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Original Article

The impact of COVID-19 on foot and ankle surgery in a major trauma centre

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ABSTRACT

Introduction and aims: COVID-19 has had a significant impact on orthopaedic surgery globally. This paper aims to evaluate the impact of COVID-19 on foot and ankle trauma in a major trauma centre.
Methods: A retrospective observational study of prospectively collected data was performed. All foot and ankle trauma patients over a 33 week period (1st December 2019–16th July 2020) were analysed. All patients with trauma classified by the AO/OTA as occurring at locations 43 and 81–88 were included.
Results: Over the 33 weeks analysed, there was a total of 1661 trauma cases performed; of these, only 230 (13.85%) were foot and ankle trauma cases. As percentage of cases during each period of lockdown, foot and ankle made up 15.20% (147 out of 967) pre-lockdown, 8.81% (17 out of 193) during lockdown and 13.17% (66 out of 501) post lockdown. This difference was statistically significant ($p < .001$). The most significant change in trauma management was the treatment of malleolar fractures.
Further analysis showed that during the lockdown period 29 foot and ankle fractures were treated the same and 13 were treated differently, (i.e. 31% of fractures were treated conservatively, when the consultants preferred practice would have been surgical intervention). Of the 13 patients, 3 have had surgical management since lockdown has been eased.
Conclusion: It is evident that the trauma case activity within foot and ankle was significantly reduced during the COVID-19 period. The consequences of change in management were mitigated due to a reduction in case load.

1. Introduction

The World Health Organisation announced COVID-19 as a pandemic on the 12th March 2020 [1]. Closely following this, on the 17th March 2020, the UK Government declared increased restrictions on the UK public including the postponement of non-urgent operations in the National Health Service, aiming to increase bed capacity and protect patients and healthcare staff [2,3]. The 23rd March 2020 saw a state of 'Lockdown' declared by the government, with enforceable restrictions throughout the UK [4]. These changes saw considerable impact on the British public: discouragement of socialising; non-essential activities prohibited; increase in 'work from home'; and limits to freedom of movement. The easing of lockdown in the UK was publicised from the 24th May 2020 following a televised announcement by Prime Minister Boris Johnson; this resulted in the incremental return of usual NHS activity, albeit on a reduced scale [5].

Governing bodies recognised the possible effect of the reallocation of resources and personnel to the overwhelming effect of the COVID-19 and produced guidelines to allow rationing of services [6]. Prior to March 2020, the foot and ankle trauma attending our unit was filtered via admissions and virtual fracture clinic through a foot and ankle service consisting of two full day foot and ankle trauma lists and 3 half day foot and ankle trauma clinics a week. Most open fractures and fractures requiring circular frame fixation were done on separate orthoplastic and limb reconstruction lists.

As of 30th March 2020, based on local requirements, elective practice was cancelled, junior medical personnel were recommissioned to medical wards and the full consultant body was allocated to the treatment of trauma. There was built in resilience to the system, and capacity for operative intervention reduced from four trauma lists per day, to one general trauma list occupied by 2 consultant orthopaedic and trauma surgeons. Orthopaedic minor injuries was relocated from accident and

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emergency to fracture clinic, where a mini-C arm allowed conservative management under radiographic guidance.

Based on national guidelines from the British Orthopaedic Association and the Federation of Surgical Specialty Associations the Liverpool Orthopaedic and Trauma Service reviewed and rewrote numerous local policies that appreciated the changes in circumstance [6,7]. This supported triaging the urgency of procedures and implementing alternative management. Specific to foot and ankle trauma, open fractures treatment remained unchanged. Where reduction was possible with mini-C arm, all foot and ankle trauma was treated non-operatively. Surgery was required where reduction was not possible. The rotas were designed to ensure resilience, and also to keep specialty based knowledge every day. A consultant member of the foot and ankle trauma team was present every day, and all cases where there was a change of routine practice, was discussed by at least 2 consultants.

This paper aims to evaluate the impact and experiences of the foot and ankle department in a major trauma centre from December 2019 to August 2020 based on the aforementioned structural and system changes afforded due to the COVID-19 pandemic.

2. Methods

This was a retrospective observational study of prospectively collected data from the foot and ankle trauma unit. The study was conducted under the auspices of a service evaluation; therefore no ethical approval was required. All surgically treated trauma cases admitted to the Liverpool Orthopaedic and Trauma Service are prospectively added to our database (Bluespier, Droitwich, UK). All foot and ankle trauma patients over a 33 week period were retrospectively analysed. All new patients attending fracture clinic during the lockdown period were added to a separate prospectively collected database, where it was recorded if the consultant surgeon had veered from what is their normal practice.

Inclusion criteria included all trauma classified by the AO/OTA as occurring at locations 43, and 81–88 [8]. This included distal tibia; malleolar; talus; calcaneus; midfoot; and phalanges. Raw daily data was combined to give weekly data for operation. Where more than 1 anatomical site required surgical intervention, this was included as more than one procedure. Time intervals were divided into: Pre-lockdown defined as the date of surgery or treatment of all cases prior to the 23rd March 2020; Lockdown from 23rd March 2020 to 24th May 2020; and Post-lockdown from the 24th May 2020 to 16th July 2020. Pre-lockdown included 16 weeks of trauma cases, the lockdown period lasted 9 weeks, and a further 8 weeks were analysed following lockdown. Time periods were dictated by the UK Government announcements of national lockdown and easing of lockdown measurements [9].

2.1. Statistical analysis

The study was completed according to STROBE guidelines for observational studies [10]. Continuous variables were tested for normality distribution, and presented as means and 95% confidence intervals. Whereas categorical and qualitative variables are expressed as numbers and percentages. The Student t-test was used for continuous variables if the criteria for normality and equality of variances were fulfilled. Alternatively, the Mann-Whitney U test was performed. Categorical variables were analysed using the Chi-square test. The one-way analysis of variance (ANOVA) was used where comparison between the means of three or more independent groups was required. A p value less than 0.05 was considered significant. All data was analysed using SPSS Version 26.0 (SPSS Inc., IBM, Chicago, IL).

3. Results

Over the 33 weeks analysed (1st December 2019 – 16th July 2020), there was a total of 1661 trauma cases treated; of these, only 230 (13.85%) were foot and ankle trauma cases. As percentage of cases during each period of lockdown, foot and ankle made up 15.20% (147 out of 967) pre-lockdown, 8.81% (17 out of 193) during lockdown and 13.17% (66 out of 501) post lockdown. This difference was statistically significant ($p < .001$). Figs. 1 and 2show the comparative weekly case numbers and percentage case load per trauma specialty. This indicates that foot and ankle trauma cases reduced by the greatest number as compared to other specialties, however all case numbers were reduced except hip fractures. The average number of cases and percentage of cases per week is illustrated in Table 1 with differentiation by anatomical location and time period. Fig. 3illustrates a box plot showing the most significant change in practice was in the treatment of malleolar fractures.

For the surgical treated patients, where possible they were discharged immediately post injury, to be re-admitted for surgery. Both during the lockdown and post-lockdown period, patients were screened for COVID-19 and had to self-isolate post screening for 1 week. All cases were treated as day cases where appropriate. There have been no recorded cases of COVID-19 infection in surgically treated foot and ankle trauma patients throughout the study.

Further analysis was completed on the database for recording if patients had been treated differently to the consultant's normal practice during the lockdown period. This showed that during the lockdown period 29 foot and ankle fractures were treated the same and 13 were treated differently, (i.e. 31% of fractures were treated non-operatively, when the consultant's preferred practice would have been surgical intervention). Of the 13 patients, 3 have had surgical management since lockdown has been eased.

4. Discussion

This study shows the significant effect the COVID-19 pandemic has had on both the case numbers and provision of care of foot and ankle trauma for our unit. It is evident from the results above, that the trauma case activity within the Foot and Ankle department in the Liverpool Orthopaedic and Trauma Service was significantly reduced in comparison to normal during the lockdown period and has not yet returned to normal. Both studies in the UK and in Germany have found similar reduction in both case load and resources to our findings [11,12]. The rebound effect (an increase in surgically treated cases post lockdown) was not witnessed in foot and ankle trauma, although in other lower limb trauma specialties there was a large rebound effect in our unit. The greatest change in practice was observed in the treatment of malleolar fractures. There are a number of possibilities for this, however the satisfactory treatment of unstable ankle fractures in some groups using conservative management has certainly had an effect [13,14]. In our

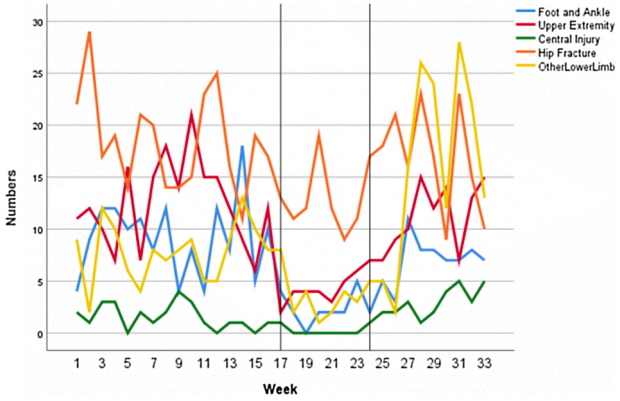

Fig. 1. Number of cases per trauma specialty. Vertical lines represent different time periods: pre-lockdown, lockdown and post-lockdown. Significant rebound effect is shown in trauma of the lower limb excluding foot and ankle and hip fractures.

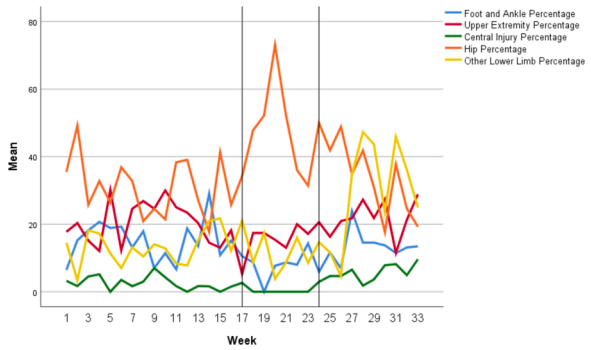

Fig. 2. Percentage of cases per trauma specialty of overall cases undertaken. Vertical lines represent different time periods: pre-lockdown, lockdown and post-lockdown. This shows that foot and ankle had the most significant reduction in surgical treatment as compared to other specialties. The percentage of hip fractures per list significantly increased as the resources diminished.

unit, improved functional results have been witnessed with surgical management of unstable ankle fractures although this does depend on the quality of ankle reduction [15]. Randomised control trials in the UK are investigating conservative versus surgical management for ankle fractures in younger age groups, as the question regarding what treatment in unstable ankle fractures gives the best functional outcome has yet to be answered. Other intra-articular fractures, such as talus and pilon fractures, showed no significant reduction. This maintenance of surgical reduction of articular injury was also observed by Vosoughi et al in Iran [16].

Liverpool University Hospital NHS Foundation Trust (LUHFT) comprises of Aintree University Hospital (AUH), a level 1 major trauma centre serving a population greater than 2.5 million people in Merseyside and Cheshire [17], the Royal Liverpool University Hospital and Broadgreen University Hospital. Prior to March 2020, all inpatient trauma occurred at Aintree University Hospital, with additional daily trauma clinics occurring at the Royal Liverpool Hospital. With the reallocation of resources and reconfiguration of clinical estate to accommodate COVID-19 patient care, all trauma was subsequently moved to one site and has remained in this current state since. Our specialist clinic setup is based on our previous work that found significant improvement in results with the use of specialist clinics and lists for foot and ankle trauma [18].

Prior to March 2020, the Liverpool Orthopaedic and Trauma Service ran four trauma theatres per day; where a full day foot and ankle trauma theatre occurred twice a week. During the lockdown period four trauma lists per day were condensed into one list, resulting in pressure to triage and prioritise cases. Hip fracture treatment, and the treatment of open fractures and dislocated joints remained unchanged during lockdown. Additional trauma lists were made available at one local private hospital from 20th May 2020 which was shared by upper and lower limb trauma teams to deal with trauma depending on demand. This has allowed some improvement in the throughput of surgical case numbers being performed with the resumption of normal specialist trauma clinics. COVID-19 'safe' pathways were set up for the treatment of trauma patients, with presurgical testing and dedicated wards. As we had no cases of COVID-19 in the foot and ankle trauma patients, we are unable to look at the effect this may have had.

The reduction in case load due to the national lockdown has certainly limited the effect of rationing and prioritising of cases by limiting the activities of social mobility of individuals. The reduction in activities during lockdown that typically result in foot and ankle trauma, such as sports activities, socialising and travel, contributed to the dramatic reduction in trauma cases. This study clearly shows a significant

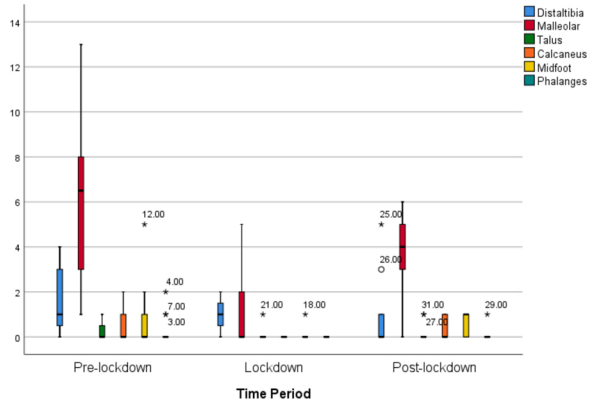

Fig. 3. Box plots representing mean number of cases per anatomical location in foot and ankle trauma per time period.

Table 1
Average number and percentage of surgical procedures completed per week divided by anatomical location and then by time period. Percentage of total foot and ankle is compared to total case performed per week, and percentage for each anatomical location is compared to the total foot and ankle cases per week.

		Mean	95% Confidence Interval		P Value	Percentage of Total (mean)	95% Confidence Interval		P Value
			Lower	Upper			Lower	Upper	
Total foot and ankle	Pre-Lockdown	9.06	7.04	11.09	**.000**	14.94	11.75	18.13	**.007**
	Lockdown	2.38	1.12	3.63		7.97	4.58	11.37	
	Post-Lockdown	5.89	4.65	7.13		11.25	9.42	13.08	
Distal Tibia	Pre-Lockdown	1.63	.90	2.35	.588	21.50	10.37	32.62	.200
	Lockdown	1.00	.37	1.63		46.88	14.42	79.33	
	Post-Lockdown	1.11	−.24	2.47		25.00	−7.94	57.94	
Malleolar	Pre-Lockdown	5.88	4.05	7.70	**.000**	62.12	48.70	75.54	.058
	Lockdown	1.13	−.45	2.70		28.13	−6.20	62.45	
	Post-Lockdown	3.56	1.83	5.28		55.54	29.96	81.12	
Talus	Pre-Lockdown	.25	.01	.49	.978	3.86	−.14	7.87	872
	Lockdown	.13	−.17	.42		6.25	−8.53	21.03	
	Post-Lockdown	.22	−.12	.56		4.07	−2.17	10.32	
Calcaneus	Pre-Lockdown	.38	.05	.70	.195	4.43	.34	8.52	.249
	Lockdown	.00	.00	.00		.00	.00	.00	
	Post-Lockdown	.33	−.05	.72		4.83	−.80	10.45	
Midfoot	Pre-Lockdown	.69	−.01	1.38	.271	5.75	.03	11.46	.841
	Lockdown	.13	−.17	.42		6.25	−8.53	21.03	
	Post-Lockdown	.56	.15	.96		8.70	2.12	15.28	
Phalanges	Pre-Lockdown	.25	−.06	.56	.428	2.34	−.46	5.15	.471
	Lockdown	.00	.00	.00		.00	.00	.00	
	Post-Lockdown	.11	−.15	.37		1.85	−2.42	6.12	

reduction in case numbers as a result. In any future COVID-19 waves or other factors causing an overwhelming loss of capacity to surgical services, such circumstances may not occur again. In our unit 13 patients (31% of fracture volume) in foot and ankle trauma had their management changed due to lack of resources and perceived risk of COVID-19 due to patient comorbidities. Follow up of these patients is crucial to understand the ongoing effect this will have on their long term function. Multiple authors from America, Italy, Ireland and Singapore have published their adaptive responses to the COVID-19 pandemic, however the results of such adaptations are not yet know [19–22].

Guidance on the ethical effects of decision making in COVID-19, promoted that decisions made were reasonable in the circumstances, based on best evidence available at the time and made in a collaborative way as much possible [23]. Our unit ensured all decision making processes were shared amongst senior clinicians with subspecialty interests and that the updated hospital fracture management guidelines were based on what was safe with the resources we had available. All potential trauma cases for surgical treatment were discussed in a daily trauma meeting with no fewer than 3 consultants present to aid decision making [6]. Loss of the senor clinicians to reconfiguration would have certainly been detrimental in this instance. Although not part of the analysis of this study, the use of virtual fracture clinics became the gateway to our unit, and limited the potential face to face interactions that could have promoted COVID-19 spread. The use of virtual clinics has been widely adopted in healthcare during the pandemic and has certainly developed a clear role in helping to minimise the spread of COVID-19 [24,25].

There are limitations to this study. The authors started the analysis of trauma cases from December 2019, as prior to this date the Liverpool Orthopaedic Trauma Service was two separate entities, and thus a different service and not comparable. Previous year's activity would have been preferable as there may have been a seasonal or time of year affect that will cause bias. Analysis for a longer period after the first wave would also have been preferable, however this may have been curtailed by a second wave and thus not show normalising of the activity.

5. Conclusions

COVID-19 has had a substantial impact on all orthopaedic surgery at the Liverpool Orthopaedic and Trauma Service, especially on foot and ankle trauma cases. There was a reduction in caseload but also a necessary change in practice (under the guidance of national bodies). There were no cases of COVID-19 infection in our cohort suggesting that the surgery is relatively safe to perform, especially if screening and self-isolation regimes are instituted. 31% of fractures were treated conservatively, differing from normal practice. These patients will require close follow-up for outcome.

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