Point-of-Care Guides

Bruising Characteristics to Predict Child Abuse

Aaron Saguil, MD, MPH, FAAFP, F. Edward Hébert School of Medicine, Uniformed Services University of the Health Sciences, Bethesda, Maryland

Ruben Salinas Jr., MD, FAAFP, Carl R. Darnall Army Medical Center Family Medicine Residency Program, Fort Hood, Texas

Clinical Question

Is it possible to predict the likelihood of child abuse based on bruising characteristics detected on examination?

Evidence Summary

Among children four years and younger, 11,149 died from child abuse between 1999 and 2014.[1] That is a rate of 3.5 deaths per 100,000 children in this age group per year.[1] Bruising is the most common injury of child abuse to be overlooked or misdiagnosed before the death of a child due to abuse, representing a missed opportunity to intervene.[2] Although some bruising is expected in newly mobile children, especially below the knees and on the forehead, accidental bruising over other areas (e.g., ears, neck, genitalia) is rare.[3] A clinical prediction rule that assists physicians in discriminating nonaccidental from accidental bruising could potentially prevent the morbidity and mortality associated with a missed diagnosis of child abuse.

In 2010, a group from the University of Louisville proposed the TEN-4 Bruise Clinical Decision Rule to distinguish nonaccidental from accidental bruising in children four years and younger *(Table 1)*.[4] The group conducted a case-control study of 95 children admitted to a pediatric intensive care unit with trauma, 71 of whom had bruises. They found that a bruise on the torso, ear, or neck, or any bruise on a child younger than four months was considered suspicious. The TEN-4 rule correctly identified 32 of 33 children who had bruises as being abused, and 32 of 38 children who had bruises that were the result of an accident, for a sensitivity of 97% and a specificity of 84%.[4]

In 2021, an expanded group of researchers affiliated with five urban children's hospitals released the results of a study externally validating and refining the TEN-4 rule. In this study conducted in pediatric emergency departments in Chicago, Cincinnati, Louisville, and San Diego, researchers screened 21,123 children younger than four years for bruising from 2011 to 2016 and enrolled 2,161 children.[2] Patients were excluded if they had been injured in a motor vehicle crash, had known coagulation abnormalities, spasticity from preexisting neuromuscular impairment, or extensive skin disorders because this may obscure bruise characteristics.[2] The group conducted comprehensive histories and skin examinations, documented bruises with photographs and skin maps, noted bruise counts and locations, and made annotations of patient skin tone (i.e., fair, light, midtone, brown, or dark).[2] Patient cases were determined as being abuse (n = 410), nonabuse (n = 1,713), or indeterminant (n = 38) by a panel of physicians and a biomechanical engineer, each with expertise in pediatric injury evaluation. Interrater reliability was high.[2]

Using this cohort and the original TEN-4 rule criteria, the researchers identified 331 of 410 patients who had been abused with a sensitivity of 81% (95% CI, 77% to 84%) and specificity of 91% (95% CI, 90% to 92%).[4] This was considered unacceptably low by the authors, so they used this cohort to find additional predictive variables to increase sensitivity. The authors found that extending the age considered suspicious for bruising (i.e., from younger than four months to younger than five months), adding new bruising locations (i.e., frenulum, angle of the jaw, fleshy part of the cheek, eyelids, and subconjunctival bruises), and determining whether the bruising was patterned (i.e., a bite, grip, slap, squeeze, or

This guide is one in a series that offers evidence-based tools to assist family physicians in improving their decision-making at the point of care.

This series is coordinated by Mark H. Ebell, MD, MS, deputy editor for evidence-based medicine.

A collection of Point-of-Care Guides published in *AFP* is available at https://www.aafp.org/afp/poc.

CME This clinical content conforms to AAFP criteria for CME. See the CME Quiz on page 582.

Author disclosure: No relevant financial relationships.

TABLE 1

TEN-4 Bruise Clinical Decision Rule for Predicting Nonaccidental Trauma in Children Four Years and Younger

Location of bruise
Torso (including abdomen, back, buttocks, chest, genitourinary area, hip)
Ear
Neck
Anywhere on a child younger than four months
Interpretation: one or more positive items indicate an increased likelihood for nonaccidental trauma.

Information from reference 4.

TABLE 2

TEN-4-FACESp Bruise Clinical Decision Rule for Predicting Nonaccidental Trauma in Children Younger Than Four Years

Location of bruise
Torso (including abdomen, back, buttocks, chest, genitourinary area, hip)
Ear
Neck
Anywhere on a child younger than five months
Frenulum
Angle of jaw
Cheek (fleshy part)
Eyelids
Subconjunctivae
Is the bruising in a pattern (e.g., bite, grab, slap, squeeze, multilinear)?
Interpretation: one or more positive items indicate an increased likelihood for nonaccidental trauma.

Information from reference 2.

made by a linear object; *Table 2*[2]) increased sensitivity to 96% (95% CI, 93% to 97%), but decreased specificity to 87% (95% CI, 85% to 89%).[2] The negative predictive value was determined to be 99% (95% Cl, 98% to 99%), the positive predictive value was 64% (95% Cl, 60% to 68%), the positive likelihood ratio was 7.4 (95% CI, 6.6 to 8.2), and the negative likelihood ratio was 0.05 (95% CI, 0.04 to 0.06). The prevalence of abuse in the sample population was 19%.[2]

Although the TEN-4-FACESp Bruise Clinical Decision Rule performs better than the TEN-4 rule, it is important to note that it has not yet been externally validated. Of patients with bruising who were eligible to participate in the study, 784 were not enrolled (629 declined to participate, 94 were missed because the team enrolled other patients, and 61 were not enrolled for unknown reasons). The patients who were not enrolled in the study represent 26% of the total population with bruises who were eligible to be studied but were not. The authors note that the TEN-4-FACESp rule was generated with data drawn from pediatric emergency departments and may not perform as well in a primary care environment.

Applying the Evidence

A 10-month-old infant is brought to the emergency department. The caregiver reports concern for intermittent vomiting and fussiness. As you examine the infant and perform a head-to-toe skin evaluation, you note bruising on the ear and back. The bruise on the back consists of two linear marks. When asked about the marks, the caregiver replies that the infant is clumsy. Applying the TEN-4-FACESp rule identifies three positive items, indicating the possibility of child abuse. You ensure the safety of the infant while the appropriate authorities are contacted.

Editor's Note: Dr. Saguil is a contributing editor for *AFP*.

Address correspondence to Aaron Saguil, MD, MPH, FAAFP, at aaron.saguil@usuhs.edu. Reprints are not available from the authors.

The views expressed are those of the authors and do not reflect the official policy or position of the Uniformed Services University of the Health Sciences, the Department of the Army, the Department of Defense, or the U.S. government.

References

1. Farrell CA, Fleegler EW, Monuteaux MC, et al. Community poverty and child abuse fatalities in the United States. *Pediatrics*. 2017;139(5):e20161616.
2. Pierce MC, Kaczor K, Lorenz DJ, et al. Validation of a clinical decision rule to predict abuse in young children based on bruising characteristics [published correction appears in *JAMA Netw Open*. 2021;4(9):e2130136]. *JAMA Netw Open*. 2021;4(4):e215832.
3. Kemp AM, Dunstan F, Nuttall D, et al. Patterns of bruising in preschool children—a longitudinal study. *Arch Dis Child*. 2015;100(5):426-431.
4. Pierce MC, Kaczor K, Aldridge S, et al. Bruising characteristics discriminating physical child abuse from accidental trauma [published correction appears in *Pediatrics*. 2010;125(4):861]. *Pediatrics*. 2010;125(1):67-74. ■