


Eyes on the prize: harnessing computer vision for automated detection of traumatic rib and clavicle fractures in chest radiographs

Joshua Aaron Villarreal, Joseph D Forrester 

To cite: Villarreal JA, Forrester JD. Eyes on the prize: harnessing computer vision for automated detection of traumatic rib and clavicle fractures in chest radiographs. *Trauma Surg Acute Care Open* 2024;9:e001455. doi:10.1136/tsaco-2024-001455

Cheng *et al*¹ in ‘Development and Evaluation of a Deep Learning-Based Model for Simultaneous Detection and Localization of Rib and Clavicle Fractures in Trauma Patients’ Chest Radiographs’ add to the rapidly growing body of literature using supervised and unsupervised machine learning algorithms for fracture detection in patients with trauma.^{2–5} The authors introduce CXR-FrNET, a deep learning algorithm that uses chest X-ray Portable network graphic (PNG) formatted images and provides a heat map representation of all potential rib and clavicle fracture sites, to aid providers in detecting rib and clavicular fractures with a high sensitivity and acceptable accuracy (86.8 and 83.7, respectively). The authors included 991 chest X-rays over an 8-year period in their data set, with 2409 rib fracture bounding boxes and 331 clavicle fracture bounding boxes. These bounding boxes were created by two experienced trauma surgeons in conjunction with radiology reports and chest CT scans.

Timely diagnosis of traumatic chest wall fractures is a crucial component to avoid delays in treatment and poor patient outcomes.⁶ We commend the authors for tackling an impactful problem with the potential to improve diagnostic chest X-ray accuracy and reduce potentially avoidable radiation exposure for patients. The use of computer vision models for diagnostic radiology use cases has exploded.⁷ For now, the clinical use case for this model is narrow given the diagnostic focus on rib and clavicle fractures only. Practical implementation will need to be targeted towards resource-constrained healthcare settings, where access to radiologists or CT scanners is limited necessitating a diagnostic aid for timely diagnosis based on chest X-ray alone.

Notable limitations of the study include lack of radiologist involvement for internal validation of bounding box chest X-ray labels, inter-rater reliability assessment among the two trauma surgeon labellers was not conducted, and lack of public availability of the CXR-FrNET algorithm for greater transparency. While this initial model is promising and the authors are to be commended, further work is needed to determine the clinical utility of this model, implementation feasibility and potential for impact on patient outcomes. Having this tool available freely as a simple software solution capable of

integrating into existing radiology platforms could help the authors implement their tool more broadly.

Contributors JAV and JDF contributed equally to this work.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Commissioned; internally peer-reviewed.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Joseph D Forrester <http://orcid.org/0000-0001-6380-4880>

REFERENCES

- Cheng C-T, Kuo L-W, Ouyang C-H, Hsu C-P, Lin W-C, Fu C-Y, *et al*. Development and evaluation of a deep learning-based model for simultaneous detection and localization of rib and clavicle fractures in trauma patients’ chest Radiographs. *Trauma Surgery & Acute Care Open* 2024.
- Lopez-Melia M, Magnin V, Marchand-Maillet S, Grabherr S. Deep learning for acute rib fracture detection in CT data: a systematic review and meta-analysis. *Br J Radiol* 2024;97:535–43.
- Edamadaka S, Brown DW, Swaroop R, Kolodner M, Spain DA, Forrester JD, Choi J. FASTER: a deep learning algorithm to automate identification and characterization of rib fractures on chest computed tomography scans. *J Trauma Acute Care Surg* 2023;95:181–5.
- Gipson J, Tang V, Seah J, Kavnoudias H, Zia A, Lee R, Mitra B, Clements W. Diagnostic accuracy of a commercially available deep-learning algorithm in supine chest radiographs following trauma. *Br J Radiol* 2022;95:20210979.
- Jin L, Yang J, Kuang K, Ni B, Gao Y, Sun Y, Gao P, Ma W, Tan M, Kang H, *et al*. Deep-learning-assisted detection and Segmentation of rib fractures from CT scans: development and validation of Fracnet. *EBioMedicine* 2020;62:103106.
- Lagazzi E, Argandykov D, de Roulet A, Proaño-Zamudio JA, Romijn A-SC, Abiad M, Razaqat W, Velmahos GC, Hwabejire JO, Paranjape CN. Evaluating the impact of timing to rib fixation in patients with traumatic brain injury: a nationwide analysis. *J Trauma Acute Care Surg* 2023;95:846–54.
- Kelly B, Judge C, Bollard SM, Clifford SM, Healy GM, Yeom KW, Lawlor A, Killeen RP. Radiology artificial intelligence, a systematic evaluation of methods (RAISE): a systematic review protocol. *Insights Imaging* 2020;11:133.



► <http://dx.doi.org/10.1136/tsaco-2023-001300>

© Author(s) (or their employer(s)) 2024. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

Department of Surgery, Stanford University Department of Medicine, Stanford, California, USA

Correspondence to

Dr Joshua Aaron Villarreal; joshuav1@stanford.edu