UNIVERSITÄTSKLINIK FÜR RADIOLOGIE
UND NUKLEARMEDIZIN
MEDIZINISCHE UNIVERSITÄT WIEN

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Department of Biomedical Imaging and Image-guided Therapy

Medical University of Vienna

Diagnosis

Therapy-related Changes

Prognosis

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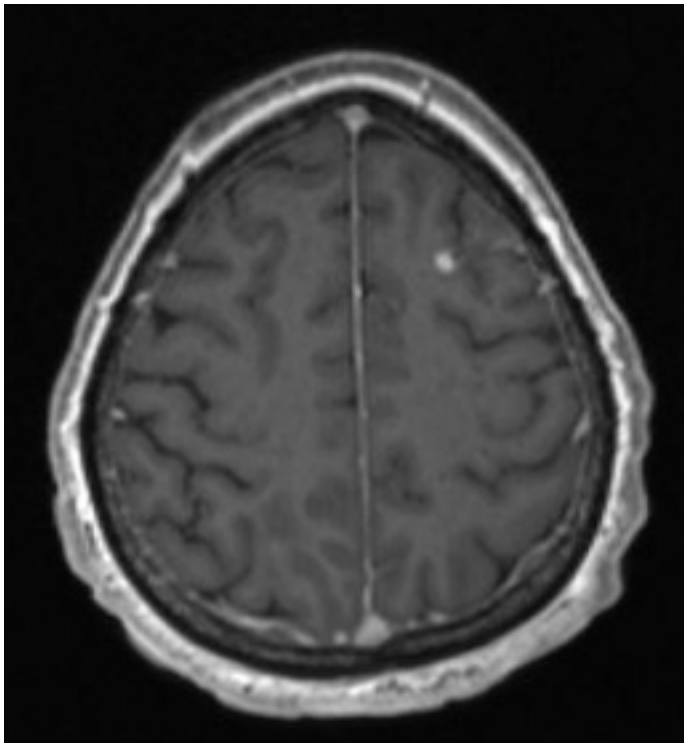
Diagnosis

CT

MRI



Diagnosis

CT

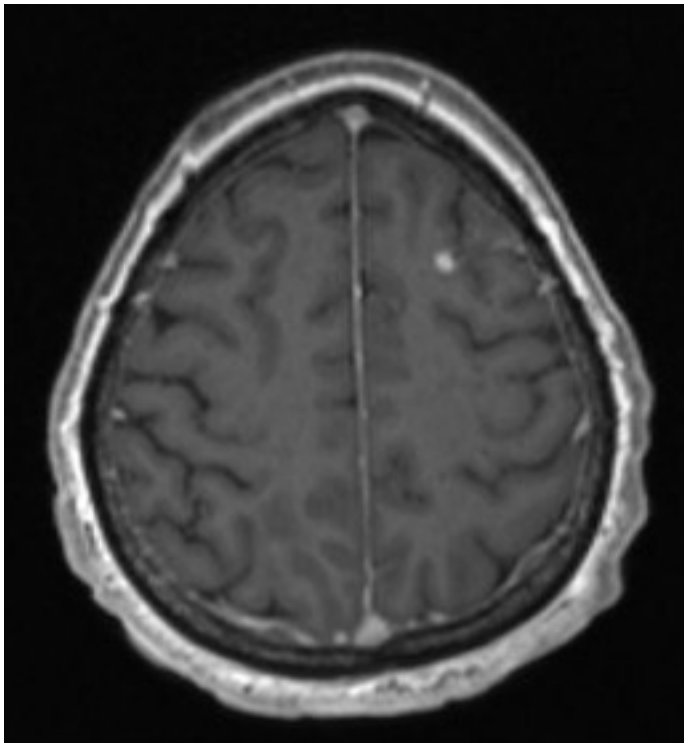
CT is only recommended

- MRI contraindication
- MRI is not available

Brain metastases imaging.
Delmaire C, Savatovsky J, Boulanger T, et al. 2015, Cancer Radiotherapy

Diagnosis

MRI



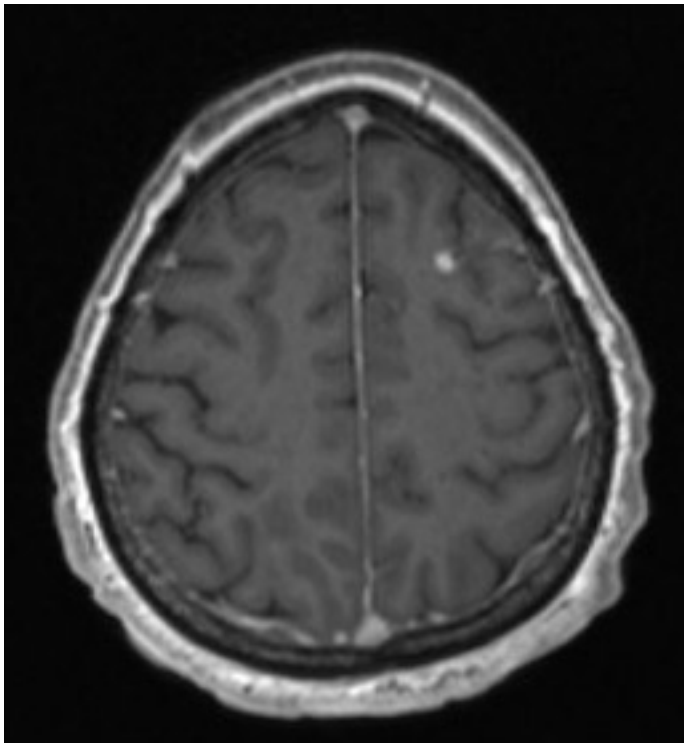
Recommended MRI protocol:

- Non contrast T1
- Diffusion-weighted images
- Susceptibility-weighted images
- MR perfusion images
- contrast-enhanced FLAIR (3D)
- contrast-enhanced T1 (3D)

Brain metastases imaging.
Delmaire C, Savatovsky J, Boulanger T, et al. 2015, Cancer Radiotherapy

Diagnosis

MRI



Leptomenigeal Metastases

- ≥1.5 Tesla MRI
- Contrast-enhanced T1weighted images and FLAIR images
- 10 minutes after injection of 0.1mmol/kg Gadolinium
- Slice thickness ≤ 1mm
- Before surgical intervention (lumbar puncture, shunt placement)

EANO-ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up of patients with leptomeningeal metastasis from solid tumors.
Le Rhun E, Weller M, Brandsma D, et al. 2017, Ann Oncol.

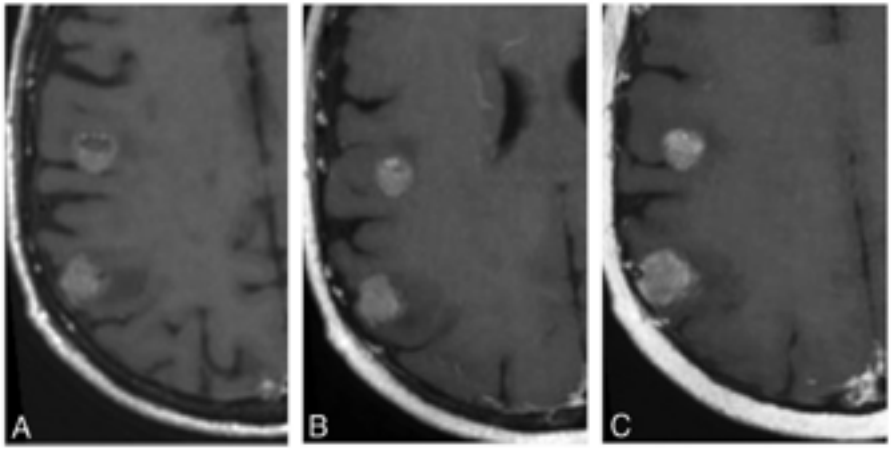
Diagnosis

Published August 9, 2018 as 10.3174/ajnr.A5747

ORIGINAL RESEARCH
ADULT BRAIN

Evaluation of Thick-Slab Overlapping MIP Images of Contrast-Enhanced 3D T1-Weighted CUBE for Detection of Intracranial Metastases: A Pilot Study for Comparison of Lesion Detection, Interpretation Time, and Sensitivity with Nonoverlapping CUBE MIP, CUBE, and Inversion-Recovery-Prepared Fast-Spoiled Gradient Recalled Brain Volume

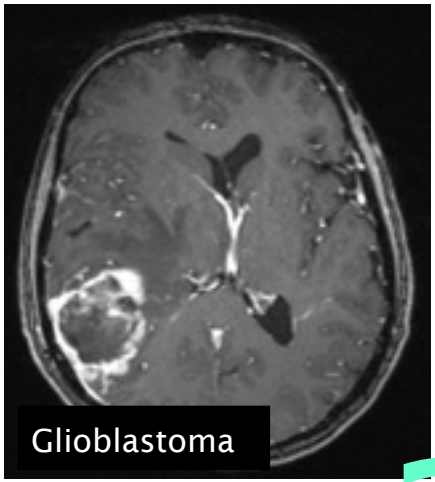
B.C. Yoon, A.F. Saad, P. Rezaii, M. Wintermark, G. Zaharchuk, and M. Iv

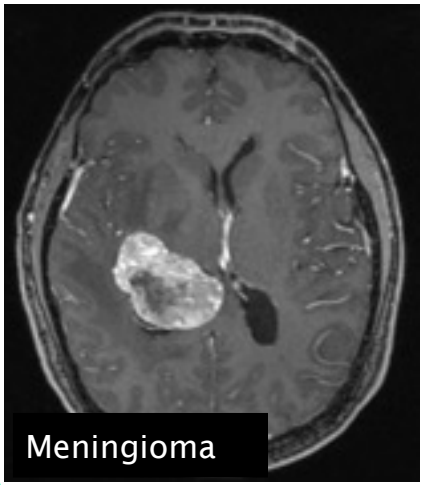


T1-w CE | Non-overlap. MIP | Overlap. MIP

- no significant difference in the number identified metastases
- Interpretation time:
  50s were at least saved per case
- Mean contrast-to-noise ratio for small lesions (<4mm) was lower for non-overlapping MIPs

Diagnosis





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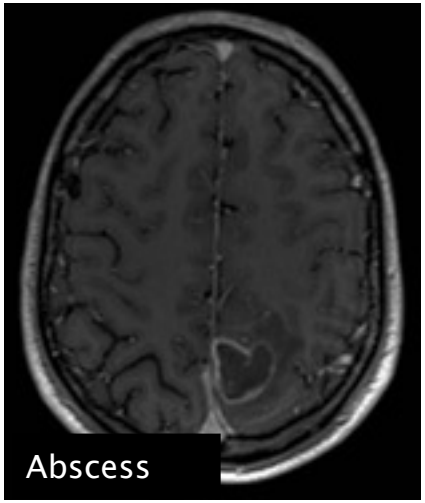

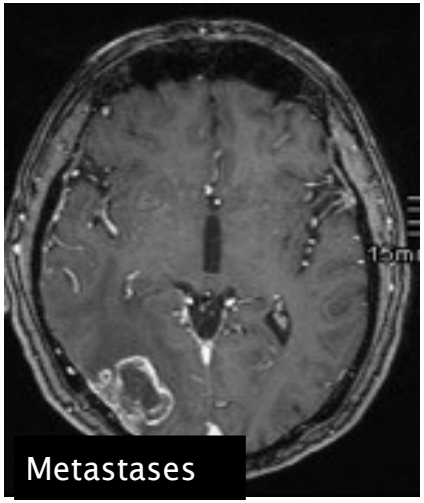

- Imaging key role in tumor characterization
- Conventional MRI sometimes not sufficiently
- Multimodal Imaging!

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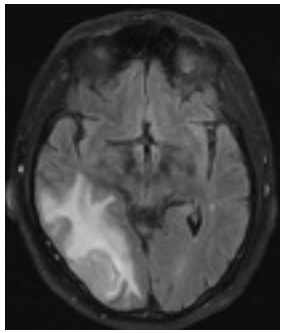
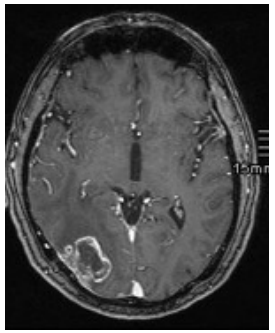
Diagnosis

Detection

conventional MRI





Tumor characterization

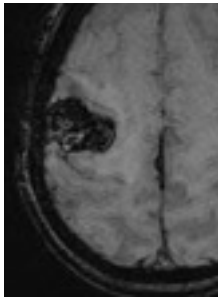
Diffusion-weighted Imaging (DWI)

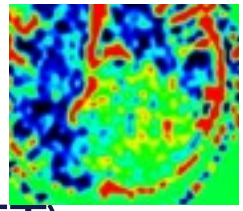
Susceptibility-weighted Imaging (SWI)

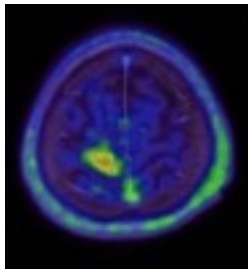
MR-Perfusion (DSC, DCE, ASL)

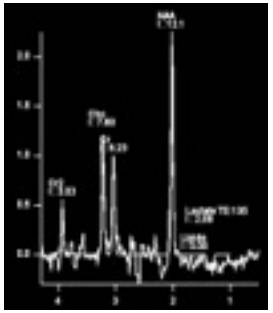
MR-Spectroscopy (MRS)

Positron-Emission-Tomography (PET)









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Diagnosis

Published July 26, 2018 as 10.3174/ajnr.A5725

ORIGINAL RESEARCH
ADULT BRAIN

Added Value of Spectroscopy to Perfusion MRI in the Differential Diagnostic Performance of Common Malignant Brain Tumors

A. Vallée, C. Guillevin, M. Wager, V. Delwail, R. Guillevin, and J.-N. Vallée

PLOS ONE

TOMOGRAPHY RESEARCH ARTICLE

Brain Tumor Characterization Using Multibiometric Evaluation of MRI

Faris Durmo[1], Jimmy Lätt[2], Anna Rydelius[3], Silke Engelholm[4], Sara Kinhult[4], Krister Askaner[3,5], Elisabet Englund[6], Johan Bengzon[7], Markus Nilsson[1], Isabella M. Björkman-Burtscher[1,2,8], Thomas Chenevert[9], Linda Knutsson[10,11], and Pia C. Sundgren[1,2,9]

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RESEARCH ARTICLE

Differentiation of glioblastoma multiforme, metastases and primary central nervous system lymphomas using multiparametric perfusion and diffusion MR imaging of a tumor core and a peritumoral zone—Searching for a practical approach

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Diagnosis

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Tumor charaterization
Multimodal Imaging Protocol

TOMOGRAPHY RESEARCH ARTICLE

Brain Tumor Characterization Using Multibiometric Evaluation of MRI

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Therapy-related Changes

Prognosis

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Therapy-related Changes

Therapy monitoring - Chemoradiotherapy

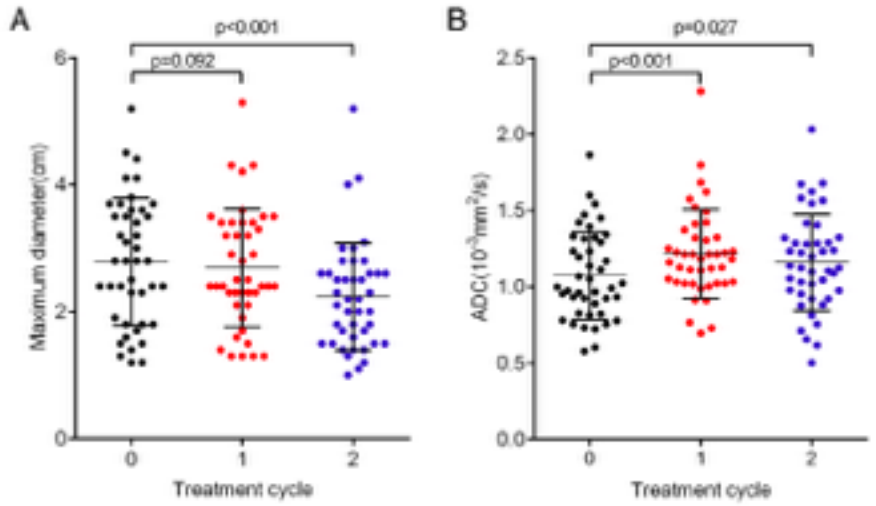


Table 3 The maximum diameters of tumors and ADC values for brain metastases from lung cancer ($n = 43$)

Treatment	The maximum diameters of tumors (cm)	ADC values (10^{-3} mm^2/s)
One week before treatment	2.78 ± 0.15	1.07 ± 0.29
One treatment cycle	2.69 ± 0.14	1.21 ± 0.29**
Two treatment cycles	2.24 ± 0.13**	1.16 ± 0.32*

*$p < 0.05$, **$p < 0.01$, compared to one week before treatment

Effective subgroup:

- ADC values increased after first treatment cycle
- max. tumor diameter decreased earliest after the second cycle

Invalid subgroup:

- No difference of ADC values between BL and after first treatment cycle

Liu et al. 2018, BMC Medical Imaging

Therapy-related Changes

Stereotactic Radiosurgery

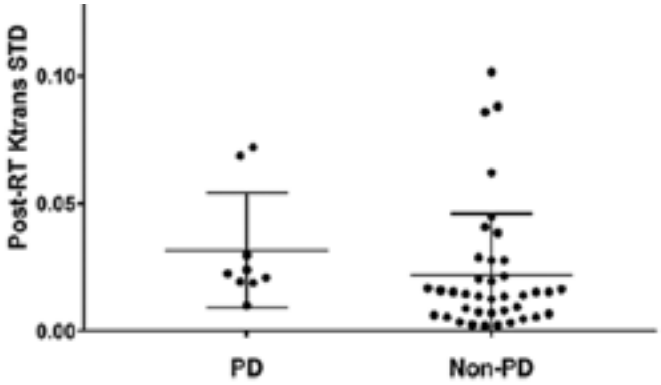
Neuro-Oncology

XX(XX), 1–9, 2017 | doi:10.1093/neuonc/nox159 | Advance Access date 24 August 2017

Early posttreatment assessment of MRI perfusion biomarkers can predict long-term response of lung cancer brain metastases to stereotactic radiosurgery

Neil K. Taunk, Jung Hun Oh, Amita Shukla-Dave, Kathryn Beal, Behroze Vachha, Andrei Holodny, and Vaios Hatzoglou

Department of Radiation Oncology (N.K.T., K.B.), Neuroradiology Service, Department of Radiology (B.V., A.H., V.H.), and Department of Medical Physics (J.H.O., A.S.D.), Memorial Sloan Kettering Cancer Center, New York, New York



- MRI < 12 weeks after SRS
- Significant difference (p=0.032) of Ktrans SD between patients with PD and without PD
- Posttreatment volume change was not associated with outcome (p=0.941)

Therapy-related Changes

Radiation necrosis

Typical radiological Findings:

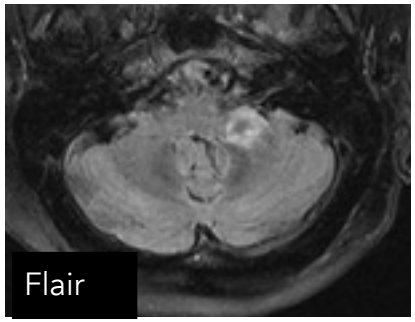
- Contrast-enhancing lesion
- Mass effect and edema – atrophy

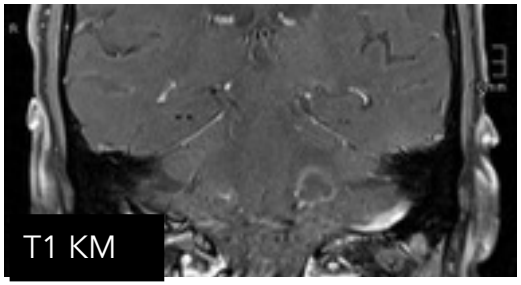
Rare:

- involvement of corpus callosum with midline crossing
- multiple lesion
- subependymal spread

Therapy-related Changes

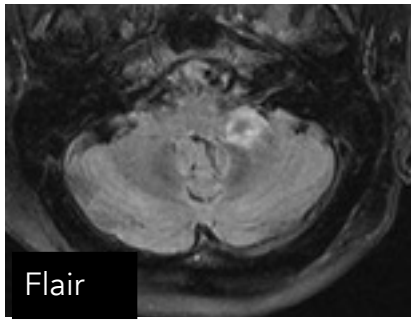
47y lung cancer patient

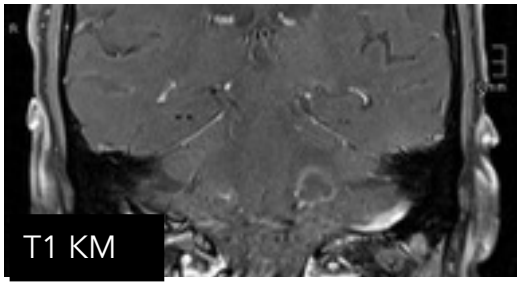


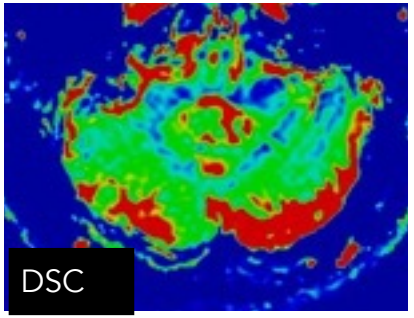


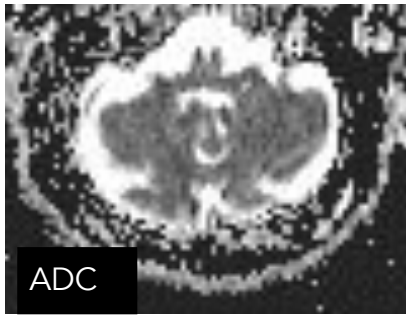
Therapy-related Changes

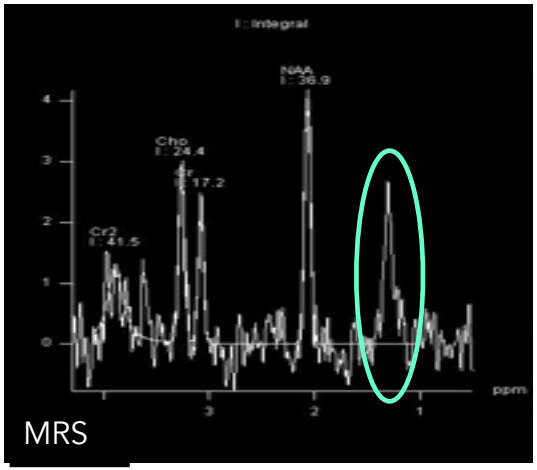
47y lung cancer patient

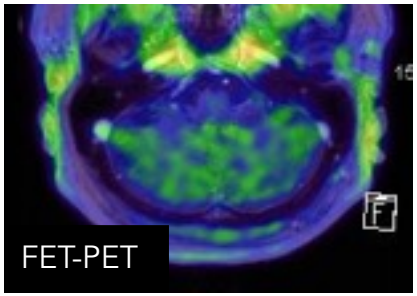






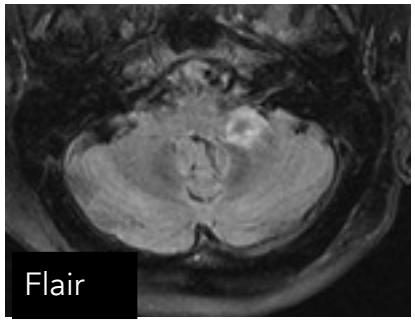


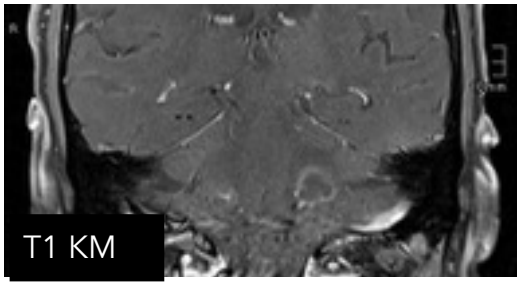


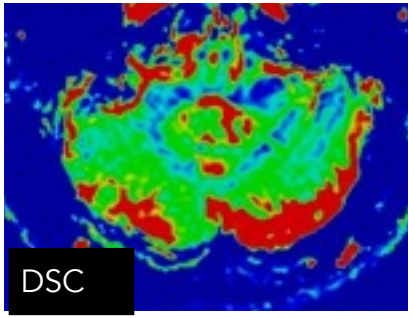


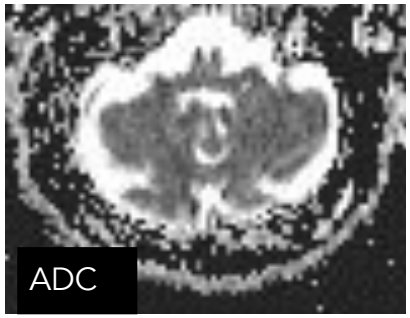
Therapy-related Changes

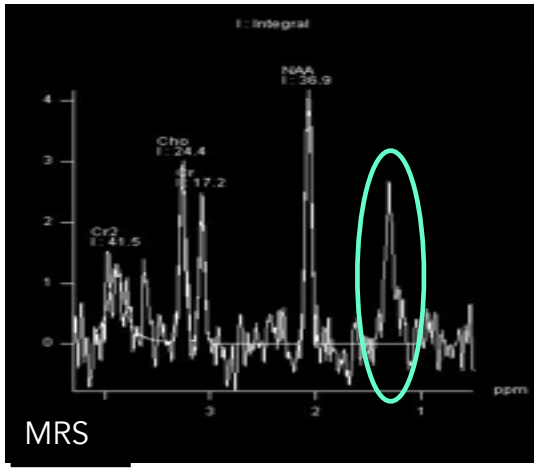
Radiation necrosis

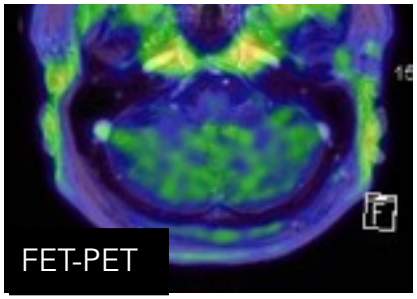






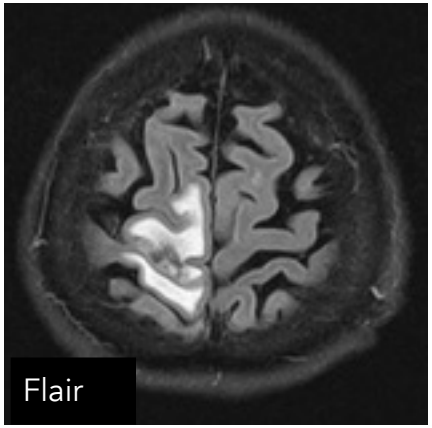


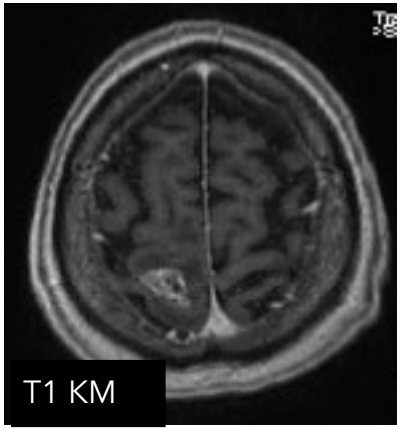




Therapy-related Changes

69y breast cancer patient





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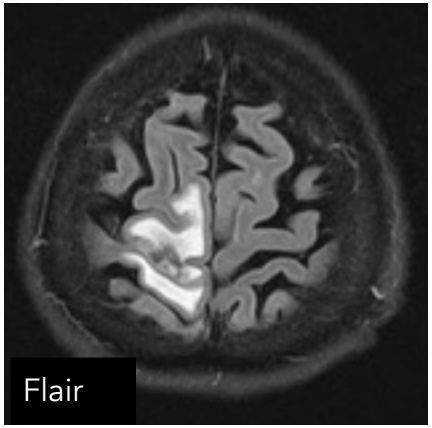
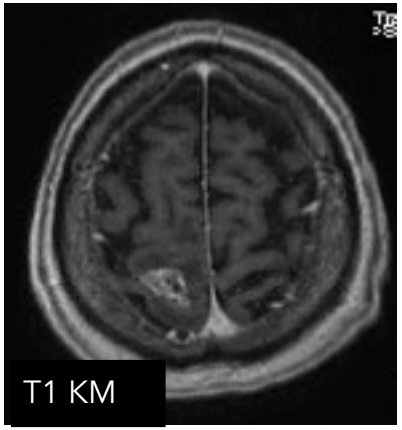
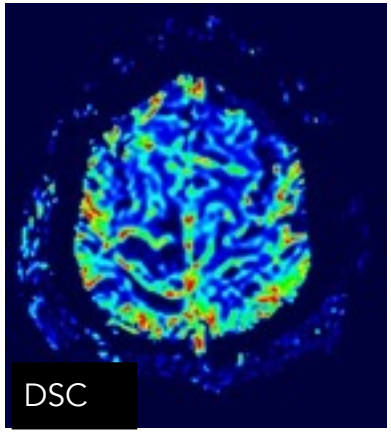
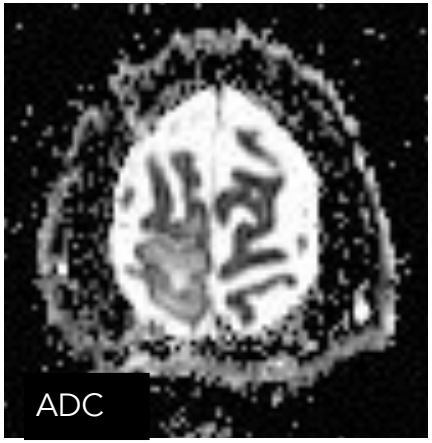
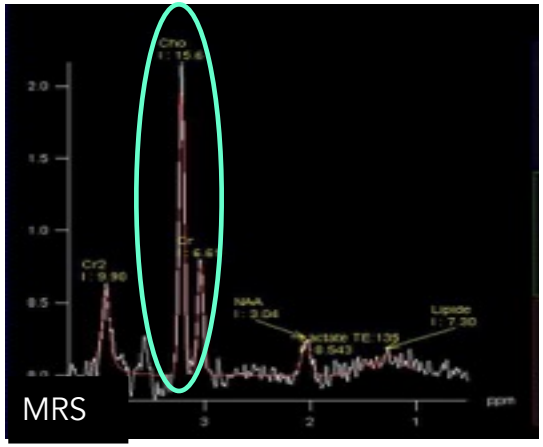
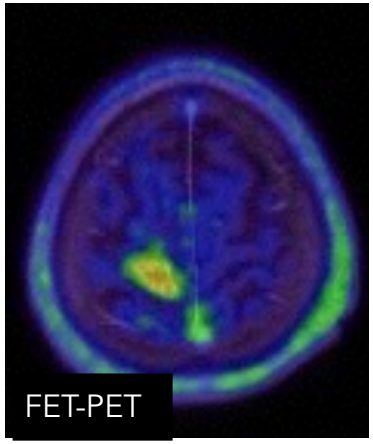






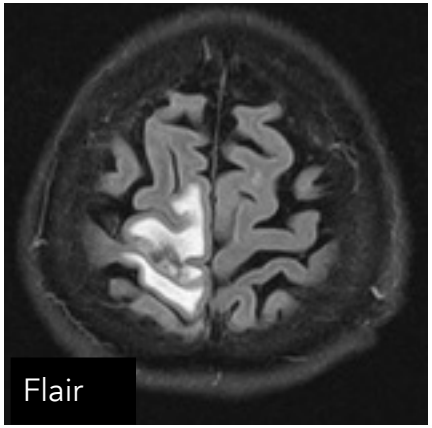


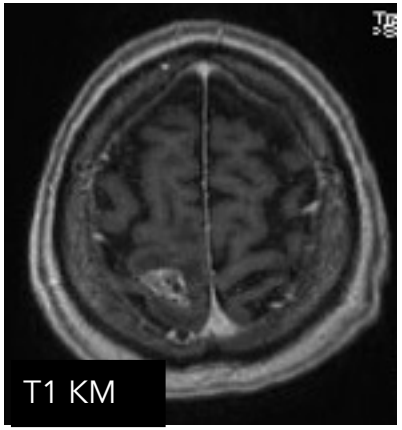


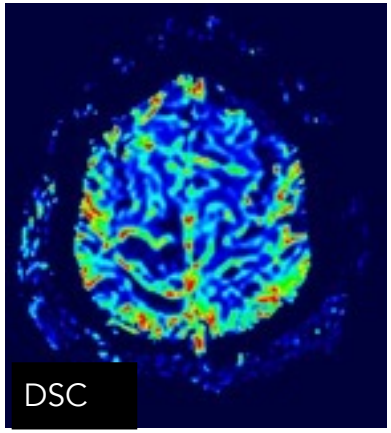


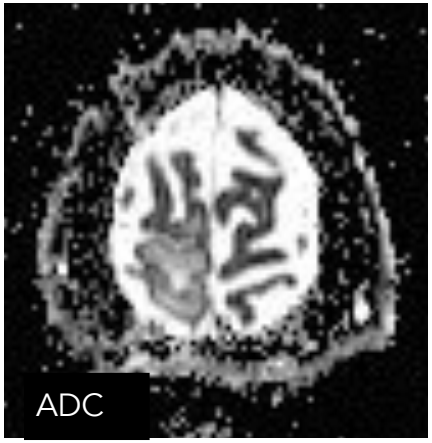
Therapy-related Changes

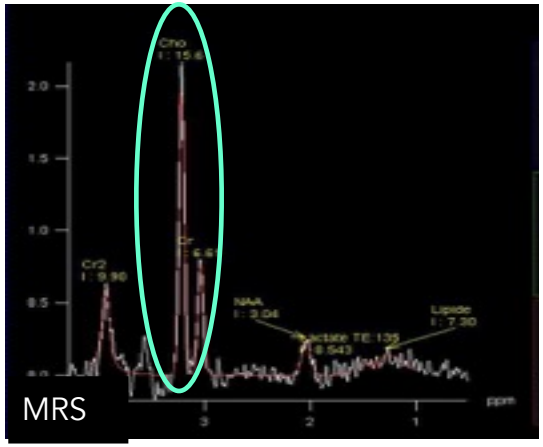
Tumor recurrence

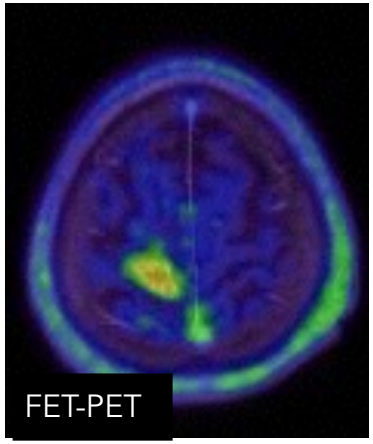












Therapy-related Changes

NeuroImage: Clinical 20 (2018) 537–542

Contents lists available at ScienceDirect

NeuroImage: Clinical

journal homepage: www.elsevier.com/locate/ynicl

Combined FET PET/MRI radiomics differentiates radiation injury from recurrent brain metastasis

Philipp Lohmann[a,b,*,1], Martin Kocher[a,b,1], Garry Ceccon[c], Elena K. Bauer[c], Gabriele Stoffels[a], Shivakumar Viswanathan[a], Maximilian I. Ruge[b], Bernd Neumaier[a], Nadim J. Shah[a,d], Gereon R. Fink[a,c], Karl-Josef Langen[a,e], Norbert Galldiks[a,c,f]

Diagnostic accuracy:

CE- MRI 81%
FET-PET 83%

→ Combination 89%

Diagnosis

Therapy-related Changes

Prognosis

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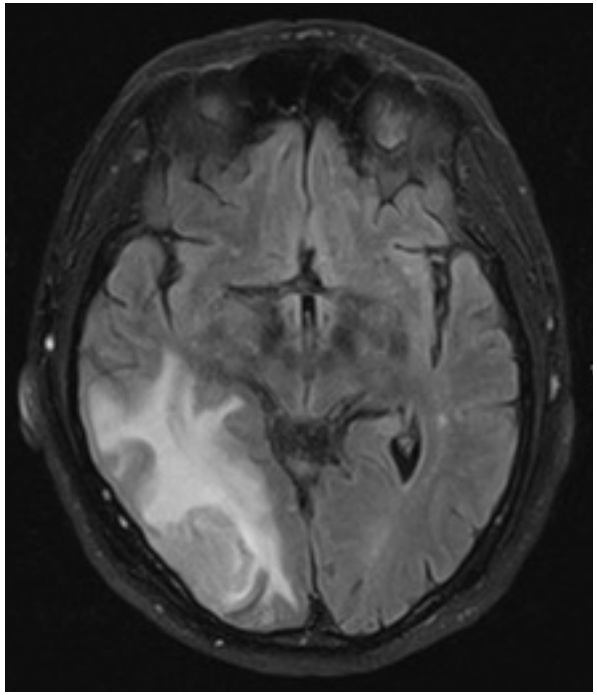
Prognosis

Edema



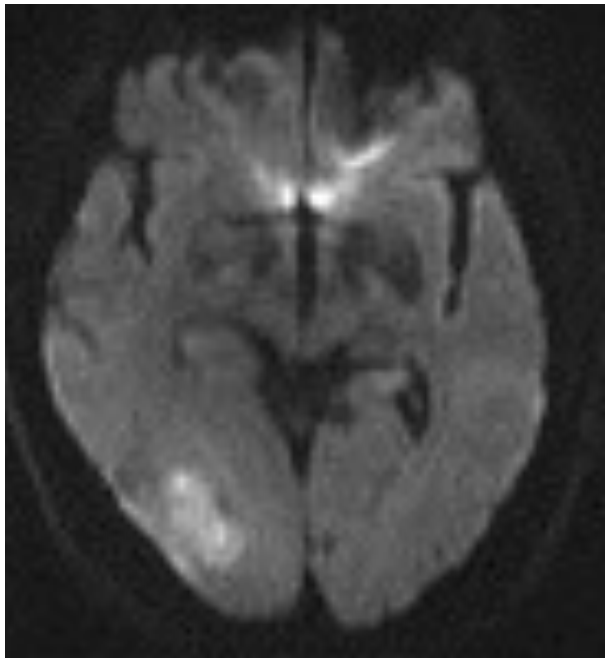
positive correlation

edema – overall survival

Extent of peritumoral brain edema correlates with prognosis, tumoral growth pattern, HIF1a expression and angiogenic activity in patients with single brain metastases. Spanberger T, Berghoff AS, Dinhof C, et al. 2013 Clin Exp Metastasis

Prognosis

Diffusion restriction



Negative correlation

Diffusion restriction - survival

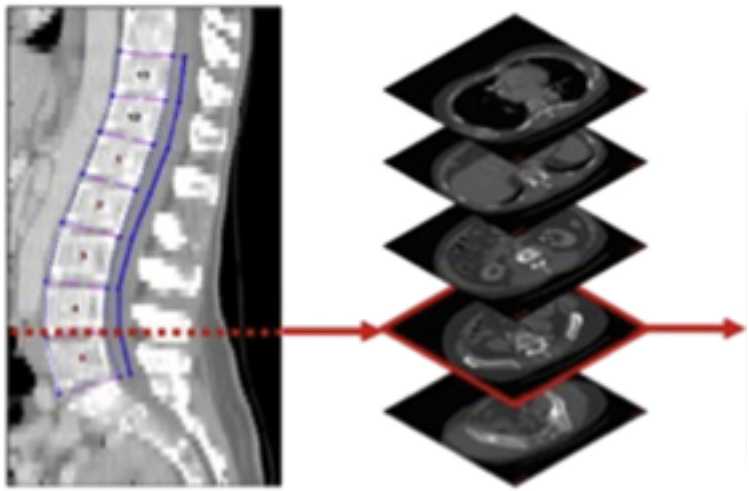
Preoperative diffusion-weighted imaging of single brain metastases correlates with patient survival times. Berghoff AS, Spanberger T, Ilhan-Mutlu A, et al. 2013 PLoS One

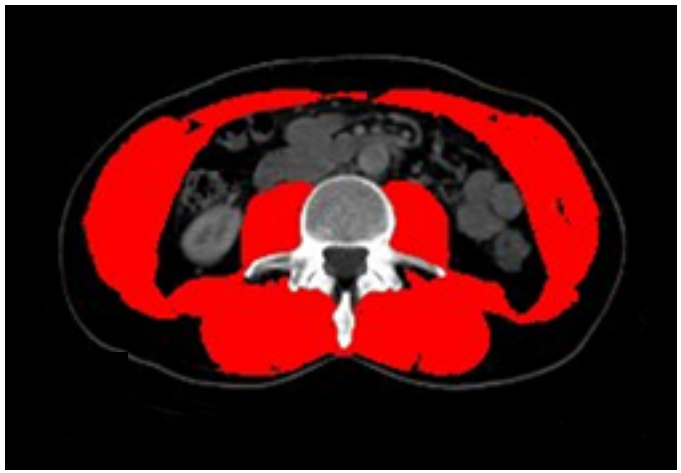
Prognosis

Temporal muscle thickness

Sarcopenic based approach

Cancer patients with muscle mass loss – worse outcome

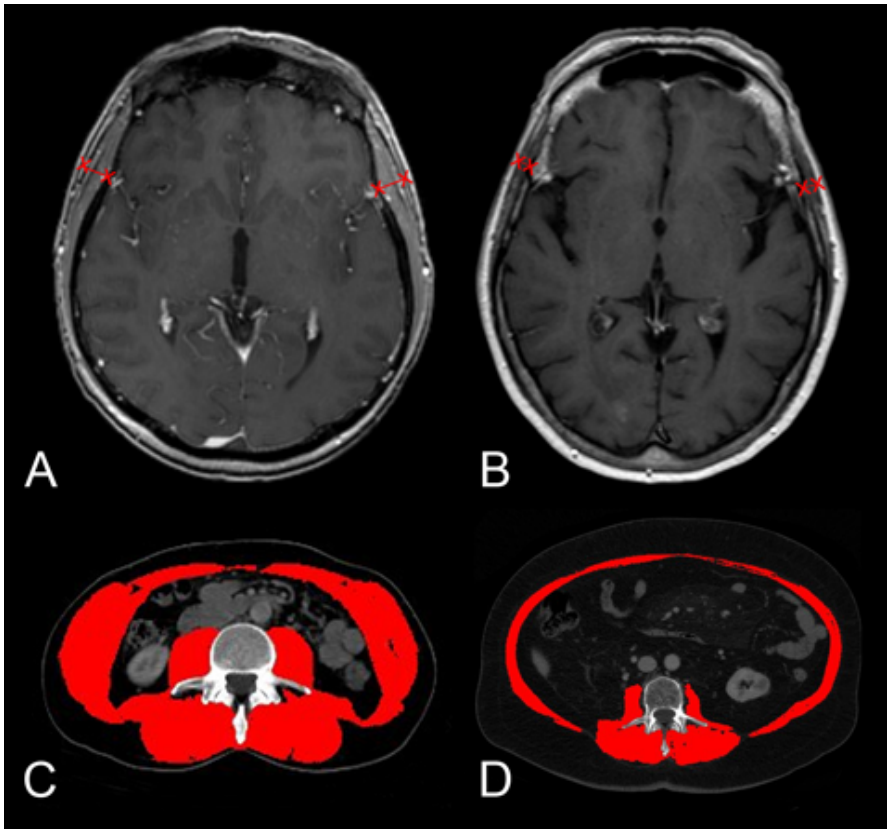


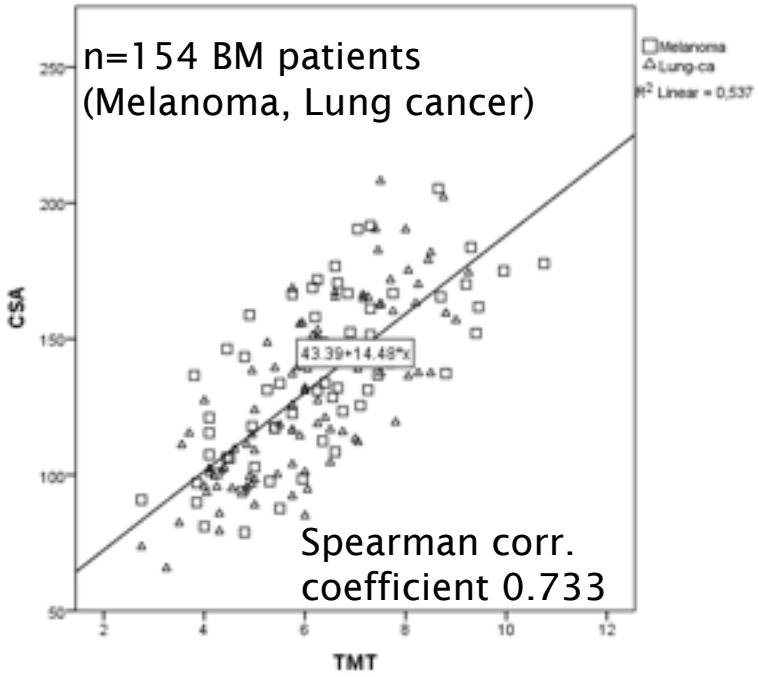


Cross sectional area of lumbar muscles L4

Prognosis

Temporal muscle thickness





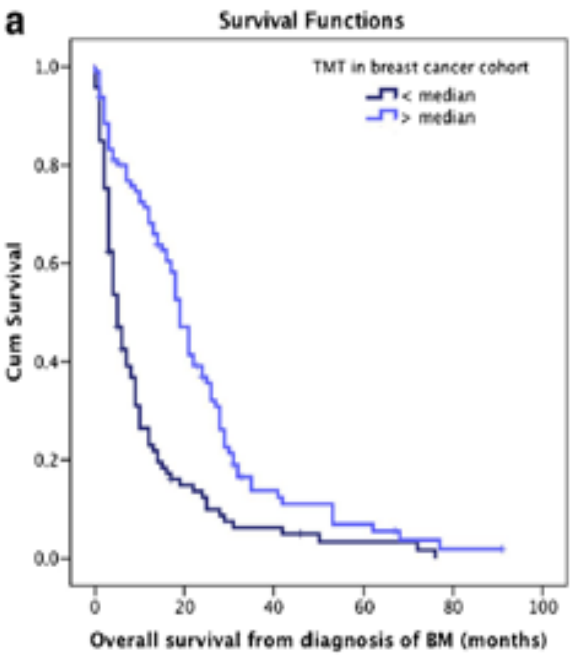
Correlation of cross-sectional area of the lumbar skeletal muscle - TMT

Leitner J, et al. in revision

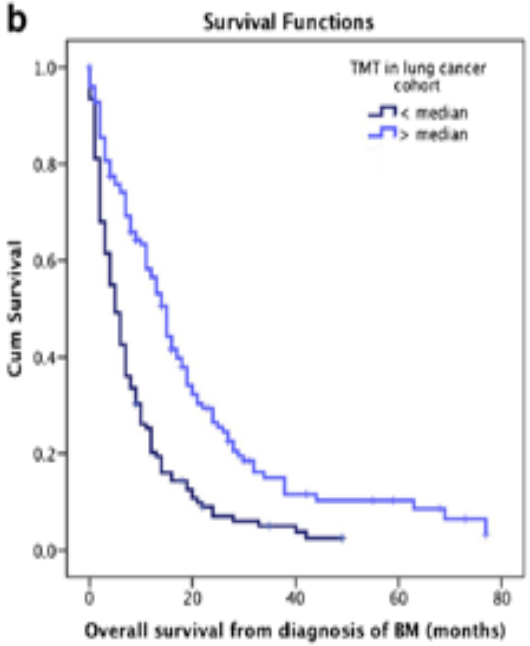
Prognosis

Temporal muscle thickness

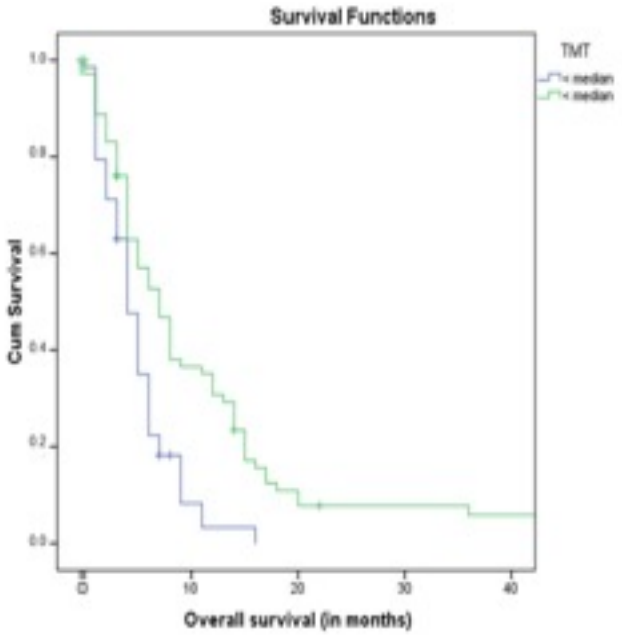
Breast cancer (n=188)



NSCLC (n=247)



Melanoma (n=146)

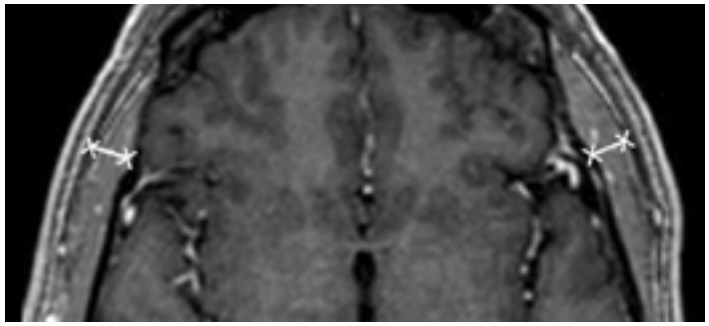


Risk of death was reduced by 19% (breast cancer), 24% (NSCLC) and 27,9% (Melanoma) with every additional millimetre of baseline TMT

Furtner J, et al. 2017 Neuro-Oncol; Furtner J, et al. 2018 J Neurooncol

Prognosis

Temporal muscle thickness



positive correlation
TMT – survival

- Baseline TMT correlates with prognosis in patients with brain metastases

- Surrogate maker for sarcopenia, which can be assessed on cranial MRI

Conclusion

Diagnosis

- Detection– conventinal MRI
- Tumor characterization/Therapy-related changes – Multimodale Imaging approach!!!

Prognosis

- Edema – pos. correlation
- Diffusion restriction – neg. correlation
- Temporal muscle thickness – pos. correlation

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