

Näokolju ja koljupõhimiku trauma

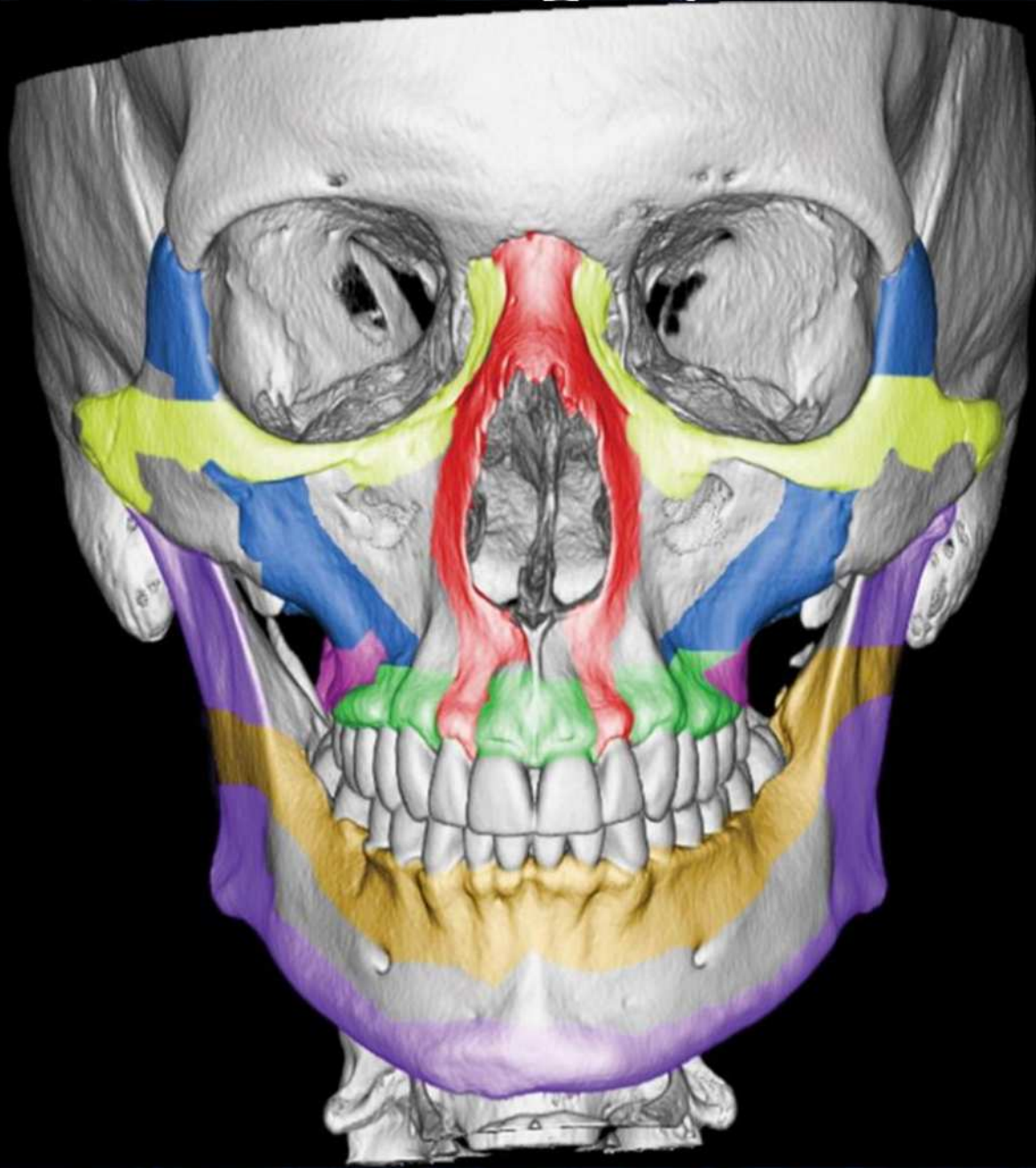
27.10.2021

Kaur Valk
IIa radiologia
resident
TÜK

Näokolju trauma^{1,2}

- KT-uuring esmavalik
 - Kirurgilise ravi planeerimiseks
 - Madala energiaga traumade korral lisandina aju natiiv-KT-le ja/või lüüsisamba kaelaosa KT-le
 - Kõrge energiaga trauma korral lisandina polütrauma protokollile
- Radioloogid peaksid teadma kirurgidele olulisi anatoomilisi klassifikatsioone
- Vigastuste tuvastamiseks vajalik süstemaatiline lähenemine
 - Nt alt-ülesse või ülevalt-alla
- Mitut luud haaravad näokoljumurrud korduvad sageli sarnaste mustritena

Terminoloogia ja anatoomiline jaotus²



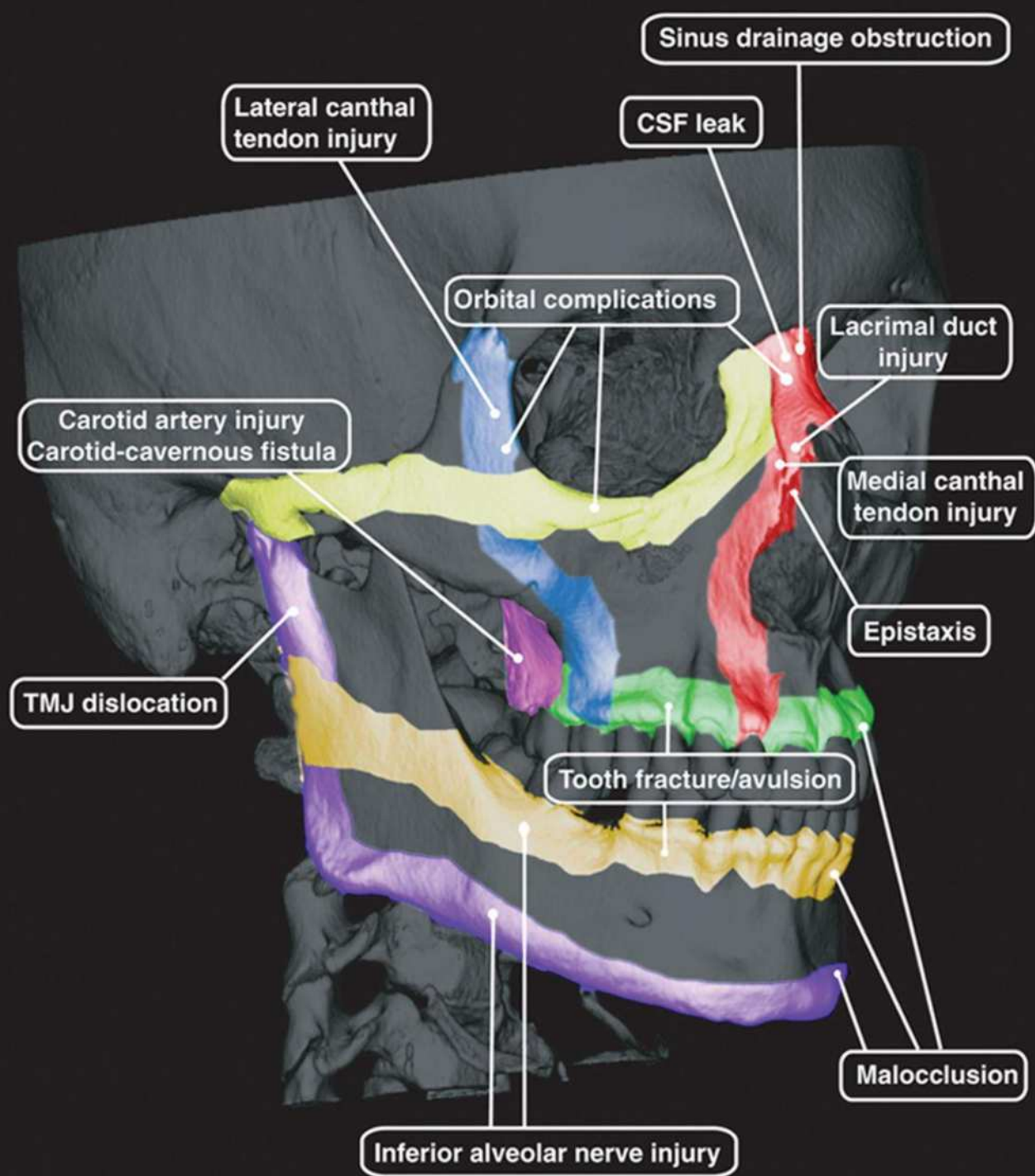
- Horisontaalsed:
 - upper transverse maxillary (yellow)
 - lower transverse maxillary (green)
 - upper transverse mandibular (orange)
 - lower transverse mandibular (purple)
- Vertikaalsed
 - medial maxillary (red)
 - lateral maxillary (blue)
 - posterior maxillary (magenta)
 - posterior vertical mandibular (purple)



Murdude jaotus regioonideks: ²

1. Ülemine
2. Keskmine
3. Alumine

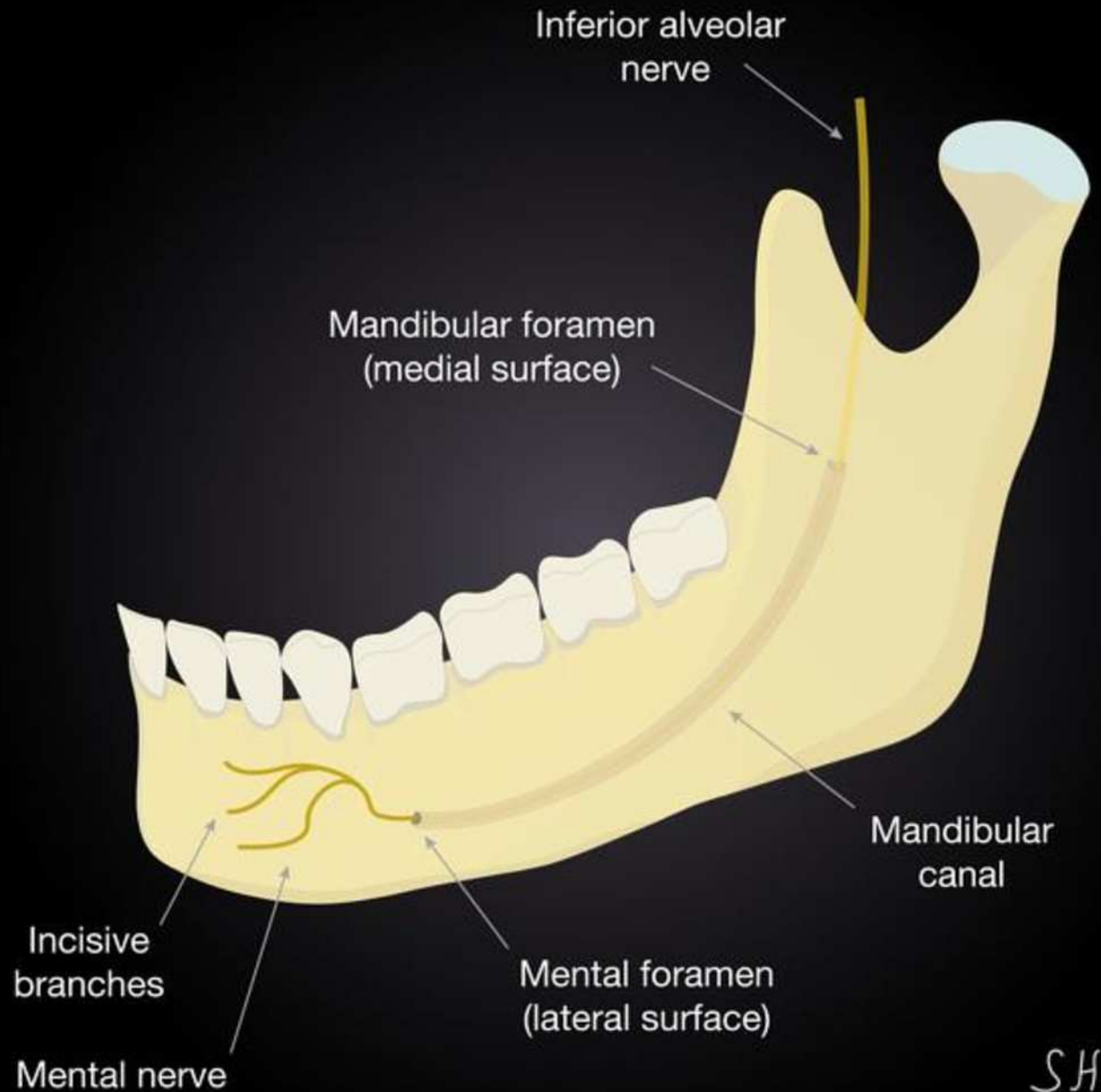
Näokolju murdude tüsistused^{1, 2}

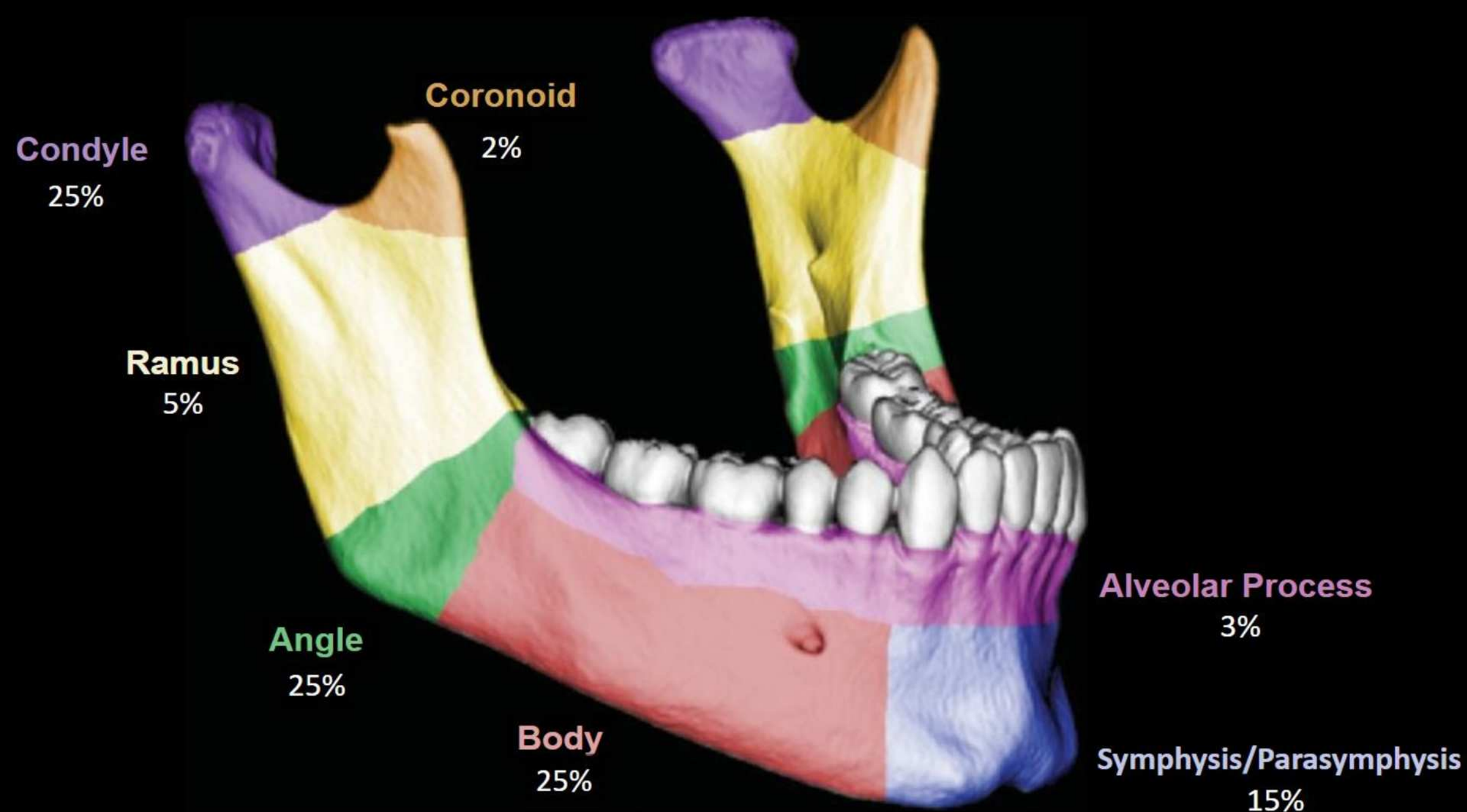


Affected structures	Complications
Intraorbital contents	Blindness, ophthalmoplegia and diplopia, increased orbital volume with exophthalmos
Nerve foramina	Orbital apex (CN I) → unilateral blindness Superior orbital fissure-(CN III, CN IV, CN V1, and CN VI) → ophthalmoplegia, diplopia, ptosis Mandibular canal (branch of CN V3) → anesthesia of the ipsilateral lower lip, chin, anterior tongue, and mandibular teeth.
Temporalis muscle impingement	Trismus
Teeth	Dental fracture, avulsion, devitalization, malocclusion, soft-tissue infection, airway aspiration
Drainage canals impairment	Frontal recess, sphenoidal recess or ostiomeatal complex → mucocele Lacrimal duct → dacryocystitis
Medial canthal tendon	Telecanthus
Cribriform plate	Leakage of cerebrospinal fluid
Multiple middle face fractures, condylar fractures	Blunt carotid artery injury
Posterior extension	Blunt carotid artery injury, skull base nerve foramina affectation

Alalõualuu (*mandibula*)^{2,3}

- Kõige sagedasem pärast ninaluude murdusid
- Kirjeldada murru asukohta, fragmente, nihet ja mandibulaarkanali, alveolaarjätquete ja temporomandibulaarliigese haaratust

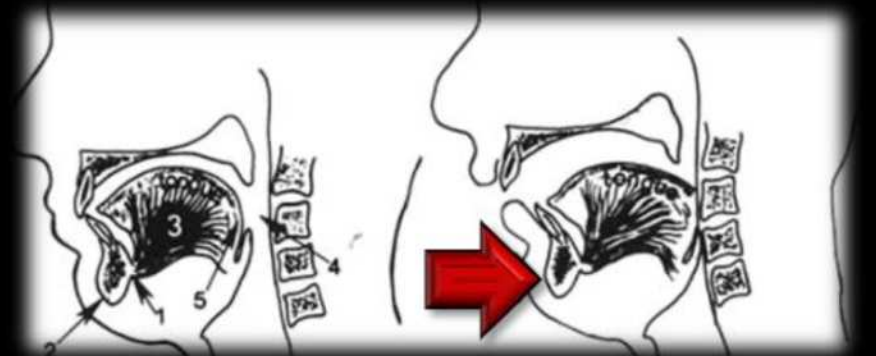
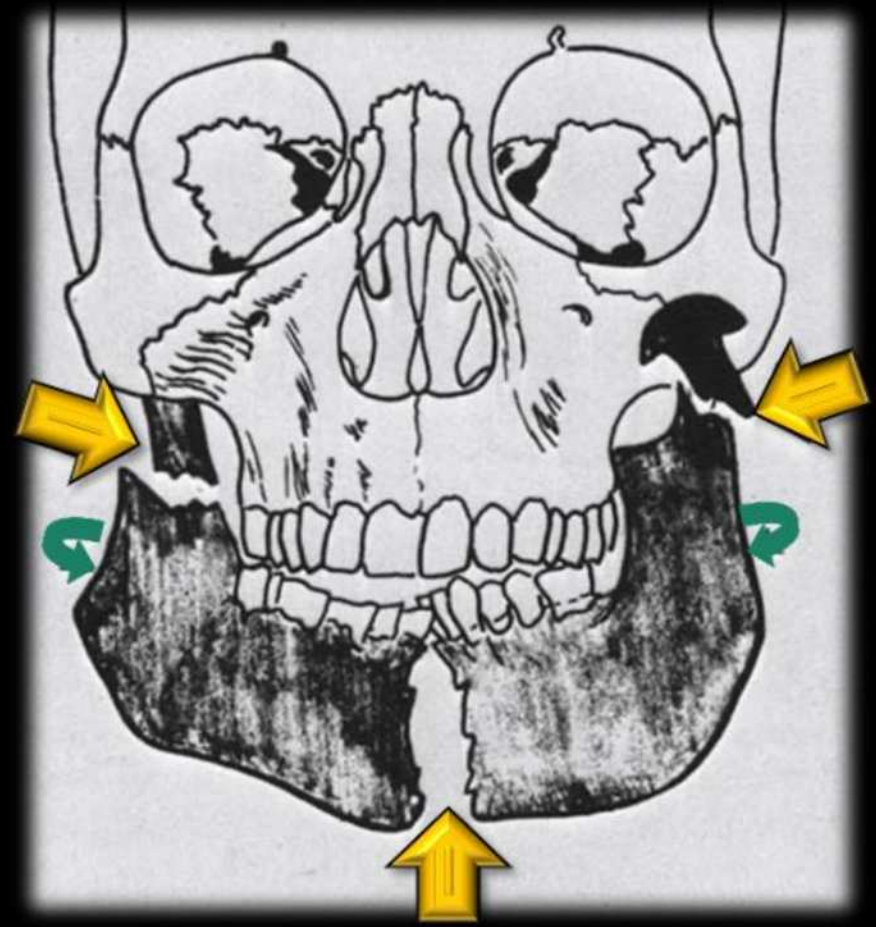






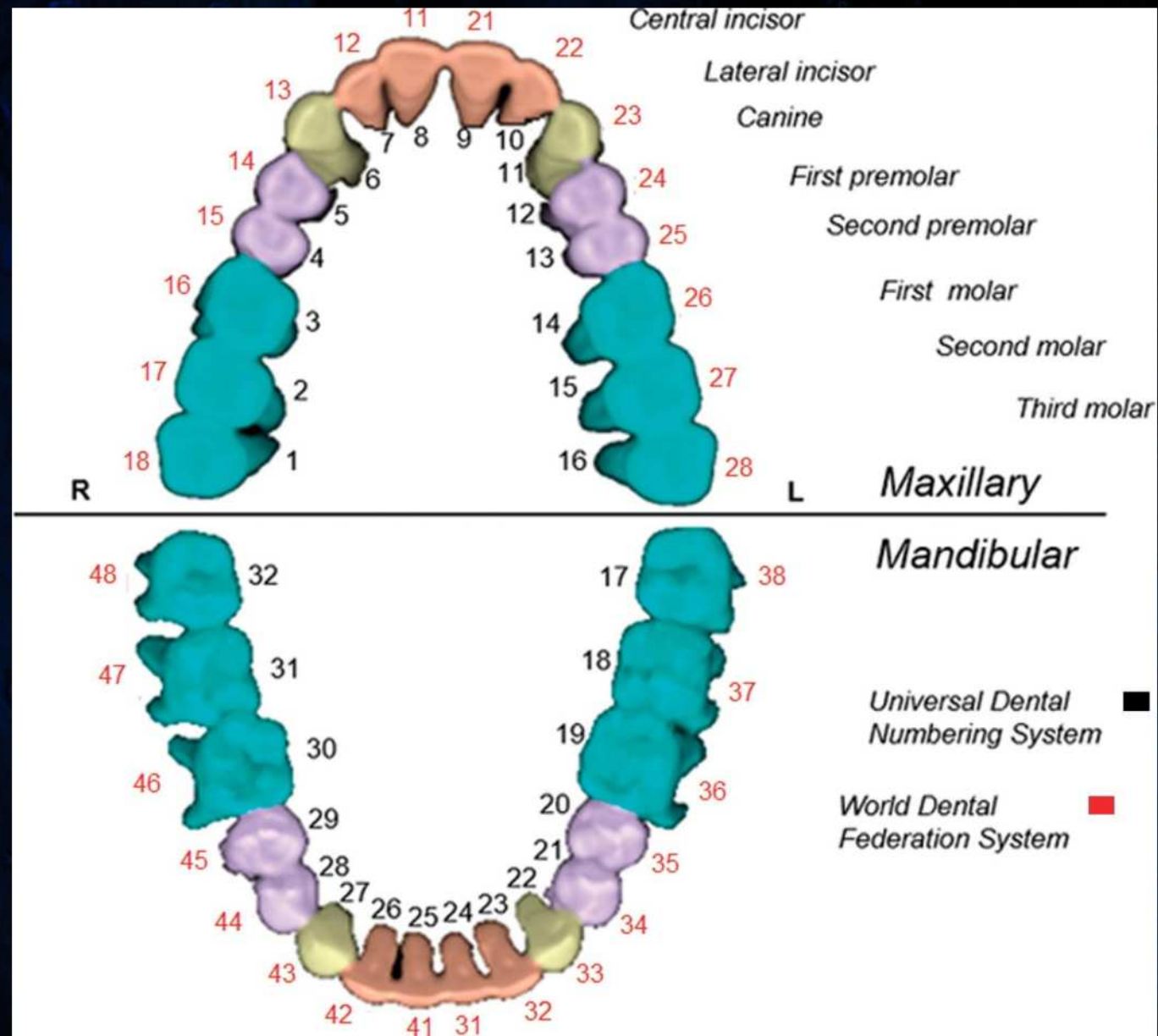
Ebastabiilne alalõualuu³

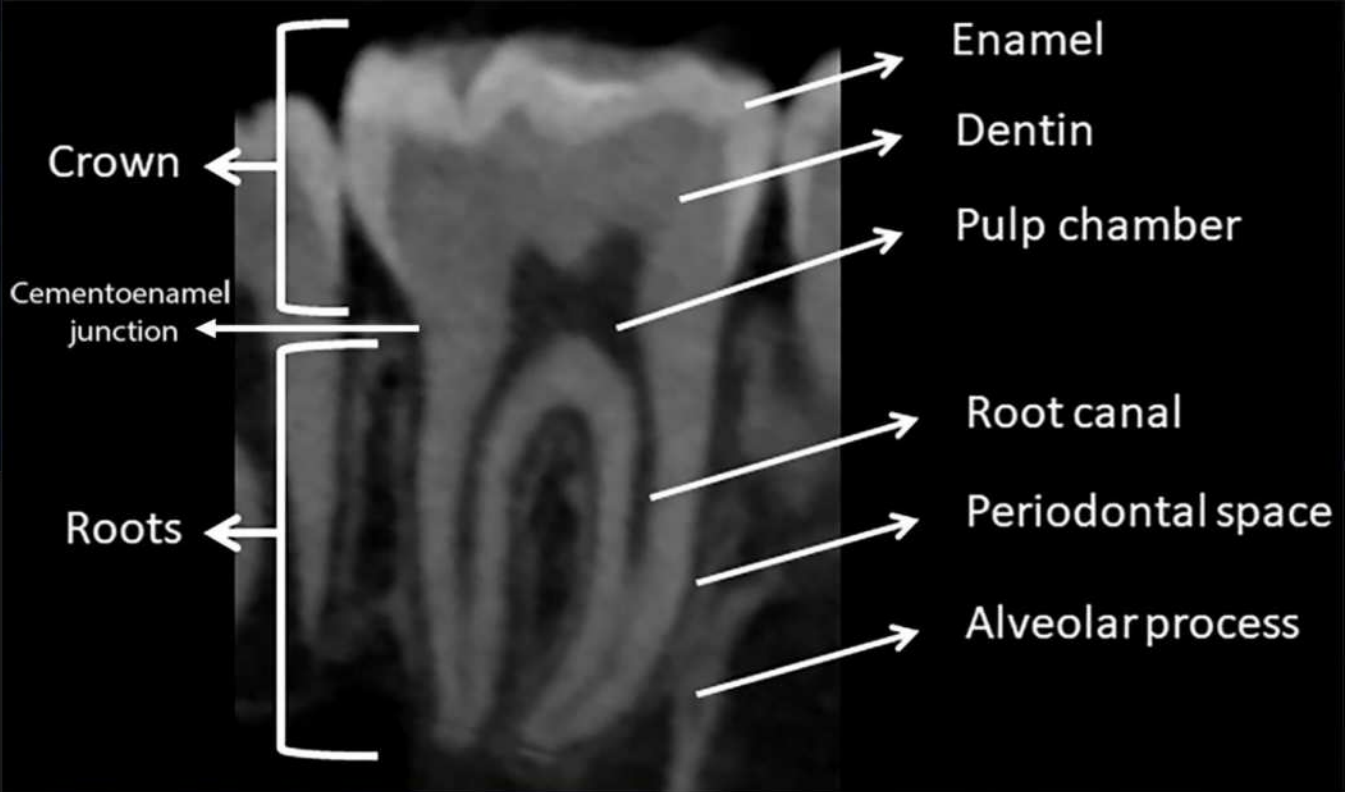
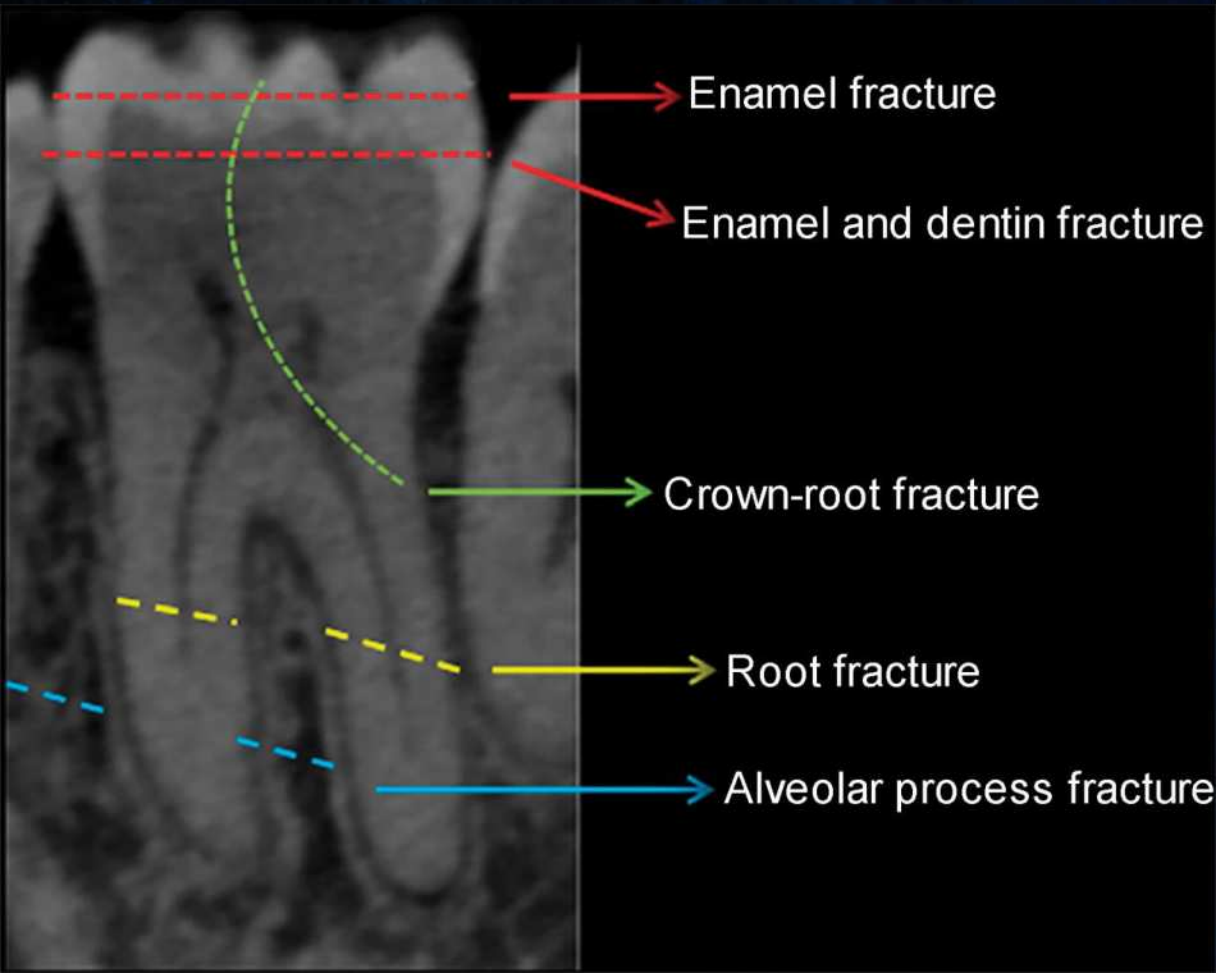
- Tekib trifokaalse murru korral
- Keele protrusiooni teostavad lihased muutuvad ebaefektiivseks
- Tekib alalõualuu posteroinferioorne tõmme
 - Oht hingamisteede sulguseks



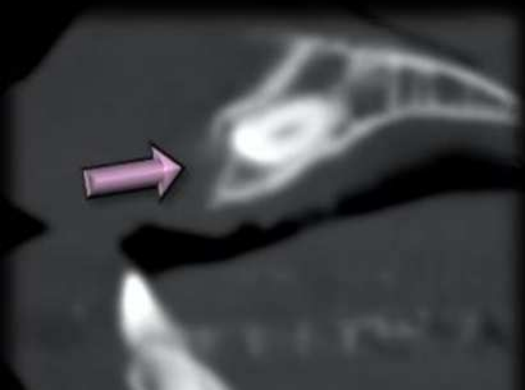
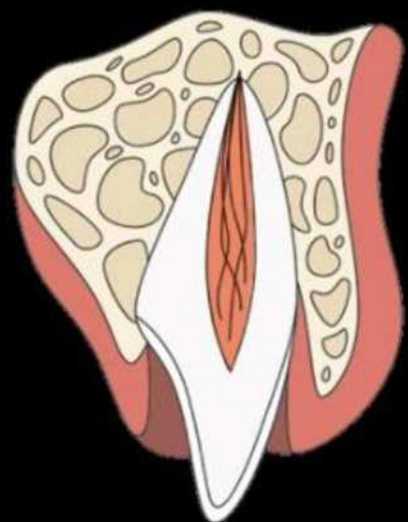
Dentoalveolaarsed murrud^{2, 3, 4}

- Hamba murrud võiks klassifitseerida krooni/juure murruks või nende kombinatsiooniks
- Vigastused saab jagada murruks, luksatsiooniks või avulsiooniks

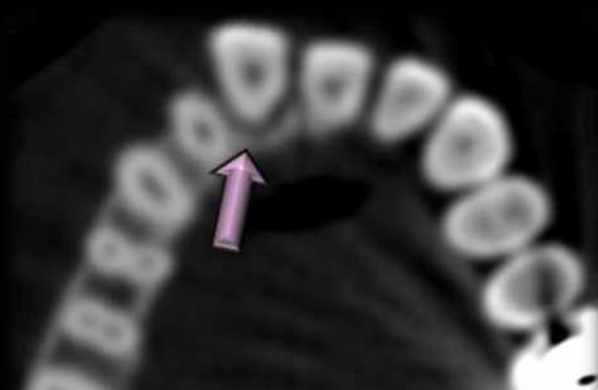
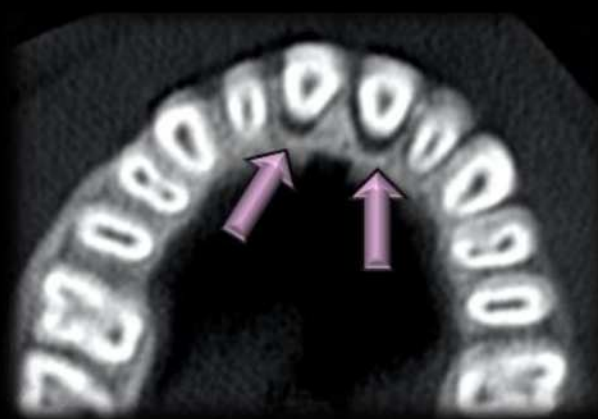
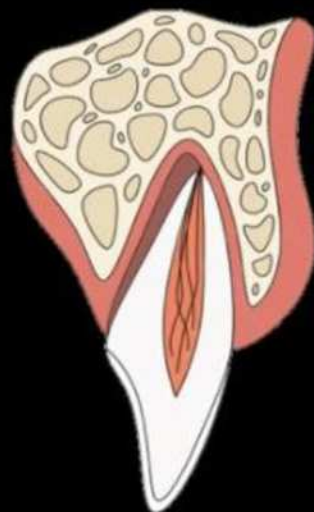




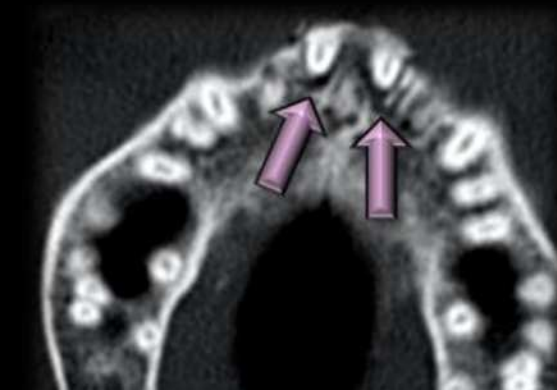
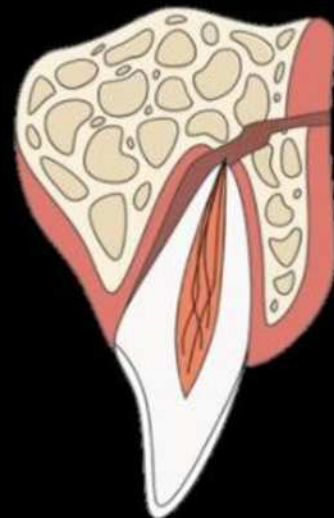
Intrusive Luxation/Impaction



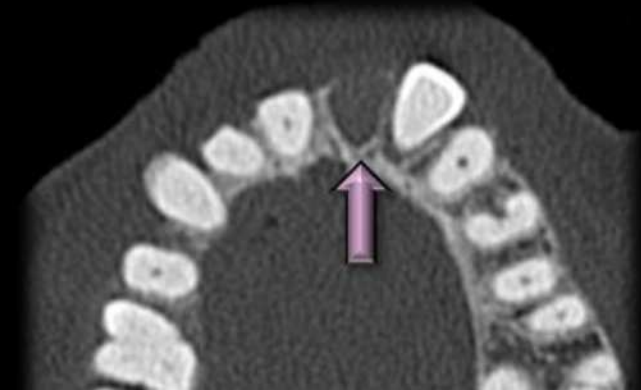
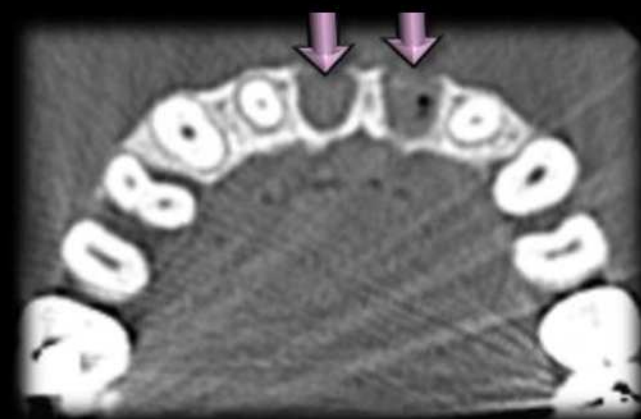
Extrusive Luxation



Lateral Luxation

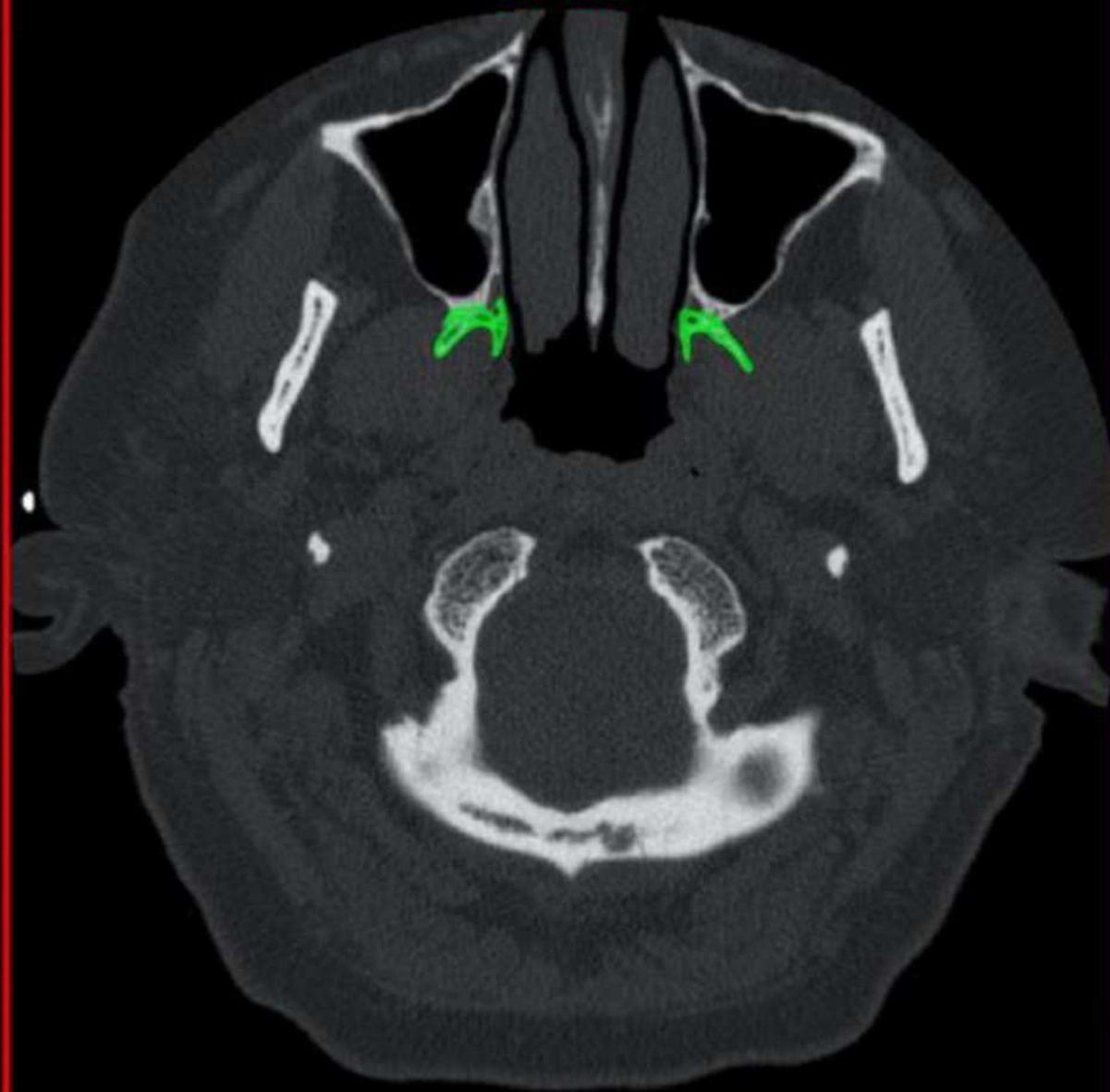


Avulsion



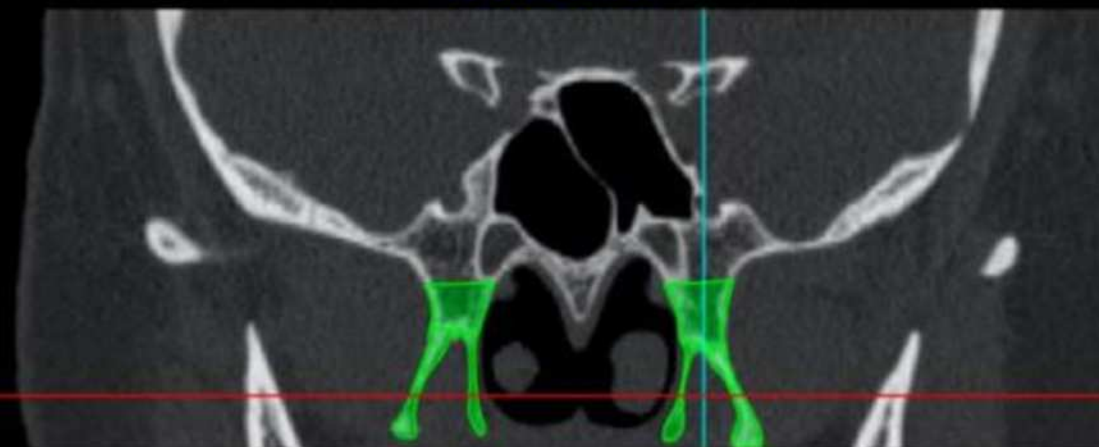
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axials



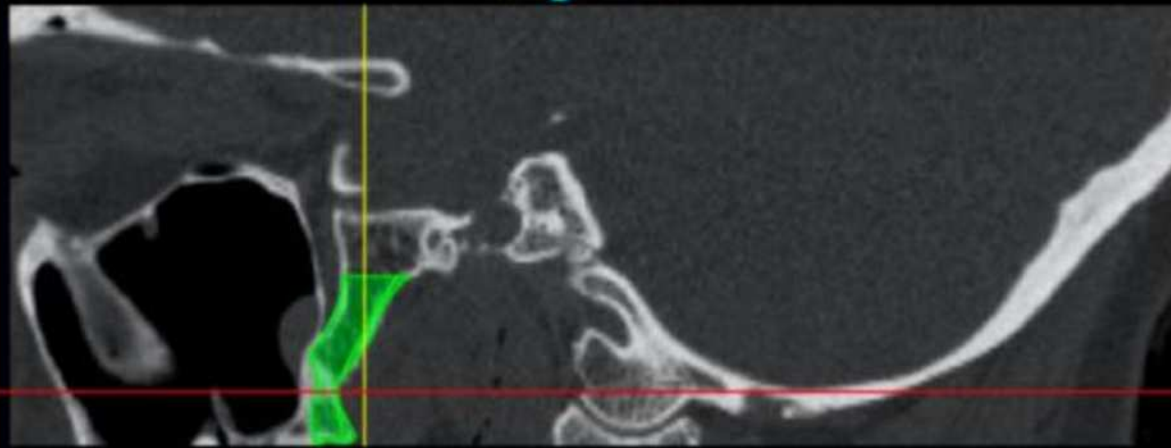
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coronals



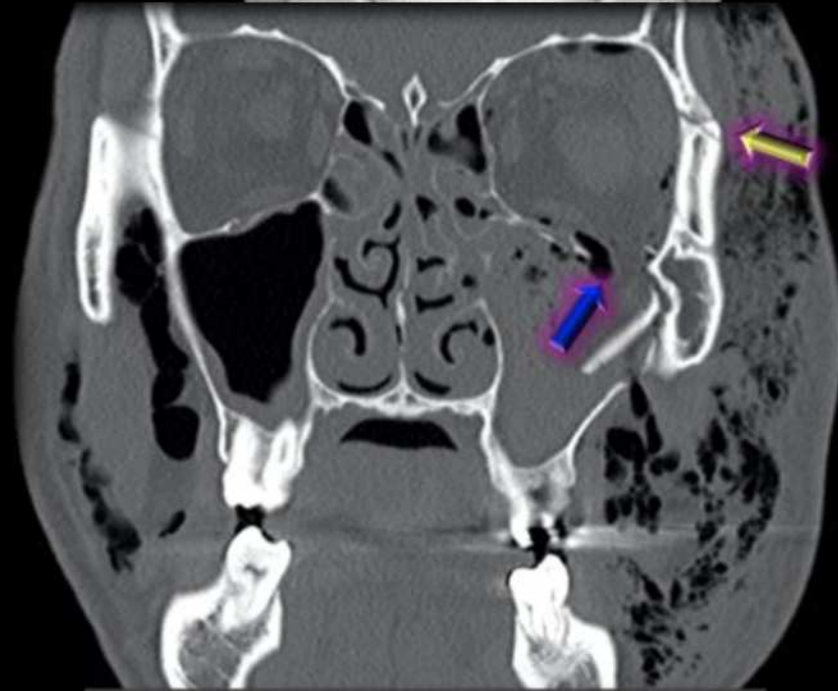
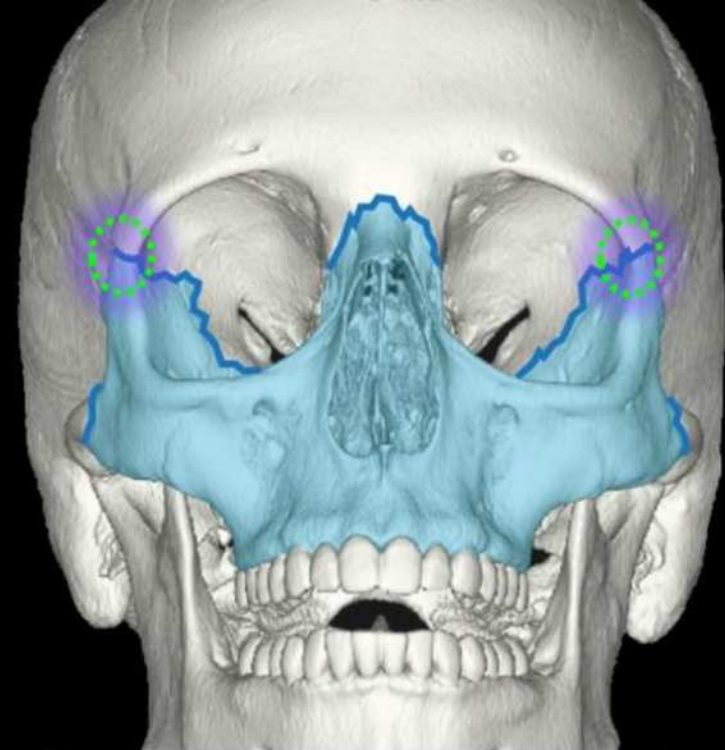
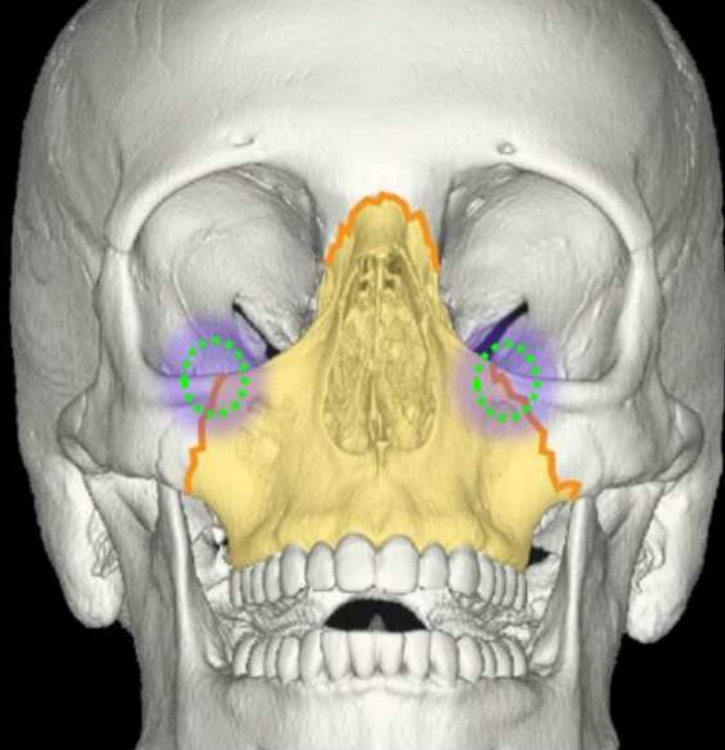
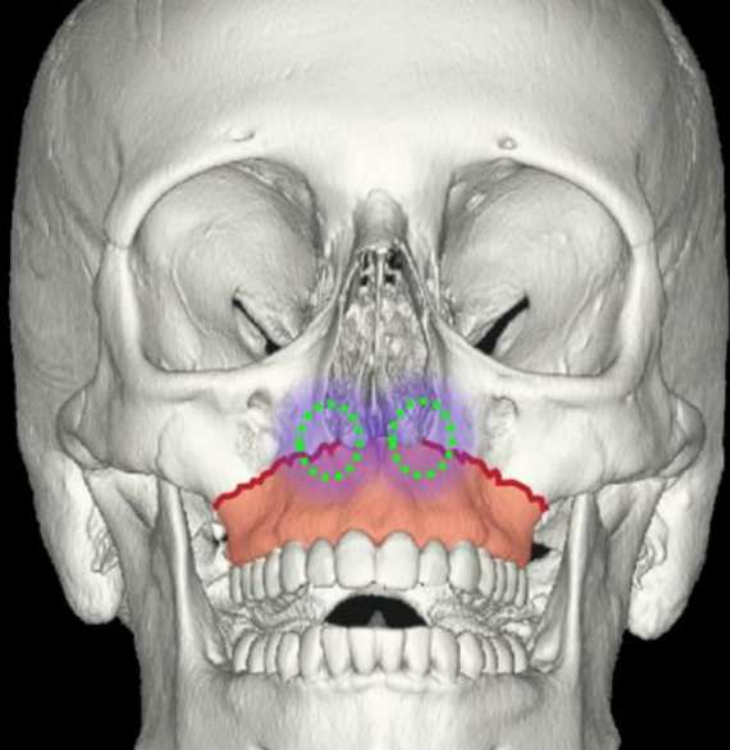
68

sagittals



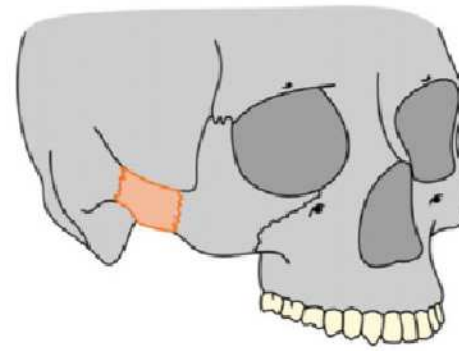
Le Fort^{1, 3}

- *Le Fort I* ehk hõljuv suulagi
 - Eraldab kõvasuulae ülejäänud näokoljust ja koljupõhimikust
 - Haarab maksillaarsiinuse seinasid
- *Le Fort II* ehk püramiidmurd
 - Põikimurd mis haarab mediaalse orbita seina ja orbita põhja
- *Le Fort III* ehk kraniofatsiaalne dissotsiatsioon
 - Haarab sarnaluud ja orbita lateraalset seina
- Eeldab tiibjätke murdusid
 - 37% juhtudel on tiibjätke murrud mitte Le Fort kompleksidega seotud

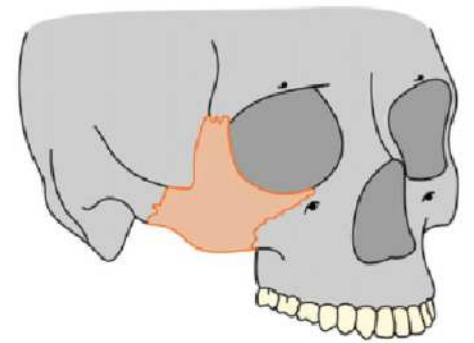


Zygomaticomaxillary complex (ZMC) murd^{2,3,7}

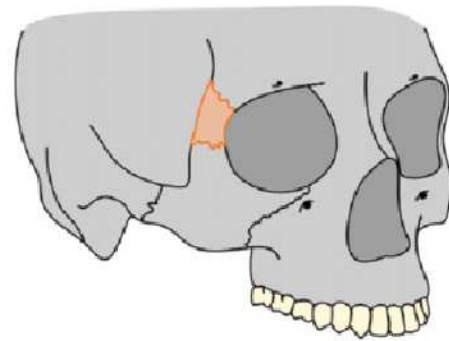
- Läbib kõiki nelja sarnaluu õmblust, tekib vabalt hõljuv sarnaluu
 - Haarab orbita põhja ja maksillaarsiinuse lateraalseina
 - Sageli saab viga ka *canalis infraorbitalis* (oht *n. infraorbitalise* vigastusele)
 - Sarnaluu murdude Zingg klassifikatsioon
 - A: osalised, haaravad ühe sarnaluu jätke
 - B: eraldiseisev sarnaluu fragment
 - C: killunenud murrud
- } Vajavad kirurgilist fiksatsiooni



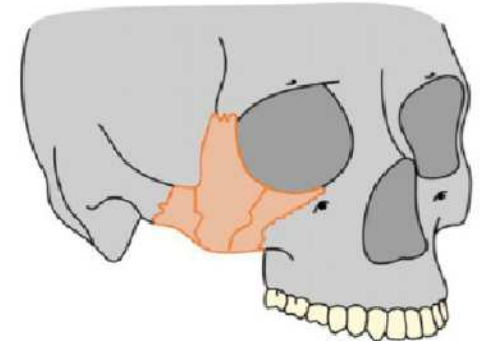
A1



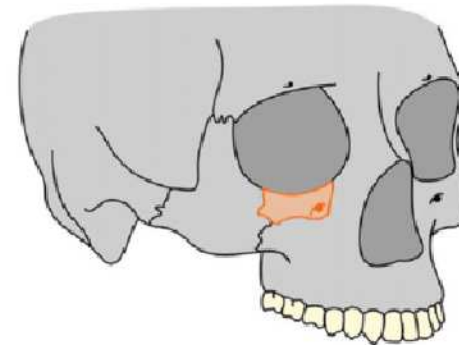
B



A2

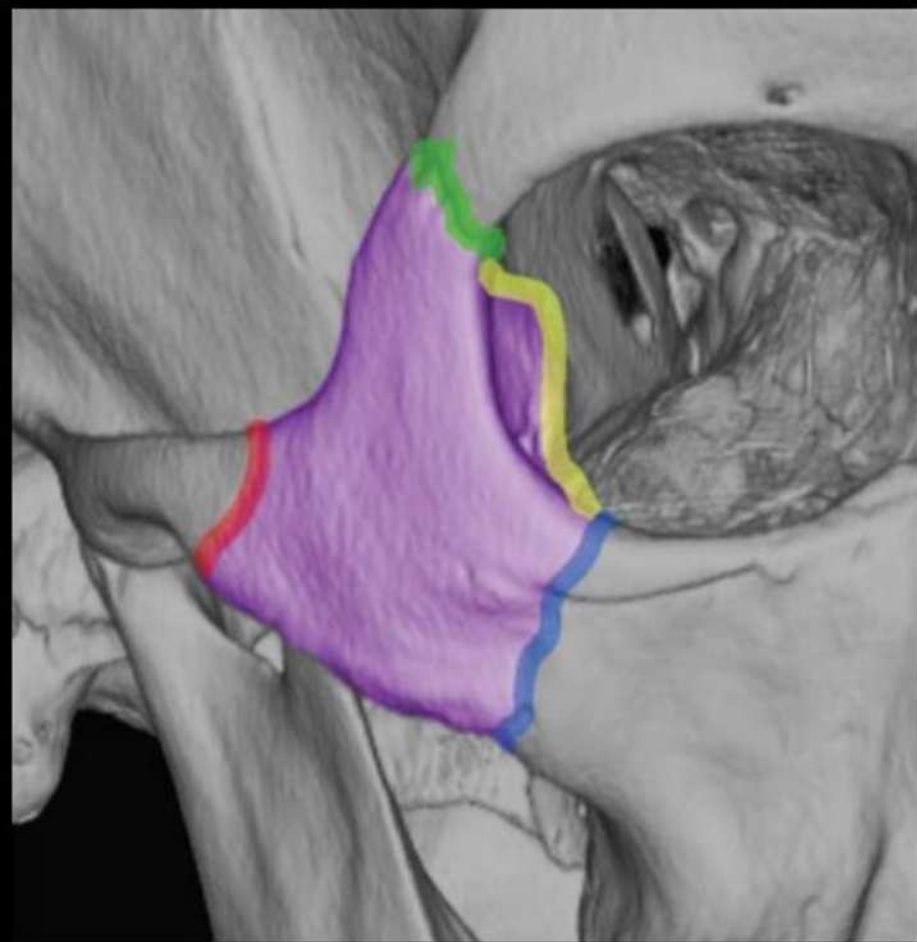


C

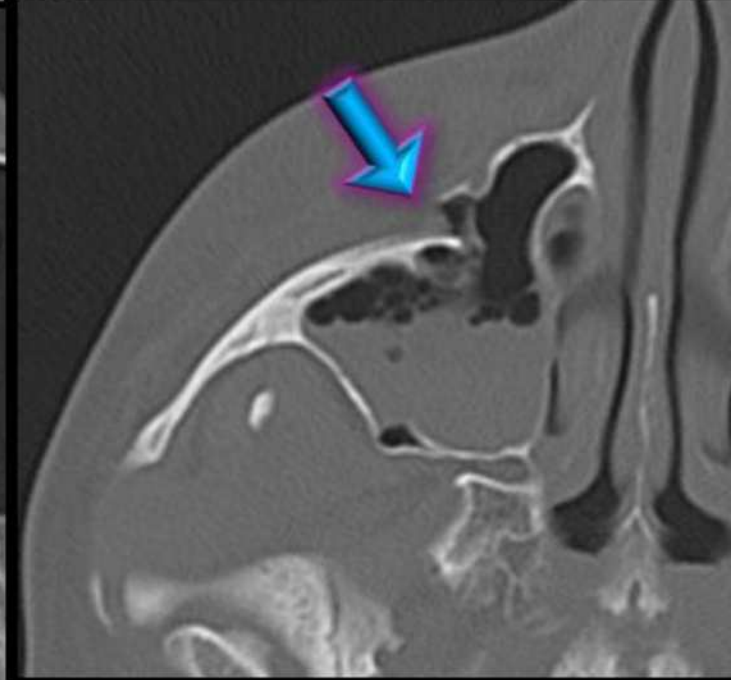
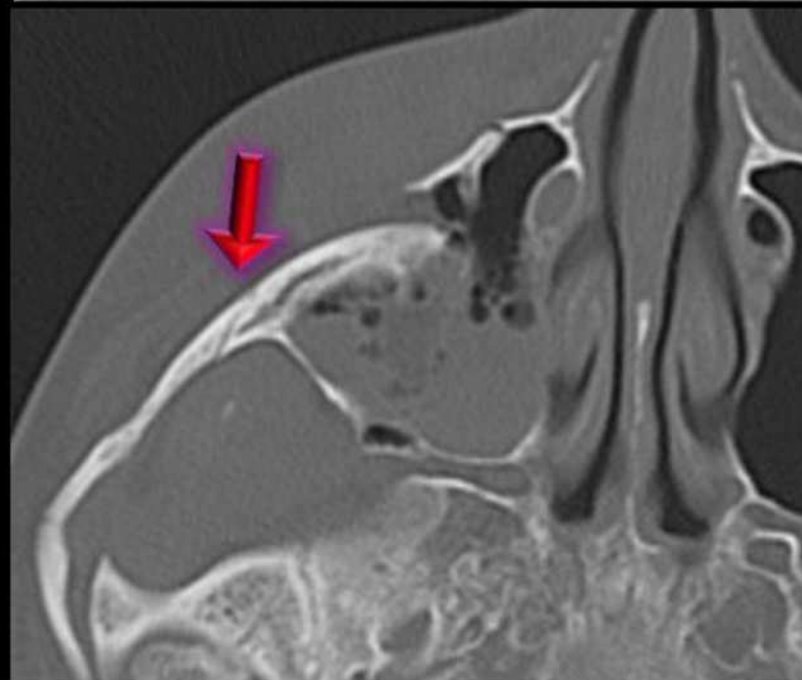
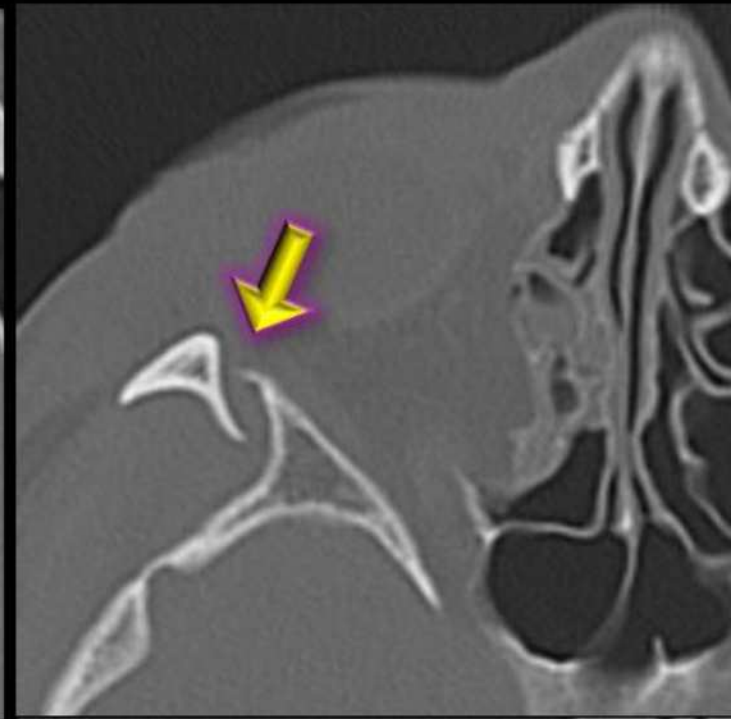
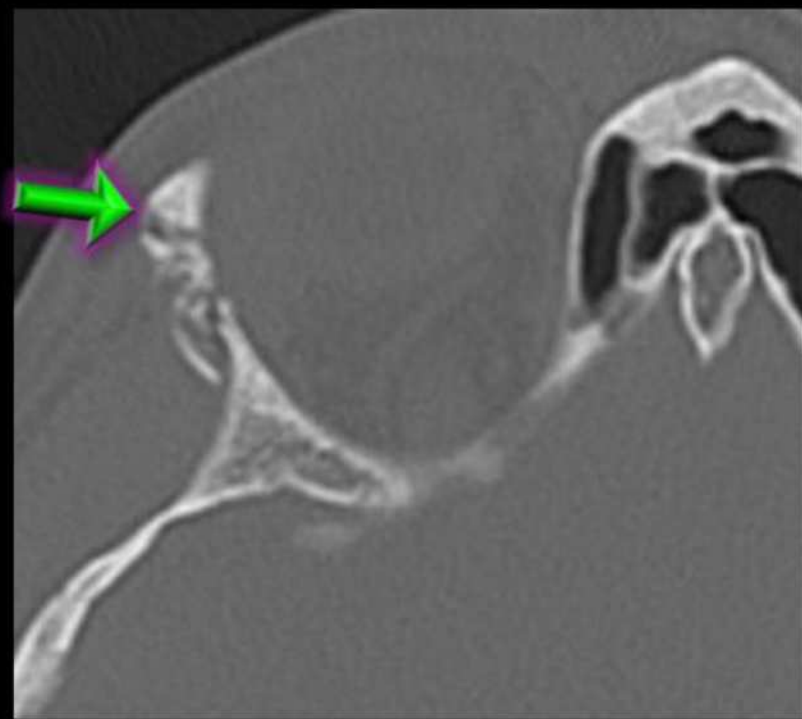


A3

K. DeLeon
—M.D.



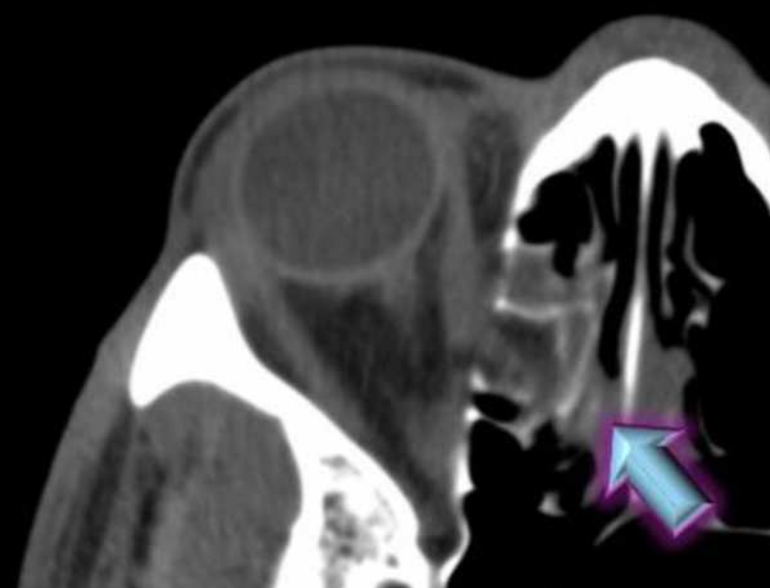
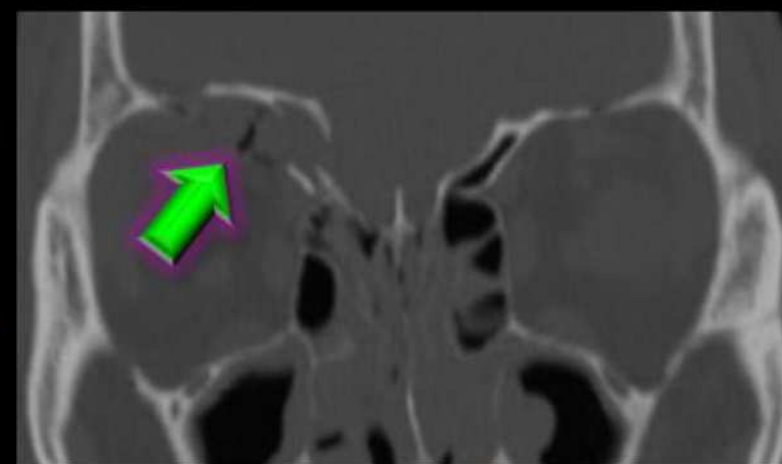
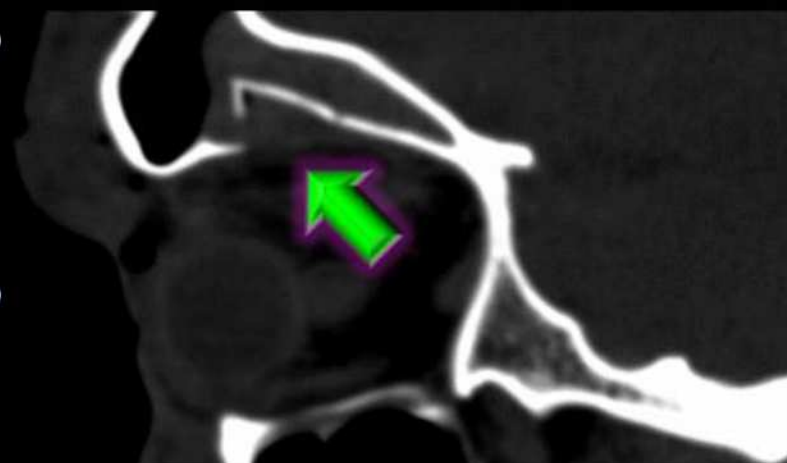
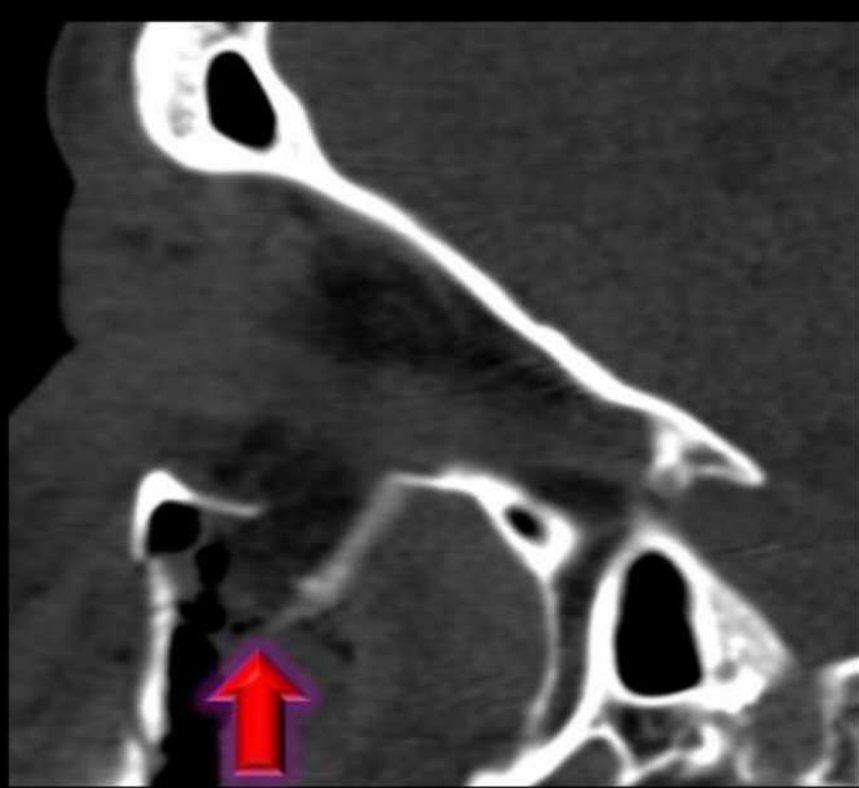
- 4. Zygomaticofrontal
- 3. Zygomaticosphenoid
- 2. Zygomaticotemporal
- 1. Zygomaticomaxillary



Isoleeritult orbitat haaravad murrud^{1, 2, 3}

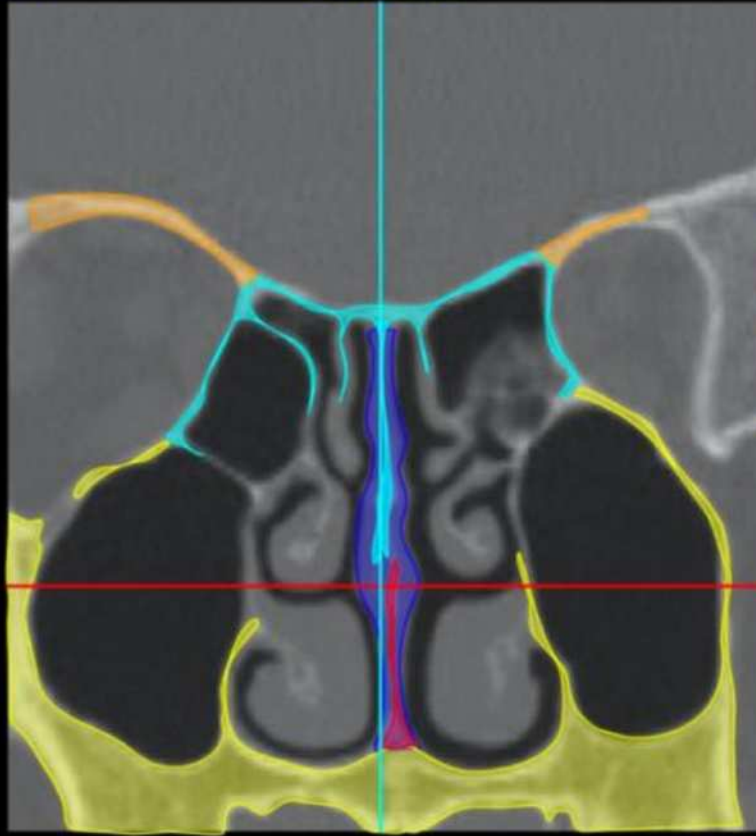
- Enamasti haaratud orbita põhi või mediaalne sein (*lamina papyracea*)
- Tekivad *blow-out* tüüpi murrud
 - Luufragmentide ja orbita sisu protrusioon maksillaar- ja etmoidaalsiinustesse
 - Kliiniliselt oluline silmaliigutajalihaste pitsumine
- Orbita lae *blow-up* murd ulatub eesmisesse koljulohku
 - Kaasvalt intrakraniaalsed vigastused





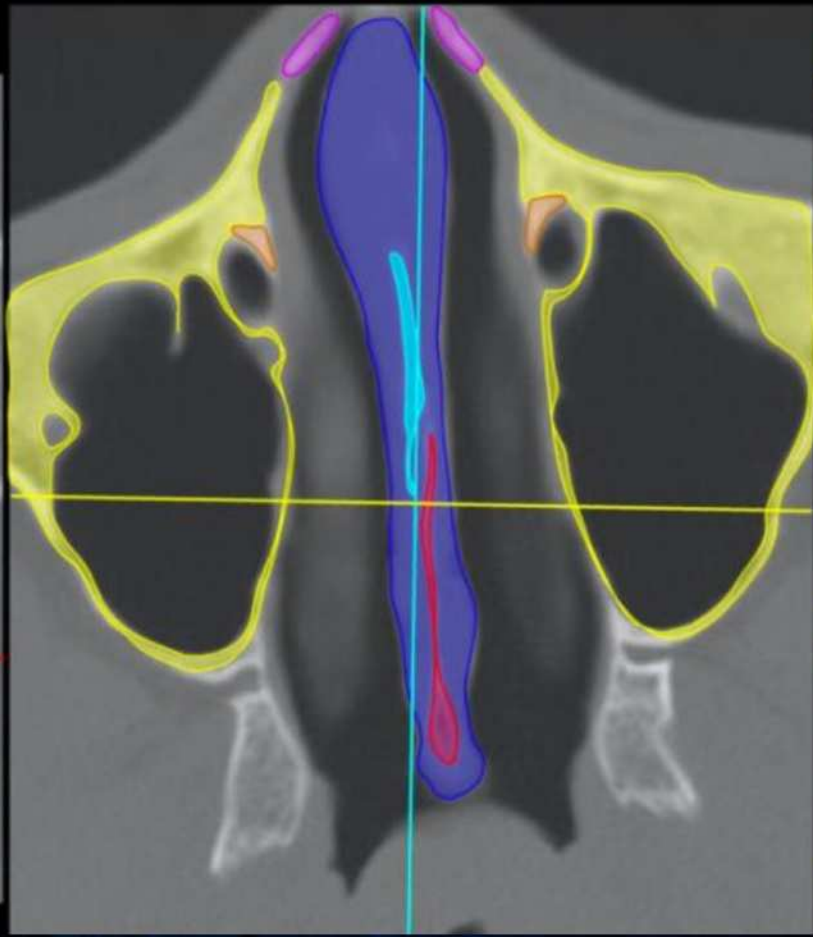
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coronals



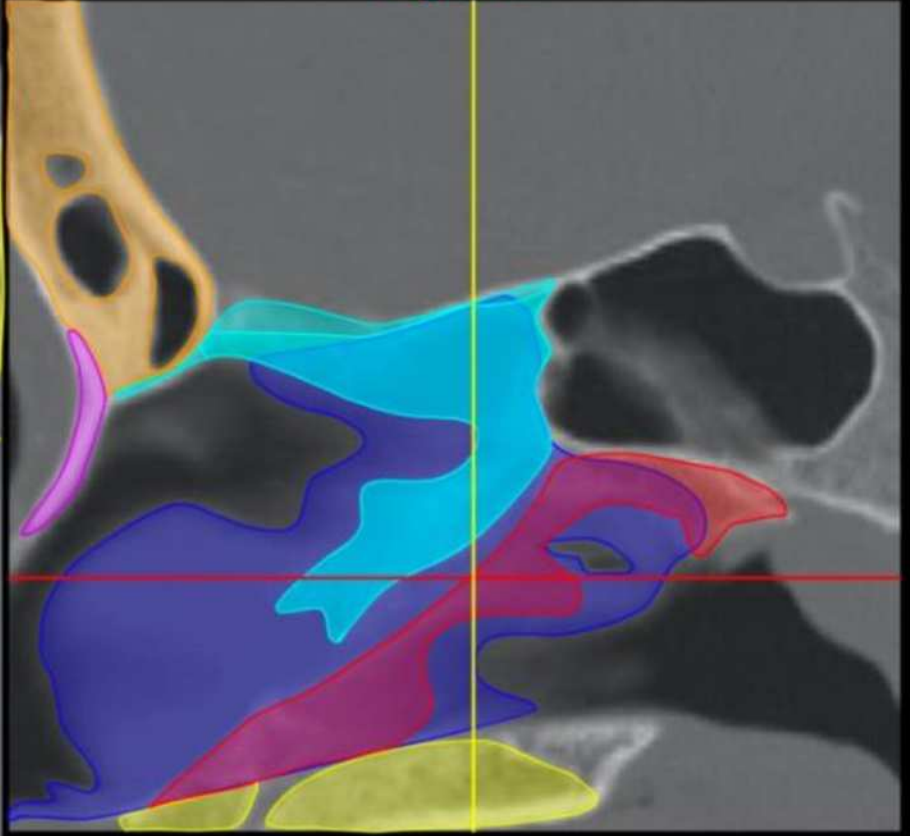
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axials



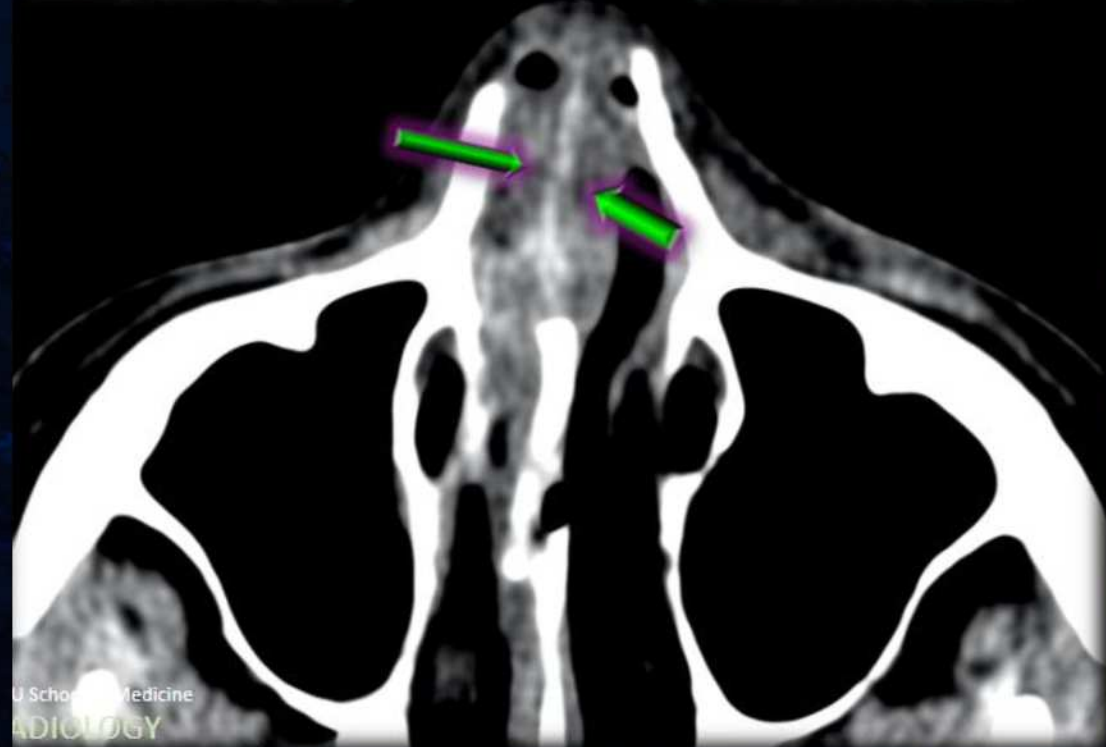
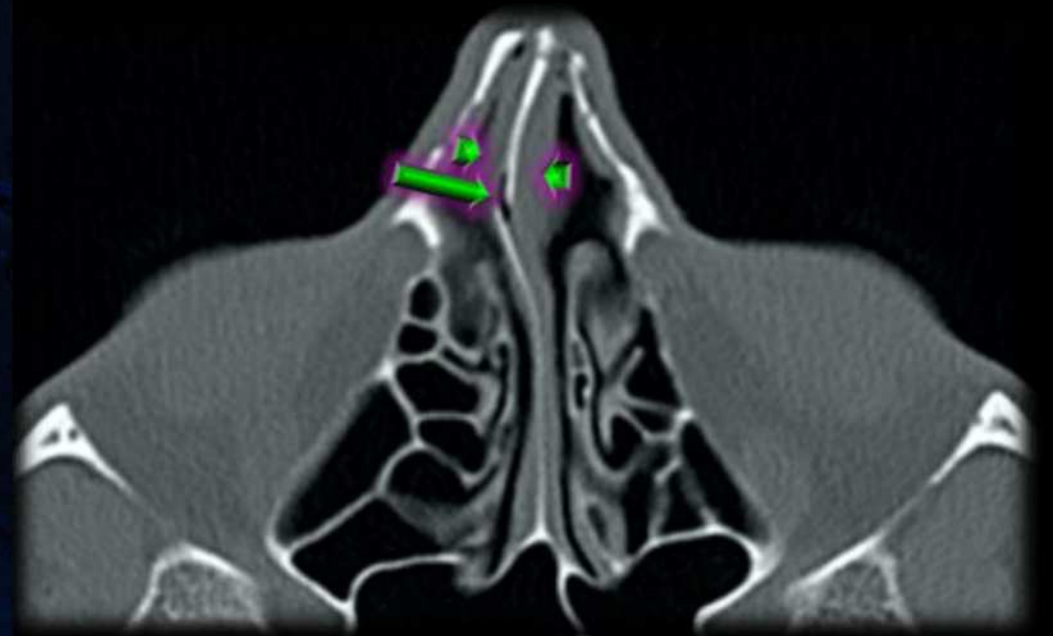
18

sagittals



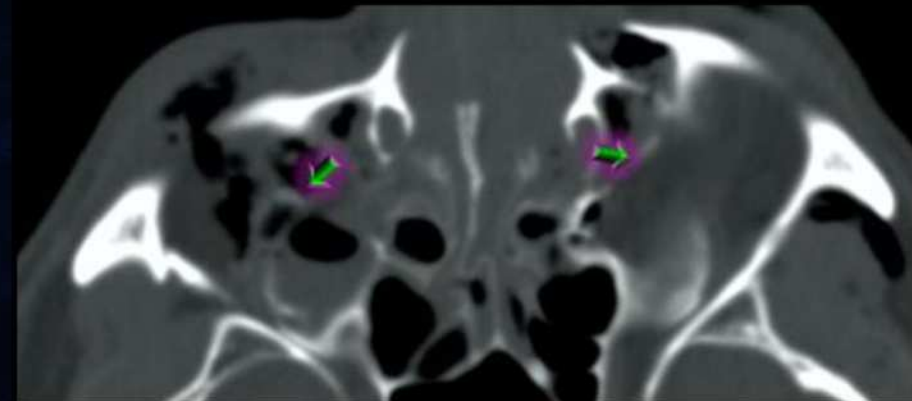
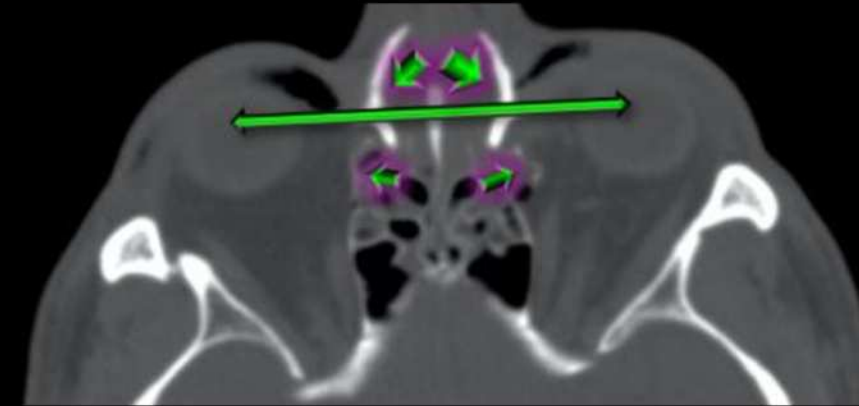
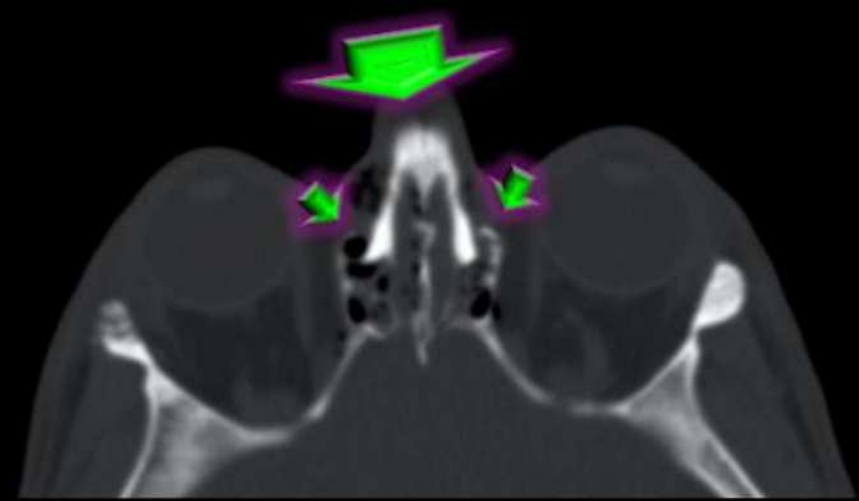
Nasoseptaalsed murrud^{2,3}

- Kõige sagedasem näokolju vigastus
- Ninavahesein eesosas kõhreline, tagaosas luuline
- Tüsistusena ninavaheseina hematoom

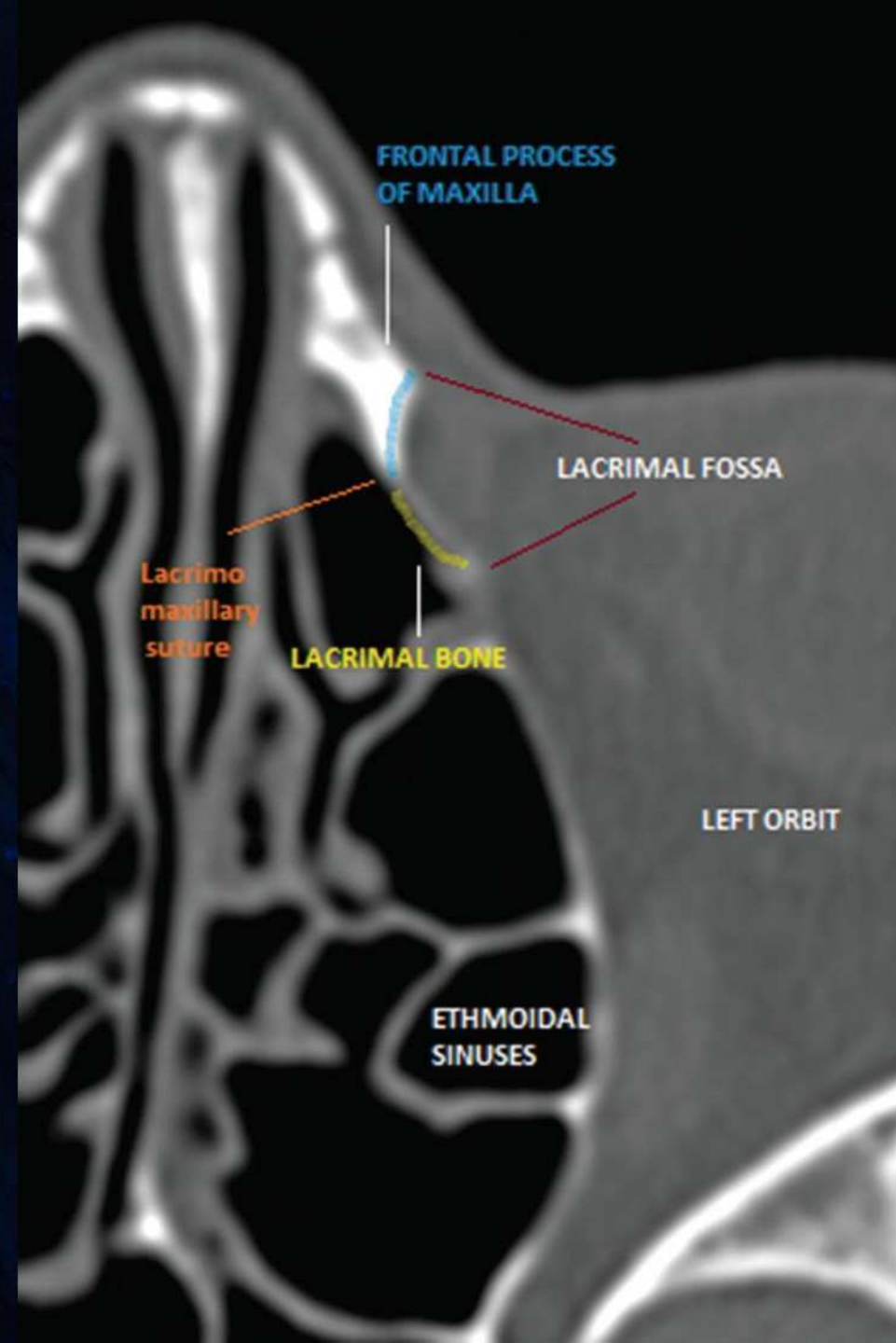


Naso-orbito-etmoidaalregioon ja NOE fraktuur^{1, 2, 3}

- Tekib tugevast löögist vastu nina
 - Ninaluud nihkuvad dorsaalsele
 - *Maxilla proc. frontalis*'ed lateraalsele
 - Etmoidrakustik kiildub sisse
 - *Orbita* mediaalse seina blow-in murd
 - Murd ulatub *orbita* põhjani
- Tüsistusteks eksoftalm, telekantus, liikvorileke, nasolakrimaaljuha ja silma vigastused



- Markowitz ja Mansoni klassifikatsiooni alusel jaotus kolmeks *medial canthal tendon* haaratuse alusel (*ligamentum palpebrale mediale*)
 - Jaotuse aluseks KT-I orbita mediaalse seinaga tsentraalse fragmendi killunemine ja nihe
 - Kinnituskohad paiknevad *fossa lacrimalis*'e piirkonnas

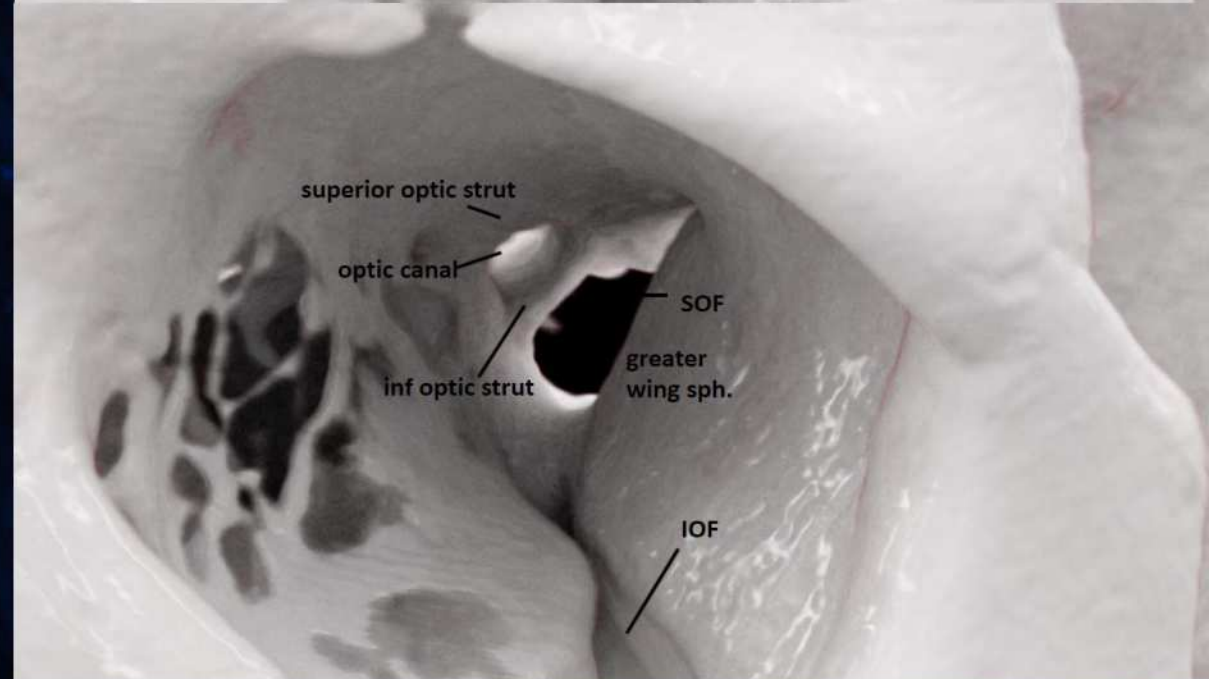
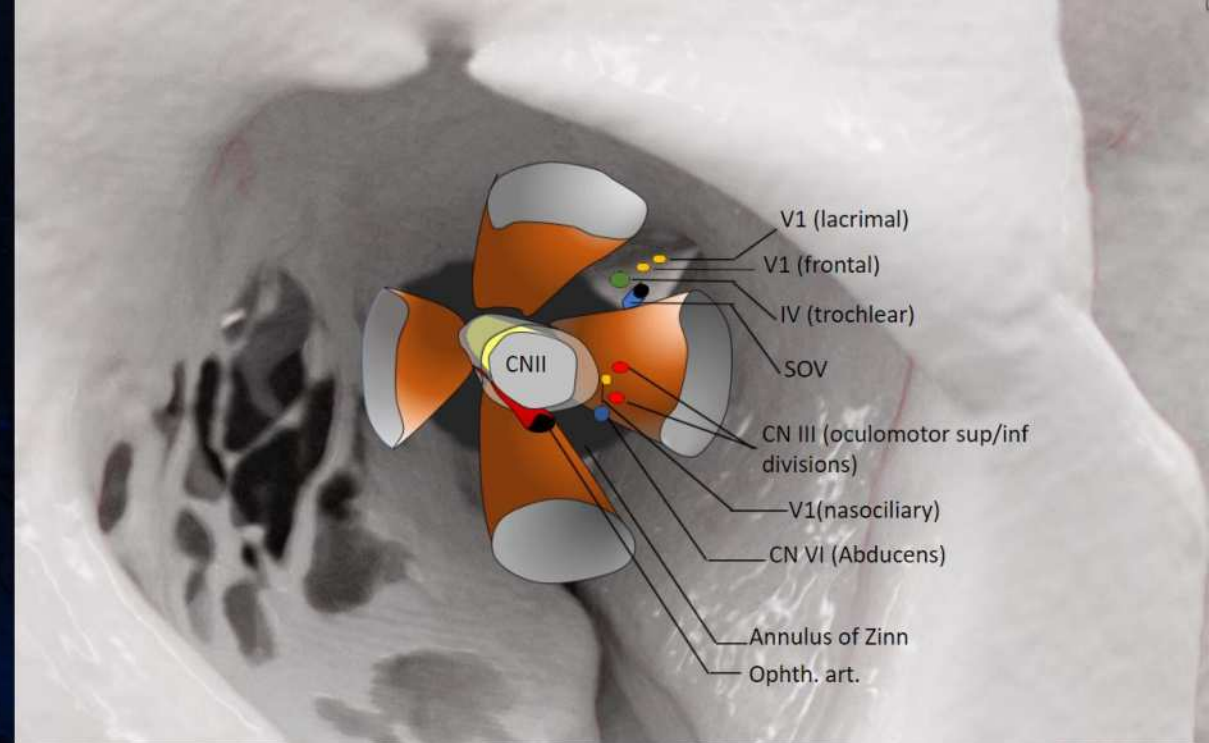


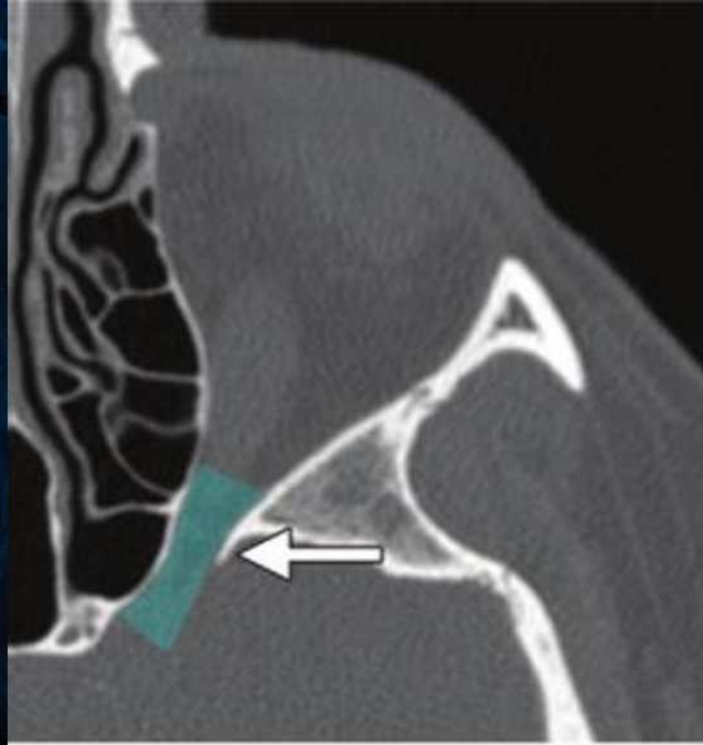


- Tüüp I – kõõlus on intaktne ja ühe suure fragmendi küljes
- Tüüp II – killunenud murd, kuid kõõlus on ühe suure fragmendi küljes
- Tüüp III – killunenud murd koos kõõluse avulsiooniga

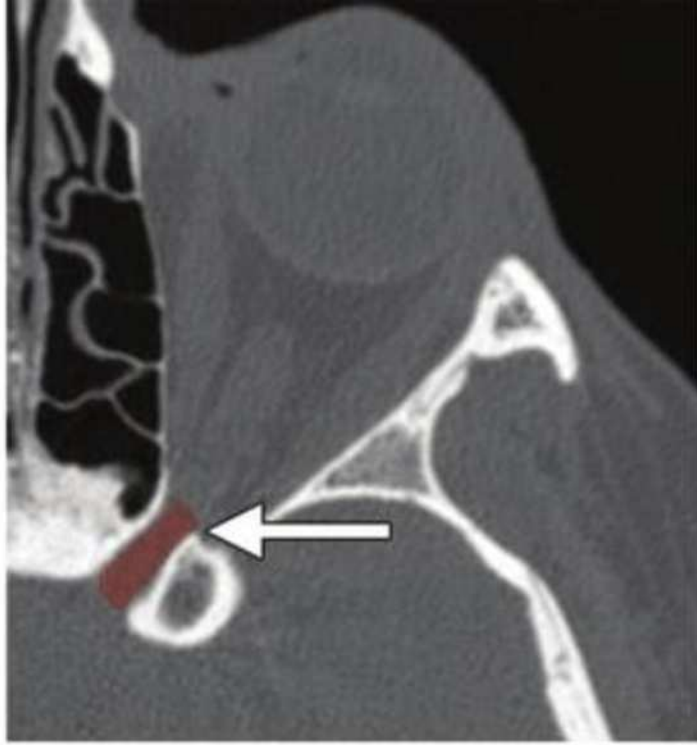
Orbita sündroomid^{1, 2, 8}

- *Orbita* seinte murrud võivad haarata *fissura orbitalis superior*'t (SOFS)
 - KN III, IV, V1, VI
 - Vigastused põhjustavad oftalmopleegiat, diploopiat, ptoosi, eksofalmi
- *Nervus opticus*'e vigastuse korral *orbita* tipu sündroom
 - Nägemiskaotus

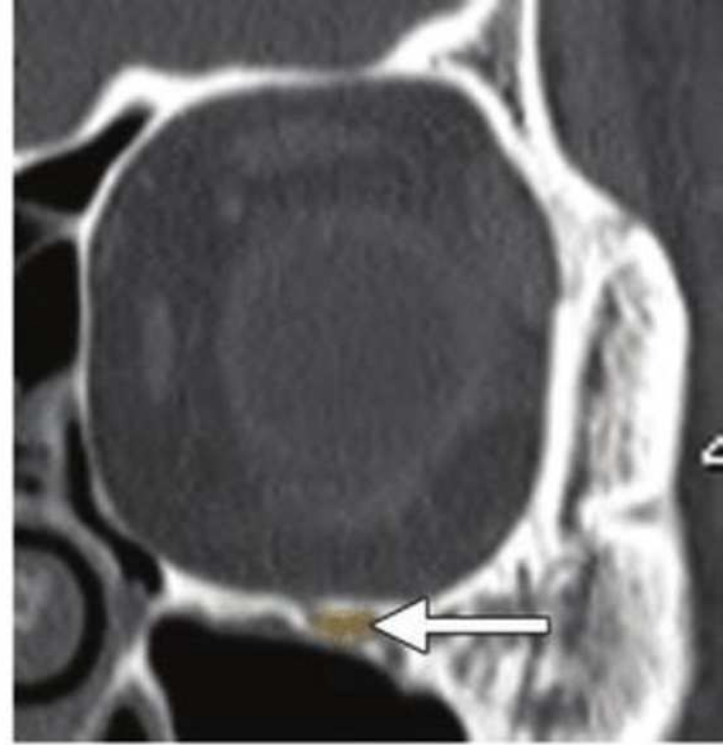




a.



b.



c.



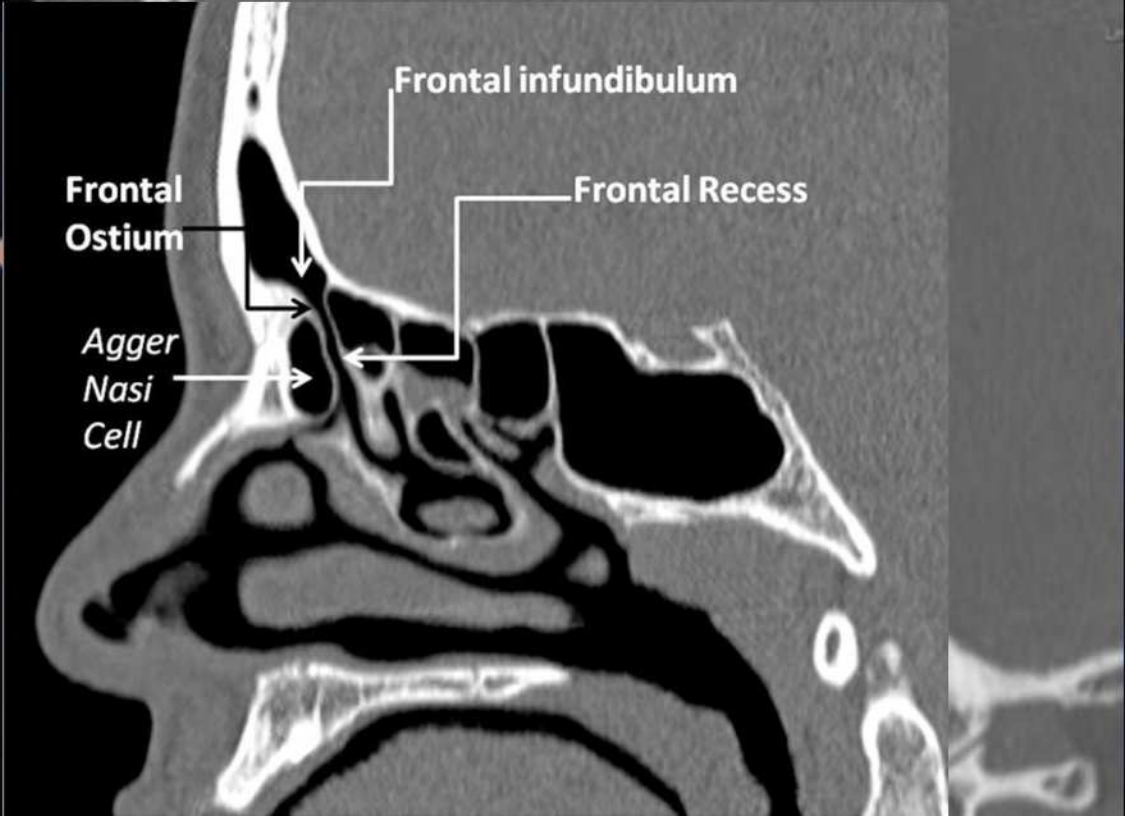
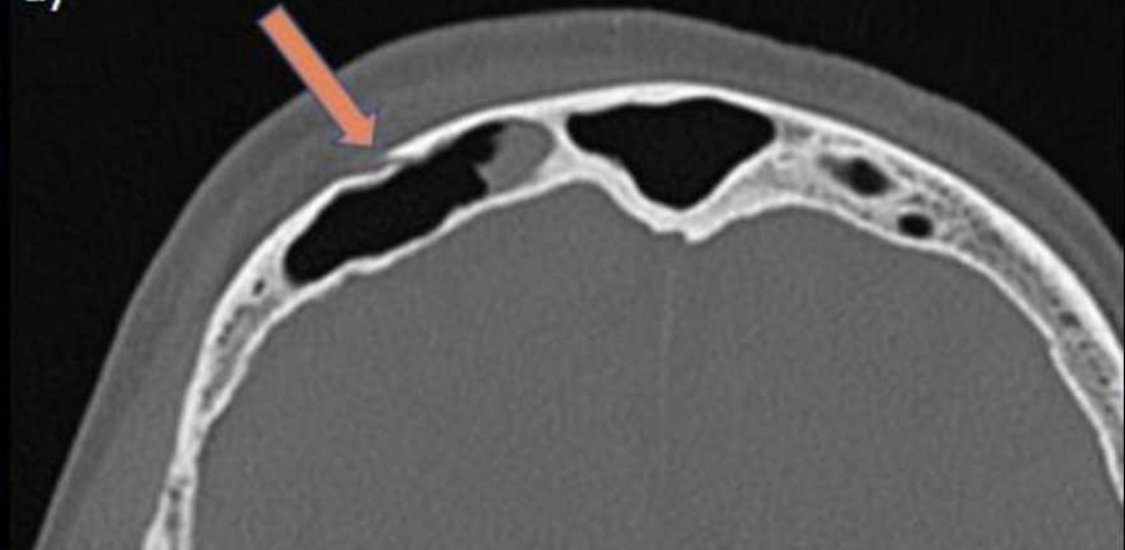
- a. *fissura orbitalis superior*
- b. *canalis opticus*
- c. *canalis infraorbitalis*

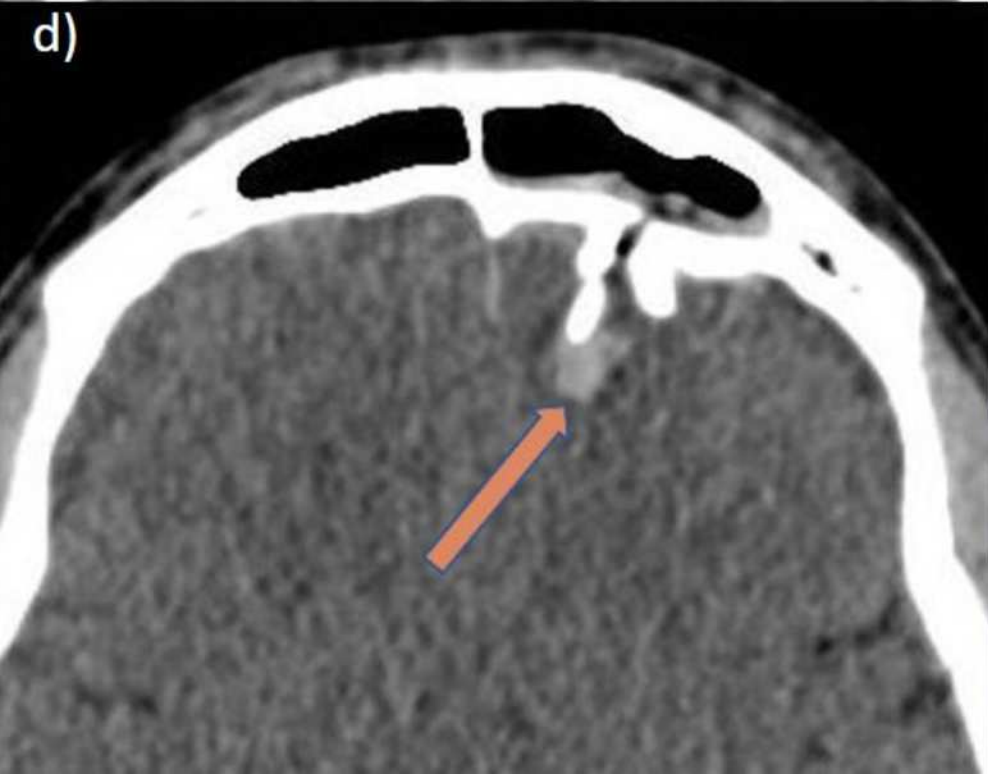
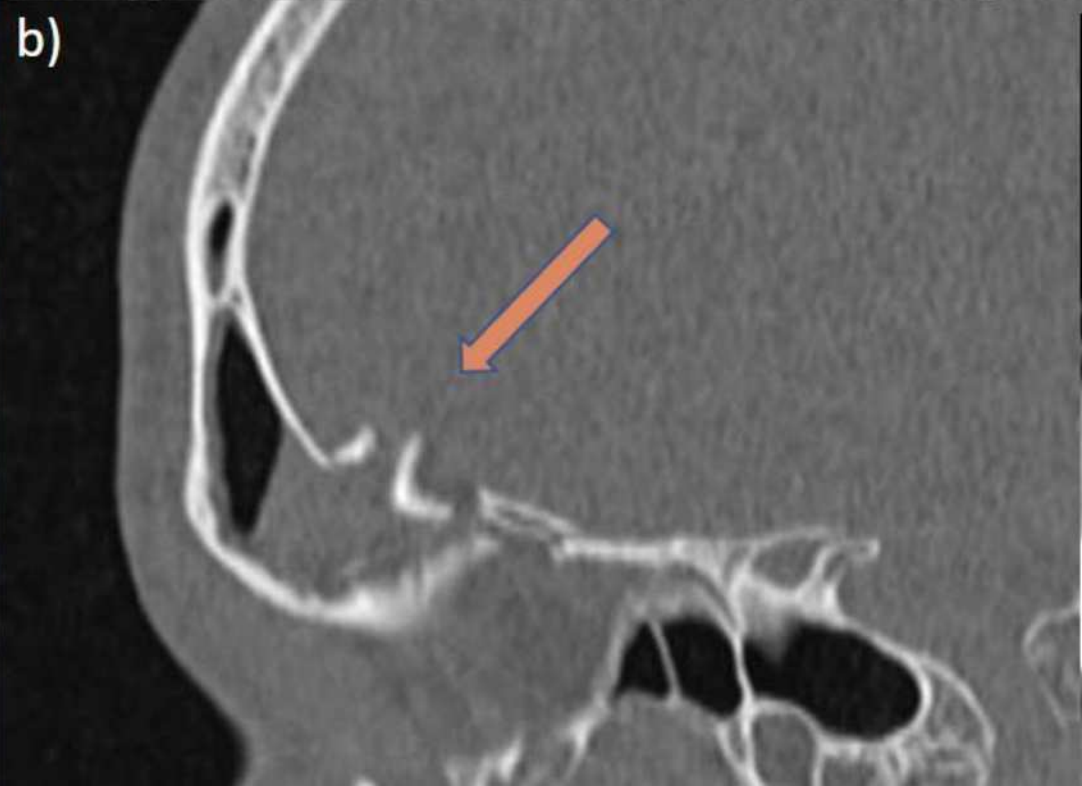
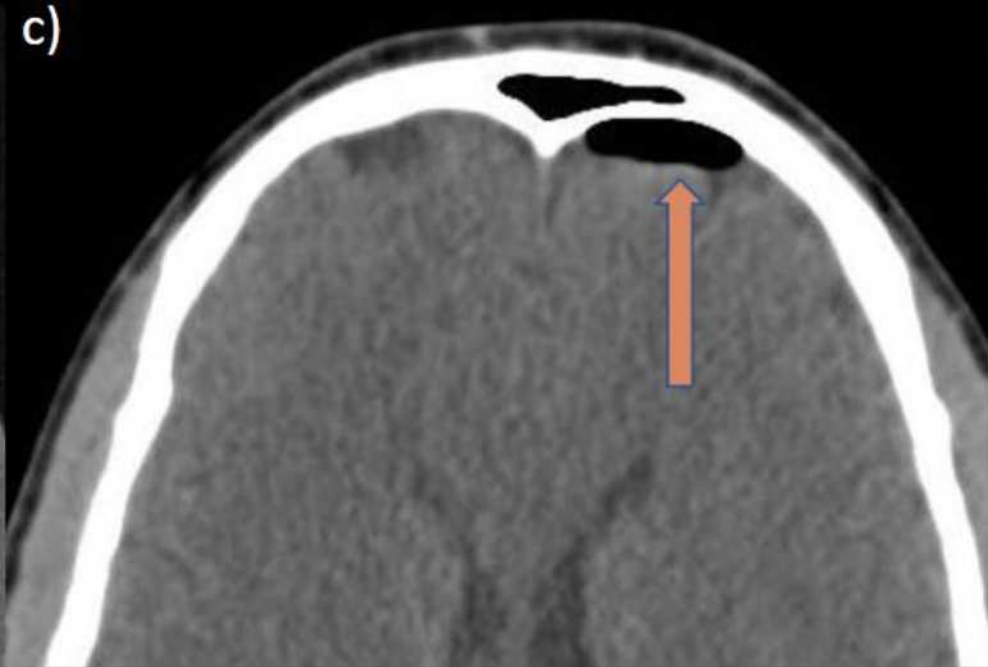
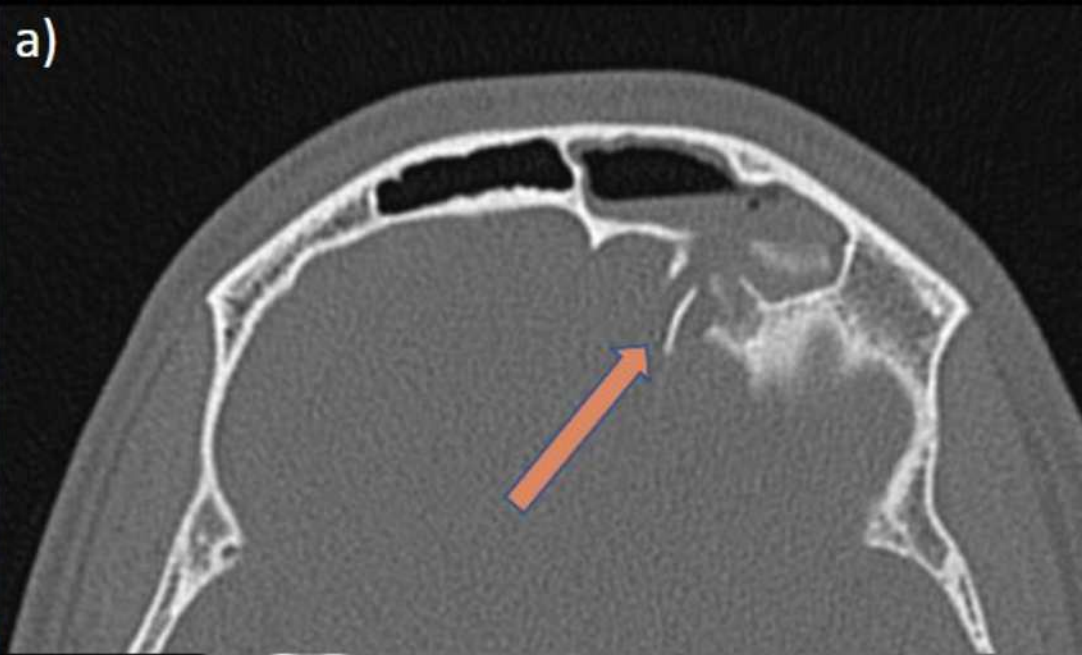
Fissura orbitalis superior't haarav murd

Frontaalsiinuse murrud^{2, 5, 6}

- Eesseina murrud 1/3
- Ees- ja tagaseina murrud 2/3
- Tüsistusteks intrakraniaalne hematoom, liikvori leke, aju herniatsioon, pneumotseefalus, infektsioon
- Mediaalsele ulatuvad murrud võivad haarata frontaalretsessi ja põhjustada äravooluhäiret frontaalsiinusest ja mukotseele teket

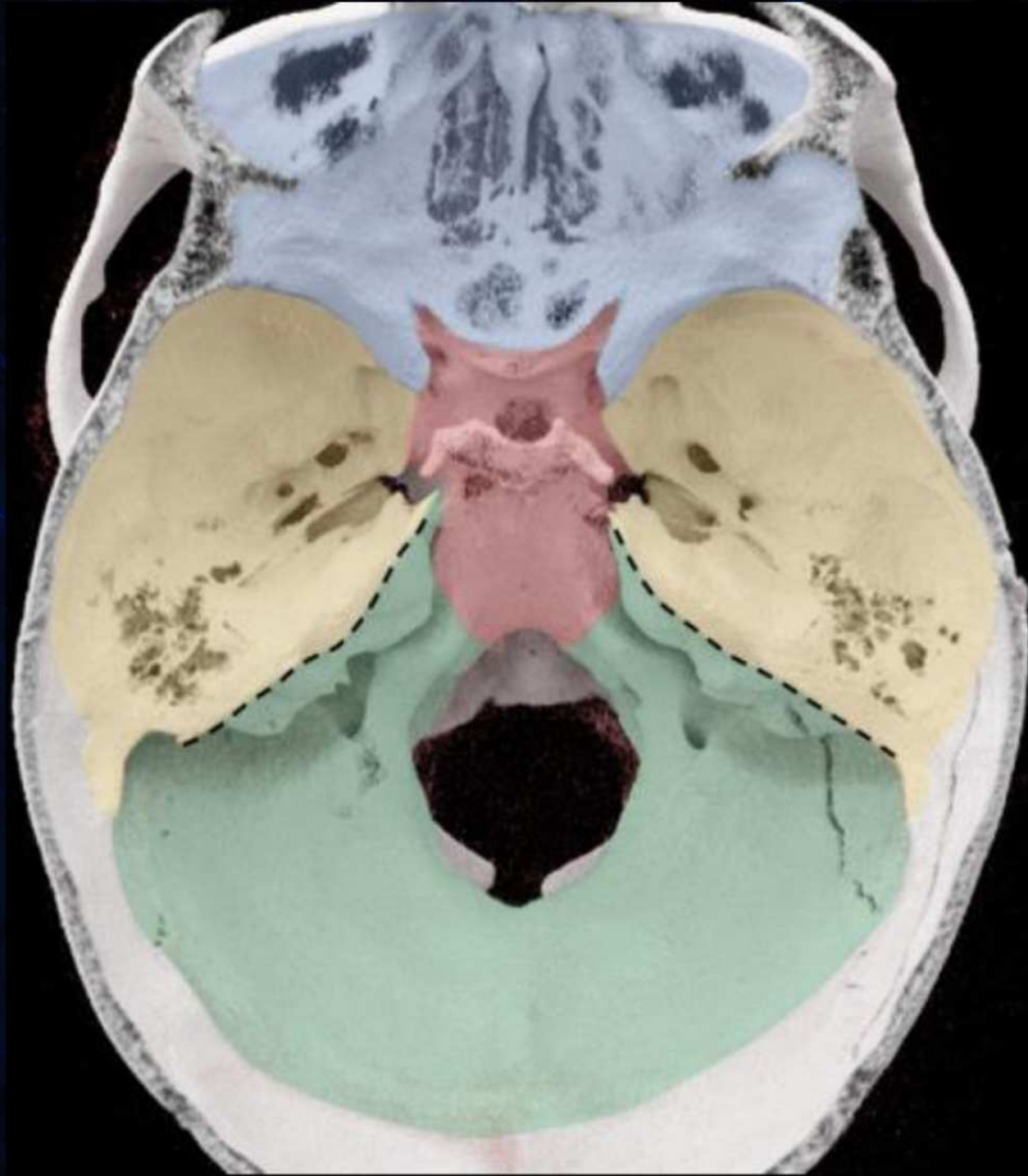
a)

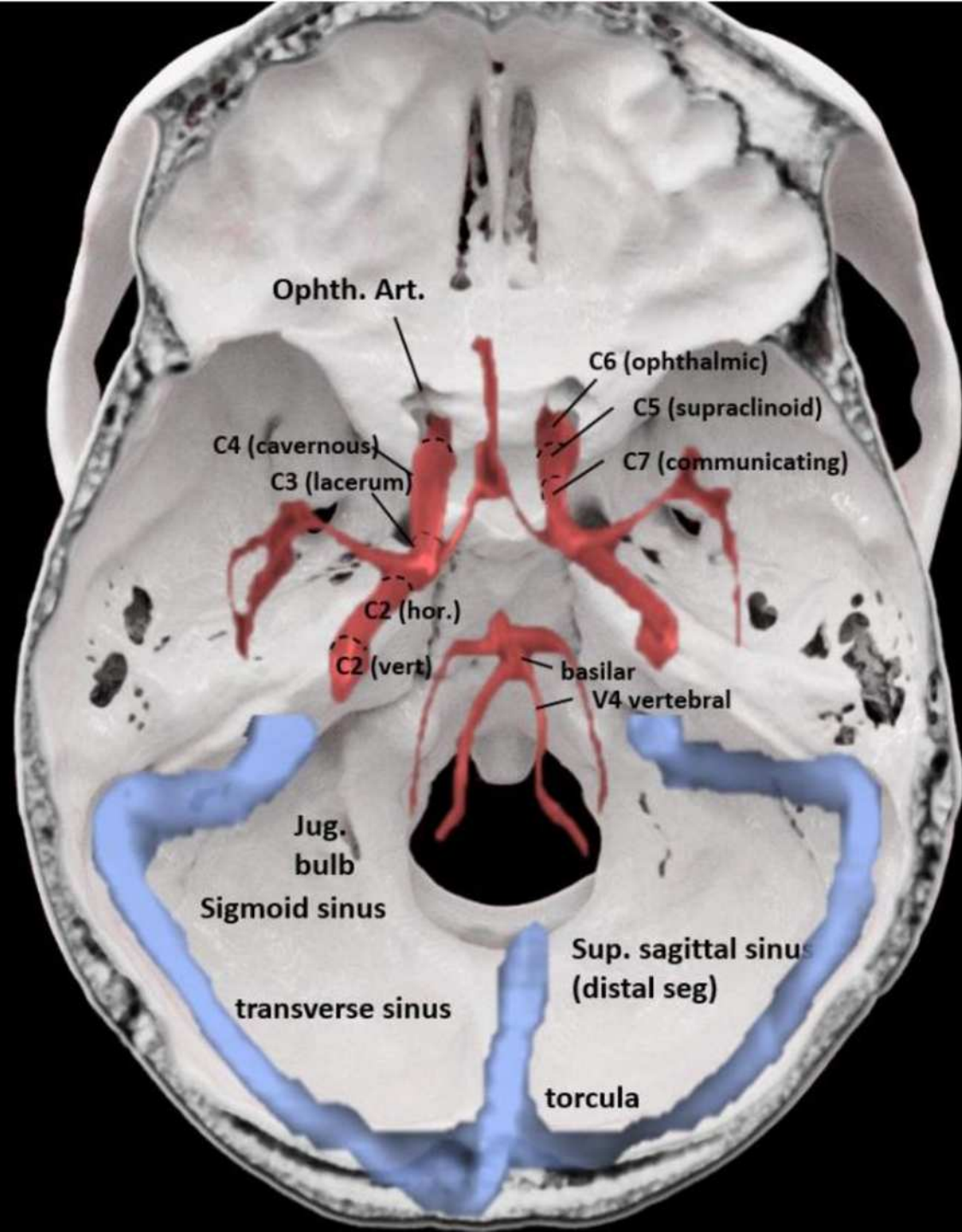
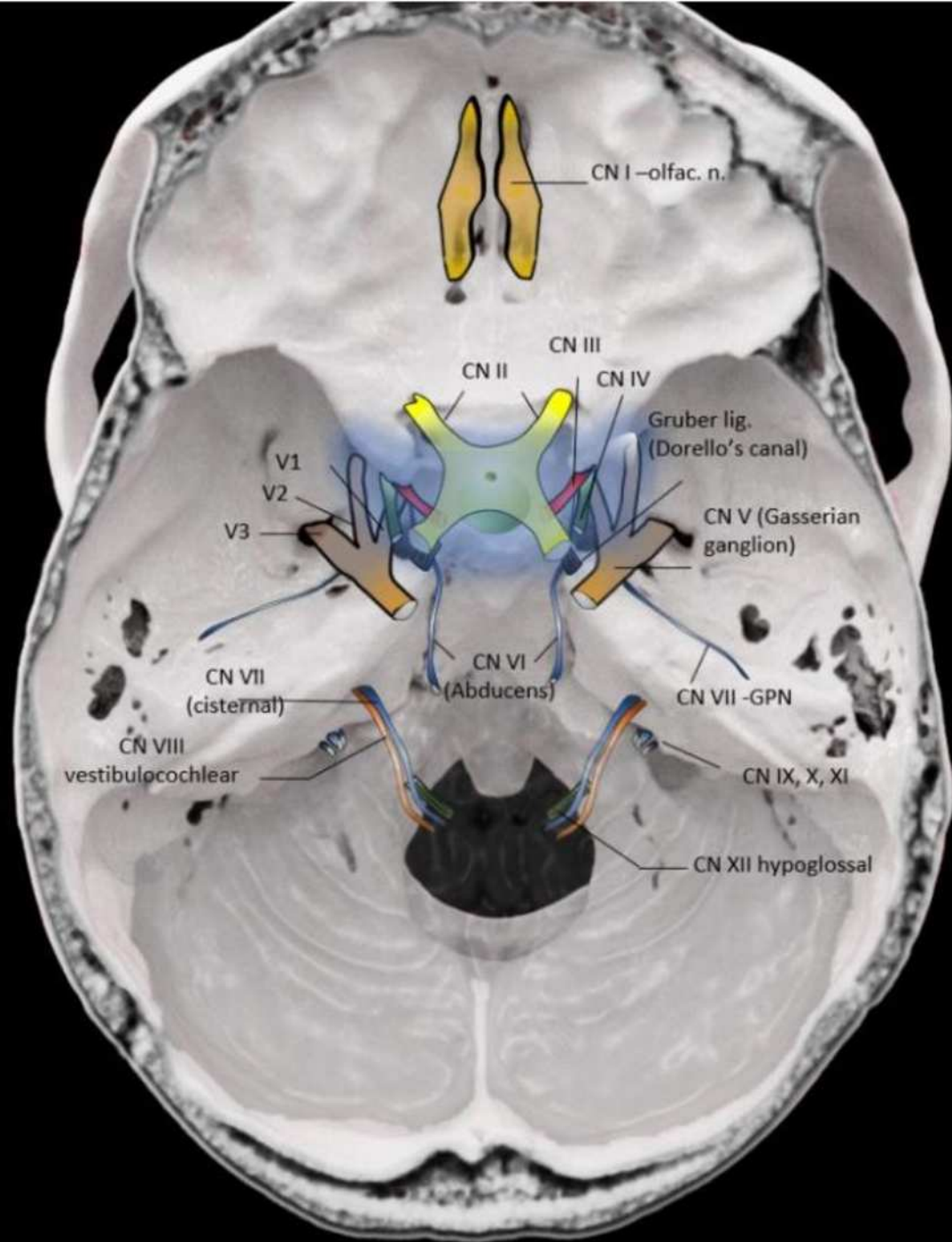




Koljupõhimiku murrud⁸

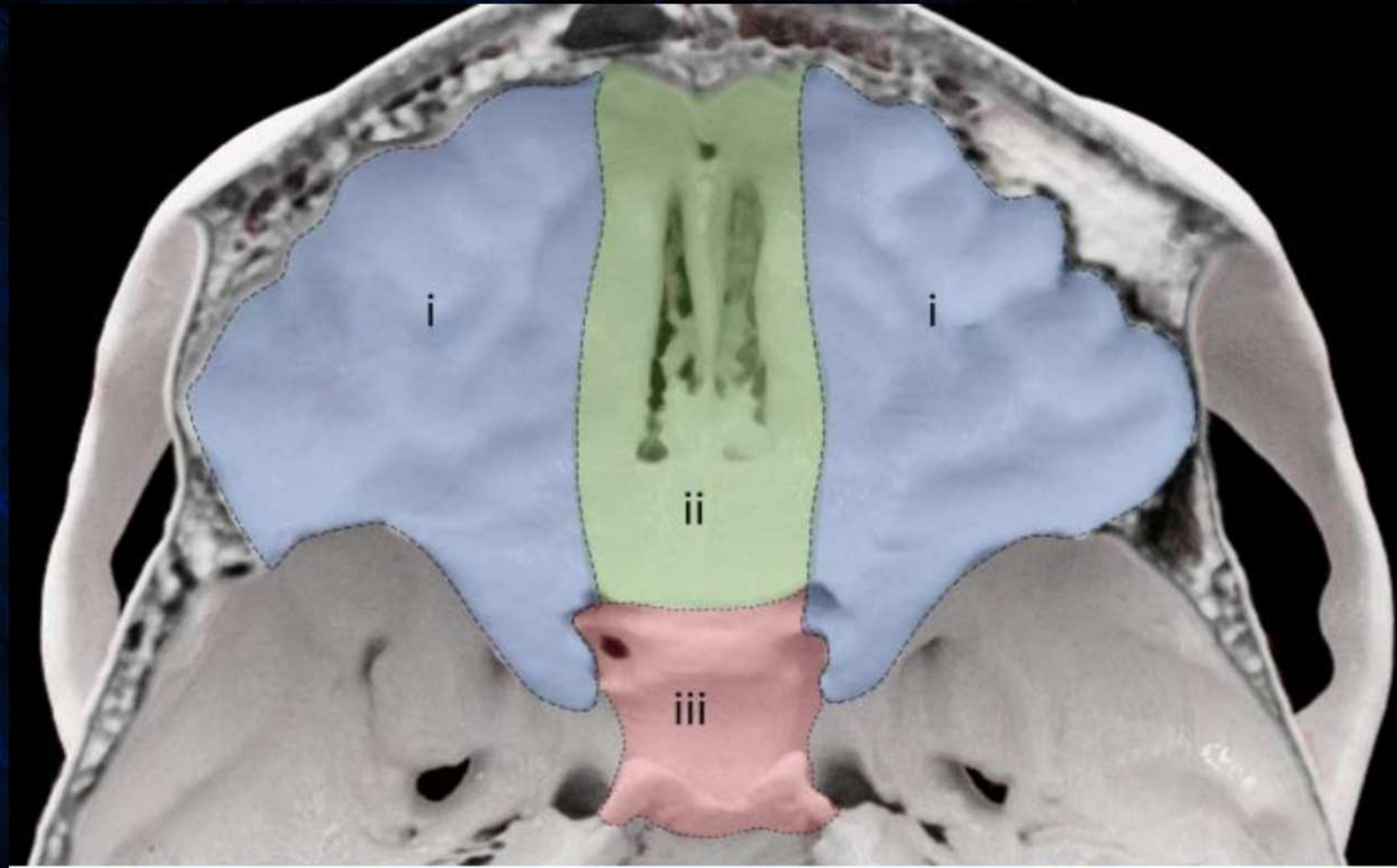
- Lisaks diagnostilisele väärtusele annab KT prognostilist informatsiooni tüsistuste kohta
 - Tüsistusteks liikvori leke, aju herniatsioon, meningiit, orbita tipu sündroomid, kraniaalnärvide paralüüs, kuulmiskaotus, veresoonte vigastused ja kolesteatoom
- Oimuluu haaratud ca 40%, orbita lagi 24%, kiilluu 23%, kuklaluu 15%, sõelluu 11%
- Vaja kirjeldada defektide suurust ja fragmentide nihet, haaratud struktuure
 - Veresoonte vigastuse kahtlusel KT-angio



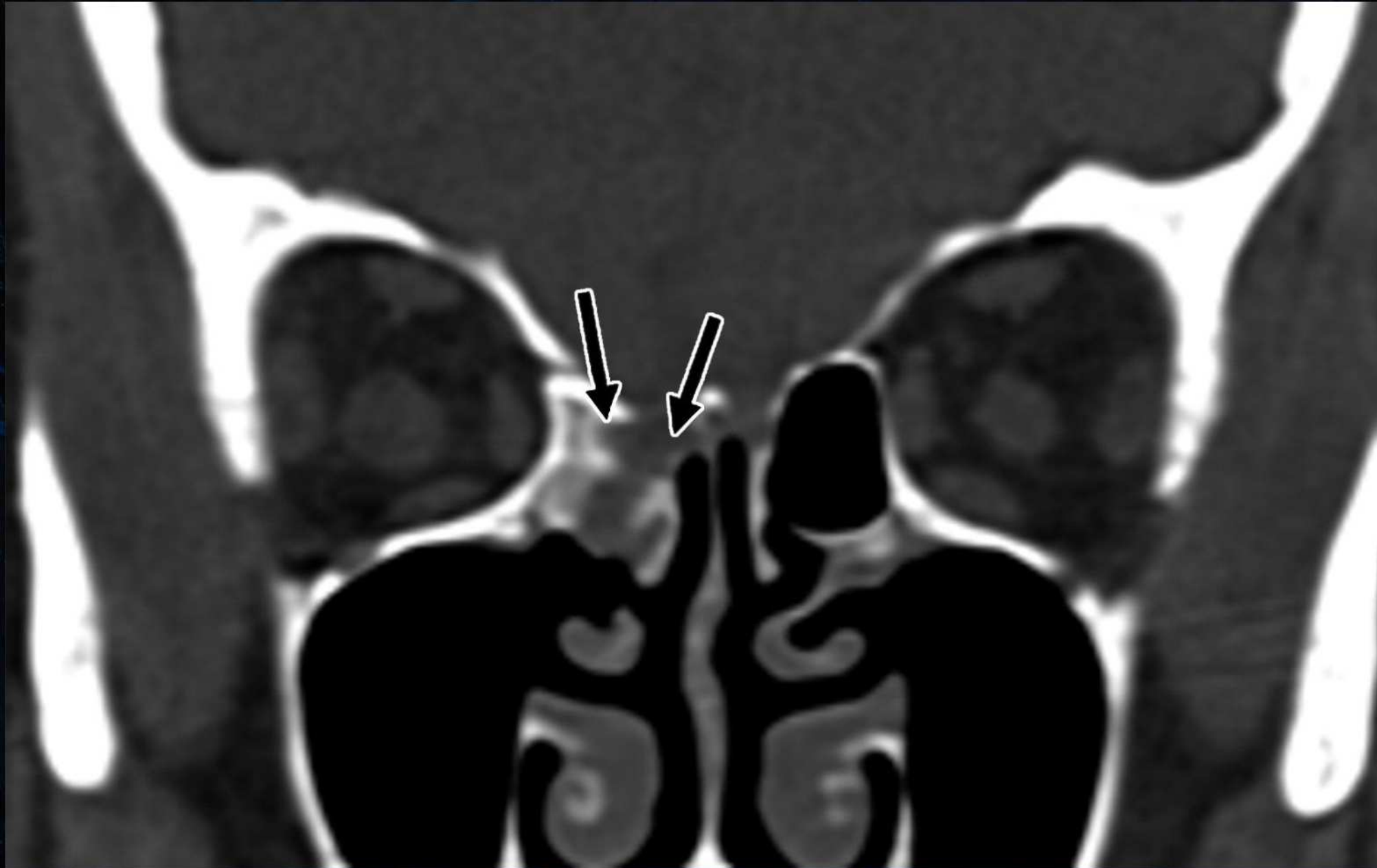


Frontobasaalsed murrud^{8,9}

- Varieeruvad väikestest lineaarsetest kuni ulatuslike killunenud murrudeni
- Liikvori lekke korral spontaanselt tõenäoliselt ei sulgu
 - 1-2 cm defektid (eriti mediaalsed või sfenoidsiinust läbivad)
 - >10 ml pneumotseefalus
- Orbita tipu sündroomid: *fissura orbitalis superior, canalis opticus*
- Vaskulaarsed tüsistused: ICA vigastus C3-C4 segmentides, kavernoos-karotiid fistel või pseudoaneurüsm
- Haistmisnärv mõlemapoolne vigastuse korral hüpo/anosmia



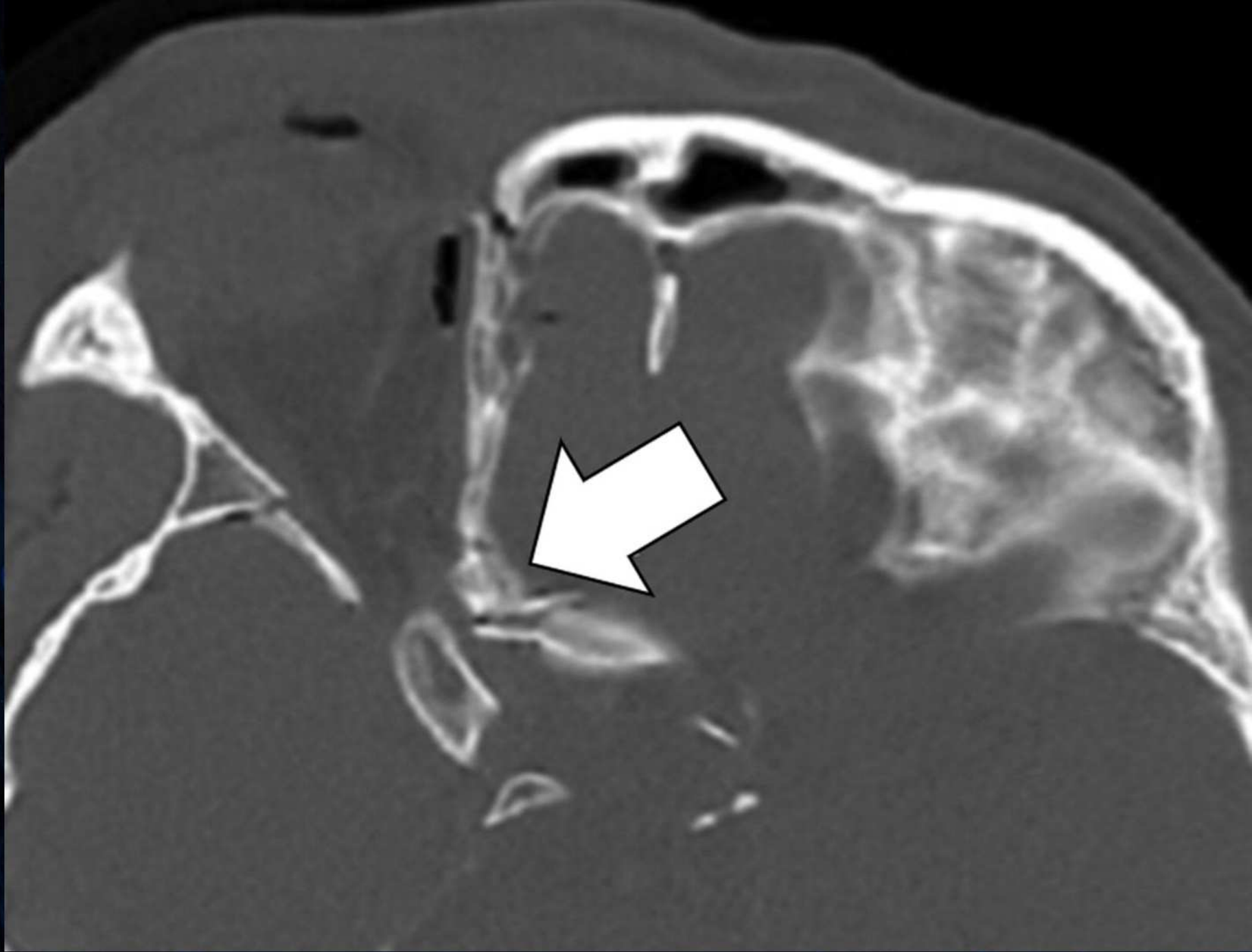
i – orbita lagi, ii – *ethmoid-cribriform complex*, iii – kiilluu keha



Liikvori fistel vana murru järgselt, defect lamina cribrosas.



Traumaatiline nägemiskaotus. Lateraalne frontaalne murd, mis haarab *canalis opticus*'t.

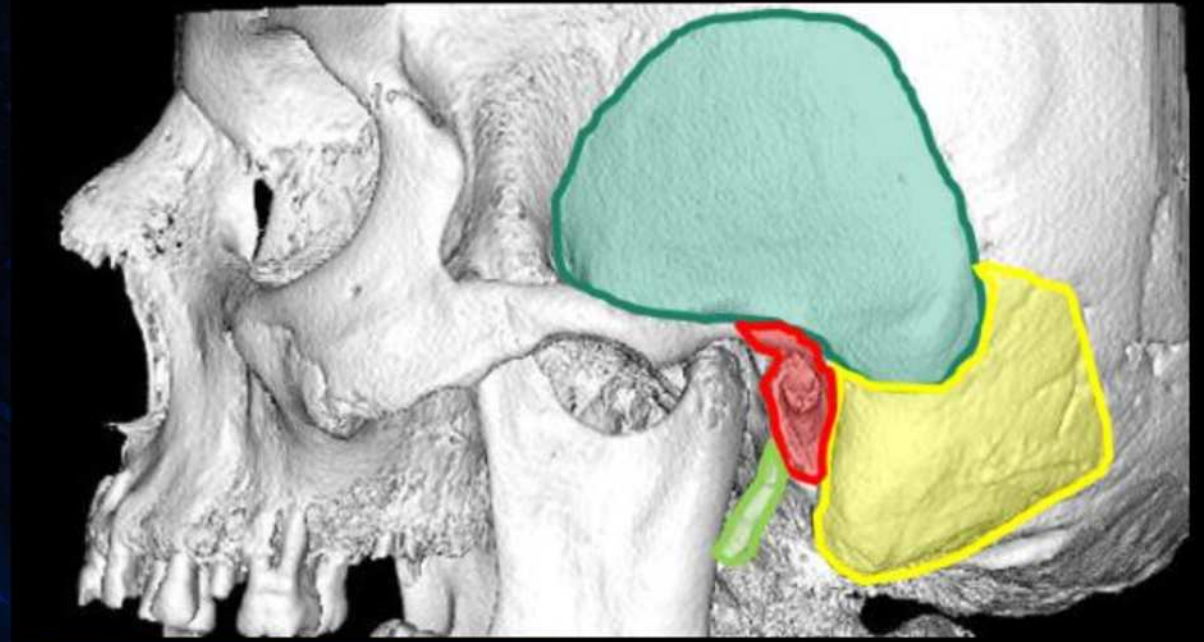


Angiograafial varane kavernoossiinuse täitumine. Leid viitab kavernooskarotiidfistlile sisemise unearteri vigastuse tüsistusena.



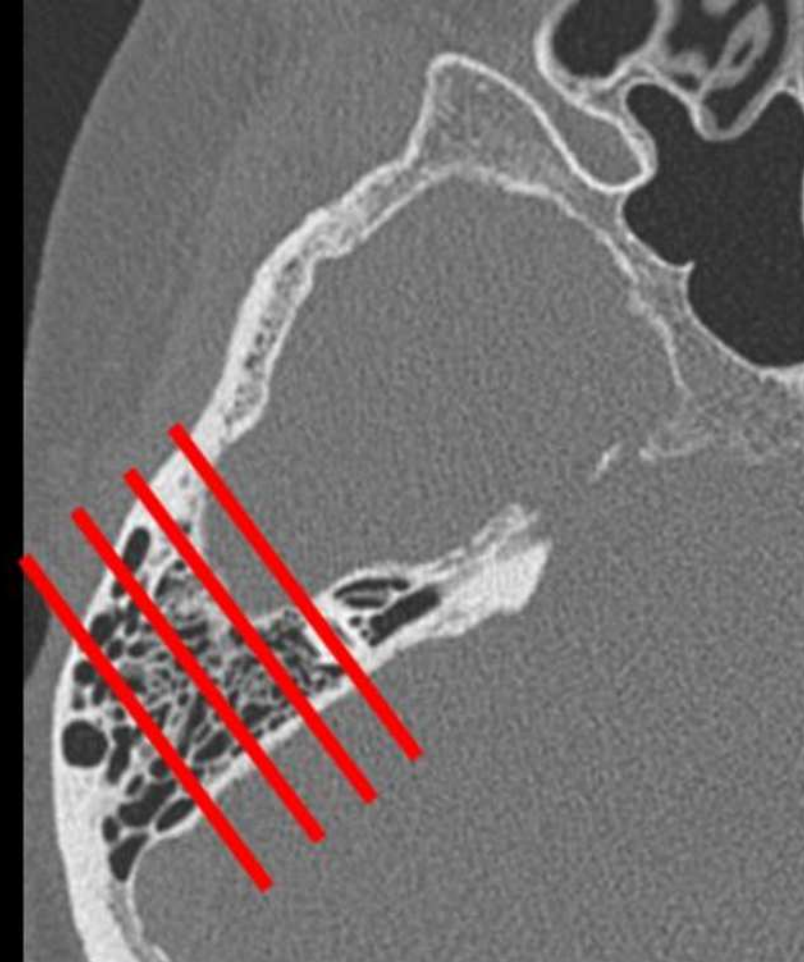
Laterobasaalsed murrud^{8,9}

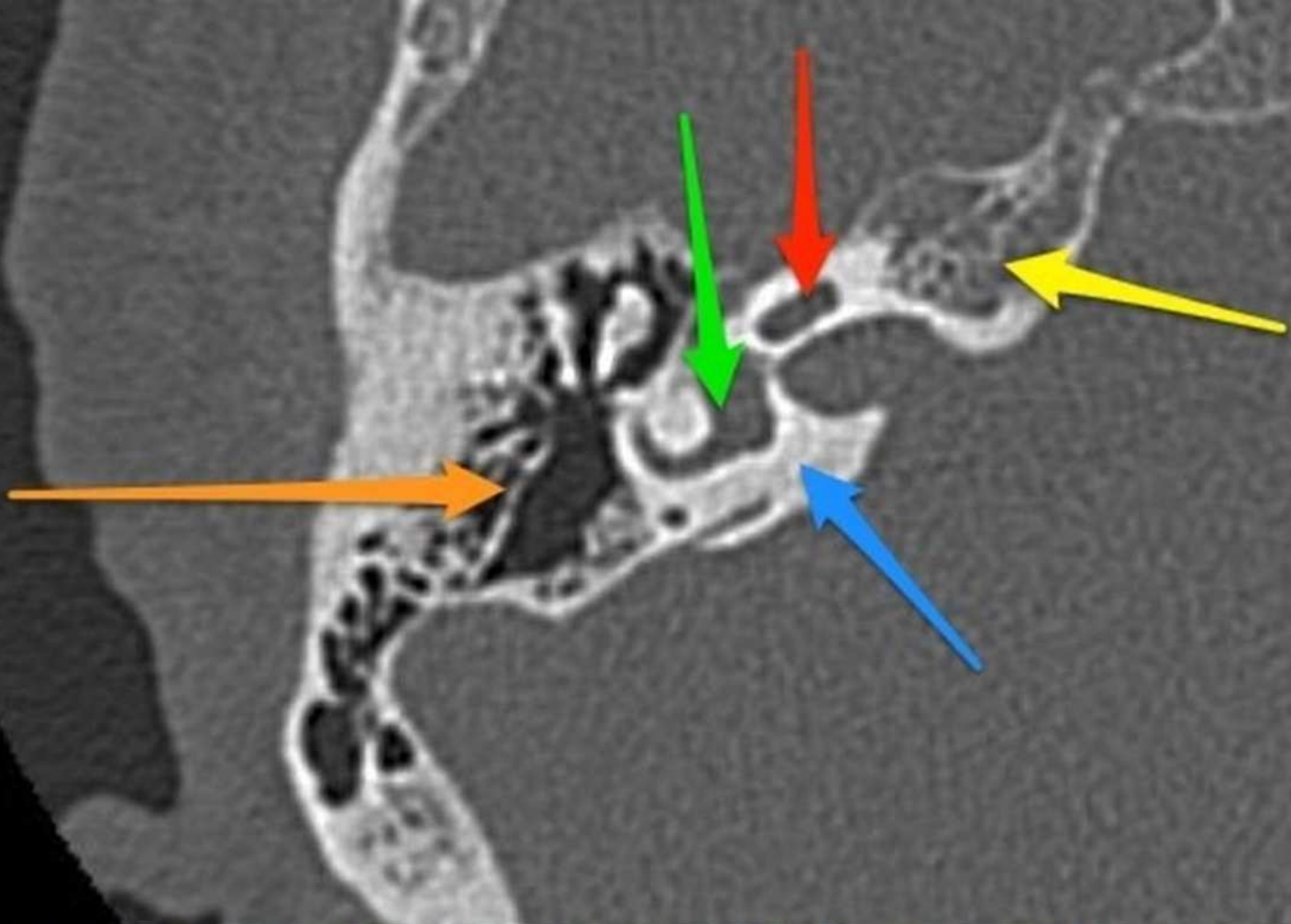
- Tüsistused sõltuvad murru tüübist ja karotiidkanali, näonärvikanali kõrvakapsli, kuulmeluukeste ja *tegmen*'i haaratusest
- Kirjeldada tuleks murru suunda ja haaratud struktuure
 - Eristada *otic capsule violating* (OCV) murd
- >1-2 cm *tegmen*'i defektide korral suurem risk liikvori lekkeks, entsefalotseeleks
- Hilistüsistustena kolesteatoom ja luustuv labürintiit



- Temporaalluu murdude jaotus (Kang et al)

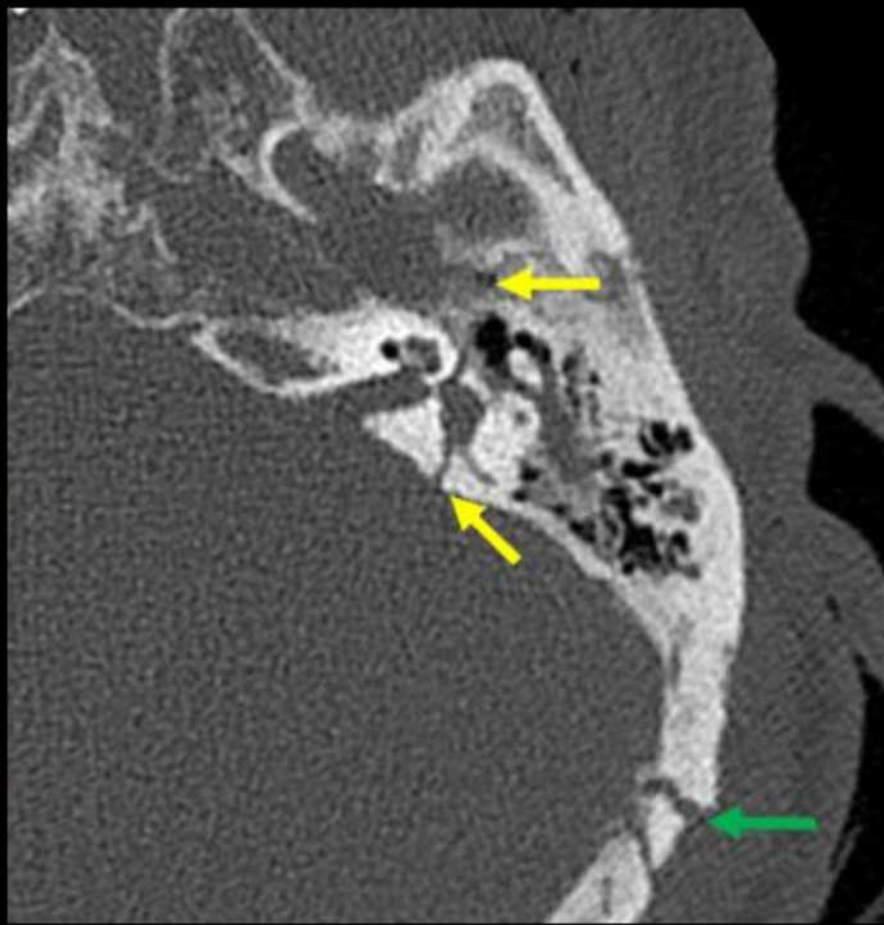
- Piki (80%)
 - Tüsistusena konduktiivne kuulmiskadu
- Risti (20%)
 - Näonärvi vigastus, sensorineuraalne kuulmiskadu, vertiigo
- Petroosne
- Segatüüpi





- Sinine nool – *otic capsule*. Roheline nool – esik. Punane nool – tigu. Oranž nool – mastoidrakustik. Kollane nool – petrosne tipp.

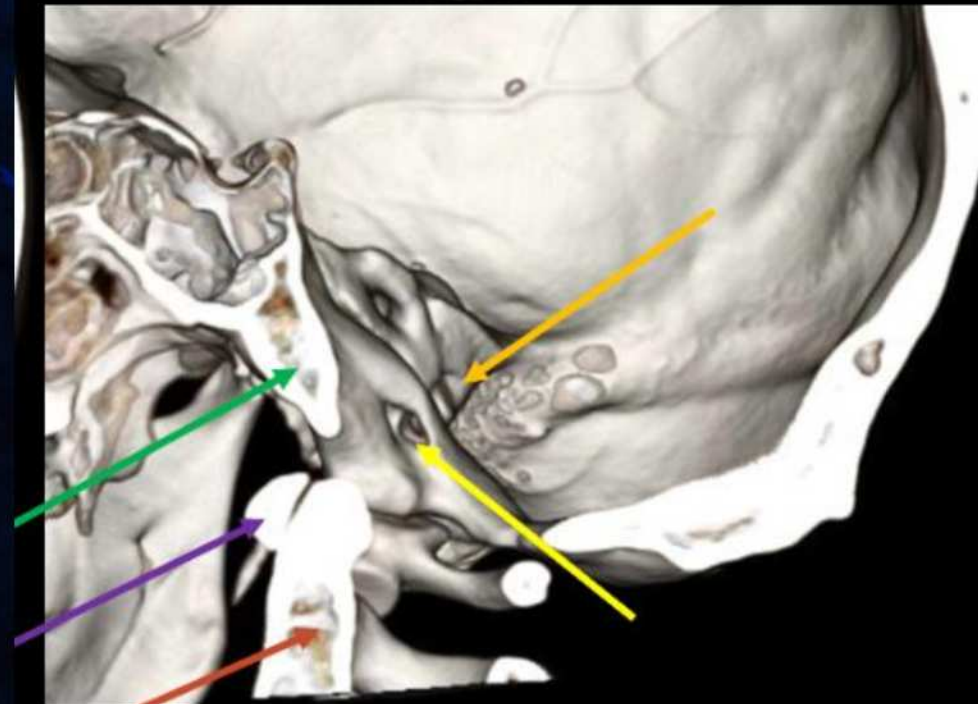
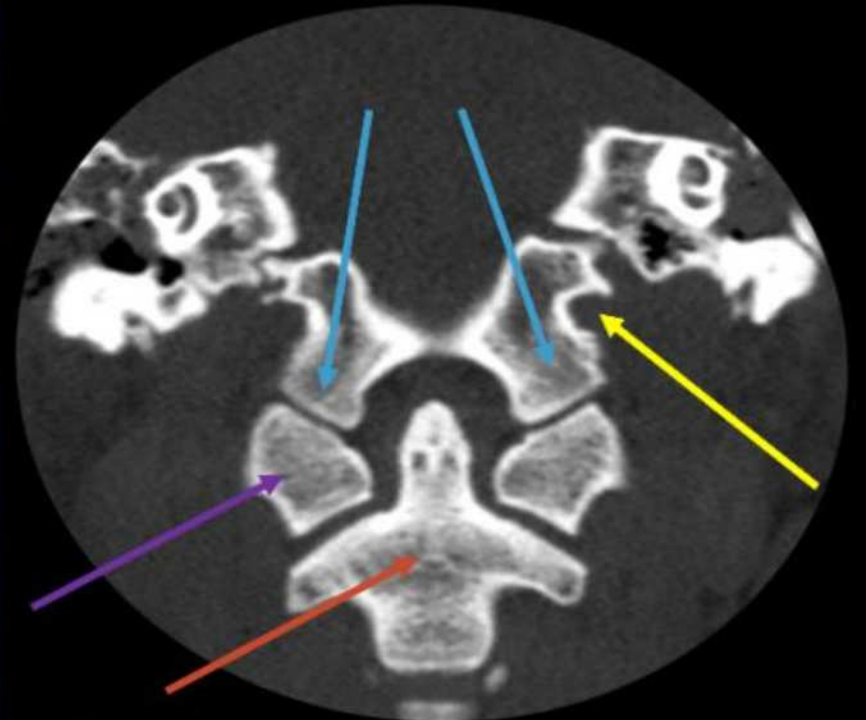
Parempoolsel pildil suur *tegmen*'i defekt.

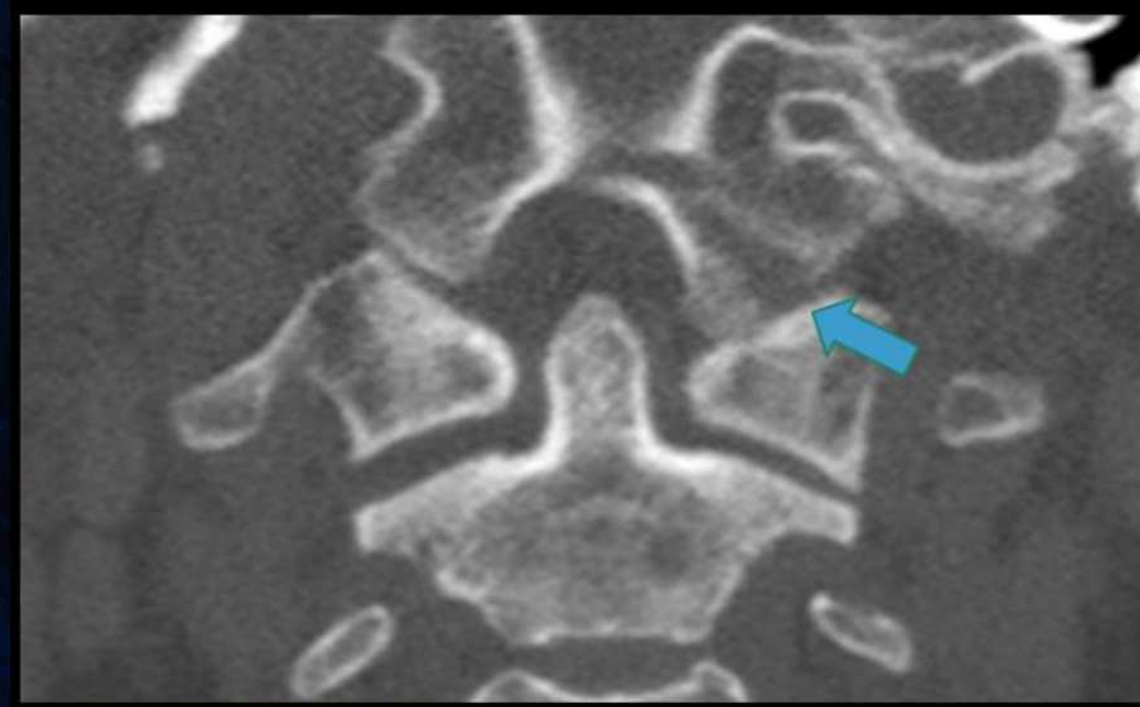
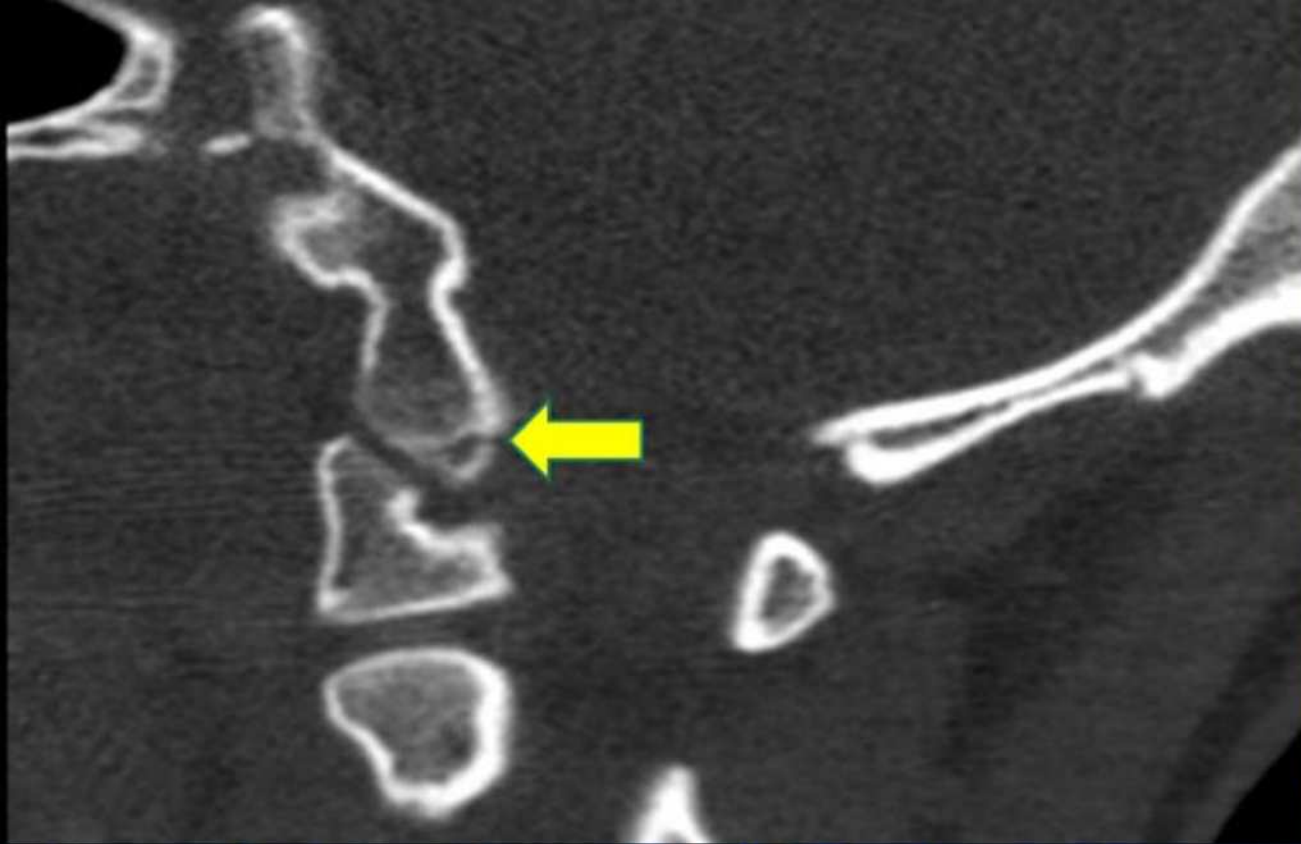


- Kõrva kapslit haarav murd (8,5%)
 - Tihe petrosne luu mis ümbritseb sisekõrva membranooset labürinti
 - *Otic capsule-violating* (OCV)
 - 7-25x suurem tõenäosus sensorineuraalsele kuulmiskaole
 - 5-9x suurem tõenäosus näonärvi vigastusele
 - 4-8x suurem tõenäosus liikvorilekkele

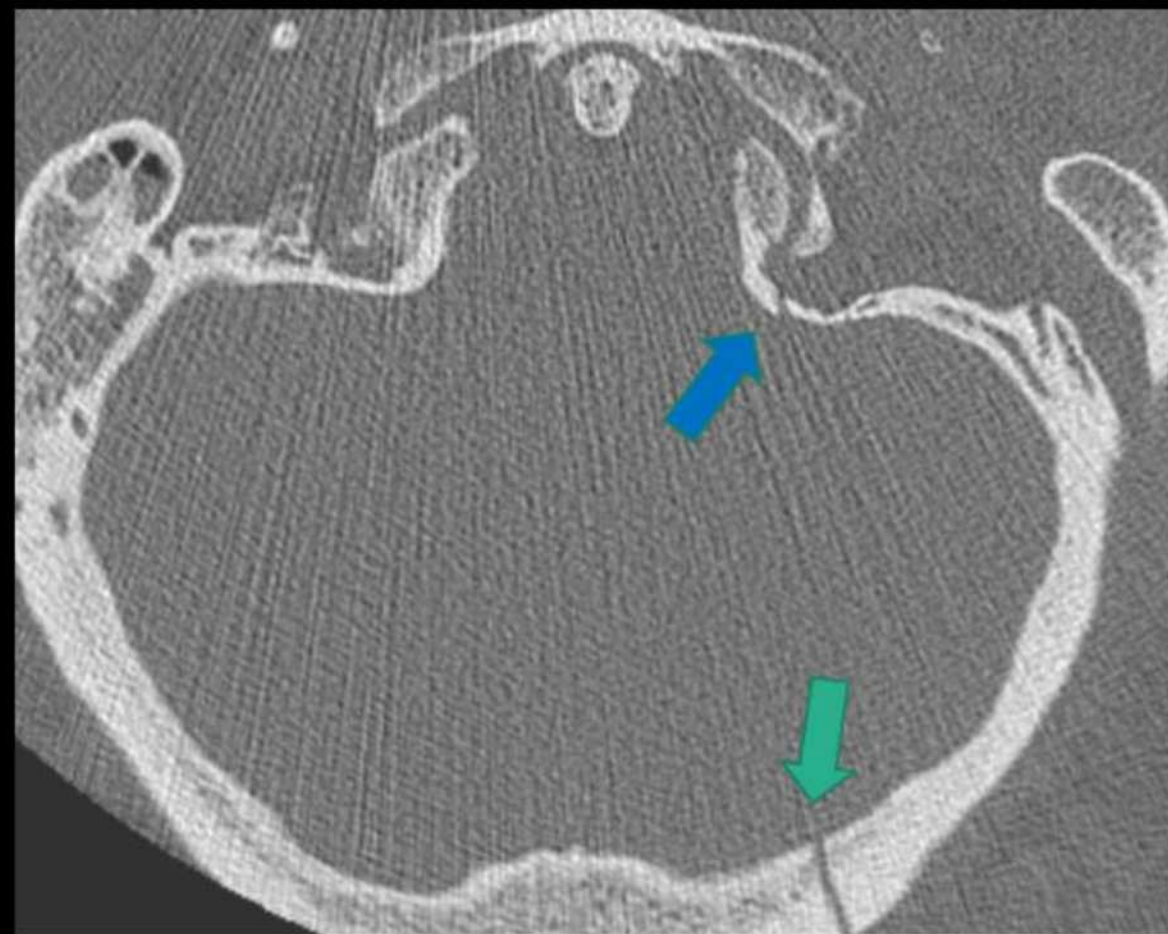
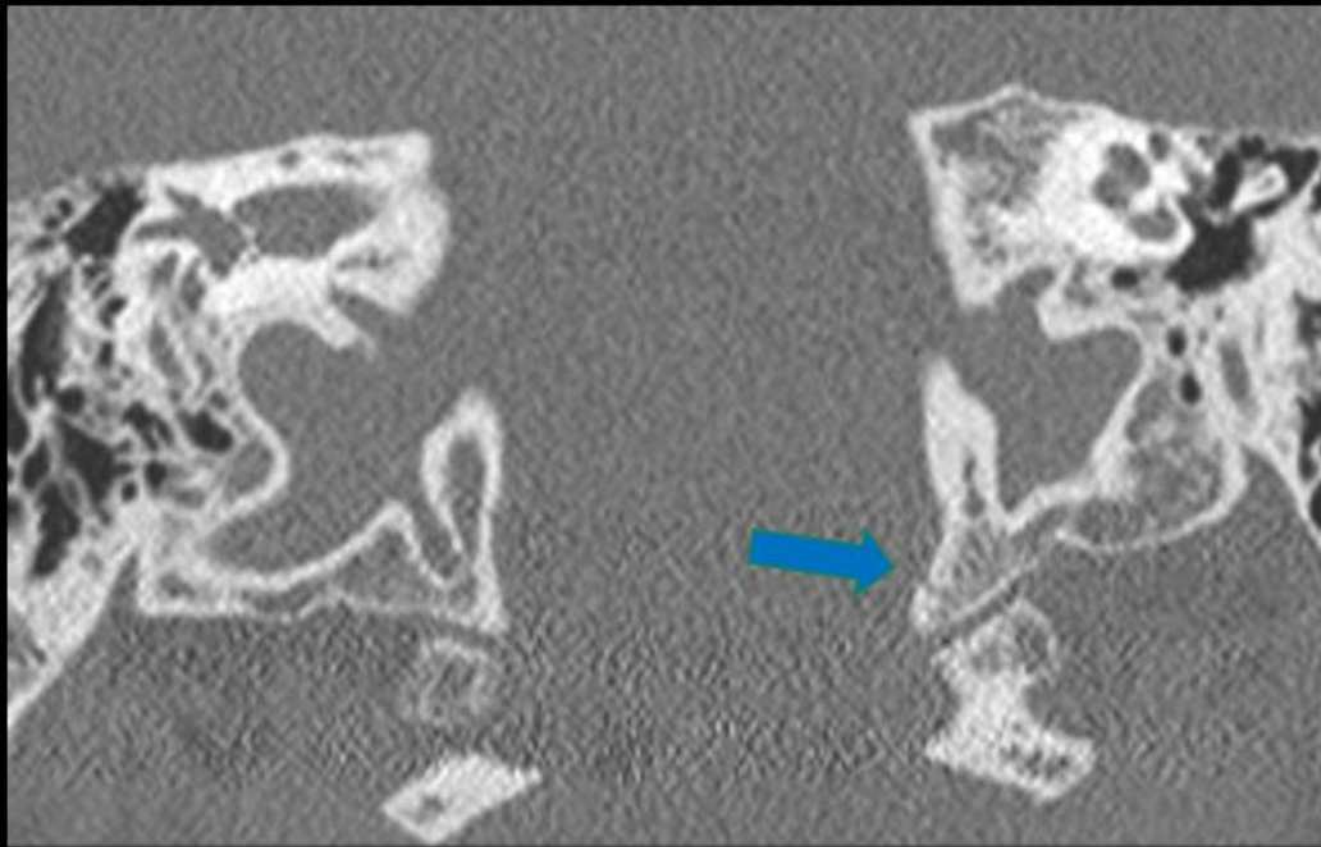
Posterobasaalsed murrud^{8,9}

- *Condylus occipitalis*'t haaravad murrud (Anderson ja Montesano klassifikatsioon)
 1. Sissekiildunud murd, aksiaalsest survest
 2. Läbib põnta ja posterioorsel kuklaluud
 3. Põnta avulsioonmurd, potentsiaalselt ebastabiilne ligamentide vigastuse tõttu
- *Clivus*'t haaravad murrud
 - Põiki-, risti-, pikimurrud
 - Kõrge suremus ajutüve infarkti või verdumise tõttu
- Vaskulaarsete vigastuste hindamiseks vajalik KT-angiograafia ja –venograafia
 - Venoosinuste ja vertebrobasilaarsüsteemi vigastused

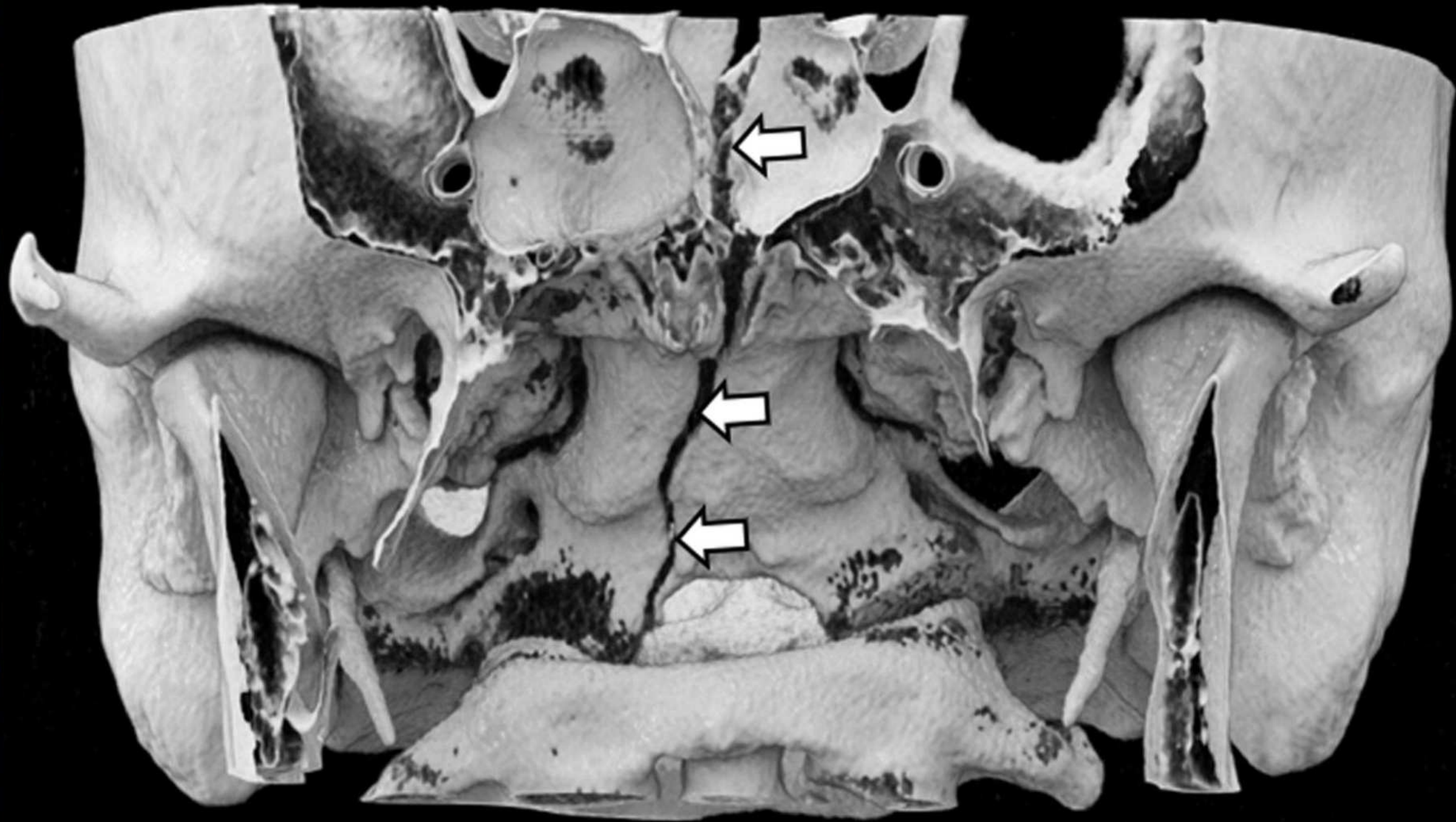




- Kollane nool – tüüp I kondüüli murd, vähene impakteerunud (stabiilne)
- Sinised nooled – tüüp III kondüüli avulsioonmurd (potentsiaalselt ebastabiilne)



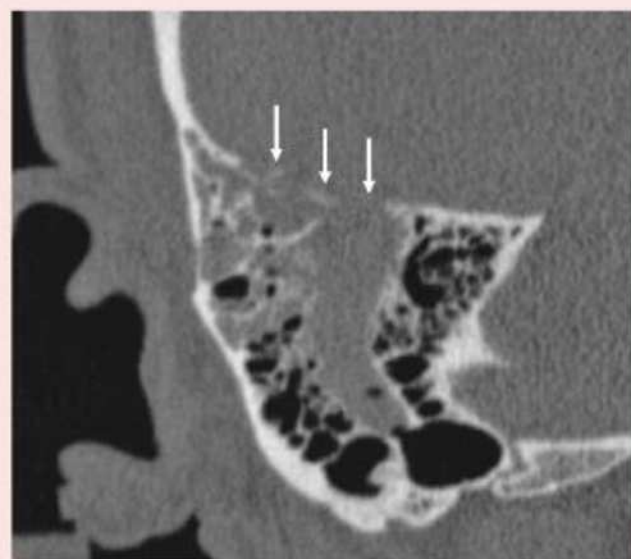
- Tüüp II oktsipitaalsele ulatuv murd (stabiilne)



Clivust haarav pikimurd.

CT of Skull Base Fractures: Classification Systems, Complications, and Management

CSF leak considerations specific to laterobasal fractures



Otic capsule-violating fracture



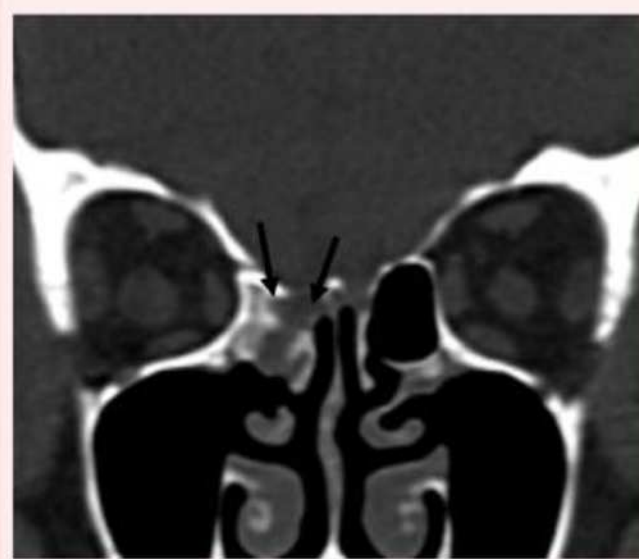
Strong imaging predictor of CSF leak

Defects >1-2 cm strongly suggest encephalocele



Unlikely to spontaneously resolve

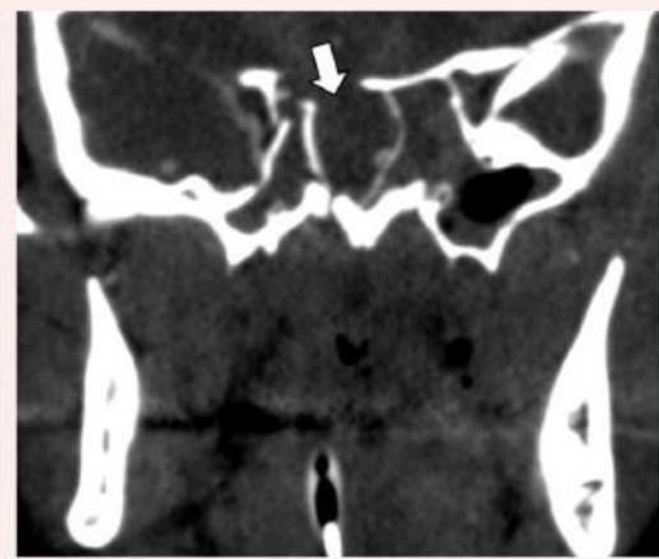
CSF leak considerations specific to frontobasal fractures



Defect at ethmoid-cribriform complex



Strong imaging predictor of CSF leak



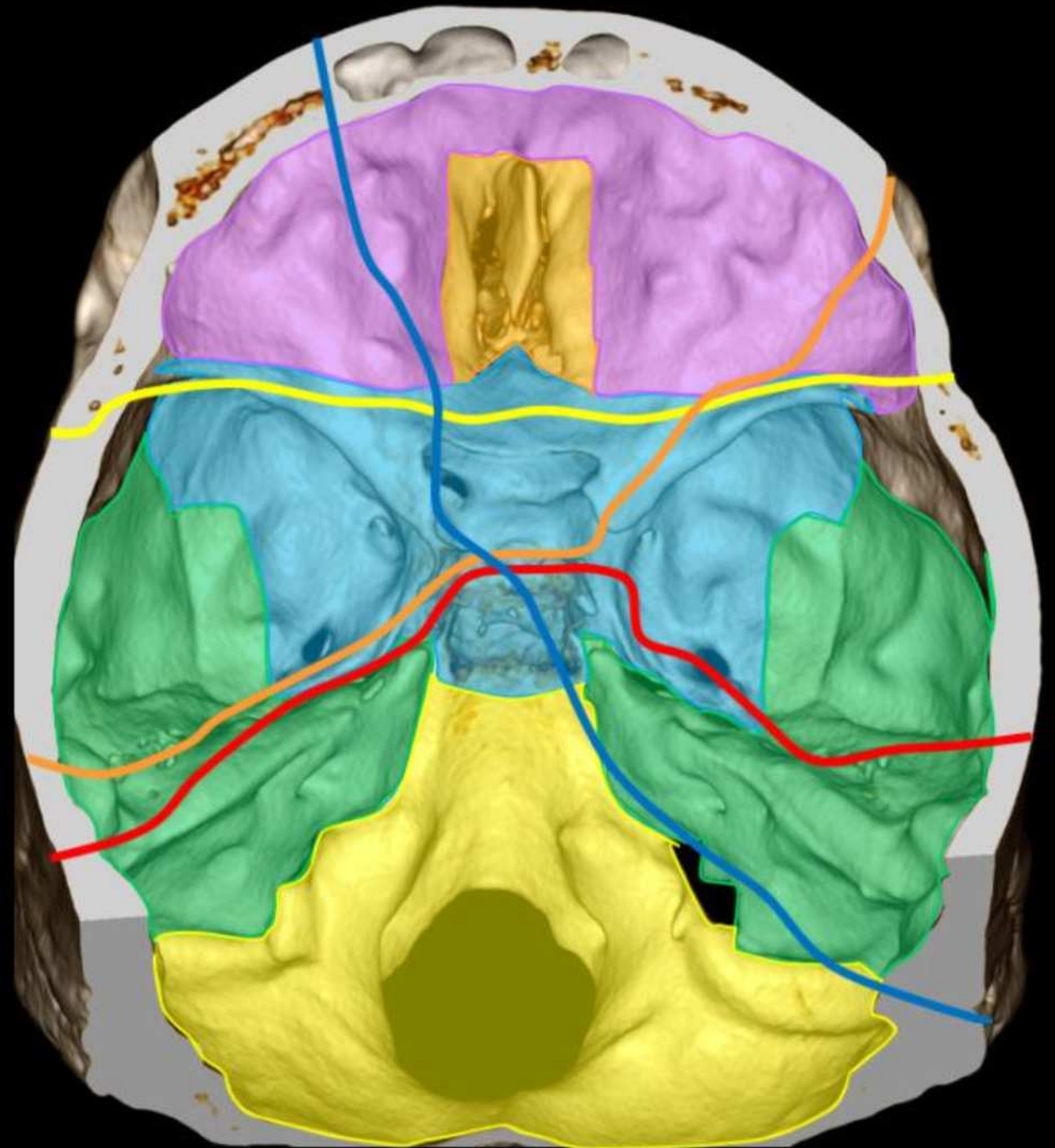
Defect >1-2 cm involving sellar-sphenoid body



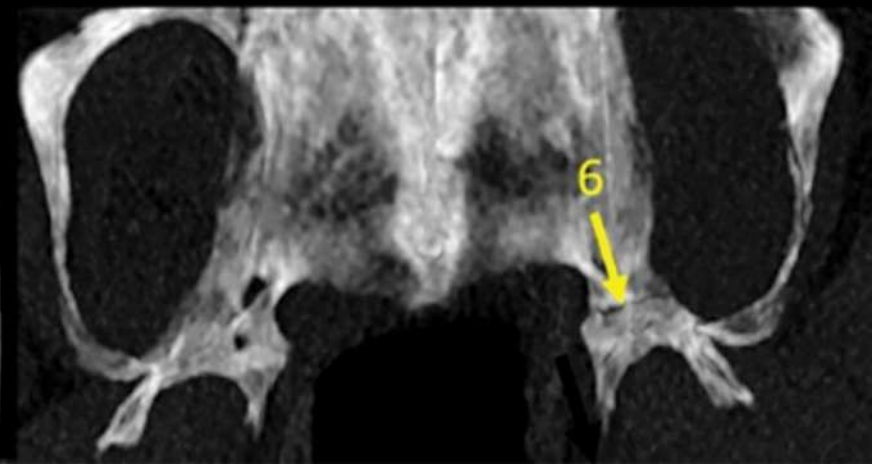
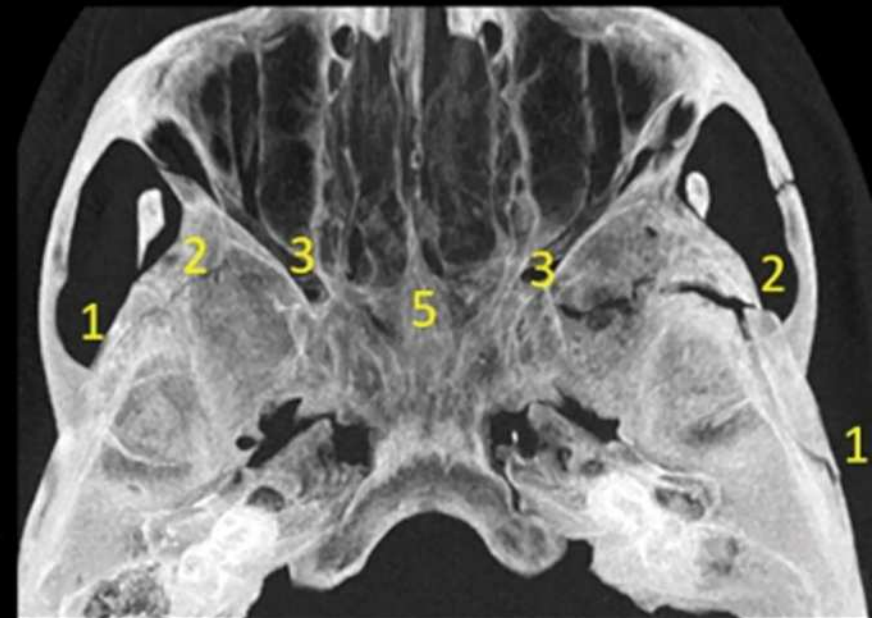
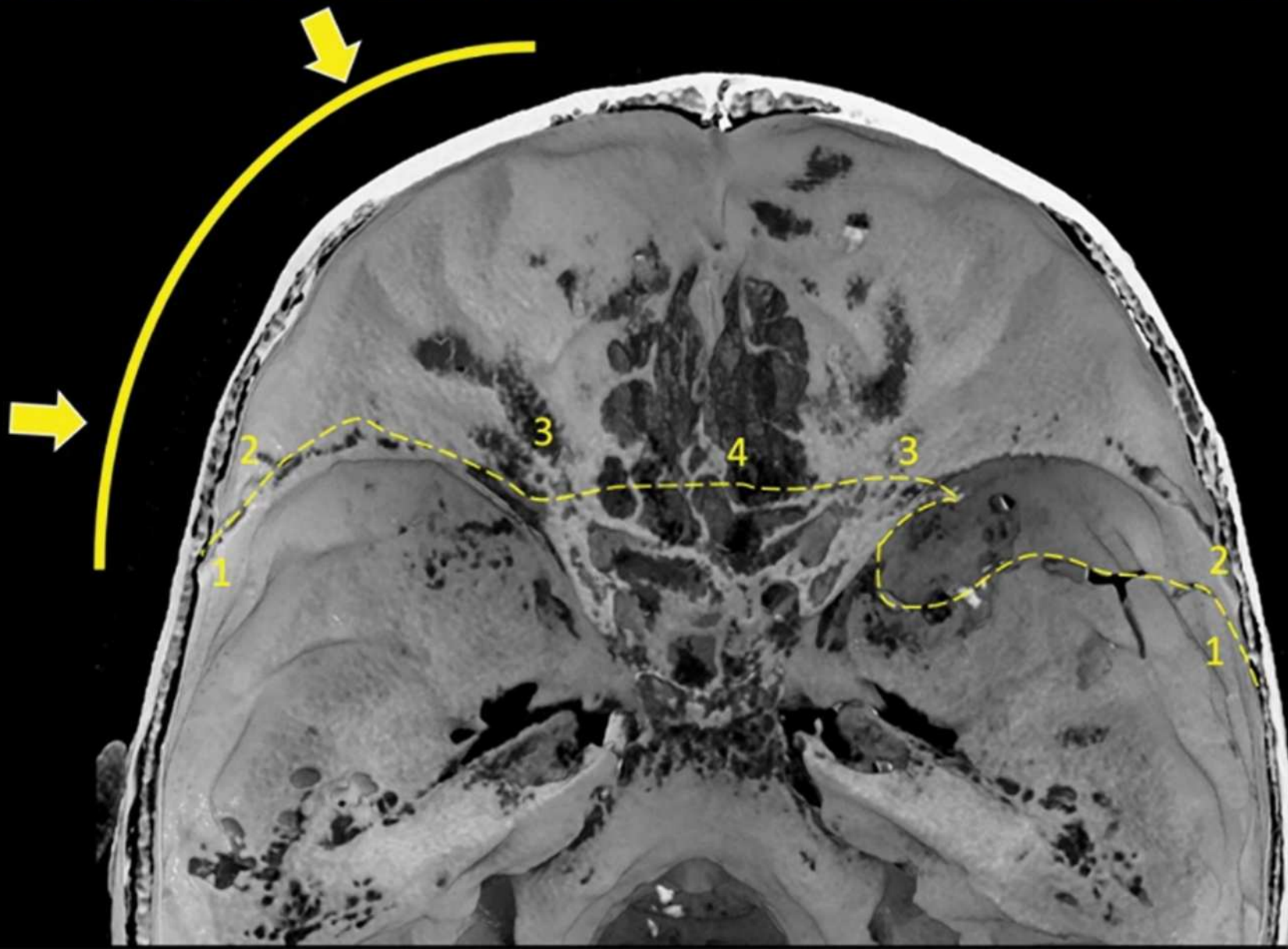
Unlikely to spontaneously resolve

Transsfenoidaalsed murrud^{8,9}

- Kõrge risk neurovaskulaarseteks tüsistusteks
 - Tõusnud suremus:
 - Diagonaalne kulg
 - Löögikohal killunemine
 - Õmbluste kohal diastaas
- Nõrgad kohad:
 - Eesmine kiilluu keha-sõelluu
 - Tagumine kiilluu keha-clivus
 - Lacerum-sfenopetroos õmblus
- Neli murru mustrit
 - Anterior transverse (AT)
 - Posterior transverse (PT)
 - Lateral frontal diagonal (LFD)
 - Mastoid diagonal (MD)

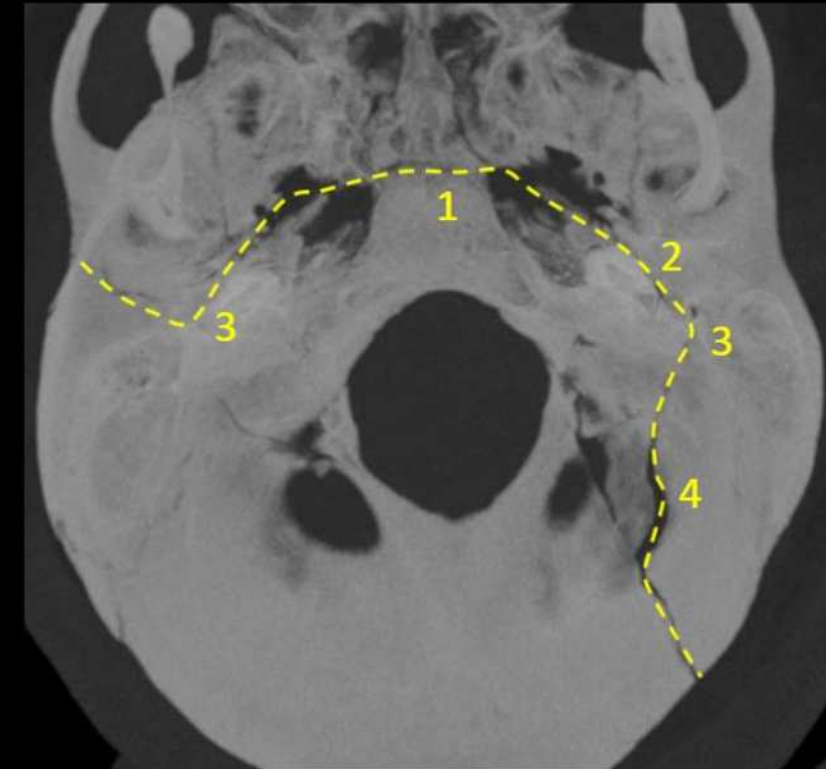
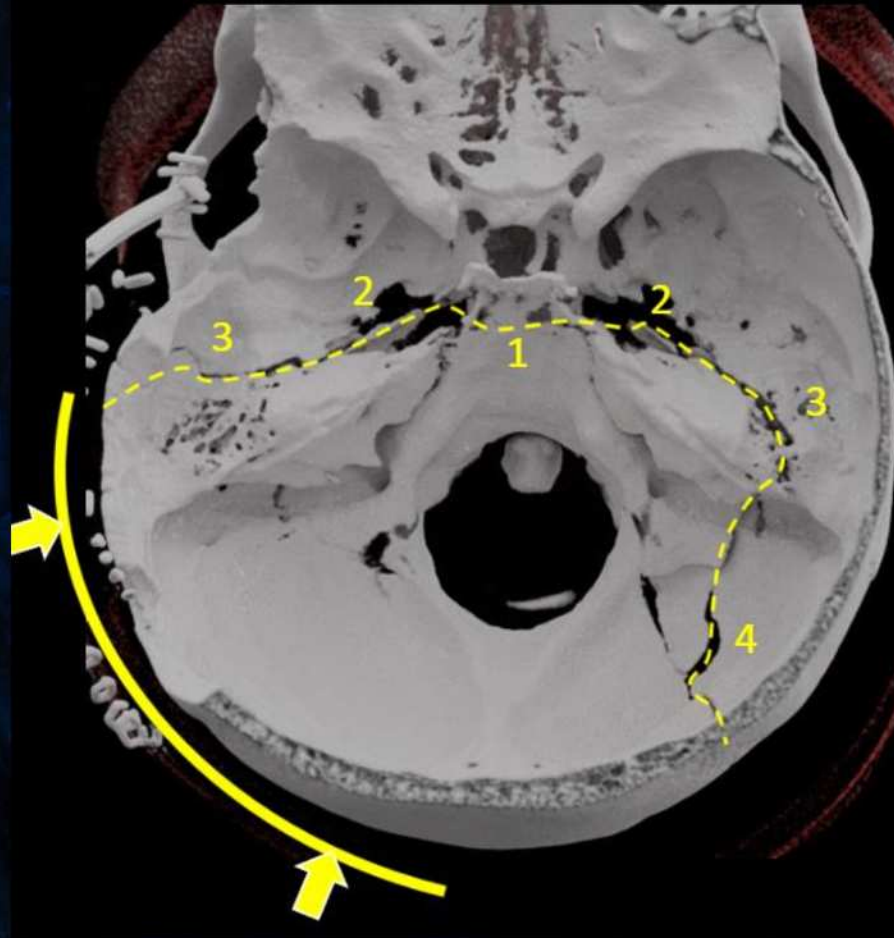


Transsfenoidaalne eesmine ristimurd_{8,9}



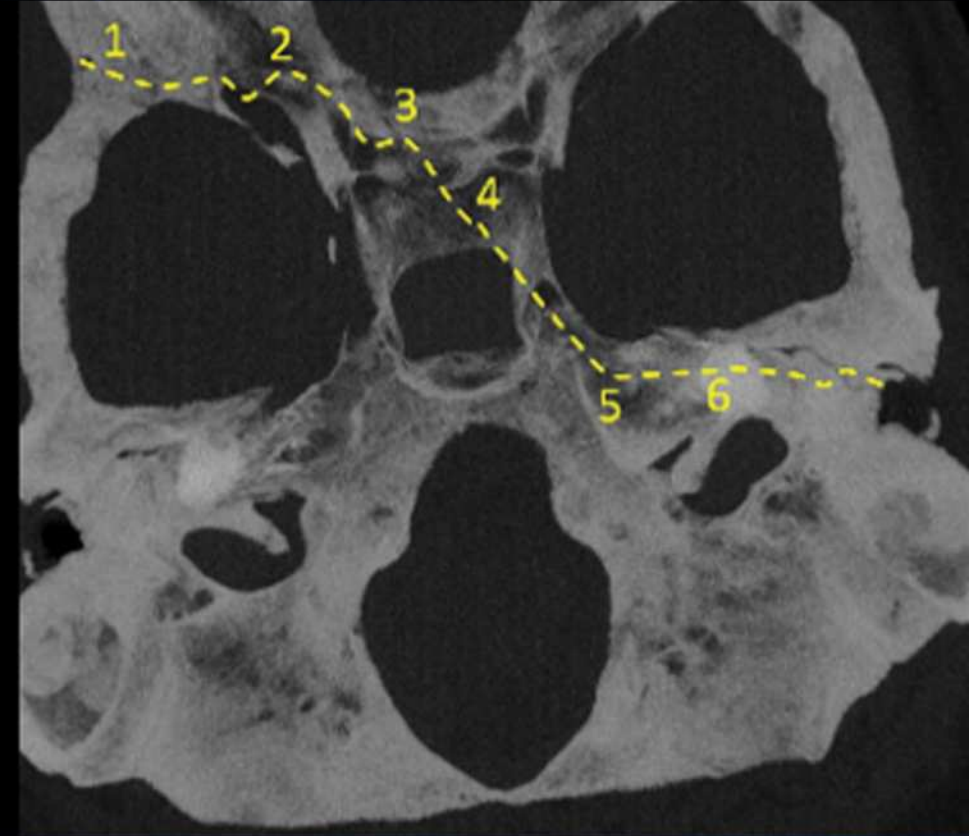
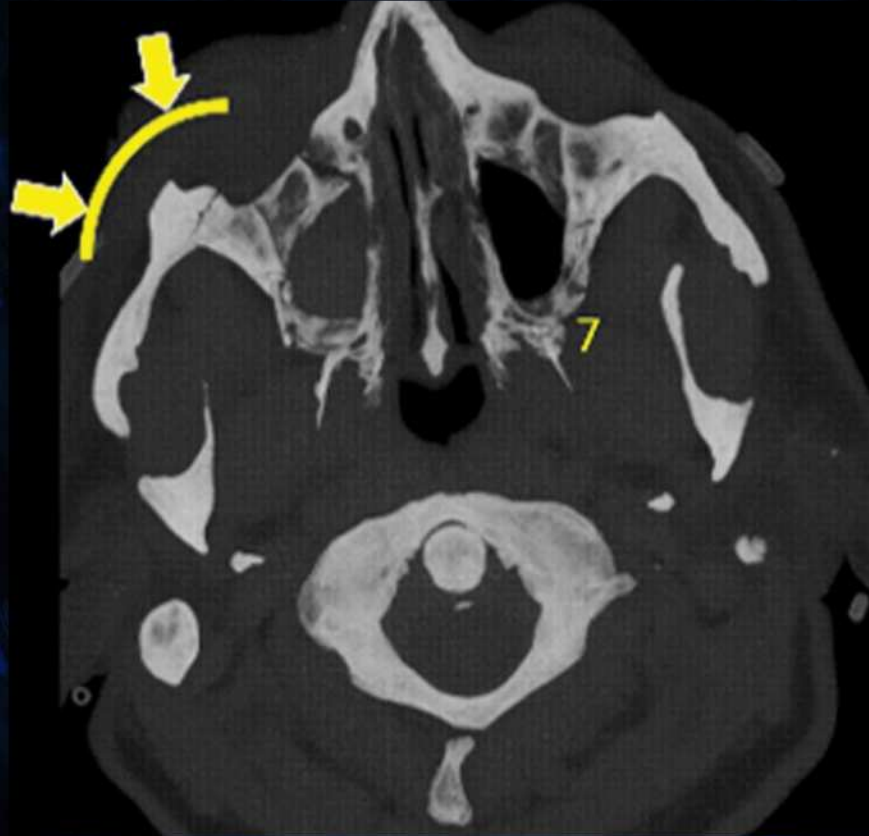
Transsfenoidaalne tagumine ristimurd^{8,9}

- Temporaalne-oktsipitaalne löök. Tagurpidi U-kujuga.
- 1 tagumine sfenoid/clivus horisontaalselt, 2 sfenopetroosfissuur, 3 bilateraalselt temporaalluud, 4 võib haarata petro-oktsipitaalsutuuri
- Tüsistustena ICA kanali vigastus, foramen jugulare haaratuse korral venoosinustromboos. Kuulmiskadu, liikvori leke.



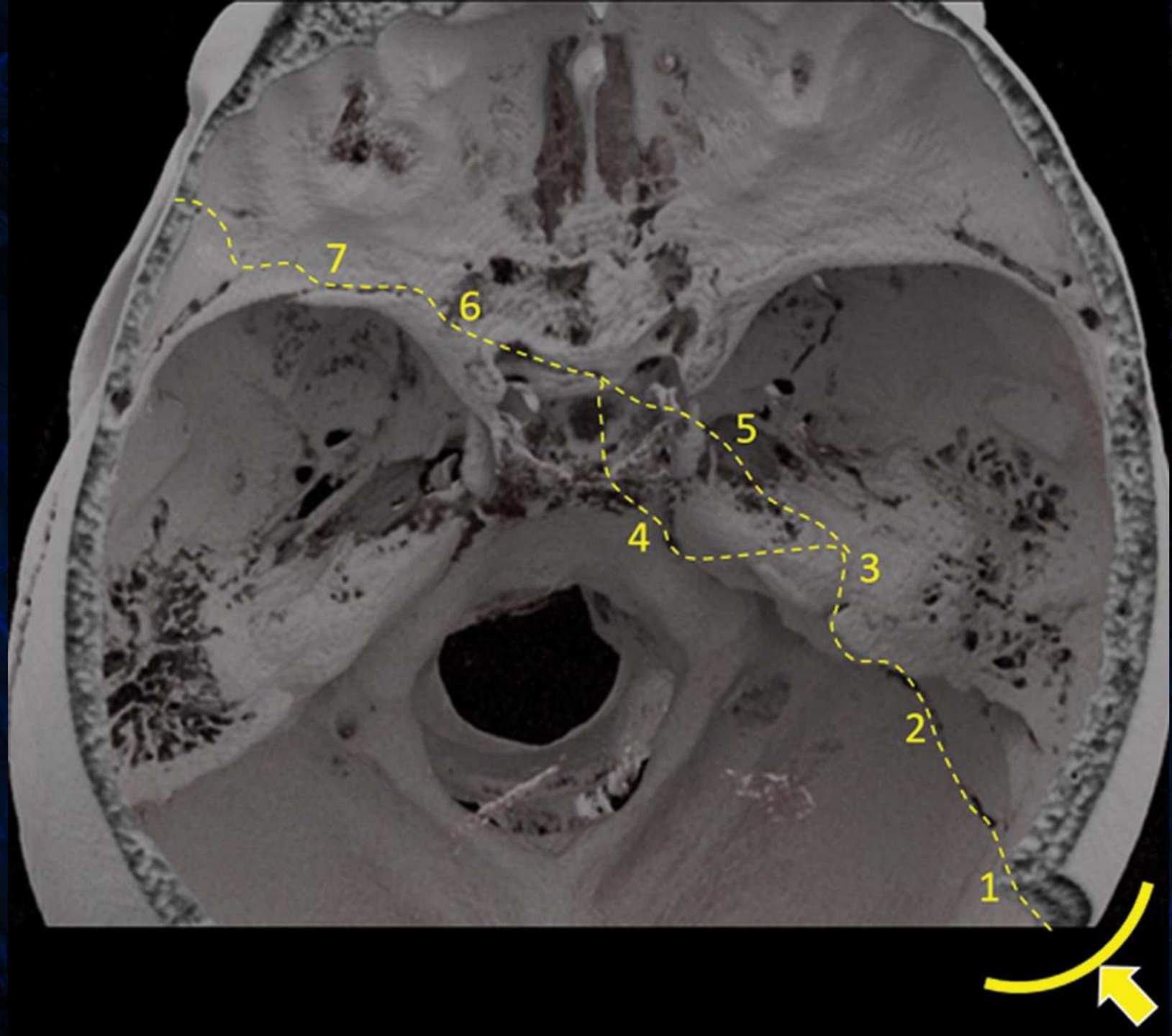
Transsfenoidaalne lateraalne frontaalne diagonaalne murd^{8,9}

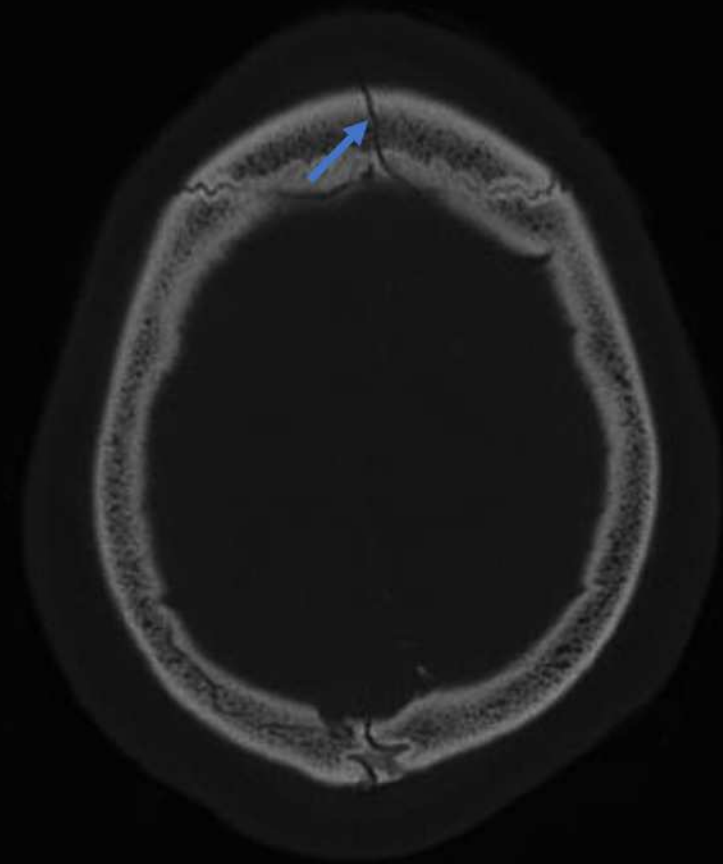
- Löögikoht sarnaluu või superolateraalne orbita.
- Kulgeb üle keskjoone.
- 1 sfenotemporaalne sammas, 2 orbita tipp ja lagi, 3-4 kiilluu keha põiki või risti, 5 sfenopetroosne fissuur, 6 petrosne temporaalluu
- Halb prognoos.
- Liikvori leke, ICA vigastus, SOFS, OAS, TON, kuulmiskadu, KN VII vigastus, siinustromboos.



Transsfenoidaalne mastoid diagonaalne murd^{8,9}

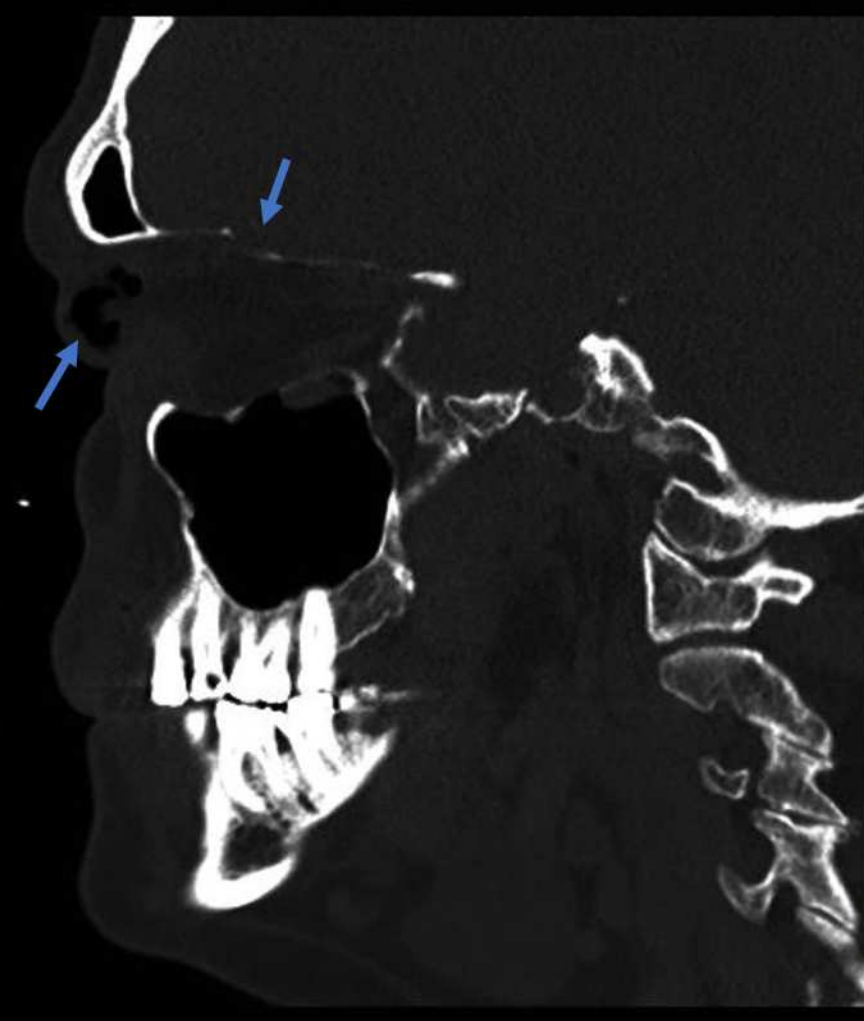
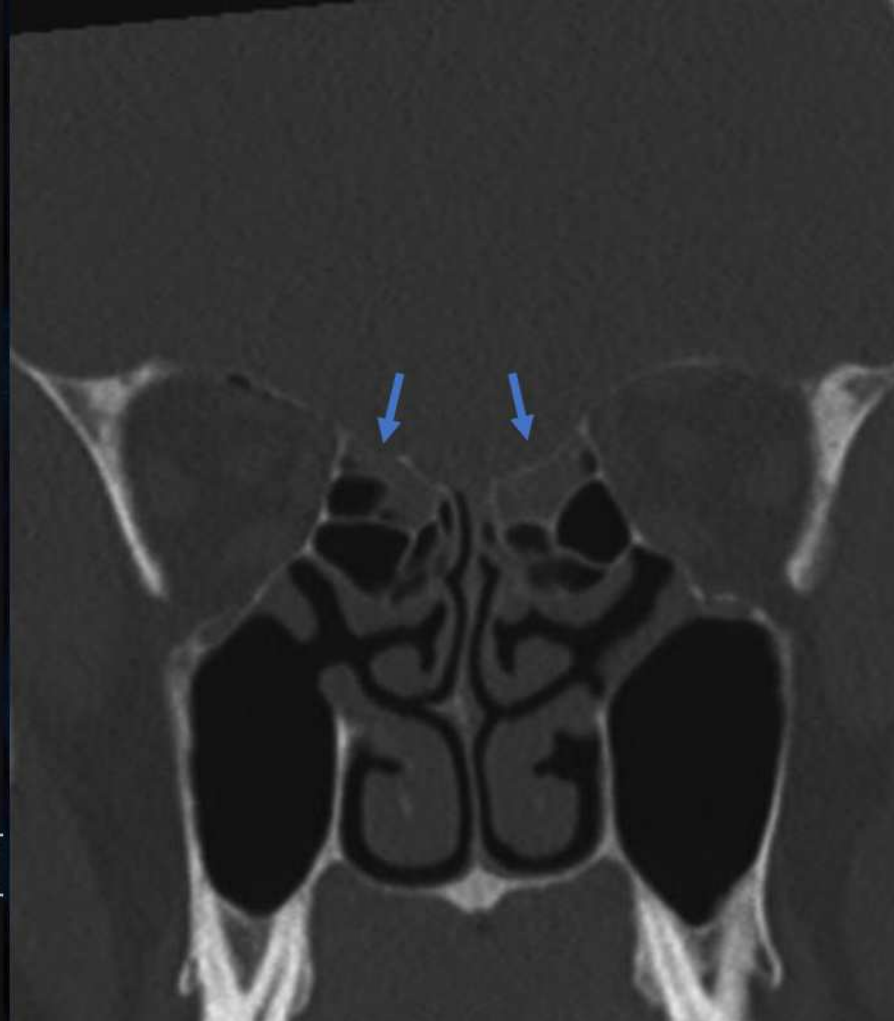
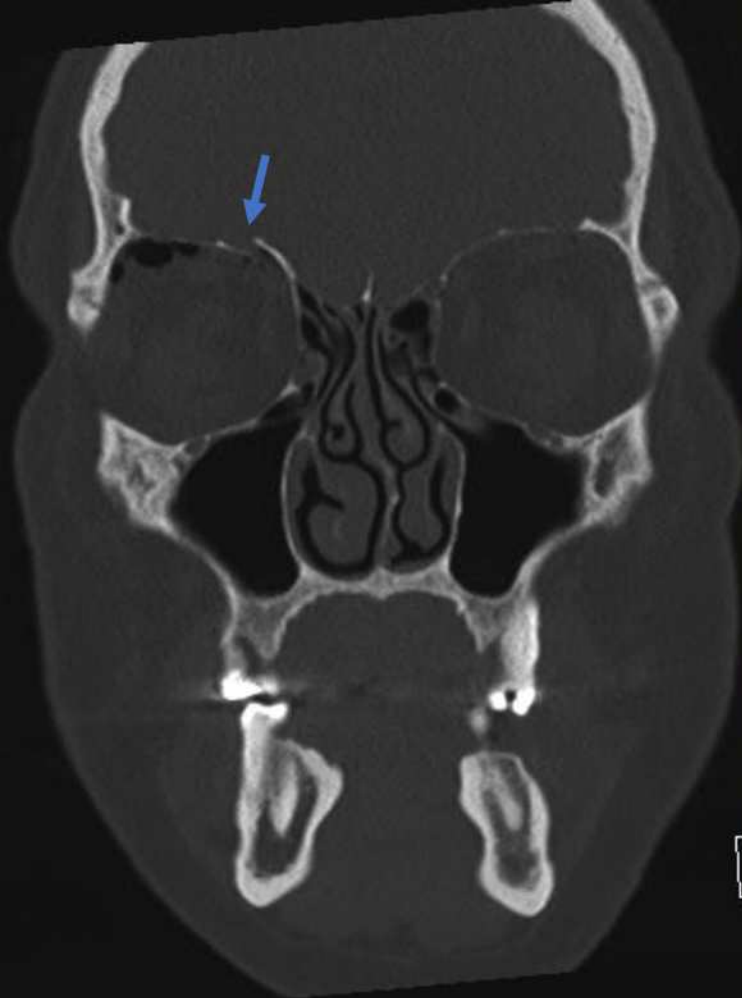
- Löögikoht temporaalluu mastoid.
- Enamasti letaalne.
- Läbib sfenoidi diagonaalis.
- 1 oksipitomastoid õmblus, 2 petrosne temporaalluu, 3 sfenopetroosfissuur, 5 sella ja kiilluu põiki, 6-7 orbita tipp ja lagi
- ICA vigastus, liikvori leke, siinustromboos, kuulmiskadu, KN vigastused.



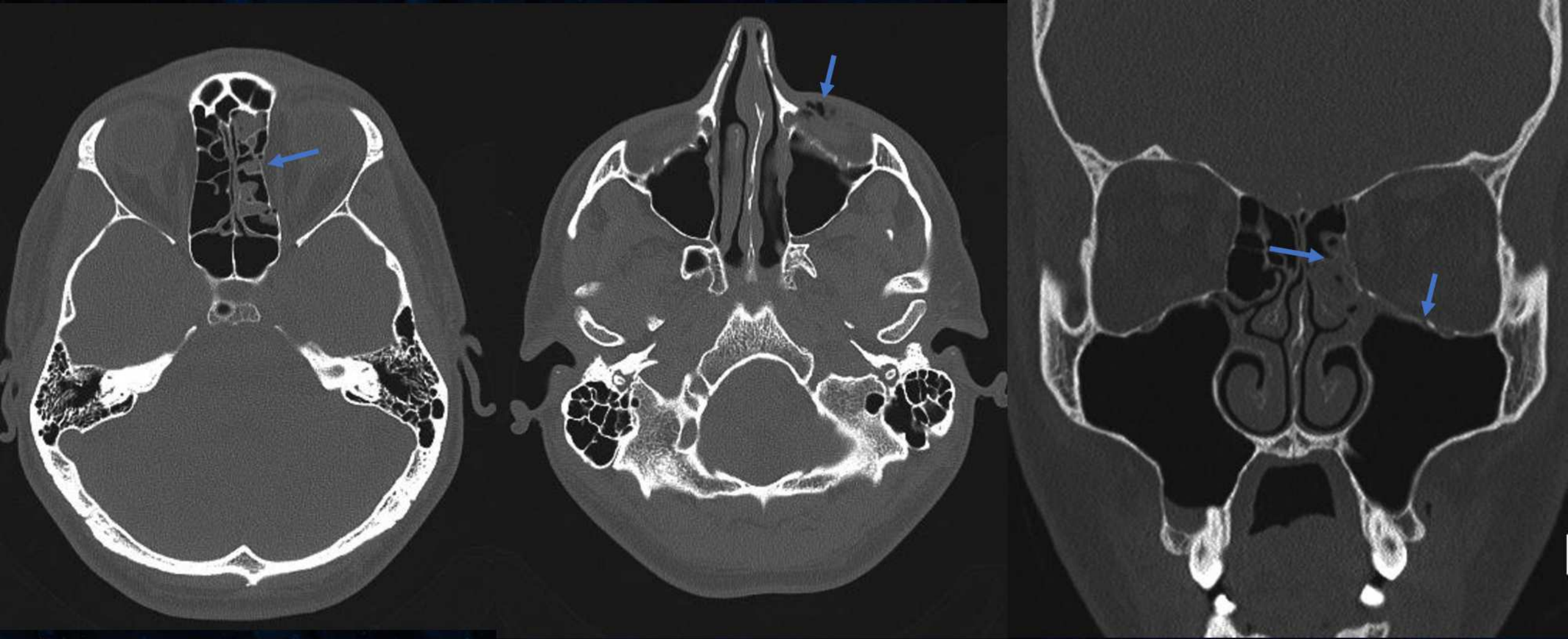


- Kukkunud libedaga kukla piirkonnaga vastu maad. Kaebab tugevat peavalu otsmiku piirkonnas, ninast verejooks, hematoom parema orbita piirkonnas.
- Juhtunut mäletab, ajas, kohas, isikus orienteeritud. Kurdab peavalu, muid kaebusi pole.

M60a



- Bifrontaalsel hemorraagilised kontusioonikolded. Vasakut parietaal- ja frontaalluud haarav põikimurd. Mõlemapoolne orbita lae blow-in tüüpi murd. Paremal orbita lae fragmendi vähene nihe intraorbitaalsele. Mõlemapoolselt orbita mediaalsete seinte oluliste niheteta murrud. Intraorbitaalsel õhkemfüsem. Kahtlus lamina cribrosa nihketa murrudele <math>< 0,5\text{ cm}</math> defektidega. Minimaalne pneumotseefalus.



- Rauast tööriist lendas pinge all vasakusse silma. Patsient kaebab topeltnägemist.
- Vasakul orbita mediaalse ja alumise seina blow-out tüüpi murrud. Lamina papyracea fragmendi vähene nihe etmoidaalsele. Orbita alumise seina murrud ulatub canalis infraorbitalisesse. Etmoidrakustikus verd, intraorbitaalsel õhkemfüsem. Silmaliigutajalihaste pitsumisele viitavat ei tähelda.

M34a

TÜK

Tänään kuulamast!

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7. Kathia Dubron et al. Incidence, Aetiology, and Associated Fracture Patterns of Infraorbital Nerve Injuries Following Zygomaticomaxillary Complex Fractures: A Retrospective Analysis of 272 Patients. June 2021 Craniomaxillofacial Trauma and Reconstruction. DOI:10.1177/19433875211022569
8. David Dreizin, Osamu Sakai, Kathryn Champ, Dheeraj Gandhi, Bizhan Aarabi, Arthur J. Nam, Robert E. Morales, and David J. Eisenman. CT of Skull Base Fractures: Classification Systems, Complications, and Management. RadioGraphics 2021 41:3, 762-782. <https://pubs.rsna.org/doi/10.1148/rg.2021200189>
9. Christopher Rhodes, MD, Jason E. Lally, MD. Skull Base Fracture Evaluation. RSNA 2020 All Day Room: NA Digital Education Exhibit. <https://dps2020.rsna.org/exhibit/?exhibit=NR165-ED-X>