AMJ Australasian Medical Journal [AMJ 2023;16(3):550-552]

A Novel AI Tool for Automated Detection Of Osteoporotic Vertebral Fractures On Routine Chest Radiographs

Jenna Silberstein, Zhonghua Sun*

Discipline of Medical Radiation Science, Curtin Medical School, Curtin University, Perth, Australia

EDITOR NOTE

Please cite this paper as: Silberstein J, Zhonghua Sun. A Novel AI Tool for Automated Detection Of Osteoporotic Vertebral Fractures On Routine Chest Radiographs. AMJ 2023;16(3):550-552

https://doi.org/10.21767/AMJ.2023.3934

Corresponding Author:

Zhonghua Sun

Discipline of Medical Radiation Science,

Curtin Medical School, Curtin University,

Perth, Australia

z.sun@curtin.edu.au

ABSTRACT

Dear Editor,

In this letter to the editor, I would like to share my experience of conducting a research project during the summer period between December 2022 and February 2023. I am a 3rd year Medical Imaging student who has recently been awarded the Faculty of Health Sciences Summer Scholarship at Curtin University to undertake a 10-week research internship project. This was an invaluable experience that opened my eyes to the future of medical imaging and the potential impact Artificial Intelligence (AI) will have on radiology and clinical practice.

My research investigated the new AI software “Ofeye 1.0”, developed by Chinese University of Hong Kong researchers Xiao et al[1], which has been successfully validated and implemented into Asian clinics as a tool to identify Osteoporotic Vertebral Fractures (OVFs). Ofeye 1.0 can batch process up to 100 radiographs in a single operation. If an OVF is detected, Ofeye 1.0 outputs the probability of fracture as labelled on the original image. A fracture is highlighted if the probability that there is a fracture is at least 60 per cent[1]. Ofeye 1.0 can be integrated as part of PACS or installed on a personal computer.

During the summer internship, I learned that elderly women are susceptible to fractures of their vertebral column, secondary to osteoporosis. However, OVFs are globally missed by radiologists on chest radiographs not referred for spinal disorders, creating a missed opportunity for early detection and treatment[2]. I also learned to use the Ofeye 1.0 for automated detection and analysis of some chest radiographs. This is something very new to me, and most likely to most of the medical imaging or medicine students, despite the widespread use of AI in current practice.

Australian clinics will invariably treat Caucasian patients, for which the AI tool has not yet been validated. Thus, my research aimed to determine the validity of the AI tool for use in Caucasian populations.

My research revealed the potential clinical value of this AI tool for supporting radiologists in their work as the AI correctly identified fractures that radiologists did not detect (Figure 1). This tended to be the case when fractures were mild and required close inspection. This is understandable considering radiologists will naturally overlook spinal pathology as they silo their focus to the heart and lung anatomy for which was requested on the referral. This study revealed that radiologists tended to report the more obvious OVFs (Figure 2).

Additionally, the significance of OVF is largely unrecognised by clinicians[1]. OVFs are an indication of poor bone health, and the precursor for subsequent serious pelvic, hip and limb fractures. OVFs can progress and cascade to cause debilitating spinal deformity leading to pain and morbidity. However, since most women with initial stages of OVF (mild deformity) are asymptomatic, imaging does not specifically request spinal analysis [2,3].

As part of my research, I acted as an additional observer to my supervisor, a qualified radiologist. We independently assessed the images for fractures and collaborated to form a mutually agreed upon diagnosis. Our observations served as the gold-standard to which the accuracy of the AI tool was calibrated against. I was particularly surprised as to how challenging it was to identify mild fractures, as they can be extremely subtle. This reaffirmed the challenge that time-poor radiologists face when having to diagnose OVFs with a demanding workload and the likelihood that mild fractures would be missed on routine chest X-rays when not specifically requested for the spine.

I learned the value of using a categorical evaluation tool such as Genant, et al.’s[4]. Visual semiquantitative grading method to diagnose OVFs. This helped me to consider fracture according to morphology of vertebrae. Vertebra with at least 20% height loss to the anterior, middle, or posterior aspects was classified as fractures. Additionally, endplate deformities and generalised abnormal appearances relative to adjacent vertebra, served as indicators of OVF[4].

I initially found it difficult to discriminate between osteoarthritic (OA) related spinal degeneration and osteoporotic related fractures. I learned that osteophytes, a feature of OA, tended to occur on edges with anterior lipping of the vertebra; whereas endplate fractures in OVFs tended to occur centrally, and could be evaluated by disruption to the continuity and smoothness of the endplate lines. This will be invaluable for me in the future evaluation of patient Xrays. Interestingly, I discovered that radiologists tended to group the pathologies of OA and OVFs when reporting, using ambiguous terms such as "thoracic kyphosis and degenerative remodelling of the explored skeleton". This absent diagnosis is likely a contributing factor to lack of clinician action and the missed opportunity for identifying and treating OVF.

I was fortunate to use Ofeye 1.0 first hand and was pleasantly surprised at how easy it was to learn. The AI tool rapidly managed to download batches of 30 radiographs and then evaluate for diagnosis in only a few seconds. I can imagine the implementation and integration of this AI software into the clinical workflow and hospital systems, with rapid flagging of OVFs, allowing early detection and improved clinical outcomes.

In conclusion, my research experience has validated the use of Ofeye 1.0 for Caucasian populations and revealing the most impact in the detection of mild OVFs, which are often missed by radiologists. However, the initial findings showed that the sensitivity of this AI tool was relatively low, thus radiologists must remain vigilant for the detection of mild OVFs. Additionally, the AI tool occasionally classified osteoarthritic changes as OVF, or artifact due to oblique projection and overlying lung markings. I therefore believe that radiologists will not be replaced by this AI technology and will need to remain accountable. The AI tool will likely serve as complimentary aids to the radiologist for the detection and improved clinical outcome of OVF in elderly women.

References

1. Xiao BH, Zhu MS, Du EZ, et al. A software program for automated compressive vertebral fracture detection on elderly women's lateral chest radiograph: Ofeye 1.0. Quant Imaging Med Surg. 2022;12(8):4259. doi: 10.21037/qims-22-433
2. Lenchik L, Rogers LF, Delmas PD, et al. Diagnosis of osteoporotic vertebral fractures: Importance of recognition and description by radiologists. Am J Roentgenol.2004;183(4):94958. Doi:10.2214/ajr.183.4. 1830949.
3. Griffith JF. Identifying osteoporotic vertebral fracture. Quant Imaging Med Surg. 2015;5(4):592. Doi: 10.3978/j.issn.2223-4292.2015.08.014
4. Genant HK, Wu CY, Van Kuijk C, et al. Vertebral fracture assessment using a semiquantitative technique. J Bone Miner Res. 1993;8(9):1137-48. Doi: 10.1002/jbmr.5650080915

[AMJ 2023;16(2):546-548]

ACKNOWLEDGEMENT

Authors would like to thank the Faculty of Health Sciences, Curtin University for providing the Summer Scholarship for supporting this project.

Figures

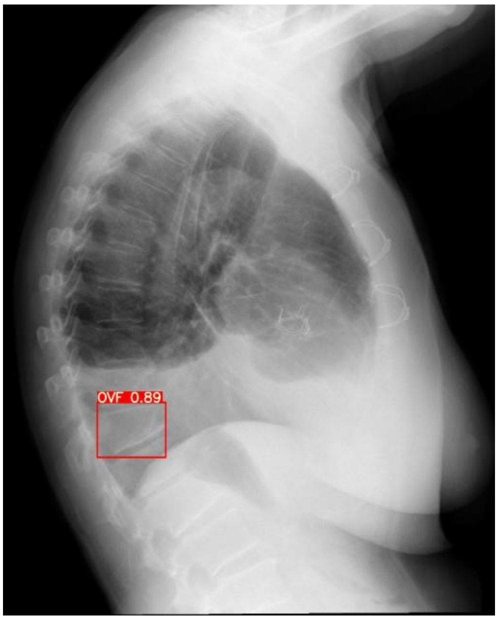

Figure 1: Mild OVF detected by AI, but missed by the radiologist report in a 74-year-old female.

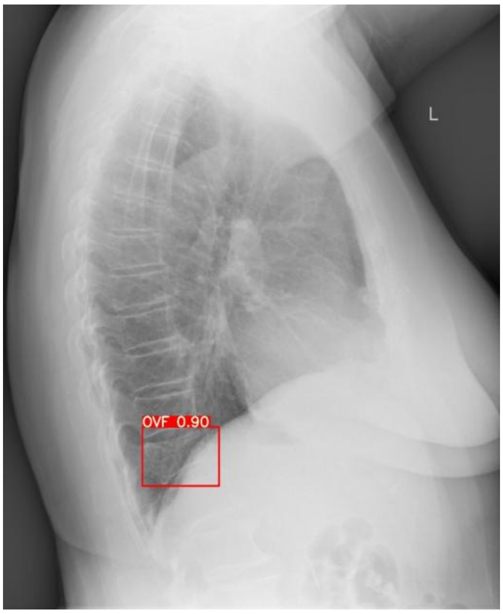

Figure 2: Moderate OVF detected by AI and also indicated on the radiologist report in a 79-year-old female.

Received: *24-Feb-2023, Manuscript No. AMJ-23-3933;* ***Editor assigned:*** *27-Feb-2023, PreQC No. AMJ-23-3933(PQ);* ***Reviewed:*** *10-Mar-2023, QC No. AMJ-23-3933;* ***Revised:*** *15-Mar-2023, Manuscript No. AMJ-23-3933(R);* ***Published:*** *21-Mar-2023*