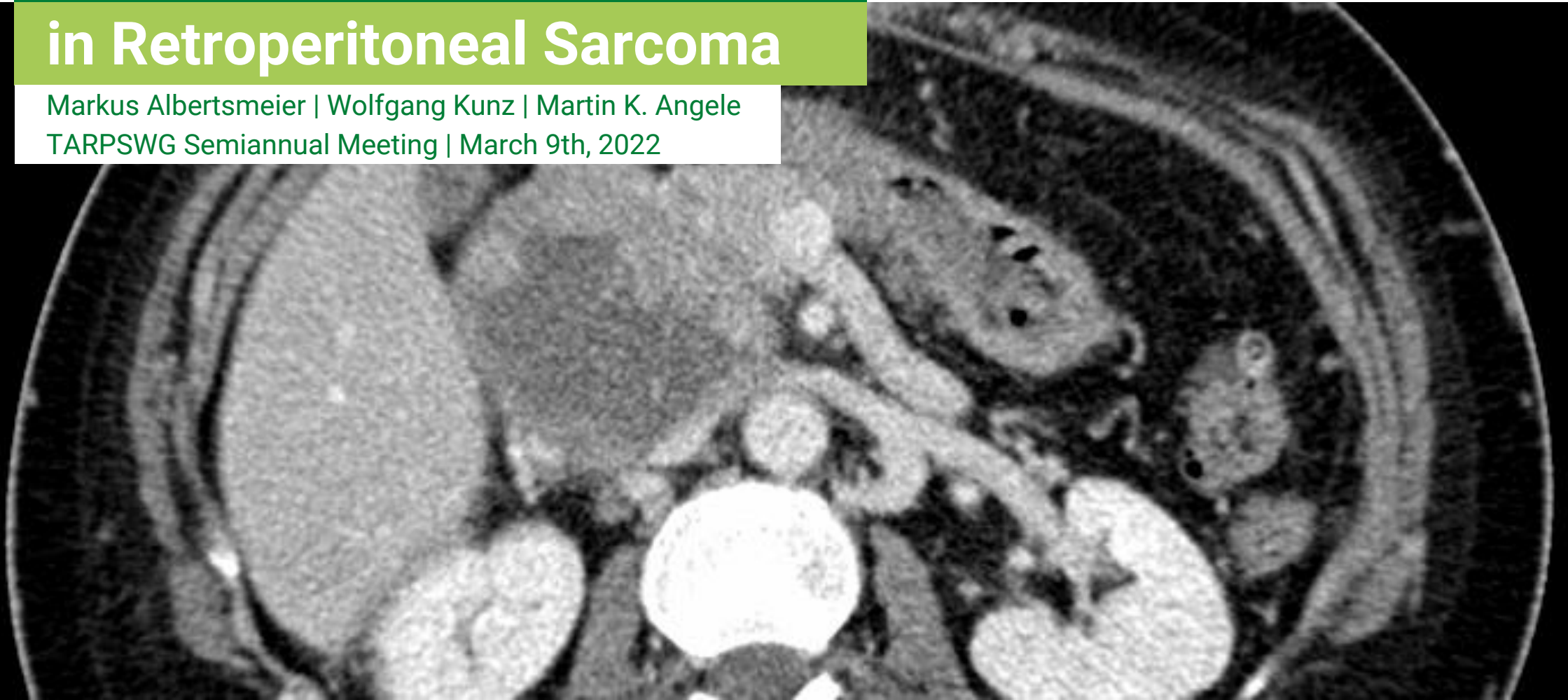


Radiology Synoptic Reporting in Retroperitoneal Sarcoma

Markus Albertsmeier | Wolfgang Kunz | Martin K. Angele
TARPSWG Semiannual Meeting | March 9th, 2022



Radiology Synoptic Reporting

Rationale

- Traditional reports: free text narratives in variable format
 - omission of important data
- Complexity of radiology reports increases with medical progress

Schwartz LH, et al. (2011); Radiology 260 (1): 174-181

- Standardization in acquisition and reporting is key for future applications of radiomics or AI

Lambin P, et al. (2017); Nature Reviews Clinical Oncology 14 (12): 749-762

Gillies RJ, et al. (2016); Radiology 278 (2): 563-577



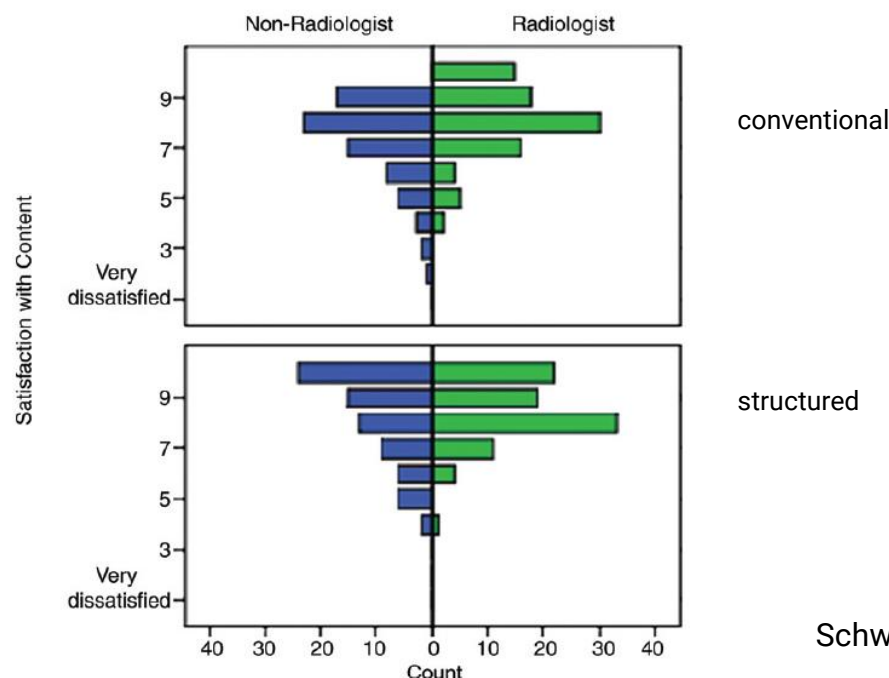
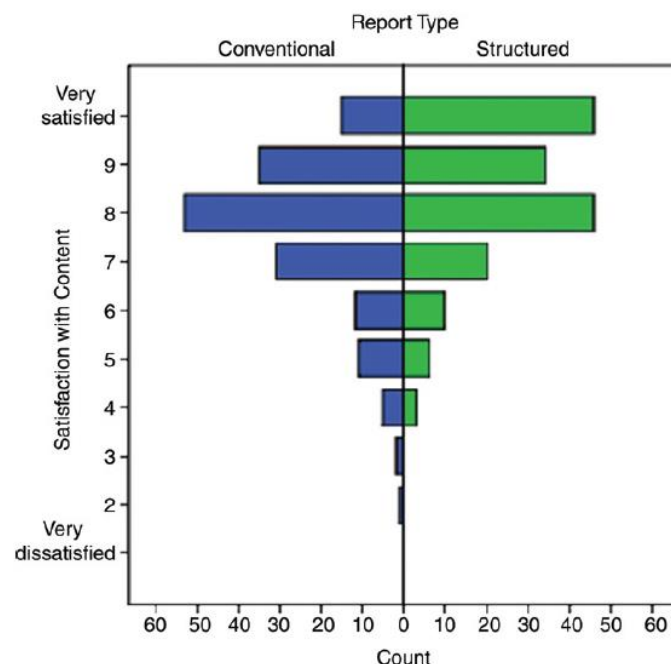
Art V. Sc. 2.
This illustration by an unknown author is licensed according to [CC BY](#)

Radiology Synoptic Reporting Evaluation

- Increased satisfaction with structured reports
 - content and clarity
 - referring physicians $\approx$ radiologists

Retroperitoneal Sarcoma = Rare disease

Knowledge $\downarrow \rightarrow$ Standardization $\uparrow$



Schwartz LH, et al. (2011); Radiology 260 (1): 174-181

Radiology Synoptic Reporting

Structured Primary RPS Template

Retroperitoneale Raumforderung:

- Größenangabe in drei Dimensionen [streng axial/ koronar/ sagittal]
- Seitenangabe [uni-/ bilateral]
- Intratumorale Heterogenität dokumentieren [vorhanden / nicht vorhanden]
 - Solide Anteile [inkl. Größenangabe des größten Anteils]
 - Fetthaltige Anteile
 - Zystische Anteile
 - Verkalkte Anteile
- Lagebezug zu umgebenden Strukturen [kein Kontakt / Kontakt / Infiltration]
 - Definition kein Kontakt:
physiologisches Fett separiert die Raumforderung von umgebender Struktur
 - Definition Infiltration:
über Kontakt hinausreichende Ausbreitung in der umgebenden Struktur
 - Organe
 - Magen
 - Pankreas
 - Duodenum
 - Milz
 - Leber
 - Nieren, Ureteren und Harnblase
(ipsi- / kontralateral, ggf. Harnstau und Graduierung)
 - Dünn- und Dickdarm
 - Bauchwandstrukturen
 - Zwerchfell
 - Muskuläre Bauchwand
 - Leistenkanal
 - Ossäre und neuronale Strukturen
 - Wirbelsäule
 - Neuroforamina
 - Periphere Nerven (N. femoralis / ischiadicus / obturatorius)
 - Beckenknochen

WS_GIST_Patient2, -- Befundverlauf 1
*1932-12-19 ID:1234567891234 LMU Retroperitoneale Sarkome

Baseline
... In Bearbeitung

Befundzusammenfassung...

Primarius

Lateralität: Links Rechts Bilateral

Fokalität: Unifokal Bifokal Multifokal

Metastasen

Lungenmetastasen: ☒

Lungenmetastasen: Klassifikation: Singulär Oligofokal Multipel Disseminiert

Kontralaterale Nierenfunktion zur präoperativen Planung

Organkontrastierung: Regelrecht Verzögert Nicht vorhanden

Organvolumen: Regelrecht Reduziert

Primä PT01 Retroperitoneum

PT 01 Solide Anteile ☒

Messung des dominanten soliden Tumoranteils axial

Messung hinzufügen

Region

Messung des dominanten soliden Tumoranteils

kraniokaudal

Mittlere Dichte	21.3 HU
Std.-abweichung	29.2 HU
Dichte	
Minimale Dichte	-319.0 HU
Maximale Dichte	98.0 HU
Langachse	29.7 mm
Kurzachse	19.7 mm
Dichte	21.3 ± 29.2 HU

Fern

Radiomics Einblenden

Histogramm Einblenden

Fetthaltige Anteile ☒

Zystische Anteile ☒

Verkalkte Anteile ☒

Lagebezug zu umgebenden Strukturen: Organe

Lagebezug zu umgebenden Strukturen: Vaskuläre Strukturen

Aorta: Kein Kontakt Kontakt Infiltration

Vena cava inferior

Die aktuell angezeigte DICOM-Serie ist in 2 Bildern

Bifasica
5.7 Torace+addome per mts (bifasica)
SN: 2
CT

PT01: Messung des do...
29.7 mm x 19.7 mm

L: 40 W: 400
IN: 186
SL: -314.80 mm
ST: 3.75 mm
PS: 0.65 / 0.65 mm

Zeitlicher Verlauf: PT01 Retroperitoneum

Radiology Synoptic Reporting

Structured Primary RPS Template

- Vaskuläre Strukturen
 - Zusätzlich werden die Ausprägung des zirkulären Kontaktes (in ° der Ummauerung) und das Vorhandensein einer Kompression der vaskulären Strukturen dokumentiert.
 - Aorta
 - Vena cava inferior
 - Iliakalgefäße
 - Viszeralgefäße
 - Truncus coeliacus
 - Arteria mesenterica superior
 - Rechter Vorhof
- Radiologische Einordnung bezüglich der histologischen Entität
 - Liposarkom-Kriterien
 - Solide und fetthaltige Tumoranteile
 - Optional Verkalkungen
 - Keine der Kriterien für renales Angiomyolipom
 - Exophytisches renales Angiomyolipom-Kriterien
 - Feeding Vessel Sign
 - Claw Sign
 - Renaler Parenchymdefekt an der Kontaktzone
 - Ausschluss adrener Ursprung (DD Myelolipom)
- Kontralaterale Nierenfunktion zur präoperativen Planung
 - Organkontrastierung [regelrecht / verzögert / nicht vorhanden]
 - Organvolumen [regelrecht / reduziert]

WS_GIST_Patient2, -- Befundverlauf 1
 *1932-12-19 ID:1234567891234 LMU Retroperitoneale Sarkome

Baseline
 ... In Bearbeitung

Befundzusammenfassung...

Primarius

Lateralität: Links Rechts Bilateral

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Primä PT01 Retroperitoneum

PT 01 Solide Anteile ☒

Messung des dominanten soliden Tumoranteils axial

Regio: Messung des dominanten soliden Tumoranteils

kraniokaudal

Mittlere Dichte	21.3 HU
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Dichte	
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Dichte	21.3 ± 29.2 HU

Fern: Radiomics Einblenden

Histogramm Einblenden

Fetthaltige Anteile ☒

Zystische Anteile ☒

Verkalkte Anteile ☒

Lagebezug zu umgebenden Strukturen: Organe

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Vena cava inferior: Kein Kontakt Kontakt Infiltration

Die aktuell angezeigte DICOM-Serie ist in 2 Bildern dargestellt

Bifasica
 5.7 Torace+addome per mts (bifasica)
 SN: 2
 CT

PT01: Messung des do...
 29.7 mm x 19.7 mm

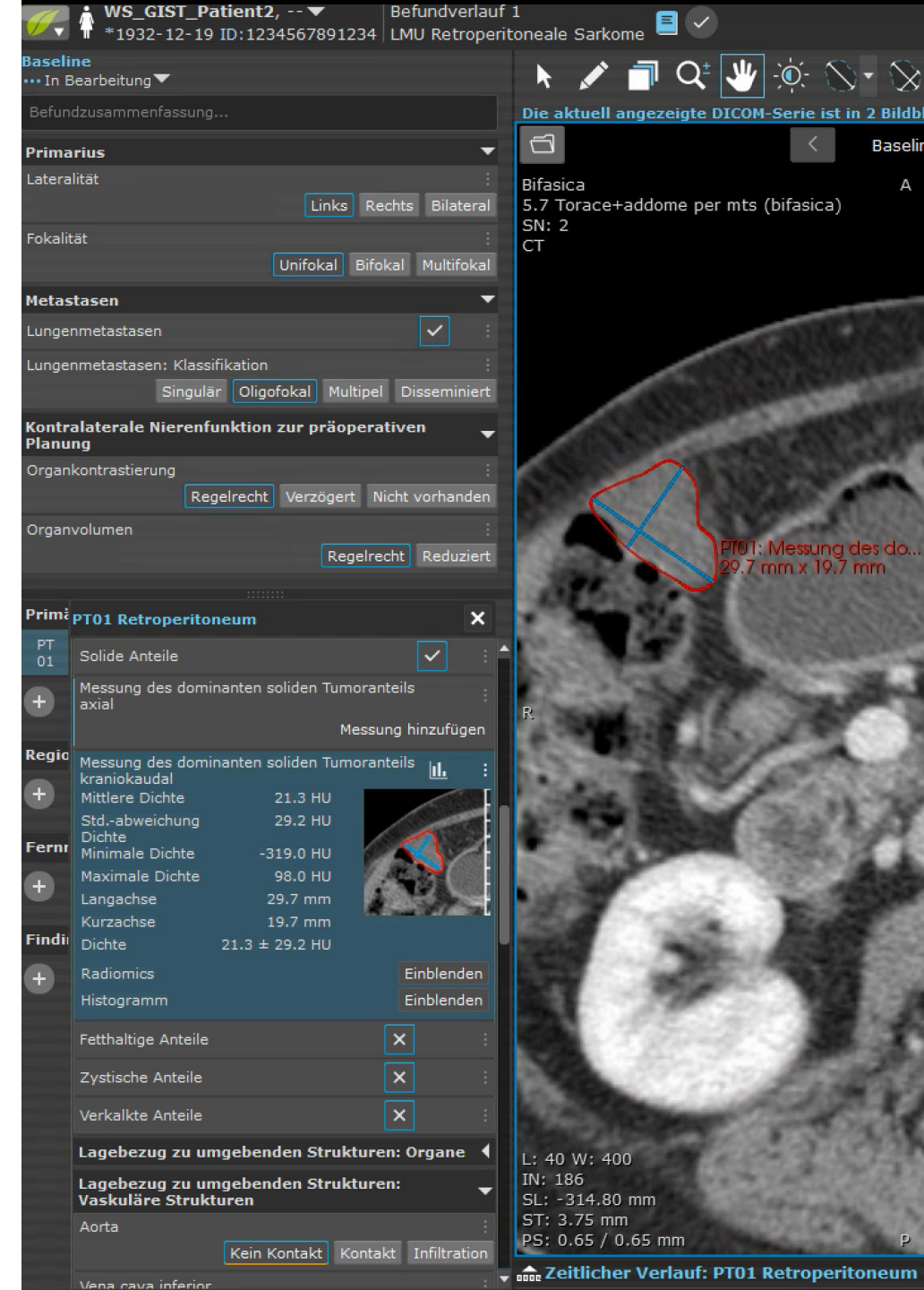
L: 40 W: 400
 IN: 186
 SL: -314.80 mm
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 PS: 0.65 / 0.65 mm

Zeitlicher Verlauf: PT01 Retroperitoneum

Radiology Synoptic Reporting

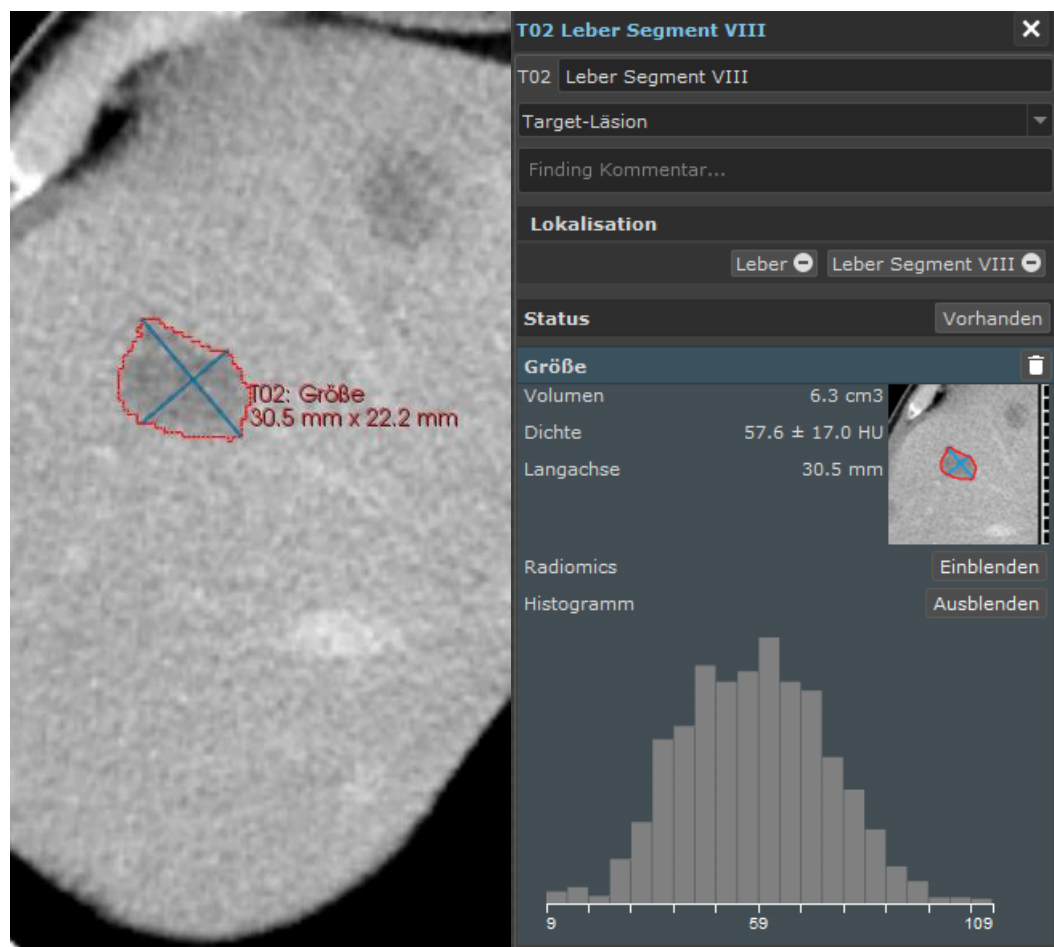
Structured Primary RPS Template

- Web-based version (demo) + stand-alone
- Localizable
- Integration of image data
 - Tumor size
 - Uni- vs. multifocality
 - Tumor composition (solid, sat, calcification, cystic)
 - Contact or infiltration of visceral organs
 - Contact or infiltration of vascular structures



Radiology Synoptic Reporting

Simultaneous Radiomics Data Collection



Histogram-based (1st order texture)

Min
Max
Mean
Standard deviation
Skewness
Kurtosis
Uniformity
Entropy
Mean absolute deviation
Robust mean absolute deviation
Median absolute deviation
Coefficient variation
Quartile coefficient dispersion
Range
Interquartile range
P10th / p25th / p50th / p75th / p90th / p100th
Minimum histogram gradient
Minimum histogram gradient intensity
Maximum histogram gradient
Maximum histogram gradient intensity

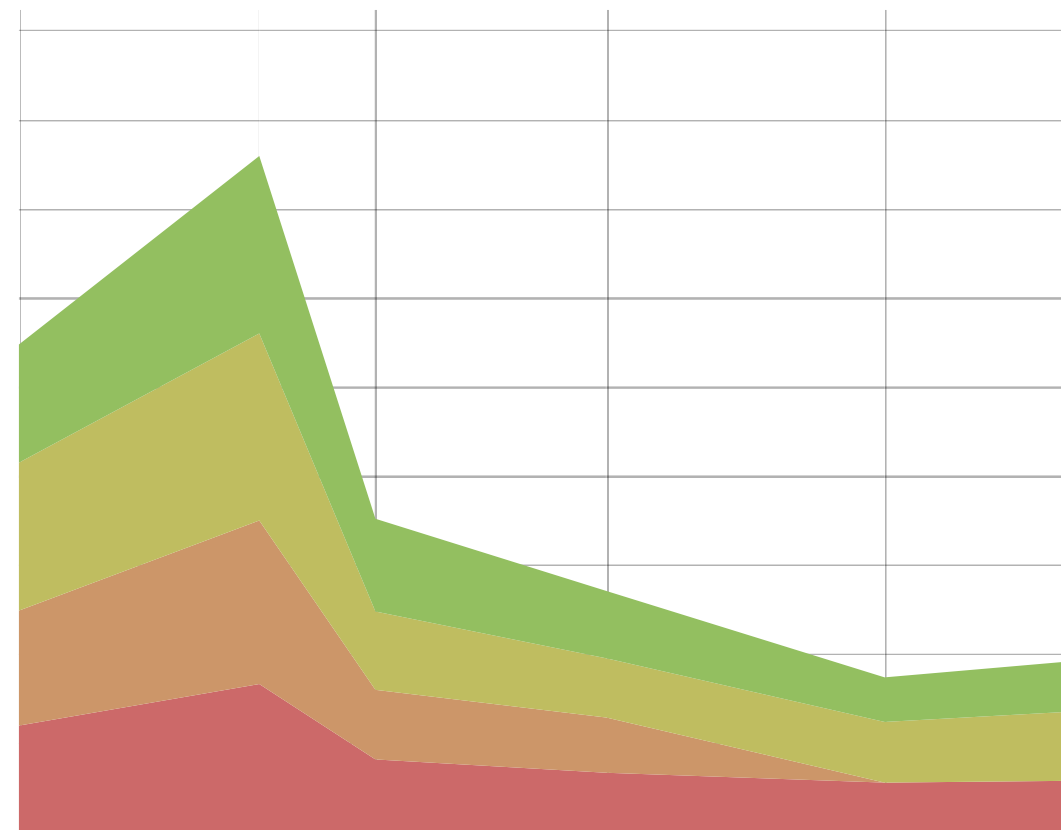
GLCM-based (Gray-level co-occurrence matrix) (2nd order texture)

Joint maximum / Joint average
Standard deviation
Joint variance
Joint entropy
Difference average
Difference variance
Difference entropy
Sum of averages
Sum of variance
Sum of entropy
Angular second moment
Contrast
Dissimilarity
Inverse difference
Inverse difference normalized
Inverse difference moment
Inverse diff. moment normalized
Inverse variance
Correlation
Auto correlation
Cluster shade
Cluster prominence
Cluster tendency
Information correlation 1 / 2

Radiology Synoptic Reporting

Longitudinal Documentation of Tumor Lesions

	Baseline (27.01.2020 (CT, OT))	Follow-Up 1 (09.04.2020 (CT, OT))	Follow-Up 2 (14.05.2020 (CT))	Follow-Up 3 (23.07.2020 (CT))	Follow-Up 4 (15.10.2020 (CT))	Follow-Up 5 (10.12.2020 (CT))
Target-Läsionen						
T01 Peritoneal 1 Peritoneum						
Größe	LA: 24.0 mm SA: 20.0 mm	LA: 33.3 mm (+38.8% ΔP) SA: 29.2 mm (+46.0% ΔP)	LA: 16.4 mm (-50.8% ΔP) SA: 14.4 mm (-50.7% ΔP)	LA: 13.4 mm (-18.3% ΔP) SA: 10.4 mm (-27.8% ΔP)	LA: 11.2 mm (-16.4% ΔP) SA: 9.0 mm (-13.5% ΔP)	LA: 11.6 mm (+3.6% ΔP) SA: 8.5 mm (-5.6% ΔP)
T02 Peritoneal 2 Peritoneum						
Größe	LA: 25.8 mm SA: 18.8 mm	LA: 36.7 mm (+42.2% ΔP) SA: 27.0 mm (+43.6% ΔP)	LA: 15.6 mm (-57.5% ΔP) SA: 9.2 mm (-65.9% ΔP)	LA: 12.4 mm (-20.5% ΔP) SA: 7.6 mm (-17.4% ΔP)	LA: 0.0 mm (-100.0% ΔP) SA: 6.5 mm (-14.5% ΔP) Disappeared	LA: 0.0 mm (- ΔP) SA: 6.1 mm (-6.2% ΔP) Disappeared
T03 Leber Segment IVa Leber Segment IVa						
Größe	LA: 33.2 mm SA: 31.3 mm	LA: 42.0 mm (+26.5% ΔP) SA: 37.2 mm (+18.8% ΔP)	LA: 17.6 mm (-58.1% ΔP) SA: 17.6 mm (-52.7% ΔP)	LA: 13.3 mm (-24.4% ΔP) SA: 9.8 mm (-44.3% ΔP)	LA: 13.6 mm (+2.3% ΔP) SA: 10.9 mm (+11.2% ΔP)	LA: 15.5 mm (+14.0% ΔP) SA: 10.0 mm (-8.3% ΔP)



Radiology Synoptic Reporting

Example: Patterns of Metastatic disease

LUNGS: INCREASED BILATERAL PULMONARY NODULES. REF. LESIONS: 1. RIGHT UPPER LOBE (SERIES 3, IMAGE 19) MEASURING 1.7 X 1.0 CM, PREVIOUSLY 0.9 X 0.6 CM 2. RIGHT LOWER LOBE (SERIES 3, IMAGE 30) MEASURING 2.5 X 1.9 CM, PREVIOUSLY 1.1 X 0.9 CM 3. LEFT UPPER LOBE (SERIES 3, IMAGE 9) MEASURING 1.3 X 1.0 CM, PREVIOUSLY 1.0 X 0.7 CM

PLEURA: NO EFFUSION

TH NODES: NO ADENOPATHY

LIVER: STATUS POST RIGHT AND PARTIAL LEFT HEPATECTOMY WITH HYPERTROPHIC CHANGES IN THE REMAINING LIVER PARENCHYMA. GROSSLY STABLE HETEROGENEOUS INFILTRATIVE HYPODENSE LESION AT THE SEGMENT 4 RESECTION MARGIN MEASURES 6.0 X 4.3 CM. SATELLITE ILL-DEFINED HYPODENSE AREAS IN DIRECT CONTINUITY TO THE LATTER ALSO GROSSLY STABLE. STABLE POSITION OF INTERNAL WALLSTENT WITHIN THE PROXIMAL LEFT HEPATIC DUCT WITH DISTAL TIP IN COMMON DUCT. STABLE BILIARY DILATATION IN SEGMENT 2

SPLEEN: STABLE SPLENOMEGALY 19.3 CM. STABLE SCATTERED HYPODENSE SPLENIC LESIONS MEASURING UP TO 2.7 CM

PANCREAS: STABLE 1.0 CM CYSTIC MASS IN THE PANCREATIC HEAD

ADRENALS: RIGHT ADRENAL REMAINS INSEPARABLE FROM RECURRENT LIVER LESION. LEFT ADRENAL REMAINS UNREMARKABLE

RENAL: STABLE PROBABLE BILATERAL RENAL CYSTS INCLUDING A 1.4 CM LEFT LOWER POLE LESION WITH DENSITY SLIGHTLY HIGHER THAN WATER, PROBABLY A COMPLEX OR HEMORRHAGIC CYST

AP NODES: STABLE HYPODENSE RETROCAVAL NODE MEASURING 2.0 X 1.3 CM AND OTHER CLUSTERED SUBCENTIMETER INTRAPERITONEAL NODES

PELVIC ORGANS: PROSTATIC AND PERIURETHRAL CALCIFICATIONS, PROBABLY SECONDARY TO CHRONIC INFLAMMATION. NONSPECIFIC ENHANCEMENT IN THE RIGHT SIDE OF THE PROSTATE, STABLE

BOWEL/PERITONEUM: STATUS POST LEFT COLECTOMY. NO BOWEL OBSTRUCTION OR ASCITES

BONES/SOFT TISSUES: UNREMARKABLE

OTHER: HEPATIC ARTERIAL INFUSION PUMP WITH TIP PROJECTED OVER THE REGION OF THE GASTRODUODENAL ARTERY. RIGHT CHEST WALL PORT WITH TIP IN CAVAL ATRIAL JUNCTION

IMPRESSION: 1. SINCE XX/XX/XX, INCREASED BILATERAL PULMONARY METASTASES. 2. SINCE XX/XX/XX STABLE SIZE OF METASTASIS AT THE RESECTION MARGIN OF HEPATIC SEGMENT 4 AND STABLE SPLENOMEGALY WITH SPLENIC METASTASES

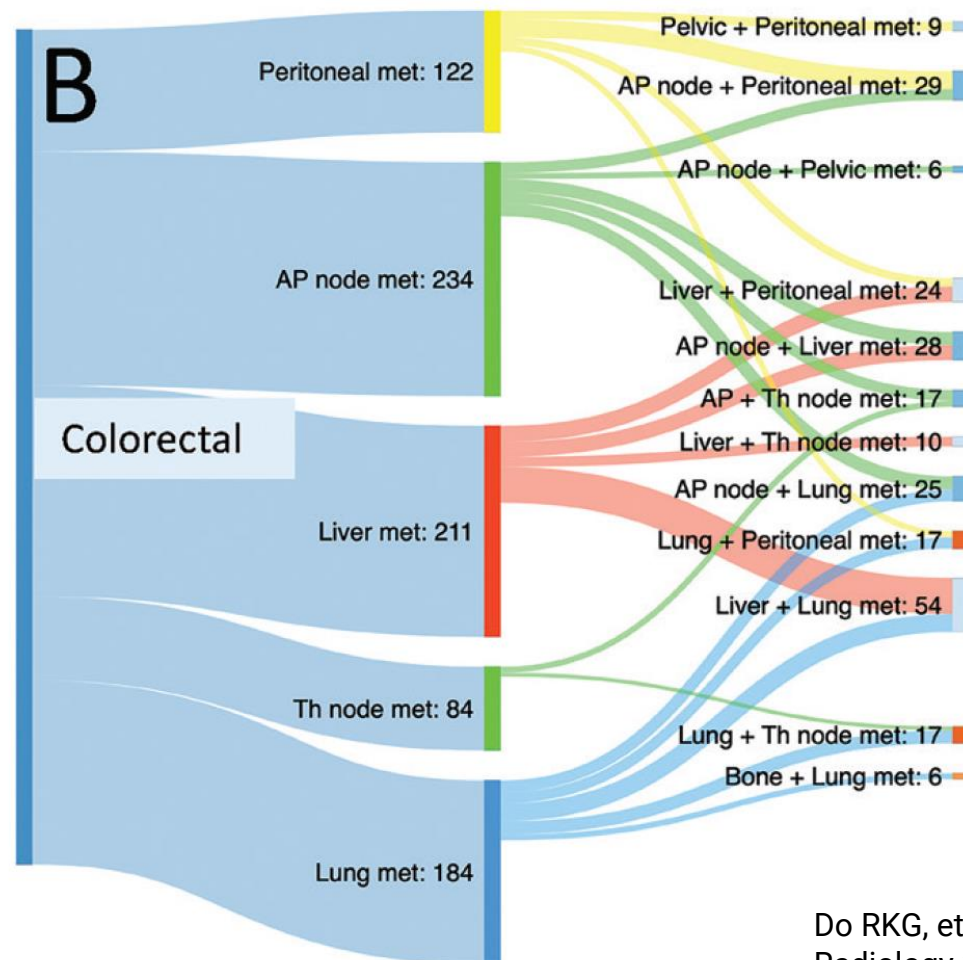
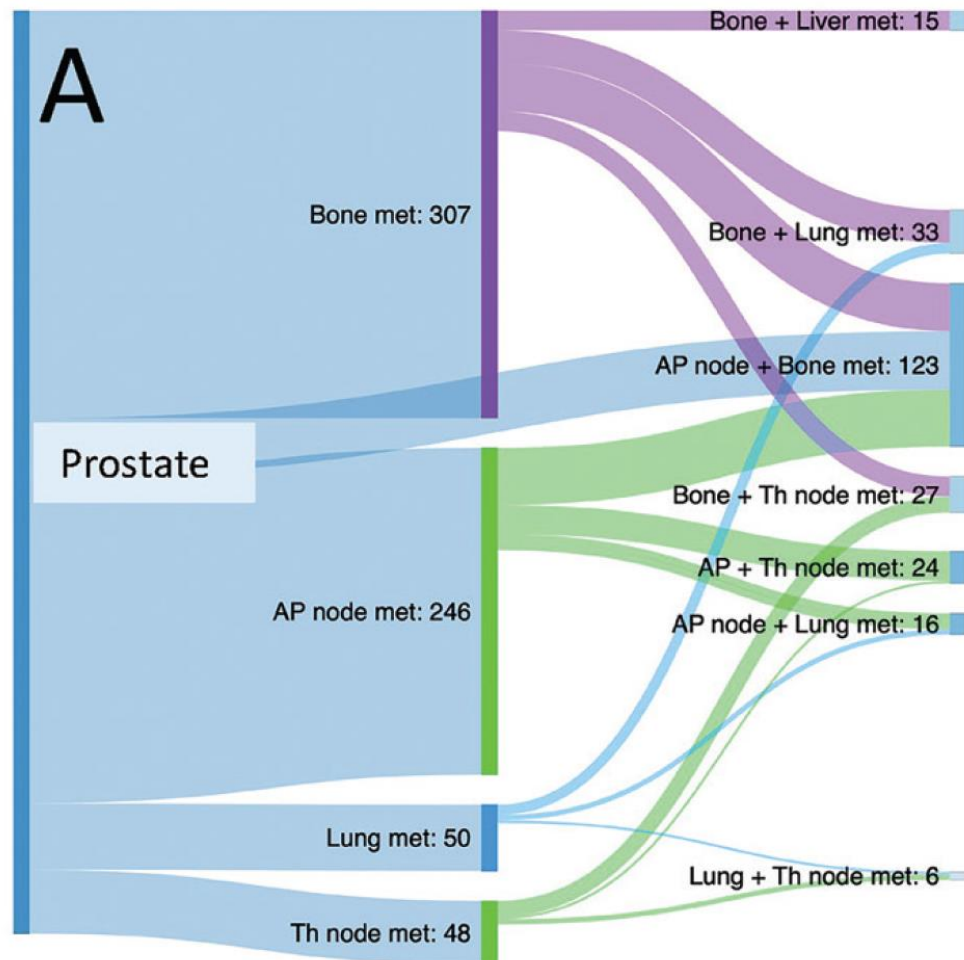
Organ	Metastasis
Lung	Yes
Pleura	No
Th Nodes	No
Liver	Yes
Spleen	Yes
Adrenals	No
Renal	No
AP Nodes	No
Pelvic Organs	No
Peritoneum	No
Bowel	No
Bones	No
Soft Tissues	No



Do RKG, et al. (2021);
Radiology 301 (1): 115-122

Radiology Synoptic Reporting

Example: Patterns of Metastatic disease



Do RKG, et al. (2021);
Radiology 301 (1): 115-122

Radiology Synoptic Reporting

Possible applications in TARPSWG

- Evaluating the template in a TARPSWG or RESAR pilot study
 - satisfaction/content/clarity/accuracy
- A radiomics project within the group:
image-based grading and risk stratification of RPS
- Establishing a basis for future trials
 - Association with centralized imaging in RESAR may save/reduce the cost for reference radiology

Thank you!

Markus Albertsmeier

Martin K. Angele

Department of General, Visceral
and Transplantation Surgery

malberts@med.lmu.de

Wolfgang Kunz

Department of Radiology

wolfgang.kunz@med.uni-muenchen.de

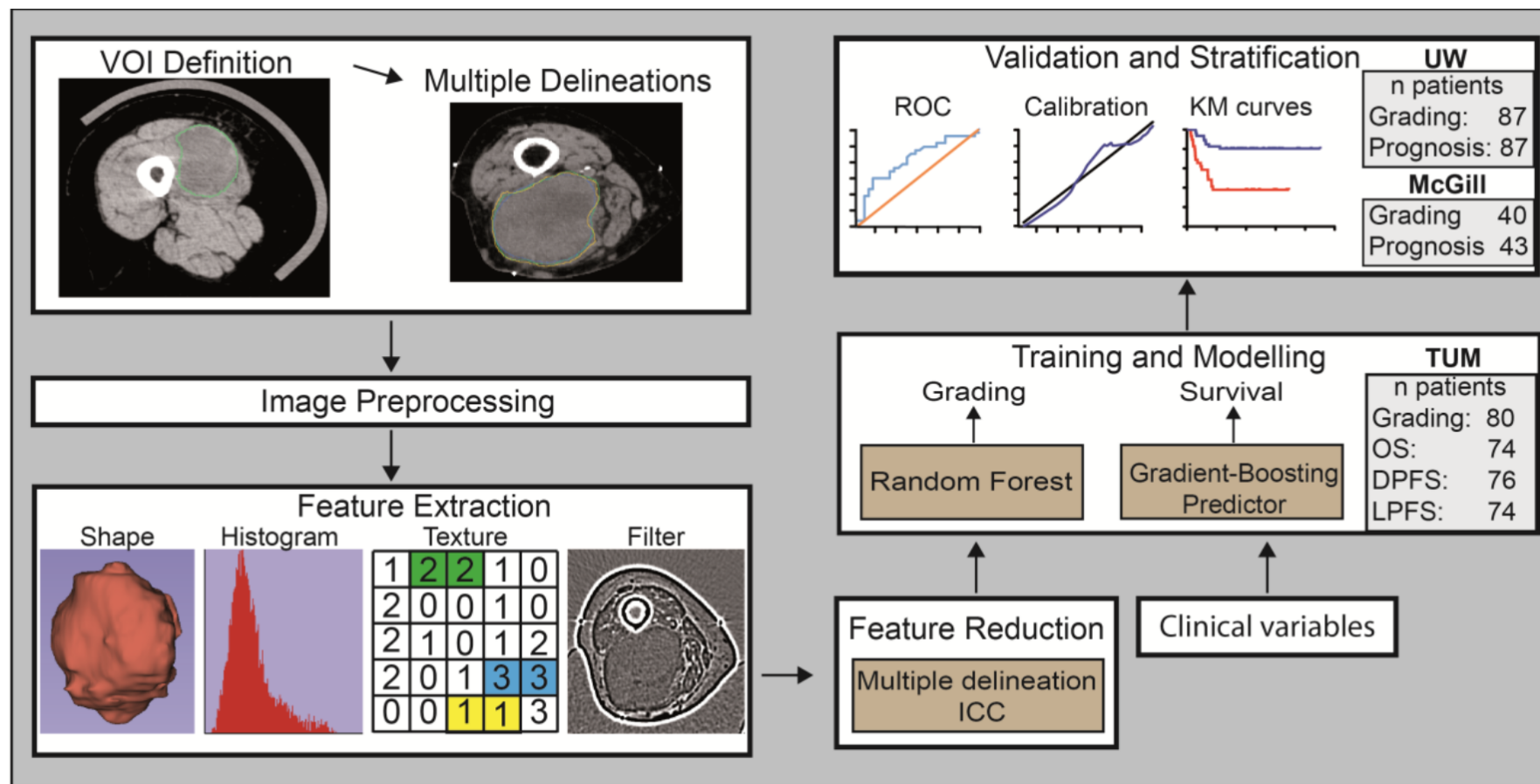


Backup



CT-based radiomics in extremity STS

Prediction of grading and prognostic value

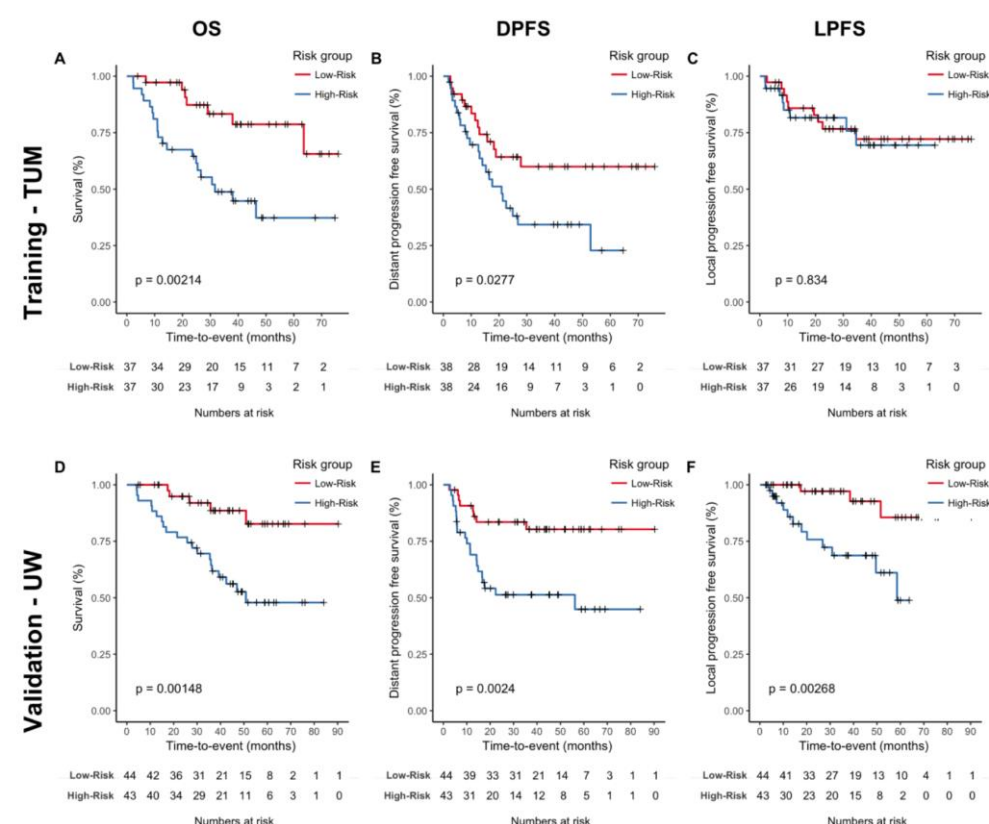
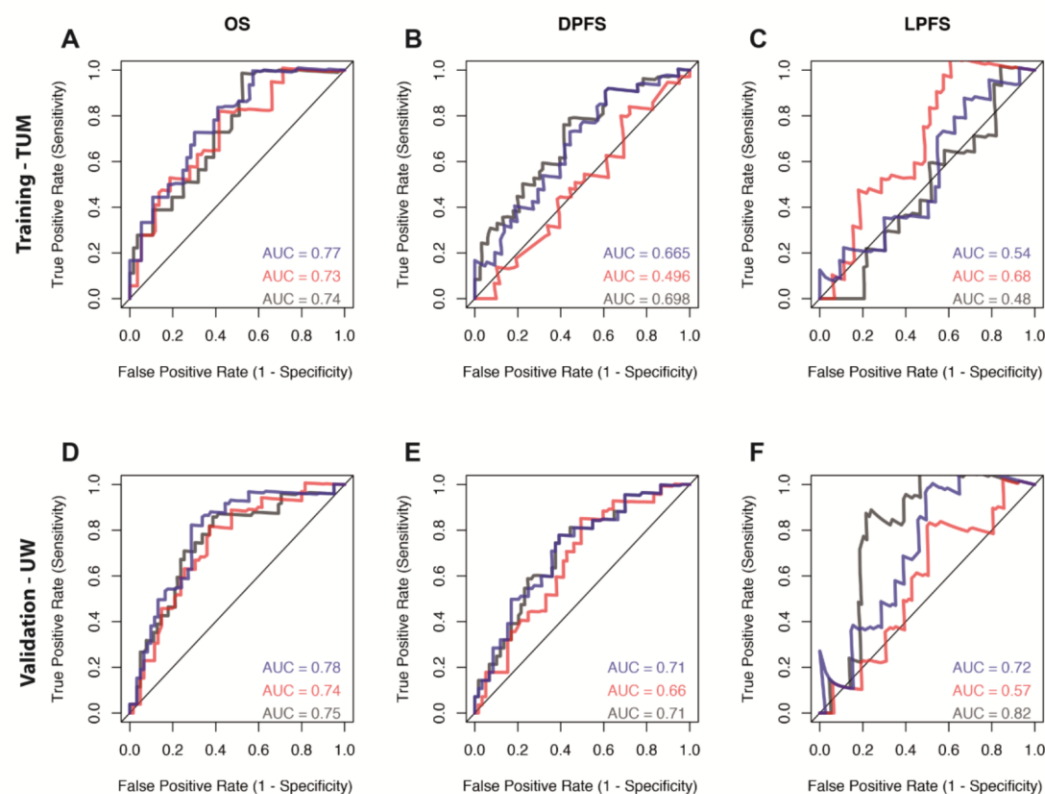


Peeken JC, et al. (2019); Radiotherapy and Oncology 135 187-196

CT-based radiomics in extremity STS

Prediction of grading and prognostic value

Figure 2. **Radiomics, Clinical and Combined** prognostic models predicting overall survival (OS), distant (DPFS) and **local** progression free survival (LPFS).



Peeken JC, et al. (2019); Radiotherapy and Oncology 135 187-196