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Tips & Tricks

CT Working Group

Dose saving options in maxillofacial trauma

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Maxillofacial trauma

- Cause: Sports activities, violence, activities of daily life, play, traffic, and work accidents
- Patients: 24% are between 20 and 29 years old and almost 60% are aged from 20 to 40 years
- Incidence: mountain sports region Innsbruck, Tirol, Austria

  300.000 inhabitants, 30.000 students, 3.000.000 guest nights per year

> 700 maxillofacial bone fractures per year

> 1000 maxillofacial CTs per year

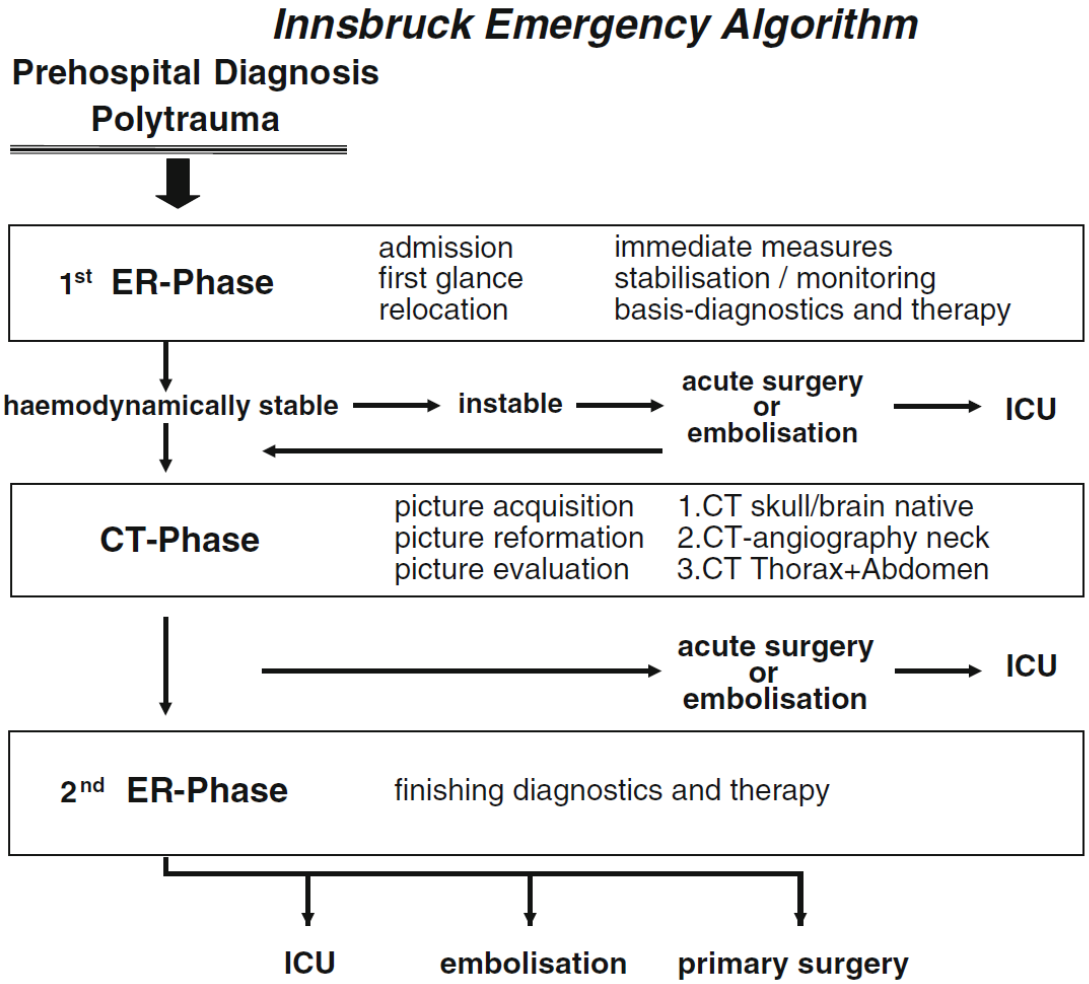
Kraft et al. Craniomaxillofac Trauma Reconstr. 2012.

Role of CT imaging in maxillofacial trauma

- Diagnosis
- Treatment planning
- Stereolithographic model fabrication
- Intraoperative guidance – computer aided surgery
- Postoperative evaluation

Quality demands: high resolution image data with submillimetric accuracy in all three dimensions

Polytrauma



Wick et al. Arch Orthop Trauma Surg. 2010.

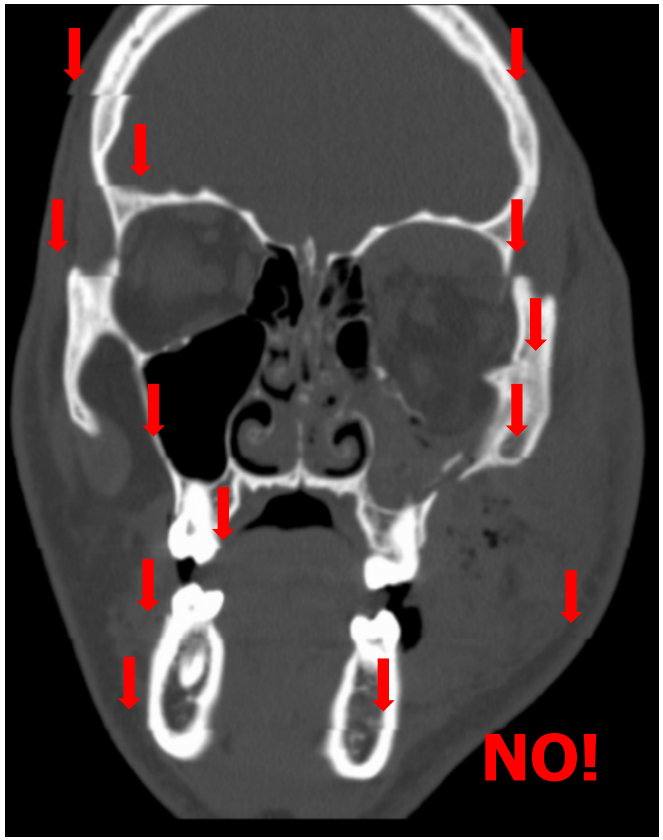
Maxillofacial reconstructions using CT brain from CT emergency algorithm?

CT brain DRL: $CTDI_{vol}$ 60 mGy, DLP 850 mGycm (16 cm head phantom)*

- Primary focus: skull fracture, ICB (EDH, SDH, SAB), contusion, DAI
- Technique: axial scan of the brain with tilted gantry (maxilla and mandible are not included in the scan)
- Extension of the scan length to include maxilla and mandible means additional radiation dose
- Stair-step artifacts from axial scanning mode limit MPR and VR reconstructions

Abbreviations: DRL – diagnostic reference level. $CTDI_{vol}$ – computed tomography dose index volume. DLP – dose length product. ICB – intracranial bleeding. EDH – epidural haematoma. SDH – subdural haematoma. SAB – subarachnoidal bleeding. DAI – diffuse axional injury. MPR – multiplanar reconstructions. VR – volume rendering.
*German diagnostic reference levels (BfS § 16 Absatz 1 Satz 3)

Maxillofacial reconstructions using CT brain from CT emergency algorithm?



Example: fracture of the left orbital floor and left lateral maxillary wall

- Note stair-step artifacts at different locations due to the axial scanning mode (red arrows)

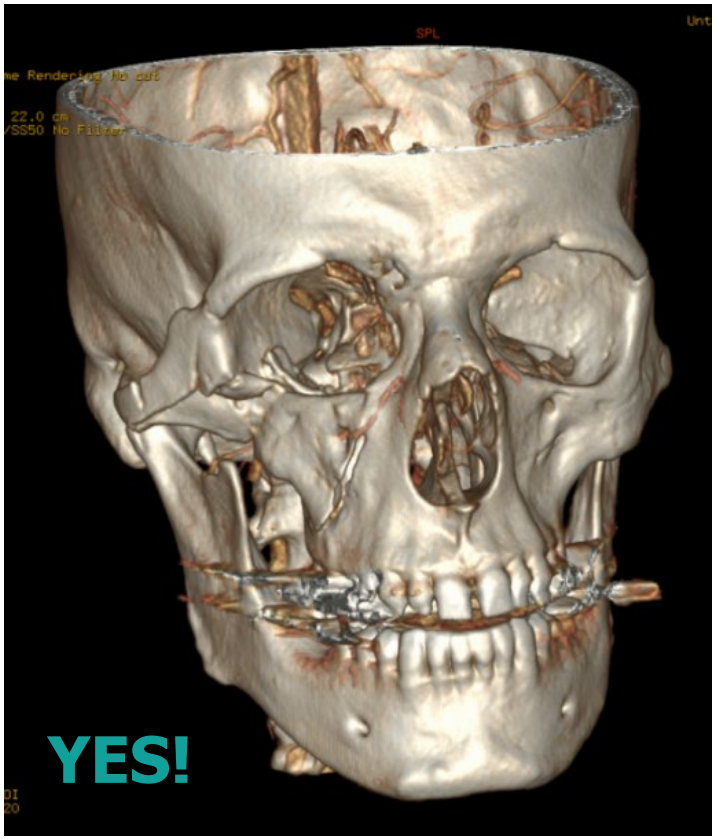
Maxillofacial reconstructions using CTA neck from CT emergency algorithm?

CTA neck DRL: $CTDI_{vol}$ 20 mGy, DLP 600 mGycm (32 cm body phantom)*

- Primary focus: spine fracture, blunt cervical vascular injury
- Technique: Helical scan from vertex to aortic arch
- Maxillofacial area can be reconstructed without additional scan and radiation dose
- Images can be used for MPR and VR

Abbreviations: DRL – diagnostic reference level. $CTDI_{vol}$ – computed tomography dose index volume. DLP – dose length product. MPR – multiplanar reconstructions. VR – volume rendering.
*German diagnostic reference levels (BfS § 16 Absatz 1 Satz 3)

Maxillofacial reconstructions using CTA neck from CT emergency algorithm?



Example: fracture of the right orbital floor, lateral orbital wall and right maxillary process

- VR reconstruction without stair-step artifacts

Maxillofacial CT

German diagnostic reference levels (BfS § 16 Absatz 1 Satz 3)

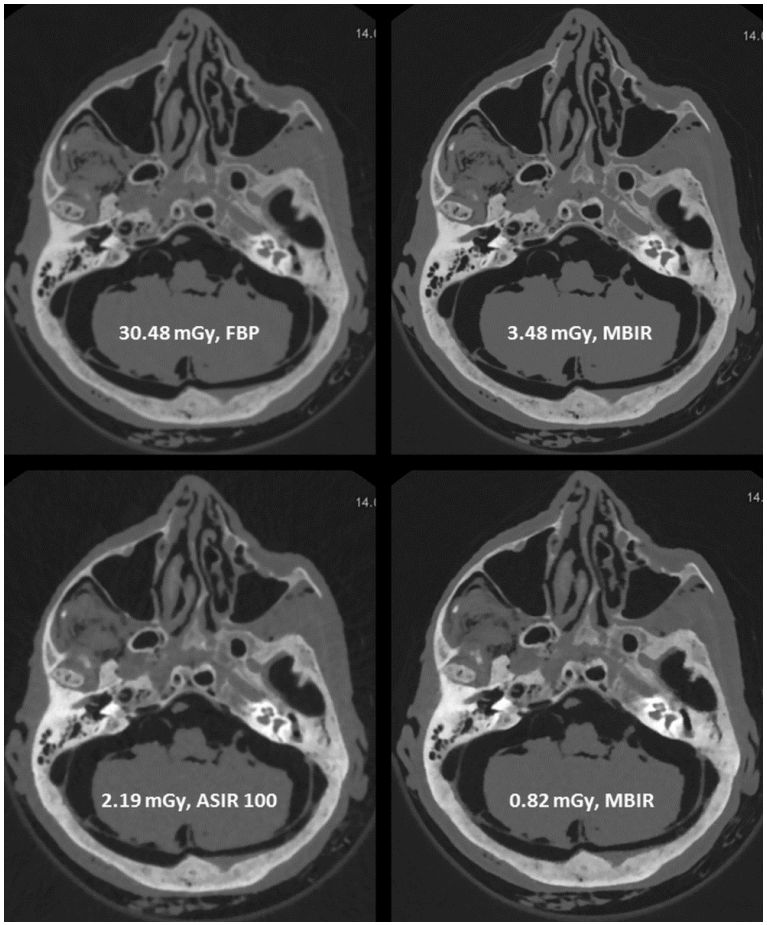
DRL CT craniomaxillofacial bone (oncology)

- $CTDI_{vol}$ 20 mGy
- DLP 200 mGycm

DRL CT paranasal sinus (sinusitis)

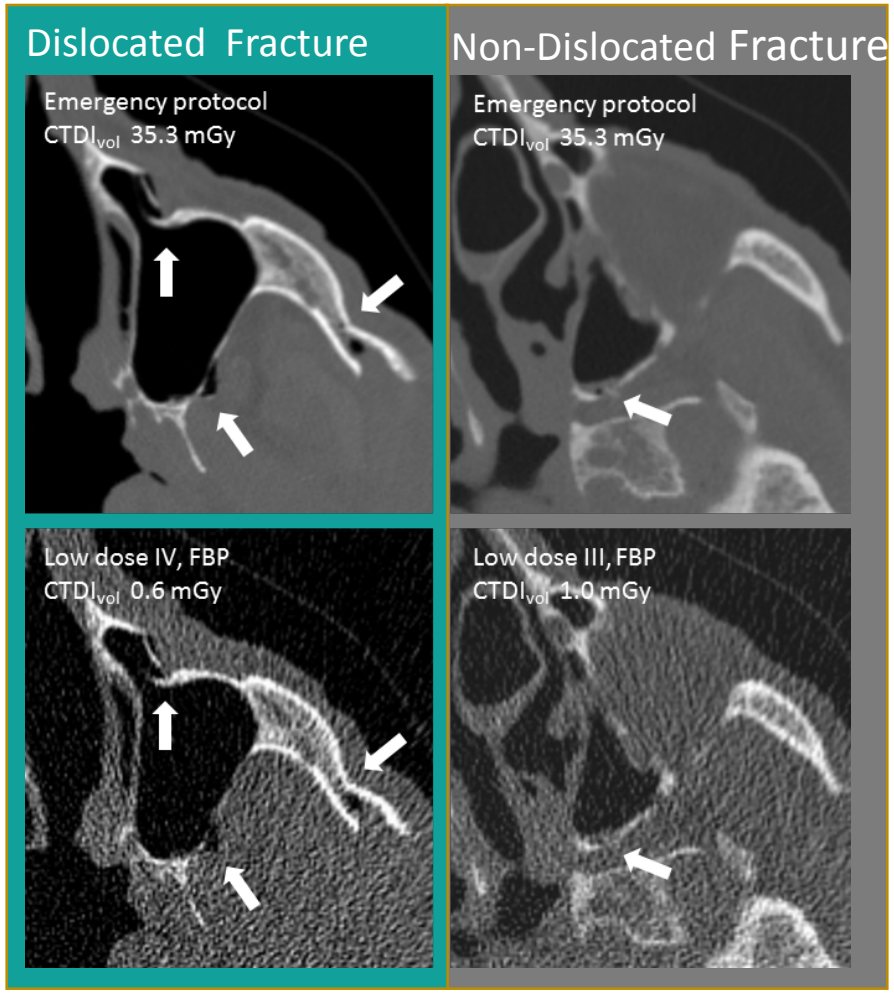
- $CTDI_{vol}$ 8 mGy
- DLP 90 mGycm

- How much dose is sufficient in trauma?



Widmann et al. AJR Am J Roentgenol. 2015.

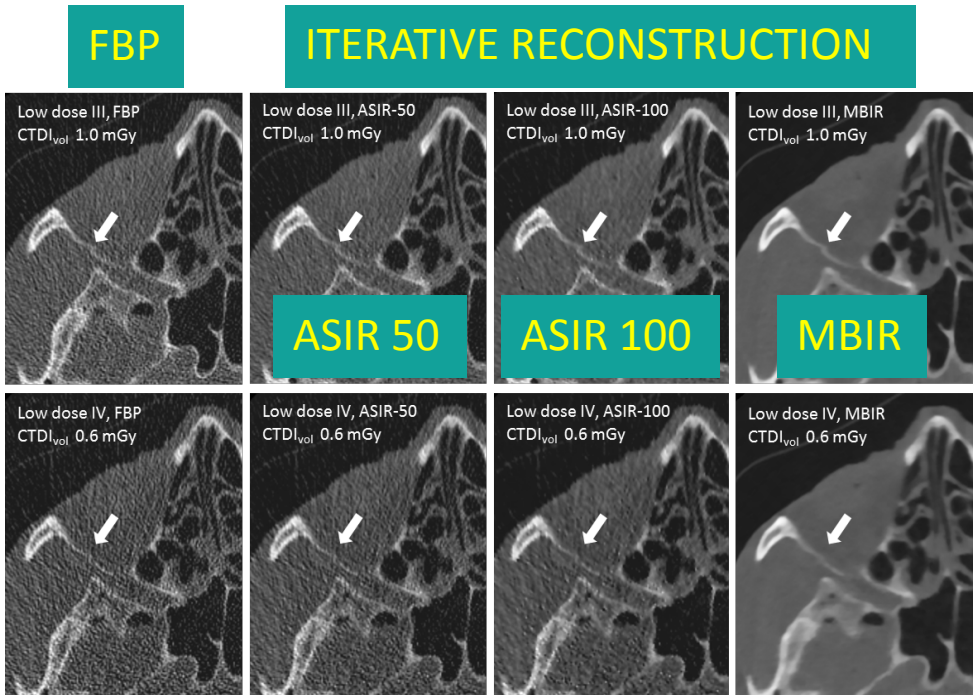
Ultralow dose protocols (< 5 mGy)



- Dislocated fractures are clearly detected also with ultralow doses of 0.6 mGy
- Non-dislocated fractures may be missed using doses of < 2 mGy

Widmann et al. Int J Oral Maxillofac Surg. 2015.

Ultralow dose protocols (< 5 mGy)

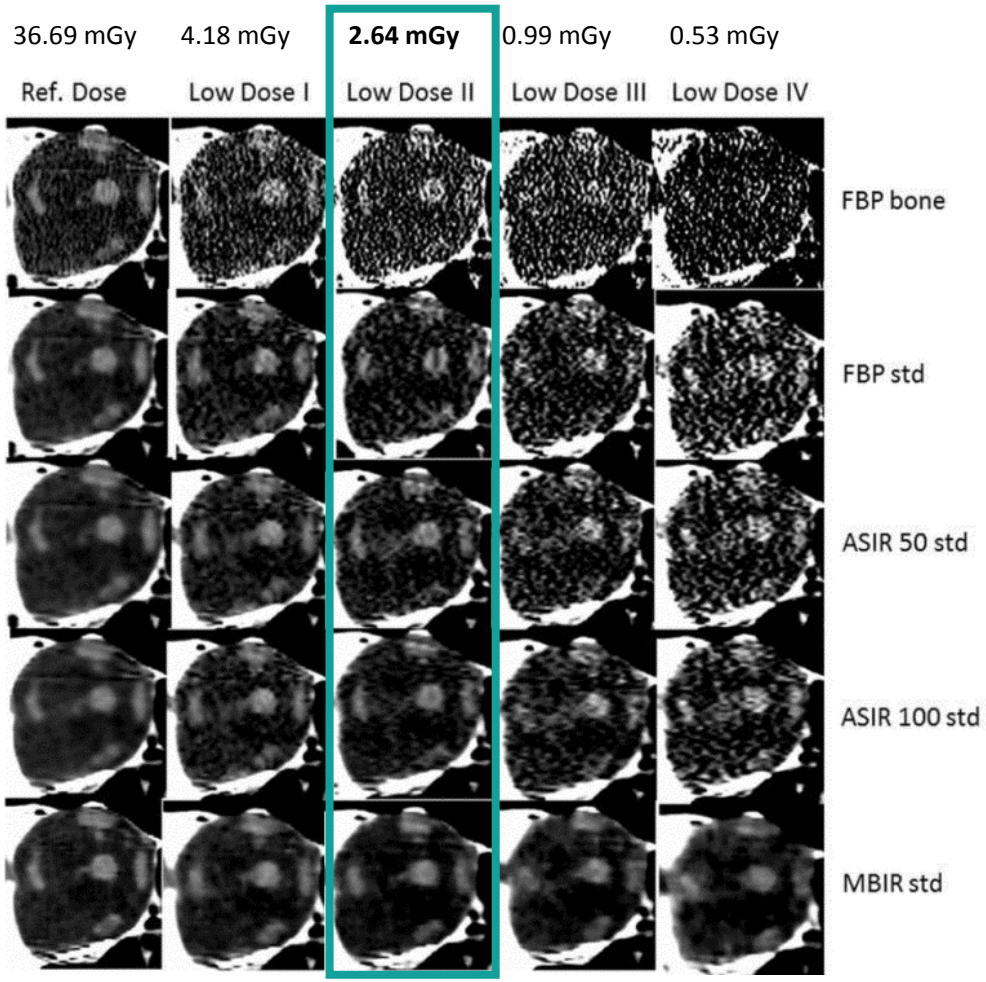


Widmann et al. Int J Oral Maxillofac Surg. 2015.

- Iterative reconstructions do not improve spatial resolution due to smoothing effects

Abbreviations: ASIR - Adaptive Statistical Iterative Reconstruction.
MBIR – Model Based Iterative Reconstruction

Ultralow dose protocols (< 5 mGy)



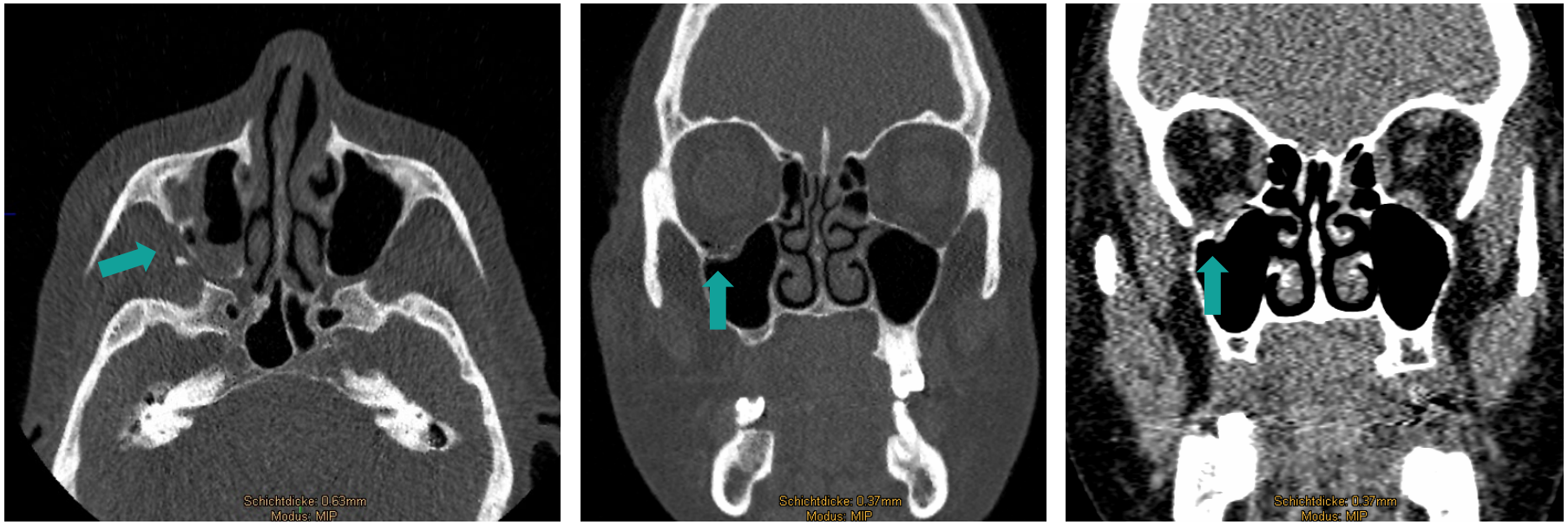
Widmann et al. AJNR Am J Neuroradiol. 2017.

Iterative reconstructions in orbital floor fracture:

- Noise reduction
- Improved contrast to noise ratio (CNR) of orbital soft tissues

Maxillofacial CT protocol example

- 80 kV, 40-55 mA, $CTDI_{vol}$ 2.6 mGy, bone kernel, soft kernel, ASIR-50



Example: fracture of the right orbital floor and lateral wall of the right maxillary sinus (arrows). Clear visibility of the orbital soft tissues in the right image.

SUMMARY

Maxillofacial trauma:

- Young adults (20-40a), sports activities, violence

Maxillofacial reconstructions from polytrauma algorithm:

- DO NOT enlarge scan length of brain CT
- Use CTA neck scan for maxillofacial reconstructions

Maxillofacial CT:

- DO NOT use « standard dose »
- $CTDI_{vol}$ of ≤ 5 mGy may be sufficient
- Iterative reconstructions improve CNRs of soft tissues

References

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