Considerations and Strategies for Restarting Elective Spine Surgery in the Midst of a Pandemic of COVID-19

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Abstract:

The 2019 coronavirus disease (COVID-19) pandemic outbreak has rapidly spread to the globe, causing severe global socioeconomic disruption on an unprecedented scale. As the first wave of COVID-19 pandemic is now going to settle down, many medical organizations are in the process of reopening surgical services. This paper describes a few key factors that spine surgeons should consider prior to resuming elective spine services namely, local outbreak situations, availability of hospital resources, manpower and personal protective equipment (PPE). Spine surgeons should prioritize their operating list based on clinical indications and likely benefits from surgical intervention so as to make optimum use of hospital resources and operating room listings. International organizations have published on general principles and recommendations on how to restart elective surgery. However, with different regions at varying phases of the outbreak and unpredictable nature of the COVID-19 pandemic, a general set of practice guidelines may not be applicable. This paper also proposes, on top of perioperative precautionary measures already in place, clearly-defined risk stratification algorithms for hospital visitors, as well as a disease-testing protocol for patients planned for elective surgery. It is of critical importance for surgeons to define key areas of concern and assimilate these principles into clearly-defined algorithms which can be applied to the field of spine surgery so as to help re-establish continuity of care for patients.

Keywords:

COVID-19, elective surgery, spine surgery, disease screening, precautionary measures

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Introduction

The 2019 coronavirus disease (COVID-19) pandemic outbreak has taken the world by storm since the first reported case to the World Health Organization (WHO)[1)] on December 31st, 2019. By the time of writing, more than 200 countries and territories have been devastated, socially, and economically, by this outbreak. Most international bodies had recommended immediate cessation or postponement of elective surgical services in tandem with redeployment of manpower[2-4)] in order to conserve medical resources for the fight against this medical crisis. In response, hospitals around the world have had to make abrupt radical changes for the provision of clinical services and surgical care to surging number of infected patients. As the first wave of the COVID-19 pandemic is now going to settle down, many medical organizations are in the process of reopening surgical services.

Japan's healthcare system was also critically affected in the first wave of the pandemic. While international guidelines have so far focused on general principles and recommendations for restarting elective surgery[5-7)], the literature has been scarce with regards to specific algorithms on how to resume medical services for the field of spine surgery when the COVID-19 pandemic is under control, and as of May 25, 2020, with improvement to the infection situation, the Japanese government lifted the state of emergency in all prefectures, and spine specialists around the country are in the early phase of restarting elective surgery. Based on available evidence and strategies, this article aims to discuss the considerations and possible strategies for spine surgeons who are in the process of restarting elective surgical service.

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Alert	Situation	General Medical Care System	COVID-19 Care System
Green	- No increase in the number of COVID-19 patients in the local region/prefecture. - Epidemics may be seen in other countries.	- Patients to be triaged using the original universal screening form and - Additional tests for high risk COVID-19.	- Secure the minimum required beds for normal day to day operation, in consultation with a regional government.
Yellow	- Number of COVID-19 patients increasing in your region without declaration of state of emergency in other neighboring prefectures.	- Enhanced triage pathway. - Review and stratification according to significant contact or travel history together with presence of symptoms.	- Preparation for conservation of hospital beds and resources. - Preparation for expansion of hospital beds for COVID-19 patients.
Red	- Increase in prevalence of COVID-19 outbreak in local prefecture/region itself. - Emergency declaration in local prefecture or neighboring prefectures.	- Cessation of elective surgeries. - Cessation of new outpatient referrals and reduction of outpatient clinic for existing outpatient pool.	- Coordination and expansion of regional hospital beds. - Regional coordination of medical care for COVID-19 patients.

Figure 1. Local/Regional Outbreak Situation - Prefectural COVID-19 Alert Warning System.

Check Local-regional Outbreak Situation First

The Japanese government had issued their national policy for COVID-19 outbreak control on March 28, 2020. This was revised on May 25, 2020[8]. Prior to the easing of emergency measures, the Japanese government had set a criterion to be met, which is a reduction in cumulative number of new infections to 0.5 or less per 100,000 people in a week. This numerical criterion is to be taken in context with three other key considerations which are: 1) The epidemiological trend; 2) the readiness of the local healthcare system in coping with the outbreak; and 3) a surveillance system. Together, this set of four criteria forms the basis for social restriction policies in outbreak control at the national and prefectural level. The same principles can be applied at the institution level for medical facilities opening during this time. The nature of this pandemic outbreak remains unpredictable and, within the same country or prefectures, it is not uncommon to observe that different areas are in varying phases of the outbreak. Medical institutions should aim to establish individual disease-control strategies and systematic testing protocols so as to maximize protection of both health care workers and patients Additionally, medical institutions in the process of reopening elective services should consider strategizing based on the regional outbreak situation (Fig. 1), together with well-defined algorithms that allow quick response to changes in the regional COVID-19 situation so as to minimize intra-hospital cross-infection.

Prioritization for Restarting Elective Spine Surgeries

The first wave of the outbreak highlighted our vulnerability to medical resources and supplies shortage. Reports of hospitals running out of personal protective equipment, face masks, screening kits, and hospital beds, as well as ventilators were common during the peak of the first wave. Under these circumstances, priority should be given to safe restoration of surgical treatment and continuity of care for patients afflicted with spinal pathologies. At the same time, this objective should be achieved with the most efficient use of precious medical resources while providing sufficient protection for both healthcare workers and patients without fueling a second outbreak. Spine surgeons who are contemplating restarting elective surgeries should focus on a few key considerations; 1) Hospital readiness; 2) the optimum timing for reopening medical services to the public; 3) pre-operative screening protocol; and 4) surgical safety for patients with active COVID-19. Prior to restarting elective surgery, it is important for spine specialists to perform an accurate analysis of their readiness to cope with the additional demands of looking after post-operative patients while expecting newly diagnosed COVID-19 patients. This can be done by collating critical information with regards to local COVID-19 outbreak-related data (Table 1). The guiding principle is that hospitals should not resume elective surgery unless there is adequate protective equipment (PPE, N95 masks, medical supplies), manpower availability, and isolation capacities[6].

Ideally, reopening elective surgical services should start when the pandemic is at least not endemic in the region. However, going by the protracted course this outbreak is following and given that the incubation period of the virus is approximately 5-14 days, many hospitals around the world are choosing to restart medical services once the local outbreak situation has crossed its peak, and a sustained decrease in number of new infections within the region for at least 14 days is required before reopening elective surgical services to the public. It is also recommended to adopt a re-

Table 1. Hospital Preparedness Information.

Patient Related
1. Local COVID-19 prevalence
2. Daily new cases and trends
3. Number of COVID-19 admissions per day
4. Number of active COVID-19 inpatients
5. Estimated Number of COVID-19 discharges per day
6. Mortality rates from COVID-19
7. Age breakdown and Demographics
8. Co-morbidities and breakdown by ASA status
Healthcare Workers Related
1. Total Manpower
2. Number of trained staff
3. Total number of teams of healthcare workers required for functioning
4. Training Refresher courses required
5. Number of healthcare workers on quarantine orders/self-isolation
Hospital Related
1. Total number of beds and Bed occupancy ratio
2. Capacity of isolation wards/rooms
3. Critical care capacity (High Dependency and ICU beds) vs Percentage occupancy
4. Number of ORs available
5. Projected capacity of functioning OR vs Number of projected cases
6. Adequacy of PPE
7. Adequacy of N95 masks
Disease and Screening Test Related
1. Local screening policies: Screening encounters, intervals
2. Daily Screening capacity
3. Isolation and De-isolation policies
Perioperative Demands
1. Projected number of patients requiring post-operative critical care
2. Number of projected cases
3. Estimated duration of surgery
4. Estimated length of hospitalization for each patient planned for Op

alistic approach toward restarting of elective spine service in phases[5], starting with reopening of outpatient clinics and elective operating rooms at partial surgical capacity before gradually increasing clinical load at intervals. Such a workflow allows a more controlled use of medical resources in case of a second wave of outbreak in the community or occurrence of intra-hospital cluster.

The other reason for scaling down clinical workload is also a pragmatic one. During the peak of the COVID-19 outbreak, much has been written on the principles of risk management during urgent/emergency spine surgeries. Restarting of outpatient clinics with newly implemented disease-control practice is also another aspect of hospital operation that has undergone significant change, in addition to peri-operative and intra-operative precautionary measures are still maintained. Expectedly, while the above additional steps are important to curbing the spread of the disease, they also bring about a decrease in clinical and operating room (OR) efficiency. Realistically, spine surgeons should expect to reduce clinical listings for both outpatient clinics and surgeries at least for the initial phase of restarting medical service. In these circumstances where resources are limited, surgical listings and hospital resources need to be prioritized for: 1) patients who have absolute indications for surgery; and 2) patients who would benefit the most out of the elective surgery.

One of the unique considerations that spine surgeons face in restarting elective surgery relates to the complexity of spine pathologies and the nature of major spine surgery. Since the post-operative care of patients who just underwent major elective spine surgery is complicated, the need for closer peri-operative monitoring and even critical care (ICU or High-Dependency management) is higher, with the main concerns being intra-operative blood loss, need for blood transfusion, long duration surgery, need for post-operative hemodynamic-ventilatory support, and post-operative complications. Additionally, they are also less mobile, with many patients requiring intensive post-operative rehabilitation for recovery of ADL. The above factors are all potential reasons for prolonged hospitalization for post-operative spine patients and spine surgeons should factor them into the calculations of capacity goal projections. These include realistic projections of: 1) Number of cases to be done per OT session; 2) number of allocated critical care beds (HD/ICU); 3) number of general ward cases; 4) total number of inpatients; 5) estimated hospitalization duration; and 6) manpower requirement for surgery.

At the peak of the crisis, the suspension of elective surgeries and outpatient clinics made the process of prioritization a necessary one. Priority was given to patients with conditions that needed urgent surgical treatment. The process of prioritization can be moderated to include patients whose conditions warrant elective surgery. Nonetheless, the basic principle still follows that priority should be given to patients with the lowest surgical risk profile and those who are most likely to benefit from the operation. Reports have suggested that age above 75, morbid obesity, and significant comorbidities such as diabetes mellitus, uncontrolled hypertension, chronic pulmonary disease, obstructive sleep apnea, chronic heart disease, or immunocompromised state were all risk factors for higher severe disease presentation as well as mortality and morbidity rates in COVID-19 patients[9-12]. Additionally, COVID-19 infection itself presents patients with significantly higher peri-operative mortality and morbidity rates. In a study by Lei et al[13], the authors reported a high peri-operative morbidity rates in COVID-19 patients undergoing non-cardiac surgery, with 44.1% of these patients requiring post-operative intensive care management. In the same study, it was also observed that there was a significantly higher post-operative mortality rate in COVID-19 patients undergoing non-cardiac surgery (20.6%) when compared to: 1) COVID-19 patients without surgery (2.3%); and 2) non-cardiac surgical patients without COVID-19 infection

Table 2. Risk Factor Screening Form.

Patient Information
1. Name, Age, Gender, Address
2. Co-habitants at same residence: Name, Age, Gender, Relations
3. Referral Source
4. Occupation
5. Allergy History
6. Smoking History: Number of pack years
7. Medical History: Diabetes, Hypertension, Dyslipidemia, Asthma, Cancer history, Coronary Heart Disease, Stroke
8. Medication History
Contact Risk Factors: Recent (within 14 days) close contact with:
1. Any individuals who are suspected/tested positive for SARS-CoV2
2. Family members staying in the same residence who are suspected/tested positive for SARS-CoV2
3. Any individuals who have contact with anyone who are suspected/tested positive for SARS-CoV2
4. Any family members (staying in the same residence) who have contact with any individual suspected/tested positive for SARS-CoV2
Travel History Risks Factors: Recent (within 14 days) travel to:
1. Countries/areas where SARS-CoV2 is endemic or where an emergency state is declared
2. Family members (staying within the same residence) who traveled to countries/areas where SARS-CoV2 is endemic or where an emergency state is declared
Social Risk Factors: Recent (within 14 days) exposure to public place (3 “C”s)
1. Exposure to risk factor in social circumstance (close contact setting, closed space, crowded places)
Symptoms Factors (within 14 days)
1. Sudden onset of Fever 37.5 degrees of at least 1 day duration:
A) Still febrile; B) Subsided<96 h; C) Subsided>96 h ago or Known cause
2. Cough:
A) Acute onset of dry cough; C) Productive cough with yellow sputum; C) Known cause
3. Shortness of breath:
B) Severe dyspnea of acute onset within 14 days; C) Dyspnea onset more than 14 days ago
4. Loss or smell/Taste:
A) Acute onset, Unknown cause; C) Chronic with known diagnosis
5. Fatigue: B) Present
6. Malaise: B) Present
7. Sore throat B) Present

A defines significant major criteria in algorithm

B defines intermediate/minor criteria in algorithm

C defines questionable significance of symptoms as criteria in algorithm

Modified and adapted from universal screening questionnaire developed from the National Hospital Organization Hokkaido Medical Center, Sapporo, Japan

(7.9%) who were admitted to the Intensive Care Unit. In patients with high surgical/COVID-19 risk profile, surgeons should consider postponing elective spine surgery until after the pandemic is settled down or at least until better prevention and treatment protocols are established.

An Algorithm on how to Screen Patients

One serious concern with opening of medical services to the public during a disease outbreak is the risk of disease transmission between infected patients and healthcare workers in hospitals. Observational studies have also offered some insight into some of the presenting symptoms that are prevalent in symptomatic carriers of the virus. A study by Tao et al.[14] reported that fever (more than 70%) and cough (more than 66%) were the commonest symptoms reported by COVID-19 patients. Other symptoms known to be associated with COVID-19 include dyspnea, fatigue, and myalgia, as well as atypical complaints such as sore throat, acute anosmia, and loss of taste. Based on symptoms report alone, these individuals are likely to be missed, as one of the issues that has hindered our efforts in controlling the outbreak stems from the knowledge that a large proportion (6%-41%) of infected individuals are asymptomatic carriers of the virus or display only mild non-specific symptoms[15-19]. Taking heed of these findings, it would be wise to include other risk factors (such as travel and contact history) into the triaging process as these can potentially help reduce the number of patients missed based on symptoms report alone.

Based on the aforementioned reasons, this paper proposes a simple screening form to triage all hospital visitors prior to consult (Table 2). The screening questionnaire, designed to identify at-risk individuals, consists of four main risk assessment components: 1) Recent history of close contact with patients who tested positive for the virus themselves or have had close contact with other individuals who tested

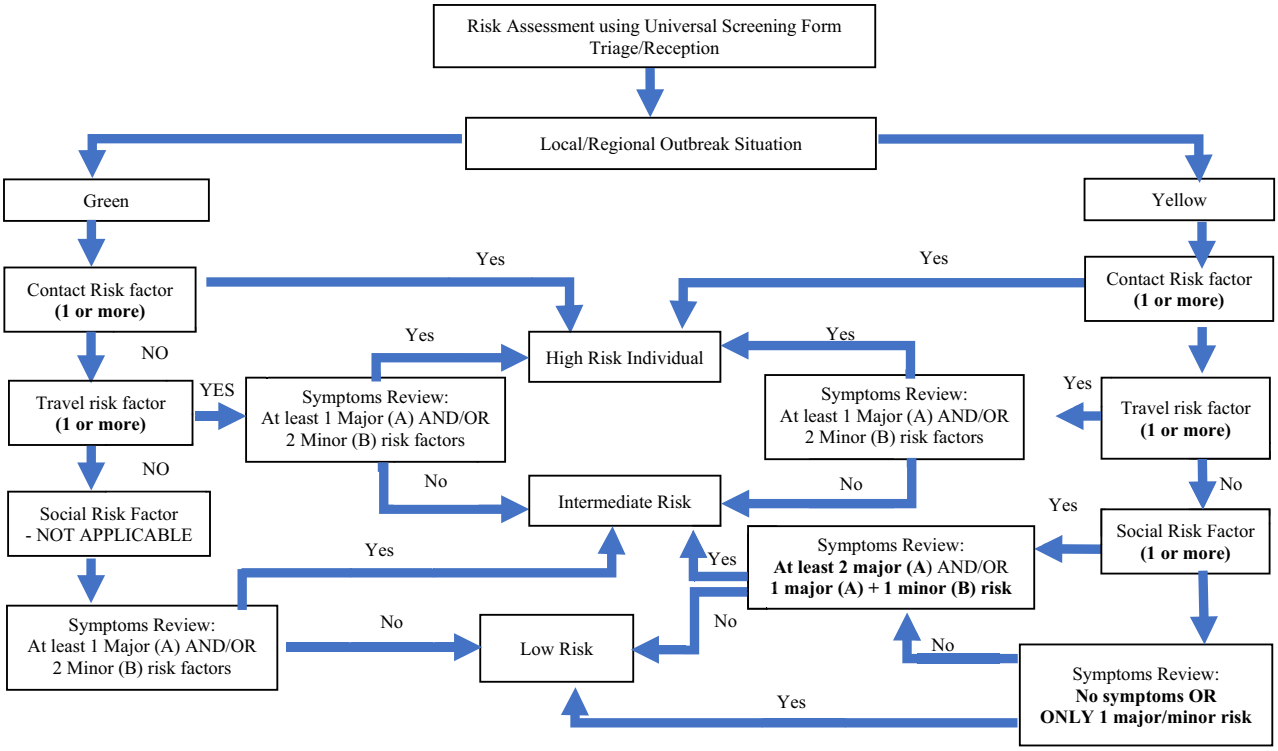

Figure 2. Algorithm Pathway for Outpatient Clinic (Risk factors as listed in table 2).

positive for the virus; 2) recent travel history to areas where SARs-CoV2 is endemic or where an emergency state was declared; 3) social risk factor of exposure in public under crowded/closed contact setting; and 4) symptoms associated with COVID-19. In Fig. 2, an algorithm is shown for determining the risk profile of all patients and the level of precautionary measures needed to be taken during consult. The algorithm takes into account the regional outbreak situation (set by the local government) as well as significant risk factors (based on the questionnaire) with particular emphasis on: history of possible close contact with infected individuals, travel to countries or areas where COVID-19 is still endemic, and unexplained acute onset of symptoms such as fever, dry cough, and loss of taste/anosmia. All outpatient attendees can then be stratified according to an algorithm/pathway into three main groups (Fig. 2): 1) High Risk (Red); 2) Intermediate Risk (Yellow); and 3) Low Risk (Green). Particular considerations should be given to patients with: 1) Positive contact history; 2) history of travel to countries where COVID-19 is endemic; and 3) presence of 1 "major" and/or 2 "minor" COVID-19 related symptoms. Social risk factors (history of visit to crowded places) are then factored into the risk assessment in conjunction with the regional outbreak situation. The advantage of this algorithm is that risk exposure is weighted according to the regional outbreak situation and alternative pathways are already defined.

Pre-operative Screening Protocol

Given the high prevalence of asymptomatic patients of COVID-19, many medical organizations strongly recommend mandatory screening as well as testing for the SARS-CoV2 virus prior to elective surgery. However, reports from available literature would suggest that even with the most comprehensive screening regime, a significant proportion of "true positive" infected individuals are likely to be missed. Based on available evidence, an algorithm (Fig. 3) is proposed for pre-operative screening of patients due for elective procedures. The algorithm utilizes a combination of questionnaire-based risk assessment, mandatory chest CT scan together with SARS-CoV2 RT-PCR test 24-72 h prior to admission to identify patients according to risk of COVID-19 infection. Studies on the COVID-19 outbreak have reported that symptoms mostly appear within two days to two weeks post-exposure and that the incubation period ranges from three to seven days. As a result, various guidelines have advocated pre-operative screening protocol three days to one week prior to the planned elective surgery. However, one of the problems is the lack of one absolute clinical indicator to base screening on. The reliability of current objective screening modalities is also another subject of debate. The commonest screening tool adopted by most countries is the Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) test which confirms infection via detection of viral nuclei acid. However, its reliability as a single screening test has been questioned due to reports of suboptimal sensitivities (37%-71%) as well as high false negative rates (more than 21%)[20-22]. The addition of CT scan of the chest has been suggested as a complementary screening tool due to presence of radiological features of pneumonia even in early infections or patients with mild symptoms[23,24], as well as superior sensitivities compared to RT-PCR test (98%

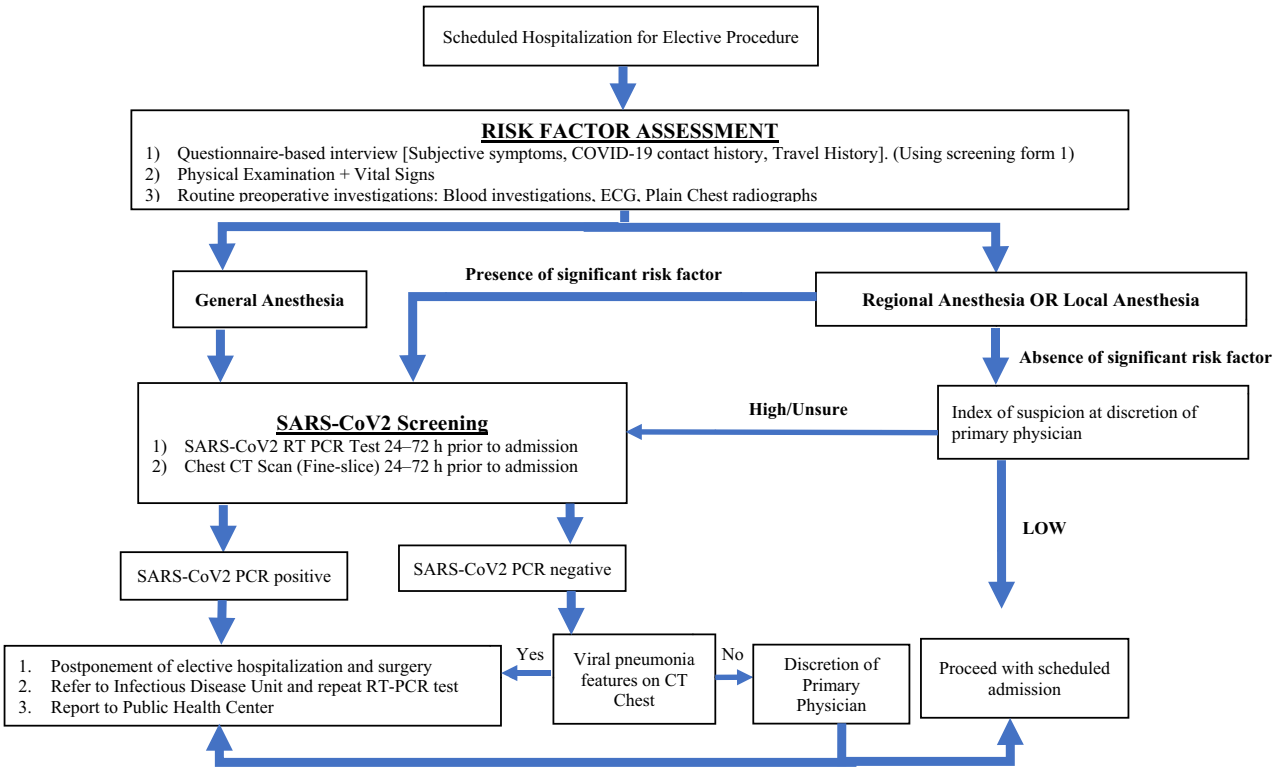

Figure 3. Pre-Operative Screening Protocol.

vs. 71%)[20].

With the above considerations, the proposed screening algorithm includes the use of three screening modalities which can potentially improve the accuracy of our screening process while keeping within local policy regulations. This proposed algorithm aims to map out clearly-defined workflow for patients in three main groups: 1) Those who tested positive for SARS-CoV2 on the RT-PCR test; 2) patients who tested negative for SARS-CoV2 on the RT-PCR test and do not have viral pneumonia features on CT Chest scan; and 3) patients whose infective status are non-conclusive. Patients who test positive for SARS-CoV2 on the RT-PCR test or have viral pneumonia features on the chest CT scan will be counseled on postponement of elective surgery and referral made to the infectious disease specialist for further evaluation and repeat testing. With regards to patients non-conclusive screening test results, this algorithm gives the option for discretion from the surgical team in deciding whether to proceed with elective procedure or postponement of elective procedure until patient tests negative on re-screening.

Peri- and Intra-Operative Considerations

In the aftermath of the peak of the COVID-19 outbreak, one key consideration is the need to shorten the turnover time of hospital beds in preparation for a possible second wave of outbreak. This is especially so for patients who undergo major spine surgery where post-operative recovery and rehabilitation can potentially lead to prolonged hospitalization. There has been little consensus on the ideal strategy for optimizing hospital turnover time during this unique situation. The solution to the above question stems from judicious selection of patients, as well as the ideal surgical procedure. Spine surgeons should choose the safest technique that achieves the best surgical outcome within the swiftest means possible. The options of minimally invasive surgery (MIS) and endoscopic spine procedures can be considered if medically feasible. The advantage of minimally-invasive or endoscopic approaches to the spine is that recovery time is shorter which can shorten the duration of hospitalization and post-operative inpatient rehabilitation. In the selection of procedure, spine surgeons should also factor in the issue relating to ease of post-operative sterilization of surgical equipment used during operation. The safety of use of large bulky equipment in spine surgery such as the O-ARM, robots, and navigation platforms during a pandemic outbreak like this is largely still unknown. Experts have voiced out concerns with their use as the post-operative sterilization process of these large equipment is theoretically difficult. Some spine surgeons would agree that the use of these equipment, unless strongly indicated, should be avoided at least for the initial phase of restart of medical services.

During the peri-operative phase, the main hazard to healthcare workers arises from aerosol transmission secondary to aerosol generating procedures (AGPs). Specific precautions aiming at reduction of aerosol generation during the intubation and extubation[25-27] process, as well as intra-operative strategies during spine surgeries have been widely published during the peak of the first wave of the outbreak[28-30]. Many of these principles of safe surgery should

still be followed as long as the virus is still endemic. Yet, there is still much that we do not know about the infectivity and transmission process about the virus. One area of concern is the ideal type of surgical protective equipment as well as post-operative sanitization process. Evidence is still lacking with regards to the type of surgical protective equipment during surgery. Most guidelines[6,7,31] recommend a rationale and balanced approach with regards to protective equipment for surgeons in low risk situations (e.g., patients tested negative within the past three to seven days and low risk procedures), standard sterile surgical gown with surgical masks together with face shield has been proposed to offer sufficient protection for the surgeons. On the contrary, in high-risk surgical procedures (AGPs), it is recommended that the entire surgical team wear full PPE, N95 masks, and face shield/protective eyewear together with neck cover[6,7]. That said, it is still highly advisable for surgeons to exercise certain discretion with regards to the level of precautionary precautions required according to other factors such as the regional outbreak situation, as well as the infective status of the patient. For example, in areas of high disease incidence or where results of disease screening testing is unavailable due to whatever reason, it is better for the surgical team to adopt a more cautious approach and proceed as they would for a high-risk situation. Another point of consideration is the viability and infectivity of virus particles on gowns and inanimate surfaces as studies have shown human coronaviruses can be found to be still viable on hard surfaces for 2 h to up to nine days, depending on the type of materials and environmental conditions[32]. Findings from a study done during the 2003 SARs outbreak[33] and a recent systematic review[34] showed that infectivity of the human coronaviruses was kept to almost undetectable levels after absorption and drying on cotton material, suggesting that gowns made from absorptive materials such as cotton are safer for protection against virus infection when compared to non-absorptive material. Additionally, systematic decontamination protocol of the OR can potentially reduce the risk of virus transmission. One strategy includes a routine post-operative terminal cleaning of all inanimate surfaces in the OR using a quarternary ammonium-containing compound disinfection wipe and additional ultraviolet irradiation for 20-30 min after each surgical procedure is completed in the OR[35].

Post-operatively, as long as COVID-19 is still endemic, we strongly recommend the surgical team and healthcare staff continue to adopt droplet and contact precautions when caring for all post-operative patients in the recovery area. All personnel looking after patients in the recovery area should be protected with mask and face shield/protective eyewear. Although this point is dependable on the clinical conditions of each patient, it is also advisable for patients to don a surgical mask post-operatively in the recovery area. Additionally, overcrowding in the recovery area should be avoided and patients should be separated from each other by a minimum distance of 2 m. At the same time, patient's stay in the recovery area should be minimized to reduce unnecessary contact time with other patients in the recovery area. As much as possible, patients should be recovered and post-operative confirmatory radiographs of the spine should preferably be done in the OR/induction room before transfer to the ward[6]. Another strategy worth considering is the separation of the recovery area into two separate zones—one for post-operative patients who tested negative during the pre-operative screening. These patients should be separated from another group of patients—suspected/COVID-19 patients or patients who require urgent surgery before the entire screening protocol can be completed. Some hospitals with sufficient space can consider setting up a "second" recovery zone (either at an adjacent hospital complex or on a separate floor) in order to segregate these "clean" patients from COVID-19 patients.

Lastly, with the introduction of various additional peri-operative precautionary steps as well as post-operative sanitization of the OR, overall OR efficiency is expected to decline. One strategy is to consider improvising on OR workflow so as to allow utilization of multiple operating rooms by a single team of surgeons[6]. In principle, the spine team will rotate between two ORs, operating in one while the other is being cleaned and left empty for adequate air exchange. Such an arrangement involves compacting multiple operating lists and the collaboration with surgeons from other surgical disciplines to exchange surgical lists. The potential advantages to both parties are: 1) Surgeries are left to continue uninterrupted; 2) reduced turnover time; and 3) more efficient use of manpower. This arrangement is particularly relevant to the field of spine surgery as major spine procedures are more complex and time-consuming. Facilitating efficiency by allowing multiple OR utilization will allow more spine cases to be completed in a single surgical day with less time lost to cleaning and turnover. On the contrary, the argument against utilization of multiple ORs for a single operating list is the theoretical risk of simultaneous contamination of multiple ORs should one patient test positive post-operatively. Such a strategy would not be well suited at a time when the region is still experiencing peak number of new infected cases of COVID-19.

Conclusion

This paper described a few key factors that spine surgeons should consider prior to resuming elective spine services: local outbreak situations, availability of hospital resources as well as manpower and adequacy of personal protective equipment. Many international organizations have published on general principles and recommendations on how to restart elective surgery, and spine surgeons should prioritize their operating list based on clinical indications and likely benefits from surgical intervention so as to make optimum use of hospital resources and OR listings. However, with different regions at varying phases of the outbreak (even within the same country) and unpredictable nature of the COVID-19 pandemic, a general set of practice guidelines

may not be adequate. This paper proposes, in addition to peri-operative precautionary measures already in place, clearly-defined risk stratification algorithms for hospital visitors, as well as a disease-testing protocol for patients planned for elective surgery. In the conception of these algorithms and protocols, important considerations such as the regional outbreak situation and a multiple risk factor screening approach have been included. For spine surgeons planning to resume elective spine surgeries, these algorithms and strategies may serve as guiding principles at their respective institutions. The points raised in this article, however, are not exhaustive. When additional knowledge or guidelines are formed, the proposed strategies and practice standards will need revision accordingly.

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Author Contributions: Wang Tzong-Jing Victor took the lead in conducting the literature review as well as the drafting and writing of the manuscript.

Odani Toshio provided important information and conception of algorithms related to outbreak-control measures.

Ito provided critical feedback to every draft copy as well as the co-writing of the manuscript.

All the authors were involved in the conception of this study as well as in revision of every draft.

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