



Original Article

Impact of strict population confinement on fracture incidence during the COVID-19 pandemic. Experience from a public Health Care Department in Spain



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ABSTRACT

Background: the COVID-19 pandemic has led to drastic “stay-at-home” measures for the population. The aim of this study was to know the influence of the population strict confinement on the presentation of the different types of fracture as well as on the needs of hospital admission by the Orthopedic Surgery and Traumatology Service.

Methods: a retrospective observational analytical descriptive study was carried out on the population attended in the Emergency Services of two general hospitals in a public Health Care Department in Spain. Data were studied from the two-months confinement period in 2020 and compared with the same period in 2018 and 2019.

Results: A total of 56,332 emergency cases were included. There was a decrease in the total number of patients attended along the confinement period compared to the same period in the two previous years. Fracture cases decreased by 58.8% in the confinement period (330 in 2020; 715 in 2018 and 884 in 2019). Also there was a 37.6% reduction in fractures needing admission or surgery. The percentage distribution of the types of fractures that required admission resulted in a decrease in upper and lower limb fractures, whereas the number of vertebral and hip fractures remained unchanged.

Conclusions: both the reduction of fractures attended in the emergency department and the maintenance of the number of hip fractures must be taken into account when establishing contingency plans in the event of a pandemic situation in order to properly plan human resources and materials.

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1. Introduction

On March 11, 2020, when the WHO declared the pandemic situation by COVID-19 [1]. As of May 20, 2020, more than 4,700,000 cases and more than 316,000 deaths have been reported worldwide and more than 230,000 cases and 27,700 deaths in Spain [2]. In response to this crisis, the Government of Spain promulgated the State of Alarm on March 14, 2020, by which strict rules of confinement and social distancing were imposed [3]. This state of alarm has been extended, to date, 6 times, and will remain in force at least until June 21, 2020 [4].

This pandemic has put great pressure on health systems, leading to the saturation of the Spanish Health System, and reaching in some areas the capacity of Intensive Care Units at the peak of the pandemic [5]. This situation has forced the mobilization of resources from all specialties and the suspension of elective surgery to improve the treatment of patients with COVID-19 [5–9]. During the situation of population confinement and social restriction, the emergency demand for casual, sport, work and traffic accidents seem to have decreased; and accordingly, hospital admissions due to fractures. Nevertheless, the incidence of all types of fractures may have not decreased in equal proportion and there are contradictory reports showing that the incidence of hip fractures in the elderly has remained stable [10,11] or has been reduced [12–14]. Beside these considerations, quality standards should be maintained in the treatment of orthopedic

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patients in a period with shortage and redistribution in available healthcare resources.

The objective of this study is to describe the influence of strict population confinement on the incidence of the different types of fracture as well as on the needs of hospital admission by the Orthopedic Surgery and Traumatology Service. Knowledge of these data can be useful in planning medical-hospital resources in this and in future epidemic/pandemic situations and restriction of work and social activity.

2. Materials and methods

A retrospective observational analytical descriptive study was carried out on the patients attended in the hospital emergency services of our Health Care Department. The Spanish Health System has universal health coverage for the entire population and is divided into Departments with at least one hospital to provide specialized coverage to the assigned population. Our Health Care Department has 2 public hospitals serving a population of 320,000 inhabitants, and they are a reference for specialized health assistance. The authorization of the local Ethics Committee has been obtained to carry out this study.

Patients seen in Hospital Emergencies have been reviewed in three different periods of time: period of strict confinement decreed by the Spanish Government (March 15 to May 15, 2020) [3,4] and the same periods corresponding to the years 2018 and 2019. The inclusion criteria were as follows: patient attended in the Emergency Department of one of the 2 hospitals of the Health Care Department, them being diagnosed with a fracture and/or requiring admission for a traumatic cause. In case of having been attended in the Emergency Room more than once during the same period of the year or in any of the two previous years, the clinical case of each occasion will constitute a different episode. Data were extracted from the hospital patient management system and the electronic medical records. If missing data were found in more than 2 variables the entire case was excluded from analysis.

The following variables have been collected: total number of emergencies attended in Hospital Emergency Department, number of fractures attended and whether they were treated on an outpatient basis or required admission, age, sex, type of injury, surgery, delay until surgery, duration of hospital admission and mortality. The diagnosis of COVID-19 was established with positive PCR (polymerase chain reaction) or, in case of failure, with the presence of symptoms and pulmonary CT (computed tomography) compatible with the infection.

The types of trauma injuries have been classified as follows: skull, facial, rib/sternum fractures, upper limb, lower limb (excluding hip), pelvis, spine and hip (subcapital, pertrochanteric and subtrochanteric).

In the design of the project and writing of results, the recommendations of the STROBE statement for observational studies were followed [15].

2.1. Statistical analysis

A descriptive analysis of the variables has been performed, the distribution of frequencies, absolute values and percentages for the qualitative variables and the arithmetic mean and the 95% confidence interval for the quantitative variables being calculated. The normal distribution and homogeneity of the variances have been verified with the Kolmogorov and Levene tests, respectively. To determine the differences between the values of variables in each group, a one-way analysis of variance (ANOVA) was carried out using a post hoc multiple comparison test (parametric – Bonferroni –, or non-parametric – Kruskal Wallis –, based on the results of the

tests of normality and homogeneity of the variances) for quantitative variables, and Chi square for categorical variables. Statistically significant differences were considered for values of $p < 0.05$. The statistical analysis was carried out by means of the IBM SPSS v26 software.

3. Results

A total of 56,332 patients were treated in the Hospital Emergency Departments at the 2 hospitals of the Health Care Department in the 3 periods studied: 21,502 patients (38.2%) in 2018 period, 23,439 (41.6%) in the 2019 period and 11,391 (20.2%) in the 2020 confinement period (Table 1).

Parallel to the total of Emergency Care patients, the total number of fractures attended in the Emergency Department and the total number of trauma and orthopedic emergencies that required admission decreased in the 2020 epidemic period compared to 2018 and 2019. Fracture cases decreased in the confinement period (2020 vs 2018, 54% and 2020 vs 2019, 63%). Also there was a reduction in fractures that needed admission or surgery (2020 vs 2018, 36% and 2020 vs 2019, 39%). However, the percentage of trauma emergencies that required admission for surgery was higher in the epidemic period (31%) than those percentages from the same period in the two previous years (22% in 2018 and 19% in 2019) ($p < 0.001$). Also, there was an increase in the mean age of both admitted patients and those treated on an outpatient basis (Table 1). The percentage distribution of the types of fractures that required admission was significantly different ($p = 0.01$) in 2020 compared to the 2 control periods. A decrease in upper and lower limb fractures was observed. The number of vertebral and hip fractures remained unchanged along the study periods (Table 1).

The data related to hip fractures are shown in Table 2. The distribution by types of hip fracture has remained constant. Taking all 3 periods as a whole, the most frequent type of hip fracture was pertrochanteric. The mean age of hip fracture patients did not change unlike what was observed in the general computation of admitted fracture cases. There were neither statistically significant differences in the conservative or surgical treatment decision, nor in the length of hospital stay, nor in the delay until the surgical intervention or in the mortality rate. Two patients (4%) were admitted with COVID-19 pneumonia together with the presence of a hip fracture. Both patients underwent surgery, one of whom died 15 days after surgery.

4. Discussion

The main finding of the study was a drastic reduction in the number of fractures attended during the period of confinement, parallel to a reduction in the total number of patients treated in the Emergency Department. However, the number of cases of hip and spinal fractures remained stable during the quarantine span compared to the same period in the previous two years. Recent experiences in health areas affected by the covid-19 epidemic confinement report a similar reduction in trauma cases attended in the emergency department [10–12,16]. It seems reasonable to think that the drastic reduction in the number of visits to trauma emergencies is due to the limitations in mobility in road traffic, work, sports and social activities imposed by the “shelter-in-place” order from the authorities. An additional explanatory factor for the reduction in emergency department visits, especially affecting minor pathologies, could be the fear to COVID-19, which induces avoidance behaviors and refusal to seek medical assistance [17].

In our study, a change was observed in the percentage distribution of the types of fractures that required admission in the period of strict confinement in 2020, compared to the same period

Table 1Patients attended in Hospital Emergency Department between March 15th and May 15th.

		2018	2019	2020
Total emergencies attended		21,502	23,439	11,391
Total fractures attended	N (% of total emergencies)	715 (3.3)	884 (3.8)	330 (2.9)
	Age, years ^d	52 (51–54)	49 (47–51) ^b	61 (59–64) ^c
	Male (%)	321 (45)	400 (45)	120 (36)
Fractures treated on an outpatient basis	N (% of total fractures attended)	556 (78)	719 (81)	229 (69 ^c)
	Age, years ^d	51 (49–53)	46 (44–48) ^b	58 (55–61) ^{a,b}
	Male (%)	254 (46)	331 (46)	80 (35) ^{a,b}
Trauma and orthopedic emergencies that required admission	N (% of total fractures attended)	159 (22)	165 (19)	101 (31) ^c
	Fracture location (%of total fractures admitted)			
	skull	0 (0)	1 (0.5)	0 (0)
	Facial	2 (1)	8 (4)	1 (1)
	Ribs/sternum	6 (3)	7 (4)	3 (3)
	Upper limb	55 (31)	39 (22)	18 (17)
	Lower limb	57 (32)	51 (28)	22 (21)
	Pelvis	5 (3)	9 (5)	3 (3)
	Spine	6 (3)	7 (4)	7 (7)
	Hip	49 (27)	59 (33)	52 (49)
	Age, years ^d	59 (55–63)	64 (60–68)	69 (65–73) ^b
	Male (%)	67 (42)	69 (42)	40 (40)
	Hospital stay, days ^d	4.8 (3.9–5.7)	5.9 (4.7–7.2)	4.7 (3.7–5.6)
	Delay until surgery, days ^d	1.9 (1.6–2.2)	3.6 (2.7–4.5) ^b	2.2 (1.7–2.7) ^a
	Exitus (% of total admitted)	1 (0.6)	2 (1.2)	4 (3.9)

^a Statistically significant differences regarding 2019 data $p < 0.05$.^b Statistically significant differences regarding 2018 data $p < 0.05$.^c Statistically significant differences regarding 2018 and 2019 data $p < 0.001$.^d Data shown as Mean and confidence interval 95%.**Table 2**Hip fractures between March 15th and May 15th.

		2018	2019	2020
Total		49	59	52
Age, years ^a		83 (79–86)	82 (80–85)	81 (78–84)
Male (%)		12 (25)	11 (19)	17 (33)
Type				
	Subcapital	26	24	17
	Pertrochanteric	21	31	28
	Subtrochanteric	2	4	7
Conservative treatment (%)		3 (6.1)	1 (1.6)	1 (1.9)
Hospital Stay, days ^a		7.4 (6.3–8.5)	7 (6.2–7.8)	6.2 (5.1–7.3)
Delay until surgery, days ^a		2.1 (1.6–2.6)	2.1 (1.8–2.5)	2.0 (1.3–2.7)
Surgery on the first 24 h (%)		50	30	39
Surgery on the first 48 h (%)		64	65	87
Exitus (%)		1 (2)	2 (3.4)	4 (7.8)

^a Data shown as Mean and confidence interval 95%.

in 2018 and 2019. During the quarantine period, upper limb fractures and lower limb fractures have decreased dramatically, while the number of hip fractures has remained stable. There are contradictory reports showing that the incidence of hip fractures in the elderly during confinement has remained stable [10,11] or has been reduced [12–14,18]. Previous studies in nonpandemic periods have shown that the incidence of appendicular fractures is associated with physical activity that predisposes to falls or trauma [19,20]. Hip fractures are fundamentally fragility fractures that occur spontaneously or by simple falls at home. Several epidemiological studies show that hip fractures are more related to poor bone mass, age, and gait and balance difficulties than to vigorous physical activity [21,22]. In the present study we have chosen the comparison with the same annual periods of the previous two years because there is evidence on the effect of seasonality and weather in the incidence of fractures [23]. It is possible that decrease in vitamin D was associated with falls in elderly population; a cross sectional study in children in the COVID pandemic confinement showed a decrease in vitamin D levels [24]. So it is likely this phenomenon may also have happened in elderly population and favoring falls, but with this study we cannot measure the impact of this specific risk factor for hip fracture. In our study, mean age and gender

distribution of hip fractures remained stable, as it was seen in other series [10,14,18], however, during lockdown period, the mean age of the total fractures was higher than in the previous years. Based on the literature, we believe that this could be due to a decrease in fractures due to high-energy trauma (more frequent in younger people) while fragility fractures remained stable during the confinement period [11]. In a high percentage of cases, fragility fractures (like most hip and vertebral fractures) occur at home and therefore were not affected by lockdown, and fragility fractures are more common in old people.

During lockdown period, general delay until surgery was lesser than in 2019 period, and hip fractures surgery percentage on the first 48 h trends to increase in 2020 period; we think that this happens because, as there are fewer total fractures, the pressure care in the trauma department has been reduced, so delay until surgery could be improved.

Mortality of hip fractures has doubled in this series from 3.4% in 2019 to 7.8% in the period of 2020, although, as in other studies, this increase is not statistically significant [10]; other authors have reported a significant increase in the mortality of proximal femur fractures in the pandemic period [14,25]. Two of our patients with hip fracture who underwent surgery were admitted with COVID-19 pneumonia, and one of them died.

The saturation of the Health System caused by the COVID-19 pandemic has exceeded the capacity of hospitals and especially of Intensive Care Units, thus forcing non-urgent surgery to be suspended in order to try to have the highest percentage of beds available for treatment of patients with COVID-19. Hospitals have adapted their activities and reorganized their personnel. In most of them, elective surgery has been suspended [6,7,26,27] and their surgical teams have been reduced [26]. Knowledge of the rate and types of fracture in these circumstances is of utmost importance for planning the workforce and the resources required in new pandemic situations. Unfortunately, it is not possible to know when a new epidemic or outbreak will occur, but the availability of a strategic action plan would allow the optimization of health resources. In recent years there have been several viral epidemics with international spread with variable repercussions in

the European (SARS 2003, Avian Flu 2005, Influenza A 2009), African (Ebola 2014) or American (Zika 2015) health systems. In the current COVID-19 pandemic, the enormous spread of the disease and its severity have forced an urgent restructuring of hospital activity, all non-urgent surgical and outpatient activities being cancelled. Additionally, emergency care has also been modified to prioritize care for COVID-19 patients. The data from our study supports the notion of maintaining the resources allocated to surgical and urgent care of hip fractures without reduction.

The limitations of this study are its retrospective design and the fact that the data belong to a single Health Care Department. The strengths of this work lie in the fact that it includes the total duration of the period of strict confinement in our region, the size of the population (320.000 inhabitants) and the universality in the public attention of the inhabitants of the studied area.

5. Conclusions

During the strict confinement of the population caused by the COVID-19 pandemic, there has been a decrease in care in hospital emergencies, as well as a decrease in the number of fractures attended in the Emergency Department and in the number of patients requiring admission by trauma. However, the number of hip fractures, which is the most frequent cause of emergency admission in trauma, has remained stable. When establishing contingency plans in a pandemic situation, these data must be taken into account so as to adequately plan the resources of material health equipment and personnel.

Declaration of competing interest

None.

References

- [1] World Health Organization. Coronavirus disease 2019 (COVID-19) situation report-51 [Internet]. Mar 11. 2020 [cited 2020 May 20]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf?sfvrsn=1ba62e57_10.
- [2] World Health Organization. Coronavirus disease 2019 (COVID-19) situation report-120 [Internet]. May 19. 2020 [cited 2020 May 20]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200519-covid-19-sitrep-120.pdf?sfvrsn=515cabfb_2.
- [3] Gobierno de España. Real Decreto 463/2020, de 14 de marzo, por el que se declara el estado de alarma para la gestión de la situación de crisis sanitaria ocasionada por el COVID-19 [Internet]. Boletín Oficial del Estado; 2020 Mar 14. p. 1–13 [cited 2020 May 20] (In Spanish). Available from: <https://www.boe.es/buscar/pdf/2020/BOE-A-2020-3692-consolidado.pdf>.
- [4] Gobierno de España. Real Decreto 555/2020, de 5 de junio, por el que se proroga el estado de alarma declarado por el Real Decreto 463/2020, de 14 de marzo, por el que se declara el estado de alarma para la gestión de la situación de crisis sanitaria ocasionada por el COVID-. Boletín Of del Estado 2020 Jun 5: 38027–36 (In Spanish). <https://www.boe.es/buscar/pdf/2020/BOE-A-2020-5767-consolidado.pdf>.
- [5] Legido-Quigley H, Mateos-García J, Campos V, Gea-Sánchez M, Muntaner C, McKee M. The resilience of the Spanish health system against the COVID-19 pandemic. *Lancet Public Heal* 2020 May;5(5):e251–2.
- [6] Haffer H, Schömig F, Rickert M, Randau T, Raschke M, Wirtz D, Pumberger M, Perka C. Impact of the COVID-19 pandemic on orthopaedic and trauma surgery in University hospitals in Germany. *J Bone Jt Surg Am Vol* 2020 Jul 15;102(14):e78.
- [7] Iannuzzi NP, Lack WD, Gee AO, Chansky HA. An orthopaedic department's response to the COVID-19 health-care crisis. *J Bone Jt Surg Am Vol* 2020 Jul 1;102(13):e65.
- [8] González del Castillo J, Cánora Lebrato J, Zapatero Gaviria A, Barba Martín R, Prados Roa F, Marco Martínez J. Epidemia por COVID-19 en Madrid: crónica de un reto. *Emergencias* 2020 Jun;32(3):191–3 (In Spanish).
- [9] Giorgi D, Gallazzi E, Capitani P, D'Alberti G, Bove F, Chiara O, Peretti G, Schirò GR. How we managed elective, urgent, and emergency orthopedic surgery during the COVID-19 pandemic the Milan metropolitan area experience. *Bone Jt Open* 2020 May 6;1(5):93–7.
- [10] Nuñez JH, Sallent A, Lakhani K, Guerra-farfan E, Vidal N, Ekhtiari S, Minguell J. Impact of the COVID-19 pandemic on an emergency Traumatology Service: experience at a tertiary trauma centre in Spain. *Injury* 2020 Jul;51(7):1414–8.
- [11] Hampton M, Clark M, Baxter I, Stevens R, Flatt E, Murray J, Wembridge K. The effects of a UK lockdown on orthopaedic trauma admissions and surgical cases. *Bone Jt Open* 2020 Jul 21;1(5):137–43.
- [12] Luengo-Alonso G, Pérez-Tabernero FG-S, Arguello-Cuenca JM, Calvo E. Critical adjustments in a department of orthopaedics through the COVID-19 pandemic. *Int Orthop* 2020 Aug;44(8):1557–664.
- [13] Maniscalco P, Poggiali E, Quattrini F, Ciatti C, Magnacavallo A, Caprioli S, Vadacca G, Michieletti E, Cavanna L, Capelli P. The deep impact of novel COVID-19 infection in an orthopedics and Traumatology Department: the experience of the piacenza hospital. *Acta Biomed* 2020 May 11;91(2):97–105.
- [14] Maniscalco P, Poggiali E, Quattrini F, Ciatti C, Magnacavallo A, Vercelli A, Domenichini M, Vaienti E, Pogliacomì F, Ceccarelli F. Proximal femur fractures in COVID-19 emergency: the experience of two Orthopedics and Traumatology Departments in the first eight weeks of the Italian epidemic. *Acta Biomed* 2020 May 11;91(2):89–96.
- [15] Vandenbroucke JP, Elm E Von, Altman DG, Götzsche PC, Mulrow CD, Pocock SJ, Poole C, Schlesselman JJ, Egger M, STROBE initiative. Strengthening the reporting of observational studies in epidemiology (STROBE): explanation and elaboration. *PLoS Med* 2007 Oct 16;4(10):e297.
- [16] Zagra L, Faraldi M, Pregliasco F, Vinci A, Lombardi G, Ottaiano I, Accetta R, Perazzo P, Apolito RD. Changes of clinical activities in an orthopaedic institute in North Italy during the spread of COVID-19 pandemic: a seven-week observational analysis. *Int Orthop* 2020 Aug;44(8):1591–8.
- [17] Harper CA, Satchell LP, Fido D, Latzman RD. Functional fear predicts public health compliance in the COVID-19 pandemic. *Int J Ment Health Addiction* 2020 Apr 27:1–14. <https://doi.org/10.1007/s11469-020-00281-5> [Published online ahead of print]. <https://link.springer.com/article/10.1007/s11469-020-00281-5>.
- [18] Ojeda-Thies C, Cuarental-García J, Ramos-Pascua LR. Decreased volume of hip fractures observed during COVID-19 lockdown [Internet]. *Eur Geriatr Med* 2021 January. <https://doi.org/10.1007/s41999-020-00447-3>. <https://link.springer.com/article/10.1007/s41999-020-00447-3>.
- [19] Keegan THM, Kelsey JL, King AC, Quesenberry CP, Sidney S, Permanente K, Care M. Characteristics of fallers who fracture at the foot, distal forearm, proximal humerus, pelvis, and shaft of the tibia/fibula compared with fallers who do not fracture. *Am J Epidemiol* 2004 Jan 15;159(2):192–203.
- [20] Kelsey J, Samelson E. Variation in risk factors for fractures at different sites. *Curr Osteoporos Rep* 2009 Dec;7(4):127–33.
- [21] Johnell O, Kanis JA, Oden A, Johansson H, Laet C De, Delmas P, Eisman JA, Fujiwara S, Kroger H, Mellstrom D, Meunier PJ, Iii LJM, Neill TO. Predictive value of BMD for hip and other fractures. *J Bone Miner Res* 2005 Jul;20(7):1185–94.
- [22] Johansson H, Kanis JA, Oden A, Johnell O. BMD, clinical risk factors and their combination for hip fracture prevention. *Osteoporos Int* 2009 Oct;20(10):1675–82.
- [23] Bischoff-Ferrari H, Orav J, Barrett J, Baron J. Effect of seasonality and weather on fracture risk in individuals 65 years and older. *Osteoporos Int* 2007 Sep;18(9):1225–33.
- [24] Yu L, Ke HJ, Che D, Luo SL, Guo Y, Wu JL. Effect of pandemic-related confinement on vitamin D status among children aged 0–6 years in Guangzhou, China: a cross-sectional study. *Risk Manag Healthc Pol* 2020 Nov 19;13:2669–75. <https://www.dovepress.com/effect-of-pandemic-related-confinement-on-vitamin-d-status-among-child-peer-reviewed-fulltext-article-RMHP>.
- [25] Muñoz Vives J, Jornet-Gibert M, Cámara-Cabrera J, Esteban P, Brunet L, Delgado-Flores L, Camacho-Carrasco P, Torner P, Marcano Fernández F. Mortality rates of patients with proximal femoral fracture in a worldwide pandemic: preliminary results of the Spanish HIP-COVID observational study. *J Bone Jt Surg Am Vol* 2020 Jul 1;102(13):e69.
- [26] Ranuccio F, Tarducci L, Familiari F, Mastroianni V, Guizio E. Disruptive effect of COVID-19 on orthopaedic daily practice: a cross-sectional survey. *J Bone Jt Surg Am Vol* 2020 Jul 15;102(14):e77.
- [27] Askari A, Arasteh P, Jabalameli M, Bagherifard A, Razi M. COVID-19 and orthopaedic surgery: experiences from Iran. *J Bone Jt Surg Am Vol* 2020 Jul 1;102(13):1126–8.