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Outcomes of orthopaedic trauma patients undergoing surgery during the peak period of COVID-19 infection at a UK major trauma centre

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ARTICLE INFO

Article history:

Received 5 June 2020

Received in revised form

11 November 2020

Accepted 26 November 2020

Available online 25 December 2020

Keywords:

COVID-19

Orthopaedic trauma surgery

Outcomes

ABSTRACT

Background: To review the clinical outcomes of all patients undergoing emergency orthopaedic trauma surgery at a UK major trauma centre during the first 6 weeks of the COVID-19 related lockdown.

Methods: A retrospective review was performed of all patients who underwent emergency orthopaedic trauma surgery at a single urban major trauma centre over the first six-week period of national lockdown. Demographics, co-morbidities, injuries, injury severity scores, surgery, COVID-19 status, complications and mortalities were analysed.

Results: A total of 76 patients were included for review who underwent multiple procedures. Significant co-morbidity was present in 72%. The overall COVID-19 infection rate of the study population at any time was 22%. Sub-group analysis indicated 13% had active COVID-19 at the time of surgery. Only 4% of patients developed COVID-19 post surgery with no mortalities in this sub-group. The overall mortality rate was 4%. The overall complication rate was 14%. However mortality and complications rates were higher if the patients had active COVID-19 at surgery, if they were over 70 years and had sustained life-threatening injuries.

Conclusion: The overall survival rate for patients undergoing emergency orthopaedic trauma surgery during the COVID-19 peak was 96%. The rate of any complication was more significant in those presenting with active COVID-19 infections who had sustained potentially life threatening injuries and were over 70 years of age. Conversely those without active COVID-19 infection and who lacked significant co-morbidities experienced a lower complication and mortality rate.

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Introduction

The novel coronavirus disease of 2019 (COVID-19) caused by the SARS coronavirus 2 (SARS-CoV-2) reached the United Kingdom (UK) by early 2020.^{1–4} COVID-19 is a highly contagious virus with transmission through respiratory droplets, aerosols and fomites on surfaces.^{5,6} A consequence of densely populated urban areas is that they are susceptible to rapid viral spread if normal activities continue unchecked. Active infection carries severe morbidity and mortality risks.^{1,2,7} Already over 300,000 deaths have occurred globally with the

UK suffering the second highest recorded number of deaths at over 35,000.⁷

The infection can present with a variety of clinical manifestations. Patients can be asymptomatic, experience a mild illness or less commonly develop a severe infection that can lead to a cytokine storm, acute respiratory distress syndrome, multi-organ failure and death.^{1,2,8} The risk factors for severe infection and mortality: include older age, male sex, presence of co-morbidities including cardiorespiratory disease, diabetes, hypertension and ethnicity (African or Asian descent)^{9–11}.

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<https://doi.org/10.1016/j.surge.2020.11.009>

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Whilst most non-essential clinical services were placed on hold following the UK lockdown time critical emergency work was required to continue. Orthopaedic trauma is one of the designated National Health Service (NHS) services that continued to provide active surgical care during this period.¹² Providing safe and effective trauma care is essential at any time. Major trauma is the greatest cause of mortality in people under 40 while fractures to the proximal femur (such as neck of femur fractures) are the second-ranking cause of 30-day mortality following emergency hospital admissions.^{13,14} Patients admitted to acute hospitals carry the risk of developing hospital-acquired infection. Unfortunately patients with acute fractures are particularly susceptible to pulmonary infection, especially those with lower limb fractures, significant pre-existing co-morbidities and impaired ambulatory abilities.¹⁵ There are now reports of hospital acquired COVID-19 infections.¹⁶

This cocktail of factors poses a safety conundrum for orthopaedic surgeons when advocating the best way forward. Existing literature regarding outcomes of orthopaedic trauma patients during the COVID-19 pandemic is sparse.^{17–19} However the accepted benefits of centralisation of major trauma patients remain clear.^{13,20} As COVID-19 testing in the UK has not been universal for acute hospital admissions in asymptomatic patients, the result is that some COVID-19 positive patients remain unknown whilst in hospital.^{21,22} This situation is compounded by the accuracy of the testing itself with a known false negative rate of over 20%.^{22,23} National bodies and societies have tried to help mitigate some of the risks posed to patients and clinicians because of this through the provision of guidelines in treatment for orthopaedic trauma patients during the COVID-19 period.^{24,25} These guidelines were based on borrowed principles and the best extrapolation of available knowledge. The limited literature that exists regarding operating on patients during the COVID-19 has initially come from countries further along the infection wave.^{17–19} Published studies had presented an alarmingly high risk of mortality and intensive care admission of 21% and 44% respectively for patients undergoing elective surgery during this period.¹⁷

The aim of the study was to assess the clinical outcomes of all patients undergoing emergency orthopaedic surgery at a UK major trauma centre (MTC) during the first 6 weeks of lockdown. The secondary aim was to review if post-surgery COVID-19 infection rates and related complications were in keeping with other international experiences.

Methods

A retrospective cohort review was performed of all patients who underwent emergency orthopaedic trauma surgery at a single central London major trauma centre over the first six-week period (from 23rd March) following the UK lockdown. All patients had a history of general exposure within the South-East of London or surrounding counties. A database was constructed to record the population demographics, mechanisms of injury, co-morbidities, ASA classification, orthopaedic injuries, associated injuries, orthopaedic procedures, injury severity score (ISS), COVID-19 status and any related complications encountered. This was completed

through analysis of existing clinical records, radiological and laboratory examination results and supplemented as required during standard telephone follow-up consultations. COVID-19 laboratory testing and confirmatory reporting was through standard UK NHS processes with quantitative RT-PCR on samples from the respiratory tract.

A further standard assessment of the patients post surgery COVID-19 status was completed at a minimum of 2 weeks following surgery. The 2 week minimum time period was chosen as this is in keeping with the viral incubation period stated by the UK government.²⁶ If the patients expressed concern over a development of a post-surgery COVID-19 infection additional history was taken. This included the speed of onset of symptoms, the character of symptoms, the method of diagnosis and testing and subsequent management. All patients were reviewed for any medical or surgical complication that they may have developed independent of their COVID-19 at any time point. Statistical t-testing was performed with a 95% confidence interval to calculate differences in rate of complication or mortality between subgroups (Microsoft Excel). A p value less than 0.05 was considered statistically significant. Relative risk was calculated by using the COVID-19 positive/exposed group as the test group and COVID-19 negative group as the control group for each patient sub-group (medcalc.org).

Results

As expected and in keeping with local peers the unit experienced a decrease in total activity during the initial phase of lockdown. In the same six-week period in 2019 a total of 219 cases were performed. The decrease in activity was in keeping with other changes in workloads experienced across the UK and in other major international orthopaedic trauma hubs.^{27,28} However a significant patient volume and complexity of injury was still received and operated on [Tables 1–5]. This included notable volumes of high energy injuries with subsequent open fractures and polytrauma diagnoses with correspondingly high ISS. A total of 76 patients underwent surgery. In total these patients underwent 80 anaesthetics. For the polytrauma patients multiple procedures were delivered at each anaesthetic as required. Injuries sustained during exercise and home improvement tasks accounted for approximately a quarter of all mechanisms. Almost a third of all cases undertaken were for patients presenting with open fractures. The number of patients presenting with fragility type fractures was notable and were in the main sustained by elderly patients falling at home. A significant mental health history was present in almost a third of all patients in the population. The rates of significant co-morbidity was 72% across the population, but as expected was more significant in those over 70 years old.

COVID-19 infection rates

The proportion of patients in the study population that had a COVID-19 infection at any time point was 22% (average age 72 years, age range 44–89 years) [Table 6]. This was significantly greater as compared to the reported national community

Table 1 – Demographics of population.

	n=	%
Age (range, average)	7–95 years, 57 years	
Male: Female	44: 32	58%:42%
ASA		
1	21	28%
2	24	32%
3	31	41%
Any comorbidity	55	72%
Injury Severity Score	Average: 8.8, Range: 1–59	Lethal Dose 50 (LD ₅₀) 7% (n = 5)
COPD	8	10%
Hypertension	24	30%
Malignancy	7	9%
Diabetes	12	15%
cardiovascular disease	8	10%
Cerebrovascular disease	18	23%
Renal disease	10	13%
Mental health disease	26	33%
Ethnicity		
White/white other	52	68%
Indian/Asian/Other Asian ethnic group	13	17%
African/Caribbean/Black	6	8%
Mixed	1	1%
Not known	4	5%

incidence of COVID-19 infection at this time of 0.27%.⁴ This likely reflects the study being undertaken during the peak of COVID-19 infection in a central London teaching hospital that was a designated escalation zone for acutely unwell COVID-19 patients. Follow-up of the cohort revealed the rate of developing post-surgery COVID-19 infection was 4%. Of these all had surgeries for injuries that have accepted morbidity risks (polytrauma n = 1, hip fracture n = 2, open ankle fracture n = 2, patellar fracture n = 1). In addition, all patients had pre-existing co-morbidities (classified as ASA2 n = 1, ASA 3 n = 2) and had an average age of 66 years.

Mortality rates

The overall mortality for all patients within the population was 4% (n = 3/76) [Table 7]. All three of these were expected deaths. Two of these cases related to elderly patients who had

sustained neck of femur fractures and had significant pre-existing co-morbidities and active but stable COVID-19 respiratory infections at the time of surgery.

The first patient was a 85 year female who had sustained polytrauma injuries following a fall at home with hip and shoulder fractures with a medical history including active COVID-19, heart failure, Alzheimer's dementia, recent admission for community acquired pneumonia, chronic kidney disease stage 3, hypothyroidism, cerebral infarct, hypertension, infective endocarditis and B12 deficiency. The second was a 82 year old male who had sustained polytrauma injuries following a fall at home with a hip fracture and acute head injury with a medical history including active COVID-19, COPD, Parkinson's disease, Alzheimer's disease and hypertension. The third mortality related to a patient with a high energy injury who sustained a cerebral injury that could not be salvaged.

Sub-group analysis indicated the mortality rate to be 12% (n = 2/17) for patients that had experienced a COVID-19 infection at any time point assessed. The mortality rate of patients that had never experienced a COVID-19 infection at any time point was 2% (n = 1/59). The mortality rate was more significant (p < 0.05) for those patients over 70 years, with a hip fracture and an active concomitant COVID-19 infection 22%

Table 2 – Mechanism of injury.

Mechanism of injury	n=	%
Fall at home	27	36%
Collapse ? cause	(6/27)	
Seizure	(1/27)	
Fall in hospital	2	3%
Fall shopping	1	1%
Fall from height	4	5%
Road traffic accident	9	12%
Deliberate self harm	4	5%
Home improvement accident	7	
Gardening & guttering	(3/7)	9%
Exercise	11	14%
Assault	2	3%
Removal of metalwork	2	3%
Infection	6	8%
Neurological impairment	1	1%

Table 3 – Type of trauma presentation.

Injury	n=	%
Isolated injury	65	86%
Polytrauma	11	14%
Which additional system		
Head	9	80%
Spine	5	45%
Chest	7	63%
Abdominal	2	18%
Additional ortho injuries	5	6%

Table 4 – A. Orthopaedic injuries by location and type. B. Subgroup of open orthopaedic injuries.

Orthopaedic injury		n=
Shoulder	Shoulder fracture dislocation	1
	Clavicle fracture & ACJ dislocation	1
	Coracoid fracture	1
	Dislocated shoulder	1
Elbow	Olecranon fracture	1
	Supracondylar fracture	2
Hand & wrist	Wrist fracture	3
	Wrist septic arthritis	1
	Finger fracture	4
	Degloving arm injury	1
	Laceration	2
Pelvis/Hip/femur	Pelvic/Acetabulum fracture	5
	Femur shaft fracture	5
	Hip Fracture - neck of femur	20
	Peri-prosthetic hip fracture	1
Knee	Patellar tendon rupture	1
	Patellar fracture	1
	Quadriceps tendon	1
	Traumatic below knee amputations	2
	Distal femur fracture	1
	Acute bucket handle meniscal tear	1
Tibia/Foot & Ankle	Tibia fracture	7
	Pilon fracture	4
	Ankle fracture	8
	Foot fracture	5
	Diabetic foot infection	4
		n=
Closed versus open fractures	Closed n = 51 Open n = 25	Closed 67% Open 33%
Open Injuries		
Grade 1	5	20%
Grade 2	8	32%
Grade 3A	4	16%
Grade 3B	5	20%
Grade 3C	3	12%
Location		
Clavicle	1	4%
Olecranon	1	4%
Forearm	2	8%
Hand	2	8%
Femur	2	8%
Fibia	7	28%
Pilon	4	16%
Foot	6	24%

(n = 2/9) as compared those under 70 without COVID-19. A similar picture was noted for complication rate on comparison of these 2 groups [Tables 7 and 8].

Other complication rates

The overall rate of complication (including death) for all patients in the study at any time point was 14% (11/76) [Tables 7 and 8]. If patients who had a COVID-19 infection at any time were excluded the complication rate decreased to 8% (n = 5/59). Conversely the complication risk for patients who had a COVID-19 infection at any time was significantly higher $p < 0.05$ (n = 6/17, 35%). If COVID-19 was active at the time of surgery the rate of complication rose again to 50% (n = 5/10). A total of 3 patients (4%) who were not COVID-19 symptomatic pre surgery went onto be diagnosed with a COVID-19 infection

post surgery. Only one of these had a complication which was a pulmonary embolus that was successfully managed. This patient had been admitted with a hip fracture and had a known venous thromboembolic history that normally necessitated formal anti-coagulation. The complication rate at any time point was zero if patients over 70 with hip fractures or open polytrauma injuries were excluded. None of the involved clinicians developed COVID-19 secondary to contact with patients as is best known, however clinicians were not tested if asymptomatic.

Discussion

This is the first UK study to have tracked the short-term outcomes and complications of solely orthopaedic trauma

Table 5 – Orthopaedic procedures performed.

Area of Surgery	Surgery performed	n=
Shoulder	Shoulder fracture orif	1
	Lateral end clavicle fracture open reduction & internal fixation	1
	Dislocated shoulder MUA	1
Elbow	Olecranon fracture open reduction & internal fixation	1
	Supracondylar fracture open reduction & internal fixation	2
Forearm, Wrist & Hand	Wrist fracture open reduction & internal fixation	3
	Forearm shaft fracture open reduction & internal fixation	2
	Wrist washout	1
	Guyons canal & carpal tunnel release	1
	Finger fracture fixation	4
	Free flap arm & wrist fusion& median nerve repair & flexor tendon repair	1
Pelvis, Hip & Femur	Pelvic/Acetabulum fracture open reduction & internal fixation	4
	Femur shaft intramedullary nailing	3
	Femur fracture external fixator	2
	Hip Fracture - neck of femur Hemiarthroplasty	12
	Hip Fracture - neck of femur Total Hip Replacement	2
	Hip Fracture - neck of femur Dynamic Hip Screw	1
	Hip Fracture - neck of femur intramedullary nailing	5
Peri-prosthetic Hip fracture revision arthroplasty	1	
Knee	Patellar tendon repair	1
	Patellar fracture tension band wiring	1
	Quadriceps tendon repair	1
	Traumatic below knee amputations	2
	Distal femur orif & intramedullary nailing	1
Tibia, Foot & Ankle	Arthroscopic bucket handle meniscal tear	1
	Tibia shaft fracture intramedullary nailing	5
	Tibia fracture taylor spatial frame	2
	Hindfoot intramedullary nailing	2
	Diabetic foot surgery	4
	Ankle fracture open reduction & internal fixation	8
	Tibia intramedullary nailing revision to taylor spatial frame	1
Others	Wound washout, debridement, fracture external fixation & vac pump placement	6
	Abscess drainage	1
	Laceration washout and closure	2
	Removal of metalwork	4
	Removal of foreign body	1

patients following emergency surgery during the COVID-19 pandemic. Trauma patients always face significant risks following injury and surgery. These risks would logically seem heightened secondary to the current risks of COVID-19 infection. This study reports an overall survival rate of 96% at a minimum of 2 weeks following emergency orthopaedic trauma surgery at the height of the UK COVID-19 infection period. This study population includes high acuity patients with complex multi-system injuries, significant comorbidities and other potential risk factors including mental health and ethnicity.

Orthopaedic surgeons have a long tradition in using outcome collection during times of crisis to fuel an evidence-based approach in innovating how services are delivered and can be best standardised to optimise patient outcomes.²⁹ Other agendas such as value based healthcare and the 'get it right first time' program also support this mantra.^{30–33} Harm is a potential outcome of any intervention, independent of its timing.³⁴ How significant these risks are and how far this has changed from baseline for patients undergoing surgery in this current crisis is of paramount concern to all orthopaedic surgeons.

There has been a general reduction in the activity of orthopaedic trauma services during the pandemic.^{27,28} Additionally there is limited global published work regarding the risks and complications reported following orthopaedic trauma surgical procedures during this pandemic. One such study reviewed the outcomes of elective surgery during the COVID-19 period in asymptomatic patients.¹⁷ This study was undertaken in China and reported that all 34 patients in its population developed COVID-19 pneumonia post-surgery and 7 (21%) of the patients subsequently died. The results of our study are markedly different and do not echo these findings. Another separate limited review of 10 orthopaedic trauma patients at different centres in China also reported high rates of mortality and post surgery nosocomial COVID-19 infection of 40% and 70% respectively.¹⁸ In contrast the patients in our study whilst carrying an elevated risk profile in comparison had significantly lower risks of mortality and development of COVID-19 infection post surgery of 4% and 4% respectively. This may reflect a geographical phenomena alternatively it may represent how different healthcare approaches may change outcomes.³⁰ The approach in our centre is a team based one that requires consistent consultant led

Table 6 – COVID status of patients.

	n=	%
COVID-19 at any time	17	22%
COVID-19 at any time prior to surgery	11	14%
COVID-19 active at time of surgery	10	13%
COVID-19 developed post-surgery	3	4%
Symptoms of patients who had COVID-19 at any time prior to surgery or were actively positive at surgery:		
Cough	7	50%
Shortness of breath	7	50%
Fever	6	43%
Delirium	2	14%
Cardiac related	2	14%
None	2	14%
Symptoms of patients who COVID-19 developed post-op:		
Cough	2	67%
Shortness of breath	2	67%
Fever	1	33%
Average days to onset of symptoms	Average 8 days	
How was it diagnosed (formal v self)	Formal: 2 Self: 1	
Did the patient require readmission	0	0%
Patients requiring respiratory support (non-invasive or invasive)	1	33%
Patients admitted to intensive care for post-surgery COVID-19 infection	0	0%

multidisciplinary review and support in conjunction with expert emergency clinicians, intensivists and anaesthetic care. COVID-19 has no impact on ISS scores. However the expectation would be that mortality rates would be accentuated in those with high ISS scores and COVID-19 infection. The survival rate from this study population independent of COVID-19 infection was better than expected when assessed from the prism of ISS. The percentage of those with a lethal dose 50 (LD₅₀) ISS score was greater than the observed mortality rate [Tables 1 and 7].

Patients presenting with open fractures or other such high acuity trauma injuries require time-critical emergency surgery to stabilise their physiology, manage their injuries and to promote early recovery, mobilisation and optimal rehabilitation. A reasonable expectation is that trauma patients

undergoing surgery would be susceptible to both becoming infected with COVID-19 and potentially suffer its related complications. An early study from Wuhan, China, revealed that many patients requiring hospitalization had elevated pro- and anti-inflammatory cytokines including IL-1, IL-6, IL-10 and TNF-alpha. Some were also found to have raised D-dimer levels indicating a hypercoagulable state.⁹ These findings have implications for surgical patients, especially those with polytrauma injuries. It is established that trauma stimulates an inflammatory response and early serum IL-6 levels can a predictor of the development of a systemic inflammatory response syndrome to trauma.³⁵ Damage control orthopaedics has been a principle of management in those with severe injuries, high injury severity scores and whose physiological status precludes definitive management of their injuries.³⁶ With this in mind it is interesting that the patients in our study fared as well as they did. However the results from our study do echo other studies in that patients who have significant pre-existing co-morbidities and active COVID-19 respiratory infections face an elevated risk of mortality and COVID-19 related complications.^{17–19}

When considering the implications to orthopaedic trauma patients the sub-group of those sustaining fragility type hip fractures are of prime concern. Hip fractures are a common injury impacting almost 70,000 patients a year in the UK and normally have a 30 day mortality risk of approximately 7% and a one year mortality of 30%.^{37,38} Hip fracture surgery is potentially life-saving and is advised to be considered even in the palliative setting.³⁹ A risk of shielding the elderly at home is to potentially increase the number of falls at home. This mechanism of injury accounted for a third of all presenting mechanisms in this study. We would advocate counselling patients and relatives regarding the elevated risks for complication and mortality in patients with hip fracture and active COVID-19 infections. This is in keeping with other local international experiences.¹⁹

Avoiding exposing a patient to the risk of surgery and offering non-interventional management is always an option. Sensible selection of patients for trauma surgery and the pragmatic use of conservative treatment was recommended by the British Orthopaedic Association and Royal College of

Table 7 – Table of all complications.

Complications	n=	%	Additional notes
Total morbidity	8	11%	
In-hospital fall	1	13%	
Pulmonary embolus	1	13%	
Peri-arrest	1	13%	
Cardiac arrhythmia (AF)	1	13%	
Pericarditis	1	13%	
Hospital acquired pneumonia (non-COVID)	2	25%	
Heparin Induced Thrombocytopenia	1	13%	
Patients that had any complications & had developed COVID-19 prior to their surgery or had active COVID-19 at surgery	5	50%	All hip fracture patients Average age 81 years
Patients that had any complications & had developed COVID-19 post their surgery	1	33%	Hip fracture patient aged 80 years
Patients that had any complications & had COVID-19 at any time point	6	35%	
Patients that had any complications & never had COVID-19 at any time point	5	8%	
Mortality	3	4%	2 COVID-19 positive patients

Table 8 – Comparison of risk of different patient sub-groups against COVID-19 status. Complication being defined as any complication occurring including death.

	<70 years old + Co-morbidities	>70 years old + Co-morbidities + No Hip fracture	>70 years old + Co-morbidities + Hip fracture
COVID-19 positive			
Total	5	3	9
Number of complications	0	0	6
Rate of complications	0%	0%	67%
COVID-19 negative			
Total	23	7	10
Number of complications	1	1	3
Rate of complications	4%	14%	30%
Relative risk	1.33 (95% CI 0.06 to 28.8)	0.67 (95% CI 0.034 to 12.96)	2.22 (95% CI 0.77 to 6.37)
	P = 0.8544	P = 0.79	P = 0.14
	Z is 0.183	Z is 0.268	Z is 1.486

Surgeons (England) at the beginning of the pandemic.^{12,24,25} The clinicians involved in this study have used this advice and found it beneficial. During the period assessed the total volume of trauma work undertaken in the unit was notably reduced as compared to pre-COVID-19 times. In the same 6-week period in the year preceding a total of 219 cases were performed, as compared to 80 cases in this study. This was in keeping with other changes in activity experienced elsewhere across the UK and in other European trauma hubs.^{27,28}

Currently UK guidelines are based on the application of reasoned experience in addition to the limited existing literature. The results from this study indicate a low risk of complication and mortality in those without significant co-morbidity, age or life-threatening injuries. This study can also provide surgeons with some objective evidence when managing patients with isolated closed injuries regarding their treatment options. The inclusion of surgical management is something that can be judiciously considered now on a case-by-case basis, especially for time-critical injuries. The reported complication rate in this study was low regarding such patients. Conversely operating on high risk patients with active COVID-19 infections and significant co-morbidities for non-emergency indications remains something to be avoided if possible and needs careful consideration and patient counselling if it is to happen. These points may influence evidence based decision making regarding the return of elective surgery as there would potentially be significant comparators at either end of the patient and procedure risk spectrums.⁴⁰

This study has multiple flaws that need appreciation when evaluating its relevance to general practice. The advice for patients and surgeons, particularly on personal protective equipment (PPE), changed during the period of assessment.⁴¹ This lack of fixed PPE practice meant potentially not all patients faced the same exposure risks, especially as evidence indicates that clinicians can be vectors for infection.⁴¹ Also not all the patients in the study had COVID-19 testing performed. This was in keeping with government guidance at the time.⁴² It is known that approximately 5–80% of COVID-19 positive patients may be asymptomatic.^{21–23} This issue is compounded by the fact the actual COVID-19 test is reported to have a false negative rate of up to 30%.^{22,23} This combination of scenarios means that the true number of COVID-19 positive patients in this study may well have been higher

than is reported. However the number of complications and mortalities would not change as these are absolutes. Indeed if the number of COVID-19 positive patients was greater it would in turn mean the rates of mortality and complication would be lower than reported. The numbers of patients and procedures are limited to a 6 week period of review which was only at the peak of the UK COVID-19 pandemic experience. This may skew the results negatively. The number of patients with active COVID-19 operated on was small and limited to orthopaedic surgery only. These operations were only conducted in potential life-threatening situations. To that end the patients faced significant risks of complication and mortality independent of the surgery. To understand the complete impact of operating on COVID-19 positive patients more comprehensively a larger study population would be required as well as a greater spectrum of surgical disciplines and variation in risk profile of surgical interventions performed.⁴³ The surgeon and anaesthetist were not constants, however this was a consultant delivered service in a centre with extensive experience in regularly managing high acuity patients. This is a positive consequence of the MTC network and may not be replicable in all sites. Not all patients were formally admitted as in-patients, potentially meaning not all patients faced the same in-hospital COVID-19 infections risks. Ambulatory trauma patients such as upper limb fractures were conducted as much as possible in a day surgery setting. This is the units standard practice independent of COVID-19 which has reported previous favourable outcomes.³¹ Statistical analysis would have benefitted from matched groups regarding morbidities and size. This study does represent a pragmatic coal face experience regarding the provision of acute orthopaedic trauma surgical services and its subsequent short term outcomes.

In conclusion this study demonstrates a relatively low rate of complication and mortality in the population of patients undergoing emergency orthopaedic surgery during the COVID-19 peak. Overall survival rates were excellent, however rates of complication and mortality were more significant in those presenting with active COVID-19 infections who had sustained potentially life threatening injuries and were over 70. Conversely those without active COVID-19 infection and who lacked significant co-morbidities experienced a low complication and mortality rate. These results suggest

surgery may be safely undertaken at this current time in selected groups. Patients who have higher risks need appropriate advice regarding their elevated risks. More comprehensive testing and follow-up is required to confirm these findings across other sites and enable better surgical decision making.

Declaration of competing interest

None.

Acknowledgements

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