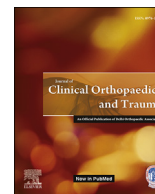




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Safety evaluation of providing trauma service during COVID-19 phase one lockdown



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ABSTRACT

Aims: To evaluate the safety and transmission of COVID-19 in trauma patients during the coronavirus pandemic at a time of rapid reorganization of hospital health services.

Methods: All patients sustaining trauma requiring surgery treated in our institution during the lockdown period were included. Retrospective data for all admissions were collected, including outcomes, length of stay and complications. Telephone interviews were performed with all patients, families or their carers to assess COVID-19 transmission at minimum of 6 week post-discharge.

Results: 161 patients underwent surgery, 107 females and 54 males with average age of 56 (2–99). There were lower limb related procedures, upper limb related respectively. 13 people died during this period, of these one was directly attributed to COVID-19 related morbidity. 75% responded to telephone interviews and found no cases of symptomatic spread to any patient or household members.

Conclusion: Following reorganization, our experience has shown that trauma services can be safely resumed with little to no significant adverse effect to patient or spread into community, especially as concerns of second wave risk overwhelming the NHS. We advocate that rigorous testing of COVID pre-operatively and with development of local COVID-19 standard operating protocols will also reduce and prevent the spread of COVID-19

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1. Introduction

Coronavirus disease 2019 (COVID-19) is a public health worldwide pandemic which has challenged all nations' healthcare systems regardless of the socio-economic development. Several countries have taken unparalleled steps to manage the increased demand to increase acute inpatient capacity.

The United Kingdom went into national lockdown on the 23rd March 2020. National Health Service England (NHSE) announced the immediate cessation of all non-urgent elective services to optimise and redirect services towards the anticipated COVID-19 surge.^{1,2} In our institution elective surgery ceased to operate from 17th March 2020 due to increasing concern of rising coronavirus cases, however emergency trauma surgery continued.

Consequently, British Orthopaedic Association (BOA) guidelines for the delivery of trauma and orthopaedics services and management of musculoskeletal conditions were produced during this period.³

A recent study has shown that operating on a paediatric population during the peak of COVID-19 did not result in symptomatic spread of COVID-19 in any patient or their households.⁴ Despite this, there were still concerns that children may be asymptomatic carriers.^{5–7} Furthermore, some hospital institutions restarted elective orthopaedic surgery on green (non-covid) sites during the de-escalation phase and early results show that elective surgery is safe and had high satisfaction rates with adequate resources and appropriate infrastructure.

However, there is little literature available on operated adult trauma cases during early lockdown period in terms of post-operative complications and the transmission of symptomatic COVID-19 to households as a possible vector. The aim of this study is to contribute to this process and as UK cases are on the rise again.

2. Methods

All trauma patients admitted and operated on during the first national lockdown, from 23rd March - 31st May were identified. Permission was granted by our institution's research and development committee to conduct the study, contact patients and

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ethical approval was not required. Telephone interviews with the patient, family or their carers/guardians were conducted at least after 6 weeks post discharge. The interviewees had specific sensitively scripted questioning about development of COVID-19 symptoms (high temperature, new continuous cough, loss of smell and/or taste), complications and transmission within the household after return from hospital. Further information about demographics, length of stay and nature of injury and surgery was obtained from hospital records.

Standard operating procedure (SOP) for theatre pathway was expeditiously developed in response to the pandemic with relevant stakeholders. This is outlined below and in appendix (Figs. 1 and 2).⁸

2.1. Surgical site

Tunbridge Wells Hospital is a 528 bedded level-2 trauma centre where routinely trauma and elective procedures are performed. This institution was the red site where all confirmed/suspected COVID patients were admitted to designated COVID wards.

2.2. Patient flow and COVID standard operating procedures

Patients were categorised into four groups: green patient elective, green patient non-elective, amber and red patient. All patients in our trust had an additional COVID-19 consent form to provide patients with additional risks with admission to hospital during the pandemic.

Green non-elective patients were identified as those that required surgery due to an acute injury or illness, swab COVID-19 negative and were asymptomatic and stable surgery. Those that were green elective patients were those that required planned surgery; this group was not included in our study as all elective surgery had ceased during the first wave.

Red patients were identified by a positive COVID-19 swab and/or showing symptoms of COVID 19 as defined by Public Health England. These symptoms were: high temperature, new continuous cough, loss of smell and/or taste.

Amber patients were asymptomatic patients that required urgent surgery however their COVID-19 swab wasn't available or ready before surgery. If the surgery could not wait for a swab result, they followed the same process as red patients in regards to personal protective equipment (PPE) for all staff. However, they could still be operated on in the Green theatre and required recovering in theatre. Theatres then had the appropriate decontamination.

Paediatric patients were still allowed to be escorted to theatre by a single parent. The parent had to wear a surgical face mask in addition to normal theatre pathways. Following the patient losing consciousness they then left via the appropriate route, dependant on the category of the patient.

2.3. Theatre environment

All non-necessary equipment was removed to reduce cross-contamination. Portable donning stations were stocked appropriately outside of the anaesthetic room with an allocated doffing station in theatre sluice. The recovery bays were converted to allow for 2 m distance between each bay.

Aerosol Generating Procedures (AGPs) were defined at the time of first lockdown as:

- Intubation, extubation and related procedures, for example, manual ventilation and open suctioning of the respiratory tract (including the upper respiratory tract)

- Non-invasive ventilation (NIV); Bi-level Positive Airway Pressure Ventilation (BiPAP) and Continuous Positive Airway Pressure Ventilation (CPAP)
- Surgery involving high-speed devices, including drills and saws
- High Frequency Oscillatory Ventilation (HFOV)
- High flow Nasal Oxygen (HFNO)

All anaesthetic team members wore full PPE for airway intubation (endotracheal or supraglottic). For regional anaesthesia/spinal or epidural without airway intubation, standard infection prevention and control precautions were acceptable with the performing clinician wearing standard PPE, if no AGPs were being carried out. The patient wore a surgical mask throughout the operation if no airway was insitu. Red patients were anaesthetised in theatre to prevent inadvertent disconnection of tubing and to minimise the risk of spread of aerosols.

If the planned surgical procedure did involve AGPs then the perioperative team had to wear full COVID PPE regardless of being red, amber or green patient. When transferring the patient to theatre the circuit was disconnected after the HME filter, to prevent exposure to aerosols.

At the end of the operation with an intubated patient all theatre staff left via the doffing station, leaving the minimum number of anaesthetic team to extubate the patient.

After extubation, a clean surgical mask was placed on the patient between the patient's mouth and oxygen mask to protect against any patient coughing. If at any time there was a risk to the patient airway the mask could be temporarily removed.

Post procedure the patient was recovered in theatre wearing full COVID PPE. The theatre team took the patient back to the ward via the allocated red lifts and doffed at the appropriate ward doffing station. Theatres were decontaminated appropriately.

Full COVID PPE comprised of fluid repellent surgical gown, FFP3 mask, sterile gloves and visor.

3. Results

During the 1st phase of lockdown, from 1st April to 31st May, 151 patients (96 female/55 male) were admitted and underwent 161 procedures. 7 patients had more than 1 procedure. The mean age was 56 (2–99). All procedures were consultant led. One patient underwent re-do ankle fracture fixation after failure.

With COVID-19 restriction and BOA guidance, trauma referral numbers dropped by 32%. Patients who would normally be followed up in clinic were seen via telephone consultation. Absorbable sutures and removable casts were utilised where appropriate.

Our cohort had 42 (26%), upper limb, 89 (55%), lower limb and, 30 (19%) wound-related injuries referred. The commonest injury was to proximal femur, 29 (18%) followed by ankle, 21 (13%) (Fig. 3). Most of the common operations were of soft tissues, 40 (25%) followed by proximal femur operations (Fig. 4).

Mean length of stay was 6.7 days (0–100). The two COVID patients' hospital stay was 9 days and 7 days.

Our cohort were 83% negative and 1% positive covid swab result with 16% unknown (Table 1).

There was 1 reported complication where ankle fixation had failed and underwent revision (Table 2). The 13 patients that died during lockdown had an average length of stay of 7.2 days. Of the 13, one had been certified as COVID related death (Table 3).

We were able to contact 120 out of 161 (75%) patients, their families or carers for a telephone interview (Table 4). During lockdown not all patients followed complete isolation. We found that no transmission occurred in their respective household.

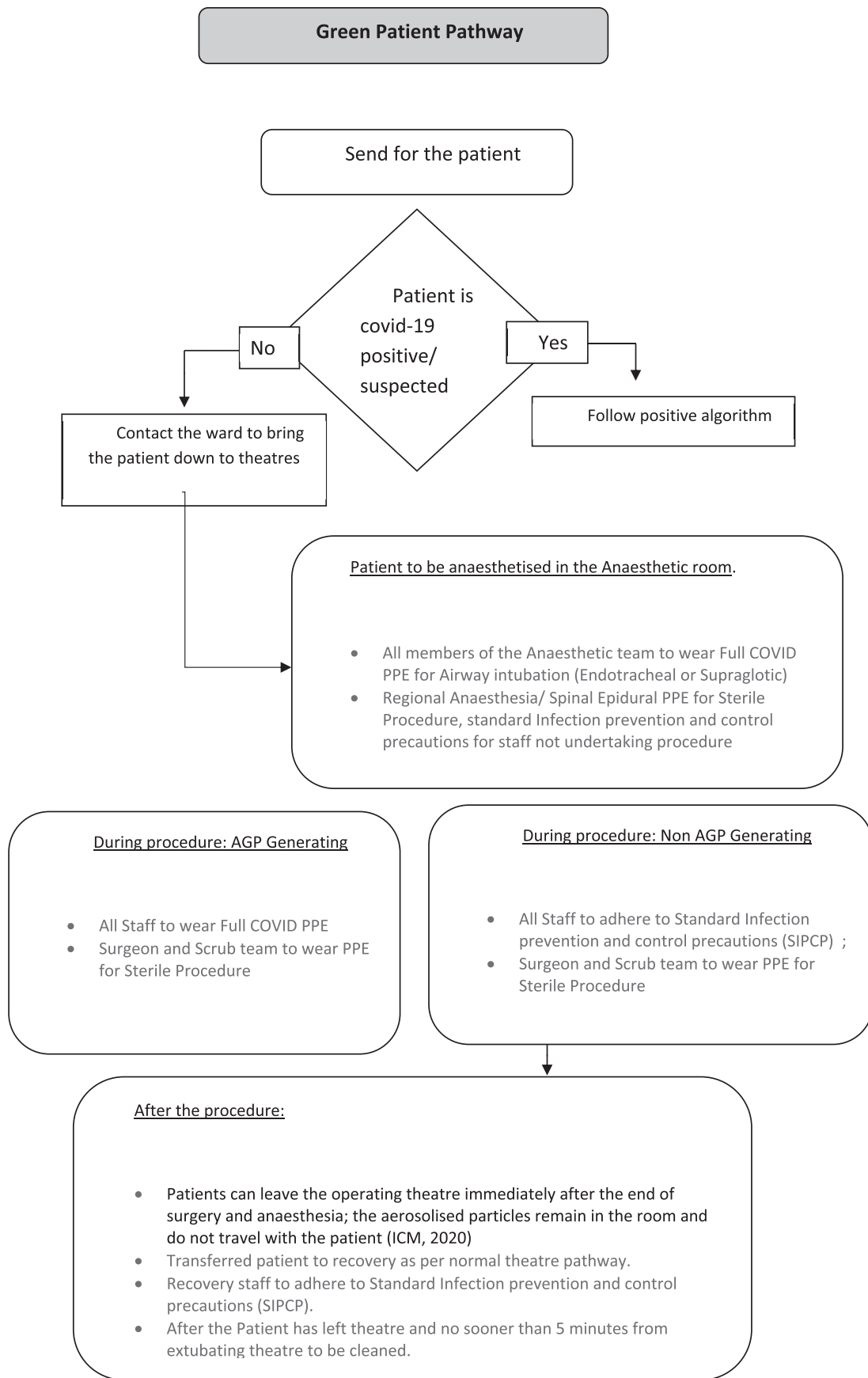


Fig. 1. Patient flow for green patient.

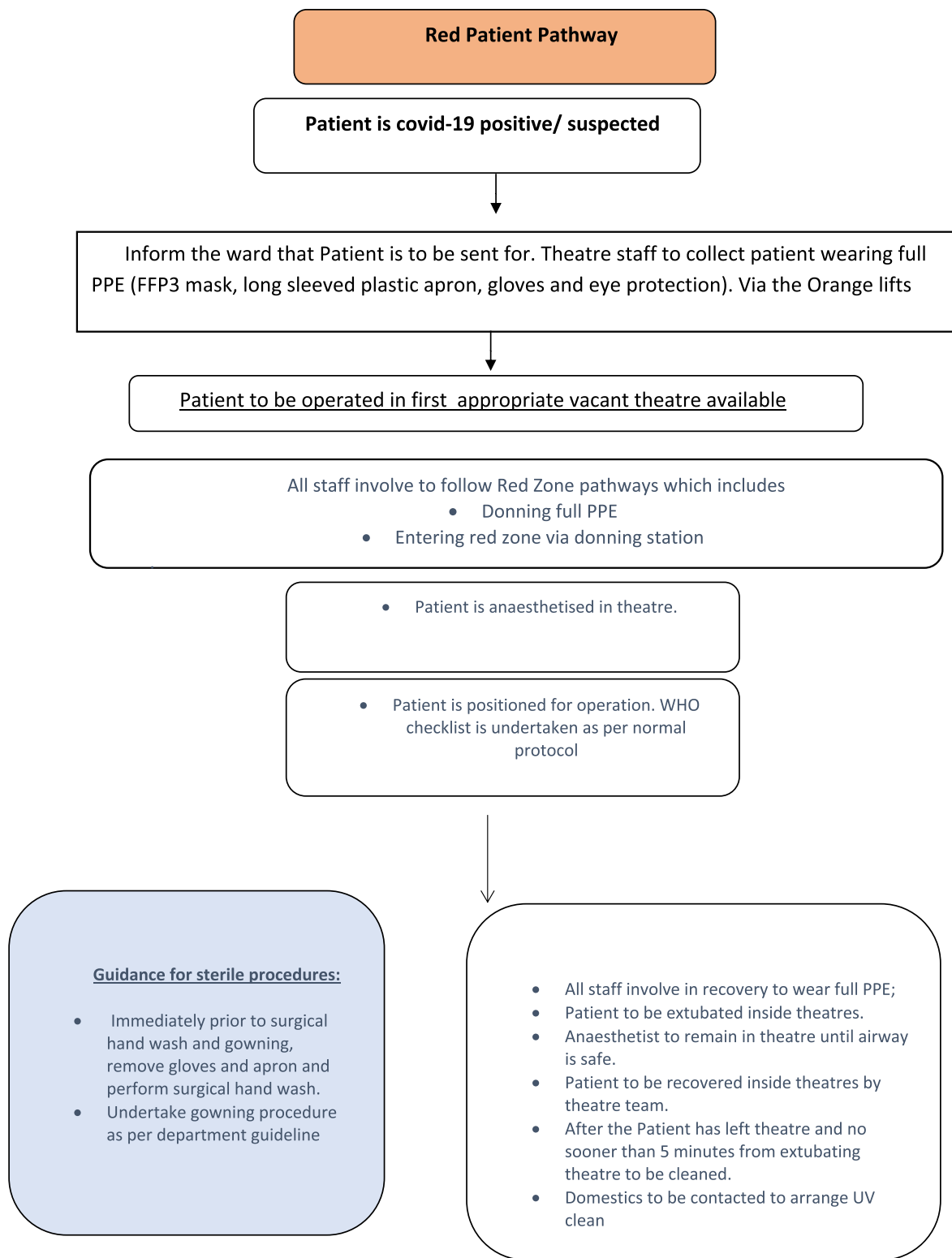


Fig. 2. Patient flow for red patient.

4. Discussion

As the second wave of COVID-19 sweeps the UK, hospitals across the country are on high alert. At time of writing this article, the north west regions of UK have high numbers of hospital admissions with COVID-19 and are placed in Tier 3 level of lockdown.⁹

During phase 1 national lockdown, Maidstone and Tunbridge Wells Trust had 285 patients tested positive for COVID-19. Transmission of SARS-COV-2 can occur through direct, indirect, or close contact, droplet, air borne, fomite, faecal-oral, bloodborne transmission.¹⁰ Orthopaedic surgery involves the use of high-speed saws, power drills, pulsed lavage, which can cause wound droplet

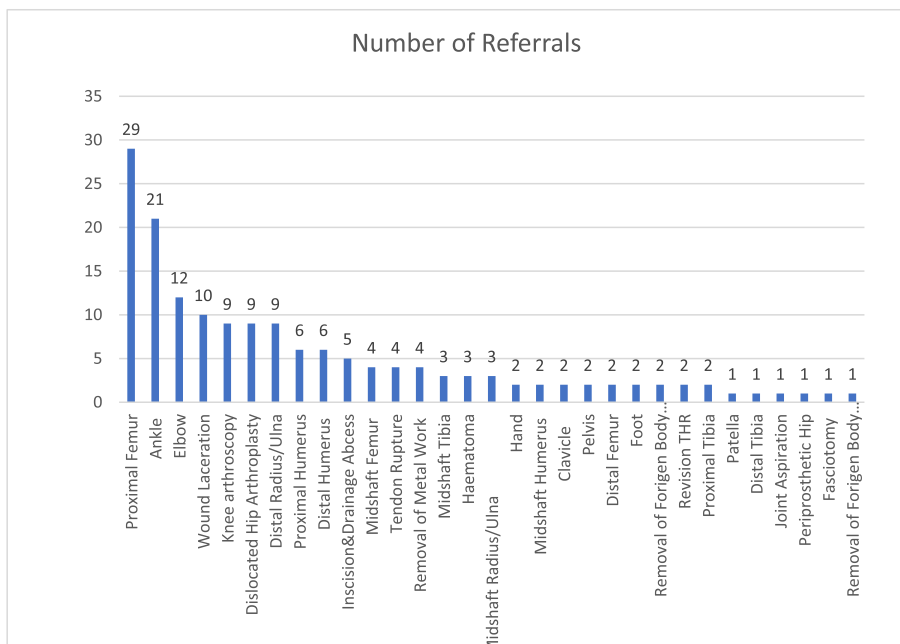


Fig. 3. Fractures treated through trauma pathway.

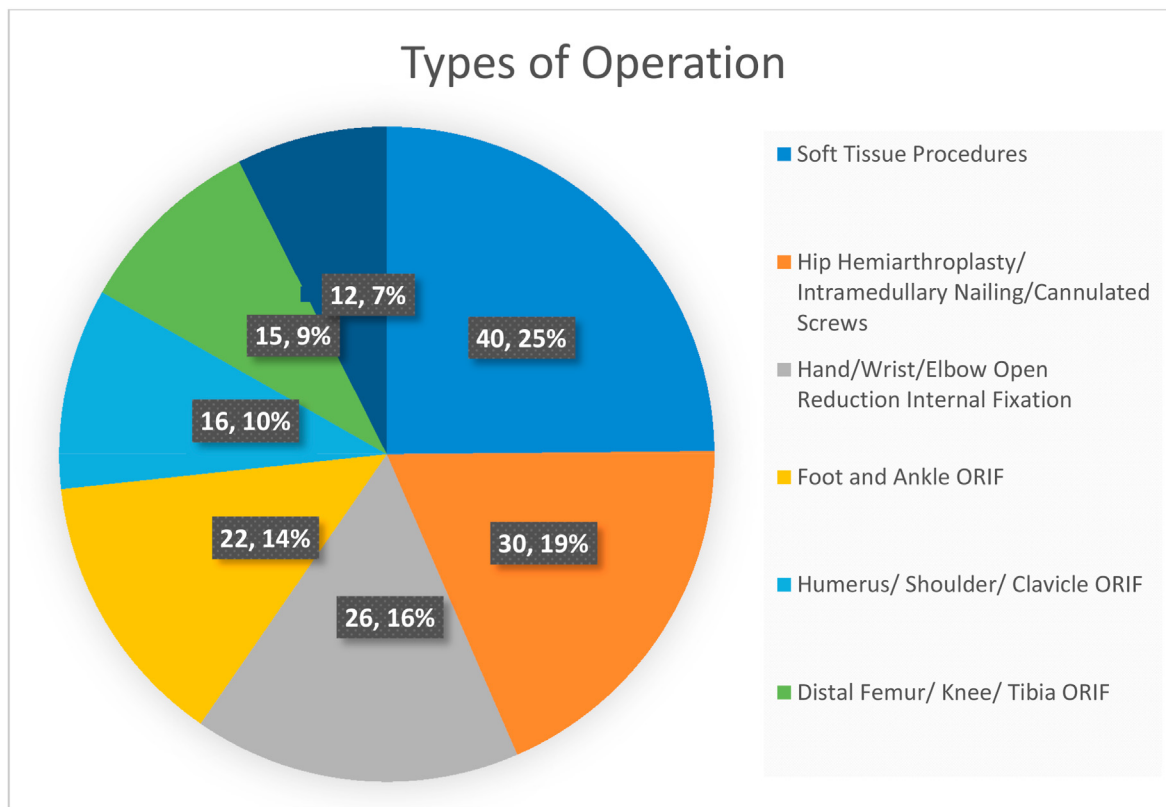


Fig. 4. Procedures performed through trauma pathway.

shedding.¹¹ Hence, aerosol generating procedures can act as increased risk of transmission to staff and patient. Transmission rates amongst orthopaedic surgeons have been ranging from 1.5% to 20.7% and this can act as close contact vector to patient population.¹²

All attempts were made to treat injuries in the outpatient department if possible, and only those not amenable to this were taken to theatre. Of the 162 patients operated, 2 were COVID-19 positive. 13 died of which, 1 died directly attributed to COVID-19 post operatively.

Table 1
Covid Swab status.

Covid Status	Number of cases
Negative	135
Positive	2
Swab not done	24

Table 2
Complications.

Covid Status	Complication	Number of Cases
Negative	Failed Metalwork	1
Positive	Deceased	1
Unknown	None reported	0

Our study had 55% lower limb related procedures, the most common indication for an operation was for a neck of femur fracture. Being a retrospective study, accurate surgical duration was not possible due to different anaesthetic, surgical, and recovery protocols in place due to pandemic. Variable staff numbers will inevitably give a skewed surgical time and longer procedure means greater exposure risk. Despite these factors of non-uniformity our study features low transmission risk.

The 120 out of 161 (75%) patients that were followed up had no symptomatic transmission of COVID-19 into their respective household post discharge.

Most (83%) of our cohort was tested preoperatively before surgery. However, 29 (17%) patients were not swabbed and were clinically screened for symptoms. They were at the start of the lockdown period and swab tests were sparse and rationed.

Concerns have been raised over COVID 19-related morbidity and mortality following general anaesthesia in previously asymptomatic patients.¹³ An early study from Wuhan, China, retrospectively analysed clinical data of 34 patients who underwent elective surgeries in the presymptomatic phase of COVID-19. 15 (44.1%) required intensive care unit (ICU) and mortality rate was 20.5%. In this cohort, 7 had Orthopaedic procedures. Authors concluded that surgery may accelerate and exacerbate disease progression of

COVID-19. Their median age was 55(IQR 43–63) and 20 of 34 patients were female. ICU admitted patients were older, had more underlying co-morbidities and longer surgical time.

This has been corroborated by one of the largest studies to date, The COVIDSurg Collaborative¹⁴ reported 30-day mortality assessing postoperative outcomes in 1128 adults with COVID-19. Severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) infection was diagnosed post operatively in 806 of 1128 patients (71.5%) patients. The mortality rate was high at 23.8% (268 of 1128 patients). Pulmonary complications occurred in 577 (51.2%) patients and their 30-day mortality was 38% (219 of 577), accounting for 82.6% (219 of 265) of all deaths. Risk factors included age 70 years or older, male sex, poor preoperative physical health, emergency surgery over elective, malignant over benign and major v minor surgery. This highlights the importance of ensuring to control the transmission of COVID-19 particularly as a place of healing and not a place of spreading the disease.

Our study cohort had a mean age of 56 (2–99). The median age operated was 62 with SD ± 27.7. K-S test to assess distribution was D = 0.11872 with a p-value of 0.01904 shows that age was not normally distributed. This is an expected outcome as general trauma list tend to lean more towards the elderly furthermore in lockdown, playground/leisure related injuries were significantly reduced due to closure of schools and leisure centres.

The standard operating protocols placed in response to this pandemic at a red site i.e. COVID-19 accepting hospital has shown no symptomatic spread of COVID-19 to patients and their households and had 1 inpatient death directly attributed to COVID-19. This is encouraging as could show a way to operate normal medical services during this pandemic without stopping altogether.

The two patients that had COVID-19; one of them deceased during admission. This particular patient was admitted for septic arthritis and underwent knee arthroscopic washout. Co-morbidities included old age, dementia, breast cancer, hypertension. The second patient had recovered and did not need ICU admission was admitted following a fall and underwent hip hemiarthroplasty.

The other deaths were due to non-COVID related causes. We cannot completely assert that the adjustments made in response to

Table 3
Causes of death.

Covid Status	Surgery Performed	Age	Cause of Death
Negative	Hip Hemiarthroplasty	84	Met. Prostatic Cancer
Negative	Dynamic Hip Screw	99	Advanced Dementia
Negative	Intramedullary Nailing Hip	85	Sepsis
Negative	Intramedullary Nailing Hip	99	Pneumonia
Negative	Distal Femur Replacement	84	Ischaemic Bowel Disease
Negative	Acetabular ORIF and THR	92	Myocardial Infarction
Positive	Knee Arthroscopic Washout	93	COVID Pneumonia
Negative	Incision & Drainage Foot Abscess	85	Unknown
Negative	Hip Hemiarthroplasty	85	Unknown
Negative	Intramedullary Nailing Femur	85	Unknown
Negative	Prophylactic Nailing Femur	84	Unknown
Negative	Hip Hemiarthroplasty	66	Unknown
Negative	Intramedullary Nailing Femur	85	Unknown

Table 4
COVID 19 symptoms in cohort and symptomatic transmission.

Initial Covid Status	Number of cases	Continuous Cough	Fever	Loss of Smell	Loss of Taste	Isolate	Symptomatic Transmission in household
Unknown	24	0	0	0	0	13	0
Negative	135	0	1	0	0	65	0
Positive	2	0	0	0	0	0	0
TOTAL	161	0	1	0	0	78	0

COVID-19 were a possible contribution to their deaths or an inevitable conclusion but comparing with previous year mortality in the same month was not dissimilar.

Two studies from different trusts have reported similar outcomes in terms of safety evaluation. A paediatric population study reviewing 100 operated children over 6-week period with a telephone interview found no COVID-19 symptoms or transmission of COVID-19 to their respective households. Similarly, a safety outcome and patient satisfaction study of elective orthopaedic services at a green (non-covid) site which reviewed 100 adults at two local private hospitals found only one patient postoperatively with positive COVID test. This had a high satisfaction rate and their group developed no COVID-19 symptoms at 2 and 6 weeks.

However, paediatric population is known to be generally asymptomatic and only symptomatic patients were tested. Study by Zahra et al., had stringent operating criteria and operated at a non-COVID site to minimise unnecessary risk.¹⁵ Our study assesses the transmission and safety of at risk group who are geriatric adults with co-morbidities requiring emergency surgery at a red site. Furthermore, these patients did not seem to transmit symptomatic COVID-19 to their respective households.

Whilst these results show that operating on high risk patients during first wave was safe with precautions taken there are still limitations that should be considered whilst interpreting our findings.

As a hospital with single bedded rooms keeping patients isolated was much easier. This is a small population sample and during the height of pandemic very high-risk patients would have been reconsidered for conservative management. The anaesthetists also had to change practice to adopt the response to minimise the risk of spread to themselves and health care staff. This study doesn't report the impact of COVID-19 transmission on healthcare staff and its outcomes. We were unable to contact 41 out of 161 families for a telephone interview at a minimum of 6 weeks post-discharge despite multiple attempts. However, our cohort is pragmatic group of orthopaedic patients and reflects a standard regular trauma list in a typical hospital.

We conclude from our experience that trauma services can be safely resumed with little to no significant adverse effect to patient or spread into community especially as concerns of second wave risk overwhelming the NHS. We advocate that rigorous testing of COVID pre-operatively will reduce chances and with development of local COVID-19 standard operating protocols will also prevent the spread of COVID to the communities. This should add evidence to current literature and provide reassurance to health care professionals, patients and families regarding morbidity and mortality.

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Declaration of competing interest

None.

References

1. NHS. *Clinical Guide for the Management of Trauma and Orthopaedic Patients during the Coronavirus Pandemic*. National Health Service; 2020. <https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/C0274-Specialty-guideOrthopaedic-trauma-v2-14-April.pdf>.
2. Khan H, Williamson M, Trompeter A. The impact of the COVID-19 pandemic on orthopaedic services and training in the UK. *Eur J Orthop Surg Traumatol*. 2021 Jan;31(1):105–109. <https://doi.org/10.1007/s00590-020-02748-6>. Epub 2020 Jul 26. PMID: 32715327; PMCID: PMC7382703.
3. British Orthopaedic Association. *Emergency BOAST: Management of Patients with Urgent Orthopaedic Conditions and Trauma during the Coronavirus Pandemic*; 2020. <https://www.boa.ac.uk/resources/covid-19-boasts-combined.html>.
4. Iliadis AD, Eastwood D, Bayliss L, et al. Providing a paediatric trauma and orthopaedics service during the peak of the COVID-19 pandemic: the Royal National Orthopaedic Hospital Experience. *Bone Joint Open*. 2020;1–6:287–292.
5. Morand A, Fabre A, Minodier P, et al. COVID-19 virus and children: what do we know? *Arch Pediatr*. 2020;27(3):117–118.
6. She J, Liu L, Liu W. COVID-19 epidemic: disease characteristics in children. *J Med Virol*. 2020;92(7):747.
7. Dong Y, Mo X, Hu Y, et al. Epidemiology of COVID-19 among children in China. *Pediatrics*. 2020;145(6), e20200702.
8. Appendix. *Standard Operating Procedure (SOP) for Theatre Pathway during Covid-19 Pandemic*. 2020.
9. BBC. Covid: greater manchester to move to tier 3 restrictions from friday [online]. Available at: <https://www.bbc.co.uk/news/uk-54622293>; 2020. Accessed October 20, 2020.
10. WHO. Transmission of SARS-CoV-2: implications for infection prevention precautions [online]. Available at: <https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions>; 2020. Accessed October 20, 2020.
11. Basso Trude, Dale Håvard, Langvatn Håkon, et al. Virus transmission during orthopedic surgery on patients with COVID-19 – a brief narrative review. *Acta Orthop*. 2020;91(5):534–537.
12. Xiaodong Guo, Jiedong Wang, Dong Hu, Lisha Wu, Li Gu, Yang Wang, Jingjing Zhao, Lian Zeng, Jianduan Zhang, Yongchao Wu. Survey of COVID-19 disease among orthopaedic surgeons in Wuhan, People's Republic of China. *J Bone Joint Surg*. May 20, 2020;102(10):847–854.
13. Lei S, Jiang F, Su W, et al. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. *Clin Med*. 2020;(21):100331.
14. COVIDSurg Collaborative. Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. *Lancet*. 2020;396:27–38.
15. Zahra W, Dixon JW, Mirtorabi N, et al. Safety evaluation of a strategy to restart elective orthopaedic surgery during the de-escalation phase of COVID-19 pandemic. *Bone Joint Open*. 2020;1–8:450–456.