Review Article

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Breakthrough in Surgeries during Covid-19 Pandemic Era: An Orthopedic Perspective

Sagar Chaudhari[1*], Ajit Govind Jangale[2], Sharayu Dhande[3] and Sheetal Ajit Jangale[4]

[1]*Consulting Orthopedic Surgeon, Mumbai, Maharashtra, India*

[2]*Dr Vasanat Rao Pawar Medical College, Nashik, Maharashtra, India*

[3]*Department of Periodontology and Oral Implantology, M A Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India*

[4]*Pedodontist and Preventive Dentist, Private Practitioner, Mumbai, Maharashtra, India*

***Correspondence author**

Sagar Chaudhari
Chaudhari Clinic
Anand Nagar
Opp Metro Junction Mall
Haji Malang Road
Netivli, Kalyan (East)
Mumbai, Maharashtra
India

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Abstract

The Coronavirus disease (COVID) has brought major breakthrough in day to day Orthopedic practice in an unrivalled way. Majority of hospitals have been adopting preventing strategies to help prevent the spread of the viral infection among the healthcare professionals and patients affected by other diseases. On the other hand, hospitals also have been restructured to help provide the best care to COVID patients, with proper allocation of the staff, patient isolation and restrictive visiting hour policies. As a consequence, the notion of urgency and indications for elective orthopedic surgeries have been profoundly revamping. In addition, several healthcare professionals have been recruited to serve COVID patients despite of their original specialties, resulting in profound reshaping of both the inpatient as well as the outpatient care. Surgical considerations have been thus reformulated, with the elective cases being promptly postponed while treating only the emergency interventions requiring exceptional attention, especially in suspected or COVID patients.

Keywords: Elective Orthopedic Surgery; COVID-19; Occupational Exposure.

Introduction

COVID-19 is an abbreviation for Corona virus disease- 2019 which is an infectious viral disease caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), it was therefore named by WHO and International Committee on Taxonomy of Viruses (Ghebreyesus, 2020; Hsu et al., 2020; Kumar et al., 2020; World Health Organization [WHO], 2020).

The current Coronavirus outbreak has refocussed orthopedic surgeons to manage many orthopedic injuries conservatively, which would have otherwise require operative management. It is mainly because of the restraints put on by this COVID, limited availability of resources including personnel, operating theatre slots and also due to reluctance of undertaking operative intervention in an atmosphere of increased risk of viral transmission, responsibility of protecting staff and 'social distancing' guidelines (Alyami et al., 2020; Di Gennaro et al., 2020; Probert et al., 2021).

The main purpose of this review is to help provide orthopedic surgeons with a list of certain recommendations and safety measures aimed at reducing pathogen transfer while resuming elective orthopedic surgeries with a focus on preventing the spread of severe acute respiratory syndrome (SARS-CoV-2) infection with adequate sterilization and disinfection protocols as the pandemic begins to unfasten its initial grip on the globe and we contemplate resuming the most awaited road back towards normalcy (Abdelnasser et al., 2020; Boyce, 2016; Brindle & Gawande, 2020; Lu et al., 2020; Scarlat & Mavrogenis, 2020).

Orthopedic Surgical Approach: (Boa et al., 2020; British Orthopedic Association, 2020; Venkatesan et al., 2020)

Based on the guidelines proposed by local universities and institutions and international societies, including the American Academy of Orthopedic Surgeons (AAOS), along with American College of Surgeons (ACS), elective surgeries should be deferred until the prevalence of COVID-19

and resource availability (PPE, ICU beds, respirators and personnel) recovers.

Due to the advent of COVID-19 pandemic, it has been cognized by the British Orthopedic Association (BOA) and the National Health Service England (NHSE) to manage urgent critical orthopedic trauma conditions practically by following appropriate guidelines and providing optimum infection control protocol for treatment of patients and with adequate resource utilization.

According to American Academy of Orthopedic Surgeons: Orthopedic trauma is divided in to four phases: (Mouton et al., 2020)

A) Only Emergency surgeries
B) Only Urgent surgeries
C) Only Urgent/somewhat elective surgeries
D) Only Elective surgeries

CATEGORY	**A**	**B**	**C**	**D**
Degree of Emergency	Emergency	Urgent	Urgent/somewhat elective	Elective
Types of Procedures (non-exhaustive selection)	Life or Limb-threatening conditions	Joint/ Arthroplasty infections Most Trauma cases	Acute intra- and peri-articular ligament and tendon conditions (eg. ACL tears, meniscus, bucket handle tears) Selected trauma cases	Total joint arthroplasty Osteotomes Chronic intra- and peri-articular ligament and tendon conditions Chronic peripheral nerve compression syndromes

Certain Strategies For Scheduling Elective Orthopedic Surgical Procedures In 4 Phases Based On Patient's Age, Comorbidities, Type Of Surgery And Length Of Hospital Stay: (Mouton et al., 2020)

Priority	1	2	3		4		5	
Scenario	A	B	C	D	E	F	G	H
Patient Age	< 60	< 60	All ages	All ages	< 60	< 60	All ages	All ages
Surgery	Minimally invasive	Minimally invasive	Minimally invasive & open surgery	Minimally invasive & open surgery	Minimally invasive	Minimally invasive	Minimally invasive and open surgery	Minimally invasive and open surgery
Length of hospital stay	Maximum for 3 days	Maximum for 3 days	Maximum for 3 days	Maximum for 3 days	All	All	All	All
Co- morb idities	None	None	None	None	None/ Existing	None/ Existing	Existing	Existing
COVID-19	No risk detected/ Potentially recovered	Infected/ With symptoms	No risk detected/ Potentially recovered	Infected/ With symptoms	No risk detected/ Potentially recovered	Infected/ With symptoms	No risk detected/ Potentially recovered	Infected/ With symptoms

Definition Of Elective Orthopedic Surgery

Elective surgeries are defined as those not meeting the following criteria "threat to the patient's life if surgery or procedure is not performed, threat of permanent dysfunction of an extremity or an organ system, risk of metastasis or progression of staging, or risk of rapidly worsening to severe symptoms" (According to Ohio Hospital Association) (Lee et al., 2020; Sarac et al., 2020; Stahel, 2020).

Pre-Surgical Perspective For Patients Willing To Undergoing Orthopedic Surgeries During The Covid Pandemic: (British Orthopedic Association, 2020; Mouton et al., 2020; Stahel, 2020)

The main objective before recommencing any orthopedic surgical procedure is to reassure that all imperative and obligatory measures are in place within the healthcare infrastructure to allow for the welfare of the patients, surgeons,

and other healthcare professionals of the hospital until the resolution of the ongoing COVID-19 pandemic.

- Pre-screening of every single patient for COVID is essential in order to avoid planning of surgeries during the incubation period of COVID and adequate policy should be enforced to prevent any peri-operative infection.
- In all scheduled cases, COVID symptoms along with temperature and oxygen saturation levels should be constantly examined until the time of surgery.
- Category 1 - Patients who are not known to have been exposed or infected should perform Rt-PCR test 48 to 72 h before any planned surgery.
- Category 2 - Patients who are not known to have been exposed or infected or a patients who have been exposed but remain asymptomatic, a chest CT-scan 48-72 hours along with Rt-PCR test before commencement of any surgery should be mandatory.
- Category 3 – Patients who have recovered from COVID but may be adequately immune should be advised to undergo a immune/serology test 48 to 72 hour before planned surgery.
- Category 4 - Patients who surmise to be infected should be advised for repeated Rt-PCR test, along with chest CT-scan before commencing any orthopedic surgeries.
- Category 5 and 6 - Lastly, surgery in COVID positive patients should be postponed until full recovery (at least 2 months). Later on, before commencing any surgery Rt-PCR test, and a chest CT-scan should be advised 48 to 72 h before any surgery.

Relevant clinical and microbiological screening should be advised for each patient. Before contemplating any surgical procedure following factors should be closely considered - COVID infection status/exposure, age, ASA physical status classification system or risk factors, financial condition and surgical indication. Elective surgeries should be deferred at even slight surmise of COVID-19 infection.

Patient should be advised mouth rinses to reduce oral microbial load prior to surgery, especially when operating in the head and naso-pharyngeal region (Basso et al., 2020; O'Donnell et al., 2020; Moosavi et al., 2020). In accordance with the guidelines developed for the diagnosis & treatment of COVID-19, of the National health republic of china, chlorhexidine rinse may not be sufficient to kill SARS-CoV-2. Flavonoids have essential function in corona virus replication & inhibition of host immune response (Ngwa et al., 2020). Moreover, SARS-CoV-2 is vulnerable to oxidation, it is recommended to use a mouth rinse containing oxidizing agents such as Citrox to reduce salivary load of viral oral microbiota. Mouth rinses with Amphiphilic β-Cyclodextrin act by disrupting the outer shell of virus & block its growth. This property can be potentially used for therapeutic oral biofilm rinses & is considered in preventing viral transmission via the oro-pharyngeal route (Carrouel et al., 2021; Hooper et al., 2011). Mouth rinses with combination of cyclodextrins & citrox help lower nasopharngeal microbiota after coughing & sneezing. β-Citrox therapeutic rinses affect oral biofilms & help reduce viral load of infection & prevent progression of disease (Bidra et al., 2020; Braga, 2019; Carrouel et al., 2021).

Povidone Iodine containing Mouthwashes, Gargle or even Nasal Spray can be a effective alternative to citrox and cetyl-pyridium chloride and also help reduce Nasopharyngeal Viral Load in Patients With COVID-19 (Challacombe et al., 2020; Frank et al., 2020; Guenezan et al., 2021; Kawana et al., 1997; Nagatake et al., 2002; Pattanshetty et al., 2020).

Hydrogen peroxide (H2O2) did not cause any observable damage on microvilli of oral mucous membranes post gargling with 3% H2O2. Another most common route for SARS-CoV-2 is through the nasolacrimal ducts. And hence, use of iodopovidone eye drops 0.5% - 0.6% (1 drop 3 times a day on conjunctiva of both the eyes) can be used due to its antiseptic action within a minute against corona viruses. According to Caruso et al 2020, application of this regimen in our surgical practice, will result in to significant reduction of the rate of hospitalization and respiratory complications in patients positive for COVID-19 with or without mild-to-moderate symptoms (Caruso et al., 2020; Cortelyou, 1968; Urban et al., 2017).

Finally, patients should be operated when conditions for required postoperative follow-up is reassured. Even though all the preventive measures are undertaken by the healthcare professionals to avoid COVID-19 infections during surgery or hospitalization, the infection risk cannot be 100% excluded. As a result, an informed consent should be always duly signed from the patient. Also to avoid of risk of cross-infection, temperature and oxygen saturation of all hospital staff should be checked twice daily using hospital-issued oral digital thermometers, and entered into electronic records monitored by respective hospital administrative personnel (Basso et al., 2020; O'Donnell et al., 2020; Moosavi et al., 2020; Tang et al., 2020).

Anesthetic Considerations During Orthopedic Surgeries

Droplet transmission of COVID, places anesthetist at a high risk of contacting nosocomial infections. All guidelines are now directed towards alleviation of aerosol generation during procedures and thus limiting the exposure of healthcare personnel (Ong et al., 2020; Tang et al., 2020).

Anesthetists should prefer intravenous anesthesia for orthopedic surgeries since it minimizes risk of virus transmission. High risk aerosol generating procedures, such as intubation, should be curtailed in order to reduce the risk of viral transmission. Regional anesthesia should be strongly recommended for patients undergoing elective surgery during such pandemic (Kim et al., 2020; Patwa et al., 2020; Society, 2020).

Considerations To Minimize Aerosol Generation During Ga Induction/Reversal – (Jewett et al., 1992; Kim et al., 2020; Ong et al., 2020; Patwa et al., 2020; Society, 2020; Tang et al., 2020; Yeh et al., 1995)

- Prefer Rapid Sequence Induction method
- Avoid high-flow nasal cannulas and bag valve mask ventilation wherever possible
- Secure endotracheal tubes properly to avoid air leaks
- Minimize patient coughing on emergence
- Laryngeal mask airways should be avoided, due to their high propensity for leaking and absence of a closed circuit
- All anaesthetic interventions should be completed before the surgical team enters the OR for patient positioning and the subsequent surgical procedure.
- Prefer regional anaesthesia (spinal/epidural/blocks/wide awake anaesthesia)
- After a regional anaesthesia, surgical masks must be placed on patients at all times.
- Use nasal prongs instead of conventional masks for oxygenation, under the patients' surgical masks if sedation is concurrently administered to minimize aerosolization.

Operating Room (Or) Management

Operating surgeons in the operating room should be reduced to minimum and unnecessary rush inside or outside should be discouraged. Surgeries advised to be performed in negative-pressure ORs to avoid the dispersion of the COVID aerosols outside the operation theatre. However, ORs are usually equipped with positive-pressure systems to curtail the risk of surgical operatory contamination. Therefore, operatory conversion to negative pressure should be pre-planned beforehand. If negative pressure cannot be obtained, positive pressure should be turned off and a portable high-efficiency particulate air (HEPA) filtration system with frequent air changes should be preferred for surgery (Ambrosio et al., 2020; Centers for Disease Control and Prevention [CDC], 2020; Chow et al., 2006; Liang et al., 2020; Stinner et al., 2020; Wong et al., 2020).

Intraoperative Considerations: (Neradi et al., 2020; Parvizi et al., 2020; Rodrigues-Pinto et al., 2020; Stinner et al., 2020; Ti et al., 2020; Vashisht, 2021)

- Surgeons should focus to minimize bleeding by using tourniquet/tranexamic acid/good haemostasis
- Higher aerosol generation should be managed properly
- Use of cautery should be as minimal as possible, at low settings and in presence of smoke evacuators or the advanced HEPA filters
- Avoid pulse lavages; also prefer gentle lavages over high pressure lavages
- Avoid high power instruments: drills, reamers, burs. Prefer osteotomes, nibblers, manual reamers or do unreamed nailings or uncemented implants, also considering using a Gigli saw, sharp osteotomes, and manual reaming whenever possible.
- Surgeons can use transparent sterile plastic covers over wounds to potentially reduce aerosol spread in operation theatres during drilling/reaming.
- Avoid staged surgeries and if required, then can postpone
- Minimize the surgical time (<60min)
- Prefer absorbable sutures
- Avoid voluminous dressings wherever possible, use minimal visible dressings like Opsite, Tegaderm etc.
- Wound inspection should be carried out by maintaining safe distance.
- Always opt for removable splints/slabs instead of casts.
- Cast removal involves higher chances of patient contact, easier home based management.
- Regular anti-emetics should be prescribed to avoid nausea and vomiting.
- Prefer multimodal adequate analgesia [NSAID's to be avoided if possible, believed to act on ACE2 receptors and increase their expression].

Precautions To Be Taken While Operation Theatre Cleaning In Covid Era : According To Indian Orthopedic Association: (Vashisht, 2021)

Strict protocols should be followed for sterilization. Clean the used surgical instruments cautiously, disinfect with 2% glutaraldehyde, followed by autoclave, C-arm should be cleaned thoroughly following the manufacturers guidelines. 70% Ethyl alcohol to disinfect reusable equipments. 1% Sodium hypochlorite (equivalent 5000ppm) should be used for disinfection of frequently touched surfaces. If COVID suspected patient is operated, the operatories should be refrained from use for atleast for 2 hours after disinfection. Vaporization of the operatories with 0.5% Hydrogen Peroxide should be done after each single surgery. Used apparels post surgery should be collected in a single labelled container and soaked in 0.05% chlorine solution for 30 mins, followed by cleaning with detergent under hot water (60-90 degrees). Lastly, clean with water and dry in sunlight.

Changes That Need To Be Implemented In The Recovery Room And In The Post-Operative Care Of Patients: (Dexter et al., 2020; Sento et al., 2017; Tan et al., 2020)

Inside the post-anesthesia care unit (PACU):

1. Patients should be adequately spaced from eachother atleast 2m (6 feet) from each other.
2. Accompanying person should be advised to wear an N-95 mask at all times.
3. Minimize the hospital stay of the patient while maintaining peri-operative safety.
4. Overcrowding should be avoided.
5. The patients who cannot be extubated in the operating room should be immediately transferred to the intensive care unit (ICU), bypassing the PACU.
6. Bed linen should be substituted at regular intervals and surrounding surfaces around each bed should be wiped down after transfer of the patient and prior to arrival of the next operated patient.
7. By pass the PACU if the patient seems to recover fast and transfer the patient immediately to their respective rooms.
8. Separate PACU is advised for COVID negative patients to avoid cross contamination.
9. Postoperative radiographs should be taken up in the operating room itself. In case radiographs need to be made in the PACU, the x-ray plates and other equipment coming

in contact with the operated patient should be thoroughly cleaned according to manufacturer's instructions after their use.

Changes To Be Made In Postoperative Care Protocols For Patients Undergoing Elective Surgery During The Sars-Cov-2 Pandemic: (Dexter et al., 2020; Neradi et al., 2020; Parvizi et al., 2020)

- In-patient rehabilitation should be reduced. Post-operative protocol should be as virtual as possible.
- The patients should be instructed to carry required physiotherapy at home.
- Refrain post discharge visits to the hospital unless experienced any wound healing complication or any chances of suspected fracture, stiffness of joints etc.

Common Medications Prescribed Post Orthopedic Surgery And Their Potential Implications In Covid Patients With Musculoskeletal Conditions: (Carr, 2020; Gautret et al., 2020; Grant et al., 2020; NIH, 2020; Philippe et al., 2020; Russell et al., 2020; Shanthanna et al., 2020; Sodhi & Etminan, 2020; Tan et al., 2020; Testa et al., 2020)

- Analgesics and antipyretics most commonly preferred are paracetamol, for previously encountered COVID patients too.
- NSAIDs can be advised to post COVID patients if required.
- Buprenorphine should be prescribed as it is most safe drug to be administered to the immunocompromised or elderly patients susceptible to any infections. Since, opiods rely on the mechanism of immunosuppression along with respiratory depression, they should be advised only when required in post COVID patients.
- Refrain prescribing systemic steroids. COVID patients can continue according to their physicians consult. Orthopedic surgeons should take up a stringent followup for patients who have undergone Orthopedic surgery and are on steroids for a longer period at regular intervals of time to rule out possible complication of avascular necrosis.
- Parenteral heparin should be administered whenever required by strictly avoiding anti-coagulants.
- Penicillin and Clindamycin are safe and effective anti-microbials and can be continued for post COVID-19 patients.
- However, for COVID-19 patients, the antibiotics can also be switched to macrolides and tetracyclines if the organisms are sensitive to these antibiotics, so as to cover for the Orthopedic infection while potentially having therapeutic effects on the COVID-19 infection as well.
- Lastly, multivitamins along with B complex with zinc, vitamin C and vitamin D potentially are known to have therapeutic benefits for COVID-19 patients, and therefore, prescription for these vitamins should continue as per usual clinical practice.

Conclusion

For the non-operative and operative management of patients during COVID-19 pandemic era, few general principles of surgery should be stringently followed whilst protecting patients and other healthcare professionals, along with conservation of healthcare resources need to be modulated. Proper care should be taken on pre-operative, intra-operative, and post-operative settings to minimize inadvertent occupational exposure to SARS-CoV-2 caused COVID-19. The objective behind any orthopedic surgery taken up during COVID era should be to minimise risk of viral transmission by avoiding Aerosol Generating Procedures (AGP) and minimising risk of viral infection with appropriate use of Personal Protective Equipment (PPE). These principles should critically be implanted in our current response to the pandemic. It is peremptory that we familiarize ourselves with the key considerations, so as to ensure the safety of orthopedic surgeons, patients along with other healthcare professionals, as we overcome this COVID-19 pandemic while effectively and efficiently delivering the treatment to the patients.

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