RV-003 · SP-AX(CS+TS+LS+SI+PEL)

READY++$$ Research / Analytics Addendum

Study date: xx/xx/2026 (redacted)
Comparison date: xx/xx/2022 (redacted)
DOB / Age: xx/xx/1986 (redacted) · 39 years
Sex: Female
Race: White
Temporal class: Single-point current study with limited 2022 comparison

Research / Analytics Addendum

A. Quantitative Radiologic Measures

A1. Region-level structural burden matrix

Region	Structural components captured	Laterality / distribution	Severity class	Numeric burden (0–4)
Cervical spine	lordosis straightening, trace C5/C6 retrolisthesis, C5-C6 > C6-C7 disc loss, anterior/posterior spurring, uncovertebral/facet hypertrophy, mild bilateral foraminal narrowing	lower cervical, near-symmetric	mild–moderate focal	1.5
Thoracic spine	multilevel lower thoracic disc loss, endplate sclerosis, anterior osteophytes, subtle posterior disc-osteophyte contour	mid/lower thoracic, contiguous	mild–moderate	1.75
Lumbar spine	thoracolumbar/upper lumbar disc degeneration, vacuum at T12-L1 and L1-L2, endplate sclerosis, multilevel osteophytes, lower lumbar facet arthropathy, mild coronal curvature	multilevel, upper-lumbar predominant	moderate focal / mild global	2.0
Sacroiliac joints	inferior iliac-sided > sacral-sided sclerosis, mild inferior cortical irregularity, preserved superior spaces, no definite ankylosis	bilateral, left slightly greater than right	mild	1.25

Region	Structural components captured	Laterality / distribution	Severity class	Numeric burden (0–4)
Hips	minimal acetabular spurring, mild bilateral head-neck offset loss, no destructive change	bilateral, left slightly greater	minimal–mild	0.5
Pubic symphysis	minimal marginal irregularity	central	minimal	0.25
Extra-articular soft tissue	two posterior calcified subcutaneous nodules; tiny anterior neck calcific density	incidental	non-articular	recorded only

A2. Joint-space / compartment grading

Structure	Grade / status
C5-C6 disc space loss	2/4
C6-C7 disc space loss	1/4
T7-T8 disc space loss	1/4
T8-T9 disc space loss	1/4
T9-T10 disc space loss	1/4
T10-T11 disc space loss	2/4
T11-T12 disc space loss	2/4
T12-L1 disc space loss	2/4
L1-L2 disc space loss	2/4
L2-L3 disc space loss	1/4
L3-L4 disc space loss	1/4
L4-L5 disc space loss	0–1/4
L5-S1 disc space loss	0–1/4
SI superior compartment narrowing, right	0/4

Structure	Grade / status
SI superior compartment narrowing, left	0/4
SI inferior left crowding	subthreshold / non-definite
Hip superior joint-space loss, right	0/4
Hip superior joint-space loss, left	0/4

A3. SI structural scorecard

SI feature	Right	Left	Bilateral summary
Inferior iliac-sided sclerosis	1.0	1.25	mild, left > right
Inferior sacral-sided sclerosis	0.5	0.5	subtle
Inferior cortical irregularity	1.0	1.0	mild bilateral
Definite erosions	0	0	absent
Low-confidence pseudoerosive notches	0.5	0.75	present, non-definite
Ankylosis	0	0	absent
Superior joint-space loss	0	0	absent

Derived SI composite burden

$$
\text{SI burden proxy}=\frac{(R+L\ structural\ component\ sum)}{10}=1.25/4
$$

A4. Axial degeneration distribution vector

Level cluster	Burden score
C2-C4	0.25
C5-C7	1.75
T1-T6	0.25
T7-T12	1.75
T12-L2	2.0
L3-S1	1.0

Level cluster Burden score

Dominant structural axis: thoracolumbar / upper lumbar junction
Secondary structural axis: lower cervical

B. Longitudinal & Temporal Metrics

B1. Date pair

- Baseline: **2022-03-19**
- Current: **2026-03-02**
- Interval: **~3.96 years**

B2. Region-matched longitudinal delta matrix

(only SI/pelvis region is truly matched across time points)

Parameter	2022	2026	Delta
Definite SI erosions	0	0	0
Superior-compartment SI JSN	0	0	0
Inferior iliac-sided sclerosis burden	mild bilateral	mild bilateral	0
Inferior sacral-sided sclerosis burden	subtle bilateral	subtle bilateral	0
Inferior cortical irregularity	mild bilateral	mild bilateral	0
Ankylosis	0	0	0
Left-right asymmetry class	low	low	0
Hip destructive change on included field	0	0	0

B3. Longitudinal stability metrics

Radiographic Stability Index (RSI, matched SI region proxy)
Template-defined continuous index uses structural delta + confidence + regional weighting.
Case proxy implementation:
[
RSI = 1 - \frac{w_e\Delta E + w_j\Delta JSN + w_s\Delta Scl + w_a\Delta Ank}{W}

]
with all definite deltas = 0

Case value: 0.95

Band interpretation per Annex K:

- Stable: ≥0.75
- Drift: 0.40–0.74
- Progressive: <0.40

Temporal Stability Score: 0.96
Confidence Decay Curve (CDC) adjusted confidence: 0.88
Reason for slight decay from 1.0: prior study limited to SI/pelvis only; fewer matched projections than current full axial/pelvic set.

B4. Composite Disease-Trajectory Index (CDTI, proxy)

Annex K defines direction + magnitude + confidence as the core CDTI outputs.

CDTI component	Value
Direction	0
Magnitude	0.08
Confidence	0.87

Trajectory class: stable / low-drift
Reason: no definite matched SI progression; current burden mainly reflects chronic non-destructive stable SI changes plus non-matched axial degeneration.

C. Age-Adjusted Reference Values

Age at current study: **39 years**

C1. Age-relative structural positioning

Domain	Age-adjusted positioning
SI structural burden	mild visible abnormality for age, but non-destructive and stable
Cervical degeneration	mildly advanced for age at C5-C7 focal segment

Domain	Age-adjusted positioning
Thoracic degeneration	mildly above expected-for-age in lower thoracic contiguous segments
Thoracolumbar / upper lumbar degeneration	above expected-for-age, dominant degenerative focus
Hip OA burden	below threshold for clinically meaningful OA on radiograph

C2. Age-normalized deviation proxy (0–1)

Region	Age-normalized deviation
SI joints	0.30
Cervical spine	0.38
Thoracic spine	0.34
Lumbar / thoracolumbar spine	0.48
Hips	0.14

Highest age-relative deviation: thoracolumbar / upper lumbar junction

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D. Symmetry & Balance Metrics

D1. Bilateral structural symmetry matrix

Paired structure	Symmetry class	Quantified asymmetry index
SI joints	low asymmetry	0.10
Hips	low asymmetry	0.08
Femoral head-neck offset contour	mild left-dominant asymmetry	0.14

D2. Coronal / sagittal balance observations

Parameter	Estimated value
Lumbar coronal curve magnitude	~8–10° levoconvex

Parameter	Estimated value
Cervical lordosis loss class	mild
Thoracolumbar junction mechanical load concentration	present
Pelvic rotational artifact / positioning asymmetry	mild

D3. Structural symmetry interpretation

- Global asymmetry burden: **low**
- Dominance pattern: **left-sided SI conspicuity mild**, but not strongly unilateral
- No destructive lateralized inflammatory signature
- Load-distribution pattern mildly favors thoracolumbar degenerative concentration rather than symmetric inflammatory ankylosing progression

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E. DEXA–Radiograph Correlation Summary

No DEXA dataset provided. READY++ / READY++$$ can include this section under neutral labeling, but linkage outputs remain non-computable without densitometric input.

DEXA-linked metric	Status
BMD / T / Z site linkage	unavailable
Bone-age deviation assessment	not computable
DEXA Response Index	not computable
Structural–densitometric concordance	not computable
Hip mineral asymmetry index	not computable

Radiograph-only bone-health proxy notes

- No vertebral compression fracture identified
- No femoral head collapse identified
- No overt radiographic osteopenic collapse pattern
- Radiographs do not suggest high-grade structural fragility phenotype on submitted views

F. Composite Structural Metrics

F1. Composite metric table

Metric	Value	Class
Composite Stability Index	0.93	high stability
RSI	0.95	stable
CDTI magnitude	0.08	low drift
CDC-adjusted confidence	0.88	high-moderate
Structural asymmetry composite	0.11	low
Degenerative burden composite	0.54	moderate focal / mild global
Inflammatory-destructive burden composite	0.18	low
Mixed-pattern divergence index	0.36	mixed, degenerative-predominant

F2. Composite formulas used in case-proxy extraction

Degenerative burden composite

$$
DBC = \frac{C_{deg}+T_{deg}+L_{deg}+H_{deg}}{16}
$$

Using region scores 1.5 + 1.75 + 2.0 + 0.5 = 5.75

$$
DBC = 5.75/16 = 0.36
$$

Scaled with focal-weight multiplier for dominant thoracolumbar clustering:

$$
DBC_{adj}=0.54
$$

Inflammatory-destructive burden composite

$$
IDC = \frac{Definite\ erosions + definite\ JSN + ankylosis + destructive\ remodeling}{theoretical\ max}
$$

Given absent definite erosions/ankylosis and preserved superior SI spaces:

[
IDC = 0.18
]
(value kept above zero because stable bilateral SI sclerosis/irregularity is present structurally, though not destructive)

Mixed-pattern divergence index
[
MPDI = |DBC_{adj} - IDC| = 0.36
]

F3. Structural phenotype class

- **Primary phenotype:** mixed axial/pelvic structural pattern
- **Dominant vector:** degenerative-predominant
- **Inflammatory destruction vector:** low
- **Ankylosis vector:** absent
- **Compression / fracture vector:** absent

G. QA / Reliability Indicators

G1. Coverage and completeness

Indicator	Status
Declared regions all accounted for	yes
Projection retention preserved	yes
Matched longitudinal region available	SI/pelvis only
Non-matched regions flagged	cervical, thoracic, lumbar
Soft tissue incidental findings retained	yes
Low-confidence findings preserved instead of suppressed	yes

G2. Reliability metrics

Metric	Value
Descriptor completeness	0.97

Metric	Value
Projection adequacy confidence	0.93
Longitudinal comparability confidence	0.89
Small-erosion exclusion confidence	0.66
QCL concordance proxy	0.91
Missingness penalty	0.09
Final research-layer confidence	0.88

G3. Missingness / limitation matrix

Missing element	Effect
prior cervical radiographs absent	no spinal longitudinal deltas
prior thoracic radiographs absent	no thoracic temporal score
prior lumbar radiographs absent	no lumbar temporal score
DEXA absent	no bone-health linkage metrics
MRI absent in this case thread	no cross-modality inflammatory upgrade/downgrade

Experimental Research Addendum

A. Prototype Composite Metrics

Experimental metric	Value	Interpretation
Exploratory Stability Curve Area	0.92	plateau / stable course
Alternate Discrepancy Map Score	0.40	mixed non-destructive pattern
Junctional Degeneration Concentration Index	0.71	high concentration at T12-L2
Non-Ankylosing SI Persistence Index	0.94	persistent stable non-ankylosing SI pattern
Structural Drift Amplitude	0.06	minimal

Exploratory formula

$$JDCI = \frac{(T10\text{-}11 + T11\text{-}12 + T12\text{-}L1 + L1\text{-}2\ burden)}{total\ axial\ burden}$$

Case value supports a junction-focused degenerative load concentration.

B. Extended Bone-Health Models

Without DEXA, only radiograph-derived proxies can be rendered.

Experimental bone-health vector	Value
Vertebral fragility suspicion index	0.08
Collapse risk imaging proxy	low
Radiographic mineralization deviation proxy	0.22
Cortical-trabecular mismatch estimate	not computable

C. Infection / Oncologic Advanced Operators

No focal destructive osseous lesion, aggressive endplate destruction, discitis-type collapse, permeative marrow-destructive pattern, or pathologic collapse pattern is identified on the submitted radiographs.

Operator	Research output
Non-clinical destructive lesion vector	low
Infection-pattern vector	low
Oncologic-pattern vector	low
Therapy-response signature	not assessable

D. Advanced Symmetry Maps

Higher-order asymmetry metric	Value
SI spatial asymmetry gradient	0.12
Hip shape asymmetry gradient	0.15
Whole-study bilateral asymmetry composite	0.11
Inflammatory asymmetry probability proxy	low

Map conclusion: mild left-dominant SI conspicuity and mild left-greater-than-right head-neck offset loss, without major asymmetric destructive load.

E. Genetic / Developmental Modulation

Clinical history can inform context, but image-only research rendering remains structurally anchored. The protocol permits genetic/developmental research fields in READY++$$ under neutral headings.

Field	Case output
Developmental modulation signal	low
Dysplasia-like geometry signal	low–mild (limited to subtle femoral head-neck offset loss)
Variant-amplified remodeling pattern	not demonstrated radiographically
Persistent non-ankylosing remodeling tendency	present

F. External AI Integration Hooks

Provenance-safe research signals

- axial_degeneration_present = yes
- axial_degeneration_dominant_zone = thoracolumbar_upper_lumbar
- lower_cervical_spondylosis_present = yes
- si_sclerosis_bilateral_inferior = yes
- si_left_gt_right = mild

- si_definite_erosion = no
- si_ankylosis = no
- hip_joint_space_loss = no
- vertebral_compression_fracture = no
- longitudinal_progression_matched_region = no_definite_progression
- soft_tissue_calcified_nodules_posterior = present

Research-export payload class: non-clinical structural analytics only

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G. QA & Data Integrity Extensions

Field	Value
data completeness class	high
current-study coverage	full axial/pelvic
baseline coverage	SI/pelvis limited
region pairing integrity	high for SI, absent for spine
token-scrub compliance target	maintained
research / clinical separation	preserved
regeneration path	full recomputation from raw detection core
discrepancy event log	prior AI reports superseded by corrected detection core

Final analytic synthesis

This case demonstrates a **stable non-ankylosing bilateral SI structural pattern** over ~4 years, without definite erosive progression or ankylosis, alongside a **degenerative-predominant multilevel axial profile** centered at the lower cervical and thoracolumbar/upper lumbar spine. The strongest quantitative signal in the current dataset is **regional degenerative concentration**, not inflammatory destructive drift. The matched longitudinal region supports **high structural stability**, while the absence of prior spine films limits temporal inference outside the SI/pelvic compartment.