Informal Regionalization of Uncomplicated Pediatric Fracture Care in the Greater Toronto Area

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ABSTRACT

Background. Operative management of pediatric fractures is an expected competency in the specialty of Orthopedic Surgery by the Royal College of Physicians and Surgeons of Canada. However, specialized pediatric centres may be providing care for increasing numbers of uncomplicated fracture patients previously treated at community hospitals.

Methods. We examined trends of uncomplicated pediatric fractures presenting to a specialized pediatric centre (SickKids) from anywhere in the Greater Toronto Area (GTA) between April 1, 2008 and March 31, 2015. Consecutive patients admitted to SickKids and requiring operative intervention for a supracondylar humerus (SCH) or femur fracture were considered. Changes in operative incidence rates per year were calculated by multivariable negative binomial regression models.

Results. Baseline characteristics of 945 SCH and 421 femur fractures were similar irrespective of which year fixation occurred. The annual incidence rate of uncomplicated SCH fracture cases increased from 108 to 169 (53%) at an adjusted rate of 7.5% per year (adjusted IRR=1.075, 95% CI=1.072-1.079, $p<0.001$). Similarly, femur fracture cases increased from 49 to 69 (45%) at an adjusted rate of 5.3% per year (adjusted IRR=1.053, 95% CI=1.044-1.062, $p<0.001$). Significant increases were observed independent of fracture classification, stabilization method, whether patients were transferred from an outside hospital or presented directly, patient geographic location, or the season in which the fracture occurred.

Conclusion. Adjusted annual incidence rates significantly increased during the study period. Further work is needed to assess the clinical impact of informal, regionalized care, and determine if the phenomenon occurs in other specialties.

INTRODUCTION

Supracondylar humerus (SCH) and femur fractures are the two most common operatively treated pediatric fractures in Ontario.(1) Operative management of simple and complex pediatric fractures is an expected competency within the Objectives of Training in the specialty of Orthopedic Surgery for the Royal College of Physicians and Surgeons of Canada (RCPSC).(2) However, anecdotes in our region indicate specialized pediatric centres are providing care for increasing numbers of uncomplicated fracture patients previously treated in community hospitals. This 'informal regionalization' of uncomplicated pediatric trauma care may not yield benefits ascribed to 'formal regionalization', which include cost savings and improved quality.(3-6)

Therefore, the primary objective of this study was to examine trends for uncomplicated pediatric fractures presenting to a specialized pediatric centre from anywhere in the Greater Toronto Area (GTA, population 6.054 million in 2011). Secondary objectives included assessing direct costs attributable to treating uncomplicated trauma cases at a dedicated pediatric centre and to determine the location of residence of these patients. We hypothesized patients were increasingly arriving from several geographic areas within GTA, both by direct presentation and outside hospital transfer, after adjustment for population changes and several covariates that may have influenced these rates.

METHODS

Setting

We conducted a retrospective, serial, cross-sectional study at the Hospital for Sick Children (SickKids) in Toronto, Ontario. Consecutive patients admitted to the hospital and requiring operative intervention for a SCH or femur fracture between April 1, 2008 and March 31, 2015 were identified using the hospital's *Surgical Information System* database (SIS 4.7.10a, Surgical Information Systems LLC).(7) The beginning of the study period was chosen on the basis of when recording detailed data regarding every surgical case became routine (Supplementary Appendix). Detailed chart abstraction followed and was performed by medical and orthopaedic trainees (authors DP and SM, acknowledgements AU and HM) and reviewed by two pediatric orthopaedic surgeons (authors MG and MC). The investigation received approval from the SickKids Research Ethics Board.

<ins>Population</ins>

Patients aged 0-14 requiring operative intervention for a SCH or femur fracture during the study period were eligible for inclusion. "Complicated" fractures were defined as those necessitating pediatric orthopaedic specialist referral and operationalized as being: (a) associated with bone cysts, pathological lesions, or non-accidental injury or (b) referred for revision surgery or treatment failure after initial non-operative management. Lookback for "complicated" cases occurred to January 1, 2000. Geographic boundaries of the GTA were defined by the borders of Local Health Integrated Networks (LHINs) 5, 6, 7, 8 and 9; patients residing outside these regions were excluded.

<ins>Outcomes</ins>

The primary outcome comprised annual incidence rates of SCH and femur fractures. The number of operations performed each fiscal year are population-adjusted to account for population changes during the study period. Specifically, all rates are standardized to the 2011 age 0-14 GTA population (2011 Canadian census).

Healthcare costs, inpatient length of stay, and patient location of residence were also considered. Direct healthcare costs (CDN$2014) incurred by each patient during their index admission and paid by the hospital were calculated by the hospital's case costing methodology, which attributes resource intensity weights (RIWs) to care episodes. Each patient was also mapped to their location of residence or "dissemination area (DA)" using ArcGIS 10.2 (ESRI) software. DAs are the smallest geographic unit for which census population data are available in Canada. The bar chart option was used to create bar maps, where the height of the bar represents the total sum of fractures by year in each LHIN.

Main exposure and covariates

The fiscal year (April 1 to March 31) in which surgery occurred constituted the primary exposure. Several covariates potentially motivating pediatric orthopaedic specialist referral were also measured. Need for dedicated pediatric anesthesia was assessed using the American Society of Anesthesiologists (ASA) score and the presence of patient comorbidity (yes/no) listed on hospital admission records. Several injury specific variables included: (a) the Gartland classification for SCH fractures (II versus III or IV),(8) (b) femur stabilization method (fixation versus spica casting), (c) injury energy including open fractures, (d) associated fracture, neurovascular injury or compartment syndrome, and (e) the requirement for reoperation (up to

March 31, 2016). Admission characteristics comprised: (a) being transferred directly from an outside hospital (b) surgery occurring during summer months (April – September) or “after-hours” (between 1700-0700 hours during the week or anytime over the weekend), (c) time elapsed from SickKids emergency department (ED) presentation to surgery, and (d) duration of surgery (total time elapsed in the operating room).

Statistical Analysis

Descriptive statistics were calculated for all variables. Age was normally distributed and expressed with other continuous variables using means and standard deviations. Categorical variables were calculated as proportions. Whether baseline characteristics changed over time was assessed using the Cochran–Armitage Trend test for categorical variables and simple linear regression for continuous variables. Changes in SCH and femur operative incidence rates were calculated using incidence rate ratios (IRRs) for 1-year increments spanning each fiscal year. To address potential temporal confounding by demographic, injury and admission characteristics that may have differentially motivated pediatric orthopaedic specialist referral by year, adjusted IRRs were calculated using two multivariable negative binomial regression models. Predictors included in the multivariable model for SCH operative rates were age, sex, ASA, LHIN, Gartland classification, open fracture, pre-operative nerve palsy, associated fracture, summer, and after-hours surgery. Predictors included in the multivariable model for femur operative rates were age, sex, presence of comorbidity, LHIN, injury severity (high/low energy), stabilization method (spica/fixation), open fracture, associated fracture, summer, and after-hours surgery. IRRs and 95% confidence intervals (CIs) are reported.

Sensitivity Analyses

We examined for the presence of effect modification in subgroup analyses stratified according to: (a) patient transfer status (outside transfer/direct presentation), (b) Gartland SCH fracture classification, (c) femur stabilization method (fixation versus spica casting), (d) patient location (LHIN) of residence, and (e) season of surgery (summer versus winter). All statistical analyses were performed using SAS® Studio 9.3 University Edition (SAS® Institute, NC) and the type I error probability was 0.05 for all two-sided tests of statistical significance.

RESULTS

Baseline characteristics

Amongst 1366 uncomplicated fractures that underwent operative intervention between 2008 and 2014 and met inclusion criteria for the study, 945 were SCH fractures and 421 were femur fractures, respectively (Figure 1). The mean age of SCH patients during the study period was 5.44 years and 52.6% were male. With regards to femur fracture patients, their mean age was 5.53 years and the majority were male (74.4%).

Comparing baseline characteristics by year of surgery (Tables 1a and 1b), mean SCH surgery duration was shorter (69.98 ±32.87 versus 81.40 ±21.51, p for trend = 0.005) and a smaller proportion of femur procedures were performed after-hours (39.1% versus 66%, p for trend = 0.003) in 2014 compared to 2008. The proportion of both SCH and femur patients with any comorbidity listed on their admission record increased (p for trend = <0.001). However, ASA classification did not change over time. Other baseline characteristics were similar in both SCH and femur fracture groups, independent of which year fixation occurred.

Outcomes

The annual incidence rate of uncomplicated SCH fracture cases increased from 108 to 169 (53%) during the study period at an adjusted rate of 7.5% per year (adjusted IRR = 1.075, 95% CI = 1.072-1.079, p<0.001). Similarly, the annual incidence rate of uncomplicated femur fracture cases increased from 49 to 69 (45%) during the study period at an adjusted rate of 5.3% per year (adjusted IRR = 1.053, 95% CI = 1.044-1.062, p<0.001, Figure 3).

Sensitivity Analyses

Significant increases in adjusted fracture rates were observed independent of the SCH fracture classification or femur stabilization method (Table 2 and Figures 4a and 4b). Adjusted SCH fracture rates increased independent of whether patients were transferred or presented directly. In contrast, increases in adjusted femur fracture rates were only significant for transferred patients, not those who presented directly (adjusted IRR = 1.060, 0.99-1.13, p = <0.089).

Secondary outcomes

A) Patient location of residence

The location of residence for each patient during the study period (by dissemination area) can be visualized in Figure 2. Furthermore, the incidence of uncomplicated fractures increased each successive year, from the majority of LHINs in the GTA (Figure 4a).

B) Costs

Considering direct healthcare costs incurred by fracture patients presenting during the year 2014 only, SickKids paid $821,248 for these index admissions. Of this total, $715,026 (or 87.1%) was spent that year to treat 193 patients living outside the Toronto Central LHIN. Alternatively, the hospital paid $705,451 (or 85.9%) to treat 187 patients who were transferred directly from outside hospitals.

Interpretation

Principal findings

We examined trends for the two most commonly treated operatively treated pediatric fractures in Ontario presenting to our hospital from anywhere in the GTA between 2008 and 2014. Patient baseline characteristics were similar irrespective of which year fixation occurred. The annual incidence rate of uncomplicated SCH fracture cases increased from 108 to 169 (53%) at an adjusted rate of 7.5% per year (adjusted IRR = 1.075, 95% CI = 1.072-1.079, p<0.001). Similarly, femur fracture cases increased from 49 to 69 (45%) during the study period at an adjusted rate of 5.3% per year (adjusted IRR = 1.053, 95% CI = 1.044-1.062, p<0.001). Significant increases in adjusted fracture rates were observed independent of fracture classification, fracture stabilization method, whether patients were transferred from an outside hospital or presented directly, patient geographic location, or the season in which the fracture occurred.

Implications

We found significantly increased annual incidence rates of uncomplicated fractures managed at a specialized pediatric centre, even after adjustment for population changes and several covariates that may have influenced these rates. At present, operative management of pediatric fractures is an expected competency in the specialty of Orthopedic Surgery by the RCPSC.(2) In order to attain that competency, a surgical trainee must be given opportunities to perform pediatric fracture operations. The potential risk to the patient at hand may be mitigated by appropriate supervision and justified by the benefit to future patients having access to a competent surgical workforce(9-11). However, our findings call into question whether the active involvement of orthopaedic trainees in the technical aspects of these cases is ethically justifiable if they will not be treating these injuries as general orthopaedic surgeons.(2)

We also observed the vast majority of uncomplicated pediatric fracture cases treated at SickKids during the study period were transferred from outside hospitals (>70% every year for both fracture types). Although we cannot know whether the indication to transfer patients for definitive treatment was due to the technical difficulty of these cases, our experience is that the indication for referrals in the vast majority of cases is primarily logistical and that some surgeons and/or hospitals may be categorically refusing to treat patients with these injuries.

Prior surveys found that only 29% of ED physicians said their orthopaedist always came in when asked to evaluate a patient; the top two barriers being complexity of the injury and day/night or weekend timing.(12) However, we found significant increases in adjusted fracture rates occurred independent of the complexity of injury and whether surgery was performed after hours or during the summer. Median surgeon SCH fixation volume is only 9 cases per year in Ontario.(13) Thus, over time, referrals may be self-fulfilling; transfers begetting transfers as case volumes and associated technical competence decreases, particularly in the context of increasing specialization.(3, 14-21)

Although informal regionalization appears to be occurring in the GTA for uncomplicated peadiatric trauma, its effect on clinical outcomes is unclear. Controversy exists about whether lower complication rates are related to treatment at academic facilities for pediatric fractures,(13, 22-24) particularly when transfer delays are expected.(25) Irrespective of its effect on clinical outcomes, our study illustrates that informal regionalization is already occurring in the GTA for pediatric fractures. Assuming Ontario's operative SCH rates have remained similar to those during the 2000s (Supplementary Appendix), SickKids went from treating approximately one third of all SCH cases in the Province to one half during the study period. However, centralization of care has occurred without formal horizontal integration between hospitals or surgeons.(4) While formal regionalization arrangements recognize that cost savings and improved quality may arise from consolidation efforts,(6) informal regionalization is occurring without these benefits. For example, although 193 uncomplicated fracture patients living outside the Toronto Central LHIN were treated at our hospital in 2014, costs ($715,026) required for care did not follow. The "quality-based procedure" paradigm in

Ontario is an example of how policy and funding regarding pediatric orthopaedic trauma care may be formalized.

At the same time, specialized pediatric centres are being increasingly challenged with providing timely care for increasing numbers of uncomplicated patients previously treated in the community. In the absence of a dedicated orthopaedic trauma program to manage these injuries, approximately half of the operative cases in this study occurred after-hours, and wait times for these procedures did not improve over the course of the study period. Thus, our findings may help inform policy, funding, and formal integration regarding pediatric orthopaedic trauma care in our region and beyond.

Limitations

The most important limitation of this study is that we could not identify fracture rates presenting to other institutions in the GTA. Although it is possible that rates are also increasing at other hospitals in our region, this is unlikely for several reasons. First, rates of SCH fixation procedures in Ontario remained stable, or decreased, during the 2000s.(13) Second, the age 0-14 GTA population was expected to increase by a significantly lower rate (0.45%) than the fracture rates observed during the study period (2011 Canadian census). Indeed, all reported rates in this article were population standardized to remove the influence of population changes. Lastly, adjusted rates accounted for several potential temporal confounders and sensitivity analyses removed potential effect modification. For example, practice patterns would not have been expected to change for both Gartland II and Gartland III SCH fractures during the study period. A significant strength of our study design was the detailed chart review which enabled us to precisely define “complicated” cases, exclude them, and stratify our analysis by the severity of injury.

Second, although the beginning of the study period was chosen on the basis of when recording consecutive surgical cases became reliable, we recognize that changes may have occurred well before 2008. We also cannot explain the large incidence increase in 2011. Since our objective *a priori* was to describe adjusted fracture rates presenting to our institution, rather than explore a specific occurrence in 2011 or the influence of a specific intervention, we did not conduct a formal time-series analysis. Lastly, we only evaluated two operative fracture types. Thus, our analysis likely significantly underestimated the cost of treating uncomplicated cases from outside institutions.

Final Conclusions and future directions

Throughout the study period, patients increasingly arrived from several geographic regions within the GTA, both by direct presentation and outside hospital transfer. We advocate that policy and funding regarding pediatric orthopaedic trauma care in our region be formalized. Our findings may also inform future training requirements for general orthopaedic surgeons. Further work is needed to assess the clinical impact of informal, regionalized care, to determine if the phenomenon is found in other specialties, and to understand why it is occurring.

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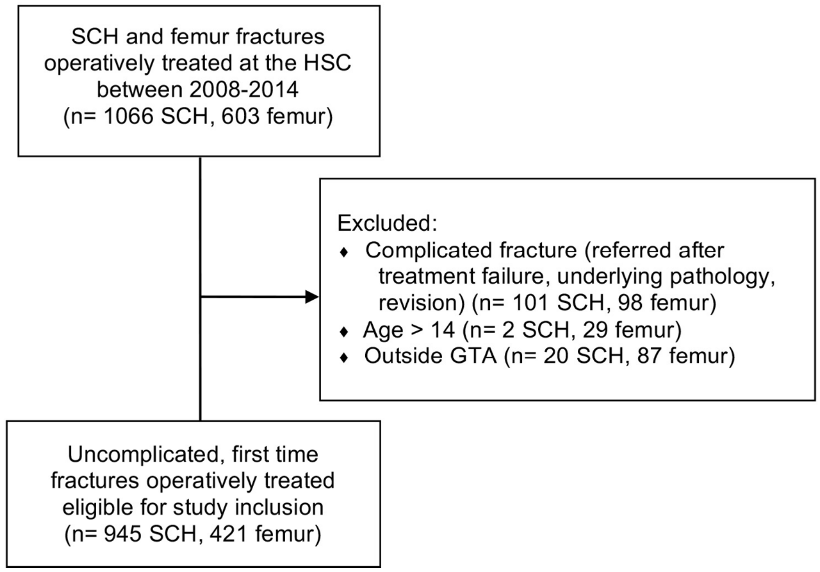

Figure 1. Uncomplicated paediatric fracture patients operatively treated at the Hospital for Sick Children between 2008 and 2014 included and excluded in the study cohort.
Amongst 1366 uncomplicated fra
153x96mm (300 x 300 DPI)

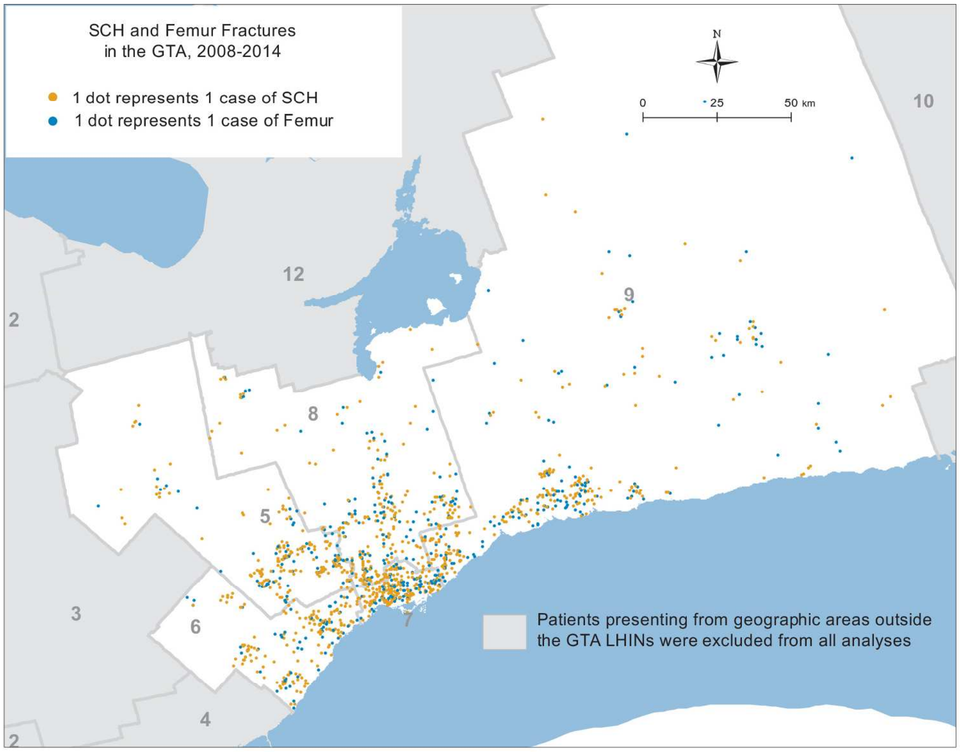

Figure 2. Location (dissemination areas) of patients with uncomplicated fractures treated operatively at the Hospital for Sick Children (2008-2014).
The location of residence for
196x152mm (300 x 300 DPI)

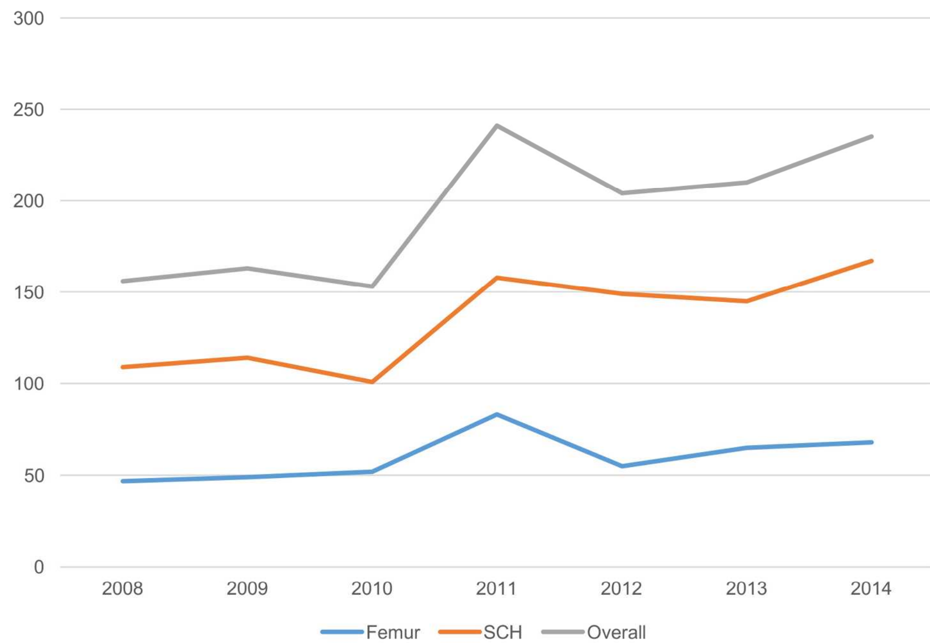

Figure 3. Population standardized* annual incidence rates of uncomplicated fractures treated operatively at the Hospital for Sick Children (2008-2014). *GTA population aged 0-14 year 2011.
Similarly, the annual incidenc
171x117mm (300 x 300 DPI)

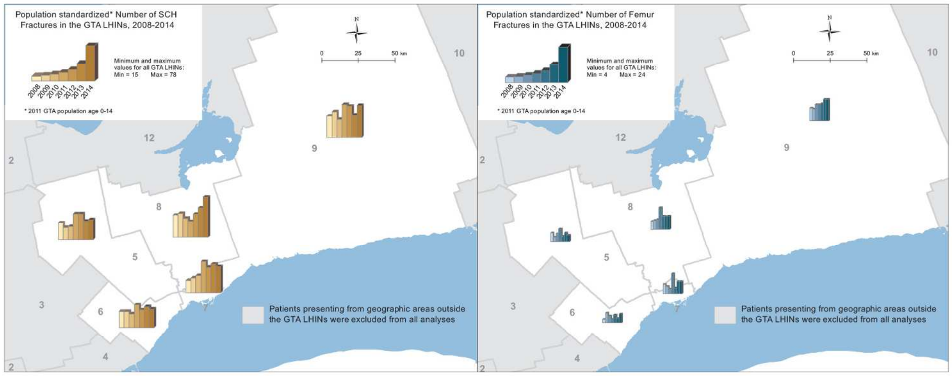

Figure 4a. Subgroup analyses. Population standardized annual incidence rates of uncomplicated fractures treated operatively at the Hospital for Sick Children (2008-2014), by patient LHIN.
Significant increases in adjus
201x91mm (300 x 300 DPI)

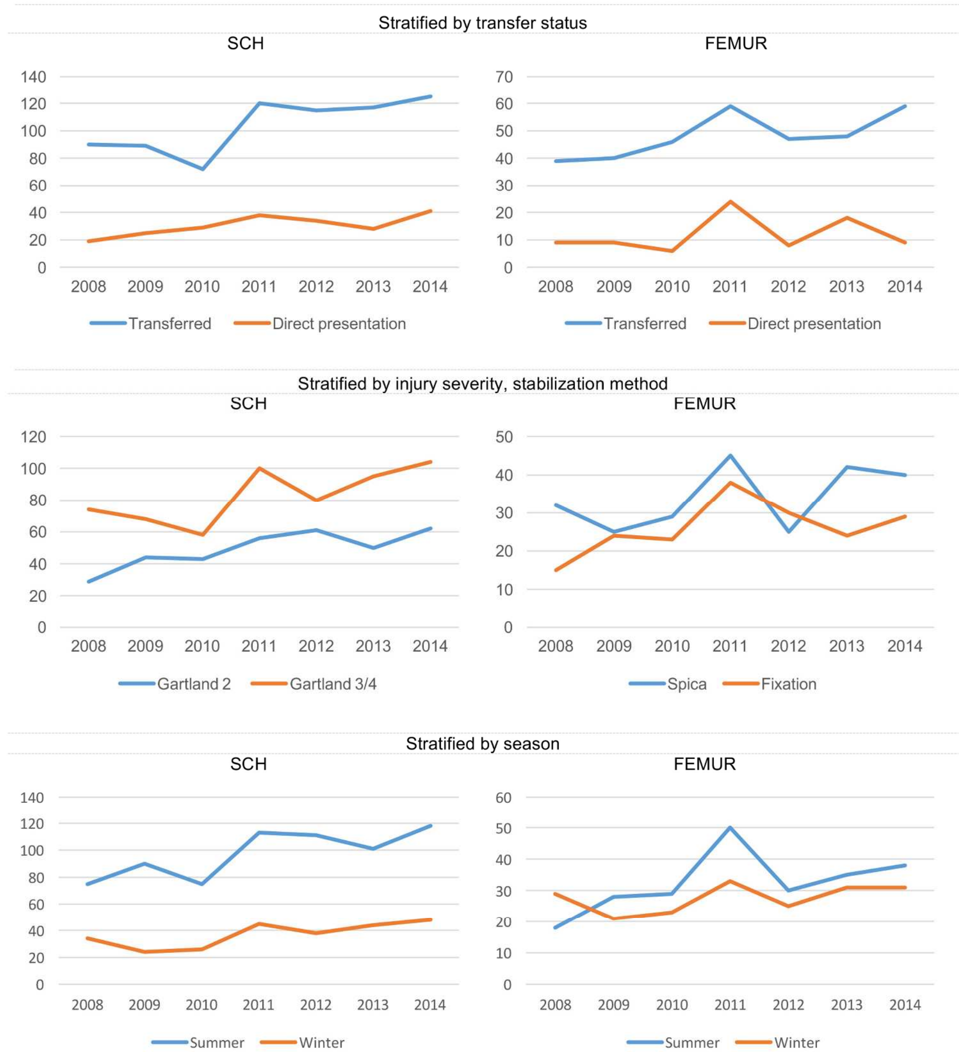

Figure 4b. Subgroup analyses. Population standardized* annual incidence rates of uncomplicated fractures treated operatively at the Hospital for Sick Children (2008-2014), by patient subgroup. * *GTA population aged 0-14 year 2011.
Significant increases in adjus
200x228mm (300 x 300 DPI)

Table 1a (SCH)

	2008 (n=108)	2009 (n=113)	2010 (n=101)	2011 (n=158)	2012 (n=150)	2013 (n=146)	2014 (n=169)	Missing, n (%)	p (for trend)
Demographics									
Age, mean (±SD)	5.44 (±2.47)	5.20 (±2.54)	5.66 (±2.78)	5.35 (±2.42)	5.53 (±2.55)	5.51 (±2.50)	5.43 (±2.47)	0 (0)	0.695
Female, n (%)	56 (51.9)	64 (56.6)	39 (39.4)	68 (43.6)	63 (42.0)	70 (48.0)	86 (50.9)	4 (0.4)	0.593
ASA								30 (3.2)	0.345
- 1, n (%)	86 (86.9)	96 (90.6)	85 (87.6)	136 (88.3)	129 (87.8)	128 (87.7)	154 (92.8)		
- 2, n (%)	11 (11.1)	9 (8.5)	11 (11.3)	16 (10.4)	17 (11.6)	16 (11.0)	10 (6.0)		
- 3, n (%)	2 (2.02)	1 (0.94)	1 (1.03)	2 (1.3)	1 (0.7)	2 (1.4)	2 (1.2)		
Presence of any comorbidity, n (%)	0 (0)	0 (0)	2 (2.0)	3 (1.9)	0	7 (4.8)	5 (3.0)	0 (0)	0.007
Injury characteristics									
Gartland (III or IV), n (%)	73 (71.6)	67 (60.4)	58 (57.4)	100 (64.1)	89 (59.3)	96 (65.8)	105 (62.5)	11 (1.2)	0.615
Open fracture, n (%)	3 (2.8)	1 (0.9)	1 (1.0)	4 (2.6)	2 (1.4)	0 (0)	2 (1.2)	13 (1.4)	0.259
Associated injury, n (%)	3 (2.8)	5 (4.4)	8 (7.9)	4 (2.5)	6 (4.0)	3 (2.1)	4 (2.4)	0 (0)	0.229
Pre-operative nerve palsy, n (%)	24 (22.2)	21 (19.4)	17 (17.4)	22 (14.5)	19 (12.8)	18 (12.4)	34 (21.0)	23 (2.4)	0.321
Compartment syndrome, n (%)	1 (0.9)	0 (0)	1 (1.02)	0 (0)	0 (0)	0 (0)	2 (1.2)	14 (1.5)	0.848
Vascular compromise, n (%)	0 (0)	0 (0)	2 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	13 (1.4)	0.346
Reoperation (any reason), n (%)	3 (2.8)	0 (0)	4 (4.0)	2 (1.3)	4 (2.7)	1 (0.7)	4 (2.4)	10 (1.1)	0.957
Admission characteristics									
Transferred from outside hospital, n (%)	89 (82.4)	88 (77.9)	72 (71.3)	120 (76.0)	116 (77.3)	118 (80.8)	127 (75.2)	0 (0)	0.632
Summer surgery, n (%)	74 (68.5)	89 (78.8)	75 (74.3)	113 (71.5)	112 (74.7)	102 (69.9)	120 (71.0)	0 (0)	0.580
Evening, overnight or weekend surgery, n (%)	52 (48.2)	59 (52.2)	50 (49.5)	100 (63.3)	86 (57.3)	74 (50.7)	98 (58.0)	0 (0)	0.182
Delay to fixation (hours), mean (±SD)	13.73 (±18.44)	12.74 (±5.99)	11.53 (±6.54)	13.49 (±7.54)	12.39 (±7.34)	12.54 (±6.71)	11.27 (±6.28)	31 (3.3)	0.075
Surgical duration (mins), mean (±SD)	81.40 (±21.51)	81.60 (±30.95)	86.43 (±59.75)	85.13 (±42.77)	81.23 (±32.35)	78.42 (±29.91)	69.98 (±32.87)	4 (0.4)	0.003
Length of stay (days), mean (±SD)	1.25 (±1.08)	1.22 (±0.41)	1.28 (±0.70)	1.20 (±0.40)	1.23 (±0.43)	1.22 (±0.47)	1.14 (±0.48)	4 (0.4)	0.16
Cost of index admission, mean (±SD)	2560 (±1190)	2306 (±507)	2685 (±951)	2512 (±673)	2529 (±599)	2457 (±586)	2353 (±767)	4 (0.4)	0.185

Table 1b (Femur)

	2008 (n=47)	2009 (n=49)	2010 (n=52)	2011 (n=83)	2012 (n=55)	2013 (n=66)	2014 (n=69)	Missing, n (%)	p (for trend)
Demographics									
Age, mean (±SD)	5.19 (±4.22)	6.00 (±4.55)	5.65 (±4.33)	5.61 (±4.44)	6.80 (±4.84)	4.73 (±4.28)	4.97 (±4.08)	0 (0)	0.695
Female, n (%)	14 (29.8)	7 (14.3)	18 (34.6)	20 (24.1)	16 (29.1)	18 (27.3)	15 (21.7)	0 (0)	0.844
Presence of any comorbidity, n (%)	0 (0.0)	1 (2.0)	0 (0.0)	2 (2.4)	2 (3.6)	8 (12.1)	8 (11.6)	0 (0)	<0.001
Injury characteristics									
Fixation (vs. spica casting), n (%)	15 (31.9)	24 (49.0)	23 (44.2)	38 (45.8)	30 (54.5)	24 (36.4)	29 (42.0)	0 (0)	0.830
High energy mechanism, n (%)	46 (97.9)	44 (89.8)	48 (92.3)	81 (97.6)	52 (94.5)	65 (98.5)	69 (100.0)	2 (0.5)	0.022
Open fracture, n (%)	1 (2.1)	0 (0.0)	0 (0.0)	1 (1.2)	1 (1.8)	0 (0.0)	1 (1.4)	0 (0)	0.996
Associated injury, n (%)	1 (2.1)	1 (2)	0 (0.0)	5 (6.0)	2 (3.6)	5 (7.6)	3 (4.3)	0 (0)	0.131
Reoperation (any reason), n (%)	3 (6.4)	11 (22.5)	7 (13.5)	16 (19.3)	11 (20.0)	8 (12.1)	2 (2.9)	0 (0)	0.162
Admission characteristics									
Transferred from outside hospital, n (%)	38 (80.9)	40 (81.6)	46 (88.5)	59 (71.1)	47 (85.5)	48 (72.7)	60 (87.0)	0 (0)	0.985
Summer surgery, n (%)	18 (38.3)	28 (57.1)	29 (55.8)	50 (60.2)	30 (54.5)	35 (53.0)	38 (55.1)	0 (0)	0.333
Evening, overnight or weekend surgery, n (%)	31 (66)	28 (57.1)	31 (59.6)	43 (51.8)	32 (58.2)	33 (50.0)	27 (39.1)	0 (0)	0.005
Delay to fixation (hours), mean (±SD)	18.72 (±26.01)	24.13 (±58.70)	15.30 (±8.55)	19.77 (±14.67)	16.55 (±12.04)	15.65 (±10.57)	18.68 (±22.20)	7 (1.6)	0.075
Surgical duration (mins), mean (±SD)	99.13 (±61.61)	112.61 (±57.52)	104.31 (±58.65)	126.99 (±83.65)	129.11 (±76.35)	107.03 (±72.10)	97.14 (±51.33)	0 (0)	0.003
Length of stay (days), mean (±SD)	2.57 (±1.84)	3.08 (±3.11)	2.29 (±1.21)	3.00 (±3.32)	2.29 (±1.24)	2.35 (±2.50)	2.86 (±6.39)	0 (0)	0.158
Cost of index admission, mean (±SD)	4152 (±2193)	4865 (±3961)	4083 (±1843)	5541 (±7728)	4494 (±2037)	4871 (±8029)	6139 (±17646)	0 (0)	0.185

SCH fracture

	Adjusted IRR, 95% CI	p-value
Overall	1.075 (1.072-1.079)	<0.001
Transferred	1.069 (1.065-1.073)	<0.001
Direct	1.075 (1.075-1.10)	<0.001
Gartland 2	1.088 (1.080-1.097)	<0.001
Gartland 3	1.070 (1.064-1.075)	<0.001

Femur fracture

	Adjusted IRR, 95% CI	p-value
Overall	1.053 (1.044-1.062)	<0.001
Transferred	1.056 (1.048-1.065)	<0.001
Direct	1.060 (0.99-1.13)	0.089*
Spica	1.055 (1.037-1.74)	<0.001
Fixation	1.060 (1.043-1.69)	<0.001

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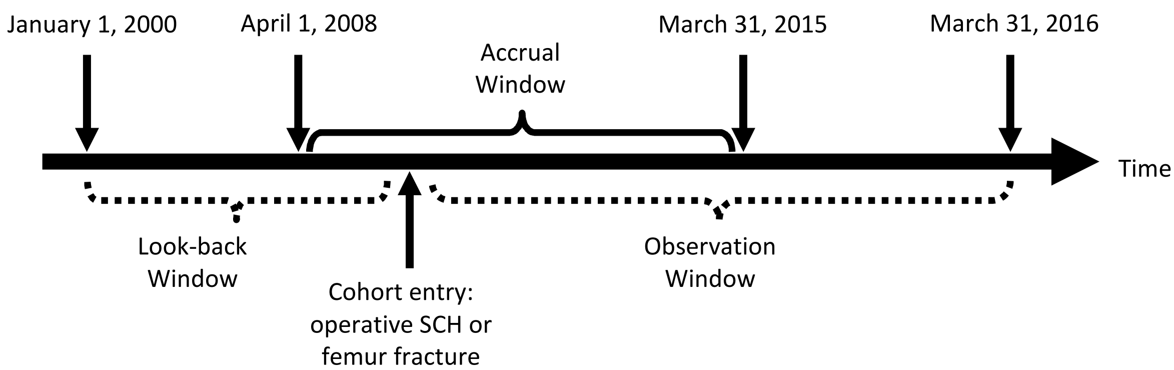
Supplementary Figure 1: Study timeframe definitions



Supplementary Table 1: Incidence of supracondylar humerus fractures treated in Ontario between 2002-2010 from *Khoshbin et al*.

	Surgical Technique		
Year/Season	CRPP	OR	Total
April 2002 – March 2003 (Summer 2002/Winter 2003)	287 (73.8%)	102 (26.2%)	389
April 2003 – March 2004 (Summer 2003/Winter 2004)	318 (80.1%)	79 (19.9%)	397
April 2004 – March 2005 (Summer 2004/Winter 2005)	357 (82.1%)	78 (17.9%)	435
April 2005 – March 2006 (Summer 2005/Winter 2006)	328(77.0%)	98 (23.0%)	426
April 2006 – March 2007 (Summer 2006/Winter 2007)	349 (78.6%)	95(21.4%)	444
April 2007 – March 2008 (Summer 2007/Winter 2008)	307 (77.7%)	88 (22.3%)	395
April 2008 – March 2009 (Summer 2008/Winter 2009)	309 (80.5%)	75 (19.5%)	384
April 2009 – March 2010 (Summer 2009/Winter 2010)	292 (80.0%)	73 (20.0%)	364
Total	2547	688	3235

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1	"We conducted a retrospective, serial, cross-sectional study at the Hospital for Sick Children (SickKids) in Toronto, Ontario."
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2	See abstract.
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3	See introduction.
Objectives	3	State specific objectives, including any prespecified hypotheses	3	See introduction.
Methods				
Study design	4	Present key elements of study design early in the paper	4	See "setting" and "population".
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4	See "setting" and "population".
Participants	6	*Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	4	See "setting" and "population".
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6	See "outcomes" and "main exposure".
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-6	See "outcomes" and "main exposure".
Bias	9	Describe any efforts to address potential sources of bias	6-7, 12-13	"Statistical analysis", "Sensitivity analyses" "Limitations"
Study size	10	Explain how the study size was arrived at	N/A	N/A

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6	See "outcomes" and "main exposure".
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6-7	"Statistical analysis", "Sensitivity analyses"
		(*b*) Describe any methods used to examine subgroups and interactions	6-7	"Statistical analysis", "Sensitivity analyses"
		(*c*) Explain how missing data were addressed	N/A	Reported in Tables 1a and 1b. Missing data was not a concern in this study.
		(*d*) *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	4	See "setting" and "population".
		(*e*) Describe any sensitivity analyses	7	"Sensitivity analyses"
Results				
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	4	"Population", Figure 1 and Tables 1a and 1b.
		(b) Give reasons for non-participation at each stage	4	"Population" and Figure 1.
		(c) Consider use of a flow diagram	N/A	See Figure 1.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders		
		(b) Indicate number of participants with missing data for each variable of interest	N/A	Reported in Tables 1a and 1b. Missing data was not a concern in this study.
Outcome data	15*	*Cross-sectional study*—Report numbers of outcome events or summary measures	Tables	Table 1 and 2, Figure 3
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6, Table 2	"To address potential temporal confounding by demographic, injury and admission characteristics that may have differentially motivated pediatric orthopaedic specialist referral by year, adjusted IRRs were calculated using two multivariable negative binomial regression models." Reported in Table 2.
		(*b*) Report category boundaries when continuous variables were categorized	N/A	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A	N/A

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-9	See "sensitivity analyses" and "secondary outcomes"
Discussion				
Key results	18	Summarise key results with reference to study objectives	9	"Principal findings"
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12	"Limitations"
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10	"Implications", "Final conclusions"
Generalisability	21	Discuss the generalisability (external validity) of the study results	Title, 13	We examine practice in the "Greater Toronto Area", "We only evaluated two operative fracture types", "Further work is needed to...determine if the phenomenon is found in other specialties"
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13	"SOURCE OF FUNDING"

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.