

Teeth2Point: A Two-Stage Dental CBCT ROI-to-Point Segmentation Framework

Qi Ma¹, Shipra Jain², Niko Benjamin Huber², Ender Konukoglu¹
¹ETH Zurich ²Align Technology
qi.ma@vision.ee.ethz.ch



Motivation

Why Points?

- Dental CBCT is mostly background; teeth only 0.5-1.4% of the full volume.

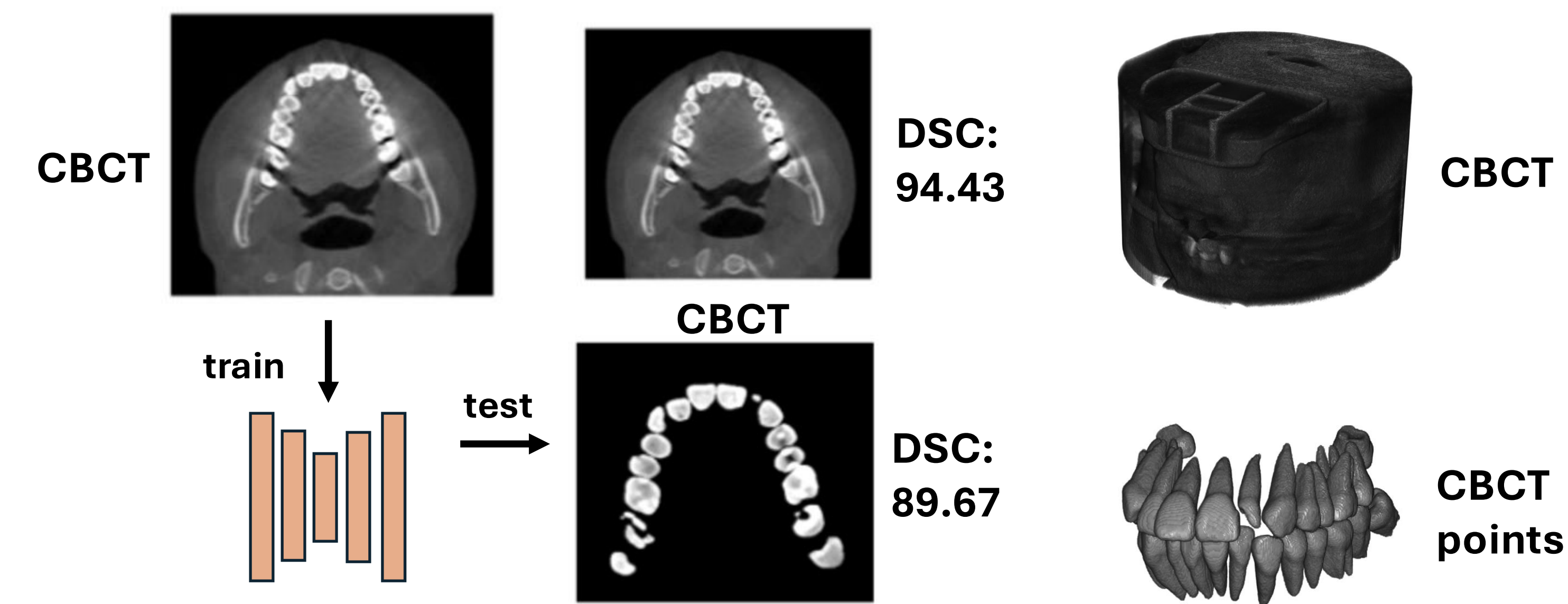
Why Transformer?

- Missing & malpositioned teeth require global context

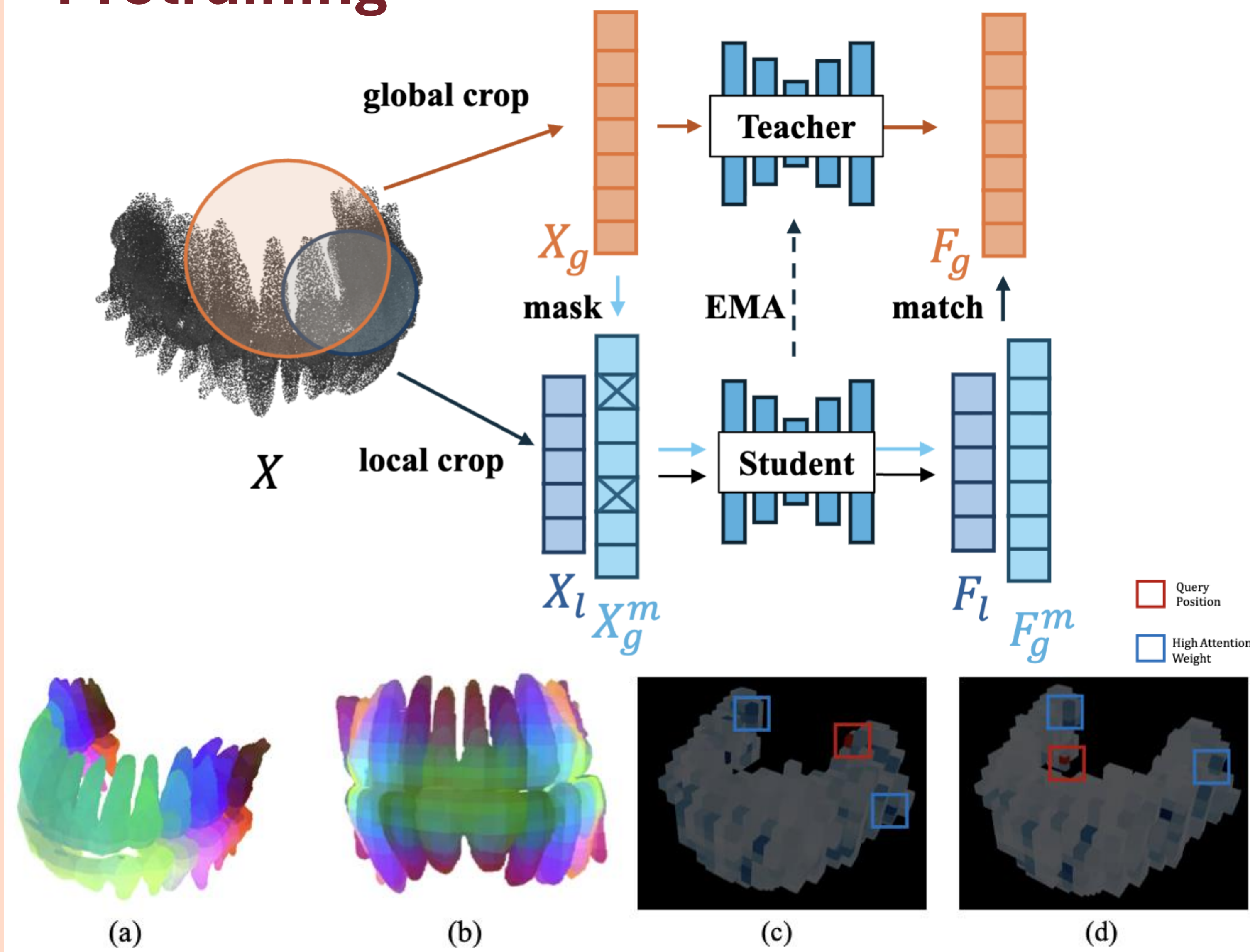
Proof

- Background contributes less critically.

Dataset	Sample	Foreground Ratio	Absent Teeth Ratio
STS2024	27	0.5%	6.6%
Toothfairy2	480	1.4%	23.4%
Toothfairy3	532	1.3%	23.1%
Internal Dataset	1786	0.97%	9.0%

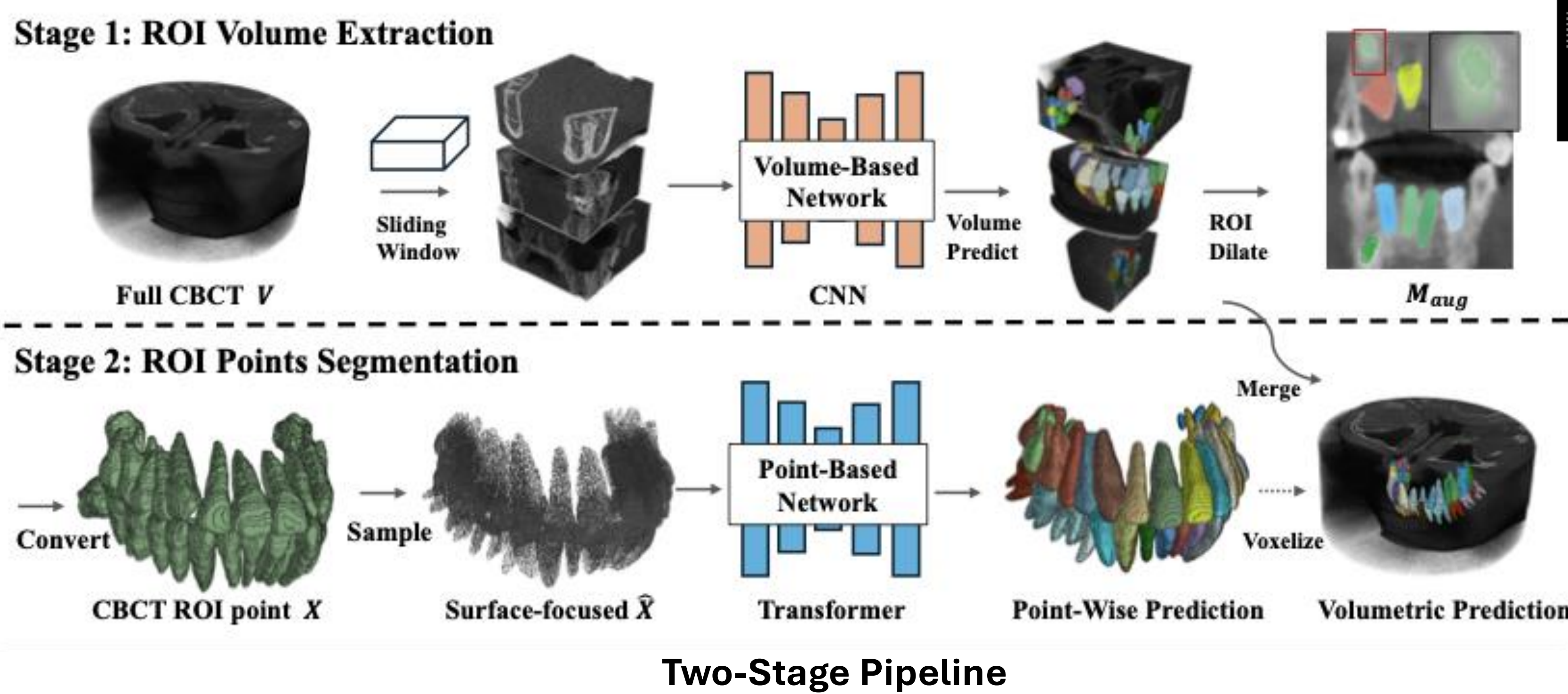
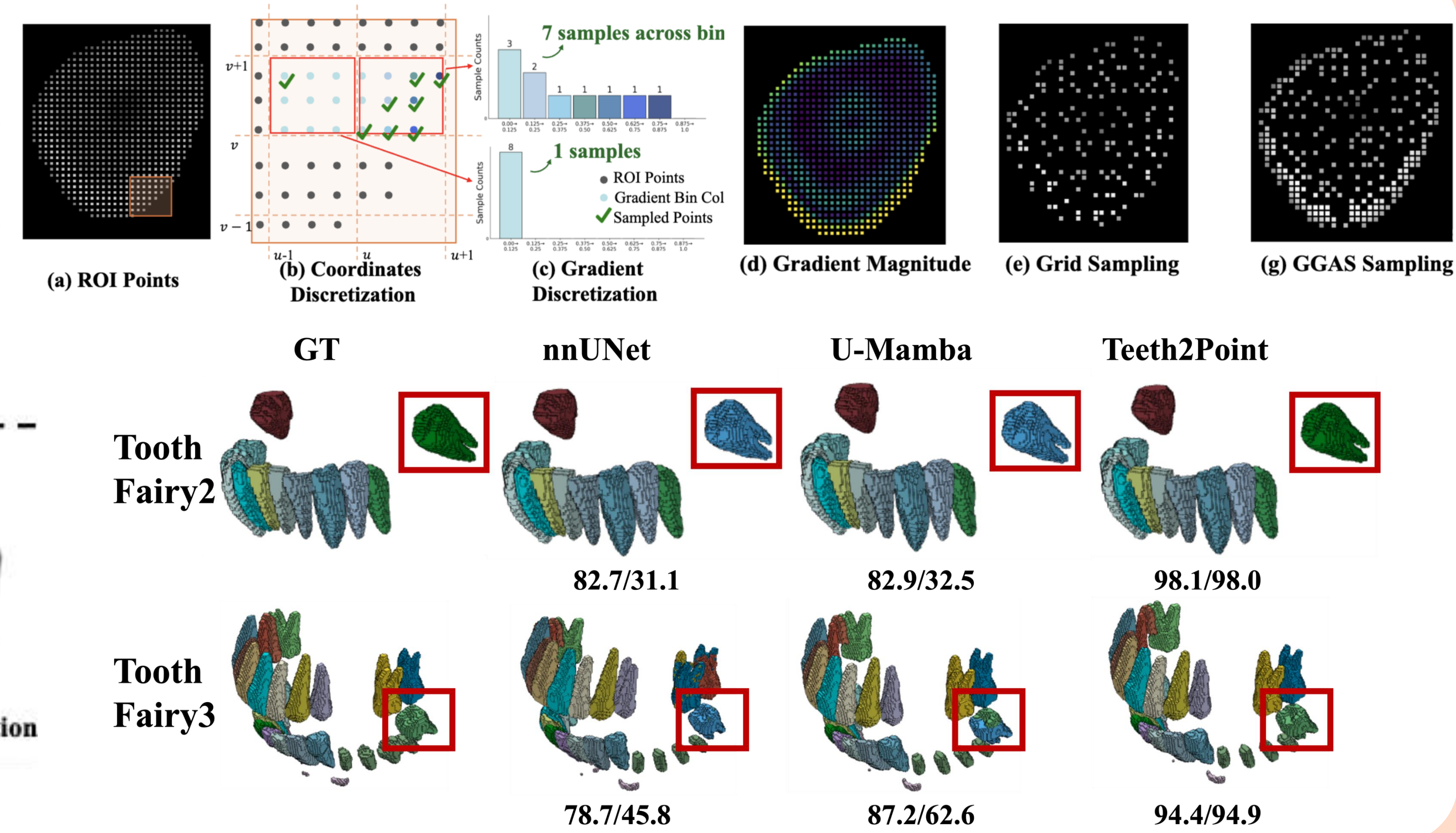


Pretraining

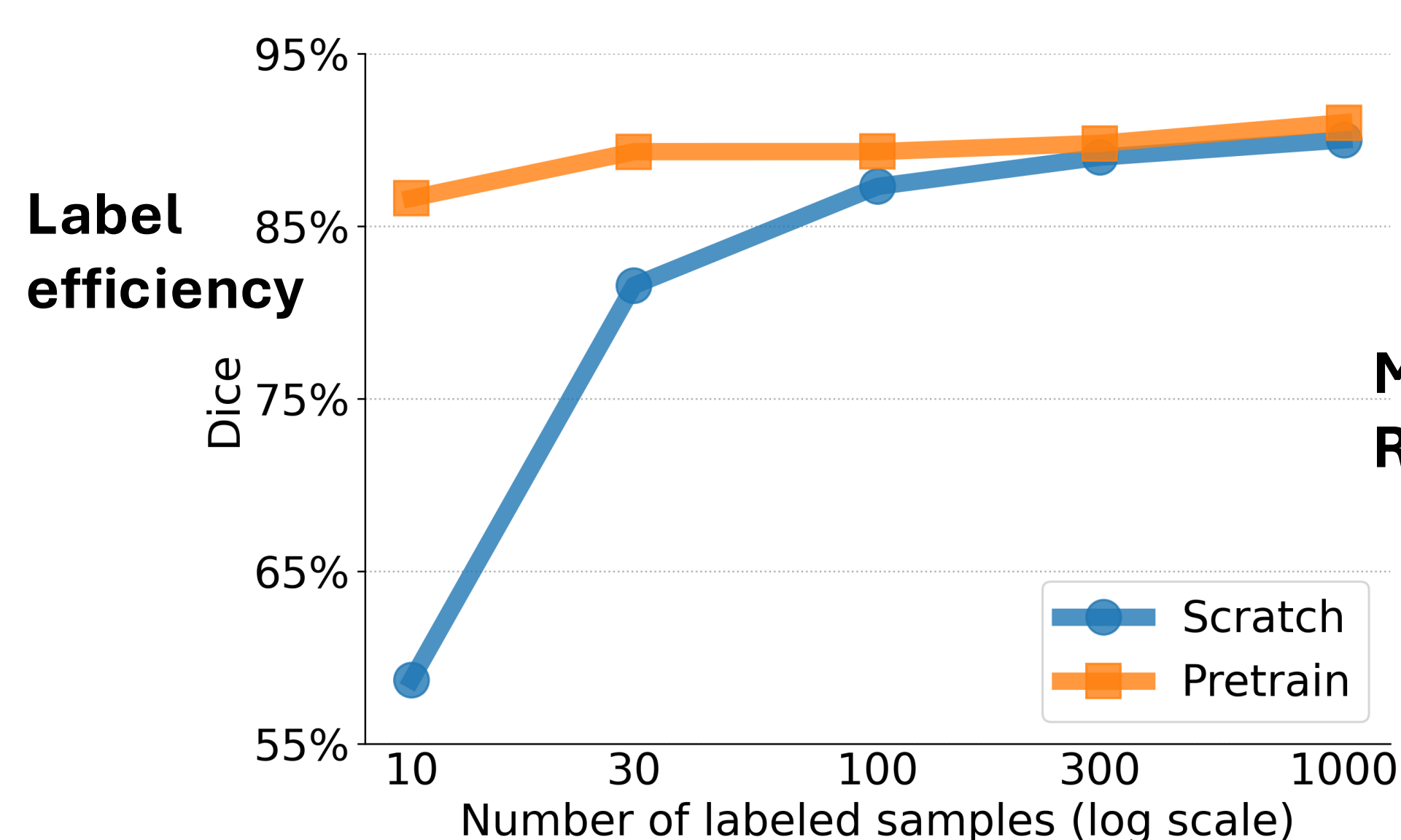


- 3,224 unlabeled CBCT scans; 8 A6000 GPUs.
- DINOv2-learned representations attend to both left-right and upper-lower dental correspondences.

Supervised Training



Results



Configuration	DSC	M-DSC
Train and test on GT ROI	90.1	89.6
Test same model on estimated ROI	84.5	83.8
+ Predicted-ROI adaptation	88.3	86.5
+ CBCT augmentation and GGAS	88.5	87.2
+ DINOv2-style pretraining	89.0	87.5

Ablation

Main Results

Method	SW	Time (s)	STS2024	ToothFairy2	ToothFairy3	Internal	Average
			DSC M-DSC	DSC M-DSC	DSC M-DSC	DSC M-DSC	DSC M-DSC
Full-Volume CBCT							
nnU-Net [20]	72	12.8	92.69 86.23	90.66 86.48	89.04 88.34	88.81 86.96	90.66 88.43
MedNeXt [38]	72	6.7	87.94 84.54	86.95 83.45	85.53 83.92	87.29 86.90	86.93 84.70
VideoTeeth [30]	149	51.2	91.84 85.51	88.71 85.72	86.52 83.92	88.72 86.91	88.95 86.93
U-Mamba [29]	75	33.9	94.09 89.75	91.77 86.55	89.51 87.86	88.79 86.93	91.04 87.27
ROI-Cropped CBCT							
nnU-Net [20]	18	8.1	94.13 91.92	90.99 86.93	89.16 88.36	88.83 87.01	90.78 88.56
VideoTeeth [30]	43	17.1	92.09 86.68	90.95 87.35	87.01 86.02	88.80 87.03	89.71 86.77
U-Mamba [29]	18	14.9	94.19 89.61	91.86 87.00	89.43 87.21	88.85 87.02	91.08 87.71
Point-UNet [19]	1	0.7	87.21 86.40	88.02 86.15	88.30 85.82	81.98 79.88	86.38 84.56
Teeth2Point	1	0.9	95.46 94.23	92.36 89.48	90.12 89.62	89.04 87.68	91.75 90.25

Analysis

Subset	Ratio	nnU-Net	Teeth2Point	Δ
Clean dentition	32%	93.8	94.2	+0.4
Missing teeth	68%	89.1	90.6	+1.5

Stage-1 detection status	Case ratio	Teeth2Point DSC
Missing ≥ 2 teeth	1.7%	75.24
Missing = 1 tooth	5.9%	87.33
Missing = 0 teeth	92.4%	92.22

- Pretraining matches 100-sample scratch training using only 10 labels.
- +0.97 DSC and +1.69 M-DSC over ROI-cropped nnU-Net; strongest gain is in molars.