



Lülisamba kaelaosa tömptrauma

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2023

Ettekande eesmärk ja kava:

Kuigi enamus lülisamba kaelaosa traumasid ravitakse konservatiivselt, on oluline aru saada, millised vigastused on ebastabiilsed ja vajavad kirurgilist ravi.

Paljude luuliste vigastuste identifitseerimiseks on vaja olla tuttav pehmekoe anatoomiaga. Raske vigastus võib kliiniliselt end esialgu mitte ilmutada.

Hea on teada normivariante.

Millest juttu tuleb:

- kellele ja mis uuringut teha
- olulisemad kraniotservikaalsed ligamendid
- valik tavalisemaid kraniotservikaalseid vigastusi (sh murde) ja nende klassifitseerimine
- mõned tähelepanekud subaksiaalsete vigastuste kohta

- Lülisamba kaelaosa on vigastatud ca 5-10% polütrauma patsientidest; kaelaosa võrreldes lülisamba teiste osadega 55% juhtudest.
- Kas pt-l võib olla (ohtlik) kaelavigastus? -> **teadvushäireta** haigel kliinilised otsustustoad NEXUS ja Canadian C-spine rule
- Rõ ei ole piisavalt tundlik.
MRT näitab täpsemalt pehmekoe trauma ulatust, sh diski ja ligamentide vigastusi.
- KT polütrauma protokoll: kael-rindkere-kõht-vaagen parenhümatoosne faas
Vastavalt vigastuse mehhanismile ja traumatiimi esmase ülevaatuse leiule vajadusel juurde ka angio faas.
- Juhul kui KT-s on uuritud ainult kaela ja sealt leitakse vigastus, on seejärel vajalik terve lülisamba uurimine -> tõenäosus leida vigastus ka mujalt ca 10-15%.
- Radioloogi roll: 1) kas vigastus on olemas; 2) kas see on stabiilne vigastus

Table 1: Low-Risk Criteria for Clinical Exclusion of Cervical Spine Injury in Alert Stable Patients

NEXUS criteria

- No posterior midline cervical tenderness
- No intoxication
- No focal neurologic deficit
- No painful distracting injuries

Canadian C-spine rule criteria

- Age < 65 years
- No dangerous mechanism, such as:
 - Fall from height of >91 cm (>3 ft)
 - Axial loading injury (eg, diving accident)
 - High-speed motor vehicle collision (MVC) (>100 km/h), rollover, or ejection
 - Recreational motor vehicle, motorcycle, or bicycle injury
- No paresthesias
- Sitting position in emergency department
- Ambulatory at any time
- Neck rotation of 45° left and right

Millal on vajalik ka kaela veresoonte uurimine?

- Paljudes keskustes on kaela tömptrauma korral KT-angio tegemine rutiinsem, aga meil esmaselt pigem mitte. Saab vajadusel juurde teha.

Table 2: Risk Factors for Blunt Cerebrovascular Injury

Le Fort II or III facial fractures
Skull base fracture extending to petrous internal carotid artery canal
Fractures of C1–C3
Fracture line reaching a transverse foramen
Facet subluxation or dislocation
Scalp degloving injury
Severe mandibular fractures
Closed head injury
Major chest trauma

Kraniotservikaalse ühenduse vigastused:

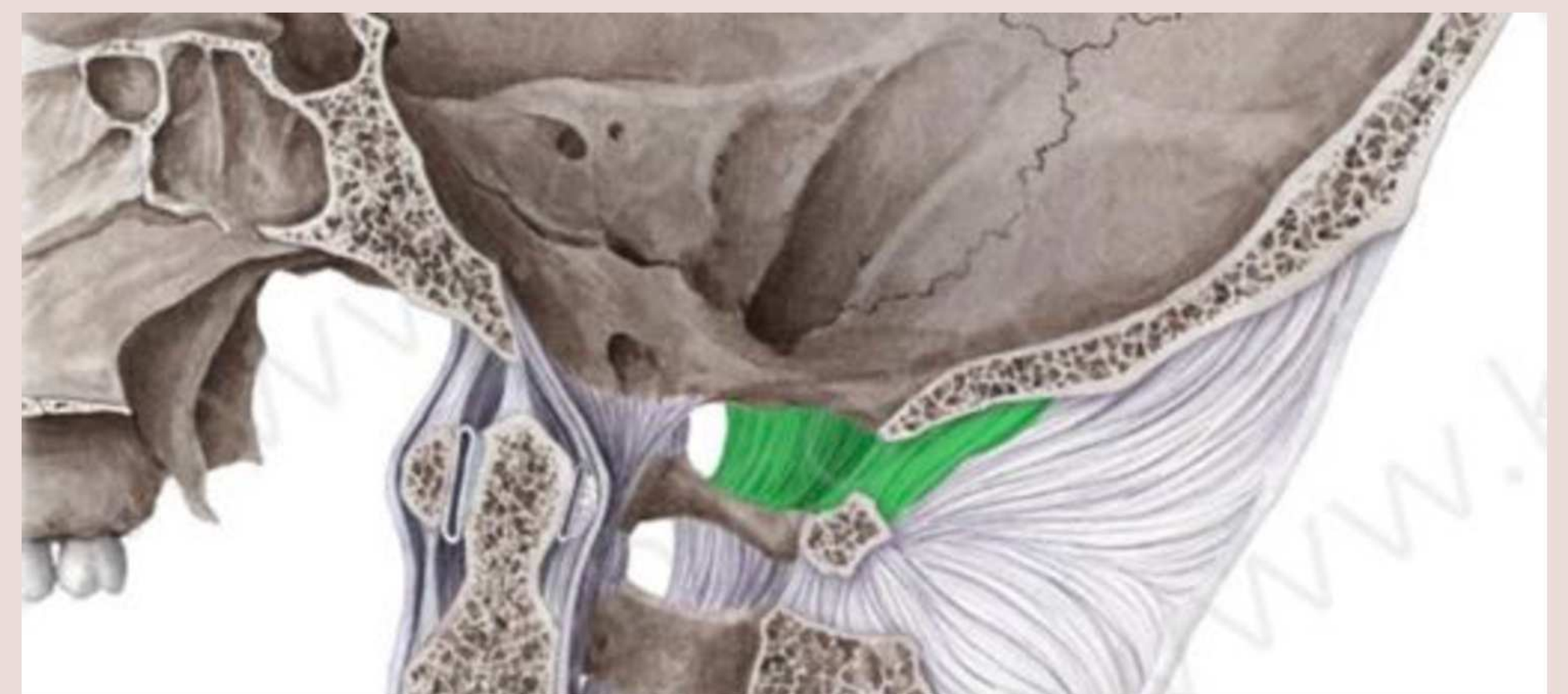
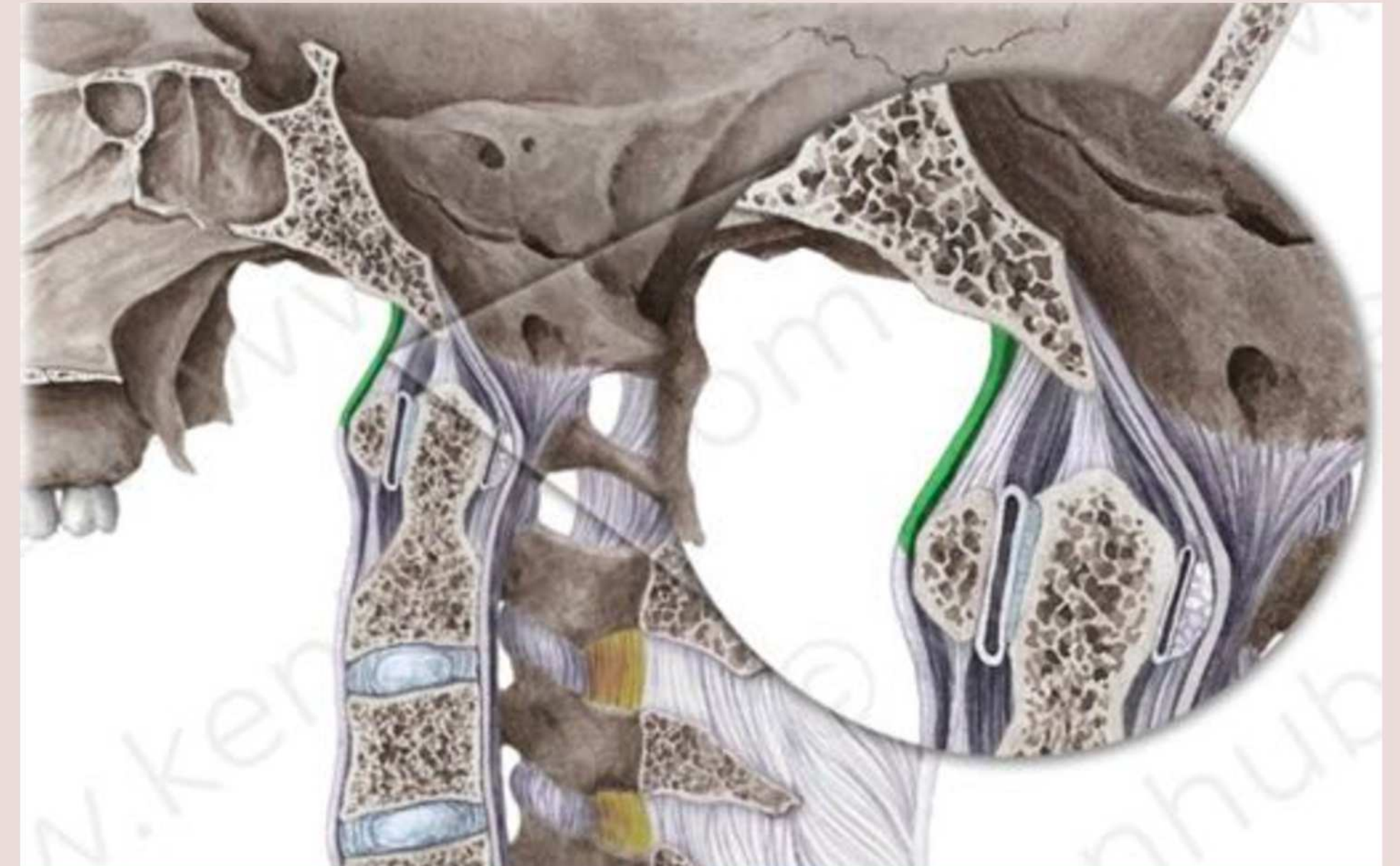
- kraniotservikaalne dissotsiatsioon
- kuklaluu kondüülide vigastused
- C1 murrud
- C2 murrud
- atlantoaksiaalne rotatoorne subluksatsioon

Kraniovertebraalsed ligamendid

Atlanto-occipital ligaments:

- *anterior atlanto-occipital membranes* - tugevad kiud foramen magnumi eesservast altasele, sealt edasi läheb sujuvalt üle eesmiseks pikiligamendiks
- *posterior atlanto-occipital membranes* - õhukesed kiud foramen magnumi tagaservast atlase tagaserva

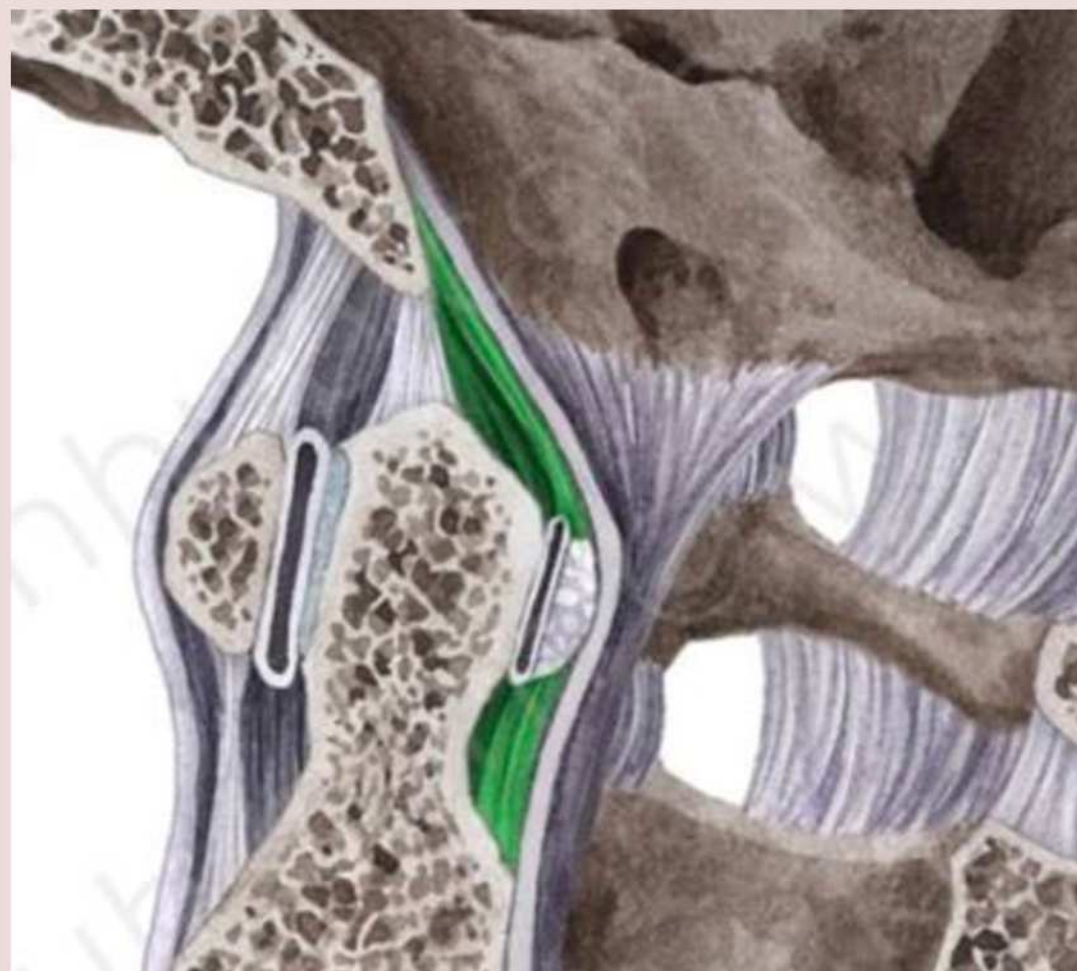
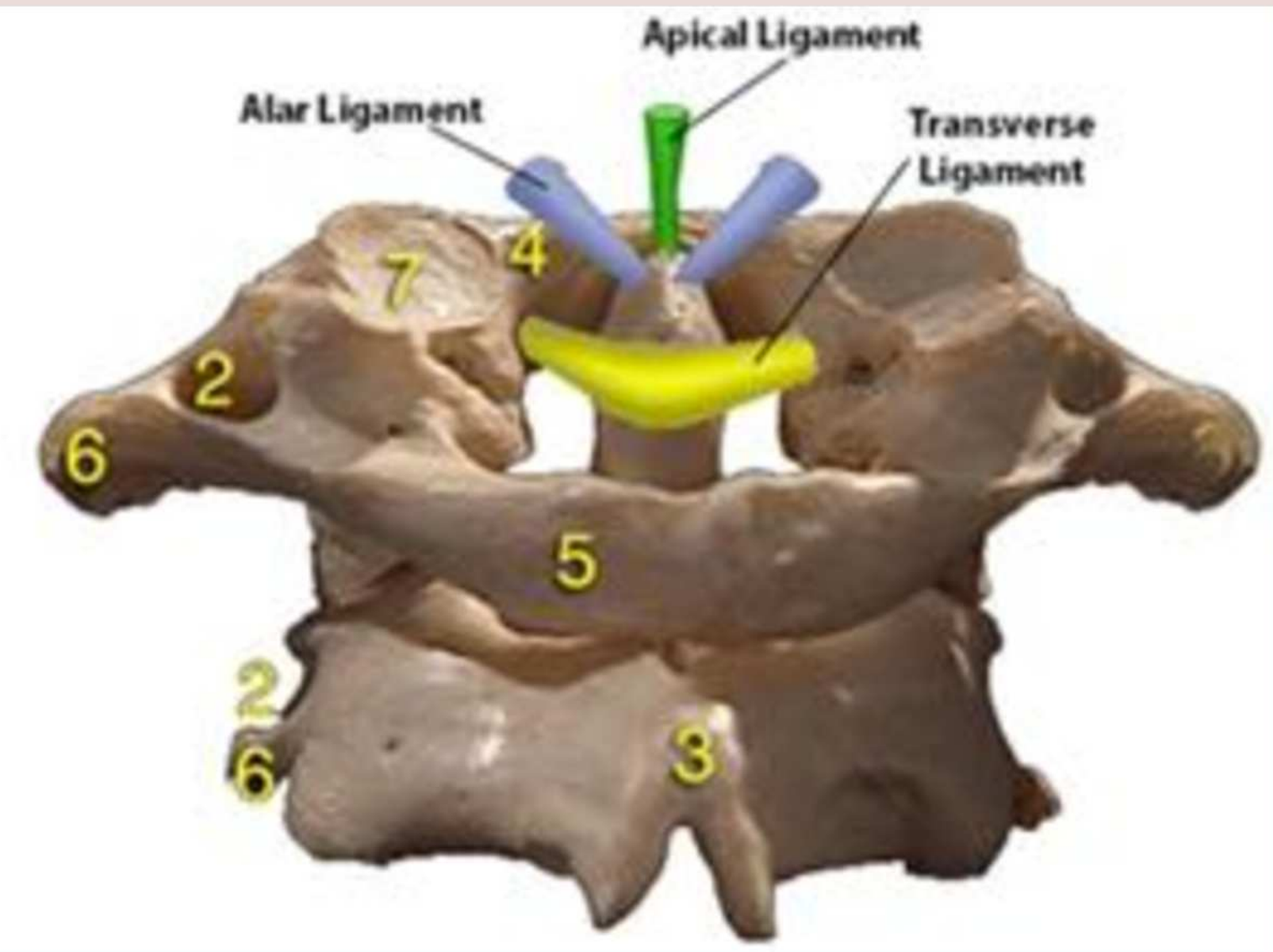
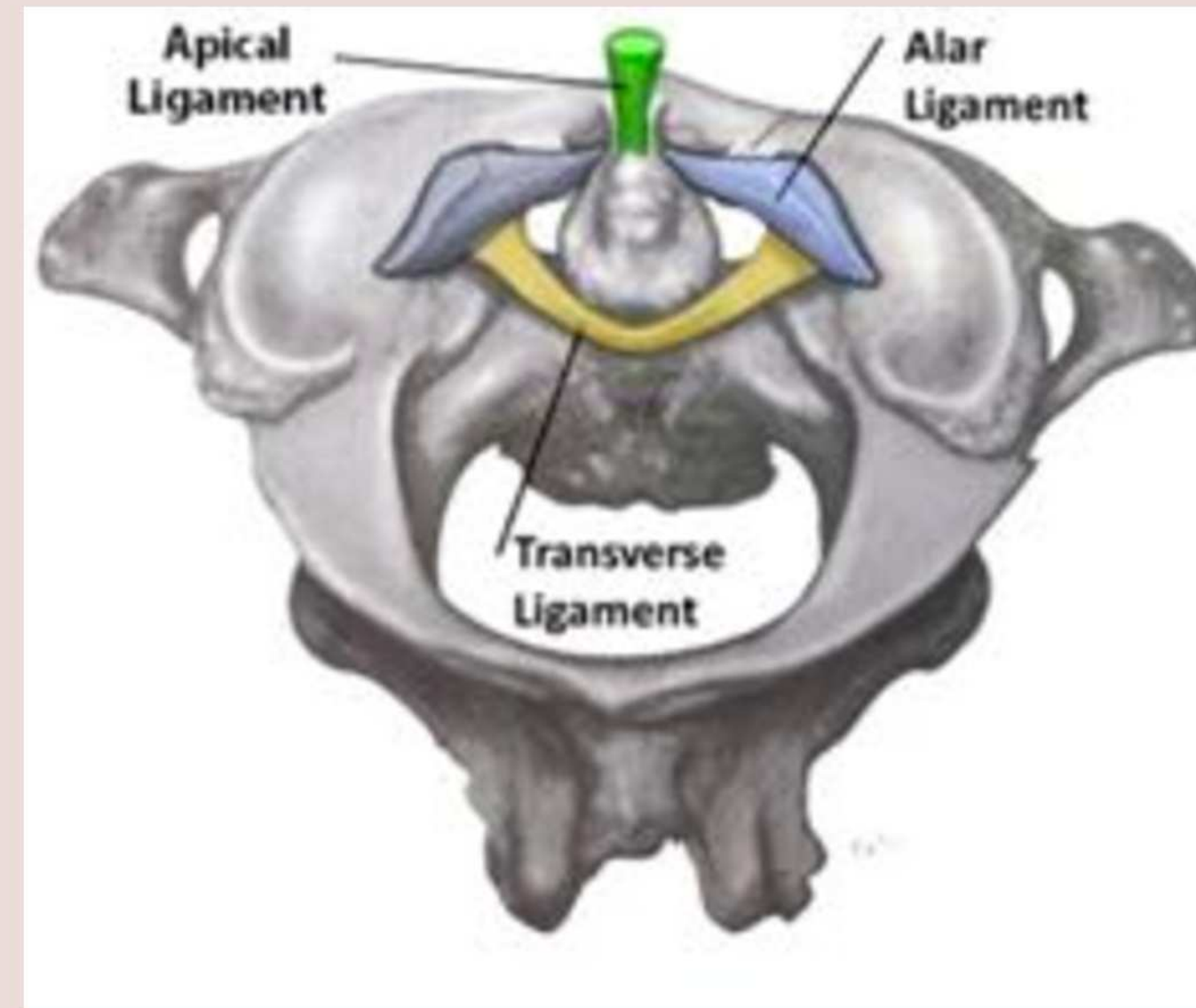
Anterior atlanto-occipital membrane.



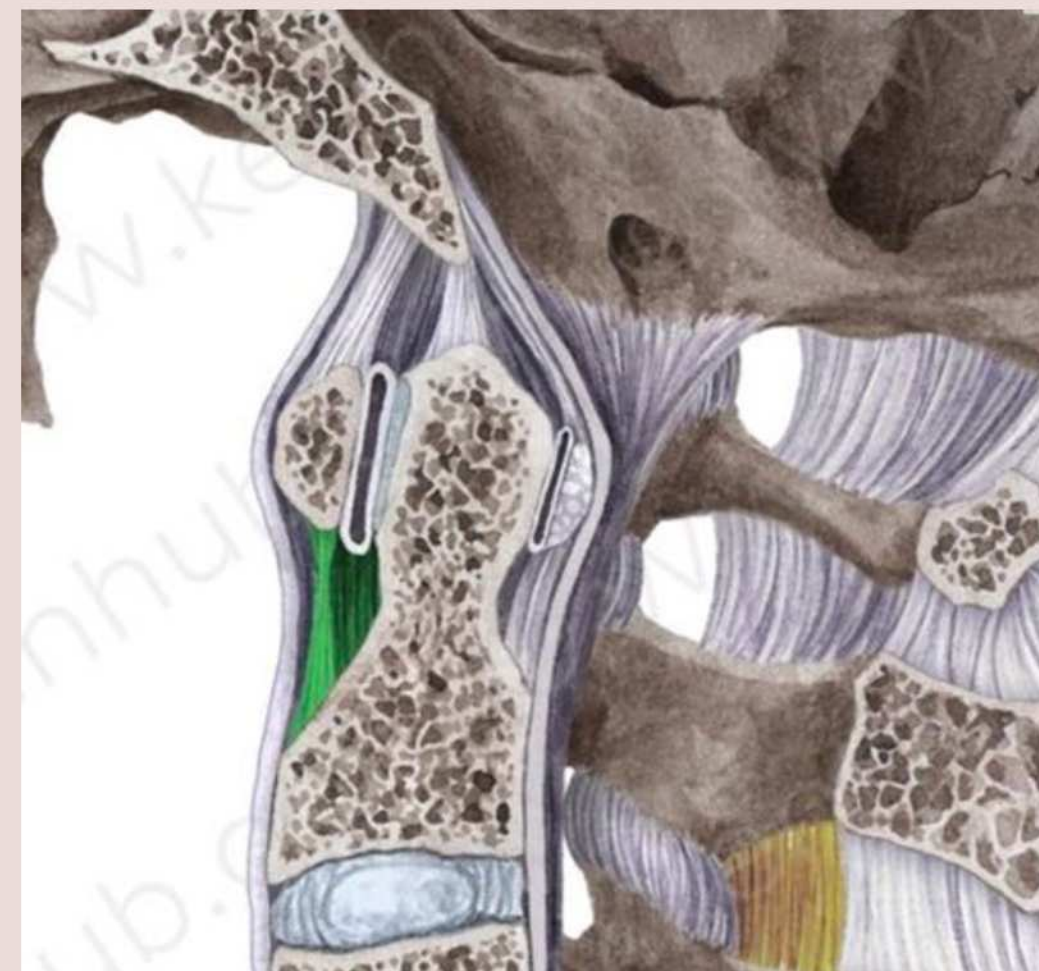
Posterior atlanto-occipital membrane.

Atlanto-axial ligaments:

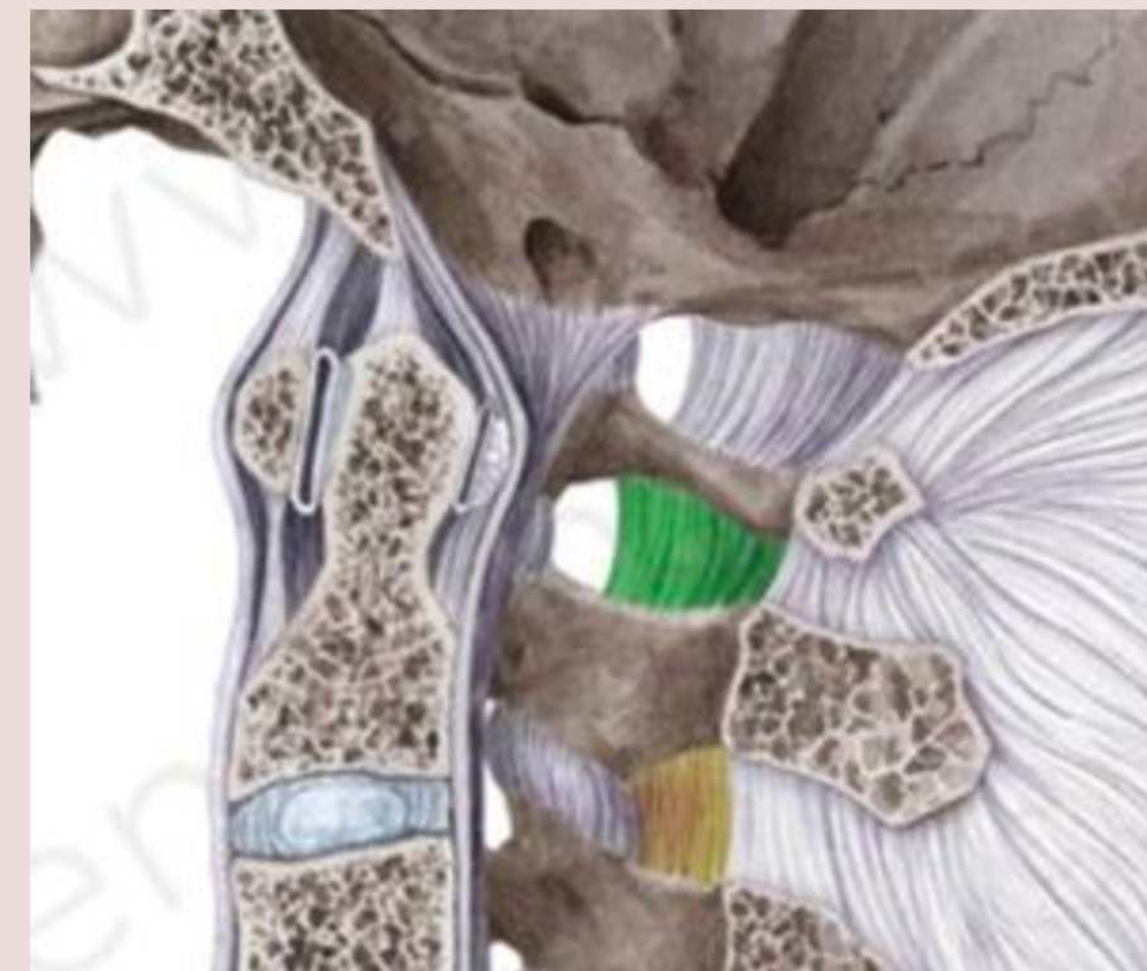
- *transverse ligament of the atlas* - tugev, hoiab densi õiges kohas
- *cruciform ligament of the atlas* - transverse ligament + ligament kuklaluule
- *alar ligaments* - densilt foramen magnumile, kaitsevad ülemäärase rotatsiooni eest
- *apical ligament of the dens* - nõrk väike ligament, ei stabiliseeri
- *anterior and posterior atlanto-axial membrane* - eesmine on tugevam
- *tectorial membrane* - tugev tagumise pikiligamendi jätk, mis fuseerub duraga



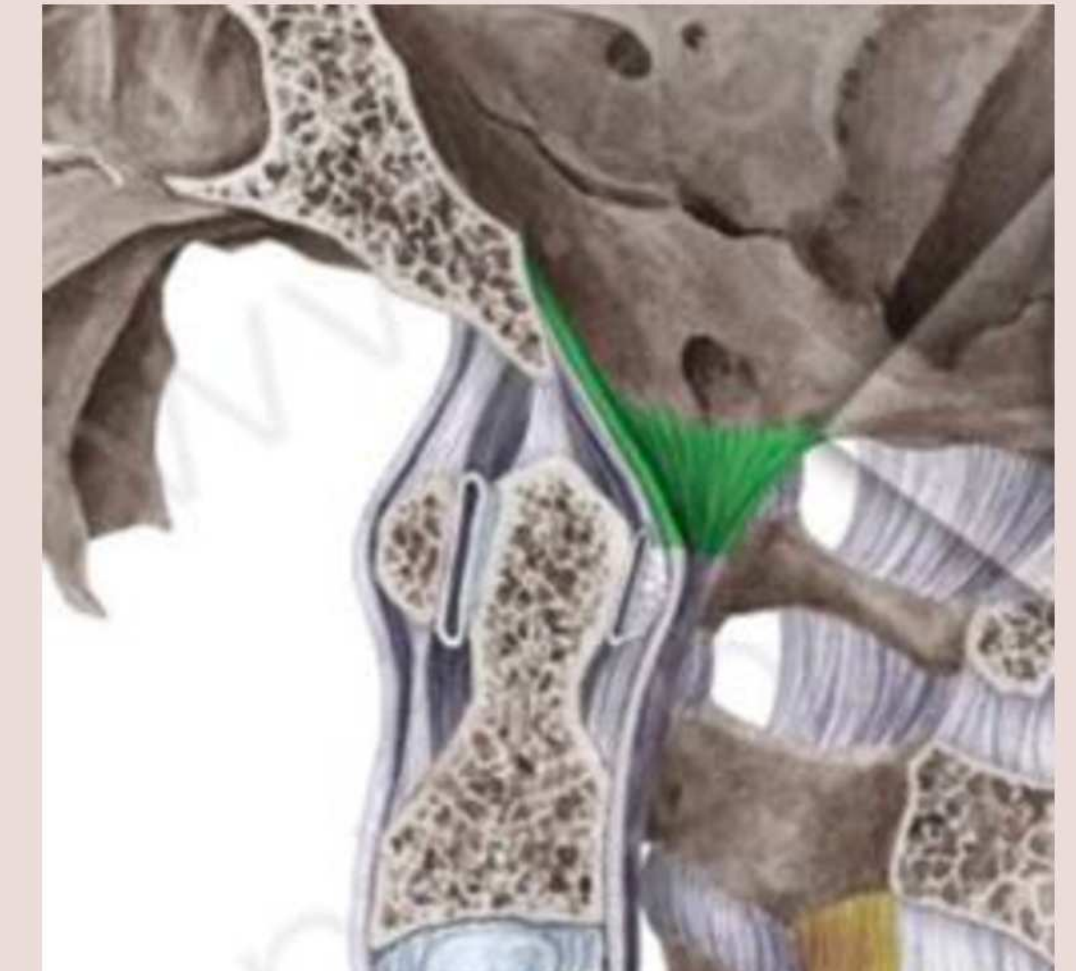
Cruciform ligamendi longitudinaalsed kiud



Anterior atlanto-axial membrane



Posterior atlanto-axial membrane



Tectorial membrane

Kraniotservikaalne dissotsiatsioon

- kraniotservikaalne ehk kraniovertebraalne ühendus: kuklaluu kondüülid, atlas (C1) ja axis (C2) ning nende vahelised liigesed. Hõlmab endas nii luukude, ligamente kui ka närvikude/KNS.
- täielik kraniotservikaalne dissotsiatsioon - fataalne
osaline eraldumine/subluksatsioon - veidi parem prognoos
- oma olemuselt **ebastabiilne vigastus ulatusliku ligamentoose katkemisega**.
Väljendunud kliiniline neuroloogiline leid tavapärane.
Sageli kaasuv ajutrauma ja muud lülisamba vigastused.
- **väikestest (ent kriitiliselt olulistest) muutustest kerge mööda vaadata ka kogenud radioloogil**



N9. Kraniotservikaalne dissotsiatsioon.
Basion-dens intervall 18mm.

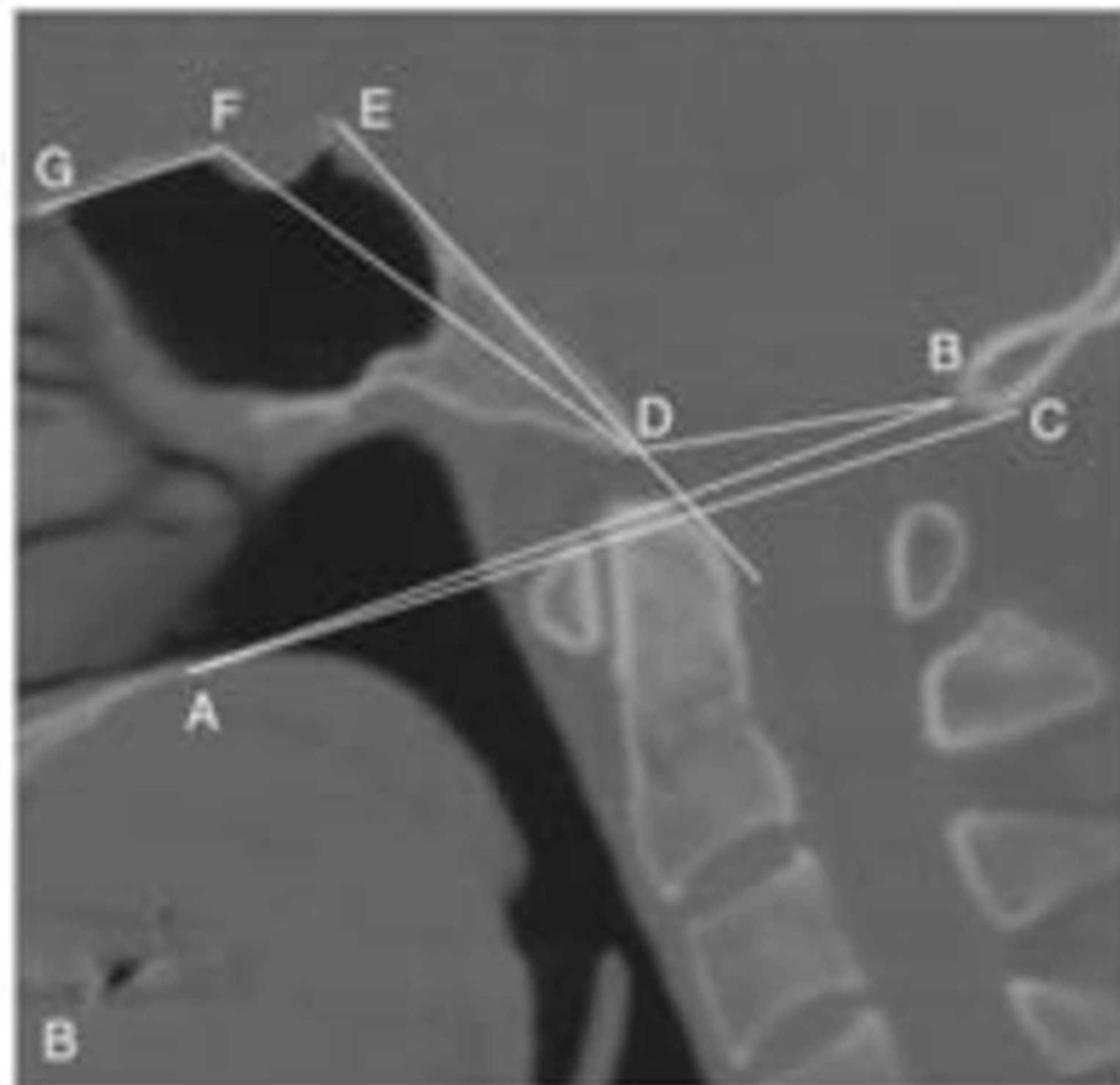
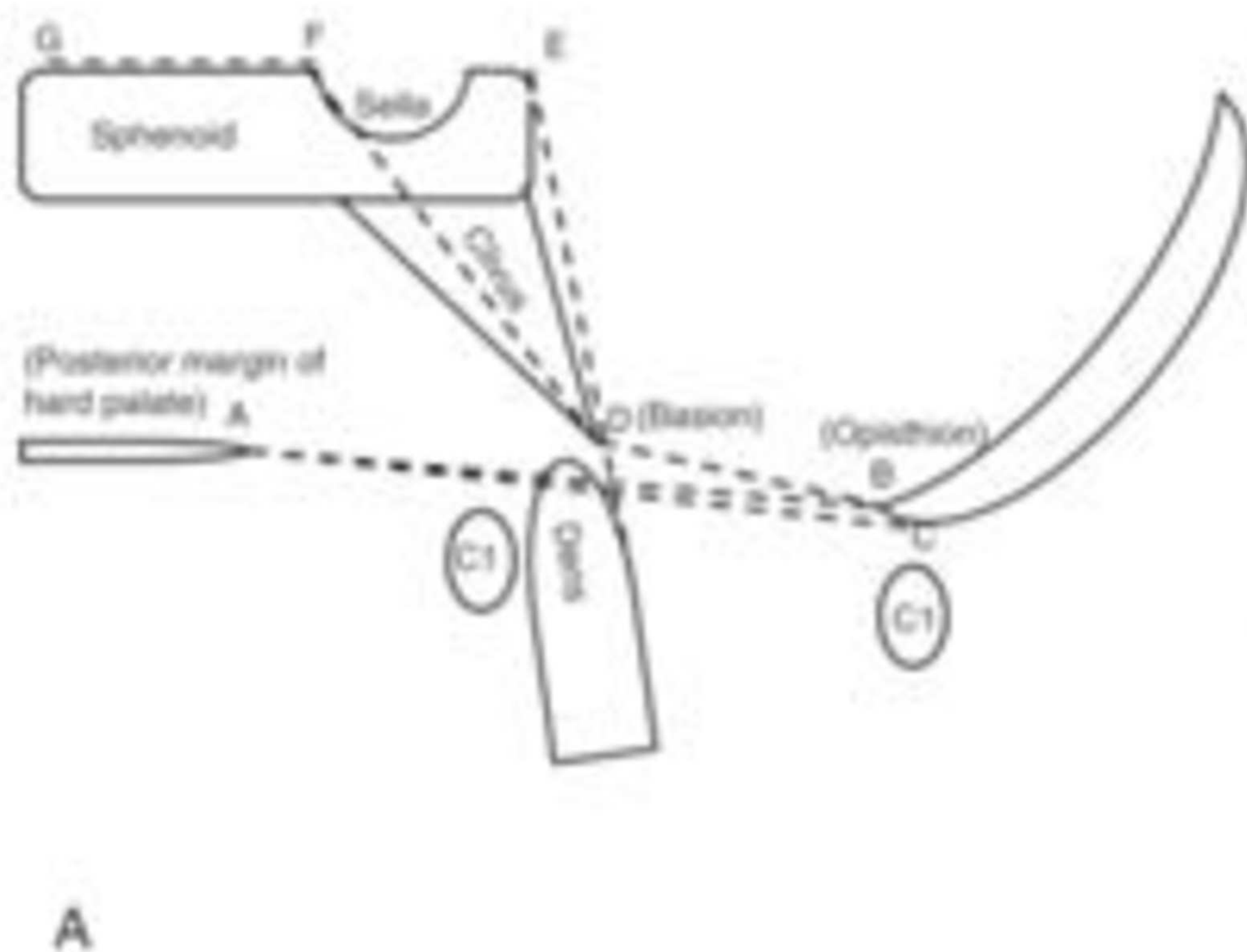
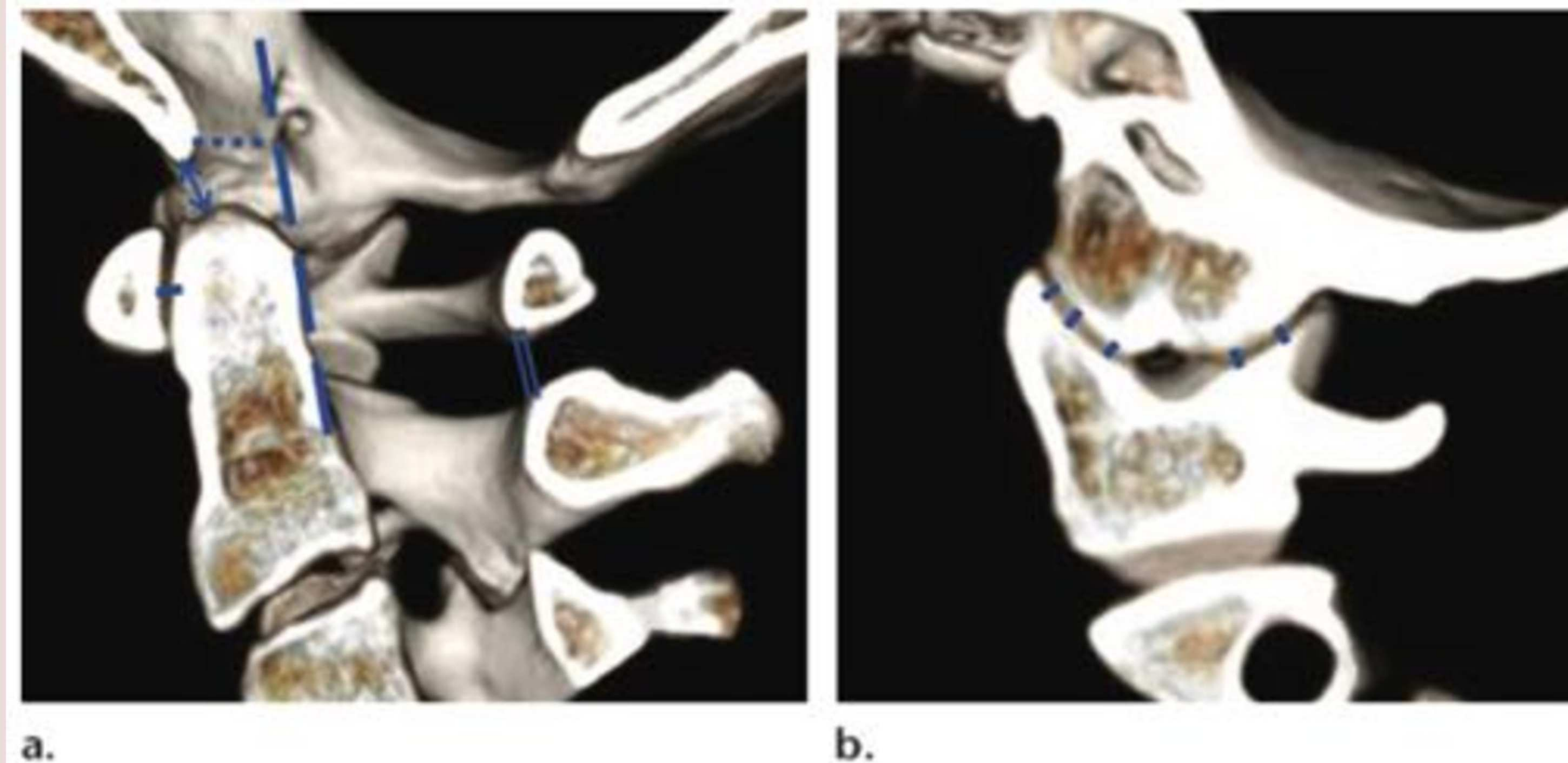


Fig. 14.1

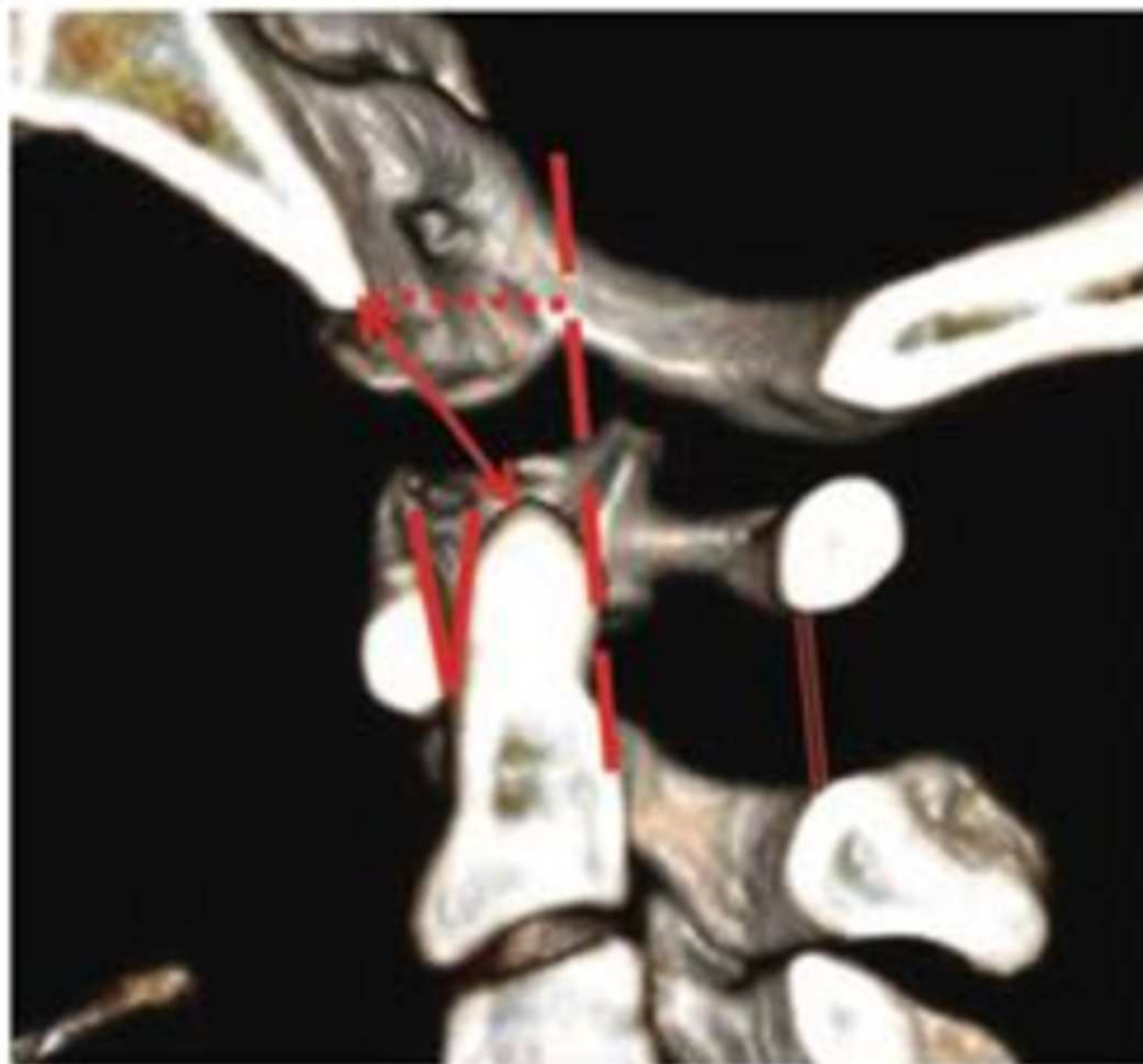
(A and B) Measurements commonly used in evaluating craniovertebral junction on lateral projection. For the name of different lines, refer to [Table 14.1](#). A, posterior margin of hard palate; B, opisthion; C, inferior margin of the posterior rim of foramen magnum; D, basion; E, dorsum sellae; F, anterior clinoid process; G, floor of anterior cranial fossa.



Atlantodental intervall - kuni 2mm.

Basion-dens intervall - alla 8-9mm.

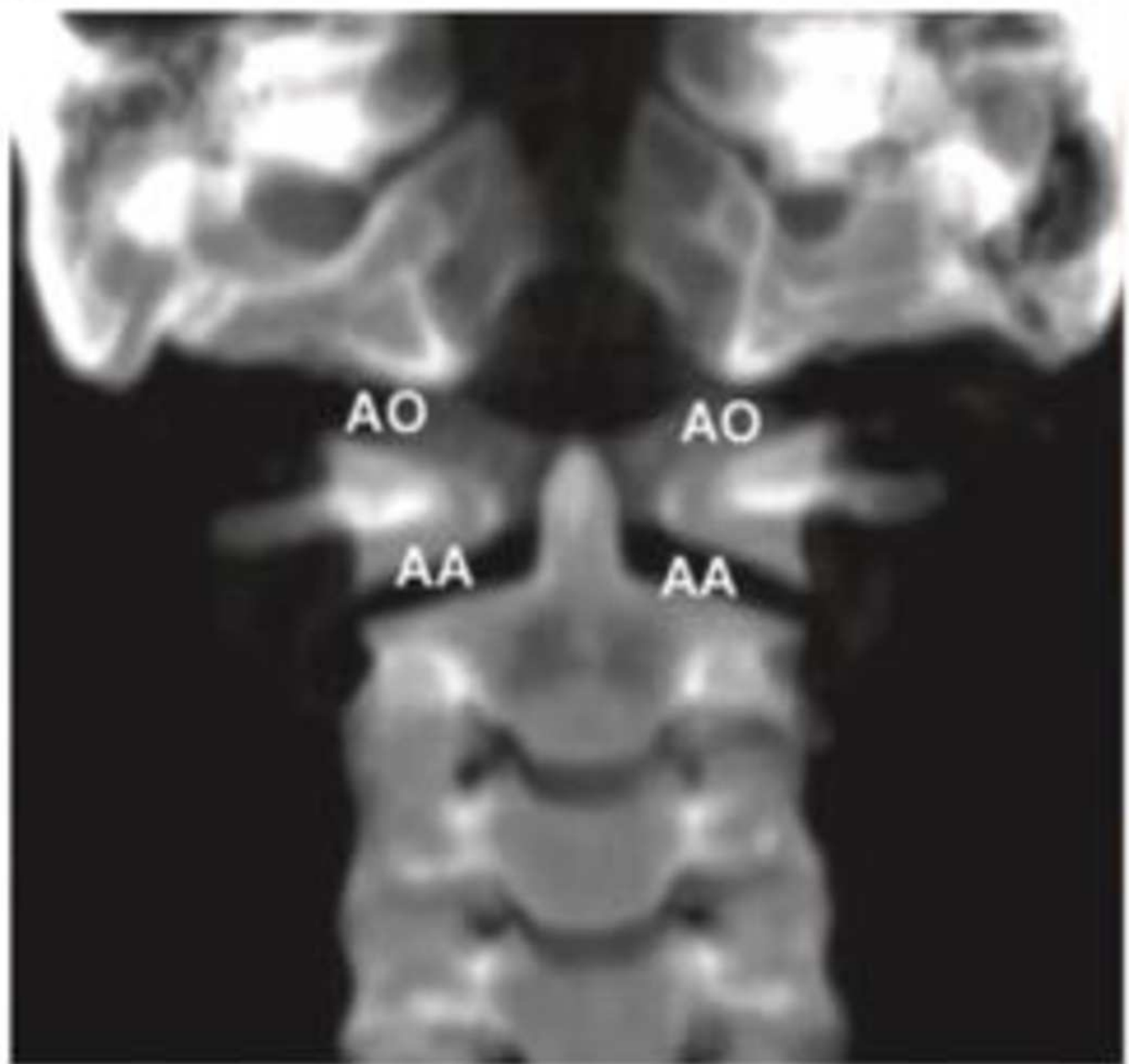
Figure 1. Normal intervals of the craniocervical junction. **(a)** Midsagittal half-space volume-rendered CT image shows the atlantodental interval (solid line), the basion-dens interval (double-headed arrow), the posterior axial line (dashed line), the basion-to-posterior axial line interval (dotted line), and the C1–C2 spinolaminar distance (parallel lines). **(b)** Volume-rendered CT image shows the normal relationship of an occipital condyle and the lateral mass of C1, with close apposition, and the nearly equidistant intervals (solid lines) along all points in the midsagittal plane of the joint.



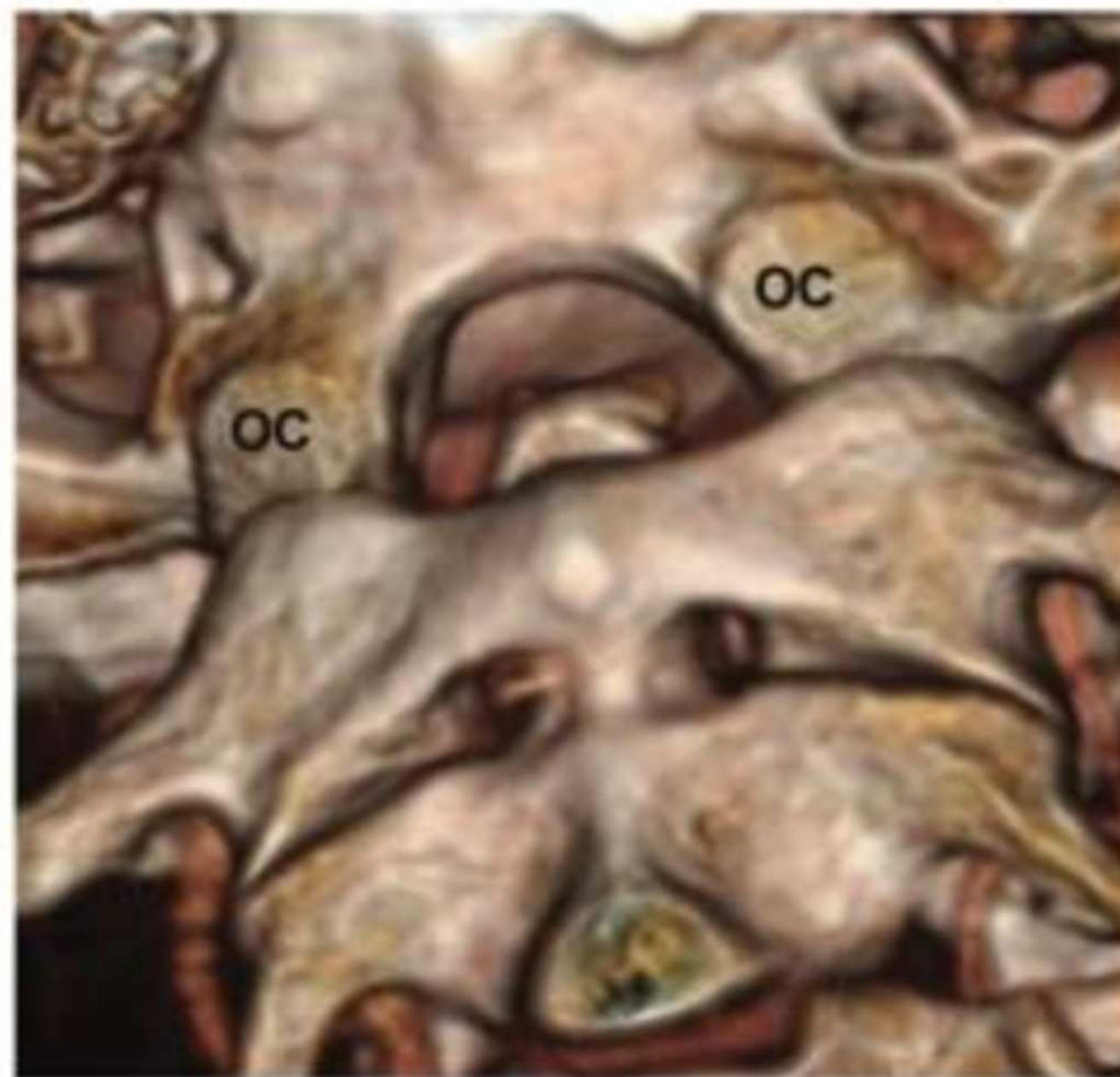
a.



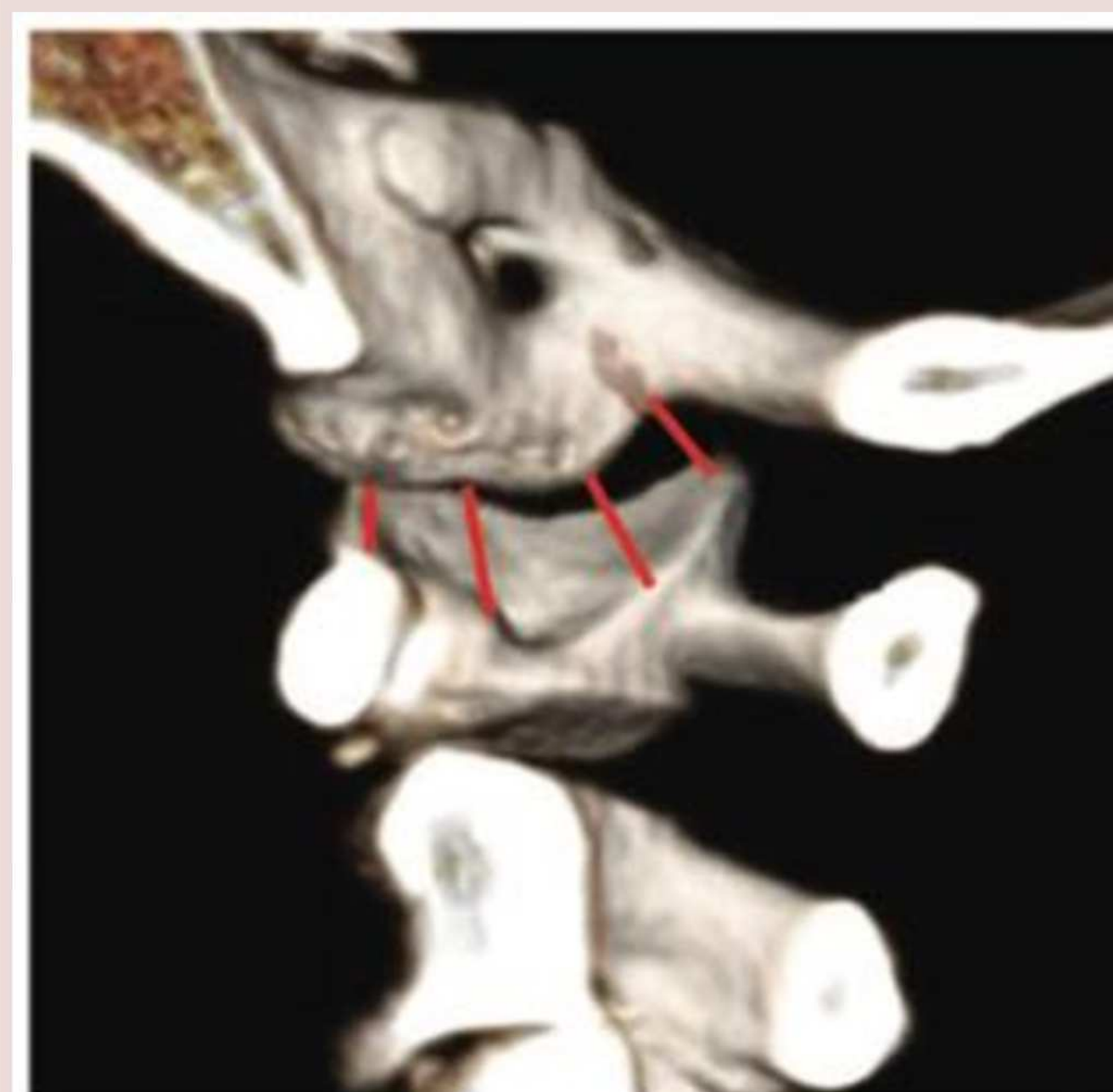
b.



c.



d.



e.

A - atlanto-oktsipitaalne dissotsiatsioon.

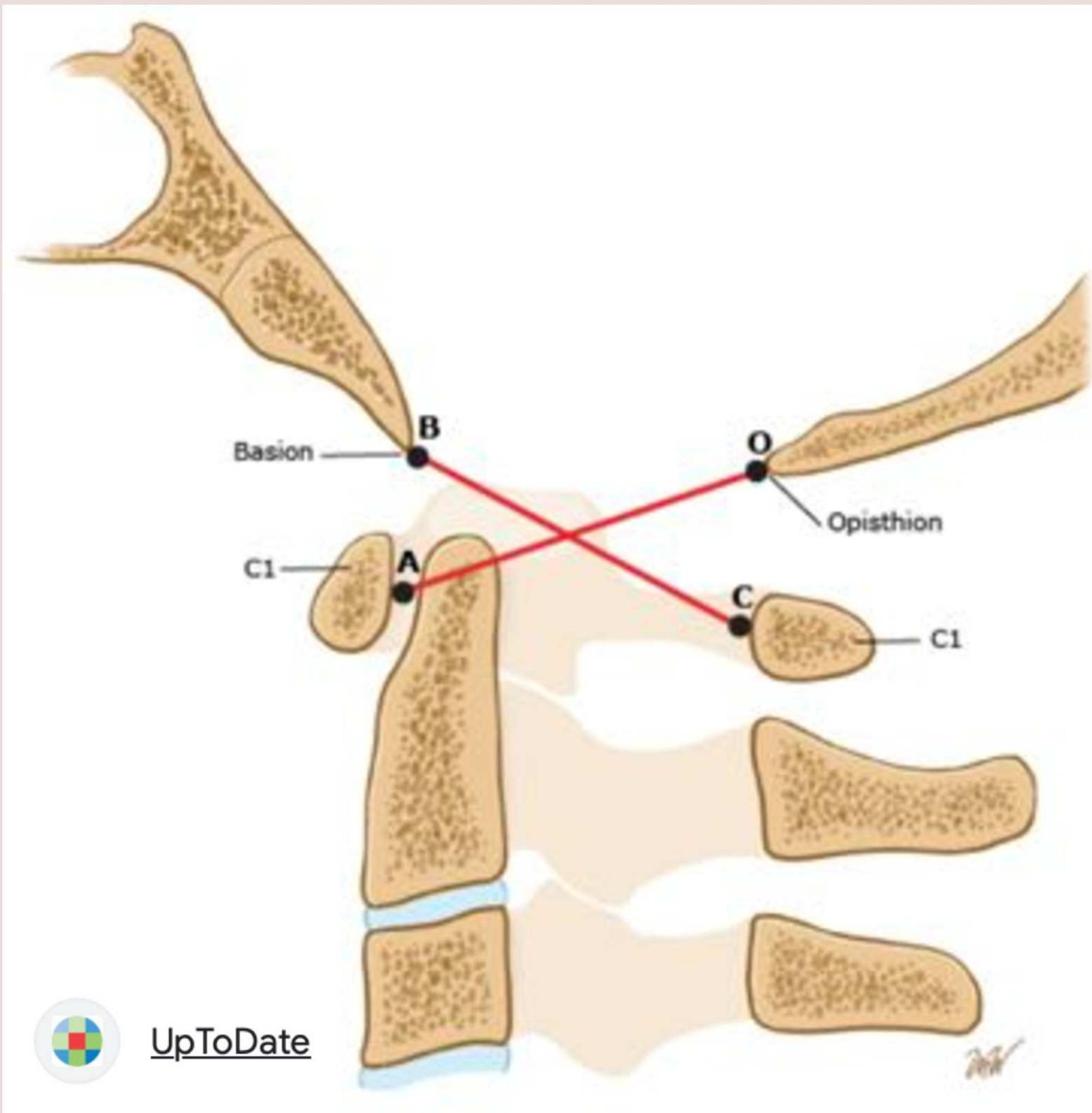
B - atlanto-dental intervalli suurenemine transverse ligamendi vigastuse tõttu.

C - atlanto-oktsipitaalsed ja atlanto-aksiaalsed liigesepilud on laienenud.

D ja E - atlanto-oktsipitaalne iigesepilu laienemine ja dislokatsioon.

Table 4: Normal Measurements in the Craniocervical Junction

Interval	Ligaments Injured	Radiography Cutoff/Reference	Multidetector CT Cutoff/Reference
Basion-to-dens interval	Alar ligaments, tectorial membrane	12 mm/Harris et al (44)	8.5–9.5 mm/Rojas et al (37), Chang et al (35)
Basion–axial line interval	Alar ligaments, tectorial membrane	>12 mm anterior or 4 mm posterior to the posterior axillary line/Harris et al (44)	Difficult to reproduce/Rojas et al (37)
Atlantodental interval	Transverse ligament, atlanto-occipital and C1-C2 capsules, tectorial membrane, alar ligaments	3 mm (men), 2.5 mm (women)/Hinck and Hopkins (45)	2 mm/Rojas et al (37)
Atlanto-occipital interval	Atlanto-occipital joint capsules, alar ligaments, tectorial membrane	No data in adults	4.0 mm (summed)/Chang et al (35); 2.5 mm (single atlanto-occipital interval)/Rojas et al (37)
Atlantoaxial interval	C1-C2 joint capsules, alar ligaments, tectorial membrane	No data in adults	Midsagittal, 2.6–4.0 mm/Gonzalez et al (46), Chaput et al (41); lateral margins, 1.2 mm/Radcliff et al (47); posterior and anterior margins, 1 mm/Gonzalez et al (46)
Powers ratio	Transverse ligament, atlanto-occipital joint capsules, tectorial membrane, alar ligament	Anteriorly displaced atlanto-occipital distraction indicated by Powers ratio >1/Powers et al (42)	Anteriorly displaced atlanto-occipital distraction indicated by Powers ratio >1/Dziurzynski et al (43)



$$\text{Powers ratio} = \frac{AB}{CD}$$



Craig Hacking
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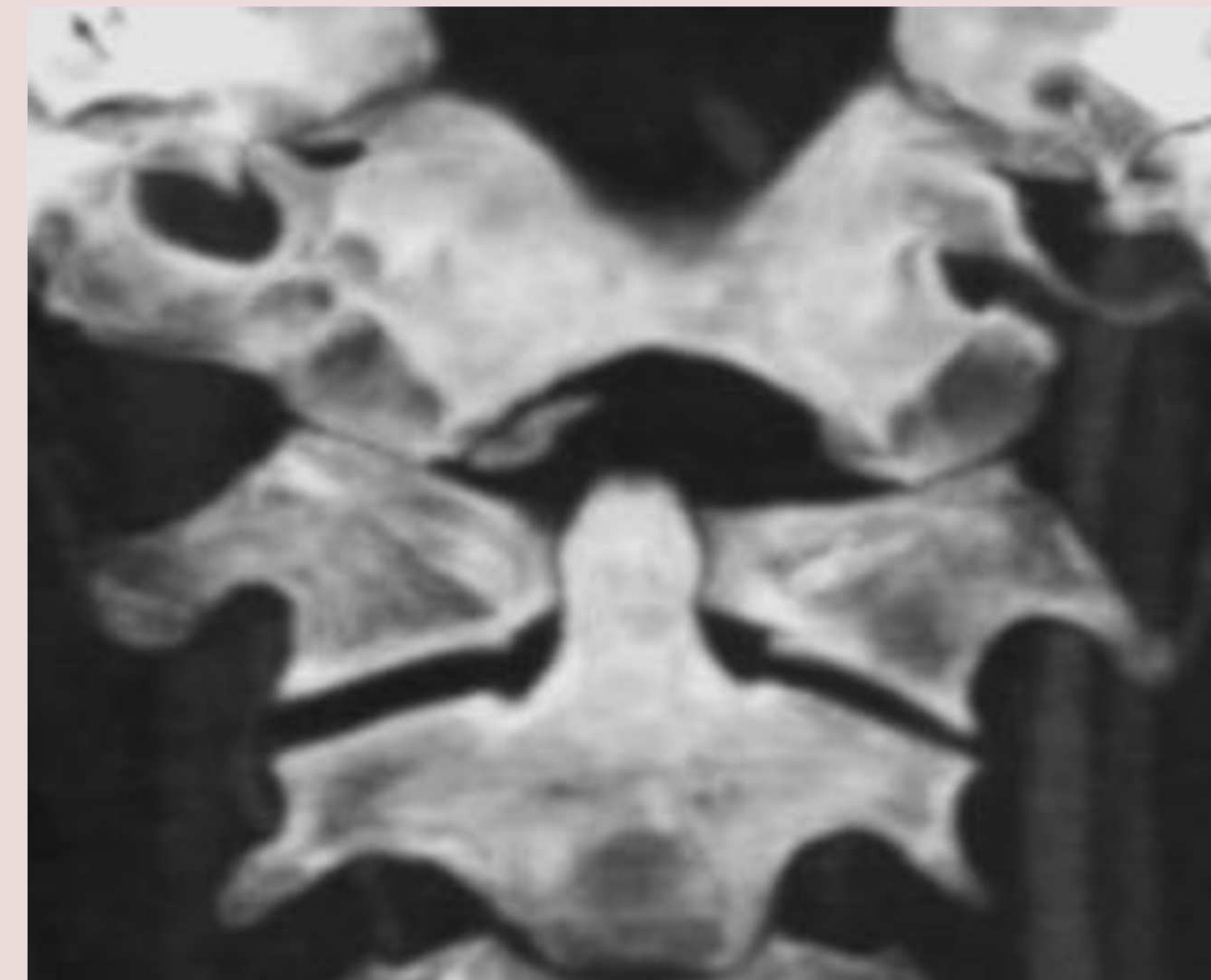
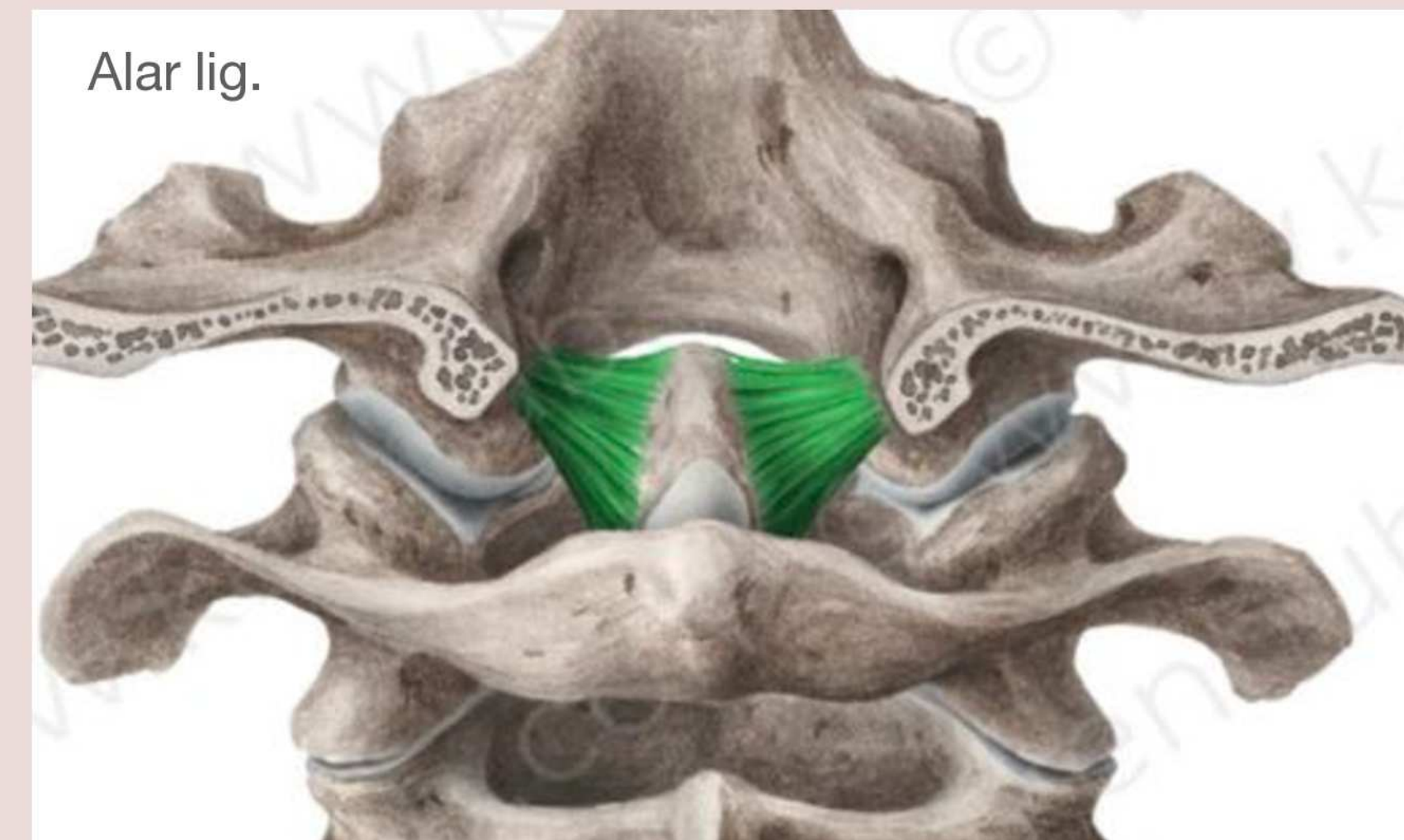
Powers suhe - normväärtus on alla 1.

Kuklaluu kondüüli murd

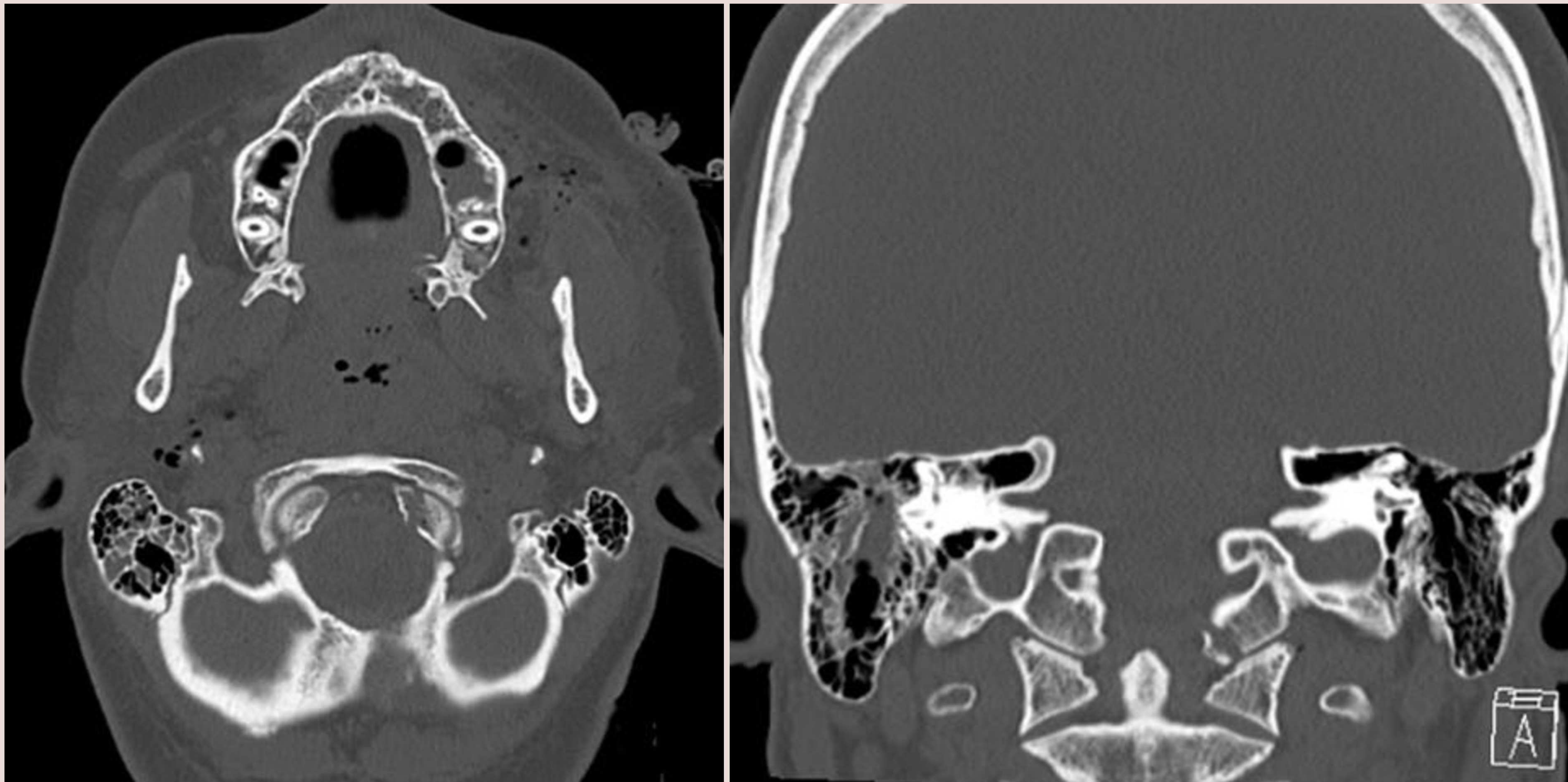
- kõrge energiaga traumale viitav leid, sageli koos teiste vigastustega
kliiniline leid võib olla minimaalne, GKS võib olla normis
- atlanto-oktsipitaalset liigest stabiliseerivad peamiselt liigeskapsel ja **alar ligamendid** (kaudselt ka teised suured kraniotservikaalsed ligamendid nt atlantodental)
- murd võib olla seotud kraniotservikaalse dissotsiatsiooniga
- Anderson & Montesano klassifikatsioon, mis seletab nii mehhanismi kui ka prognoosi

Occipital condyle fractures (Anderson and Montesano [53])

Type I: axial loading with minimal or no fracture displacement	Stable
Type II: skull base fracture extending through the condyle	Stable
Type III: alar ligament avulsion fracture	Unstable



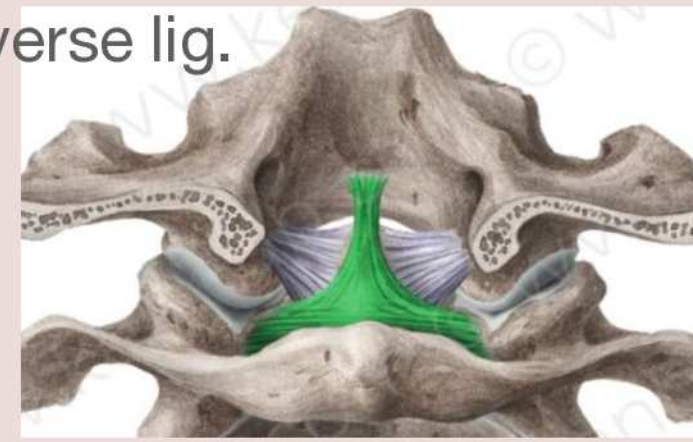
III tüüpi murd.



N20. Autoavarii. Lisaks muule kuklaluu kondüüli III tüüpi murd vasakul.

Atlase murrud

Transverse lig.

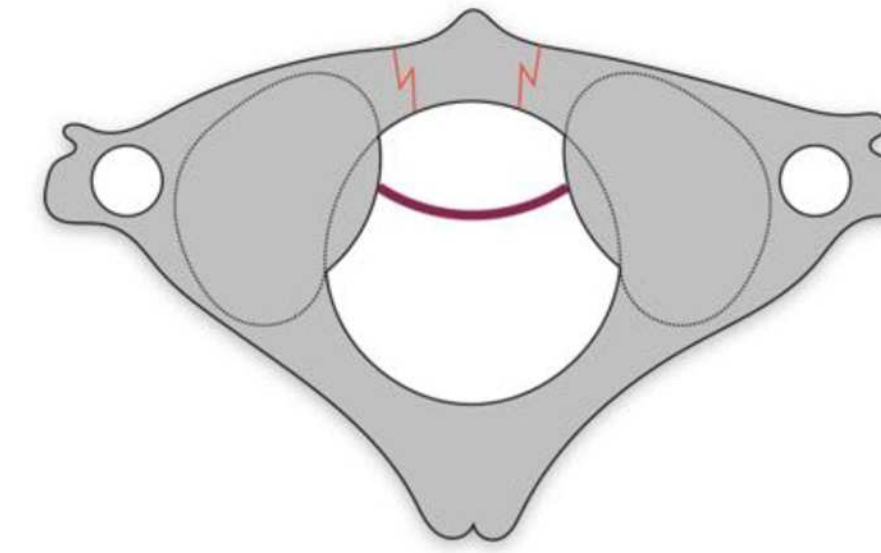


- moodustavad 25% kraniotservikaalsetest vigastustest, peaaegu pooltel juhtudest on murr ka axes
- Jefferson tegi esimese klassifikatsiooni, nüüd on kasutusel tema järgi modifitseeritud **Gehweileri klassifikatsioon**, kus tüüp III on nn klassikaline Jeffersoni purustusmurd: haaratud on korraga tagumine ja eesmine kaar uni/bilat
- enamasti on atlase murrud stabiilsed. Operatiivse ravi vajaduse **tüüp III puhul transverse ligamendi intaktsus** (-> Dickmani alamklassifikatsioon).
- isoleeritud anterioorse kaare murr on harv, kõige sagedasem on klassikaline III tüüp.

Diagram

Atlas fracture

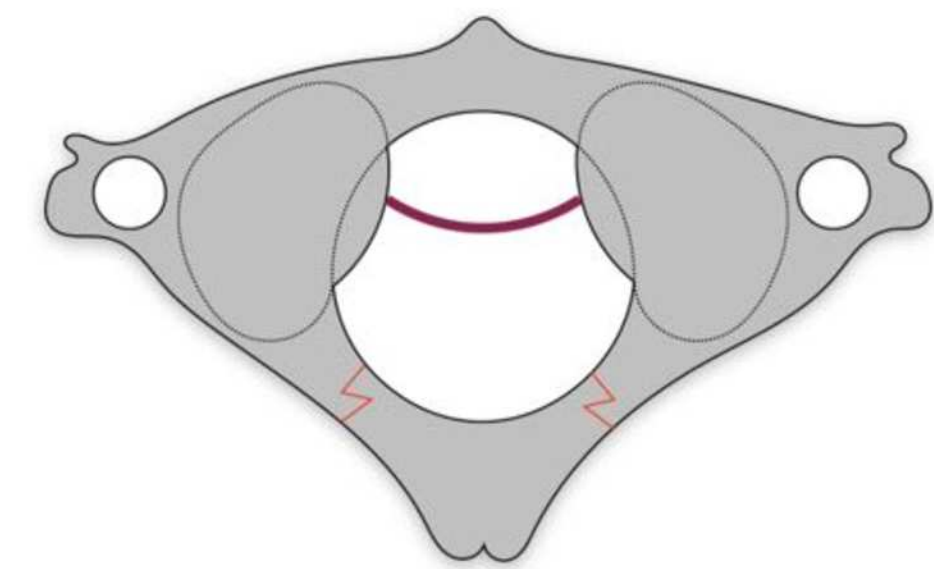
Gehweiler type 1



Diagram

Atlas fracture

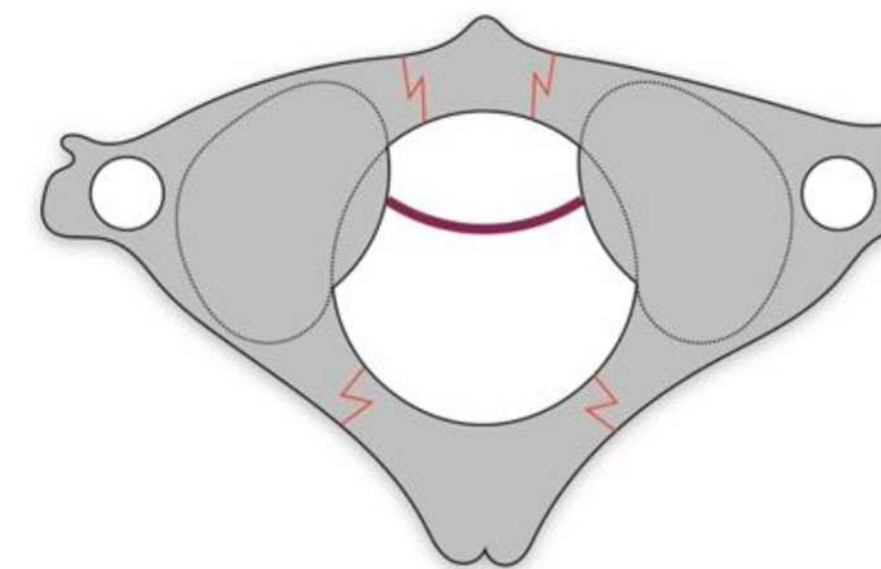
Gehweiler type 2



Diagram

Atlas fracture

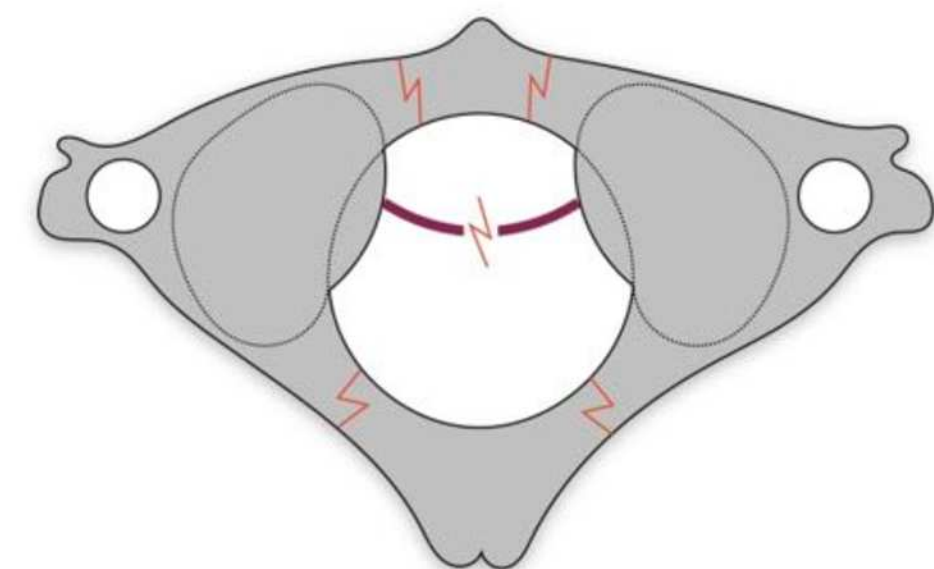
Gehweiler type 3a



Diagram

Atlas fracture

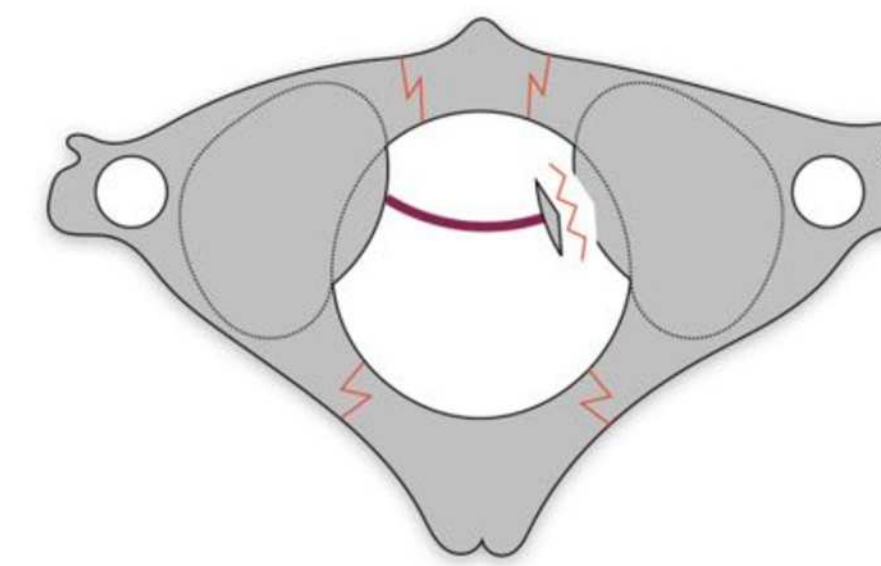
Gehweiler type 3b
Dickman type 1



Diagram

Atlas fracture

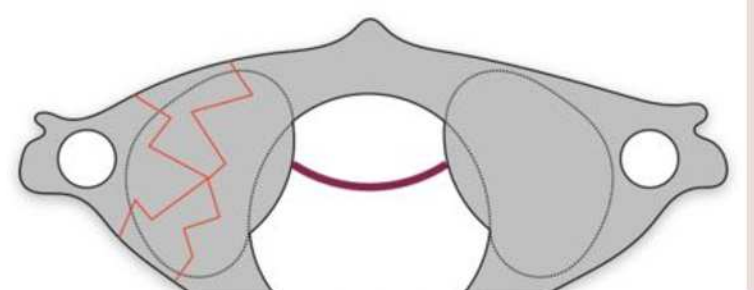
Gehweiler type 3b
Dickman type 2



Diagram

Atlas fracture

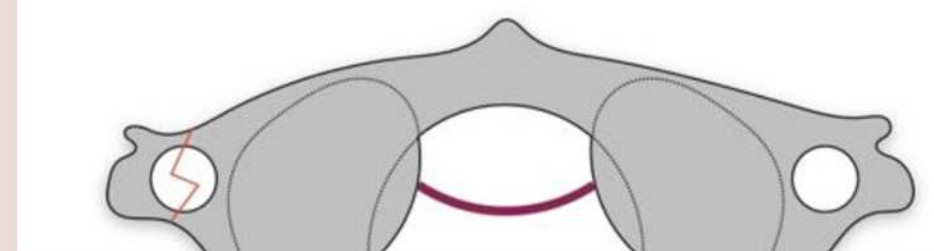
Gehweiler type 4



Diagram

Atlas fracture

Gehweiler type 5



Atlas fractures (Jefferson, as modified by Gehweiler et al [54])

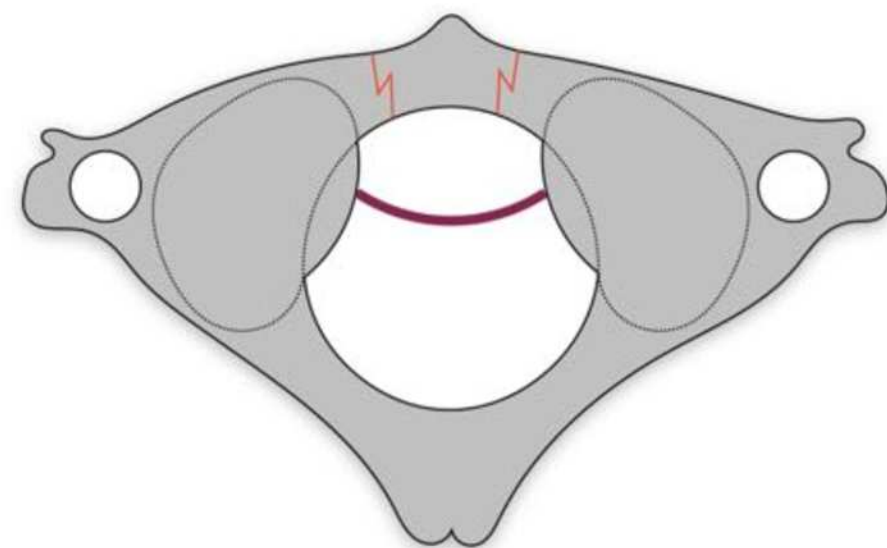
Type I: posterior arches	Stable
Type II: anterior arch	Stable
Type III: bilateral posterior arch with bilateral or single unilateral anterior arch (“Jefferson burst”)	Depends on integrity of transverse ligament
Type IV: lateral mass	Stable
Type V: transversely oriented anterior arch fractures (avulsion of longus colli or atlantoaxial ligament)	Stable

Kirjanduses on selle klassifikatsiooni osas erinevusi.

Diagram

Atlas fracture

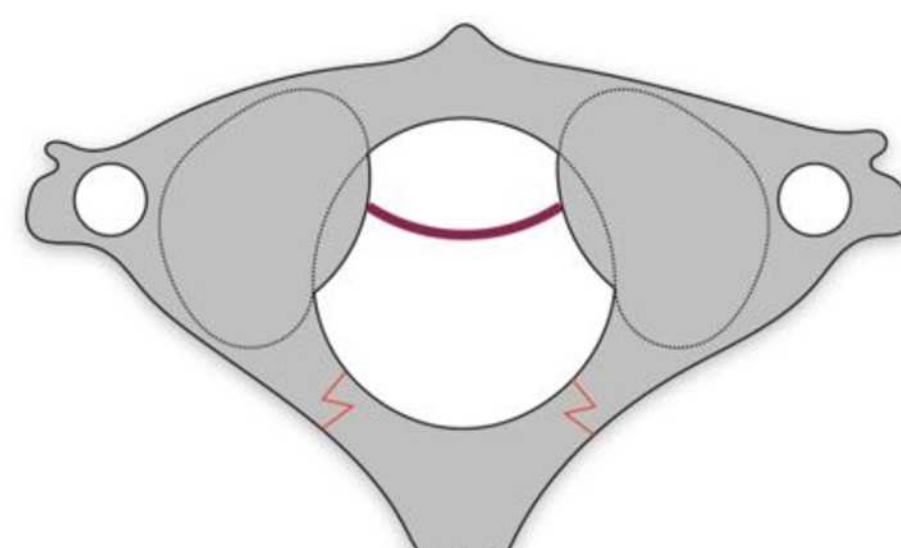
Gehweiler type 1



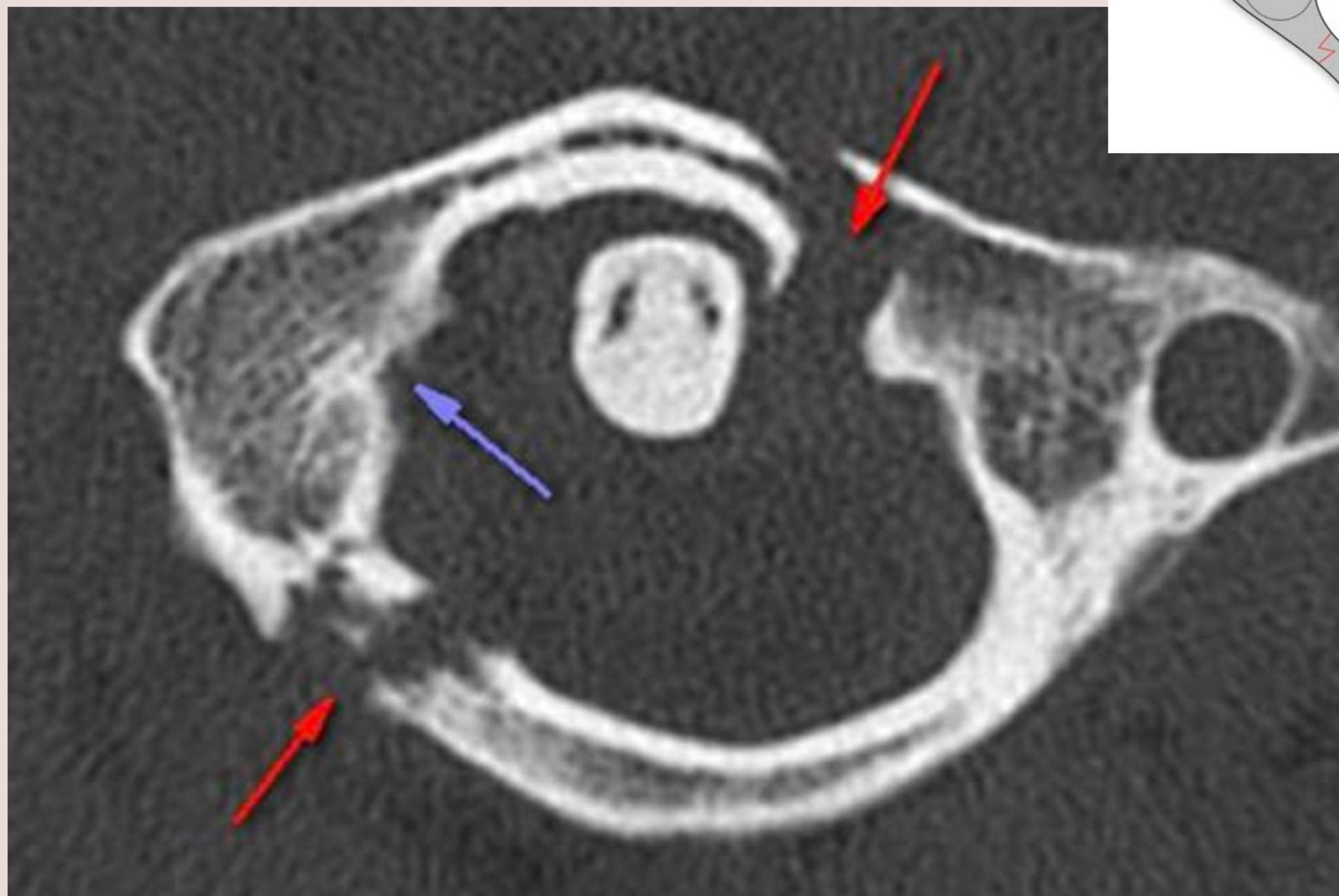
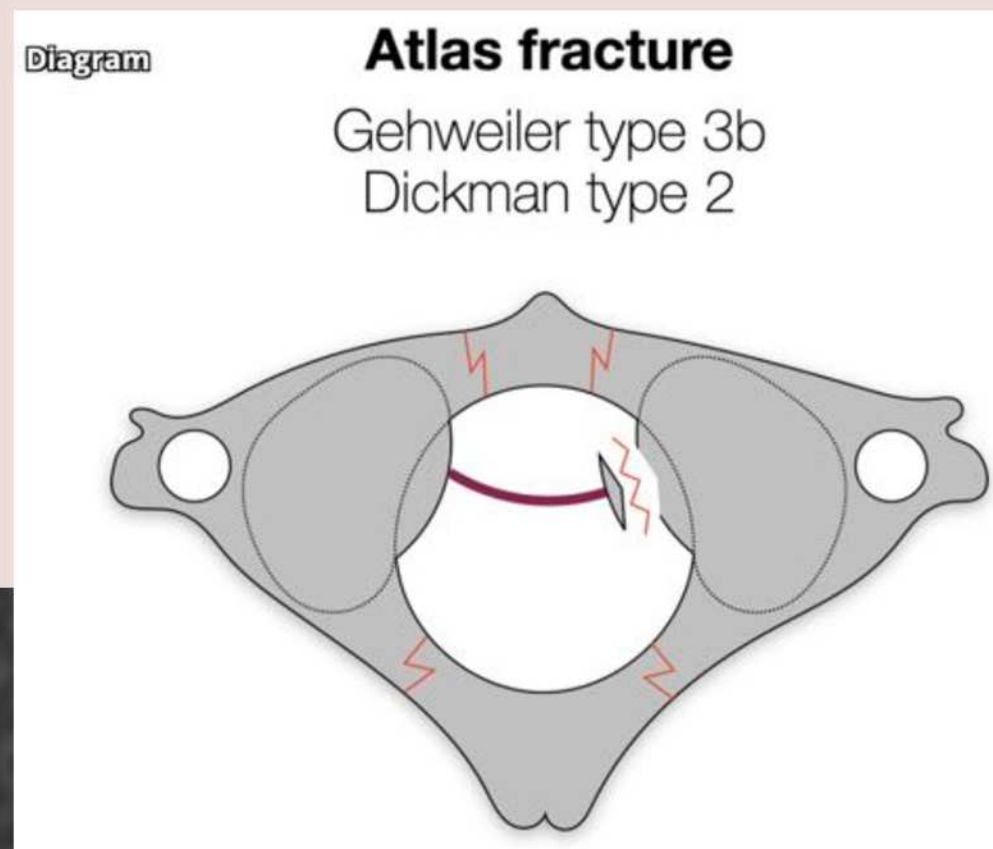
Diagram

Atlas fracture

Gehweiler type 2



- **type 1:** fractures of the anterior arch
- **type 2:** fractures of the posterior arch and are usually bilateral

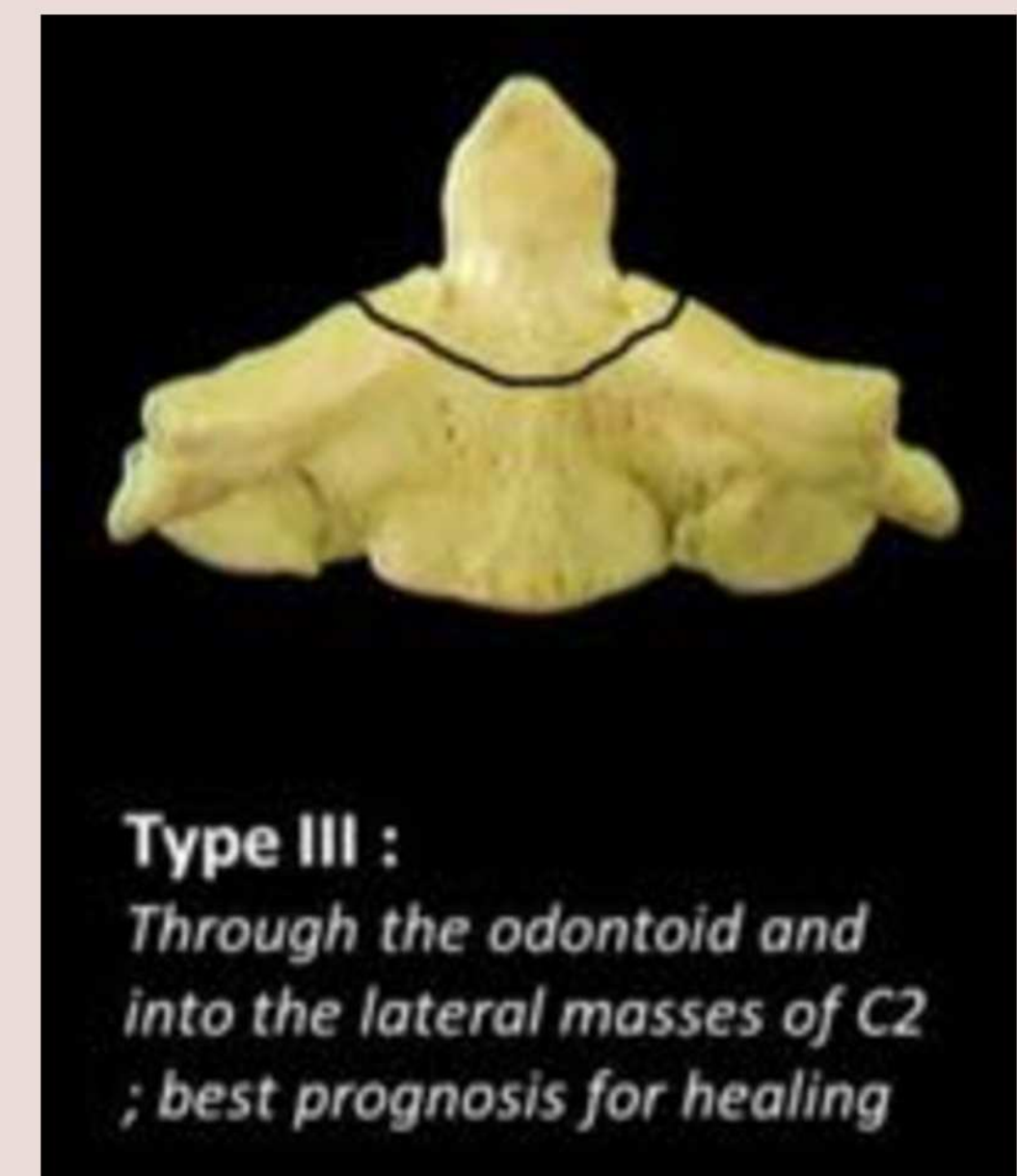
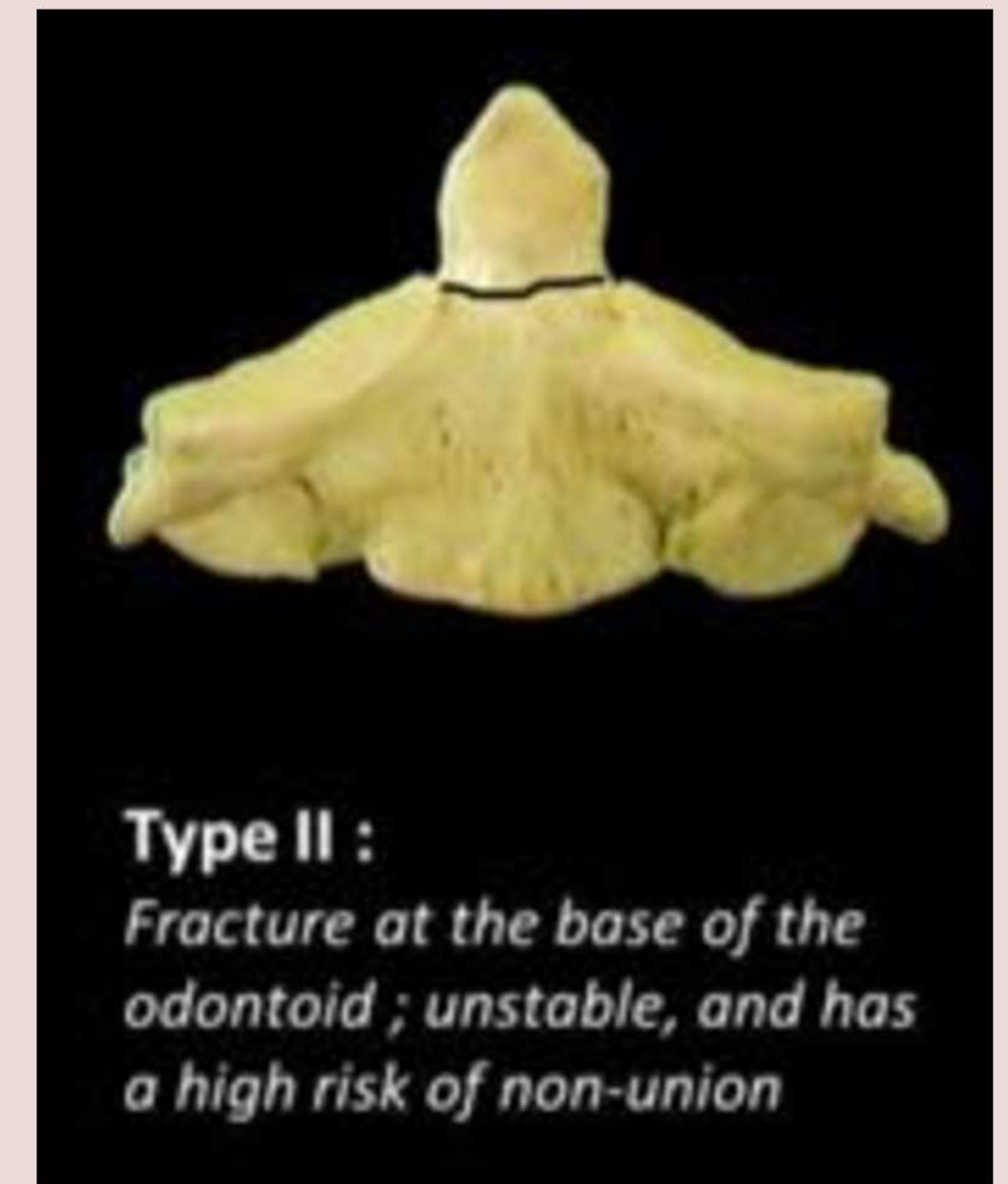
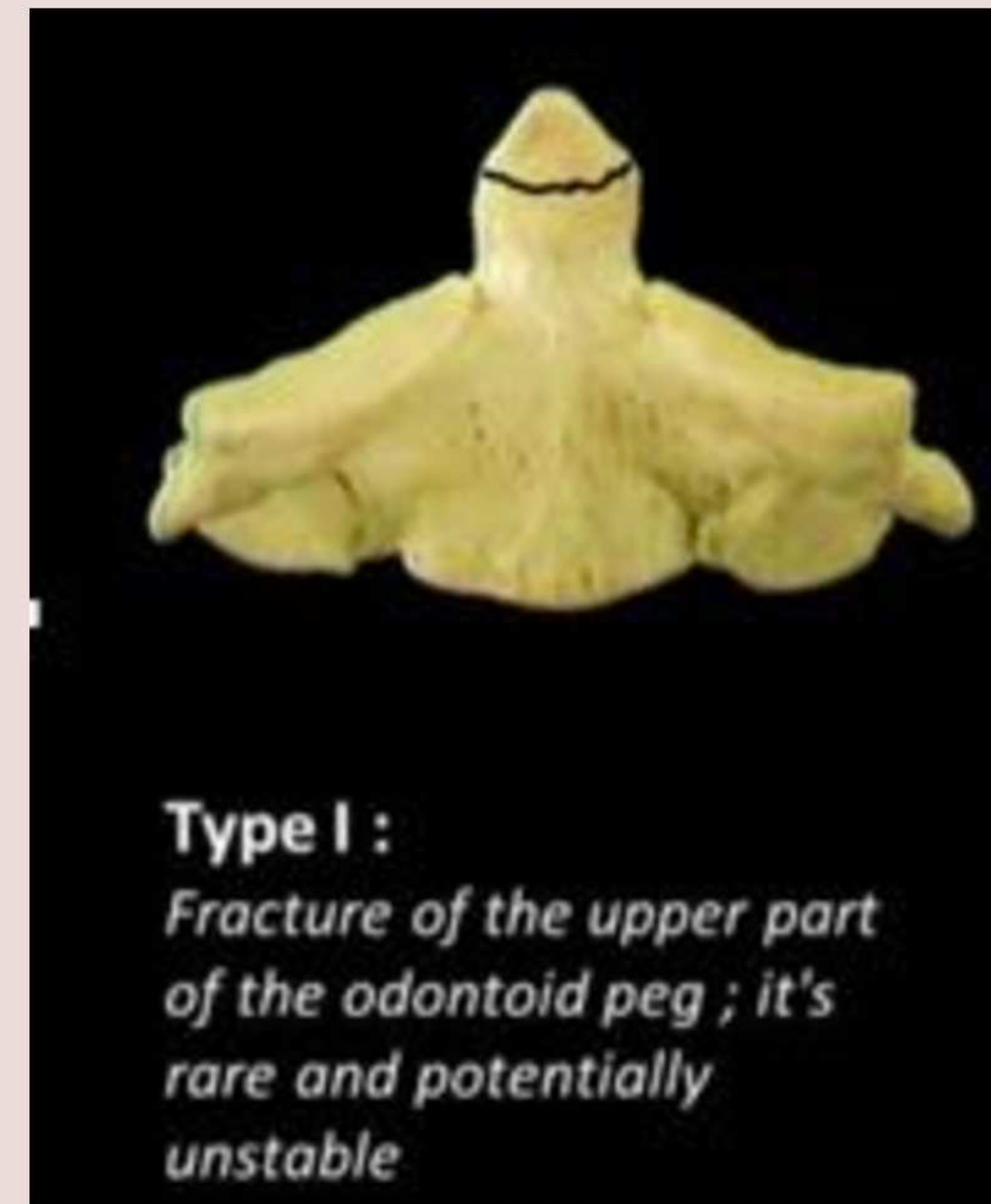


M20. Mootorrattaõnnetus. Atlases klassikaline Jeffersoni murd (eesmises ja tagumises kaares, punased nooled) koos transverse ligamendi avulsioonmurruga (lilla nool).

Axise murrud: dens

- Axise murrud üldiselt kuni 20% kaelaosa murdudest.
60% axise murdudest on densi murrud
- neuroloogiline leid sageli puudub
- Anderson and D'Alonzo klassifikatsioon: I tüüpi väga harva, **II tüüp kõige sagedasem** (kuni 60%)
- Oluline panna täpselt kirja, kust-kuhu murd ulatub (praktilas võib olla raske määratleda tüüp II vs III)

Alar lig.



Odontoid fractures (Anderson and D'Alonzo [55])

Type I: oblique fracture through the tip of the odontoid, result of alar ligament avulsion	Stable
Type II: dens-body junction	Unstable*
Type III: cancellous portion of the axis body	Heals well with immobilization but can cause canal compromise

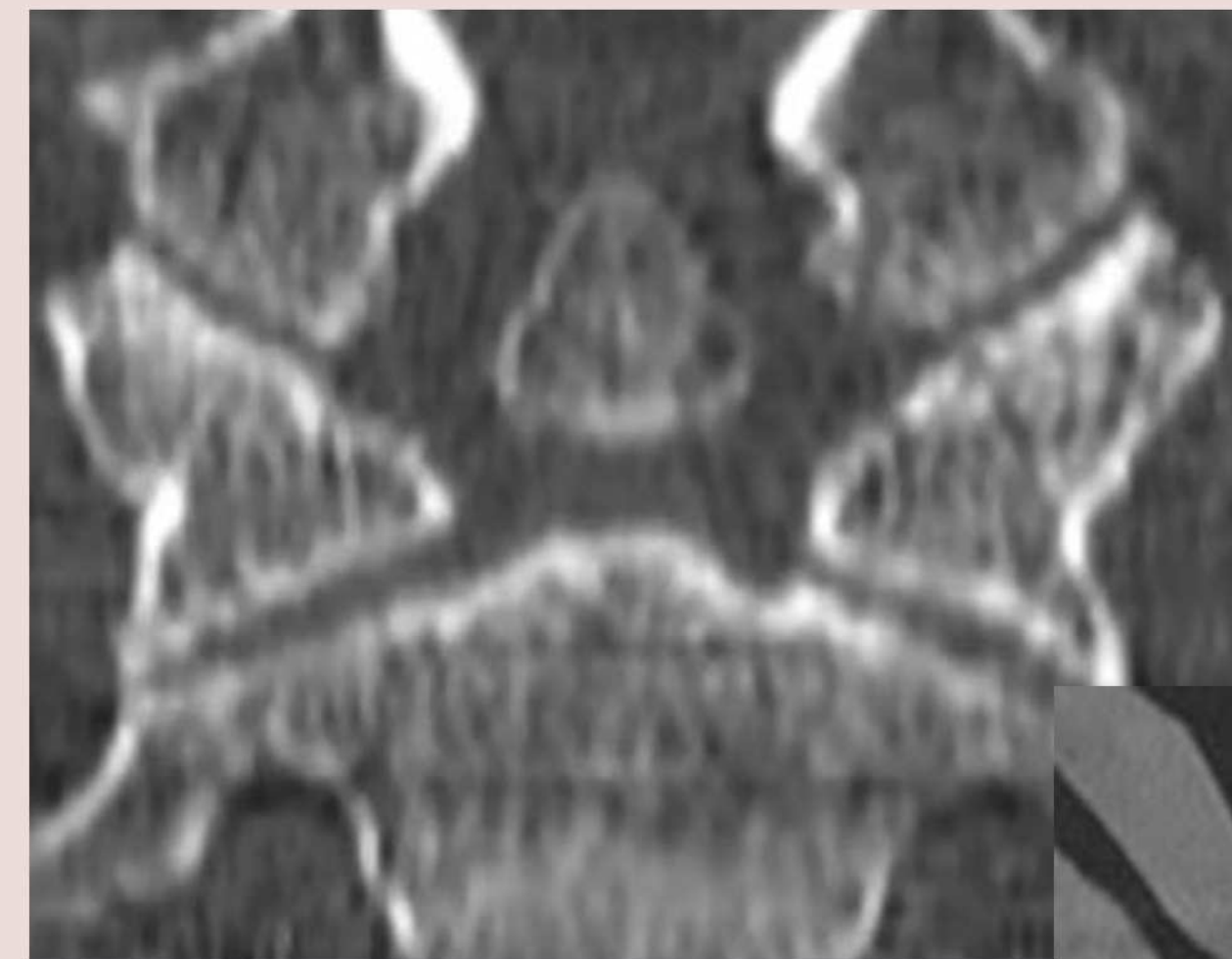
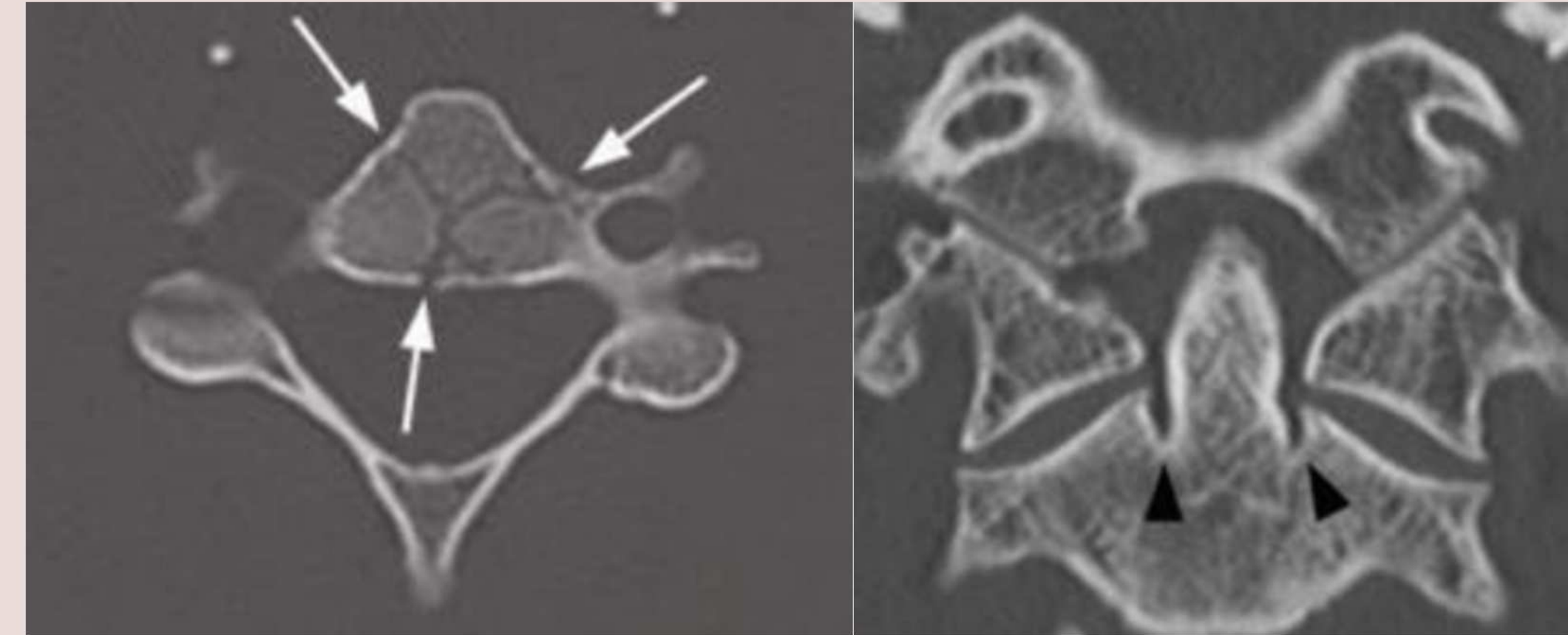
*The risk factors for nonfusion of type II odontoid fractures are (a) age older than 50 years, (b) 6 mm or more of dens displacement, and (c) comminution and splinter fragments at the fracture site.



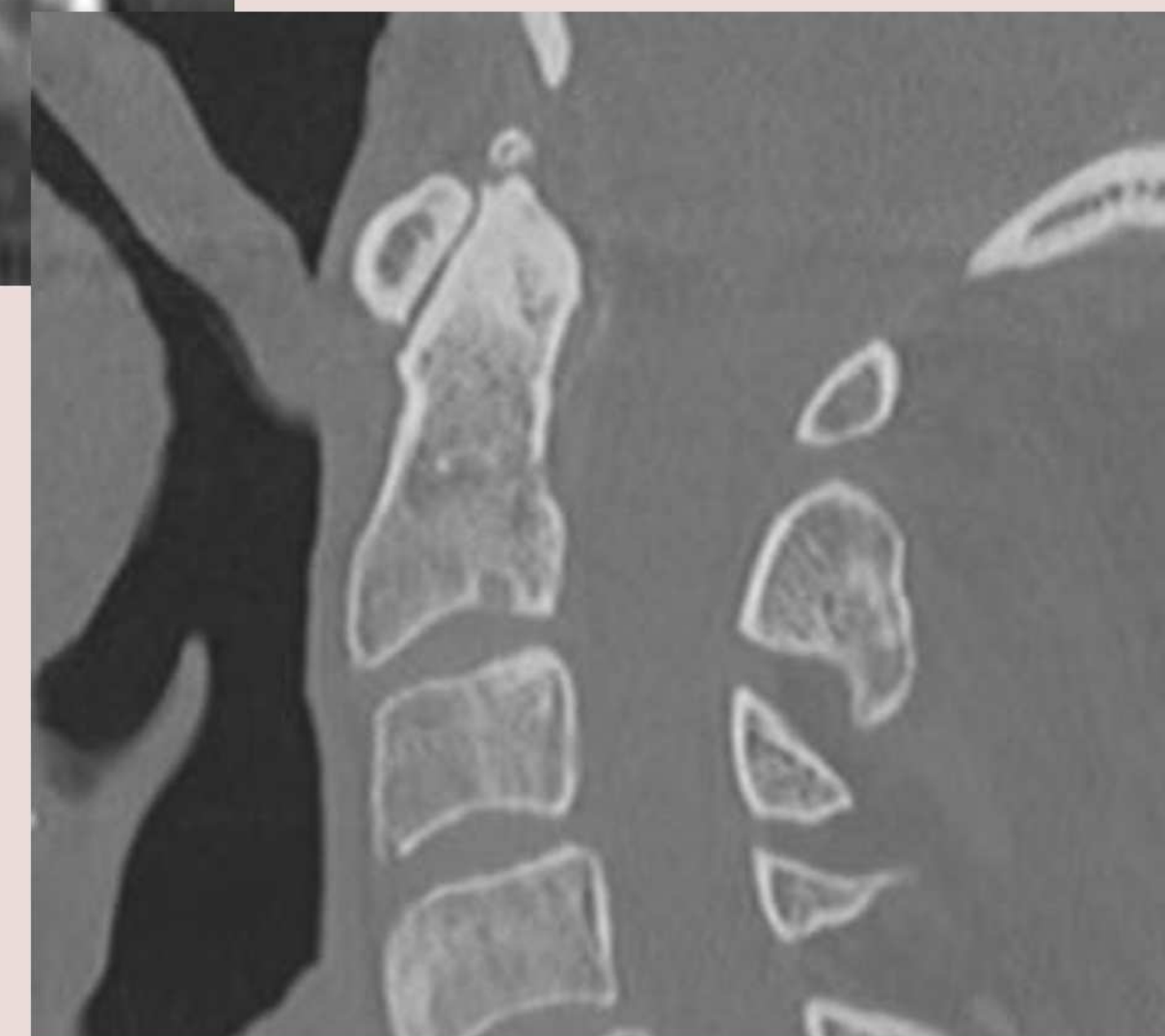
M30. Autoavarii. Neuroloogiline koldeleid puudub, kaelavalu.
Densi II tüüpi murd, C1 tub. anteriori murd.

Densi murru pitfallid:

- **vaskulaarsed kanalid**
- ***os odontoideum*** - pigem lapseea vana murd kui fuseerumata luustumistuum; võib tekitada kroonilist ebastabiilsust/kaebusi. Murru jaoks liiga suur intervall C2 kehaosa ja fragmendi vahel, fragment on sklerootiline ja ümaraservaline.
- ***ossiculum terminale (of Bergmanni)*** - sekundaarne luustumistuum, mis jääb fuseerumata. Paikneb alar ligamendist kõrgemal ja on asümptomaatiline. Samuti sklerootiliste servadega.



M35. Kukkunud.
Os odontoideum.



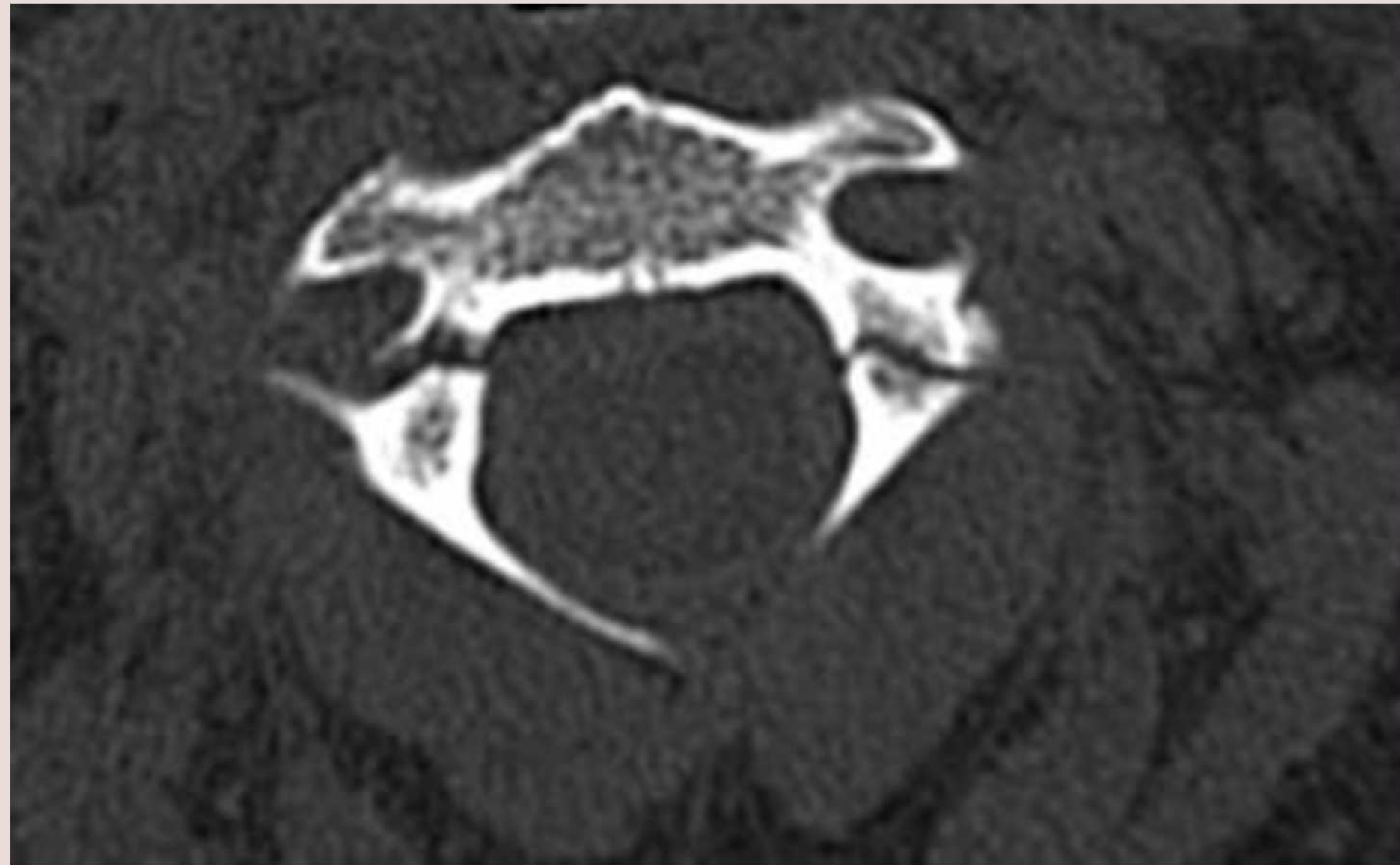
M80. Kukkunud.
Ossiculum Bergmanni.

Axise murrud: Hangman

- Hangman murd - eponüüm C2 traumaatilisele spondülolüüsile, enamasti hüperekstensiooni vigastus
- neuroloogiline leid vaid ca 25% patsientidest, enamasti mitteoperatiivne ravi, aga sõltub tüübist
- klassifitseeritakse vastavalt nihke ulatusele

Hangman fractures (Effendi et al [56], modified by Levine and Edwards [57])

Type I: hairline fractures, <2-mm translation	Stable
Type II: angulation > 11°, >2-mm translation	Variable, external immobilization often used
Type IIa: severe angulation without translation, intact anterior longitudinal ligament	Angulation can worsen with initial traction
Type III: bilateral facet dislocation	Unstable

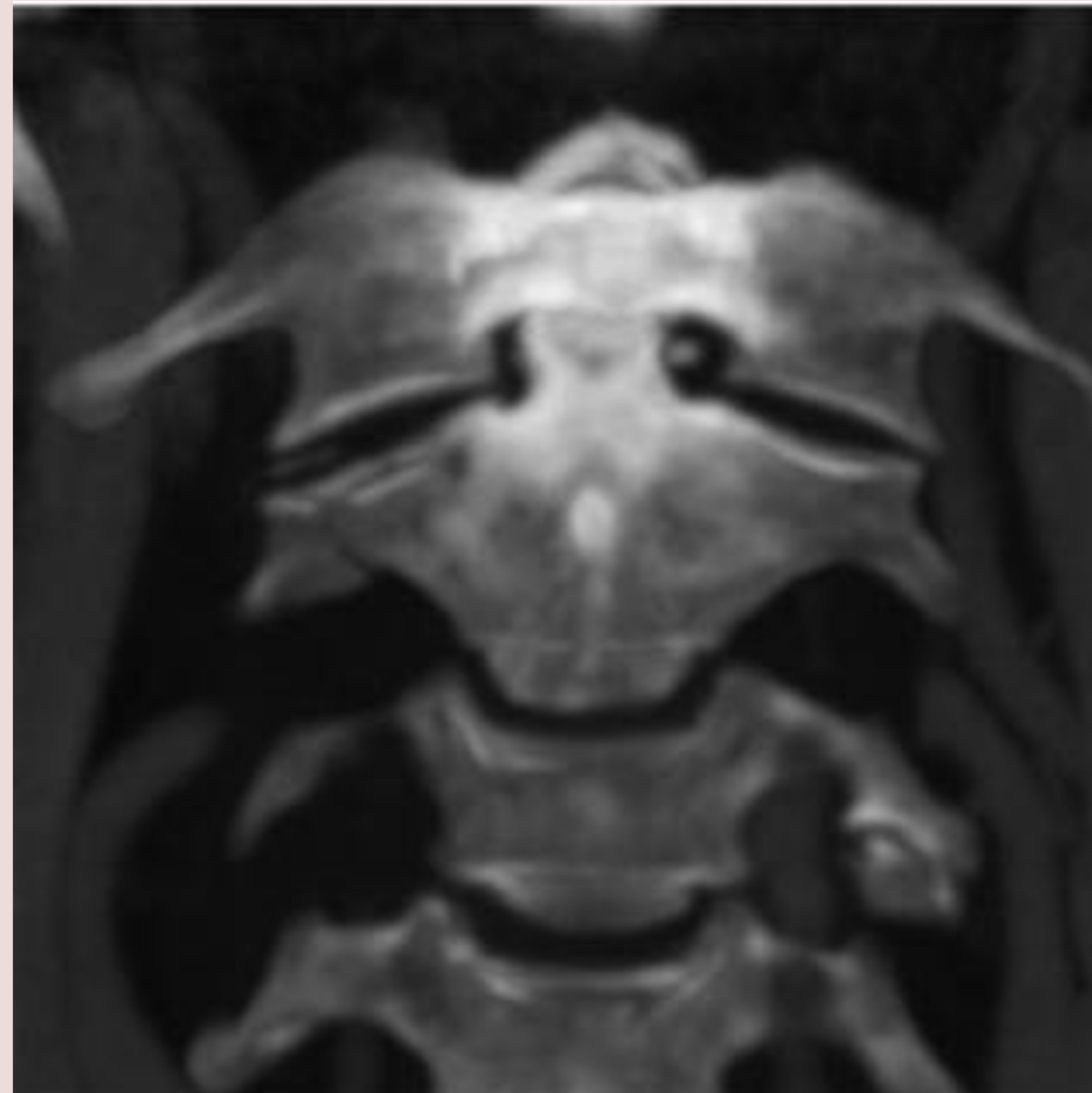


F2

N20. Liiklusavarii. Mõlemapoolselt C2 pars interarticularise murd - Hangman murd, pigem I tüüp. C2/3 lülivahemik on veidi laiem, on aimata C2 anterolisteesi.

Axise murrud: kehaosa

- isoleeritud lateraalmassi, pediikli, proc. transversuse murrud
- võivad olla ka purustusmurrud
- sageli pigem mitteoperatiivne ravi



M73. Autoavarii.
Isoleeritud C2 lateraalmassi murd.

Atlantoaksiaalne rotatoorne sublüksatsioon

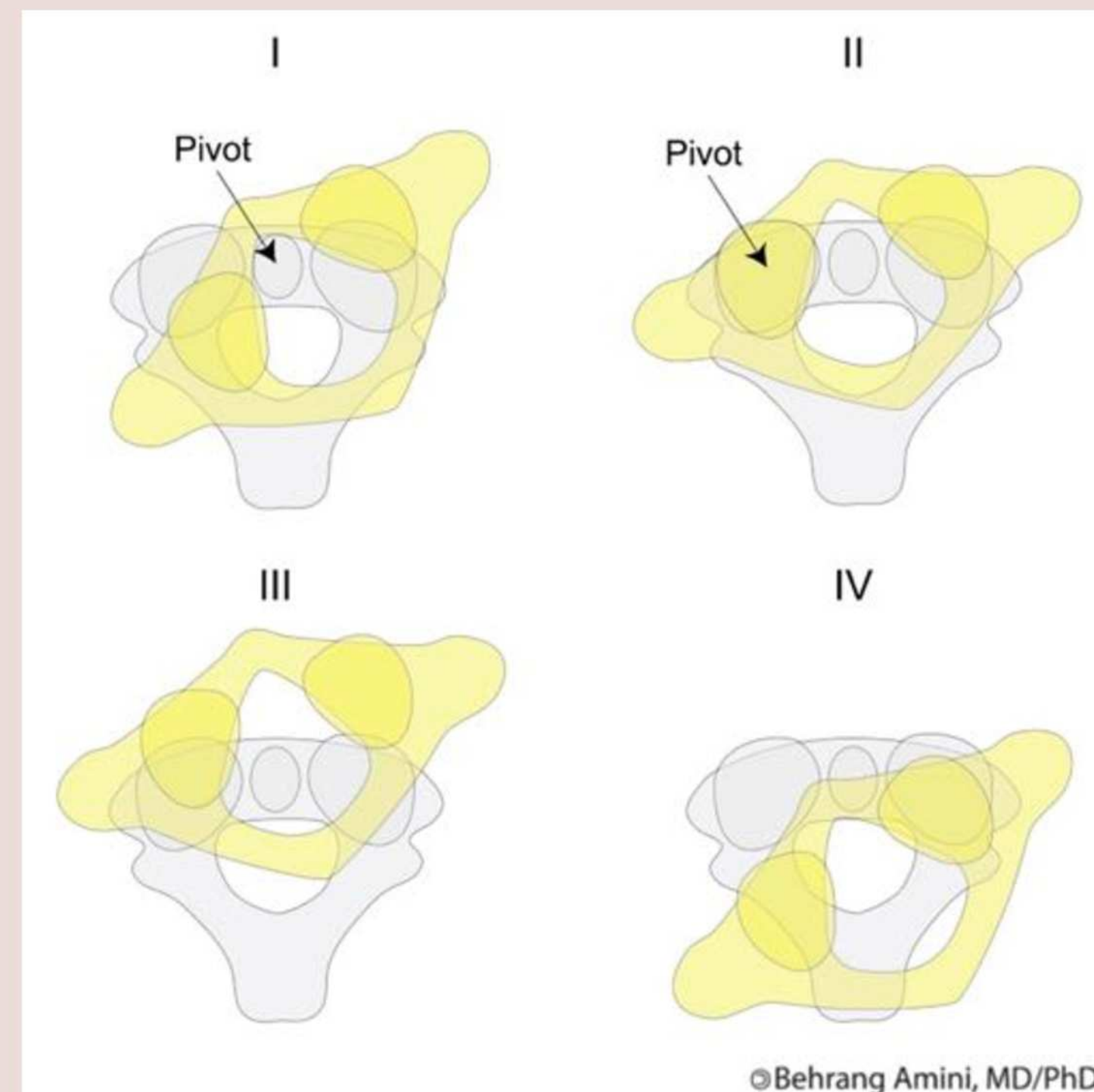
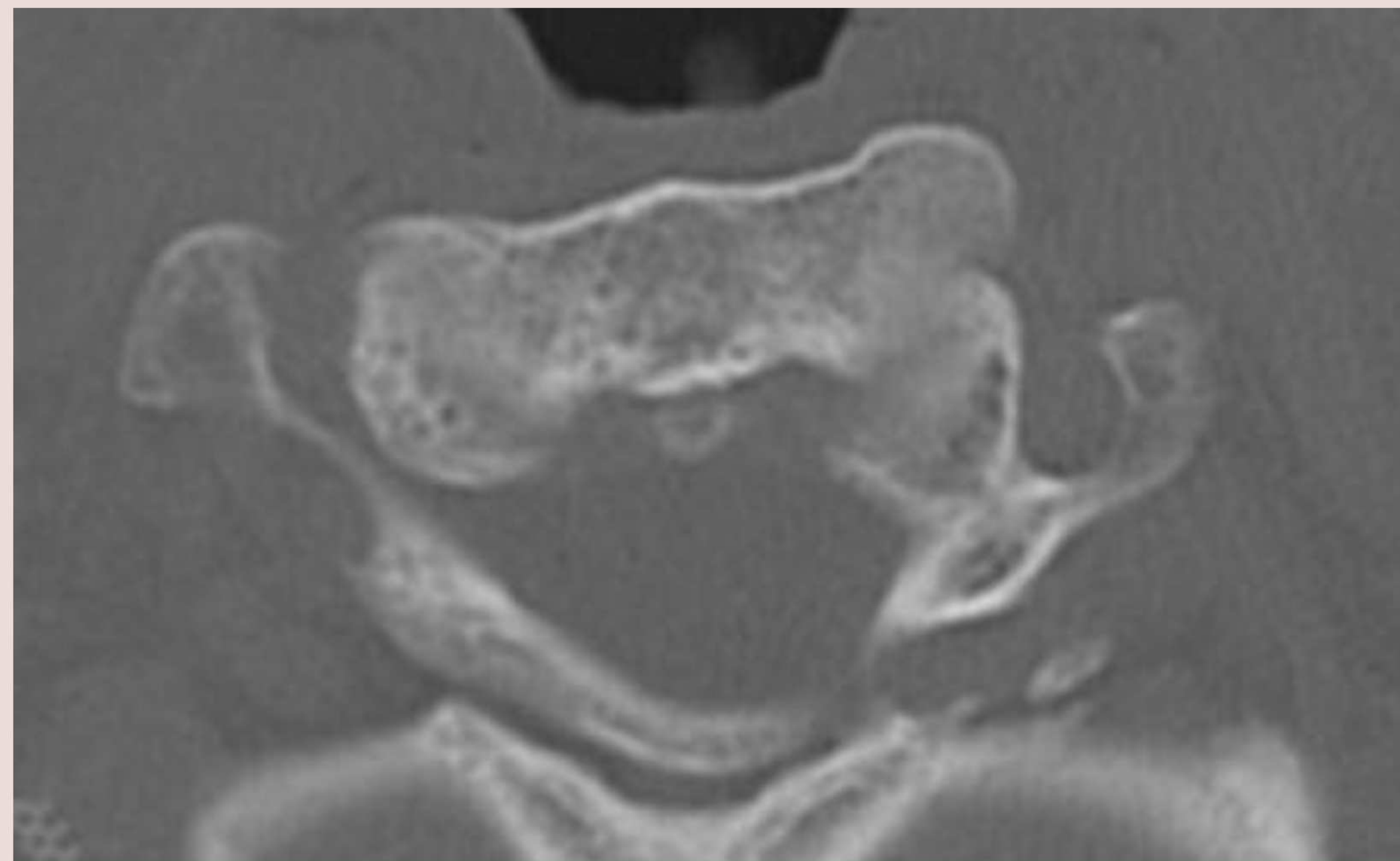
- I tüüpi vigastuse puhul on ligamendid terved ja rotatsioon toimub füsioloogilise normi piires. Seda on raske eristada lihtsalt KT masinas pööratud peaga asendist. Oluline on kliiniline leid.

Atlantoaxial rotatory subluxation and fixation (Fielding and Hawkins [58])

Type I: rotatory fixation in normal physiologic range ($<48^{\circ}$ – 52° left or right), dens acts as a pivot, intact alar and transverse ligaments	Need for surgery depends on degree of rotation, prognosis improves with early reduction
Type II: transverse ligament injured, center of rotation shifts to lateral mass, anterior displacement of the atlas < 5 mm	Unstable
Type III: transverse and alar ligaments both deficient, similar to type II but anterior displacement of the atlas > 5 mm	Unstable
Type IV: deficient odontoid, with posterior displacement of the atlas	Unstable

N65. Kukkunud. Kaela passiivne liigutamine väga valulik.
Sag-suunal näha C1 ja C2 lateraalmasside osas kerge inkongruentsus.
Ax-suunal vasakul pool näha samuti inkongruentsust.

14,15



Subaksiaalsed vigastused

- **65% kaelaosa murdudest, 75%** dislokatsioonidest on subaksiaalsel
- klassifikatsioon on palju erinevaid
Minu ettekande baasiks olev RadioGraphicsi artikkel pakub radioloogidele "uuema" meetodina välja SLIC süsteemi (kus esimene ja teine kategooria on pildiliselt hinnatavad, kolmas kliiniliselt), kuid ma ei ole kohanud selle aktiivset kasutust
- üldiselt murdude osas laialdaselt kasutusel **AO klassifikatsioon** - <https://surgeryreference.aofoundation.org/spine/trauma>

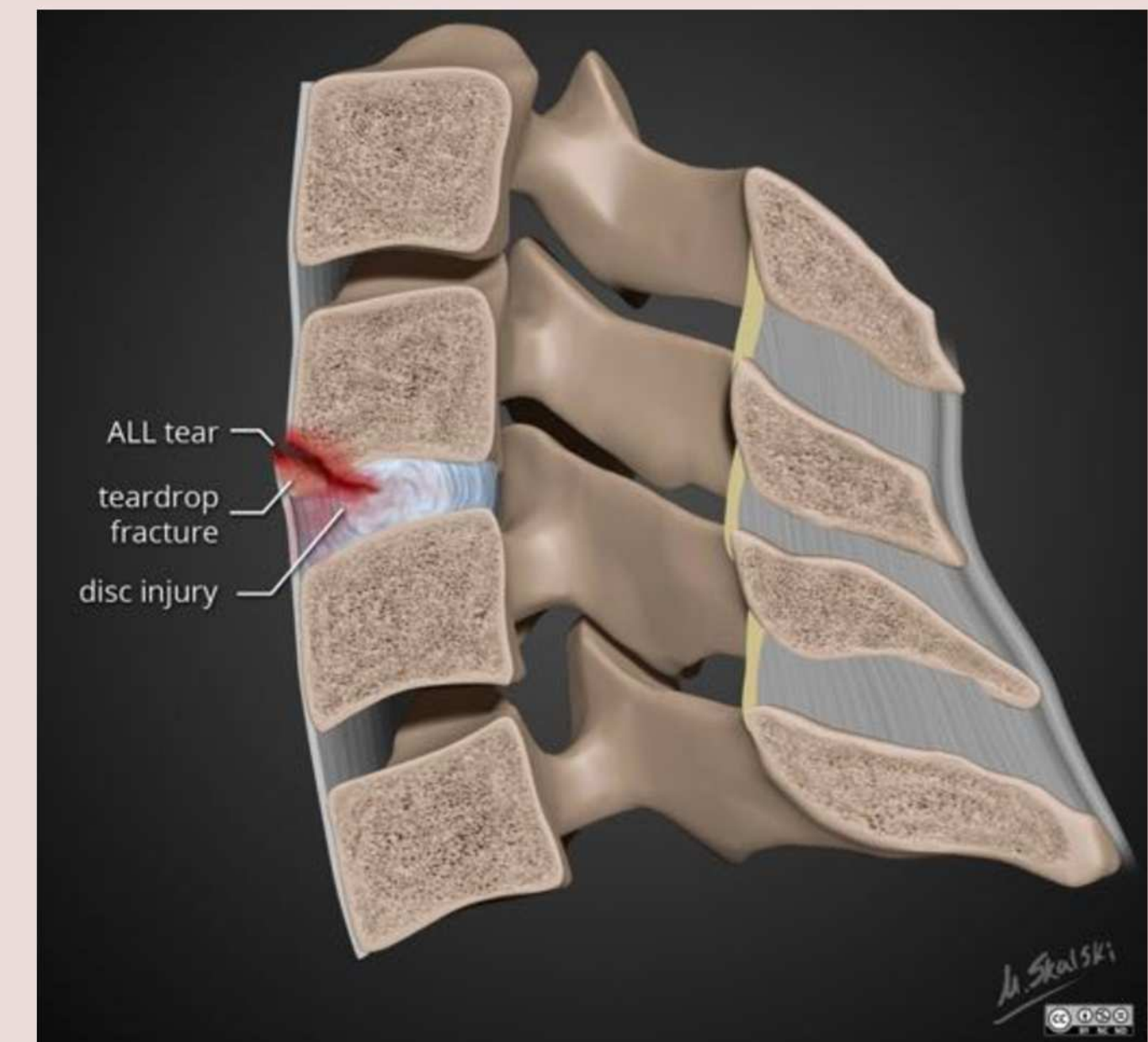
Table 6: SLIC Score Determination

SLIC Categories	Score*
Morphology	
No abnormality	0
Compression	1
Burst	2
Distraction	3
Translation or rotation	4
Discoligamentous complex	
Intact	0
Indeterminate	1
Disrupted	2
Neurologic status	
Intact	0
Root injury	1
Complete cord injury	2
Incomplete cord injury	3
Incomplete cord injury with ongoing cord compression	4

*Total SLIC score: ≤ 3 = nonsurgical, 4 = indeterminate, ≥ 5 = surgical.

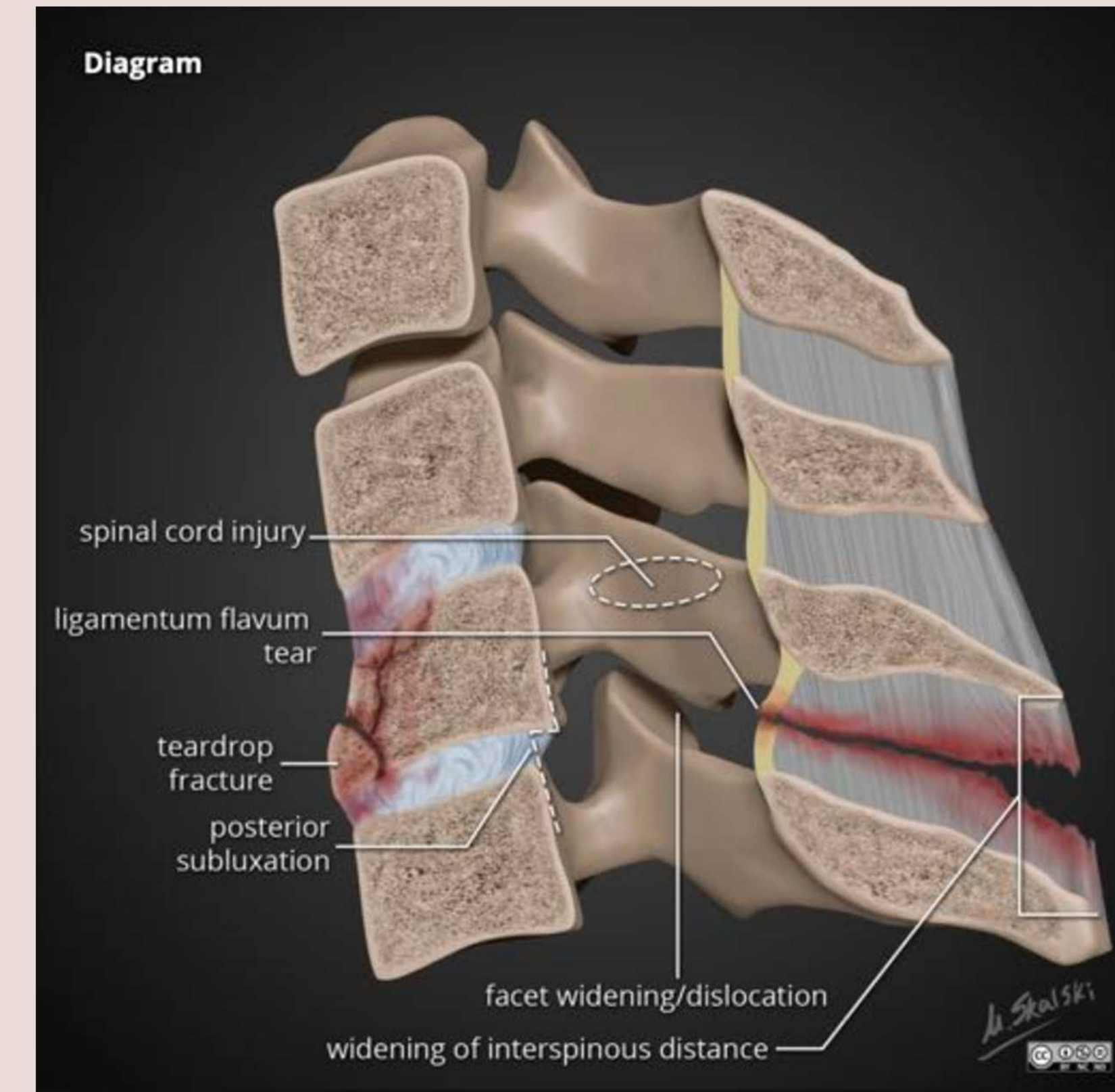
Radioloogiline *extension teardrop fracture* - kliiniliselt seos *central cord syndrome*'iga

- hüperekstensiooni vigastus
- eesmine pikiligament on vigastatud - ekstensioonis on need vigastused ebastabiilsed, fleksioonis stabiilsed
- tekib **lülakeha anteroinferioorse nurga avulsioonmurd** (ligamendi kinnituskoht), sageli on fragment kolmnurga kujuline; **eesmise diskiruumi laienemine**
- sagedamini **C2** tasemel; sageli muid kaasuvaid murde
- *central cord syndrome* - motoorne defitsiit enam kätes kui jalgades, lisaks erineva tasemega sensoorne defitsiit. Sageli eakatel, kes kukuvad oma jalalt ja näoga maa suunas. Predisponeeriv faktor on juba varasem spinaalstenooos. Parema prognoosiga kui teised traumaatilised spinaalsed sündroomid.



Radioloogiliselt *flexion teardrop fracture* - kliiniliselt seos *anterior cord syndrome*'iga

- hüperfleksiooni vigastus
- oluline ära tunda, sest sellega kaasneb **ulatuslik ligamentoosne vigastus ja ebastabiilsus**; kaasnev seljaaju vigastus on väga sage
- vigastatud on eesmine ja tagumine pikiligament, tagumine terve diskoligamentoosne kompleks
- tekib lülakeha **anteroinferioorse nurga avulsioonmurd ja lülakeha retrolistees või fragmentide retropulsatsioon** (võib tekkida lokaalne küfoos); sõltuvalt vigastuse raskusastmest veel sama lülakeha/muud murrud, fasettliigeste dislokatsioon, interspinoosne laienemine, diskoligamentoosne vigastus ja diskiruumi ahenemine
- sagedamini **C4, C5 ja C6** tasemel
- *anterior cord syndrome* - seljaaju eesosa vigastusest parapleegia ja bilat valu ja temperatuuritundlikkuse kadu (dorsaalväärtide propriotseptiivne tundlikkus säilib). Halva prognoosiga.





M18. Kukkunud üle pea maastikurattaga.
 C4 teardrop murd, lisaks C4 ja C5 vertikaalsuunalised
 murrud läbi terve lülikeha. Moodustub lokaalne küfoos.
 C4/5 fassettliigeste pilu on ebasümmeetriliselt
 laienenud - kerge dislokatsioon.
 MRT-uuringul on küfoosi piirkonnas näha
 ulatuslik seljaaju vigastus (hemorraagia ja turse).



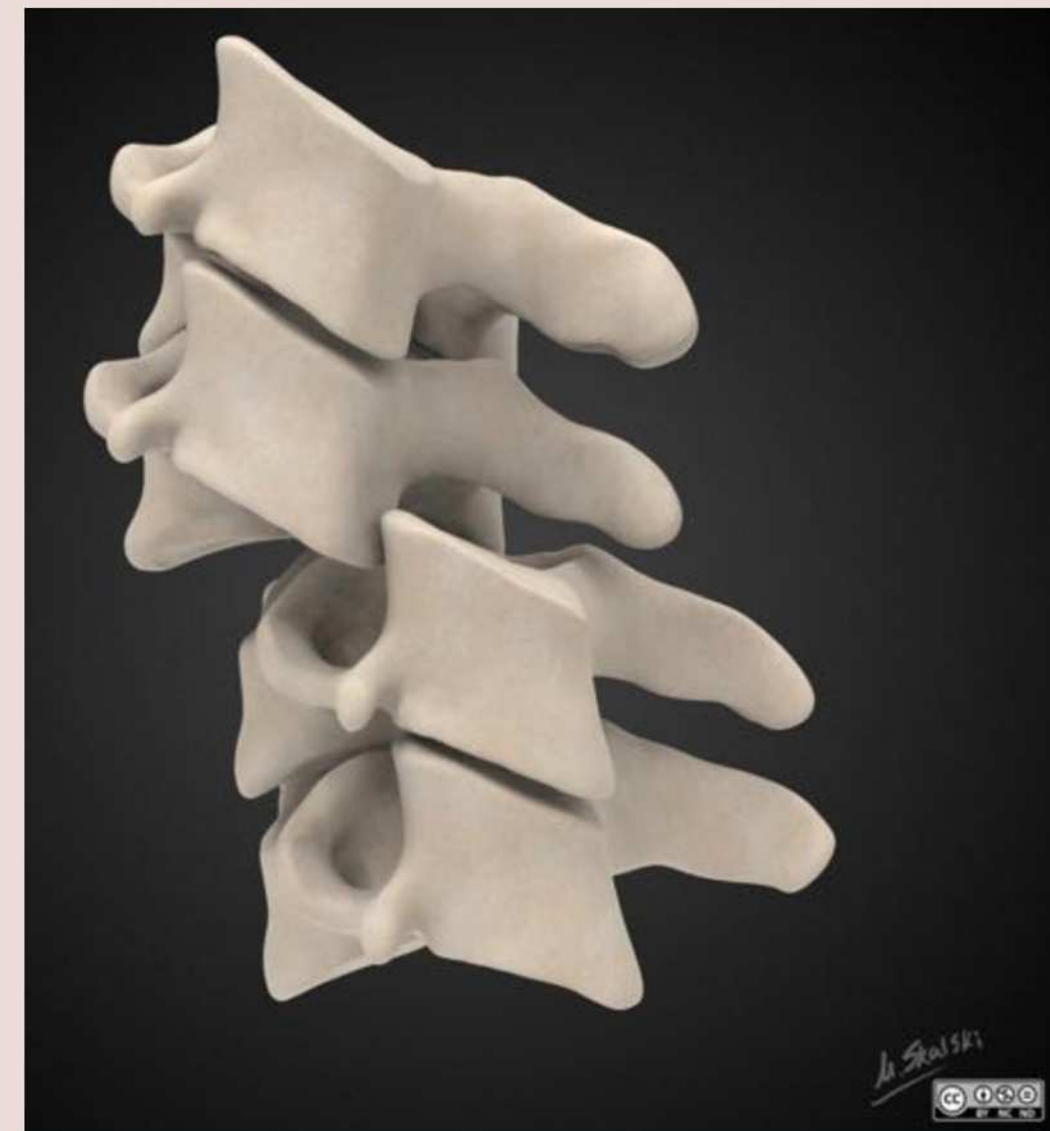
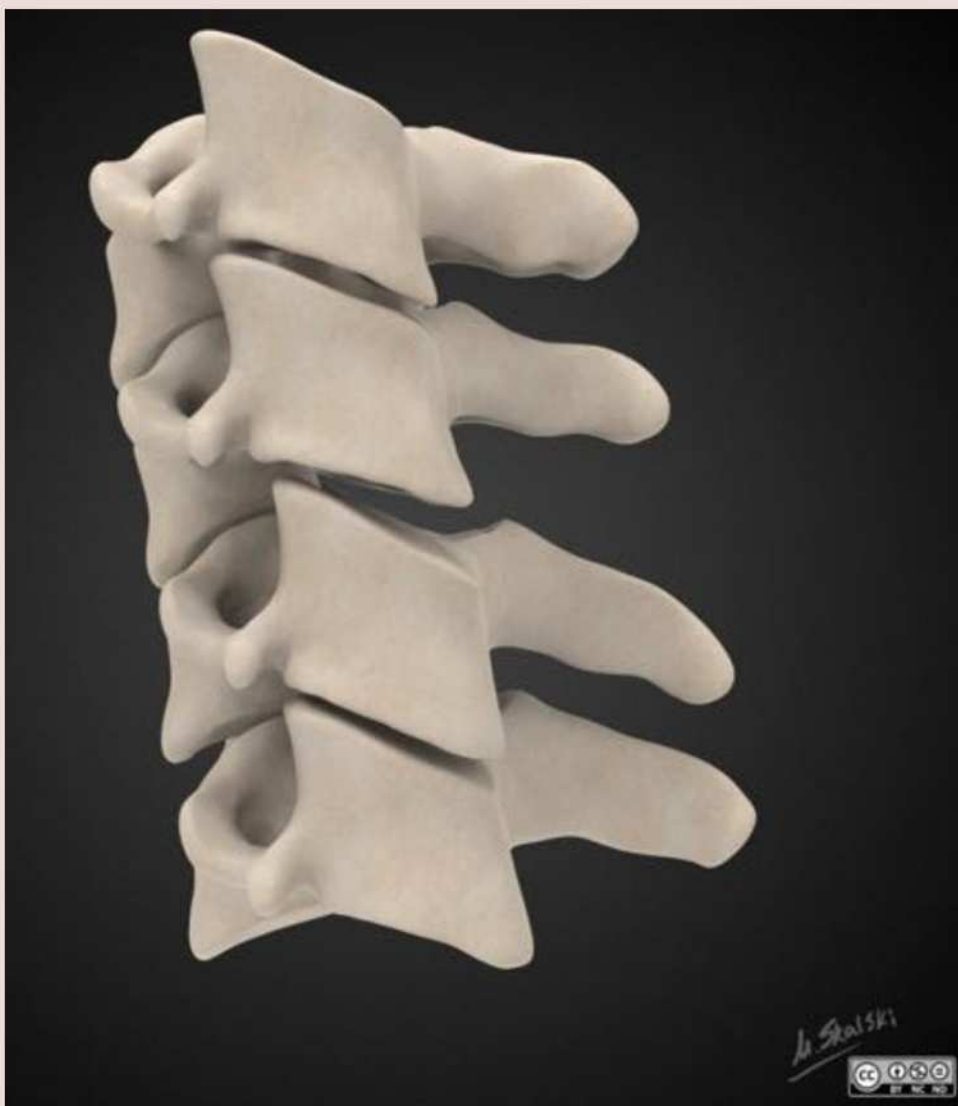
Ära unusta kontrollida fassettliigeseid

Norm.



Nn *perched*,
sisuliselt ikka subluksatsioon.

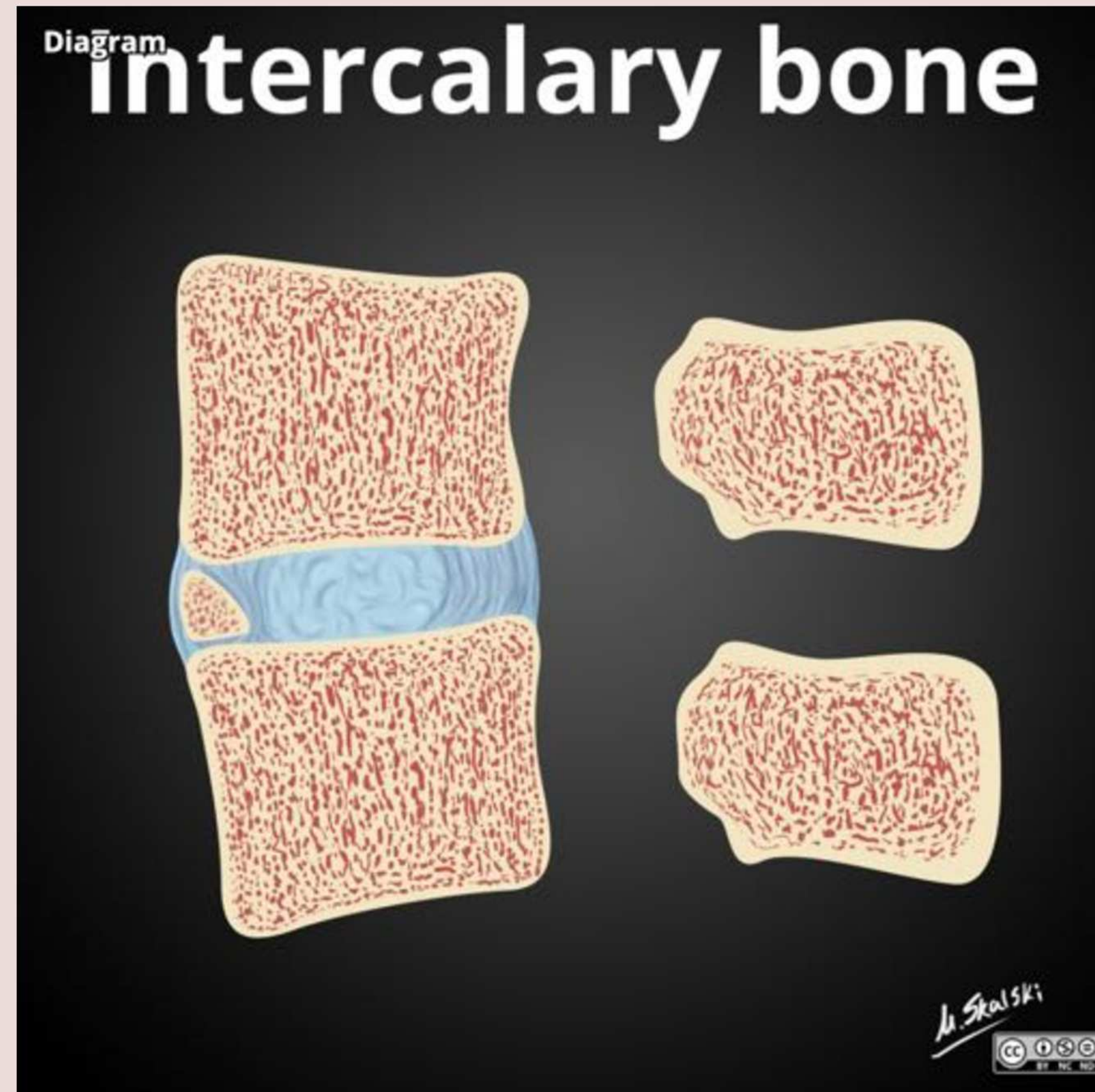
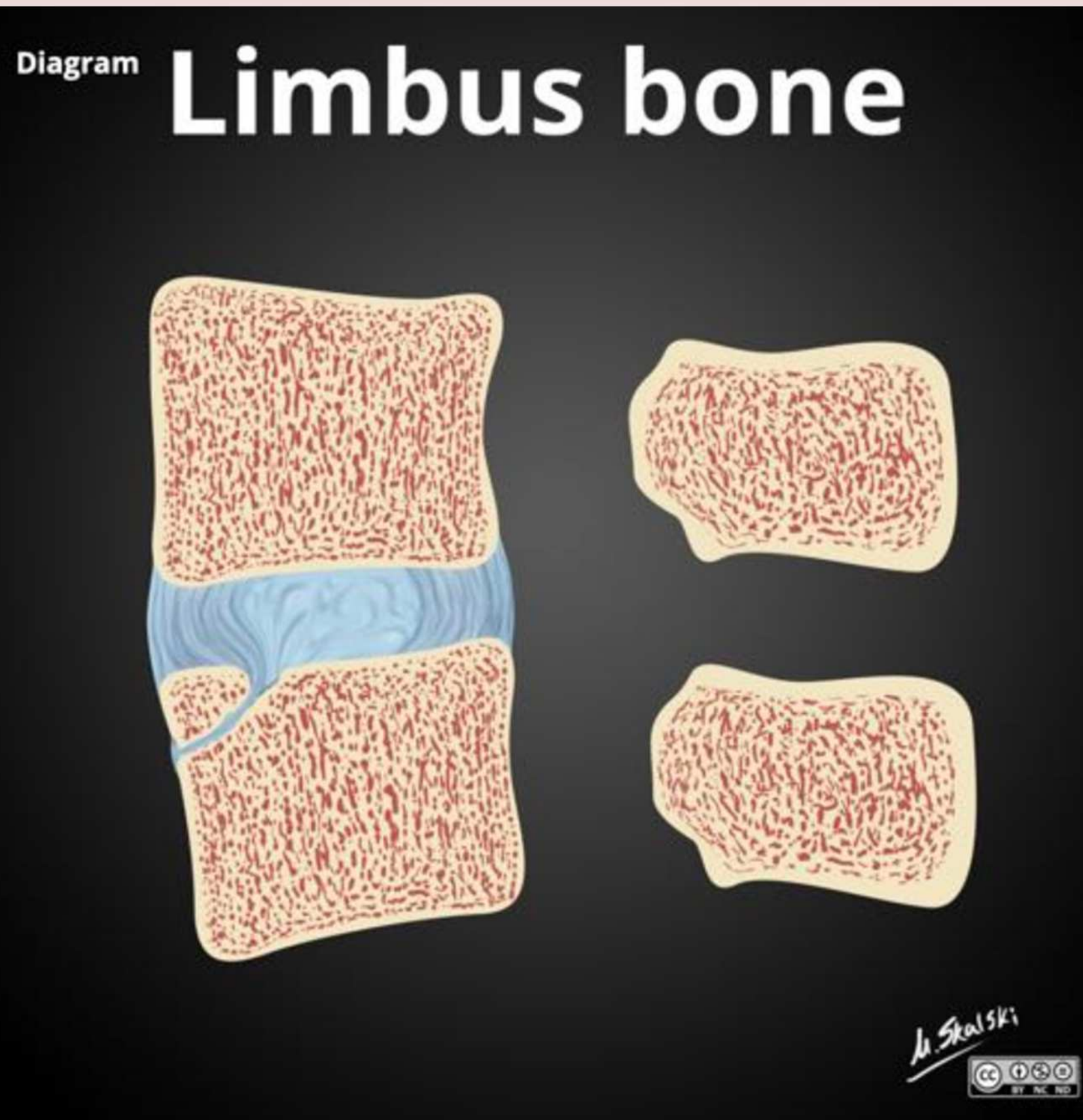
Subluksatsioon.



Lukustunud (luksatsioon);
kui kahepoolsest, siis
ebastabiilne.



(Teardrop) murru pitfallid



C5 intercalary bone, mitte murd.

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