

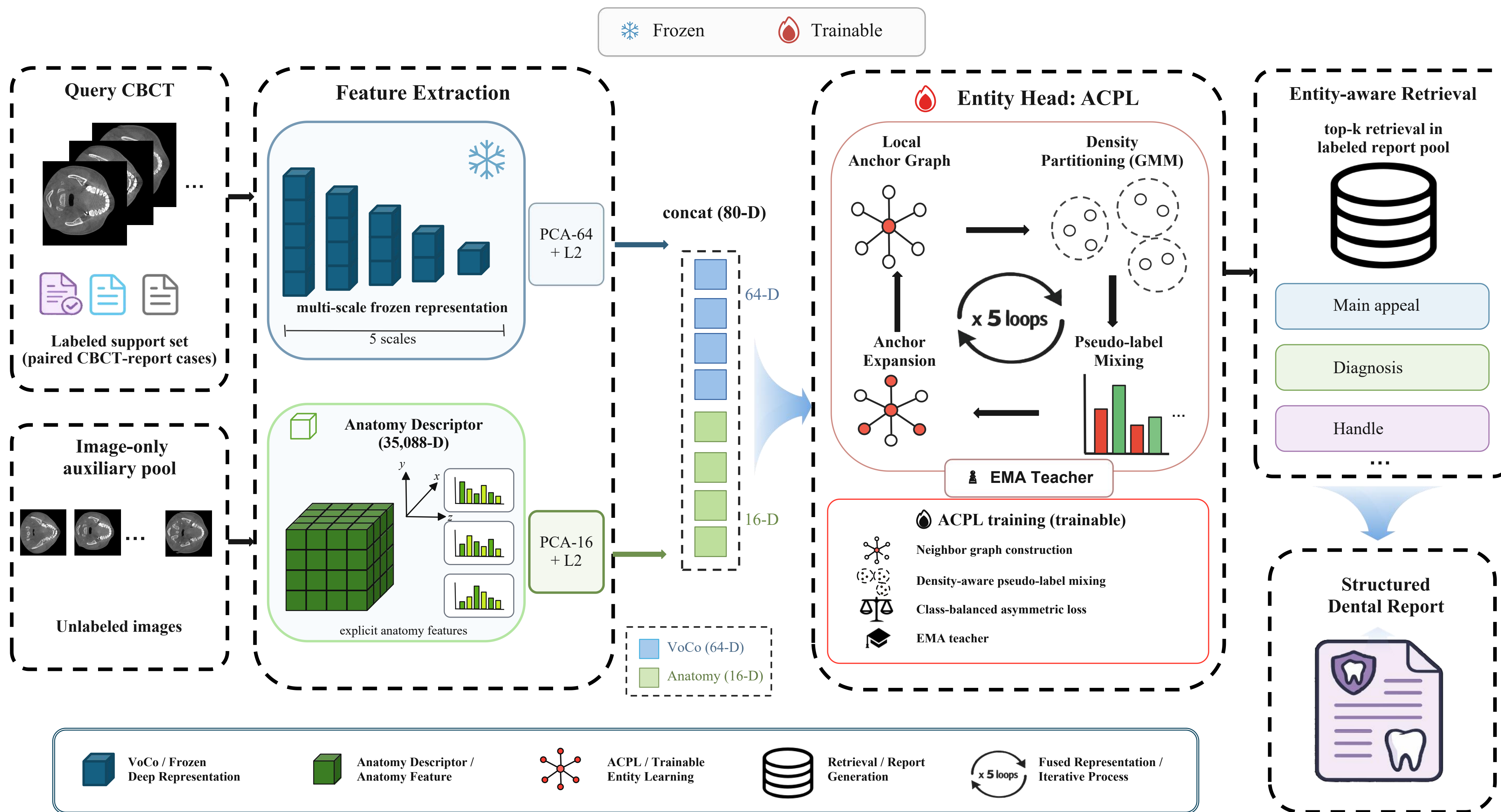
Semi-Supervised Dental CBCT Report Generation via Entity-Aware Dual-Space Retrieval

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Method Overview



Our framework combines semantic and anatomical features with semi-supervised entity learning from 50 paired cases and 200 image-only scans. A compact 41,186-parameter entity head guides dual-space retrieval for structured dental reports.

Clinical Task & Data

Generate seven-field dental reports from CBCT despite limited paired supervision and fields that are only partly supported by imaging.

50

Paired training
Entity labels +
report-memory text

200

Image-only training
PCA + pseudo-labels;
no report-memory text

50

Validation
Hidden references;
inference only

Entity Learning & Field Retrieval

1 Frozen dual-space representation

Five-scale VoCo-B features [1] and explicit anatomy descriptors are reduced to 64-D and 16-D. Their 80-D concatenation feeds the entity head.

2 Semi-supervised entity prediction

ACPL [2] selects low-density image-only samples and mixes neighbour targets with EMA-teacher predictions using reliability-weighted pseudo-labels.

3 Extractive, field-specific retrieval

Separate semantic and anatomy similarities combine with predicted entity agreement. All output strings come from the paired report memory.

Training Protocol & Efficiency

Setting	Submitted configuration
CBCT input	1 × 64 × 128 × 128 tensor
Dual-space PCA	64-D + 16-D; training data only
ACPL schedule	k = 5; 450 + 5 × 220 steps
Trainable head	41,186 parameters; cached features
Inference	246 s / 50 cases (4.92 s/case)

One RTX A6000 (48 GB). Validation is excluded from fitting, tuning and model selection.

Selected References

- [1] Wu et al. VoCo: A Simple-Yet-Effective Volume Contrastive Learning Framework for 3D Medical Image Analysis. CVPR, 2024.
- [2] Liu et al. ACPL: Anti-Curriculum Pseudo-Labeling for Semi-Supervised Medical Image Classification. CVPR, 2022.
- [3] Wang et al. MICCAI 2023 STS Challenge: A Retrospective Study of Semi-Supervised Approaches for Teeth Segmentation. Pattern Recognition 170:112049, 2026.

Official Results — 50 Validation Cases

0.2364

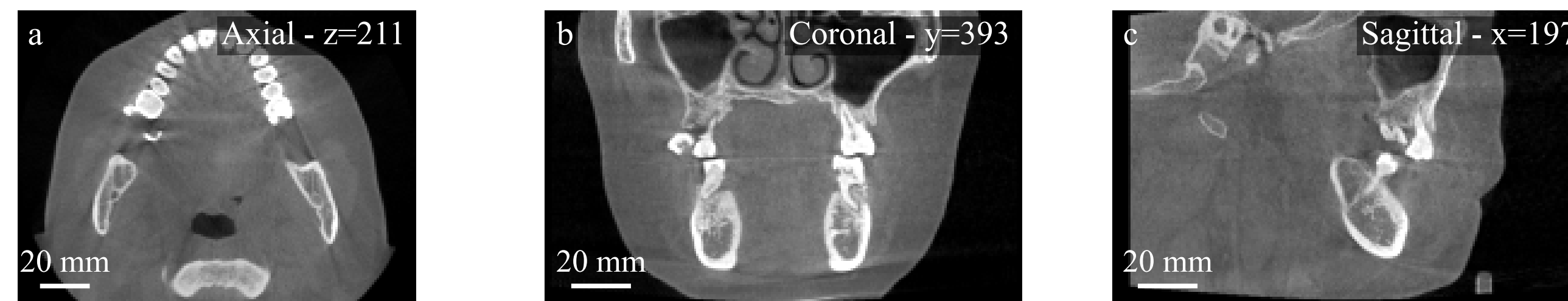
Official Weighted Score

50 / 50

Completed predictions

Entity category	F1
Tooth	0.1304
Diagnosis	0.0940
Treatment action	0.3226
Medication	0.1867

Qualitative Example — Case 515



Selected model output (3 of 7 fields)

Field	Model output
Main appeal	Pain in upper right back tooth for several days
Diagnosis	Chronic apical periodontitis (K04.500) Marginal gingivitis (K05.104).
Doctor advices	Follow-up for discomfort.

Conclusion & Limitations

Complete reports with a compact trainable entity head. No matched baseline or ablation is available. Coverage is not clinical correctness; hidden references also prevent case-level verification.

Paper: openreview.net/forum?id=YIUUA180oAs

- [4] Wang et al. MICCAI STS 2024 Challenge: Semi-Supervised Instance-Level Tooth Segmentation in Panoramic X-ray and CBCT Images. Medical Image Analysis, 103986, 2026.
- [5] Lumetti et al. Ontology-Grounded Structured Prediction for Dental CBCT Reporting. MICCAI, 2026.
- [6] Lumetti et al. Do Multimodal LLMs Understand Intraoral Dental Data? Dataset, Platform, and Baselines. ECCV, 2026.