

# Standardizing Radiological Findings for Non-Accidental Trauma in the Pediatric Population

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## Abstract

The objective of this project was to review skeletal survey reports and examine the differences in reporting of non-accidental trauma (abuse) in pediatric patients with similar radiological findings. The ultimate goal of the project is to develop a standardized reporting system for radiological findings suspicious for non-accidental trauma. Ten years worth of skeletal survey reports were obtained on over 1,500 pediatric patients. These reports were individually reviewed and their findings were categorized in a data base separating findings suspicious for non-accidental trauma. Analysis was completed to inspect the consistency of reporting in studies with similar fractures. It was concluded that there are inconsistencies in reporting of non-accidental trauma in reports with similar fracture types. We propose a Skeletal Survey – Reporting and Data System (SS-RADS) score which will help radiologist standardize their reporting of non-accidental traumas for more consistent clinical outcomes.

## Introduction

Child abuse, also referred to by the more politically correct term *non-accidental trauma*, is a common occurrence that is often overlooked by the medical community. Every year, approximately 1 million children are injured and five thousand killed due to non-accidental trauma in the United States. Age is the single most important risk factor. It is estimated that 25-56% of all fractures in children under one year of age are due to abuse.

When physical abuse is suspected in a child with the appropriate history and physical, a skeletal survey x-ray can be ordered by the primary care physician to examine the bones of the child. The purpose of the skeletal survey is to document the presence of findings suspicious for abuse to aid the primary care physician in the management of the patient. The standard skeletal survey includes AP and lateral views of the skull and chest; lateral views of the spine; anterior/posterior views of the pelvis, long bones of the extremities, and feet; and posteroanterior oblique views of the hands.

No fracture or radiograph finding is pathognomonic for abuse, but certain findings are more suspicious for it. Posterior rib fractures, classic metaphyseal lesions, and long bone fractures are highly specific for non-accidental trauma in the right clinical setting. Additionally, skull, sternal, spinous process, and scapular fractures can also suggest non-accidental trauma. A thorough history is vital in determining the likelihood of abuse with these finding on radiograph.

The purpose of this project is to examine whether or not there are inconsistencies in reporting of non-accidental trauma in skeletal surveys that are suspicious for such findings. This can lead to uncertainty amongst primary care physicians in determining what the next best step is for the care of a patient. Ultimately, we would like to suggest a standardized reporting system for fractures that are suspicious for non-accidental trauma.

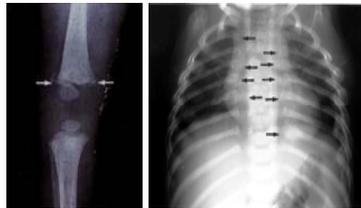


Figure 1: Corner Fracture (left) and multiple posterior rib fractures (right). Both specific for child abuse.

## Methods

A list of patient's that had skeletal survey reports ordered at St. Joseph's Hospital from 03/2000 to 01/2010 was obtained from the hospital medical data base. A Microsoft Excel Spreadsheet was created that categorized every patient's skeletal survey finding. The spread sheet included long bone fractures, rib fractures, metaphyseal corner fractures, sternum fractures, scapular fracture, spinous process fractures, healing fractures, and skull fractures. In addition, the spreadsheet contained a column titled 'SNAT noted' to determine which skeletal surveys had a specific note that stated that there was suspicion for non-accidental trauma. A sample screen shot of this spreadsheet is shown in Figure 2.

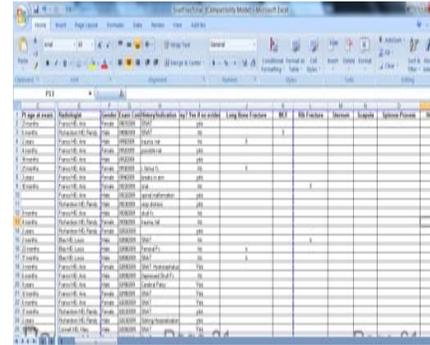


Figure 2: Screen shot of the spread sheet with categorization of findings. Note layout and categorization of fractures.

After categorization, the 1490 records were separated into two groups. The first group contained the reports which specifically mentioned that the findings were *suspicious for non-accidental trauma*. The second category contained all the other skeletal surveys that did not specially mention SNAT. Analysis was completed on these two data sets and compared. *The Fischer Exact Test* is a statistical method that was used to determine whether the two sets of data were significantly different.

## Results

	Totals (n=1490)	SNAT (n=67)	SNAT %	SNAT 95% CI	Non-SNAT (n=1423)	Non-SNAT %	Non-SNAT 95% CI	P-Value
LBF-MCF-Rib	186	9	13.4	5.24%-21.6%	177	12.4	10.7%-14.2%	0.85
MCF-LBF-Rib	21	7	10.4	3.13%-17.8%	14	0.98	0.47%-1.49%	<0.01
Rib-LBF-MCF	60	19	28.4	17.6%-39.2%	41	2.88	2.01%-3.75%	<0.01
LBF+MCF-Rib	20	10	14.9	6.4%-23.5%	10	0.70	0.27%-1.13%	<0.01
LBF+Rib-MCF	23	9	13.4	5.27%-21.6%	14	0.98	0.47%-1.49%	<0.01
MCF+Rib-LBF	7	4	5.97	0.3%-11.6%	3	0.21	-0.03%-0.45%	<0.01
LBF+MCF+Rib	7	6	8.95	2.12%-15.8%	1	0.07	-0.07%-0.21%	<0.01

Figure 3: This chart compares the skeletal surveys which contained the phrase SNAT vs those which did not. Notice the discrepancy in reporting SNAT for similar fractures.

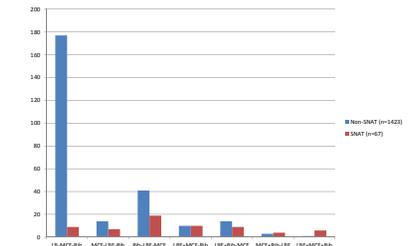


Figure 4: Bar graph comparing fractures which contained SNAT vs non-SNAT. Y-axis depicts numbers of cases and X-axis depicts fracture type.

## Discussion and Conclusions

As shown in Figure 3, there appears to be a significant difference in reporting of *non-accidental trauma* amongst radiologists, even amongst fractures that are highly suspicious for abuse. Using Long Bone Fractures as an example, it can be seen that there was an equal distribution of physicians stating SNAT vs not stating it. This is expected as LBF are not very specific for abuse. Compare this to patients who had LBF+MCF+RIB. This is highly specific for abuse, yet there was a case in which a child did not have SNAT reported. This type of discrepancy epitomizes the purpose of the project. The case with multiple fractures suspicious of non accidental trauma should have stated SNAT in the report.

We propose a standardized reporting system for abusive fractures in children to help identify those fractures most suspicious of abuse. We suggest a Skeletal Survey – Reporting and Data System (SS-RADS) score. The SS-RADS score will range from zero to five. A score of zero indicates an incomplete skeletal survey study. A score of 1 suggests a negative skeletal survey with no fractures. A score of 2 suggests benign findings. A score of 3 suggests probably benign findings. A score of 4 suggests a suspicious abnormality. A score of 5 suggests a highly suspicious skeletal survey abnormality that requires immediate action. This reporting system will help radiologist and primary care physician identify the children at highest risk for abuse so immediate action can be taken to remove them from the presence of the abuser.