

# General anatomical notes on the relative measurement of the head structures

Overview of base points, lines, and planes

# General Anatomy Sources

- Berkowitz et al.: Oral Anatomy, Histology and Embryology. 3<sup>rd</sup> ed.. Mosby 2002*
- Woelfel, Scheid: Dental Anatomy, 6<sup>th</sup> ed. Williams & Wilkins, 2002*
- Feneis, Dauber: Pocket Atlas of Human Anatomy. Georg Thieme, 2007*
- Weber: Memorix Zahnmedizin. 2<sup>nd</sup>. ed., Georg Thieme Verlag 2003*
- Schuenke, Schulte, Schumacher: Head and Neuroanatomy. Thieme, 2006*
- Fehrenbach, Herring: Anatomy of the Head and Neck. 3<sup>rd</sup> ed., Saunders Elsevier, 2007*
- Snell: Clinical Anatomy for Medical Students. Williams and Wilkins, 2004*
- Moore, Agur: Essential Clinical Anatomy, Williams and Wilkins 2002*
- Lang: Clinical Anatomy of the Masticatory Apparatus and Peripharyngeal Spaces. Stuttgart, Thieme, 1995*
- White, Pharoah: Oral Radiology: Principles and Interpretation 5<sup>th</sup> ed., Mosby, 2003*
- Bath-Balogh: Workbook for Illustrated Dental Embryology, Histology and Anatomy. 2<sup>nd</sup> ed. 2005, Saunders*
- Whaites: Essentials of Dental Radiography and Radiology. 4<sup>th</sup> ed., 2006  
Churchill Livingstone*
- Ivo Klepáček, J. Mazánek et al.: Klinická anatomie ve stomatologii. Grada 2002*
- Own archive*

*see: [www.lf1.cuni.cz](http://www.lf1.cuni.cz)*

*or: <http://anat.lf1.cuni.cz/aindex.html>*

Rostoucí poptávka po ortodoncii dospělých a operacích čelistí a tváře zvyšuje potřebu porozumět procesu změn obličeje i lebeční kostry s věkem.



Connie Culp

Shooted to face;  
defect corrected

2004



The increasing demand for adult orthodontics and orthognathic surgery increases the need to understand the skull and facial aging process.

**FIGURE 7-24** A to E, Presenting a computer-generated simulation of the posttreatment profile can greatly help patients understand the differences between alternative treatment approaches, in this case, the probable profile outcome of orthodontic camouflage of a skeletal Class II problem versus orthognathic surgery to correct the jaw relationship. Although showing patients these simulations heightens their esthetic awareness, it does not seem to create unrealistic expectations.





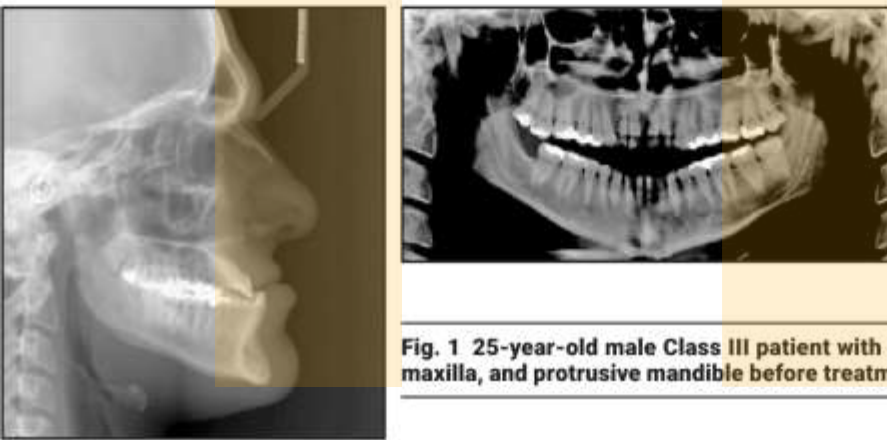
Fotografická analýza  
obličeje  
Photographic face  
analysis



Vyšetření zubů  
Teeth examination



Sagitální analýza  
Sagital analysis



Kefalometrická analýza  
Cephalometric analysis

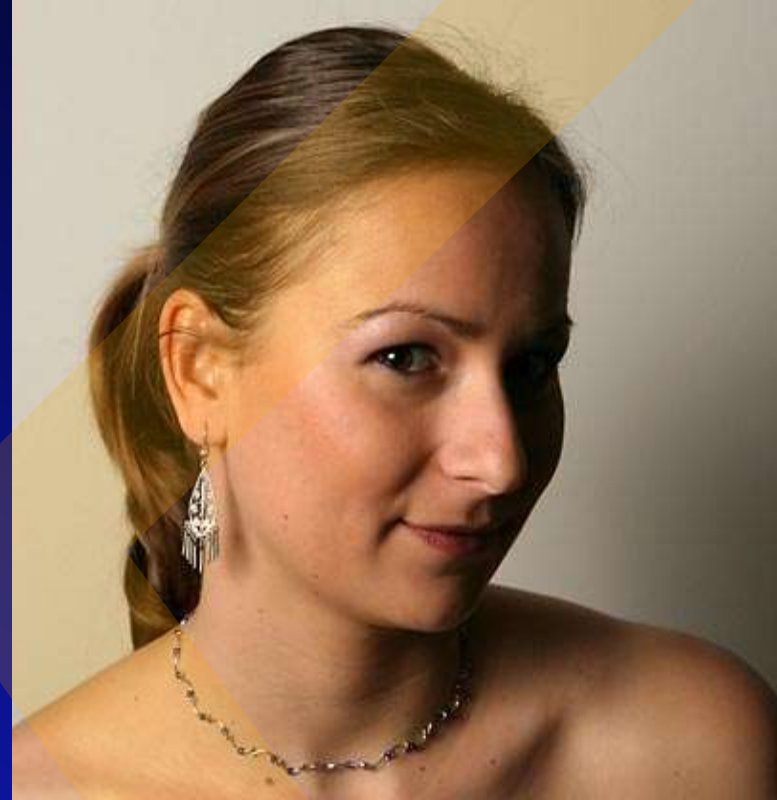
Orthopanthomogram  
Orthopantomogram analysis

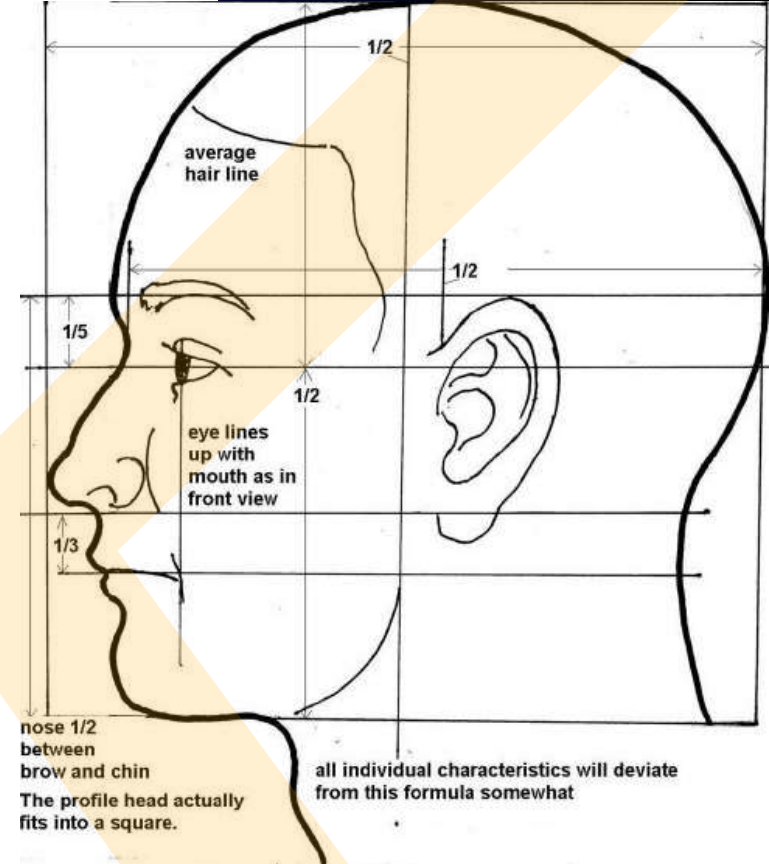
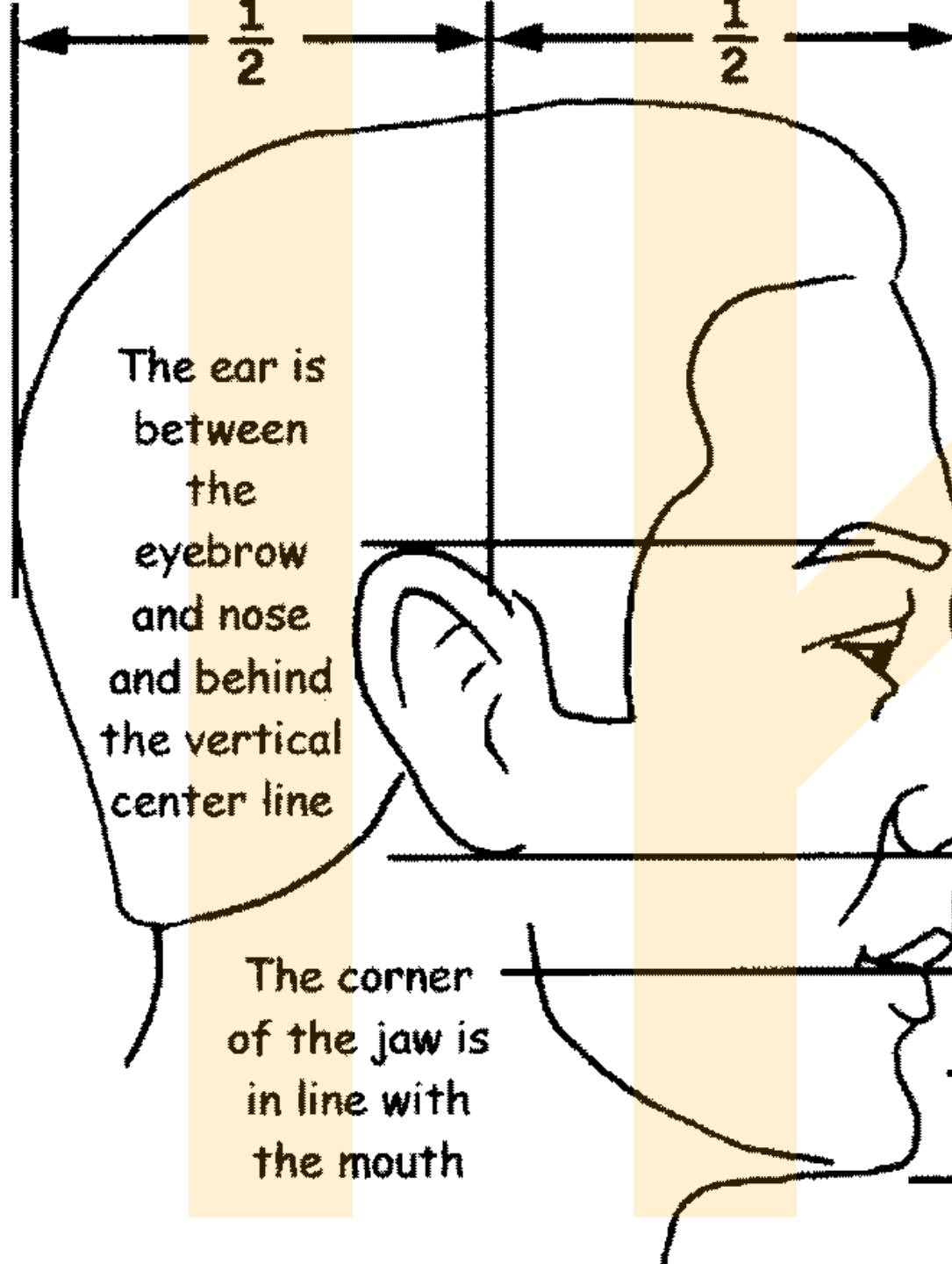
Fig. 1 25-year-old male Class III patient with anterior crossbite, retrusive maxilla, and protrusive mandible before treatment.

In aesthetic perception of the face, we assess it according to the morphological arrangement of the mimic muscles in relation to the formation of the skull.

Aesthetically acceptable is a face with a slight protrusion of the lower (dental) third of the face.

The lower dental third may exceed one-third of the average by 5-10 mm without being aesthetic. Aesthetically unfavorable is the shorter height of the dental third compared to a third of the middle (deep bite).





all individual characteristics will deviate from this formula somewhat

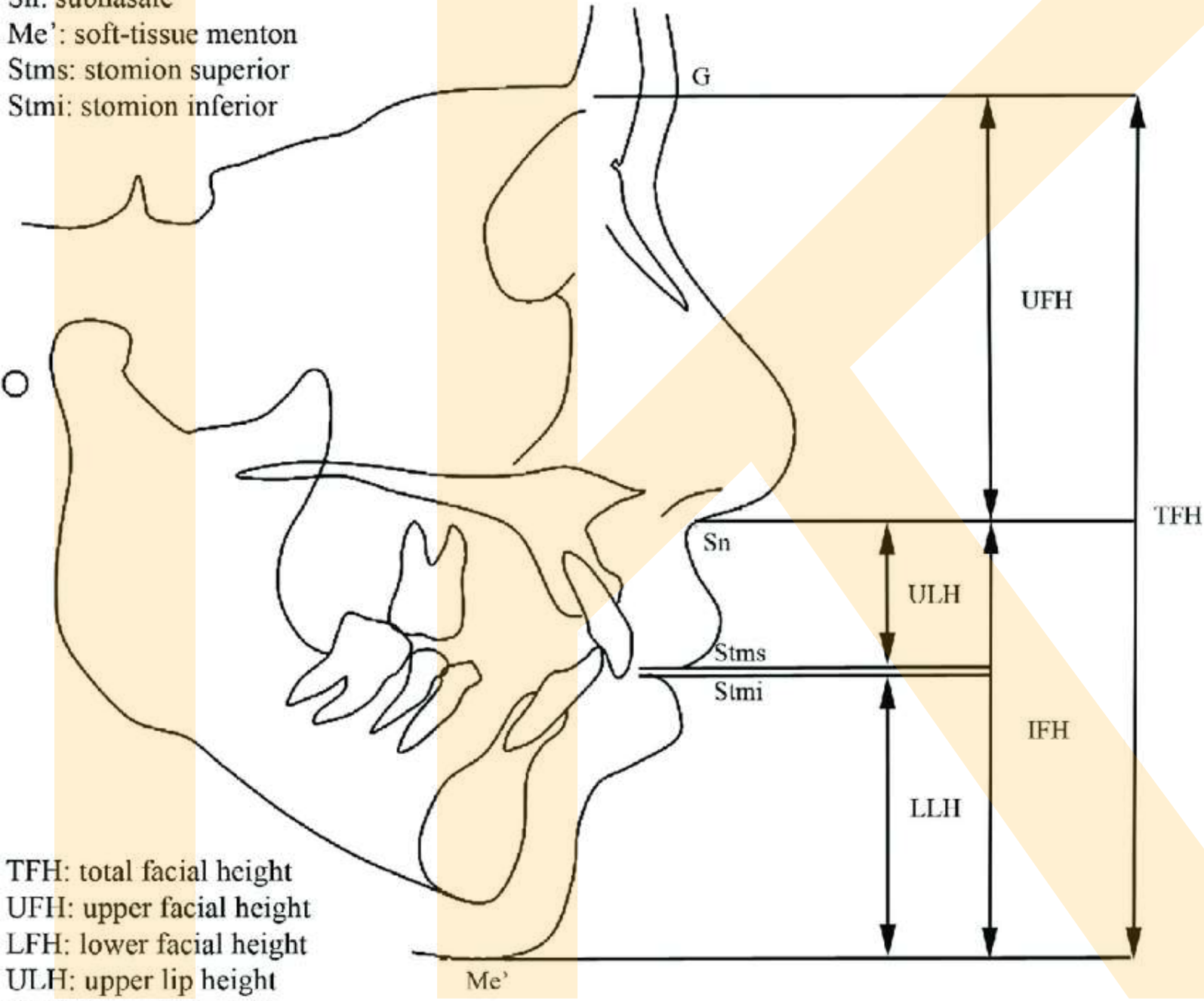
1/3

1/3

1/3



G: glabella  
Sn: subnasale  
Me': soft-tissue menton  
Stms: stomion superior  
Stmi: stomion inferior



TFH: total facial height  
UFH: upper facial height  
LFH: lower facial height  
ULH: upper lip height  
LLH: lower lip height



## PROFILE

### ANALYSIS

#### PROPORTIONAL ANALYSIS

Ideal profile provides a basic standard for assessment of **average profile**

**Ideal profile** ; Can be divided into three equal parts

Frontal Third ( Tr- N )

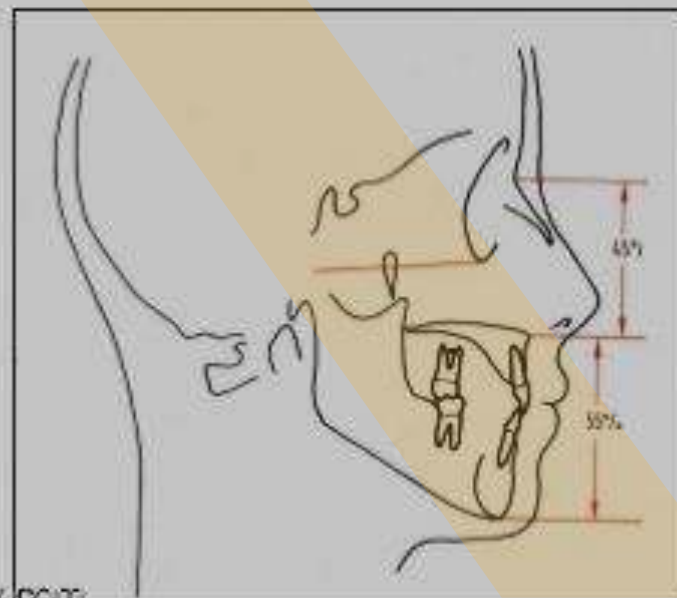
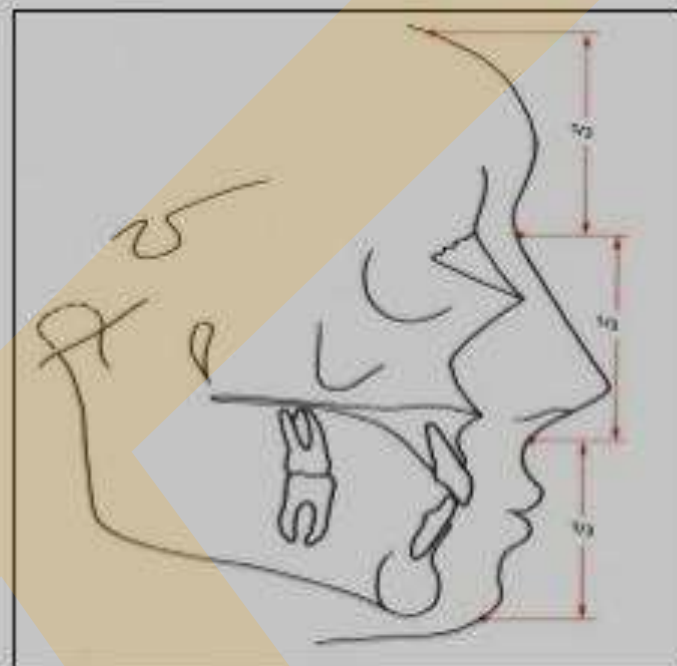
Nasal Third ( N - Sn )

Gnathic Third ( Sn - Gn )

#### ANTERIOR FACE CAN BE PROPORTIONED ( N - Gn )

Midface - N To Sn - 45%

Lower Face - Sn To Gn - 55%





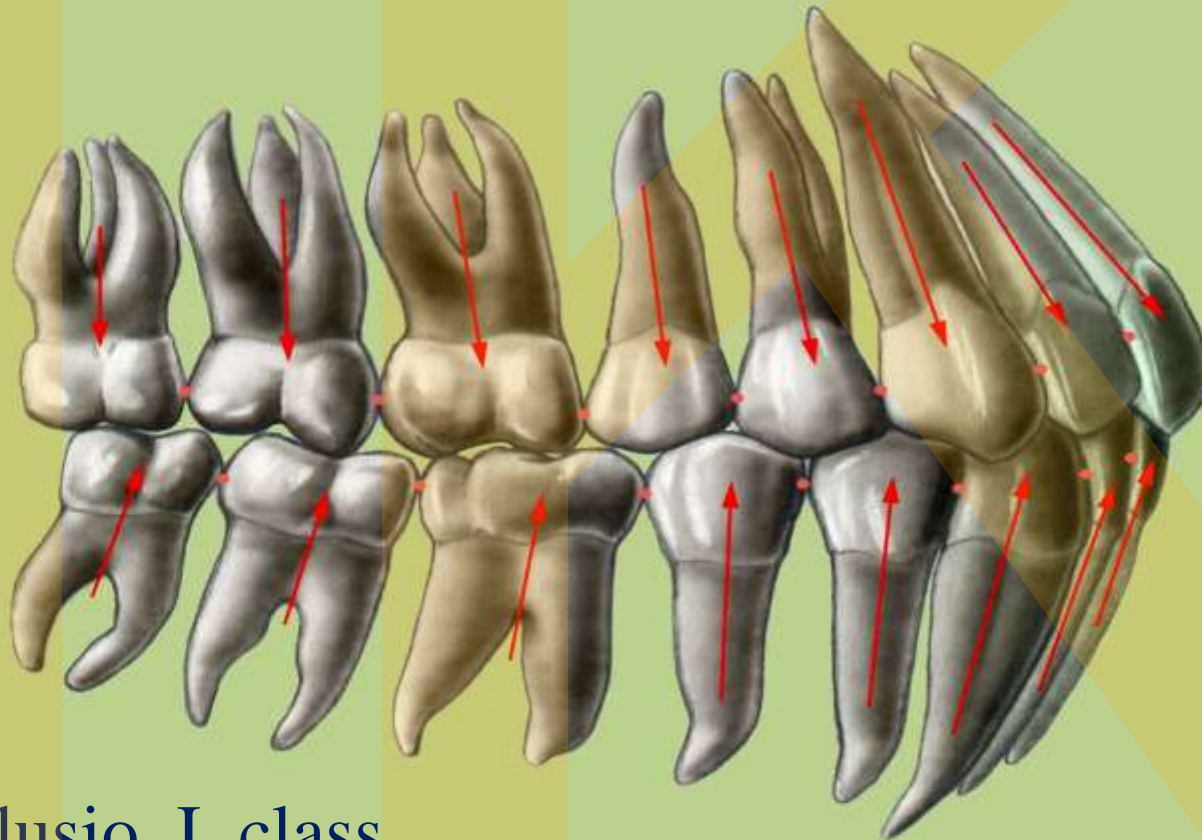
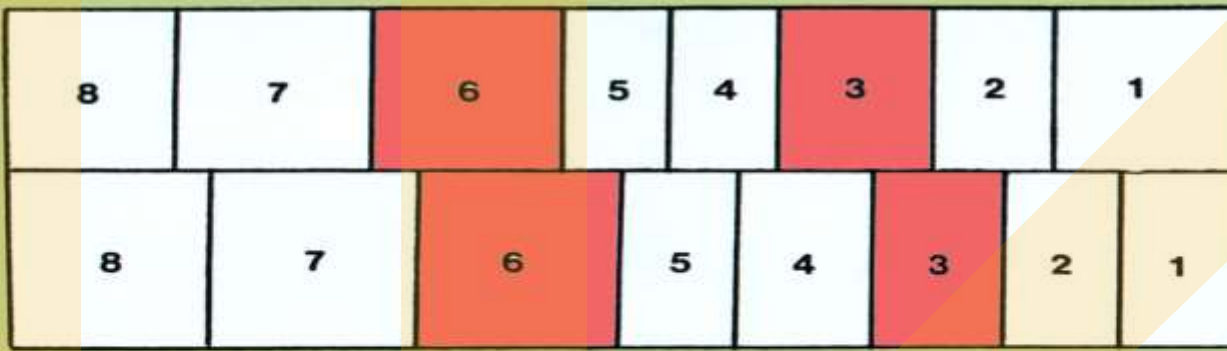
**Skeletal analysis (kephalometric)** - side analysis of the skull based on anatomical or constructed points and lines creating sagittal and vertical parameters of the skull profile image. Three skeletal classes are defined according to the relationship of the apical bases of the upper and lower jaw

Proč linie body a roviny



Why lines, points and planes

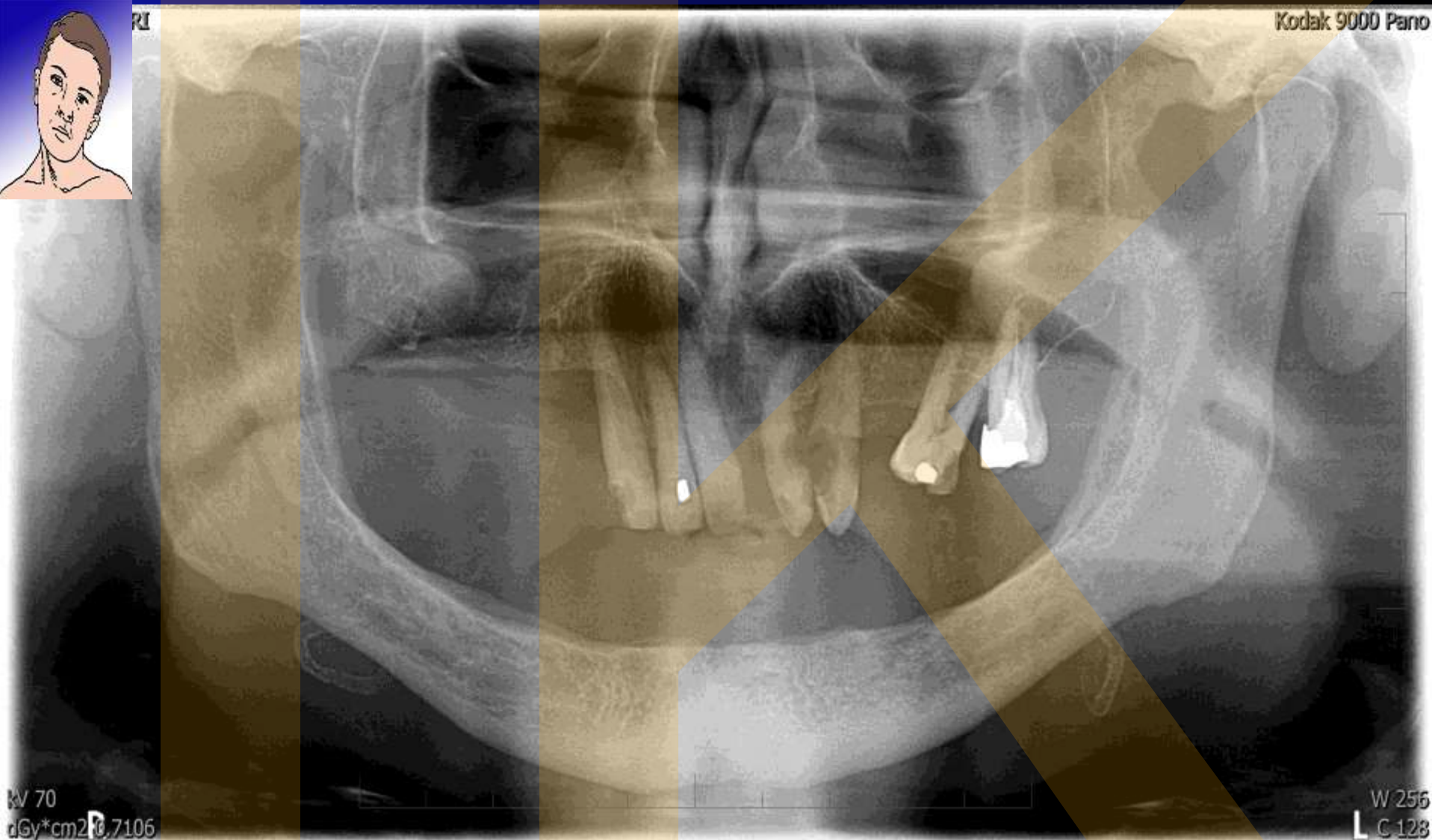
**Sagittal analysis** - Angle - dental analysis according to the sagittal relationship of the first permanent molars I., II., III. Class



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

Normoocclusio I. class

The usual occlusal relationship between the teeth of the opposite arcs



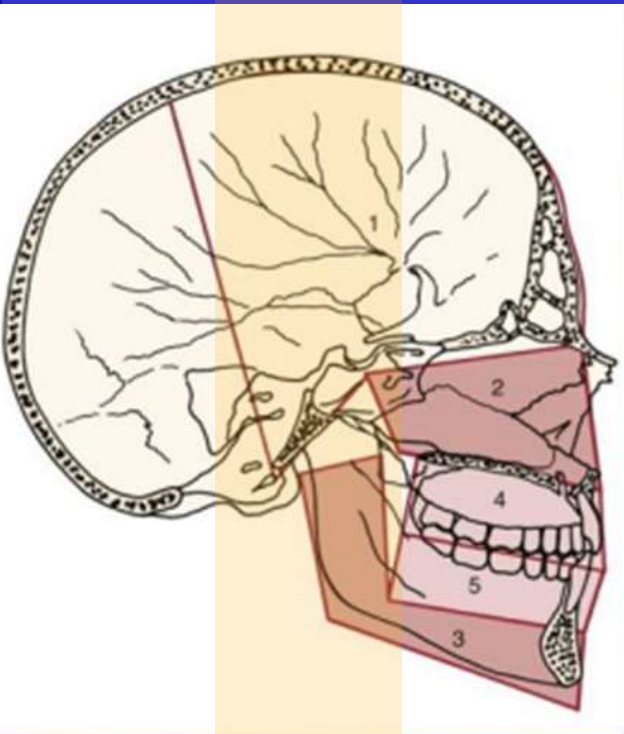
Lze rozeznat chorobné nebo úrazové změny zobrazených kostí, větší (i skryté) zubní kazy a orientačně také stupeň poškození parodontu.

Bone structures of the upper jaw, including all teeth, the image of the jaw cavities and the nasal cavity, and at the same time a picture of the entire lower jaw with both jaw joints and teeth.

It is possible to distinguish diseased or traumatic changes of the displayed bone, larger (even concealed) dental decay, and indicatively the degree of periodontal damage.

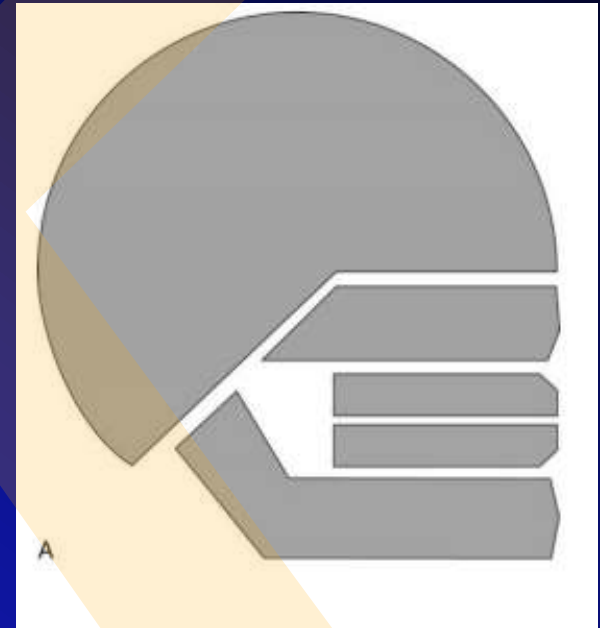


Ideální vztahy mezi obličejovými a zubními komponentami: Kefalometrická analýza dokáže rozlišit a vyjasnit zubní a skeletální příspěvky k malokluzím, které představují identické dentální vztahy.



Basis cranii,  
the skeletal maxilla, the  
skeletal mandible  
and nasomaxillary complex  
are face parts existing whether  
there is or not dentition.

The teeth and alveoli are  
independent functional units,  
which can be displaced  
relative to jaw bone,  
respectively.



The cephalometric analysis is to establish the relationship of all face components in both the anteroposterior and vertical planes of space.

**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.**



**Třída II. Malokluze třídy 1 by mohla být způsobena**

B) Protruzí maxilárních zubů, přestože je čelist normální

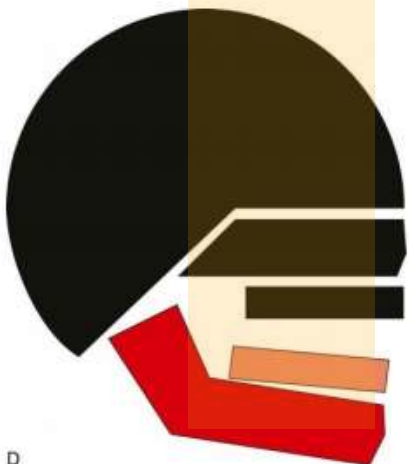
C) malá mandibula, ale zubní oblouky obou čelistí jsou spolu normálně související

D) otáčení mandibuly směrem dolů a nazad, podporuje nadměrný vertikální růst horní čelisti, prodlužování čela

Příklad k úvaze

Perhaps the most important clinical use of radiographic cephalometrics is in recognizing and evaluating changes brought about by orthodontic treatment. Superimpositions taken from serial cephalometric radiographs before, during, and after treatment can be superimposed to study changes in jaw and tooth positions retrospectively (Figure 6-39). The observed changes result from a combination of growth and treatment (except in nongrowing adults). It is all but impossible to know what is really occurring during treatment of a growing patient without reviewing cephalometric

**The objective of cephalometric analysis is to visualize the contribution of skeletal and dental relationships to the malocclusion**

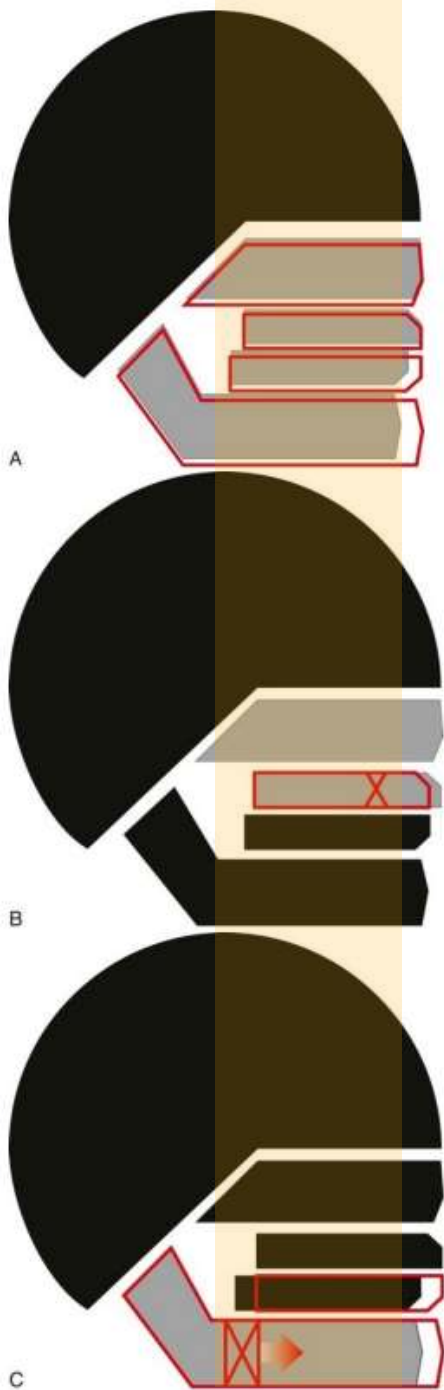


Možné korekce skeletální třídy II. znamenají úpravu::

A) stimulace dopředného růstu mandibuly pokud je jedinec mladý

B) Maskování větší maxily retrakcí horních řezáků;

C) Orthognathická chirurgie, která posune dolní čelist do správné polohy



**FIGURE 7-35** The possibilities for correction of a skeletal Class II problem include the following: **A**, Differential forward growth of the mandible, which is the ideal method if the patient has not yet gone through the adolescent growth

sprint; **B**, camouflage by retraction of the maxillary incisors, which can be quite successful *if* the other facial features allow it; and **C**, orthognathic surgery to move the mandible forward to a normal relationship. In the absence of growth, camouflage and surgery are the only possibilities.

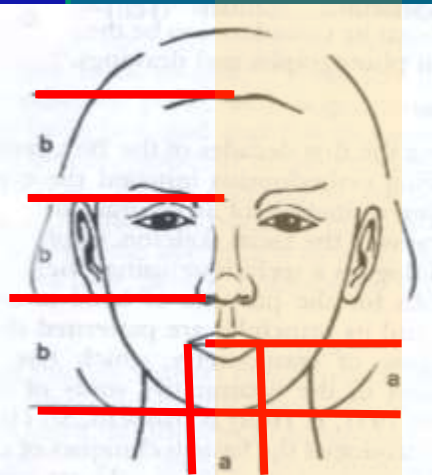
Пříklad k úvaze

Rozměry, úhly, body,  
linie

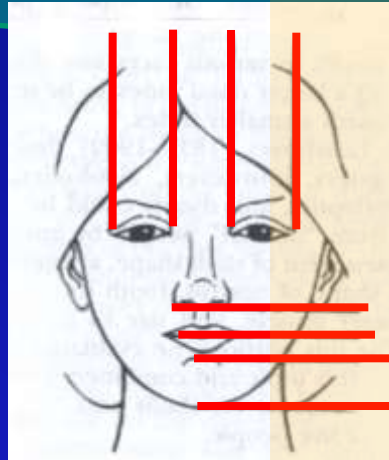
Proportions, sizes,  
angles, points, lines

# ? Esthetic and proportionally accepted face ?

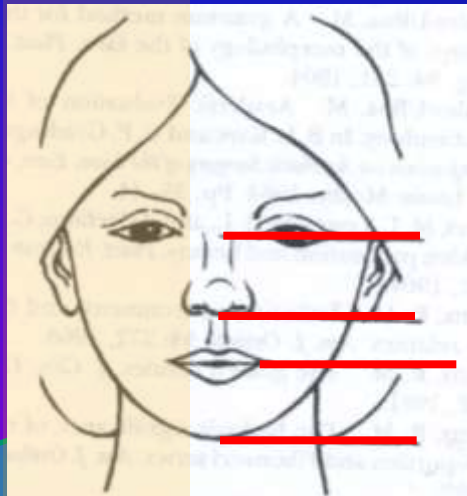
Pythagoreans → Euclid → Egyptians → Greeks → up to date



Leonardo da Vinci  
1452-1519



Albert Dürer  
1471-1528



R.M. Ricketts

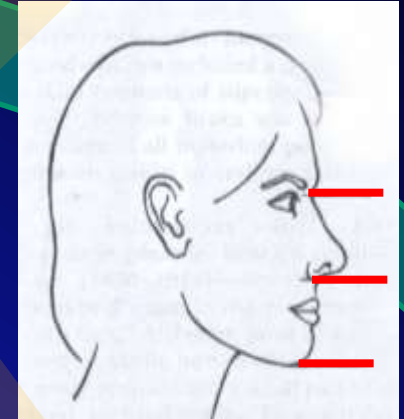
Petrus Camperus  
(Pieter Camper)  
1722-1789

Joseph A. de Gobineau  
1816-1882

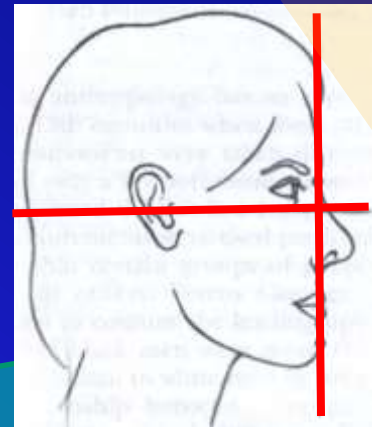
Paul Broca  
1824-1880

Paul Topinard  
1830-1911

Cesare Lombroso  
1836-1909



Jacques Joseph  
1865-1934



Mario González-Ulloa  
1913-1995



## Occlusal plane ('bite' plane, *planum occlusale*)

It is the plane passing through the upper incisor point and the spikes of the two interobubular bumps of the first upper chambers.

It is the plane passing through the lower incisor point and the flowing distobucal bumps of the other lower stools. It lies at the level of the touch point between the upper and lower lips.

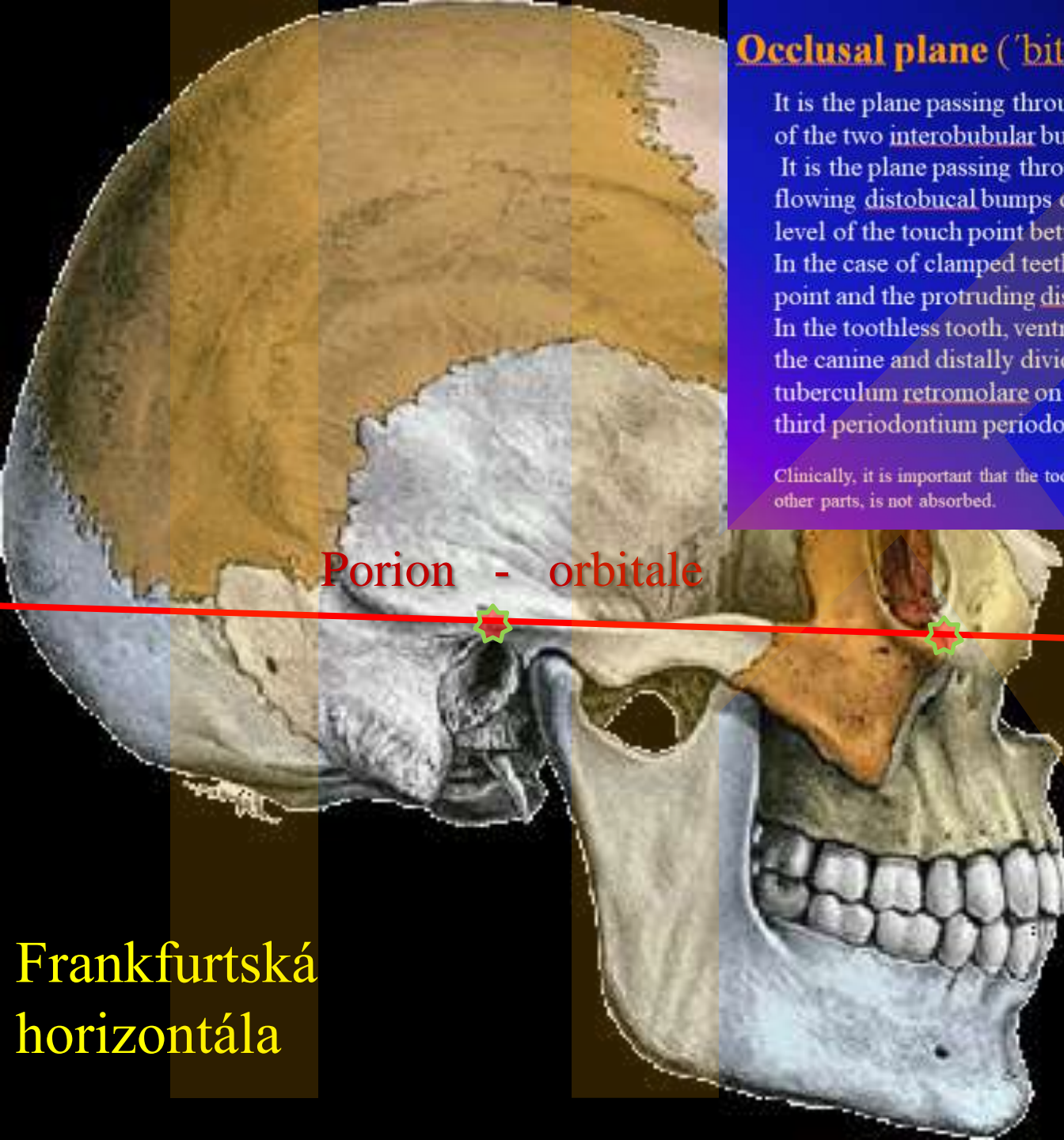
In the case of clamped teeth, it passes through the upper incisor point and the protruding distobucal bumps of the other lower stools. In the toothless tooth, ventrally passes through the retina, the tip of the canine and distally divides the **trigonum retromolare** or **tuberculum retromolare** on both sides. This remainder of the lower third periodontium periodontal is evident in the toothless jaw.

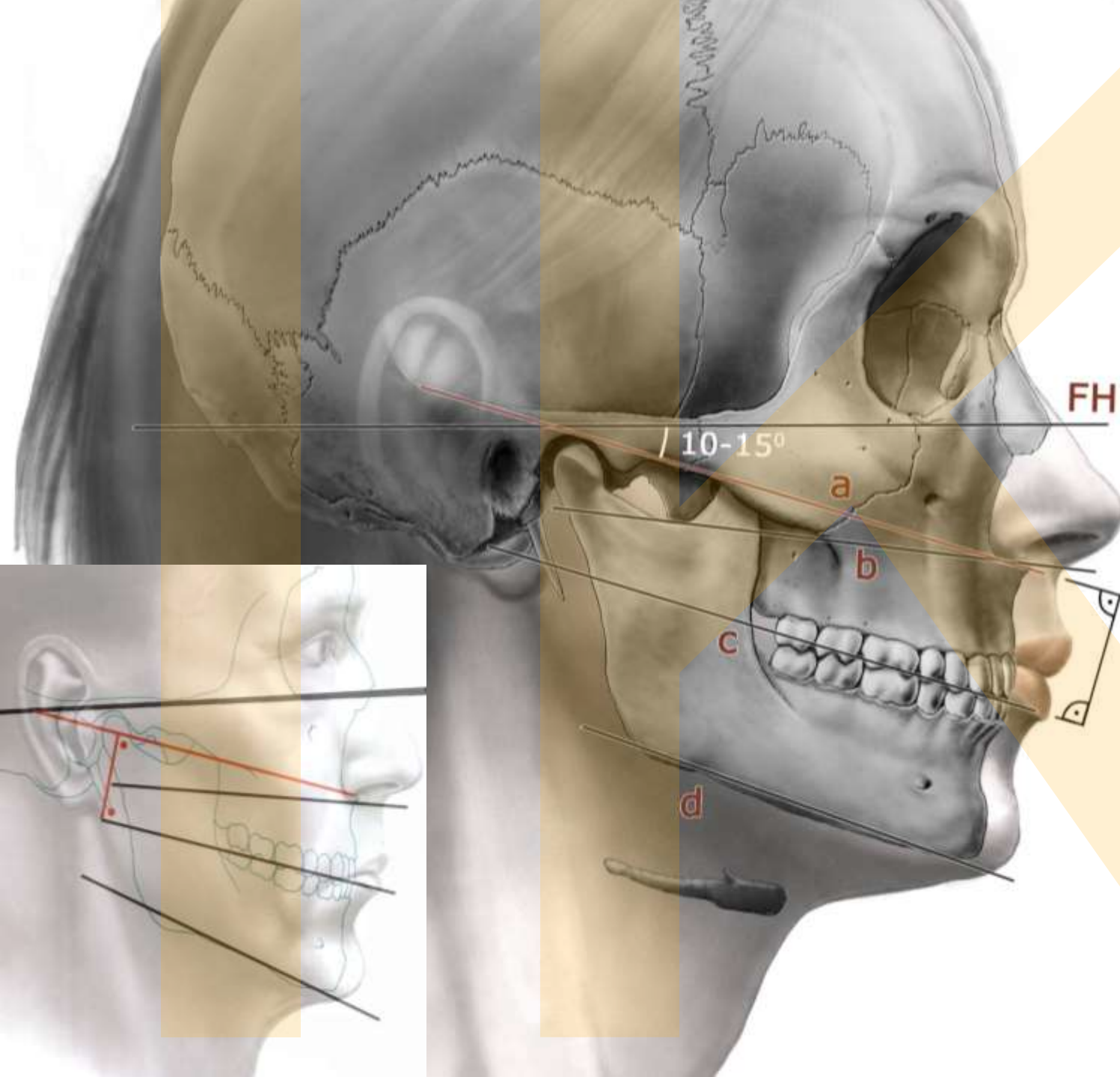
Clinically, it is important that the toothless alveolar protrusion underneath it, unlike its other parts, is not absorbed.

Porion - orbitale

Reid line,  
Line of zygomatic  
bone,  
Frankfurter  
horizontal plane

Frankfurtská  
horizontála





Determination of the occlusal plane using Camper plane (a);

It relates to maxilar (b) and mandibular (d) planes



Ferdinand Graf von Spee  
(1855-1937), German embryologist

Spee curve

Frontální  
Linie

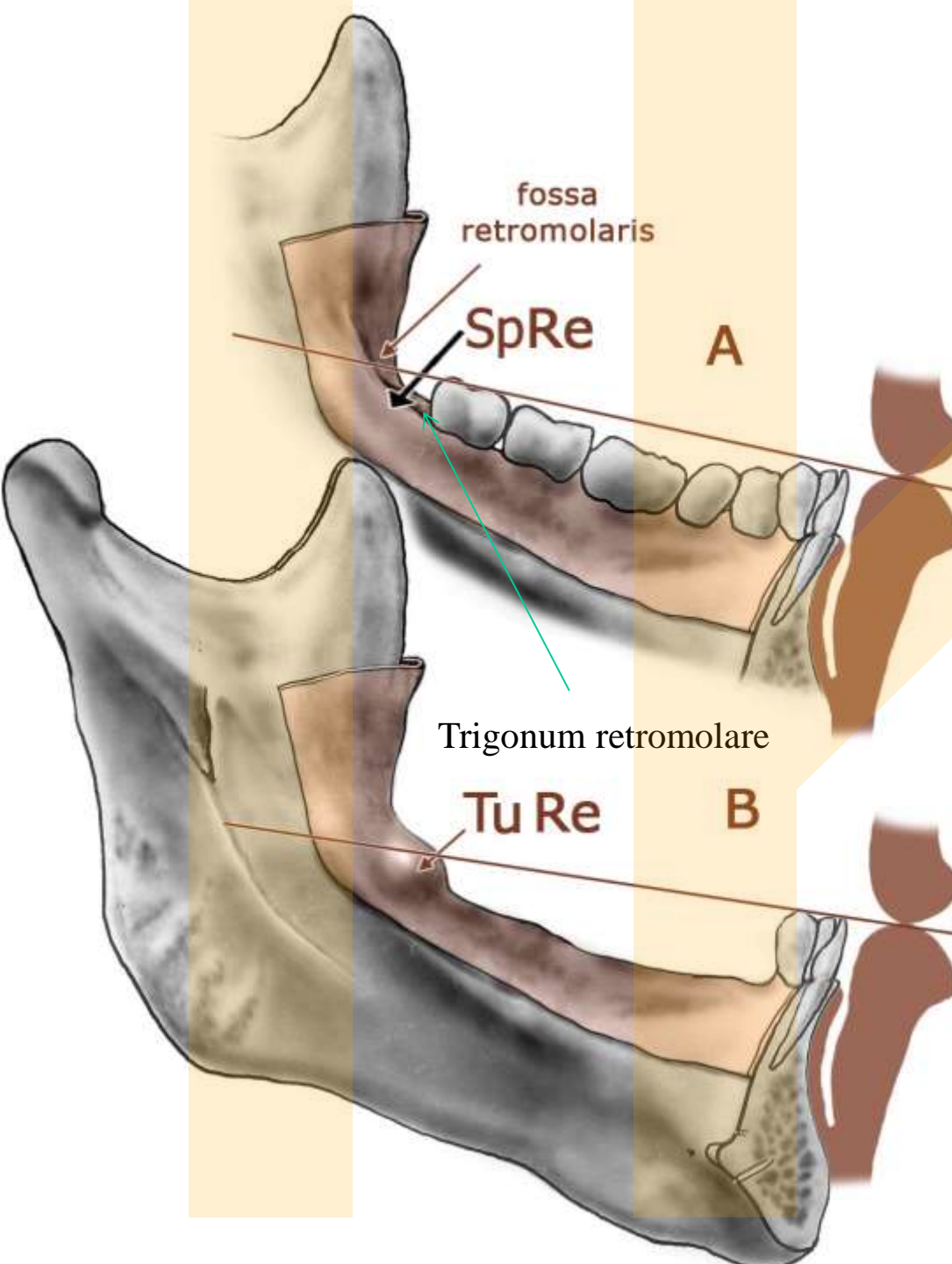
Frontal  
line

Laterální  
Linie

Lateral  
line

Monson (Wilson) curve

George S. Monson  
(1869-1933), am. dentist

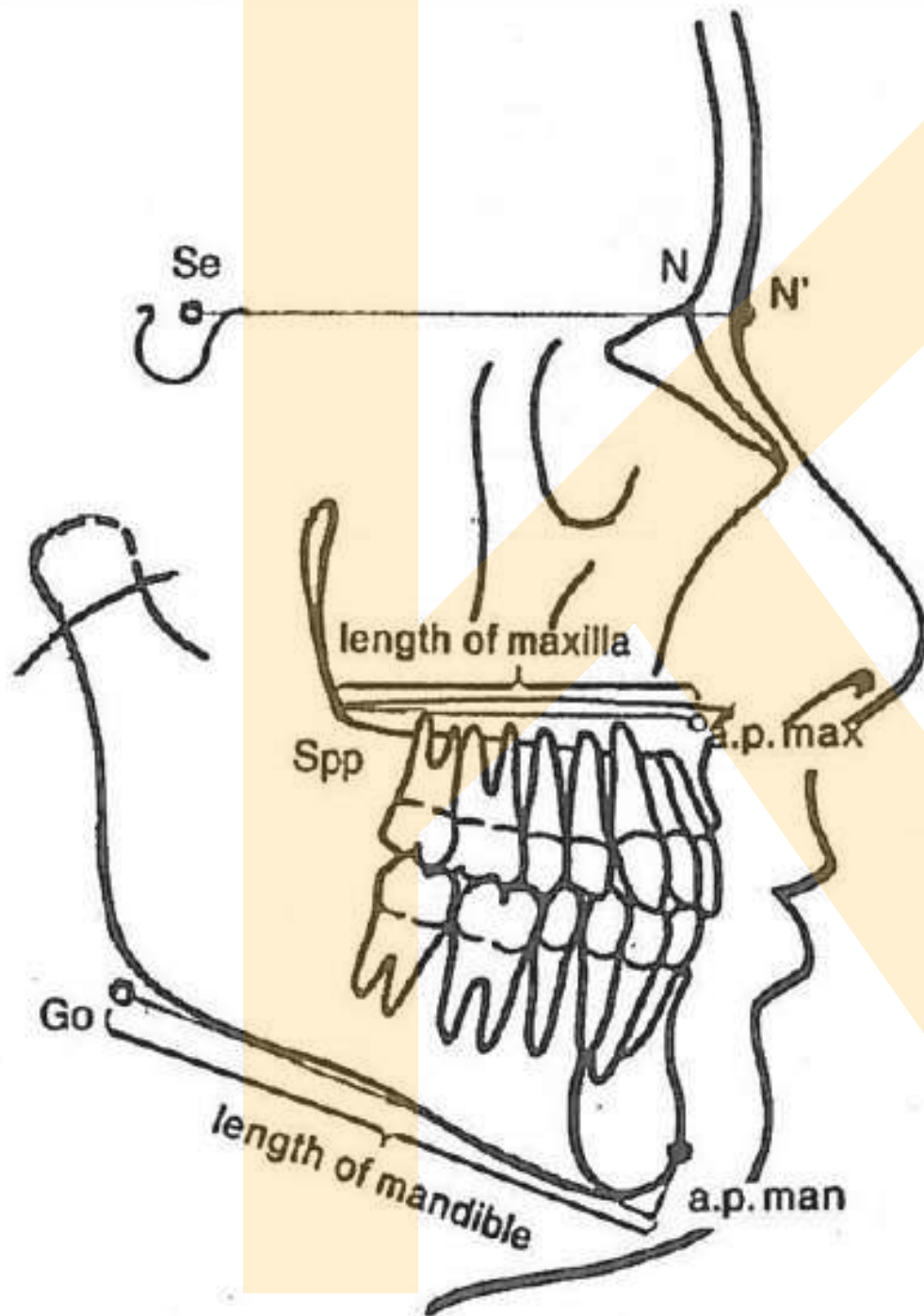


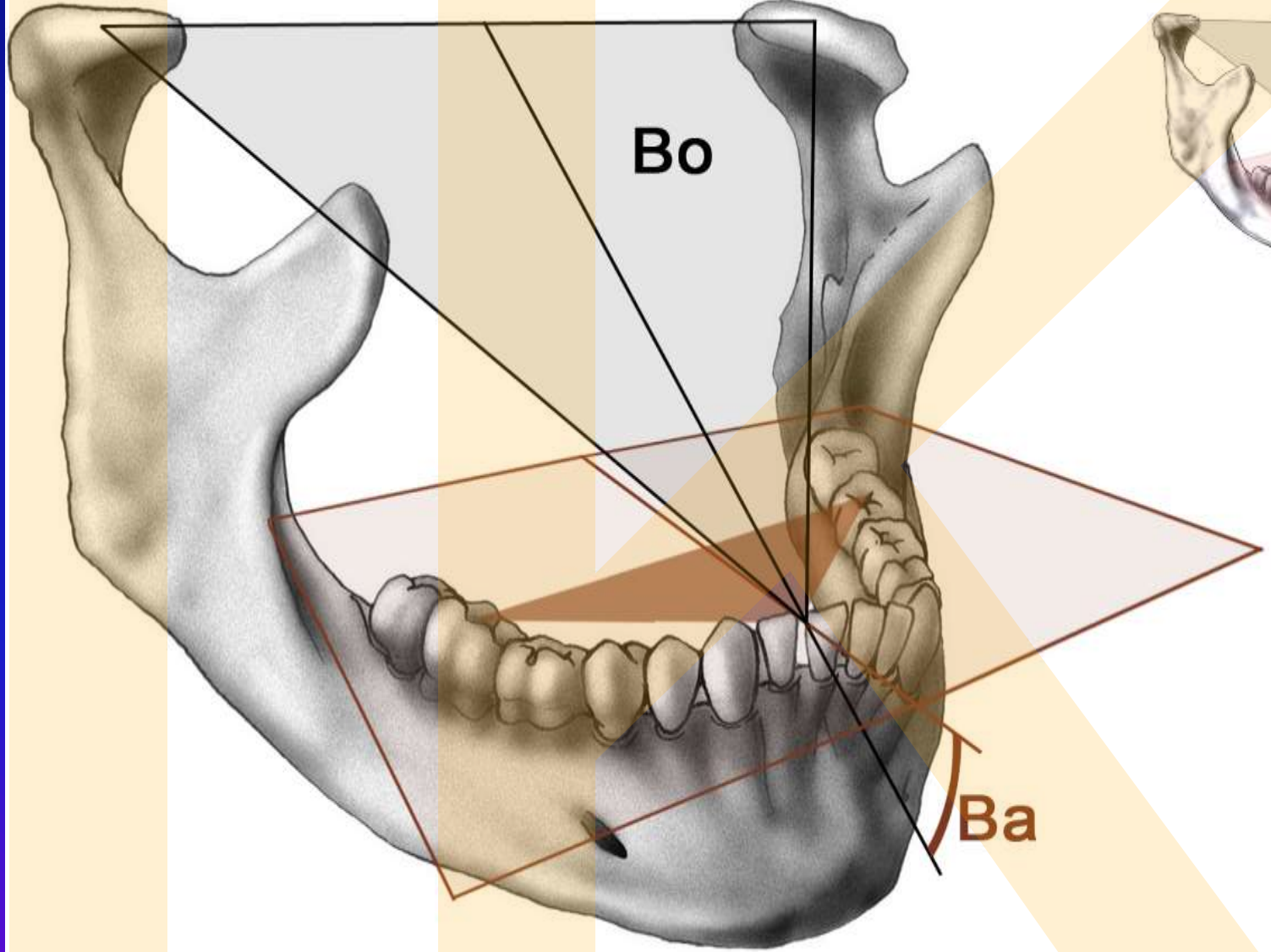
Determination  
of the occlusal  
plane if there is  
complete  
or incomplete  
dentition

**S**patium **re**tromolare

**T**uberculum **re**tromolare







**Bonwill triangle** is an equilateral triangle, the vertices of which are the lower incisor point and the geometric centers of the mandibles. The length of one side is about 10.5 cm. They touch the spikes of the lower canines. The plane of the triangle is at an angle of  $20^\circ$  to  $25^\circ$  with the occlusal plane (**Balkwill angle**).

# Palatal index:

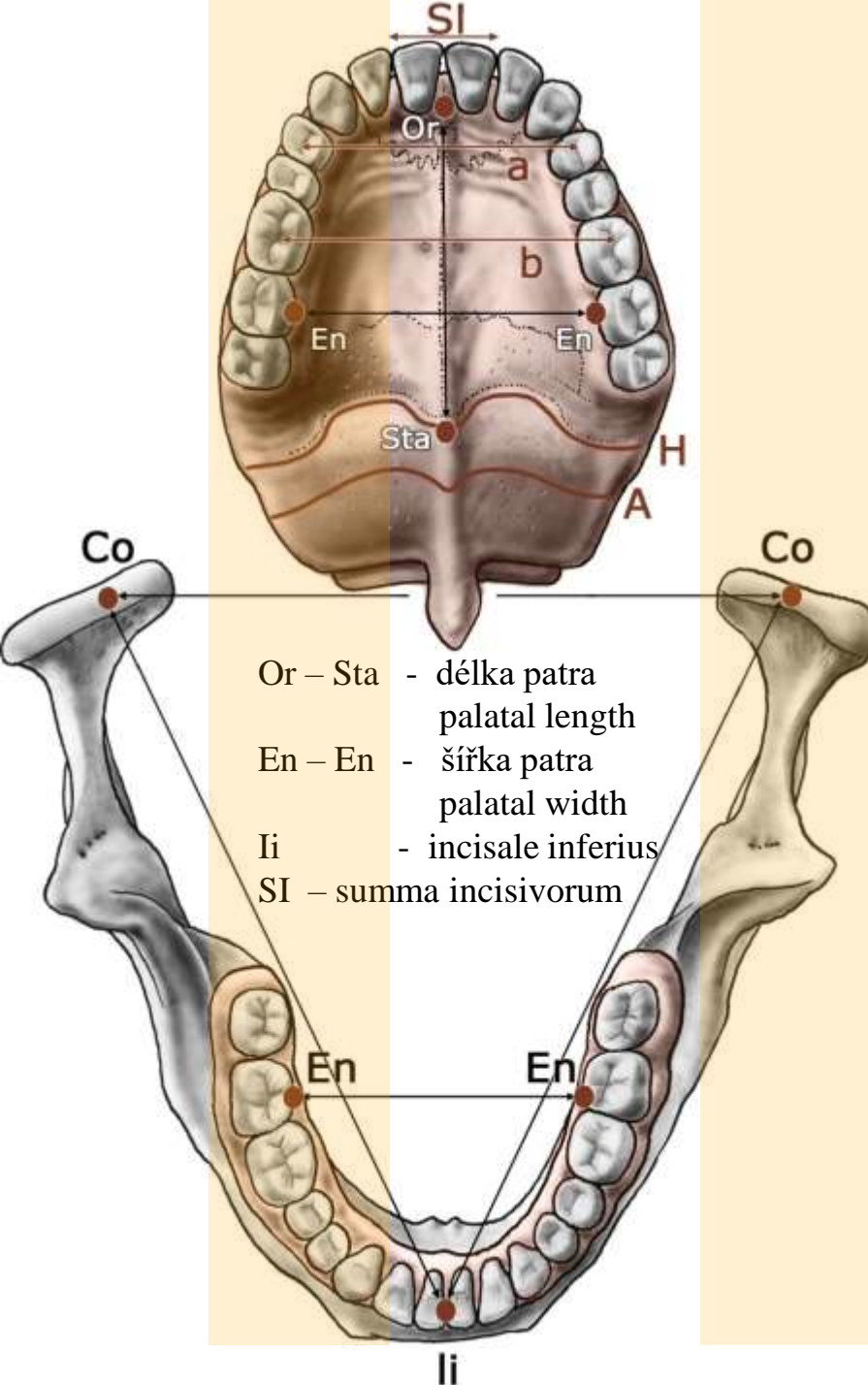
$$i = \text{En-En} \times 100 / \text{Or-Sta}$$

- i - do 79,9 - úzké patro**; narrowed palatum  
leptostaphylinní
- i - 8-84,9 - středně široké patro**;  
middle wide palatum  
mezostaphylinní
- i - do 79,9 - široké patro**; wide palatum  
eurystaphylinní  
(brachystaphylinní)

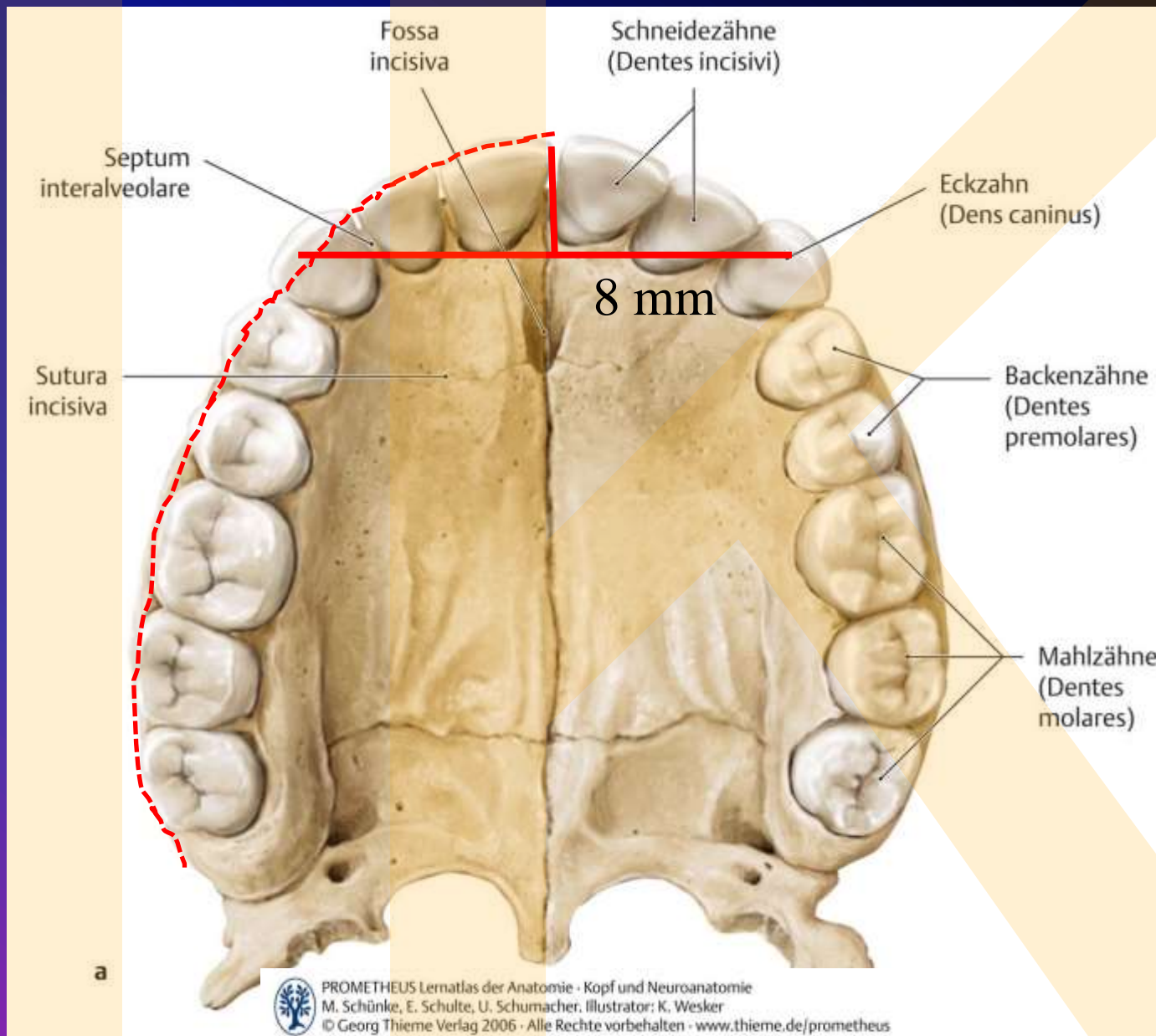
**H** – linie mezi tvrdým a měkkým patrem  
Hauptmayer line

**A** – linie mezi pohyblivou a méně pohyblivou částí  
měkkého patra  
line between moveable and relative non moveable  
parts of the soft palatum

**Co-Ii-Co** – Bonvillův trojúhelník  
Bonvill triangle







Hrbolková linie  
 Tubercular line

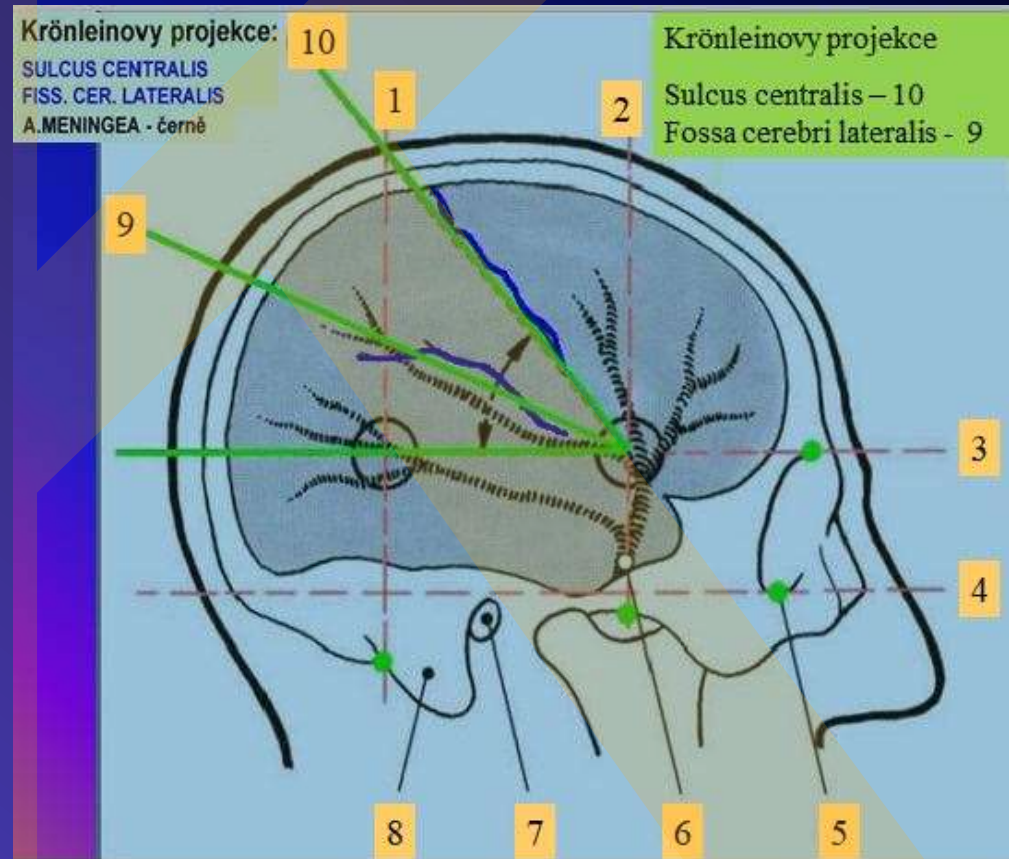
Vzdálenost od řezákového bodu ke spojnici mezi hroty špičáků  
 Distance between incisale point and line connecting tops of canini

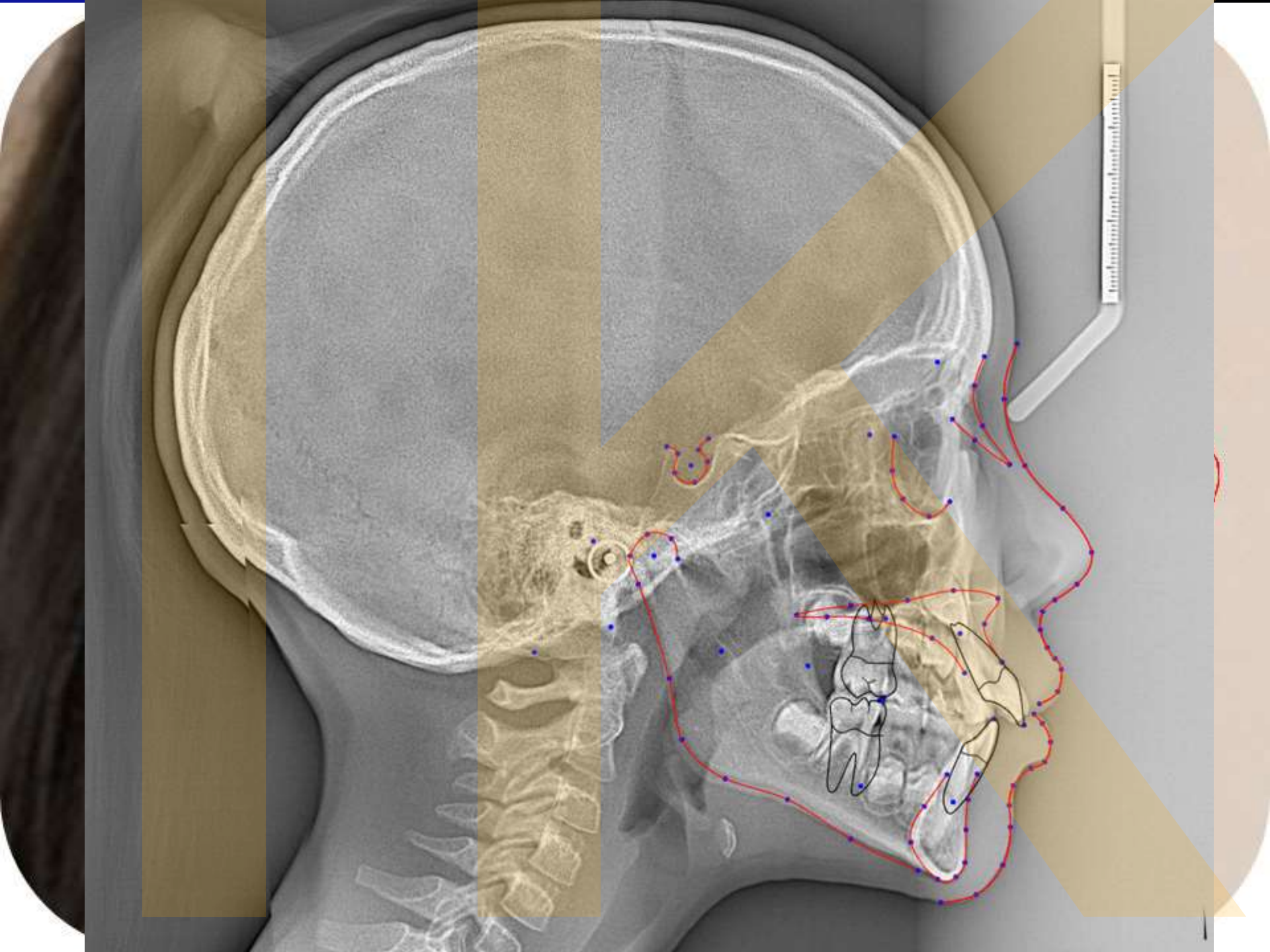


# Kroenlein lines and points for detections of intra- and extra- located arteries

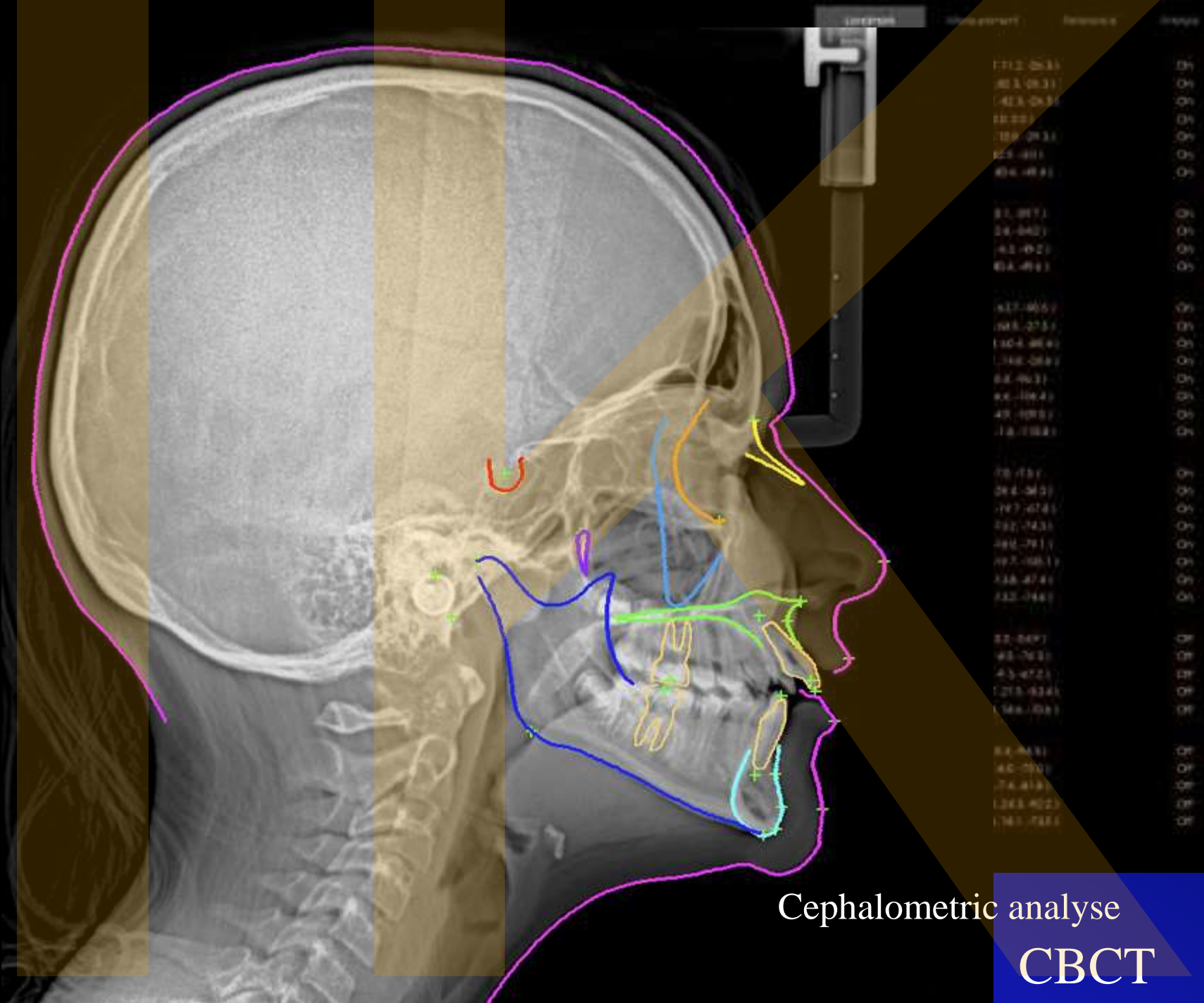
Point K (determines the place of ligament of the temporal artery. We determine it as the point of intersection of the line passing through the center of the zygomatic arch and the perpendicular Frankfurter horizontal line.

Point K1 serves to ligate the ramus frontalis of the same artery  
point K2 to ligate its ramus parietalis.









Cephalometric analyse  
CBCT



# Analysis of craniofacial morphology changes during aging and their connection with facial age estimation

•Koruga Petra, Bača Miroslav, Schatten Markus

The aging process affects the structure and appearance of people in different ways. One of such is the change in craniofacial morphology (CM) of individuals. The subject of a person's CM and age estimation is by itself insufficiently researched. Especially on the analysis of children's CM at different ages, because it hasn't been considered thoroughly. This paper will analyze certain characteristics of the CM and their changes during aging from a biometrics perspective, and will also give an...

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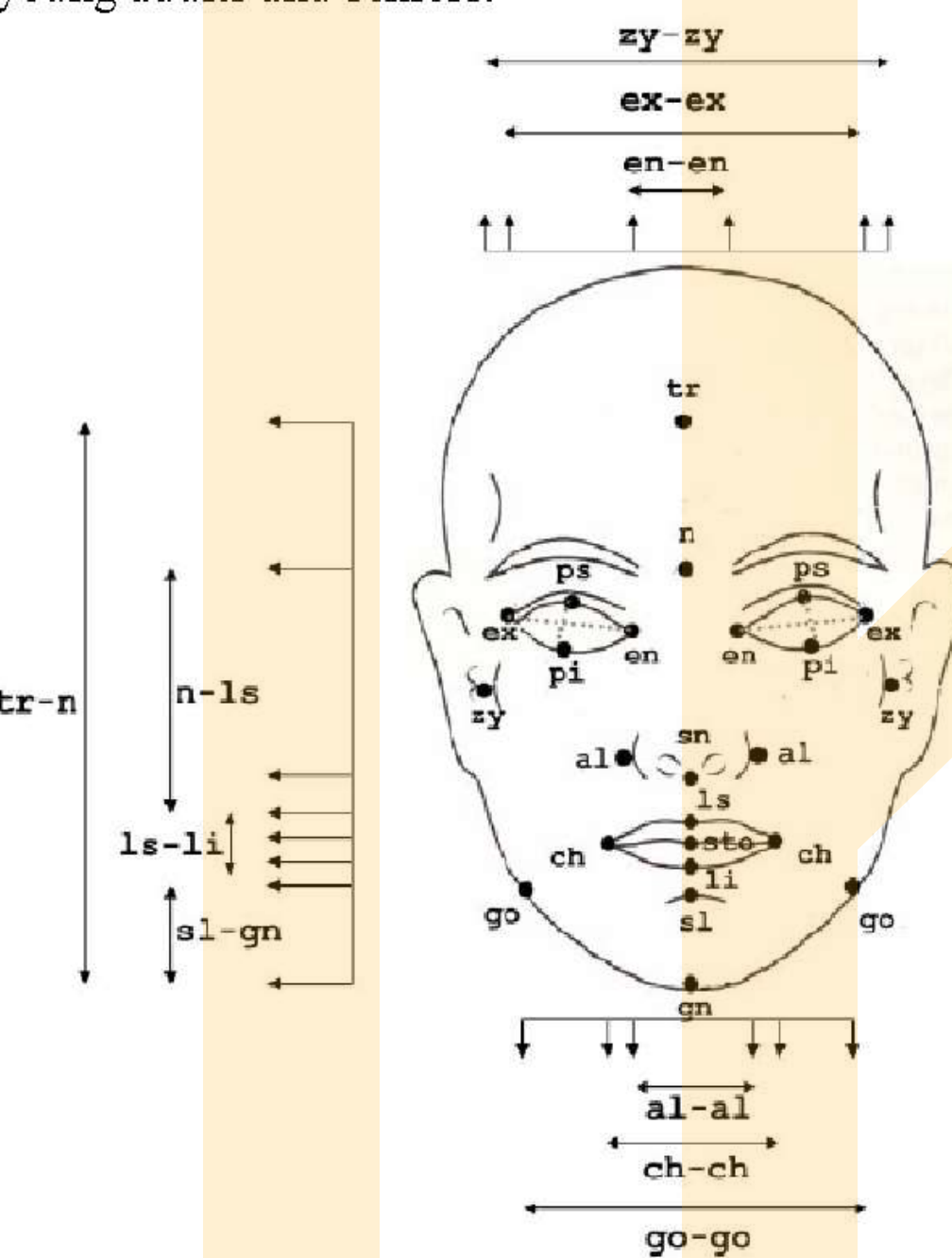


Figure 9. Facial characteristics ratios – Geng et al. [4]

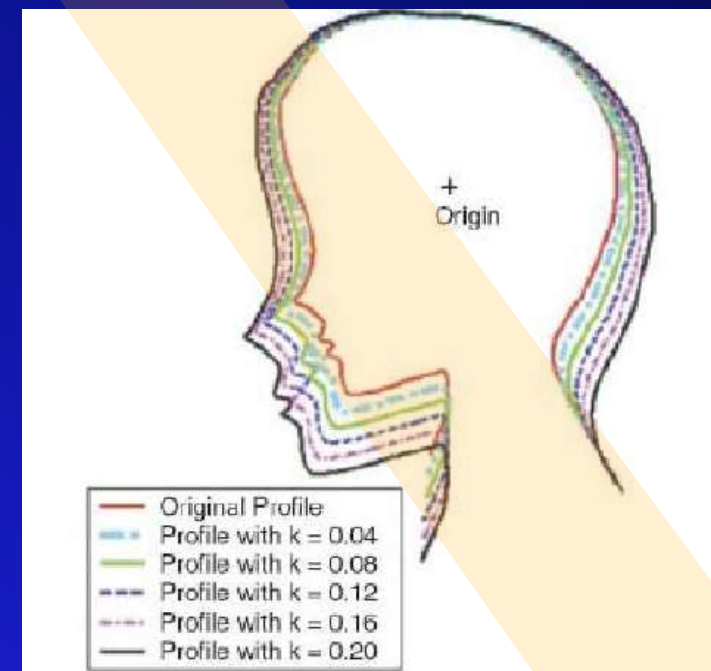
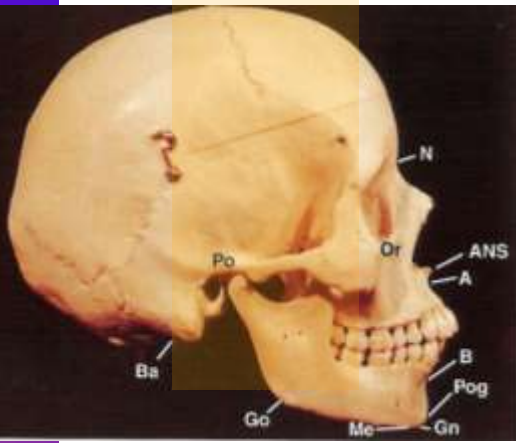
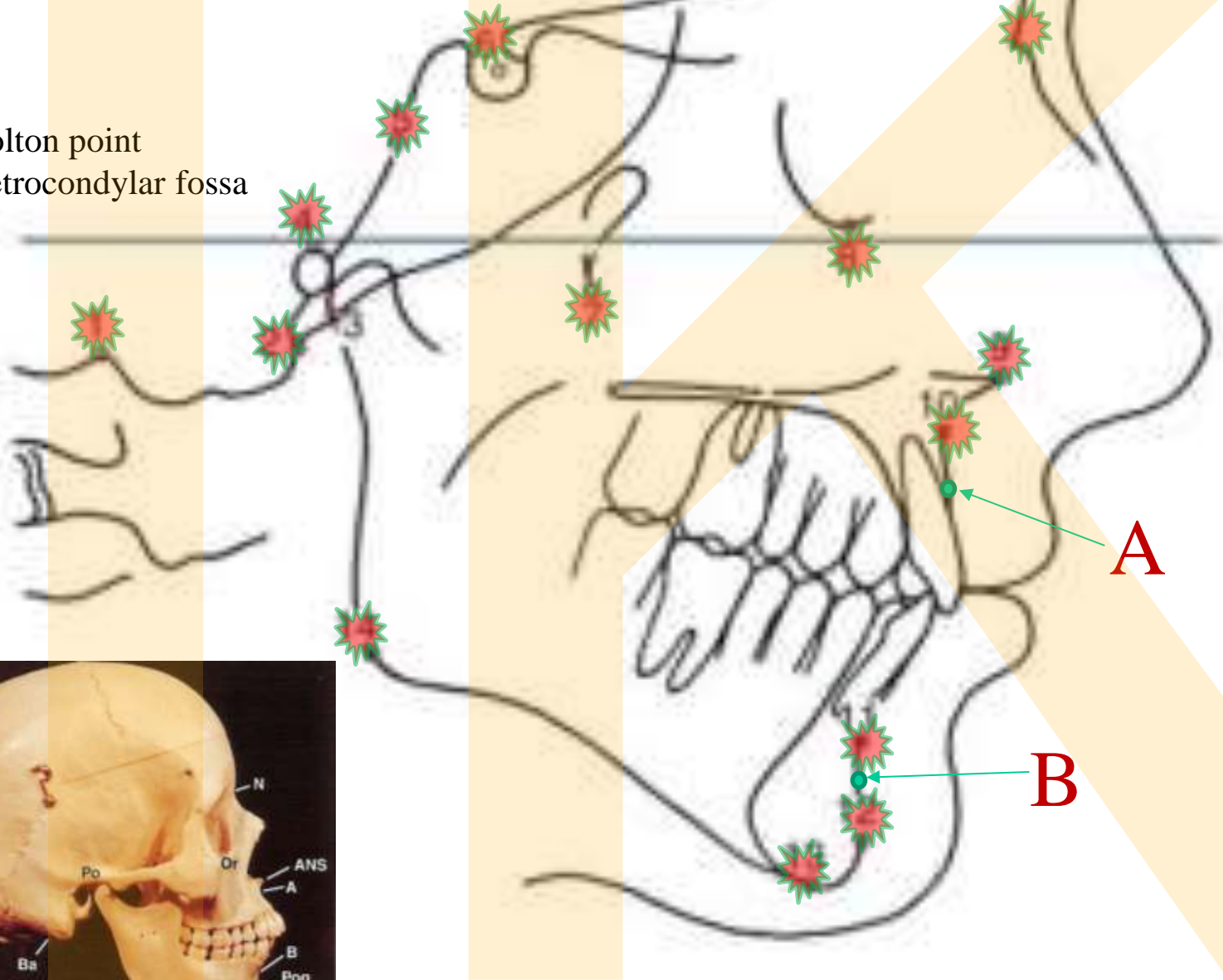


Figure 1. Shape changes caused by

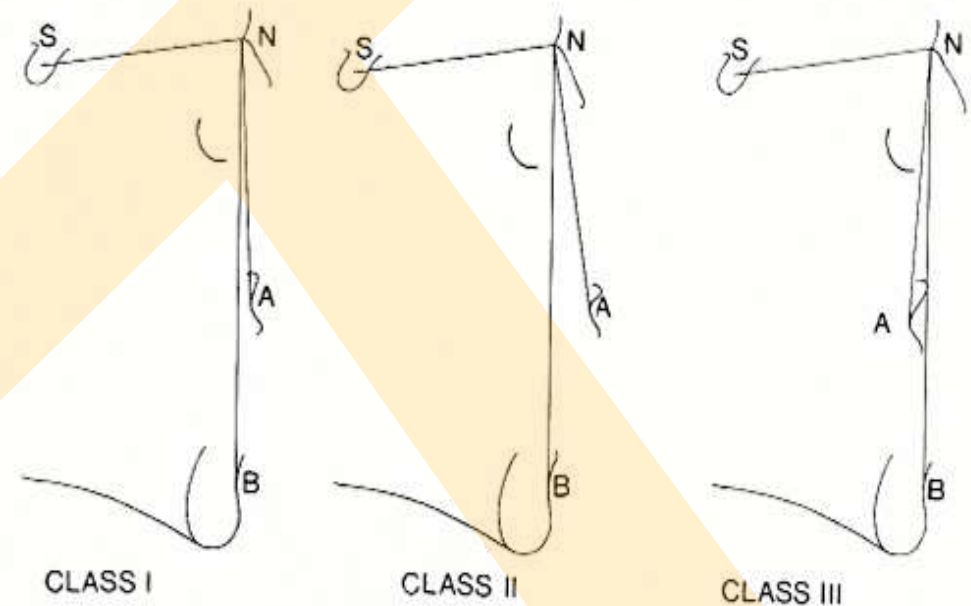
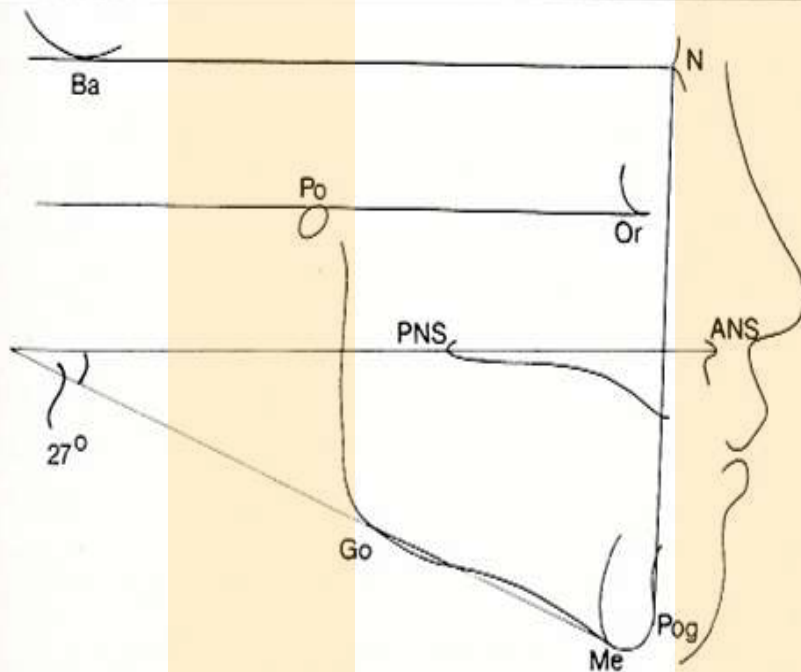
# ometric points important for analysis

Bolton point  
Retrocondylar fossa



# Cephalometric analysis of jaw relationships and facial form

## The use of SNA and SNB angles to record maxillary-mandibular skeletal relationship

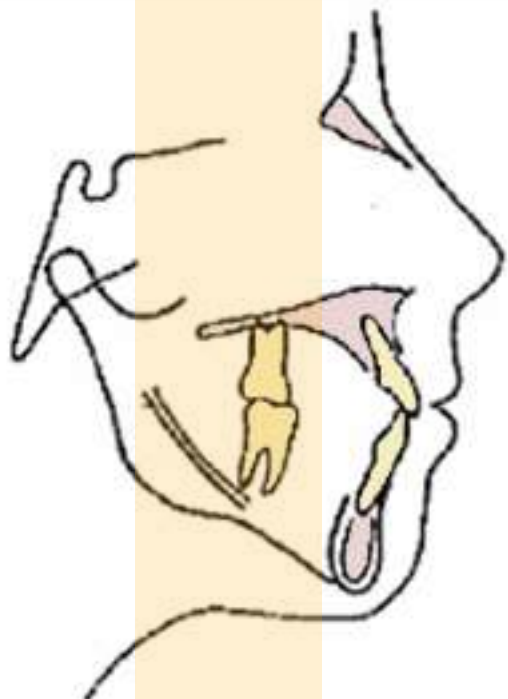


| Měření | Norma | Zvětšený             | Zmenšený                            | Poznámky                            |
|--------|-------|----------------------|-------------------------------------|-------------------------------------|
| S-N-A  | 81°   | prognátní HČ         | retrognátní HČ        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



# Sagittal analysis interjaw relationship

© S-N-A



After clockwise

ve směru hodinových ručiček  
= vertikální růstová tendence  
= **posteriorotace mandibuly**

Strukturální vodítka  
**structural landmarks**

**ramus** větev

← dlouhá                      krátká →

canalis mandibulae

← přímý                      zahnutý →

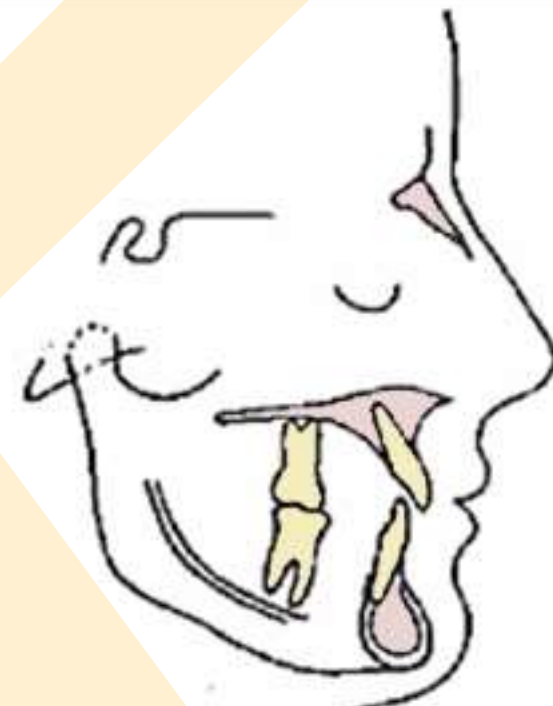
**symphysis**

← úzká                      široká →

spodní okraj corpus mandibulae

← „antegonial notching“

lower margine of th mandibular body



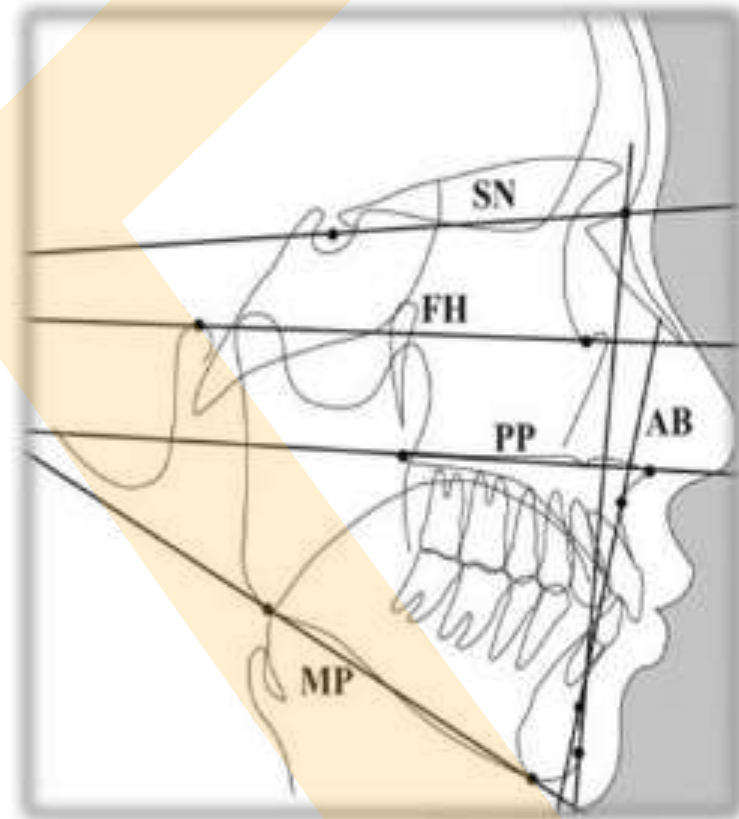
counter clockwise

proti směru hodinových  
ručiček  
= horizontální růstová  
tendence  
= **anteriorotace mandibuly**

neutrální  
**neutral**

## A-B PLANE ANGLE

- Angle formed at the intersection of point A – point B line to nasion – pogonion line.
- Average value-  $-4.6'$  ( $-9$  to  $0'$ )
- Significance- indicative of maxillo mandibular relationship in relation to facial plane.
- Negative since point B is positioned behind point A.
- Positive in class III

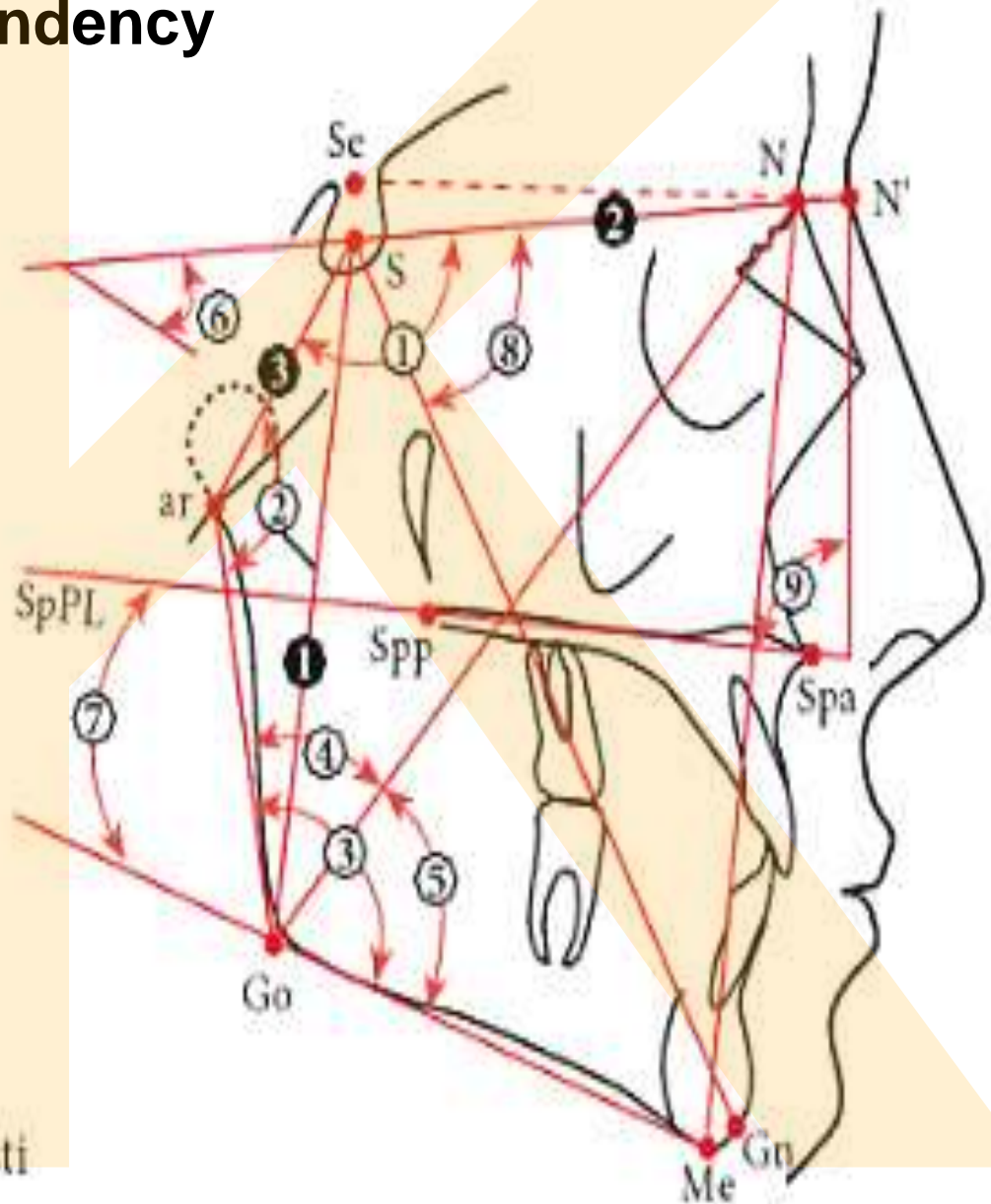


# Analýza růstové tendence [mod. podle Rakosiho a Jonase 1989]

## Analysis of the growth tendency

Potřebné referenční body:

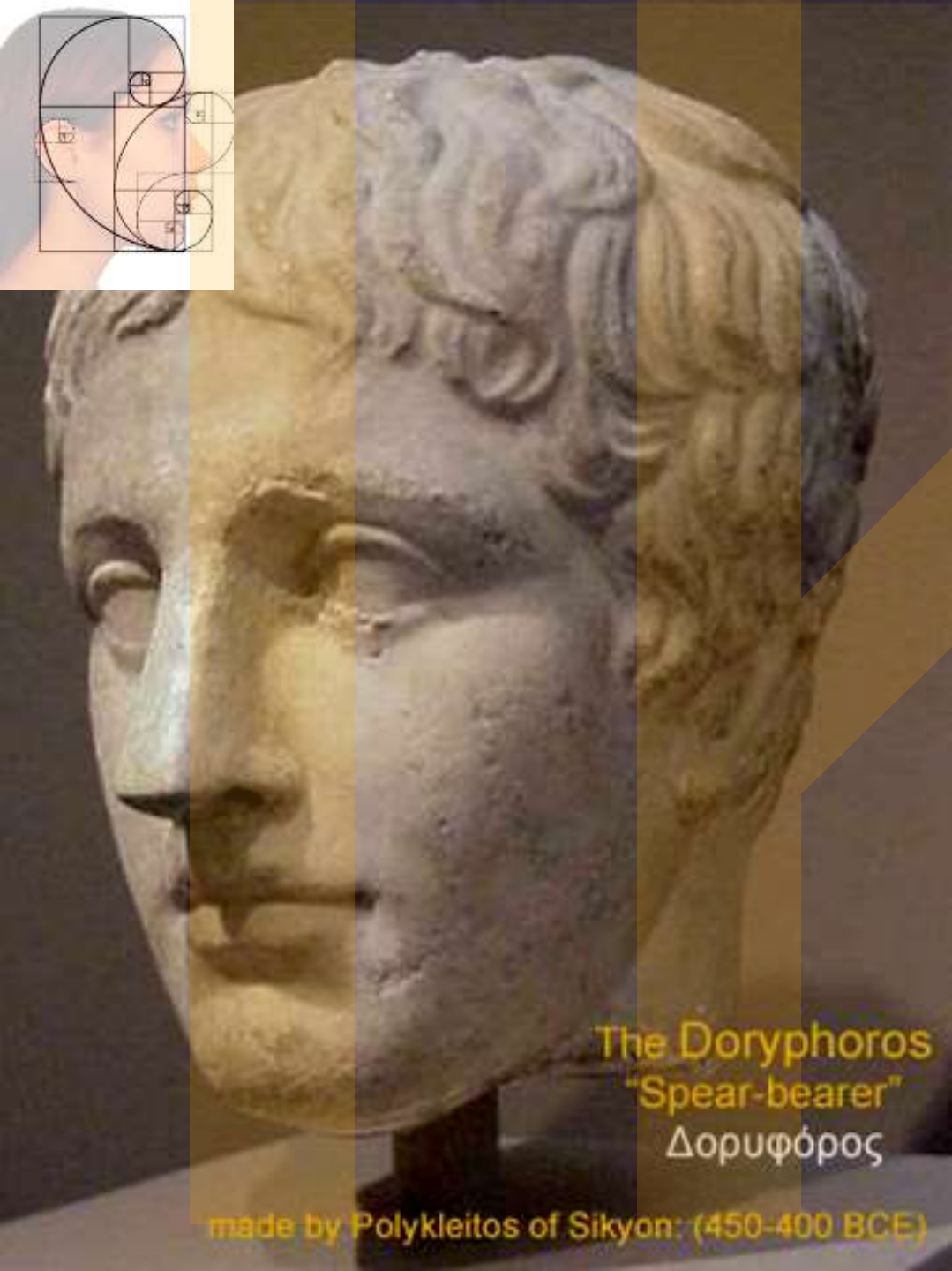
|      |                               |
|------|-------------------------------|
| S    | střed selly                   |
| Se   | vstup do selly                |
| N    | nasion                        |
| ar   | articulare                    |
| Go   | gonion                        |
| Me   | menton                        |
| Gn   | gnathion                      |
| Spp  | spina nasalis posterior       |
| Spa  | spina nasalis anterior        |
| SpPL | základní rovina horní čelisti |





The increasing demand for adult orthodontics and orthognathic surgery increases the need to understand the facial aging process.

Rostoucí poptávka po ortodoncii dospělých a ortognatických operacích zvyšuje potřebu porozumět procesu stárnutí obličeje.



The Doryphoros  
"Spear-bearer"  
Δορυφόρος

made by Polykleitos of Sikyon: (450-400 BCE)

poměr  
větší části  
k menší  
části je  
stejný jako  
poměr  
celé části  
k větší  
části.

Hodnota tohoto  
poměru je rovna  
iracionálnímu  
číslu: 1.618

Klaudios Galénos (*Claudius Galenus*),  
29 ?-216? AD): beauty and harmony



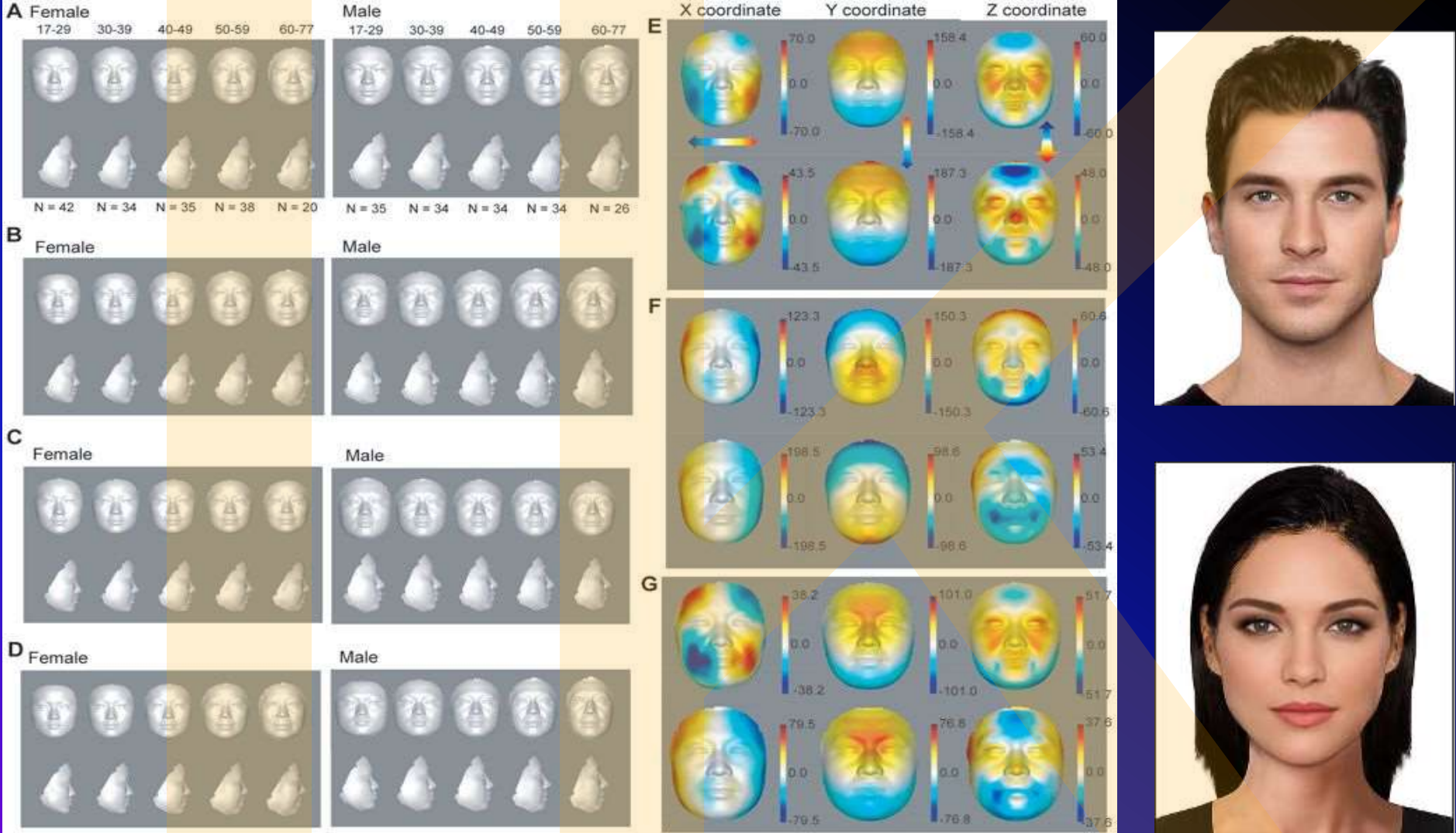


euroamerican

korean

Hwang HS, Kim WS, McNamra, JA: Ethnic differences in the soft tissue profile of korean and european-american adults with normal occlusions and well-balanced faces. Angle orthodont. 72-80, 2002





**Visualization of facial aging.** (A) The female and male average profiles of five age groups from 17 to 77 years old. N indicates the number of subjects in each age group. (B-D) Synthesized female and male average profiles between  $-2$  and  $+2$  SD of loading values of age-correlated PLS component 1 (B), component 2 (C) and combined components 1 and 2 (D). (E-G) Heat map of 3D effects displaying loading values of age-correlated PLS component 1 (E), component 2 (F) and combined components 1 and 2 (G) shown on female and male faces. The loading values were multiplied by 10 000. Red and blue denote, respectively, higher and lower values along x-, y- and z-axes.

Orbitální  
krajina  
se mění  
jen  
pomalu



Prototypic female face of high attractiveness  
("sexy face")



Prototypic female face of low attractiveness  
("unsexy face")

Orbital  
area  
form is  
slowly  
changed



Ideal Face



Sagger



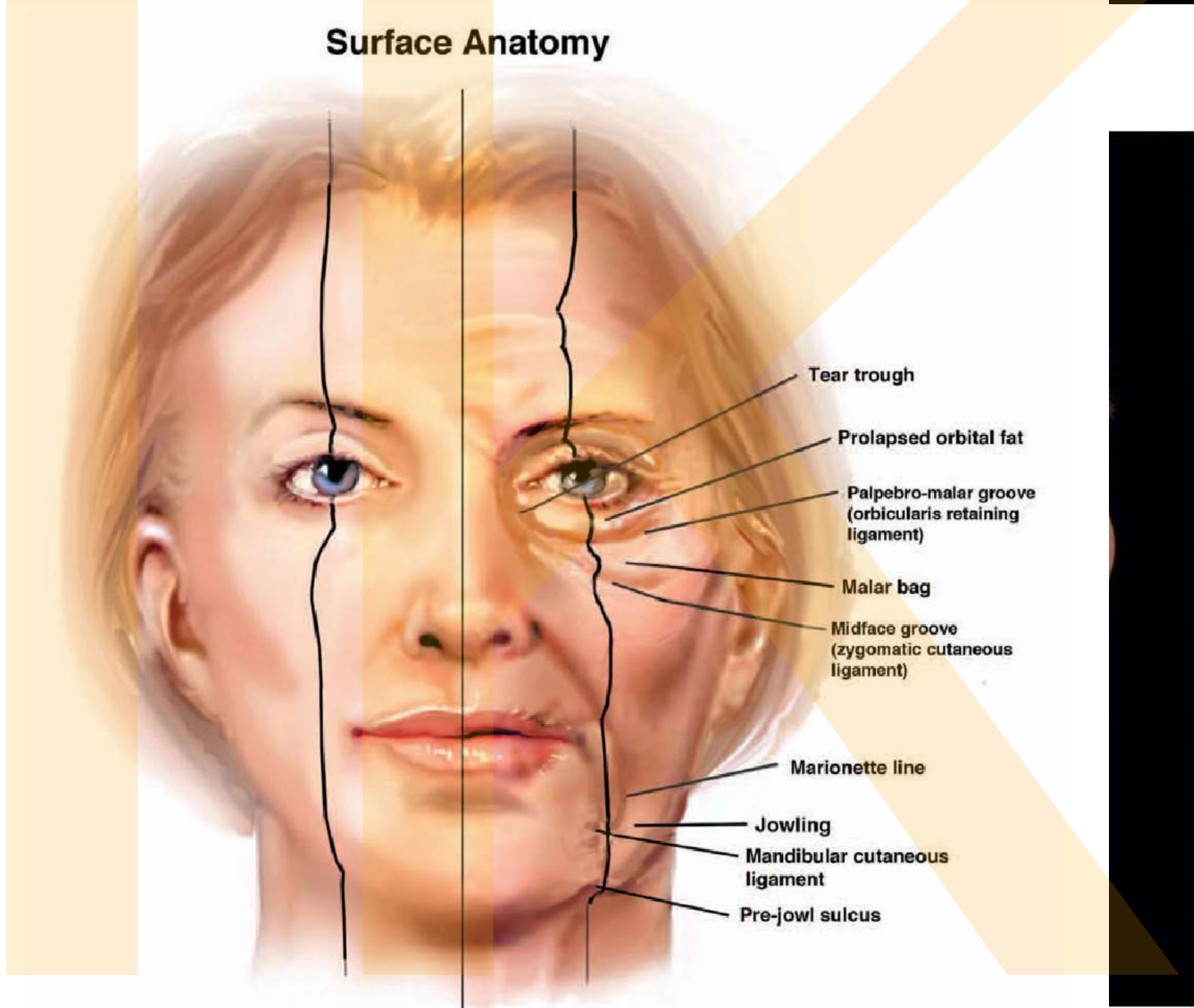
Sinker







# Surface Anatomy



Tear trough

Prolapsed orbital fat

Palpebro-malar groove  
(orbicularis retaining  
ligament)

Malar bag

Midface groove  
(zygomatic cutaneous  
ligament)

Marionette line

Jowling

Mandibular cutaneous  
ligament

Pre-jowl sulcus

As we age and  
causing shadow  
Gaining a better  
time may help y  
treatment options



Fotografická  
analýza  
vzhledu  
ve srovnání  
s lebkou

Photographic  
facial  
analysis  
in  
comparison  
with skull



brachyfacial



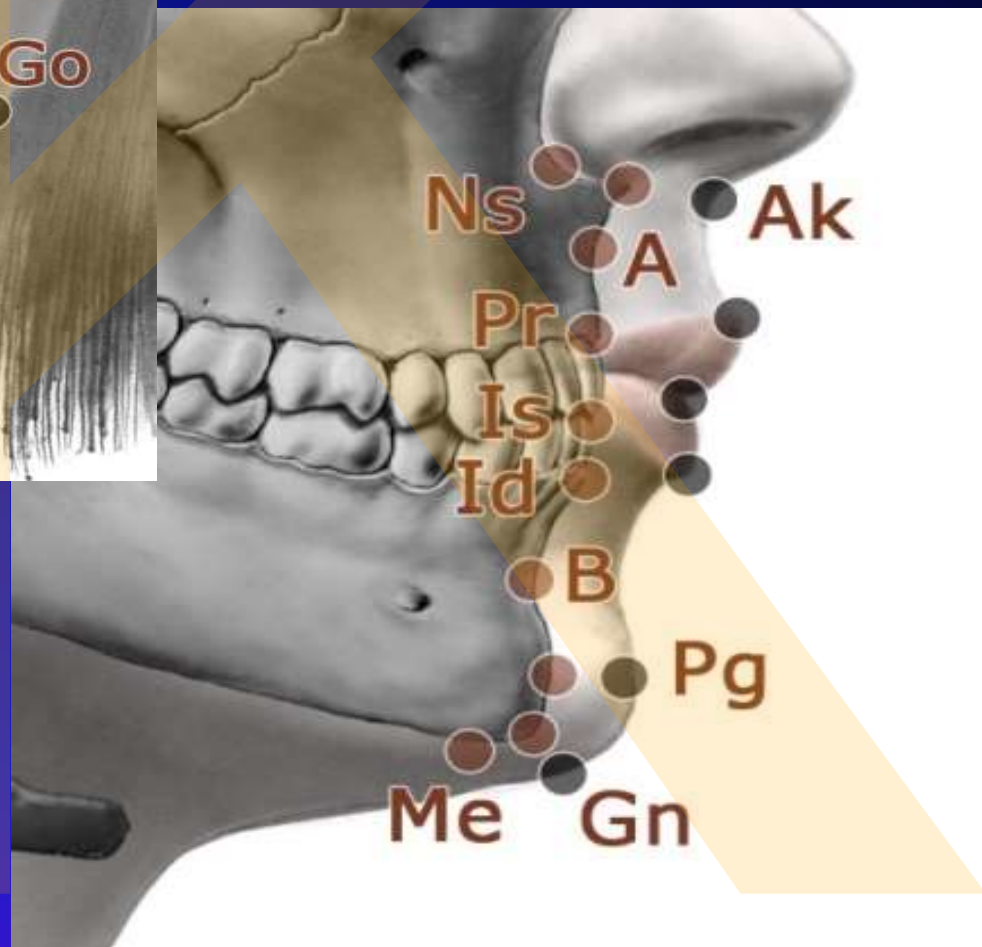
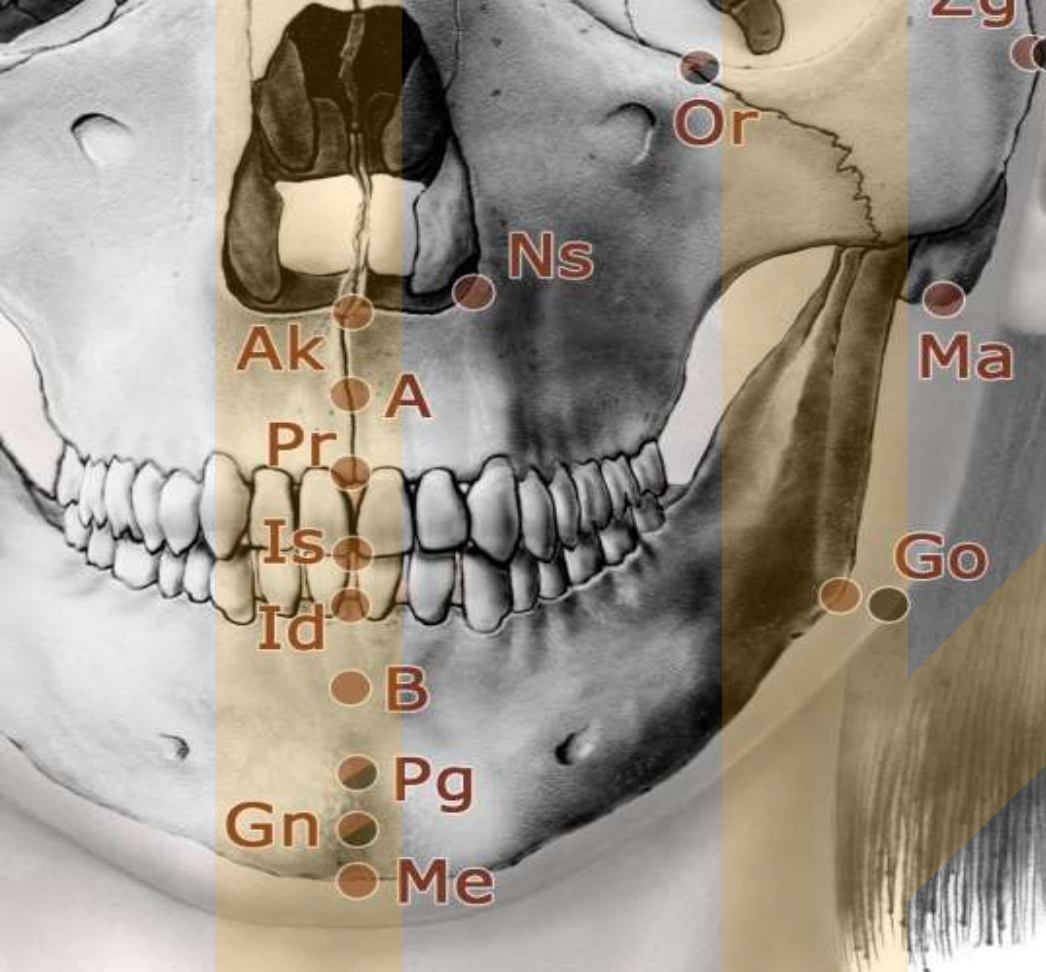
mesofacial



dolichofacial

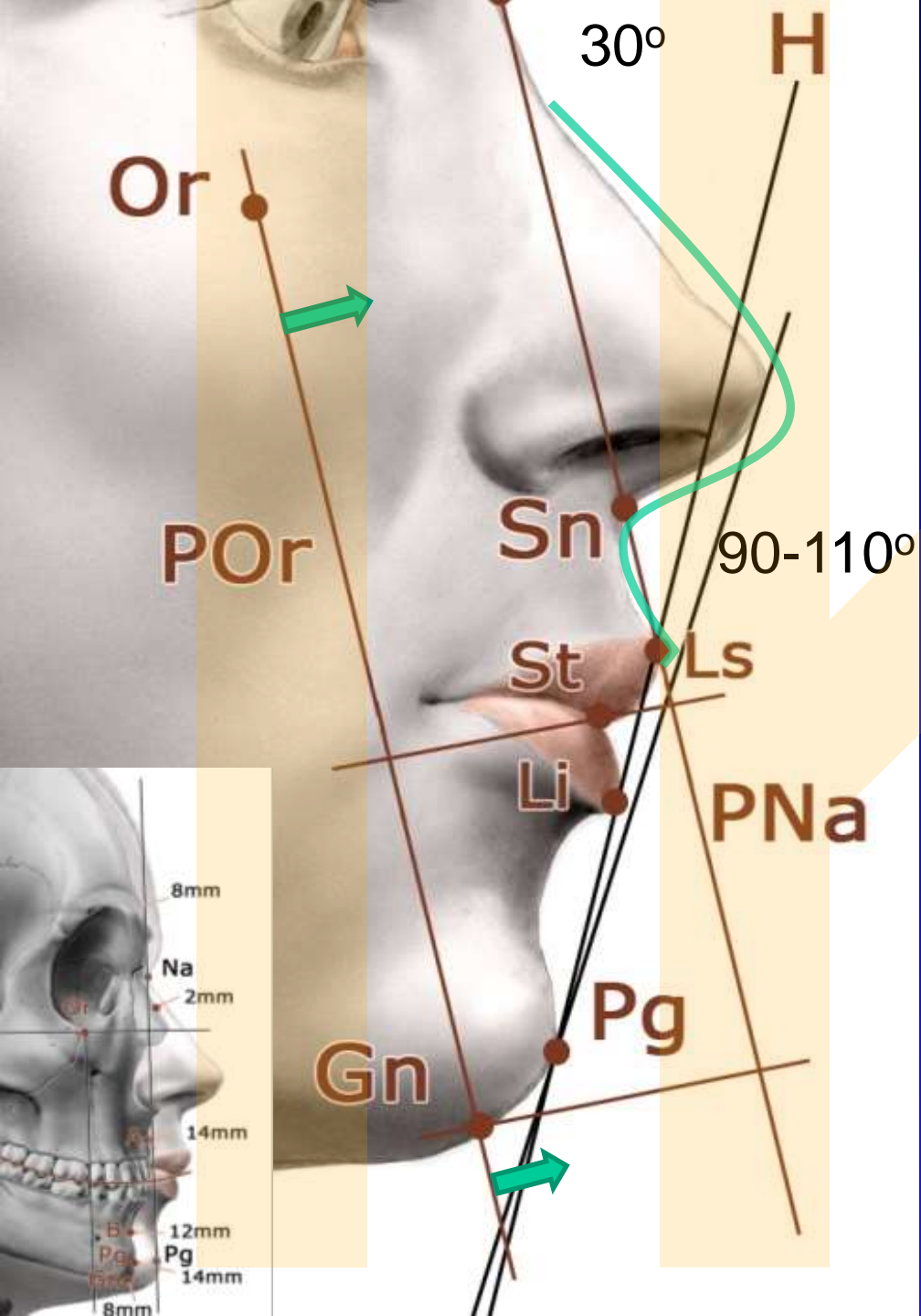
**Figure 1** - Extraoral photographs (front and profile) and lateral radiographs with corresponding SN.GoGn values, representative of the female sample. Facial balance was classified into three facial types: **A)** Brachyfacial, **B)** mesofacial and **C)** dolichofacial.





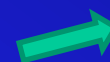
# Gnathometric points

- Incisale inferius (Ii) - Lower incisor point - is the intersection of the lines inserted into the cutting edges of the lower first incisors
- Incisale superius (Is) - upper incisor point - is the intersection of the lines inserted into the cutting edges of both large incisors
- Infradentale (Id) - the highest point of the alveolar septum between the two incisors
- Labrale inferius (Li) - the most forward-looking point of the lower lip Labrale superius (Ls) - the most prominent point of the upper lip
- Mentale (Mn) - the deepest point on the foramen mental
- Nasion (Na) - Point on the root of the nose
- Nasospinale (Ns) - Point in the middle line at the lower edge of the apertura piriformis (foot of the spinal nasalis anterior)
- Orale (Ol) - between the front incisors at the edge of the alveolar protrusion at the back (the anterior border of the skeletal palate)
- Pogonion (Pg) - at the front edge of the protuberantia menti and covering her chin
- Prosthion (Pr) - between the front medial incisors at the edge of the alveolar protrusion at the front Punctum S (S) - center sella turcica
- Staphylion (St) - point on the spina nasalis posterior (corresponds to the back of the hard palate) Stomion (Sto) - The point of contact of the upper and lower lip in the middle line
- Subnasale (Sn) - the point at the nose partition transition in the upper lip
- Subspinale (Sb, according to the Downse Protective Top Point A) - indicates the position of the anterior apical base and is placed at half the distance between akanthion and prosthion. It is at the front of the alveolar protrusion.
- Supramentale (Sm, according to Downs prosthetic lower point B) - corresponds to the lower apical basal, lying on the front surface of the lower jaw approximately at the level of the roots of the lower incisors
- Menton (Me) - Most down and back of the bone chin



Nose feature before line H and lip curve behind it form together symmetric „S“ line. Anterior nasal spine is usually  $5 \pm 2$  mm behind za touto linií.

“Biometric field“



Point positions vary in relation of bone growth: os zygomaticum, maxilla and mandibula



# Facial profile analysis

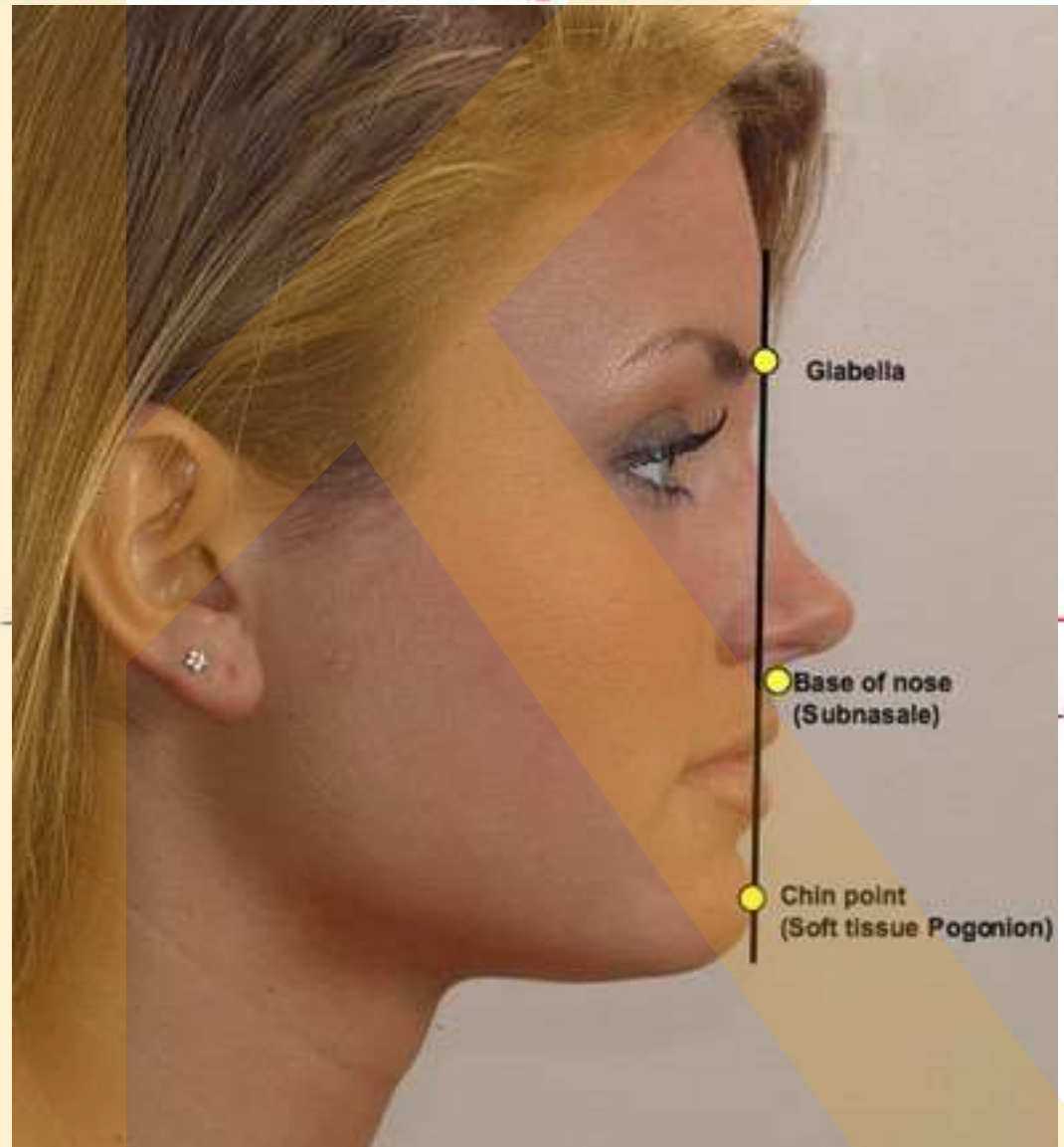
## Analysis of the maxillary area

- **Nasal base** (Meridian line)
- **Nasal projection** (TVL)

**Anteroposterior lip position** (TVL, E line, S line, H line)

- **Relationship of upper lip to nose**

*Gonzales-Ulloa 1966*  
*Arnett & Bergman 1993*  
*Ricketts 1979*  
*Steiner 1966*  
*Holdaway 1983*  
*Fish & Epker 1981*



## PROFILE

### ANALYSIS

#### PROPORTIONAL ANALYSIS

Ideal profile provides a basic standard for assessment of **average profile**

**Ideal profile** ; Can be divided into three equal parts

Frontal Third ( Tr- N )

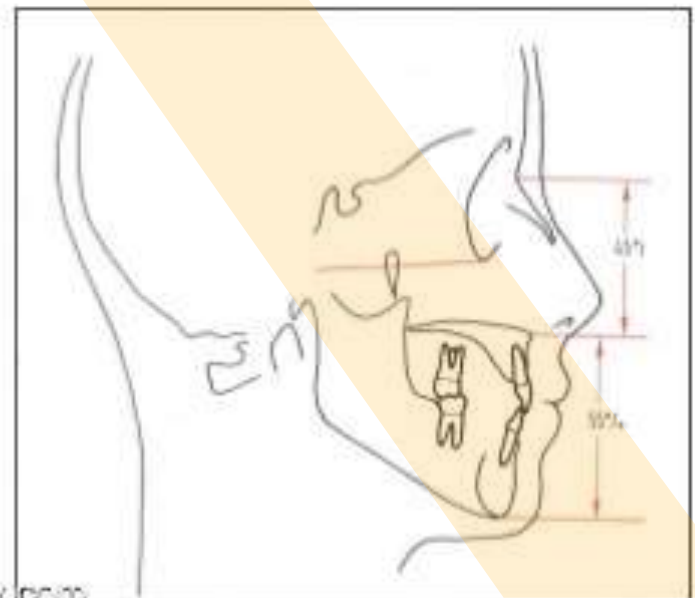
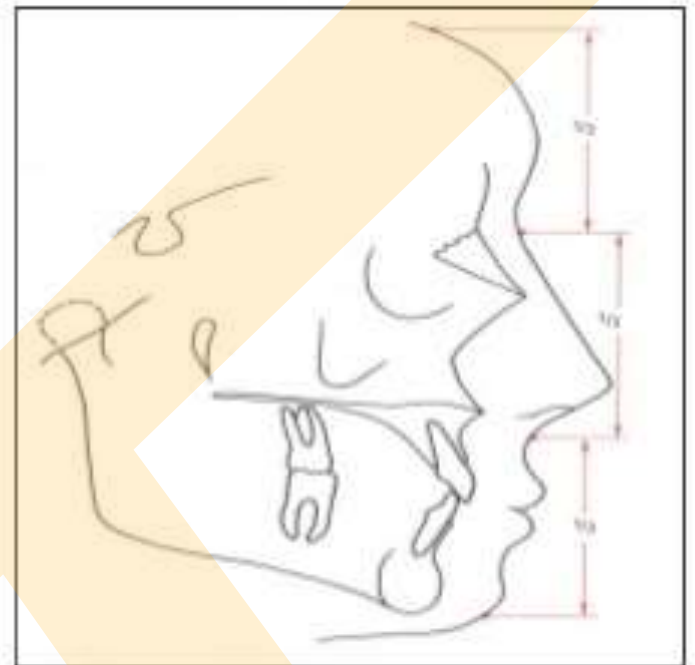
Nasal Third ( N - Sn )

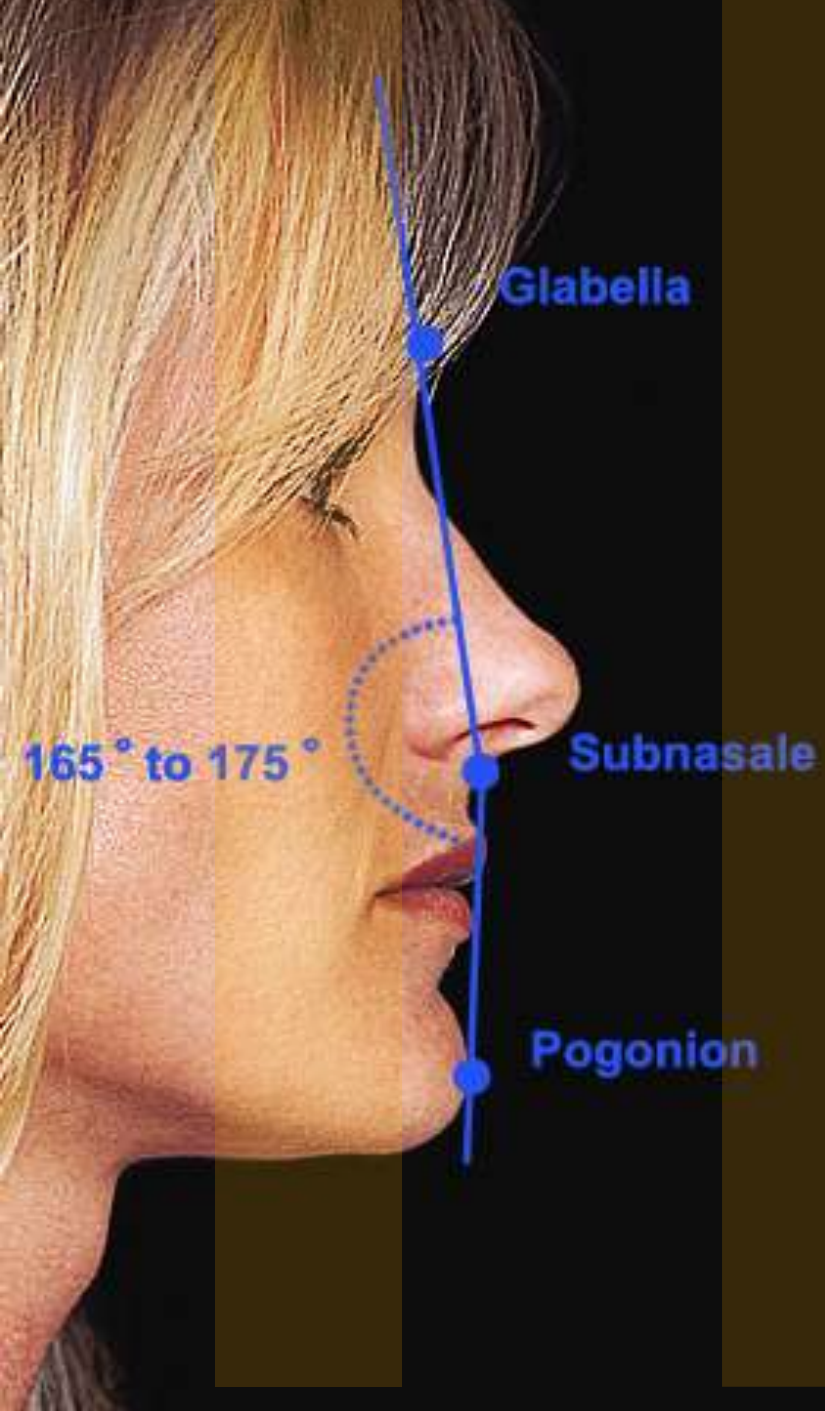
Gnathic Third ( Sn - Gn )

#### ANTERIOR FACE CAN BE PROPORTIONED ( N - Gn )

Midface - N To Sn - 45%

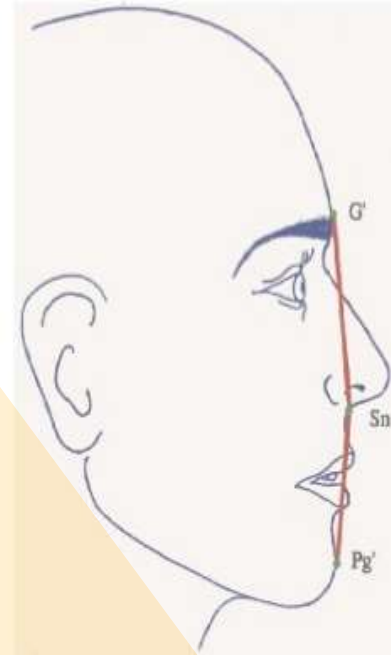
Lower Face - Sn To Gn - 55%





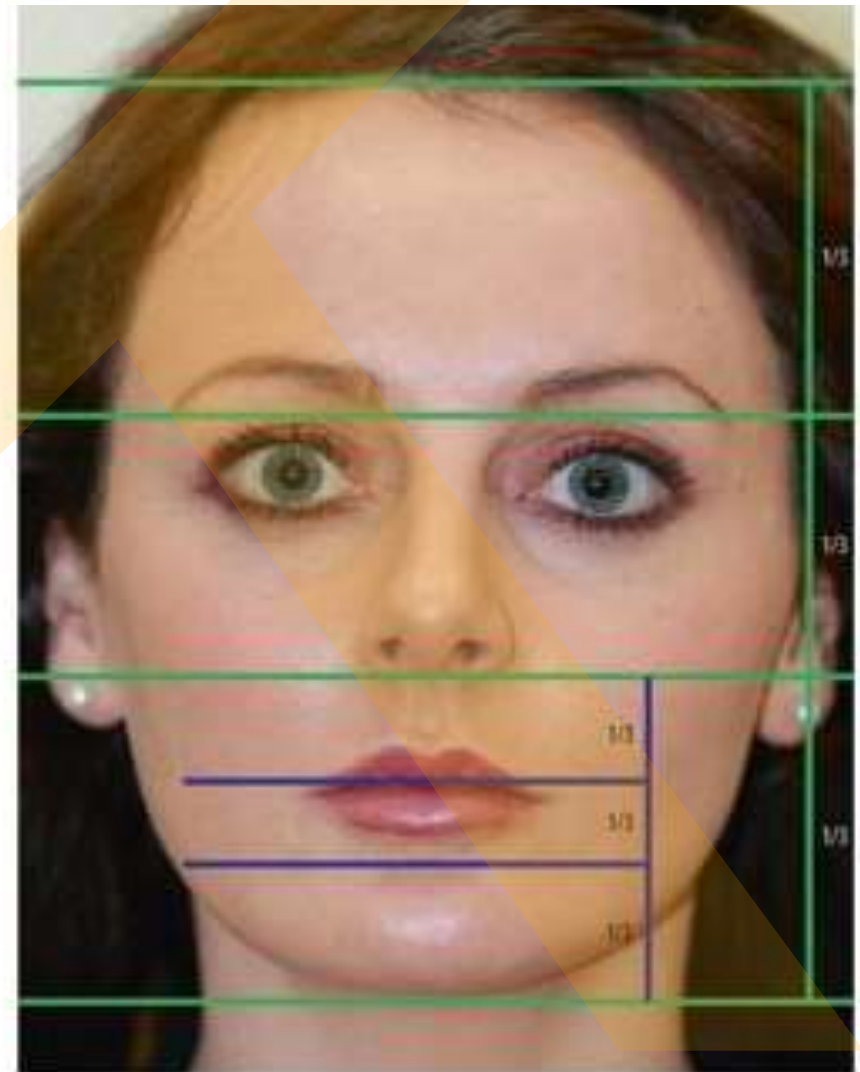
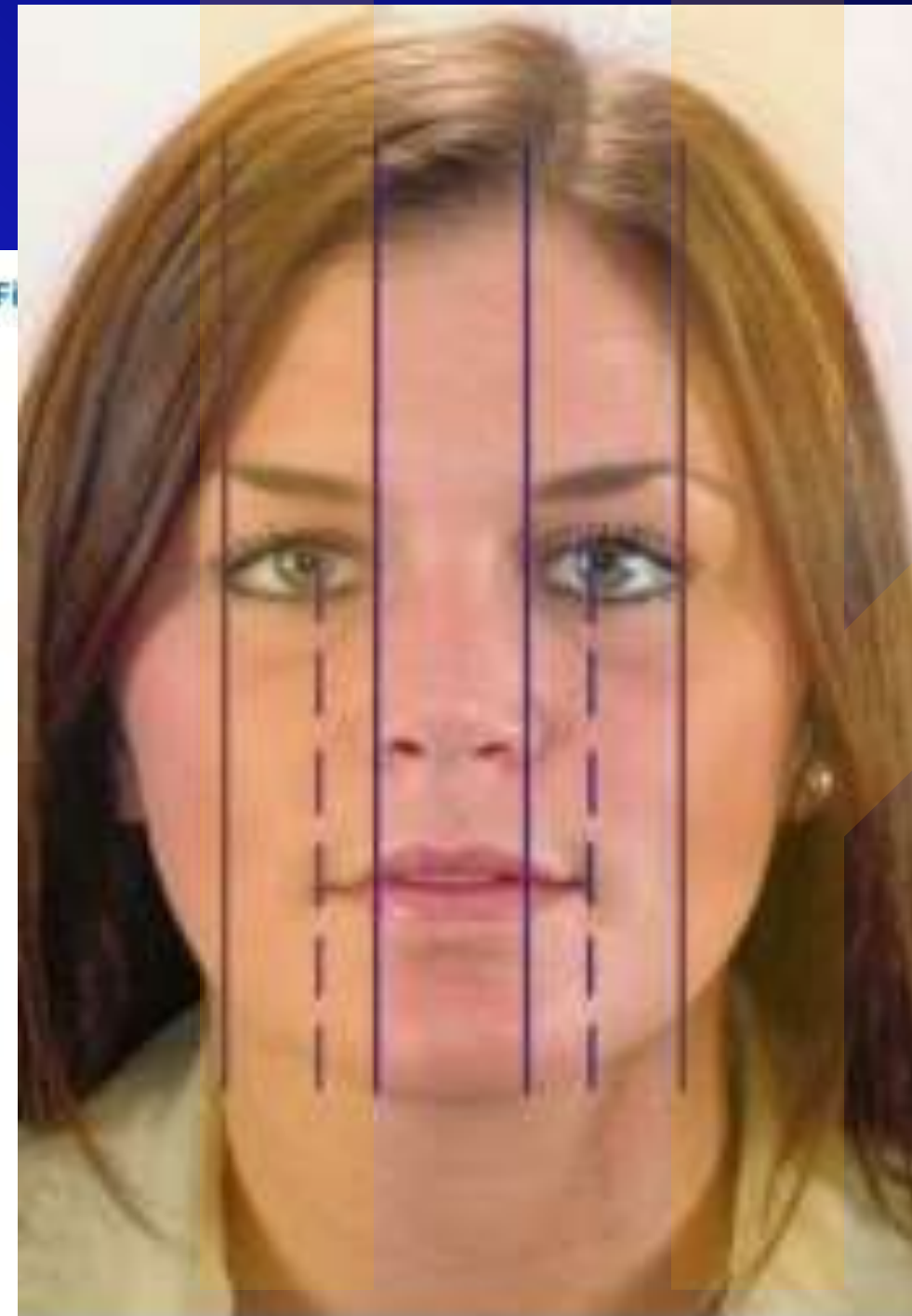
## Profile angle

- This is formed by connecting soft tissue glabella, subnasale, and soft tissue pogonion
- Class I occlusion presents a total facial angle range of 165 to 175 degree
- In class II less than 165 degree
- In class III greater than 175 degree














**Fig. 2.3** Horizontal facial thirds. The upper third extends from the hairline to glabella, the middle third from glabella to subnasale, and lower third from subnasale to menton. The lower third is further divided into thirds: the upper third from subnasale to stomion, middle third from stomion to the labiomental crease, and the lower third from the labiomental crease to menton. These thirds define the upper lip, lower lip, and chin. Note that the thirds are not equal



## KANONY KRASY

| Kánon   | Klasické znění  | Korigované znění  | Nákres   |
|---------|---|---|--|
| Kánon 1 | Obličej tvoří polovinu výšky hlavy, hranicí je kořen nosu.      | Vzdálenost vertex – endocanthion je větší než endocanthion – gnathion v 80% případů.  |    |
| Kánon 2 | Obličej s čelem lze rozdělit na 3 stejné části.                 | Nasion – subnasale < subnasale – gnathion ve 100%. Trichion – nasion > nasion – subnasale v 95%. Poměr trichion – nasion : subnasale – gnathion je variabilní.  |   |
| Kánon 3 | Výšku hlavy lze rozdělit na 4 stejné části.                     | $G - Sn > V - Tr$ v 87%.<br>$V - Tr > Tr - G$ v 52%.<br>$Sn - Gn > G - Sn$ v 68%.<br>$Sn - Gn > Tr - G$ ve 100%.<br>$Sn - Gn > V - Tr$ ve 100%.                 |   |
| Kánon 4 | Délka nosu je rovna výšce ucha.                                 | Délka nosu je menší než výška ucha v 95% případů.   |   |
| Kánon 5 | Interokulární vzdálenost je stejná jako šířka nosu.             | Interokulární vzdálenost je menší než šířka nosu u 38% probandů a větší u 21,4% případů.  |    |
| Kánon 6 | Interokulární vzdálenost je stejná jako šířka oční štěrbin.     | Interokulární vzdálenost je větší nebo stejná jako šířka oční štěrbin v 85% případů.  |    |
| Kánon 7 | Šířka úst je 1,5 – násobek šířky nosu.                          | Ústa jsou širší než 1,5 – násobek šířky nosu u 60% případů.   |   |
| Kánon 8 | Šířka nosu je stejná jako 1/4 šířky obličeje.                   | Šířka nosu je větší nebo menší než 1/4 šířky obličeje u 60% probandů.   |  |
| Kánon 9 | Inklinace dorza nosu je stejná jako inklinace podélné osy ucha. | Inklinace dorza nosu je větší než inklinace podélné osy ucha v 91% případů. (na vedlejším obrázku je srovnání klasického – A a moderního obličeje bělocha – B.) |  |

# Kánon krásy

## canon of beauty