Ask EuroSafe Imaging
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

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

Innsbruck Emergency Algorithm

Prehospital Diagnosis
Polytrauma

1\textsuperscript{st} ER-Phase
- admission
- first glance
- relocation
- immediate measures
- stabilisation / monitoring
- basis-diagnostics and therapy

haemodynamically stable → stable

stable → acute surgery or embolisation → ICU

CT-Phase
- picture acquisition
- picture reformation
- picture evaluation
- 1.CT skull/brain native
- 2.CT-angiography neck
- 3.CT Thorax+Abdomen

acute surgery or embolisation → ICU

2\textsuperscript{nd} ER-Phase
- finishing diagnostics and therapy

ICU → embolisation → primary surgery

Maxillofacial reconstructions using CT brain from CT emergency algorithm?

**CT brain** DRL: $\text{CTDI}_{\text{vol}}$ 60 mGy, DLP 850 mGy/cm (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


*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\textsubscript{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\textsubscript{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$_{\text{vol}}$ 20 mGy
- DLP 200 mGycm

DRL CT paranasal sinus (sinusitis)
- CTDI$_{\text{vol}}$ 8 mGy
- DLP 90 mGycm

- How much dose is sufficient in trauma?
**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.

Ultralow dose protocols (< 5 mGy)

- 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)

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\textsubscript{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 $\leq 5$ mGy may be sufficient
- Iterative reconstructions improve CNRs of soft tissues
References


