


Management and Scheduling of Spine Surgery in a Level I Trauma Center in the Setting of the COVID-19 Pandemic: Feasibility and Considerations for Reimplementation of Elective Spine Surgery

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Abstract

Introduction: Determination of what constitutes necessary surgery in the setting of acute hospital resource strain during the COVID-19 pandemic is an unprecedented challenge for healthcare systems. Over the past two years during the COVID-19 pandemic, there have been many changes in reviews of medically necessary spine surgery. There continues to be no clear guidelines on recommendations and further discussion is necessary to continue to provide appropriate and high-level care during future pandemics. **Significance:** This review critically appraises and evaluates current barriers to medically necessary spine surgery during the COVID-19 pandemic and evaluates future decision making to maintain spine surgery during future pandemics or limitations in medical care. **Results:** Multiple studies included in this review have shown that while various orthopaedic surgeries may be considered elective, medically necessary spine surgery will need to continue during settings of limited medical care. This review discussed multiple methods and recommendations to limit transmission of virus from patients to providers and providers to patients. **Conclusion:** Continued medically necessary spine surgery in the setting of the COVID-19 pandemic and future pandemics should continue while limiting risk of transmission to continue providing high-level medical care and allowing hospitals to maintain financial responsibility.

Keywords

basic research, biostatistics, economics of medicine, spine surgery, physical therapy, occupational therapy, non-operative spine

Introduction

In response to the SARS-CoV-2 (coronavirus COVID-19) pandemic declaration on March 11, 2020, American hospitals gradually implemented system-wide changes in an effort to decrease risk to patients, prevent spread, and preserve resources to avoid overwhelming healthcare systems.¹ Surgery-specific regulations were designed to

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accommodate expected acute or emergent patient surgical conditions while limiting unnecessary exposure. For example, the American College of Surgeons (ACS) recommended that “hospitals, health systems, and surgeons must review all scheduled elective procedures to minimize, postpone, or cancel electively scheduled operations”.² This led to large-scale cancellations of cases that are traditionally classified as “elective”.³ By contrast, other cases (e.g., oncology cases and oncologic reconstructive operations) were prioritized because of the potential for disease progression.^{3,4} This “elective case” designation, however, was a blanket designation based on how patient cases are historically categorized and scheduled when operating room availability is at baseline.⁵ Moreover, this recommendation failed to consider the repercussions of blanket cancellations based on “elective” status as the pandemic response, in resources and regulations, evolves over time.^{6,7} Cases of sub-acute or chronic higher acuity spine surgery are elective “in name only,” and further evaluation is warranted to prioritize these cases based on pathology.⁵ A recent commentary provides support for this notion, endorsing the reclassification of “elective” procedures as “medically-necessary, time sensitive (MeNTS) procedures”.^{8,9} This approach applies a scoring system designed to weigh the necessity of the procedure and the risks of delaying against the potential strain on the hospital system. As such, MeNTS allows for the consideration of all relevant factors and strikes a balance between the need for overall prompt surgical management and pandemic safety restrictions.⁹ Now being in yet another severe wave of Covid infections, with the Omicron variant and with the understanding that Covid is here to stay, we need to be more astute at adapting to the existence of Covid while moving on to providing patient care for non-Covid conditions. The importance of this topic and the focus of this paper yet again is emphasized in real time.

From an orthopaedic surgery perspective, numerous arthroplasty, sports, and even spine surgeries were deemed elective and disproportionately cancelled during initial stages of the pandemic.^{8,10,11} In terms of spine surgery, emergent cases were designated to continue as expected, including traumatic injuries, acute progressive neurological deterioration, epidural abscesses, and neuro-oncologic cases. However, other insidious spinal conditions, such as degenerative cervical myelopathy, radiculopathy, and fractures or stenosis with secondary neurological compression, were classified as “elective” and thereby not encouraged during pandemic conditions.

As the only level 1 trauma center in the area, we consider the following questions: 1) Can we identify the potential harm done to patients by delaying surgical management of cases with high risk of long-term neurological deficit such as sub-acute cord compression? 2) Can we minimize the patient and provider risk of coronavirus

exposure through the adoption of safe and streamlined operating room protocols and appropriate use of PPE? And 3) What are the socioeconomic consequences of disrupting standard-of-care surgery timelines and optimizing outcomes in the pandemic era?

Characterizing Spine Pathology Requiring Time-Sensitive Surgery in a Pandemic Setting

In a recent study by Donnally and colleagues, spine pathology and surgical need was categorized at varying levels of severity based upon the center’s clinical experience during the pandemic.⁵ Spine pathologies were categorized into three levels based on current or anticipated neurologic compromise, knowing pathologies such as cervical myelopathy, have correlations between time to surgery and functional outcomes.¹²⁻¹⁴ Expanding on this approach, we focused on the non-acute spine pathology designated by a physician to have caused neurological deficit or to be at high risk of future acute neurological compromise. Conditions with progressive and debilitating natural histories such as cervical/thoracic myelopathy or deformities with neural compression may result in sustained disabilities if their care is delayed. Despite these conditions being classified as “elective” at hospitals outside of pandemic status, their respective operations remain time-sensitive due to progressive compromise of neurological function.

At other institutions, patients who required urgent surgery could proceed with surgery at ambulatory surgery centers or in-hospital surgery depending on COVID-19 situation. *Rizkalla et al* developed an algorithm to determine surgical urgency of spine pathology and appropriate setting.¹⁵ Additionally, a cohort of 16 fellowship-trained spine surgeons from 10 academic medical centers constructed a scoring system for the triage and prioritization of emergent and elective spine surgeries.¹⁶ This scoring system factored in neurologic status, risk of progression, spine stability but also expected hospital course, skilled nursing facility discharge, and resource limitations. While transitioning low risk or negative patients to ambulatory surgery centers to reduce transmission risk, concerns over personal protective equipment remain as the surgical attire will still be required whether in a surgery center or in-hospital operating room. Scoring systems such as the one by *Sciubba et al* take into account both spine pathology but also additional healthcare resource limitations and will be critically useful in the future.

The risk-benefit analysis of patient surgery must be considered within the scope of the local context of a pandemic.^{5,8,17,18} Particularly, as the exclusive level 1 trauma center in the area, consideration must be given to the possible harm to patients by delaying care. Each case must be reviewed by the provider, especially in the setting of

predisposing risk factors such as obesity, diabetes, and immunosuppression, all of which would both make spine surgery more technically difficult and increase the risk for perioperative virus exposure and subsequent complications. In the pediatric population, the Children's Hospital Association has recommended continuing non-urgent spine cases in healthy, asymptomatic patients and urgent cases such as spina bifida in all patients, while continuing to minimize risk to staff and family members.¹⁹

General and Spine-Specific Recommendations for Minimizing Risk to Patient and Staff

In pre-operative evaluation, patients must be evaluated on a case-by-case basis as well as considered within the scope of the current pandemic burden on medical centers. For non-emergent time-sensitive cases, patient demographics warrant attention as part of this consideration. Patient selection is a crucial tool in minimizing perioperative complications, particularly for patients with underlying comorbidities. Recent data suggest that the presence of diabetes mellitus type 2, hypertension, and chronic lung disease may predict worse hospitalization outcomes in patients who have contracted COVID-19.^{20,21} Under Prachand and colleagues' MeNTS scoring system, a high MeNTS score is associated with poorer perioperative patient outcomes, increased risk of COVID-19 transmission to the healthcare team, and increased hospital resource utilization.⁹ Although spine cases may be high acuity, care must be taken to minimize patient risk and hospital resources through the use of a metric such as MeNTS, risk-stratification, and physician judgment.

General techniques to prevent the spread of the virus also warrant consideration. Hospitals have implemented longer staff shifts with fewer teams to limit surgical mask consumption, increased sanitation of operating rooms during terminal cleaning with UV-C or an equivalent and minimizing reliance on large post-anesthesia care units.¹⁵ At our institution, we have adopted additional measures to promote a healthy workforce and maintain staff resources, which includes rotational surgeon staffing on a week-to-week basis. Additionally, our institution has the benefit of in-house COVID-19 testing, with 24-hour turnaround time, for patient and staff risk awareness. To the extent institutions have the ability to perform similar rapid testing, it should be prioritized peri-operatively to better account for patient beneficence of surgery in the setting of their spine pathology. Future steps include testing for immunity, particularly sentinel staff immunity in advance of a potential second wave of seasonal COVID-19 infections, and development of strategies for PPE preservation and allocation based on staff immunity status.

In the peri-operative setting, patients may recover in the room in which they underwent surgery, or, if COVID-positive, in the COVID unit to ensure prioritization of

operating room (OR) cleaning while maintaining reduced traffic in and out of rooms. To further facilitate a safe surgical environment, recent studies recommend utilizing an alcohol-based hand rub, ensuring prompt disposal of contaminated material, double-gloving during induction, and using quaternary ammonium compound and alcohol solution for induction equipment.²² Standard patient decolonization in the pandemic setting is additionally recommended with pre-procedural chlorhexidine wipes, mouth rinse, and two doses of nasal povidone iodine within one hour of incision.²² Of particular interest to the current review, Rodrigues and colleagues offer a patient and provider safety report that incorporates a peri-operative routine encompassing five consecutive surgical zones to minimize transmission of the coronavirus COVID-19 virus in Orthopaedic surgery.²³ In pre-operative Zones 1 and 2, the authors focus on basic PPE, surgical hand preparation, placement of an appropriate respirator, and, lastly, the donning of either a surgical space suit or an appropriate alternative followed by repeat surgical hand scrubbing.²³ Zone 3 is the operating room, while Zone 4 and Zone 5 involve removal of PPE and of scrub suits followed by showering.

For spine cases at our institution, we recommend adjustments to patient care to preserve PPE and decrease the need for in-person patient follow up. Staff members present for intubation and extubation are potentially at greater risk for respiratory exposure, requiring fitted N-95 masks. To better preserve PPE, some hospitals have implemented a policy of restricting portions of the surgical team from the room for up to 30 minutes after intubation to minimize potential viral exposure. Our current policy is similar in that it maintains a three-person maximum in the room during intubation and extubation with the room remaining free of other persons for a 15-minute period reducing the risk of aerosolizing potential coronavirus particles. With recent improvement in our institution's preoperative testing capabilities these precautions are not necessary if a patient tests negative preoperatively, ideally within 24 hours prior to procedure.

Although there have been no reported cases of transfusion-transmitted coronavirus at the time of writing, approximately 15% of lab-confirmed COVID-19 patients had viral RNA in their plasma.²⁴ As such, the possibility of transmission of coronavirus via aerosolized blood products and bone fragments during surgery cannot be entirely ruled out and necessitates the use of N95 protection for OR team members. That said, Awad and colleagues noted PPE conservation can be maintained by supplementing a second, looser-fitting surgical mask over the N95 respirator to protect from gross contamination during surgery.²⁴ This precaution may further decrease the risk of transmission and facilitate the disinfection and reuse of the N95 apparatus while transferring the burden on PPE shortages

from N95 respirators to surgical masks. An acceptable alternative to N95 filtration respirators includes air isolation masks such as the powered air-purifying respirator (PAPR).²³ The potential for designation between larger COVID respiratory centers and expanding on permitted surgeries through ambulatory ORs has also been explored.²⁵ Although such an approach could alleviate operational strain on COVID centers and perhaps reduce patient risk, the shifting of surgical procedures to ambulatory ORs would likely require the same PPE usage described here.

In order to promote post-op follow up through telemedicine, spine surgeons are adopting procedural changes meant to decrease the need for patients to be seen in person. This includes Monocryl® (poliglecaprone 25) closure, rather than staple closure, minimizing the use of drains, and utilizing telemedicine follow up. While the benefits of telemedicine such as patient and physician convenience as well as cost reduction have been extensively studied, the pandemic provides a need for larger-scale implementation of this tool.²⁶ One of the largest barriers to telemedicine prior to this pandemic was creating the infrastructure regarding telemedicine reimbursement, which has been making large strides during this pandemic due to the necessity of agreed-upon standards for documentation and billing. Further studies will be needed to evaluate appropriate patient considerations for postoperative telemedicine follow ups, particularly with data from the COVID-19 pandemic.

The overarching pandemic goals are to maintain standard-of-care and promote optimal patient outcomes while minimizing patient and provider risk of acquiring COVID-19. With appropriate implementations mentioned above, surgical operations can be expanded upon while maintaining minimal risk during a pandemic.

Risk of COVID-19 Transmission in Healthcare Providers and Patients

Throughout the pandemic, healthcare providers and staff were diligent in utilizing PPE to prevent transmission from COVID positive patients to staff. To assess the concern and risk factors associated with healthcare providers acquiring COVID from patients who are COVID positive, Jacob et al performed a multicenter analysis on this risk.²⁷ Among 24,749 healthcare providers (HCP) in the study, over 50% (12,413 HCPs) reported workplace contact with patients positive for COVID-19. Multivariate analysis compared cumulative incidence of community and HCPs COVID rates indicating there were no associated increased risks of COVID transmission working in healthcare setting compared to community transmission. Authors found that seropositivity was associated with community exposures but no increased risk with workplace role, environment, or

contact with patients with known COVID. This research shows that current infection prevention practices in diverse health care settings are effective in preventing transmission from COVID positive patients to HCPs. Additional research from New York found no association between work location or direct patient care and seropositivity for COVID.²⁸

During the height of the COVID pandemic which has come and gone in several waves, patients feared contracting COVID and limited presentation to the hospital or other healthcare settings. This may lead to over 10,000 additional deaths from breast and colorectal cancer, as well as numerous additional deaths from myocardial infarctions, cerebrovascular accidents, and other acute or chronic conditions.²⁹⁻³¹ Brigham and Women's Hospital in Boston evaluated the rates of transmission of seropositive staff to patients at their institution showing the risk of transmission and seropositivity is low.³² There were 253 total exposures between seropositive staff and seronegative patients in inpatient, emergency, and outpatient settings and only two reported case of transmission. One case was confounded by intimate household member also testing seropositive, resulting in one clear case of COVID transmission from provider to patient.

A major concern of continuing surgical procedures, particularly spine surgery during a pandemic such as the COVID pandemic, is the risk of transmission between staff and patients. This could significantly increase the numbers of seropositive individuals. This would lead to further increased utilization of resources as well as draining critical resources of available HCPs. However, these studies suggest the risk of transmission from seropositive patients in a variety of clinical and non-clinical settings is low. Additionally, there is low risk of transmission from seropositive staff to patients. These reduced rates of transmission with appropriate PPE ensure the ability of continuation of necessary healthcare procedures and practice.

Potential for Economic Benefit

The healthcare system and its constituent medical centers have undergone unprecedented strain during the recent pandemic.^{17,33-35} By cancelling their primary source of income through elective surgeries, hospitals are expected to lose up to 80% of expected revenue while simultaneously shouldering increased burden for resources in response to the pandemic.³⁴⁻³⁶ Neurosurgery and Orthopaedic surgery are considered to be among the largest hospital revenue generators, with both specialties ranked in the top 3 in 2019 with an annual average of \$3,437,500 and \$3,286,764, respectively.³⁷ An estimated 17% of all operations performed in the United States consist of five orthopedic and neurosurgical procedures: hip and knee

arthroplasty, laminectomy, spinal fusion, and lower extremity fracture or dislocation.^{38,39} Without the revenue from these procedures, many health care systems will struggle to maintain staffing levels and quality of care.³⁹ Without diminishing the importance of patient and provider safety, resumption of spine surgeries deemed medically necessary may provide income to support basic hospital operations and to weather the economic impact of the pandemic. Indeed, with careful and considered risk-assessment, selective resumption of spinal surgeries will assist hospitals in maintaining economic support for all patient care while prioritizing spine patients' long-term outcomes. In many cases, spine surgery can correct or ameliorate a debilitating condition permitting a patient to reintegrate into the workplace. Despite the initial expense of surgical treatment, cost per quality-adjusted life year (QALY) reveals cost-effective calculations for discectomy and decompression between \$34,000 to \$80,000.⁴⁰ For example, in degenerative cervical myelopathy (DCM), an "electively" managed condition, patient follow-up determined around 20% of patients presenting with moderate or severe baseline myelopathy had no signs of myelopathy on follow-up with prompt surgical management.⁴¹ However, the DCM diagnosis is often delayed due to patient age and presentation of symptoms, which makes prompt surgical treatment within the recommended first six months of symptoms difficult.^{12,42} Considering the impact of surgical intervention on quality of life for many patients, the cost often leads to beneficial results that favor the hospital in the short term and population workforce in the long term.

It is important to note that at face value, statements of cost-benefit analyses such as these may appear particularly callous in juxtaposition to the tragic number of lives lost each day to COVID-19. This misses the point of this scientific note entirely. The critical point here is that while patient safety is always the priority, all "elective" procedures are not the same. "Elective" and "medically necessary" are not mutually exclusive. The progressive nature of certain "elective" conditions makes clear that prompt surgical treatment is the most medically appropriate course of action for these cases regardless of the risk or benefit to the hospital.

Conclusion

Determination of what constitutes a necessary surgery in the setting of unprecedented hospital resource strain, as created during the COVID-19 pandemic, is a remarkable challenge for our nation's health care systems. As the recent resurgence of the COVID-19 pandemic with delta and other variants, careful case-by-case evaluation and weighs the risks of delaying surgical management against individual risk of patient and provider COVID-19 exposure. Here, we detail additional management considerations that are expected to minimize

viral transmission risk and a frank consideration of the economic consequences of discontinuing medically appropriate surgeries during this time and future pandemics. Future prospective and retrospective studies are needed to evaluate pandemic preparedness and long-term effects of current protocols through data from the spring of 2020 and throughout the current pandemic. However, our conclusions regarding spine patient management reflect current opinions, protocols from large academic centers, and economic considerations for hospital support in upcoming months as well as with concerns for continued COVID-19 resurgence in the fall of 2021. Now being in the midst of the largest rise in Covid infections to date, due to the Omicron variant, and with the understanding that Covid is here to stay we need to be more astute at adapting to the existence of Covid while moving on to providing patient care for non-Covid conditions. The importance of this topic and the focus of this paper yet again is emphasized in real time as of January 2022.

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