Publications and Clinical Research Highlights

AIM

Accessible Precision Care

采風智匯股份有限公司

Executive Summary

DeepXray™ — AI-powered bone mineral density analysis from standard plain X-rays, enabling precision opportunistic osteoporosis screening without dedicated DXA equipment.

ACCURACY

r = 0.901

Pearson r vs. DXA gold standard

Retrospective
95.1% accuracy | 100% specificity

Prospective
AUC 0.969 | 100% PPV / specificity

Tohoku University Hospital, Japan
J. Clinical Densitometry (ISCD), 2025

Frontiers in Endocrinology. 2026

FRACTURE PREDICTION

Equivalent to DXA

All-site fracture AUC:

AI 0.699 vs DXA 0.677

6-year follow-up (n=540)

ESCEO-IOF Young Investigator Award, WCO-IOF-ESCEO 2026, Prague

MULTI-SITE EVIDENCE

10+

conference presentations

Japan, Taiwan, Vietnam

3 abstracts: IOF Poster Guided Tour, Tokyo 2026

IOF Tokyo, JOS, TOA, WCO, RSNA

100+ clinical sites deployed — Taiwan · Japan · Vietnam

Regulatory Clearances & Submissions

US FDA 510(k) (FDA CLEARED)

DeepXray™ Spina K253192
DeepXray™ (Genu) K223621

PMDA Japan (in progress)

DeepXray™ Spina 機 P4986

Taiwan FDA

DeepXray™ Spina MOHW-MD-008246
DeepXray™ Coxa MOHW-MD-007975
DeepXray™ (Genu) MOHW-MD-007907

Vietnam MOH

DeepXray™ Spina 250000092/PCBB-HCM
DeepXray™ Coxa 240000792/PCBB-HCM
DeepXray™ (Genu) 240000568/PCBB-HCM

Clinical Evidence & Recognition at a Glance

▶ Peer-Reviewed Publications (Tier 1)

- Taiwan University Hospital (Taiwan) — Osteoporosis International (IOF), 2026
- Tohoku University (Japan) — J. Clinical Densitometry (ISCD), 2025
- Hue Central Hospital (Vietnam) — Osteoporosis & Sarcopenia (AFOS), 2026

▶ Awards & Recognition (Tier 2)

- 🏆 ESCEO-IOF Young Investigator Award — WCO-IOF-ESCEO 2026, Prague (Oral OC24)
- 3 abstracts — IOF Poster Guided Tour, 9th Asia-Pacific Bone Health Conf., Tokyo 2026
- 2nd Place ITEM of the Year Expert Recommendation Award 2025, Japan
- National Innovation Award (IBMI) — 20th 2023 / 22nd 2025, Taiwan

▶ Multi-Site Supporting Evidence (Tier 3)

- 10+ conference presentations: WCO-IOF-ESCEO 2026, IOF Tokyo 2026, JOS 2025, TOA 2025, WCO-IOF-ESCEO 2024, RSNA 2024

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Osteoporosis International

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International Osteoporosis Foundation Regional 9th Asia-Pacific Bone Health Conference

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Dept. of Orthopedics, National Taiwan Univ. Hospital Yun-Lin Branch. Taiwan

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IOF Tokyo 2026

International Osteoporosis Foundation Regional 9th Asia-Pacific Bone Health Conference

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Niigata Rehabilitation Hospital, Japan

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IOF Tokyo 2026

International Osteoporosis Foundation Regional 9th Asia-Pacific Bone Health Conference

PI: Fu, Shau-Huai

Dept. of Orthopedics, National Taiwan Univ. Hospital Yun-Lin Branch. Taiwan

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PI: Fu, Shau-Huai

Dept. of Orthopedics, National Taiwan Univ. Hospital Yun-Lin Branch. Taiwan

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AI-derived bone mineral density from standard radiographs compared with DXA for fracture prediction in a 10-year real-world cohort study

Tzu-Hao Tseng , Tseng Ti Huang , Jing En Huang, Shi-Chien Tzeng, Yu-Chen Wang , Pei-Chen Tsao, Chih Chien Hung , Chia-Che Lee , Jui-Yo Hsu, Hung-Kuan Yen , Chih-Hsing Wu , Chung-Yi Li, Chen-Yu Wang , Shau-Huai Fu

Abstract

AI-derived bone mineral density from routine radiographs showed strong agreement with DXA and comparable ability to predict incident fractures. This opportunistic approach may support osteoporosis screening and early identification of high-risk individuals without reliance on dedicated DXA examinations.

Introduction

Osteoporosis is a major cause of fragility fractures, yet limited access to DXA leads to underdiagnosis and delayed treatment. Recent advances in artificial intelligence enable extraction of bone structural information from routine radiographs, providing a potential tool for opportunistic osteoporosis screening. Whether AI-derived BMD can approximate DXA and predict real-world fracture risk remains unclear.

Methods

Adults aged ≥ 20 years who underwent both lumbar DXA and radiographic examinations (lumbosacral or kidney-ureter-bladder) within six months between January 2014 and December 2024 were retrospectively analyzed. Lumbar BMD was estimated using DeepXray Spina and compared with DXA using Pearson correlation, intraclass correlation coefficient (ICC), and Bland-Altman analysis. Diagnostic performance for osteoporosis (T-score ≤ - 2.5) and fracture prediction was evaluated using receiver operating characteristic (ROC) analysis, Cohen's κ, and logistic regression.

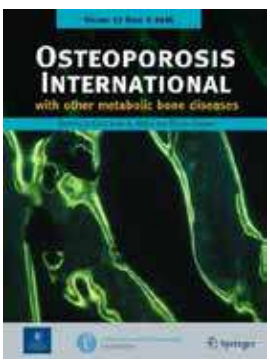
Results

Among 540 participants (73.9% female; mean age 57.0 years; mean follow-up 6.4 years), AI- and DXA-derived BMD showed strong agreement (r = 0.943; ICC = 0.934). For osteoporosis diagnosis, AI-derived T-scores achieved an AUC of 0.959, κ = 0.74, and 90% accuracy. AI- and DXA-derived BMD showed comparable performance for predicting vertebral (AUC 0.704 vs. 0.678) and hip fractures (0.716 vs. 0.678). For all-site fractures, AI-derived BMD showed a modestly higher AUC than DXA-derived BMD (AUC, 0.699 vs 0.677; P = 0.042). Lower AI-derived BMD was independently associated with higher fracture risk.

Conclusions

AI-derived BMD from routine radiographs closely correlates with DXA and demonstrates comparable fracture prediction. This approach may support opportunistic osteoporosis screening without reliance on DXA.

https://pubmed.ncbi.nlm.nih.gov/42313179/



Osteoporosis prediction from Frontal Lumbar Spine X-rays

Ryusei Inamori, Tomoya Kobayashi, Eichi Takaya, Junya Iwazaki, Carlos, Makoto Miyauchi, Saori Ikumi, Yoshikazu Okamoto, Cheng Wei Lin, Sheng Che Hsiao, Qingzong Tseng, Shinya Sonobe

Abstract

Background

This study aimed to evaluate the performance of DeepXray™ Spina, a software that estimates bone mineral density (BMD) and T-scores from frontal lumbar spine X-ray (FLS-X), in predicting osteoporosis.

Methodology

Patients from a Japanese cohort who underwent both FLS-X and dual-energy X-ray absorptiometry (DXA) using Hologic systems within 30 days at Tohoku University Hospital (May 2014-April 2024) were included. BMD was estimated from FLS-X using DeepXray™ Spina, which was developed using dataset from a Taiwanese Cohort. BMD assessed by DXA (observed BMD) and BMD estimated from FLS-X by DeepXray™ Spina (estimated BMD) were compared using Pearson's correlation coefficient (PCC) and normalized root mean square error (NRMSE). T-scores were converted to osteoporosis classifications as normal, osteopenia, or osteoporosis following the World Health Organization criteria. Classification performance was evaluated by accuracy, sensitivity, specificity, Cohen's kappa, and quadratic-weighted Cohen's kappa.

Results

The correlation between estimated and observed BMD was strong, with a PCC of 0.901 and an NRMSE of 0.070. For osteoporosis classification, the accuracy, sensitivity, specificity, and Cohen's kappa were as follows: 0.902, 1.000, 0.842, and 0.803 for normal; 0.854, 0.729, 0.924, and 0.673 for osteopenia; 0.951, 0.810, 1.000, and 0.863 for osteoporosis. The quadratic-weighted Cohen's kappa was 0.884.

Conclusion

This study evaluated the performance of Deep Xray™ Spina in predicting osteoporosis from FLS-X. The software is a practical and reliable tool for predicting osteoporosis, with high performance and robustness.

https://www.sciencedirect.com/science/article/pii/S1094695025001180

About the Journal

Journal of Clinical Densitometry

The official journal of the International Society for Clinical Densitometry (ISCD), the *Journal of Clinical Densitometry: Assessment and Management of Musculo-Skeletal Health* publishes the latest clinical research on the uses of **bone mass** and **density measurements** in medical practice, as well as state-of-the-art review articles on critical topics.

Artificial intelligence-assisted screening reveals high prevalence of osteoporosis in Vietnamese adults using pelvic and hip radiographs

Dat Minh Nguyen, Chih-Hsing Wu, Tuan Van Nguyen, Lan T. Ho-Pham, Kim Thi Hoang Dang, Hy Van Nguyen, Sung-Yen Lin, Chung-Hwan Chen, Ta-Wei Tai

Abstract

Objectives

Osteoporosis is a silent disease with low screening rates in many developing countries. This study aimed to evaluate the feasibility of using an artificial intelligence (AI)-based system to screen osteoporosis from pelvic and hip radiographs in Vietnam.

Methods

We conducted a cross-sectional study at a tertiary medical center in Central Vietnam in 2023. A total of 2000 consecutive pelvic and hip radiographs from patients aged ≥ 40 years were collected. After excluding poor-quality images, 1987 radiographs were analyzed using an AI-based software designed to estimate bone mineral density (BMD) from plain radiographs and derive T-scores. Osteoporosis was defined as a T-score ≤ −2.5. Patient characteristics, radiographic findings, and risk factors for osteoporosis were analyzed.

Results

Among 1987 patients (mean age 66.4 ± 15.1 years; 41.3% men), osteoporosis was identified in 872 patients (43.9%). The prevalence increased with age and was higher in women than in men (58.7% vs 22.8%, P < 0.001). Osteoporosis was associated with femoral neck (OR = 3.8, 95% CI: 2.7–5.2) and intertrochanteric fractures (OR = 7.0, 95% CI: 4.5–11.0). Patients with lower T-scores had a higher risk of hip fractures, especially those with T-scores ≤ −3.0 (OR = 11.5, 95% CI: 5.5–24.5).

Conclusions

AI-based analysis of pelvic and hip radiographs is a feasible and effective tool for osteoporosis screening in Vietnam. The prevalence of osteoporosis in this hospital-based setting was high, particularly among elderly women. AI-assisted screening may offer an accessible strategy for early detection of osteoporosis in resource-limited settings.

https://www.sciencedirect.com/science/article/pii/S2405525526000026

About the Journal

Osteoporosis and Sarcopenia

Osteoporosis and Sarcopenia is the official, peer-reviewed open-access journal of the Asian Federation of Osteoporosis Societies (AFOS). The journal aims to further research in the areas of osteoporosis, fracture, sarcopenia, frailty, metabolic bone diseases, mineral metabolism, as well as biology, physiology, and pathology of bone and muscle with a specific focus on Asian uniqueness in genetic, ethnic, social, and environmental differences. Despite the journal's Asian focus, we welcome appropriate submissions from all over the world.

Comprehensive opportunistic osteoporosis screening with AI: retrospective development and prospective validation of dual-site BMD prediction from a single radiograph

Hsuan-Yin Lin, Jyh-Wen Chai, Qingzong Tseng, Cheng-Wei Lin, Kuan-Jung Pan, Kai-Wei Liu, Ya-Chu Shih

Abstract

Purpose

To develop and validate an AI algorithm that enables dual-site (spine and hip) BMD assessment for opportunistic osteoporosis screening using a single kidney-ureter-bladder (KUB) radiograph.

Materials and methods

In this institutional review board approved prospective study, we developed the SHield pipeline for opportunistic osteoporosis screening. From an initial dataset of 15,175 KUB images, a final cohort of 4,436 patients (mean age 69.0 ± 12.2 years) was included for model development after exclusions for suboptimal quality or incomplete region of interests. The pipeline analyzes both the spine and hip regions on a single KUB to predict site-specific BMD values. Finally, it integrates these dual-site predictions to determine the lowest T-score, mimicking the standard clinical DXA reporting protocol which evaluates both the lumbar spine and proximal femur.

Results

On the internal test set (628 patients), the hip and spine AI models demonstrated Pearson correlation coefficients of 0.887 and 0.921 and RMSEs of 0.057 and 0.062, respectively, compared to DXA-measured BMD, achieving AUCs of 0.894 and 0.956 for predicting T-scores ≤-2.5. In a subsequent prospective feasibility study (51 patients), we employed a conservative detection threshold of T_m-score ≤-2.8 to minimize false positives and unnecessary referrals. The final AI pipeline achieved a Pearson correlation of 0.959, an AUC of 0.969, 100% PPV, 100% specificity, and 83.8% NPV.

Conclusion

This paper presents the first AI pipeline that enables gold-standard-aligned, dual-site BMD estimation and opportunistic osteoporosis screening from a single KUB radiograph. Validated prospectively, its high accuracy and specificity confirm its potential to significantly increase early detection rates without overwhelming clinical workflows.

https://www.frontiersin.org/journals/endocrinology/articles/10.3389/fendo.2026.1906679/full

About the Journal

Frontiers in Endocrinology

The world's most cited endocrinology and metabolism journal, advancing understanding and treatment of hormonal disorders impacting health worldwide.

Awards & Recognition

Validated by the world's leading osteoporosis organizations

ESCEO-IOF Young Investigator Award
WCO-IOF-ESCEO 2026, Prague

IOF Poster Guided Tour ×3
9th Asia-Pacific Conf., Tokyo 2026

🏆 ESCEO-IOF Young Investigator Award — WCO-IOF-ESCEO 2026, Prague

Fracture Risk Prediction Using DXA-measured BMD Versus AI-predicted BMD from Spinal Radiographs: A Multicenter Retrospective Study in Hospital and Community Settings

Tseng TH, Fu SH, et al. (incl. AIM). Oral Presentation OC24. Awardee: Jui-Yo Hsu, National Taiwan University Hospital.

Study Design

Multicenter retrospective cohort
n = 540 adults
(399 women; mean age 57.0 ± 12.4 yrs)
Period: 2014–2024
76.5-month fracture follow-up

Cross-Sectional Accuracy

Pearson r (AI vs DXA) **0.943**
ICC **0.934** ($p < 0.001$)
Bland-Altman mean diff. **0.005 g/cm²**
AUC for osteoporosis **0.959**
Optimal T-score cutoff: T = −2.27
(Sens. 86.7%, Spec. 92.1%)

Fracture Prediction (6-Year Follow-up)

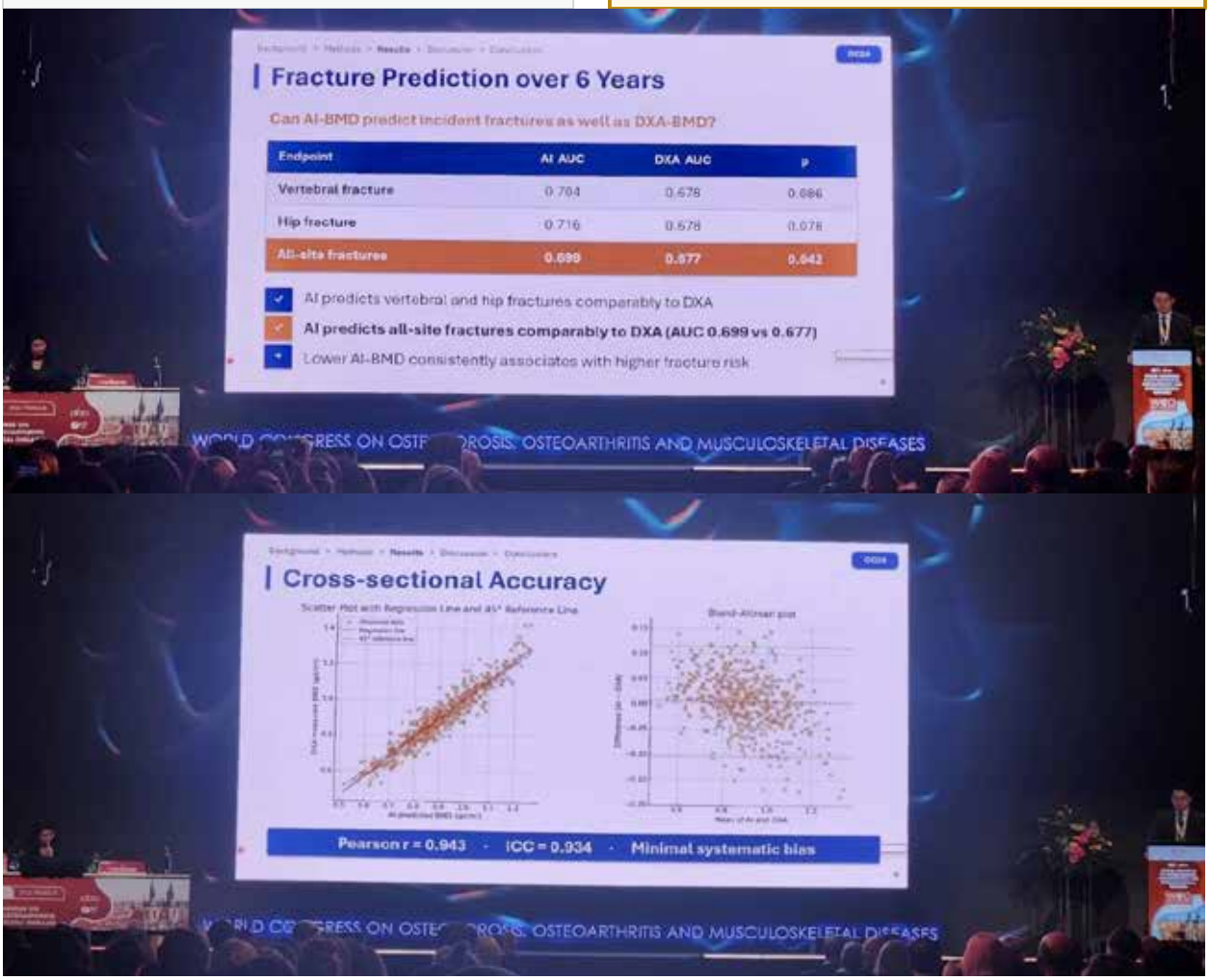
Endpoint	AI AUC	DXA AUC	p
Vertebral Fracture	**0.704**	**0.678**	**0.086**
Hip Fracture	**0.716**	**0.678**	**0.078**
All-site Fracture	**0.699**	**0.677**	**0.042★**

★Statistically significant: AI on par with DXA for all-site fracture prediction

Why This Matters

This answers the most critical clinical question: can AI T-scores from plain X-ray support the same treatment decisions as DXA?

For all-site fractures, DeepXray™ AI was statistically superior. The most prestigious global recognition in osteoporosis research — awarded by ESCEO-IOF at the World Congress on Osteoporosis 2026.



中華民國骨質疏鬆症學會
The Taiwanese Osteoporosis Association

IOF REGIONAL TOKYO '25
9TH ASIA-PACIFIC BONE HEALTH CONFERENCE

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Two-stage Osteoporosis Screening Using AI from Lumbar Spine, Pelvic, and Chest Radiographs Combined with OSTA: A Retrospective Study

J.-Y. Hsu [1], S.-H. Fu [2], C.-H. Wu [3], C. Li [4], Y.-C. Lu [5], N.-H. Sie [5], C.-Y. Wang [5]

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[2] Department of Orthopedics, National Taiwan University Hospital Yun-Lin Branch, Douliu..
[3] Department of Family Medicine, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan.
[4] Institute of Allied Health Sciences, College of Medicine, National Cheng Kung University, Tainan, Taiwan.
[5] National Center for Geriatrics and Welfare Research, National Health Research Institutes, Huwei, Taiwan

Background

The Problem
In settings with constrained DXA capacity, a pragmatic two-stage screening approach is crucial to balance early case-finding with the referral burden.

Existing Tools
Simple questionnaire tools like the Osteoporosis Self-Assessment Tool for Asians (OSTA) are easy to deploy but often imprecise.

A New Opportunity
Artificial intelligence (AI) can estimate Bone Mineral Density (BMD) from routine radiographs (like chest, pelvic, or lumbar spine X-rays) taken for other reasons, enabling opportunistic screening.

Can combining the simplicity of OSTA with the specificity of AI create a superior screening strategy?

Study Objective

To Evaluate a Novel Two-Stage Screening Strategy for Osteoporosis

We aimed to compare the diagnostic performance of:

1. The OSTA questionnaire alone.
2. Two distinct AI models that analyze routine radiographs.
3. Three different strategies combining OSTA and AI (serial, parallel, and an optimized rule).

Methods

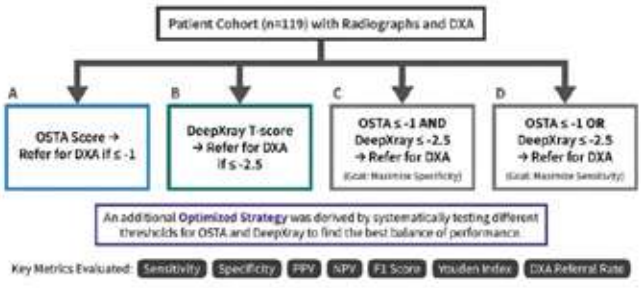
Study Design & Population

- **Design:** Retrospective cohort study.
- **Population:** 119 adults who had both DXA scans and radiographs available.
- **Demographics:** Mean age 60.9 years; 69.7% women.
- **Primary Endpoint:** Osteoporosis defined as the lowest T-score ≤ -2.5 at the lumbar spine, total hip, or femoral neck. The prevalence in this cohort was 14.4% (17 of 118 patients).

Screening Tools Assessed

- **Questionnaire:** OSTA (Osteoporosis Self-Assessment Tool for Asians).
- **AI Model 1:** DeepXray (Analyzes lumbar spine and pelvic radiographs).
- **AI Model 2:** Veriosteo (Analyzes chest radiographs - CXR).

Comparing Four Distinct Screening Pathways



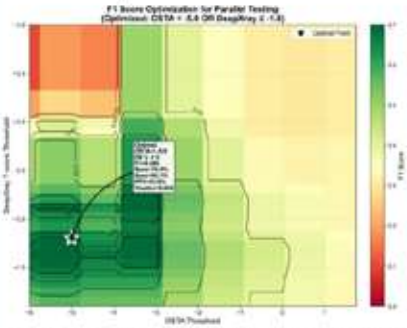
Results

- Total participants: 119 (**69.7% women**).
- Overall osteoporosis prevalence (any site): **14.4%**.
- Men were significantly older and had higher baseline BMD than women.

Individual Screening Tools Show a Clear Performance Trade-Off

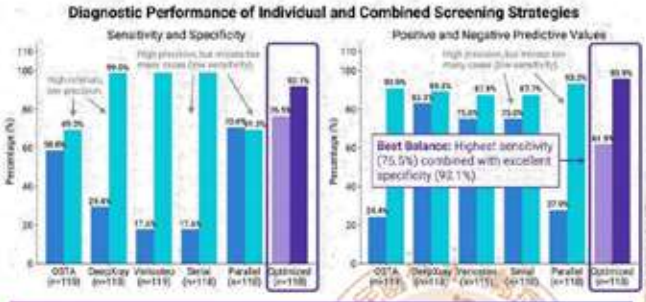
- **OSTA** Achieves **moderate sensitivity (58.8%)** but suffers from low specificity (68.6%), leading to a high DXA referral rate of 35.3%.
- **DeepXray Spina** Delivers **excellent specificity (99.0%)** but has very limited sensitivity (29.4%).

How the Optimal Thresholds Were Determined



- A systematic grid search was performed to evaluate the F1 score (a measure of overall accuracy) across all possible combinations of OSTA and DeepXray thresholds.
- The optimal point, marked by the star, was identified at **OSTA < -5.0 OR DeepXray T-score ≤ -1.8.**
- This combination maximizes the model's ability to correctly classify both positive and negative cases.

Optimized AI+OSTA Strategy Outperforms All Other Approaches



Conclusions

A High-Performance, Low-Burden Pathway for Osteoporosis Screening

Integrating AI-derived BMD estimates from routine lumbar spine and pelvic radiographs with OSTA enables a superior two-stage screening pathway.

- **Contact information**
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  - jyhsu@ntu.edu.tw **(Jui-Yo Hsu M.D)**

IOF REGIONAL TOKYO 2025, 9TH ASIA-PACIFIC BONE HEALTH CONFERENCE, P179

PREDICTION OF BONE MINERAL DENSITY FROM RADIOGRAPHIC OF LUMBAR AND HIP JOINT IN JAPANESE FEMALES USING ARTIFICIAL INTELLIGENCE

K. Nishino [a,b], N. Yamamoto [b], M. Muramatsu [b], N. Kodama [c], Q. Tseng [d]

[a] Uonuma Institute of Community Medicine, Niigata University, Japan, [b] Niigata Rehabilitation Hospital, Japan
[c] Niigata University of Health and Welfare, Japan, [d] Alpha Intelligence Manifolds, Inc., Taiwan

Background

Bone mineral density (BMD) detected from dual energy x-ray absorptiometry (DXA) is used worldwide as gold standard in osteoporosis diagnosis. In recent years, a new method has been developed to estimate BMD using easily available X-ray images with the assistance of artificial intelligence (AI) solution system.
Objective: To investigate the predictability of BMD from new method (X-ray&AI) by comparing DXA BMD.

Method

Scan site	**Lumbar**	L2 to L4 (L-spine)
	Hip joint	➢ Femoral neck ➢ Total hip
Test	**(I) DXA**	Horizon® System QDR series (Hologic, Inc., USA) ⇨ True BMD
	(II) X-ray&AI	➢ Frontal X-ray imaging AeroDR SYSTEM (KONIKA MINOLTA, Inc., Japan) ➢ AI solution system **(Fig.1)** DeepXray™ Spina, Coxa (Alpha Intelligence Manifolds, Inc., Taiwan) ⇨ Estimated BMD
Participants (Fig.2)	**Period**	57 months (June 2020 to March 2025)
	Inclusive	➢ Japanese females with aged ≥30 years ➢ Underwent two tests on lumbar and/or hip joint
	Exclusive	➢ Interval between two tests (I&II) >180 days ➢ With implant on spine, with implants on both sides of hip joint ➢ Severe bone deformity & Poor X-ray image
Statistics		➢ Correlation analysis between true and estimated BMDs (α =5%) ➢ Accuracy of regression model: mean absolute error (MAE) ➢ Predictive accuracy for osteoporosis using ROC curve

(A) Lumbar (B) Hip joint

Fig.1 AI solution system

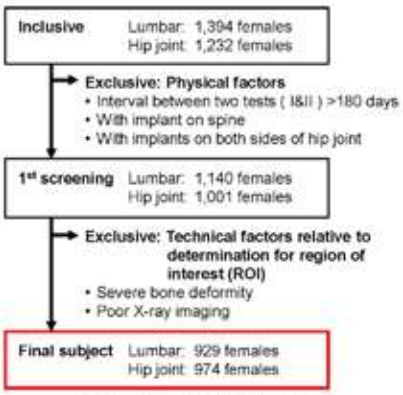
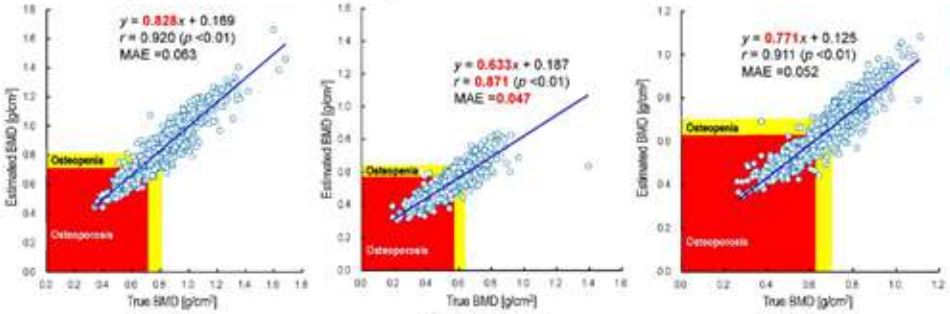


Fig.2 Flowchart to final subject

Results

Final subjects for the analysis were 929 females (Age: 74.0±13.7 [73.1-74.9 95%CI] years) in lumbar and 974 females (75.7±13.9 [74.8-76.6] years) in hip joint. The femoral neck had the lowest correlation among the three scan sites, yet still demonstrated a strong relationship (r =0.871). Across all scan sites, the MAE between true and estimated BMDs ranged from 0.047 to 0.063. The regression slopes were also consistent, ranging from 0.633 to 0.82. (**Fig.3**). The AUCs in all scan sites ranged from 0.934 to 0.967 (**Table 1**).



(A) L-spine (B) Femoral neck (C) Total hip

Fig.3 Correlations between true and estimated BMDs

Table 1 Predictive accuracy for osteoporosis

Metrics		L-spine	Femoral neck	Total hip
	AUC (p value)	0.953 (p<0.01)	0.934 (p<0.01)	0.967 (p<0.01)
Standard T-score ≤-2.5[1]	Cutoff [g/cm²]	0.708	0.565	0.625
	Sensitivity [%]	96.4	71.3	88.7
	Specificity [%]	65.8	94.0	93.6
Highest Youden's index	Cutoff [g/cm²]	0.780	0.542	0.606
	Sensitivity [%]	83.8	83.5	80.7
	Specificity [%]	93.3	87.0	96.4

1) Model QDR (Table 3 in Osteoporosis Japan. 21(1). 2013)
AUC: area under the ROC curve

Discussion & Conclusion

The lowest correlation coefficient in femoral neck may be due to higher variability of the determination for the region of interest (ROI) on DXA. The estimated BMD from X-ray&AI was very close to true BMD from DXA. Furthermore, X-ray&AI may be able to detect the cases at risk of osteoporosis with high predictive accuracy. Thus, X-ray&AI will be useful for screening to detect the cases at osteoporosis risk in large populations.

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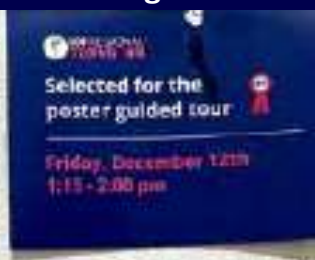

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FRACTURE RISK PREDICTION USING DXA-MEASURED BMD VERSUS AI-PREDICTED BMD FROM SPINAL RADIOGRAPHS: A MULTICENTER RETROSPECTIVE STUDY IN HOSPITAL AND COMMUNITY SETTINGS

T.-H. Tseng [1], S.-H. Fu [2], C.-C. Li [3], C.-H. Wu [4], C.-Y. Li [5], Q.-Z. Tseng [6], C.-Y. Wang [7]

Background

Dual-energy X-ray absorptiometry (DXA) is the gold standard for diagnosing osteoporosis and predicting fracture risk, yet **DXA availability and utilization remain low worldwide.** Artificial intelligence (AI) applied to routine radiographs offers a potential solution by providing automated, quantitative bone mineral density (BMD) estimation at minimal cost and without additional radiation.

This study evaluated **whether AI-derived lumbar spine BMD from standard radiographs (DeepXray Spina) correlates with DXA and predicts real-world fractures.** Secondary aims included validating diagnostic performance for osteoporosis and assessing agreement between AI- and DXA-derived measurements.

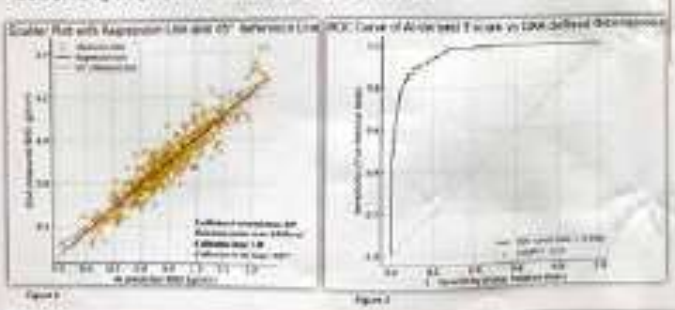
Method

A retrospective cohort of **540 adults (399 women; mean age 57.0 ± 12.4 years)** who underwent both lumbar DXA and radiographs (KUB or lumbosacral AP) **within** 6 months **between 2014–2024 was analyzed.**

AI model: DeepXray Spina, FDA-cleared and TFDA-approved, estimates lumbar BMD via multi-stage deep learning (YOLOv5 detection, HRFormer alignment, RegNet regression). Predicted BMD values were converted to Hologic-equivalent units following validated cross-calibration procedures. Reference standard: Lumbar DXA BMD and T-scores (L1–L4), following ISCD guidelines.

Fracture outcomes: Incident vertebral, hip, and all-site fractures (2014–2025) confirmed through imaging and medical records.

Statistical analysis: Pearson correlation, ICC, linear regression, Bland–Altman, ROC analysis (DeLong test), logistic regression, Cohen's κ, McNemar's test, and Brier scores.



Result

AI–DXA Agreement and Diagnostic Accuracy

AI-derived and DXA BMD values were **highly correlated** ($r = 0.943$, $p < .001$)(Figure 1) with excellent agreement (ICC = 0.934). Bland–Altman mean difference was 0.005 g/cm², indicating minimal bias. AI demonstrated **strong diagnostic performance for osteoporosis (DXA-T ≤ −2.5): AUC = 0.959**, κ = 0.74, accuracy = 90%. Optimal AI T-score cutoff: −2.27 (Sensitivity 86.7%, Specificity 92.1%). (Figure 2)

Fracture Prediction

During a mean follow-up of 76.5 months, 57 vertebral, 13 hip, and 100 all-site fractures occurred.

Predictive AUC (AI vs. DXA):

Vertebral fractures: 0.704 vs. 0.678 ($p = 0.086$)

Hip fractures: 0.716 vs. 0.678 ($p = 0.078$)

All-site fractures: 0.699 vs. 0.677 ($p = 0.042$, AI superior)

(Table 1)

Table 1: **ROC analysis of AI and DXA BMD for incidental fractures**

		AUC	p	Optimal cutoff (T-score)	Sensitivity	Specificity
Vertebral	AI	0.704	0.086	0.880 (-1.74)	86.7%	56.4%
fracture	DXA	0.678		0.880 (-1.72)	88.9%	54.3%
Hip fracture	AI	0.716	0.078	0.834 (-1.58)	92.3%	48.2%
	DXA	0.678		0.853 (-1.99)	84.6%	56.4%
All fracture	AI	0.699	0.042	0.871 (-1.82)	72.0%	62.3%
	DXA	0.677		0.895 (-1.61)	80.0%	53.4%

Conclusion

AI-derived BMD from routine radiographs shows **excellent correlation and agreement** with DXA and **provides comparable—or slightly superior—prediction of real-world fractures.**

This quantitative AI approach enables opportunistic, cost-effective **identification of individuals at high fracture risk without requiring** DXA, potentially narrowing the diagnostic gap in osteoporosis care. Integration of AI-based radiographic analysis into clinical workflows may facilitate earlier intervention and population-level screening.

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Research Highlights

& Conference Abstracts

IOF Tokyo 2026
7 abstracts

TOA 2025 | JOS 2025
Taiwan & Japan national conferences

WCO-IOF-ESCEO 2024 | RSNA 2024
Global radiology & osteoporosis congresses

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Feasibility of an AI-based Algorithm Using Spinal Radiographs to Predict Longitudinal Changes In Bone Mineral Density: A Multicenter Study in Hospital and Community Settings

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Background

This Study Validates an AI Algorithm for Both Snapshot Screening and Longitudinal Monitoring of Bone Density

Primary Objective

To evaluate the **longitudinal performance** of a commercial AI algorithm in tracking changes in lumbar spine BMD over time using routine radiographs, compared to serial DXA scans.

Secondary Objective

To assess the **cross-sectional accuracy** of the AI algorithm for predicting lumbar spine BMD at single time points.

Key Question: Can an AI algorithm applied to routine spine radiographs move beyond one-time screening to reliably monitor a patient's bone health progression?

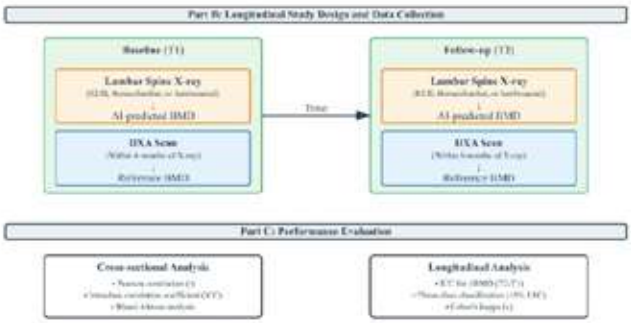
Methods

Study Design

- **Design**: Retrospective diagnostic accuracy study.
- **Timeline**: Data collected from March 2014 to December 2024.
- **Reference Standard**: Lumbar spine DXA.
- **Index Test:** AI-predicted BMD from routine kidney-ureter-bladder (KUB), thoracolumbar, or lumbosacral radiographs using commercial software (DeepXray Spina).

Study Population

- Hospital Cohort (n=504): Patients from a tertiary medical center and its regional affiliate undergoing routine clinical follow-up.
- Community Cohort (n=96): Adults aged ≥50 from rural community centers enrolled in a separate healthy aging trial.



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Result

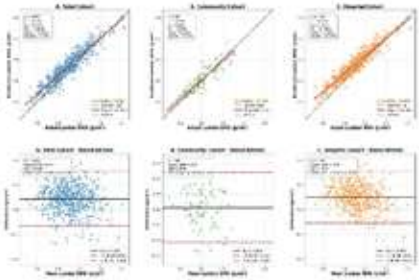
The AI Algorithm Demonstrates Excellent Cross-Sectional Agreement with DXA Measurements

Key Findings

- For the total cohort (1,000 measurements), the AI-predicted BMD showed a very strong correlation with DXA-measured BMD.
- Performance was robust at both baseline (T1) and follow-up (T2) time points.
- Bland-Altman analysis confirmed minimal systematic bias, though with a slight tendency for AI to overestimate BMD.

Key Statistics (Total Cohort, T1+T2)

Pearson Correlation (r): 0.93
Intraclass Correlation (ICC): 0.90
Root Mean Squared Error (RMSE): 0.074 g/cm²
Mean Difference (Bias): 0.04 g/cm²



However, Tracking Longitudinal BMD Changes Proves More Challenging for the Algorithm

Key Findings

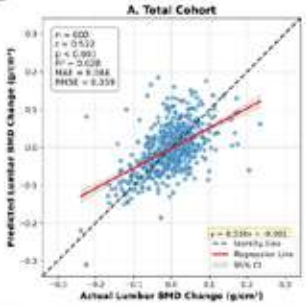
- When assessing the change in BMD between two time points (ΔBMD), the agreement between the AI prediction and DXA measurement was moderate.
- The correlation, while statistically significant, is substantially lower than the cross-sectional performance.

Key Statistics (Total Cohort, ΔBMD)

Intraclass Correlation (ICC): 0.52 (95% CI: 0.46–0.58)

Pearson Correlation (r): 0.52

Mean Difference (Bias): -0.001 g/cm² (virtually no bias in predicting change)



Conclusions

This AI Algorithm is a Validated Tool for Opportunistic Screening, While Longitudinal Monitoring Requires Further Refinement

Conclusions

- **Excellent for Screening:** The AI algorithm achieves excellent cross-sectional accuracy for estimating lumbar spine BMD from routine radiographs, reinforcing its value for opportunistic screening to identify at-risk patients.
- **Moderate for Monitoring:** The algorithm's ability to track longitudinal change is moderate. This performance reflects the inherent precision limits of DXA and the small magnitude of true biological BMD changes.

Clinical Meaning & Future Directions

In Practice Today: This technology can significantly improve osteoporosis detection by leveraging existing radiographs in patients who may not otherwise receive a DXA scan.

For the Future: While not yet a replacement for serial DXA in tracking treatment response, this study provides a critical benchmark. Future algorithms designed specifically to detect temporal changes may overcome current limitations and enhance monitoring capabilities.

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Diagnostic Performance of AI-based X-ray Analysis versus Traditional Questionnaires For Predicting Bone Mineral Density in the Community

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Background

Osteoporosis screening remains underutilized, leaving many at-risk individuals undiagnosed. **Artificial intelligence (AI) applied to routine radiographs** offers a promising approach for opportunistic bone mineral density (BMD) estimation. Traditional screening tools—**OSTA, OSTAi, and MOSTAi**—are widely used but frequently generate false positives, especially in older adults.

This study compared the diagnostic performance of two AI-based tools (**DeepXray and VeriOsteo**) with three traditional questionnaires for identifying lumbar spine osteoporosis, using dual-energy X-ray absorptiometry (DXA) as the reference standard.

Method

We prospectively analyzed **357 community-dwelling adults** (249 women, 108 men; mean age 60.9 ± 10.8 years) who underwent both plain radiography (chest, lumbar spine, or pelvis) and DXA.

AI-based prediction
DeepXray and **VeriOsteo** estimated lumbar BMD from X-rays. Predictions were calibrated to Hologic-equivalent values.

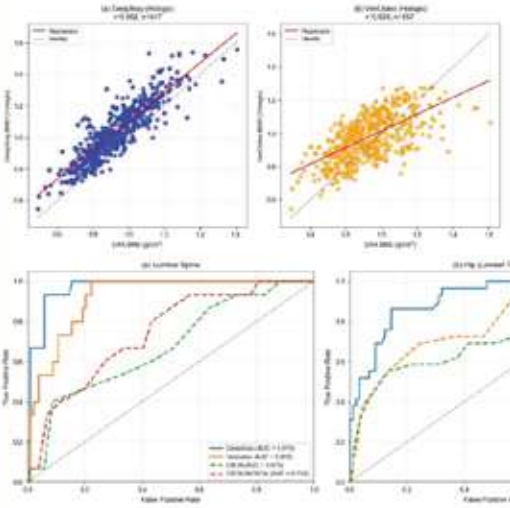
Traditional questionnaires
OSTA, OSTAi, MOSTAi were calculated from demographic variables.

Reference standard
Lumbar spine DXA; osteoporosis defined as **T-score ≤ –2.5**.

Outcome measures
Pearson correlation with DXA
Sensitivity, specificity
Area under the ROC curve (AUC)
Error pattern evaluation (false positives / false negatives)

Result

Correlation with DXA
DeepXray: r = **0.882**, P < .001
VeriOsteo: r = **0.633**, P < .001



Diagnostic accuracy for lumbar spine osteoporosis

Tool	Sensitivity	Specificity	AUC
DeepXray	83.3%	99.0%	0.970
VeriOsteo	20.0%	99.0%	0.919
OSTA	53.3%	67.3%	0.675
OSTAi/MOSTAi	46.7%	73.1%	0.742

Conclusions

1. **AI tools demonstrated excellent specificity (99%) and very high AUC, indicating strong discriminative ability.**
2. **Traditional tools showed higher sensitivity but very poor specificity, leading to substantial overdiagnosis.**
3. **AI tools showed a tendency to underestimate disease severity, resulting in false negatives, especially among older women.**

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ARTIFICIAL INTELLIGENCE–BASED REMOTE SCREENING REVEALS RISK FACTORS FOR OSTEOPOROSIS AND HIP FRACTURES IN VIETNAM

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Introduction

Osteoporosis is a silent, progressive disease that increases fracture risk and healthcare burden, especially in aging populations. In Vietnam, screening and diagnosis remain limited due to inadequate access to dual-energy X-ray absorptiometry (DXA) and low public awareness. Artificial intelligence (AI)-based software offers a novel, cost-effective method for opportunistic screening using existing radiographs. This study aimed to evaluate the feasibility of using AI-assisted analysis of pelvic and hip radiographs for osteoporosis detection in a hospital-based Vietnamese population.

Methods

We conducted a cross-sectional study at a tertiary medical center in Central Vietnam between January and December 2023. A total of 2,000 pelvic and hip radiographs from adults aged ≥40 years were consecutively collected. **After excluding poor-quality images, 1,987 radiographs were analyzed using DeepXray Coxa, a Taiwan FDA-cleared AI software that estimates bone mineral density (BMD) and calculates T-scores based on hip and femoral neck landmarks.** T-scores were classified according to WHO criteria: normal (> -1.0), osteopenia (-2.5 to -1.0), and osteoporosis (≤ -2.5). Demographics, radiographic fracture types, and hip diseases were recorded.

Results

The cohort included 1,987 participants (mean age: 66.4 ± 15.1 years; 58.7% female). The overall prevalence of osteoporosis was 43.9%, significantly higher in women than men (58.7% vs. 22.8%, $p < 0.001$). BMD decreased with age in both sexes, but women showed a rapid decline starting at menopause, while men experienced a more gradual decline.

Hip fractures were found in 609 patients, and 74.5% of them had osteoporosis. Specifically, 72.6% of femoral neck fractures and 82.5% of intertrochanteric fractures occurred in osteoporotic patients. Conversely, high-energy fractures were more common in non-osteoporotic individuals.

Sex-stratified multivariate analysis demonstrated that increasing age was significantly associated with a higher risk of osteoporosis in both men and women **(Table 1)**. However, the magnitude of risk was more prominent in women. In men, the OR for osteoporosis increased from 2.9 in those aged 50–59 years to 35.6 in those aged ≥80 years. In women, the corresponding ORs increased from 3.6 to 127.6. Hip fractures remained strong independent risk factors for osteoporosis in both sexes, with higher ORs observed in women than in men.

The risk of hip fracture strongly correlated with T-score. Compared to individuals with T-scores ≥ -1.0, those with T-scores between -2.5 and -2.9 had an adjusted OR of 8.1 for hip fracture, while those with T-scores ≤ -3.0 had an OR of 11.5 ($p < 0.001$) **(Table 2)**.

Table 1: Risk of Osteoporosis

Characteristics	Men		Women	
	Odd Ratio (95% CI)	P value	Odd Ratio (95% CI)	P value
40 ≤ Age < 50	1.00		1.00	
50 ≤ Age < 60	2.9 (1.0–8.0)	0.041*	3.6 (1.6–8.0)	0.002*
60 ≤ Age < 70	7.7 (2.9–20.6)	<0.001*	13.0 (5.9–28.4)	<0.001*
70 ≤ Age < 80	13.1 (4.9–35.1)	<0.001*	31.0 (13.8–69.6)	<0.001*
80 ≤ Age	35.6 (13.6–93.9)	<0.001*	127.6 (53.6–306.4)	<0.001*
Femoral neck fracture	2.2 (1.3–3.7)	0.002*	5.4 (3.5–8.5)	<0.001*
Intertrochantoric fracture	5.8 (3.4–10.1)	<0.001*	8.1 (3.8–17.1)	<0.001*

Table 2: Risk of Hip Fractures

T-score	Univariate Analysis		Multivariate Analysis	
	Odd Ratio (95% CI)	P value	Odd Ratio (95% CI)	P value
≥ -1.0 (n= 161)	1.00		1.00	
-1.1 ~ -1.9 (n= 597)	1.5 (0.7–3.2)	0.245	1.2 (0.6–2.6)	0.579
-2.0 ~ -2.4 (n= 356)	5.1 (2.5–10.5)	<0.001*	3.6 (1.7–7.4)	0.001*
-2.5 ~ -2.9 (n= 319)	13.4 (6.6–27.2)	<0.001*	8.1 (3.9–16.8)	<0.001*
≤-3.0 (n= 554)	24.2 (12.1–48.3)	<0.001*	11.5 (5.5–24.5)	<0.001*

Conclusions

This study demonstrates the feasibility and clinical utility of AI-assisted osteoporosis screening using routine pelvic and hip radiographs in Vietnam. The prevalence of osteoporosis was notably high, particularly among elderly women. A strong association was found between lower T-scores and increased hip fracture risk.

AI-based radiographic assessment represents a scalable and accessible solution for early osteoporosis detection in resource-limited settings. These findings support the integration of AI screening tools into clinical practice to improve osteoporosis management and fracture prevention in Vietnam.

Conflicts of Interest: This study was supported by an educational grant from the Taiwanese Osteoporosis Association (partially provided by Alpha Intelligence Manifolds, Taiwan). The authors have no financial relationships with the company and received no payments or benefits related to this study.

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AI-ASSISTED HIP BONE MINERAL DENSITY SCREENING IN TAIWANESE COMMUNITIES

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1. OBJECTIVE

This study aims to utilize Artificial Intelligence (AI) assisted analysis of hip Bone Mineral Density (BMD) to evaluate bone health in community residents across Taoyuan, Nantou, and Hualien. We assessed the prevalence of normal bone mass, low bone mass, and osteoporosis.

2. METHODS

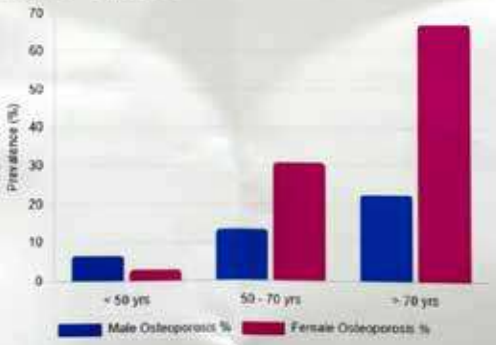
- **Design:** Cross-sectional study.
- **Locations:** Taoyuan, Nantou, Hualien (Taiwan).
- **Participants:** N = 3,515, Mean age 61.4 years.
- **Screening Tool:** AI-assisted pelvic radiograph analysis.
- **Classification:** Normal, Low Bone Mass, Osteoporosis.
- **Statistical Analysis:**
  Chi-square tests
  Multinomial logistic regression

3. RESULTS

3.1 Overall Prevalence

3.3 Age & Gender Trends

Osteoporosis prevalence increases significantly with age, particularly in females > 70 years old.



3.2 & 3.4 STATISTICS

Gender Differences

Females had significantly higher prevalence than males ($p<0.001$).

FEMALE (43.2%)

MALE (15.3%)

Risk Factors (Adjusted OR)

Female	OR ≈ 3.0
Age 50-70	OR ≈ 2.6
Age > 70	OR ≈ 5.7

Ref: Age < 50, Male

REFERENCES

Ref: Nguyen, H.G., et al. Artificial intelligence system for predicting areal bone mineral density from plain X-rays. Osteoporos Int (2025).

Acknowledgment: We thank Alpha Intelligence Manifolds, Inc. for their collaboration in this screening program.

Disclosures: No conflicts of interest.

SUMMARY

High Prevalence & AI Utility

AI screening effectively identified high prevalence of bone issues in the community.

Key Predictors

Female gender and advanced age are strong independent predictors of bone deterioration.

AIM
Accessible Precision Care

Taiwanese Osteoporosis Association Annual Meeting 2025

Exploring the Feasibility and Clinical Validation of X-ray Imaging Combined with AI-based Smart Healthcare Analysis as a Replacement for Bone Mineral Density Testing

Principal Investigator

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Abstract

Osteoporosis screening and monitoring are often limited by the availability, cost, and reimbursement of dual-energy X-ray absorptiometry (DXA), especially in community and primary care settings. This series of studies explored the feasibility of using routine spinal radiographs combined with artificial intelligence (AI) analysis as an alternative to DXA for bone mineral density (BMD) assessment and fracture risk prediction. In a multicenter study, an AI algorithm (DeepXray Spina) demonstrated excellent cross-sectional agreement with DXA (r = 0.93; ICC = 0.90), and moderate longitudinal tracking ability (ICC = 0.52), with sensitivity and specificity of 56.5% and 68.4% for detecting significant BMD loss. In community-based screening, AI analysis achieved an AUC of 0.97 and outperformed traditional risk questionnaires (OSTA, OSTAi, MOSTAi) in diagnostic accuracy. For fracture prediction, AI-predicted BMD showed excellent concordance with DXA (ICC = 0.934) and comparable vertebral fracture prediction performance (AUC: 0.712 vs. 0.705).

Overall, AI-based X-ray analysis offers a practical and accurate approach for osteoporosis screening, diagnosis, and risk stratification, with the potential to serve as an adjunct or alternative to DXA, particularly in resource-limited settings.

Post-Market External Validation Demonstrating DeepXray BMD Estimation Comparable to DXA

Taiwanese Osteoporosis Association Annual Meeting 2025

AI-Driven Radiographic Screening Across Borders: A Real-World Model of Remote Collaboration for Osteoporosis Detection in Vietnam

Principal Investigator

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Abstract

Osteoporosis remains underdiagnosed in Vietnam, where access to DXA is limited. To address this gap, we implemented a novel cross-border, AI-driven screening model that leverages routinely obtained pelvic and hip radiographs for osteoporosis detection. Radiographs from 1,987 adults aged ≥40 years, collected at Hue Central Hospital in Central Vietnam, were de-identified and securely transferred to Taiwan for analysis using *DeepXray Coxa* (Alpha Intelligence Manifolds, Taiwan), an AI-powered software cleared by the Taiwan FDA. This system estimates bone mineral density and T-scores from radiographs and classifies osteoporosis according to World Health Organization criteria.

The prevalence of osteoporosis in this hospital-based cohort was strikingly high at 43.9%, reaching 64.1% in women and 28.2% in men aged ≥50 years. Osteoporosis was strongly associated with hip fractures, with adjusted odds ratios of 3.8 for femoral neck and 7.0 for intertrochanteric fractures. Patients with T-scores ≤ –3.0 had an 11.5-fold higher risk of hip fracture compared with those with normal bone mass.

This study demonstrates the feasibility of a remote AI-driven collaboration model: radiographs acquired in Vietnam were analyzed in Taiwan using advanced software, enabling opportunistic osteoporosis screening without additional imaging. Such cross-border partnerships highlight how AI technology can extend diagnostic capacity to regions with limited resources, support early identification of high-risk patients, and potentially reduce fracture-related morbidity and mortality.

Cross-Border Clinical Validation (VN) Demonstrating DeepXray Estimated BMD Associated with Fracture Risk

O-62 AIソフトウエアによる股関節X線画像の骨粗鬆症診断

新潟リハビリテーション病院整形外科[1]、
新潟リハビリテーション病院リハビリテーション科[2]、
新潟リハビリテーション病院放射線科[3]、新潟医療福祉大学診療放射線学科[4]、
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山本　智章（やまもと　のりあき）[1]、西野　勝敏[2]、村松　真理[3]、児玉　直樹[4]、
ツェンチンゾン[5]

【目的】骨粗鬆症の定量的な診断ツールとして、近年、単純X線像から人工知能（AI）エンジンの支援によって骨密度を評価するソフトウェア（AIソフトウェア）が多数開発されてきており、骨粗鬆症診断やスクリーニングへの応用が期待されている。本研究では、DXA法とAIソフトウェアとを比較し、AIソフトウェアによる骨粗鬆症診断の有用性を検討した。【方法】当院を受診した骨粗鬆症患者の内、DXA法と股関節X線検査を3か月以内に行った患者65名（男性11名、女性54名）を対象にした。DXA法はHorizon 骨密度測定装置を用いて左股関節を分析し、左股関節にimplantが入っていた場合は、手術歴が無い右股関節を分析した。股関節の正面X線検査は、AeroDR SYSTEMを用いて撮影した。股関節X線像はX線画像診断装置ワークステーション用プログラム医用画像解析ソフトウェアDeepXra Bone Viewer ver1.0.0（医療機器認証番号：第307AGBZI00004000号；Alpha Intelligence Manifolds, Inc., Taiwan）に連動するAIエンジンを搭載した骨密度解析ソフトウェアDeepXra Coxa ver1.6.0を用いて分析し、骨密度検査と同側の股関節を評価した。評価部位は、大腿頚部および大腿骨近位部の骨密度BMD（g/cm2）とTスコアを求めた。BMDにおける2つの分析法の相関は、ピアソンの積率相関係数を用いて評価した（α=5%）。また、両者のBMDの差を二乗平均平方根誤差（RMSE）で分析した。【結果】65例の内、女性4例がAIソフトウェアによる分析結果に疑義を生じた（診断成功率93.8%）。その4例を除いた61例（平均77.4±9.9歳）で統計分析した結果、BMDの相関係数は大腿頚部r=0.857（p<0.01）、大腿骨近位部r=0.900（p<0.01）であった（図1）。BMDのRMSEは、大腿頚部0.133、大腿骨近位部0.067であった。【考察】骨粗鬆症患者における股関節単純X線検査を用いたAIソフトウェア診断成功率は非常に高く、DXA法でのBMDと2つの部位共に高い相関を得た。特に大腿骨近位部は、AIソフトウェアにおいて診断のために使う特徴を多く含んでいることが高い相関と小さいRMSEを示したものと推測する。骨粗鬆症のスクリーニングする上ではAIソフトウェアは有用であると考える。【結論】骨粗鬆症患者における股関節単純X線検査を用いたAIソフトウェアでの解析によりDXA法とBMDと高い相関を認めた。骨粗鬆症のスクリーニングとして有用と考えられる。

JOS 2025 O-62 (For Reference – Summary Translation)

AI Software for Osteoporosis Diagnosis Using Hip X-Ray Images

- Niigata Rehabilitation Hospital Orthopedic Surgery,
- Niigata Rehabilitation Hospital Rehabilitation Department,
- Department of Radiology, Niigata Rehabilitation Hospital3, Department of Radiological Technology, Niigata University of Health and Welfare,
- Alpha Intelligence Manifolds, Inc.

The study targeted 65 patients who visited Niigata Rehabilitation Hospital for osteoporosis and underwent both DXA and hip X-ray examinations within three months (11 males, 54 females).

The correlation coefficient for BMD was femoral neck $r=0.857$ ($p<0.01$), proximal femur $r=0.900$ ($p<0.01$). The RMSE for BMD was femoral neck 0.133, proximal femur 0.067.

Analysis using AI software with plain hip X-ray examination in osteoporosis patients showed a high correlation with DXA method and BMD. It is considered useful for osteoporosis screening.

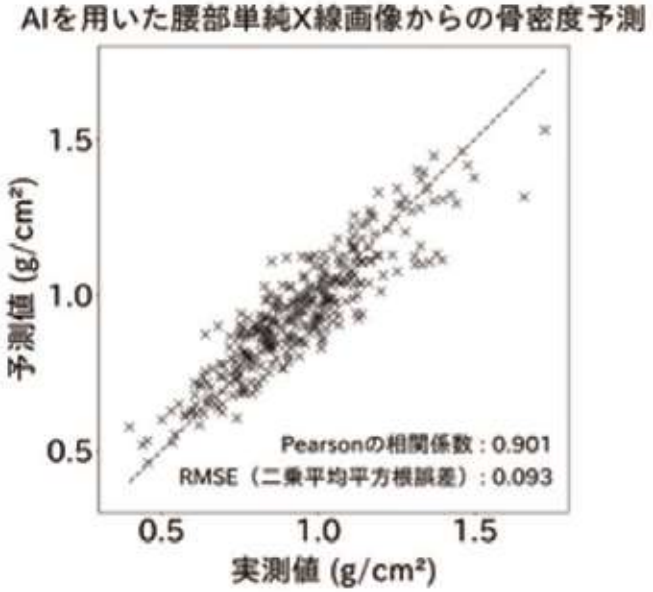
Cross-Border Clinical Validation (JP) Demonstrating DeepXray Estimated BMD Highly Correlated with DXA

O-61 AIを用いた腰部単純X線画像からの骨密度予測

東北大学病院AILab[1]、東北大学大学院医学系研究科医用画像工学分野[2]、
東北大学大学院医学系研究科画像診断学分野[3]、
東北大学大学院医学系研究科神経外科先端治療開発学分野[4]、
東北大学大学院医学系研究科麻酔科麻酔科学・周術期医学分野[5]、
Alpha Intelligence Manifolds, Inc.[6]

稲森（いなもり） 瑠星（りゅうせい）[1,2,3]、園部 真也[1,4]、小林 智哉[1,3]、高屋 英知[1,3]、
岩崎 淳也[1]、宮内 誠[1]、井汲 沙織[1,5]、曾 慶宗[6]、
林 政衛[6]、蕭 聖哲[6]

【目的】健康寿命延伸のため骨粗鬆症の早期診断が重要である。一方で骨密度検査は実施可能施設や検査枠が限られるため、必要な症例に対して適切に機会が提供されているとは言えないのが現状である。Alpha Intelligence Manifolds社が開発したDeepXray™Spinaは、腰部単純X線写真からAI技術を用いて骨密度を予測するソフトウェアであり、骨粗鬆症のスクリーニングにおける有効性が期待されている。本研究では、DeepXray™Spinaが骨粗鬆症の早期診断に寄与するかどうか評価することを目的とし、その予測精度を検証する。【方法】2014年から2024年の期間に東北大学病院でDXA法による骨密度検査を実施した患者のうち、骨密度検査施行の前後30日以内に腰部単純X線写真が撮像された患者を対象とした。DXA法により計測された骨密度（実測値）と、腰部単純X線写真からDeepXray™Spinaを用いて算出した値（予測値）との、Pearsonの相関係数と二乗平均平方根誤差（RMSE）を算出した。【結果】計328名（男性67名、女性238名）が解析された。13歳から91歳までが含まれており、50歳以上は292名（89%）であった。DeepXray™Spinaによる予測値と実測値のPearsonの相関係数は0.901、RMSEは0.093であった。【考察】DeepXray™Spinaは高い精度で骨密度を予測でき、骨密度検査が必要な症例の発見に役立つ。比較的に簡易な設備で施行できるという利点を有しており、骨粗鬆症の評価が行き届かないという課題に対して一つの解決策を提供し得る。【結論】DeepXray™Spinaは骨粗鬆症の早期診断に寄与する可能性がある。



JOS 2025 O-61 (For Reference – Summary Translation)

Predicting Bone Density from Lumbar X-Ray Images Using AI

- Tohoku University Hospital AILab, Tohoku University Graduate School of Medicine, Medical Imaging Engineering,
- Tohoku University Graduate School of Medicine, Radiological Diagnostics,
- Tohoku University Graduate School of Medicine, Advanced Neurosurgical Therapeutics,
- Tohoku University Graduate School of Medicine, Anesthesiology and Perioperative Medicine,
- Alpha Intelligence Manifolds, Inc.

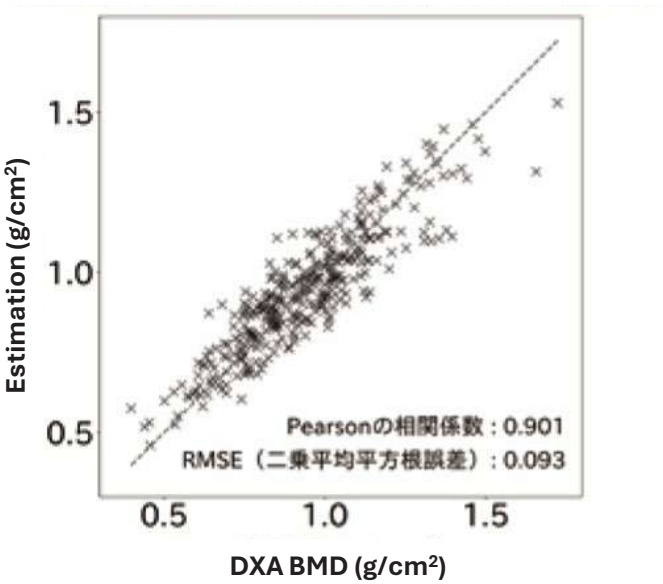
Patients at Tohoku University Hospital who underwent DXA bone density tests from 2014 to 2024, and had lumbar X-ray images taken within 30 days before or after the tests were included.

A total of 328 patients (67 males, 238 females) were analyzed, ranging from 13 to 91 years old, with 292(89%) being over 50 years old.

The Pearson's correlation coefficient between the predicted and actual values by DeepXray Spina was 0.901, and the RMSE was 0.093.

DeepXray Spina may contribute to the early diagnosis of osteoporosis.

Predicting bone mineral density from plain L-Spine X-ray images using AI



Cross-Border Clinical Validation (JP) Demonstrating DeepXray Estimated BMD Highly Correlated with DXA

OCs3 - P498

FROM PIXELS TO PREVENTION: AI-POWERED DIGITAL RADIOGRAMMETRY DEMOCRATIZES OSTEOPOROSIS DIAGNOSIS

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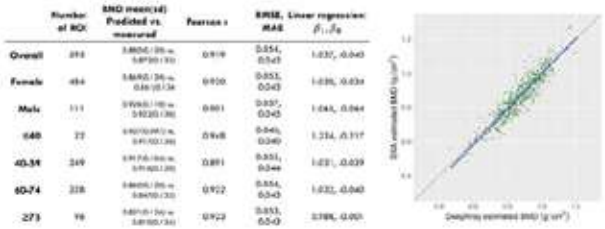
[1]Dept. of Orthopedics, National Taiwan Univ. Hospital Yun-Lin Branch, Douliu, [2]Alpha Intelligence Manifolds, Taipei, [3]Radiology Dept., Far-Eastern Memorial Hospital, New Taipei City, Taiwan

Objective: BMD, assessed through DXA, is the gold standard for diagnosing osteoporosis. However, the availability of DXA remains a challenge, especially in rural areas. This study investigates the estimation of BMD from standard pelvic radiographs as an alternative.

Methods: The study employed deidentified data from Far Eastern Memorial Hospital and three primary care clinics in Taiwan, including 2,235 patients with 2,321 paired pelvic radiograph-DXA samples. The BMD values obtained from standard DXA scan within ±6 months of the Xray imaging time were used as the ground truth value for AI model training. A hip landmark model was developed to extract radiogrammetric parameters, such as Cortical Thickness Index and Femoral Neck Width. Test-time intensity augmentation and ablation studies were performed to assess feature contributions. An AI-augmented radiogrammetric BMD estimation model was developed based on the RegNet neural network architecture while incorporating radiogrammetric features. The model was trained with paired Xray-DXA data from 85% of the patients. The remaining 15% of patient data was reserved for model performance testing. Pearson correlation and RMSE between model-predicted and DXA-measured BMD were evaluated. Binary classification performance of the model for osteoporosis was also assessed.

Results: In the test set of 595 hip x-ray-DXA BMD pairs (81.3% female, mean age 61.4 y), the prevalence of osteoporosis was 24.7%. The Pearson correlation between predicted total hip BMD and measured BMD was 0.919. Subgroup analysis for female and male showed correlations of 0.920 and 0.901, respectively. Correlations remained strong across age groups. Predicted femoral neck BMD and measured BMD correlated at 0.868. Using a T-score ≤ -2.5 as the cutoff, the positive predictive value was 0.903, the negative predictive value was 0.907, and the ROC AUC was 0.950.

AI-Estimated BMD Closely Matched DXA Measurements (Total)



Conclusion: The AI model estimates BMD by radiogrammetry rather than absorptiometry, providing a robust and accurate BMD estimate that is highly correlated with DXA-measured BMD. This correlation allows rapid classification of osteoporosis according to established criteria. In addition, the implementation of an opportunistic screening strategy can expand diagnostic coverage, particularly benefiting rural areas.

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AI-ENABLED RADIOGRAMMETRY FOR OPPORTUNISTIC OSTEOPOROSIS SCREENING: A REAL-WORLD FEASIBILITY STUDY

Author Block: H. Lin[1], Q. TSENG[2], C. LIN[3], S. HSIAO[4], J. Chai[1];
[1]Taichung Veterans General Hospital, Taichung, TAIWAN, [2]Alpha Intelligence Manifolds, Inc., New Taipei City, TAIWAN, [3]Alpha Intelligence Manifold Inc., New Taipei City, TAIWAN, [4]New Taipei City, TAIWAN.

Abstract:
***Purpose:** Osteoporosis(OP), characterized by reduced BMD and increased fragility fracture risk, is a growing epidemic due to aging populations. Despite the potential for prevention, it remains underdiagnosed due to DXA access. Opportunistic screening, utilizing existing medical images, offers a cost-effective way for OP identification. While AI-assisted radiogrammetry has been explored, pelvic and hip X-rays are not routinely obtained in standard health examinations and chest X-rays lack hip BMD data - critical for assessing fracture risk. Plain abdomen X-rays (KUB), however, are routinely ordered and provide both lumbar and hip information. This study aims to validate the use of AI to facilitate OP screening using KUB radiographs.
***Methods and Materials:** The institutional review board approved this prospective study (TCVGH-IRB No. SF23547B). The performance of an AI software (DeepXray Coxa, Alpha Intelligence Manifolds, Inc.) was first validated using retrospectively collected data of DXA BMD values and KUB obtained at Taichung Veterans General Hospital between 2011-2022. The study used DXA BMD measurements conducted on a Lunar iDXA (GE, Chicago, USA). After excluding images with incomplete femur or implants on the region of interest (ROI) (n=15784), tags on the ROI (n=1577) and suboptimal quality (n=855), 3,850 paired DXA-KUB were enrolled for further AI analysis [78% Female; mean age 71.8 ± 11.8 years]. This study then employed the AI algorithm combining the feature extraction capabilities of a convolutional neural network with established radiogrammetric principles, for prospective BMD estimation.

***Results:** 34.97% of KUB are eligible for AI analysis. On the internal test set (942 hips from 365 individuals), the AI model demonstrated a root mean square difference (RMSD) of 0.059 g/cm² and a Pearson correlation of 0.88 compared to DXA-measured BMD, achieving an AUROC of 0.924 for predicting T-scores ≤ -2.5 (PPV/NPV: 84%/87%, OP prevalence: 27%). In a subsequent prospective feasibility study (116 hips from 61 patients), the AI model maintained an RMSD of 0.062 g/cm² and a Pearson correlation of 0.87. To minimize false positives and unnecessary referrals, we employed a conservative detection threshold of T-score ≤ -2.8. The AI model achieved a 100% PPV and 83.6% NPV.
***Conclusions:** This paper presents an AI model that is capable of using routine KUB to estimate hip BMD, which is highly correlated with DXA measurements. A prospective study confirms its effectiveness in opportunistic screening for high-risk OP cases in a real-world setting while minimizing false alarms.

***Clinical Relevance/Application:** This AI model enables opportunistic OP screening using a widely available method, potentially facilitating early treatment and reducing medical financial burdens.

Category (Complete): Imaging Informatics -> INMLIB - AI and Machine Learning: Image-based
Format Preference (Complete): Electronic Poster in slide-show (pptx) format
Questions (Complete):
Trainee Research Prize: Not Applicable
Disclosure of "Off-Label" usage: No, I do not intend to discuss off-label uses
IRB / IACUC Response: Human subject, and received IRB approval
If needed, please explain: : Approval No. TCVGH-IRB No. SF23547B
Has this work been previously presented or published?: No
2nd Format Opportunity: Yes, I would be interested if accepted to showcase my work in an additional format (2 meter Hardcopy Backboard).

Attached Files: ROI extraction, QC process and the diagnostic performance of the AI model for BMD estimation from plain abdomen radiograph (PDF, 171882 bytes)

Status: Complete

Feedback

AIM White Paper

DeepXray™ Coxa
Osteoporosis

DeepXray™ Spina
Osteoporosis

DeepXray™ Genu
Osteoarthritis

AIM
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Makes AI Trustable & Explainable

DeepXray™ Coxa

AI-Powered Rapid Screening for Osteoporosis

Osteoporosis (OP) is one of the most prevalent chronic diseases affecting 200 million patients worldwide. According to the International Osteoporosis Foundation (IOF), 1 in 3 women and 1 in 5 men aged over 50 will experience an osteoporotic fracture[1]. Healthcare costs associated with osteoporosis exceed those of heart attack, stroke, and breast cancer in Europe and the United States. The mortality rate within one year after a hip fracture is more than 20%[1,2]. With the growing aging population, early diagnosis and treatment of OP has become a serious and urgent public health issue.

The diagnosis of OP is based on the Bone Mineral Density (BMD) of the hip or lumbar spine measured by Dual Energy X-ray Absorptiometry (DXA), the level of BMD is further categorized as: Osteoporosis, Osteopenia, and Normal according to the World Health Organization (WHO). Nevertheless, OP remains largely underdiagnosed even in the developed countries. The cost and limited accessibility of DXA have been major barriers to an effective screening campaign to improve patient awareness. Worse, because OP has no obvious symptoms or pain prior to fracture, most patients with OP are not identified and treated at an early stage.

BMD Estimation from Plain Xray Radiograph

DeepXray™ Coxa, developed by Alpha Intelligence Manifolds (AIM), is an AI-assisted diagnostic system for OP(*Fig.1*). It performs BMD estimation based on interpretable radiogrammetry parameters and image texture features learned by a convolutional neural network (CNN). AIM's patented algorithm intelligently capture image texture and signal correlation to accurately estimate BMD while minimizing the influence of signal intensity caused by diverse imaging conditions.

The clinical validation study using data from multiple orthopedic clinics and Far Eastern Memorial Hospital in Taiwan has shown that BMD estimated by ***DeepXray™ Coxa*** is highly correlated with BMD measured by DXA at all 4 anatomical sites of the hip. The estimation for the total hip BMD has an RMSE less than 0.06 g/cm², and a correlation coefficient over 0.9 (as shown in *Fig.2*) with reference to the matching DXA measurement. This precision is comparable to the state-of-the-art performance previously published[3].

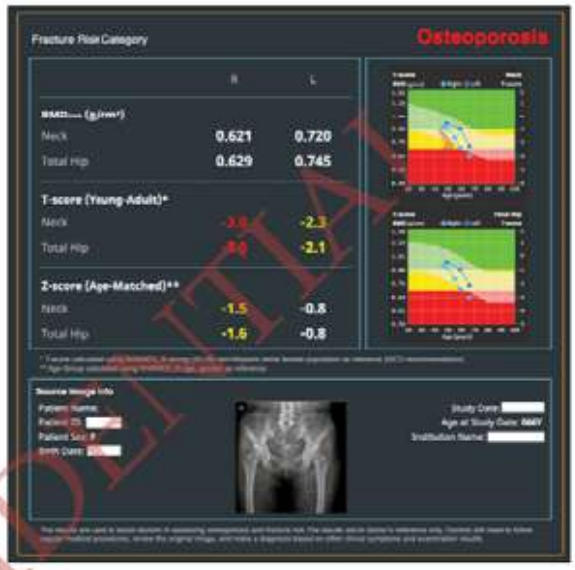

Fig. 1: DeepXray™ Coxa provides osteoporosis analysis with BMD, T-/Z-score and disease progression.

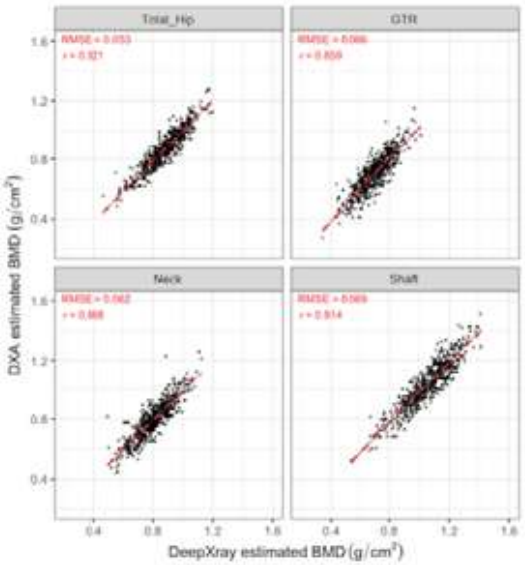

Fig. 2: DeepXray™ Coxa precisely estimated BMD at different anatomical locations.

Democratization of Osteoporosis Screening

Based on accurate BMD estimates comparable to the DXA measurement, ***DeepXray™ Coxa*** calculates T-score using the NHANES database as recommended by the ISCD guideline[4] and further classifies fracture risk

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categories based on the WHO standard. Utilizing ***DeepXray™ Coxa***, patients can be quickly identified and diagnosed for early follow-up treatment before it is too late.

In another independent validation study including 500 individuals conducted at Taichung Veterans General Hospital in Taiwan, the performance of ***DeepXray™ Coxa*** for predicting OP (DXA T-score ≤ -2.5) reached an AUC of 94.6% (*Fig. 3*). The positive predictive value (PPV) is greater than 90%, which means 9 out of 10 candidate screened as positive by ***DeepXray™ Coxa*** will also be diagnosed with OP by DXA scan. This high predictive power enables conventional radiography to perform rapid screening of OP on a large scale.

DeepXray™ Coxa can also perform opportunistic screening using radiographs taken for other indications, e.g. KUB view for abdominal exams, when proper hip features are detected on the image. This capability can significantly increase the coverage of OP screening without additional X-ray exposure, which in turns helps more patients become aware of their fracture risk and will alleviate financial burdens on healthcare system.

Full-Spectrum of Fracture Risk Assessment

It is widely recognized in the clinical literature that BMD is not the only risk factor for osteoporotic fracture. Other important risk factors such as hip geometry and microstructure of bone trabeculae have been shown to be highly correlated with bone strength and fracture risk[5]. ***DeepXray™ Coxa***'s AI image analysis not only predicts BMD, but also follows clinician's image reading practice of identifying key anatomical features of the hip, and automatically calculates various structural parameters, such as Femur Neck Width, Cortical Bone Index, Neck Shaft Angle, Hip Axis Length, etc., to assist clinical professionals in assessing additional fracture risks (*Fig. 4*).

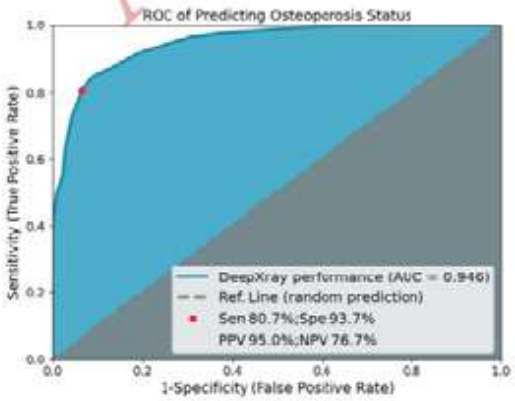

Fig. 3: Osteoporosis prediction by DeepXray™ Coxa

Fig. 4: Hip structure analysis by DeepXray™ Coxa

Furthermore, with AIM's continual R&D effort, ***DeepXray™ Coxa*** will be able to quantify micro-structural parameters such as Trabecular Bone Score (TBS) by calculating porosity, fractal analysis, etc. These digital image biomarkers could potentially be more responsive to therapeutic agents, thereby accelerating the discovery of new drugs for the treatment of osteoporosis.

Conclusion

DeepXray™ Coxa accurately estimates BMD at the axial skeleton from conventional X-ray using AIM's proprietary algorithm. The classification into WHO fracture risk categories is also highly consistent with DXA results. This AI-assisted diagnostic system has demonstrated high predictive value in identifying individuals with osteoporosis. By augmenting widely available X-ray hardware installations, ***DeepXray™ Coxa*** can serve as an effective and efficient screening tool to further democratize the diagnosis of osteoporosis and significantly increase patient awareness.

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DeepXray™ Spina

AI-Powered Precision BMD Analysis

Osteoporosis (OP) is a major public health problem, contributing to millions of fractures worldwide and placing a significant burden on healthcare systems[1]. The lumbar spine is a critical site for assessing bone health, reflecting early changes in bone mineral density (BMD) and serving as a key indicator for the diagnosis of osteoporosis. However, the standard diagnostic modality of dual-energy x-ray absorptiometry (DXA) remains underutilized due to limited accessibility and cost barriers. In contrast, kidney-ureter-bladder (KUB) and lumbar spine radiographs are among the most commonly performed imaging studies in clinical practice for various medical indications. Given the widespread use of these imaging protocols, BMD anslysis using plain radiographs offers an effective pre-screening solution or alternative approach for osteoporosis diagnosis, further enhancing diagnostic coverage and facilitating early intervention.

BMD Estimation from Routine KUB and Lumbar Spine X-rays

DeepXray™ Spina, developed by Alpha Intelligence Manifolds, is an AI-assisted diagnostic software designed to measure BMD using frontal KUB and L-spine radiographs. By employing interpretable radiogrammetry parameters[2] and advanced image texture analysis powered by state-of-the-art AI/ML algorithms, ***DeepXray™ Spina*** provides highly accurate BMD estimations at individual vertebrae (L1–L4). The system allows users to manually exclude vertebrae affected by artifacts or degeneration, then calculate the lumbar spine BMD average accordingly (Fig. 1).

Clinical validation studies conducted across multiple orthopedic clinics, Taichung Veterans General Hospital, and Far Eastern Memorial Hospital in Taiwan have demonstrated a high correlation between ***DeepXray™ Spina*** BMD estimates and DXA measurements at corresponding lumbar spine regions. The system achieved a Pearson correlation coefficient (r) of 0.924, a root mean square error (RMSE) of 0.061 g/cm², and a mean absolute error (MAE) of 0.048 g/cm² (Fig. 2).

Unlike methods that rely on inter-site BMD correlations —such as those using chest X-rays, which provide only partial or no lumbar vertebra visibility—***DeepXray™ Spina*** directly matches with DXA's measurement regions, ensuring accuracy and precision. Such

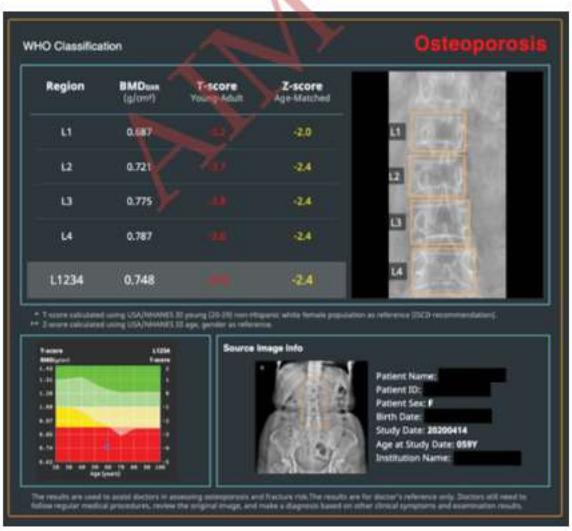

*Fig. 1: **DeepXray™ Spina** provides osteoporosis risk analysis with BMD estimation, T-/Z-scores, disease progression tracking, and allowing users to exclude vertebrae unsuitable for analysis.*

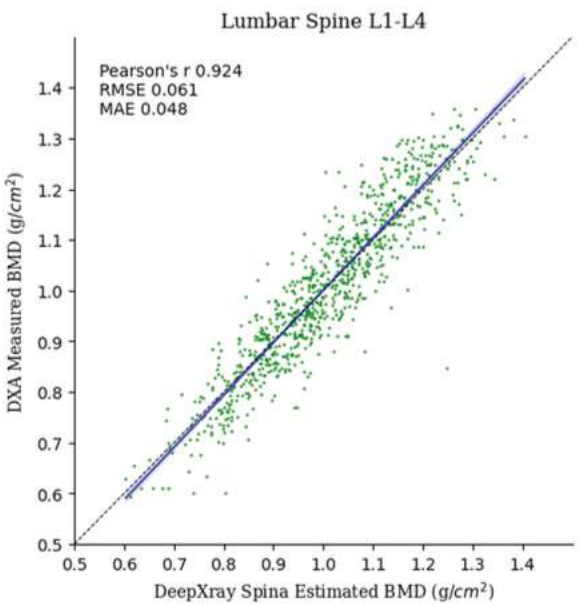

*Fig. 2: **DeepXray™ Spina** estimates lumbar spine BMD (L1–L4) with high correlation to DXA measurements, demonstrating strong agreement with low residual error (Pearson's r, RMSE, MAE) and aligning closely with the reference diagonal line.*

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anatomical region-of-interest (ROI) alignment minimizes dependency on statistical extrapolation[3], making ***DeepXray™ Spina*** a more robust and reliable alternative for osteoporosis screening.

Advancing Precision Diagnosis of Osteoporosis

With BMD estimates highly consistent with DXA measurements, ***DeepXray™ Spina***, likewise ***DeepXray™ Coxa***, further calculates T-scores using the NHANES database, as recommended by ISCD guidelines[4], or a user-specified reference database. The system classifies fracture risk based on WHO criteria and has demonstrated an AUROC > 0.95 in predicting osteoporosis (DXA T-score ≤ -2.5) in both internal and external clinical validation studies, enabling precise identification of individuals at risk for osteoporosis.

In multiple post-market clinical studies—including seven medical centers, three regional hospitals, and three primary clinics in Taiwan and Japan—***DeepXray™ Spina*** and ***Coxa*** have demonstrated excellent correlations with DXA measurements. The systems consistently achieved a diagnostic positive predictive value (PPV) above 80% (Fig. 3 & 4), meaning that for every ten people diagnosed with osteoporosis by ***DeepXray™***, more than eight were confirmed to have osteoporosis by DXA.

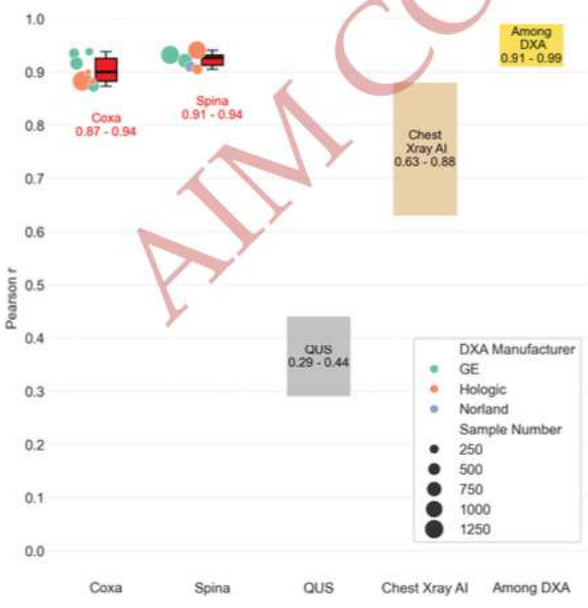

*Fig. 3: **DeepXray™ Spina & Coxa** consistently exhibit high correlation with DXA BMD across multiple real-world clinical studies, approaching the inter-DXA correlation range and surpassing methods such as QUS and Chest X-ray AI.*

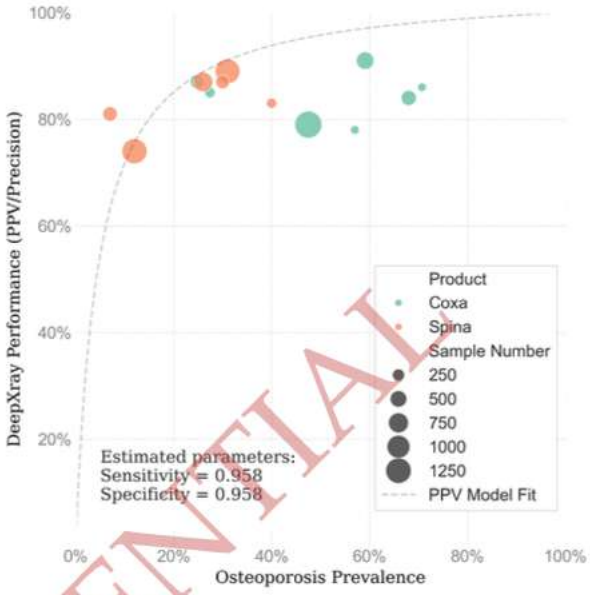

*Fig. 4: Post-market real-world performance of **DeepXray™ Spina & Coxa** demonstrating consistent precision (PPV) across varying osteoporosis prevalence rates.*

Conclusion

DeepXray™ Spina and ***DeepXray™ Coxa*** measure BMD at the lumbar spine and hip, directly matching central DXA's measurement sites—crucial for assessing fracture risk. Unlike methods that infer BMD from peripheral skeletons or chest radiograph, ***DeepXray™*** provides direct anatomical measurement at the hip and spine, where fractures carry the highest healthcare burden.

By leveraging widely performed KUB and lumbar spine X-rays, ***DeepXray™ Spina*** enables cost-effective, large-scale, and opportunistic osteoporosis screening without additional radiation exposure. With proven accuracy and consistency, ***DeepXray™*** empowers clinicians with reliable, automated assessments to support early diagnosis and effective patient care.

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Makes AI Trustable & Explainable

DeepXray™ Genu

AI-Powered Precision Diagnosis for Osteoarthritis

Radiographic diagnosis of osteoarthritis (OA) is based on the Kellgren-Lawrence (KL) grading system adopted by the World Health Organization (WHO). However, the descriptive nature of KL grading lacks an objective and quantitative basis. Additional disease assessments have been developed to improve the granularity of grading, such as joint space narrowing (JSN), osteophytosis, and subchondral sclerosis as defined by the Osteoarthritis Research Society International (OARSI), and quantitative joint space width (JSW) measurement. However, the need for physicians to categorize, classify, and measure each individual feature could significantly impact the efficiency of the diagnostic workflow, and non-quantitative classification is also prone to subjective bias by individual physicians[1].

AI-Enabled Disease Assessment

DeepXray™ Genu is an AI-assisted diagnostic system for knee OA. It has been developed and validated using tens of thousands of data annotated by expert orthopedists during the Osteoarthritis Initiatives (OAI) multicenter clinical study[2]. It provides overall disease severity of knee OA as well as assessment for individual radiographic features (IRFs), including JSN, osteophyte and sclerosis based on the KL/OARSI grading criteria[3,4]. Quantitative measurements of JSW and Femoral-Tibial Angle (FTA) are also automatically performed. This detailed information allows physicians to accurately diagnose and monitor disease progression. Optimal treatment plans and more comprehensive explanations could be communicated to the patient (*Fig. 1*). AI-assisted diagnosis further reduces the subjective bias of qualitative grading and improves the reliability and predictability of disease management.

Fig. 1: DeepXray™ Genu: AI-assisted diagnosis for Knee OA.

AI-Powered Precision Diagnosis

The algorithm used by ***DeepXray™ Genu*** outperforms international competitors (e.g. KOALA, ImageBiopsy Lab, Austria; RBknee, Radiobotics, Denmark) in KL grading as well as in each IRF. The sensitivity of ***DeepXray™ Genu*** for the diagnosis of knee OA was 92%, with a specificity of 94% (KL grade ≥2 or <2). The sensitivities and specificities for determining each IRF were also above 90% (*Fig. 2*), with a high degree of agreement with the grading results given by the senior orthopedists (Cohen's kappa 0.85-0.94).

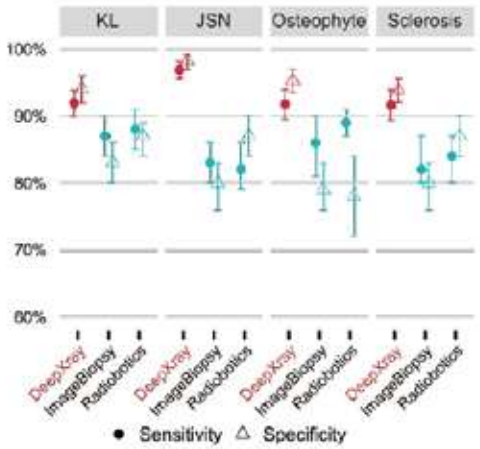

Fig. 2: Comparing the grading performance of KL and IRFs between DeepXray™ Genu and major competitors.

Trustable AI Based on Full Suite QC Process

AI models are inherently limited by the data domain used during development and training. If the input data

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in the real-world application deviates from the original training data, the results will degrade and produce unexpected or even wild results. ***DeepXray™ Genu*** is designed to follow the image reading practice of the medical professionals. It performs quality checks on input data and automatically identifies those with abnormal and poor quality. ***DeepXray™ Genu*** also verifies whether the output values show an unreasonable deviation from the existing dataset. Users are alerted to any potential quality issues detected throughout the analysis pipeline.

Explainable AI for Better Disease Interpretation

In addition to semi-quantitative severity grading and quantitative measurements, ***DeepXray™ Genu*** also provides users with markup images highlighted with disease locations or reference lines used for automated measurements. These markup images further facilitate the interpretation of the AI output and help physicians to communicate disease conditions to patients (*Fig. 3*). ***DeepXray™ Genu*** uses an ensembled regression tree algorithm based on multiple IRF assessments and quantitative measurement results from over 30,000 images annotated by OAI's clinical experts. By leveraging image features familiar to the physicians, ***DeepXray™ Genu*** faithfully follows the grading principle established by Kellgren & Lawrence. It is different from other black-box medical image AI application, and makes it more trustable and explainable in clinical applications.

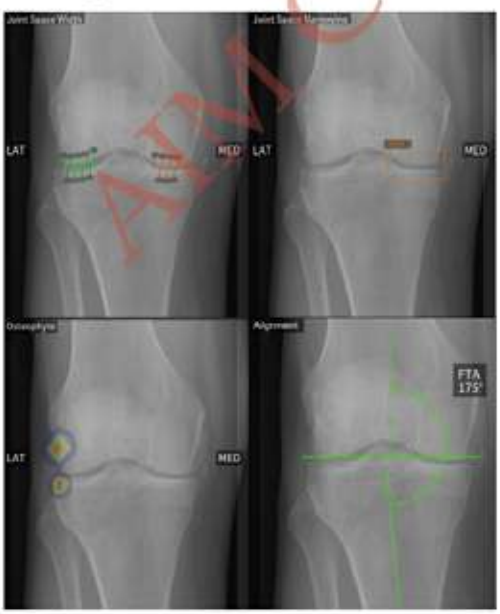

*Fig. 3: **DeepXray™ Genu** provides automated assessments and diagnosis report for the knee OA.*

Diagnosis Reliability Augmented by AI

Alpha Intelligence Manifolds' joint research with the NTU Medical School and the Far Eastern Memorial Hospital has demonstrated that the diagnostic performance of junior/non-specialist physicians can be significantly improved to a level close to that of senior specialist physicians. The diagnostic consistency among senior physicians also improved with the use of ***DeepXray™ Genu*** (*Fig. 4*).

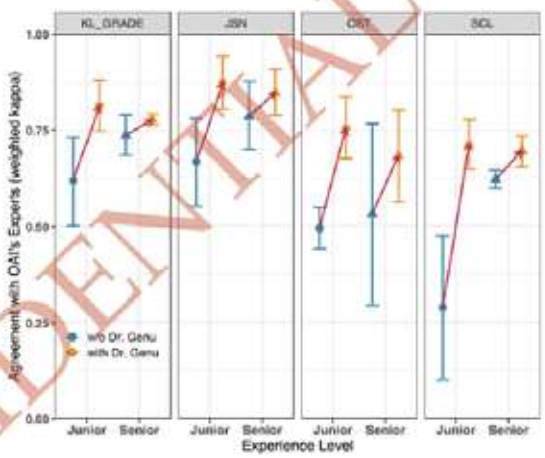

*Fig. 4: **DeepXray™ Genu** improved diagnostic performance and consistency for both junior and senior physicians.*

Conclusion

DeepXray™ Genu harnesses a large amount of medical image data, annotated by international medical experts, and combines it with clinical diagnostic workflow to build highly reliable AI models and analysis pipelines. It provides physicians with accurate, and explainable recommendations for diagnosing knee OA. This AI-assisted system brings great clinical value by providing precision diagnosis and tracking reports to help patients better manage their OA disease progression.

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