Enhancing Quantitative Image Synthesis through Considerated Pretraining and Resolution Scaling for Bone Mineral Density

Estimation from a Plain X-Ray Image



Imaging-Based Computational Biomedicine
Biomedical Imaging Intelligence

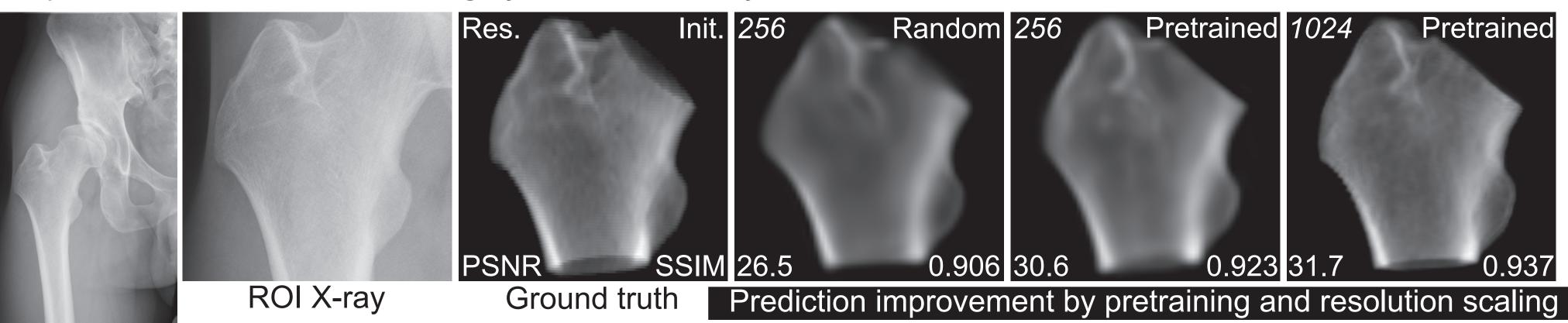


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Prediction corresponding error maps

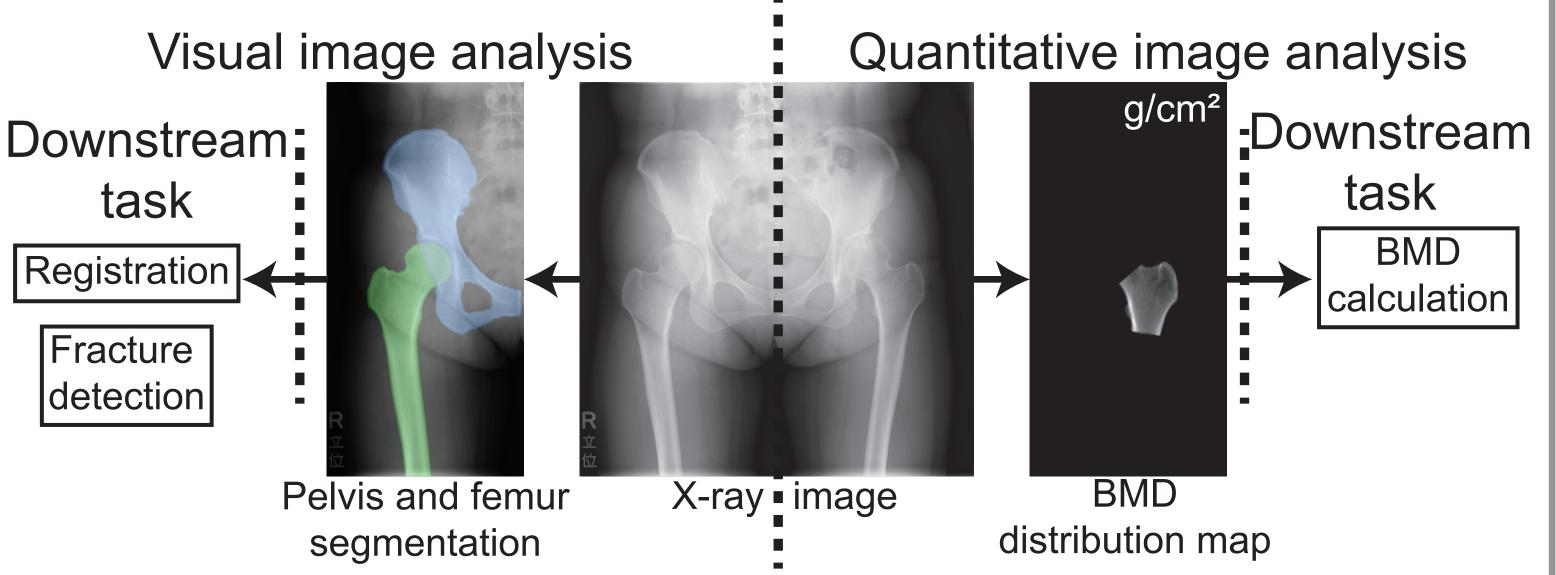
Bone mineral density (BMD) distribution maps (g/cm²)

Visualization of significant improvement by applying pretraining and resolution scaling on a quantitative image synthesis task.

Introduction

Quantitative image analysis is **important in medical field**.

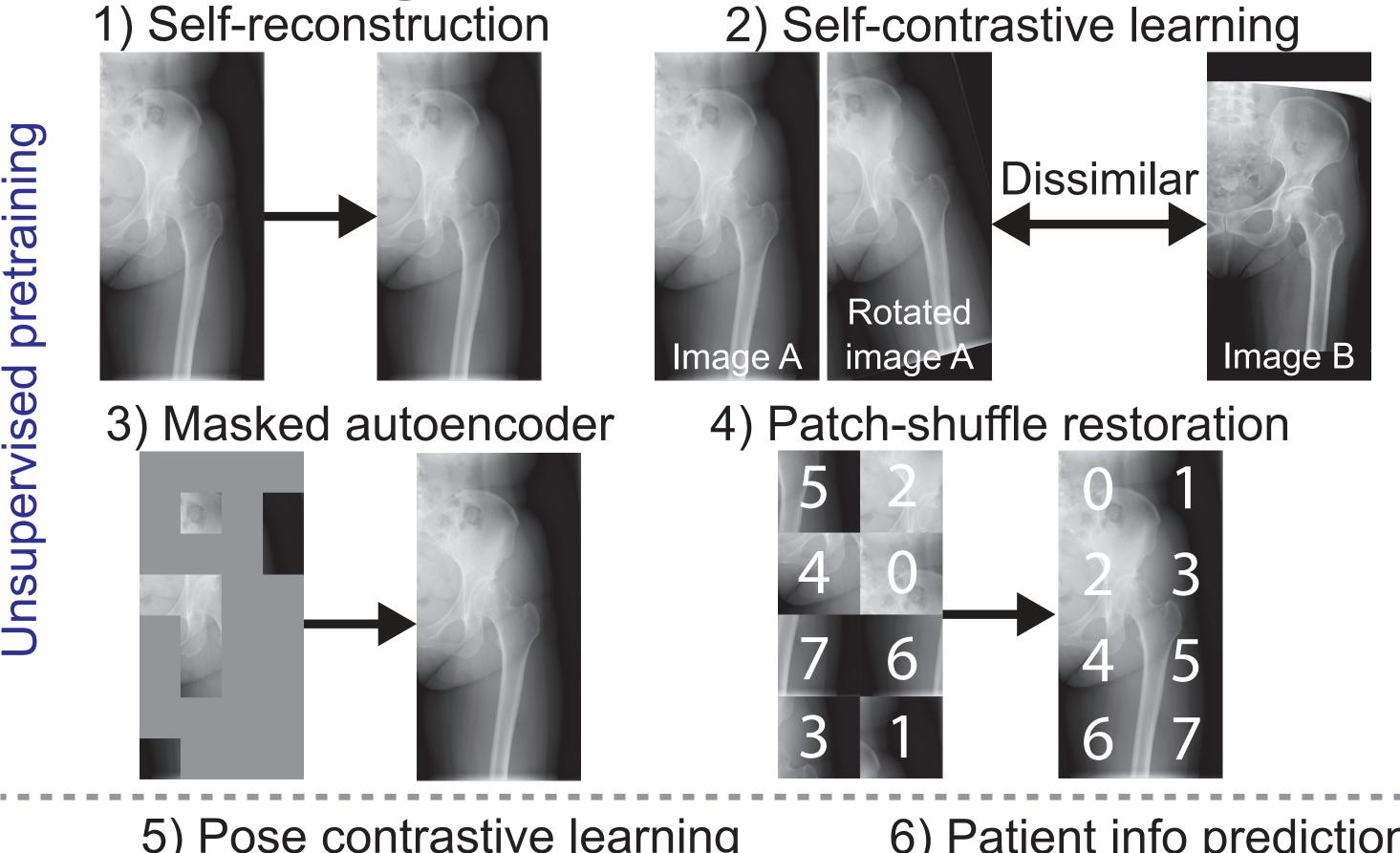
Pretraining and resolution scaling has **been barely explored** for **Quantitative image synthesis**.

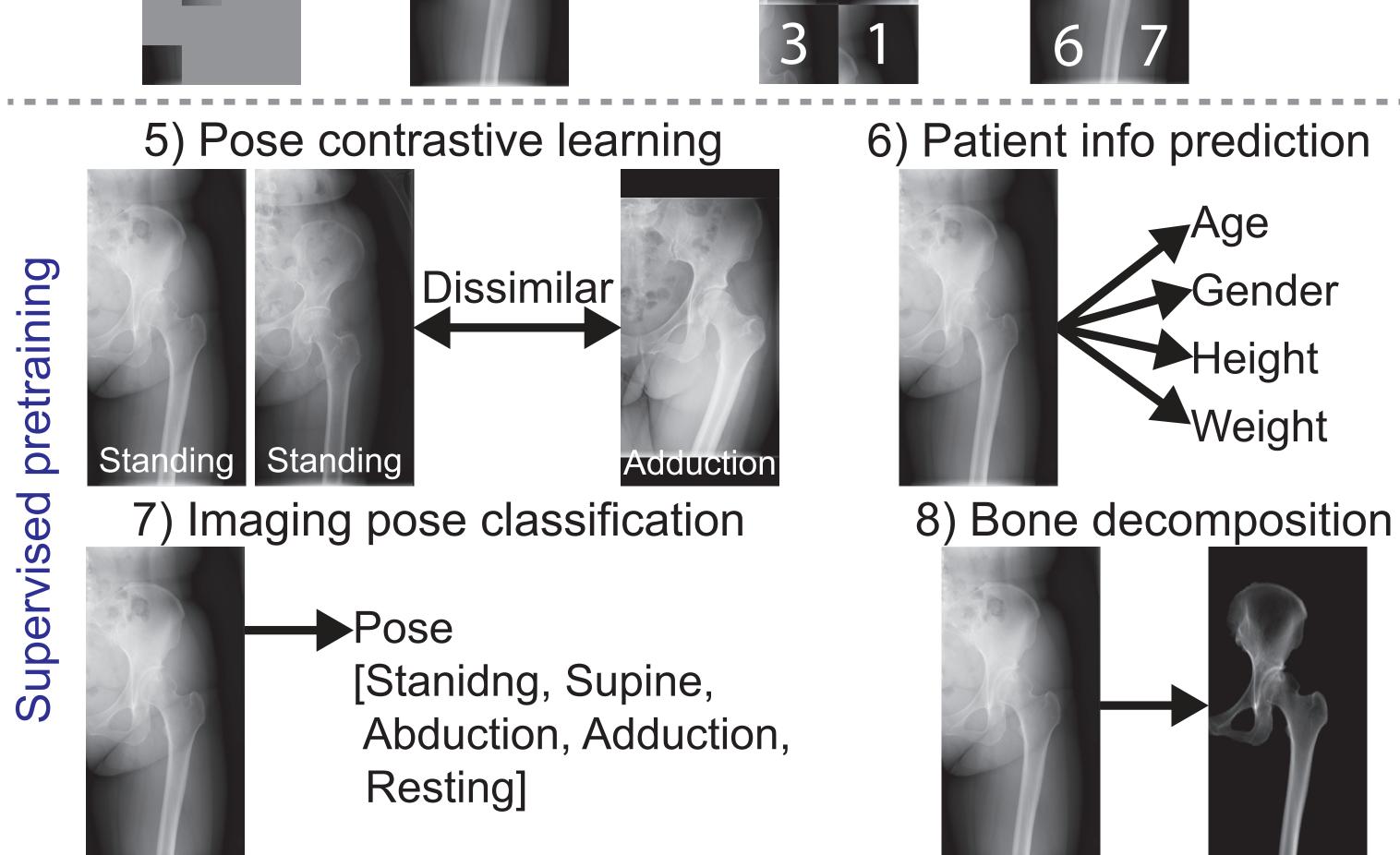


Contributions:

- Development of a **pretraining zoo of 10 techniques** over a large X-ray image database.
- Significant improvement by applying suitable pretraining and resolution scaling on a large-scale (2656 X-rays) dataset.

Pretraining zoo





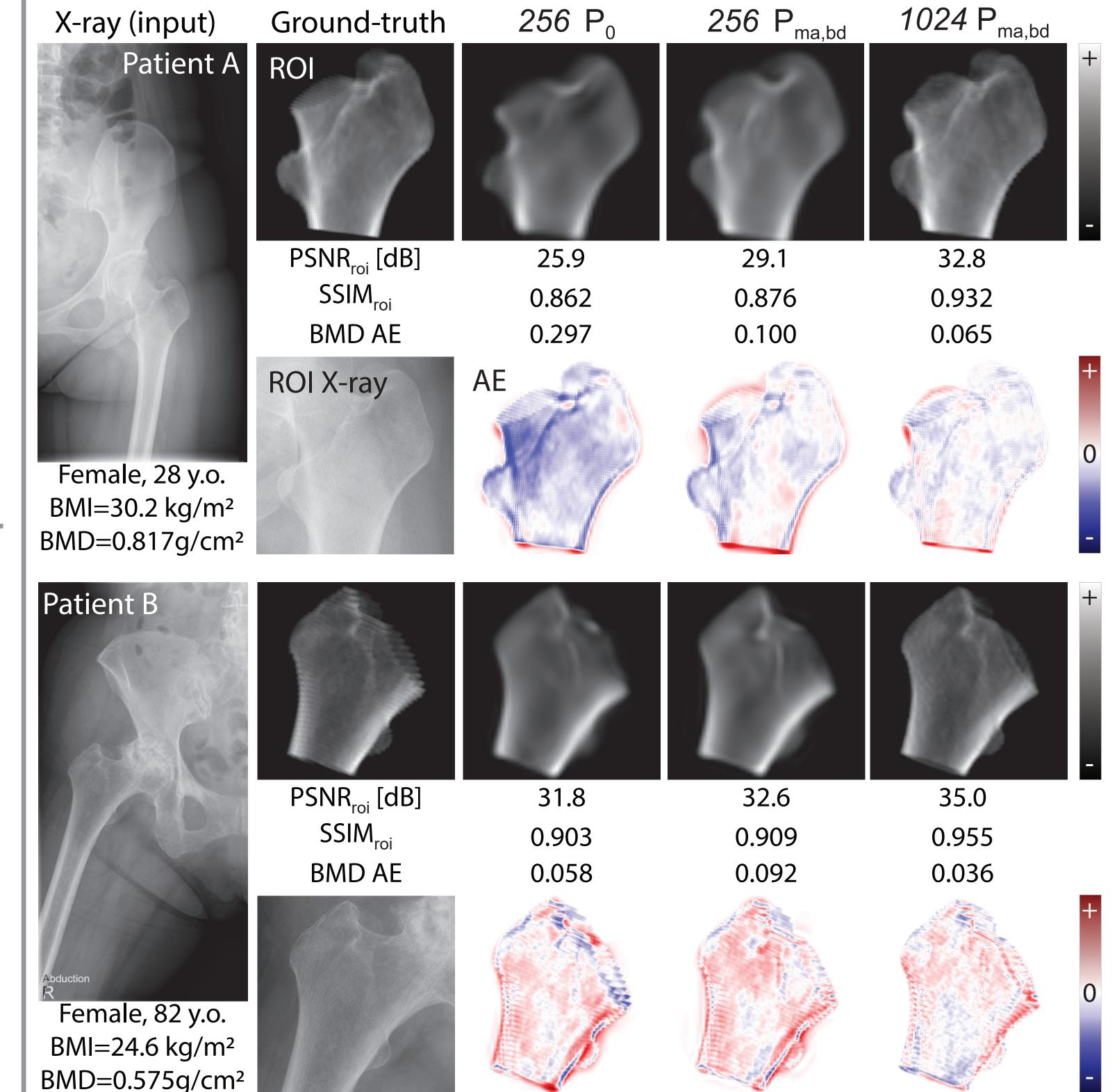
Results

Quantiative evaluation 256 w/o pretraining 256 w/ pretraining 1024 w/ pretraining PCC=0.898 PCC=0.923 PCC=0.820 (g/cm²) ICC=0.812 ICC=0.886 ICC=0.914 **BM** 0.6 **b** 0.4 $MAE=0.049\pm0.042$ $MAE=0.069\pm0.055$ $MAE=0.043\pm0.036$

Predicted BMD (g/cm²) derived from synthesized quantitative image

Method	BMD evaluation			Image evaluation		
	PCC	ICC	MAE	PSNR	PSNR _{roi}	$SSIM_{roi}$
256 P ₀	0.820	0.812	0.069	39.9	28.6	0.887
256 P _{ma}	0.869	0.864	0.056	40.7	29.4	0.894
256 P _{bd}	0.886	0.876	0.053	40.9	29.6	0.897
256 P _{ma,bd}	0.898	0.886	0.049	41.3	29.9	0.898
$512 P_{\text{mabd}}$	0.917	0.909	0.044	42.3	30.9	0.925
1024 P _{ma,bd}	0.923	0.914	0.043	42.3	31.0	0.928

Qualitative evaluation



• We investigated the effect of pretrining and resolution scaling on quantitatie image synthesis.

Conclusion

- We found that suitable pretraining improves the performance (while some may degrade it).
- Simple resolution scaling-up gives effective and significant boost on the performance.
- The future works include **generalization** to other quantitative image synthesis tasks.

