Osteoporotic fractures worsen patients’ quality of life and increase the mortality rate [1]. The mortality rate within the first 12 months after a hip fracture in Koreans aged 50 years or older was 14.0% for women and 21.0% for men [2]. Osteoporosis is an inevitable consequence of aging, but fracture prediction is the starting point to preventing fractures; therefore, accurate fracture prediction is more important than ever. Although lower bone mineral density (BMD) increases the risk of fracture, fractures also occur in patients with less marked reduced bone mass. In Korea, the 10-year cumulative incidence of fragility fractures was 31.1% and 37.5% in postmenopausal women with normal BMD and osteopenia, respectively, whereas it was 44.3% in women with osteoporosis [3]. Therefore, BMD measurements and bone quality should be reflected in evaluations of bone strength.

Efforts are being made to evaluate bone quality by analyzing the microstructure of bone using advanced diagnostic tools such as high-resolution peripheral quantitative computed tomography. Additionally, several devices have been available to assess bone quality, such as magnetic resonance imaging, quantitative ultrasound, or high-frequency ultrasound multispectroscopy, but none provide complete information on bone quality. Furthermore, higher costs and space constraints for the equipment limit the easy accessibility of those methods for evaluating fractures. The trabecular bone score (TBS) is an indirect indicator of bone microarchitecture. It evaluates bone quality based on the information obtained by lumbar dual-energy X-ray absorptiometry (DXA) images [4]. Since it is a method of analyzing lumbar spine texture based on DXA, a disadvantage of this method is that analysis is possible only when a DXA image is available.

More than 13 web-based fracture risk calculators have been used to estimate the absolute risk of osteoporotic fracture [5]. The Fracture Risk Assessment Tool (FRAX) is a country-specific calculator that integrates several clinical risk factors for fractures and can be used with or without BMD [6]. The FRAX score is a basis for initiating osteoporosis treatment or selecting anti-osteoporotic medication in many countries [7]. Although the FRAX score provides information on fracture risk, it does not reflect all ethnicities, so large-scale validation for Koreans is still required.

It is difficult for patients to recognize the need for osteoporosis examinations because osteoporotic fractures do not have symptoms until the fracture occurs. Therefore, it is necessary to increase the accessibility of examinations for patients by choosing the most straightforward method to evaluate the bone mass and predict the risk of fractures. It should be simple, inexpensive, and non-invasive. X-ray examinations are an easily accessible imaging modality with little radiation exposure. Techniques for obtaining additional information from simple X-ray imaging using machine learning have recently been introduced in Korea [8,9]. These studies used deep...
Various methods have been introduced to evaluate bone quality and calculate fracture risk. Still, each examination has advantages and disadvantages, so relying only on one approach is challenging. The same will be valid for analyses using artificial intelligence (AI). For AI-based models to be validated in clinical practice, thorough verification is required over an extended period. As mentioned by the authors, the limitation of the relatively small sample size can be overcome through analyses of more patients in the future. This study will be a new milestone in the arduous journey of predicting osteoporotic fractures in a simple but accurate way if thorough verification is done. Until more validation is performed, this technique should be used as a complement to existing evaluation methods. It is necessary to identify the most effective combination for predicting fractures in harmony with the existing methods of DXA, TBS, and FRAX, and the direction of these developments should be beneficial to the patient. Congratulations to the authors for the excellent research.

**CONFLICTS OF INTEREST**

No potential conflict of interest relevant to this article was reported.

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**REFERENCES**

1. Curtis EM, Moon RJ, Harvey NC, Cooper C. The impact of fragility fracture and approaches to osteoporosis risk assessment worldwide. Bone 2017;104:29-38.
2. Ahn SH, Park SM, Park SY, Yoo JJ, Jung HS, Nho JH, et al. Osteoporosis and osteoporotic fracture fact sheet in Korea. J Bone Metab 2020;27:281-90.
3. Baek YH, Cho SW, Jeong HE, Kim JH, Hwang Y, Lange JL, et al. 10-Year fracture risk in postmenopausal women with osteopenia and osteoporosis in South Korea. Endocrinol Metab (Seoul) 2021;36:1178-88.
4. Harvey NC, Gluer CC, Binkley N, McCloskey EV, Brandi ML, Cooper C, et al. Trabecular bone score (TBS) as a new complementary approach for osteoporosis evaluation in clinical practice. Bone 2015;78:216-24.
5. Williams S, Khan L, Licata AA. DXA and clinical challenges of fracture risk assessment in primary care. Cleve Clin J Med 2021;88:615-22.
6. Kanis JA, Oden A, Johansson H, Borgstrom F, Strom O, McCloskey E. FRAX and its applications to clinical practice. Bone 2009;44:734-43.
7. Gregson CL, Armstrong DJ, Bowden J, Cooper C, Edwards J, Gittoes NJL, et al. UK clinical guideline for the prevention and treatment of osteoporosis. Arch Osteoporos 2022;17:58.
8. Sung J, Park S, Lee SM, Bae W, Park B, Jung E, et al. Added value of deep learning-based detection system for multiple major findings on chest radiographs: a randomized crossover study. Radiology 2021;299:450-9.
9. Kim DH, Jeong JG, Kim YJ, Kim KG, Jeon JY. Automated vertebral segmentation and measurement of vertebral compression ratio based on deep learning in X-ray images. J Digit Imaging 2021;34:853-61.
10. Seo JW, Lim SH, Jeong JG, Kim YJ, Kim KG, Jeon JY. A deep learning algorithm for automated measurement of vertebral body compression from X-ray images. Sci Rep 2021;11:13732.
11. Kong SH, Ahn D, Kim BR, Srinivasan K, Ram S, Kim H, et al. A novel fracture prediction model using machine learning in a community-based cohort. JBMR Plus 2020;4: e10337.
12. Kong SH, Lee JW, Bae BU, Sung JK, Jung KH, Kim JH, et al. Development of a spine X-ray-based fracture prediction model using a deep learning algorithm. Endocrinol Metab (Seoul) 2022;37:674-83.