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How COVID-19 has affected emergent visits to a Latin-American trauma department: Experience at a Peruvian national trauma referral center

Juan F. Pintado^{a,*}, William Gibaja^a, Rodrigo A. Vallejos^a, William Rosas^a, Ernesto Guerra-Farfan^c, Jorge H. Nuñez^{b,c,*}

^a Department of Traumatology and Orthopedic Surgery, Edgardo Rebagliati Martins Hospital, Jesús María 15072, Lima, Perú

^b Department of Traumatology and Orthopedic Surgery, University Hospital of Vall d'Hebron. Barcelona, Passeig de la Vall d'Hebron, 119-129, 08035 Barcelona, Spain

^c Department of Traumatology and Orthopedic Surgery, Mutua de Terrassa Hospital. Terrassa, Plaça del Doctor Robert, 5, 08221 Terrassa, Barcelona, Spain

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ABSTRACT

Introduction: By May 2020, Peru was the country with the third most COVID-19 cases in the Americas. The current study's overall aim was to examine the impact of the current COVID-19 outbreak on the number of non-COVID-related patient presentations to a major national emergency traumatology/orthopedics referral center in Latin America.

Methods: An observational study was performed at one of Peru's main tertiary trauma referral centers, during the current COVID-19 pandemic. Numbers of non-follow-up patients presenting to the traumatology/ orthopedics service were counted and compared between January through April 2019 and January through April 2020; and between the month immediately prior to the Peruvian government's implementation of national lock-down measures (Feb 16–Mar 15; Period 1) and the month immediately following (Mar 16–Apr 15; Period 2). The number of surgery service hospitalizations also was compared pre- versus post lockdown initiation (Period 1 vs. 2), as were patient characteristics and outcomes, like age, sex, discharge disposition, mortality, indications for hospital admission, and COVID-19 status.

Result: Comparing 2019 and 2020, no appreciable differences were detected in the number of patients seen in either January or February. However, relative to March and April 2019, the numbers of patients seen in March and April 2020 (the two months after the first Peruvian case of COVID-19 was detected) were reduced by 55.8 and 88.6%, respectively. Comparing the months immediately pre and post lockdown, the number of service patients declined by 79.9% in April, while the number of hospitalizations declined by 30.9%. The number of admissions for various surgical indications either remained stable or declined in parallel with the overall decline in admissions for all indications except for osteoporotic hip fractures and diabetic foot ulcers (both of which increased proportional to the overall number of admissions) and for hand and foot fractures, both of which decreased.

Conclusion: At our hospital, not all indications for traumatology/orthopedics service utilization declined despite the national government's directive to reduce non-COVID-related consultations and admissions. Some disorders presented with even greater frequency, which must be considered when developing contingencies for the reallocation of healthcare resources during a pandemic.

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Introduction

On March 11th, 2020, the World Health Organization (WHO) declared coronavirus disease-19 (COVID-19) a pandemic, due to the high number of cases in 112 countries outside China (Wuhan), where the disease started in late 2019. Currently, almost 8.7 million people worldwide have been infected with this virus, and

* Corresponding authors.

E-mail addresses: pintadomejia.juanfra@outlook.com (J.F. Pintado), hassan2803med@gmail.com (J.H. Nuñez).

more than 460,000 have died [1]. In Peru, on March 6th, the first COVID-19 case was confirmed, in a 25-year-old Peruvian aviator with a history of recent travel to Spain, France and the Czech Republic. Since then, exponential growth of confirmed infections with this novel SARS-CoV2 has been reported [2].

Despite early implementation of Peru's governmental prevention strategy, initiated on March 16th as a general lock-down accompanied by curfew measures, by May 2020, Peru ranked third in the Americas in terms of the number of COVID-19 cases, after the United States and Brazil [1,2]. As of the current date in Peru, 316,448 people have had infections with this virus confirmed, and 11,314 people have died [1,3]. Most of the COVID-19 cases have been located in Lima, the capital city, a phenomenon that can be explained in various ways. This includes its disproportionately large population of over 9.6 million inhabitants, which accounts for roughly 30% of the country's total population; the low adherence to lock-down measures by Lima's population; and an overburdened urban healthcare system, which was ill prepared to face the impact of a pandemic of this magnitude and severity [3]. Such problems have been reported in other Latin-American countries, as well [4,5]. Even before the current pandemic crisis erupted, most Latin American countries were facing severe problems related to the capacity of their healthcare systems to meet the huge demand of residents who depend on public systems for even for their most basic healthcare service needs [5].

Our institute, which performs more trauma and orthopedic surgeries than any other center in Peru [6], was declared a national referral center for patients with suspected or confirmed COVID-19 during the pandemic. As a result, due to COVID-19 hospitalizations, during the first month of the outbreak, the number of effective trauma beds was reduced by 80%, surgical shifts were reduced by approximately 75%, and surgeons were instructed only to perform surgery for trauma emergencies, resulting in an 84% decline in operating room use.

Another adaptation process adopted at our hospital during this pandemic period was a directive that orthopedic surgeons considered at high risk for serious complications from COVID-19 (e.g., due to advanced age, comorbid disease, or frailty) suspend their inpatient hospital activities, which has reduced surgical activity for over 100 days, through the writing of this manuscript. On the other hand, the demand for surgery in our country has started to reach unexpected levels, such that roughly 20 trauma surgeons under the age of 50 and having no known risk factors were redistributed by institutional necessity to other COVID-19 clinical services. This has resulted in trauma surgeons being called to face challenges beyond our usual practices, demonstrating that traumatology can play an important role, in emergency situations, during any public health crisis.

Accordingly, many strategies have been proposed and implemented, worldwide and in Peru, in an attempt to contain this pandemic, some of them more successful than others [7–9]. To date, considerable information has been published on the impact of the COVID-19 outbreak, including the orthopedic field, in Asia, North America and Europe [10–16]. However, little is yet known about the impact of the COVID-19 outbreak in Latin America. The overriding aim of the current study is to overview the impact of the COVID-19 outbreak on an emergency trauma department in Peru, a Latin American country. To our knowledge, no reports on the impact of COVID-19 on orthopedic and traumatology services in Latin America have yet been published. We think this information is important, because it is known that pandemic alertness varies across regions, and that certain countries are particularly vulnerable to a destructive outbreak. It is important both to report and learn from our experiences with this COVID-19 outbreak, including flaws in our approach, to augment future healthcare policies.

Materials and methods

An observational study was performed at a tertiary care hospital within the Peruvian National Health System, located in Lima, during the first month of Peruvian lock-down measures for the COVID-19 outbreak [2].

To overview the impact on the number of patients seen in our emergency department during the worldwide COVID-19 outbreak, patients seen within our traumatology emergency department over the first four months of 2019 and 2020 were compared. To study and compare the outbreak's impact on common orthopedic pathologies and surgeries performed, two different periods were analyzed: the month immediately prior to the Peruvian government declaring a State of Emergency (February 16th to March 15th, 2020; hereafter referred to as Period 1), and the first month of the State of Emergency (March 16th to April 15th, 2020; referred to as Period 2).

To be included in analysis, patients (1) had to have received traumatology or orthopedic emergency services within the observation periods of interest; 2) be over 14 years of age at the time of presentation to our service; and (3) have some pathology that would be appropriate for our clinicians to treat, including all bone fractures, dislocations, etc., in addition to diabetic and other cutaneous wounds, with referral to Plastic Surgery made, if indicated. If the same patient visited the emergency service two or more times during the same time period, only one clinical visit was counted. Excluded from analysis were 1) patients less than 14 years old at the time of presentation, and 2) patients only seen for non-complicated post-operative monitoring. Variables collected were patient's age and gender, date of their trauma, discharge disposition (home discharge, hospital admission, discharge against medical advice, or death). Data collected on patients admitted to the hospital included the admission diagnosis, whether or not surgery was required, the indication for surgery, postoperative complications, and whether or not COVID-19 was diagnosed. COVID-19 was diagnosed in patients with or without fever, dyspnea or other respiratory symptoms, who had (a) at least one positive reverse transcription polymerase chain reaction (RT-PCR) test for COVID-19, or (b) a positive COVID-19 IgM/IgG Rapid Test. The protocol for COVID-19 positive patients with indication for an orthopedic procedure has been resume in [Table 1](#).

Statistical methods

Descriptive statistics were used to present the results. To compare continuous variables between different time periods (one month pre- versus one-month post lockdown; and 2019 versus 2020), non-parametric tests for independent samples were used (Mann Whitney's U test) when a variable was not normally distributed (determined using the Wilk-Shapiro test), while parametric tests were used when data exhibited a normal distribution. For proportions, Pearson chi-square analysis was performed. For statistical analyses, we used the statistical package IBM SPSS version 25.0 (IBM Corp., Armonk, New York, USA), all inferential tests were two-tailed, and $p \leq 0.05$ was used as the criterion for statistical significance.

Results

During the first four months of 2019, the number of patients who presented for either traumatology or orthopedic emergency services, was 11,299, versus just 6363 over the same four months in 2020. Comparing each of the four months individually between 2019 and 2020, in January 2020 there was a 16.2% reduction in cases, and in February a 12.8% reduction in cases relative to those same months in 2019. Comparing March and April 2020 versus

Table 1

Protocol for COVID-19 positive patients with indication for an orthopedic procedure during the government-mandated nationwide lockdown for COVID-19 in Peru.

For All admissions patients

Patients: Mask, gloves, Chest x-ray and COVID-19 test (RT-PCR)
 Health worker contact insulation: gown, N95 or FFP2 mask, and gloves
 Wait COVID-19 Test results

For patients with Covid-19 positive Test

Patients were transferred to Covid-19 positive hospitalization area.
 If patients do not need optimization or do not have active pneumonia, dyspnea or fever: **Early Surgery.**
 If patients need optimization or have active pneumonia, dyspnea or fever: **Deferred Surgery.**

For surgery in patients with Covid-19 positive Test

Personal protective equipment (PPE) was wear for all the health workers.
 The PPE included waterproof gown, mask (the N95 and FFP2/FFP3 masks), glasses, full face coverage screen,
 Sterile gloves (2 pairs), cap and exclusive footwear, without perforations.

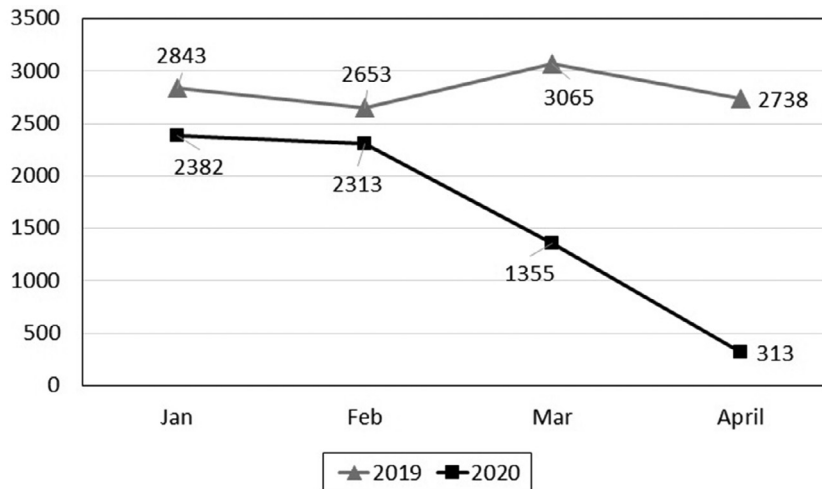


Fig. 1. Number of non-follow-up patients seen by the hospital's emergency orthopedic trauma surgery service, by month from January through April, comparing 2019 and 2020.

Table 2

Comparing the number of emergent traumatology/orthopedic service visits in the month immediately prior to and immediately after Peru's national State of Emergency declaration.

Variable	Period 1 Feb 16-Mar 15, 2020	Period 2 Mar 16-Apr 15, 2020	Statistical significance	TOTAL
Number of service visits				
Total number of service visits	2213	450		2663
Number of men (%)	945 (42.7%)	208 (44.5%)	$p = 0.40$	1153 (44.5%)
Number of women (%)	1268 (57.3%)	242 (53.5%)		1510 (55.5%)
Median age	58	61	$p < 0.05$	59
Outcome				
Discharged home	2035 (92.0%)	327 (72.7%)	$p < 0.001$	2362 (88.7%)
Hospitalized	178 (8.0%)	123 (27.3%)		301 (11.3%)

%; percentage; Period 2: the first month of the Peruvian State of Emergency.

2019, however, reductions in cases were much larger, at 55.8 and 88.6%, respectively (Fig. 1). Similarly, comparing the month immediately prior to the Peruvian government's March 16th, 2020 declaration of a State of Emergency (February 16th – March 15th, Period 1) against the month immediately following that declaration (March 16th – April 15th, Period 2), the number of patients seen by the traumatology or orthopedic service dropped from 2213 to 450, a reduction of 79.7%.

Over the two-month period combining the month immediately prior to the Peruvian government's declaration of a State of Emergency (Feb 16-Mar 15, 2020; Period 1) and the month immediately following that declaration (Mar 16-Apr 15, 2020, Period 2), a total of 2663 emergency traumatology visits were analyzed: 2213 visits during Period 1 (83.1%) and 450 during Period 2 (16.9%). Comparing the two time periods by patient gender, there was no difference (Table 2). There was, however, a statistically-significant differ-

ence in the age of patients, with the median age three years older in the second time period ($p < 0.001$). There also was a significant change in the disposition of patients, with the percentage of patients requiring admission to hospital increasing from 8.0 to 27.3% from pre- to post lockdown ($p < 0.001$).

Table 3 summarizes the indications for hospital admission and compares them between the pre- and post-lockdown declaration time periods. Overall, the number of hospital admissions to the traumatology service declined by 30.0%. Hip fractures comprised the most common reason for hospital admissions. Overall, there was a statistically significant change in the distribution of indications for hospital admissions ($p = 0.02$), with *post hoc* analysis revealing statistically-significant increases in the percentage of patients admitted for osteoporotic hip fractures (from 18.0 to 29.3%, respectively) and diabetic foot related problems (from 2.2 to 11.4%, respectively), but reductions in the percentages admitted for hand

Table 3

Comparing indications for traumatology service admission immediately prior to versus immediately after initiation of a government-mandated nationwide lockdown for COVID-19 in Peru.

Indication for surgery	Period 1: Feb 16-Mar 15, 2020		Period 2: Mar 16-Apr 15, 2020		Statistical significance
	Number	%	Number	%	
Osteoporotic Hip Fracture	32	18.0%	36	29.3%	p < 0.05
Ankle Fracture	24	13.5%	16	13.0%	NS
Forearm Fracture	23	12.9%	12	9.8%	NS
Hand Fracture	20	11.2%	5	4.1%	p < 0.05
Foot Fracture	11	6.2%	1	0.8%	p < 0.05
Tibial Plateau Fracture	10	5.6%	8	6.5%	NS
Humeral Fracture	10	5.6%	3	2.4%	NS
Tendon Injury	8	4.5%	2	1.6%	NS
Others	8	4.5%	6	4.9%	NS
Infection	7	3.9%	4	3.3%	NS
Hand Injuries	6	3.4%	3	2.4%	NS
Diabetic Foot	4	2.2%	14	11.4%	p < 0.05
Polytrauma	4	2.2%	6	4.9%	NS
Clavicle Fracture	4	2.2%	3	2.4%	NS
Non Osteoporotic Femoral Fracture	4	2.2%	1	0.8%	NS
Tumors	3	1.7%	3	2.4%	NS
Total	178	100%	123	100%	p = 0.02

%; percentage; Period 2: the first month of the Peruvian State of Emergency; NS:no statistically-significant difference.

Table 4

Demographics and clinical status of COVID-19 positive patients admitted to the traumatology/orthopedic service in the month immediately following the Peruvian government's declaration of a national State of Emergency.

Case N°	Age	Gender	Reason for admission	Date of admission	Date of surgery	Outcome	Length of stay
1	89	M	Proximal Hip Fracture	21/03/20	15/05/20	Died	55
2	84	F	PJI	4/2/2020	26/02/20	Died	30
3	55	F	Forearm Fracture	7/4/2020	21/04/20	Alive	14
4	75	F	Distal Femoral Fracture	16/04/20	-	Died	18
5	65	F	PJI	25/02/20	16/03/20	Died	20
6	72	M	PJI	5/3/2020	28/04/20	Alive	53
7	80	F	Proximal Hip Fracture	6/4/2020	9/5/2020	Alive	58
8	84	F	Proximal Hip Fracture	8/4/2020	After 15/04/20	Alive	NA
9	93	F	Proximal Hip Fracture	14/04/20	30/05/20	Alive	50
10	79	F	Proximal Hip Fracture	15/04/20	-	Died	15
11	89	M	Proximal Hip Fracture	19/03/20	After 15/04/20	Alive	NA
12	74	M	Proximal Hip Fracture	27/03/20	After 15/04/20	Alive	NA
13	84	M	PJI	28/02/20	7/3/2020	Alive	20
14	85	M	Proximal Hip Fracture	3/3/2020	24/03/20	Alive	21
15	82	F	Proximal Hip Fracture	12/3/2020	15/03/20	Alive	29
16	96	F	Proximal Hip Fracture	6/4/2020	-	Died	20

N°: number; PJI: Periprosthetic joint infection; M: Male; F: Female, NA: Information not available.

fractures (11.2 to 4.1%) and foot fractures (6.2 to 0.8%), all $p < 0.05$. Prior to the State of Emergency declaration, the leading indications for admission, in terms of absolute numbers, were osteoporotic hip fracture ($n = 32$), ankle fracture ($n = 24$), forearm fracture ($n = 23$), and hand fracture ($n = 20$), together accounting for 55.6% of all admissions. After the State of Emergency began, the four leading indications for admission continued to include osteoporotic hip fracture ($n = 36$), ankle fracture ($n = 16$), and forearm fracture ($n = 12$), but now also included diabetic foot disease ($n = 14$), instead of hand fracture ($n = 5$). (Fig. 2) These four diagnoses together accounted for a slightly increased 63.4% of the admissions (NS). The absolute number of osteoporotic hip fractures remained relatively stable over the two time periods, with 32 patients admitted in Period 1 and 36 in Period 2.

Sixteen of the 123 patients admitted to the hospital for treatment of orthopedic trauma tested positive for COVID-19 (13.0%) (Table 4). Of these 16, ten were female (62.5%) and six were male. Mean age among the 16 admitted with COVID-19 was 80.4 years old, which was statistically almost 20 years older than the mean age of the overall population of patients seen on our service over that time period ($p < 0.001$). By far the most common indication for surgery in these 16 was a proximal osteoporotic hip fracture ($n = 10$), with four additional admissions for periprosthetic joint infection, and one each for a distal femoral fracture and forearm

fracture. Of the total hip fractures during the COVID-19 outbreak, 66.0% occurred at home and 94.8% underwent surgery (37/39). The 2 patients, who were not operated on for hip fractures, were because they died before surgery.

Six of the 16 admitted patients who tested positive for COVID-19 died in hospital (37.5%), among whom five were female, three had hip fractures, and the mean age was 81.3 years. The mean length of hospital stay, among the 13 with disposition data, was 31.0 days. The cause of death of these patients were related with Covid-19 infection.

Discussion

The pandemic and resulting global emergency that led to a state of alarm in Peru has drastically changed the country's orthopedic and trauma services. Our study uncovered several relevant findings. First among them is that the number of patients visiting our traumatology/orthopedics department for new injuries markedly declined, starting in March 2020 following the first cases of COVID-19 in Peru, and continuing throughout April. A second major finding is that the overall number of patients and hospitalizations declined precipitously following the Peruvian government's declaration of a national State of Emergency. There are a variety of potential reasons for this, which include governmental and

hospital directives to preserve beds for COVID-19 cases; governmental lockdowns and curfews that limit the number of individuals permitted to see healthcare providers for anything but emergent conditions; the reduced likelihood of injury that comes from people remaining at home and out of the workplace; and many in the general public fearing going to hospitals due to the risk of contracting COVID there, among others.

Similar to our experience, others have reported reductions in the utilization of non-COVID related emergency department services during the first weeks of the current pandemic [14,17,18]. In the United States (US), data extracted from the National Syndromic Surveillance Program (NSSP) reveal that emergency department visits declined 42% early in the COVID-19 pandemic (from March 29–April 25, 2020), to just 1.2 million from a mean of 2.1 million visits per week over roughly the same time period in the previous year (March 31–April 27, 2019) [17]. Christey et al. identified a virtually identical 43% reduction in all injury-related admissions to a New Zealand Major Trauma Service when they compared two-week periods sandwiching the introduction of lockdown measures in New Zealand [18]. This reduction has been explained in other reports as an indirect effect of lockdown measures because, if people are at home, not surprisingly, the number of workplace accidents and traffic accidents should decline, as well as the risk of fractures, since most falls occur outdoors [10,17,18]. One potential reason that we observed an even greater pre- to post- lockdown reduction in patient presentations (from 2213 patients between February 16th and March 15th to just 450 between March 16th and April 15th, a 79.9% reduction) than they observed in the US and New Zealand might relate to our institution's status as a national referral center for patients with suspected or confirmed COVID-19 during the pandemic [6]. As such, despite our hospital also being our country's primary referral center for trauma, many individuals may have chosen to seek their care for injuries at other centers, due to fear of contracting COVID-19 at our hospital.

During the COVID-19 outbreak, it has become clear that emergency departments not only need to prepare for increasing numbers of COVID-19 patients; they also must preserve sufficient capacity to handle emergencies that are unrelated to the current pandemic (like falls leading to osteoporotic fractures in the elderly). In our study, we identified a reduction of approximately 90% in the number of emergent visits for orthopedic trauma in April 2020, relative to the same month in 2020. However, despite this reduction in patients seen, the absolute number of patients admitted to the hospital for osteoporotic fractures increased (from 32 to 36), and the number of patients admitted for diabetic feet increased markedly, more than tripling, from 4 to 14 patients. For both conditions, the increase in the proportion of patients admitted from the month before the State of Emergency declaration to the month immediately afterwards was statistically significant (from 18 to 29% and from 2 to 11%, respectively). Osteoporotic hip fractures have also been named the most common fractures treated during the pandemic in other countries worldwide [14,19,20]. In Italy, Giuntoli et al. reported that proximal femoral fracture was the most common fracture, both in March 2019 and March 2020, noting an 8% increase in the number of these fractures during the pandemic [20]. In a retrospective multicenter study conducted during the outbreak of COVID-19 in China, Zhu et al. also identified hip fractures as the most common fracture [19]. And in Spain, another country hard hit by COVID-19, Nuñez et al. found that, despite most trauma-related presentations decreasing in frequency over the course of the COVID-19 outbreak, the number of osteoporotic hip fractures remained stable [14]. We believe that one reason the number of hip fractures has remained stable during the pandemic is that the majority of such fractures are domestic, low-energy injuries [19]. This is an interesting finding because there is a broad international diversity in the percent-

age of residents who are 65 and older between these countries and our country: 22.4% in Italy, 18.8% in Spain, 15% in China, and just 6.8% in Peru.

The other indication for surgery that markedly increased in frequency of presentation at our hospital after a State of National Emergency was declared was diabetic foot disease, which rose from being the 11th most common indication for surgical admission to third. Gangrene and infections are two of the more serious sequelae of diabetic foot ulcer disease, often causing long-term disability, lost income, amputations, and sometimes even death [21]. As such, their proper management is central to the care of diabetes patients. We can only speculate as to the reason we observed such a sharp increase in the number of diabetic foot ulcer admissions to our service. But one potential explanation is that the country's overall reduction in non-COVID-related healthcare provision paralleled a reduction in the delivery of professional diabetic foot care. As such, patients who previously might have had ulcers detected early and treated non-surgically were only presenting to healthcare providers once their ulcers had progressed to the point of requiring surgical intervention. Similarly, the monitoring of blood sugars and diabetes severity may have suffered, with many patients being monitored by telephone rather than in person [22]. Note that, like osteoporotic hip fractures in the elderly, diabetic foot ulcers are usually manifested in elderly, non-working people, whose risk of injury thereby should not have been impacted by staying home from work.

Conversely, the only two indications for trauma surgery service admission that declined in frequency were hand and foot fractures, both of which might be expected to decline in frequency with fewer people working in blue-collar positions deemed “non-essential” by the government. Meanwhile, the absolute number of hospital admissions for all the other indications for surgery either declined in parallel to the overall decline in admissions (evidenced by minimal changes in the proportion of admissions accounted for) or remained roughly the same.

A final finding of note is that, of the four most common indications for surgery service admission prior to the State of Emergency declaration – osteoporotic hip fracture, ankle fracture, forearm fracture, and hand fracture – the top three remained within the top four afterwards and experienced no meaningful decline in the proportion of surgical admissions they account for. Only hand fractures fell out of this list. What all these findings mean is that, even with largely-successful government- and/or institution-mandated measures put into place to reduce the number of non-COVID patients admitted to hospitals, certain traumatic injuries continue to occur at high-enough rates that the provision of adequate services, operating time, and hospital beds should not be forsaken. Certain conditions, like osteoporotic hip fractures and diabetic foot ulcers, might even require additional services, operating room time, and beds. In other words, it is essential that those creating pandemic contingency plans should not automatically assume that all the indications for surgery will decrease.

The current study has limitations, which include its retrospective observational, single-center design. We also only analyzed data from one year besides 2020. We also only collected data for one month immediately before and immediately after mandated lockdown measures were implemented; as such, we cannot draw conclusions as to the long-term impact of the lockdown on patient numbers. On the other hand, strengths include it being the first to report on the impact of the present global crisis on Latin-American traumatology and orthopedic services, and that our institution is our country's largest tertiary referral center for trauma cases within the Peruvian National Health Service.

In summary, care must be taken when developing contingency plans for reallocating healthcare service resources during States of Emergency. We have found that certain health problems, like os-

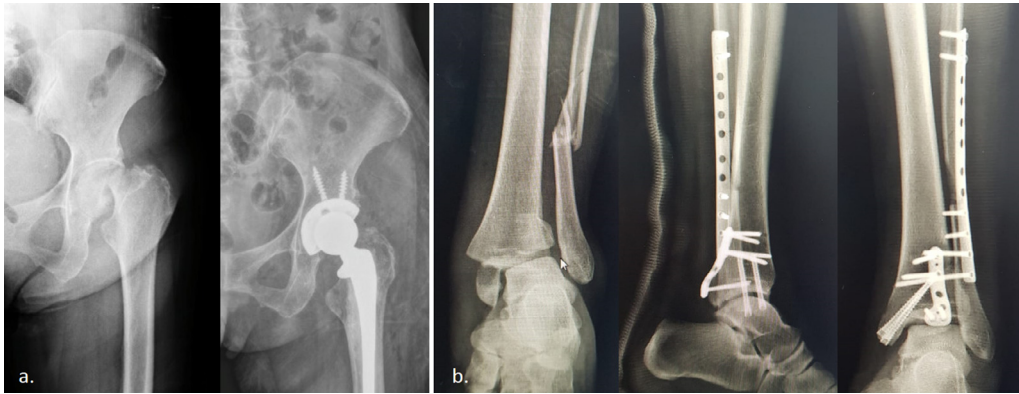


Fig. 2. Example of two treated cases during the implementation of national lock-down measures in our service. a. Hip fracture treated with a total hip arthroplasty. b. Ankle fracture treated with an open reduction and internal fixation.

teoporotic hip fractures, might not decline in the incidence of their presentation for traumatology or orthopedic services, and that others, like diabetic foot ulcers, might even increase in incidence during lockdown periods. Further research is necessary to verify our findings in other Latin American countries and elsewhere.

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Declaration of Competing Interest

Juan F. Pintado, William Gibaja, Rodrigo A. Vallejos, William Rosas, Ernesto Guerra-Farfan and Jorge H. Nuñez, declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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