covers may increase contamination risk) 7. Hand hygiene before and after putting on/taking off PPE

Table 6 (*Continued*)

Location	Mechanism	Study groups involved
Operating room 2	Urgent surgery with aerosol generation and blood droplets in Covid-19-positive patients or subjects with fever and/or respiratory signs	1. PAPRs if available or 2. Tight-fitting NIOSH-certified N95 mask 3. Eye protection: goggles (with lateral cover) or face shields 4. AAMI level III disposable surgical gown 5. Double surgical gloves with extended cuff (alternatively, vertical strips of tape can be used to keep gloves secured to gown) 6. Shoes must be fluid-resistant and easily decontaminated (disposable shoe covers may increase contamination risk) 7. Hand hygiene before and after putting on/taking off PPE 8. Take a shower after procedures generating respiratory aerosols.
Recovery room	PPE removal	1. Pay special attention to avoid self-contamination during PPE removal.

5. Asymptomatic patient under no quarantine and outside the perimeter of a total quarantine.

In stage IV, the postponement of all possible elective surgeries has been determined under ministerial decree and global recommendation,[10] along with all ambulatory or urgent medical attention for conditions that are not life-threatening or potentially leading to severe sequelae. The pathophysiology of SARS-CoV-2 in the human body,[11] affecting not only the alveolar epithelium but also the kidney, liver, brain and intestine,[12] increases the morbidity and mortality of trauma[4] or invasive-surgery patients. The stress associated with a fracture and its surgical treatment can trigger an oxidative cascade and excessive inflammatory response that decreases the immune capacity of the patient, thus increasing lung and systemic damage from SARS-CoV-2 and other pathogens.[3]

Different surgical and orthopedics associations worldwide recommend Covid-19-related measures for the care of trauma patients at the emergency room.[10,13,14]

The following is a summary of Covid-19-related recommended measures for trauma-patient care at the emergency room:

1. Staff. The presence of personnel at all levels should be minimized.
2. Avoid the presence of non-essential work materials.
3. Provide safe and effective dispensers of protective gowns, shoe covers and masks, as well as containers for their disposal. Anything used with the patient must be discarded immediately upon completion of care.
4. Minimize imaging requests to avoid patient referral to the imaging service.
5. Avoid traffic of personnel entering and leaving the Covid-19 traumatology ward.
6. Perform resolutive procedures for the repair of soft tissue.
7. At the end of the care, do not allow the patient to wander outside the ward. In case of a major (spinal, femoral) or open fracture requiring hospitalization and/or surgical management, a computed tomography scan of the thorax should be requested because the Covid-19 test result may be delayed. In a recent study[4] evaluating patients with major fractures and Covid-19, three of them were negative on RT-PCR on admission, and their diagnosis was confirmed by a computed tomography scan revealing findings suggestive of pneumonia related to SARS-CoV-2.[4,15]
8. At outpatient discharge, schedule a supervised appointment to a specialty office dully prepared for two situations: Covid-19-positive or suspected trauma patients, and patients with no Covid-19 suspicion. If possible, follow-up visits should be carried out via telemedicine.

The remaining trauma patients, with little suspicion of Covid-19, should be submitted to rapid tests to rule out infection in 10 to 15 minutes due to the high percentage (ranging from 25% to 50%) of asymptomatic subjects. For trauma studies, request a supplementary chest radiography.[13]

Severe polytraumatized patients deserve a special mention, since resuscitation or acute care rooms must follow all hygiene and protection measures for the trauma team. In the epidemiological context, every patient with these features must be considered potentially infected.[13]

Pediatric Emergency Trauma Patient

Although pediatric cases should follow the same aforementioned recommendations, their musculoskeletal biology warrants some considerations[14,16]

If possible, treat the following diagnostic suspicions with no radiology support:

(a) Soft tissue injuries.
(b) Wrist, scaphoid, forearm, clavicle, and proximal humeral fractures.
(c) Long bone fractures with clinical deformity.
(d) Foot fractures with no significant clinical deformity or swelling.

The Following Injuries Can Be Treated with no Cast (Using Removable Immobilization)

(a) Knee ligament and simple patellar injuries.
(b) Stable ankle fractures.
(c) Rearfoot, midfoot, and forefoot injuries.

A one-time outpatient check-up at 4 to 12 weeks, depending on the fractured limb or bone, is acceptable for most injuries.

Close initial follow-up with radiographs at 2 weeks and subsequent teleconferences at 4 to 6 weeks is appropriate at these circumstances:

(a) Patellar subluxations and dislocations, knee ligament injury, and meniscal injuries, except for locked knee.
(b) Lateral malleolar fractures and potential ankle avulsion fractures.
(c) Foot injuries, except for suspected midfoot and rearfoot injuries.
(d) Displaced wrist, forearm, clavicle and humerus fractures, including proximal humeral fractures, reduced at the operating room.
(e) Supracondylar Gartland type-2 or -3 fractures requiring reduction under anesthesia.

Injuries Definitively Managed with Cast at the Emergency Room for Eventual Removal at Home and Subsequent Teleconference at 4 to 6 Weeks

(a) Ankle fractures with no neurovascular or soft tissue involvement (Salter Harris 2, triplane fracture, Tillaux fracture). A small number of these patients may require intervention:
  - Admit the patient if there is a high risk of compartment syndrome (high-energy injuries or adolescent subjects).
  - Consider sedation to reduce a clinically important deformity.
  - Accept that residual deformity, joint involvement, or poor union may require corrective surgery.
(b) Displaced wrist fractures reduced at the emergency room in children under 10 years old.
(c) Non-displaced ankle and forearm fractures.
(d) Non-displaced supracondylar, Gartland 2 fractures.
(e) Clavicle fractures.
(f) Non-displaced lateral condylar fractures.

Regarding the aforementioned recommendations, there should be a strong agreement at the institutional level to coordinate and unify the management of all adult and pediatric patients according with the local epidemiological, infectious, and healthcare scenario.

Performance of Surgeries during this Stage

Initially, we recommend reviewing informed consent forms and adding information regarding Covid-19.[9] Assume all patients are asymptomatic carriers because tests have shown variable sensitivity, ranging from 77% to 92%, and there were severe cases with repeated negative tests.[17–19]

How to Manage the Operating Room in Cases of Confirmed or Suspicious Covid-19-Positive Patients?

Ideally, due to the large amount of aerosol, the main mechanism for the spread of SARS-Cov2,[20] operating rooms must be negatively pressured, especially in surgeries under gas sedation or general anesthesia. So far, there are few reports about it, mainly two,[21,22] including one on negative pressure use during anesthetic induction, and another in patients with colon cancer submitted to surgery. Laminar flow is not recommended.[23]

At least three filters between the patient and the operating room staff are required (for instance, respirator, mask use by the staff, and mask use by the patient until intubation).

The PPE should include a mask with N95 filters or similar (FPP2 or FPP3), eye protection, gloves, disposable apron, blue balaclava,[23] shoe covers,[24–26] and, ideally, a face shield[23] (►**Table 6**). Suits with headtops[23] are not recommended because the motor unit may spread infected droplets inside the garment, maybe even increasing the viral load.

All aerosol-generating situations must be avoided during surgery. Two specific recommendations include the use of a covered electrosurgical unit with suction (cut the blue part of the suction tube and, with a scalpel, make a slot at the transparent part to pass the tip of the electrosurgical unit; this enables smoke [which aerosolizes the virus] aspiration during the section) and to avoid pulsatile rinsing.[23] In addition, be careful when drilling, and, if possible, use a manual drill that produces lower levels of blood dispersion and aerosol formation.[23]

As far as possible, use absorbable sutures and cover the wounds with transparent plastic (such as Tegaderm [3M, Saint Paul, Minnesota, US]) to observe them without uncovering. Minimize contact with the patient at the outpatient setting[23] (wounds can also be monitored using telemedicine).

It is recommended that the anesthesiologist stay alone with the patient at the operating room, and an anesthesia assistant is deemed unnecessary. The operating room nurse should never contact the medical surgical nurse, only leave supplies on the sterile table.[9] Everyone should stay inside the operating room until the patient leaves it; next, PPE must be properly removed within the operating room (►**Fig. 1**).[22]

What Surgeries Should be Performed in This Period?

Vital urgencies and/or with risk of major sequelae (amputation, para/quadriplegia).

- Severe hand/foot injury.
- Compartment syndrome.
- Unstable pelvic fracture with current or imminent hemodynamic compromise.
- Spinal cord trauma with neurological compromise.
- Tumors with imminent long bone and/or spinal fracture with current or imminent neurological compromise.
- Cauda equina syndrome.
- Dislocation of native or prosthetic joints (reduction at the emergency room).
- Joint fractures with major deformity resulting in neurological and/or vascular compromise that does not improve after orthopedic reduction and adequate immobilization.
- Gustilo III or equivalent open fractures.
- Femoral fracture in subjects under 45 years old.

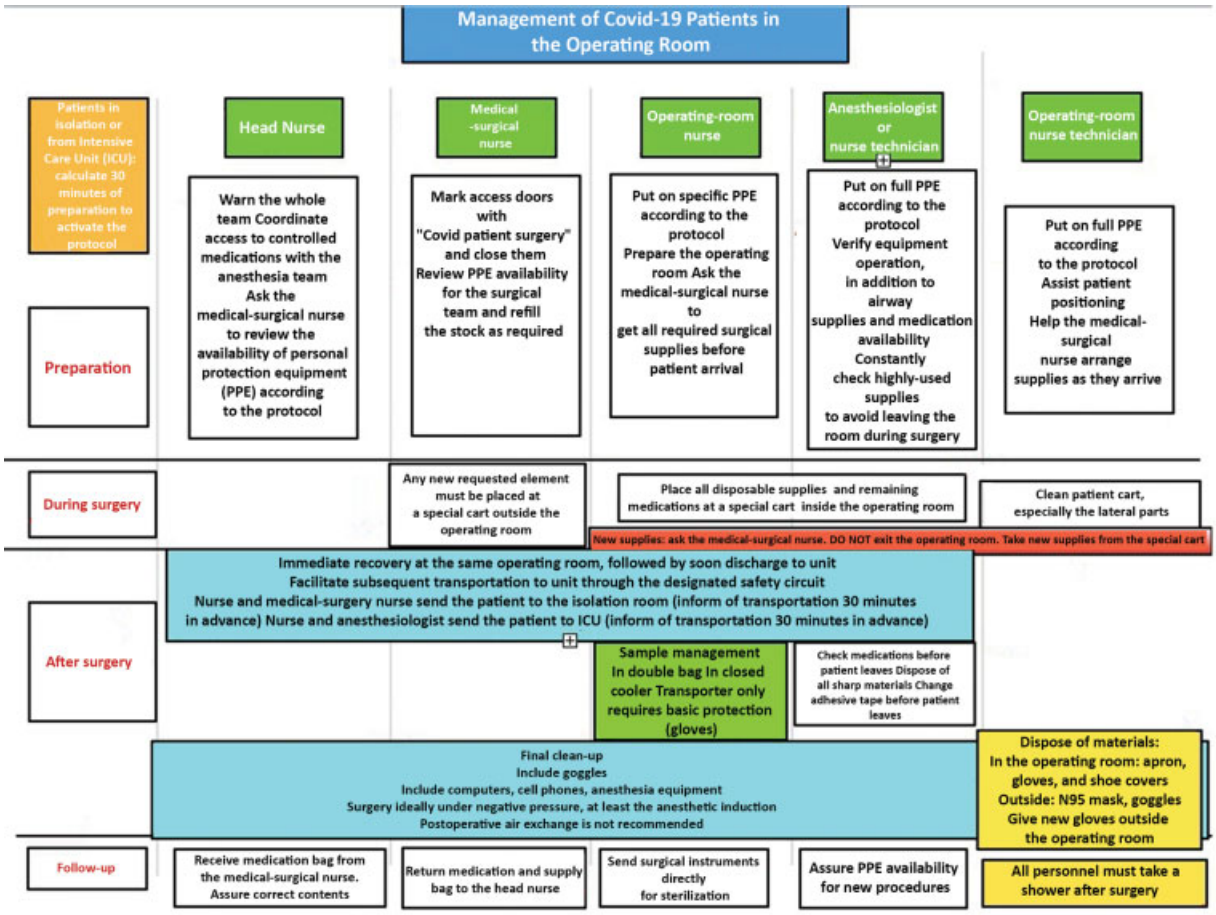

Fig. 1 Management of coronavirus disease 2019 (Covid-19) patients in the operating room.

- Abscesses with no septic compromise: drainage at the emergency room.
- Infectious arthritis with systemic involvement (formal sepsis): main operating room.
- Traumatic injuries with no fractures but with neurovascular compromise.
- Open traumatic injuries with no fractures and with acute or subacute tendon injury.
- Patient with previous joint replacement who presents fever, or requires wound drainage.

Urgencies with Delayed Treatment

- Gustilo I to II or equivalent open fractures.
- Hip fractures in elderly subjects must be resolved within 48 to 72 hours.
- Long bone fractures in the lower extremities: distal tibial fracture, tibial plateau fracture Schatzker IV to VI. Reduction in one surgical time; consider the external fixator as definitive surgery if it is used.
- Rapidly-progressive cervicoarthrosis myelopathy.
- Disabling radiculopathy with $\leq$ M3 motor impairment.
- Patient with indication for joint replacement who presents pain exacerbation.
- Compressive vertebral fracture, except for those orthopedically treated.
- Spine infection.
- Symptomatic proximal junctional kyphosis.
- Scoliosis with neurological deficit.

Delayed Treatment with Potential Disability that May Be a Candidate for Complex Reconstruction

- Displaced fractures not described in the previous sections with no risk of exposure, neurological or vascular compromise after reduction.
- Knee ligament injuries that do not involve formal knee dislocation.

Non-urgent Conditions

- Any other orthopedic pathology not described here.

Hospitalizations should be reduced as much as possible; the length of stay should be shorter than 23 hours; patients should be operated as soon as possible.[27]

Resuming Elective Surgery

To resume elective surgeries, we recommend the following:

1. At least 14 days of downward disease transmission curve.
2. Clear, institutionalized protocols and compliance control.

3. Screening: prioritize more severe, urgent cases.
4. Consider mandatory testing of all patients who must undergo surgery, considering the high percentage of false-negative results (30%). Screening must include two tests.
5. Do not relax personal protective measures.
6. Consider the capacity of beds at the hospital's intensive care unit before resuming surgery.
7. Consider whether support units are available. These units may have been closed due to personnel issues, financial problems, or contamination.
8. Psychological status of the personnel working at the reopening.
9. Do not reduce the quality of care.[28]

Conclusions

1. Minimize contact with the patient, whether at the outpatient facility, emergency room or surgical setting.
2. Be very strict with personal protection measures.
3. Do not operate anything that is not strictly urgent.
4. Maintain the communication and cohesion of the medical teams, including for doctors in training.
5. Prepare for urgent care.
6. Do not disseminate unconfirmed information.
7. Centralize decisions and the use of the operating algorithm in leadership groups.

Authors' Contributions

The present aerticle was approved by all subscribed authors:

Karen Weissmann: study conception, manuscript draft, revision, and approval of the final version for publication.

Carlos Huaiquilaf: manuscript draft, revision, and approval of the final version for publication.

Marcelo Costa: manuscript draft, revision, and approval of the final version for publication.

Cristian Correa: manuscript draft, revision, and approval of the final version for publication.

Alan Bey: manuscript draft.

Luis Bahamondes: manuscript draft, revision, and approval of the final version for publication.

Conflict of Interests

The authors have no conflict of interests to declare.

References

1 Vannabouathong CDT, Ekhtiari S, Chang Y, et al.The Orthopedic Forum. Novel Coronavirus Covid-19: Current evidence and Evolving Strategies. JBJS 2020Express

2 Chanqueo LHJ, Legarraga P, Moreno V, et al.DIAGNÓSTICO MICROBIOLÓGICO DE SARS-CoV-2 (COVID-19) v1.0 In: Sochinf. CdMC-S, editor. *http://www.sochinf.cl/portal/templates/sochinf2008/documentos/2020/Diagnostico_de_laboratorio_COVID19_SOCHINF.pdf?fbclid=IwAR0P4LXUJ8nHAKM-oo9xmR6oepXhl59XSFlQWd-WPip3A_lk2ffZao4TcWE2020*

3 Lv H, Yin P, Long A, et al. Clinical characteristics and risk factors of postoperative pneumonia after hip fracture surgery: a prospective cohort study. Osteoporos Int 2016;27(10): 3001–3009

4 Mi B, Chen L, Xiong Y, Xue H, Zhou W, Liu G. Characteristics and Early Prognosis of COVID-19 Infection in Fracture Patients. J Bone Joint Surg Am 2020;102(09):750–758

5 Chang Liang Z, Wang W, Murphy D, Po Hui JH. Novel Coronavirus and Orthopaedic Surgery: Early Experiences from Singapore. J Bone Joint Surg Am 2020;102(09):745–749

6 Guo X, Wang J, Hu D, et al. Survey of COVID-19 Disease Among Orthopaedic Surgeons in Wuhan, People's Republic of China. J Bone Joint Surg Am 2020;102(10):847–854

7 Chen G, Wu D, Guo W, et al. Clinical and immunologic features in severe and moderate forms of Coronavirus Disease 2019. Medrxiv 2020

8 COVIDSurg C. Global guidance for surgical care during the COVID-19 pandemic. Br J Surg 2020;107(09):1097–1103

9 Pahys JSP, Bas T, Brayda SD, et al. SRS Covid-19 Webinar. Scolisois Res Soc 2020

10 Mary B, Gawande A. Managing COVID-19 in Surgical Systems. Ann Surg 2020

11 Li G, Fan Y, Lai Y, et al. Coronavirus infections and immune responses. J Med Virol 2020;92(04):424–432

12 Zhang C, Shi L, Wang FS. Liver injury in COVID-19: management and challenges. Lancet Gastroenterol Hepatol 2020;5(05): 428–430

13 ciujanos A. RECOMENDACIONES GENERALES DE ATENCION DE LA PATOLOGIA QUIRURGICA URGENTE EN EL CONTEXTO DE LA PANDEMIA POR COVID-19 (SARS COV-2): www.aecirujanos.es2020

14 Management of patients with urgent orthopaedic conditions and trauma during the coronavirus pandemic. 2020

15 Abdelaziz MH, Abdelwahab SF, Wan J, et al. Alternatively activated macrophages; a double-edged sword in allergic asthma. J Transl Med 2020;18(01):58

16 Farrell S, Schaeffer EK, Mulpuri K. Recommendations for the Care of Pediatric Orthopaedic Patients During the COVID-19 Pandemic. J Am Acad Orthop Surg 2020;28(11):e477–e486

17 Chen Z, Li Y, Wu B, Hou Y, Bao J, Deng X. A Patient with COVID-19 Presenting a False-Negative Reverse Transcriptase Polymerase Chain Reaction Result. Korean J Radiol 2020;21(05): 623–624

18 Guo L, Ren L, Yang S, et al. Profiling Early Humoral Response to Diagnose Novel Coronavirus Disease (COVID-19). Clin Infect Dis 2020;71(15):778–785

19 To KK, Tsang OT, Leung WS, et al. Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: an observational cohort study. Lancet Infect Dis 2020;20(05): 565–574

20 Wang J, Du G. COVID-19 may transmit through aerosol. Ir J Med Sci 2020;189(04):1143–1144

21 Luo Y, Zhong M. [Standardized diagnosis and treatment of colorectal cancer during the outbreak of corona virus disease 2019 in Renji hospital]. Zhonghua Wei Chang Wai Ke Za Zhi 2020;23(03): 211–216

22 Ti LK, Ang LS, Foong TW, Ng BSW. What we do when a COVID-19 patient needs an operation: operating room preparation and guidance. Can J Anaesth 2020;67(06):756–758

23 COVID-19–Evidence based best practice guidelines specifi to orthopedic surgeons. 2020

24 Iacobucci G. Covid-19: Lack of PPE in care homes is risking spread of virus, leaders warn. BMJ 2020;368:m1280

25 Kantor J. Behavioral considerations and impact on personal protective equipment (PPE) use: Early lessons from the coronavirus (COVID-19) outbreak. J Am Acad Dermatol 2020
26 Sorbello M, El-Boghdadly K, Di Giacinto I, et al. The Italian coronavirus disease 2019 outbreak: recommendations from clinical practice. Anaesthesia 2020
27 Giorgi PD, Villa F, Gallazzi E, et al. The management of emergency spinal surgery during the COVID-19 pandemic in Italy. Bone Joint J 2020;102-B(06):671–676
28 Kogan M, Klein SE, Hannon CP, Nolte MT. Orthopaedic Education During the COVID-19 Pandemic. J Am Acad Orthop Surg 2020;28 (11):e456–e464

