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ABSTRACT

Background: The COVID-19 pandemic has caused a great impact on orthopedic surgery with a significant curtailment in elective surgeries which is the major bread and butter for orthopedic surgeons. It was also observed that the spectrum of orthopedic trauma injuries has shifted from more severe and frequent road traffic accidents (high energy trauma) to general, low energy house-hold injuries like low energy fractures in the elderly, pediatric fractures, house-hold sharp cut injuries and nail bed lacerations. The aim of this study is to appraise the effect of the COVID-19 pandemic on orthopedic surgical practice, both inpatient and outpatient facility.

Materials and methods: This is a retrospective cross sectional study conducted in a tertiary care teaching hospital. We collected data of patients admitted from February 1, 2020 to 30th April 2020 in the orthopedic service line using non-probability consecutive sampling. This study population was divided into pre-COVID and COVID eras (6 weeks each). The data included patient demographic parameters like age, gender and site of injury, mechanism of injury, diagnosis and procedure performed and carrying out of COVID-19 Polymerase Chain Reaction (PCR) test in the COVID-era.

Results: We observed that outpatient clinical volume decreased by 75% in COVID era. Fifty percent of surgical procedures decreased in COVID era as compared to pre-COVID era. Trauma procedures reduced by 40% in COVID era. Most common mechanism of injury was household injuries like low energy falls. A significant reduction in elective surgeries by 67% was observed in the COVID era.

Conclusion: The impact of COVID-19 pandemic has significantly changed the spectrum of orthopedic injury. More household injuries have occurred and are anticipated due to the ongoing effects of lockdown.

1. Introduction

Since the initial spread of novel coronavirus from Wuhan, China, the world's dynamics have changed in almost every sector of life. Despite desperate containment measures taken by China the virus has spread in 210 Countries and Territories around the world. The World Health Organization (WHO) declared Covid-19 as a pandemic on March 11, 2020 [1,2].

Pakistan reported its first case on 26th February 2020 in Karachi [3]

-the patient had travelled back from Iran; this case was diagnosed at our institution. Since then the tally has risen to 160,118 cases and 3093 deaths as of today, June 18, 2020 [4]. Steps had been taken pre-emptively by the government and enforced across the country via law enforcement agencies (military, police and paramilitary staff) in accordance with federal and provincial laws and regulations to restrict the spread of the virus. A complete lockdown was put in order on 15th March 2020, with closure of all businesses with exception of essential services, like grocery shops and the healthcare sector. All means of

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public transport, as well as inter-city and international travel were restricted. Information regarding precautions which included hand hygiene, use of facial masks, physical and social distancing was disseminated and reinforced repeatedly [5].

The COVID-19 pandemic has adversely impacted the entire world with the brunt to be borne even by third world and Lower-Middle Income Countries (LMICs). In Pakistan, it has negatively affected our struggling economy, industries, and private businesses and institutions. Hospital dynamics have seen an interesting dichotomy: on one hand hospitals are overwhelmed with COVID-19 cases, while at the same time many private hospitals are struggling with a decrease in number of elective procedures and are therefore at a financial disadvantage. To ensure the availability of Personal Protective Equipment (PPE) and restrict spread of COVID-19; all elective surgeries were put on hold and only emergency and semi-urgent procedures were facilitated nationwide, and in our institute as well, from 16th March 2020 to 30th April 2020. Outpatient clinics and the orthopedic emergency bay were restricted to emergency issues such as infections, fractures, and follow-up care of post-operative patients. The screening of these patients was done by clinical staff and consultants only (residents were excused from the clinics); the rest of the patients were managed via tele-clinics which is a promising evolving modality [6–8]. All academic and administrative meetings were switched from physical to virtual ones.

It was also observed that the spectrum of orthopedic trauma injuries has shifted from more severe and frequent road traffic accidents (high energy trauma) to general, low energy house-hold injuries like low energy fractures in the elderly, pediatric fractures, house-hold sharp cut injuries and nail bed lacerations. This in turn may be a consequence of the nation-wide lockdown, where the majority of the population was living indoors. We have also observed some fire arm gunshot injuries. This may implicate the impact that joblessness and the subsequent economic burden (precipitated by the lockdown) has had on people; such instances have taken place despite deployment of law enforcement personnel in the city. The aim of our study was to appraise the effect of the COVID-19 pandemic on orthopedic surgical practice, both inpatient and outpatient. In this article we describe change in spectrum of orthopedic trauma objectively and compare procedures performed before and during the Covid-19 pandemic using the hospital management system at our institution.

2. Materials and methods

This is a retrospective cross sectional study conducted in one of the best tertiary care teaching hospitals in the region after obtaining IRB approval from our hospital’s ethical review committee. Our work has been reported in lines with STROCCS criteria [9]. The research registry unique identifying number is researchregistry5558. We collected data of patients admitted from February 1, 2020 to 30th April 2020 in the musculoskeletal and sports medicine service line using non-probability consecutive sampling. This study population was divided into pre-COVID and COVID eras (6 weeks each) according to date of admission: from 1st February 2020 to 15th March 2020, and 16th March 2020 to 30th April 2020 respectively. Patients in the pre-COVID era were admitted through Orthopedic Emergency Bay and clinics before imposition of lockdown and all sorts of emergency and elective surgeries were performed, while patients in the COVID era were admitted when lockdown was enforced in the city. Data was obtained from operation theatre and admission logs using the hospital information management system. The data included patient demographic parameters like age, gender and site of injury, mechanism of injury, diagnosis and procedure performed and carrying out of COVID-19 Polymerase Chain Reaction (PCR) test in the COVID-era.

Diagnosis and procedures were categorized into 4 major categories: trauma, infections (arthrotomy, debridements, synovectomy etc.), tumors and elective surgeries (arthroplasty, sports related ligamentous procedures, removal of implants etc.). Trauma surgeries were further

categorized into soft tissue procedures and fracture fixation. Trauma surgeries were also stratified according to the region involved and subdivisions as per site involved. Microsoft Excel and statistical package for social sciences (SPSS v24) was used for data entry and statistical analysis. Nominal and categorical variable like gender and type of procedure were recorded as frequency and percentages and analyzed via Chi-square test or Fischer Exact test. Discrete and continuous data like age and length of stay were expressed as means with standard deviation or median with inter-quartile ranges and analyzed using independent *t*-test. A *p*-value of ≤ 0.05 was considered as significant with the confidence interval kept at 95%.

3. Results

3.1. Descriptive characteristics of study participants

A total of 405 patients who were admitted were included in the study during three months period for both eras (Pre-COVID: 269 patients & COVID: 136 patients) representing the fact that 50% admissions were reduced due to lockdown in COVID-19 era. The mean age (\pm SD) of study participants was 42.9 (\pm 21.4) years in Pre-COVID group and 37.6 (\pm 23.5) in COVID group. The higher age in Pre-COVID era is due to elective surgical procedures in older age group, like total joint replacement. Males were predominant in both groups: 62.8% and 68.4% in pre-COVID and COVID era respectively (Table 1). Out of 136 patients in the COVID group, 40 patients (29.3%) had their SARS-CoV-2 (PCR) tests done and only 2 (5%) tested positive for COVID-19.

3.2. Change in spectrum of orthopedic injuries and surgical intervention

During the study duration of three months, 390 surgical procedures were performed out of 405 patients admitted to the musculoskeletal service line at our institution. Majority of the procedures performed during COVID era were associated with trauma (62.8%) while only 21.71% of the procedures were performed as semi-elective surgeries, which included tumors and removal of implants (as semi-elective procedure by certain patients) during lockdown. Table 2 shows the distribution of surgical procedures performed based on presenting diagnosis before and during COVID era.

COVID-19 disrupted daily practices: elective orthopedic procedures like joint replacements, nerve and tendon transfer, reconstruction of sports related injuries and care delivery system of orthopedic surgery. The number of surgical procedures performed during COVID era ($n = 129$) were 50% less as compared to pre-COVID group ($n = 261$). This effect was observed in number of ways. First, the number of elective procedures was reduced significantly in COVID era: 28 as compared to 80 cases in pre-COVID period. Similarly, tumor procedures were reduced from 21 in pre-COVID group to 7 in the COVID group. Infection

Table 1
Summary of descriptive statistics of study participants.

S#	Variables	Pre-COVID Era N = 269 n (%)	COVID Era N = 136 n (%)	<i>p</i> -value
1	Mean Age (in years)	42.9 \pm 21.4	37.6 \pm 23.5	0.03 (CI = 0.53–9.99)
2	Gender	169 (62.8%)	93 (68.4%)	0.322
	Male	100 (37.2%)	43 (31.6%)	
	Female			
3	Admission type	189 (70.3)	80 (58.8)	0.026
	Clinic	80 (29.74)	56 (41.2)	
	ER			
4	Surgical Intervention	261 (970)	129 (94.9)	0.278
	Yes	8 (3.0)	7 (5.1)	
	No			

Table 2
Distribution of surgical procedures performed based on diagnosis.

S#	Surgical procedures based on diagnosis	Pre-COVID Era N = 261 n (%)	COVID Era N = 129 n (%)	p-Value
	Trauma related procedures	133 (51.0)	81 (62.8)	0.246
	Infection related procedures	27 (10.3)	13 (10.1)	
	Tumor related procedures	21 (8.0)	7 (5.4)	
	Elective procedures	80 (30.7)	28 (21.7)	

related procedures were reduced almost 50% from 27 pre-COVID, to 13 in the COVID period. Surgical procedures related to trauma were reduced from 133 to 81 from pre-COVID to COVID era. Covid-19 also changed the spectrum of traumatic injuries in terms of the nature of injuries, age, gender, site and region of injury, mechanism of injuries, and number of cases (procedures performed).

Our study showed that presentation of road traffic accidents (RTA) decreased radically from 51.5% (Pre-COVID) to 24.7% (during COVID) while household injuries increased from 40.9% (Pre-COVID) to 64.2% (during COVID). Table 3 demonstrates the change in mechanism of orthopedic injuries from Pre-COVID to COVID era in relation to age.

We further segregated the trauma data into fractures and soft tissue

Table 3
Mechanism of injuries from Pre-COVID to COVID era in relation to age.

S#	Age Group	Mechanism of Injury	Pre-COVID Era N = 132 n (%)	COVID Era N = 82 n (%)	p-value
	0–16 years N = 37 (18 = Pre-COVID and 17 = COVID)	RTA	9 (50.0)	4 (21.1)	0.242
		Machine/industrial injuries	1 (5.6)	1 (5.3)	
		Household injuries	6 (33.3)	13 (68.4)	
		Pathological fracture	1 (5.6)	0 (0.0)	
		Miscellaneous (gunshots and assaults)	1 (5.6)	1 (5.3)	
		RTA	36 (63.2)	11 (32.4)	
	17–50 Years N = 91 (57 = Pre-COVID and 34 = COVID)	Machine/industrial injuries	2 (3.5)	3 (8.8)	0.41
		Household injuries	16 (28.1)	17 (50.0)	
		Pathological fracture	0 (0)	0 (0)	
		Miscellaneous (gunshots and assaults)	3 (5.3)	3 (8.8)	
		RTA	23 (40.4)	5 (17.9)	
		Machine/industrial injuries	1 (1.8)	0 (0)	
	>50 years N = 85 (57 = Pre-COVID and 28 = COVID)	Household injuries	32 (56.1)	22 (78.6)	0.117
		Pathological fracture	1 (1.8)	0 (0)	
		Miscellaneous (gunshots and assaults)	0 (0.0)	1 (3.6)	
		RTA	68 (51.5)	20 (24.7)	
		Machine/industrial injuries	4 [3]	4 (4.9)	
		Household injuries	54 (40.9)	52 (64.2)	
4	Total N = 213 (132 = Pre-COVID and 81 = COVID)	Pathological fracture	2 (1.5)	0 (0)	0.02
		Miscellaneous (gunshots and assaults)	4 (3.0)	5 (6.2)	
		RTA	68 (51.5)	20 (24.7)	
		Machine/industrial injuries	4 [3]	4 (4.9)	
		Household injuries	54 (40.9)	52 (64.2)	
		Pathological fracture	2 (1.5)	0 (0)	

injuries. We encountered 110 procedures of fracture fixation in Pre-COVID era (out of 261) as compared to 59 patients (out of 129) in COVID era. Lower limb fractures were fixed mainly 48.2% in Pre-COVID and 45% in COVID era. Most common lower limb procedures among adults involved fixations for proximal femur fractures including neck of femur and per-trochanteric fractures in both eras. No significant difference was observed between the two groups (p = 0.176).

Among the upper limb fractures in adults, the major bulk was confined to mid-shaft humerus, supracondylar and distal radius fractures. In COVID era low energy distal radius fractures topped the group (43%) while mid-shaft and distal humerus fractures involving a younger population was the most common injury (35.6%). Most of the fractures in the pediatric population (<16 years) were supracondylar fractures (Table 4).

We observed a significant change in spectrum of soft tissue injury (p = 0.045). Nail bed lacerations and clean sharp lacerations increased from 19% in the pre-COVID to 43% in the COVID era. Moreover clean and acute tendon and nerve injuries requiring repair also increased approximately 4 times in COVID era as compared to the pre-COVID era. However requirement of wound debridement for dirty wounds decreased by almost 32% in the COVID era. One patient required fingertip flap after auto-amputation of finger in the COVID era as compared to 2 patients who required flap coverage procedures for the same in pre-COVID era (Table 5).

4. Discussion

The burden of orthopedic trauma in Pakistan is already high due to few and far between tertiary health care centers and state of art facilities throughout the country. Tertiary care centers are available in major cities of Pakistan like Karachi in the south and Lahore in the center. Neglected, missed and mismanaged orthopedic injuries add to this burden. The current pandemic has aggravated the already compromised situation leading to further delay in optimal management. Most of orthopedic procedures involving use of power tools like drills, reaming and saw generate lots of aerosol particles, that can be a potential source of spreading infection, however there is no direct evidence to date regarding presence of viral particles in bone and bone marrow. Pulse lavage is commonly used in multiple orthopedic procedures. Pathogens surviving in these droplets of <5 micron suspended in the air can be a source of acquiring COVID-19 infection for orthopedic surgeons and

Table 4
Spectrum of Trauma in Pre-COVID and COVID eras.

Diagnosis	Pre-COVID Era N = 110 n (%)	COVID Era N = 59 n (%)	p-value
Lower limb fractures			0.176
Proximal femur fractures	16 (30.2)	13 (48.1)	
femur and tibia shaft fractures	14 (26.4)	8 (29.6)	
Foot and ankle fracture	13 (24.5)	5 (18.5)	
Distal femur and proximal tibia fractures	10 (18.9)	1 (3.7)	
Total	53 (100)	27 (100)	
Upper limb fractures			0.327
Proximal humerus and clavicle	8 (17.8)	3 (14.3)	
Mid-shaft and distal humerus	16 (35.6)	4 (19.0)	
Radius Ulna shaft	7 (15.6)	2 (9.5)	
Distal Radius	9 (20)	9 (42.9)	
Carpal/Metacarpal/Phalanges	5 (11.1)	3 (14.3)	
Total	45 (100)	21 (100)	
Pelvis/acetabulum and spine fractures			0.545
Pelvis and acetabulum	3 (42.9)	3 (75.0)	
Spine	4 (57.1)	1 (25)	
Total	7 (100)	4 (100)	
Pediatric fractures			0.636
Supracondylar humerus fractures	4 (80.0)	5 (71.4)	
Distal femur fractures	1 (20.0)	2 (28.6)	
Total	5 (100)	7 (100)	

Table 5
Comparison of soft tissue procedures for traumatic injuries.

Soft tissue procedures	Pre-COVID Era N = 26 n (%)	COVID Era N = 21 n (%)	p-value
Laceration repair	5 (19.2)	9 (42.9)	0.045
Wound debridement	17 (65.4)	5 (23.8)	
Tendon + nerve repair	2 (7.7)	6 (28.6)	
Flap coverage	2 (7.7)	1 (4.7)	
Total	26 (100)	21 (100)	

staff [10]. This phenomenon of fear can affect the orthopedic work force and increase morbidity among health care professional [11,12]. Five orthopedic residents in our center tested positive for COVID-19 and accordingly several other residents and staff had to be quarantined due to contact tracing despite of using proper PPE during patient care and procedures.

In our study we observed a significant reduction in the total hospital volume, both outpatient and inpatient facility in the COVID era. Our outpatient clinic volume for orthopedic service was reduced significantly from 3834 in pre-COVID era to 994 in COVID era (almost 25% of that in the Pre-COVID era). This volume included initial, follow-ups, and tele-clinic consultations. The number of orthopedic admissions reduced by approximately 50% (Pre-COVID era N = 269 and COVID era N = 136) with a significant reduction of admissions from the clinic and an increase in admissions from the emergency department ($p = 0.026$). This change in admissions was due to the fact that the outpatient facility was restricted to semi-elective and urgent issues like infections, fractures and tumors. Moreover the fear of contracting the COVID-19 virus dissuaded patients from coming to the hospital. In a cross-sectional study conducted in Hong Kong, Wong et al. [13] reported 49.2% reduction in orthopedic hospital admissions among 43 public hospitals and 21.9% reduction in out-patient clinic volume among 122 outpatient facilities.

It was observed that the majority of admissions in COVID era were due to trauma (63%); however we noted a 40% reduction in trauma related procedures (Pre-COVID era $n = 133$ and COVID era $n = 81$). This change was possibly due to the lockdown, with very few vehicles on the roads. This also lead to a 70% reduction in number of road traffic accidents in the COVID era (Pre-COVID $n = 68$ and COVID $n = 20$). It was observed that the commonest mechanism of injury among the trauma patients of COVID period was household injuries including low energy fractures due to falls, sharp cut and nail bed lacerations. The number of cases in this subgroup remained almost the same in the COVID era as compared to the pre-COVID era, however its proportion among the trauma cases significantly increased from 41% (Pre-COVID era) to 64% (COVID era). When stratified according to age it was seen that there were two common age group presentations: pediatric age group with nail bed lacerations and pediatric fractures, and geriatric age group with low velocity injuries like fractures of hip and distal radius. The younger, active, and more agile age group (from 25 to 45 years) usually involved in RTAs was missing in the COVID era and open fractures were also reduced due to lockdown.

Our findings showed a significant reduction in elective surgeries by 67% ($p < 0.001$). In pre-COVID duration, 24 knee replacements, 8 hip replacements, 5 anterior cruciate ligament reconstructions, 6 meniscectomies, 4 elective Achilles tenotomies, and 17 implant removal procedures were performed. In COVID era, two elective hip replacements (due to unbearable pain secondary to Rheumatoid Arthritis) were performed, one ACL reconstruction was performed and 22 implant removal procedures were done. The implant removal procedures were semi-elective in 10 cases, (8 procedures in the pediatric population, and 2 procedures in adults for infection), the rest of the 12 procedures were elective. The patients who opted for implant removal electively did so because they were bound to stay home due to mandatory lockdown; otherwise they would have to take earned leave from their jobs. Tendon and nerve decompression procedures for carpal tunnel syndrome and

tenosynovitis were not performed in the COVID era while in pre-COVID era 16 of such procedures were performed. Wong et al. [13] reported 73.9% reduction in elective procedures including Arthroplasty and sports ligamentous procedures which is comparable to our study. Nicholas et al. [14] projected a massive decrease in the arthroplasty procedures in USA in year 2020 due the effects of pandemic.

This is the first orthopedic study from hospital database systems that evaluates the change in the spectrum of orthopedic injuries during the COVID era from our country. The caveat of our study is that the sample size is small, and that it is a single center study due to the scarcity of well-maintained hospital databases in the majority of health care units in the country.

The COVID-19 pandemic has hit world economy especially LMIC with struggling economy. It has become difficult for developing countries to cope with the prolonged lockdown, continued economic disruption, and unemployment. However relaxing the restrictions will likely lead to accelerated spread of COVID-19 and a huge increase in the burden of COVID-19 patients on the health care system, which may not be able to cope with this situation. We have seen this happening in Italy, U.K., Spain and other European countries. Yet restrictions on business, industries and mobility are not sustainable for long, as they may lead to a different type of crises –poverty, hunger, desperation and crime with reverse outcomes again adversely affecting the population. The conundrum is exacerbated by a marked insensitivity among much of the population towards the threat COVID-19 poses –with abundant and remorseless violations of the SOPs that the governments have rolled out in parts of both developed and developing countries.

The caveats were significantly reduced workforce as residents were reassigned to COVID ward coverage, reduced scheduled OR time, financial implications of using PPEs. These were managed by attending doing outpatient clinics with no residents and having only one resident/fellow scrub in the OR for every case.

The way forward is to strike a balance: the imposition of what is being called “smart lockdown”, completes with the avoiding of non-essential gatherings, maintaining social distancing, frequent hand washing and stringent use of face masks –all this with the concurrent opening of business, industries, and hospitals for elective work. We are unsure when the chaos and uncertainty will end, or if the world will be the same again –but the damage can be mitigated we use rationale decision making based on strong scientific evidence.

5. Conclusion

The impact of COVID-19 pandemic has significantly changed the spectrum of orthopedic injury. More household injuries have occurred and are anticipated due to the ongoing effects of lockdown. There will be a rebound surge of elective surgeries such as Arthroplasty, correction of mal-united fractures and contractures due to prolonged and inadequately managed cases during the lockdown period. Orthopedic surgeons should take extra measures during COVID crisis to protect orthopedic community and staff from corona disease while working to ensure optimal outcomes for their patients.

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Appendix A. Supplementary data

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