Title: THE EFFECTS OF THE COVID-19 PANDEMIC ON PEDIATRIC ORTHOPEDIC TRAUMA, A SINGLE-CENTER RETROSPECTIVE STUDY

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Abstract

Introduction:
The novel coronavirus-2019 (COVID-19) pandemic caused significant disruption to the fields of orthopedic and trauma surgery worldwide. Government-imposed lockdown and hospital reallocation of resources led to significant changes in admission rates and treatment protocols. Current literature is sparse on epidemiological data, specifically within the United States, regarding changes in orthopedic trauma surgery in the pediatric population following COVID-19 lockdown. Thus, to help enhance the understanding of how pandemics impact the incidence and distribution of orthopedic trauma in pediatric patients, our study seeks to elucidate epidemiological trends from patient records as well as analyze the changes in the types of orthopedic injuries and the mechanisms associated with such injuries. Further understanding of the considerable effects of the COVID-19 pandemic on pediatric orthopedic trauma can help guide future healthcare resource allocation.

Methods:

We conducted a retrospective cohort study on pediatric patients ages 1 day to 16 years old, admitted for any orthopedic injury over the past 5 years (9/2018 to 8/2021) at a Midwest level 1 trauma center. Cases were stratified into two groups based on the United States COVID-19 lockdown (March 19, 2020), Pre-COVID-19 cases were any cases prior to lockdown, and Intra-COVID-19 which are cases following lockdown. Numerical data and categorical variables were summarized and the normality of the distribution of data was evaluated using the Anderson-Darling normality test. Differences between the case groups were examined using a two Proportion Z-Test or an Independent Two-Sample t-test. Pearson's chi-squared or Fisher's exact tests were used to compare categorical data between groups.

Results:

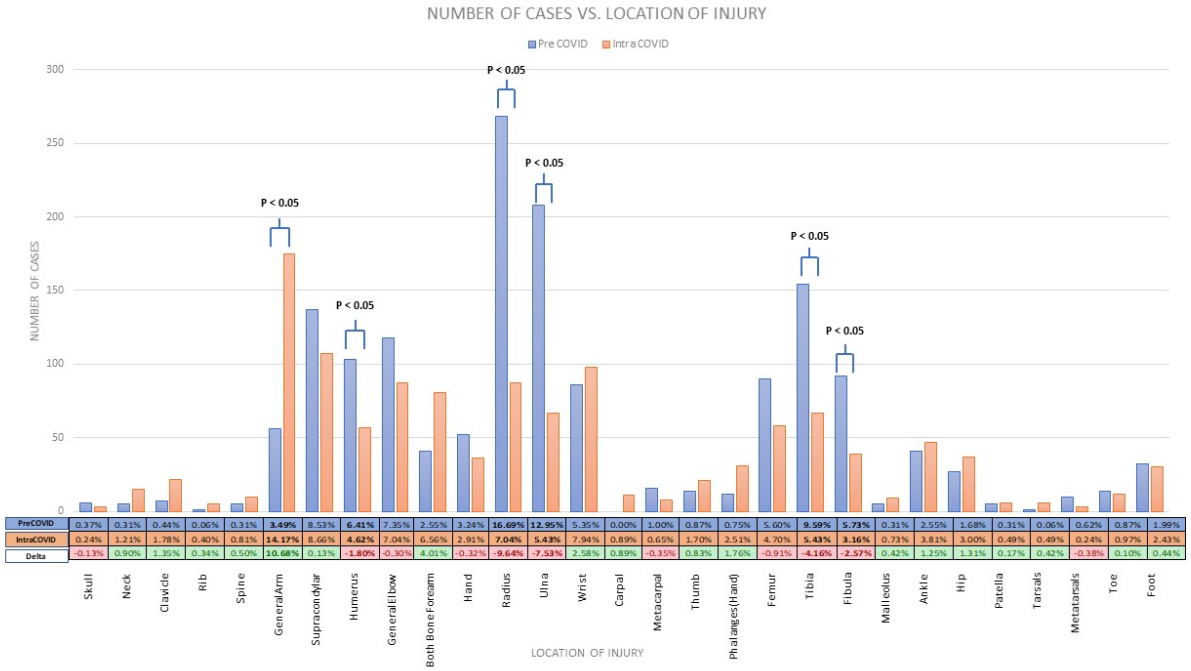
A total of 3,179 pediatric orthopedic referrals occurred between the Pre-COVID-19 and Intra-COVID-19 study periods. A total of 1,606 injuries were charted during the Pre-COVID-19. We observed a general decrease in orthopedic injuries following COVID-19 lockdowns with 1235 injuries following lockdown. Patterns in the locations of injuries changed, notably,

fractures at the humerus (103 Pre-COVID-19 vs. 57 Intra-COVID-19), individual radius (268 Pre-COVID-19 vs. 87 Intra-COVID-19), individual ulna (208 Pre-COVID-19 vs. 67 Intra-COVID-19), tibia (154 Pre-COVID-19 vs. 67 Intra-COVID-19), and fibular injuries (92 Pre-COVID-19 vs. 39 Intra-COVID-19) decreased significantly ($p < 0.05$) (**Figure 1**). Injury mechanisms also showed a shift in trends as the most commonly documented mechanisms of injury during the Pre-COVID-19 era were non-specific falls (616), monkey bars (125), and basketball (68) (**Figure 2**). During COVID-19, the causes changed with most injuries being a result of non-specific falls (318), bicycles (113), and trampolines (82). Notably, several mechanisms of injuries decreased in a statistically significant manner following the onset of covid. Specifically, in terms of causes cited for the injuries, monkey bars decreased by 3.1% ($p < 0.05$), basketball decreased by 1.7% ($p < 0.05$), and automobiles decreased by 1.5% ($p < 0.01$). The largest increases in the frequency of mechanism of injury seen across the study periods were trampolining and bicycling, with 4.1% and 6.7% cases cited more frequently during covid. Shifts in the setting of injuries were also noticeable as 161 injuries were documented at home which increased to 253 following lockdown ($p < 0.01$). Additionally, the number of injuries dropped from 123 to 44 at school following lockdown ($p < 0.01$).

Conclusions:

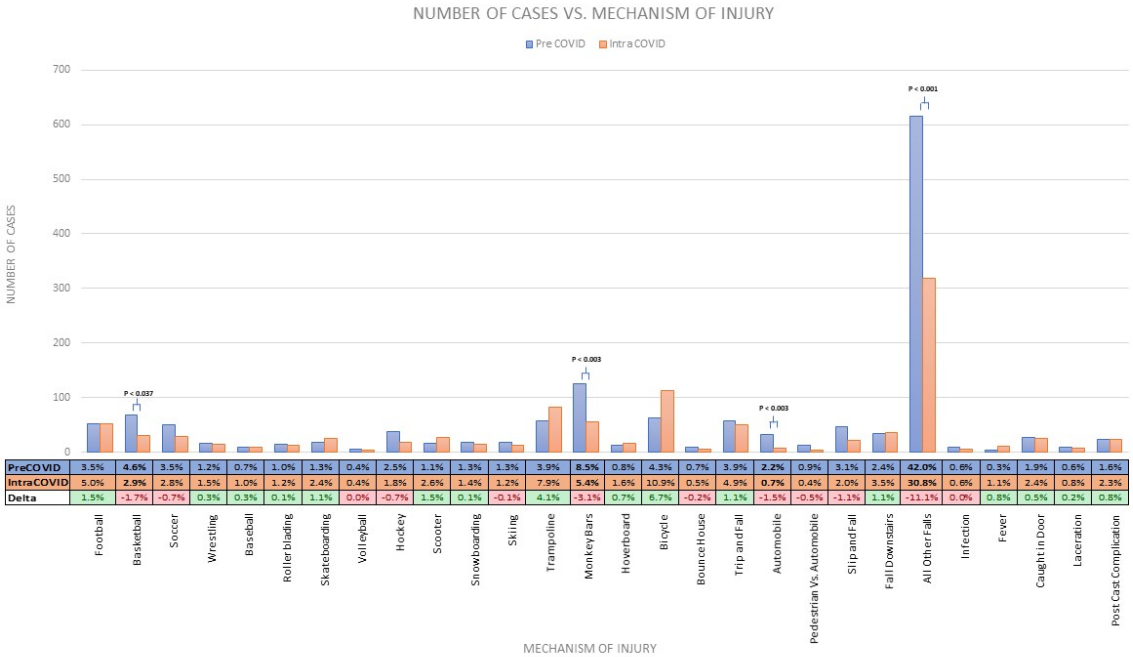
The COVID-19 pandemic and its related countermeasures (lockdown, school shutdowns, etc.) have had significant impacts on pediatric orthopedic disease trends with regard to location, mechanism, and setting of the location. Although there was a reduction in acute orthopedic trauma referrals, many injury mechanisms displayed similar trends regardless of restrictions. Understanding changes in injury and treatment trends allows us to highlight potential red flags when evaluating these patients in this context. In addition, our work assessing care latency highlights the importance of effective, pre-emptive resource allocation. Further epidemiological studies are required to assess the impacts of the resultant delayed and virtual care on patient outcomes which would further underline this point.

Figure 1: Comparative Assessment of Pediatric Orthopedic Cases Pre-COVID-19 and Intra-COVID-19



	Skull	Neck	Clavicle	Rib	Spine	General Arm	Supracondylar	Humerus	General Elbow	Both Bone Forearm	Hand	Radius	Ulna	Wrist	Carpal	Metacarpal	Thumb	Phalanges (Hand)	Femur	Tibia	Fibula	Malleolus	Ankle	Hip	Patella	Tarsals	Metatarsals	Toe	Foot
PreCOVID	0.37%	0.31%	0.44%	0.06%	0.31%	**3.49%**	8.53%	**6.41%**	7.35%	2.55%	3.24%	**16.69%**	**12.95%**	5.35%	0.00%	1.00%	0.87%	0.75%	5.60%	**9.59%**	**5.73%**	0.31%	2.55%	1.68%	0.31%	0.06%	0.62%	0.87%	1.99%
IntraCOVID	0.24%	1.21%	1.78%	0.40%	0.81%	**14.17%**	8.66%	**4.62%**	7.04%	6.56%	2.91%	**7.04%**	**5.43%**	7.94%	0.89%	0.65%	1.70%	2.51%	4.70%	**5.43%**	**3.16%**	0.73%	3.81%	3.00%	0.49%	0.49%	0.24%	0.97%	2.43%
Delta	-0.13%	0.90%	1.35%	0.34%	0.50%	**10.68%**	0.13%	**-1.80%**	-0.30%	4.01%	-0.32%	**-9.64%**	**-7.53%**	2.58%	0.89%	-0.35%	0.83%	1.76%	-0.91%	**-4.16%**	**-2.57%**	0.42%	1.25%	1.31%	0.17%	0.42%	-0.38%	0.10%	0.44%

Figure 2: Comparative Assessment of Pediatric Orthopedic Cases Pre-COVID-19 and Intra-COVID-19



	Football	Basketball	Soccer	Wrestling	Baseball	Rollerblading	Skateboarding	Volleyball	Hockey	Scooter	Snowboarding	Skiing	Trampoline	Monkey Bars	Hoverboard	Bicycle	Bounce House	Trip and Fall	Automobile	Pedestrian Vs. Automobile	Slip and Fall	Fall Downstairs	All Other Falls	Infection	Fever	Caught in Door	Laceration	Post Cast Complication
PreCOVID	3.5%	**4.6%**	3.5%	1.2%	0.7%	1.0%	1.3%	0.4%	2.5%	1.1%	1.3%	1.3%	3.9%	**8.5%**	0.8%	4.3%	0.7%	3.9%	**2.2%**	0.9%	3.1%	2.4%	**42.0%**	0.6%	0.3%	1.9%	0.6%	1.6%
IntraCOVID	5.0%	**2.9%**	2.8%	1.5%	1.0%	1.2%	2.4%	0.4%	1.8%	2.6%	1.4%	1.2%	7.9%	**5.4%**	1.6%	10.9%	0.5%	4.9%	**0.7%**	0.4%	2.0%	3.5%	**30.8%**	0.6%	1.1%	2.4%	0.8%	2.3%
Delta	1.5%	-1.7%	-0.7%	0.3%	0.3%	0.1%	1.1%	0.0%	-0.7%	1.5%	0.1%	-0.1%	4.1%	-3.1%	0.7%	6.7%	-0.2%	1.1%	-1.5%	-0.5%	-1.1%	1.1%	-11.1%	0.0%	0.8%	0.5%	0.2%	0.8%