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ORIGINAL RESEARCH

Management and Sedation

Do kids with forearm fractures need opioids at discharge from the emergency department? Analgesic prescribing and pain control following closed reduction of pediatric forearm fractures

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The retrospective half of the study was presented at the 2020 Society for Academic Emergency Medicine Southeast Regional Conference.

Abstract

Objective: The purpose of this 2-part study is to determine opioid prescribing patterns and opioid use and pain control after discharge following closed reduction of pediatric forearm fractures.

Methods: A retrospective study was conducted from December 2016 to January 2018 at a level 1 trauma center to determine opioid prescribing habits for patients 1–17 years old with forearm fractures treated with closed reduction. A prospective study was then conducted from August 2019 to October 2020 to determine pain control and opioid use after discharge. Data were collected through chart review and with telephone surveys on post-discharge days 1, 3, and 5 to collect pain scores and opioid use.

Results: Fifty patients with a median age of 8 (interquartile range [IQR], 5–11) years old and 51 patients with a mean age of 9 (IQR, 6–11) years old were included in the retrospective and prospective cohorts, respectively. From the retrospective study, 21 patients (42%) were prescribed a median of 10 opioid doses (IQR, 8–12) at discharge. From the prospective study, 12 patients (24%) were discharged with a median of 8 opioid doses (IQR, 5.5–10), for a total of 98 total doses. Of those, only 7 doses (7%) were used by 3 patients. Higher weight and initial pain score were associated with increased rates of opioid prescription.

Conclusions: Pediatric patients who undergo closed reduction of a forearm fracture under procedural sedation in the emergency department are prescribed approximately 14 times the amount of opioid that is used. We propose that prescribing only non-opioid analgesics to these patients would afford equivalent pain control without the side-effects and abuse potential of opioid use at an early age.

KEYWORDS
analgesics, closed reduction, forearm fracture, opioids, pain, pain management, pediatrics, radius fracture, ulna fracture

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1 | INTRODUCTION

1.1 | Background

It is well-known that the United States currently faces an opioid abuse epidemic. One of the driving factors for this is over prescription by medical professional. Centers for Disease Control and Prevention (CDC) data indicates from 1999 to 2019, nearly 247,000 people died in the United States from prescription-related opioid overdoses.[1] In children 0–17 years old specifically, opioid prescriptions are continuing to rise, with 2.5 million opioid prescriptions being given to children in 2012.[2] Furthermore, misuse of these opioids in this population is associated with increased risk of adverse behavior and long-term effects, such as persistent opioid use following surgery and initiation of heroin use during adolescence.[3–4]

1.2 | Importance

Opioids are frequently prescribed to children following surgeries and non-operative management of orthopedic injuries. However, guidelines and practices for opioid prescriptions vary significantly among medical professional and hospital systems with regard to medication of choice, amount prescribed, and duration.[5] The American Academy of Orthopedic Surgeons Information Statement regarding opioid use supports provider-specific and practice-specific guidelines to limit opioid use.[6] This further highlights the necessity for standardized guidelines for administration of opioids, especially in children.

Although several studies in the past have documented the over prescription of opioids in children following surgery,[7] only 3 studies have analyzed actual at-home usage of opioids.[8–10] A 2019 study by Nelson et al[10] determined that patients used <25% of prescribed opioid doses following closed reduction and percutaneous pinning of supracondylar humeral fractures. A 2020 study by Stillwagon et al[9] analyzed a similar population and found that, although children were prescribed a mean of 47 doses of opioid medication following surgery, only 4 doses on average were used for adequate pain control. Finally, a 2021 study by Keil et al[8] analyzed opioid use following all operative fractures in children excluding supracondylar humeral fractures and determined that opioids are still being prescribed at 4–5 times the amount needed for adequate pain control.

The above studies published amidst a nationwide opioid abuse crisis led to the development of an initiative at our institution in August 2019 aimed at standardizing the prescription of opioids for pediatric patients presenting to the emergency department (ED) for orthopedic-related concerns. This initiative led to a change in prescribing practices in the ED among emergency medicine physicians and orthopedic surgeons at our institution between the retrospective and prospective portions of our study. However, this rollout was created without any evidence of prescribing practices for the pediatric population presenting with forearm fractures to the ED. Therefore, the evidence regarding the prescription and consumption of opioids in this population remains unknown and the primary objective of this article, independent of the change in practice at our institution.

The Bottom Line

Opioids were significantly over prescribed compared to the amount used by pediatric patients who underwent closed reduction of forearm fractures in the emergency department, suggesting an important area for change in prescribing practices given the current opioid crisis.

1.3 | Goals of this investigation

As previously stated, to our knowledge, no studies have looked at home usage patterns of opioids prescribed following closed reduction of pediatric forearm fractures in the ED. Patients treated with closed reduction of forearm fractures may require even less opioid analgesia than operatively treated patients, but there currently remains limited evidence regarding opioid prescription patterns and actual home usage of opioids in this population. The primary objective of the retrospective study was to characterize opioid prescription habits in pediatric forearm fractures treated with closed reduction in the ED. The primary objective of the prospective study was to determine the impact of opioid prescription and usage on pain following closed reduction of pediatric forearm fractures in the ED. We hypothesized that pain would be adequately controlled with minimal or no need for opioids after discharge, and a significant proportion of opioid doses prescribed would remain unused.

2 | METHODS

2.1 | Study design and setting

This was a combined retrospective cohort study and prospective observational cohort study at a single pediatric emergency department at a level 1 trauma center in the southeastern United States. It was approved by the local institutional review board (IRB) and prepared using STROBE guidelines for observational studies.

2.1.1 | Part 1: Retrospective methods

Selection of participants

All patients 1–17 years of age who underwent closed reduction of an isolated forearm fracture under sedation in the ED from December 2016 to January 2018 were selected for review. Subjects were identified with Current Procedural Terminology codes used for sedation and further filtered with manual chart review. All included fractures were sufficiently angulated, displaced, or shortened that the orthopedic surgery resident on call deemed procedural sedation and

closed reduction necessary. Non-displaced and minimally displaced fractures were therefore excluded. Patients were further excluded if they were lost to follow-up, missing analgesic prescribing data or pain scores, admitted to the hospital rather than discharged home from the ED, or underwent operative management of the forearm fracture.

Measurements

Patient demographics, fracture characteristics, pain severity scored on a 0–10 scale in the ED, type and doses of analgesics administered in the ED, and type and doses of analgesics prescribed at time of discharge were collected from electronic medical record (EMR) chart review and recorded in a REDCap database.[11,12] The pain severity score scored on a 0–10 scale recorded at the first follow-up visit was collected and recorded in our REDCap database.

Outcomes

The primary outcome assessed was the number of doses of opioid prescribed at time of discharge from the ED. Total doses of analgesic administered in the ED and at discharge were collected to determine if there was an association between analgesic administration and pain score at presentation. Additional information was collected on independent variables, such as patient age, sex, weight, fracture pattern, and pain scores on presentation to determine any additional associations with opiate prescriptions at discharge.

Analysis

Statistical analysis was completed using *t* tests, χ^2 tests, and Kruskal–Wallis tests when multiple variables were analyzed, to obtain significance levels. Significance level was set at $P < 0.05$.

2.1.2 | Part 2: Prospective methods

Selection of participants

All patients 1–17 years of age who underwent closed reduction for an isolated forearm fracture in the ED were identified with daily screening of an EMR list maintained by the orthopedic surgery department. Patients were identified from August 2019 to October 2020 when at least 50 patients were identified and had a complete collection of data. As with the retrospective study, all included fractures were sufficiently angulated, displaced, or shortened that the orthopedic surgery resident on call deemed procedural sedation and closed reduction necessary. Non-displaced and minimally displaced fractures were therefore excluded. In addition to the exclusion criteria from the retrospective study, non-English-speaking patients were also excluded from this study.

Measurements

Demographic data, fracture type, initial pain scores, and opioid analgesics prescribed in the ED and at discharge were obtained via chart review. Specifically, data regarding medication used, route, frequency, and total doses given were collected. All patients were then contacted on post-injury days (PID) 1, 3, and 5. Phone call surveys were completed with the parent/guardian of the patient. If the parent/guardian was unavailable, a voicemail was left with a brief description of the study and a time at which a second call would be made. A total of 3 calls were attempted over the course of 1 day. If the parent was unavailable for all 3 calls, then the patient was omitted from the study. After obtaining consent for inclusion from the parent, the patient's pain score of 0–10 and opioid and/or over-the-counter analgesic usage were obtained over the phone and documented. Pain scores were obtained using the same scale as the retrospective study. To ensure consistency, all parents/guardians were asked about the patient's pain score. For older patients who were able to relay their pain score from 0 to 10, the parent asked the patient directly. For younger patients who were unable to relay their pain score, the parent was asked to use factors such as activity level and patient mood to assess pain score via the Face, Legs, Activity, Cry, Consolability (FLACC) scale. Finally, pain scores from patients' initial follow-up visits were collected by EPIC chart review using the same approach. All data were collected and managed using REDCap.

Outcomes

The primary outcome assessed was pain severity score on PID 1, 3, 5, and at the first follow-up visit after discharge from the ED. Total doses of analgesic administered in the ED and at discharge were collected to determine any associations. Furthermore, number of opioid and non-opioid analgesics taken on PID 1, 3, and 5 were recorded and compared to reported pain score on those days. Finally, additional information was collected on independent variables such as patient age, sex, weight, fracture pattern, and pain scores on initial presentation to determine any additional associations.

Analysis

Statistical analysis was completed using *t* tests, χ^2 tests, and Kruskal–Wallis tests when multiple variables were analyzed, in order to obtain significance levels. Significance level was set at $P < 0.05$.

3 | RESULTS

3.1 | Part 1: Retrospective

3.1.1 | Characteristics of study subjects

We chart reviewed all pediatric patients who underwent closed reduction under sedation for an isolated forearm fracture until 50 patients who met inclusion criteria were identified from December 2016 to January 2018. Sixty-two charts in total were reviewed for inclusion. Twelve were excluded for loss to follow-up (5), missing data (4), hospital admission (1), and operative management (2).

Retrospective results

The median age of our retrospective cohort was 8 years (interquartile range [IQR], 5–11) with 33 males (66%) and 17 (34%) females. Fracture

TABLE 1 Demographics, injuries, pain scores, and opioid use for retrospective cohort

	Opioid use			
	Discharged with opioid (N = 21)	Discharged without opioid (N = 29)	Total (N = 50)	*P* value
Age, median, years (IQR)	6.5 (5.0, 11.0)	8.0 (5.0, 10.0)	8.0 (5.0, 11.0)	0.8456[a]
Weight (kg)	27.9 (20.6–42.5)	29.9 (23.9–37.3)	29.4 (22.9– 38.6)	0.9758[a]
Sex, No. (%)				0.3659[b]
Female	9 (42.9)	8 (27.6)	17 (34.0)	
Male	12 (57.1)	21 (72.4)	33 (66.0)	
Fracture type, No. (%)				0.9080[b]
BBFF	12 (57.1)	19 (65.5)	31 (62.0)	
Isolated radius	7 (33.3)	8 (27.6)	15 (30.0)	
Isolated ulna	2 (9.5)	2 (6.9)	4 (8.0)	
Initial pain score in ED, median (IQR)	6.0 (4.5, 7.0)	7.0 (4.0, 8.5)	6.0 (4.0, 8.0)	0.8616[a]
Discharge opioid doses prescribed, median (IQR)	10.0 (8.0, 12.0)	0.0 (0.0, 0.0)	–	–
Total discharge opioid doses prescribed	209	0	–	–
Pain score at first follow-up, median (IQR)	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	0.6904[a]

Abbreviations: BBFF, both bone forearm fracture; ED, emergency department; IQR, interquartile range.
[a]Wilcoxon rank-sum *P* value.
[b]Fisher exact *P* value.

TABLE 2 Fracture type versus pain score and opioid prescriptions for retrospective cohort

	Fracture type				
BBFF (N = 31)	Isolated radius (N = 15)	Isolated ulna (N = 4)	Total (N = 50)	*P* value	
Initial pain score in ED, median (IQR)	4.0 (4.0, 7.0)	5.0 (2.0, 7.0)	4.0 (4.0, 5.5)	4.0 (4.0, 7.0)	0.8414[a]
Discharge opioid doses prescribed, median (IQR)	10.0 (7.5, 12.0)	10.0 (8.0, 14.25)	–	–	0.6790[a]
Total discharge opioid doses prescribed	114	70	25	209	
Pain score at first follow-up, median (IQR)	1.0 (0.0, 1.0)	0.0 (0.0, 2.0)	NA	0.0 (0.0, 1.0)	0.1690[a]

Abbreviations: ED, emergency department; IQR, interquartile range.
[a]Kruskal–Wallis *P* value.

patterns included 31 both bone forearm (radius and ulna) fractures (62%), 15 isolated radius fractures (30%), and 4 isolated ulnar fractures (8%) (Table 1). Thirty-four patients (68%) were administered an opioid while in the ED. The most frequently administered opioid in the ED was morphine (71%), followed by oxycodone (32%) and fentanyl (29%). At discharge, opioid was prescribed to 21 patients (42%) with a median of 10 doses (IQR, 8–12). Oxycodone was the only opioid prescribed at discharge (100%).

Median initial pain score at presentation was 6 of 10 (IQR, 4–8). Average follow-up interval was 8 days, with a range of 4–26 days. Median follow-up pain score was 0/10 (IQR, 0–1) (Table 1). The smallest number of doses prescribed was 5 (n = 1 patient) and the highest number of doses prescribed was 16 (n = 1 patient). Prescription of an opioid at discharge from the ED was not associated with sex ($P = 0.366$), age ($P = 0.846$), or fracture type (0.679) (Table 2). Opioid prescription at discharge was further not associated with initial pain score on presentation ($P = 0.862$) or follow-up pain severity ($P = 0.690$).

3.2 | Part 2: Prospective

3.2.1 | Characteristics of study subjects

We identified 111 pediatric forearm fracture patients treated with closed reduction from August 2019 to October 2020. Of these, 5 non-English speakers were excluded. Of the remaining 106, 51 patients completed all surveys and were included in the analysis. Nine patients declined to participate, 30 patients did not answer the PID 1 phone call, 6 did not answer the PID 3 phone call, 5 did not answer the PID 5 phone call, and 5 did not follow up in clinic. The demographic characteristics of the 51 patients who completed the study and were

TABLE 3 Demographics of eligible included and excluded patients for prospective cohort

	Excluded (N = 60)	Included (N = 51)	Total (N = 111)	*P* value
Age, median, years (IQR)	9.0 (7.0, 12.0)	9.0 (6.0, 11.0)	9.0 (7.0, 12.0)	0.6346[a]
Weight (kg), median (IQR)	33.6 (24.3, 54.2)	30.8 (23.7, 39.6)	31.8 (24.0, 47.8)	0.1766[a]
Sex, No. (%)				0.8483[b]
Female	28 (46.7)	22 (43.1)	50 (45.0)	
Male	32 (53.3)	29 (56.9)	61 (55.0)	

Abbreviations: ED, emergency department; IQR, interquartile range.
[a]Wilcoxon rank-sum *P* value.
[b]Fisher exact *P* value.

included in the analysis did not statistically differ from those of the 106 patients eligible for the study (Table 3).

3.2.2 | Prospective results

Our prospective cohort had a median age of 9 years (IQR, 6–11) and included 29 males (57%) and 22 females (43%). The median weight was 30.8 kg (IQR, 23.7–39.6). Fracture patterns included 34 both bone forearm fractures (67%), 13 isolated radius fractures (25%) and 4 isolated ulna fractures (8%) (Table 4). There was a statistically significant association between receiving an opioid prescription and age ($P = 0.0497$) and weight (0.0256), but not with sex (0.518). Furthermore, initial pain score and amount of discharge opioid doses from the ED did not vary significantly based on the type of fracture obtained (Table 5).

The median initial pain score for all 51 patients was 7/10 (IQR, 4–8). There was an association between higher initial pain scores and receiving an opioid prescription at discharge ($P = 0.0438$), with a median initial pain score of 8/10 (IQR, 6–9) among those who were prescribed an opioid and 6/10 (IQR, 2–8) among those who were not (Table 4).

An opioid was prescribed to 12/51 patients at discharge with a median of 8 doses (IQR, 5.5–10) (Table 4). The smallest number of doses prescribed was 3 (n = 1 patient) and the highest number of doses prescribed was 18 (n = 1 patient). Oxycodone was the most frequently prescribed opioid (n = 11 patients), followed by hydrocodone-acetaminophen (n = 1 patient). Only 3 of 12 patients who received a prescription for an opioid took any of the medication, with only one of those patients taking any past PID1. Of the 98 total doses that were prescribed to all patients, only 7 doses were used (7% of total prescribed doses.) Seventy-five percent of patients who received a prescription did not take any opioid doses.

Median follow-up pain scores were as follows: 3/10 (IQR, 2–4) on PID1, 2/10 (IQR, 0–3) on PID3, and 0/10 (IQR, 0–1) on PID5 (Table 4). There was no association between receiving an opioid prescription and pain scores on PID1 ($P = 0.528$), POD3 ($P = 0.561$), and POD5 ($P = 0.201$).

4 | LIMITATIONS

Our study has a number of important limitations. First, our study recruited 50 patients for the retrospective portion and 51 patients for the prospective portion. It is possible with a smaller sample size that the study was not powered to detect differences in prescribing patterns across demographic characteristics. That being said, our finding that only 7 of 98 prescribed doses of opioid were used highlights the consistent over prescription of opioids even in our smaller patient population. Next, pain is subjective, and all available pain scores offer an imperfect translation of the experience of pain. Although pain was consistently recorded on a 0–10 point scale, the specific scale used by ED staff was not consistently documented, and when it was documented, they varied between visual analog scale, Wong Baker facial pain scale, FLACC scale, and unspecified scales. However, the collection of pain scores by telephone interviews was done by two researchers in a consistent fashion for all parents, and we do not feel that variability in pain scales used in the ED compromises the validity of our results. Furthermore, although inevitable variation in parental perception of their child's pain score is expected, the literature suggests that children's pain scores closely correlate to their parent's perception of their pain, and that parents' evaluation should be used in the absence of self-report from a child.[13] With regard to provider-specific practices, it was not addressed in this study which medical professionals were prescribing opioids and whether the over prescription was provider-specific or institution-based. However, the EMR was reviewed daily throughout the study period to identify eligible patients, minimizing the likelihood that certain medical professionals contributed to overprescribing practices more than others. Finally, we did not collect information or verify whether opioid scripts were filled and collected because it did not pertain directly to the addressed outcomes of the study. That being said, it is an important area of future research to determine the extent of opioids available within the community.

In the prospective study, non-English speaking patients were excluded from the study due to translation service limitations for study participants. This is a limitation of our study and the pain management experience of non-English speaking patients with these injuries is an area for possible future research. We also encountered difficulty recruiting patients to the prospective arm of the study, with only 51 out of 106 eligible participants completing the study. However, reaching this percentage of participants using delayed telephone consent with contact information obtained in the ED electronic chart is consistent with response rates quoted by studies using a similar contact strategy.[14] Last, potential racial disparities in pain and prescribing were not assessed in this study. This is a growing area of interest in pediatric fractures and pain, and future studies should incorporate this into the study design.

TABLE 4 Demographics, injuries, pain scores, and opioid use for prospective cohort

	Opioid use			
	Discharged with opioid (N = 12)	Discharged without opioid (N = 39)	Total (N = 51)	*p* value
Age, median, years (IQR)	11.0 (8.5, 13.0)	8.0 (6.0, 11.0)	9.0 (6.0, 11.0)	0.0497[a]
Weight (kg), median (IQR)	45.3 (28.8, 53.6)	30.7 (22.6, 35.4)	30.8 (23.7, 39.6)	0.0256[a]
Sex, No. (%)				0.5178[b]
Female	4 (33.3)	18 (46.2)	22 (43.1)	
Male	8 (66.7)	21 (53.8)	29 (56.9)	
Fracture type, No. (%)				0.3168[b]
BBFF	7 (58.3)	27 (69.2)	34 (66.7)	
Isolated radius	5 (41.7)	8 (20.5)	13 (25.5)	
Isolated ulna	0 (0.0)	4 (10.3)	4 (7.8)	
Initial pain score in ED, median (IQR)	8.0 (6.0, 9.0)	6.0 (2.0, 8.0)	7.0 (4.0, 8.0)	0.0438[a]
PID pain scores				
PID 1, median (IQR)	3.0 (2.0, 4.0)	3.0 (2.0, 5.0)	3.0 (2.0, 4.0)	0.5281[a]
PID 3, median (IQR)	1.5 (0.5, 2.0)	2.0 (0.0, 3.0)	2.0 (0.0, 3.0)	0.5614[a]
PID 5, median (IQR)	1.0 (0.0, 2.0)	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	0.2010[a]
Discharge opioid doses prescribed, median (IQR)	8.0 (5.5, 10.0)	0.0 (0.0, 0.0)	–	<0.0001[a]
Total discharge opioid doses prescribed	98	0	–	–
Discharge opioids taken				–
PID 1	4	0	–	
PID 2	1	0	–	
PID 3	1	0	–	
PID 4	1	0	–	
PID 5	0	0	–	
Pain score at first follow-up, median (IQR)	0.0 (0.0, 0.5)	0.0 (0.0, 0.0)	–	0.7483[a]

Abbreviations: BBFF, both bone forearm fracture; ED, emergency department; IQR, interquartile range; PID, post-injury day.
[a]Wilcoxon rank-sum *P* value.
[b]Fisher exact *P* value.

TABLE 5 Fracture type versus pain score and opioid prescriptions for prospective cohort

	Fracture type				
BBFF (N = 34)	Isolated radius (N = 13)	Isolated ulna (N = 4)	Total (N = 51)	*P* value	
Initial pain score in ED, median (IQR)	6.0 (4.0, 8.0)	7.0 (6.0, 7.0)	7.0 (3.0, 9.0)	7.0 (4.0, 8.0)	0.8807[a]
Discharge opioid doses prescribed, median (IQR)	8.0 (6.5, 11.5)	6.0 (4.5, 9.0)	0.0 (0.0, 0.0)	–	0.2967[a]
Pain score at first follow-up, median (IQR)	0.0 (0.0, 0.25)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	–	0.5176[a]
Total discharge opioid doses prescribed	65	33	0	98	

Abbreviations: BBFF, both bone forearm fracture; ED, emergency department; IQR, interquartile range.
[a]Kruskal–Wallis *P* value.

5 | DISCUSSION

Opioids continue to be a focus of research and the notion that we are overprescribing them is not new. Multiple studies have found that we are overprescribing opioids for pediatric fracture pain at discharge, in patients discharged from the hospital and the ED.[8,9,15,16] Improvement has been seen with interventions like standardized order sets and focused education.[17,18] However, our results suggest that there is continued need for improvement in opioid prescribing patterns, specifically in pediatric forearm fractures treated with closed reduction. There is a growing body of evidence that many operatively treated fractures in children do not require outpatient opioid analgesia,[8] and

our results suggest that forearm fractures requiring a closed reduction may have satisfactory pain control with minimal or no opiates after discharge from the ED.

In our study, we found a significant association between age and weight with opioid discharge prescription, with older patients with higher weight receiving more opioid prescriptions. However, fracture type was not associated with opioid prescription, and the connection between initial pain score and receiving an opioid script is less clear. In our retrospective data, there were not a significant difference in the initial pain score in the ED when comparing those who received a prescription and those who did not. The prospective data, however, does support a positive relationship between initial pain score and likelihood of receiving opioids at discharge. This relationship may be explained by the change in the prescribing practices at the institution described previously beginning in August 2019, at the initiation of prospective cohort data collection. The new rollout may have created a more standardized approach focused on opioid prescription based on pain score, which can explain both why fewer patients were prescribed opioids in the prospective study versus retrospective study (42% vs. 24% respectively), and why the prospective cohort supports a positive relationship between initial pain score and likelihood of receiving opioids at discharge.

Several studies have indicated the wide variety in opioid prescribing practices across different emergency department sites. A 2020 study by Drendel et al[16] analyzed prescribing practices at four pediatric EDs and found that the variability in opioid prescribing was not accounted for by patient- or injury-related factors that are associated with increased pain. A 2018 study by Iobst et al[15] reviewed 1000 pediatric fracture patients and found that patients were receiving generic numbers of opioid doses as opposed to injury-specific prescribing patterns. Similarly, a 2019 study looking at opioid prescribing in distal upper extremity fractures at a pediatric ED found that discharge opioids were associated with receiving opioids in the ED and were not associated with higher pain scores.[19] These studies, in conjunction with the findings in our study, highlight the variability seen in prescribing habits and the need for formalized prescribing guidelines in this population. Our prospective cohort possibly indicates a positive trend toward decreased prescribing habits when using patient-specific pain measures, however, future study will be needed to better quantify the impact.

Importantly, our data suggest that we continue to prescribe opioids unnecessarily for these injuries without a demonstrable advantage in pain control compared to non-opioid medications in this population. Among the 3 of 12 patients who used their prescription, 1 patient took a total of 5 doses through PID4, whereas the other 2 took only 1 dose each on PID1. These 3 patients had median pain scores of 2, 2, and 0 for PID 1, 3, and 5, respectively. Table 4 of our study demonstrates these scores are comparable to the pain scores for the overall prospective cohort, indicating that opioids were consumed not because of increased severity of pain, but rather due to availability after being prescribed. In our prospective cohort, patients were prescribed 14 times the total doses of opioids used (7 doses taken of 98 doses prescribed in the cohort). This has been previously demonstrated in multiple studies looking at various pediatric fractures managed operatively and non-operatively.[9,19–21] The continued over prescription of opiates after forearm fracture reduction in the ED is among the most important findings of our study and indicates a significant opportunity for improvement.

In conclusion, we observed pain following pediatric forearm fractures treated with closed reduction under moderate sedation in the ED is consistently well controlled with little to no need for opioids at discharge. In our study, pediatric patients discharged from the emergency department following closed reduction of forearm fractures were prescribed approximately 14 times the amount of opioids used. Pediatric patients who undergo closed reduction of a forearm fracture under procedural sedation in the emergency department appear to have equivalent analgesia with or without the use of opioids. Although there has been marked improvement in our historical over prescription of opioids, our data suggest opportunities for improvement continue to exist. We propose that prescribing only non-opioid analgesics to these patients at discharge would afford equivalent pain control without the negative side-effects and potential for opioid abuse, diversion, and/or accidental overdose of unused medication in the pediatric population.

AUTHOR CONTRIBUTIONS

Anna D. Vergun conceived the study, then designed the study in conjunction with Cheryl L. Jackson. Richard E. Jernigan obtained funding and IRB approval for the study. The retrospective data collection was managed by Richard E. Jernigan and supervised by Lukas G. Keil. The retrospective data analysis was conducted by Lukas G. Keil. The prospective data collection was managed by Richard E. Jernigan and Sahil Dadoo and supervised by Lukas G. Keil. Richard E. Jernigan coordinated the prospective data analysis with department statisticians. Richard E. Jernigan and Sahil Dadoo drafted the manuscript with all authors contributing to its revision. Richard E. Jernigan takes responsibility for the article as a whole.

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CONFLICT OF INTEREST

The authors made no disclosures.

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