(a) Data Filtering and Standardization

Images

Labels

Filter Unclear Images & Ambiguous Labels

Other lesions

Surgical implant

Medical Subject Headings 2025

MeSH

Standardization of Disease Labels

Spondylolysthesis → **Standardize** → Spondylolisthesis

Right Subarticular Stenosis
Left Subarticular Stenosis → **Merge** → Subarticular Stenosis

(b) VQA Pair Construction

Sampled Images

Spinal Disease Diagnose

Diverse Question Pool

Gemini

1. What kind of spinal condition is affecting this patient?
2. Determine the spinal disease affecting this patient.
3. Which spinal disorder is this patient suffering from? ...

Hard Negative Options

Image-Label Pair

Question: What kind of spinal condition is affecting this patient?

SigLIP2 Image Encoder

I_1
I_2
⋮
I_N

Embedding Space

• Spinal Canal Stenosis • Foraminal stenosis • Osteophytia • Subarticular Stenosis
• Straight cervical vertebrae • Spondylolisthesis • cervical Lordosis • sigmoid cervical vertebrae
• Disc space narrowing • cervical Kyphosis • Vertebrae collapse

Choices:

A: Disc Space Narrow
B: Straight Cervical Vertebrae
C: Cervical Lordosis
D: Subarticular Stenosis ✓
E: healthy

Spinal Lesion Localization

Question: What is the site of the disease in the spine?

Choices:
"option A": "L2/L3"
"option B": "L3/L4"
"option C": "L4/L5" ✓
"option D": "L1/L2"
"option E": "L5/S1" ✓

Transfer to **Multiple-Choice** QA Pairs