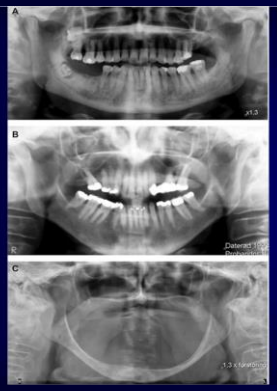
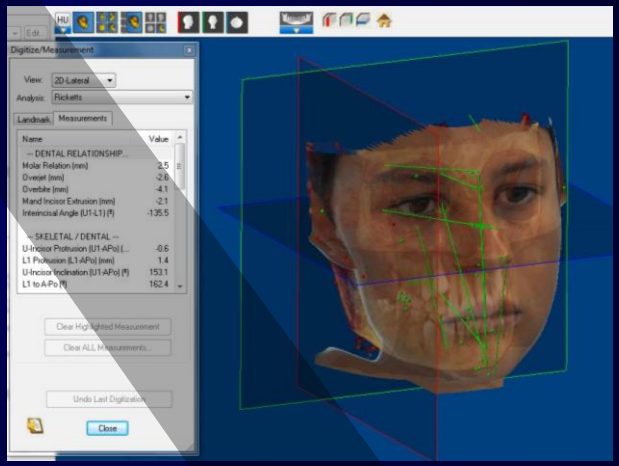
Remarks to the morfology of skull and jaw over time

The persecution of Christians began in Alexandria during the reign of the Emperor Philip.



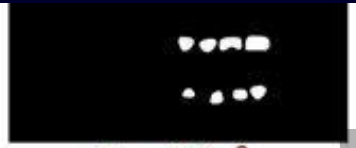
Ortopanoramatické snímky v závislosti na věku

OPG photos related to age



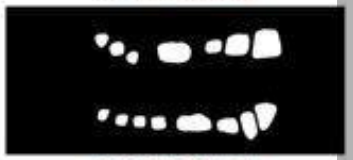
Formation of the skeleton of the face, thickened and weakened areas of the skull.

Ivo Klepáček

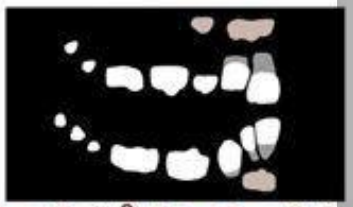


5 měsíců

7 měsíců

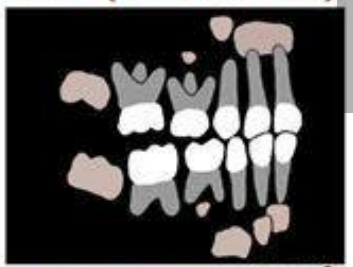


neonatus

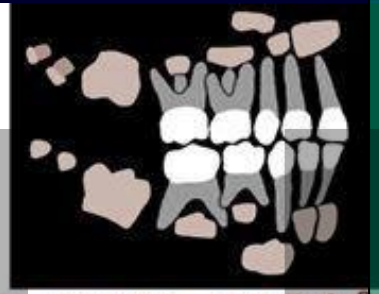


6 měsíců (+- 2 měsíce)

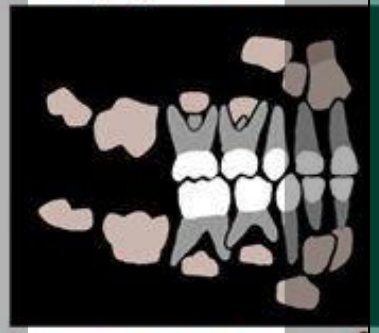
1rok (+- 3 měsíce)



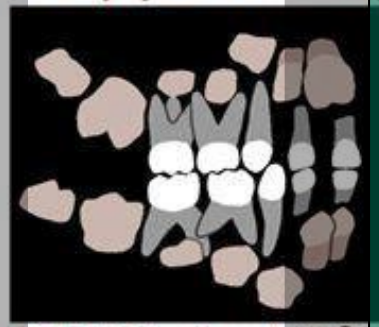
2 roky (+- 6 měsíců)



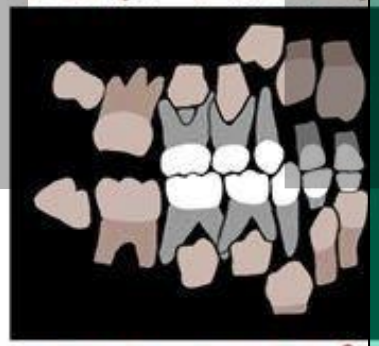
3 roky (+- 6 měsíců)



4 roky (+- 9 měsíců)

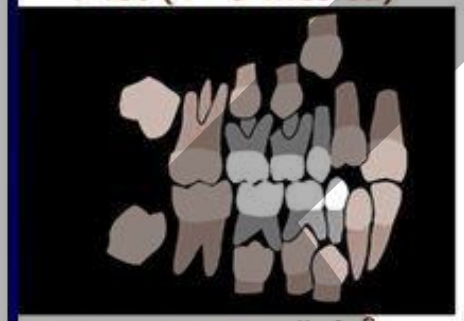


5 let (+- 9 měsíců)

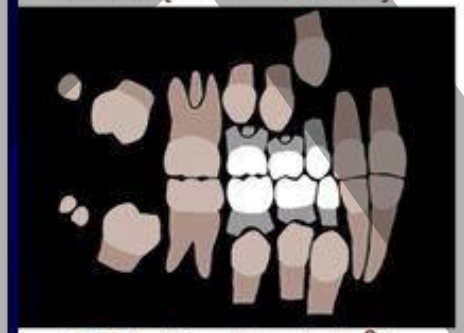


6 let (+- 9 měsíců)

7 let (+- 9 měsíců)

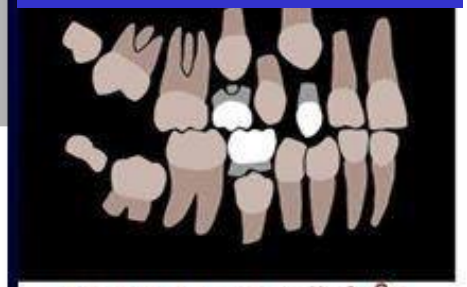


8 let (+- 9 měsíců)



9 let (+- 9 měsíců)

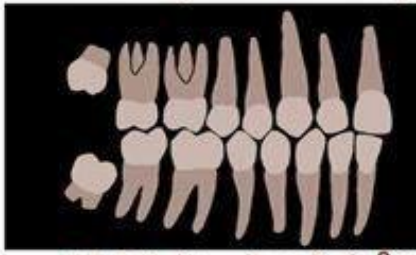
Space - (leeway space) :



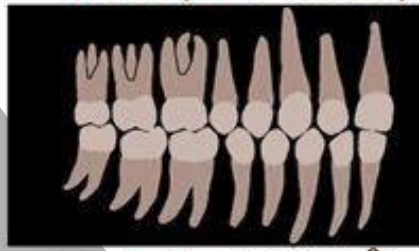
10 let (+- 9 měsíců)

11 let (+- 9 měsíců)

12 let (+- 9 měsíců)

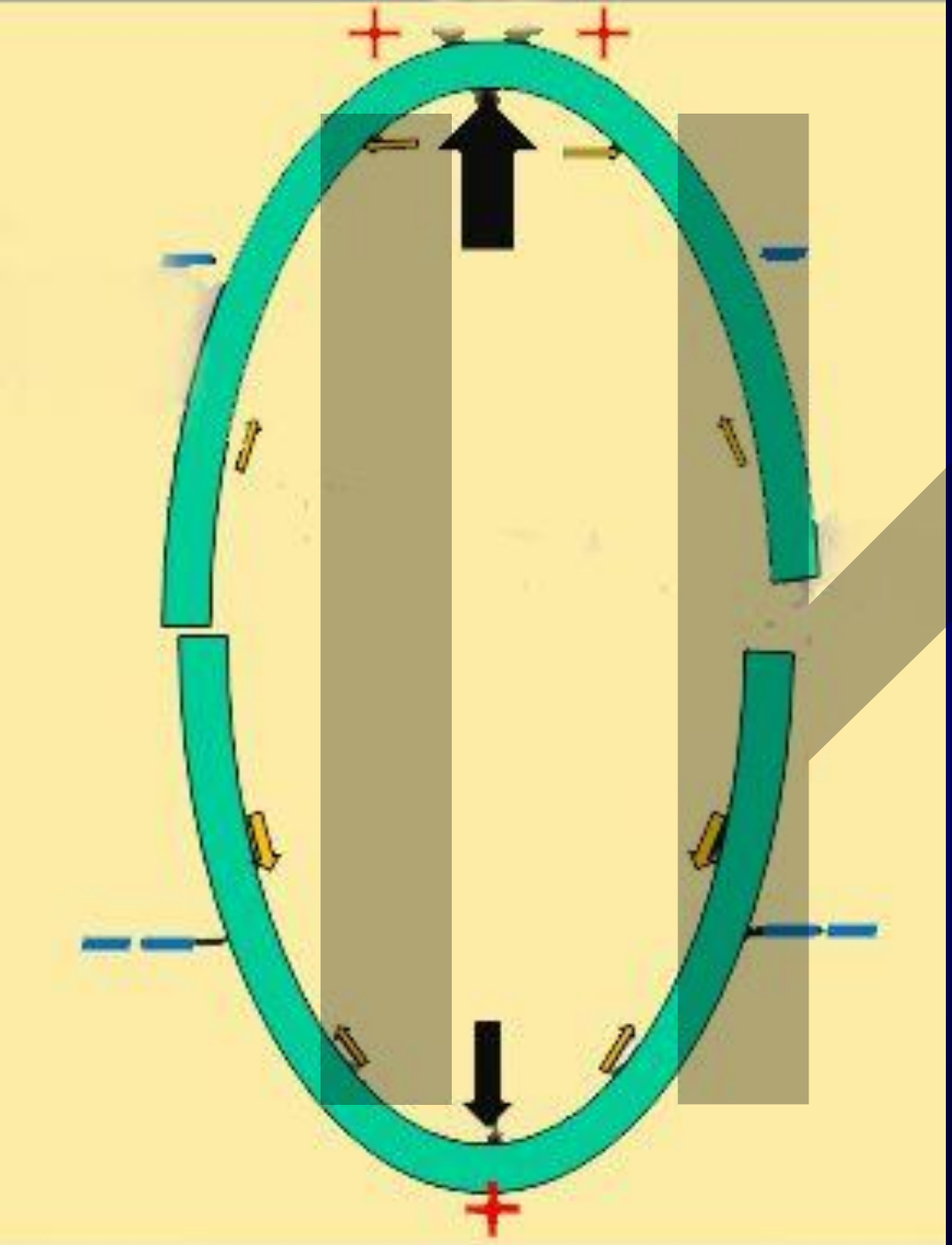


15 let (+- 9 měsíců)



21 let (+- 9 měsíců)

35 let (+- 9 měsíců)



Dental arch width

Zit is enlarging to the time of permanent C eruption

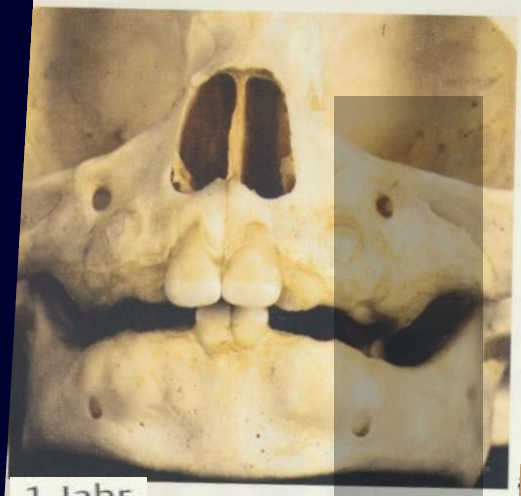
Dental arch length

It is enlarging in full agreement with the perimeter enlargement

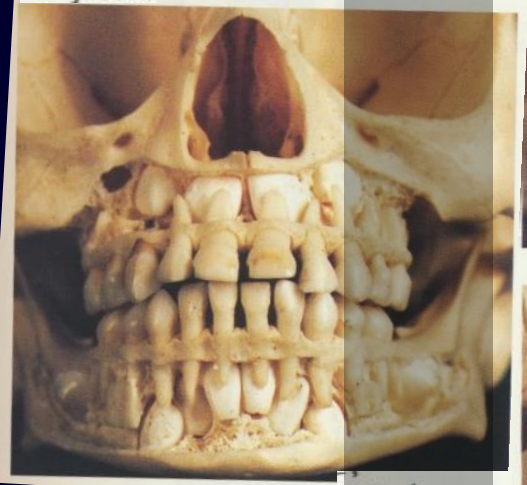
Perimeter of the dental arch

It is slowly enlarging in upper dental arch
Its size is decreasing slightly in lower dental arch

After Komínek, Steflova 2001

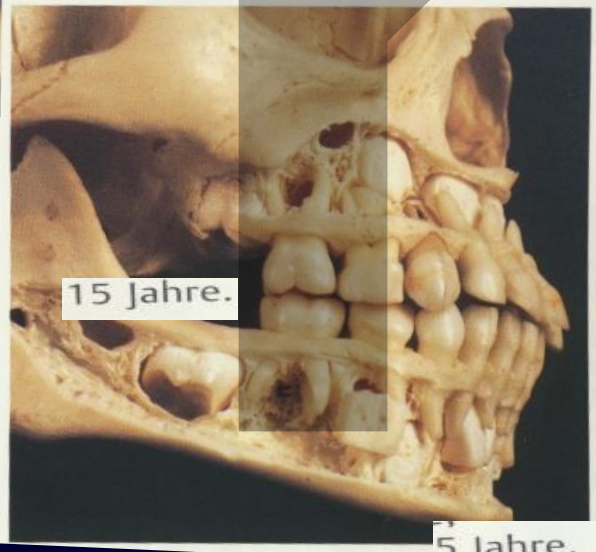


1 Jahr,



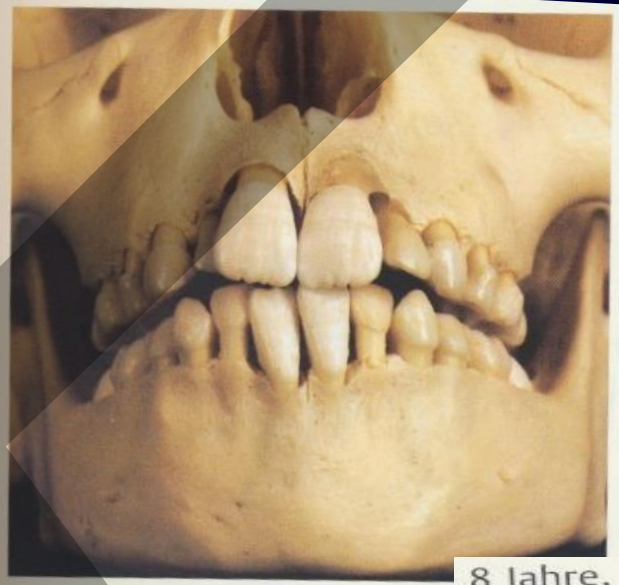
5 Jahre,

2 Jahre,



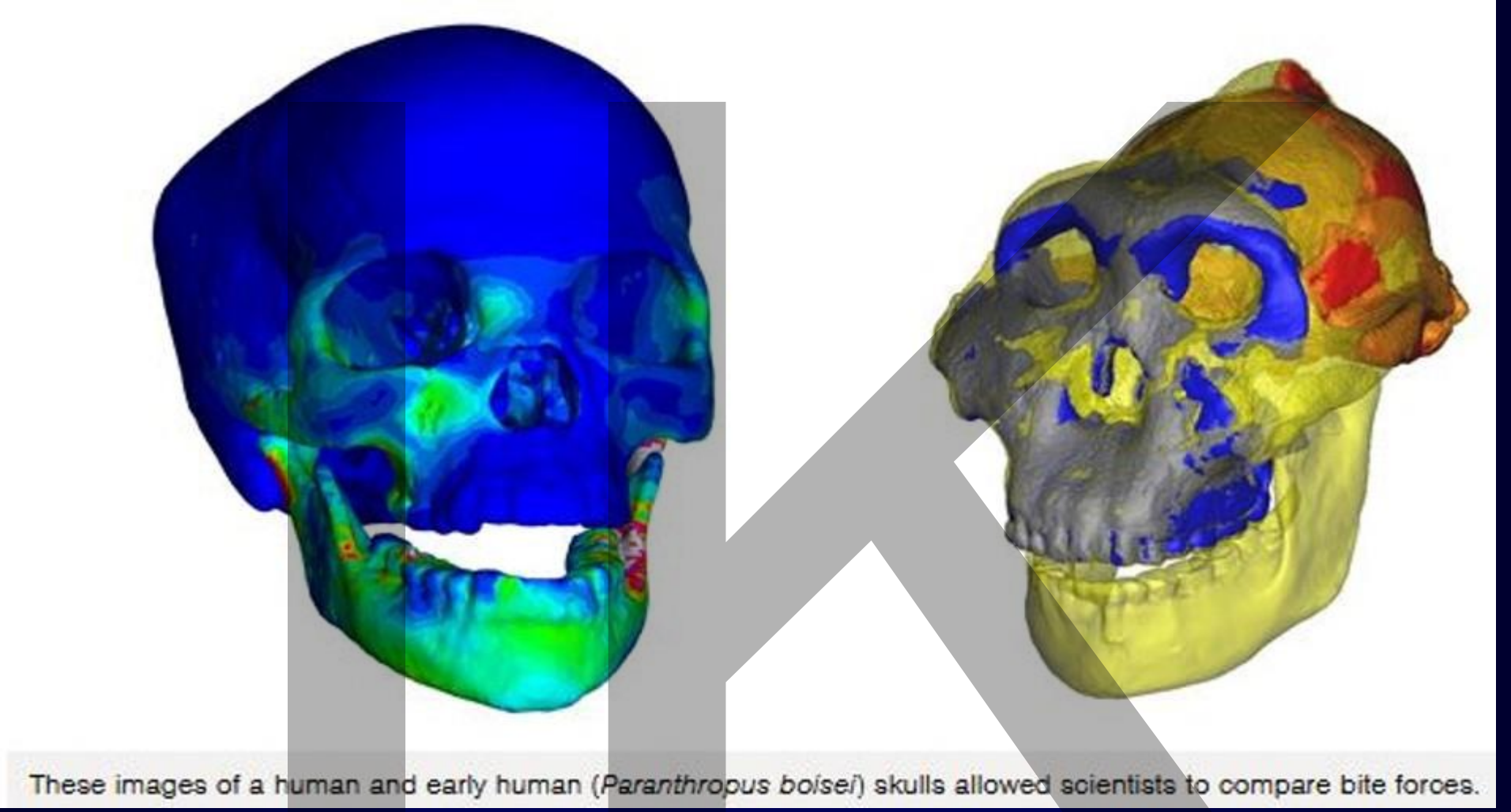
15 Jahre.

5 Jahre,



8 Jahre,

9 Jahre,



These images of a human and early human (*Paranthropus boisei*) skulls allowed scientists to compare bite forces.

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Red areas - places most stressed by mastication –
The early human (as a monkey skull) is more burdened by pressure in the temporal region
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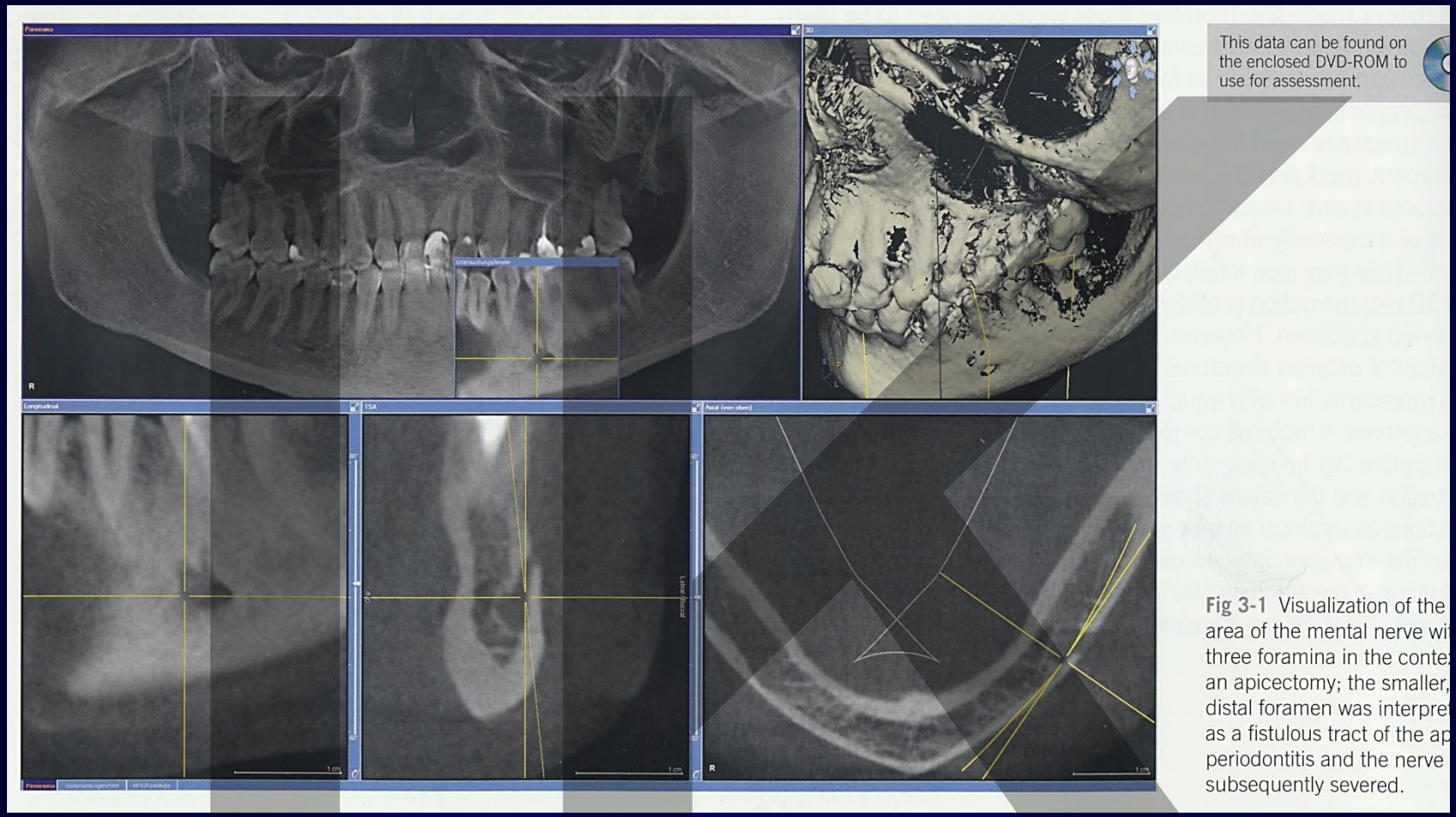
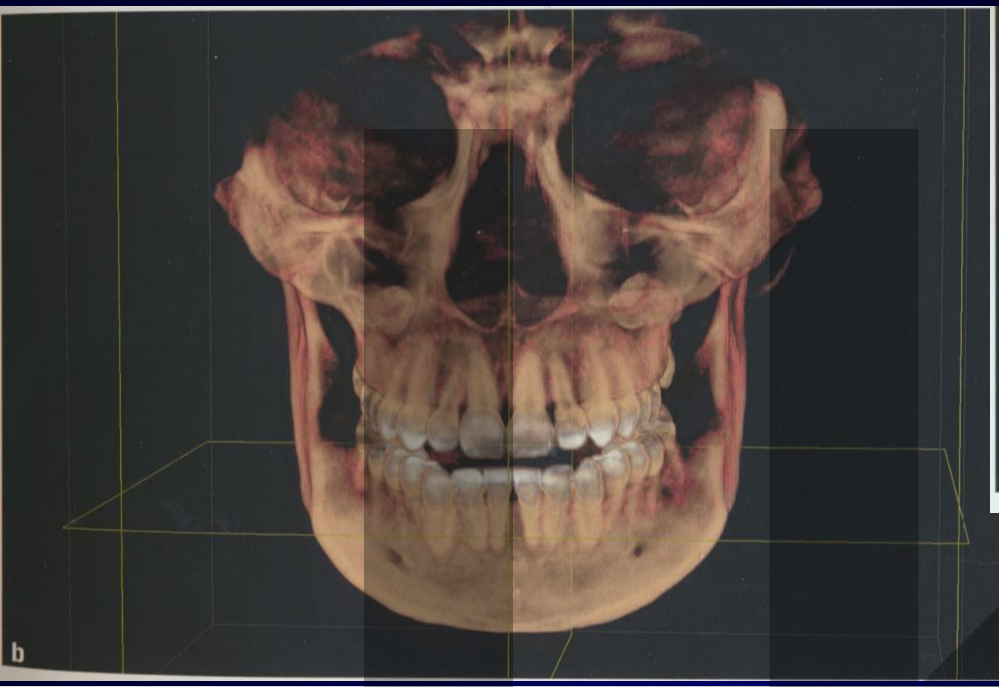


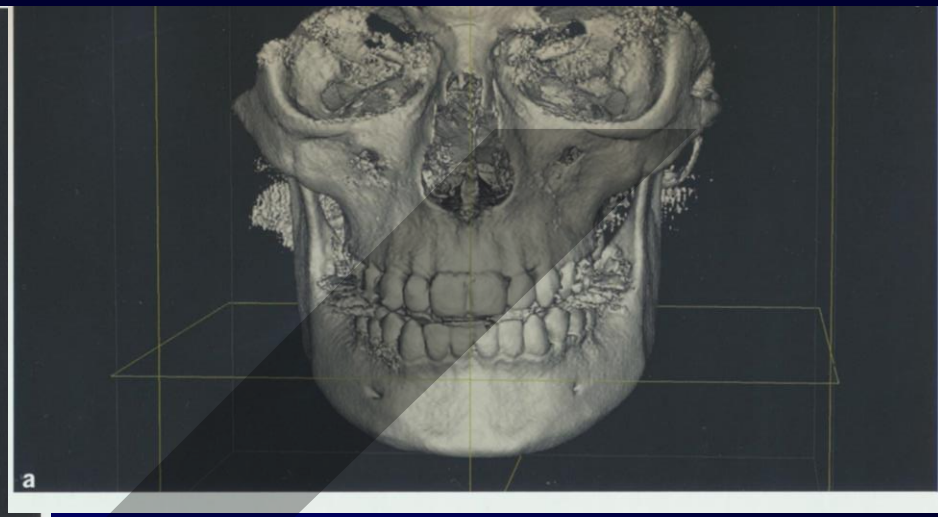
This data can be found on the enclosed DVD-ROM to use for assessment.

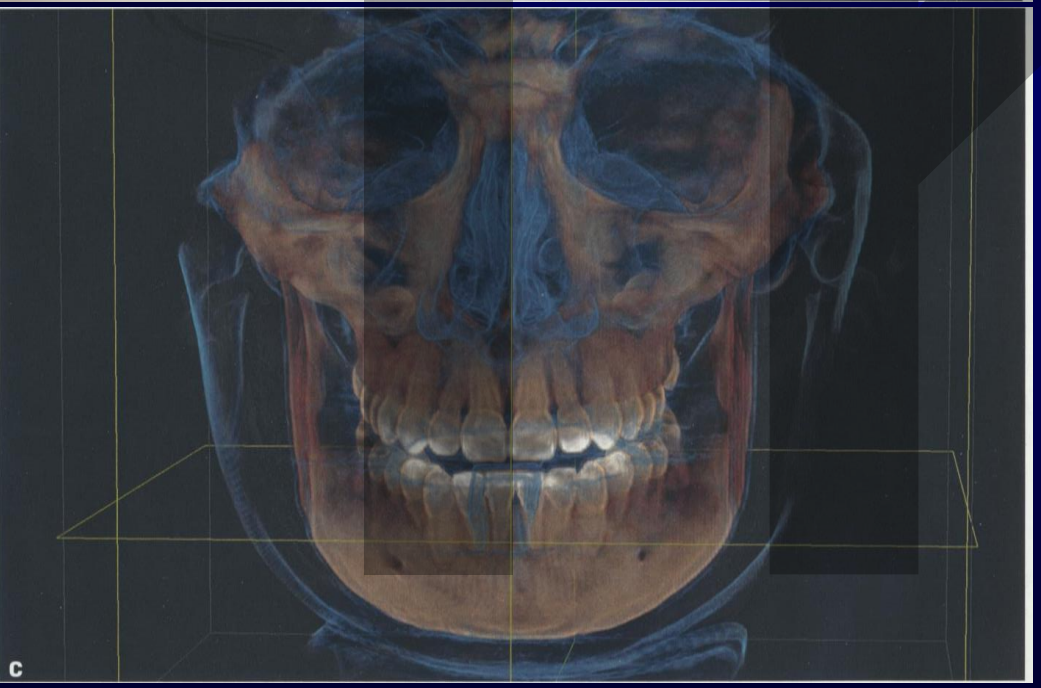
Fig 3-1 Visualization of the area of the mental nerve wi three foramina in the conte an apicectomy; the smaller, distal foramen was interpre as a fistulous tract of the ap periodontitis and the nerve subsequently severed.

Tři ortogonální hlavní projekce:
a) axiální, b) frontální, c) sagitální

Three orthogonal principal planes:
a) axial, b) coronal, c) sagital ones





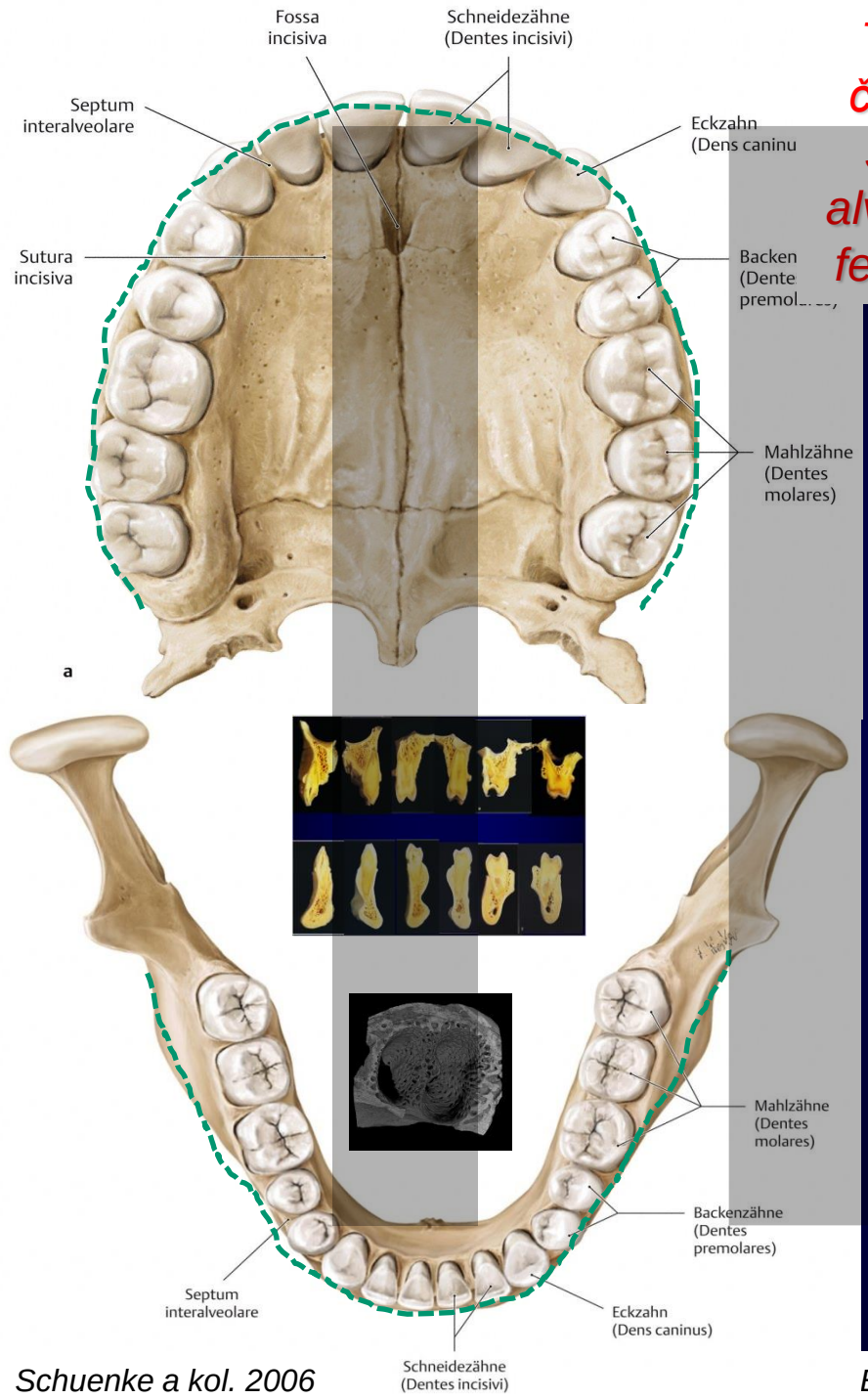


Tři zobrazení dat získaných kuželovým paprskem: a) povrchová metoda, b) objemová metoda, c) s vizualizací měkkých tkání

Three depiction of cone-beam volume data: a) surface-based method, b) volume-based method, c) with soft tissue visualization

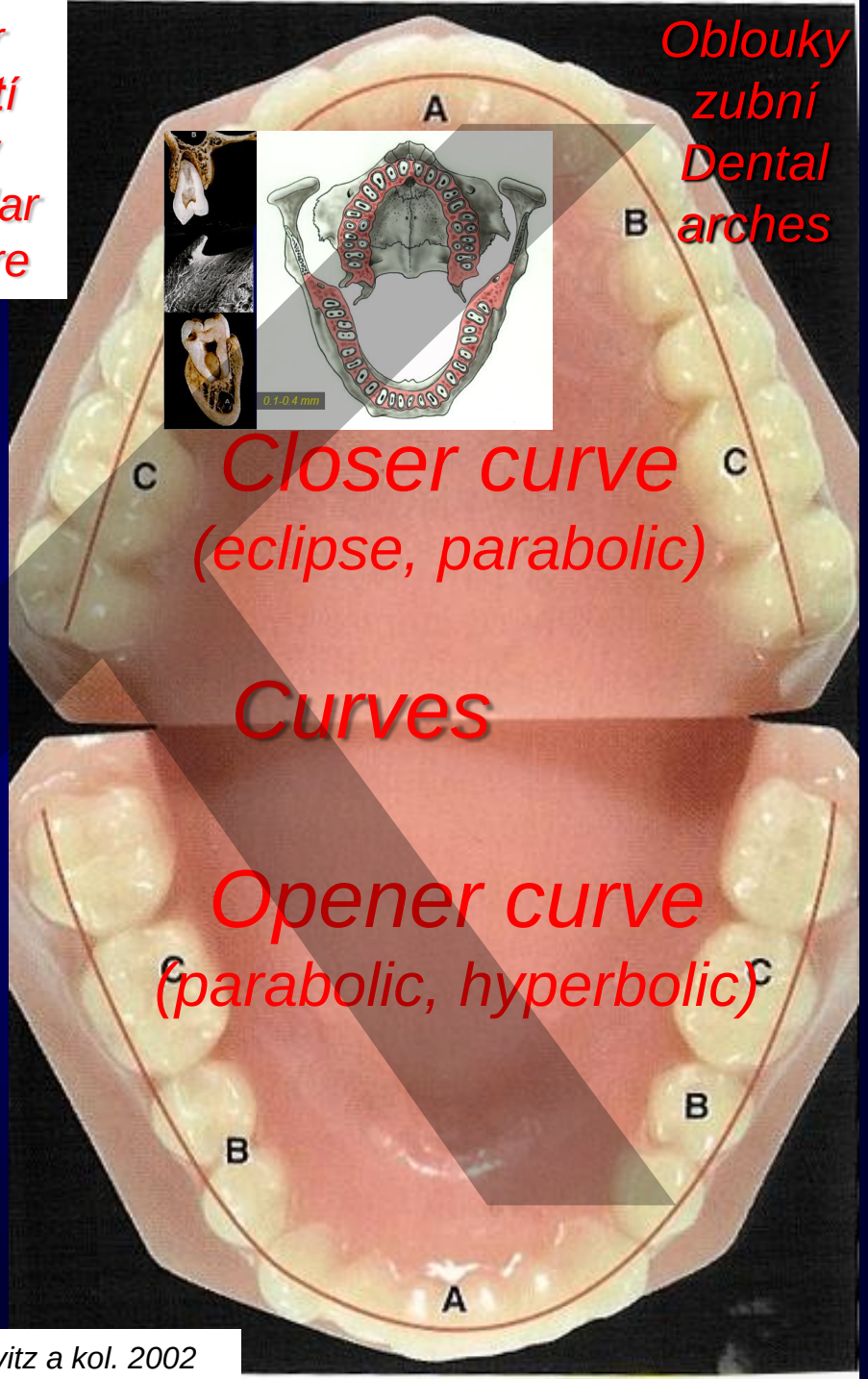
Fig 1-16 A 3D depiction of cone-beam volume data: (a) surface-based method; volume-based method (b) without and (c) with soft tissue visualization.

Tvar čelistí
Jaw alveolar feature



Schuenke a kol. 2006

Oblouky zubní
Dental arches

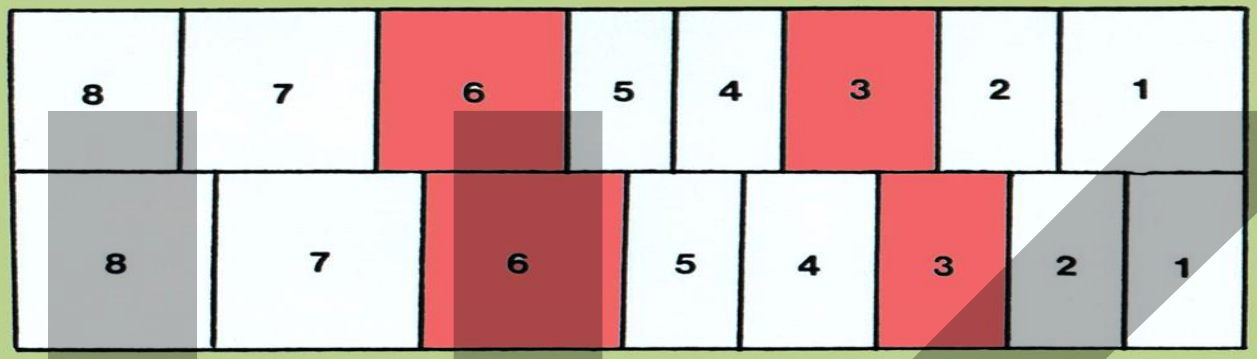


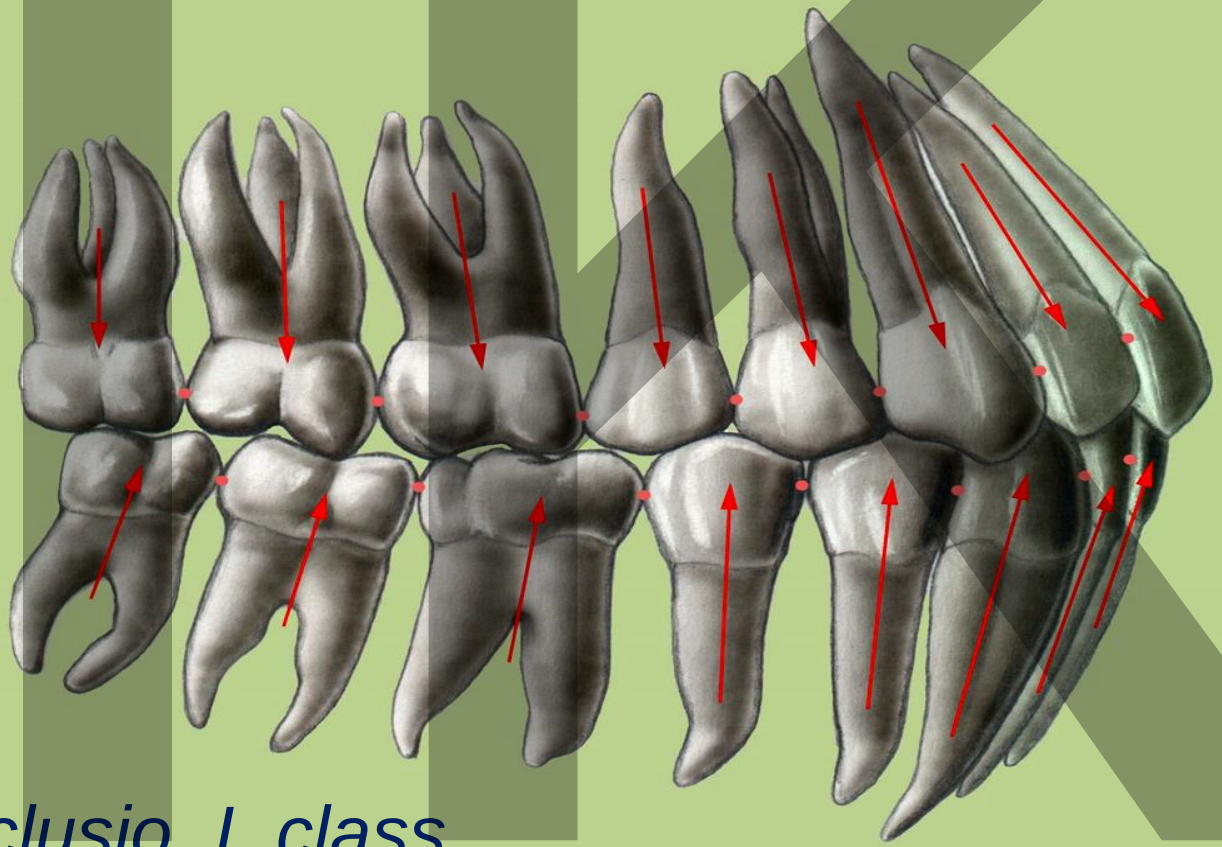
Closer curve
(eclipse, parabolic)

Curves

Opener curve
(parabolic, hyperbolic)

Berkovitz a kol. 2002



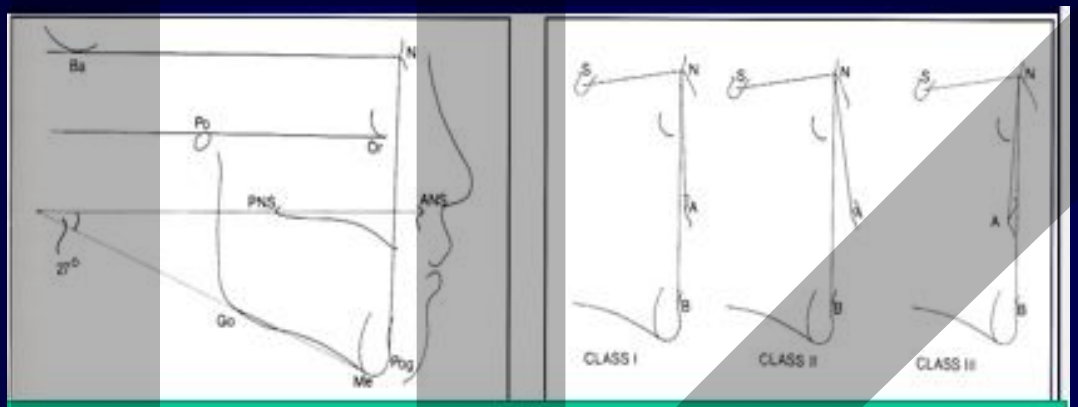


Edward Hartley Angle
(1855 – 1930)
am. Orthodontist, dentist
„father of the modern orthodontia“

Normoocclusio I. class

Sagittal analyse

Cephalometric analyse



Měření	Norma	Zvětšený	Zmenšený	Poznámky
S-N-A	81°	prognátní HČ	retrognátní HČ	
S-N-B	79°	prognátní DČ	retrognátní DČ	
A-N-B	2°	skeletální II. třída	skeletální III. třída (ANB < 0°)	závislé na SNMeGo (viz str. 138)

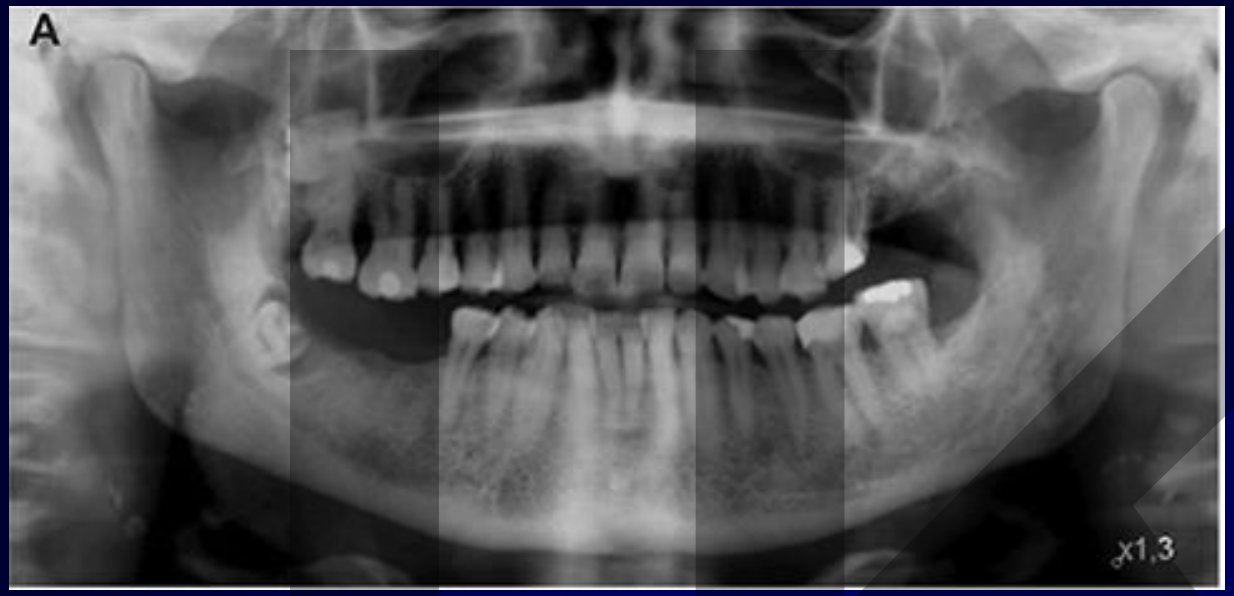
Sc. ANB angle can be related to the traditional classification following Angle classification. Principle: define relation between upper and lower jaws.

I. Skeletal class *– relation between jaws where deviation is ANB = -1 ° to + 5 °*

II. Skeletal class *– lower jaw is shifted in relation to the maxila ventrally. ANB> + 5 °*

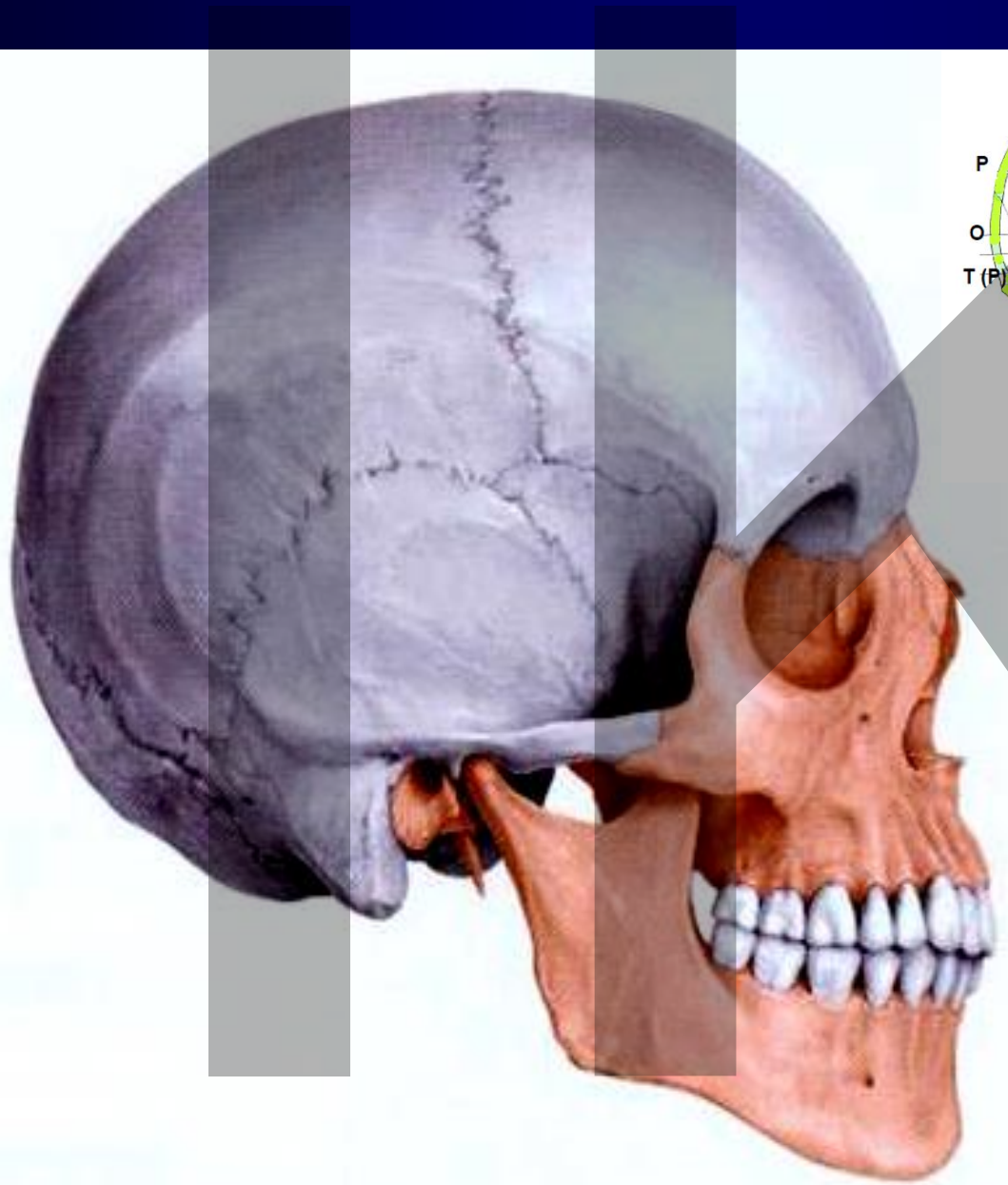
III. Skeletal class *– lower jaw is shifted olní čelist je posunuta oproti horní relativně ventrálně. ANB <-1 °*

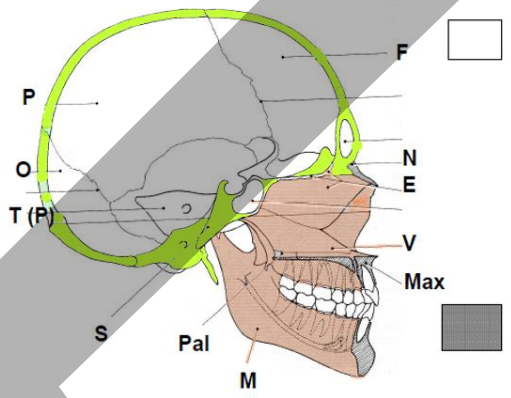
after Thaller, S.R., Bradley, J.P., Garri, J.I.: Craniofacial Surgery. Informa Healthcare USA, New York 2008, 395 s.)



OPG

neurocranium + *viscerocranium* *(splanchnocranium)*





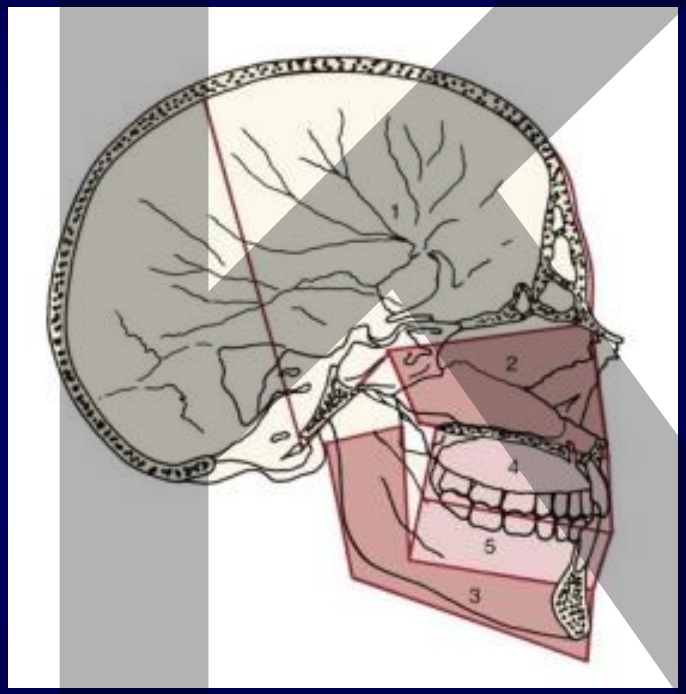
neurocranium
capsula encephalica,
capsula ethmoidalis,
capsula optica,
capsula otica

splanchnocranium
(viscerocranium)

C Bones of the neurocranium (gray) and viscerocranium (orange)
Left lateral view. The skull forms a bony capsule that encloses the brain, sensory organs, and viscera of the head. The greater size of the neurocranium (cranial vault) relative to the viscerocranium (facial skeleton) is a typical primate feature directly correlated with the larger primate brain.

- 1 Lebeční base
- 2 Tělo maxily a nasozygomaxilární komplex
- 3 Tělo dolní čelisti
- 4,5 Zuby a alveolární výběžky

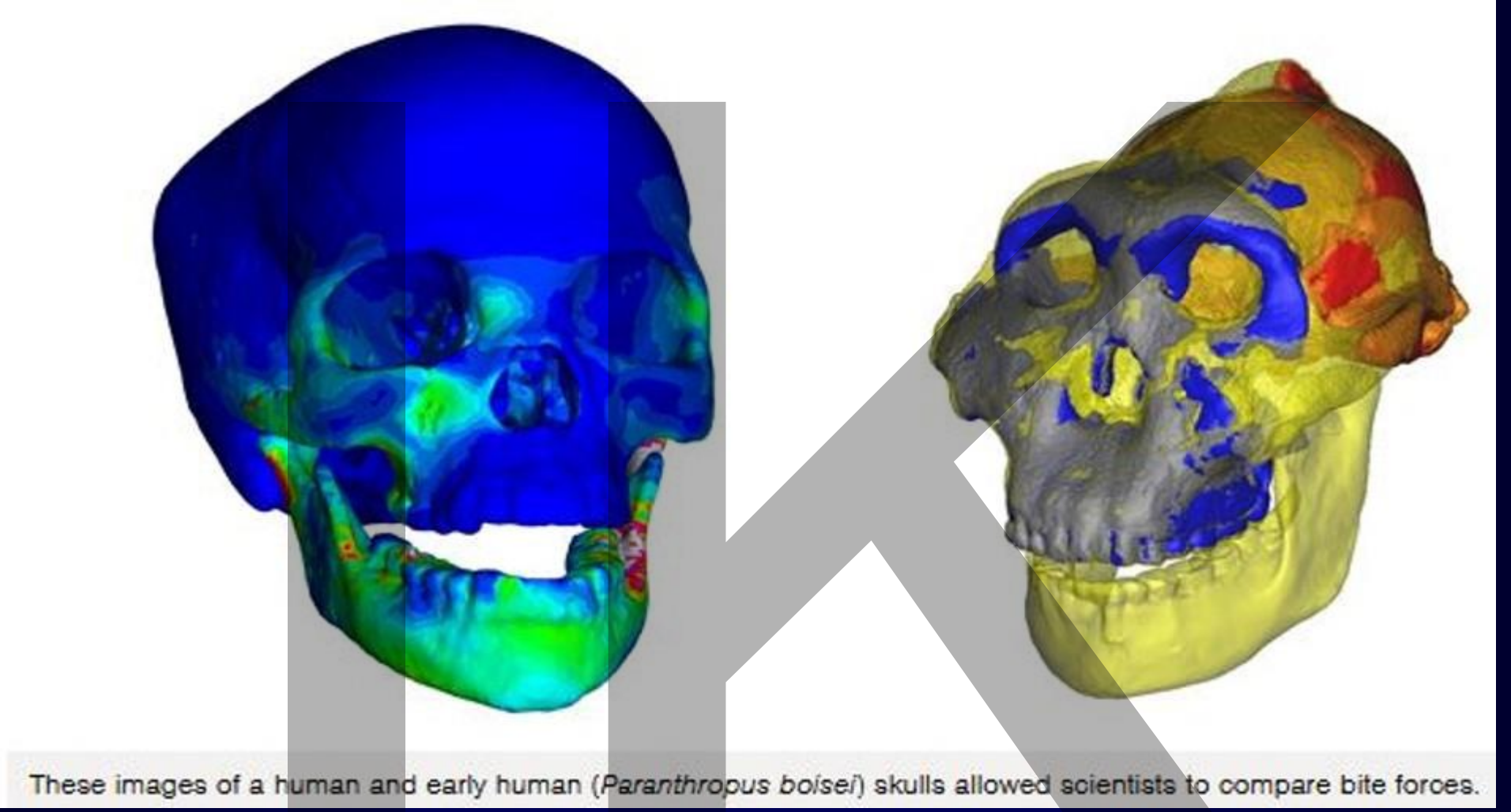
Vzájemný vztah uvedených komponent v zadopřední a vertikální rovině



The relationship between these components in the postero-anterior and vertical planes

- 1 Cranial base
- 2 Skeletal maxila and nasozygomaxilary komplex
- 3 Skeletal mandible
- 4,5 Teeth and alveolar processes

The ideal relationships of the facial and dental components can be represented as shown in A. Cephalometric analysis can distinguish and clarify the differing dental and skeletal contributions to malocclusions that present identical dental relationships.



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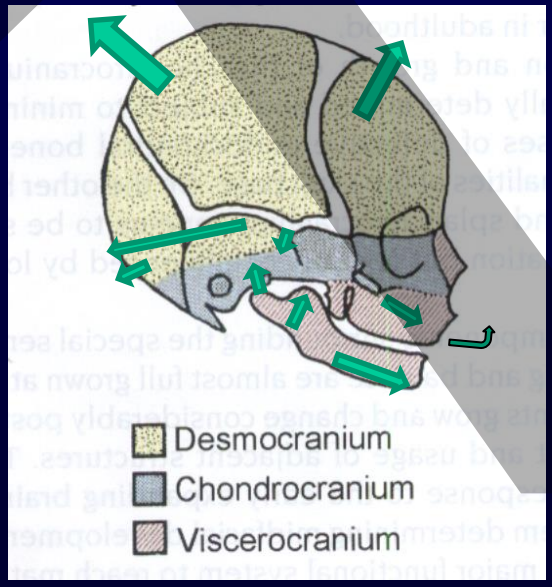
Srovnání lebky moderního člověka a předchůdce člověka

Red areas - places most stressed by mastication –
The early human (as a monkey skull) is more burdened by pressure in the temporal region
the monkey's skull and human ancestor are compared

Postnatal formation of the skull. Male and female skulls.

Postnatal growth finishes form of the bones; later even arrangement of the internal bone structures



Skull vault (calvaria,cap) ! ? !
skull basis
facial skeleton
maxila mandible

40 weeks- 0 years

3 years old

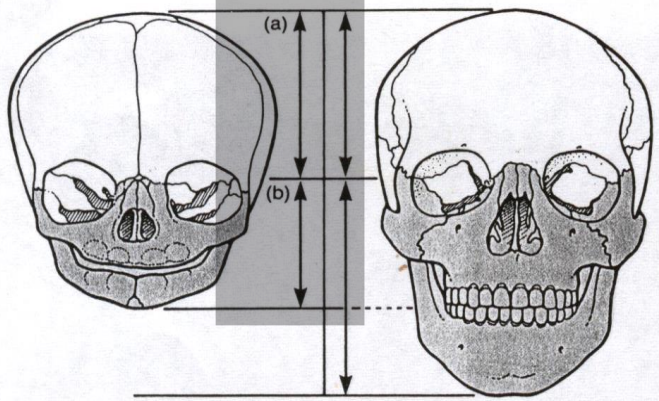
6 years old

13 years old

Human Male European Adult

Human Female European Adult

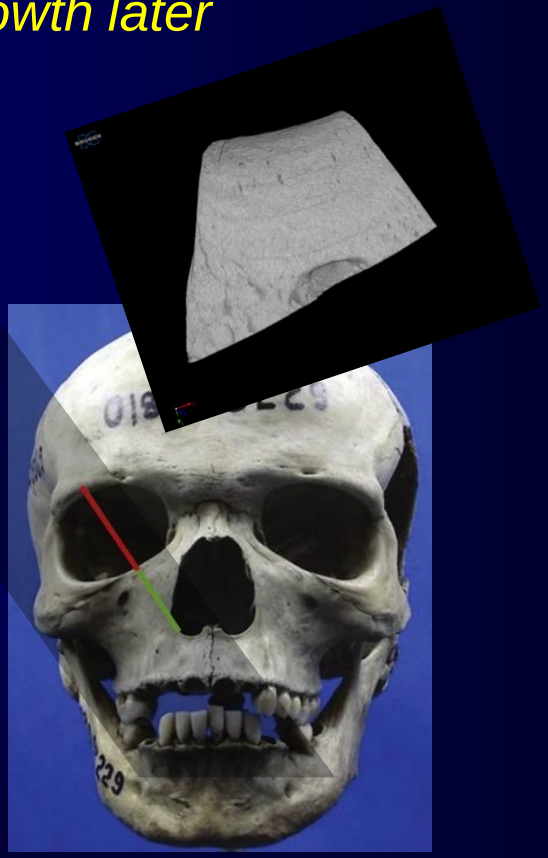
Between year 6-18 the face width in boys enlarges about 21 mm; in girls only about 18 mm



Growth of the skull. The height of the cranial vault (distance between planes a and b) is drawn the same in both the infant and adult skulls. Growth of the skull occurs almost exclusively within the bones of the facial region.

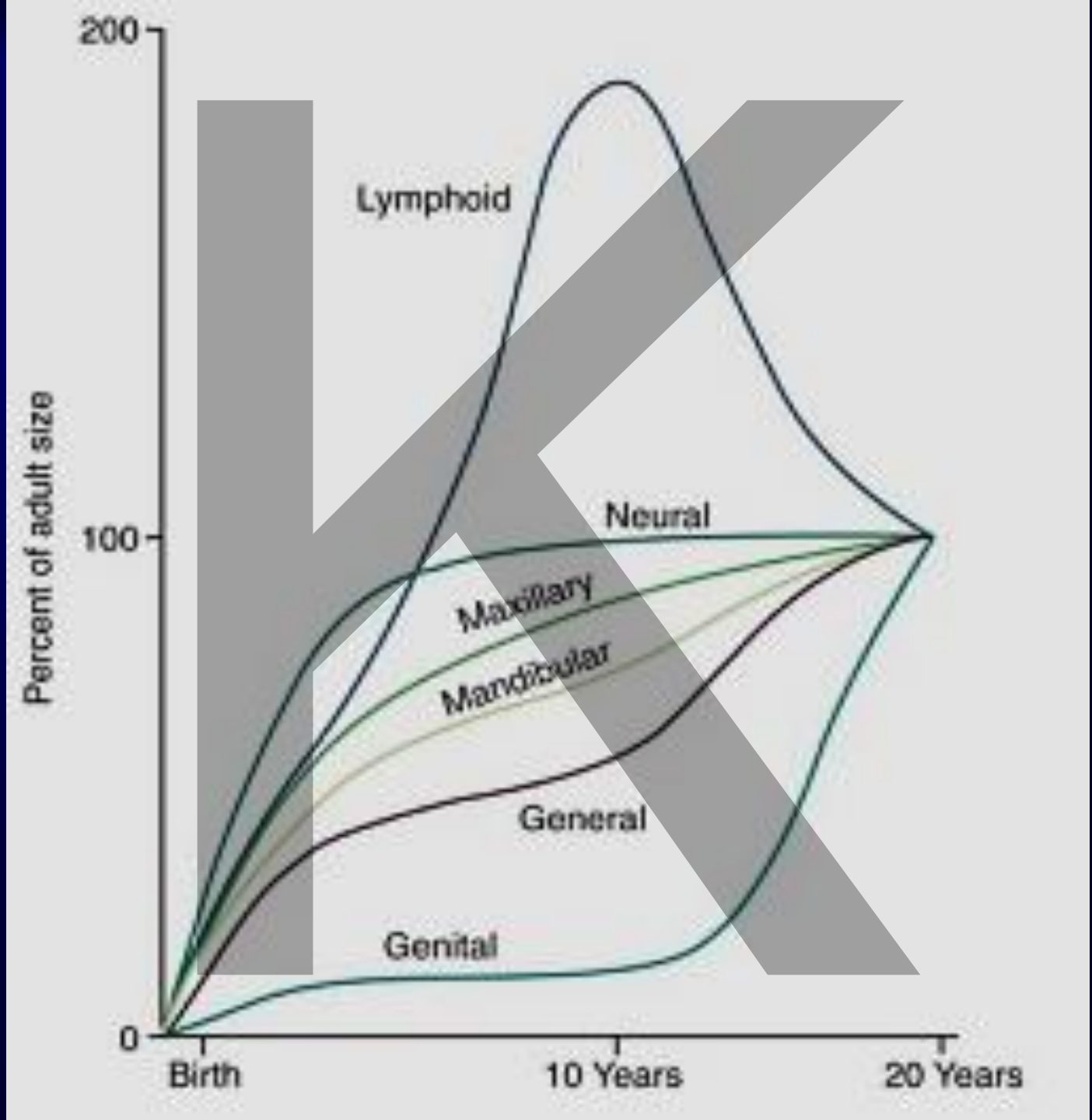
face width - starts to growth earlier

face length – finish to growth later



Růst
growth

Před pubertou
Before puberty

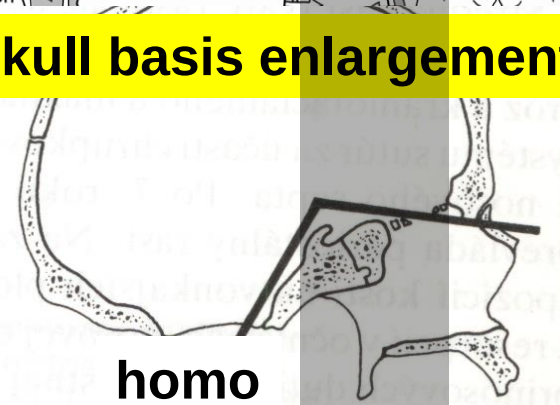


Neurocranium enlargement

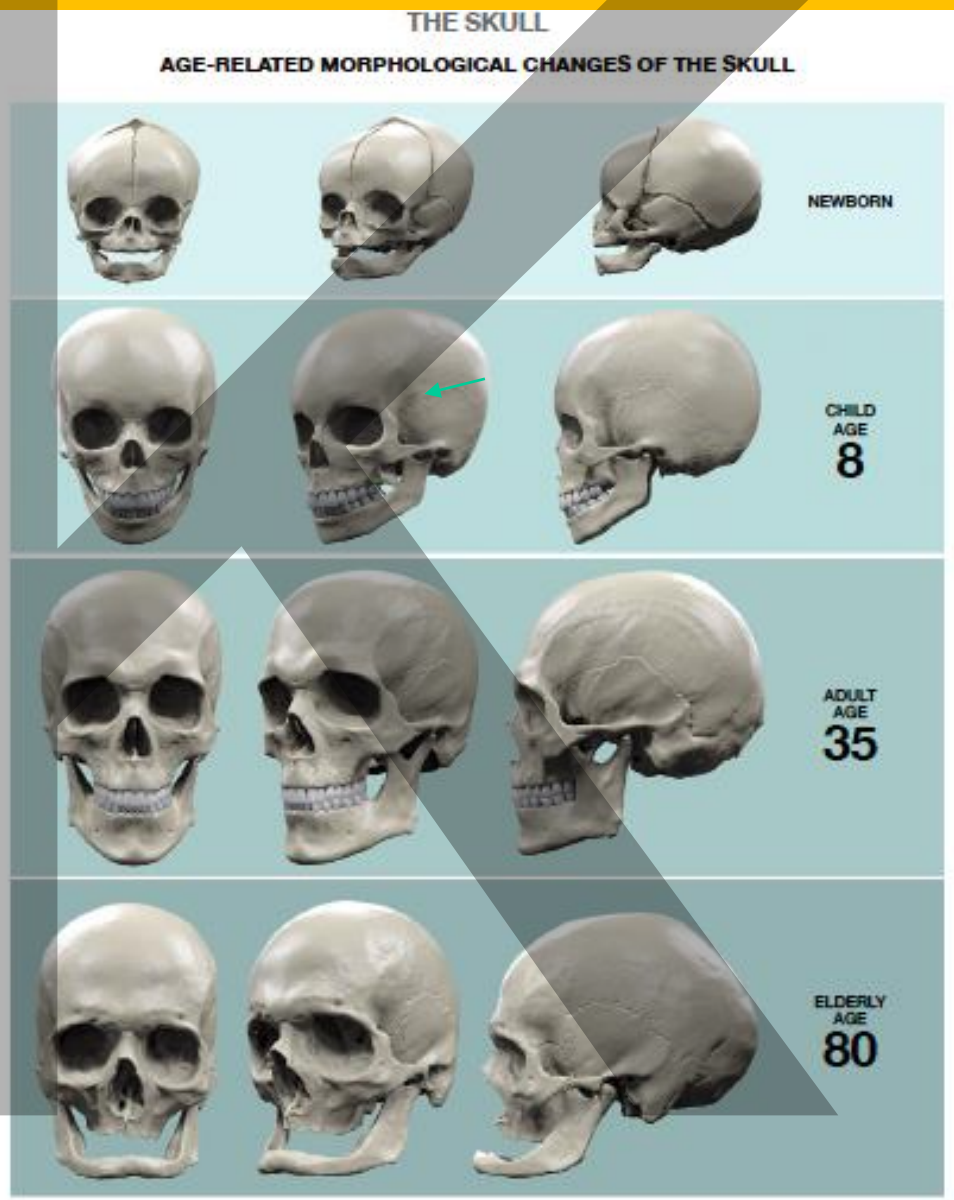
***owth spurt** - during first two years*
***bertal spurt** (maximum in girls 12.5 years, finishes in 16-17 years. Boys ve maximum in 14 years, finishes about 19 years)*

occipital rotrusion

Skull basis enlargement



homo



Postnatal face:

Width of face is enlarged slowely and is finishing that early

Face high is enlarged more and finish late

After year 40 resorption is up the aposition; Mandible grows very long

Jaw growth: ***anteriorotation***

Physiologic (ventrocaudaly)

Total (whole) influences also activity of the surrounding structures matrix or apparent rotation)

rotation of the matrix: (intramatrix rotation, angular remodelling)

Skull basis changes with age

1 yr os frontale (squama + sinus frontalis ↑)

4 yr cribriform lamina of ethmoidal bone

7 yr spheno-ethmoid,-frontal; fronto-sphenoid

resorptive areae – around lacerum foramen, jugular fossa, medial lamina of pterygoid process

Order of structures involved in activities:

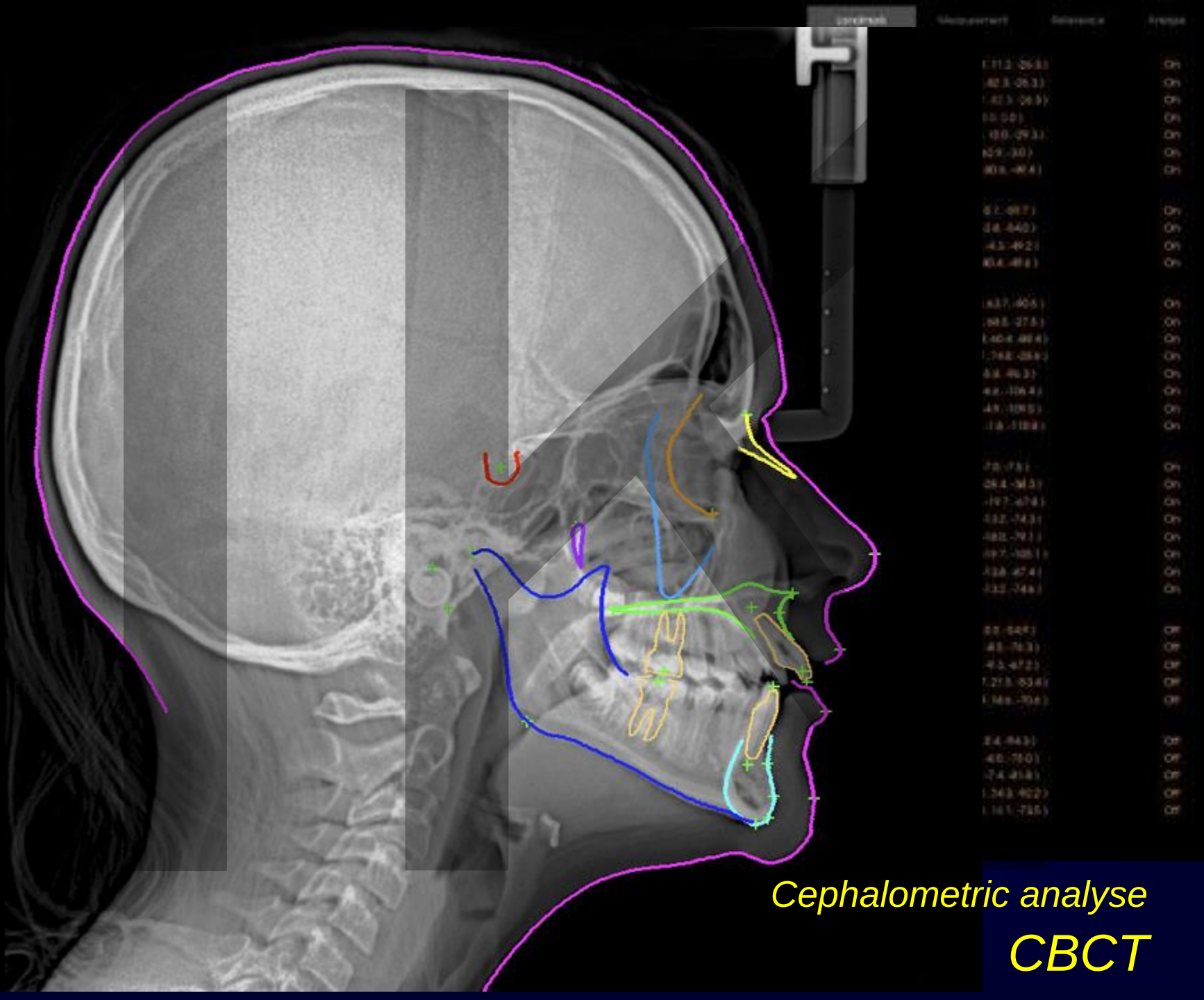
nazozygomaxillar complex – from sutures surrounding maxilla

infrazygomatic crest –

sutura palatina transversa

after Enlow 1968

Sedý 2013

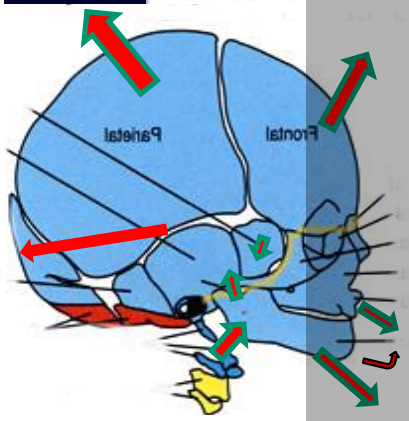

Cephalometric analyse
CBCT

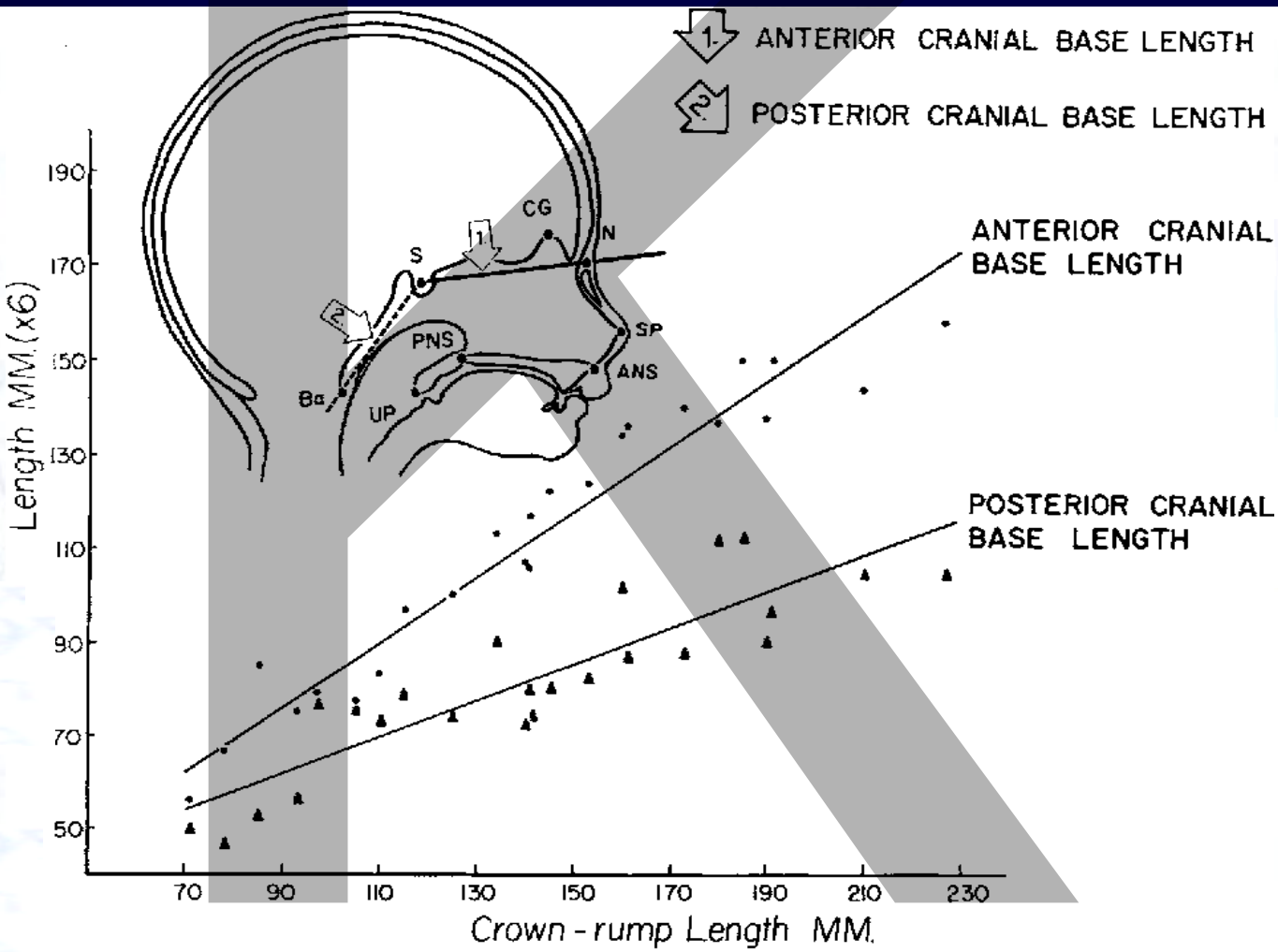
Features following changes in skull form

Brain enlargement; synchondrosis sphenooccipitalis ossification; eye bulb and orbit enlargements, muscle tractions; nasal septum growth; growth nasal,zygomatic and maxillary bonestooth eruption

Growth types:

- *neral – to 70% final size 6 yr*
- *anial – to 80% final size 6 yr*
- *cial – to 80% final size 6 yr*





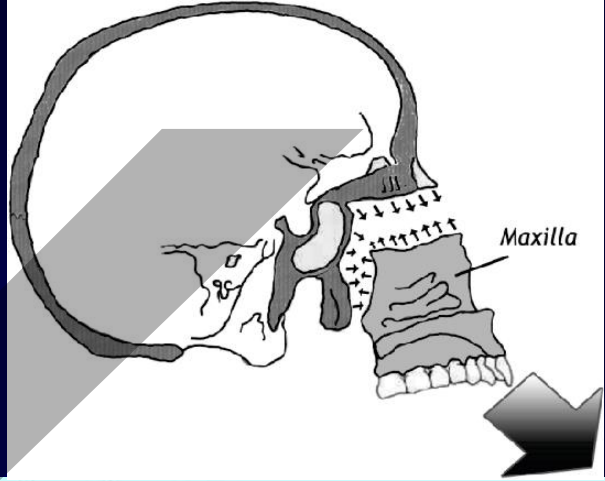
34 Weeks

nasozygomaxilární komplex
nasozygomaxillary complex

Changes in form in this area depends on two mechanisms:

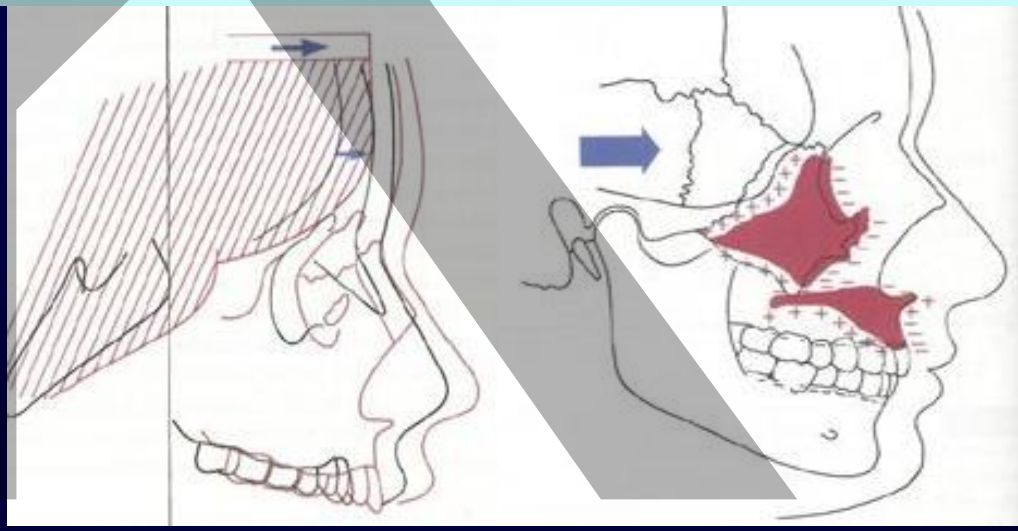
Pasivní posun *horní čelisti vpřed v důsledku růstu lebeční base*

Aktivní růst *struktur horní čelisti a nosu*



- Growth of this area produced by two basic mechanisms
- (1) Passive displacement, created by growth in the cranial base that pushes the maxilla forward, and (2) active growth of the maxillary structures and nose

Expanze švů mezi lícní kostí, kostí čelní, spánkovou a maxilou



Expansion follows sutures: zygomaticomaxillary, zygomaticofrontal (frontozygomatica), zygomaticotemporal, frontomaxillary

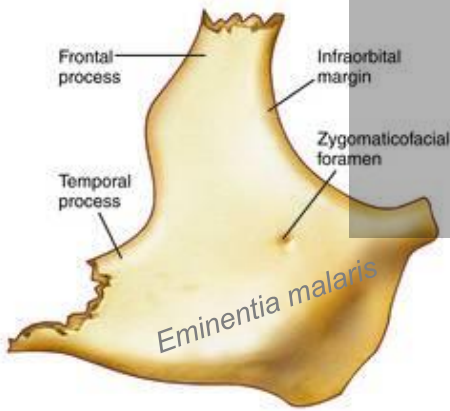
Os zygomaticum

Facies:

Orbitalis *tuberculum orbitale*

Lateralis
Temporalis
Frontalis *tuberculum palpaebrale*

Tuberculum marginale
pro m.temporalis



Changes of the facial skeleton with ageing

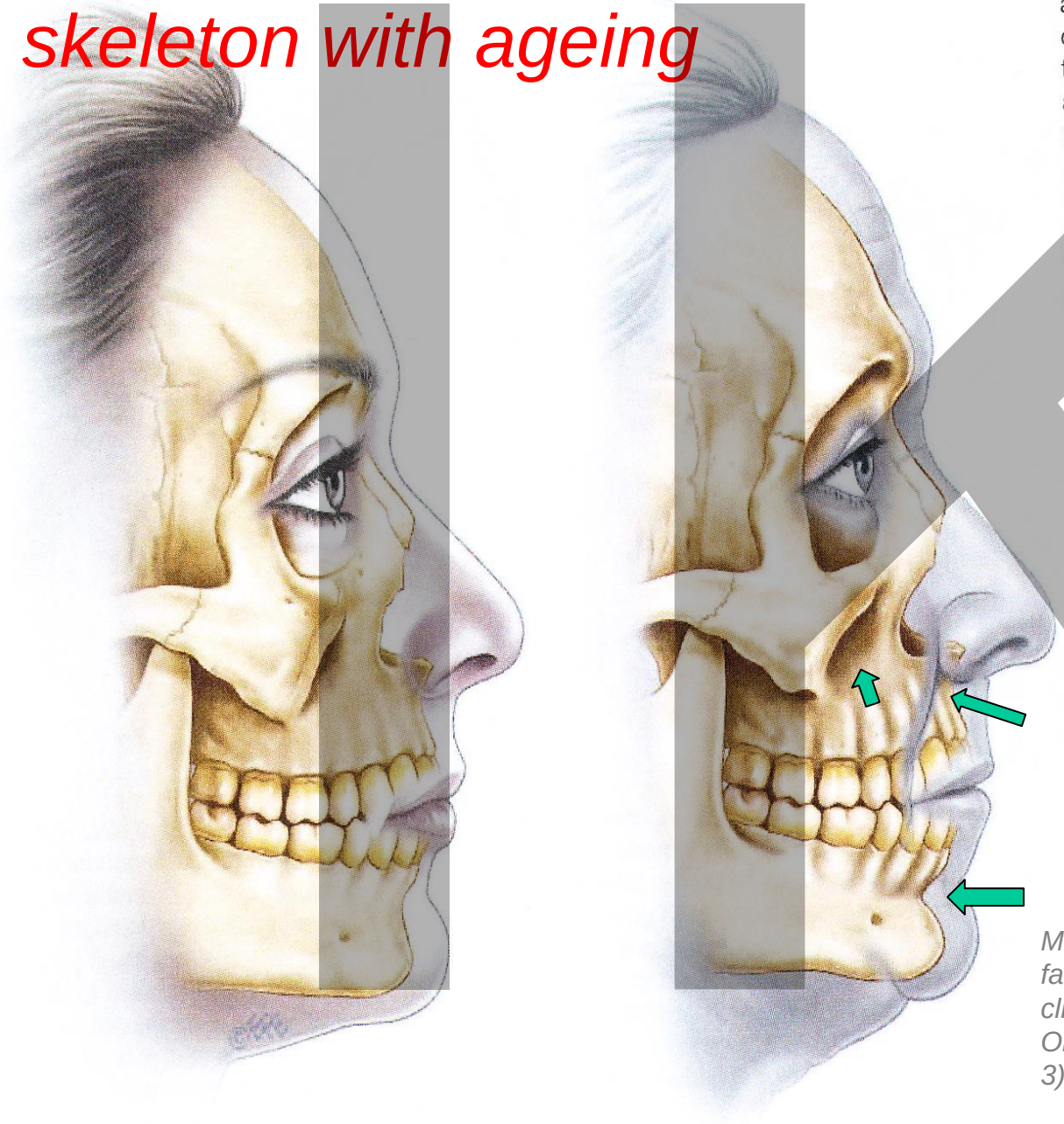
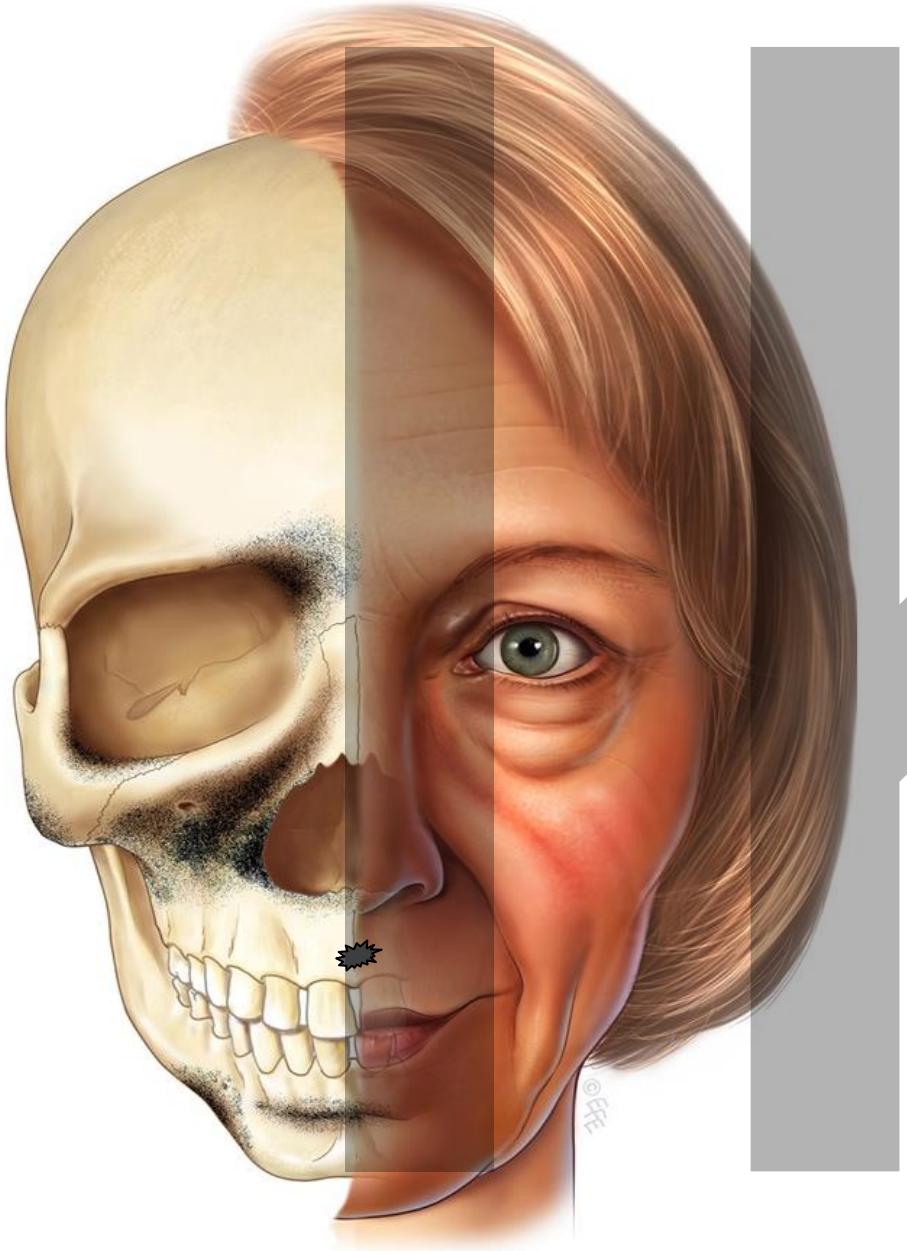


Fig. 4.3.4 Changes of the facial skeleton with ageing. The most significant amount of bony change is the mid-cheek skeleton. Shrinkage of the anterior projection of the maxilla predominates, along with a reduction of the bony rim of the piriform aperture. The inferior orbital rim, where it is formed by the zygoma, becomes more rounded, whereas the medial rim, where it is formed by the maxilla, loses its thickness. The anterior surface of the mandible becomes more hollowed and prejowl hollowing appears.

Characteristic changes in the middle of face

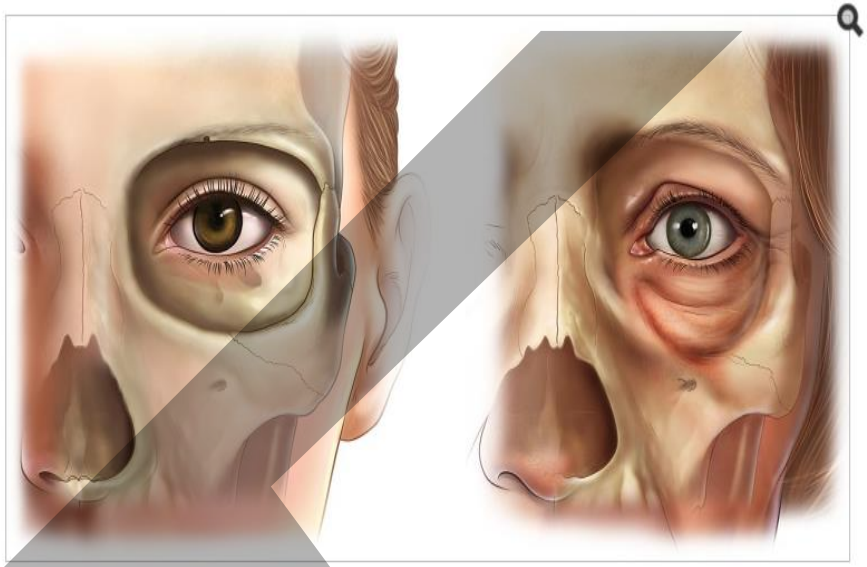
Mendelson, B., Wong, Ch,Ho: Changes in the facial skeleton with aging: Implication and clinical applications in facial rejuvenation. Online version(doi:101007/s00266-012-9904-3)

Fig. 6

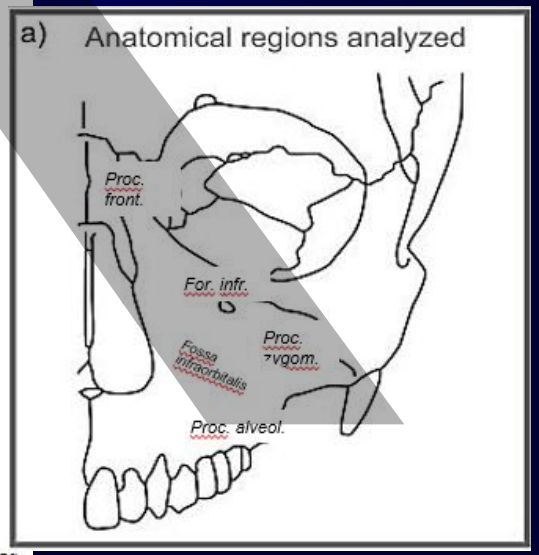


The *darker areas* are those of the greatest bone loss. The stigmata of aging, manifested by the facial soft tissues, corresponds with the areas of weakened skeletal support

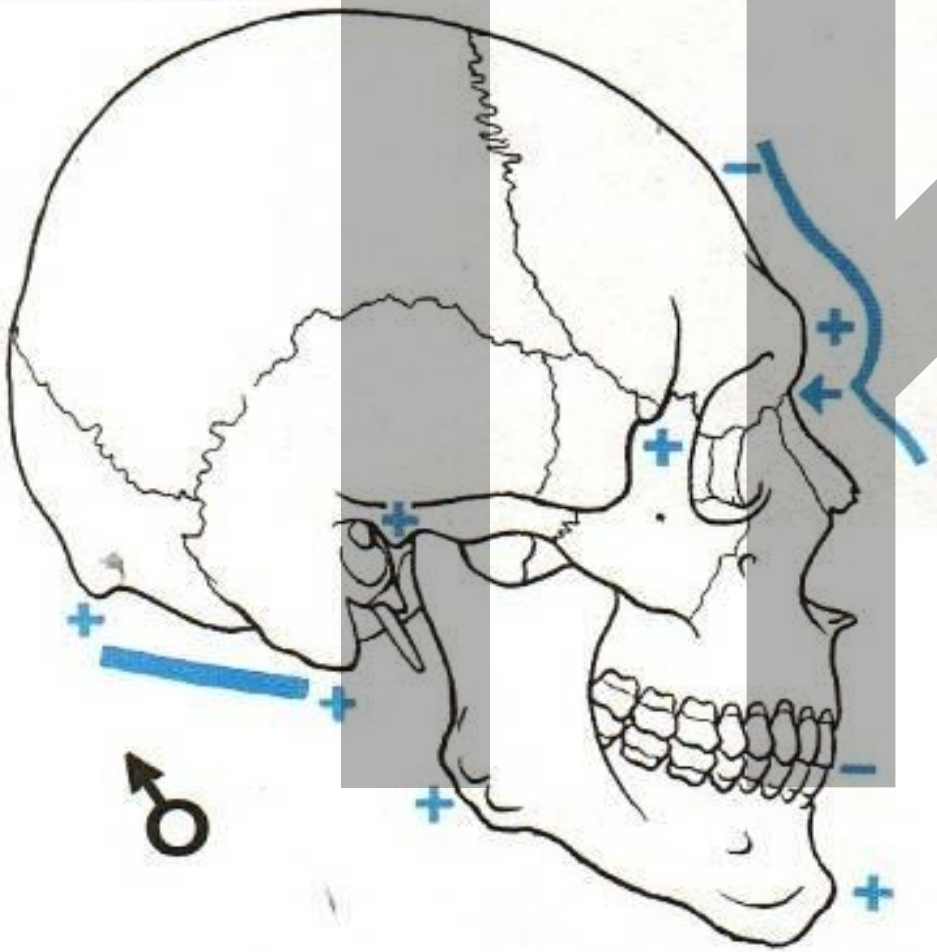
Fig. 1



Orbital aging. The superomedial and inferolateral aspects of the orbit have the greatest tendency to resorb. This contributes to the stigmat of periorbital aging such as increased prominence of the medial fat pad, elevation of the medial brow, and lengthening of the lid cheek junction



Gender differences between skulls male and female



Růst čelistí
Jaw growth

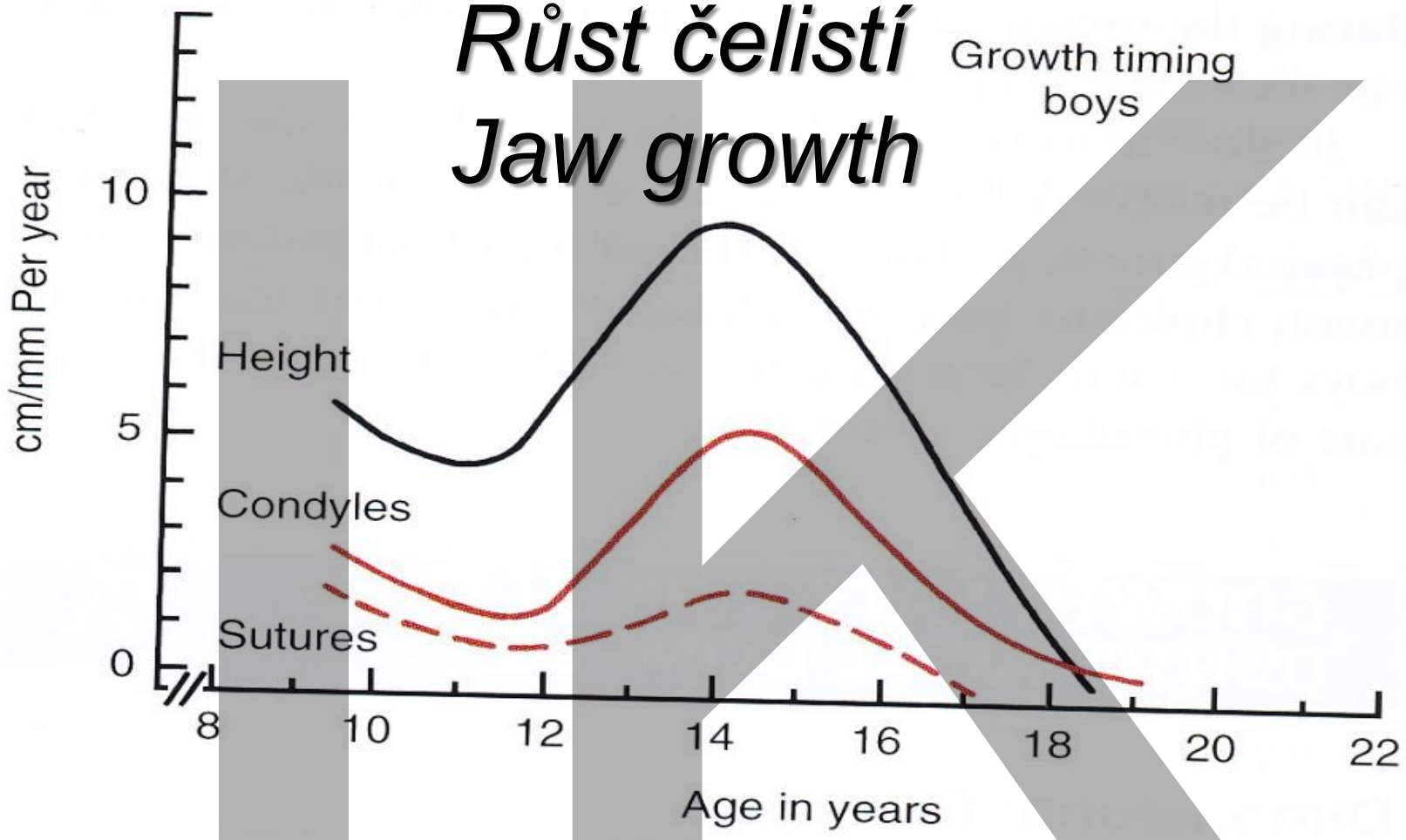


FIGURE 4-5 On average, the adolescent spurt in growth of the jaws occurs at about the same time as the spurt in height, but it must be remembered that there is considerable individual variation. (Data from Woodside DG. In: Salzmann JA, ed. Orthodontics in Daily Practice. Philadelphia: JB Lippincott; 1974.)

Maxilla

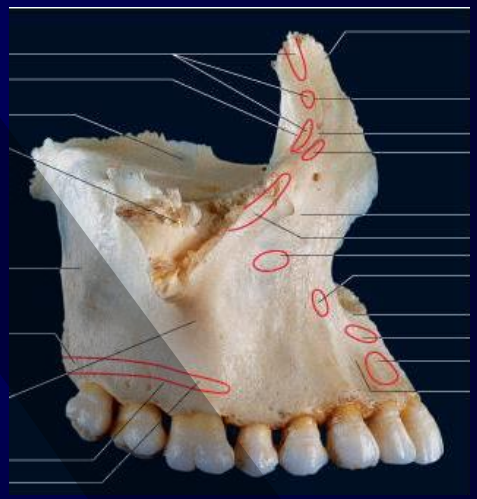
Facial depression
Fossa incisiva
fossa canina
Crista
infrazygomatica

Laterálně
lateral view

m.Levator
ang.oris

m.Depressor
septi nasi

Eminentia
alveolaris



Foramen rotundum
N. maxillaris
Ganglion trigeminale
R. meningeus
Rr. ganglionares ad ganglion pterygopalatinum
Ganglion pterygo-palatinum
Nn. alveolares superiores posteriores
Fissura orbitalis inferior
R. communicans
N. zygomaticus
N. infraorbitalis
N. alveolaris superior medius
Rr. alveolares superiores anteriores

Canalis ´sinuosus´ Parinaud´s can.
Canalis superior anterior

Maxillary changes with age

Along axis crossing intraalveolar septum between deciduous lateral incisor and caninus

(„opening bridge“)

ventrocaudally

Sutural influence: frontomaxillaris, zygomaticomaxillaris, pterygopalatina

Sutural influence: incisiva et intermaxillaris

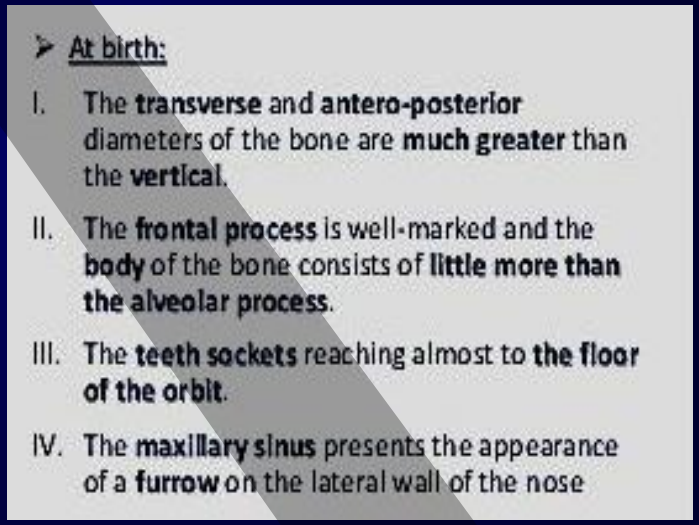
caudally

septum nasi

Influence on the surrounding structures

postnatally is seen also

sutura palatina mediana (7-19 year growth about 5 mm)



- At birth:

I. The **transverse** and **antero-posterior** diameters of the bone are **much greater** than the **vertical**.

II. The **frontal process** is well-marked and the **body** of the bone consists of **little more than the alveolar process**.

III. The **teeth sockets** reaching almost to **the floor of the orbit**.

IV. The **maxillary sinus** presents the appearance of a **furrow** on the lateral wall of the nose

CBCT maxila maxila

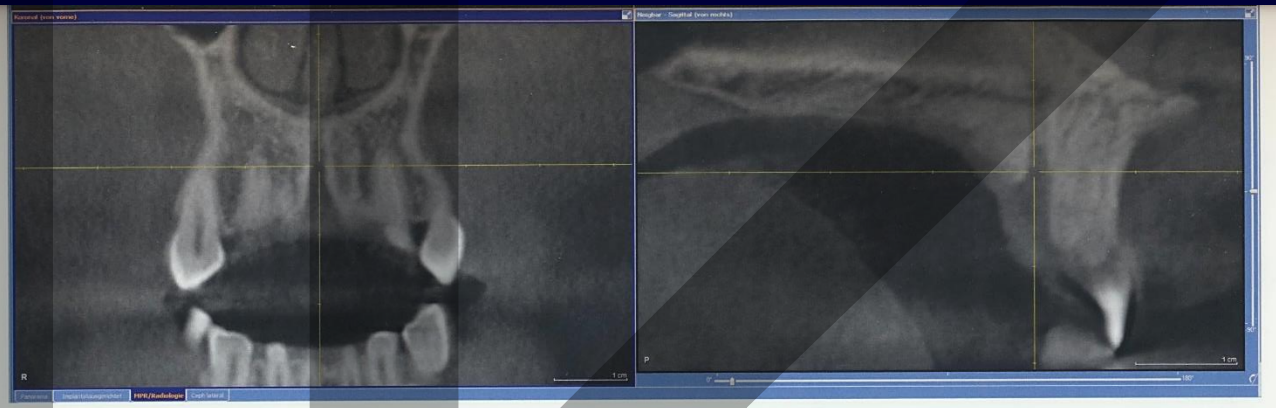


Fig 3-2 Image of the incisive foramen in the axial slice and the incisive canal in the coronal and sagittal view.

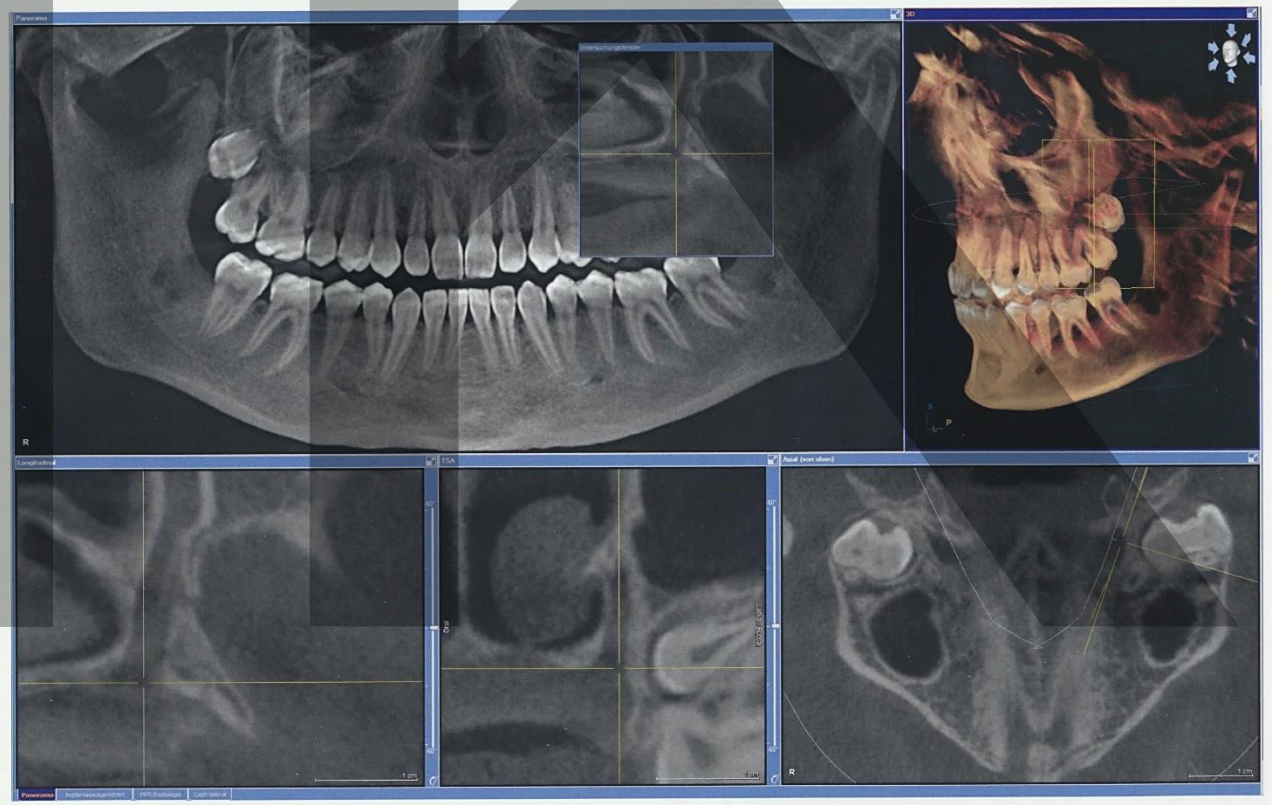


Fig 3-3 The palatine foramen with direct connection to tooth 28 and visualization of the palatine canal.

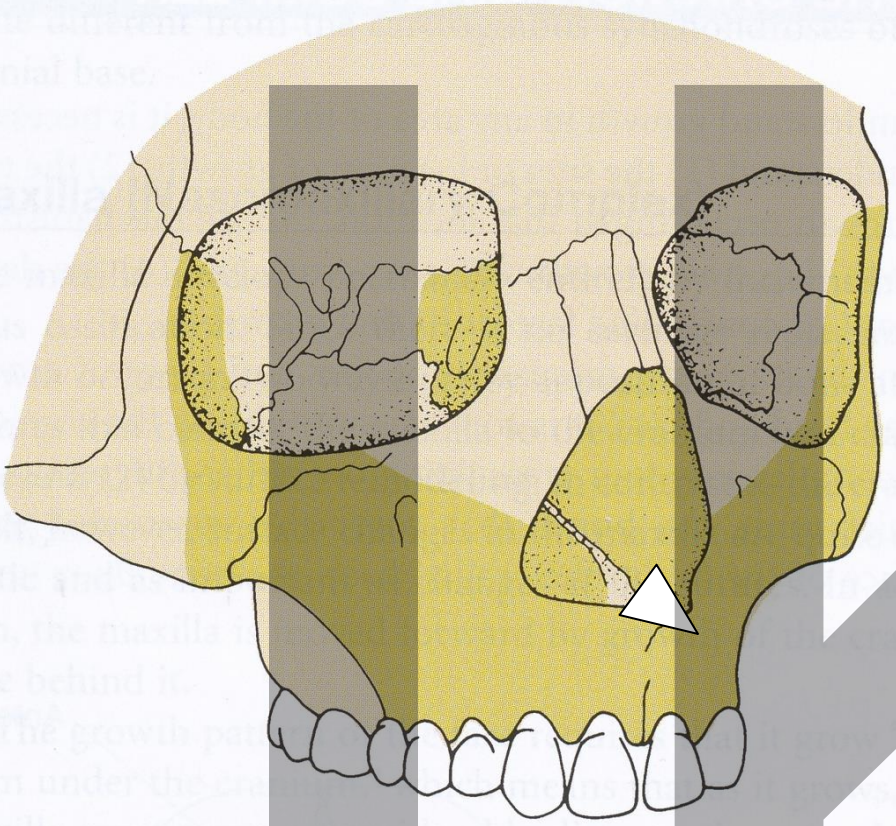
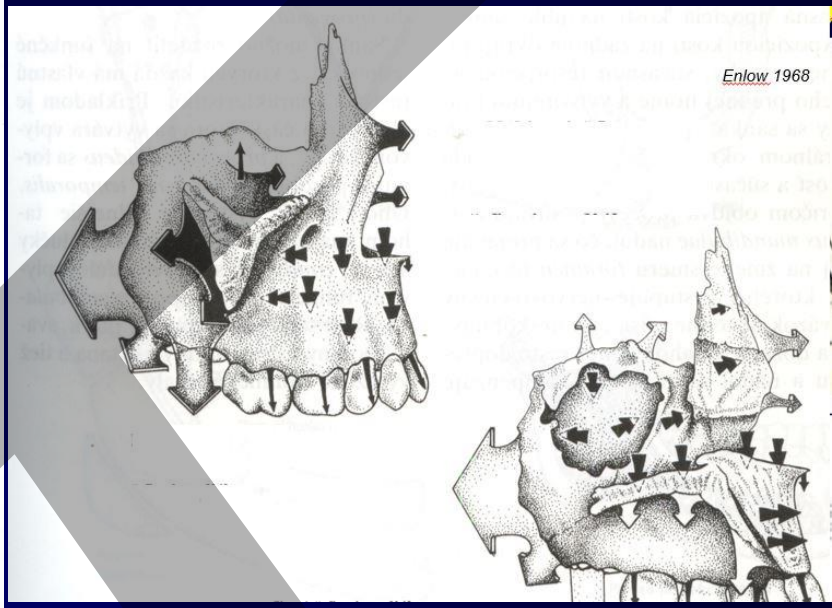
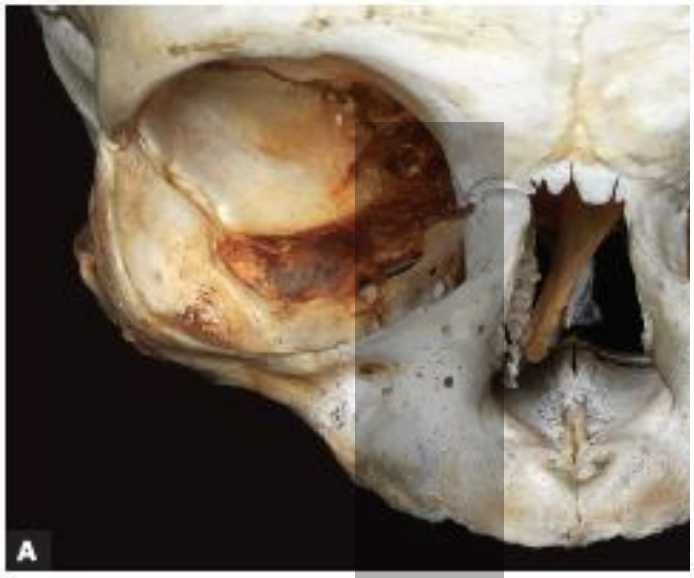


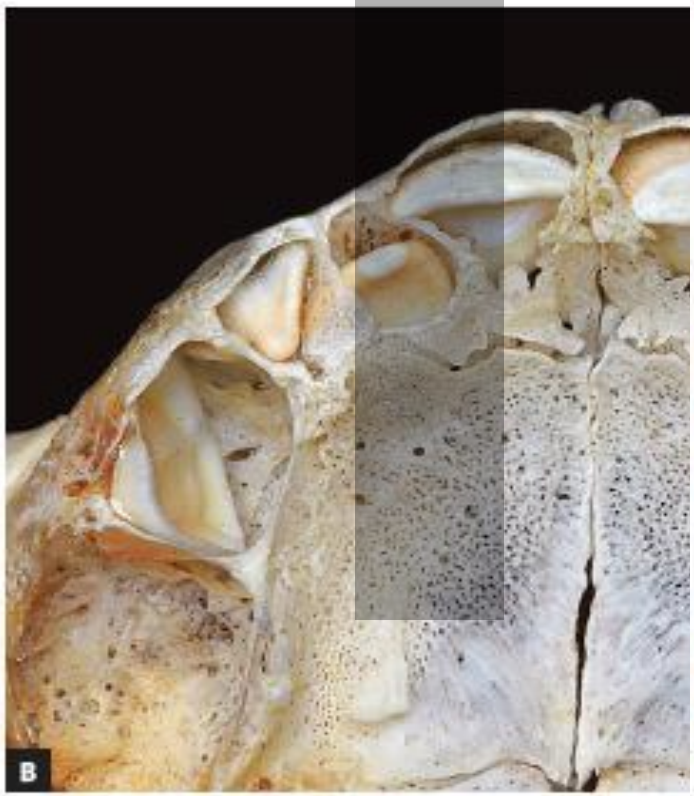
FIGURE 2-28 As the maxilla is carried downward and forward, its anterior surface tends to resorb. Resorption surfaces are shown here in dark yellow. Only a small area around the anterior nasal spine is an exception. (Redrawn from Enlow DH, Hans MG. Essentials of Facial Growth. Philadelphia: WB Saunders; 1996.)

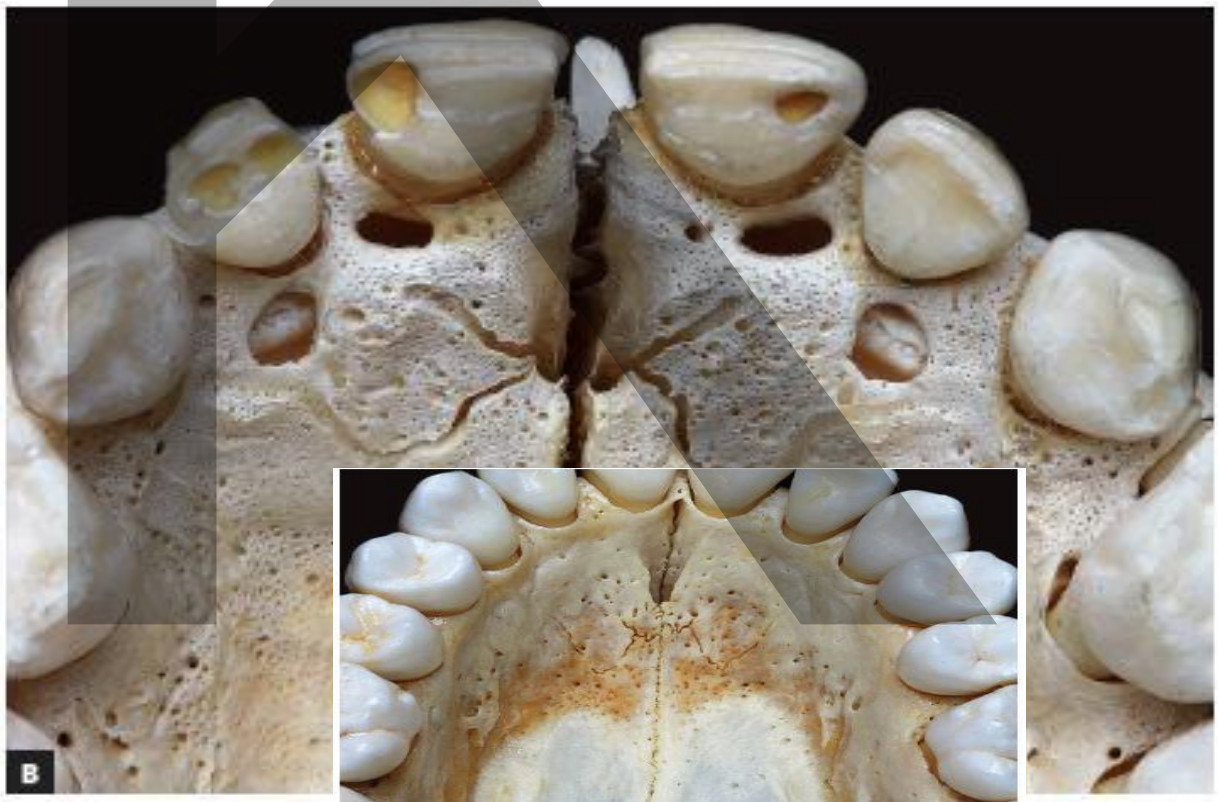


Maxila roste a její zevní povrch se resorbuje až na malý úsek spina nasalis anterior, resorbční oblast se rozšiřuje
maxila growths , anterior of its fase resorbs ; exception is spina nasalis anterior, resorbing area start to be wider - yellow

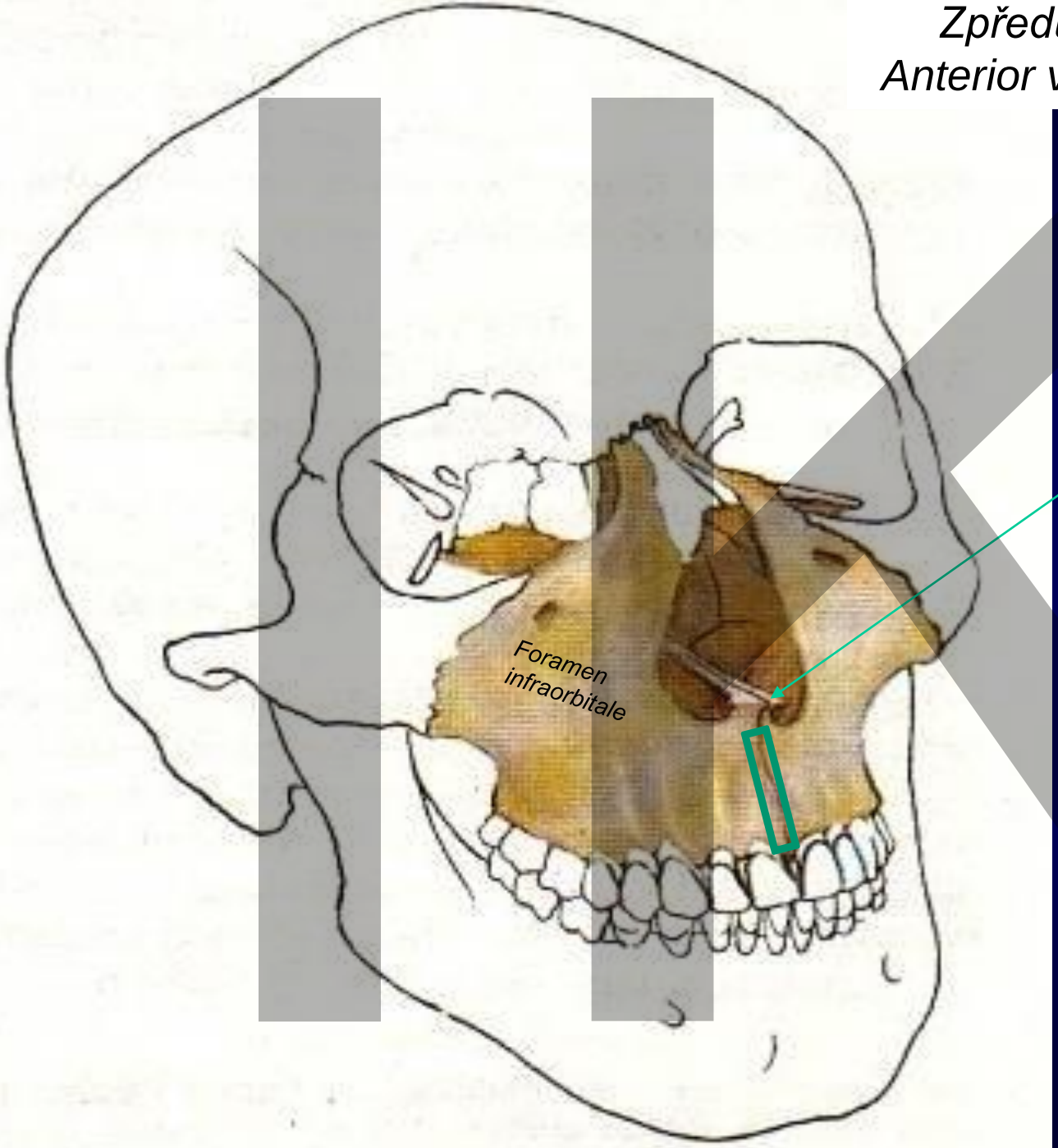

A


A


B


B

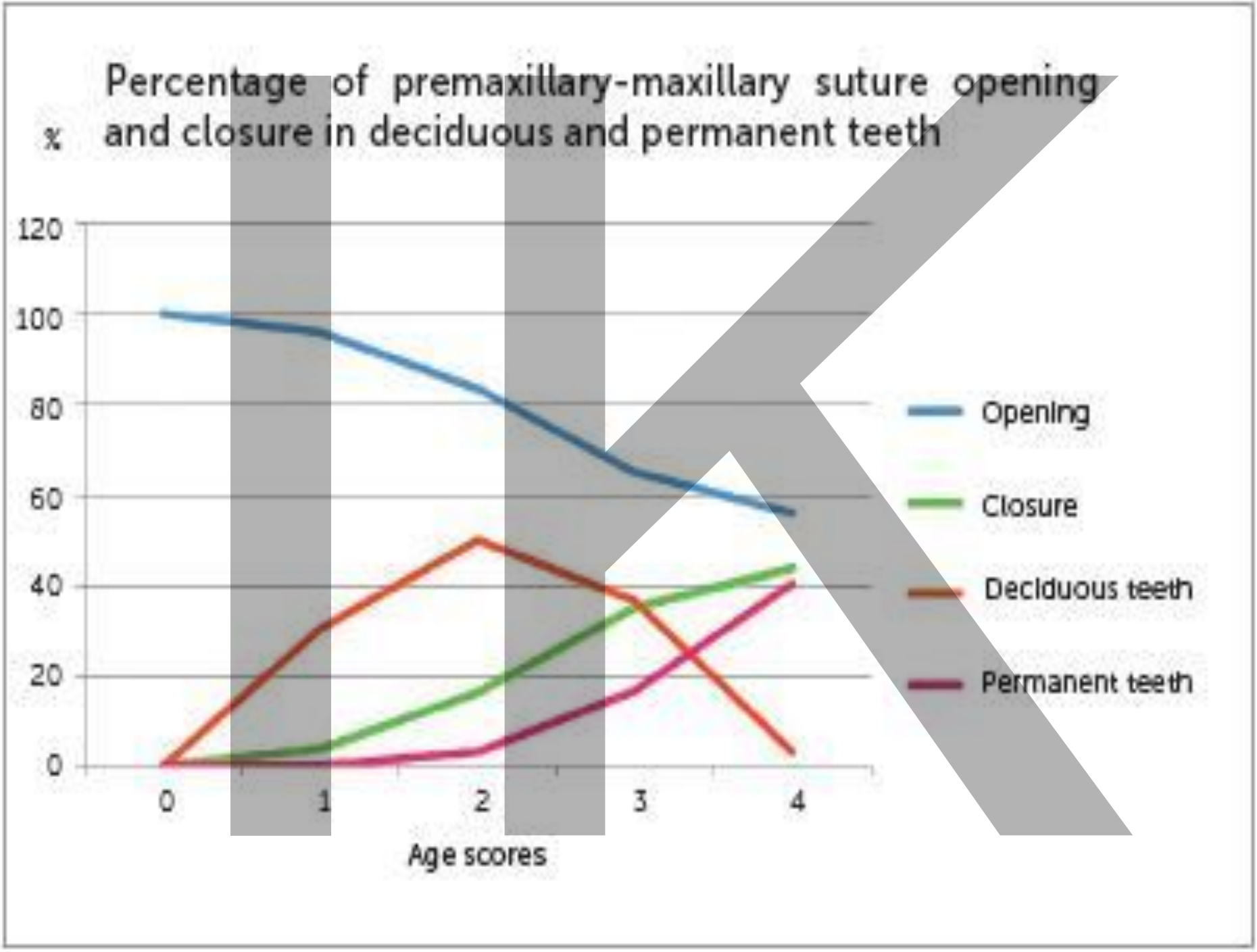
Zpředu
Anterior view



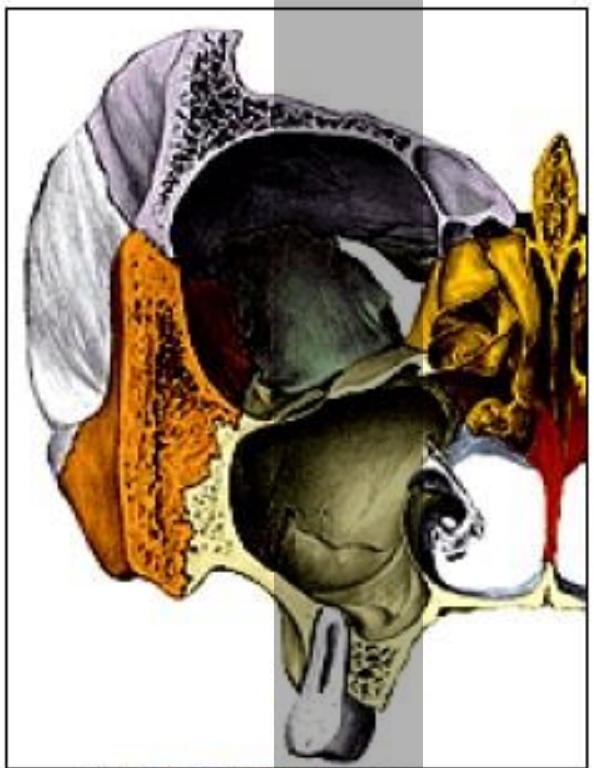
Maxila + premaxila

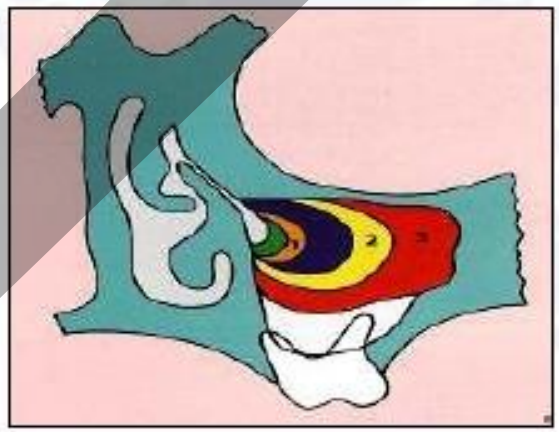
Spina nasalis anterior

sutura incisiva + sutura intermaxillaris assist in anterolateral rotation of premaxilla - The phenomenon is described as the so-called ´opening bridge´.

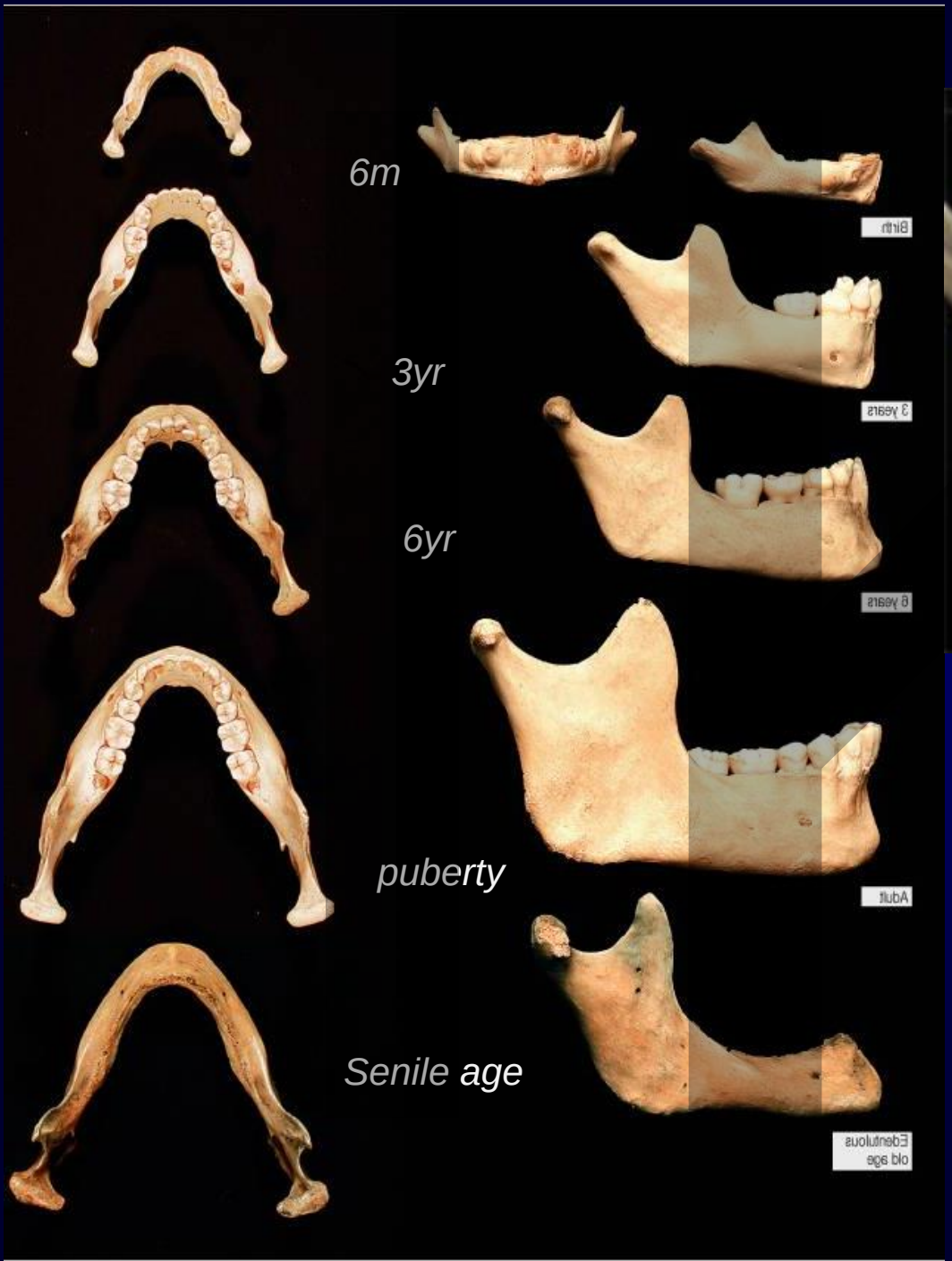

Percentage of premaxillary-maxillary suture opening and closure in deciduous and permanent teeth
%
120
100
80
60
40
20
0
0
1
2
3
4
Age scores
Opening
Closure
Deciduous teeth
Permanent teeth

Sinus maxillaris

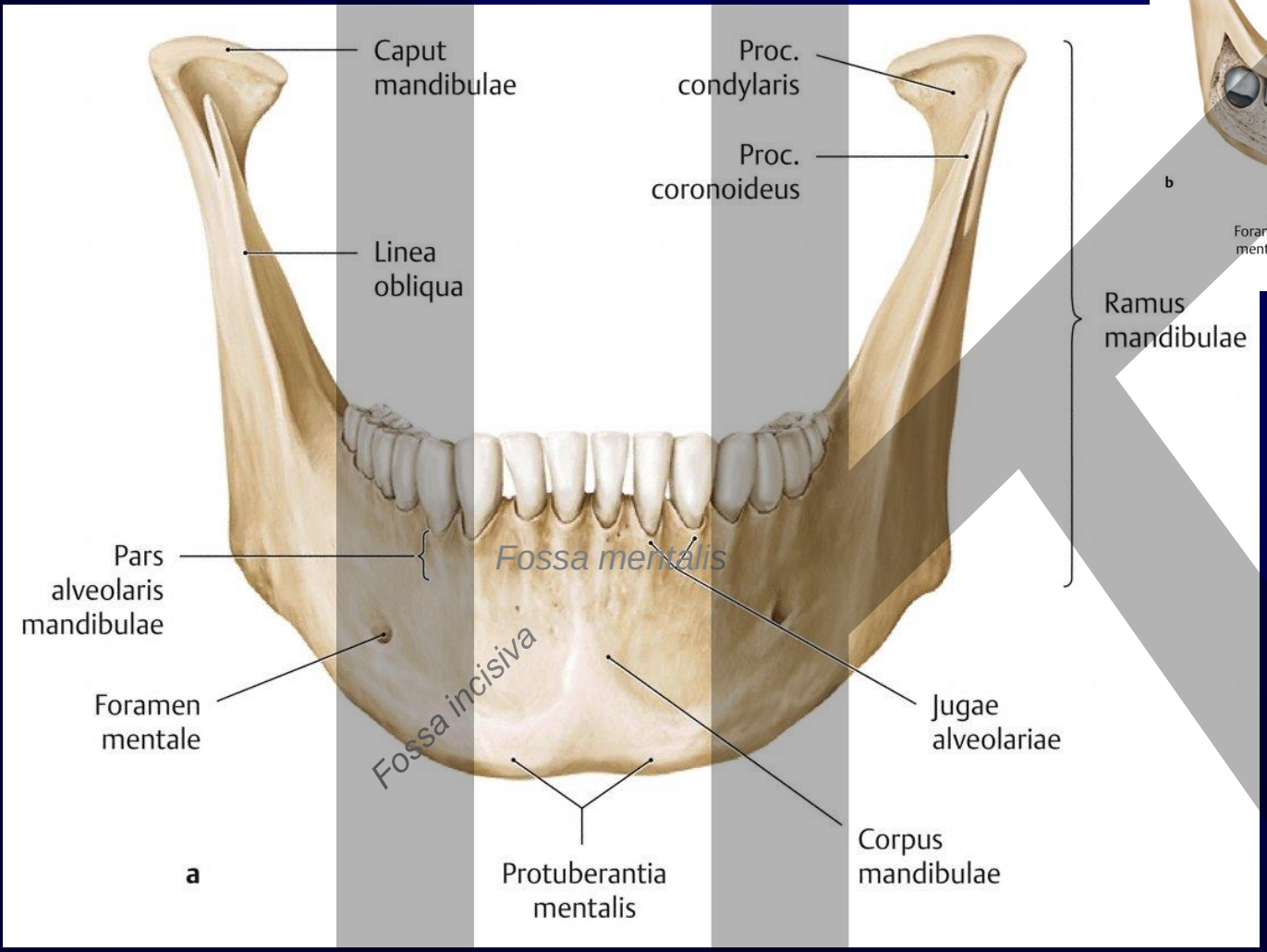


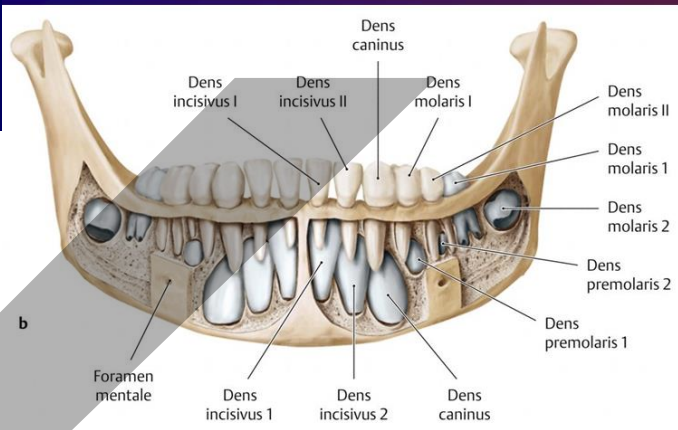


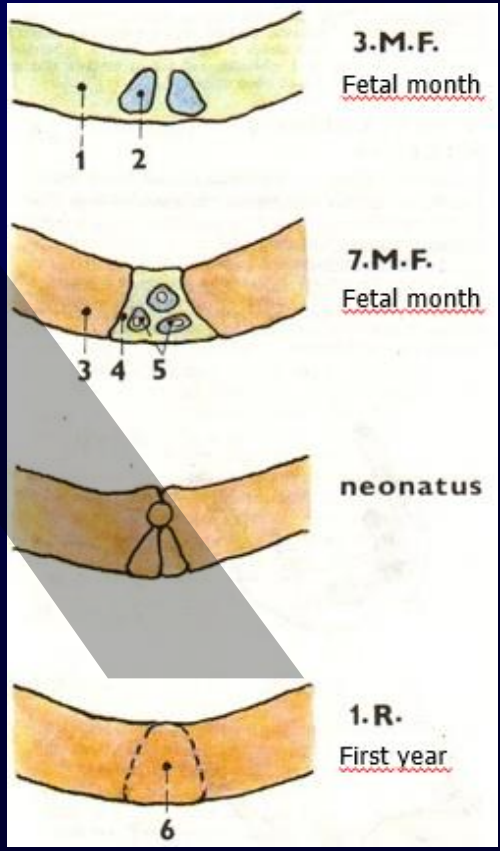
- antrum Highmori
- *birth*
  7x4x4 mm
- RTG
  4-5 *month*
- *biphasic growth*
  0-3 let & 7-12 let
- 18 let: 34x33x23 mm
- *topography*
  orbit - n. + vasa infraorbitalia
  pr. alveolaris – M1, M2, PM2, M3, C
  f. pterygopalatina & infratemporalis
  MNM – ostium + akces. ostia


6m
3yr
6yr
puberty
Senile age
Birth
3 years
6 years
Adult
Edentulous
old age

Eruptio dentorum







Mandibular changes with age

growth follows spiral axis - mandibular logaritmic spiral growth pattern

Condyle growth

Remodelace chrupavky (direction of growth influences insertion of lateral pterygoid muscle)

Relocation of the ramus mandibulae

Vertical growth and formation of alveoli

Appositton material on dorsal margine of ramus mandibulae

Reposition of foramen mandibulae: *(from location at level of alveolus to level of occlusal plane crossing wisadom tooh 3 – 15 yr*

symphysis menti is missing

It is missing about 6 postnatal month (ventrally)

Elongation of the canalis mentalis

Interstitial growth

CBCT mandible mandibula

Fig 3-11 Mental foramen in the surface rendering in the 3D model and in the sectional image with the nerve canal and the symmetrical outlet profile marked (middle picture).

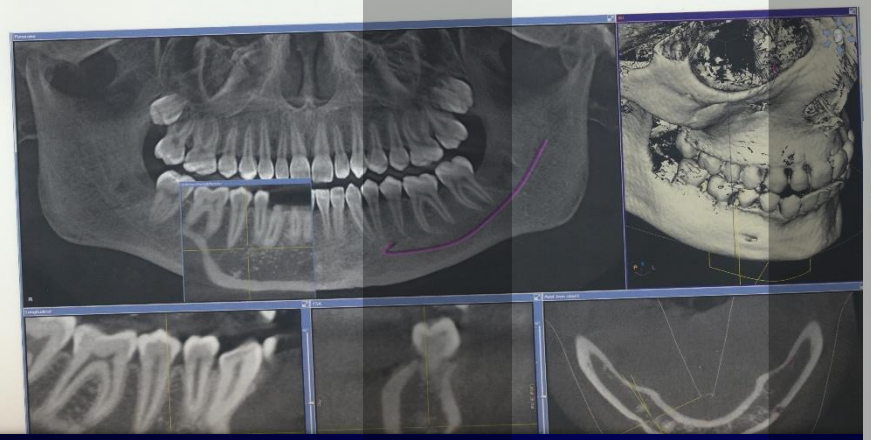
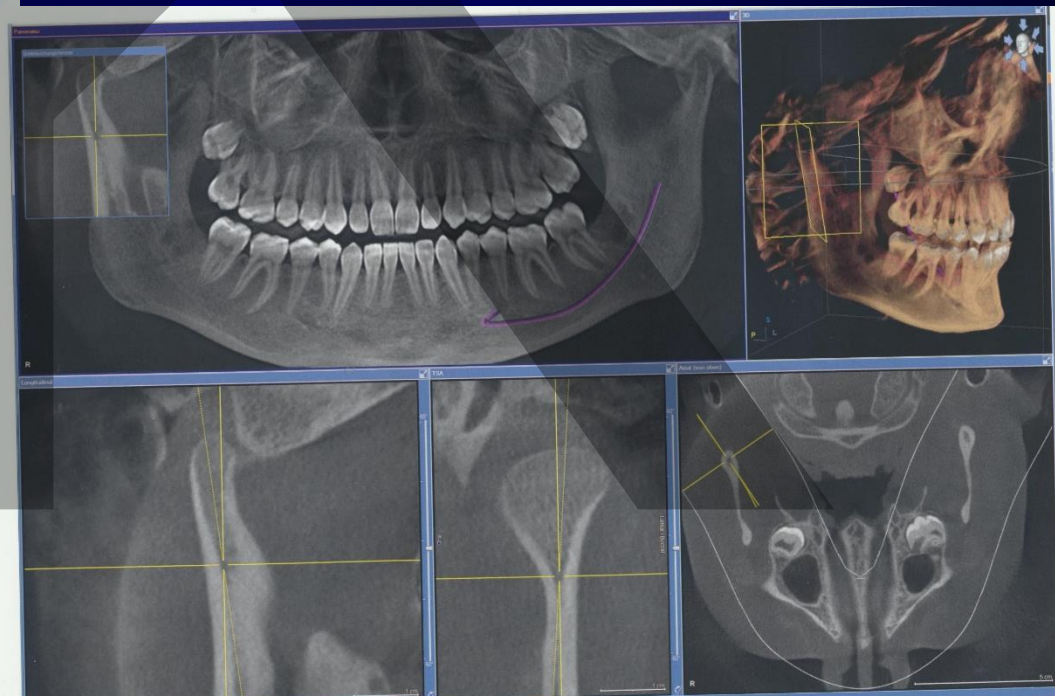
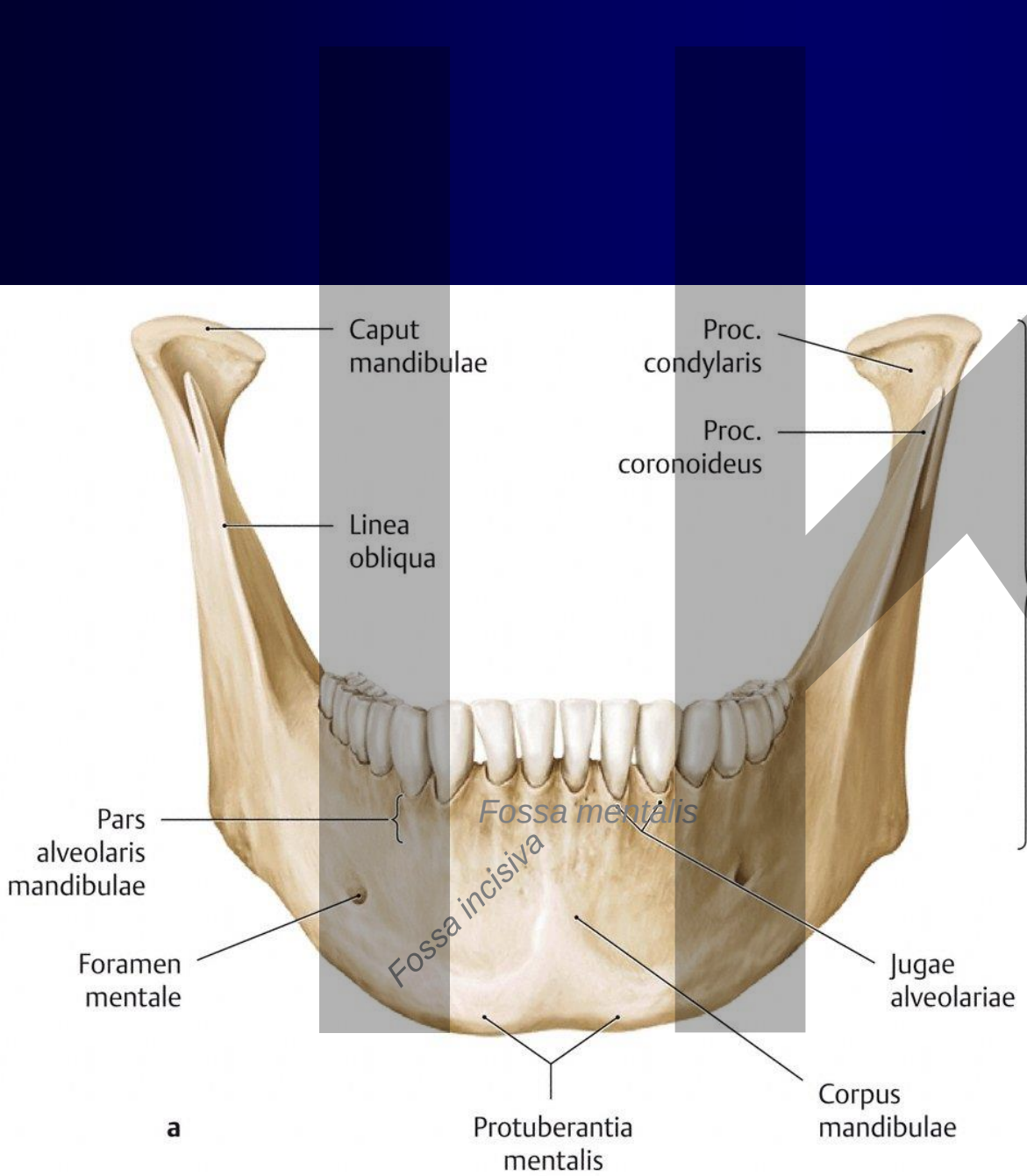
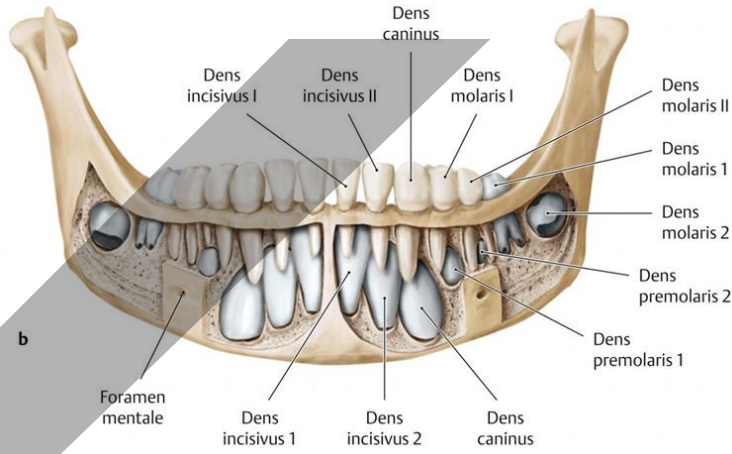


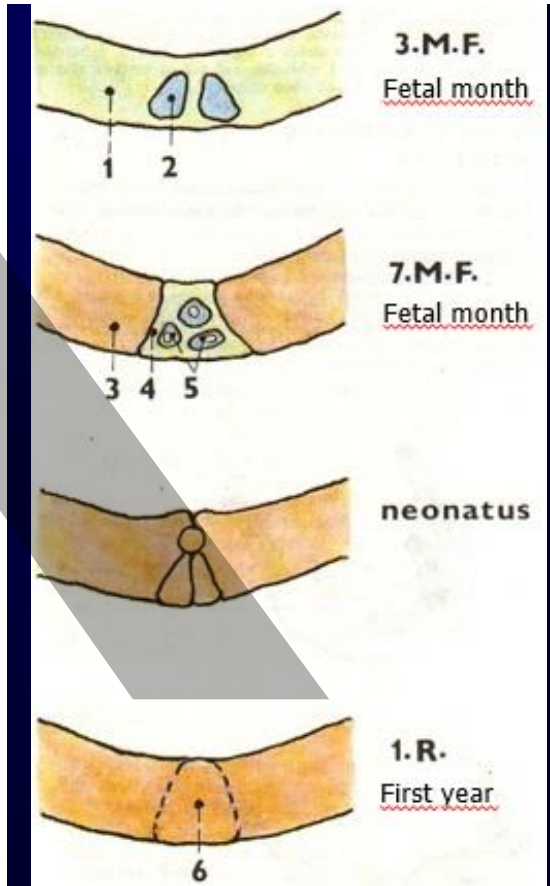
Fig 3-10 Expanded joint cavity seen on a cone-beam scan with mouth opening locked so that the crowns do not overlay each other. The temporomandibular condylar head shows an even configuration.

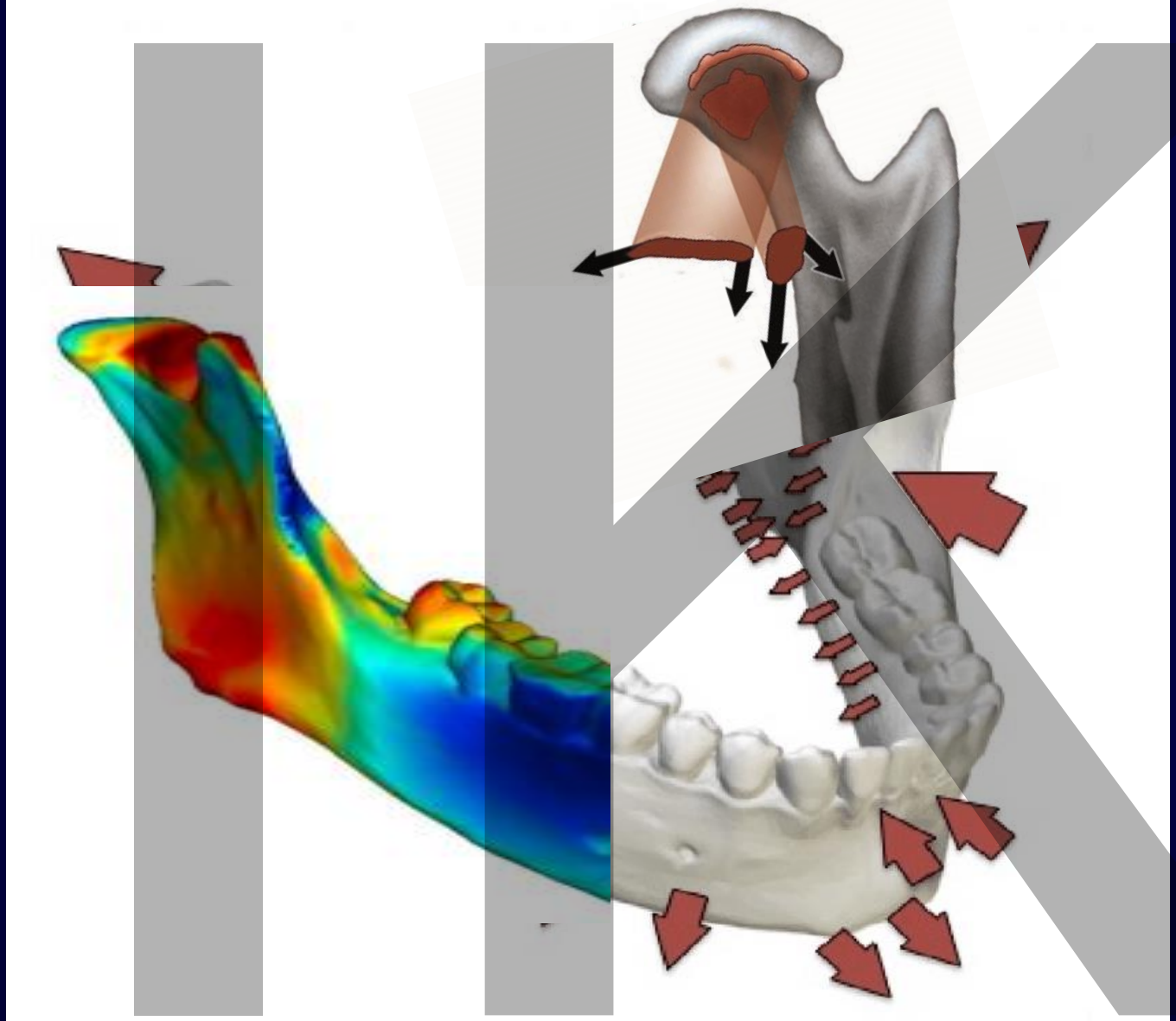


Eruptio dentorum

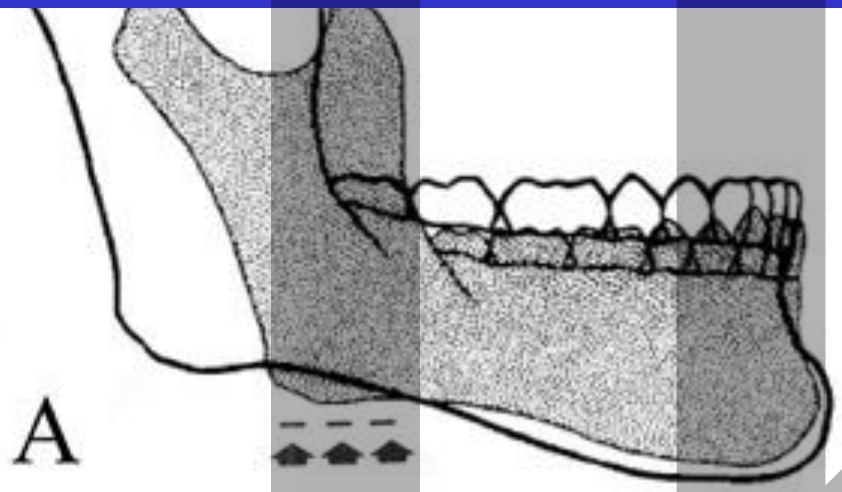


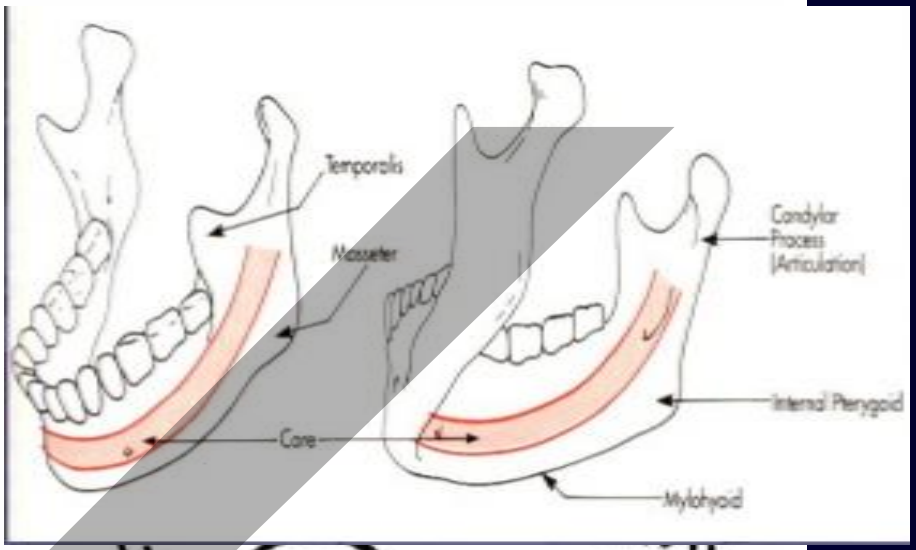


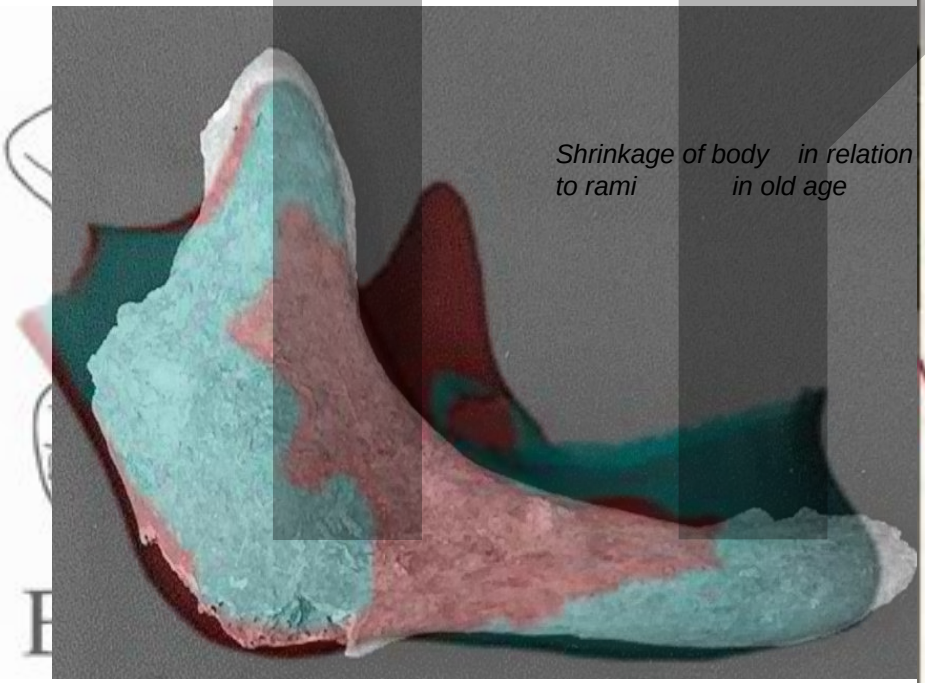




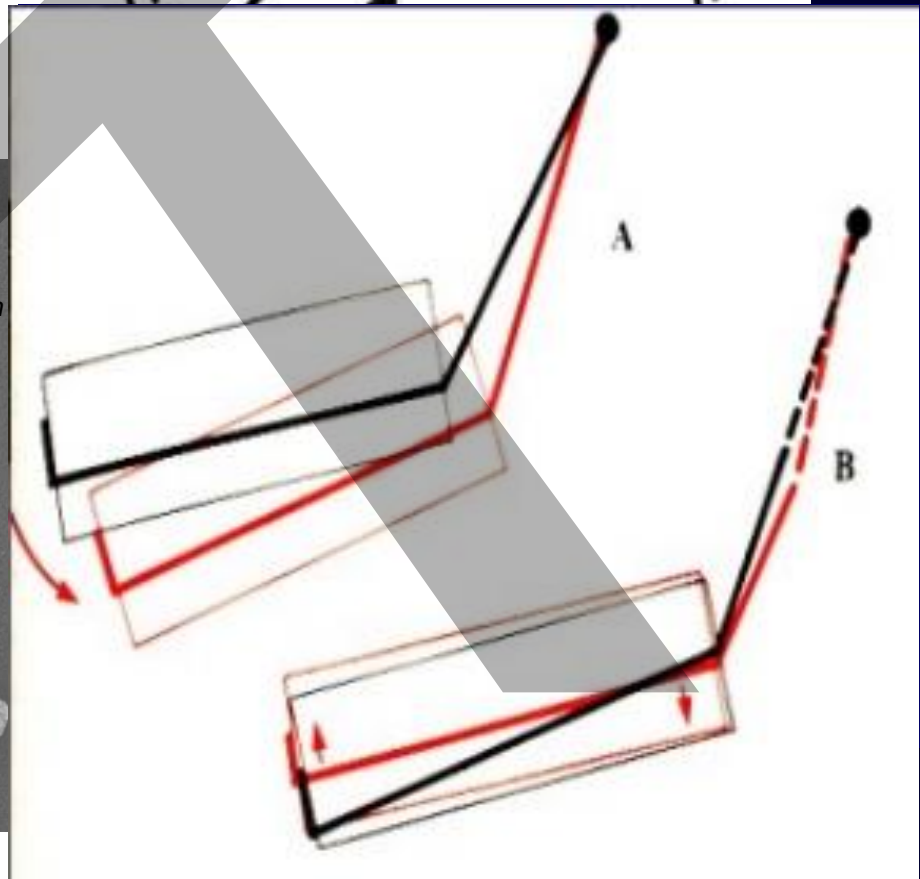
´rotace´matrix *(matrix rotation, apparent rotation):*
(´posun´ povrchové vrstvy čelisti v souvislosti se strukturami obklopující čelist)
´Vnitřní´rotace matrix *(intramatrix rotation, angular remodelling)*
(´rotace´ houbovité struktury uvnitř čelisti)





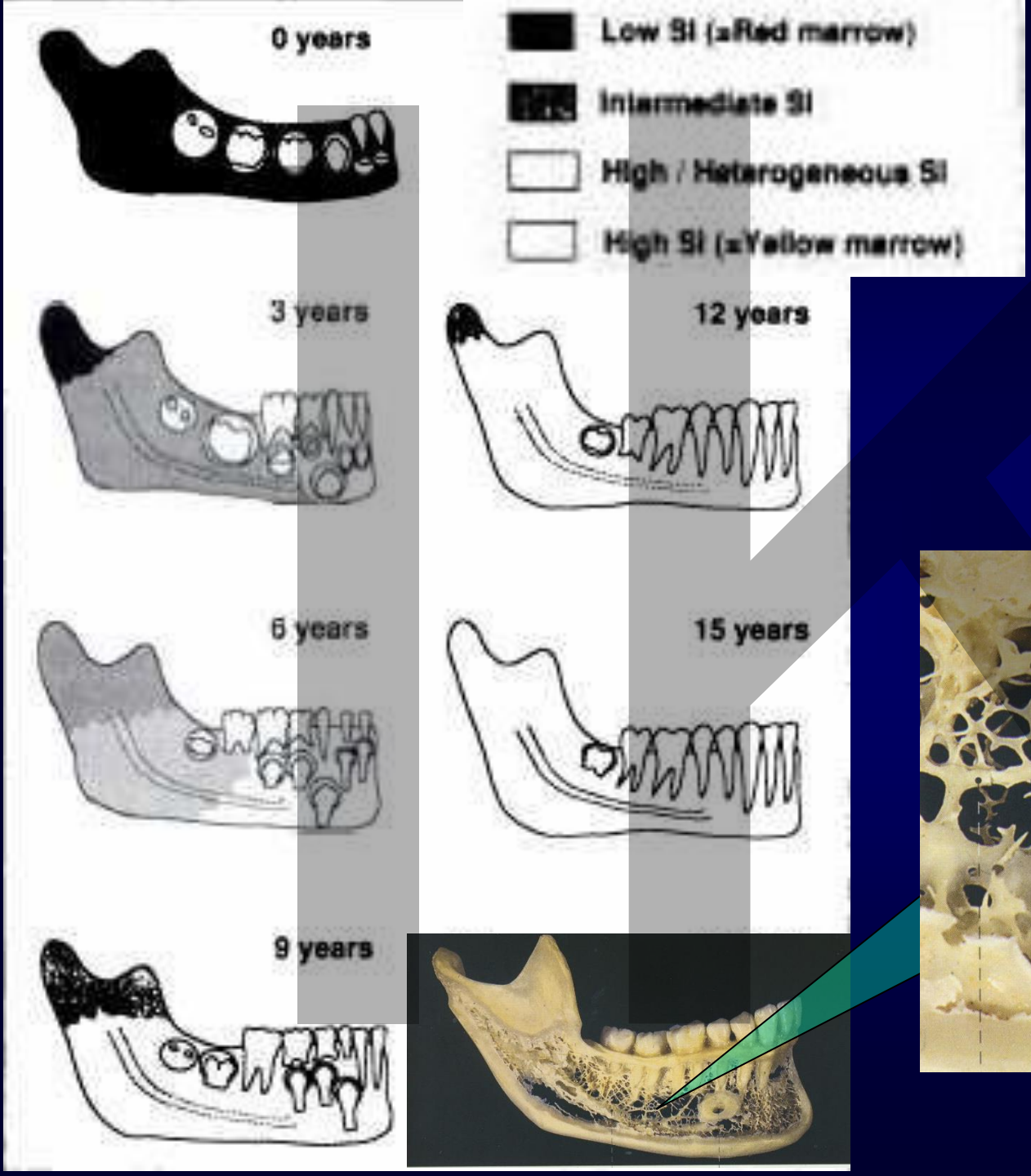


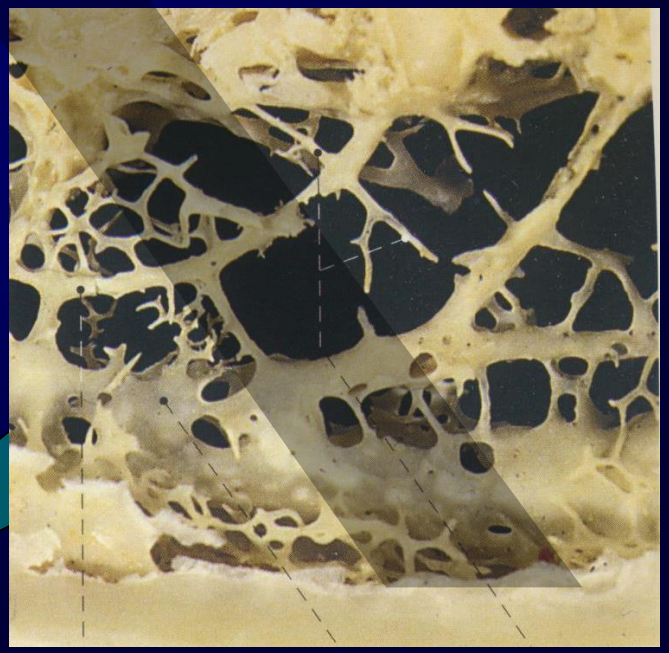
Shrinkage of body in relation to rami in old age

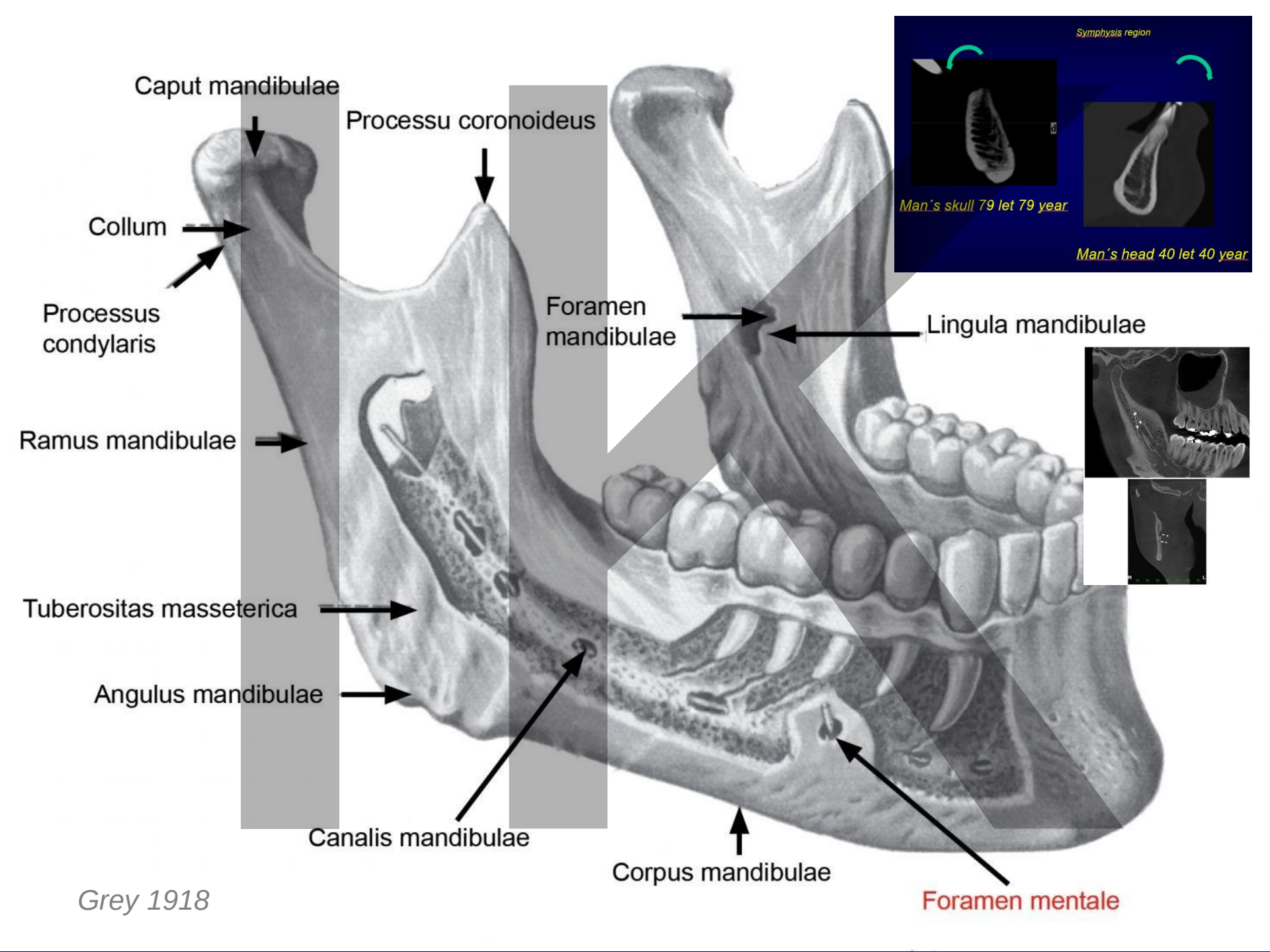


Změny v konsistenci kostní dřeně

Changes of the density of bone marrow






Caput mandibulae
Processu coronoideus
Collum
Processus condylaris
Foramen mandibulae
Lingula mandibulae
Ramus mandibulae
Tuberositas masseterica
Angulus mandibulae
Canalis mandibulae
Corpus mandibulae
Foramen mentale
Symphysis region
Man´s skull 79 let 79 year
Man´s head 40 let 40 year
Grey 1918

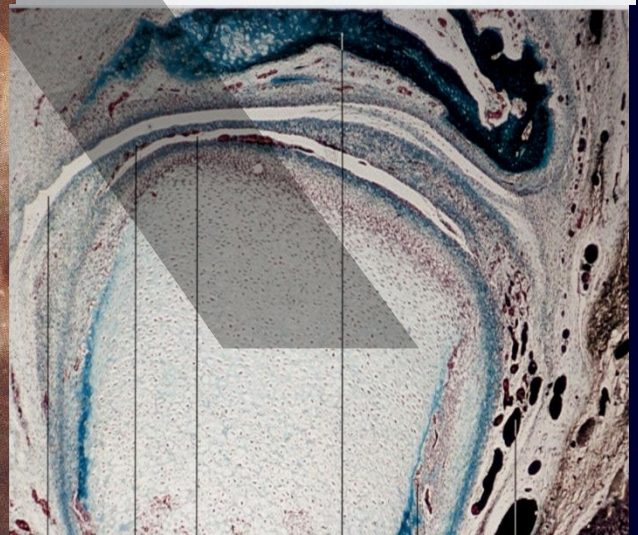
Upper space cavitas discosquamosa – 581 mm²
Lower space cavitas discocondylaris – 396 mm²

Medial view of the TMJ with the joint spaces opened
1 Articular eminence and upper joint space
2 Anterior end of lower joint space
3 Lateral pterygoid muscle
4 Articular disc
5 Posterior end of upper joint space
6 Tympanic membrane and posterior end of lower joint space

kloubní povrch kondylu tvoří čtyři vrstvy:

- *Superficial layer: superficial articular layer = connective tissue character*
- *Very cellular layer:*
- *Proliferating layer:*
- *Hypertrophic layer:*

Transverse section through the TMJ of a 14-cm-long fetus



CBCT joint Temporomandibulární kloub

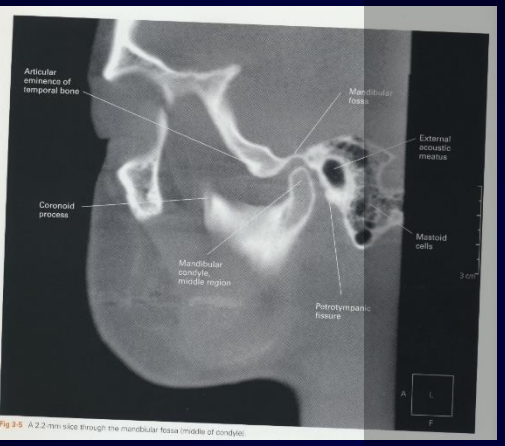


Fig 3-5 A 2.2-mm slice through the mandibular fossa (middle of condyle).

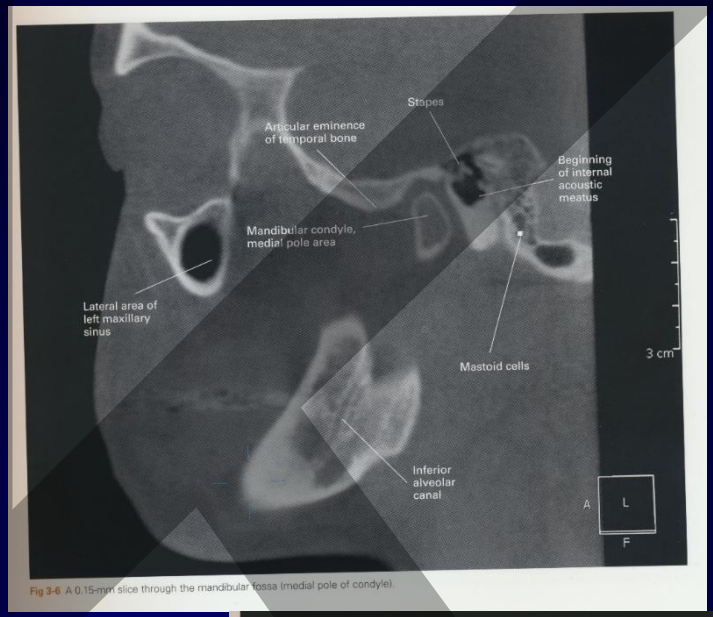


Fig 3-6 A 0.15-mm slice through the mandibular fossa (medial pole of condyle).

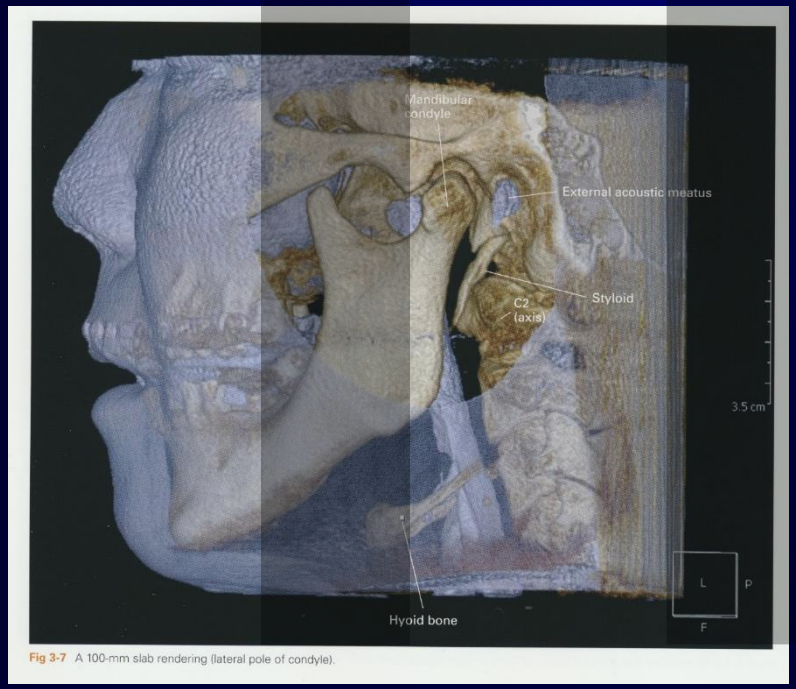
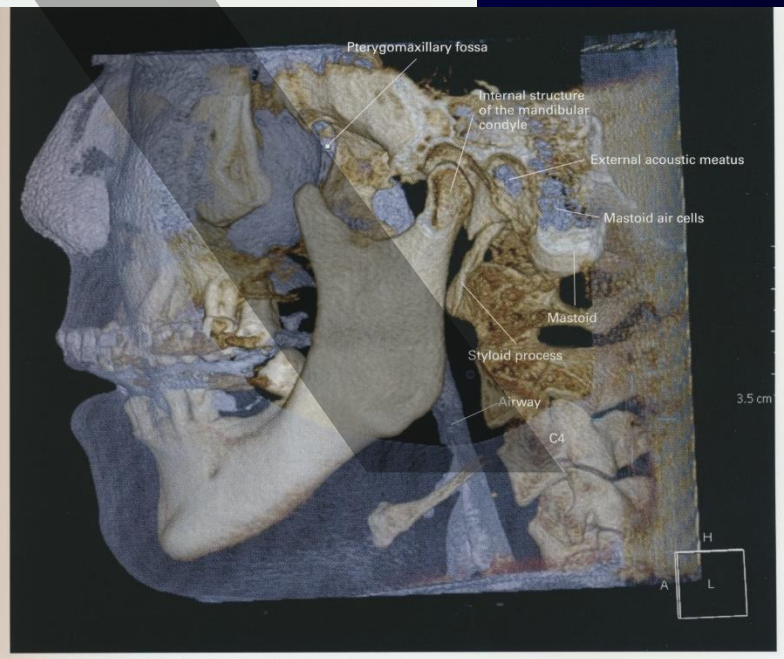


Fig 3-7 A 100-mm slab rendering (lateral pole of condyle).

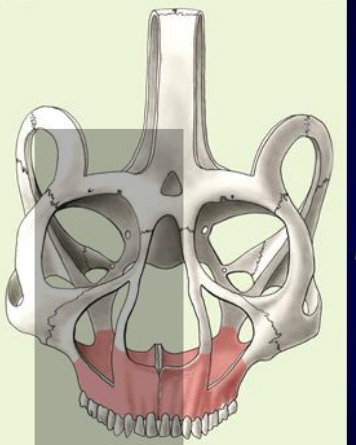


Zesílená a zeslabená místa obličejového skeletu

Thickened and weakened areas of the facial skeleton

Patrová deska

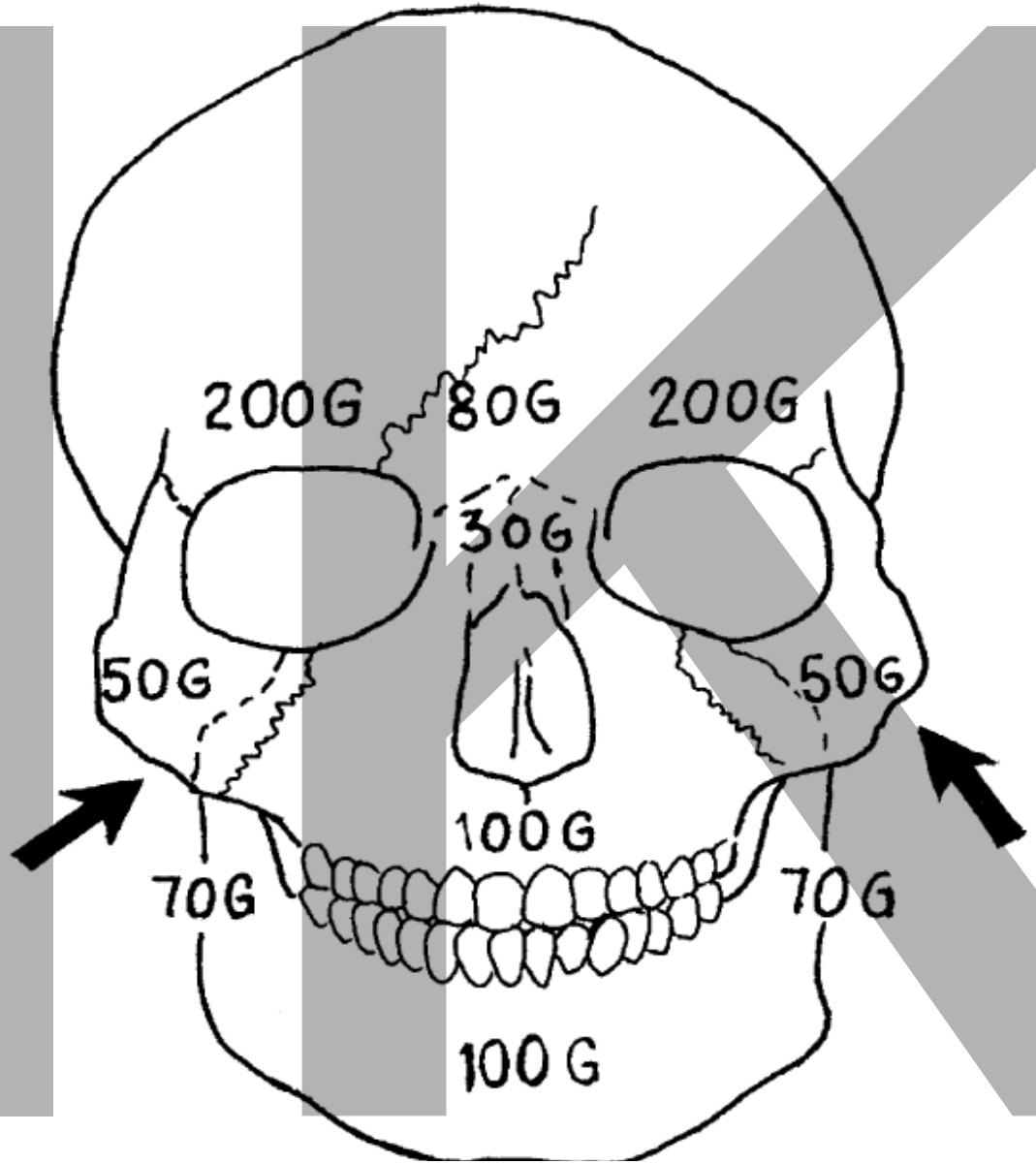
Palate plate



Podle Deffeze 1985

After Deffez 1985

Classification of the facial bones into degree of resistance to impact



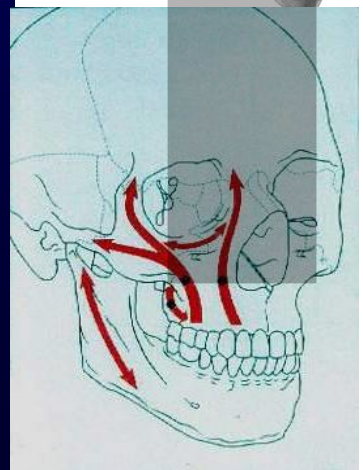
J. Maxillofac. Oral Surg. (Apr-June 2012) 11(2):224–230
DOI 10.1007/s12663-011-0289-7

Jaké linie se především sledují

Which lines are followed predominantly

Midface buttresses; tension and traction lines

- Three buttresses allow face to absorb force
  - Nasomaxillary (medial) buttress
  - Zymaticomaxillary (lateral) buttress
  - Pterygomaxillary (posterior) buttress



Vertical and transverse pillars

Transfer of chewing pressure to skull structures

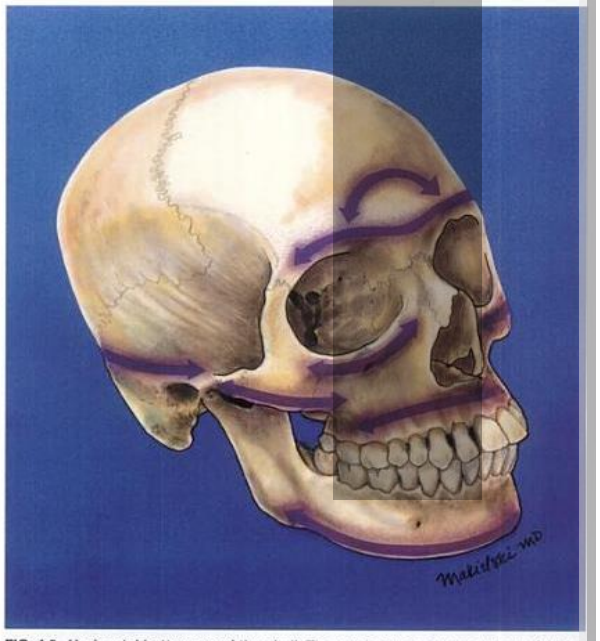


FIG. 4.8. **Horizontal buttresses of the skull.** The purple areas represent areas of thicker facial bone that are less likely to fracture than intervening areas.

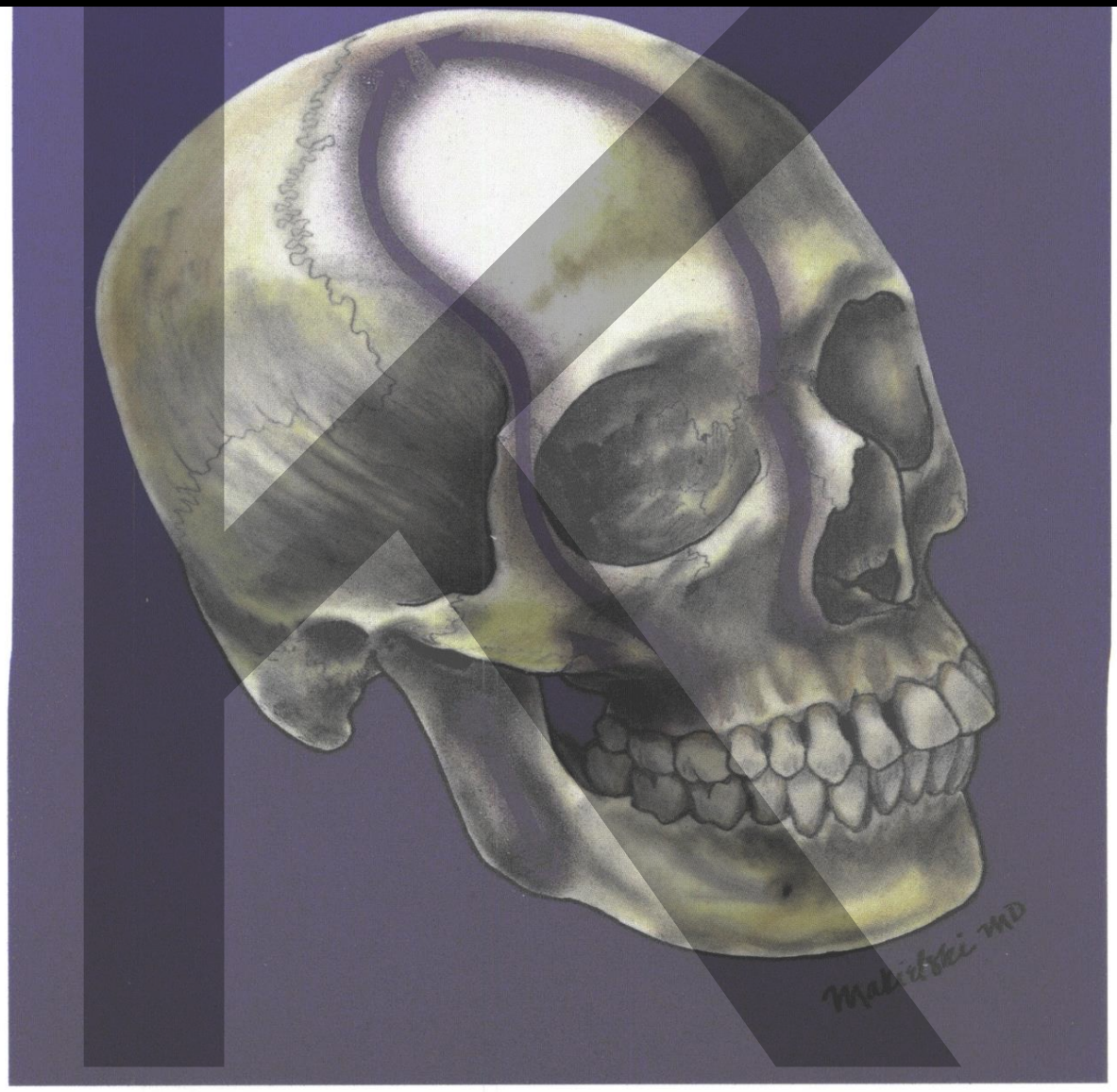
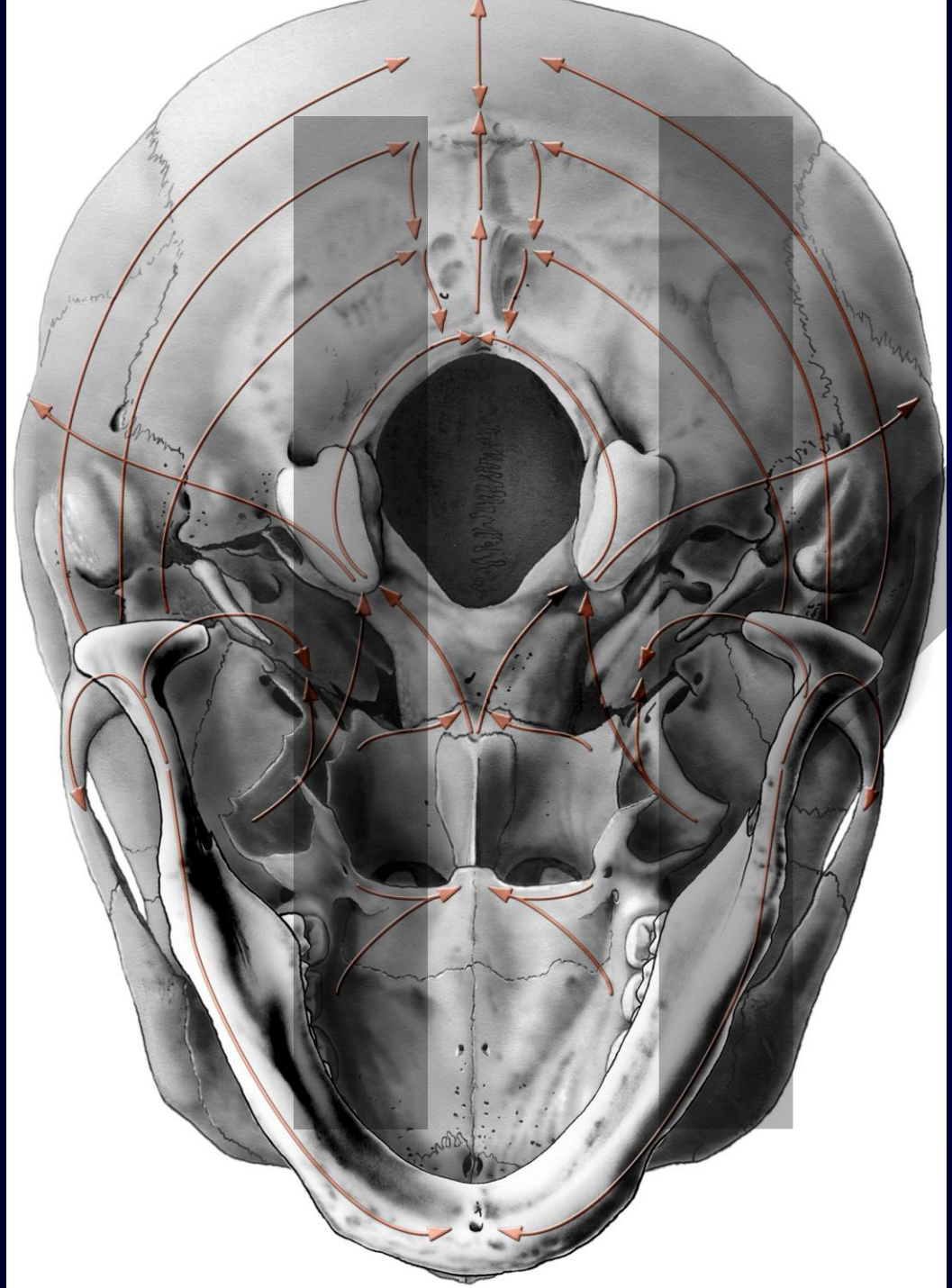
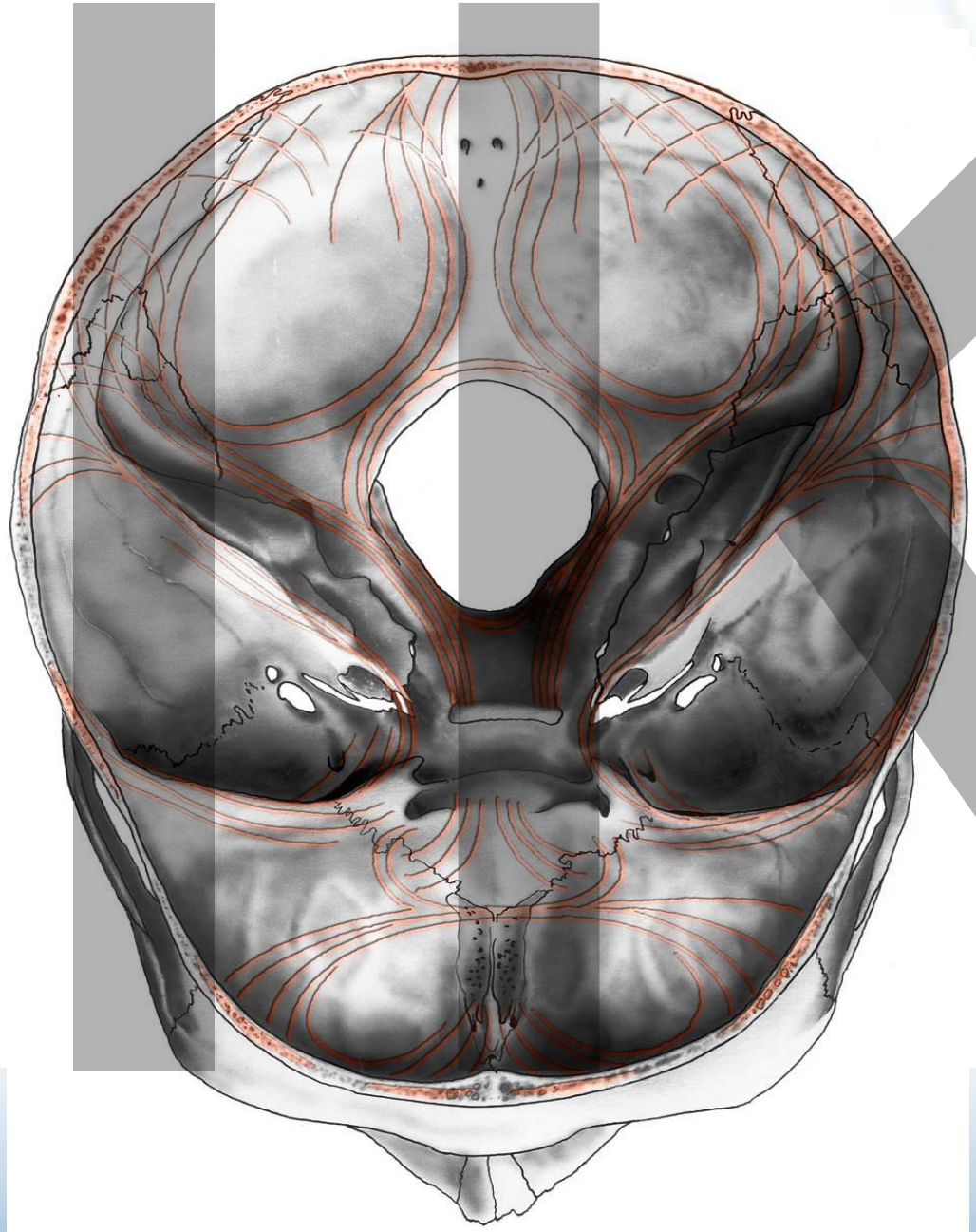


FIG. 3.9. Vertical buttresses of the skull. The purple areas represent areas of thicker facial bone that are less likely to fracture than intervening areas. Depending on the development of the sinuses, the buttress may follow the supraorbital rim and skirt the frontal sinus.



Power transfer in the in skull basis

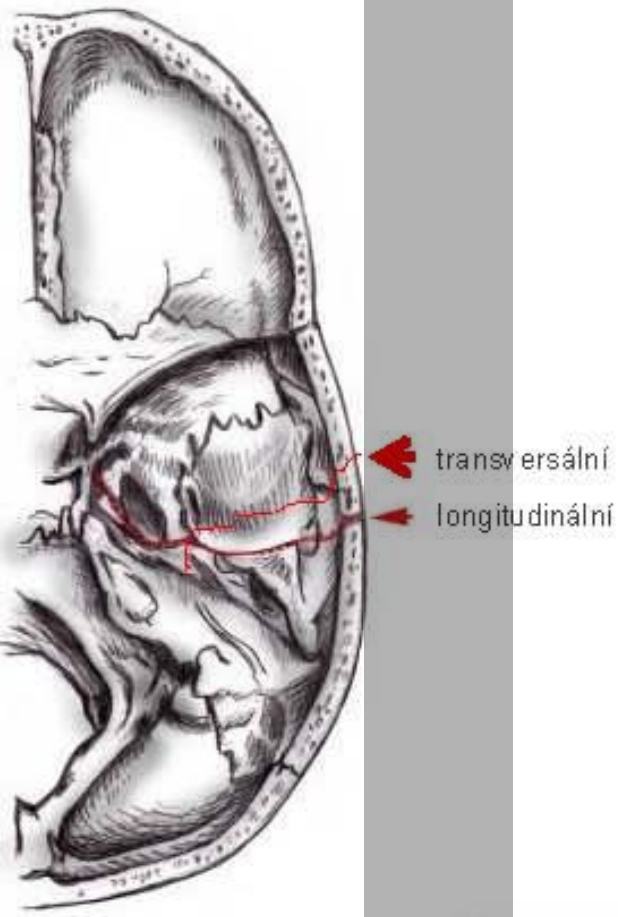
Tension and traction lines; fractures of the skull basis



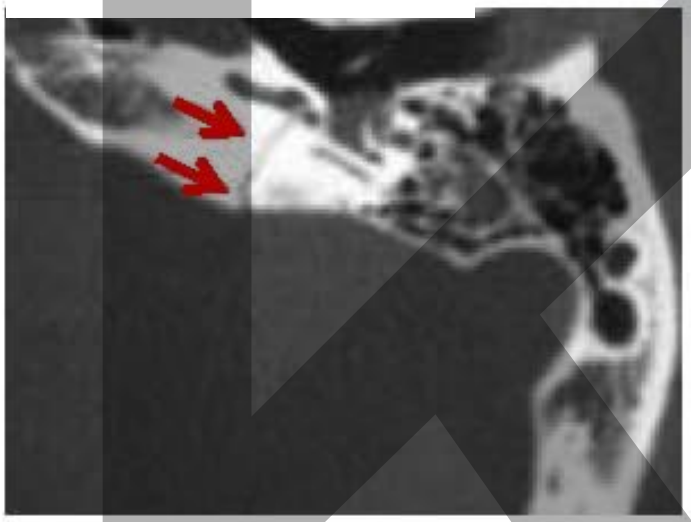
„racoon eyes“

rhinoliqourhea

Fractures of the temporal bone

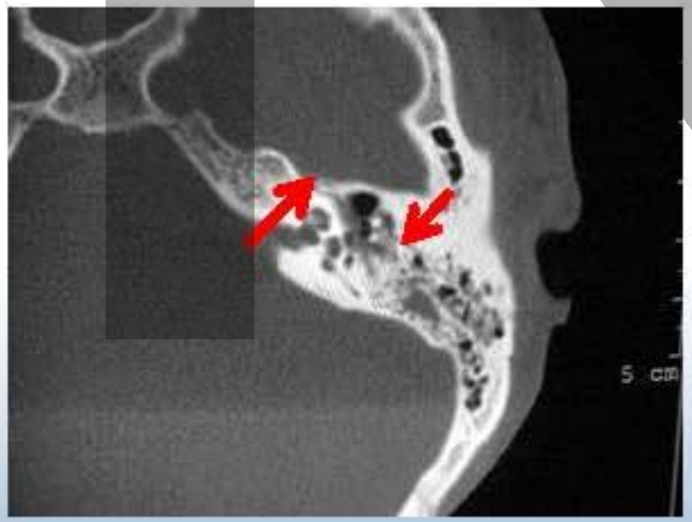


transversal

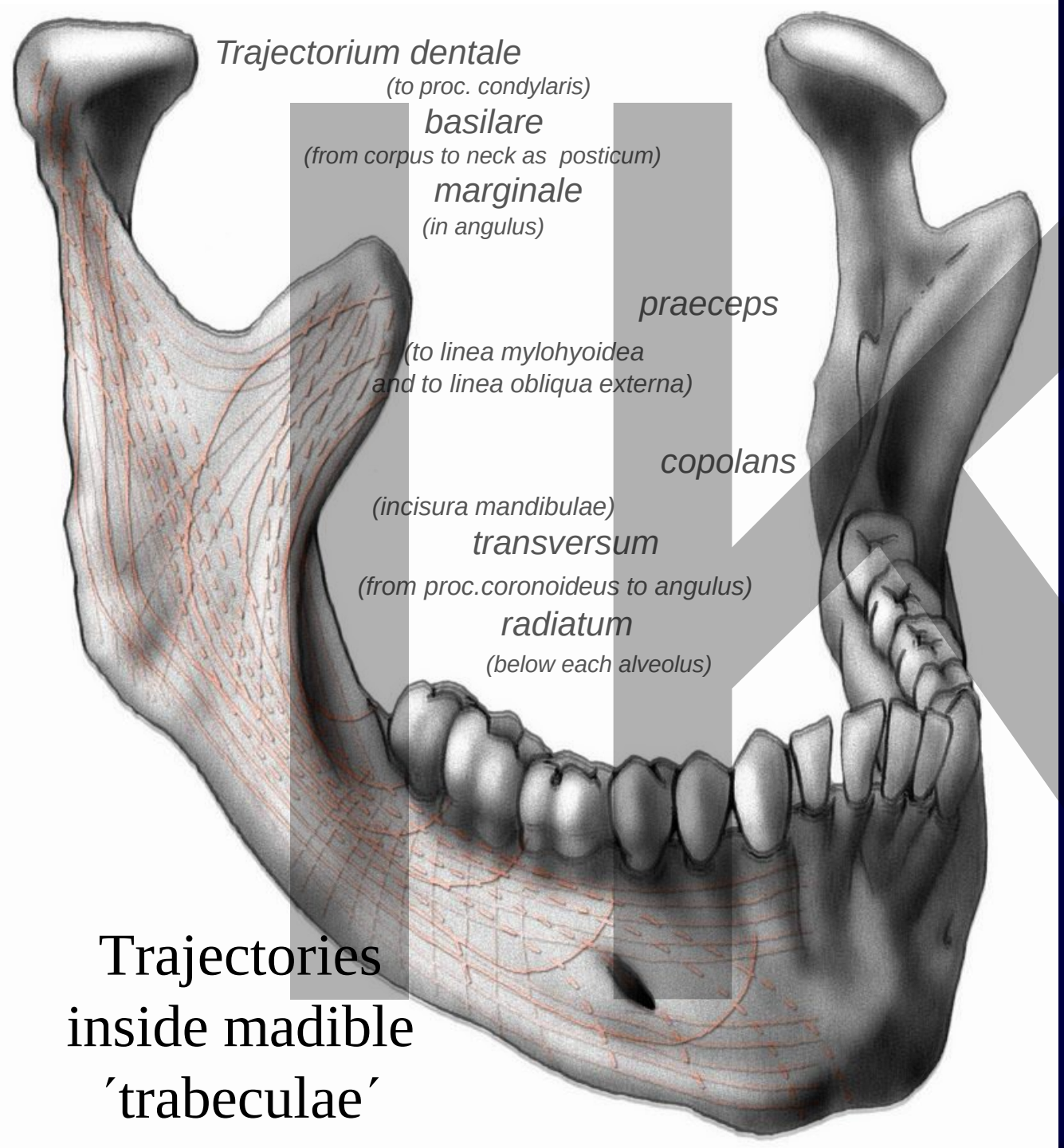


„battle sign“

longitudinal

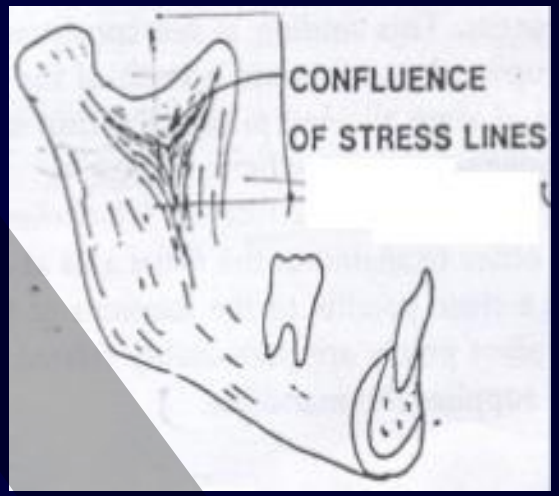


otoliqorhea

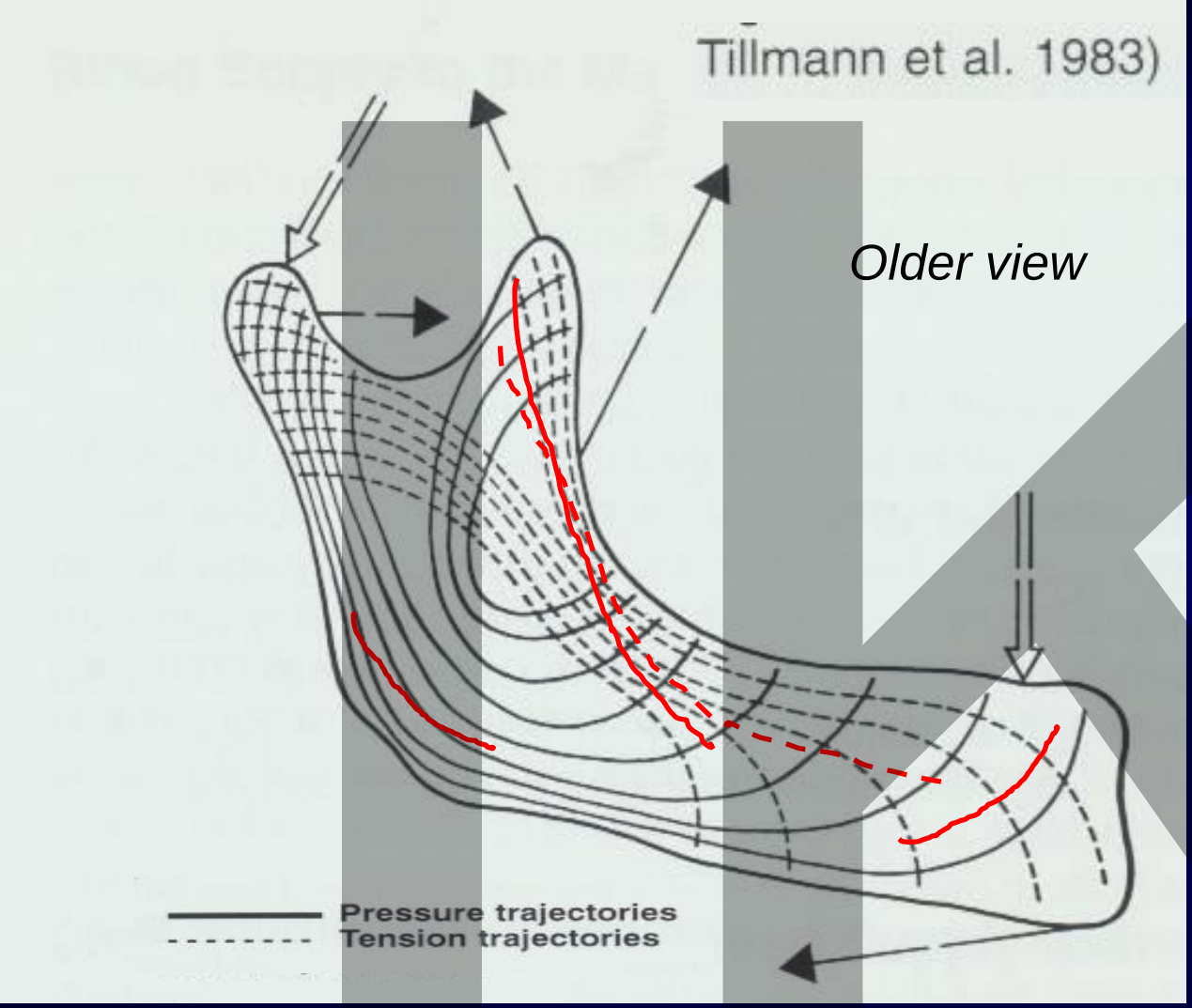


Trajectories inside madible ´trabeculae´

Tension and traction lines in mandible



After Lang 1995



Tension and traction lines in the mandible

Trajectory directions:

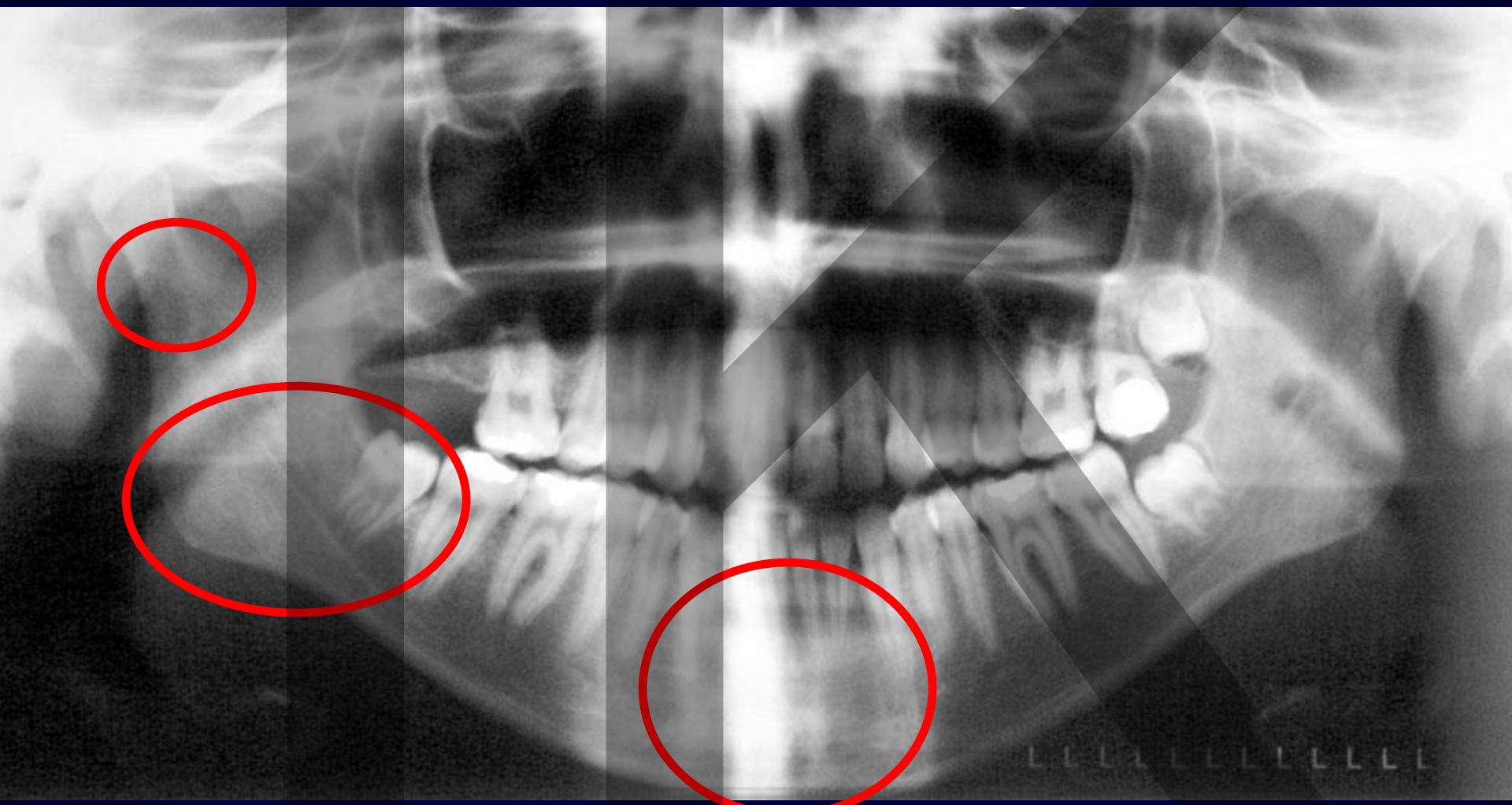
main: *Processus coronoideus - crista colli mandibulae – linea obliqua externa*

internal*: Processus coronoideus - crista temporalis - linea mylohyoidea*

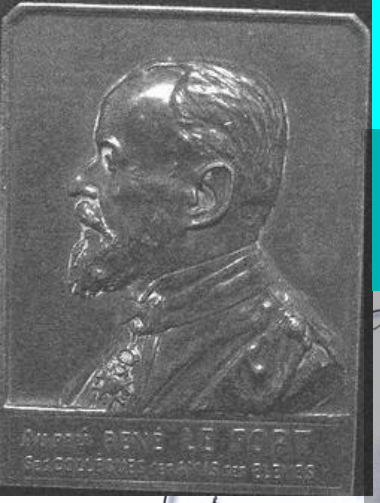
chin: *Ventrální část corpus mandibulae*

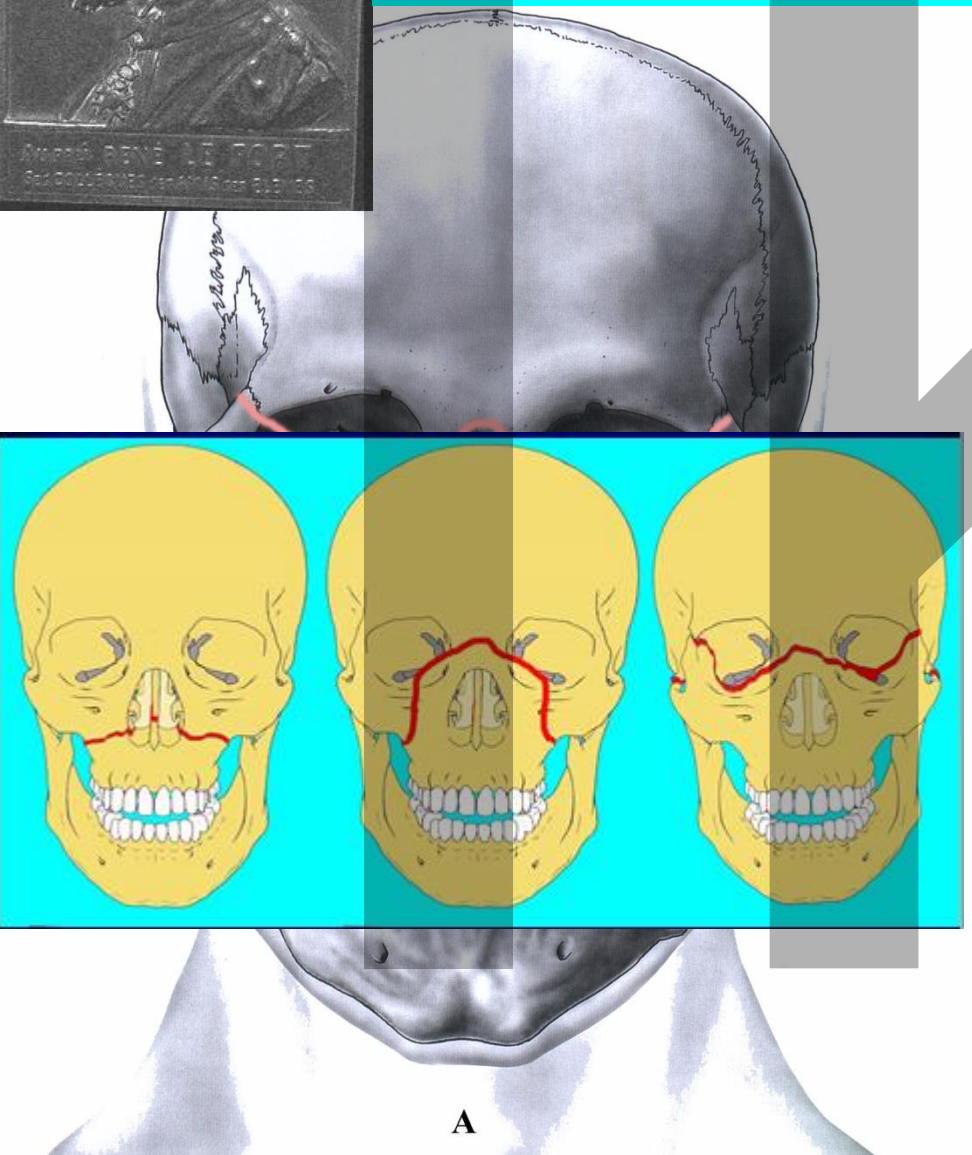
angle: ***inside*** *angulus mandibulae*

Contemporary view - red lines



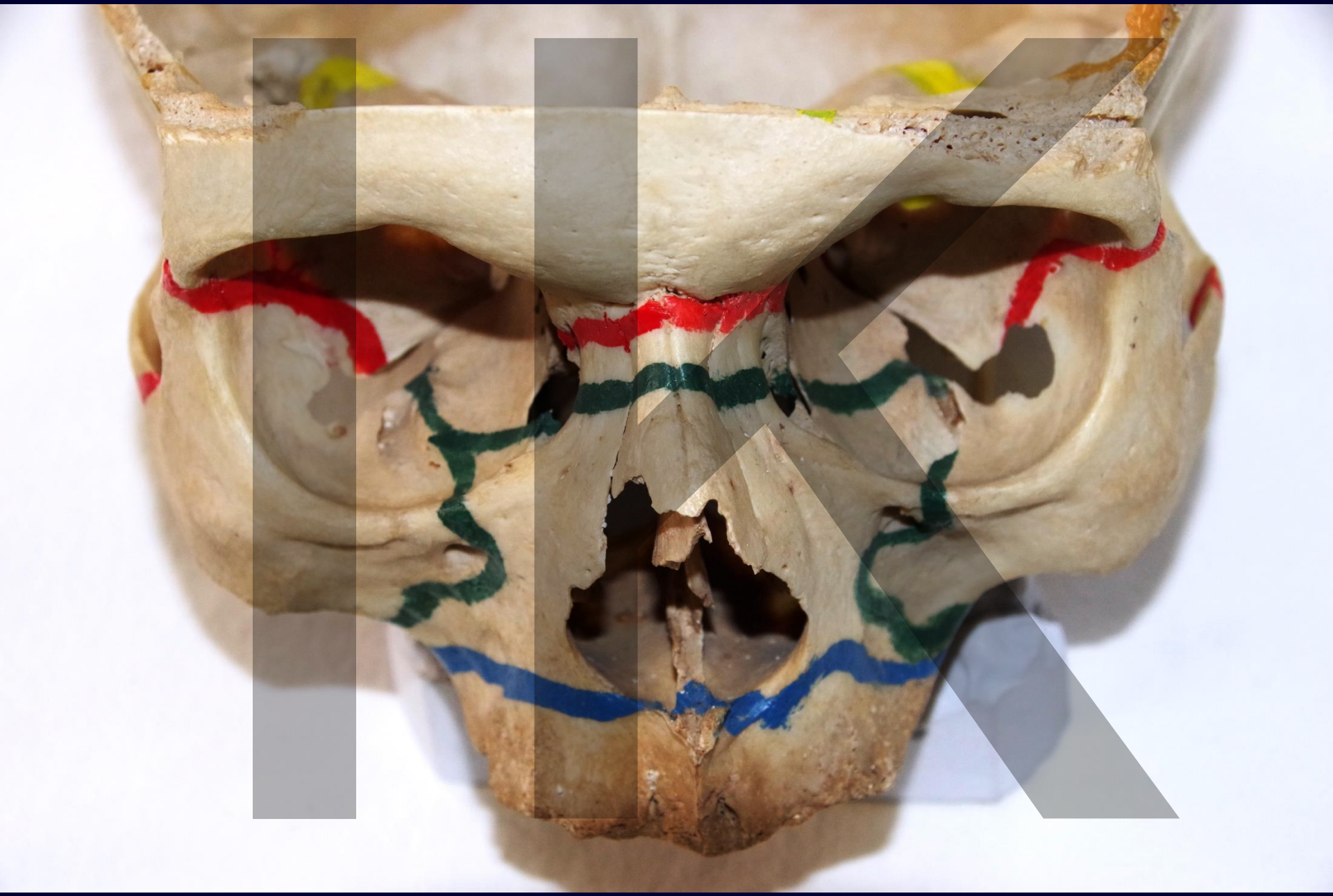
Etude expérimental sur les fractures de la machoire supérieure (1901)





Location of the fracture lines :

- *Medial orbit wall*
- *Lateral orbit wall to sutura frontozygomatica*
- *Processus pterygoideus*
- *Basal part of the nasal septum - septum nasi*
- *arcus zygomaticus*

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