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# Improving Follow-up Skeletal Survey Compliance in Suspected Nonaccidental Trauma Patients: What's the FUSS About?

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## ABSTRACT

**Introduction:** Nonaccidental trauma (NAT) victims account for a significant percentage of our pediatric trauma population. The skeletal survey (SS) and follow-up skeletal survey (FUSS) are essential in the evaluation of selected NAT patients. We identified that our clinically indicated FUSS completion rate was suboptimal. We hypothesized that implementing an intervention of postdischarge follow-up in our pediatric surgery clinic would improve FUSS completion rates. **Methods:** A follow-up clinic for NAT patients was established in July 2013. A retrospective review was performed of all suspected NAT cases younger than 2 years old seen at Kentucky Children's Hospital between November 2012 and February 2014. The study population was divided into pre (Group 1) and postintervention (Group 2). Bivariate analysis was performed. **Results:** Group 1 consisted of 50 patients (58% male; median age, 9 months). Forty-7 (94%) had an SS; fractures were identified in 37 (74%) patients. Only 20 patients (40%) had FUSS; of those, 4 had newly identified fractures. Group 2 consisted of 52 patients (54% male; median age, 7 months). All 52 children (100%) had an SS; fractures were identified in 35 (67%) patients. Forty-seven patients (90%) had FUSS. Of those, 6 had new radiographic findings. Thirty-five patients (67%) were seen in our clinic. This improvement in FUSS (40% versus 90%) was statistically significant, $P < 0.001$. **Conclusion:** The decision to follow NAT patients in our clinic had significantly increased our rates of FUSS completion. This additional clinic follow-up also provided more evidence for NAT evaluation. *(Pediatr Qual Saf 2018;3:e094; doi: 10.1097/pq9.0000000000000094; Published online August 9, 2018.)*


## INTRODUCTION

Nonaccidental trauma (NAT) is a significant cause of morbidity and mortality in the pediatric population. In federal fiscal year 2016, there were nationally 122,067 victims of child physical abuse, resulting in a rate of 1.7 victims per 1,000 American children.[1] The medical evaluation of suspected NAT victims includes obtaining a detailed history, a thorough physical examination, and appropriate ancillary testing. The American Academy of Pediatrics recommends that a skeletal survey (SS) is necessary to evaluate for occult injuries in children younger than 2 years with obvious abusive injuries, suspicious injuries, inconsistent histories, and intracranial injuries.[2] Furthermore, a follow-up skeletal survey (FUSS) is recommended when there is continued high suspicion of abuse.[3,4]

Screening for occult fractures is an essential part of the evaluation of young children who are suspected physical abuse victims. Between 10% and 40% of NAT patients have fractures that are not suspected on the basis of history and physical examination.[5–8] In addition to detecting fractures that require medical attention, the SS can identify specific patterns of injury that confirm a diagnosis of abuse. The stage of healing may provide important information regarding the timing of injuries and can help identify the perpetrator. A FUSS performed approximately 2 weeks after the initial study may provide additional information regarding the number, character, and age of injuries inflicted on infants and toddlers.[9–11] FUSS helps to identify rib and metaphyseal fractures through callous formation, which are too early to see on the SS. Recently, studies have suggested a decreased utility of FUSS in those older than 12 months old, and of no benefit in those older than 5 years old. In addition, once NAT has been ruled out, FUSS is no longer recommended. Despite this, in clinical practice, FUSS continues to be used in select cases that NAT has not been ruled out.[12]

Pediatric surgeons are frequently involved in the evaluation and management of NAT victims. When compared

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with their accidental trauma counterparts, NAT patients are younger and have worse outcomes with higher mortality, longer hospital Length of Stay (LOS), and higher rates of Pediatric Intensive Care Unit (PICU) admission.[13–15] Suspected NAT victims account for a significant portion of our hospital's pediatric trauma population. In a previous study, we demonstrated that 48% of our NAT victims had multiple injuries.[16] During this study, 3 children died as a result of abusive head trauma. This reinforces the need for a complete evaluation of these patients; preferably at a Level I Pediatric Trauma Center with a full complement of various pediatric surgical subspecialties, forensics team, and social workers.

A recent retrospective study of 366 American hospitals reported that only 48% of the children who were diagnosed with physical abuse received evaluation for occult injuries.[17] In our previous study, 97% of the suspected NAT victims received an SS to evaluate for occult fractures. We attribute our SS completion success to having a clinical practice guideline for the evaluation of suspected NAT patients. This guideline was agreed upon by members of our multidisciplinary team composed of emergency medicine physicians, pediatric trauma surgeons, and pediatric hospitalists. The evaluation includes obtaining a detailed history of the events surrounding the child's injury, a careful physical examination, imaging, labs, and evaluation by a hospital social worker. It may include an ophthalmologic examination to assess for retinal hemorrhages. As mandated by state law, suspected cases of child abuse and neglect are reported to a local child protective services (CPS) agency. Cases are reviewed at a monthly multidisciplinary conference attended by CPS and occasionally local law enforcement.

During our hospital's monthly multidisciplinary review of NAT patients, we recognized that despite a high SS rate, most of our patients were not returning for clinically indicated FUSS studies. At the time, studies were being ordered at discharge, and the radiology department contacted the caregiver to schedule the FUSS. The low compliance rate was likely multifactorial including: inadequate education for providers of FUSS indication, poor logistical postdischarge communication with caregiver, substandard provider ownership to order follow-up study, and most importantly, the lack of a concrete mechanism to ensure FUSS completion. As a result, in July 2013, we decided to have all highly suspected NAT patients follow-up in our pediatric surgery clinic. The reason for this was 2-fold: this clinic is staffed by our physician's assistant (PA), and this clinic was not being scheduled to capacity. At the visit, the children would be examined, the FUSS is completed, and the results would be communicated to CPS. The purpose of this study was to evaluate for improved compliance of FUSS completion pre and postimplementation of a follow-up clinic for NAT patients.

## METHODS

This pre- and postintervention study was approved by the University of Kentucky's Office of Research Integrity (13-0383-P1H). Kentucky Children's Hospital (KCH) is a Level I Pediatric Trauma Center that has been verified by the American College of Surgeons Verification, Review and Consultation Program. We implemented the intervention of a follow-up clinic on July 1, 2013. All patients upon discharge with highly suspected NAT were scheduled to follow-up in our pediatric surgery clinic staffed by the PA. This clinic was already being used for routine surgical follow-up and was not at capacity. The PA performed a physical examination and patients received their scheduled FUSS in outpatient radiology. Any positive findings would be conveyed to the PA and reported to CPS. Any new injuries suspicious for abuse required admission and full evaluation until CPS determined safe disposition. In addition, any patients who did not return for FUSS were reported to CPS. Eight months after the intervention, we reviewed the records of patients 8 months pre- and postintervention. Our hospital trauma registry was queried to include all patients age 2 years and younger, who were suspected NAT victims and received medical care at KCH between November 1, 2012, and February 28, 2014. Suspected NAT victims were defined as pediatric trauma patients for whom a CPS referral was made because of the circumstances of their injuries and clinical suspicion. All patients who had confirmed accidental trauma were excluded.

A retrospective chart review was performed on this patient population and data were collected on patient demographics, CPS involvement, SS results, discharge disposition, and FUSS results. Our study population was then divided into 2 groups. Group 1 includes those seen during the 8 months before the decision to follow-up in our clinic. Group 2 includes those evaluated during the 8 months after the decision. Patient characteristics and outcomes were compared between groups using Mann-Whitney *U* tests for continuous variables and Fisher's exact for binary variables. SPSS statistical software version 22 (IBM Corp, Armonk, N.Y.) was used for all calculations. Thresholds for significance were set at $P$ values $< 0.05$.

## RESULTS

During the 16-month study period, 102 children were evaluated by the pediatric trauma service for suspected NAT. Our results are summarized in Table 1. In group 1, 47 children (94%) had an SS as part of their initial evaluation. Fractures were identified in 37 studies (74%). All 48 patients (100%) were referred to CPS due to concern for suspected abuse. Two patients died as a result of their injuries; both were attributed to anoxic brain injuries. In total, only 20 patients (40%) had a FUSS completed. Two FUSS studies were completed before the children were discharged from the hospital. Three children (6%) had scheduled appointments in the clinic, and all 3 had their FUSS completed. Others were completed during scheduled visits to the emergency room or during follow-up

**Table 1. Characteristics of the 102 Nonaccidental Trauma Patients in Our Study Group and Dispositions**

| Patient Characteristics | Group 1: Preclinic Follow-up | Group 2: Postclinic Follow-up |
|---|---|---|
| Study dates | 11/1/12–6/30/13 | 7/1/13-2/28/14 |
| Months | 8 | 8 |
| Patients, n (%) | 50 | 52 |
| Male | 29 (58) | 28 (54) |
| Female | 21 (42) | 24 (45) |
| Age (mo) | | |
| Median | 9 | 7 |
| Interquartile range | 3–23 | 3–15 |
| Skeletal survey completed, n (%) | 47 (94) | 52 (100) |
| Deaths, n (%) | 2 (4) | 1 (2) |
| Clinic follow-up, n (%) | 3 (6) | 35 (67) |
| Follow-up skeletal survey completed, n (%) | 20 (40)* | 47 (90)* |
| Discharge caregiver | | |
| Parents | 20 | 26 |
| Parents with supervision | 8 | 1 |
| CPS-approved family | 8 | 15 |
| Foster care | 11 | 7 |
| LTAC/rehabilitation | 1 | 2 |

LTAC, long-term acute care facility.
*$P < 0.001$.

clinic visits to other services including orthopedic surgery and neurosurgery.

Of the 20 patients who received FUSS in group 1, 12 patients (60%) had findings that either confirmed or had no change from SS. In 4 patients (20%), FUSS provided reassurance that SS suspicious findings were not fractures. These include periosteal reaction, ulna irregularity, and femur irregularity on SS, respectively. Another 4 patients (20%) had previously unidentified fractures, including the humerus, ulna, ribs, and bilateral radius detected on FUSS. These patients with new FUSS findings did not have change in disposition. Two were discharged home with parents, and the other 2 were already placed in foster care from initial evaluation due to high suspicion of abuse. One patient who had a radius fracture read on the SS, in fact, was not a radius fracture on the FUSS. The patient benefited from fewer unnecessary follow-up visits.

In group 2, all 52 children (100%) had an SS as part of their initial evaluation. Fractures were identified in 35 studies (67%). All 52 patients (100%) were referred to CPS for suspected abuse. One patient died as the result of an anoxic brain injury. Forty-seven patients (90%) had FUSS; of these, 35 children (67%) were evaluated in our pediatric surgery clinic. Five children had their FUSS completed before discharge from the hospital. Others were completed in the emergency room and other outpatient clinics.

Of the patients who received FUSS in group 2; 41 patients (87%) had findings that either confirmed or had no changes from SS. No patients had findings that reassured that SS findings were not fractures. Six patients (13%) had additional fractures identified on FUSS including skull, femur, tibia, metatarsal, and ribs. All these children were seen in our pediatric surgery clinic. One patient had new finding of tibia fracture in addition to subdural hemorrhage on initial evaluation leading to confirmation of abuse and legal charges on mother. One patient was admitted after new identification of possible skull fracture with negative head computed tomography scan and unchanged disposition. One patient was discharged home with parents but had healing rib fractures on FUSS, and her disposition was changed to include paternal grandmother supervision (Fig. 1). The other 3 patients had confirmed fractures, but were already placed with foster parents from the initial SS. Overall, this improvement pre- and postintervention in FUSS completion (40% versus 90%) was statistically significant, $P < 0.001$.

## DISCUSSION

Due to the high incidence of NAT annually evaluated in the emergency room, a high index of suspicion is needed to identify occult skeletal injuries. This has been accomplished with the SS in those under 2 years of age with obvious, inconsistent, and intracranial injuries.[2] Of these patients, it is recommended that patients with high suspicion for abuse should receive a FUSS after 2 weeks.[4] Although there are multiple studies questioning the utility of a complete FUSS, it was the practice in our institution for those with highly suspicious or confirmed NAT. We evaluated our own compliance rate of FUSS, and it was suboptimal. We hypothesized that establishing a surgery clinic follow-up to ensure FUSS completion would improve FUSS compliance.

Before the intervention, multiple factors contributed to the poor FUSS compliance. Patients were discharged from the hospital with an understanding that they would be contacted by radiology to schedule a FUSS. Patient caregiver education regarding the necessity of this test was inconsistent. Finally, orders were missed by the discharging physician or were placed afterhours and missed by the radiology staff. The intervention allowed a more streamlined and precise process. All patients were set up with the pediatric surgery clinic. The clinic staff ensured FUSS were scheduled, and reminder calls were made. In the inpatient setting, the unit clerk upon discharge scheduled these follow-up appointments. The patient caregiver received education regarding the importance of a FUSS and the implications of a missed FUSS. There were not any barriers to the implementation of the clinic, as the clinic already existed for routine postsurgical follow-up. Most importantly, having a single clinic accountable for ensuring that FUSS was completed was the major factor to the increased compliance after the intervention.

Our study demonstrated that we successfully increased our rates of FUSS completion from 40% to 90%. Our intervention helped contribute to this result, as our clinic follow-up rate increased from 6% to 67%. We accomplished this in a manner that utilized existing resources and did not adversely impact the care of our other clinic patients. We provided the necessary continuity of care due to the lack of a dedicated child abuse specialist.

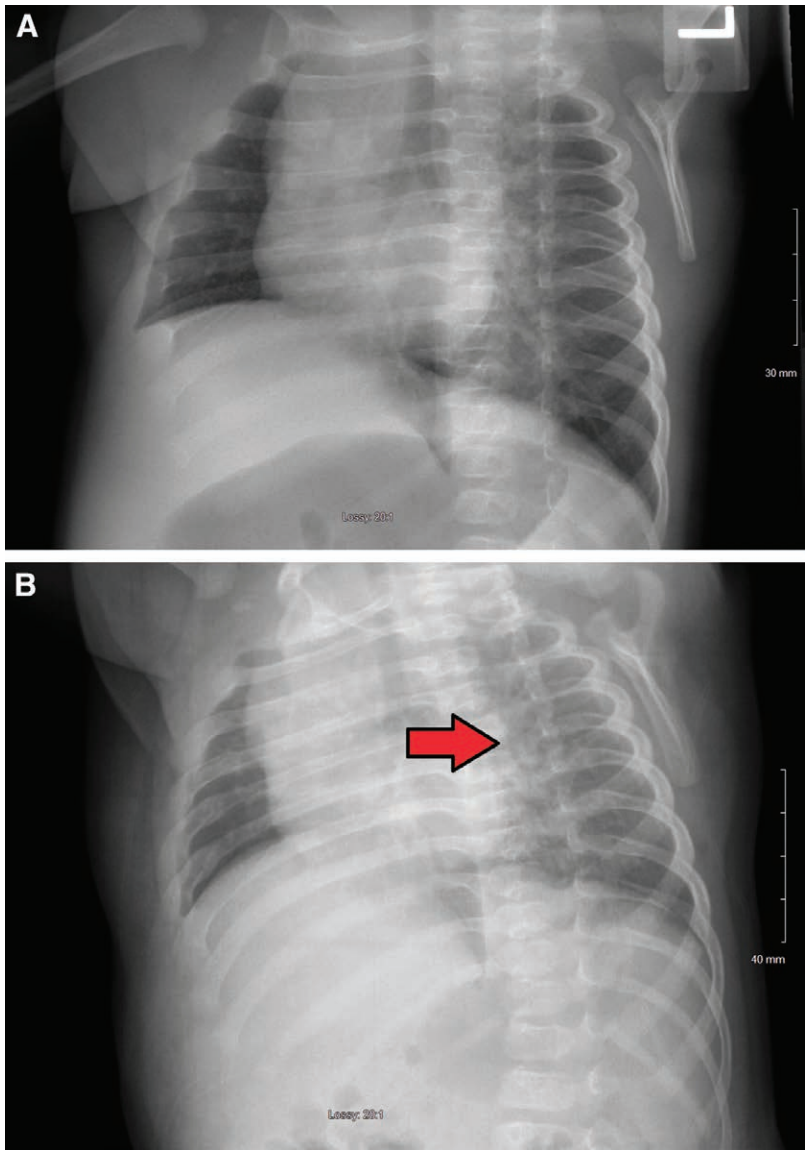


**Fig. 1.** Healing right posterolateral fourth, fifth, and sixth rib fractures identified on FUSS. A, Patient is a 2-month-old girl who initially presented with subconjunctival hemorrhage concerning for NAT. After full evaluation including SS, no additional injuries were identified. B, Patient had FUSS 2 weeks later demonstrating right 4-sixth rib fractures (arrow). Patient was discharged home with paternal grandmother supervision per CPS recommendations.

Furthermore, it helped to unburden the physicians in the emergency room and other clinics who were not structured to see these patients and to interpret their FUSS results.

Another benefit of this model was the improved communication between the pediatric surgery service, hospital social workers, and CPS. During the follow-up appointments, our PA performed a physical examination, and the FUSS was completed and interpreted by radiology. When new findings were identified on FUSS, our PA would contact the hospital social worker who would relay this information to CPS. Our study demonstrated that more than 50% of our suspected NAT patients were being discharged home with their parents. If these children returned with new evidence of obvious or suspicious injuries on FUSS, the child would be admitted to the hospital for full evaluation and await CPS safe disposition. CPS was also notified of all patients who did not return for FUSS. We believe that this is important to the well-being of these young children.

During our 16-month study period, a total of 67 children returned for their FUSS. Of these, 10 children (15%) had previously unrecognized fractures. This number is not insignificant and is consistent with other studies, which have reported the rates of new information identification to be between 8% and 46%.[10,11,18,19] Of those that received FUSS, 2 children were admitted to the hospital, and 3 children had change of disposition. One child was admitted after the identification of new rib fractures, and the other was admitted for possible skull fracture for

further evaluation and a safe disposition. Two siblings were placed in foster care because of the refusal of the caregiver to bring them to our follow-up clinic. The third child with change in disposition was found to have healing rib fractures on FUSS. After full evaluation, she was discharged home with parents with paternal grandmother supervision.

This study provided a feasible model for the improvement of compliance rates of FUSS after NAT evaluation. In addition, in the process of this study, the need for a dedicated child abuse specialist who would provide ownership to all NAT cases was identified. KCH now has 2 board-certified child abuse pediatricians.

## CONCLUSIONS

FUSS should be completed in children younger than 2 years who have an initial SS performed and who remain at high clinical suspicion for abuse. Our decision to follow NAT patients in our pediatric surgery clinic has successfully increased our rates of FUSS completion. We have been able to provide this important service by utilizing already-existing resources and without overwhelming our regular surgery clinic. Furthermore, bringing these children back for follow-up has allowed us to document a repeat physical examination and has improved communication between physicians, hospital social workers, and CPS. A follow-up clinic allowed us to identify new abuse events and confirm prior abuse events, which facilitated patient placement and thus improving NAT care.

## DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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