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The effect of COVID-19 lockdowns on paediatric lower limb orthopaedic presentations

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Abstract

Introduction As the COVID-19 pandemic was spreading in 2020, the government imposed national lockdowns. We considered the effects these lockdowns had on the paediatric population, with a specific focus on lower limb orthopaedic trauma. We hypothesise that these restrictions will have altered the mechanisms of injury and reduced the number of referrals.

Materials and methods We retrospectively analysed data from 28/08/19 to 01/04/21, considering the variations in referrals and operations during these times, and analysed these data using an online statistical calculator. We examined the rate of referrals, types of fractures referred to the centre, mechanism of injury, volume of operations performed, and average wait times to undergo an operation. The data were compared in pre-lockdown and lockdown times.

Results 67 paediatric patients with lower limb fractures were included in this study. Throughout the lockdown periods, the mean age of children referred was younger (6.9 from 11.1) and they were less likely to be injured as a result of sport ($p = 0.0493$). They were more likely to fracture their lower leg ($p = 0.0016$) when compared with other anatomical regions. The average weekly rate of referrals dropped (0.84–0.68), but the rate of operations almost quartered (0.39–0.16). The average wait times for operations dropped significantly, with patients waiting 80% less time from the date of their injury.

Conclusion This study highlights the impact of the coronavirus pandemic on the prevalence and management of lower limb paediatric trauma. The demographics and mechanisms of injury which presented to the trust over the pandemic and associated national lockdowns were significantly different. There was a drop in the number of referrals and a preference to non-operative management when patients did present.

Keywords Paediatric trauma · Lower limb trauma · Coronavirus · COVID-19

Introduction

The COVID-19 pandemic is the biggest healthcare crisis the world has faced this century. Ever since the first cases of COVID-19 began to appear on the UK's shores at the end of January 2020, collaboration with neighbouring nations and international bodies has been imperative. This was to curb the spread of the disease, whilst creating treatments and vaccines to expedite an end to this disaster.

On 23 March 2020, the UK Prime Minister, Boris Johnson announced a national lockdown would take effect [1]. Since then, there have been two further national lockdowns with variations of tiered systems bridging the gaps [2]. The paediatric population in the UK has been especially heavily impacted by these lockdowns through missing out on key elements of their social and physical development. Conversion of classes to remote learning has resulted in more sedentary, solitary activities. All this was despite the paediatric population being the least likely to become seriously unwell due to COVID-19 infection [3]. During the summer term of 2020, there was a significant drop in organised sporting activities [4]. The lockdowns have also resulted in less traffic on the roads, as well as less

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unsupervised children, leading to fewer road traffic accidents (RTAs). According to the Department for Transport, there was a 67% reduction in all RTA casualties in April 2020 when compared to the previous year [5]. As a result of all this, the landscape of trauma should have been very different during lockdown.

Predicting the impact of the pandemic on surgical services and need to cut these down to free up intensive care beds, the British Orthopaedic Association (BOA) developed Standards for Trauma and Orthopaedics (BOASTs) to streamline trauma and orthopaedic services, with a particular emphasis on non-operative management where possible and on minimising outpatient contact [6]. The Royal College of Surgeons of Edinburgh also developed guidance on stratifying case severity to prioritise patients' clinical need for admission and resulting exposure to COVID-19 [7]. These guidelines aimed to provide a two-fold benefit by both reducing transmission to and from orthopaedic patients, as well as freeing up hospital beds to prevent the NHS from becoming overwhelmed by COVID-19 admissions.

A literature search was performed using PubMed on 30/04/21 with the terms: 'paediatrics' AND 'orthopaedic' AND 'COVID', inclusive of the time period 2020–21. The titles and abstracts of 170 papers were reviewed, leaving just 8 with a paediatric focus. The majority of papers accessed focused on broader metrics regarding both adult and paediatric presentations. There were just three of the eight papers chosen that solely focused on paediatric presentations (Sugand et al. [8], Baxter et al. [9] and Ibrahim et al. [10]). There were none that focused on lower limb fractures alone in this population. This was useful in the early stages of the pandemic when there was a focus on changing the whole service in an attempt to free up beds whilst continuing essential services. However, a closer analysis of the specific areas of the service impacted is now required to consider any changes which may be needed for future pandemics.

This study aims to assess the impact of the COVID-19 pandemic and its associated lockdowns on paediatric presentations of lower limb orthopaedic conditions to the Manchester Foundation Trust (MFT) from 26 March 2020, specifically considering:

(1) The incidence of lower limb fractures during the periods of national lockdown
(2) The changes in incidence throughout the pandemic
(3) The changes in the types of fractures presenting during the national lockdowns
(4) The changes in mechanism of injury sustained during the national lockdowns
(5) The impact of the national lockdowns on the efficiency of our service

Materials and methods

Data collection

Data were collected retrospectively using the electronic patient record system eTrauma (Open Medical Ltd) and corroborated through the Electronic Patient Records (EPR) system. A search was conducted for all paediatric patients (under 16 years of age) from the period of 28/08/19 to 01/04/21. The eTrauma software is a clinical workflow management tool which has been in use within the trust since 28/08/2019 and so our data were limited to this period to keep the dataset consistent. Separate searches were undertaken for both acute fracture referrals and operations within this period. The data retrieved included patient demographics, referral date, referral findings and any pertinent clinical notes.

Data analysis

We analysed these data retrospectively looking for any variation in referrals over time, specifically for changes during the lockdown periods, the requirement for surgery in these individuals and the types of fractures presenting.

We defined the lockdown periods according to the legally enforced national lockdowns imposed by the government [2] between the following dates:

(1) 26 March 2020–10 May 2020
(2) 5 November 2020–2 December 2020
(3) 6 January 2021–8 March 2021

The data collected during these lockdown periods were then compared with the data collected when no national lockdown was in place. To provide more consistent data, rate of referrals and operations per week, as well as rate of operations per referral were chosen alongside the raw data given in Table 1.

Variables were collected from the raw data and analysed using Fisher's Exact Test with a two-tailed p value obtained through an online calculator [11].

We also considered the time taken for any given operation from both the date of injury and the booking date to see whether there was any change in the efficiency of our service during the pandemic.

Any duplicates were removed, and one patient's operation was excluded as it was for the removal of metalwork.

Results

67 paediatric patients were referred to MFT between 28/08/19 and 01/04/21. All patients who underwent surgery at our centre were between the ages of 7 and 16.

Table 1 Referrals to MFT paediatric orthopaedics

	Non-lockdown period $n=54$, $t=64$ weeks	Lockdown period $n=13$, $t=19$ weeks	p value*
Referrals per week	0.84	0.68	
Demographics	*n* (%)	*n* (%)	
Male	33 (61.1)	10 (76.9)	0.3500
Female	21 (38.9)	3 (23.1)	
Mean age	11.1	6.9	
Mechanism of injury			
Sport	20 (37.0)	1 (7.7)	0.0493
Stairs	6 (11.1)	3 (23.1)	0.3606
Trip (excl. Stairs)	6 (11.1)	2 (15.4)	0.6470
Fall from height (excl. Stairs)	3 (5.6)	0	1.0
Bike/Scooter	4 (7.4)	2 (15.4)	0.3292
Falling person	2 (3.7)	2 (15.4)	0.1667
Slide	4 (7.4)	0	0.5793
RTA	4 (7.4)	0	0.5793
Impact with stationary object	2 (3.7)	1 (7.7)	0.4822
Trampoline	1 (1.9)	2 (15.4)	0.0939
Other	2 (3.7)	0	1.0
Anatomical region			
Lower leg	12 (21.4)	9 (69.2)	0.0016
Ankle	19 (33.9)	1 (7.7)	0.0898
Knee	13 (23.2)	1 (7.7)	0.4445
Femoral shaft	7 (12.5)	2 (15.4)	0.6742
Foot	4 (7.1)	0	1.0
Proximal femur	1 (1.8)	0	1.0
Operative management	25 (46.3)	3 (23.1)	0.7474

One patient had multiple fractures of the proximal femur, femoral shaft, and ankle, whilst all other patients referred had sustained fractures at a single site. The rate of referrals dropped over the lockdown periods by 19.0% from 0.84 to 0.68 referrals per week. The average age dropped from 11.1 to 6.9, with the number of males proportionally rising slightly. 23.1% (3) of these patients were managed non-operatively during the lockdowns compared to 46.3% (25) outside of the lockdowns (Table 2).

Fracture by anatomical location

21.4% of lower limb fractures occurred in the lower leg when no lockdown was in force compared with 69.2% when there was a lockdown in place ($p=0.0016$). Ankle fractures decreased substantially during the lockdown periods (from 33.9 to 7.7%), though this was not statistically significant. Notably, there were no foot fractures during the lockdowns, though they made up 7.1% of fractures outside of the lockdown.

Table 2 Demographics of patients undergoing operations at MFT

	Non-lockdown period $n=25$, $t=64$ weeks	Lockdown period $n=3$, $t=19$ weeks
Operations per week	0.39	0.16
Operations per referral	0.46	0.23
Demographics		
Male	15 (60)	2 (66.7)
Female	10 (40)	1 (33.3)
Mean age	13.6	15.0

Mechanism of injury

The number of children presenting with lower limb fractures as a result of a sporting injury was statistically significantly lower during lockdown (7.7%) when compared to the non-lockdown period (37.0%). Other mechanisms of injury were not deemed statistically significant, though it is noted that

there were no RTA-associated fractures during the lockdown periods, and trampoline injuries increased, though this was not statistically significant (Table 1).

Average wait times for operation

The average wait times for operations dropped significantly during the lockdowns, with patients waiting 80% less time from the date of their injury, and 89% less from the time of booking during lockdown (Table 3).

Rate of referrals and operations

The rate of referrals has been increasing over the periods between lockdowns. An unexpected point was that the rate of referrals during the lockdowns varied dramatically. The first and third were roughly the same as pre-lockdown. The second lockdown saw a large drop in the rate of referrals (Fig. 1).

There were no operations undertaken at the trust during the first lockdown. This was followed by a similar rate of operations to the pre-lockdown rate before dropping again for the second lockdown. The second interim period showed a sharp increase in the rate of operations being undertaken (Fig. 2).

The rate of operations per referral was also considered, and it was found that roughly half of all referrals were operated on prior to the lockdown being implemented. After this, the rate plummeted during the first lockdown then slowly began to return to normal between the first two lockdowns (Fig. 3). During the second lockdown, every patient that presented required an operation, which then reduced to less than a third of patients during the third lockdown. Afterwards, this rate has normalised to half of patients who are referred being sent for an operation.

Table 3 The average wait times in days for operations

	Non-lockdown	Lockdown	% Change
Wait time from injury	5.08	1.00	− 80.3
Wait time from booking	3.12	0.33	− 89.4

Discussion

Our findings have concurred with many of the findings currently in the literature but are able to give a more specific view of the effect lockdown has had on paediatric lower limb trauma referrals and operations.

Patient demographics

Our cohort of referred patients were younger during the lockdown. The proposed reasons for this include a reduction in sporting activities as well as injuries sustained whilst playing with other children—typically outside the home in playgrounds or in school. Patients who sustain these injuries tend to be older than those children who are more susceptible to injury in the home.

There were slightly fewer male patients who presented with lower limb injuries during the lockdown periods. This was not statistically significant, though it would be a good point of inquiry for future research as to whether the reduction in high-risk activities—such as football, rugby and other team sports—had a greater impact on the number of males presenting with fractures than female patients. Male preponderance to injuries has been described in the paediatric

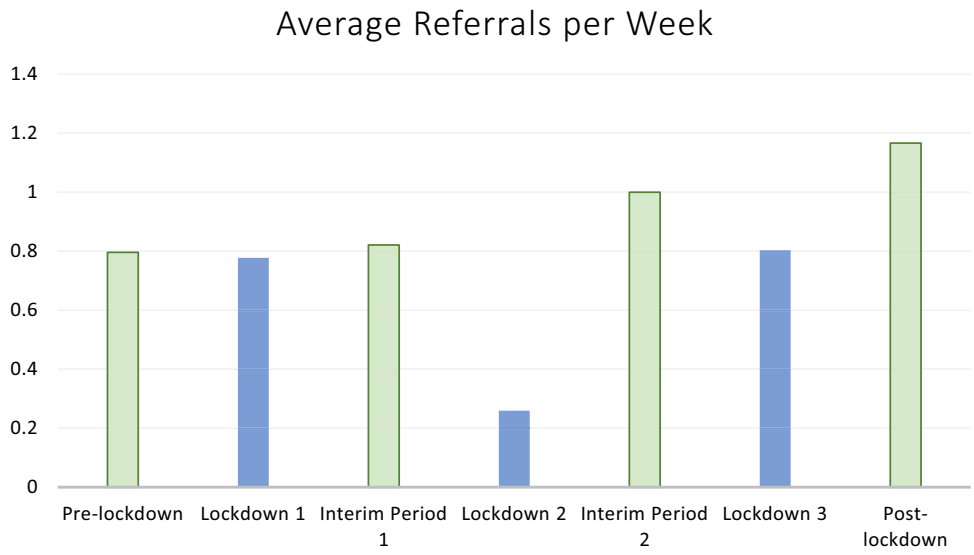

Fig. 1 Bar chart showing the rate of trauma referrals per week

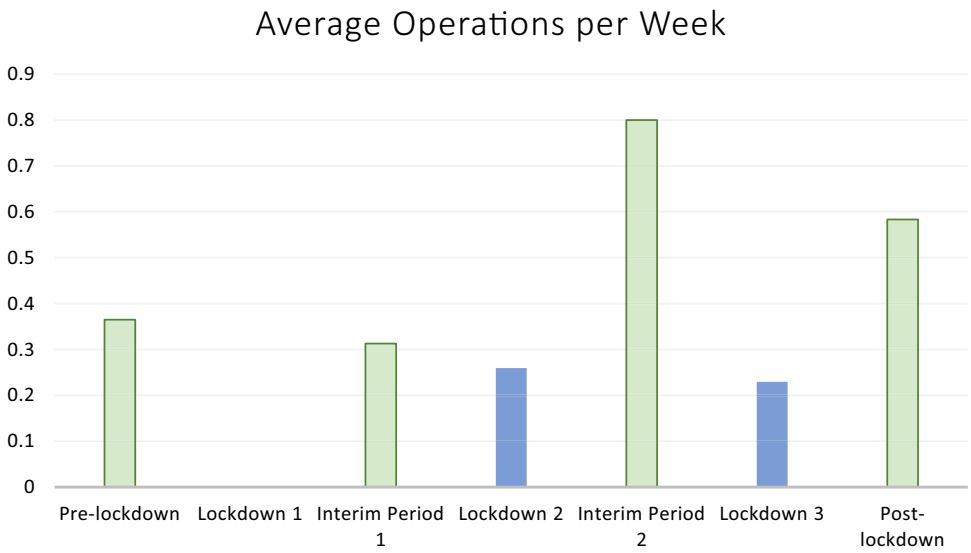

Fig. 2 Bar chart showing the rate of trauma operations per week

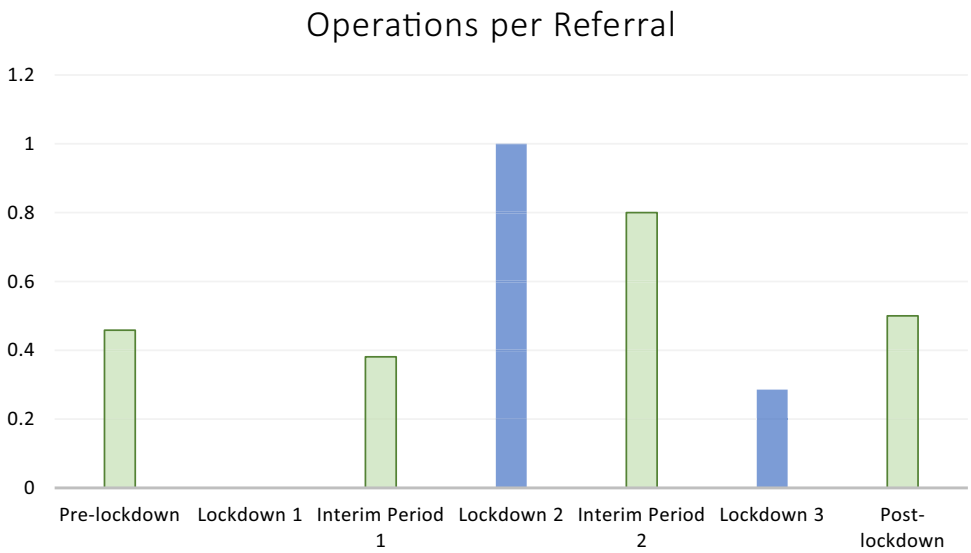

Fig. 3 Bar chart showing the proportion of referrals requiring an operation

population, such as in the context of knee injuries by Kraus et al. [12], where sporting activity was also one of the most common mechanisms of injury. 76% of all patients who presented due to sporting injuries in our study were male, and so a reduction in this type of activity would likely result in fewer males presenting overall. The reduction of sporting injuries likely also ties in with the closure of schools throughout the pandemic period. It has previously been demonstrated by Kraus et al. [13] in a retrospective evaluation of school-related paediatric injuries that 40% of those occur during school sports. Female patients were just as likely to present with an injury from a fall from tripping or falling on stairs as they were from sporting injuries.

Mechanism and anatomical site of injury

The number of lower limb fracture referrals for sporting injuries dropped significantly in the lockdown periods. Similar findings were reported by Sugand et al. [8] and Baxter et al. [9]. This was likely a result of a reduction in organised team sports being allowed to be played during the lockdown periods. The lower leg was the most common site of lower limb injury during the COVID-19 lockdowns, with 9 fractures compared with 2 femoral shaft fractures, the next most common site. Of these 9 fractures, 2 were on trampolines and 3 were on stairs. During the period where no lockdown was implemented, the most common injury site was the ankle, with 19 fractures. 7 of these were caused by sporting injuries, and so this change

in site of injury is likely linked to the changes in mechanism of injury.

There were no foot or hip fractures during lockdown, and there was a steep reduction in ankle fractures. This again indicates the types of fractures more likely to present in periods of lockdown, as well as those which are more amenable to non-operative management.

Average wait times

This was an important point for us as a service. We wanted to see whether the pandemic had reduced our capacity to the point of impacting theatre efficiency, as well as whether there was an impact on our patients' time to presentation.

Surprisingly, these improved over the course of the lockdowns. This is likely due to the reduction in referrals for surgery due to a more non-operative management strategy as laid out by the BOA [7], as well as an overall reduction in presentations. This likely resulted in the freeing up of more consultants to offer a more efficient theatre pathway.

We did not review the proportion of surgeries undertaken by consultants and juniors compared to previous years, though this is an important part of the currently published literature. The impact this is likely to have had on individuals in training is significant and is an area which needs more research.

Rates of referral

The overall rates of referral dropped significantly over lockdown. Murphy et al. [14] and Hampton et al. [15] reported similar findings in their study, with a drop of lockdown-period referrals in the rates of 34% and 50%, respectively. The pattern of referrals can be seen in Fig. 1, where the initial drop due to lockdown is not as significant as was expected. This could have been as a result of a heightened awareness of families in the home when younger children hurt themselves. Alternatively, it could be the result of children becoming bored during the latter stages of the lockdown, resulting in more high-risk activities being undertaken within the home. Notably, both of the trampolining injuries that occurred in the lockdown periods occurred during the first lockdown.

The steep drop seen in the second lockdown may have been a result of the shorter timeframe over which this lockdown took place (less than 4 weeks compared to more than 6 for the first and 8 for the third). This could also explain why there was a higher rate of referrals in the third lockdown, with children becoming increasingly frustrated with the lockdown restrictions and so taking part in more high-risk activities. Seasonal variation in weather may be a further contributing factor to rates of referrals. As described by Sinikumpu et al. in the context of forearm fractures [16] and supracondylar humerus fractures [17], incidence significantly increases in warmer temperatures and in the absence of rain, although we have not examined this closely in our study.

Rates of operations

It has previously been demonstrated that over the last few decades there has been an increasing trend towards surgical fixation of paediatric fractures [18, 19]. Pre-lockdown, roughly half of all fracture referrals resulted in the need for an operation. This was reduced significantly during the first lockdown amid the concerns for patients as well as the guidelines suggesting an increase in non-operative management. This was despite a normal rate of referrals during the first lockdown. Similarly, Karia et al. [20] noted a 66.7% reduction in paediatric trauma operations when comparing April 2020 with April 2019.

Overall referrals dropped by around a quarter, which indicates the service's adherence to the early guidance to increase non-operative management when possible.

Early in the pandemic, there was a fear that children were not getting ill with COVID-19 but were still able to spread the disease [21]. Limited access to testing early in the pandemic as well as fears that children could carry COVID-19 back to their families may have impacted the decisions to not operate during this time. Furthermore, Dayananda et al. [22] reported in their prospective study that patients wanted to avoid operations during the lockdown period due to a perceived greater risk of catching COVID-19.

During the second lockdown, we had more information about the disease and more access to testing for COVID-19 both pre- and post-operatively. This would likely have resulted in the higher rates of operations per referral seen in the second lockdown compared to the first.

The rates of operations in the second interim period were more than double that of the pre-lockdown rate. This could be as a result of delaying operations until after the lockdown had finished, as well as patients presenting later as a result of the lockdown.

The rate of operations per referral reduced during the third lockdown and going into the post-lockdown period to a level similar to that observed pre-lockdown. This possibly shows that the national and the local trust's infection control procedures are making an impact and the severity of injuries presenting is slowly returning to normal. This is also evidence that the UK population has adapted to the lockdowns and is more confident in coming to hospitals and undergoing procedures than during the first lockdown.

Limitations

Our data were collected retrospectively, though it should be noted that the data were pulled from a consistent electronic database and corroborated with the help of other electronic systems, which will have improved its reliability. We had a relatively small sample size and were limited by the database chosen, since the trust only began using it in late August 2019.

Conclusion

The COVID-19 pandemic has impacted our service as an orthopaedic trauma unit significantly since January 2020. The demographics of patients presenting, as well as the mechanisms of injury have altered, with a particular drop in sporting-related injuries throughout the lockdown periods. The attitudes of the service to managing patients have also changed, with a tendency to offer non-operative management during lockdowns, as per guidance from the British Orthopaedic Association.

Further study into how lockdown measures have affected paediatric orthopaedic patients' outcomes is warranted to fully assess the impact of the COVID-19 pandemic in this context.

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Declarations

Conflict of interest No conflicts of interest to declare.

Ethical approval As this was a retrospective study, and no interventions were being performed, ethical approval was not required. Approval for collection of data was granted through the department of clinical audit based at Wythenshawe Hospital, Manchester Foundation Trust [MFT] on 29/04/2021.

Informed consent No informed consent was sought.

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