DSM
What, when, why and how?

Dr. med. Niklas Lützen
Department of Neuroradiology
CSF Center Freiburg, Germany
Chairman: Prof. Dr. med. H. Urbach

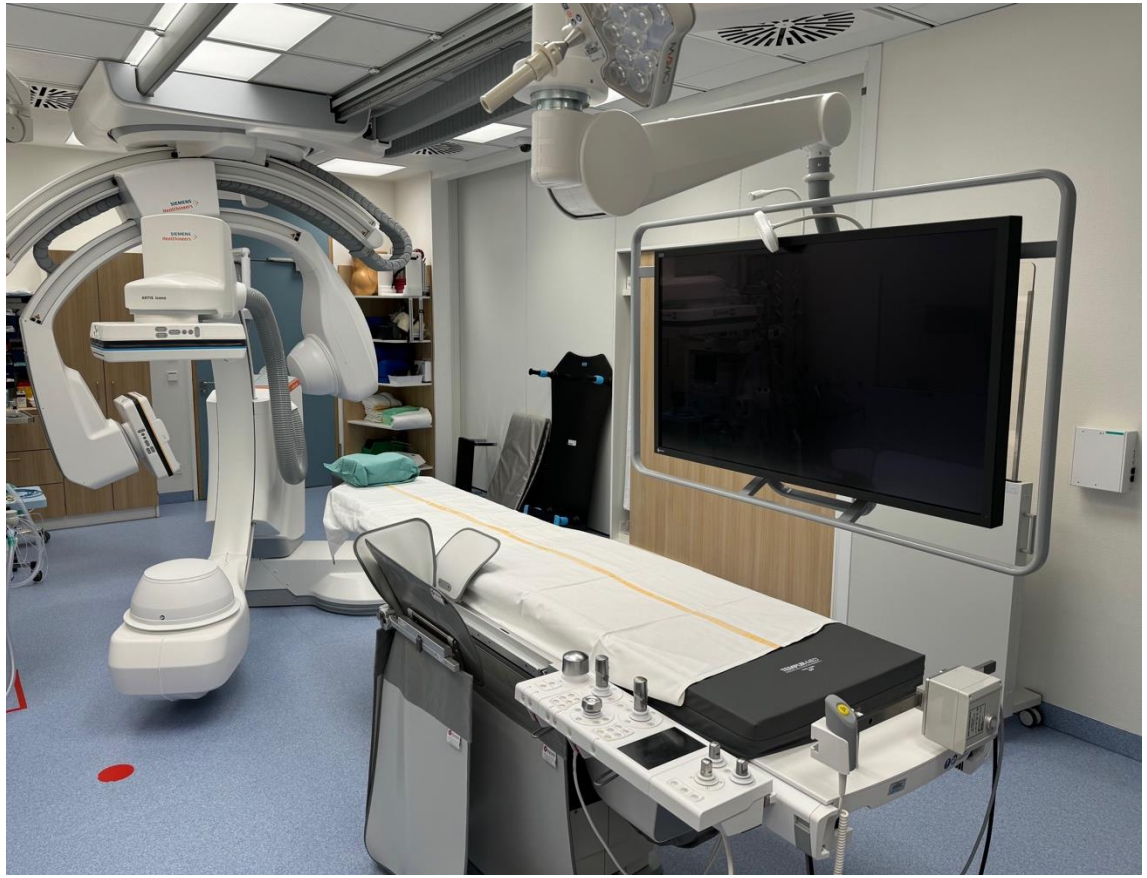
4. Dezember 2024

No disclosures

Contents

- What is DSM?
- What is fluoroscopy and cone-beam CT?
- When, why and how (for different leak types)
- Take-home message

DSM technique



Angiography suite

Digital subtraction angiography (DSA)

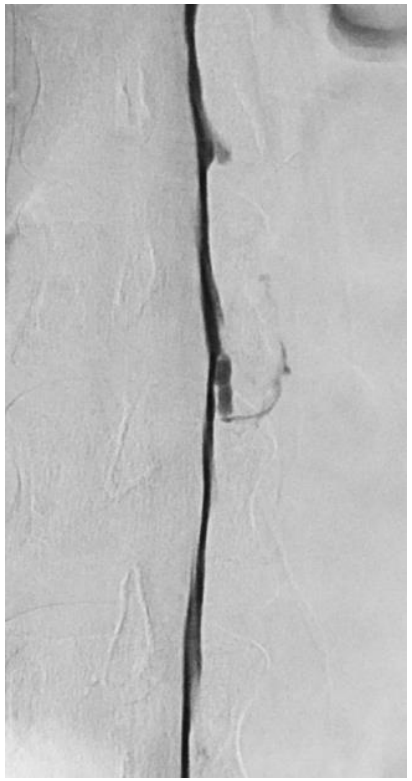
DSM technique

Pros

- High temporal resolution
- „live leak observation“
- Fluoroscopy, Conebeam CT
- Moderate radiation[1]

Native xray (mask)

Xray + contrast



Subtraction

Cons

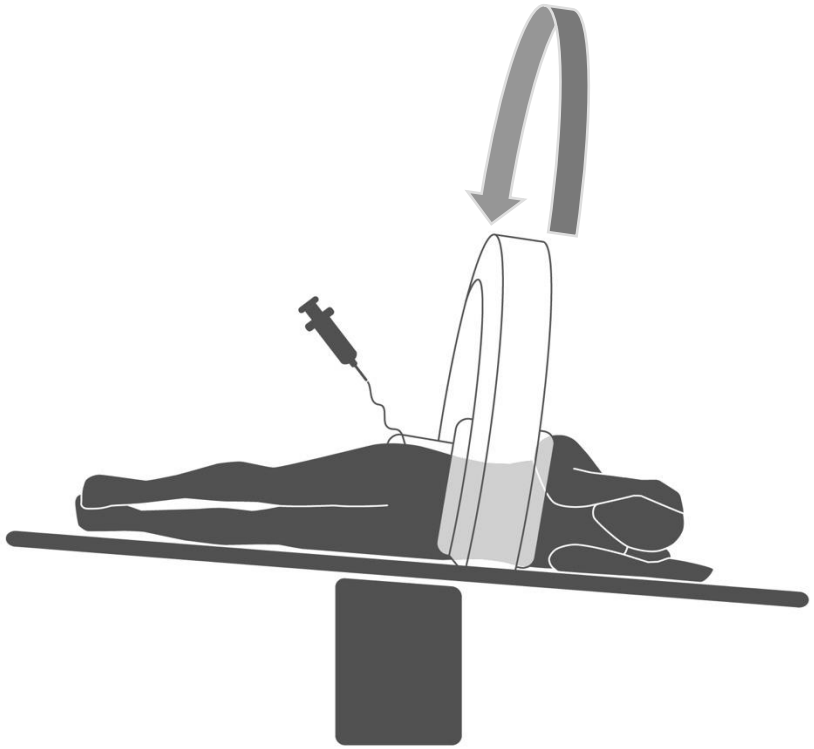
- Sensitive to moving/breathing
- Plane images (mono-/biplane)
- Usually only one try
- Limited coverage

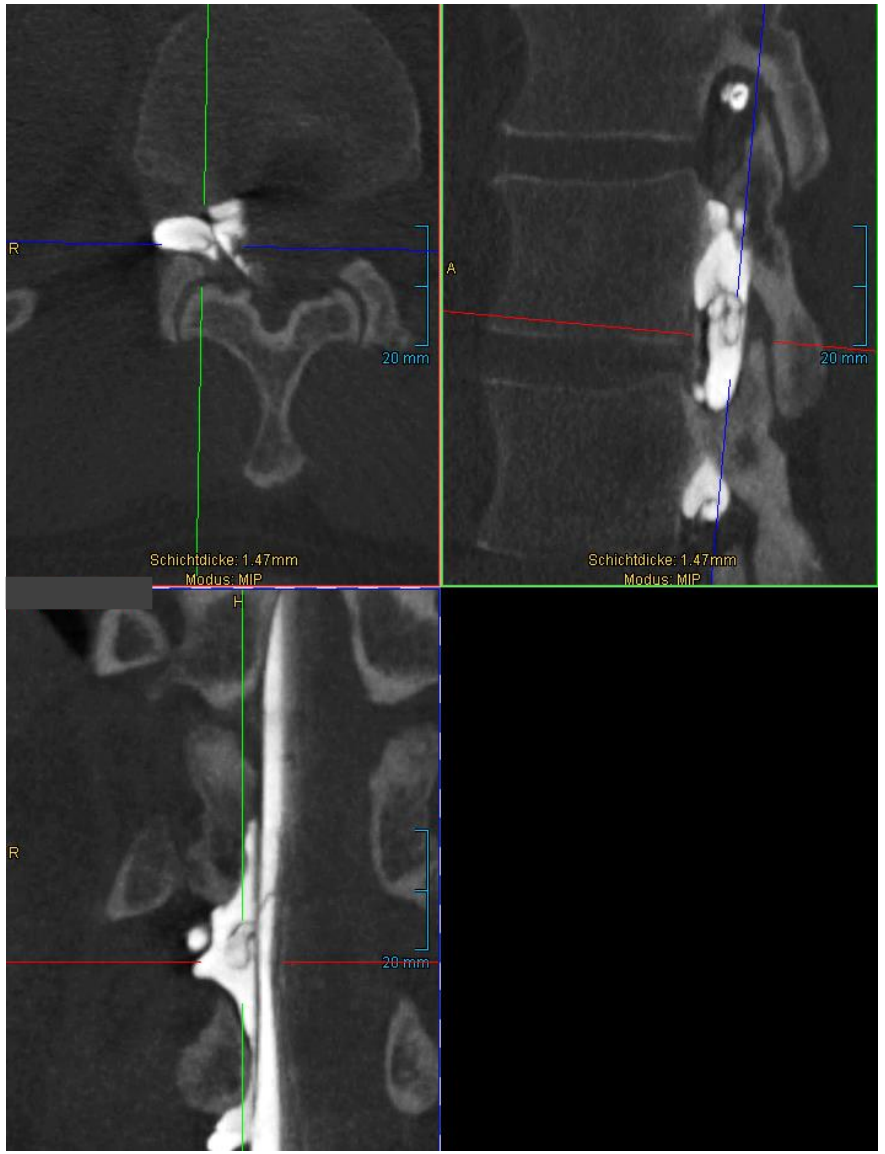
[1]*Nicholson et al., Clin. Neuroradiol. 2021*

Fluoroscopy

- Low image quality
- Usually 4-30 fps

Cone-beam CT (following DSM)



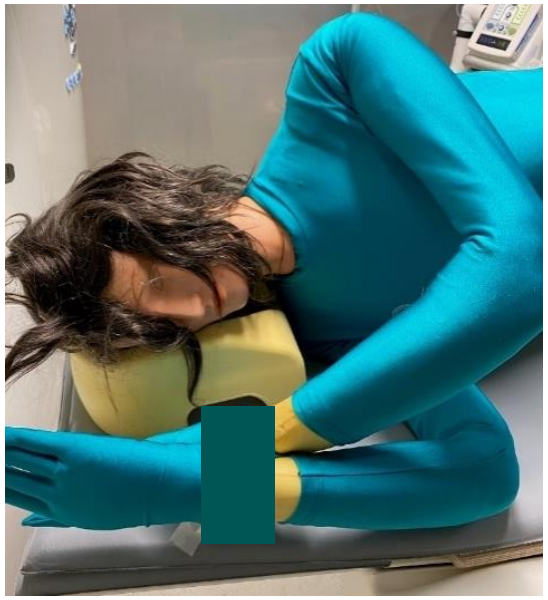


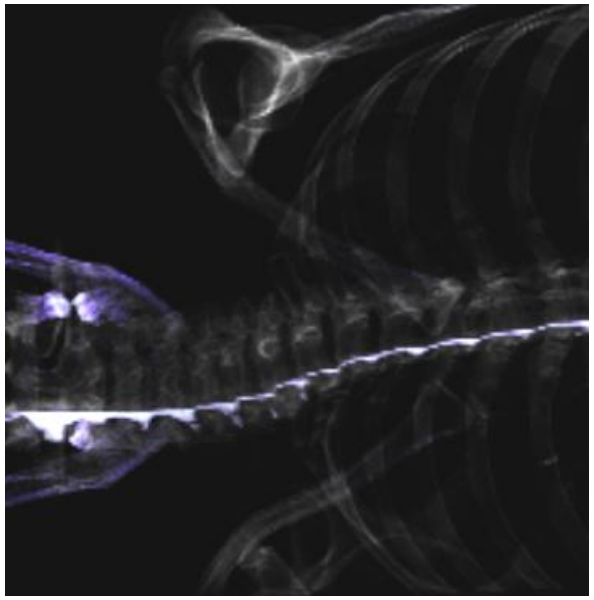
- Cross sectional images
- Limited coverage

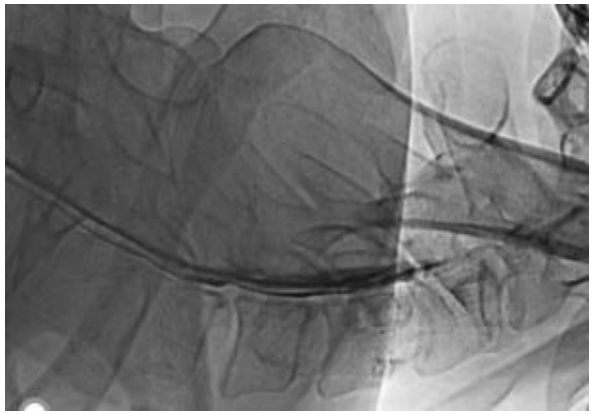
Side-effects

- Headache
- Nausea
- Vomiting
- Seizure
- (Contrast allergy)

Keep contrast out of head







Classification of spinal CSF leaks

Type 1
(ventral tear)

MRI: Fluid +

Type 2
(lateral tear)

MRI: Fluid +

Type 3
(CSF-venous fistula)

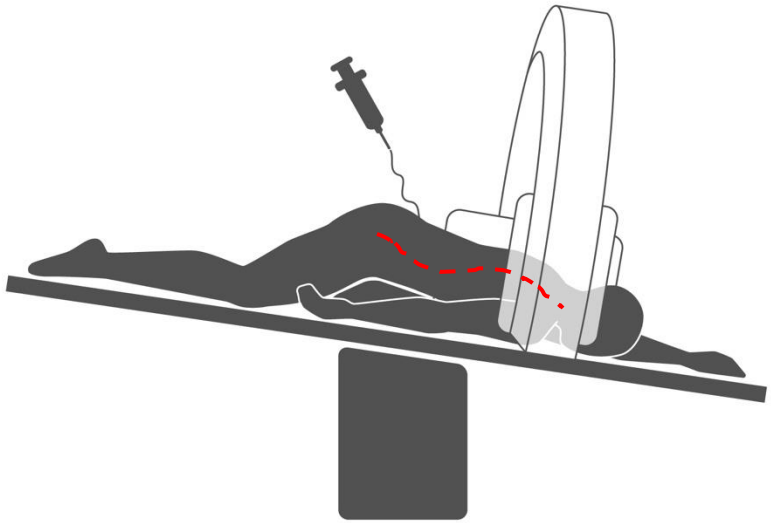
MRI: Fluid -

Sacral dural tears [1]

MRI: Fluid +

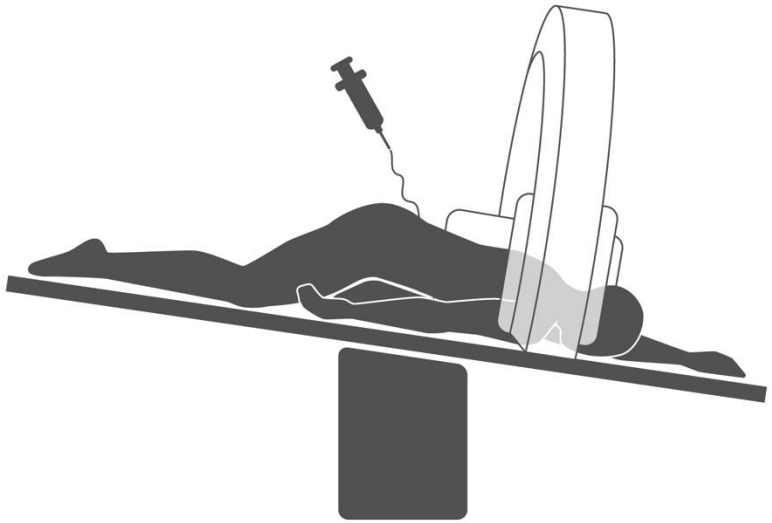
[1] *Lützen et al., Clin. Neuroradiol. 2023*

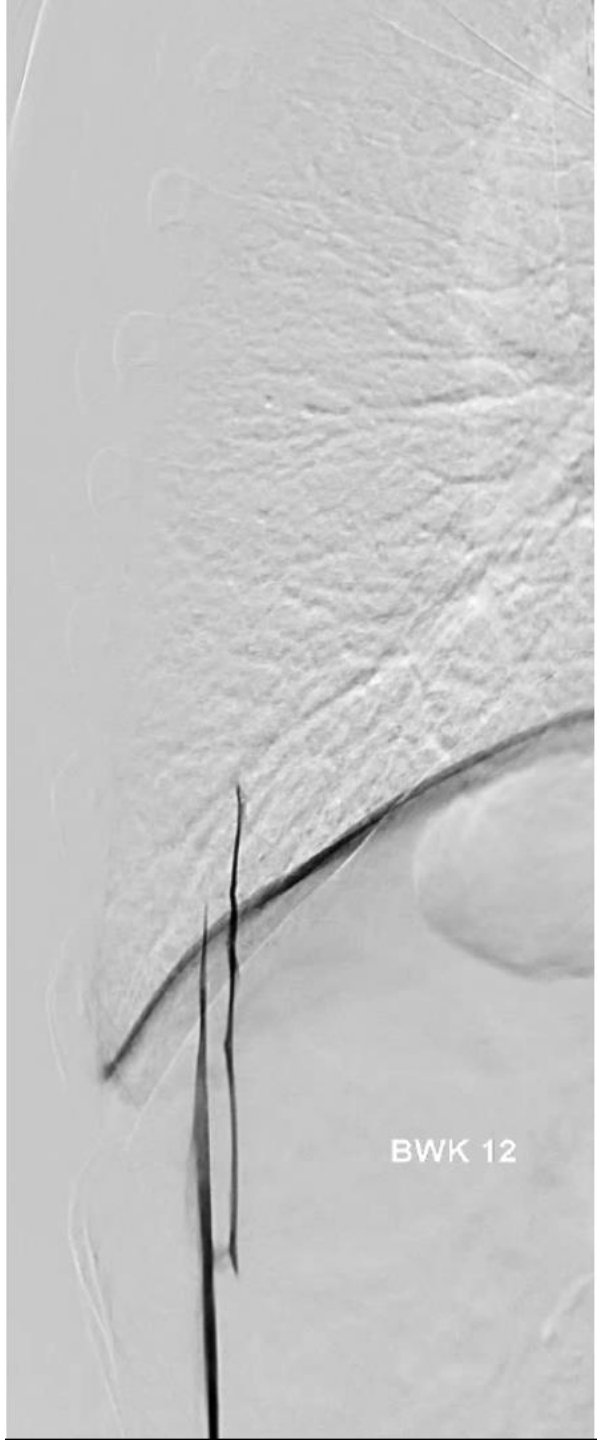
Type 1 (ventral tear)

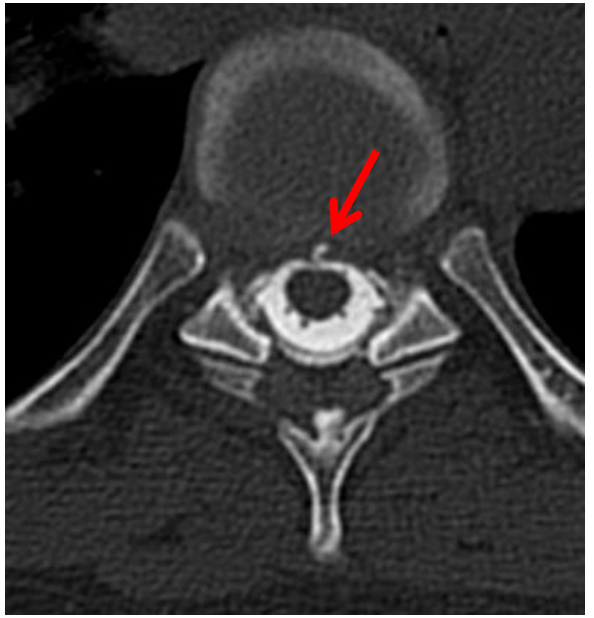


- Prone position
- High-flow leaks
- 1 fps (or more)
- **Breath-hold technique**

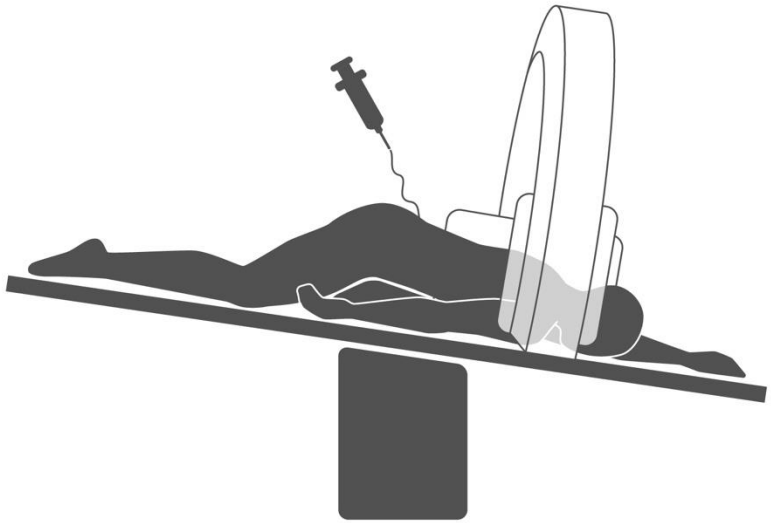
Type 1 (ventral tear)

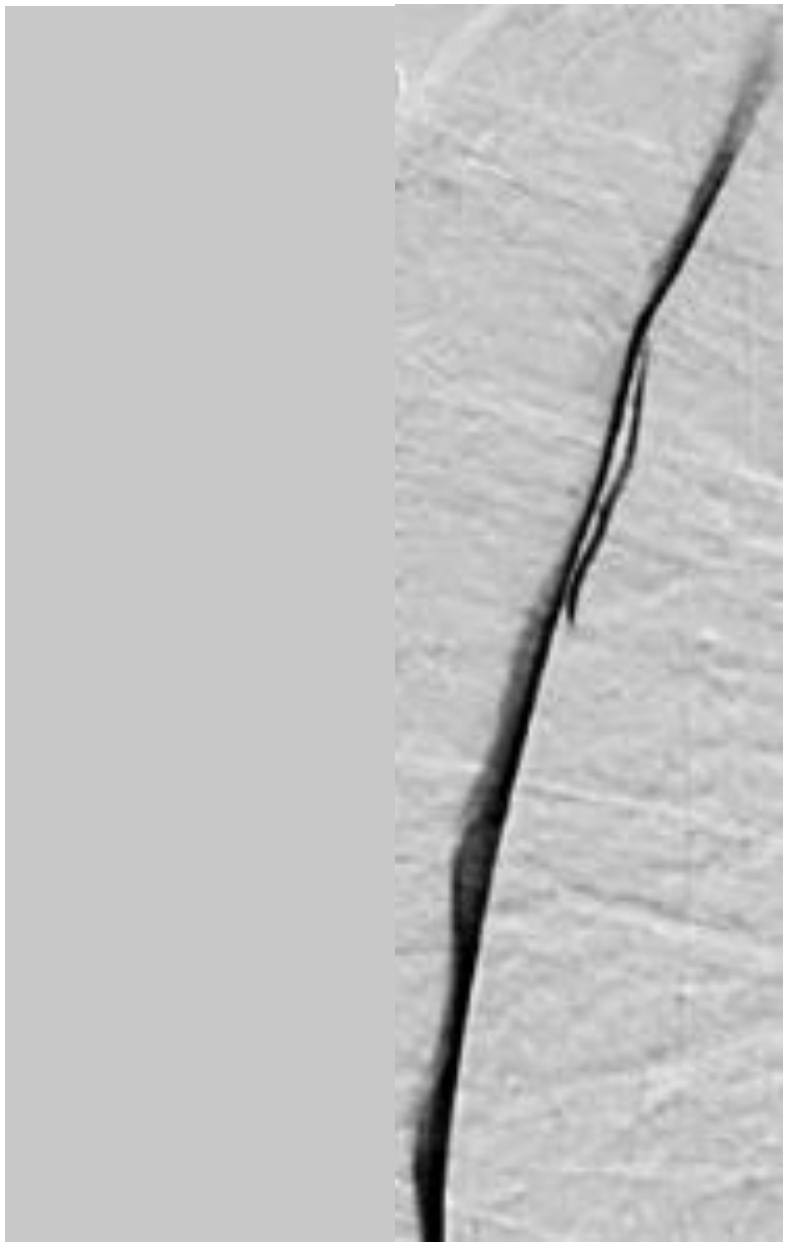




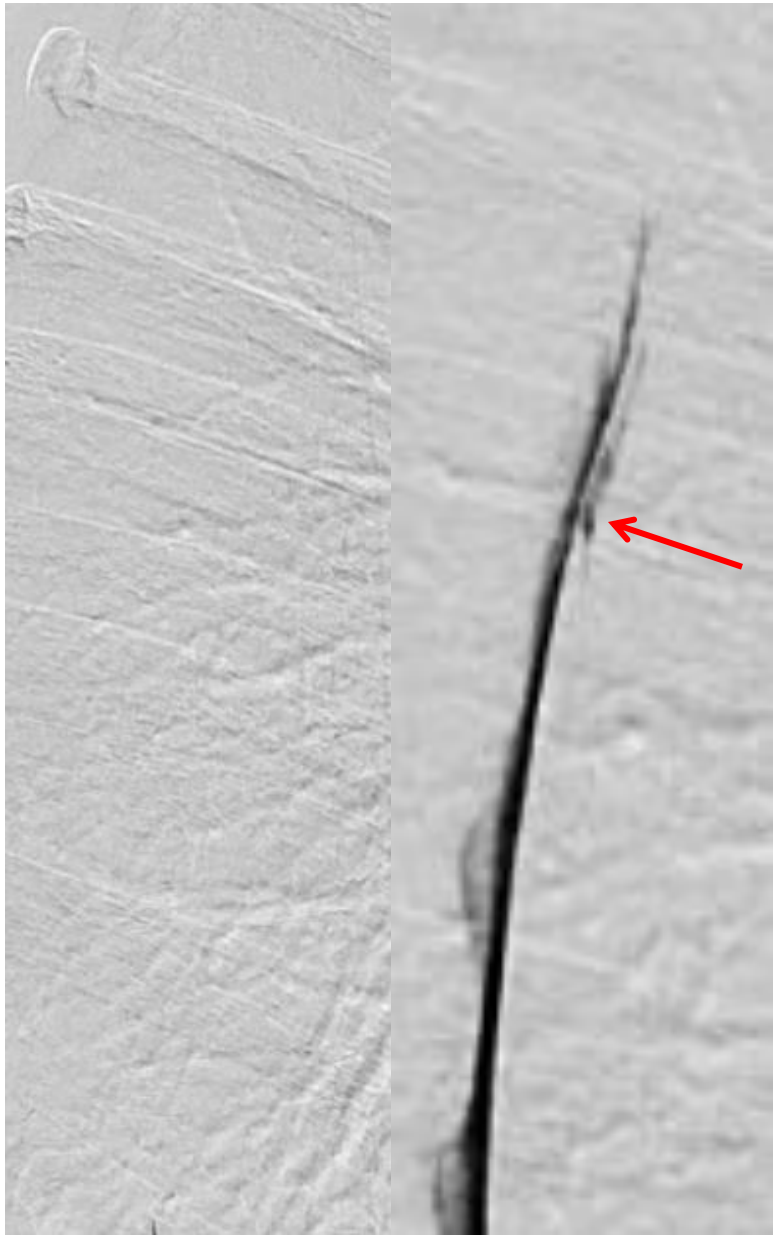


Type 1 (ventral tear)



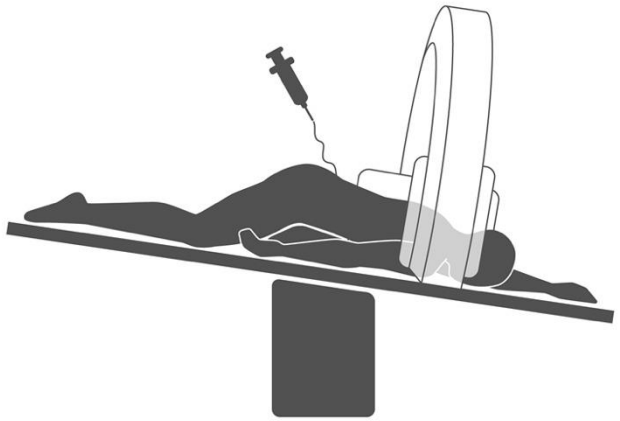


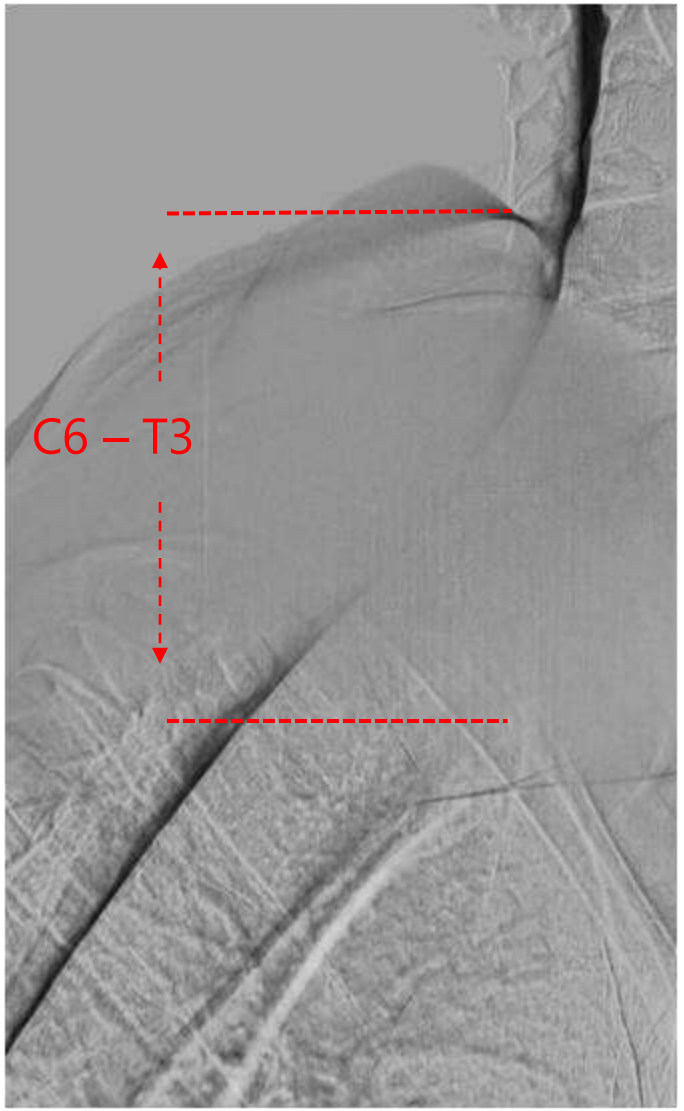
1 fps



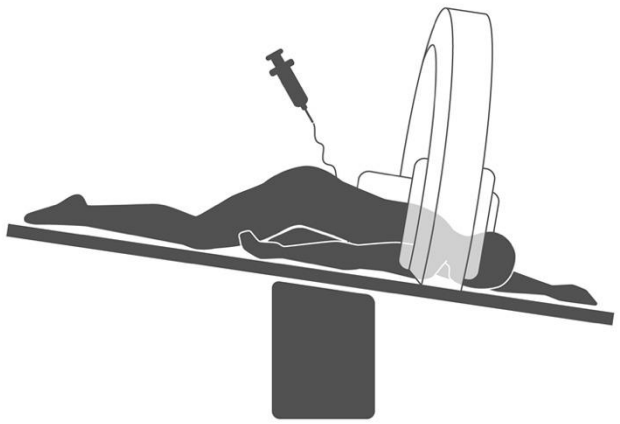
4 fps

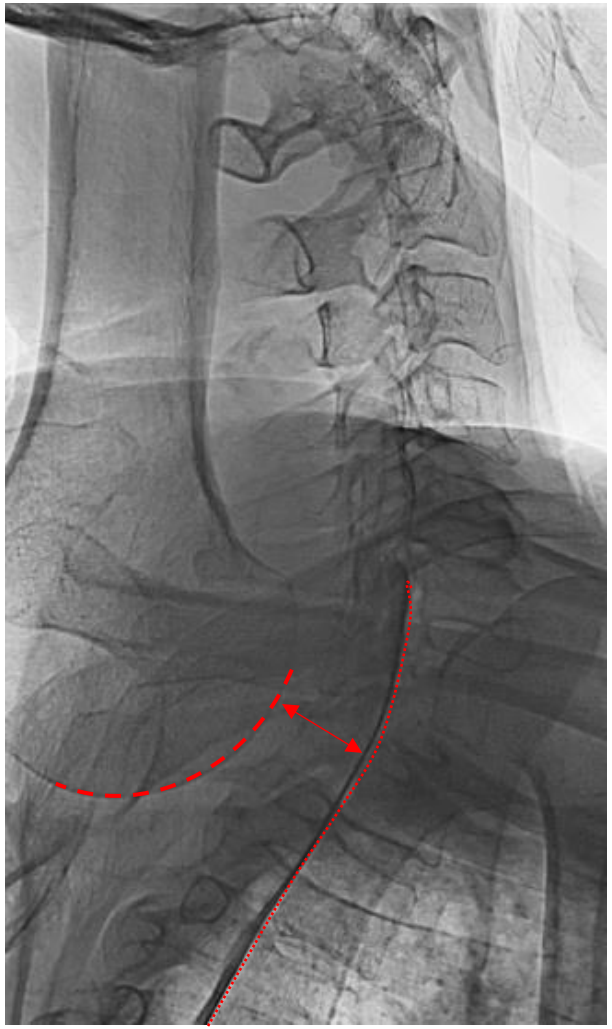
Type 1 (ventral tear)





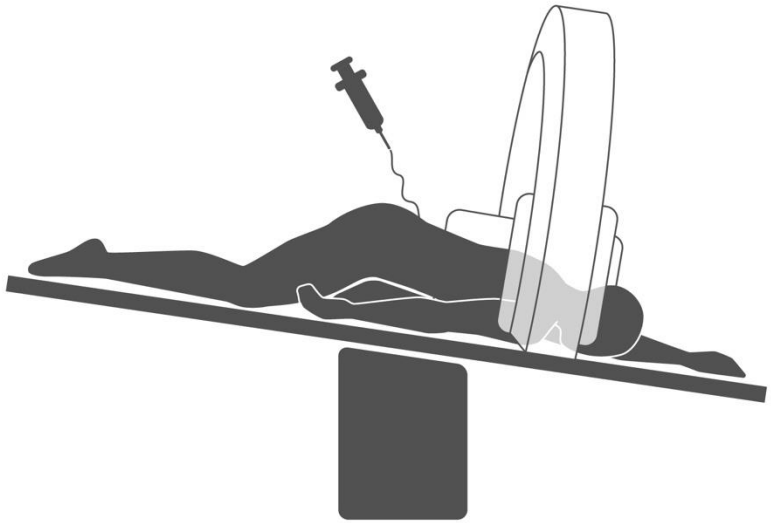
Type 1 (ventral tear)





Lützen et al., Clincal Neuroradiology 2023

Type 1 (ventral tear)



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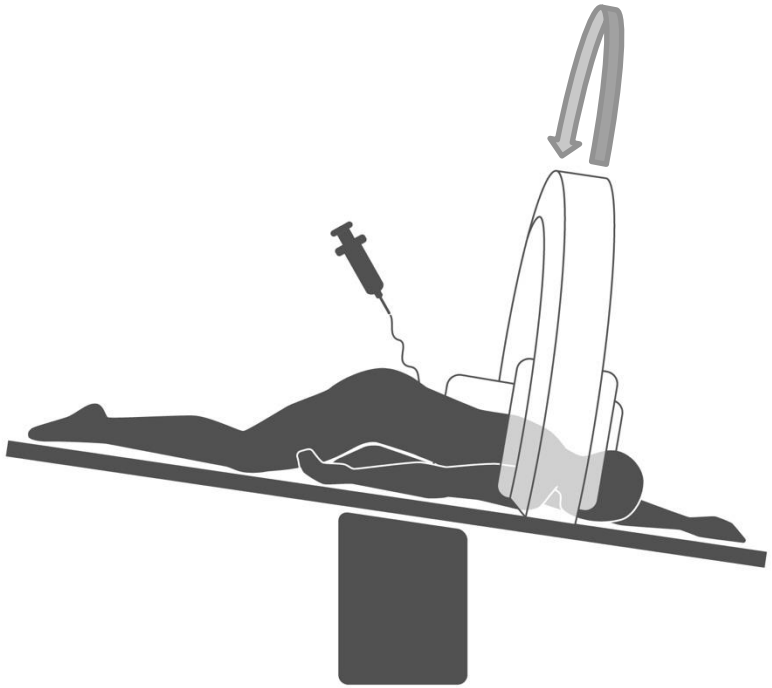
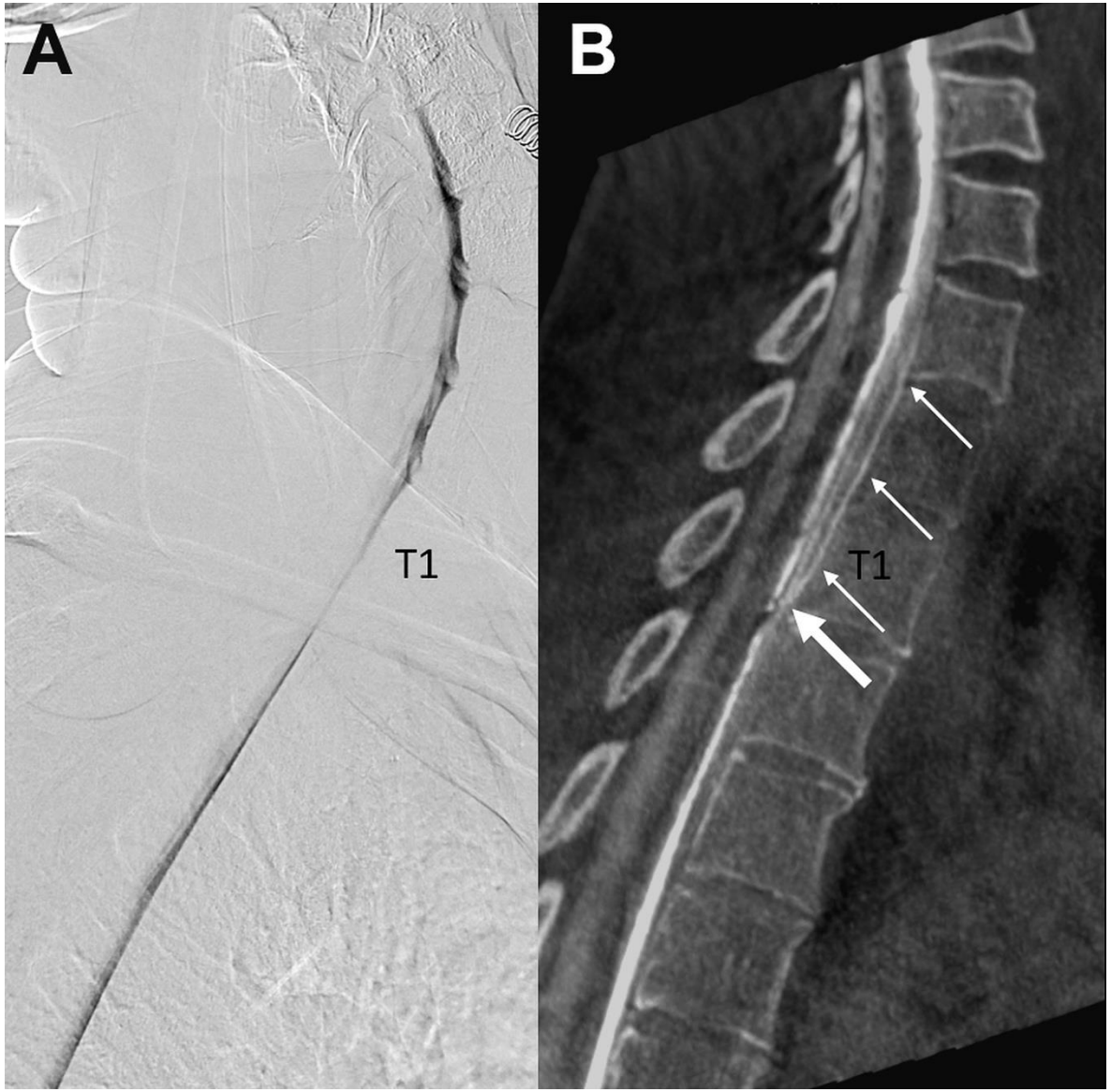
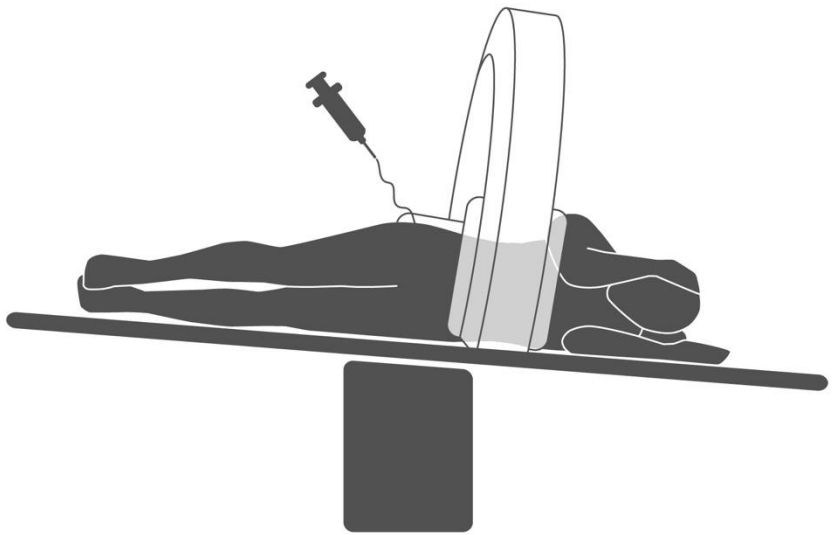


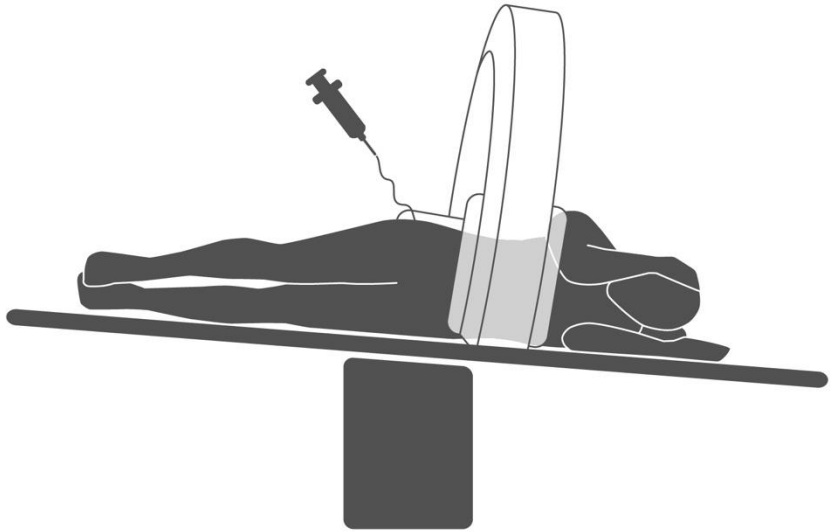


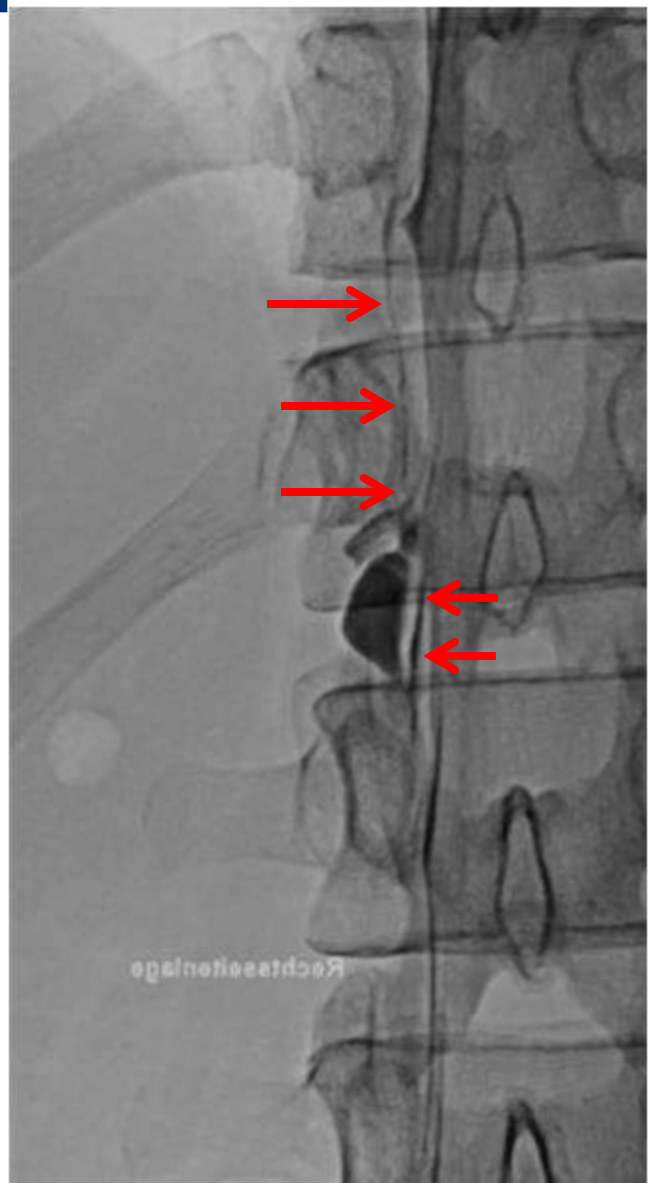
Type 2 (lateral tear)



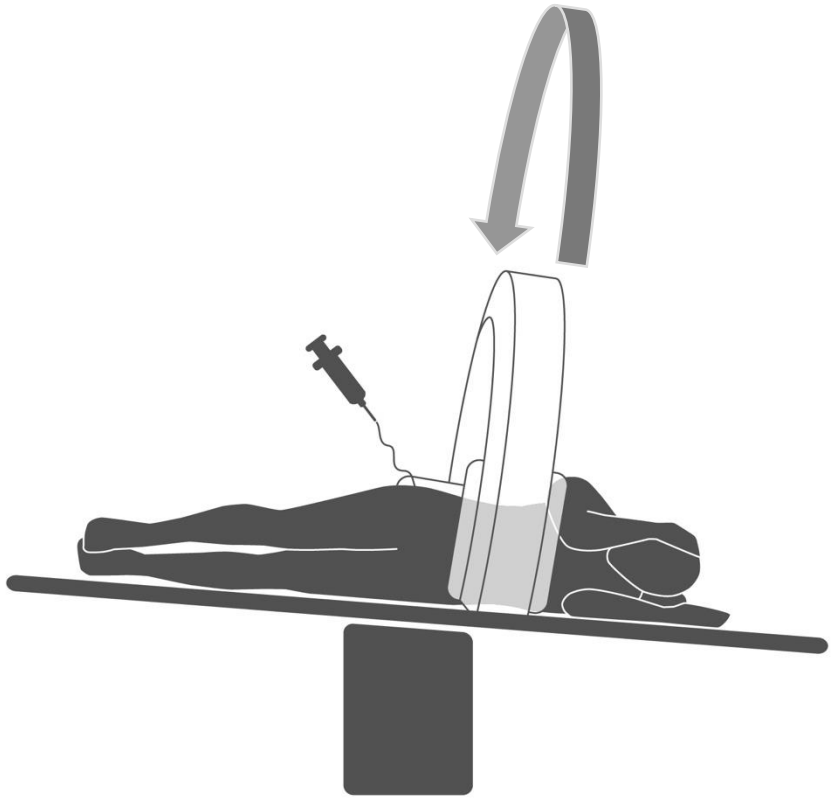
- Lateral decubitus position
- High to low flow leaks
- 60-90sec run at 1fps
- **Keep breathing (shallow)**
- (Supplement Cone-beam CT)

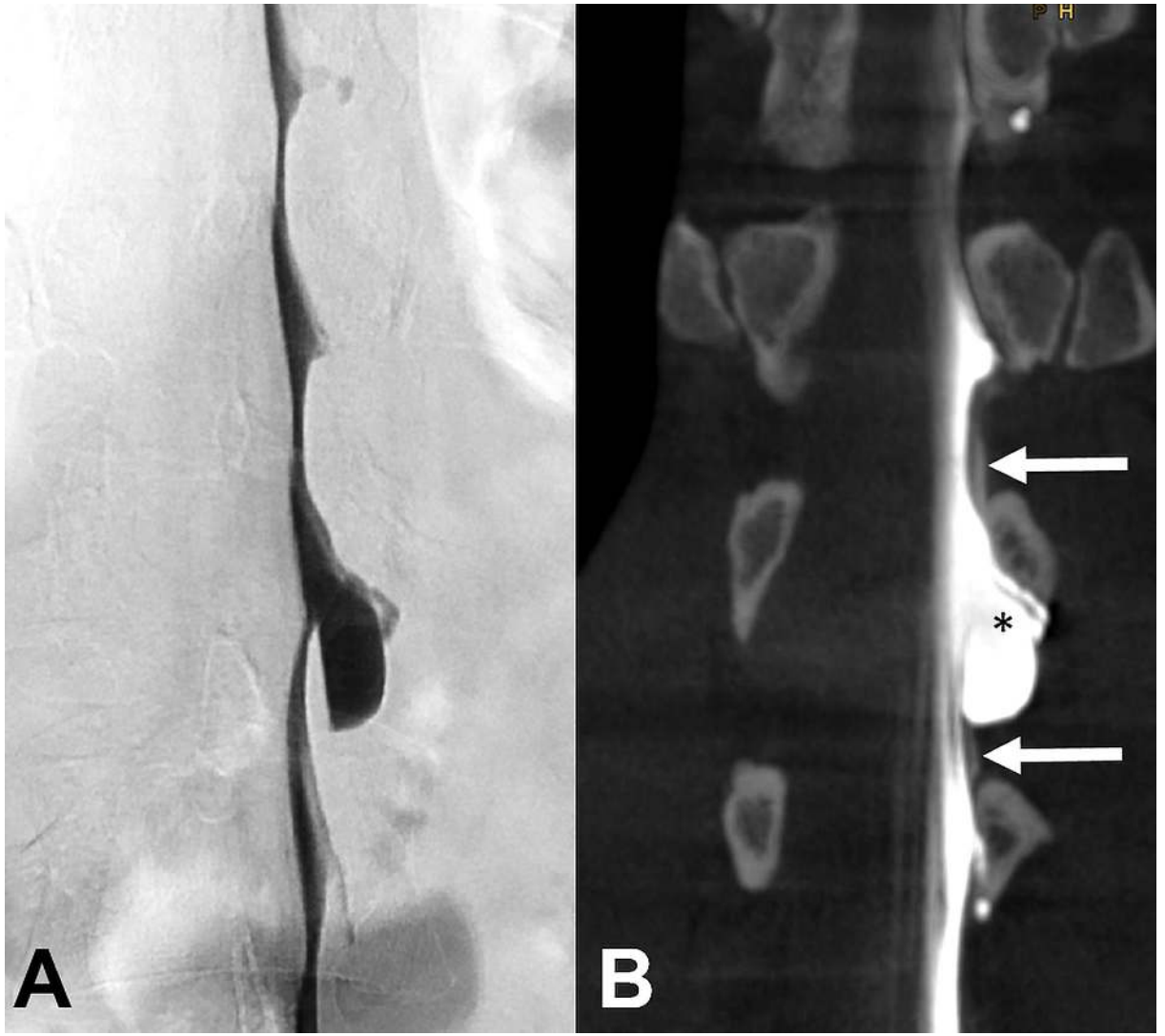
Type 2 (lateral tear)





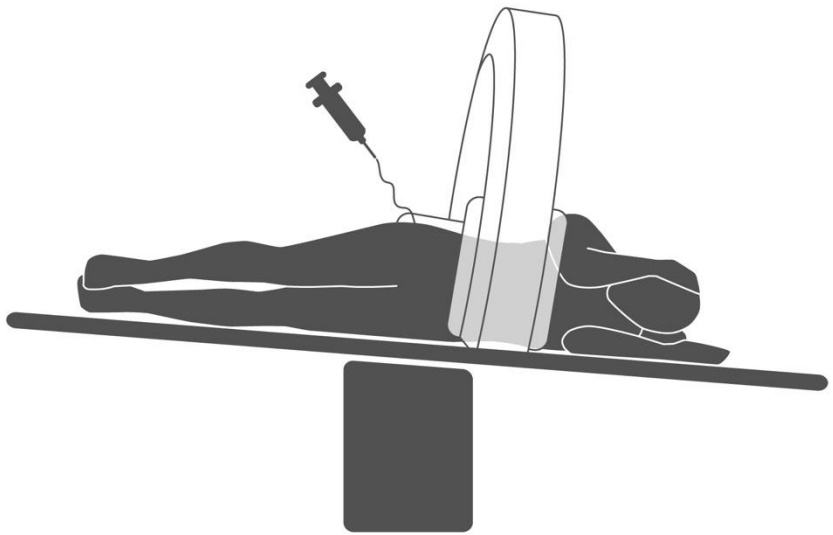
Type 2 (lateral tear)





Lützen et al., AJNR 2023

Type 3 (CSF-venous fistula)



- Lateral decubitus position
- Most appear within first min.[1, 2]
- 60-90sec run at 1fps
- **Keep breathing (shallow)**
- (Supplement Cone-beam CT)

[1] *Mark et al., AJNR 2023*

[2] *Callen et al., AJNR 2023*

DSM versus CTM

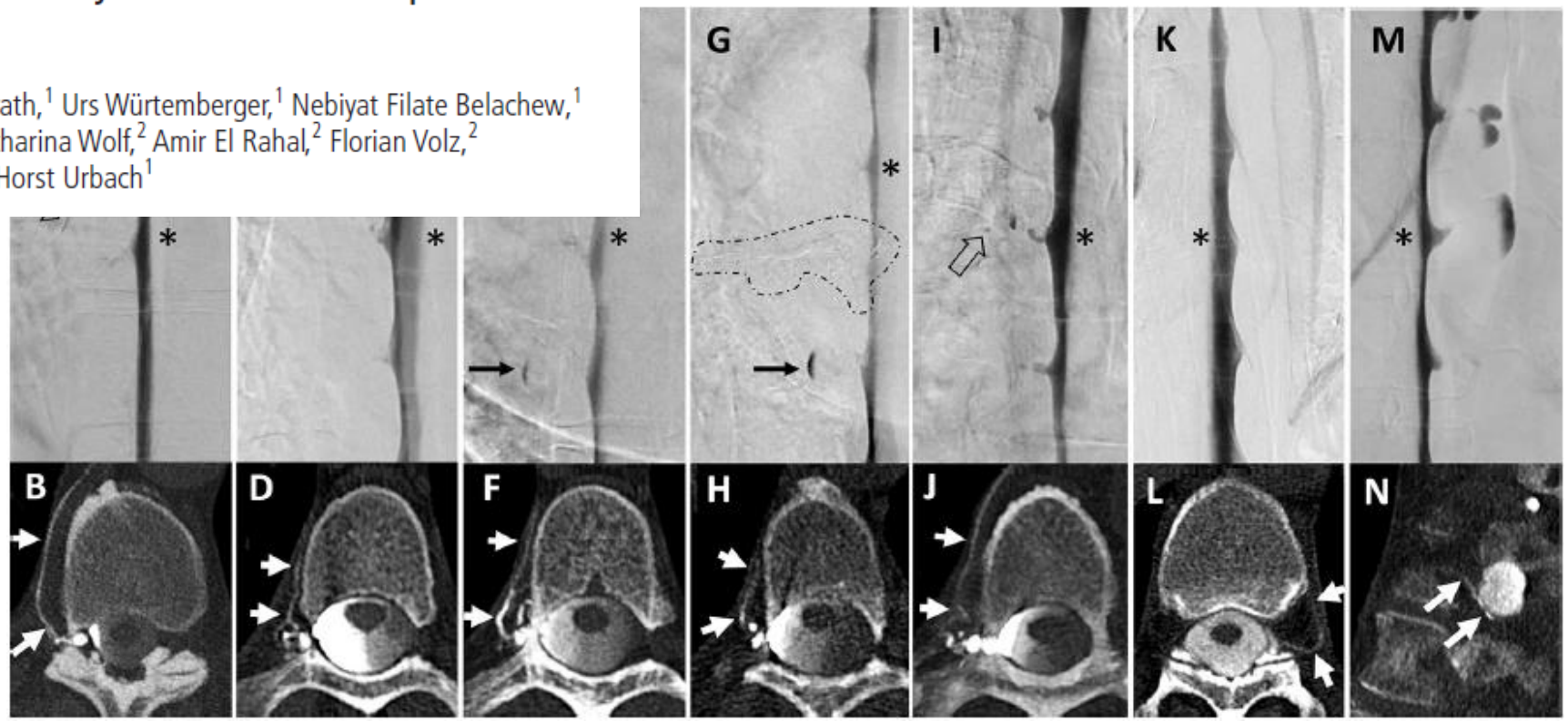
Spine

OPEN ACCESS

Original research

Direct comparison of digital subtraction myelography versus CT myelography in lateral decubitus position: evaluation of diagnostic yield for cerebrospinal fluid-venous fistulas

Niklas Lützen ,[1] Theo Demerath,[1] Urs Würtemberger,[1] Nebiyat Filate Belachew,[1] Enrique Barvulsky Aleman,[1] Katharina Wolf,[2] Amir El Rahal,[2] Florian Volz,[2] Christian Fung,[2] Jürgen Beck,[2] Horst Urbach[1]



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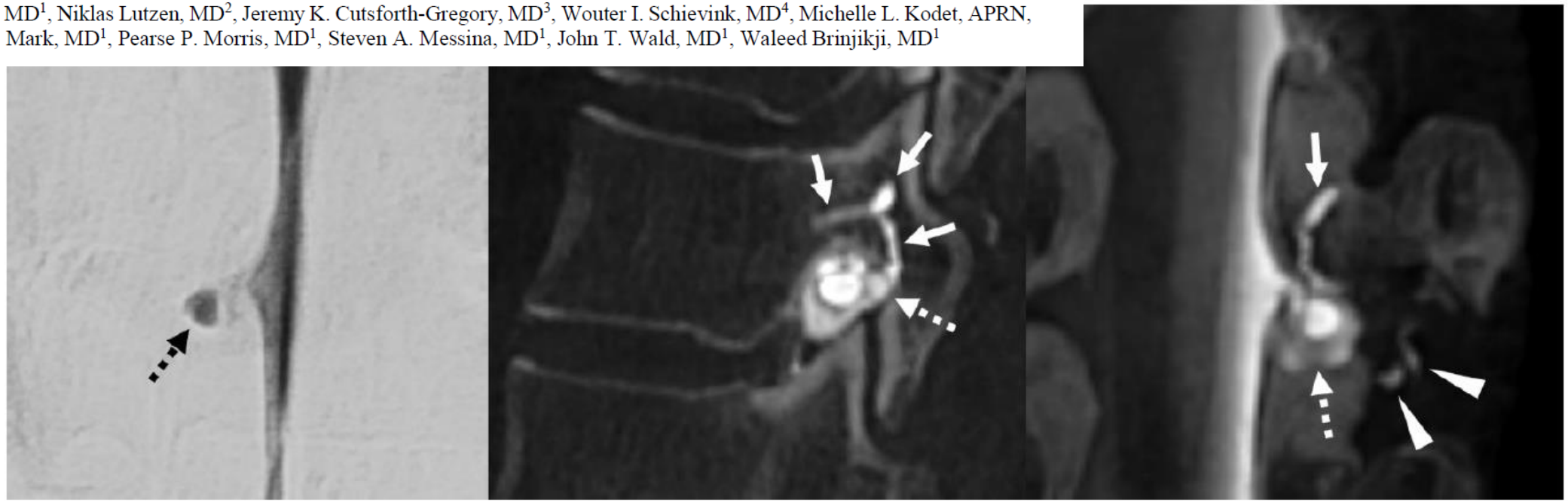
DSM versus Conebeam CT

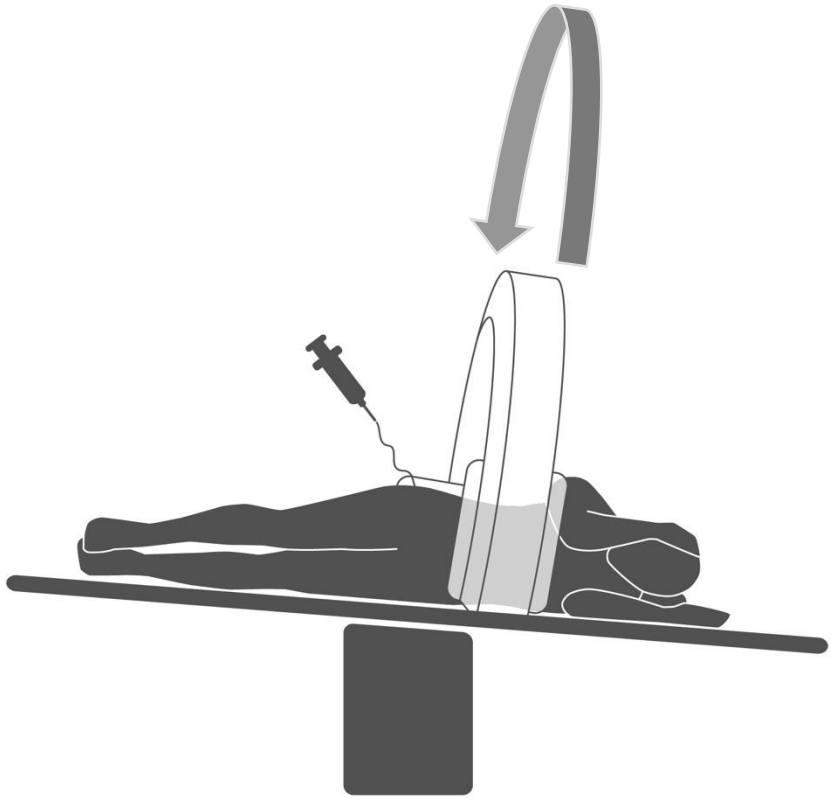
Additional Diagnostic Value of Cone Beam CT Myelography Performed After Digital Subtraction Myelography for Detecting CSF-venous Fistulas

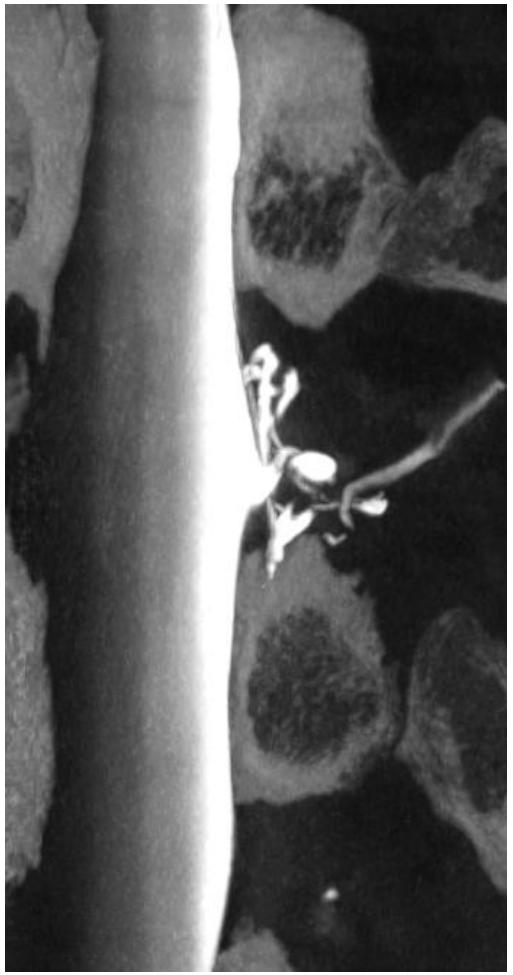
Ajay A. Madhavan, MD[1], Niklas Lutzen, MD[2], Jeremy K. Cutsforth-Gregory, MD[3], Wouter I. Schievink, MD[4], Michelle L. Kodet, APRN, CNP, MSN[1], Ian T. Mark, MD[1], Pearse P. Morris, MD[1], Steven A. Messina, MD[1], John T. Wald, MD[1], Waleed Brinjikji, MD[1]



Type 3 (CSF-venous fistula)

Ultrahigh-Resolution Conebeam CT



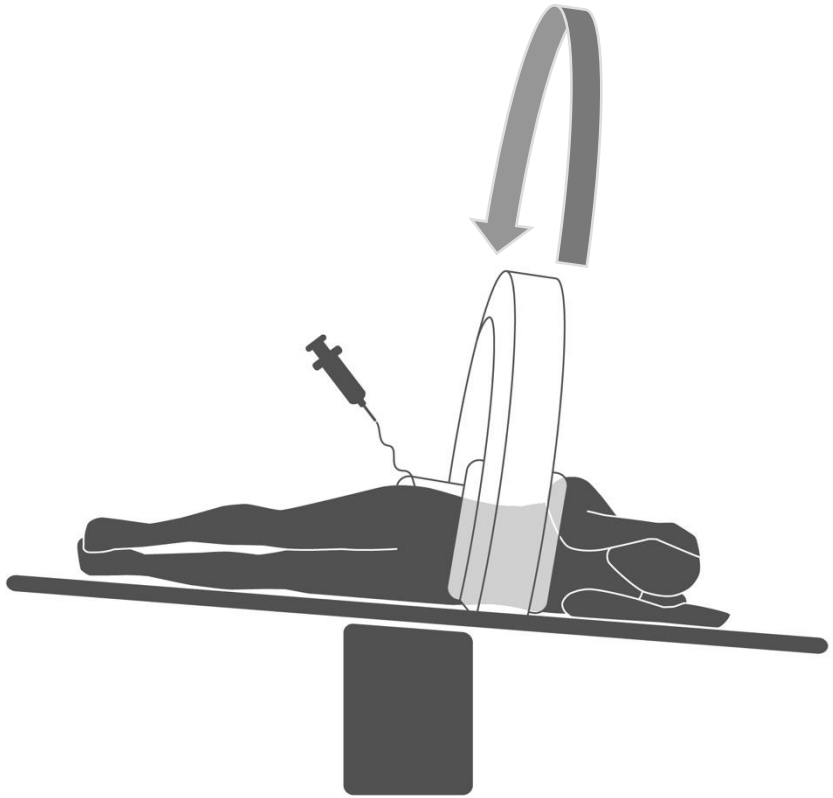


0.14mm

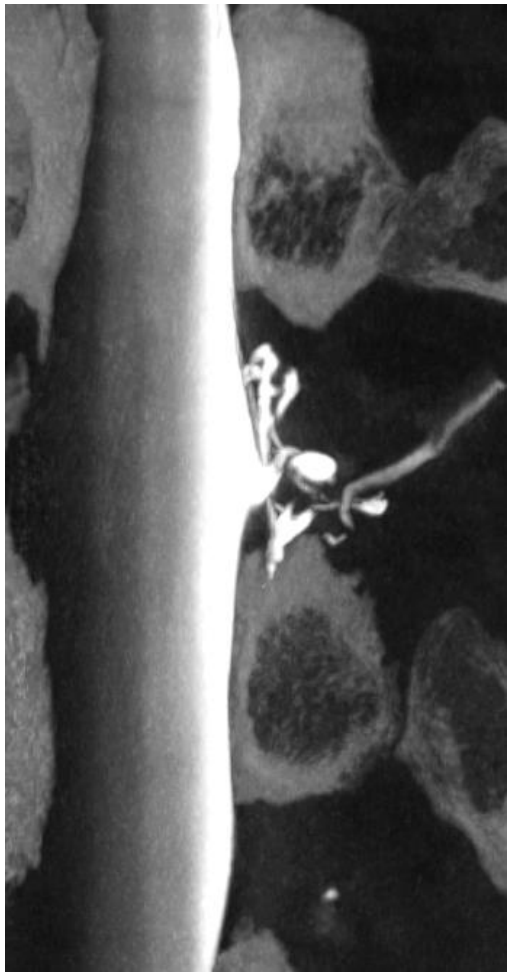
- Lateral decubitus position
- 14sec run
- **Breath-hold technique**

Lützen et al., JAMA Neurology 2023

Type 3 (CSF-venous fistula)



UHR_CBCT

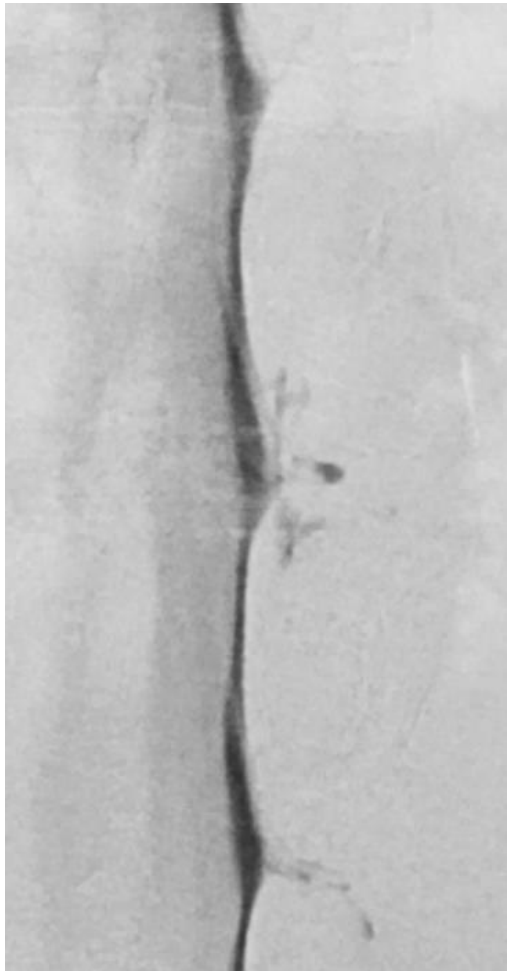


0.14mm

CTM

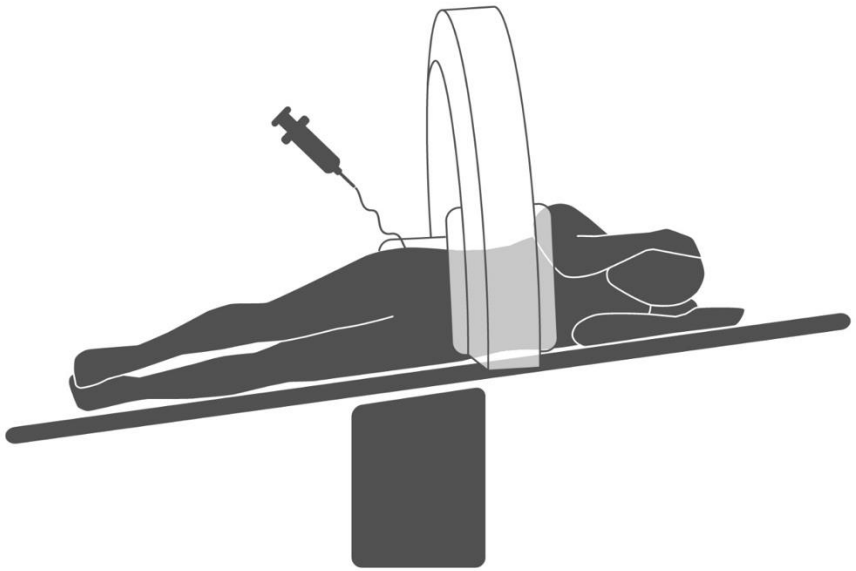
0.6mm

DSM



0.3mm

Sacral dural tears



- Lateral decubitus position (rev. Trendelenburg)
- Slow flow leaks
- 60-90sec run at 1fps
- **Keep breathing (shallow)**

Take-home message

- DSM: „live observation“ of the leak
- DSM is challenging**: planning, positioning and communication with patients**
- Particularly suitable for type 1 and 2 leaks
- **Hold breath** in type 1
- **Keep breathing** in type 2 and 3
- Cone-beam CT can be a valuable tool (type 2 and 3)

EANS CEREBROSPINAL FLUID SECTION

International Collaborations

Inselspital Bern, Switzerland
(Dorbocky, Piechowiak, Schankin, Raabe)

Lindenhofspital Bern, Switzerland
(Fung, Ulrich)

ETH Zuerich, Switzerland
(The Interface Group)

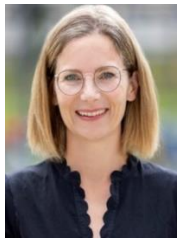
AKH, Vienna, Austria
(Kapan)

King's College, UK
(Carlton-Jones)

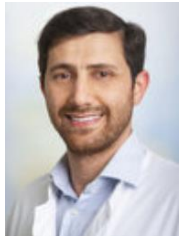
Cedars Sinai, CA, USA
(Schievink)

Stanford, CA. USA
(Carroll)

CSF-Center Freiburg




Neurosurgery & Neurology
J. Beck, K. Wolf, F. Volz,
L. Krismer, A. El Rahal, M. Shah

Neuroradiology
H. Urbach, N. Lützen,
C. Zander, T. Demerath, H. Mast

Nuclear Medicine
P.T. Meyer & Team

Anesthesiology
H. Bürkle & Team

Neuroophthalmology
W. Lagrèze & Team

Neuromedical AI Lab
T. Ball & Team

Medical Physics
M. Reisert & Team

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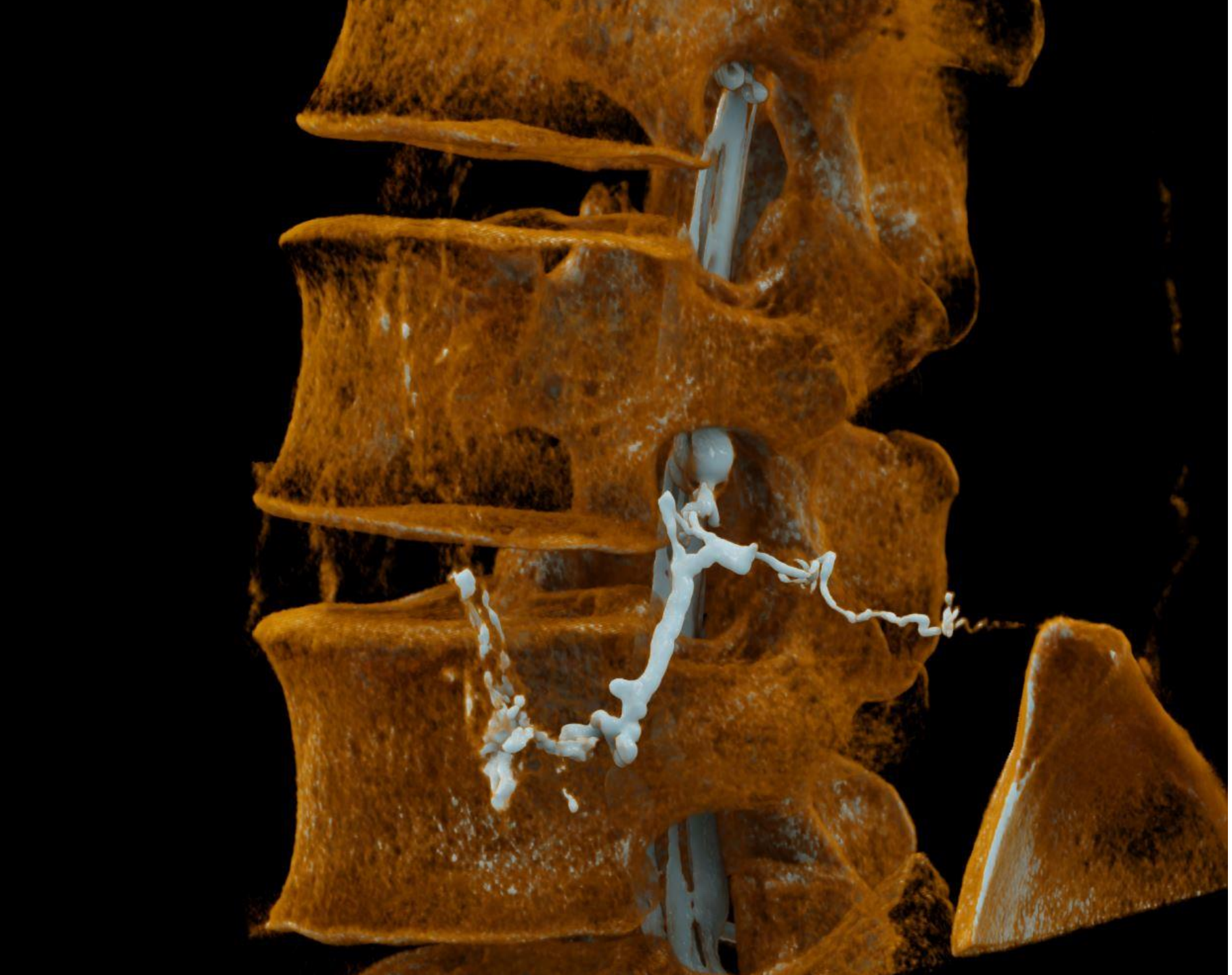
@Niklas_Luetzen

Baden-Württemberg
MINISTERIUM FÜR WISSENSCHAFT, FORSCHUNG UND KUNST



Thank you!

niklas.luetzen@uniklinik-freiburg.de