

## Commentary on “A Critical Review of the Classic Metaphyseal Lesion: Traumatic or Metabolic?”

Beverly P. Wood<sup>1</sup>

**I**n this issue, David Ayoub et al. [1], in their article, “A Critical Review of the Classic Metaphyseal Lesion: Traumatic or Metabolic?”

review the hypothesis that classic metaphyseal lesions represent traumatic changes in abused infants, and they compare these lesions with those resulting from healing rickets. The authors note that the term “classic metaphyseal lesion” was first used in 1986 by pediatric radiologist Paul Kleinman and colleagues [2], who hypothesized that the lesions represented unique metaphyseal fractures in four young infants allegedly subjected to physical abuse. Ayoub et al. conclude by stating, “The hypothesis that classic metaphyseal lesions are secondary to child abuse is poorly supported. Their histologic and radiographic features are similar to healing infantile rickets.”

This point of view is not without controversy. Paul Kleinman maintains that the “classic metaphyseal lesion is, on investigation and correlation, a characteristic metaphyseal lesion related specifically to and correlated with the mechanisms and location of physical abuse of an infant or child” (Kleinman PK, oral communication, 2013). He bases this statement on investigations he has made in collaboration with two histopathologists, Sandy C. Marks and Brian D. Blackburne [2, 3]. Kleinman (Kleinman PK, oral communication, 2013) also indicates that Ayoub et al. [1], in their literature review, have omitted certain relevant published articles in which the metaphyseal lesion histology and its location and cause are discussed, including correlation of the classic metaphyseal lesion with visualized skeletal manifestations of physical abuse in deceased children. Kleinman has provided additional references and comments related to this topic [4–22].

Kleinman (Kleinman PK, oral communication, 2013) asserts that, “the conclusion by

Ayoub et al. [1] that classic metaphyseal lesions are not traumatic lesions contradicts published investigations and is made in contrast to the classic discussions of child abuse in publications such as that of John Caffey [5].” Caffey noted these lesions as early as the 3rd (1956) edition of his text, *Pediatric X-Ray Diagnosis* [5], in which metaphyseal “chip” fractures occurred in the entity he termed “traumatic infantile hyperostosis.” In a 1957 article [6] and the 4th (1961) edition of his text, *Pediatric X-Ray Diagnosis* [7], Caffey presented a diagram depicting “corner” and “bucket-handle” patterns of metaphyseal injury. In the 6th and subsequent editions of his book, Caffey stated that these injuries were the consequence of the battered child syndrome. Kleinman (Kleinman PK, oral communication, 2013) noted that Frederick Silverman [8] wrote about Caffey’s assertion that these lesions represented inflicted injuries. In 1953, Silverman [9] used the term “metaphyseal lesions,” and stated that these injuries were due to child maltreatment. He continued to do so in the textbook, *The Battered Child* [10], which led to multiple texts and scientific articles that mentioned similar characteristic inflicted injuries.

In 2011, to provide further evidence of the association of classic metaphyseal lesions and abuse, Kleinman et al. [11] identified the absence of metaphyseal abnormalities in 42 low-risk infants versus nine classic metaphyseal lesions in 18 infants who were at high risk for physical abuse, and they found a statistically significant difference ( $p < 0.0001$ ) between the two groups. According to Dr. Kleinman (Kleinman PK, oral communication, 2013), Ayoub and his coauthors [1] do not justify their stated conclusion that, “Classic metaphyseal lesions are not true fractures but rather a combination of tissue-processing artifacts and misinterpreted findings of healing rickets.” Kleinman and his coinves-

**Keywords:** child abuse, classic metaphyseal lesion, rickets

DOI:10.2214/AJR.13.11931

Received September 18, 2013; accepted without revision September 18, 2013.

<sup>1</sup>Department Pediatrics, AJR Section Editor for Pediatric Imaging, Keck School of Medicine, University of Southern California, 1975 Zonal Ave, Los Angeles, CA 90089. Address correspondence to B. P. Wood (bwood@usc.edu).

AJR 2014; 202:197–198

0361–803X/14/2021–197

© American Roentgen Ray Society

tigators [12, 13] have emphasized the importance of processing technique to avoid artifacts that may be confused with metaphyseal or physal injury. In a histologic image (Fig. 5A in Ayoub et al.), the authors do not indicate that the legend published in the original article (Fig. 1A in Kleinman et al. [13]) states that “artifactual widening of plane of fracture is evident.” The authors also do not note that the micrograph corresponds with a classic metaphyseal lesion evident on the corresponding (preautopsy) skeletal survey image published as part of the figure.

Ayoub et al. [1] indicate that rickets is a known systemic process, and typical histologic alterations are therefore evident at all active sites of endochondral bone formation [15]. In the 31 infants included in the original study as well as infant fatalities examined with Rosenberg, investigators found no histopathologic evidence of rickets [11]. In discussing infantile rickets, says Kleinman (Kleinman PK, oral communication, 2013), Ayoub et al. also invoke temporary brittle bone disease, including data from other sources [17] (Fig. 6) as well as including citations on the subject. The concept of temporary brittle bone disease has been rejected by national and international societies of pediatric radiologists [16]. Metaphyseal fragmentation lesions should merit consideration in the differential diagnosis in young children [18–21].

The radiologic-histopathologic studies by Marks, Rosenberg, Blackbourne, and Kleinman [2, 3, 13, 18] have provided insights into this distinct traumatic injury, and these studies promote differentiation of classic metaphyseal lesions from potential mimics. In their article, Ayoub et al. [1] omit a presentation of existing investigative science, although their article includes a discussion of published material, including investigated case material. Their article does not contain a validated discussion of the fact that classic metaphyseal lesions, described and histologically investigated and correlated with radiologically visible metaphyseal lesions, are characteristically encountered in

association with other life-threatening inflicted injuries, a reality that has been discussed in the literature. Kleinman (Kleinman PK, oral communication, 2013) believes that to assert otherwise may impede progress in understanding the mechanisms and appearances of injuries and may make it difficult to convey the importance of these findings to other physicians, care providers, investigators, and legal counsel. Failure to recognize and respond accordingly to cases of possible physical abuse places infants and children at risk of serious and potentially fatal injuries [22]. Statements to the contrary, such as those by Ayoub et al., have the potential to negatively affect the welfare of a group of vulnerable children and infants, whose interests pediatricians and caregivers are committed to defend.

## References

1. Ayoub D, Hyman C, Cohen M, Miller M. A critical review of the classic metaphyseal lesion: traumatic or metabolic? *AJR* 2014; 202:185–196
2. Kleinman PK, Marks SC Jr, Blackbourne BD. The metaphyseal lesion in abused infants: a radiologic-histopathologic study. *AJR* 1986; 146:895–905
3. Kleinman PK, Blackbourne BD, Marks SC, Karelis A, Belanger PL. Radiologic contributions to the investigation and prosecution of cases of fatal infant abuse. *New Engl J Med* 1989; 320:507–511
4. Perez-Rossello JM, McDonald AG, Rosenberg AE, Ivey SL, Richmond JM, Kleinman PK. Prevalence of rachitic changes in deceased infants: a radiologic and pathologic study. *Pediatr Radiol* 2011; 41:S293
5. Caffey J. Traumatic lesions of bones. In: *Pediatric x-ray diagnosis*, 3rd ed. Chicago, IL: Yearbook Medical Publishers, 1956:832–837
6. Caffey J. Some traumatic lesions in growing bones other than fractures and dislocations: clinical and radiological features. *Br J Radiol* 1957; 30:225–238
7. Caffey J. Traumatic lesions of bones. In: *Pediatric x-ray diagnosis*, 5th ed. Chicago, IL: Yearbook Medical Publishers, 1968
8. Silverman F. Letter to the editor. *Pediatr Radiol* 1994; 24:541–542

9. Silverman F. The roentgen manifestations of unrecognized skeletal trauma in infants. *AJR* 1953; 69:413–427
10. Silverman F. Radiologic aspects of the battered child syndrome. In: Helfer R, Kempe C, eds. *The battered child*. Chicago, IL: University of Chicago Press, 1968:59–76
11. Kleinman PK, Perez-Rossello JM, Newton AW, Feldman HA, Kleinman PL. Prevalence of the classic metaphyseal lesion in infants at low versus high risk for abuse. *AJR* 2011; 197:1005–1008
12. Kleinman PK. *Diagnostic imaging of child abuse*. Baltimore, MD: Williams & Wilkins, 1987
13. Kleinman PK, Marks SC Jr. A regional approach to classic metaphyseal lesions in abused infants: the distal tibia. *AJR* 1996; 166:1207–1212
14. Tsai A, McDonald AG, Rosenberg AE, Gupta R, Kleinman PK. High-resolution CT with histopathologic correlates of the classic metaphyseal lesion of infant abuse *Pediatr Radiol* 2014 (in press)
15. Shore RM, Chesney RW. Rickets. Part I. *Pediatr Radiol* 2013; 43:140–151
16. Mendelson KL. Critical review of “temporary brittle bone disease.” *Pediatr Radiol* 2005; 35:1036–1040
17. Kleinman PK, Marks SC Jr, Richmond JM, Blackbourne BD. Inflicted skeletal injury: a post-mortem radiologic-histopathologic study in 31 infants. *AJR* 1995; 165:647–650
18. Kleinman PK. Schmid-like metaphyseal chondrodysplasia simulating child abuse. *AJR* 1991; 156:576–578
19. Kleinman PK, Sarwar ZU, Newton AW, Perez-Rossello JM, Rebello G, Herliczek TW. Metaphyseal fragmentation with physiologic bowing: a finding not to be confused with the classic metaphyseal lesion. *AJR* 2009; 192:1266–1268
20. Kleinman PK, Belanger PL, Karellas A, Spevak MR. Normal metaphyseal radiologic variants not to be confused with findings of infant abuse. *AJR* 1991; 156:781–783
21. Kleinman PK. *Diagnostic imaging of child abuse*, 2nd ed. St. Louis, MO: Mosby Year Book, 1998
22. Deans KJ, Thackeray J, Askegard-Giesmann JR, Earley E, Groner JI, Minneci PC. Mortality increases with recurrent episodes of nonaccidental trauma in children. *J Trauma Acute Care Surg* 2013; 75:161–165

## FOR YOUR INFORMATION

The reader's attention is directed to the article pertaining to this commentary, which appears on the preceding pages.

**This article has been cited by:**

1. Peter J. Strouse. 2016. Child abuse: we have problems. *Pediatric Radiology* . [[CrossRef](#)]
2. T. Sieswerda Hoogendoorn, S.G.F. Robben, R.R. van Rijn. 2015. Letter to the editor. *Journal of Forensic Radiology and Imaging* **3**, 70-71. [[CrossRef](#)]
3. Jeannette M. Perez-Rossello, Anna G. McDonald, Andrew E. Rosenberg, Andy Tsai, Paul K. Kleinman. 2015. Absence of Rickets in Infants with Fatal Abusive Head Trauma and Classic Metaphyseal Lesions. *Radiology* **275**:3, 810. [[CrossRef](#)]
4. David Ayoub, Charles Hyman, Marvin Miller. 2014. Reply. *American Journal of Roentgenology* **202**:6, W604-W604. [[Citation](#)] [[Full Text](#)] [[PDF](#)] [[PDF Plus](#)]