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Alzahrani, N.M., Paddock, M., Jeanes, A. et al. (2026) Reply to the Letter to the Editor: rib fracture diagnosis in suspected abuse—clinical and methodological considerations. European Radiology. ISSN: 0938-7994

https://doi.org/10.1007/s00330-026-12507-6

Reply to the Letter to the Editor: Rib fracture diagnosis in suspected abuse—clinical and methodological considerations

Dear Editor,

We thank Hou and Li [1] for their thoughtful and constructive comments regarding our recent publication, "Rib fracture diagnosis in suspected abuse: computed tomography or radiographs (RECEPTOR)? A multicentre diagnostic accuracy observational study". We appreciate the opportunity to clarify the important clinical and methodological points they have raised.

We acknowledge that computed tomography (CT) demonstrated lower sensitivity for lateral rib fractures (54.0%), likely related to the orientation of the lateral rib arc relative to the axial imaging plane. However, CT showed substantially higher sensitivity for posterior fractures (79.7%), which are widely recognised as having the greatest specificity for inflicted injury, as well as superior overall patient-level sensitivity (90.6%). Importantly, CT detected a greater number of fractures overall across all analytical levels in our study. While fracture multiplicity and distribution are central to forensic interpretation, the availability of multiplanar reconstructions and three-dimensional volumetric rendering enables comprehensive evaluation of fracture patterns and spatial relationships. Our finding that CT has poor sensitivity for lateral rib fractures should inform the design of future studies, in which axial images should be reconstructed to the optimal plane for lateral rib fracture detection. Indeed, this is a project that could be recreated with our existing dataset for direct comparison.

Regarding the use of initial and follow-up chest radiographs as the reference standard, we acknowledge the recognised limitation of an imperfect gold standard, as stated in our manuscript. However, this comparator was deliberately selected because it reflects the current recommended standard in routine clinical practice for imaging live children investigated for suspected physical abuse, thereby ensuring direct clinical applicability of our findings. As noted in our study, some CT "false positives" may represent fractures not detected radiographically, and the fact that CT identified a greater number of fractures across all analytical levels suggests that radiography may underestimate the true injury burden rather than CT overcalling injury.

Our study specifically focused on live children rather than post-mortem cohorts. Although autopsy is often regarded as a reference standard in post-mortem evaluation, it has also been

reported as an “imperfect gold standard” for subtle acute rib fractures, with CT demonstrating superior detection in certain settings [2,3], thereby further supporting the diagnostic capability of CT in the detection of rib fractures.. Regarding the suggestion of incorporating MRI into a composite reference standard, MRI has a limited role in detecting rib fractures in children with suspected physical abuse [4,5], where CT and radiography remain the established modalities of choice. Importantly, we do not advocate abandoning the skeletal survey, which remains essential for detecting extra-thoracic occult injuries and assessing fracture healing; our study and conclusions relate specifically to rib fracture detection within the thorax and should be interpreted within that defined scope.

We acknowledge that the fracture prevalence in our cohort reflects a selected population with a high pre-test probability of abuse, and that potential selection bias exists, as chest CT is not routinely performed to evaluate rib fractures in all children with suspected physical abuse. Importantly, our analysis focused on sensitivity, specificity, and accuracy rather than predictive values, thereby minimising the influence of prevalence on the primary diagnostic performance measures. Radiation stewardship and adherence to the ALARA (As Low As Reasonably Achievable) principle remain fundamental to paediatric imaging practice. Advances in CT technology over the past decade have enabled substantial dose reduction while maintaining diagnostic image quality, and low-dose chest CT protocols with effective doses approaching those of combined initial and follow-up skeletal survey radiographs are increasingly feasible [6,7]. In addition to rib fracture detection, CT may improve visualisation of other thoracic injuries associated with physical abuse, including scapular and thoracic vertebral fractures [8]. Nevertheless, we do not advocate replacing the skeletal survey with CT as a primary investigative modality. Our conclusions relate specifically to thoracic rib fracture assessment, and the skeletal survey remains essential for identifying extra-thoracic occult injuries and for comprehensive evaluation within established age-stratified imaging pathways

In conclusion, we appreciate the constructive feedback from Hou and Li. We agree that imaging pathways in suspected physical abuse must remain guided by clinical context, safeguarding principles, and radiation stewardship. Our findings support consideration of chest CT as an imaging modality for assessing rib fractures in children under 2 years of age evaluated for suspected physical abuse. However, the development and validation of a low-dose CT protocol would be required before CT could be recommended to replace chest radiography for this indication and equivalent ability to date rib fractures from CT as from radiographs established.

Our conclusions should be interpreted within the defined scope of rib fracture evaluation and not as a replacement for comprehensive skeletal survey protocols.

References

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