RESEARCH ARTICLE

Impact of the National Lockdown Due to the COVID-19 Pandemic On Upper Limb Trauma Workload in Central London: A Multi-Centre Longitudinal Observational Study During Implementation and Ease of National Lockdown

Catrin Morgan, BSc (Hons), MBBS, MRCS[1], Kapil Sugand, PGC HBE, BSC, MBBS, MRCS, MCCT, FRSA[2], Thomas Ashdown, BSc (Hons), MBBS, MRCS[2], Nikita Nathoo, MBBS[3], Robert MacFarlane, MBChB MRes PhD (Chem Eng) FRCS (Tr & Orth) [1], Rory Dyke, BSc (Hons), MBBS, MRCS [2], Chang Park, BSc (Hons), MBBS, MRCS [2], Arash Aframian, MBBS BSc(Hons) MRCS [1], Peter Domos, MD, MRCS, FRCS(Tr&Orth)[3], Maxim D. Horwitz, MBChB FRCS (Orth) Diploma Hand Surgery (BSSH)[1], Khaled M. Sarraf, BSc(Hons) MBBS FRCS (Tr&Orth)[2], Rupen Dattani, BSc(Hons), MBChB, MRCS, MD, FRCS(Tr&Orth)[1]

Research performed at Chelsea and Westminster Hospital (Chelsea and Westminster NHS Foundation Trust), St Mary's Hospital (Imperial College Healthcare NHS Trust), and Barnet Hospital (Royal Free London NHS Foundation Trust), London, England on behalf of the COVERT Collaborative

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Abstract

Background: This study assessed the impact of the COVID-19 pandemic on acute upper limb referrals and operative case-mix at the beginning and ease of British lockdown.

Methods: A longitudinal multicentre observational cohort study was conducted for both upper limb trauma referrals and operative case-mix over a 12-week period (6 weeks from the beginning and 6 weeks from the ease of the national lockdown). Statistical analysis included median (± median absolute deviation), risk and odds ratios, and Fisher's exact test to calculate the statistical significance, set at $p \leq 0.05$.

Results: There was a 158% (n = 456 vs. 177) increase in upper limb referrals and 133% (n = 91 vs. 39) increase in the operative trauma caseload at the ease of lockdown compared with its commencement. An increase in sporting injuries was demonstrated (p=0.02), specifically cycling (p=0.004, OR=2.58). A significant increase in COVID-19 testing was demonstrated during the ease of lockdown (p=0.0001) with more patients having their management changed during the beginning of the pandemic (9.6% vs. 0.7%, p=0.0001). Of these patients, 47% went on to have delayed surgery within 6 months. No patients who underwent surgery tested positive for COVID-19 infection within 14 days post-operatively and no mortalities were recorded at 30 days.

Conclusion: The ease of lockdown has seen upper limb referrals and operations more than double compared to early lockdown. With no patients testing positive for COVID-19 within 14 days of the procedure, this demonstrates that having upper limb surgery during the current pandemic is safe.

Level of evidence: III

Keywords: Trauma, Coronavirus, COVID-19, Upper Limb, Lockdown

Introduction

The novel coronavirus SARS-COV-2 (COVID-19) was initially reported in patients in Wuhan, China in December 2019 (1). On March 11th, 2020 it was declared a pandemic and global health emergency by the World Health Organisation (2). As of January 22nd 2021, there were over 98 million cases worldwide and over 2.1 million mortalities (3).

British response to the pandemic

On the 17th of March 2020 in response to the COVID-19 pandemic the English government implemented social

Corresponding Author: Catrin Morgan,

Chelsea and Westminster Hospital, London, England, United Kingdom, SW10 9NH, UK

Email: catrin.morgan@nhs.net

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distancing measures which were followed on March 20th by the closure of all non-essential businesses including gyms, pubs and restaurants. Due to the rising number of cases, on the 23rd March 2020, the government imposed a nationwide 'lockdown' advising all members of the public to stay at home unless for essential purposes (4). The peak of the in-hospital COVID-19 deaths during the first wave in London was thought to be April 8th 2020 (5). On the 19th June, the UK's COVID-19 alert level was lowered from Level 4 (severe risk, high transmission) to Level 3 (substantial risk, general circulation) (6). The most significant ease of the lockdown was seen on July 4th, described as 'Super Saturday' which saw the reopening of restaurants, pubs and many other businesses including outdoor gyms. England then moved to a more targeted lockdown based on local outbreaks. At the time of writing, due to the identification of a new variant of COVID-19 that is rapidly spreading across England, a second national lockdown was imposed on January 4th 2021 (7).

Upper Limb Trauma and the COVID-19 pandemic

In the field of trauma and orthopaedics, the COVID-19 pandemic led to an immediate restructuring of services, redeployment of doctors and cancellation of elective operating (8). On the 24th March, the British Orthopaedic Association (BOA) published guidelines for the management of patients with urgent orthopaedic conditions during the COVID-19 pandemic (9). This guideline advised the non-operative management of upper limb fractures due to the high rates of union and recognised that some patients may require late reconstruction.

Upper limb fractures are the most common group of fractures making up to 51% of all fractures (10). The current literature looking specifically at upper limb emergencies during the COVID-19 pandemic is limited, with a number of publications focusing predominantly on hand trauma (11-13). One study demonstrated a two-third decrease in the rate of upper limb emergencies compared to 2019 with a reduction in road, work and leisure accidents compared to an increase in domestic accidents (14).

Primary objectives consisted of the following:

1. Evaluate the impact of the COVID-19 pandemic in one of the largest central London multicentre orthopaedic hospital services, evaluating the trends in acute upper limb trauma referral caseload and operative caseload within 6-week intervals at the beginning of the COVID-19 lockdown (mid-March to the end of April) and as the lockdown was eased (start of July – mid August).
2. Evaluate if the COVID-19 pandemic changed the management of upper limb injuries
3. To assess how many patients that underwent upper limb surgery during the study period went on to develop clinical symptoms of COVID-19 within 14 days of surgery.

Alternative hypothesis

The alternative hypothesis is that there will be a difference in the prevalence of acute orthopaedic referrals and orthopaedic trauma case mix at the beginning of the lockdown compared to when the lockdown was eased. As an unintended consequence, of not being able to leave the household at the beginning of lockdown, it is hypothesised that people may be at less risk of accidents during this time. It is also hypothesised that those patients who required an operation during the COVID-19 pandemic may have gone on to develop symptoms of COVID-19 in the immediate post-operative period due to becoming exposed to a high-risk hospital environment. Significant differences in grade of primary surgeons, post-operative complications and mortality rates are also expected between the peak and trough of the COVID-19 pandemic.

Materials and Methods

Patient Sampling

All acute referrals, operative notes, inpatient medical records and outpatient clinic letters were accessed using the electronic medical system within the hospital as well as from the eTrauma online system (Open Medial Ltd, London, UK), allowing for consistency in data collection. The real-time online database is accessed by those in the trauma and orthopaedic department and records all acute referrals and operations, both retrospectively and prospectively.

Hospital sites

St Mary's Hospital is a major trauma centre and the equivalent to a level 1 trauma unit managing both complex and polytrauma. Chelsea and Westminster Hospital and Barnet Hospital, hospitals are large district general hospitals, equivalent to level 2 trauma units. All three hospitals have dedicated upper limb subspecialty units which are led by upper limb consultant/attending surgeons.

Study period

The first six-week study period (Group 1) was from the start of the government-imposed social distancing on the morning of March 17th 2020 (which includes the nationwide lockdown from March 24th) to April 28th 2020. This was compared to a second six-week study (Group 2) period from July 4th 2020 to August 15th 2020 (i.e ease of lockdown from the dubbed 'Super Saturday').

Inclusion criteria

All acute orthopaedic upper limb trauma cases presenting to the Emergency Department that were subsequently referred either to a fracture clinic or to the acute referral team were included, as were all upper limb orthopaedic trauma cases that required an operation within the defined study periods. Those patients listed for an operation prior to the period of data collection were included in the final analysis. The study adhered to the STROBE guidelines.

Exclusion criteria

We excluded all hand injuries (any injury distal to the distal radius) which has been studied separately from other upper limb injuries during the pandemic. Polytrauma patients were also excluded since this was only managed at one of the centres. Routine elective orthopaedic cases and non-urgent semi-elective orthopaedic procedures were

excluded as this practice was suspended during the pandemic.

Data points

Data points were divided into acute referrals and operative case mix, as seen in Table 1 [Table 1].

All patients and their radiographs were assessed by a Consultant, who made the decision as to whether the injury would normally be treated non-operatively or operatively and if this decision had changed due to COVID-19. The COVID-19 status of the patient on initial presentation was categorised, depending on the patients symptoms and if the patient underwent COVID-19 PCR swab testing. A patient was categorised as symptomatic if they had any of the following; high temperature, new continuous cough, loss or change to sense of smell/taste (15). For those patients that underwent operative management, any immediate post-operative complications including if the patient went on to develop clinical symptoms of COVID-19 within 14 days were recorded. This was confirmed by electronic notes with a collateral history by the patient at the 2-week follow-up outpatient clinic appointment.

Table 1. Data points for acute referrals and operative case mix

Age (years)	Gender (Male/Female)	ASA (1-5)	Comorbidities
Date of injury/presentation	Type of injury	Mechanism of injury	Open versus Closed fracture
Operative procedure	Seniority of primary surgeon (Consultant vs Trainee)	Days to discharge	Management Changed due to COVID-19
COVID-19 Status Pre-Op	COVID-19 Status on presentation of injury	COVID-19 status within 14 days of surgery	Post op complications (2 weeks)

Statistics

All the data were recorded, anonymised and verified by two members of the research team for its accuracy. The data were processed using Microsoft Excel (Microsoft, Washington, USA). Shapiro-Wilk test indicated a normal distribution for patient demographics. Hence, the mean and standard deviation were reported. An unpaired two-tailed t-test was used for continuous data and Fisher's exact test for categorical data to determine statistical significance which was defined as $p \leq 0.05$. Both risk (or prevalence) and odds ratios were calculated for discreet datasets. Percentages were rounded off to one decimal place.

Results

There were a total of 633 acute upper limb referrals and 130 operations during the study periods. A comparison between the two cohorts has been tabulated for acute referrals and operative case mix [Table 2, Table 3].

Table 2. Acute upper limb referrals during early lockdown and ease of lockdown. Value are n (%) unless otherwise specified. P values not stated were not of significance.

	Early Lockdown (n=177)	Ease of Lockdown (n=456)	p-value
Demographics			
Female	102 (57.6)	220 (48.2)	0.04
Male	75 (42.9)	236 (51.8)	
Age (Mean ± SD)	39.7 ± 27.7	33.4 ± 24.1	0.005
Mean ASA (range)	1 (1-4)	1 (1-4)	
Injury			
ACJ Dislocation	1 (0.6)	6 (1.3)	
Clavicle Fracture	15 (8.5)	34 (7.5)	
Complex Elbow Injury	4 (2.3)	6 (1.3)	
Distal Humerus Fracture (Adults)	1 (0.6)	5 (1.1)	
Distal Radius Fracture	39 (22.0)	156 (34.2)	0.003
Elbow Dislocation	3 (1.7)	4 (0.9)	
Forearm Fractures	4 (2.3)	23 (5.0)	
Humeral Shaft Fracture	5 (2.8)	10 (2.2)	
Olecranon Fracture	8 (4.5)	13 (2.9)	
Other	0	2 (0.4)	
Paediatric Elbow Fracture	15 (8.5)	20 (4.4)	0.05
Proximal Humerus Fracture	29 (16.4)	47 (10.3)	0.04
Radial Head/Neck Fracture	18 (10.2)	63 (13.8)	
Scapular Fracture	1 (0.6)	2 (0.4)	
Shoulder Dislocation	12 (6.8)	23 (5.0)	

Continued of table2.

Septic Joint	0	2 (0.4)	
Soft Tissue Infections	1 (0.6)	2 (0.4)	
Soft Tissue Injury Elbow	10 (5.6)	27 (5.9)	
Soft Tissue Injury Shoulder	7 (4.0)	10 (2.2)	
Soft Tissue Injury Wrist	4 (2.3)	1 (0.2)	
Mechanism of Injury			
DIY	3 (1.7)	3 (0.7)	
Fall from Height <1.5m	107 (60.5)	240 (52.6)	
Fall from Height >1.5m	7 (4.0)	27 (5.9)	
Gym	3 (1.7)	5 (1.1)	
Road Traffic Collision	14 (7.9)	23 (5.0)	
Total Sports	36 (20.3)	135 (29.6)	0.02
- Cycling	16 (9.0)	94 (20.6)	0.0004
- Football	4 (2.3)	18 (3.9)	
- Skateboarding	7 (4.0)	12 (2.6)	
- Rollerblading	4 (2.3)	0	
- Other	5 (2.8)	11 (2.6)	
Assault	0	5 (1.1)	
Other	5 (2.8)	11 (2.4)	
Not applicable	2 (1.1)	6 (1.3)	
Open Injury	0	4 (0.9)	
Mean Days to Discharge (Range)	0 (0-11)	0 (0-29)	
Mortality	0	0	
COVID-19 Status			
- Asymptomatic, not swabbed	165 (93.2)	351 (77.0)	0.0001
- Asymptomatic, swab negative	10 (5.6)	103 (22.6)	0.0001
- Asymptomatic, swab positive	1 (0.6)	1 (0.2)	
- Symptomatic, swab positive	0 (0)	0 (0.0)	
- Symptomatic, swab negative	1 (0.6)	1 (0.2)	
Management change due to COVID-19	17 (9.6)	3 (0.7)	0.0001
- Patient led	3	1	
- Surgeon led	9	0	
- Both	5	2	

Table 3 . Operative case mix during early lockdown and ease of lockdown. Value are n (%) unless otherwise specified. P values not stated were not of significance.

	Early Lockdown (n=39)	Ease of Lockdown (n=91)	p-value
Demographics			
Female	22 (56.4)	42 (46.2)	
Male	17 (43.6)	49 (53.8)	
Age (Mean ± SD)	40.9 ± 27.4	36.9 ± 21.2	
Mean ASA (range)	1 (1-3)	1 (1-3)	
Injury			
ACJ Dislocation	0	1 (1.1)	
Clavicle Fracture	2 (5.1)	8 (8.8)	
Complex Elbow Injury	3 (7.7)	7 (7.7)	
Distal Humerus Fracture (Adults)	1 (2.6)	2 (2.2)	
Distal Radius Fracture	9 (23.1)	31 (34.1)	
Elbow Dislocation	0	1 (1.1)	
Forearm Fractures	3 (7.7)	8 (8.8)	
Humeral Shaft Fracture	2 (5.1)	2 (2.2)	
Olecranon Fracture	5 (12.8)	9 (9.9)	

Continued of table3.			
Paediatric Elbow Fracture	7 (17.9)	2 (2.2)	0.003
Proximal Humerus Fracture	1 (2.6)	8 (8.8)	
Radial Head/Neck Fracture	0	2 (2.2)	
Scapular Fracture	0	1 (1.1)	
Shoulder Dislocation	5 (12.8)	1 (1.1)	
Septic Joint	0	2 (2.2)	
Soft Tissue Infections	1 (2.6)	0	
Soft Tissue Injury Elbow	0	5 (5.5)	
Soft Tissue Injury Shoulder	0	1 (1.1)	
Mechanism of Injury			
DIY	1 (2.6)	2 (2.2)	
Fall from Height <1.5m	29 (74.4)	38 (41.8)	0.001
Fall from Height >1.5m	1 (2.6)	6 (6.6)	
Gym	0	1 (1.1)	
Road Traffic Collision	3 (7.7)	9 (9.9)	
Total Sports	2 (5.1)	30 (33.0)	0.0006
- Cycling	2 (5.1)	25 (27.5)	0.004
- Football	0	2 (2.2)	
- Other	0	3 (3.3)	
Assault	1 (2.6)	1 (1.1)	
Other	1 (2.6)	2 (2.2)	
Not applicable	1 (2.6)	2 (2.2)	
Operation			
Open reduction and internal fixation (ORIF)	23 (59.0)	60 (65.9)	
Manipulation under anaesthesia (MUA)	8 (20.5)	15 (16.5)	
Closed reduction and percutaneous wiring	5 (12.8)	3 (3.3)	
Arthroplasty	0	2 (2.2)	
Intramedullary (IM) nailing	1 (2.6)	0	
Soft tissue	1 (2.6)	4 (4.4)	
Tendon repair	0	2 (2.2)	
Joint washout	0	2 (2.2)	
Other	1 (2.6)	3 (3.3)	
Mean Days to Discharge (Range)	0.6 (0-3)	2 (0-41)	
Seniority of primary surgeon			0.03
- Consultant	19 (48.7)	25 (27.5)	
- Trainee	20 (51.3)	66 (72.5)	
Post-op complication within 14 days	3 (7.7)	2 (2.2)	
COVID-19 Status			
COVID-19 Status Pre Op			
- Asymptomatic, not swabbed	27 (69.2)	0	0.0001
- Asymptomatic, swab negative	11 (28.2)	91 (100)	0.0001
- Asymptomatic, swab positive	1 (2.6)	0	
- Symptomatic, swab positive	0	0	
- Symptomatic, swab negative	0	0	
COVID-19 status within 14 days of operation			
- Asymptomatic, not swabbed	36 (92.3)	87 (95.6)	
- Asymptomatic, swab negative	2 (5.1)	4 (4.4)	
- Asymptomatic, swab positive	0	0	
- Symptomatic, swab positive	0	0	
- Symptomatic, swab negative	1 (2.6)	0	

Prevalence, risks and odds ratio

Tables 4 and 5 have tabulated the prevalence, risk and odds ratios for only statistically significant differences [Table 4, Table 5]. In the context of this study, the prevalence ratio was interchangeable with the risk ratio. The ratios were calculated based on group 2 (i.e. ease of

lockdown) compared to group 1 (i.e. start of lockdown).

Change of management

9.6% (17/177) of patients in the early pandemic had their management altered to non-operative management due to COVID-19. The decision being surgeon-led in 52.9% of cases, patient-led in 17.6% of cases and in 29.4% of cases it was a joint decision between the patient and the surgeon. This patient cohort had a higher mean age (62.7 years vs 39.7 years) and ASA grade (2 vs 1) compared to other patients in the same timeframe. Of the 17 injuries, this included 8 distal radius fractures, 5 proximal humerus fractures, 2 clavicle fractures, one complex elbow injury and one soft tissue elbow injury. At six month follow up, 8 fracture patients (3 proximal humerus fractures, 3 distal radius fractures, 1 clavicle fracture and 1 complex elbow injury) were discharged after achieving radiological union, 6 patients went onto have delayed surgery and two patients are currently being considering for a corrective distal radius osteotomy. One patient was lost to follow-up after initial presentation. In the post lockdown group only 0.7% (3/456) had their management altered. These injuries included two distal radius fractures and one distal humerus fracture, at 3 month follow up all patients had achieved radiological union and had been discharged.

Table 4. Comparing post-lockdown to during lockdown for acute presentations

Factor	OR	PR or RR	p-value
Female	0.69	0.84	0.04
Distal radius fracture	4.25	2.48	0.003
Paediatric elbow fracture	0.50	0.52	0.05
Proximal humerus fracture	0.63	0.59	0.04
Total sports-related injuries	1.65	1.46	0.02
Cycling-related injuries	2.61	2.28	0.0004
Asymptomatic, not swabbed for COVID-19	0.24	0.83	0.0001
Asymptomatic, swab negative for COVID-19	4.87	4.00	0.0001
Management change due to COVID-19 from normal standards of practice	0.06	0.07	0.0001

Table 5. Comparing post-lockdown to during lockdown for operative caseload

Factor	OR	PR or RR	p-value
Paediatric elbow fracture	0.1	0.12	0.003
Fall from height <1.5m	0.25	0.56	0.001
Total sports-related injuries	9.1	6.43	0.0006
Cycling-related injuries	2.58	2.14	0.004
Consultant-led surgery	0.4	0.56	0.03
Asymptomatic, not swabbed for COVID-19	0.003	0.02	0.0001
Asymptomatic, swab negative for COVID-19	4.54	3.55	0.0001

Post-operative complications and mortality

Post-operative complications were monitored and recorded for all surgeries. Complications included (but not restricted to) return to theatre, wound problems, organ failure, sepsis (either local, systemic or metalwork), symptomatic of COVID-19 illness but with a negative swab up to 2 weeks post-op and 30-day mortality. There were no mortalities and only five post-operative complications recorded. During the lockdown, three complications consisted of a patient either presenting with COVID-19 symptoms with a positive swab within two weeks after the operation, return to theatre, or a neurapraxia. This was compared to post-lockdown in which two patients had to return to theatre in the early post-operative period. There was no significant difference in either post-operative complications or mortality between cohorts.

Comment on alternative hypothesis

The alternative hypothesis was not rejected with respect to injury prevalence. Our data demonstrated a 158% increase in upper limb referrals and 133% increase in the operative trauma mix during the ease of lockdown compared with the time during its commencement. As expected, the odds and risk ratios of sports-related and cycling injuries increased post-lockdown whereas falls from height <1.5m reduced. Whereas the odds and risk ratios of paediatric elbow and adult proximal humeral fractures reduced post-lockdown, this was offset with an increase in adult distal radius fractures. The prevalence and odds ratios of consultant-led operations reduced by half post-lockdown. However, apart from one patient, those patients that did require an operation during the COVID-19 pandemic did not go on to develop symptoms of COVID-19 in the immediate post-operative period. Although there was a 5.5% reduction in post-operative complications post-lockdown, the overall numbers of complications were low and it was difficult to draw any firm conclusions from this data. There were no recorded mortalities in either group.

Discussion

Shifts in referrals

The data supported the alternative hypothesis, which demonstrated that as lockdown was eased there was a significant increase in upper limb referrals compared to early lockdown. There were only 177 referrals following the introduction of the 'strict' lockdown compared with 456 referrals as the lockdown was eased. This represents a 158% increase in upper limb injuries. This increase is likely to represent a direct consequence of the governmental ease of the lockdown with people no longer being constrained to their own homes or indoors. During the initial data collection period, the government allowed only one form of exercise per day, which was later lifted in May alongside the reopening of outdoor sports facilities. As the aetiology of

upper limb fractures is linked to physical activity, the ease of lockdown has significantly increased the incidence of trauma (16, 17). Previous studies in the UK demonstrated a 33-50% reduction in the overall acute trauma referrals during the early lockdown period in comparison to 2019 (18-20); however this is the first study to look specifically at upper limb referrals following the ease of lockdown.

Demographics and type of injury

The general demographics of patients presenting with upper limb injuries changed between the two periods. Those patients presenting with injuries during the ease of lockdown had a significantly younger mean age by 15.9% (33.4 vs 39.7 years, p=0.005) compared with the beginning of lockdown. A significant difference was also noted in gender, with a shift from a higher proportion of females sustaining injuries at the beginning of lockdown to a higher proportion of males as lockdown was eased (p=0.04). This younger male cohort may represent a less risk adverse population.

The type of injury remained generally unchanged between both groups as distal radius, proximal humerus, radial head/neck and clavicle fractures represented the commonest injuries. However, there was a significant increase in the number of distal radius fractures as lockdown was eased, this is contrasted with a significant reduction in the proportion of proximal humerus fractures. There was an increase in sporting injuries as lockdown was eased (p=0.02), with a statistically significant increase seen in cycling injuries (p=0.004) by an odds of at least 2. This is not surprising given the governmental ban of team sports in the early pandemic combined with restrictions on outdoor exercise which were subsequently eased. The COVID-19 pandemic has caused a cycling boom with governmental cycling initiatives announced in May 2020, aimed at encouraging cycling and reducing overcrowding on public transport (21). Furthermore, working from home, may provide the population more time to participate in sports such as cycling, hence increasing risk of injury. Previous studies have reported a significant reduction in sporting injuries during the COVID-19 pandemic (19, 20), however, our data demonstrated as the lockdown was eased this number rose rapidly. This increase can add more pressure on an already strained health care system and workers recovering from the initial first wave of the pandemic.

Surgical decision-making during the COVID-19 pandemic

The BOA guidelines published in March 2020 recommended non-operative management of upper limb fractures during the COVID-19 pandemic with the remedial option of later corrective osteotomy if clinically indicated. Our data demonstrated that a significant proportion of patients (9.6%) in the early pandemic had their management altered to non-operative management due to COVID-19, these patients had a higher mean age and ASA grade compared to other patients in the same timeframe. Increasing age and the presence of medical comorbidities have been proven to be risk factors for COVID-19 related mortality (22, 23). Therefore, it is likely that these factors influenced the surgeon-patient decision-making process combined with a reduction in theatre capacity, due to the conversion of operating theatres to extended intensive care units to cope with the pressures of the pandemic.

Interestingly, 47% (8/17) of patients went onto have delayed surgery or are currently being considered for it. This however, leaves a group of patients that had their management altered due to the COVID-19 pandemic but went on to achieve radiological union. The COVID-19 pandemic can provide a unique opportunity for upper limb surgeons to re-evaluate how they would manage common upper limb fractures, especially in high risk patients. Even though this group of patients went on to achieve radiological union, it is not yet known if their long term functional outcomes will be affected by these decisions and further studies are needed in this area to help guide future practice.

In the post-lockdown group only 0.7% had their management altered, this data possibly correlates with the reducing number of COVID-19 cases and mortalities in London in this timeframe, combined with improved operating theatre availability due to the reducing burden of COVID-19 infection.

COVID-19 testing and Upper Limb Trauma

Our data demonstrated a significant increase in the number of COVID-19 tests carried out at the ease of lockdown compared to the beginning (6.8% vs 23%) for upper limb referrals. The same increase was demonstrated in those patients undergoing operative management (30.8% vs 100%). These findings are likely to reflect the change in threshold for COVID-19 testing and publication of national guidance for COVID-19 testing for pre-operative and acute hospital presentations. The odds of not being swabbed (even if asymptomatic) was reduced by three-quarters for acute presentations and none for those being operated on within the post-lockdown period. Furthermore, the odds of the COVID-19 swab being negative (if asymptomatic) was almost 5 times for the operative cohort and almost 5 times for acute presentations within the post-lockdown phase.

It has been shown that patients undergoing surgery during the early pandemic, that tested positive for COVID-19 infection had an increased risk of developing pulmonary complications and significantly increased 30-day mortality (22). In our data, only 2 patients (0.3%) tested positive for COVID-19, however this is likely to be underestimated due to the small proportion of patients tested. Patients with upper limb injuries tend to be ambulatory and unless they were admitted or underwent surgery, they were unlikely to be tested.

In total 130 operations were undertaken within both timeframes. However only one patient reported developing COVID-like symptoms within 14 days of the operation. This patient was swabbed and tested negative. This supported a recent study that demonstrated the rate of hospital acquired COVID-19 infection was low, indicating effective infection control policies within Western hospitals (24). These findings also support the results of another study on upper limb trauma that demonstrate with appropriate infection control measures, elective upper limb ambulatory trauma can be performed safely with a low risk of contracting COVID-19 (25).

Operative case mix

In keeping with the pattern of acute referrals, a significant increase in the number of upper limb operations performed during the ease of lockdown compared to the start of lockdown was noted, specifically operations carried out due to sporting injuries. A fall from <1.5 metres, remained the most common cause of injury within both groups, however falls represented a greater proportion of injuries in the early pandemic compared to the ease of the pandemic (p=0.001). A possible explanation for this is that a fall could have occurred at home during the early pandemic when sports were restricted.

A statistically significant difference in the seniority of the operating surgeon was noted between both groups, with a consultant being the primary surgeon most commonly during early lockdown (p=0.03). This is in keeping with other findings reporting an increase in consultant-led operating during the early pandemic (19). COVID-19 has had a significant impact on orthopaedic training, with a significant drop in trainee operative log book numbers reported in the early pandemic (26). 7.7% of cases developed a complication within 14 days in early lockdown compared with 2.2% as lockdown was eased, however this was not of statistical significance.

Strengths and limitations

The large sample size and multi-centre nature of the data collection on upper limb trauma between two timeframes are strengths of this study. The three participating hospitals lie within a hotspot of the pandemic and peak within the UK. Nevertheless, there is regional variation with respects to COVID-19 infection and upper limb injuries, as well as testing strategies, social distancing policies and lockdown measures. One limitation of the study is the reliance on positive nasopharyngeal swabs for SARS-CoV-2 RNA to assign a diagnosis of COVID-19 infection. One study has reported a false negative rate of 29%, with a systematic review suggesting the reverse transcriptase PCR sensitivity to be as low as 71% (27, 28). Yet this method of testing was out of the hands of the authors since it was imposed on a national level. Fourteen days was used as a cut-off for the development of COVID-19 symptoms in the post-operative period. COVID-19 is known to be associated with an asymptomatic incubation period most commonly reported to be between five and eight days, but this can be longer (25). Hence not all patients who eventually developed symptoms of COVID-19 may have been captured when initially screened (29).

The ease of the lockdown has seen upper limb referrals and operations more than double compared to early lockdown, with a significant increase in sporting injuries. Those patients presenting in the ease of lockdown tended to be a younger male population, potentially representing a less risk adverse demographic. Just under 10% of patients had their management decision changed due to the COVID-19 pandemic in early lockdown, however by the ease of lockdown this had reduced to 0.7%, representing return to normality.

As many areas of the world face a fourth wave, it is encouraging to observe a shift towards increasing COVID-19 testing for upper limb trauma patients. None of the patients who had surgery tested positive for COVID-19 infection within 14 days of the procedure with no mortalities at 30 days reinforcing that having upper limb surgery during the current austere circumstances is safe. A number of patients who had their management altered in the first wave of the pandemic went on to achieve radiological union, however it remains to be seen whether their long term functional outcomes will be affected by these decisions.

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Catrin Morgan, BSc (Hons), MBBS, MRCS[1]
Kapil Sugand, PGC HBE, BSC, MBBS, MRCS, MCCT, FRSA[2]
Thomas Ashdown, BSc (Hons), MBBS, MRCS[2]
Nikita Nathoo, MBBS[3]
Robert MacFarlane, MBChB MRes PhD (Chem Eng) FRCS (Tr & Orth)[1]
Rory Dyke, BSc (Hons), MBBS, MRCS[2]
Chang Park, BSc (Hons), MBBS, MRCS[2]
Arash Aframian, MBBS BSc(Hons) MRCS[1]
Peter Domos, MD, MRCS, FRCS(Tr&Orth)[3]
Maxim D. Horwitz, MBChB FRCS (Orth) Diploma Hand Surgery (BSSH)[1]
Khaled M. Sarraf, BSc(Hons) MBBS FRCS (Tr&Orth)[2]
Rupen Dattani, BSc(Hons), MBChB, MRCS, MD, FRCS(Tr&Orth)[1]
1 Chelsea and Westminster NHS Foundation Trust, London, England, UK
2 Imperial College Healthcare NHS Trust, London, England, UK
3 Barnet Hospital, Royal Free NHS Foundation Trust, London, England UK

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