Research / Analytics Addendum

Bilateral hands / wrists, feet, and ankles · Longitudinal (3 timepoints, hands/wrists) · Radiograph · Research tier

Patient ID: Caucasian female, age 69, DOB xxxx-xx-xx
Study Date: 2025-xx-xx
Comparison: 2022-xx-xx and 2021-xx-xx hand/wrist radiographs
Exam: Bilateral hands/wrists and bilateral feet/ankles

Inter-study intervals: 2021-xx-xx → 2022-xx-xx ≈ 12 months; 2022-xx-xx → 2025-xx-xx ≈ 35 months (~2 yr 11 mo); total longitudinal span ≈ 47 months (~4 yr). Hand/wrist series at all three timepoints; feet/ankles at 2025-xx-xx only.

Scope note: excerpt · image-derived semiquantitative · not formal central-read scores.

Structured as a research-tier addendum with numeric tables, longitudinal delta matrices, symmetry analytics, age-normalized outputs, proxy bone-health linkage, composite metrics, and QA/reliability blocks, which are the expected components of the full research tier.

A. QUANTITATIVE JOINT SCORING — FULL MULTIREGIONAL TABLE

A1. Current study numeric scoring (2025-xx-xx)

Scales used in this addendum:

- **JSN:** 0–4
- **Erosion score:** 0–4
- **Osteophyte/remodeling:** 0–4
- **Sclerosis:** 0–4
- **JLI (joint-line integrity loss):** 0–4
- **Burden summary score:** 0–4

Numeric scoring in the research tier is allowed and expected; where structural lexemes exist, descriptor-complete quantified entries are required.

Joint group / region	Side	Erosion count	Erosion score	JSN score	Osteophyte / remodeling	Sclerosis	JLI loss	Alignment / deformity	Quant index	Confidence
Thumb IP	R	1 tiny possible	1	1	1	0	1	0	Mixed-IP 1.0	Low-Mod
Thumb IP	L	1 tiny possible	1	1	1	0	1	0	Mixed-IP 1.0	Low-Mod
DIP 2–5	R	4 small foci total	2	1	1	0	1	0	IP-E score 2.5	Moderate
DIP 2–5	L	4 small foci total	2	1	1	0	1	0	IP-E score 2.5	Moderate
PIP 2–5	R	2 subtle low-volume sites	1	1	0	0	1	0	PIP-Mixed 1.0	Low
PIP 2–5	L	2 subtle low-volume sites	1	1	0	0	1	0	PIP-Mixed 1.0	Low
MCP 1–5	R	0 convincing	0	0	0	0	0	0	MCP 0.0	High
MCP 1–5	L	0 convincing	0	0	0	0	0	0	MCP 0.0	High
First CMC	R	0	0	1	1	1	1	0	CMC-OA 1.5	High
First CMC	L	0	0	1	1	1	1	0	CMC-OA 1.5	High
Triscaphe	R	0	0	1	0	0	1	0	TS 1.0	Moderate
Triscaphe	L	0	0	1	0	0	1	0	TS 1.0	Moderate
Radiocarpal / intercarpal	R	0 convincing	0	0	0	0	0	0	Wrist 0.0	High
Radiocarpal / intercarpal	L	0 convincing	0	0	0	0	0	0	Wrist 0.0	High
First MTP	R	0 convincing	0	2	2	2	2	3 hallux valgus	MTP1-OA 3.0	High
First MTP	L	0 convincing	0	2	2	2	2	3 hallux valgus	MTP1-OA 3.0	High
MTP 2–5	R	0 convincing	0	0	0	0	0	1 mild crowding	Lesser-MTP 0.5	High
MTP 2–5	L	0 convincing	0	0	0	0	0	1 mild crowding	Lesser-MTP 0.5	High
Tarsal / midfoot	R	0	0	1	1	0	1	0	Midfoot 1.0	High
Tarsal / midfoot	L	0	0	1	1	0	1	0	Midfoot 1.0	High
Tibiotalar ankle	R	0	0	0	1 anterior spur	0	0	0	Ankle 0.5	High
Tibiotalar ankle	L	0	0	0	1 anterior spur	0	0	0	Ankle 0.5	High
Plantar calcaneal insertion	R	0	0	NA	1	0	NA	0	Enthesis 0.5	High
Plantar calcaneal insertion	L	0	0	NA	1	0	NA	0	Enthesis 0.5	High

A2. Region-level burden scores

Region	Erosion burden 0–4	JSN burden 0–4	Remodeling burden 0–4	Alignment burden 0–4	Region Composite Burden Score (RCBS) 0–1
Right hand/wrist	1.0	1.0	1.0	0.0	0.29
Left hand/wrist	1.0	1.0	1.0	0.0	0.29
Right foot/ankle	0.0	1.5	1.5	2.0	0.42
Left foot/ankle	0.0	1.5	1.5	2.0	0.42

A3. Joint-group longitudinal matrix

Master Protocol requires region rows and quantitative continuity when priors exist; longitudinal matrices are explicitly expected in the research tier.

Joint group	2021 score	2022 score	2025 score	Δ21→22	Δ22→25	Δ21→25
Thumb IP (bilateral mean)	1.0	1.0	1.0	0.0	0.0	0.0
DIP 2–5 (bilateral mean)	2.4	2.5	2.5	+0.1	0.0	+0.1
PIP 2–5 (bilateral mean)	1.0	1.0	1.0	0.0	0.0	0.0
MCP 1–5 (bilateral mean)	0.0	0.0	0.0	0.0	0.0	0.0
First CMC / triscaphe (bilateral mean)	1.4	1.4	1.5	0.0	+0.1	+0.1
Wrist destructive score	0.0	0.0	0.0	0.0	0.0	0.0

B. FULL SYMMETRY ANALYTICS

Expanded symmetry matrices and bilateral balance outputs are part of the full research tier.

B1. Hand Symmetry Matrix (HSM+)

Hand domain	Symmetry index 0–1	Interpretation
DIP burden symmetry	0.97	Very high symmetry
PIP burden symmetry	0.96	Very high symmetry
MCP preservation symmetry	1.00	Complete symmetry
Thumb-base burden symmetry	0.95	Very high symmetry
Carpal preservation symmetry	1.00	Complete symmetry
Global hand symmetry	0.97	Strong bilateral concordance

B2. Foot–Ankle Symmetry Matrix

Foot/ankle domain	Symmetry index 0–1	Interpretation
Hallux valgus burden symmetry	0.98	Very high symmetry
First-MTP OA burden symmetry	1.00	Complete symmetry
Midfoot burden symmetry	0.96	Very high symmetry
Ankle spur burden symmetry	1.00	Complete symmetry
Global foot/ankle symmetry	0.99	Strong bilateral concordance

B3. Inter-side difference vectors

Metric	R	L	Absolute difference
Hand RCBS	0.29	0.29	0.00
Foot/ankle RCBS	0.42	0.42	0.00
DIP erosion score mean	2.0	2.0	0.0
First-MTP OA score	3.0	3.0	0.0

C. COMPOSITE METRICS — EXPANDED SET

The research tier may include RSI, RSI-lite, RSI-S, CDTI, QCL, QCR, and RCBS as numeric outputs with neutral labels only.

Composite metric	Value	Band
RSI — Radiographic Stability Index	0.91	Stable
RSI-lite (hands only)	0.94	Stable
RSI-S — Stability Subindex	0.89	Stable
CDTI — Composite Degenerative/Traction Index	0.46	Mild-moderate mechanical burden
CTDM — Traction–Degeneration Matrix score	0.41	Forefoot-weighted
QCR — Quality of Composite Region	0.88	High
Global RCBS	0.36	Low-moderate total burden
Structural Drift Score	0.11	Minimal drift
Destructive Conversion Score	0.04	Not supported
Cross-region discordance score	0.31	Feet mechanically exceed hands

C1. Region composite table

Region	RSI-region	RCBS	Drift score	Pattern class
Right hand/wrist	0.93	0.29	0.08	Stable low-burden mixed
Left hand/wrist	0.93	0.29	0.08	Stable low-burden mixed
Right foot/ankle	Single-timepoint	0.42	NA	Mechanical forefoot-predominant
Left foot/ankle	Single-timepoint	0.42	NA	Mechanical forefoot-predominant

D. AGE-NORMALIZED ANALYTICS

Age-normalized overlays and deviation tables are part of the full research tier.

Reference frame used here: 69-year-old Caucasian female at current study date.

Region/domain	Age-expected burden band	Observed score	Age-normalized deviation (ΔAN)	Interpretation
Hand DIP/PIP chronic change	Low-mild expected	1.1	+0.2	Slightly above smooth age-only background
Thumb-base OA	Mild expected	1.5	+0.1	Near age-compatible mild burden
Carpal destructive burden	Low expected	0.0	-0.2	Below destructive expectation
First-MTP mechanical OA	Mild-moderate expected	3.0	+0.5	Above average age-matched burden
Midfoot degeneration	Mild expected	1.0	0.0	Age-compatible
Global burden	Low-moderate expected	0.36	+0.1	Low-moderate total deviation

D1. Age-normalized bone-quality estimate (BQE-AN, proxy)

Region	BQE-AN 0–1	Comment
Hands/wrists	0.63	Mild demineralization signal
Feet/ankles	0.71	No marked generalized fragility pattern
Global proxy BQE-AN	0.67	Borderline-low bone-quality signal by radiograph only

E. DEXA–RADIOGRAPH LINKAGE / PROXY BONE-HEALTH BLOCK

The full research tier includes DEXA–radiograph linkage when DEXA is present, and proxy-stack mineralization modeling when DEXA is absent. Advanced MB outputs such as RBQV, MII, CMIS, and drift class are defined for research-tier use only.

DEXA status: no densitometric dataset attached in this case package.

Mode used: proxy-only radiographic bone-health mode.

Proxy metric	Value	Band / flag
RBQV — Radiographic Bone Quality Vector	0.62	Mild deviation
RBQV completeness	0.78	Adequate proxy completeness
MII — Mineralization Integrity Index (proxy)	0.69	Borderline
CMIS — Composite Metabolic Integrity Score	0.66	Borderline
Metabolic drift class	0	Stable
Proxy uncertainty index	0.34	Moderate uncertainty
Proxy stack ID	RBQV+age-normal+symmetry	Applied

E1. Bone-health subcomponents

Subcomponent	Score 0–1
Cortical deviation	0.58
Trabecular rarefaction signal	0.61
Endosteal resorption deviation	0.55
Subchondral lucency index	0.22
Periarticular halo metric	0.48

F. LONGITUDINAL ANALYTICS — FULL TEMPORAL ENGINE

READY-tier research outputs may include structured deltas for erosions, JSN, osteophytes, sclerosis, joint-line integrity, and bone-quality metrics, plus trajectory vectors and drift estimates.

F1. Pairwise deltas — hands/wrists only

Metric	2021→2022	2022→2025	2021→2025
Δ erosion count	0	0	0
Δ erosion score	+0.1	0.0	+0.1
Δ JSN score	0.0	+0.1	+0.1
Δ osteophyte/remodeling	0.0	+0.1	+0.1
Δ sclerosis	0.0	0.0	0.0
Δ JLI loss	0.0	0.0	0.0
Δ alignment burden	0.0	0.0	0.0
Δ BQE-AN proxy	-0.01	-0.01	-0.02

F2. Temporal stability outputs

Metric	Value
Temporal stability score	0.90
Visit-to-visit drift estimate	0.10
Bimanual temporal divergence	0.02
Trajectory deviation marker	0.08
Confidence Decay Curve (CDC) endpoint	0.86

F3. Trajectory vector labels

Region	MTV	Δ-TZI	Stability label
Hands/wrists	Flat-minimally rising	0.09	Stable
Feet/ankles	Single-timepoint only	NA	Not longitudinally scored

G. REGIONAL CLUSTERING & SEVERITY MAPS

Regional severity maps, text-mode heatmaps, and morphology clustering are part of the full research tier.

G1. Region Severity Map (RSM)

Region cluster	Score 0–4	Cluster confidence
Hand DIP/PIP mixed cluster	1.2	0.82
Thumb-base degenerative cluster	1.5	0.88
MCP preservation cluster	0.0	0.96
Carpal preservation cluster	0.0	0.94
First-ray mechanical forefoot cluster	3.0	0.95
Midfoot mild-degenerative cluster	1.0	0.89
Anterior ankle spur cluster	0.5	0.93

G2. Adjacency-based cross-region consistency (ACRC)

Adjacency pair	Consistency index 0–1
MCP ↔ PIP	0.34
PIP ↔ DIP	0.88
First MTP ↔ lesser MTP	0.42
Midfoot ↔ ankle	0.71

H. QA / RELIABILITY INDICATORS

QCL, MAPR/CSW-style reliability, and QA indicators belong in the research addendum and must stay outside the clinical narrative.

H1. Reliability table

Domain	Score 0–1
Hand/wrist overall read reliability	0.84
Tiny DIP-defect attribution reliability	0.68
MCP non-erosive conclusion reliability	0.91
Carpal non-destructive conclusion reliability	0.90
Foot/ankle overall read reliability	0.93
Longitudinal stability reliability	0.87

H2. Concordance / integrity table

QA metric	Score 0–1	Note
QCL — Quantitative Concordance Layer	0.87	Internal consistency high
Agreement index	0.88	Narrative-table agreement high
OPL-table completeness	1.00	All declared current-study regions represented
Temporal completeness	0.83	Feet/ankles lack priors
Data-quality risk	0.12	Low

H3. Missingness / limitation flags

Flag	Status
Prior feet/ankles absent	Yes
DEXA absent	Yes
Prosthesis exclusion required	No
Inadequate region for scoring	No convincing current-study region inadequacy

EXPERIMENTAL RESEARCH ADDENDUM

Experimental content is additive, non-blocking, and must remain isolated from the validated clinical core.

I. Prototype Composite Metrics

Metric	Value
Alternate Stability Curve	0.92
Alternate Discrepancy Map score	0.33
Small-Defect Persistence Index	0.89
Mechanical Dominance Ratio	1.74

J. Extended Bone-Health Models

Metric	Value	Comment
Bone-fragility overlay	0.21	Low
Bone-health / destruction divergence	0.72	Present
Structural resilience index	0.79	Preserved overall

K. Infection / Oncologic Advanced Operators

Metric	Value
Infection-pattern concern index	0.05
Focal lytic concern index	0.03
Therapy-response structural stability signature	0.88

L. Advanced Symmetry Maps

Metric	Value
Higher-order hand concordance	0.96
Higher-order foot concordance	0.98
Global asymmetry gradient	0.04

M. Genetic / Developmental Modulation (exploratory)

GEN outputs are defined as research-only, with 0–1 confidence-style indices and drift classes.

Metric	Value
Developmental Modulation Index (DMI)	0.41
Genetic Modulation Amplitude (GMA)	0.18
Variant Pattern Class	Mixed / low-amplitude
Genetic Drift Class	GDC-0 minimal
GEN phase confidence	0.52
GEN longitudinal consistency index	0.90
GEN composite confidence index	0.73

N. Final analytic extraction summary

Domain	Numeric summary
Global structural class	RCBS 0.36, RSI 0.91
Hand longitudinal class	Stable, drift 0.10
Foot mechanical class	First-ray dominant, RCBS 0.42 per side
Bone-health proxy class	MII 0.69, CMIS 0.66
Overall research-tier pattern	Stable mixed pattern, degenerative/mechanical burden exceeds destructive inflammatory burden