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# New Injury Patterns in Pediatric Supracondylar Fractures During COVID-19: Beds Are the New Monkey Bars

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**Background:** The coronavirus disease 2019 (COVID-19) pandemic drastically altered children's activity patterns. Our goal was to investigate how COVID-19 affected demographics, injury characteristics, treatment patterns, follow-up, and outcomes in pediatric supracondylar humerus (SCH) fractures.

**Methods:** This was an Institutional Review Board–approved retrospective analysis of patients undergoing surgery for a SCH fracture from May to November 2019 (pre-COVID-19) and from May to November 2020 (during COVID-19) at 2 tertiary children's hospitals. Demographic information, injury characteristics, hospital course, and follow-up data were collected and compared.

**Results:** SCH fractures decreased by > 50% from 2019 (149) to 2020 (72). Children in the 2020 cohort were younger (mean 5.2 y old) compared with 2019 (6.0 y old) ( $P=0.019$ ). Mechanism of injury was significantly different in 2020 ( $P<0.001$ ), as the proportion of trampoline and furniture fractures increased from 8% and 17% to 15% and 33%, respectively. The proportion of playground and monkey bar fractures decreased from 20% and 17% to 3% and 4%, respectively. Distribution of Gartland type and neurovascular injury rates were similar in 2019 and 2020 ( $P=0.411$  and  $0.538$ ). Time from emergency department admission to the operating room and duration of hospital admission were both unchanged from 2019 to 2020 ( $P=0.864$  and  $0.363$ ). The duration of postoperative follow-up in 2019 was 94.5 days compared with 72.8 days in 2020 ( $P=0.122$ ), as more pandemic patients were lost to follow up (22.5% vs. 35.2%,  $P=0.049$ ).

**Conclusions:** The demographics, mechanism of injury, and follow-up practices of pediatric SCH fractures changed significantly during the pandemic, likely because of school closures and lockdowns changing activity patterns. Different mechanisms of injury affected younger patients and reflected the new ways children played. Trampoline-related and furniture-related injuries overtook the classic playground falls as primary mechanism of injury. Despite the need for COVID-19 testing, there was

no delay in time to the operating room. Hospitalization duration did not change, yet postoperative follow-up was shorter, and more patients were lost to follow up. Despite these stressors, outcomes remained excellent in most children.

**Level of Evidence:** Level III—Retrospective comparative study.

**Key Words:** supracondylar humerus fracture, COVID-19, trauma, injury patterns, monkey bars, pediatric

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The coronavirus disease 2019 (COVID-19) pandemic spread rampantly across the world, prompting drastic government-driven public health interventions. These included recommendations for significant social distancing to reduce the demand on the health care system.<sup>1,2</sup> Although these policies have limited the spread of COVID-19, they also changed the patterns of orthopaedic trauma around the world. Notably, a significant decrease in pediatric fractures has been documented around the world after the shelter-in-place announcements of March 2020.<sup>3–6</sup>

This fundamental change in the epidemiology of pediatric fractures is likely because of the change in patterns of children's activities throughout the pandemic.<sup>7</sup> The closures of schools meant the halting of sporting activities and playground usage.<sup>8,9</sup> During the fall and spring, sports are among the most common settings for pediatric injuries.<sup>10,11</sup> Thus, it is not surprising that there has been a decrease in sports and playground-associated fractures documented since the start of the pandemic restrictions.<sup>7</sup> This decrease in sports and playground injuries has been accompanied by an increase in fractures occurring at home.<sup>3</sup>

Patterns of follow-up care for orthopaedic injuries also changed to decrease unnecessary health care traffic and to respond to strained health care capacity. The American College of Surgeons,<sup>12</sup> the Centers for Disease Control,<sup>13</sup> and the American Academy of Orthopaedic Surgeons<sup>14</sup> made recommendations to postpone all elective surgical cases during specific COVID surges. The British Society for Children's Orthopaedic Surgery<sup>15</sup> advised follow-up appointments by telephone and the use of conservative treatment for previously surgically managed injuries. Other studies have suggested that such conservative measures and reductions in in-person follow-up

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have not resulted in increased complication rates or readmissions.<sup>16</sup>

Yet to be determined is how epidemiologic and health delivery changes during the pandemic have affected the care of pediatric supracondylar humerus (SCH) fracture. SCH fractures are the most common pediatric fracture, accounting for 55% to 80% of all pediatric elbow fractures in pediatric patients with an estimated incidence of 177 per 100,000.<sup>17,18</sup> Such fractures usually occur as a result of a fall from height (eg, playground structures).<sup>19</sup> Although Bram et al<sup>7</sup> found a similar decrease in the volume of SCH fractures in 2020 compared with all types of pediatric fractures, the pandemic-related changes in epidemiology, mechanism of injury, follow-up care, and outcomes have yet to be elucidated for this common pediatric fracture.

Our goal was to investigate how COVID-19 affected patient demographics, injury characteristics, treatment patterns, follow-up, and clinical outcomes in pediatric SCH fractures.

## METHODS

### Patient Selection and Data Collection

After receiving the Institutional Review Board approval, a retrospective analysis was performed from a prospectively collected database of pediatric patients who underwent surgery for a SCH fracture at 2 affiliated tertiary children's hospitals in neighboring cities. Two time periods were evaluated, 1 after the declaration of the pandemic from May to November 2020 (COVID cohort) and 1 the year prior during May to November 2019 (pre-COVID cohort). This May to November period represents the time where operative care was significantly impacted but not in a complete state of shut down. Inclusion criteria consisted of pediatric patients 12 and younger who underwent surgical management of SCH fractures. All patients were included in the demographic analysis. Patients were excluded from the follow-up analysis if the follow-up occurred at an outside hospital.

Medical records were evaluated to extract patient demographics, injury characteristics, hospital course, and follow-up data. Hospital course information consisted of operating room (OR) wait time, defined as time from emergency department (ED) admission to OR entrance, as well as total admission time, defined as time from ED admission to hospital discharge. Follow-up data consisted of total number of follow-up visits (sum of in-person and video encounters), duration of follow-up (number of days from surgery to final clinic visit—whether in-person or by video). Cases were considered “lost to follow up” if they did not return to clinic despite the documented instructions to do so. Final pain score, degrees of elbow range of motion, and carrying angle were extracted from their final clinic visit note, whether in-person or by video. Range of motion was assessed in-person by standard physical exam. When video visits were utilized, ROM was assessed on camera with aid of parent, and carrying angle was assessed by frontal view of extended elbows on

camera. The number of patients with at least 1 video visit (a billable clinical encounter with provider) was recorded. The number of patients with at least 1 documented telephone encounter (not a billable encounter) was recorded. Telephone encounters included documented calls with provider, physician extender, nurse or administrative team member, and addressed clinical and/or logistical issues. The clinical results were graded according to Flynn criteria, which assigns a result of excellent, good, fair, or poor based on loss of carrying angle and total range of elbow motion.<sup>20</sup>

Student unpaired samples *t* tests were used to evaluate significance between mean values. A  $\chi^2$  test was used to assess significance between categorical variables in each cohort (sex, injury characteristics, and mechanisms of injury). A *P*-value of <0.05 was considered statistically significant for all calculations. All statistical computations were conducted in RStudio (version 1.3.959; RStudio: Integrated Development Environment for R).

## RESULTS

During the study periods, a total of 72 SCH fractures were treated from May to November 2020 compared with 149 SCH fractures from May to November 2019. This represents a 51.7% decrease in SCH fracture volume from 2019 to 2020 in the same 6-month period. All 221 patients were included in the demographic and hospital course analysis, though 8 patients were transitioned to an outside hospital for follow-up care and were not included in follow-up analysis.

Demographic, clinical, treatment, and outcomes findings are provided in Table 1. Children in the 2020 cohort were younger (mean 5.2 y old) compared with the 2019 cohort (mean 6.0 y old) (*P*=0.019), though sex distribution remained unchanged (53.7% male to 51.3% male, *P*=0.859). Mechanism of injury was significantly different in the 2020 cohort compared with the 2019 cohort (*P*<0.001). Specifically, the proportion of trampoline-related and furniture-related fractures increased in 2020 by 89% (from 8.1% to 15.3% of fractures) and 98% (from 16.8% to 33.3% of fractures), respectively. The proportion of playground fractures and monkey bar fractures decreased in 2020 by 86% (from 19.5% to 2.8% of fractures) and 76% (from 17.4% and 4.2% of fractures), respectively. The proportion of gymnastics (2.7% to 1.4%) and sports-related fractures (2.0% to 1.4%) was similar between the 2 cohorts.

The distributions of Gartland fracture type were similar in 2019 and 2020 (*P*=0.411). In addition, the incidence of neurovascular insult, open fracture, and open reductions were similar between the 2 cohorts (*P*=0.538, 1.000, and 0.938, respectively). The proportion of patients transferred from an outside hospital was consistent from 2019 to 2020 (68.4% vs. 69.4%, *P*=0.881). The time from admission to the ED to the OR (OR time) was not significantly different from 2019 to 2020 despite the need to wait for COVID-19 tests before surgery (*P*=0.864), and duration of hospital admission was not changed (*P*=0.363).

**TABLE 1.** Demographics, Injury Characteristics, Hospital Course, and Follow-up for 2019 (Pre-COVID-19) and 2020 (During COVID-19) Cohorts

	Pre-COVID-19	During COVID-19	P*
Included patients			
Total cohort	149	72	—
Excluded due to OSH follow-up	7	1	—
Follow-up analysis cohort	142	71	—
Demographic information			
Sex, male/female	80/69	37/35	0.859
Age, mean ± SD (y)	6.0 ± 2.3	5.2 ± 2.3	<b>0.019</b>
Mechanism of injury, n (%)	—	—	<b>&lt;0.001</b>
Fall (Other)	35 (23.5)	27 (26.4)	—
Playground	29 (19.5)	2 (2.8)	—
Monkey bars	26 (17.4)	3 (4.2)	—
Furniture	25 (16.8)	24 (33.3)	—
Wheels (bike, scooter, and skateboard)	15 (10.1)	11 (15.3)	—
Trampoline/bounce	12 (8.1)	11 (15.3)	—
Gymnastics	4 (2.7)	1 (1.4)	—
Sports	3 (2.0)	1 (1.4)	—
Injury characteristics			
Gartland type	—	—	0.411
Type 2	63 (42.3)	31 (43.1)	—
Type 3	67 (45.0)	36 (50.0)	—
Type 4	19 (12.7)	5 (6.9)	—
Injury severity			
Neurovascular Insult	21 (14.1)	8 (11.1)	0.538
Open fracture	0	0	1.000
Required open reduction	14 (9.4)	7 (9.7)	0.938
Outside hospital transfer	102 (68.4)	50 (69.4)	0.881
Hospital course			
OR wait time, h	10.0 ± 5.5	9.9 ± 5.1	0.864
Total admission time, h	21.6 ± 8.0	22.9 ± 12.2	0.363
Follow-up			
No. follow-up Visits, N	3.4 ± 1.7	3.0 ± 1.4	0.170
Duration of follow-up, d	94.0 ± 108.8	72.8 ± 52.5	0.122
Lost to follow up, n (%)	32 (22.5)	25 (35.2)	<b>0.049</b>
Pain at last visit, n (%)	6 (4.2)	4 (5.6)	0.647
Documented telephone call (nonbillable), n (%)	11 (7.8)	17 (23.9)	<b>&lt;0.001</b>
Video visit (billable clinical encounter), n (%)	6 (4.2)	26 (36.6)	<b>&lt;0.001</b>
Outcomes, n (%)			
Flynn criteria	—	—	0.081
Poor	7 (6.5)	2 (4.6)	—
Fair	7 (6.5)	0	—
Good	21 (19.6)	4 (9.1)	—
Excellent	72 (67.3)	38 (86.4)	—

Statistically significant findings P values are in bold.

\*Student unpaired samples *t* test for mean values and  $\chi^2$  test for categorical values.

The duration of postoperative follow-up lasted 94.0 days and 3.4 visits in 2019 compared with 72.8 days and 3.0 visits in 2020 ( $P=0.122$  and  $0.170$ ). This difference is underscored by the significant increase in frequency of patients who were lost to follow up in 2020 compared with 2019 (35.2% vs. 22.8%) ( $P=0.049$ ). Furthermore, utilization of phone calls placed increased in 2020 ( $P < 0.001$ ), whereas the proportion of patients who had at least 1 video visit increased from 4.2% in 2019 to 36.6% in 2020 ( $P < 0.001$ ).

Despite the changes to injury patterns and follow-up, clinical outcomes remained unchanged. The proportion of

patients with pain at their last follow-up visit was stable (from 4.2% to 5.6%). The distribution of Flynn criteria for postoperative outcomes also remained unchanged. The proportion of those patients who demonstrated poor outcomes in 2019 and 2020 was 6.5% and 4.6%, respectively. The proportion of those patients who demonstrated excellent postoperative outcomes was 67.3% and 86.4%, respectively ( $P=0.081$ ).

### DISCUSSION

The incidence of pediatric SCH fractures decreased during the COVID-19 pandemic, likely because of the changes in activity patterns and closures of schools and parks. This matches the findings of Bram and colleagues who demonstrated a 60% decrease in pediatric fractures overall and a 71% decrease in pediatric SCH fractures during their pandemic study period compared with their prepandemic study period. Similarly, Bolzinger and colleagues demonstrated a 36% decrease in upper limb pediatric fractures during the pandemic.<sup>3,7</sup>

Mechanism of injury, demographics, and follow-up practices for pediatric SCH fractures also changed during this time. Different mechanisms of injury reflect the new ways in which children played. As children avoided typical energy outlets, like parks and sports, we noticed subsequent decreases in playground and monkey bar-related fractures and concurrent increases furniture and trampoline-related fractures. As normal energy outlets became inaccessible, jumping off furniture became the most common cause (33%) of this injury. This change in distribution was also described by Bram et al<sup>7</sup> who found a 42% decrease in overall proportion of playground-related injuries, a 25% increase in the proportion of at-home fractures, and a 12% increase in high-energy fall-related fractures, such as trampoline injuries. Although trampolines are associated with pediatric fracture incidence, our pandemic cohort demonstrated a significant increase (8.1% to 15.3%) in trampoline-related elbow trauma at a time when trampoline sales skyrocketed.<sup>21,22</sup> The American Academy of Pediatrics has been explicit in their recommendation against purchasing recreational and at-home trampolines, citing numerous and safer energy outlet mechanisms for children.<sup>23</sup> Given this increase, raising public awareness about the frequency of injuries on home trampolines is imperative.<sup>24,25</sup>

Demographically, although sex distribution remained consistent, the pandemic created a younger group of patients with SCH fractures. The decreased age at the time of presentation likely reflects the change in mechanism of injury, as older children are more likely to participate in sports and use skilled playground equipment like monkey bars. Younger patients may lack the physical maturity and dexterity to participate in organized sports and navigate monkey bars, but can certainly jump off of a bed and may be more susceptible to at-home falls.<sup>26</sup> This is balanced by the concurrent increase in high-energy trampoline-related falls, which may explain why Gartland type and fracture severity, with respect to neurovascular

insult and rates of open fracture, did not decrease during the pandemic.

When analyzing hospital course, we were reassured to see that despite the COVID-19 testing, children got to the OR as expeditiously as before the pandemic. Similarly, hospital admission time did not change during the pandemic. Efficiency was likely helped by the decrease in surgical volume during the pandemic. In the United Kingdom and Turkey, Darling et al<sup>27</sup> and Turgut et al<sup>5</sup> demonstrated decreased surgical wait times for pediatric lower limb fractures during the pandemic, postulating that the reduction in surgical volume, emphasis on non-operative management, and cancellation of elective cases freed up more OR availability. Much of the literature shows that such efficiency translates to shorter lengths of hospital stay, as was the case with patients in Poland, where Olech et al<sup>28</sup> observed shorter hospital stays for pediatric distal radius fractures during the pandemic, citing cancellation of elective cases and limits to hospitalization length. In Turkey, Turgut et al<sup>5</sup> found shorter hospitalizations after humerus fractures, citing decreased surgical wait times and surgeon concern for inpatient COVID transmission hastening discharge.

Although the hospital course for our patients with SCH fractures remained unchanged during the pandemic, modalities of patient care did change, as providers relied more on telephone and video visits to complete postoperative follow-up, which is aligned with the current literature.<sup>29–31</sup> Telemedicine has been a proven method of evaluation that maximizes patient safety and accessibility. Sabbagh et al<sup>32</sup> demonstrated that shoulder surgery patients who underwent telemedicine follow-up during the pandemic showed similar patient-reported outcomes to those with traditional in person clinic follow-up. Chaudhry et al<sup>33</sup> demonstrated during the pandemic, that telehealth orthopaedic assessment for follow-up results in similar rates of surgeon and patient satisfaction. Silva et al<sup>34</sup> demonstrated this phenomenon before the pandemic, showing that for pediatric SCH fractures, telehealth follow-up showed excellent satisfaction rates compared with in-person follow-up. Furthermore, the literature shows that decreasing extraneous postoperative follow-up after pin removal, such as “check in” visits and extra radiographs, does not change clinical outcomes.<sup>35</sup> Although some aspects of care, such as cast removal, pin removal, and initial radiographs must be done in person, our cohort showed that physicians have been able to adequately assess range of motion, pain, and carrying angle over video visits, without subsequent decreases in patient outcomes. Therefore, we would recommend cast and pin removal and follow-up radiographs to be done in person. Barring the need for subsequent radiographs and neurovascular checks, we recommend range of motion checks for uncomplicated SCH fractures to be done by video visit. Providers in our practice have incorporated this as standard method of postoperative follow-up, especially for patients who travel long distances. This provides strong evidence for continuation of telehealth options for our pediatric trauma population, even after the pandemic.

Although telemedicine did provide a useful and efficacious means of follow-up during the pandemic restrictions, we still noticed a significant increase in the proportion of patients lost to follow up. This does not align with the findings of Siow et al<sup>36</sup> who showed that implementation of telemedicine during the first 4 weeks of the pandemic for an orthopaedic trauma clinic resulted in unchanged no-show rates. We also noted a decrease in the mean number of follow-up visits and duration of follow-up. These changes can be explained by patients avoiding hospital presentation in accordance with both CDC recommendations and their own COVID-19 transmission concerns.<sup>5,37,38</sup> The pandemic also placed burden on patients outside the health care settings, as patients often found difficulties with attaining adequate transportation, organizing childcare, and accessing telephone services.<sup>39–41</sup> These barriers undoubtedly played a role in increasing the proportion of patients who stopped attending postoperative follow-up visits. In addition, providers likely became more conscientious of decreasing superfluous follow-up visits because of strains on the health care system and the consideration of their own exposure risks.

Despite these barriers to access, changes to follow up modalities, and increases in pandemic stressors, our cohort showed no change to clinical outcomes after SCH fracture surgery. There was no change in the distribution of Flynn criteria during the pandemic. Although not statistically significant, we did notice an increase in the proportion of patients with excellent Flynn criteria at final postoperative assessment during the pandemic. These findings similarly agree with those of Patel et al<sup>35</sup> who showed that extraneous follow-up does not improve patient outcomes. Our findings also support studies that show unchanged patient outcomes in cohorts utilizing telemedicine as a means of follow-up during the pandemic.<sup>33,34</sup>

This study is not without limitations. First, this is a retrospective analysis, which is inherently flawed as our data are only as good as the medical record. We are unable to comment on the outcomes of patients who were lost to follow up in our study, which were a significant fraction. In addition, this study is limited to operatively treated SCH fractures. We thus were unable to comment on patients who either never sought treatment for their fracture or experienced a nonoperatively treated SCH fracture during the pandemic. We acknowledge that some patients with a displaced SCH fracture may have not presented during the pandemic because of the fear of hospital setting; however, this is likely a small percentage of significant fractures. Our population sample was also limited to 1 hospital system and cannot with certainty be extrapolated onto the general population. Our hospital system, however, encompasses 2 Children’s hospitals that service an expansive geographic area including urban and rural populations. Furthermore, SCH fractures are a good representative condition for pediatric fractures because of their high prevalence. That said, children tend to have excellent outcomes in this condition regardless of follow-up or physical therapy.<sup>42</sup> Future studies could assess pandemic effects in a condition

(eg, anterior cruciate ligament tear) where outcomes are more dependent on follow-up or physical therapy. Given that outcomes may be threatened by loss to follow up in these conditions, a larger pandemic impact may be appreciated. Finally, other future studies should focus on continued evolution of injury patterns and hospital efficiency, as pandemic restrictions change over time, as well as ways to decrease loss to follow up.

These findings ultimately may inform future treatment patterns during episodes of lockdown and future COVID surges or other pandemics. We will continue to utilize telehealth follow-up in treatment of pediatric orthopaedic trauma regardless of pandemic status. Finally, physicians must anticipate and minimize logistical challenges and family burden during a pandemic to decrease the number of patients lost to follow up.

## CONCLUSIONS

The incidence of pediatric SCH fractures decreased significantly during COVID-19, and the fractures tended to occur in younger kids because of household accidents. Different mechanisms of injury reflect the new ways in which children played, with furniture falls and trampolines becoming the new leading causes of this injury. Despite the need for preoperative COVID-19 testing, there was no delay to the OR or to hospital discharge. Although clinic follow-up adapted virtually, more patients were still lost to follow up, and clinical outcomes remained unchanged.

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