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Enhancing Patient Care Through Structured Assessment Of Supracondylar Fractures: A Quality Improvement Project At Holy Family Hospital, Rawalpindi Medical University

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Abstract

Objective: Aim of this QIP is to investigate the neurovascular status documentation of supracondylar fractures in pediatric population and to devise and implement a new assessment proforma for evaluation of these fractures.

Methods: This QIP was conducted in two cycles at Department of Orthopedic Surgery, Holy Family Hospital from October 2022 to October 2023. The first cycle was retrospective data collection and second cycle was prospective data collection. In total, there were 112 children with supracondylar fractures. The evaluation was conducted in three stages: the initial stage consisted of examining the patient on presentation, the second stage focused on evaluating after applying plaster of Paris (POP)/backslab/manipulation, and the third stage involved assessing the patient post-surgery. Throughout each stage of evaluation, any changes in vascular assessment (Yes/No) and any changes in neurological assessment (Motor and Sensory) were documented. The data was analyzed using 95% confidence interval and a significance level set at $p<0.05$.

Results:

Cycle: 1

In cycle 1, pre-Operatively, 6 patients (11.5%) had documented neurological status, 25(48.07%) had documented vascular status, and 10 (19.2%) as "NVI." After POP/backslab/manipulation, neurological status was documented in 3 patients (5.8%), vascular status in 21(40.3%), and "NVI" in 8(15.4%). Postoperatively, neurological status in 5(9.6%), vascular status in 23(44.2%), and "NVI" in 16 patients (30.8%).

Cycle: 2

On presentation in cycle 2, neurological status documentation was present in 41 patients (68.3%), vascular status documentation in 55(91.6%), and "NVI" in 40(66.7%). After POP/backslab/manipulation, neurological status documentation was in 48 patients (80%), vascular status documentation in 52(86.7%), and "NVI" in 53(88.3%). Postoperatively, neurological status documentation was in 52(86.7%), vascular status documentation in 56(93.3%), and "NVI" in 57(95.0%).

Conclusion: This QIP suggest that structured assessment of supracondylar fractures can significantly enhance patient care.

MeSH Keywords: Quality improvement, Supracondylar fractures, Neurovascular coupling.

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1. Introduction

Supracondylar fractures are one of the most common types of fractures of the elbow observed in the pediatric population. Most often these fractures result in injury to the non-dominant hand after falling on an outstretched arm[1]. Approximately 25-40% of these injuries have resulted from falling from swings or similar playground equipment[2].

Supracondylar fractures make up for about one-fifth of all pediatric fractures and 60% of all elbow fractures in children[3]. It has been reported that about 10-20% of the cases, the fracture also results in certain neurological injuries[4], while vascular complications have been reported in 20% of the cases[5]. Neurovascular complications secondary to stretch neuropraxia is associated with the extent of fracture displacement. Vascular and neurological complications most commonly occur together in severe form of fractures[6].

It is due to the grave complications following the fracture, that makes the early diagnosis and appropriate clinical management imperative for the best possible outcomes. Diagnosis is generally based on clinical assessment and conventional radiography.

A simple technique to classify supracondylar fractures was introduced by Gartland. This method of classification discussed the principles regarding the management of such fractures which have also proven to be effective over the years. According to Gartland,

supracondylar fractures can be classified as Type 1 Un-displaced fractures, Type 2 Displaced fractures with posterior hinge intact, and Type 3 Fully displaced fractures. This classification has allowed healthcare professionals to standardize the treatment of supracondylar fractures[7]. Type 1 fractures are managed non operatively, while Type 3 fractures often require reduction and fixation. In Type 2 fractures, important landmarks such as the condylar angle, dictate the mode of treatment[8].

Most recent evidences are generally unimpressive and are often limited due to poor methodology, unsatisfactory retrospective studies, and the involvement of a very small sample size. Such results don't contribute much to the ongoing debate for the optimum management of supracondylar fractures[9]. Hence, there is a dire need for further studies that would outline the best management plan for such fractures.

Our study was designed to investigate the neurovascular status documentation of supracondylar fractures in the pediatric population and to devise and implement a new assessment proforma for the evaluation of these fractures.

2. Materials & Methods

QIP was conducted at the Department of Orthopedic Surgery in Holy Family Hospital, which is attached to Rawalpindi Medical University. The Clinical Audit Department approved the study of the hospital. This was done for one year, specifically from October 2022 to October 2023. In total, there were 112 children with supracondylar fractures; among them, fifty-one were boys and sixty-one were girls.

The data collection instrument for the Quality Improvement Project (QIP) consisted of the patient's name, age/sex, medical record number (MRN), duration of injury, cause of injury, presence of related fractures (such as distal radius), and indication if the injury was open or closed. Additionally, information regarding the side of the injury (right or left) was recorded.

The evaluation was conducted in three stages: the initial stage consisted of examining the patient on presentation, the second stage focused on evaluating after applying plaster of Paris (POP)/backslab/manipulation, and the third stage involved assessing the patient post-surgery.

Throughout each stage of evaluation, the recorded parameters included the individual responsible for conducting the assessment (House Officer/PGT/Registrar/Consultant), the classification of Gartland Fracture Type based on X-ray findings (Type-I, Type-II, or Type-III), whether post-reduction X-rays were obtained (Yes/No), any changes in vascular assessment (Yes/No) accompanied by appropriate documentation if applicable, and any changes in neurological assessment (Motor and Sensory) with accompanying documentation if applicable. The data was then analyzed using suitable statistical methods with a 95% confidence interval and a significance level set at $p<0.05$. Subsequently, the results and recommendations derived from these findings were presented during departmental audit meetings to facilitate further action and implementation.

First Cycle:

During the first cycle of this QIP, retrospective data collection and review were done. We retrospectively reviewed the pediatric cases with supracondylar fractures admitted at our hospital from October 2022 to March 2023. This first cycle was made up of a total of 52 patients.

Patient age, sex, Gartland classification of fracture, mechanism of injury, and associated fractures were all documented. We also evaluated the completeness of data in neurovascular documentation at the presentation stage, post-reduction, cast application, and post-operation if need be. The sensory and motor functions of the median, AIN, ulnar nerves, and radial nerves were documented for the completeness of neurological assessment. Radial pulse and capillary filling time served as criteria for the completeness of the vascular assessment. Using the results of the first cycle, we noted the lapses in the documentation and assessment process. To close the said gaps, we created supracondylar fracture assessment proforma in clerking and documentation before and after intervention. As presented in Figure 1, this proforma was supplied in both paper and electronic versions. Furthermore, we organized multidisciplinary teaching sessions for every individual within the emergency department and trauma team to guarantee consistent evaluation and record-keeping.

Second Cycle:

This QIP was prospective cycle two that included pediatric patients who suffered a supracondylar fracture treated at our institution between April 2023 and October 2023.

The data collection and assessment process in the second cycle mirrored that of the first cycle, focusing on:

- Neurovascular status documentation completeness before and after intervention
- Abiding the new supracondylar fracture assessment proforma

- Standardized assessment and documented practices will be used to measure the effectiveness of the multidisciplinary teaching session.

The second cycle's findings and recommendations were made available in departmental audit meetings for improvement. In doing this, we aimed to improve the assessment and management of pediatric patients with supracondylar fractures at our institution.

3. Results

Cycle: 1

In this descriptive analysis of cycle 1, the mean age of the participants was 6.81 years, with a standard deviation (SD) of 3.00. The median age was 6.0, and the interquartile range (IQR) was 3 years. For time since injury, the mean was 9.42 hours, with an SD of 3.84. The median time since injury was 8.0 hours, and the IQR was 6 hours. Time to surgery had a mean of 1.90 days and a SD of 0.84, with a median of 2.0 days and an IQR of 1 day. Lastly, the follow-up period had a mean of 72.23 days, a SD of 25.61, a median of 80.0 days, and an IQR of 49 days as shown in Table 1.

Table 1: Descriptive statistic of variables (n=52)

Descriptive	Mean	SD	Median	IQR	95% C.I.
Age (years)	6.81	3.00	6.0	3	5.97 7.64
Time Since Injury (hours)	9.42	3.84	8.0	6	8.35 10.49
Time to Surgery (days)	1.90	0.84	2.0	1	1.67 2.14
Follow-up Period (days)	72.23	25.61	80.0	49	65.10 79.36

*(IQR)=Interquartile Range
*(SD)=Standard Deviation
*(CI)=Confidence Interval

In this study, the characteristics of the participants were as follows: 28 (53.8%) were male, and 24 (46.2%) were female. The type of fracture according to Gartland fracture classification was 6 (11.5%) for supracondylar type-1 fractures, 8 (15.4%) for type-II fractures, and 38 (73.1%) for supracondylar type-III fractures.
Operative treatment was received by 46 (88.4%) of the participants, while 6 (11.5%) did not undergo surgery. In terms of the side of injury, 20 (38.5%) had left-sided injuries, and 32 (61.5%) had right-sided injuries. Reduction was primarily closed in 37(80.4%) of cases and open in 9(19.5%) of cases. Table 2

Table 2: Baseline Characteristics Of Variables (N=52)

Characteristics	Frequency	Percentage
Gender		
Male	28	53.8%
Female	24	46.2%
Type Of Fracture According To Gartland Classification		
Type-I Fracture	6	11.5%
Type-Ii Fracture	8	15.4%
Type-Iii Fracture	38	73.1%
Operative Treatment		
Yes	46	88.4%
No	6	11.5%
Side Of Injury		
Left	20	38.5%
Right	32	61.5%
Reduction		
Close	37	80.4%
Open	9	19.5%

Pre-operatively in cycle 1, 6 patients (11.5%) had documented neurological status, 25 patients (48.07%) had documented vascular status, and 10 patients (19.2%) were documented as "NVI."
After POP/back slab/manipulation, neurological status was documented in 3 patients (5.8%), vascular status in 21 patients (40.3%), and "NVI" in 8 patients (15.4%). Postoperatively, neurological status was documented in 5 patients (9.6%), vascular status in 23 patients (44.2%), and "NVI" in 16 patients (30.8%) (Table 3).

Table 3: Documentation of neurovascular (nv) status cycle 1(n=52)

		On Presentation	After Pop/Back Slab/Manipulation	Post-Operatively
Neurological Status Documentation	YES	6(11.5%)	3(5.8%)	5(9.6%)
	NO	46(88.5%)	49(94.2%)	47(90.4%)
Vascular Status Documentation	YES	25(48.07%)	21(40.3%)	23(44.2%)
	NO	27(51.9%)	31(59.6%)	29(55.7%)
Documented As "Nvi"	YES	10(19.2%)	8(15.4%)	16(30.8%)
	NO	42(80.8%)	44(84.6%)	36(69.2%)

Cycle: 2
In this descriptive analysis of cycle 2, the mean age of the participants was 6.80 years, with a standard deviation (SD) of 2.88. The median age was 6.0, and the interquartile range (IQR) was 4 years. Time to surgery had a mean of 1.25 days and an SD of 0.50, with a median of 1.0 days.

Lastly, the follow-up period had a mean of 64.77 days, an SD of 21.91, a median of 66.0 days, and an IQR of 39 days as shown in Table 4.

Table 4: Descriptive statistic of variables (n=60)

Descriptive	Mean	SD	Median	IQR	95% C.I.
Age (years)	6.97	2.88	6.0	4	6.05 --- 7.55
Time to Surgery (days)	1.25	0.50	1.0	0	1.12 --- 1.38
Follow-up Period (days)	64.77	23.29	66.0	39	58.75 --- 70.78

*(IQR)=Interquartile Range
*(SD)=Standard Deviation
*(CI)=Confidence Interval

The characteristics of the participants in this study were as follows: 23(38.3%) were male, and 37(61.7%) were female. All participants received operative treatment. The reduction method was primarily closed in 53(88.3%) of cases and open in 7(11.7%) of cases. Regarding Gartland fracture types, 33(55.0%) were Type II, and 27(45%) were Type III as documented in Table 5.

Table 5: Characteristics of variables (n=60)

Characteristics	Frequency	Percentage
Gender		
Male	23	38.3%
Female	37	61.7%
Operative Treatment		
Yes	60	100.0%
Reduction		
Close	53	88.3%
Open	7	11.7%
Gartland Fracture Type		
Ii	33	55.0%
Iii	27	45%

On presentation in cycle 2, neurological status documentation was present in 41 patients (68.3%), vascular status documentation in 55 patients (91.6%), and "NVI" documentation in 40 patients (66.7%). After POP/back slab/manipulation, neurological status documentation was in 48 patients (80%), vascular status documentation was in 52 patients (86.7%), and "NVI" documentation was in 53 patients (88.3%). Postoperatively, neurological status documentation was in 52 patients (86.7%), vascular status documentation in 56 patients (93.3%), and "NVI" documentation in 57 patients (95.0%). (Table 6)

Table 6: Documentation of neurovascular (nv) status cycle 2 (n=60)

		On presentation	After pop/back slab/manipulation	Post-operatively
Neurological status documentation	YES	41(68.3%)	48(80%)	52(86.7%)
	NO	19(31.7%)	12(20.0%)	08(13.3%)
Vascular status documentation	YES	55(91.6%)	52(86.7%)	56(93.3%)
	NO	05(8.3%)	08(13.3%)	04(6.7%)
Documented as "nvi"	YES	40(66.7%)	53(88.3%)	57(95.0%)
	NO	20(33.3%)	07(11.7%)	03(5.0%)

4. Discussion

In our study, the average age of patients who were presented with supracondylar fracture was 6.81 and 6.97 years in the first and second cycles, respectively. Additionally, most of the patients presented were males in the first cycle (53.8%), while in the second cycle, a female predominance (61.7%) was seen. A similar study also reported a male predominance in the population studied, with the average age of patients being six years[5]. However, in another study, the average age of children on presentation with supracondylar fractures was seven years, with a male predominance[10].

Good documentation is the cornerstone for clinical practice and providing the best care. Maintaining a good record of clinical information improves communication and helps develop treatment strategies and interventions for devising future care plans[11].

Documentation of the neurovascular status of patients with supracondylar fractures was essential to our study. The neurovascular status was observed on the patient's presentation, after an intervention with either a cast or reduction and after surgical management if required. A proforma was made, highlighting guidelines for a detailed neurovascular status examination. On comparison of documentation between the two cycles for the assessment of neurovascular status before the application of a back slab, a documentation improvement was seen, with the lack of documentation reducing from 88.5% to 31.7% on neurological status and from 51.9% to 8.3 % on vascular status. In the analysis of post-slab documentation status, the percentage of documented neurovascular status has also improved. The quality of documentation was improved, with only 11.7 % of patients not documented as "neurovascular status intact" in cycle 2, as compared to 84.6% in cycle 1. The documentation of neurovascular

status post-operatively improved in cycle 2 as well improving the documentation from 9.6% to 86.7% in cycle 2 on neurological status and from 44.2% to 93.3%on vascular status. In cycle 2, after considerable training and the introduction of a pro forma, a slight improvement was seen in the documentation quality across all parameters.

The effectiveness of a proforma for documentation improvement was studied by Vukanic et al. to assess in-patient documentation in an orthopaedic ward. After introducing the proforma, the documentation notes comprised 86% of the information required for good documentation of patient status[12]. Since junior doctors maintain most patient records, it is essential to have strict guidelines to ensure that appropriate documentation occurs.

The period until surgical treatment was an important feature assessed in our study. In cases of supracondylar fractures, surgical treatment aims to reduce the fracture and preserve the function of the affected limb[13]. Though some articles argue that a delay in surgical intervention can cause difficulty in reducing fracture[14], some research found no association between the timing of surgery and the surgical outcomes[15].

In a study by Okkaoglu et al., the optimal timing of surgery was evaluated in pediatric patients suffering from Gartland type 3 supracondylar fracture. The parameters assessed were early or delayed surgical interventions, night or daytime surgery, or operation during working and non-working hours. The results found no association between the time of surgery and its outcome in terms of duration of surgery, reduction quality, and open reduction rate[16].

However, contrary findings were reported by Aydoğmuş et al., who found that surgeries conducted during non-working hours had poor reduction quality[17]. On the other hand, though Paci et al. found no association between reduction quality and surgical intervention during non-working hours, they did observe that patients who were operated on during non-working hours had a much higher incidence of malunion18. In our study, patients who required surgical correction of fractures had surgery 24 hours after presentation, with an average period of 1.90 and 1.25 days in the first and second cycles, respectively.

In the study, most patients who required surgical management underwent close reduction to correct the fracture. In the first cycle, 88.4% of patients required surgery which 80.4% had a close reduction; in the second cycle, 100% of patients underwent the procedure which 88.3% had close reduction. A study by Rakha et al. evaluated the efficacy of close and open reduction in the pediatric population with supracondylar fractures. The result showed an effectiveness of 89.23% with open reduction, while closed reduction was effective in 93.85% of the cases. However, the results were concluded to have a statistically insignificant difference[19]. Similar findings were also reported by Hussein et al., who also found no significant difference in outcomes following open or closed reduction for supracondylar fracture in pediatric patients. However, the study concluded that closed reduction was most often preferred over open reduction, as it requires fewer days of hospitalization and results in minimal post-operative scars[20].

Our study was limited due to certain factors. We did not observe a massive difference in terms of the quality of documentation in the two cycles. This may have occurred due to the continuous changes in shifts of the junior doctors on duty, who are mainly responsible for documentation. Documentation is crucial to patient care and can be improved by providing continuous medical education to healthcare professionals. This would help build the skills and reflexes that are essential for following patient progress.

Further research is warranted for the development of a proforma that can serve as an effective tool for improving patient care. Though this QIP managed to improve patient documentation, there still exists room for more improvement.

5. Conclusion

The results of this quality improvement project are promising and suggest that structured assessment of supracondylar fractures can significantly enhance patient care. However, it is important to acknowledge the limitations of the study, such as the sample size and the single-centre design, which may affect the generalizability of the findings. Further research is needed to validate these results in a larger, more diverse population and to explore the long-term impact of structured assessment on patient outcomes. Overall, this study provides a strong foundation for future research and quality improvement initiatives aimed at optimizing care for patients with supracondylar fractures.

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H.W, R.R.A, R.A - Conception of study
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References

1. Anjum R, Sharma V, Jindal R, Singh TP, Rathee N. Epidemiologic pattern of paediatric supracondylar fractures of the humerus in a teaching hospital of rural India: A prospective study of 263 cases. Chinese journal of traumatology. 2017; 20(03):158-60. https://doi.org/10.1016/j.cjtee.2016.10.007
2. Holt JB, Glass NA, Shah AS. Understanding the epidemiology of pediatric supracondylar humeral fractures in the United States: identifying opportunities for intervention. Journal of Pediatric Orthopaedics. 2018; 38(5):e245-51. https://doi.org/10.1097/bpo.0000000000001154
3. Talbot C, Madan S. Paediatric humeral supracondylar fractures. Surgery (Oxford). 2020; 38(9):517-25. https://doi.org/10.1016/j.mpsur.2020.06.015
4. Özcan M, Altınöz Ö, Erem M, Ciftdemir M, Çopuroğlu C, Turan FN. Prognosis and risk factors of nerve injuries in displaced pediatric supracondylar humerus fractures. Nigerian Journal of Clinical Practice. 2020; 23(5):647-53. https://doi.org/10.4103/njcp.njcp_575_18
5. Pilla NI, Rinaldi J, Hatch M, Hennrikus W. Epidemiological analysis of displaced supracondylar fractures. Cureus. 2020; 12(4). https://doi.org/10.7759/cureus.7734
6. Costales JR, Socolovsky M, Sánchez Lázaro JA, Álvarez García R. Peripheral nerve injuries in the pediatric population: a review of the literature. Part I: traumatic nerve injuries. Child's nervous system. 2019; 35:29-35. https://doi.org/10.1007/s00381-018-3974-8
7. Shenoy PM, Islam A, Puri R. Current management of pediatric supracondylar fractures of the humerus. Cureus. 2020; 12(5). https://doi.org/10.7759/cureus.8137
8. Rupp M, Schäfer C, Heiss C, Alt V. Pinning of supracondylar fractures in children–Strategies to avoid complications. Injury. 2019; 50:S2-9. https://doi.org/10.1016/j.injury.2019.03.042
9. Duffy S, Flannery O, Gelfer Y, Monsell F. Overview of the contemporary management of supracondylar humeral fractures in children. European Journal of Orthopaedic Surgery & Traumatology. 2021; 31:871-81. https://doi.org/10.1007/s00590-021-02932-2
10. Auso-Perez JR, Rodríguez-Blanes GM. Comprehensive Analysis of Pediatric Supracondylar Fractures in the Emergency Department; A Single Center Experience. Bulletin of Emergency & Trauma. 2020; 8(3):142.
11. Sjöberg M, Edberg AK, Rasmussen BH, Beck I. Documentation of older people's end-of-life care in the context of specialised palliative care: a retrospective review of patient records. BMC palliative care. 2021; 20(1):91. https://doi.org/10.1186/s12904-021-00771-w
12. Vukanic D, Kelly EG, Cleary SM. Does an orthopedic ward round pro forma improve inpatient documentation?. Journal of Patient Safety. 2021; 17(8):553-6. https://doi.org/10.1097/pts.0000000000000678
13. Vaquero-Picado A, González-Morán G, Moraleda L. Management of supracondylar fractures of the humerus in children. EFORT open reviews. 2018; 3(10):526-40. https://doi.org/10.1302/2058-5241.3.170049
14. Hubbard EW, Riccio AI. Pediatric orthopedic trauma: an evidence-based approach. Orthopedic Clinics. 2018; 49(2):195-210. https://doi.org/10.1016/j.ocl.2017.11.008
15. Pavone V, Vescio A, Riccioli M, Culmone A, Cosentino P, Caponnetto M, Dimartino S, Testa G. Is supine position superior to prone position in the surgical pinning of supracondylar humerus fracture in children?. Journal of Functional Morphology and Kinesiology. 2020; 5(3):57. https://doi.org/10.3390/jfmk5030057
16. Okkaoglu MC, Ozdemir FE, Ozdemir E, Karaduman M, Ates A, Altay M. Is there an optimal timing for surgical treatment of pediatric supracondylar humerus fractures in the first 24 hours?. Journal of Orthopaedic Surgery and Research. 2021; 16(1):484. https://doi.org/10.1186/s13018-021-02638-5
17. Aydoğmuş S, Duymuş TM, Keçeci T, Adiyeke L, Kafadar AB. Comparison of daytime and after-hours surgical treatment of supracondylar humeral fractures in children. Journal of Pediatric Orthopaedics B. 2017; 26(5):400-4. https://doi.org/10.1097/bpb.0000000000000403
18. Paci GM, Tileston KR, Vorhies JS, Bishop JA. Pediatric supracondylar humerus fractures: does after-hours treatment influence outcomes?. Journal of Orthopaedic Trauma. 2018; 32(6):e215-20. https://doi.org/10.1097/bot.0000000000001134
19. Rakha A, Khan RD, Arshad A, Khan ZA, Ahmad S, Mahmood S. Comparison of efficacy between open and close reduction in supracondylar fracture of humerus in children using Flynn's criteria. Annals of Punjab Medical College (APMC). 2020; 14(1):32-6. https://doi.org/10.29054/apmc/2020.801
20. Hussein al-Algawy AA, Aliakbar AH, Witwit IH. Open versus closed reduction and K-wire fixation for displaced supracondylar fracture of the humerus in children. European Journal of Orthopaedic Surgery & Traumatology. 2019; 29:397-403. https://doi.org/10.1007/s00590-018-2305-9