



A84 Exploring the Gap Between Anthropological and Clinical Literature on Pediatric Fracture Healing

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After attending this presentation, attendees will understand the differences within and between anthropological and clinical literature regarding the interpretation of the time since injury of pediatric healing fractures.

This presentation will impact the forensic science community by serving as a resource for understanding the variability that exists within current literature and how this impacts the applicability of certain fracture healing timelines for use in forensic contexts. Further, inconsistencies across the literature and between fields call into question the appropriateness of published timelines for use in legal contexts.

Several methods to assess time since injury using radiographic signs of healing have been proposed specifically for identification of child physical abuse. The goal of this project is to present major gaps in these methods, compare clinical and anthropological literature, and define issues that warrant future research. Through a review of scientific literature, 18 published timelines of fracture healing were identified and compared. Of these, more than half were based solely on previous literature or clinical experience. In fact, little scientific data exist to support the understanding of the rate of pediatric fracture healing and only 8 of the 18 timelines examined were based on primary research.

The most significant discrepancy across the literature is a failure to take into account intrinsic variables that may influence fracture repair, including age, anatomical location, specific bone location, and within-bone fracture location. Of the nine timelines of fracture healing with an associated age range, the majority pool various age groups of different years together with little to no consideration given to the effect of age on fracture repair. Three timelines pool adults and teens with children. Given the definite differences between mature and immature skeletons, timelines derived from such samples should be treated with extreme caution. Even pooling smaller age ranges is questionable; age ranges of 0-5 years, while more appropriate to pool together than adults and children, still include pre-ambulatory and ambulatory children whose skeletons are distinct from one another structurally and morphologically.

Further, different bone functions likely influence the healing process between broad anatomical locations (upper vs. lower extremities). Half of the published timelines examined did not take into account anatomical location of the healing fracture, though it has been preliminarily suggested to influence fracture repair rate. Malone et al. found that upper extremity fractures heal more rapidly than lower extremity fractures, yet more than half (55%) of time-since-injury methods either do not cite the specific skeletal elements from which their research was derived or they combine skeletal elements of various anatomical regions (28%).¹ Further, there is significant overrepresentation of long bones (98% of the timelines examined), with 33% represented by radius fractures; however, fracture locations used in time-since-injury studies, such as the radius, do not necessarily overlap with fracture locations that are considered specific for abuse. Finally, published timelines do not take into account within-bone location and its influence on fracture repair, particularly in the early stages of healing. This is despite the fact that there are several clinical methods to assess radiographic union for specific within-bone locations.



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Finally, stages, features, and timelines of fracture healing are inconsistent both within and between fields. There is a general lack of published timelines including early evidence of fracture healing, especially within anthropological literature. These early characteristics are of particular importance to identify occult healing fractures seen in child physical abuse. In anthropological literature, there is a tendency to use a stage system, while clinical literature tends to examine traits of specific radiographic characteristics of healing. Not only are the radiographic features of fracture healing inconsistent, the timelines presented in the literature vary significantly between one another, even for the same features.

In conclusion, time since injury of pediatric healing fractures is of great importance to the forensic field as evidence of child physical abuse; however, inconsistencies across the literature and between fields call into question the appropriateness of published timelines for use in legal contexts. This work identifies the gaps in current knowledge surrounding pediatric fracture healing. Further research is needed to determine the influence of certain variables on fracture healing and to work toward incorporation of those variables into time-since-injury estimation methods and timelines.

Reference(s):

1. Malone C.A., Sauer N.J., Fenton T.W. (2011). A Radiographic Assessment of Pediatric Fracture Healing and Time Since Injury. *Journal of Forensic Sciences*. 56(5):1123-1130.

Child Abuse, Fracture, Healing