



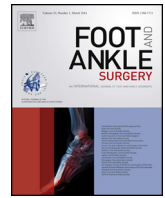
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# The UK foot and ankle COVID-19 national (FAICoN) audit – Regional variations in COVID-19 infection and national foot and ankle surgical activity

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## ABSTRACT

**Aims:** This paper details the impact of COVID-19 on foot and ankle activity in the UK. It describes regional variations and COVID-19 infection rate in patients undergoing foot and ankle surgery before, during and after the first national lock-down.

**Patients & methods:** This was a multicentre, retrospective, UK-based, national audit on foot and ankle patients who underwent surgery between 13th January and 31st July 2020. Data was examined pre- UK national lockdown, during lockdown (23rd March to 11th May 2020) and post-lockdown. All adult patients undergoing foot and ankle surgery in an operating theatre during the study period included from 43 participating centres in England, Scotland, Wales and Northern Ireland. Regional, demographic and COVID-19 related data were captured.

**Results:** 6644 patients were included. In total 0.53% of operated patients contracted COVID-19 (n = 35). The rate of COVID-19 infection was highest during lockdown (2.11%, n = 16) and lowest after lockdown (0.16%, n = 3). Overall mean activity during lockdown was 24.44% of pre-lockdown activity with decreases in trauma, diabetic and elective foot and ankle surgery; the change in elective surgery was most marked with only 1.73% activity during lock down and 10.72% activity post lockdown as compared to pre-lockdown. There was marked regional variation in numbers of cases performed, but the proportion of decrease in cases during and after lockdown was comparable between all regions. There was also a significant difference between rates of COVID-19 and timing of peak, cumulative COVID-19 infections between regions with the highest rate noted in South East England (3.21%). The overall national peak infection rate was 1.37%, occurring during the final week of lockdown. General anaesthetic remained the most common method of anaesthesia for foot and ankle surgery, although a significant increase in regional anaesthesia was witnessed in the lock-down and post-lockdown periods.

**Conclusions:** National surgical activity reduced significantly for all cases across the country during lockdown with only a slow subsequent increase in elective activity. The COVID-19 infection rate and peaks differed significantly across the country.

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<sup>1</sup> List of collaborators have been listed in Appendix A.

## Clinical relevance

- This paper highlights a significant regional variation in COVID-19 infection rates and peak of COVID-19 infections across the country; this data may be useful in planning response to subsequent waves.
- The cumulative COVID-19 infection rates suggest that the risk of contracting COVID-19 in patients undergoing foot and ankle surgery is not insignificant.
- The marked decrease in, and slow recovery of elective activity seen will need to be considered when planning restoration of elective foot and ankle services.

## 1. Introduction

Since December 2019, a global pandemic has had a confounding effect on healthcare systems worldwide with 46,591,622 confirmed cases of COVID-19 and 1,201,200 deaths as of 3rd November 2020 [1]. The United Kingdom (UK) experienced one of the highest excesses in all-cause mortality in Europe, peaking two weeks following the UK Government's announcement of a national "lockdown" with the publication of guidance "staying at home and away from others (social distancing)" on the 23rd March 2020 [2,3]. There was an all-consuming effect on the National Health Service resources in the UK leading to rationing and prioritising of care. Guidelines on apportioning services were issued with priorities set to maintain emergency surgery provision; protecting the surgical workforce; fulfilling alternative surgical roles and fulfilling alternative non-surgical roles [4,5].

On the 11th March 2020, NHS England advised that all NHS hospitals were to reduce elective activity, to the point of postponing all non-urgent elective procedures by the 15th of April 2020, for a period of at least three months [6]. Continuation of emergency surgery, including trauma was done depending on priority, with guidance on primacy of trauma produced by the British orthopaedic Association [4]. Guidance on the prioritisation of elective practice was issued by the Federation of Surgical Specialty Association [5]. The rationing of orthopaedic services occurred across the world with Phillips et al. identifying 11 reports of either selective or complete postponement of elective activity issued by orthopaedic governing bodies world-wide [7].

Although multiple authors from America, Italy, Ireland and Singapore have published their opinions on the dynamic responses to the COVID-19 pandemic in foot and ankle surgery, results of such adaptations are not yet known [8–11]. In the UK, outside of trauma and the treatment of infection or skin risk in diabetic surgery, only cases with removal of metal work across a joint and removal of intra-articular loose bodies were given an elective 'high priority' [5]. There has been limited investigation on the effect COVID-19 has had foot and ankle surgery [12]. In the UK specifically, to date there has been no study on the effects of the changes of the COVID-19 pandemic on the practice of foot and ankle surgery.

### 1.1. Aims and objectives

The primary objective of the study was to determine the regional differences in the incidence of COVID-19 positive patients receiving foot and ankle surgery in the UK, during the lockdown and peri-lockdown period. Secondary outcomes included the analysis of national foot and ankle activity across the first wave of the COVID-19 pandemic in the UK.

## 2. Methods

### 2.1. Study design

This was a retrospective national audit of foot and ankle procedures in the UK, between 13th January 2020 and 31st July 2020. All patients over 16 years of age who had undergone a foot and ankle surgical procedure were included in this study. Data was collected and anonymised by each participating NHS trust site and transferred securely to University Hospitals of Leicester NHS Trust (primary trust). Data governance was dictated by European general data protection regulations. The study was approved and registered as a clinical audit at the lead centre (Ref No. 10795). To participate, each local project lead needed to confirm local audit approval.

In each unit, patients were identified retrospectively and included if they had undergone foot and ankle surgery in an operating theatre. Each theatre attendance was recorded as a separate event. Patients were categorised into those who had COVID-19 at the time of surgery (identified as patients who had test-proven or clinically diagnosed COVID-19 infection up to 7 days before surgery), patients who had developed COVID-19 after their surgery (identified as patients in whom COVID-19 was first suspected during their index admission or within the 30 days following surgery), or patients who did not contract COVID-19 or contracted COVID-19 outside of the period above. The thresholds for these different cohorts are in keeping with other COVID-19 surgical studies [13–15].

Diagnosis of COVID-19 was based on either a positive SARS-CoV-2 lab test or computed tomography (CT) chest scan or a clinical diagnosis (no COVID-19 lab test or CT chest performed) as per study protocols of other COVID-19 surgical studies [13–15].

### 2.2. Data collection

Laboratory testing for COVID-19 infection was based on SARS-CoV-2 viral RNA detection by quantitative RT-PCR. Sampling, including nasal swabs or bronchoalveolar lavage, and analyses were done according to individual hospital protocols. All work was done in National Health Service hospitals in the UK, where the procedures for COVID-19 identification were standardised as per government guidelines. Due to the limited testing availability in the early part of the COVID-19 outbreak, patients were also included based on either clinical or radiological findings. Clinical diagnosis consistent with COVID-19 infection was made by a senior physician and based on clinical presentation of symptoms highly indicative of COVID-19 infection, including a new continuous cough, fever (37.8°) or an inability to smell or taste [16]. Radiological diagnosis was based on thorax CT, in keeping with locally implemented protocols. All patients included initially based on clinical or radiological criteria who subsequently had laboratory testing for SARS-CoV-2 infection and returned a negative result were excluded from the study.

Anonymised data was collected locally on encrypted spreadsheets before being uploaded to the Research Electronic Data Capture web application (REDCap, Vanderbilt, Tennessee). Data was collected from the 13th January 2020 to the 31st July 2020. Time periods were divided according to national guidance on the UK National lockdown (March 23rd 2020) and easing of the lockdown (May 11th 2020) [2]. Patients who contracted COVID-19 were recorded with the timing of COVID-19 diagnosis as either preoperative or postoperative. The method of COVID-19 diagnosis was entered as categorical data based on clinical or laboratory-based diagnoses. COVID-19 related complications and treatment of COVID-19 were entered as categorical data.

Surgery related variables were included. The foot and ankle diagnosis was recorded as categorical data. The diagnosis was classified based on limited variables based broadly on trauma, diabetic and elective practice. This was further divided by anatomical region and procedure.

2.3. Statistical analysis

The study was completed according to STROBE guidelines for observational studies [17]. 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 and ANOVA 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 for sample sets greater than 5, otherwise the Fisher’s exact test was used. Missing data were included in flowcharts and descriptive analyses, allowing denominators to remain consistent in calculations.

All regions in the UK were classified into single hierarchical classification of spatial units, defined by the nomenclature of territorial units for statistics (NUTS) used for statistical production across the European Union (EU).

We also analysed cumulative COVID-19 infection rate per region. This was calculated as the cumulative number of positive COVID-19 cases from the first confirmed case in this audit per region. This was expressed as a percentage of the total number of cases performed from the date of the first COVID-19 positive case in the same region.

2.4. Role of the funding source

This study was a collaborative effort of the Outcomes committee and Scientific committee of the British Orthopaedic Foot and Ankle Society who were involved in study design, data analysis, data interpretation, and writing of the report. The funders of the study had no role in the aforementioned aspects of the study. The corresponding author and analysis group had full access to all the data in the study and the corresponding author and the writing committee had final responsibility for the decision to submit for publication.

3. Results

Following communication across the UK for involvement in the national audit, 74 centres expressed an interest. A total of 43 UK centres finally participated in the audit and submitted cases as per the audit protocol. The total number of submitted episodes of surgically treated foot and ankle pathology was 7413. As per flow diagram in Fig. 1, following exclusion of cases as per audit protocol, there were 6644 unique episodes left for further analysis. All regions in the UK were represented, with the highest number of cases submitted from the South East (981 episodes) and the lowest number of cases submitted from Scotland (227 episodes).

3.1. Regional activity

The overall foot and ankle surgery activity in the submitted centres fell from an average of 399.70 (95% CI 356.56, 442.84) cases per week pre-lockdown, to 97.71 (95% CI 75.23, 120.20) cases per week during lockdown and then up to 163.58 (95% CI 145.72, 181.45) cases per week post lockdown. Fig. 1 and Table 1 illustrate the differences in submitted cases per region. Accounting for the differences in number of submitting centres in each region and the size of each centre, there was no significant difference between each region in the activity lost during lockdown or recovery post-lockdown (Fig. 2). As illustrated in Fig. 2, three regions had significant outliers at Week 10 indicating that they had started to reduce their surgical activity levels earlier than other regions.

Separating procedures by type of case (trauma, elective and diabetic surgery), the greatest loss of activity across the UK was in elective surgery (Table 2, Fig. 3). There were, however, significant decreases in trauma and diabetic surgery during lockdown, which subsequently returned to normal levels, post-lockdown. Elective surgical activity averaged 10.72% of pre-lockdown activity post lockdown, although a gradual increase was seen throughout the post-lockdown period (Fig. 3).

3.2. Regional differences in cases positive for symptomatic COVID-19

There were a total of 35 patients who were confirmed positive for symptomatic COVID-19 giving an overall infection rate across the audit of 0.53%. The first confirmed case of COVID-19 infection

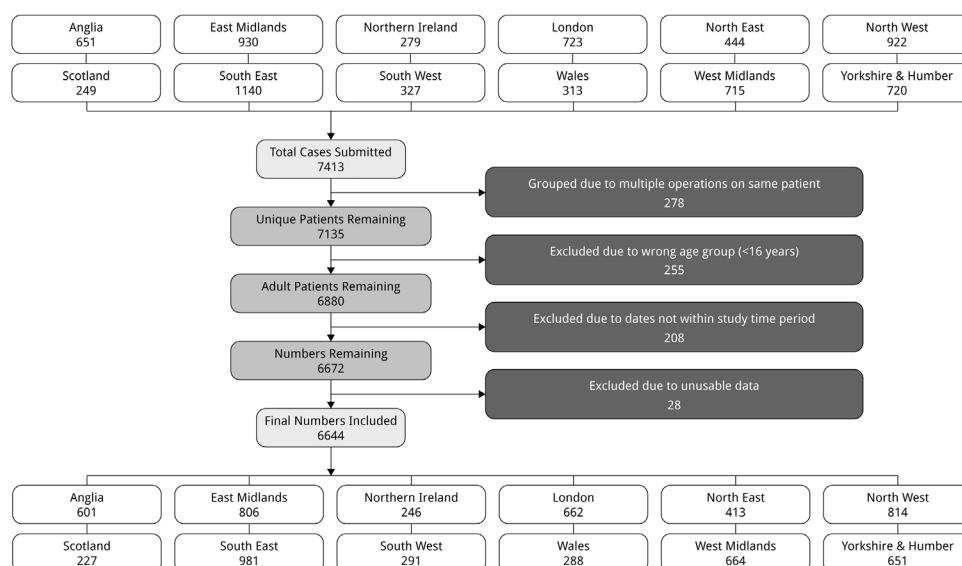
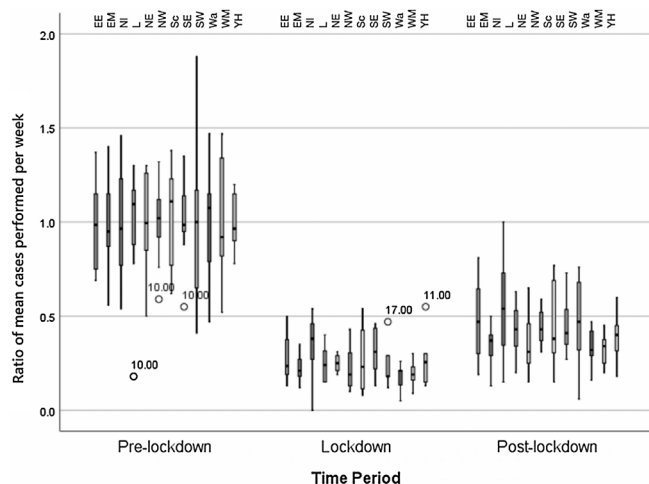


Fig. 1. Flow diagram displaying data cleansing of submitted data from each region, with different levels of case exclusion.

**Table 1**  
Percentage of COVID-19 positive case per patient per region.

	East England	East Midlands	Northern Ireland	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorks/Humber	
Total number of patients	601	806	246	662	413	814	227	981	291	288	664	651	6644
COVID-19 Positive Percentage Infection	3 0.50%	6 0.74%	0 0.00%	4 0.60%	1 0.24%	4 0.49%	0 0.00%	11 1.12%	0 0.00%	1 0.35%	1 0.15%	4 0.61%	35 0.53%



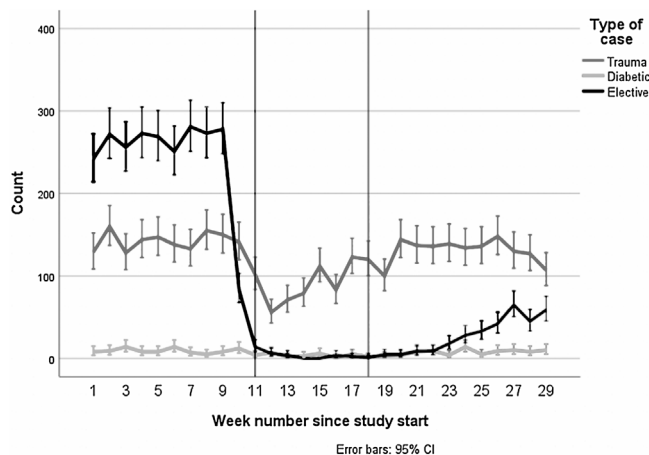
**Fig. 2.** Graphical representation of average percentage of total cases per week for each region, over time periods pre-lockdown, lockdown and post-lockdown. Using the average number of cases per region pre-lockdown to equate to 1, the lockdown and post-lockdown periods are calculated as a percentage of this average. The outlier numbers represent the week.

across the audit occurred at week 7 (week commencing 24th February 2020) in the South East Region. Using cumulative data comparison between number of positive COVID-19 cases per surgical episode from the first confirmed case in this audit, we found that the highest cumulative percentage of COVID-19 positive cases occurred at week 18 (week commencing 11th May 2020, the final week of lockdown) at 1.37%.

The rate of COVID-19 infection differed significantly ( $p < .001$ ) across the regions, with the highest percentage of COVID-19 positive cases being reported in the South East region (1.12%), and no cases being reported in Scotland, Northern Ireland and the South West regions (Table 1 and Fig. 4). Using cumulative data comparison between number of positive COVID-19 cases per surgical episode from the first confirmed case in this audit, the highest percentage COVID-19 positive cases was recorded in the South East region (3.21%) occurring at week 15 (week commencing

**Table 2**  
Mean number of patients across the UK undergoing each type of surgery per week over the different time periods in this audit.

Surgery Type		Total	Mean per time period	95% Confidence Interval		ANOVA (p value)
				Lower	Upper	
Total Trauma	Pre-Lockdown	1425	142.50	134.79	150.21	.000
	Lockdown	700	89.42	67.41	111.45	
	Post-Lockdown	1484	129.83	120.69	138.97	
Total Elective	Pre-Lockdown	93	247.90	205.74	290.06	.000
	Lockdown	30	4.29	-.17	8.74	
	Post-Lockdown	84	26.58	12.47	40.70	
Total Diabetic Surgery	Pre-Lockdown	2479	9.30	7.14	11.46	.007
	Lockdown	30	4.00	2.00	6.00	
	Post-Lockdown	319	7.17	4.90	9.43	



**Fig. 3.** Graphical representation of number of cases per week across the UK categorised by surgical type (trauma, diabetic surgery and elective). Error bars represent 95% confidence intervals. Vertical bars indicate separation of time periods between pre-lockdown, lockdown and post-lockdown.

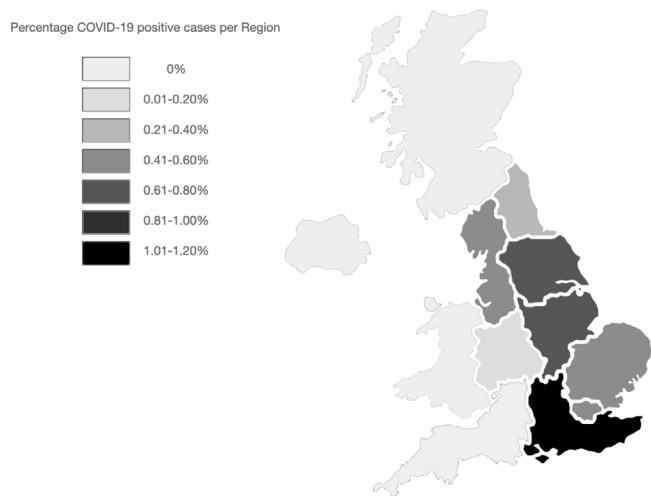
20th April 2020). The cumulative data is graphically represented for all regions in Fig. 5.

Overall, there were 16 positive COVID-19 cases that occurred out of a total of 3997 operated patients pre-lockdown (0.40%), 16 positive COVID-19 cases out of 760 patients operated on during lockdown (2.11%) and 3 positive COVID-19 cases out of 1887 patients post-lockdown (0.16%). Although most cases were clustered between weeks 8 and 12 (weeks commencing 2nd March 2020 and 30th March 2020), the South East COVID-19 positive cases peaked later at week 17 (week commencing 4th May 2020), and the North West peaked at week 18 (week commencing 11th May 2020). In the Yorkshire and Humber region the majority of cases (75%) occurred post-lockdown, with their final case occurring at week 26 (week commencing 6th July 2020).

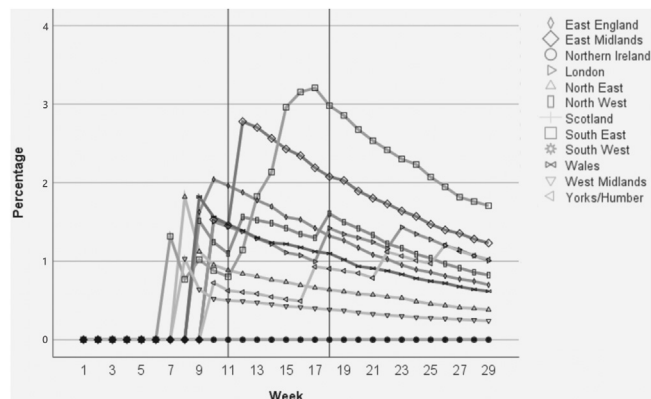
### 3.3. Case mix trauma

Comparing each anatomical location, there was a significant decrease in overall surgically treated trauma numbers during the





**Fig. 4.** Infographic illustrating the rate of COVID-19 infection across each region of the UK. The key represents the colour coding of different percentage of infection rate.



**Fig. 5.** Cumulative percentage of number of positive COVID-19 cases per surgical episode from the first confirmed case in the audit over time (weeks). Vertical bars indicate separation of time periods between pre-lockdown, lockdown and post-lockdown.

lockdown period. Table 3 compares the average weekly trauma cases across the three time periods. Significant differences were seen in all anatomical locations apart for distal tibia, talus, cuboid, cuneiform and foot and ankle tendon procedures not including Achilles. However, when accounting for the general decrease in trauma by taking each anatomical location as a percentage of total foot and ankle trauma submitted, there was a significant increase in the proportion of malleolar fractures and calcaneal fractures treated surgically in lockdown as compared to pre-lockdown, and a decrease in the percentage of Achilles ruptures. The overall numbers and percentages normalised to pre-lockdown levels post-lockdown.

### 3.4. Case mix diabetic surgery

Despite an overall decrease in diabetic surgical episodes, when subcategorised into types of diabetic surgery, there was no significant difference across the three time periods except for a decrease in the drainage of abscesses during lockdown (Table 3).

### 3.5. Case mix elective surgery

As aforementioned, the overall numbers of elective surgical episodes decreased significantly during UK lockdown, and have remained low in the post-lockdown period. When categorising into different types of elective surgery, the significant decrease in case numbers across time periods remained throughout all categories. When analysing the percentage of elective episodes allocated to each category, there was no significant difference between pre-lockdown and post-lockdown time periods for any category.

### 3.6. Anaesthetic type

The type of anaesthetic was categorised into local, regional, general and combined (general combined with regional). General anaesthesia was the most common anaesthetic used for foot and ankle surgery across all time periods and all surgery types (Table 4). There was a significant increase however ( $p < .05$ ), from pre lockdown to lockdown in the percentage of cases receiving regional anaesthesia across all surgery types. This remained similar in the post lockdown period. There were no significant differences in the use of local anaesthesia for surgery in elective or trauma, however its use in diabetic surgery reduced during the lockdown period.

### 3.7. Length of stay

In the pre-lockdown period, the majority of cases in all surgery types were done as day case procedures (Table 5). This remained the same across all time periods for elective surgery although there was a significant increase in time to discharge during the lockdown period. For trauma and diabetic surgery, the most common length of stay category post-surgical intervention changed to 3 days for trauma and 1 month for diabetes during the lockdown period which remained for the post lockdown period.

## 4. Discussion

The primary objective of the study was to determine the percentage of patients receiving foot and ankle surgery in the UK, during the audit period, who were positive for COVID-19 and their regional variation. The overall COVID-19 infection rate across the audit of 6644 patients was 0.53% (35 patients). However, the cumulative percentage COVID-19 infection rate was higher, peaking at 1.37% at week 18. When separated into regions, some regions were more severely affected, with the South East region having an overall infection rate of 1.12% and a cumulative percentage peak of 3.21% at week 17. This is the first paper to report the COVID-19 infection rate in foot and ankle surgery. A similar study in upper limb surgery by Dean et al. indicated a lower rate in upper limb surgery. However, their study only analysed the reported UK peak of COVID-19 of April 2020, with our study showing variable peaks across the country and only 20% of COVID-19 positive cases ( $n = 7$  cases) occurring in the time period they analysed [18].

Secondary outcomes of our study included the analysis of national foot and ankle activity across the first wave of the COVID-19 pandemic in the UK. Our study has shown that there were significant reductions in all cases during the COVID-19 pandemic in the UK from March to August 2020. Using the UK national lockdown period for reference, the urgent cases (trauma and diabetic surgery) recovered to normal pre-lockdown levels post-lockdown. However, in elective surgery there was a gradual recovery, which by the end of the study had only reached 22.18% of the pre-lockdown average cases per week. There were no significant differences in average activity across all regions,

**Table 3**  
Mean number and percentage of patients undergoing specific types of surgery per week across the UK during the different time periods of this audit.

Trauma Surgery		Mean	95% Confidence Interval		ANOVA	Percentage of all injuries during time period	95% Confidence Interval		Chi-Squared
Procedure			Lower	Upper	p Value		Lower	Upper	p Value
Distal Tibia	Pre-lockdown	9.90	7.86	11.94	0.215	6.98	5.56	8.40	0.174
	Lockdown	7.57	4.86	10.29		8.38	6.61	10.15	
	Post-lockdown	8.67	7.64	9.69		6.84	5.57	8.10	
Malleolar	Pre-lockdown	97.60	89.70	105.50	<b>0.000</b>	68.48	65.98	70.99	<b>0.034</b>
	Lockdown	64.71	50.13	79.30		72.87	69.54	76.20	
	Post-lockdown	86.92	80.98	92.85		67.09	64.58	69.61	
Talus	Pre-lockdown	2.00	1.11	2.89	0.497	1.45	0.77	2.12	0.661
	Lockdown	1.86	-0.10	3.81		1.87	0.13	3.61	
	Post-lockdown	2.50	1.37	3.63		1.89	1.08	2.69	
Calcaneus	Pre-lockdown	2.70	1.48	3.92	<b>0.021</b>	1.88	1.06	2.70	<b>0.025</b>
	Lockdown	2.43	1.25	3.61		2.68	1.66	3.70	
	Post-lockdown	5.08	3.28	6.89		3.82	2.55	5.09	
Cuboid	Pre-lockdown	0.10	-0.13	0.33	0.095	0.07	-0.09	0.24	0.140
	Lockdown	0.14	-0.21	0.49		0.18	-0.26	0.62	
	Post-lockdown	0.50	0.07	0.93		0.40	0.07	0.74	
Cunieform	Pre-lockdown	2.60	1.63	3.57	0.144	1.85	1.17	2.54	0.641
	Lockdown	1.14	0.02	2.27		1.28	-0.09	2.66	
	Post-lockdown	2.08	1.13	3.04		1.59	0.89	2.29	
Metatarsal	Pre-lockdown	4.10	2.61	5.59	<b>0.030</b>	2.87	1.82	3.92	0.160
	Lockdown	1.71	0.69	2.74		1.92	0.97	2.88	
	Post-lockdown	4.50	2.82	6.18		3.41	2.15	4.67	
Phalanges	Pre-lockdown	3.40	1.96	4.84	<b>0.04</b>	2.41	1.37	3.46	0.330
	Lockdown	1.29	0.26	2.31		1.32	0.18	2.47	
	Post-lockdown	3.25	2.16	4.34		2.53	1.74	3.32	
Achilles tendon	Pre-lockdown	3.50	2.53	4.47	<b>0.001</b>	2.47	1.80	3.14	<b>0.008</b>
	Lockdown	0.71	0.02	1.41		0.81	0.09	1.53	
	Post-lockdown	1.50	0.40	2.60		1.14	0.29	1.98	
Other F + A tendon	Pre-lockdown	2.20	1.20	3.20	0.340	1.57	0.87	2.27	0.842
	Lockdown	1.43	0.03	2.83		1.50	0.23	2.78	
	Post-lockdown	1.58	1.08	2.09		1.27	0.79	1.75	
Other F + A Procedure	Pre-lockdown	5.70	4.74	6.66	0.067	4.02	3.37	4.66	0.258
	Lockdown	2.14	1.02	3.27		2.49	0.89	4.08	
	Post-lockdown	6.58	3.50	9.67		4.91	2.80	7.03	
Wound management	Pre-lockdown	8.40	5.87	10.93	<b>0.024</b>	5.94	4.05	7.82	0.491
	Lockdown	4.29	1.86	6.72		4.69	2.24	7.14	
	Post-lockdown	6.67	5.33	8.00		5.11	4.23	5.98	

Diabetic surgery		Mean Number	95% Confidence Interval for Mean		ANOVA	Percentage of diabetic cases per week	95% Confidence Interval for Mean		Chi-Squared
Procedure			Lower	Upper	p Value		Lower	Upper	p Value
Wound debridement	Pre-lockdown	2.70	1.87	3.53	0.052	31.53	17.98	45.08	0.898
	Lockdown	1.13	0.08	2.17		26.49	-3.18	56.15	
	Post-lockdown	2.27	1.27	3.27		31.85	14.10	49.59	
Drainage	Pre-lockdown	0.80	0.24	1.36	<b>0.043</b>	8.87	1.39	16.34	0.085
	Lockdown	0.25	-0.14	0.64		4.58	-2.55	11.72	
	Post-lockdown	1.18	0.59	1.77		15.67	7.80	23.55	
Forefoot amputation	Pre-lockdown	4.60	2.57	6.63	0.052	45.95	32.06	59.83	0.317
	Lockdown	2.00	0.91	3.09		58.39	31.79	84.99	
	Post-lockdown	3.09	1.80	4.38		40.45	24.06	56.85	
Midfoot amputation	Pre-lockdown	0.40	-0.10	0.90	0.166	4.68	-1.94	11.31	0.233
	Lockdown	0.00	0.00	0.00		0.00	0.00	0.00	
	Post-lockdown	0.73	-0.01	1.47		7.74	-0.68	16.15	
BKA or above	Pre-lockdown	0.80	0.50	1.10	0.091	8.97	5.20	12.74	0.407
	Lockdown	0.38	-0.06	0.81		10.54	-4.34	25.41	
	Post-lockdown	0.36	0.02	0.70		4.29	-0.22	8.79	

Elective Surgery		Mean Number	95% Confidence Interval for Mean		Percentage of elective cases per week	95% Confidence Interval for Mean		Chi-Squared	
Procedure			Lower Bound	Upper Bound		Lower Bound	Upper Bound		
Elective forefoot	Pre-lockdown	125.30	100.02	150.58	<b>0.000</b>	49.74%	46.25%	53.22%	<b>0.001</b>
	Lockdown	1.50	-0.50	3.50		19.79%	0.83%	38.76%	
	Post-lockdown	12.36	4.76	19.97		36.85%	27.88%	45.82%	
Elective midfoot	Pre-lockdown	29.70	24.16	35.24	<b>0.000</b>	12.17%	10.66%	13.68%	0.256
	Lockdown	0.50	-0.13	1.13		6.99%	-1.46%	15.45%	
	Post-lockdown	3.36	1.53	5.20		13.65%	6.28%	21.01%	
Elective hindfoot	Pre-lockdown	33.90	25.64	42.16	<b>0.000</b>	13.55%	11.44%	15.66%	0.704
	Lockdown	0.88	0.18	1.57		18.45%	3.16%	33.74%	
	Post-lockdown	3.27	1.77	4.78		15.59%	7.40%	23.78%	
Elective tendon procedure	Pre-lockdown	11.20	8.80	13.60	<b>0.000</b>	4.48%	3.86%	5.10%	0.675
	Lockdown	0.13	-0.17	0.42		12.50%	-17.06%	42.06%	
	Post-lockdown	2.55	0.64	4.45		7.48%	2.16%	12.80%	

**Table 3** (Continued)

Elective Surgery		Mean Number	95% Confidence Interval for Mean		Percentage of elective cases per week	95% Confidence Interval for Mean			
Procedure			Lower Bound	Upper Bound		Lower Bound	Upper Bound		
Other	Pre-lockdown	47.80	40.77	54.83	<b>0.000</b>	20.06%	17.01%	23.10%	0.247
	Lockdown	0.88	0.05	1.70		17.26%	2.77%	31.75%	
	Post-lockdown	7.36	4.04	10.69		26.43%	18.13%	34.74%	

indicating possible similar restrictions nationally to elective recovery. With the rapid recovery of urgent surgery as compared to elective surgery, the transfer of resources away from elective surgery in the short term is likely a major factor in preventing the return to normal elective practice.

Multiple models have been proposed to predict elective recovery globally. Negopdiev et al. predicted [15] a global cancellation or postponement of 28,404,603 elective operations. Using Wuhan as their predictive model they estimated that non-urgent elective surgery would be suspended for at least 12 weeks, therefore used 12 weeks as their modelling time frame. Wood, modelled worst case scenario of restrictions on elective care to twelve months in England, with restoring performance taking two years assuming additional capacity injections of 12.5% [19]. However, neither model has factored into their calculations the initial redistribution of resources to urgent cases and is therefore likely to fail in predicting recovery. In the UK, elective orthopaedics was planned to resume in a three-phased manner, as recommended by the BOA, however further increases in COVID-19 cases nationally make these plans possibly unachievable in the short term [13].

Multiple studies, both single centre and multi-centre have shown a significant reduction in both elective and emergency orthopaedic surgery [20–22]. However, both have been problematic in predicting the effect of COVID-19 due to the restrictive time periods that have been used and the variable nature of COVID-19 infection on each community. For example, overall observational data may contradict the findings of subgroups due to the presence of Simpson paradox [23]. As aforementioned, the upper limb national audit by Dean et al. restricted their time period to one month, therefore not accounting for the variable COVID-19 peaks across the country [18]. Although, we do not believe our overall data contradicts the subgroup analysis of the regions, it was clear that there were significant differences between regions regarding COVID-19 infection rates and peaks of infections. There was however, no difference in the average proportionate decrease in

number of cases performed in trauma, elective and diabetic surgery across the regions.

The World Health Organization surveyed 155 countries during May 2020 and found half of the countries had partially or completely disrupted services for diabetes and diabetes-related complications [24]. A number of studies have also reported changing practices globally in Diabetic patients with related foot pathology due to COVID-19 [25,26]. However, our study has shown a return to normal levels of diabetic surgery practice in the post-lockdown period, with only a two month period of affected activity. Some studies have indicated a higher rate of severe infections, with significant increases in amputation rate and a higher rate of major amputation during the pandemic [27,28]. Our study however, showed no increase in minor or major amputation rate nationally.

There are multiple factors related to the differences in national trauma activity between the three time periods, with the most likely contributor being social immobility and change in activities that could cause injury due to national lockdown. To a lesser extent the rationing of surgical time, and patients opting for non-operative management would also influence the reduced numbers of surgical trauma cases. Despite guidance on the ethical effects of decision making in COVID-19, promoting that decisions made were reasonable in the circumstances, the rationing of care appears to have been mitigated by the overall reduction in the trauma volume seen [23]. Other authors have also reported a significant decrease in general orthopaedic trauma [29]. In our audit, only Achilles tendon ruptures significantly reduced in numbers and percentage of surgical trauma. This may indicate that in conditions where satisfactory results are possible without surgical management, the risk of COVID-19 infection has had its greatest influence [30].

As expected, the number of elective procedures significantly decreased during UK national lockdown due to government guidance. In our national audit there were positive cases in the elective surgical cohort of patients, two of which occurred in forefoot surgery. Therefore, foot and ankle elective surgery should not be seen as without risk. The ratio of forefoot, midfoot and

**Table 4**  
Cross-tabulation of type of anaesthesia used and time period, categorised by surgery type.

Surgery Type	Type of Anaesthetic	Time Period						Total	Chi Square
		Pre-lockdown		Lockdown		Post-lockdown			
		Number	Percentage	Number	Percentage	Number	Percentage		
Trauma	Local	20	1.44%	17	2.51%	22	1.54%	59	0.000
	Regional	211	15.23%	236	34.91%	412	28.91%		
	General	991	71.55%	361	53.40%	846	59.37%		
	Combined GA / Regional	163	11.77%	62	9.17%	145	10.18%		
	Total	1385		676		1425			
Diabetes	Local	13	13.98%	1	3.33%	11	13.10%	25	0.059
	Regional	30	32.26%	14	46.67%	33	39.29%		
	General	49	52.69%	12	40.00%	34	40.48%		
	Combined GA / Regional	1	1.08%	3	10.00%	6	7.14%		
	Total	93		30		84			
Elective	Local	353	14.51%	4	14.29%	44	13.84%	401	0.002
	Regional	256	10.52%	5	17.86%	55	17.30%		
	General	1363	56.02%	16	57.14%	180	56.60%		
	Combined GA / Regional	461	18.95%	3	10.71%	39	12.26%		
	Total	2433		28		318			



**Table 5**  
Cross-tabulation of length of stay and time period, categorised by surgery type.

Surgery Type	Length of Stay	Time Period						Total	Chi Square
		Pre-lockdown		Lockdown		Post-lockdown			
		Number	Percentage	Number	Percentage	Number	Percentage		
Trauma	Day-case	383	27.01%	136	19.51%	327	22.09%	846	0.000
	Next day	236	16.64%	153	21.95%	301	20.34%		
	3 days	270	19.04%	205	29.41%	353	23.85%		
	1 week	193	13.61%	92	13.20%	222	15.00%		
	2 weeks	180	12.69%	66	9.47%	158	10.68%		
	1 month	115	8.11%	33	4.73%	87	5.88%		
	>1 month	41	2.89%	12	1.72%	32	2.16%		
	Total	1418		697		1480			
Diabetes	Day-case	21	22.58%	5	16.67%	11	13.41%	37	0.807
	Next day	11	11.83%	2	6.67%	7	8.54%		
	3 days	7	7.53%	5	16.67%	7	8.54%		
	1 week	12	12.90%	5	16.67%	12	14.63%		
	2 weeks	13	13.98%	3	10.00%	15	18.29%		
	1 month	17	18.28%	6	20.00%	21	25.61%		
	>1 month	12	12.90%	4	13.33%	9	10.98%		
	Total	93		30		82			
Elective	Day-case	1761	71.09%	16	53.33%	203	63.84%	1980	0.000
	Next day	395	15.95%	7	23.33%	65	20.44%		
	3 days	176	7.11%	3	10.00%	22	6.92%		
	1 week	63	2.54%	0	0.00%	10	3.14%		
	2 weeks	32	1.29%	2	6.67%	4	1.26%		
	1 month	38	1.53%	0	0.00%	11	3.46%		
	>1 month	12	0.48%	2	6.67%	3	0.94%		
	Total	2477		30		318			

hindfoot cases did not change post lockdown as compared to pre-lockdown, which might have been expected if prioritisation of cases occurred on reinstatement of elective practice as recommended by the Federation of Surgical Specialty Associations [5]. However, there were no COVID-19 positive cases in elective patients during or after lockdown.

Our national audit has shown a shift in anaesthetic practice to a higher percentage of foot and ankle procedures being undertaken under regional anaesthesia in both the lockdown and post lockdown periods. General anaesthesia still remained however, the most common method of anaesthesia nationally across all time periods. There are a number of possible reasons for this change, however the most obvious contributing factor is the theory that local or regional anaesthetic would carry a lower risk of contracting a respiratory pathogen [31]. This reduction in risk was reported by Mackay et al. who found a reduction in perioperative risk of developing COVID-19 in patients undergoing regional and local anaesthesia compared to general anaesthesia [32]. However, there was significant selection bias in their groups with higher risk patients and more complex surgical procedures requiring general and spinal anaesthetic. Other factors such as reducing risk to staff and a lack of resources (ventilators) may also have contributed [31].

It has been recommended that the length of hospital stay should be kept to a minimum to prevent perioperative COVID-19 infection [31]. However, in our audit there was a national trend in the reduction in day case surgery across all surgery types. This is most likely due to a change in the type of procedures and patient types requiring surgery during the pandemic, with an increase in patients who were unable to be discharged early. Similarly, patients who had contracted COVID-19 would inevitably have an increase in hospital length of stay [33]. Therefore our data is difficult to interpret in this regard other than to note that even when early hospital discharge was recommended it was often not possible.

Our study has limitations. This was a retrospective audit of observational data and included all patients undergoing foot and ankle surgery in an operating theatre. However, during the

lockdown period a number of patients may have had interventions outside of an operating theatre or may have been treated non-operatively. Additionally, the national setup for diabetic surgery in the UK is variable, with vascular surgery sharing the responsibility for the patients. Therefore, depending on local setup, some patients would have undergone surgery not under foot and ankle and would therefore not be included in this dataset. The number of COVID-19 patients is likely an underestimation. In the early phase of our study COVID-19 swab testing was not widespread and patients were considered to have COVID-19 based on symptoms – therefore it is possible that the incidence of COVID-19 was higher than reported for this time period. Similarly, identification of COVID-19 status post-discharge was based on local / regional databases and data from readmissions. Patients who had asymptomatic COVID-19 or who travelled to another region post-operatively and developed COVID-19 may not have been captured.

## 5. Conclusion

This national audit in foot and ankle surgery has indicated that the overall COVID-19 infection rate across 6644 patients was 0.53% (35 patients), with the cumulative percentage of COVID-19 infection of 1.37%, peaking at week 18. Both the COVID-19 infection rate and timing of the peaks of infection differed significantly across the country with the highest rate being seen in the South East.

National surgical activity significantly reduced for all cases during lockdown, however in the post-lockdown period there was normalisation of activity in trauma and diabetic surgery with less than a quarter of elective activity resuming by the end of the study.

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### Competing interest statement

All authors have completed the Unified Competing Interest form (available on request from the corresponding author) and declare: administrative support from the British Orthopaedic Foot and Ankle Society and financial support from Leicester Hospitals Charity. There were no other financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

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### Transparency declaration

I (Prof Lyndon Mason), affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

### Statement of ethical approval

The principal investigator at each participating site was responsible for obtaining necessary local approvals in line with their hospitals' regulations. Collaborators were required to confirm that a local approval was in place at the time of uploading each patient record to the study database.

As this was an investigator-led, non-commercial, observational (no changes to normal patient care) audit which was extremely low risk, as only routinely available non-identifiable data was collected, then ethical approval was not required. In all cases, the project passed through the local audit department.

### Details of funding

Funding for the project was given by the Leicester Hospitals Charity to the sum of £9,300.

### Details of the role of the study sponsors

This study was a collaborative effort of the Outcomes committee and Scientific committee of the British Orthopaedic Foot and Ankle Society who were involved in study design, data analysis, data interpretation, and writing of the report. As aforementioned the funder of the study was Leicester Hospitals Charity. The funders of the study had no role in the aforementioned aspects of the study.

### Statement of independence of researchers from funders

The corresponding author and analysis group had full access to all the data in the study and the corresponding author and the writing committee had final responsibility for the decision to

submit for publication. The funders of the study had no role in the aforementioned aspects of the study.

### Patient and public involvement statement

There was no patient or public involvement in this study.

### Trial registration details

The clinical audit registration number in the principal centre was 10795.

### Data sharing statement

Data was collected by each participating NHS trust site and transferred securely to University Hospitals of Leicester NHS trust (primary trust). The data collected locally on encrypted dated sheets was then uploaded to the Research Electronic Data Capture web application. All data was anonymised.

Only anonymised data was transferred to the primary trust. All data complied with the requirements of the current legal framework in relation to data processing and with the *Regulation (EU) 2016/679* of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing *Directive 95/46/EC* (General Data Protection Regulation) as set out in the data processing agreement (uploaded separately).

The study will be carried out in accordance with national and international guidelines, as well as the basic principles of the protection of the rights and dignity of Human Beings, as set out in the Helsinki Declaration (64th Assembly Fortaleza, Brazil, in October 2013), and according to current legislation.

### Protocol

This has been submitted as a separate file.

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