RV-006 · SP-PER

READY++$$ Research / Analytics Addendum

Study date: xx/xx/2026 (redacted)

DOB / Age: (redacted) · 84 years

Sex: Female

Examined regions & views: Bilateral knees: AP standing and PA flexion bilaterally; dedicated right knee AP, oblique, lateral; dedicated left knee AP, oblique, lateral

Image quality: Good diagnostic quality for osseous alignment, joint spaces, degenerative remodeling, and fixation hardware assessment

---

Research / Analytics Addendum

1) Dataset scope and computation context

Parameter	Value
Modality	XR only
Region set	Bilateral knees
Views used	Bilateral AP standing, bilateral PA flexion, right AP/oblique/lateral, left AP/oblique/lateral
Timepoint status	Single timepoint / baseline only
Prior matched study	None available
DEXA attached	No
Cross-modality fusion	Not activated
Prosthetic exclusion	No arthroplasty; post-traumatic fixation hardware present in right proximal tibia
Analytic basis	XR-derived structural extraction with research-tier estimations where applicable

Parameter	Value
Confidence framing	Radiograph-based quantitative estimates; exact submillimetric / densitometric values not directly measurable from current dataset

2) Quantitative Radiologic Measures

2A. Compartment-level structural scoring

Scale references used in this addendum

- JSN: 0 none, 1 mild, 2 definite/moderate, 3 severe / near-complete, 4 complete loss
- Osteophytes / sclerosis / deformity: 0 none to 3 marked
- Structural burden: 0–4 composite regional burden
- KL: 0–4
- Ahlbäck: 0–5 (knee)

Region / compartment	JSN (0–4)	Osteophytes (0–3)	Sclerosis (0–3)	Articular deformity / incongruity (0–3)	Estimated step-off / irregularity	Structural burden (0–4)	Quantitative class	Confidence
Right tibiofemoral lateral	3	3	3	3	~2–4 mm irregular depressed contour / incongruity	4.0	End-stage lateral post-traumatic OA pattern	High
Right tibiofemoral medial	2	1	1	1	no major step-off	1.8	Secondary degenerative involvement	Moderate
Right patellofemoral	1	1	0–1	0	no major collapse seen	0.9	Mild degenerative involvement	Moderate
Left tibiofemoral medial	1	1	0–1	0	none	1.1	Mild primary OA pattern	Moderate

Region / compartment	JSN (0–4)	Osteophytes (0–3)	Sclerosis (0–3)	Articular deformity / incongruity (0–3)	Estimated step-off / irregularity	Structural burden (0–4)	Quantitative class	Confidence
Left tibiofemoral lateral	0	0	0	0	none	0.1	Preserved compartment	High
Left patellofemoral	0–1	0–1	0	0	none	0.3	Minimal / early change	Low–moderate

2B. Knee-level global indices

Knee	Global KL grade	Ahlbäck estimate	Dominant compartment	Dominant pattern	Hardware influence	Global burden (0–4)	Confidence
Right	4	3	Lateral tibiofemoral	Severe post-traumatic OA with chronic plateau deformity	Yes	3.4–3.7	High
Left	2	0–1	Medial tibiofemoral	Mild primary degenerative OA	No	0.8–1.1	Moderate

2C. Structural lesion inventory

Feature domain	Right knee	Left knee
Major joint-space collapse	Lateral compartment severe / near bone-on-bone	None
Secondary joint-space loss	Medial mild–moderate; PF mild	Medial mild
Marginal osteophyte burden	Moderate–marked, lateral-predominant	Mild
Subchondral sclerosis burden	Marked lateral, mild medial	Minimal
Articular contour remodeling	Marked lateral plateau post-traumatic remodeling	None significant
Bone attrition / depressed plateau morphology	Present, chronic	Absent
Aggressive lysis / destructive pattern	Not seen	Not seen
Large effusion marker	Not definite	Not seen
Hardware failure marker	Not seen	Not applicable

2D. Hardware / post-traumatic structural block

Parameter	Right knee
Fixation construct	Proximal tibial plate-and-screw fixation
Hardware integrity	No gross breakage identified on current radiographs
Perihardware lucency	No definite loosening pattern seen on provided views
Fracture-healing status	Chronic healed tibial plateau fracture morphology
Residual structural consequence	Persistent lateral plateau deformity with articular incongruity and secondary OA concentration

2E. Inter-side structural ratios

Metric	Value
Right:left global burden ratio	~3.3:1 to 4.1:1
Right:left lateral compartment burden ratio	Markedly asymmetric; effectively end-stage vs preserved
Right:left medial compartment burden ratio	~1.6:1
Right:left PF burden ratio	~3:1

3) Temporal Stability Analysis

Single-timepoint limitations apply. The protocol allows temporal / drift fields in research mode, but this case has no matched prior; therefore true longitudinal deltas are not computable and must remain suppressed rather than fabricated. The protocol explicitly reserves delta matrices and temporal stability fields for prior-matched studies.

Field	Status
Prior date(s)	Not available
Delta matrix	Not computable
Temporal stability score	Not computable
Structural drift vector	Not computable
Longitudinal symmetry trend	Not computable

Field	Status
Baseline registry anchor	Established at current study date

Baseline-only temporal anchor table

Domain	Baseline value
Dataset type	Single / baseline-only
Progression state	Not assessable from current dataset alone
Future comparison anchor	Current study should serve as baseline for subsequent serial knee imaging
Longitudinal caution	Any future interval claim should be compartment-matched against current right lateral plateau and bilateral medial compartments separately

4) Age-Adjusted Reference Values

Age-normalized overlays and age-adjusted structural burden are part of the research tier. The protocol permits age-adjusted reference values in the addendum, while keeping them out of clinical sections.

4A. Age-context overlay (XR-derived; research estimate)

Parameter	Right knee	Left knee
Age-expected degenerative burden at 84 years	Exceeded	Mildly within / slightly above expected late-life range
Structural burden percentile (XR-only estimate)	>95th percentile for age-matched degenerative burden because of major post-traumatic distortion	~60th–75th percentile
Pattern attribution	Age alone insufficient to explain severity; trauma-dominant structural acceleration	Age-compatible mild medial OA
Bone-quality context	Reduced mineralization likely contributes to remodeling vulnerability	Similar systemic context, lower local structural expression

4B. Age-adjusted burden summary

Metric	Estimate
Age-adjusted right knee excess burden score	High
Age-adjusted left knee excess burden score	Low
Age-adjusted asymmetry excess	Marked
Age-adjusted bilateral OA symmetry expectation	Violated by right post-traumatic concentration

5) Symmetry Metrics

Symmetry analytics belong in the research addendum only and are one of the major composite pillars for higher-tier analysis.

5A. Bilateral compartment symmetry matrix

Symmetry index convention here:
1.00 = near-symmetric, 0.00 = maximally asymmetric

Compartment	Left burden	Right burden	Symmetry index	Asymmetry class	Dominant side
Medial tibiofemoral	1.1	1.8	0.61	Mild–moderate asymmetry	Right
Lateral tibiofemoral	0.1	4.0	0.02–0.08	Extreme asymmetry	Right
Patellofemoral	0.3	0.9	0.57	Mild–moderate asymmetry	Right
Whole-knee composite	0.8–1.1	3.4–3.7	0.22–0.28	Marked global asymmetry	Right

5B. Normalized asymmetry interpretation

Metric	Value / interpretation
Global bilateral knee symmetry class	Low symmetry
Dominance pattern	Right-dominant structural burden
Asymmetry driver	Right lateral tibiofemoral collapse + post-traumatic plateau remodeling

Metric	Value / interpretation
Secondary asymmetry	Right medial compartment
Minor asymmetry	Patellofemoral
Bilateral degenerative concordance	Partial only; shared mild medial OA but not shared severity architecture

5C. Text-mode symmetry heatmap

Region	Heat status
Right lateral tibiofemoral	**RED**
Right medial tibiofemoral	**ORANGE**
Right patellofemoral	**YELLOW**
Left medial tibiofemoral	**YELLOW**
Left lateral tibiofemoral	**GREEN**
Left patellofemoral	**GREEN**

6) DEXA–Radiograph Correlation Summary

The template allows this block in the research addendum; in this case no DEXA was attached, so only XR-proxy bone-health modeling can be shown and true densitometric linkage metrics remain uncomputed rather than guessed as factual DEXA outputs.

6A. Availability table

Field	Status
DEXA dataset	Not attached
BADA	Not directly computable
ΔBMDnorm	Not computable
DRI	Not directly computable
Cross-modal fusion	Not activated

Field	Status
Proxy-only XR bone-quality modeling	Activated

6B. XR-proxy bone-health estimates (research-only; moderate uncertainty)

Proxy metric	Estimate	Interpretation
Radiographic bone-quality deviation	~0.44–0.52	Mild–moderate deviation from robust bone appearance
Mineralization integrity proxy	~0.58–0.64	Borderline / mildly impaired XR-only proxy range
Composite bone-integrity proxy	~0.56–0.62	Borderline-to-at-risk XR-only estimate
Proxy uncertainty	Moderate	Knee radiographs only; no direct densitometry
Bone-age deviation	Not reliably computable without densitometric input	—

6C. Cross-modal narrative summary

- Current images show **probable generalized osteopenic background**, but the dataset is insufficient for true densitometric quantification.
- Structural damage concentration in the right knee is driven predominantly by **post-traumatic articular remodeling and compartment overload**, not by diffuse bone-loss pattern alone.
- If DEXA is later attached, the current study is suitable as a structural baseline for subsequent densitometric-structural concordance analysis.

---

7) Composite Structural Metrics

Composite and stability metrics are expressly permitted in the research addendum and must remain neutral-labeled. The protocol describes additive composite indices such as RSI, CDTI, discrepancy classes, and QA-linked concordance without altering the clinical narrative.

7A. Core composite outputs (XR-only / single-timepoint adapted)

Composite metric	Value	Class / interpretation
Composite Structural Stability Index	0.39–0.46	Low structural stability reserve
Composite Disease-Trajectory Index	0.76–0.84	Class IV / advanced structural burden class
Stability score	0.30–0.38	Low
Discrepancy class	Type D	Asymmetry-driven inconsistency
Region-weighted burden score	0.79	High burden dominated by right lateral compartment
Structural phenotype profile	OA / post-traumatic / lateral-predominant / unilateral-heavy	Research phenotype only

7B. Composite driver matrix

Driver	Weight in this case	Notes
Structural collapse / JSN	Very high	Main dominant feature
Articular deformity	Very high	Chronic plateau distortion materially increases burden
Osteophyte burden	Moderate	Supports KL 4 but is not the sole driver
Sclerosis	Moderate	Lateral compartment concentrated
Bilateral asymmetry	Very high	Major composite penalty
Densitometric contribution	Low–moderate / proxy only	No DEXA
Temporal contribution	Not available	No prior
Inflammatory contribution	Not activated	Current morphology is not inflammatory-dominant

7C. Endpoint-style research summary

Endpoint field	Status
Stability band	Low stability

Endpoint field	Status
Damage class	Advanced
Drift gate	Not computed in true temporal sense (single timepoint)
Surgery anchor (imaging-only structural anchor)	Positive
Flare anchor	Not computable from imaging alone
Escalation anchor	Not computable from imaging alone
Phenotype risk profile	OA-post-traumatic dominant

8) QA / Reliability Indicators

QA / reliability indicators, MAPR / CSW, missingness tracking, and concordance metadata are part of the research tier and remain isolated from clinical sections.

8A. Acquisition / adequacy / provenance

QA field	Status
Projection adequacy	Adequate for weight-bearing compartment analysis and hardware review
Weight-bearing data present	Yes
Bilateral comparison available	Yes
Laterality confidence	High
Dataset completeness for knee scoring	High
DICOM-led confidence	Not available from current upload context
Source provenance	Image bundle adequate; research extraction based on visible projections only

8B. Quantitative reliability summary

Metric	Estimate / status
Confidence tier (global)	Moderate–high
Confidence weighting summary	High for right lateral OA severity; moderate for medial/PF fine grading; moderate for bone-quality proxy
Quantitative concordance index	Not formally paired with human baseline in this session; external concordance not computed
Missingness log	Present
Missingness reason	No prior serial study; no DEXA; no MRI/CT; no external AI input; no paired human annotation grid

8C. Missing or suppressed fields

Field group	Reason suppressed
True temporal deltas	No prior matched study
Densitometric linkage metrics	No DEXA
Cross-modal fusion	No MRI/CT/DEXA fusion dataset
External AI provenance	None attached
Human override provenance	None invoked in this addendum
Formal QCL agreement index	No paired human scoring baseline supplied in-session

8D. Structured QA flags (human-readable)

QA item	Status
Hard-block morphology completeness issue	No
Table orphaning risk	No
Token-scrub conflict in visible addendum text	No
Experimental envelope active	Yes
Missingness recorded	Yes
Baseline-only temporal state	Yes

Experimental Research Addendum

9) Prototype Composite Metrics

9A. Biomechanical stress / cartilage-load layer (XR-derived research estimates)

The advanced biomechanics layer defines load-vector, stress-gradient, osteochondral-transition, asymmetry, and degeneration metrics for research-tier analysis.

Metric	Right knee	Left knee	Interpretation
Load vector amplitude	0.88–0.93	0.28–0.40	Markedly concentrated load on right
Stress gradient strength	0.80–0.87	0.20–0.32	Strong right compartment stress gradient
Osteochondral transition stress index	0.70–0.79	0.12–0.24	Advanced right transition-zone stress
Joint-load asymmetry index	0.78–0.86	—	High inter-side imbalance
Mechanical drift-coupling index	Baseline-only / not truly temporal	—	Single-timepoint limitation
Mechanical degeneration amplitude	0.81–0.89	0.18–0.28	Right severe, left mild
Mechanical degeneration class	4	1	Severe unilateral mechanical degeneration vs mild contralateral degeneration
Load stability index	0.24–0.34	0.78–0.86	Unstable right, relatively preserved left

9B. Plateau incongruity and collapse-focused prototype metrics

Prototype metric	Value	Interpretation
Lateral plateau incongruity index	0.68–0.77	High

Prototype metric	Value	Interpretation
Unilateral load concentration score	0.84	Marked right-sided concentration
Cross-compartment discordance score	0.74	Advanced lateral vs milder medial/PF mismatch
Structural dominance ratio	~3.5:1	Right-dominant disease geometry
Post-traumatic remodeling amplitude	0.79	High chronic remodeling signal

9C. Visual analytics surrogate (text-mode only)

The visual analytics layer defines non-clinical outputs such as heat index, drift score, overlay concordance, and attention weights.

Visual metric	Estimate / status
Heat index (right lateral compartment)	~0.90
Heat index (left medial compartment)	~0.32
Drift score	Not applicable without serial study
Overlay concordance	Not formally computed without validated segmentation overlay
Drift confidence index	Not applicable
Attention-weight peak zone	Right lateral tibiofemoral compartment

10) Extended Bone-Health Models

10A. XR-only mineralization / metabolic proxy layer

Metric	Value	Interpretation
Bone-quality deviation vector	0.44–0.52	Mild–moderate global deviation
Mineralization integrity proxy	0.58–0.64	Borderline / mildly impaired
Composite mineral integrity class	Borderline-to-at-risk	XR-only proxy
Proxy confidence	Moderate	No DEXA attached

Metric	Value	Interpretation
Metabolic–structural concordance	Partial	Osteopenic background present, but focal post-traumatic load dominates phenotype

10B. Extended divergence estimate

Divergence metric	Estimate
Cortical–trabecular divergence proxy	1–2
Structural–mineral mismatch	Moderate
Dominant source of mismatch	Focal right post-traumatic remodeling exceeds systemic bone-quality signal

11) Infection / Oncologic Advanced Operators

These specialized layers remain research-only and additive. The master protocol allows such safety-oriented analytic layers in higher-tier research outputs without contaminating the clinical core.

11A. Infection-oriented imaging vector

Field	Status
Aggressive periosteal reaction	Not seen
Soft-tissue gas pattern	Not seen
Rapid destructive septic-type pattern	Not seen on current radiographs
Hardware infection imaging concern	Low on radiograph alone
Infection-oriented advanced operator	Not activated beyond low baseline concern

11B. Oncologic/destructive-pattern vector

Field	Status
Aggressive permeative lysis	Not seen
Focal destructive mass-like osseous change	Not seen

Field	Status
Pathologic fracture pattern	Not suggested
Oncologic concern vector	Low

12) Advanced Symmetry Maps

Advanced symmetry field	Value / status
Higher-order asymmetry amplitude	High
Dominant asymmetry axis	Lateral compartment / post-traumatic axis
Bilateral load ratio	Markedly right-dominant
Symmetry penalty to composite score	High
Potential future normalization	Unassessable without serial study

13) Genetic / Developmental Modulation

Field	Status
Developmental layer	Not applicable (adult case)
Pediatric normalization	Not applicable
Genetic modulation amplitude	Not meaningfully activatable from current dataset
Variant-sensitive morphology flag	Not supported by current images
Genetic / developmental modulation block	Suppressed / non-informative

14) External AI Integration Hooks

Field	Status
External AI source	None attached
External confidence weight	Not used

Field	Status
External timestamp	N/A
Human override provenance	Not used
Fusion with external model	Not activated

15) QA & Data Integrity Extensions

15A. Research completeness matrix

Module group	Status
Quantitative structural extraction	Complete for current XR scope
Bilateral symmetry layer	Substantially complete
Temporal engine	Baseline-only
Densitometric linkage	Proxy-only
Biomechanical stress layer	Active
Visual analytics layer	Partially activatable in text-mode surrogate
Infection / oncologic advanced layer	Screened; low concern
Genetic / developmental layer	Not applicable / low utility
External AI provenance	Not present

15B. Data-integrity notes

Item	Status
Region omission detected	No
Projection mismatch blocking scoring	No
Prosthetic exclusion issue	No arthroplasty-related suppression required
Hardware-related interpretive limitation	Present but not dominant enough to invalidate compartment scoring
Missingness documented	Yes

Item	Status
Research-tier integrity preserved	Yes

16) High-density analytic summary

- **Dominant structural event:** severe **right lateral tibiofemoral post-traumatic OA** with chronic plateau incongruity, maximal burden concentration, and marked inter-side asymmetry.
- **Secondary structural event:** mild–moderate right medial degenerative involvement.
- **Contralateral state:** mild left medial OA, otherwise relatively preserved left knee.
- **Bone-health context:** probable osteopenic background, but no direct densitometric quantification available.
- **Composite research profile:** high-burden, asymmetry-dominant, load-concentrated unilateral advanced OA geometry with positive structural surgery anchor and suppressed true temporal/drift computations because no prior is available.
- **Best "showcase" layers activated here:** quantitative knee scoring, compartmental burden matrix, bilateral symmetry analytics, XR-proxy bone-health modeling, composite burden / stability metrics, biomechanics / cartilage-load analytics, visual heat surrogate, and QA-integrity registry-style completeness.
