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Letter to Editor

Seeing Clearly, Worrying Less? Patient Psychology and Radiological Anxiety in the Era of Ultra-Low-Dose CT Imaging

Dear Editor

We recently have read with great interest an article entitled “Ultra-Low Dose Computed Tomography Imaging in Quantifying Bone Trauma and Disorders: A Cross-Sectional Study”, by Zarei and colleagues, which was published in your esteemed journal (IJMS Volume 50, Issue 4, April 2025).[1] They made a technically significant contribution by demonstrating the feasibility of utilizing ultra-low-dose CT (ULD-CT) protocols. Compared to standard-dose (SD) protocols, these protocols achieve a substantial radiation dose reduction (reportedly up to 98%) while maintaining diagnostically acceptable image quality for evaluating the extremities and spine. As a professor of digital health, I appreciate the significant advancements in radiological and patient safety that this represents. However, I wish to offer a perspective that focuses on the often-underestimated psychological dimensions associated with diagnostic imaging choices, radiation exposure, and diagnostic certainty.

The primary strength and clinical relevance of the study by Zarei and others[1] lie unequivocally in the remarkable radiation dose reduction achieved using the ULD-CT protocol combined with iterative reconstruction (IMR level 2). In light of the known stochastic risks associated with ionizing radiation, particularly from cumulative exposure, the ability to drastically lower patient dose without sacrificing diagnostic utility constitutes a major clinical advancement. The authors convincingly demonstrated that for evaluating bone trauma and disorders, the ULD-CT protocol is not merely theoretical but practical, yielding images predominantly rated as acceptable or better by experienced radiologists. This technical success has clear, positive implications for reducing the population-level radiation burden.

However, the successful implementation and acceptance of ULD-CT protocols in routine clinical practice involve considerations that extend beyond technical image quality metrics and dose calculations. Firstly, patient perception and anxiety regarding radiation exposure, often termed “radiophobia”,[2] represent a significant issue. As patients become increasingly aware of and concerned about the potential long-term risks of medical radiation,[3] the prospect of a substantially lower-radiation diagnostic test, as offered by ULD-CT, could significantly alleviate these anxieties. This may improve patient acceptance of necessary imaging and adherence to follow-up recommendations. While not directly measured in the study, this psychological benefit is a crucial potential advantage of ULD-CT that warrants consideration in clinical decision-making and patient communication. Effectively communicating this dose reduction could enhance trust and reduce decisional conflict for patients weighing the risks and benefits of imaging.

Conversely, the study reported an overall sensitivity range of 67%-95% for ULD-CT compared to the gold standard SD-CT, alongside a high specificity (100% for detecting normality). While this performance is deemed “acceptable,” a sensitivity at the lower end of this range, particularly for detecting subtle, yet potentially significant fractures or early-stage bone disorders, might introduce a different psychological burden: the anxiety associated with diagnostic uncertainty. Clinicians rely on imaging not just to confirm obvious pathology but also to confidently rule out significant findings. Radiologists might be less confident in their diagnoses if they perceive ULD-CT as inferior for detecting subtle lesions. This reduction in confidence, whether explicitly communicated or implicitly perceived, might increase patient anxiety and could potentially prompt recommendations for additional imaging or closer follow-up. Consequently, it would partially negate the intended benefit of a reduced initial investigation burden. The psychological impact of a potential missed diagnosis, even if statistically infrequent, versus the perceived risk of radiation exposure is a complex equation that varies among individuals and clinical scenarios.

Therefore, the term “acceptable image quality” requires careful contextualization. While technically sufficient for many diagnoses, its adequacy must also be evaluated against the psychological comfort it provides the referring clinician and the patient with the diagnostic conclusion. Future research in this area would benefit immensely from incorporating patient-reported outcomes. Studies could prospectively compare patient anxiety levels, satisfaction

with the diagnostic process, and decisional conflict between those undergoing ULD-CT and SD-CT, alongside assessments of radiologists' diagnostic confidence for specific, potentially subtle findings on ULD protocols. Understanding these human factors is critical for optimizing the implementation of dose-reduction strategies.

In conclusion, the study by Zarei and others[1] provided compelling evidence for the technical feasibility and substantial dose-reduction potential of ULD-CT with iterative reconstruction for imaging the extremities and spine. This work represented a significant advancement towards safer radiological practice. However, adopting this technology necessitates a holistic view that extends beyond dose metrics and image quality scores. Integrating an understanding of patient anxieties regarding radiation exposure and ensuring sufficient diagnostic confidence for both clinicians and patients are vital psychological considerations. Future efforts should focus not only on further technical refinement but also on developing effective communication strategies and assessing the overall patient experience. This will ensure that the benefits of dose reduction are fully realized without introducing undue diagnostic uncertainty or psychological distress.

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Declaration of AI

The authors declare that no AI tools were used in the preparation of this manuscript.

Conflict of Interest: None declared.

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The Authors' Reply

Dear Editor

We, the authors of the aforementioned paper, thank the correspondent for their encouraging comments on our findings. As stated in our paper, this research aimed to achieve satisfactory image quality with ultra-low dose computed tomography (ULD-CT) imaging. The image quality was assessed using both subjective and objective methods. For the objective analysis, it was quantified by calculating the signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR), which are widely accepted as critical parameters for this purpose.

The correspondent has raised an important concern regarding radiation phobia among both patients and physicians, suggesting these fears are often misplaced. While some of the points raised may have validity—for instance, the radiation effects are not cumulative, though this requires quantitative validation through statistical risk analysis—we advise caution. It is also suggested that radiation-induced cancer requires exposure to exceed a specific threshold. While these suggestions may be true, removing safety checks is inadvisable. This caution is necessary because a quantitative consensus on a dangerous critical exposure threshold is lacking. In the absence of such definitive evidence, we believe it is imperative to adhere to the as low as reasonably achievable (ALARA) principle, as mandated by radiation protection guidelines from agencies such as the IAEA and ICRP.

In response to the crucial point raised about physicians' concerns regarding dose reduction—a consideration we shared—our study was deliberately designed around straightforward diagnostic cases, such as fractures and degenerative joint disease (DJD).

Consultations with the radiologists revealed a resistance to modifying the established imaging procedure. The proposition that dose reduction can maintain diagnostic image quality is often met with skepticism by both radiologists and referring specialists, as their visual expertise is based on standard-dose CT images. Our cross-sectional study, which included patients with fractures and conditions such as DJD, demonstrated that ULD-CT images were diagnostically adequate. However, physicians, habituated to a certain standard of image quality, may be reluctant to accept the differences present in ULD-CT images.

We, therefore, suggest that this study be repeated with a larger cohort of patients presenting a wider range of bone pathologies, including different types of bone fractures, DJDs, and tumors. We anticipate that accepting ULD-CT image quality will pose a significant challenge, requiring considerable time, dedicated effort, and active engagement to convince our colleagues.

Besides, two important points must be noted. First, with enough experimental study and irrefutable evidence, we believe that physicians' acceptance of the ULD-CT can be achieved. Once this step is accomplished, patients will likely follow suit, trusting their physicians' judgment and becoming more cooperative. Second, we suggest collaboration between different medical physics and radiology centers across Iran to perform this larger study.

The present study revealed that the ULD-CT for bone pathologies, such as fractures and DJD, is a very safe method that delivers a very low dose to the patient while still yielding acceptable image quality. Therefore, we propose that this method can be adopted in centers where patients require serial CT imaging and can also be used for long-term patient follow-up.

Thus, while we thank the correspondent for raising these important issues and welcome further suggestions, we look forward to future collaborations on this topic.

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