

Effect of season on surgically treated pediatric supracondylar humeral fractures

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ABSTRACT

Objective: The objectives of this study were to examine the monthly rates of surgically treated pediatric supracondylar humeral fractures as a percent of total surgically treated pediatric supracondylar humeral fractures and to identify seasonality.

Method: This is a retrospective study done in the Orthopedics department in the Royal Medical Services in Jordan between Jan 2018 and Jan 2020, including patients with pediatric supracondylar humeral fractures and underwent surgical management. Epidemiological and demographic data collection including the age, gender, dominant side, season, month, school vacation, fracture pattern, most common complications and surgical pin configuration using Patient file Records and electronic radiography system archives for pre-operative, post-operative, and follow-up X-rays, data was statistically analyzed using SPSS (Ver.25).

Results: One-hundred-fifty-six patients were included in this study. Most (87.2%) were right dominance patients (12.8% left dominance patients). We found two seasonal peaks: a higher summer peak in the school vacation time and a lower winter peak close to the time of the midterm school vacation. Fractures were Gartland type II (41.7%) and type III (58.3%). The pin tract infection rate was 7.7%, the cubitus varus and cubitus valgus rates were 6.4% and 1.3%, respectively. Pre-operative nerve deficit was detected in 7.1%. Only one child had a post-operative Ulnar nerve injury.

Conclusion: Two peaks exist in this type of fracture. The higher being in the summer season, which starts in the school vacation time and another lower peak in the winter season also in the school midterm vacation time. We have also found that there is an insignificant increase in the percentage of severity between the fracture type II and III among seasonal peaks and other seasons. However, some complications related to this type of injury were more common in these peaks.

Keywords: Season, Pediatric supracondylar humeral fractures.

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INTRODUCTION

The most common type of fracture in the elbow of children is a supracondylar humeral fracture.^{1,2,3} Trauma-related common conditions that require admission and surgery are hypothetically affected by environmental variables and the annual public schedule, which might influence the type or quantity of orthopedic injuries.

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⁴ It is expected for trauma-related fractures to be more frequent in some age groups or in the warm seasons. Understanding the relationship between these variables and the annual public schedule gives officials an idea of how busy an orthopedic and trauma division is likely to be; the morbidity, mortality, and the economic implication that might also guide the efforts of developing trauma-related preventive programs. Although such a research problem is most needed by developing countries, it is reported that trauma injuries as a research problem have been largely ignored in developing countries.^{5,6} A diagnosis of pediatric supracondylar humeral fracture according to Gartland classification⁷ type II or type III (Figure 1) mandates the surgical fixation by closed reduction and percutaneous pinning (Figure 2), as strongly recommended by the American Academy of Orthopedic Surgeons AAOS Appropriate Use Criteria AUC.⁸

The purpose of this study is to determine the various epidemiological factors affecting the surgically treated pediatric supracondylar humeral fractures in the Royal Medical Services in Jordan: how do the season, month, and school vacations influence the frequency of surgically treated supracondylar humeral fractures in children?

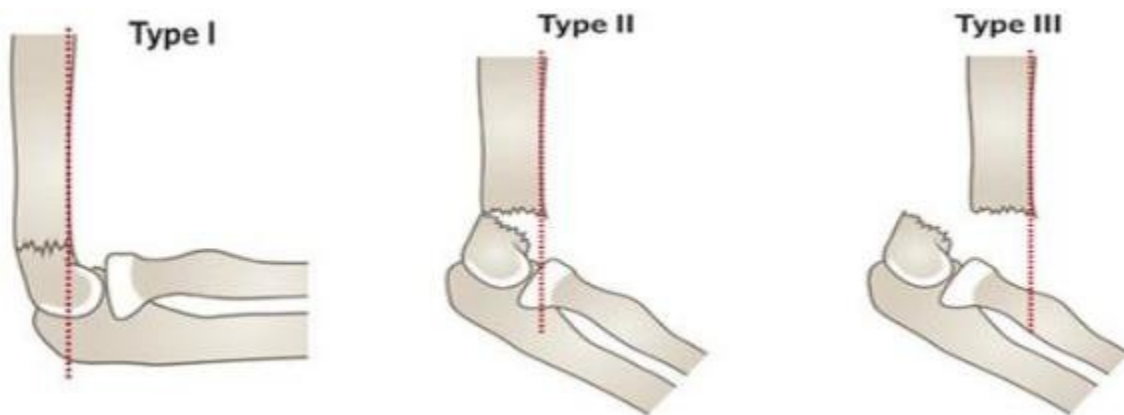


Figure 1:Gartland classification

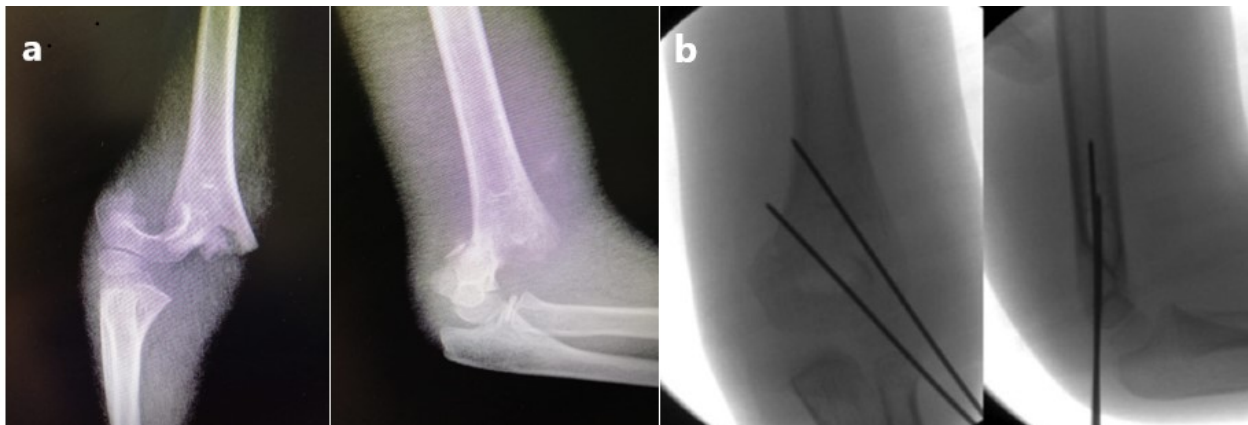


Figure 2: (a) Supracondylar humeral fracture, (b) Percutaneous pinning for fixation

METHODS

This is a retrospective descriptive study done in the orthopedics department in the Jordanian Royal Medical Services between Jan 2018 and Jan 2020 on patients with pediatric supracondylar humeral fractures and underwent surgical management. Epidemiological and demographic data collection including the age, gender, dominant side, season, month, school vacation, fracture pattern, and the most common complications using Patient file Records and electronic radiography system archives for pre-operative, post-operative, and follow-up X-rays.

Statistical analysis

Categorical data expressed in frequency and percentages, chi square of independence test was used to explore association between categorical data, power of study set at 80%, alpha level set at 0.05 considers statistically significant and SPSS (Ver. 25) used to analyze data.

RESULTS

One-hundred-fifty-six children were included in this study, 108 males and 48 females (male to female ratio, 2.25:1). The follow-up period was 5 months to 42 months. Right dominance patients accounted for 87.2% of the sample (68.4% left-sided fractures, 31.6% right-sided fractures) and left dominance patients accounted for 12.8% of the sample (60% right-sided fractures, 40% left-sided fractures) (Table I). Age ranged between 1.5 to 11 years with a peak incidence between 4 to 7 years, accounting for 63.6% of all patients of all ages; with the highest number of patients at the age of 5 years (21.8%) (Figure 3). We identified two seasonal peaks; a higher summer (June, July, August) peak in the school vacation time, accounting for 45.5% of all the patients presenting in the 12 months of the year; and a second winter peak (December, January, February), with the maximum number of patients in January (the coldest month in the year) during the shorter midterm school vacation, accounting for 26.9% of all patients (Figure 4).

Regarding Gartland classification of the fracture, 41.7% were type II and 58.3% were type III (96.7% were extension type and 3.3% flexion type). There was a little difference in the severity of the fracture type between the seasonal peaks and the other seasons, in the seasonal peaks 40.7% were type II and 59.3% were type III, while in the other seasons it was 44.2% type II and 55.8% were type III and that difference was not found to be of statistical significance (Table II).

The pin tract infection rate was 7.7%. The cubitus varus and cubitus valgus rates were 6.4% and 1.3%, respectively. One patient presented with open fracture Gustilo type I according to Gustilo Classification of open fractures. Pre-operative nerve deficit (anterior interosseous nerve) was detected in 7.1% of patients; all recovered by the 9th week after injury. Only one patient had a post-operative Ulnar nerve injury, which resolved completely after 3 weeks of pin removal. Pre-operative vascular insufficiency in the form of a pulseless hand was detected in 5.8% of the patients; all returned to normal pulses after closed reduction and percutaneous pinning, except for one patient that needed vascular exploration and repair (Table III).

An increase was observed in some complications in the seasonal peaks. Specifically, the chance of developing cubitus varus and post-operative pin tract infection were more common. 80% of all cases of cubitus varus were observed in the seasonal peaks along with 66.6% of all pin tract infection cases too. (Table IV)

Statistical analysis of the pin configuration of the surgical construct for the treatment of pediatric supracondylar humeral fractures showed that most of the patients were treated with lateral pinning, and that the surgeons have decided to treat more patients by crossed pinning in type III; in both the seasonal peaks and other seasons than in the case of type II. (Table V)

	Number of Patients	Percentage	Rt Sided Injury %	Lt Sided Injury %
Rt Dominance	136	87.2	31.6	68.4
Lt Dominance	20	22.8	60	40

Table I Patient dominance and the injured side.

Gartland Classification	Peak Seasons	Other seasons	df	X ²	P value
Type II	46 (40.7%)	19 (44.2%)	1	0.155	0.693 ^a
Type III	67 (59.3%)	24 (55.8%)			
Total	113	43			

^aChi-Square Test

Table II Fracture type distribution according to season

	Number of Patients	Percentage
Male	108	69.2
Female	48	30.8
Extension Type	151	96.7
Flexion Type	5	3.3
Pin tract infection	12	7.7
Cubitus Varus	10	6.4
Cubitus Valgus	2	1.3
Open Fracture	1	0.6
Pre-operative nerve deficit	11	7.1
Post-operative nerve injury	1	0.6
Per-operative vascular insufficiency	9	5.8

Table III Demographic data and complications

Complication	Seasonal peak	Other seasons	P value
Pin tract infection	8 (66.6%)	4 (33.3%)	0.761 ^a
Cubitus Varus	8 (80%)	2 (20%)	0.496 ^a

^aChi-Square Test**Table IV** Analysis of increased complications in the seasonal peaks

	Seasonal Peak	Other Seasons	df	X ²	P value
Crossed pins in Type II	9 (8%)	1 (2.3%)	3	2.845	0.416 ^a
Lateral pins in Type II	37 (32.7%)	18 (41.9%)			
Crossed pins in Type III	19 (16.8%)	5 (11.6%)			
Lateral pins in Type III	48 (42.5%)	19 (44.2%)			

^aChi-Square Test**Table V** Difference in pin configuration according to type of fracture and Season

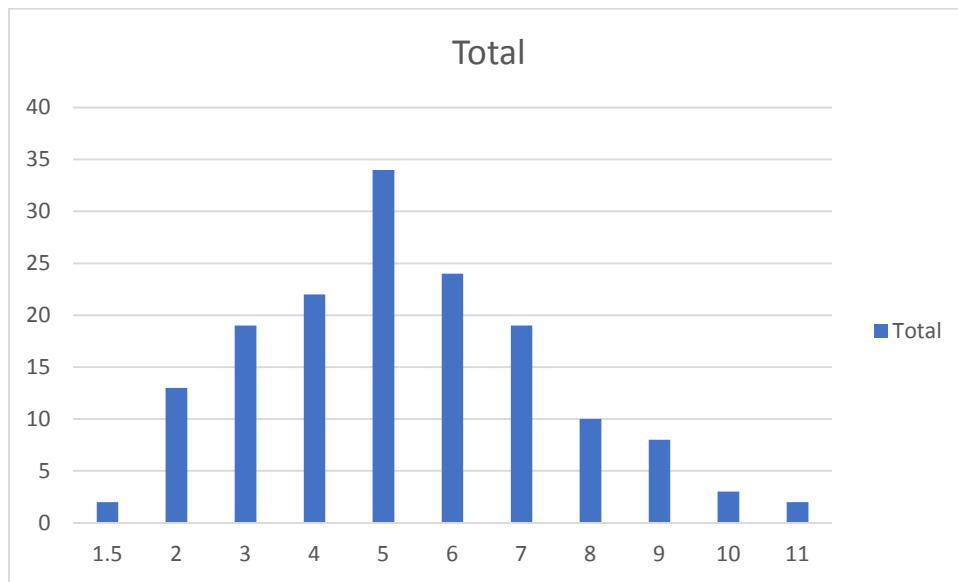


Figure 3: Incidence according to age.

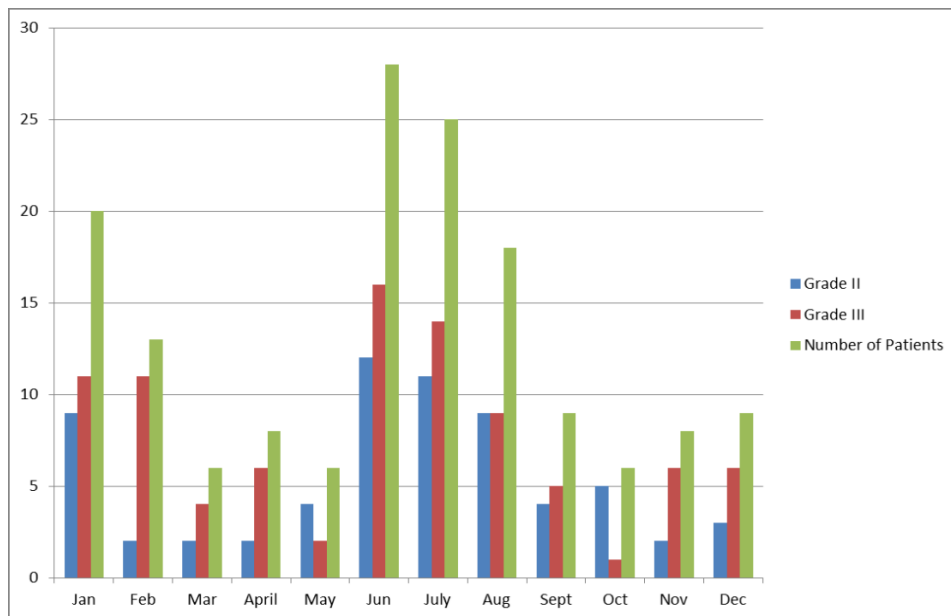


Figure 4: Seasonal and school vacation effect on incidence.

DISCUSSION

In our study, we found that there are some seasonal variations that are also affected by the timing of school vacation. We detected two peaks in the year, with the highest peak in the summer season coinciding with the beginning of the summer school vacation; that peak is expected to be present because of the increased outdoors activity of children due to the good weather and vacation. Such a result has been reported in the literature for an increase in trauma-related injuries by having a strong positive correlation with temperature changes in children and adults.^{9,10} The second unexpected peak in the winter season was only explained by the presence of the shorter winter midterm vacation of schools (Figure 4).

There is an increase in pediatric supracondylar humeral fractures in males over females in our study (ratio of 2.25:1). However, some recent reports have shown no significant difference; some other studies have recently shown that females outnumber males.¹¹ The maximum number of patients presented at the age of 5 years 21.8%; and by further analysis, the mean age of the patients with this injury was 4–7 years old, representing 63.6% of all patients (Figure 3). Challaet al. reported that the mean age for the supracondylar humeral fracture was 5–6 years.¹² In the same study, the incidence of extension type of all Supracondylar humeral fractures was 97% to 99%¹²; in our study, it was 96.7%. The non-dominant side was more affected (Table 1), which is consistent with the literature.^{13,14}

Pin tract infection is considered common in percutaneous pinning with a k-wire regardless of whether it was external or buried under the skin, with reports ranging from 1% to 25%.^{15,16,17} In our study, it was 7.7%, which usually resolves with simple oral antibiotics and completely recovers after removal of the pins. Angular deformity in the form of cubitusvarus or cubitus valgus is a frequent long-term complication in supracondylar humeral fractures;¹⁸ a complication such as a cubitusvarus has been associated with ulnar nerve tardy.¹⁹ Eren et al. studied the relationship between cubitusvarus and displacement of the fracture.²⁰ In our study, the cubitusvarus and cubitus valgus rates were 6.4% and 1.3%. Although the chance of developing pin tract infection and cubitusvarus was found to be more in the seasonal peaks, after statistical analysis we detected that it is mostly related to the increase in the number of cases presented at these seasonal peaks and that increase is of no statistical significance according to Chi-Square Test (Table 4).

The pre-operative nerve deficit rate was 7.1%; most of this type of nerve deficit is thought to be neuropraxia that usually returns to normal function in 2 to 3 months.^{21,22,23} In our study, neurological deficit returned to normal by 9 weeks post-operation. An important complication that may have legal implications is the post-operative iatrogenic nerve deficit after placement of the medial pins, which was present in 0.6% of the patients. Thankfully, they usually return to function after removal of the medial pin; this type of iatrogenic injury is documented to be 1.84-times higher in the use of medial pins.¹⁸ Brauer et al.'s systematic review suggested that the probability of ulnar nerve injury in the case of medial pinning be 5.04-times higher than with later pins.²⁴

Alterations in the vascular status of the patients with pediatric supracondylar humeral fractures are 10% to 20%.^{25,26} We had a 5.8% rate of pre-operative (before reduction) absent radial pulse, which is reported to be 7% to 12%.²⁷ In this type of vascular insufficiency, re-evaluation of the vascular status after closed reduction is a priority; because the radial pulses are restored in 80% of the cases.²⁸ We had only one patient who needed vascular exploitation and repair of the brachial artery.

Regarding the decision of pin configuration whether it is lateral pinning or crossed pinning the increase in the crossed pinning of type III in both the peak seasons and other seasons is explained by the fact that type III is more severe than type II, yet that variation was not found to be of statistical significance. (Table V)

CONCLUSION

We found that there are two seasonal peaks in this type of fracture. The higher being in the summer season, which starts in the school vacation time, and another lower peak in the winter season also in the school midterm vacation time. This study can be used as a tool for planning and policies and has important

implications for the development of effective management and prevention strategies. It can also be used as a tool for a public preventive program for school-age children, especially by raising the public's awareness of this problem during school vacation time. We suggest that there is a need to increase awareness among the medical community and to perform more research addressing injury as a research problem.

Conflict of interest statement:

No conflict of interest exists

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Ethical approval:

Ethical approval was obtained from the local institutional Ethics Committee.

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