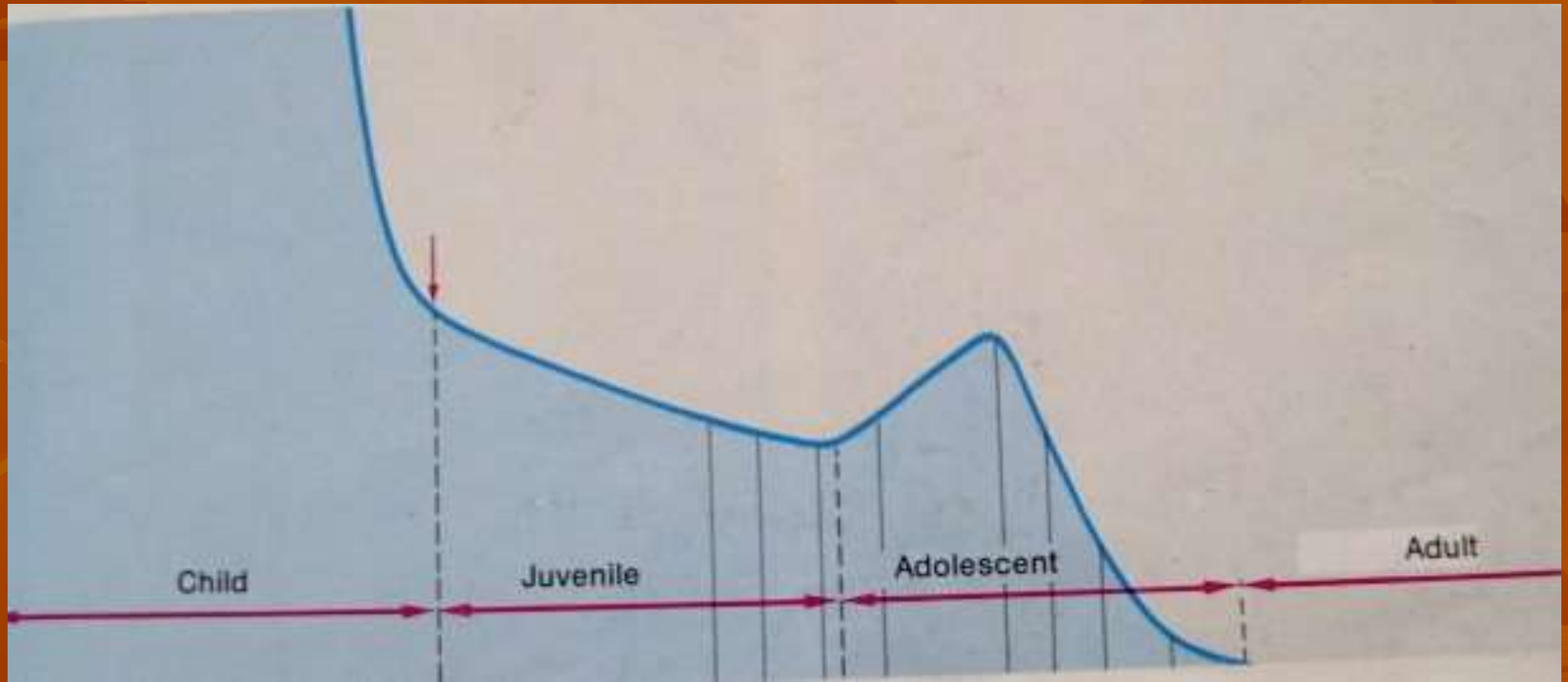


Skeletal Maturity indicators



AN
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BEYOND

Growth rhythm curve- BJORK



Introduction

□ Adolescence

□ *It is the transitional period b/w juvenile stage and adulthood during which the secondary sexual characteristics appear, the adolescent growth spurt takes place, fertility is attained, and profound physiologic changes occur.(PROFFIT)*

- Important period
- Treatment planning & outcome of treatment

Are we justified in betting the odds???

RICKETTS :

Amount of growth.

Direction of growth.

Timing.

The orthodontist – has to work with growth

- Assessment of skeletal age is important to know whether any growth remains in individual and what percentage of growth can be expected

Growth & Development –

Not uniform.

Periods of acceleration and deceleration.

- Developmental status of the child judged by :
 - i. peak height velocity
 - ii. menarche in case of girls
 - iii. voice change in boys
 - iv. dental development
 - v. skeletal ossification

Growth spurts

- *A spurt is defined as growth acceleration up to a maximum where the annual increment of growth exceeded the previous one by at least 7mm.*

-Erkstrom.

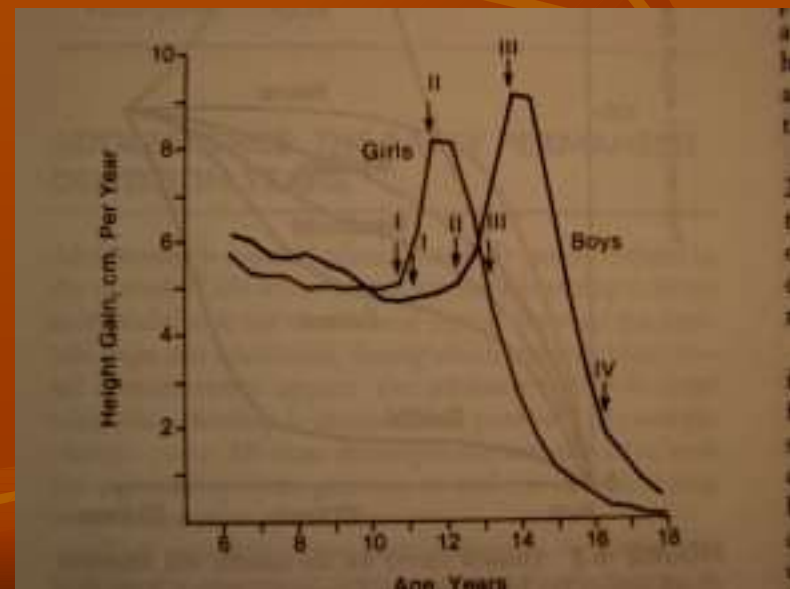
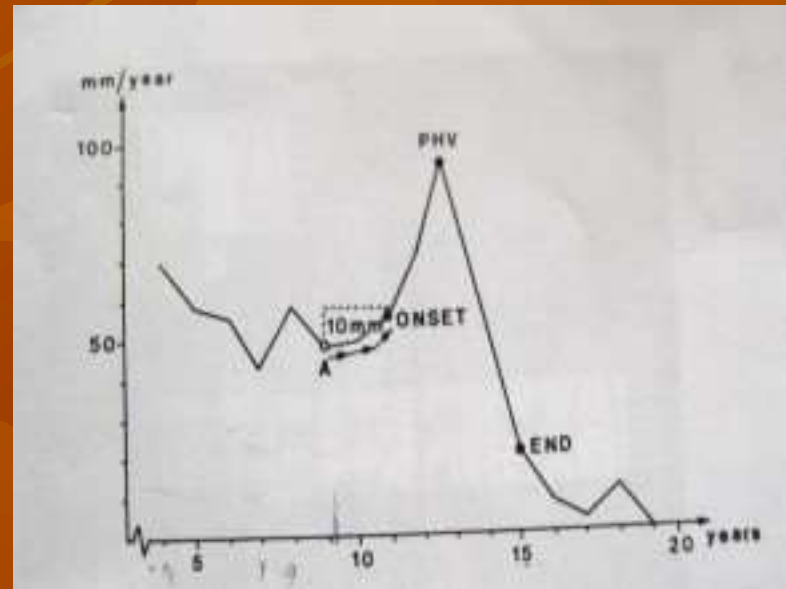
Normal growth spurts

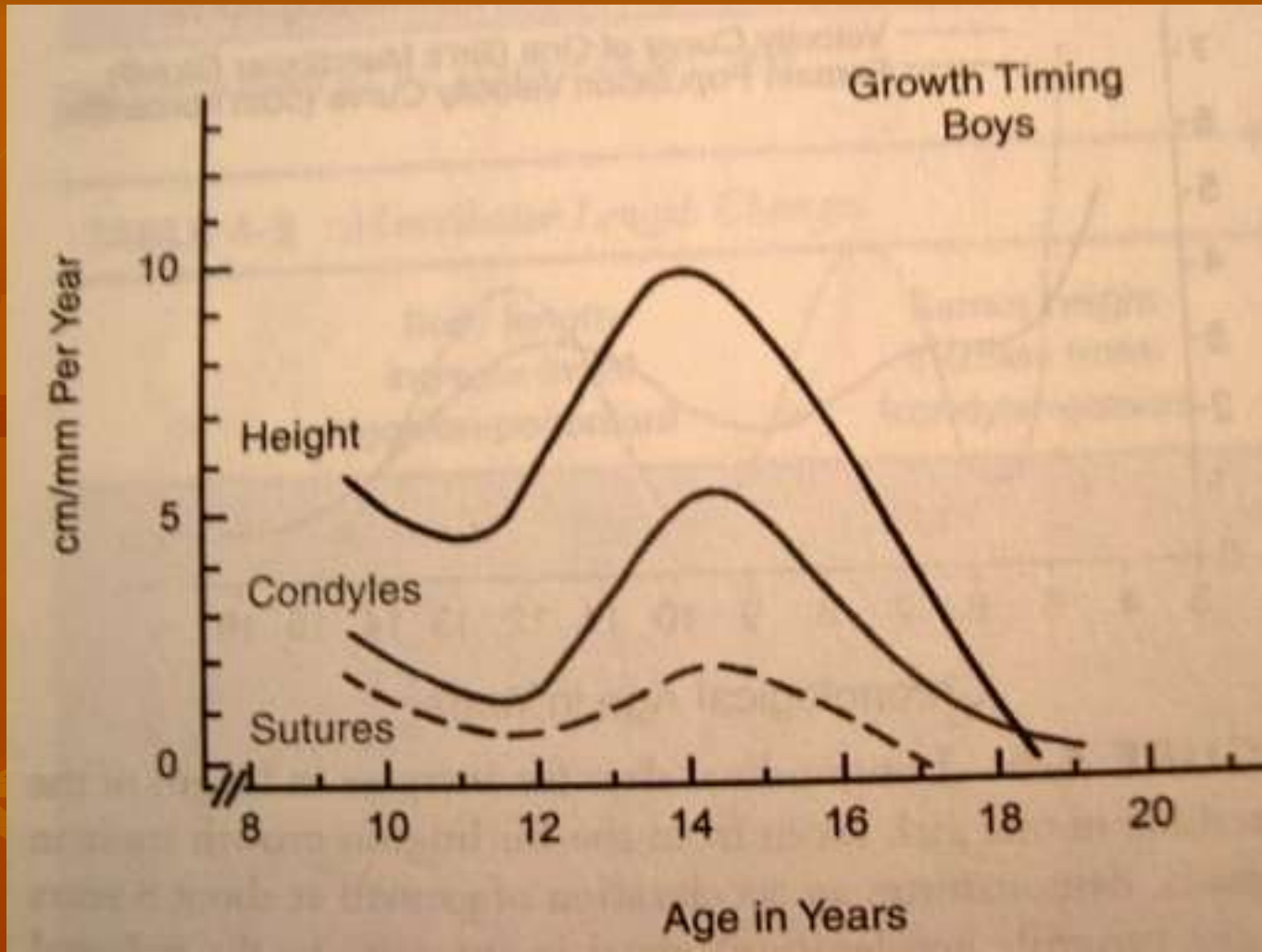
- infantile spurt – 3 years
- juvenile spurt – 7-8 years females,
8-10 years males.
- Pubertal spurt – 10-13 years females,
13-15 years males.

□ Best indicator for the pubertal growth spurt is the attainment of the peak height velocity

The clinician prefers to start the treatment during the acceleration phase

Earlier in girls






WOODSIDE

Skeletal maturity indicators

- Hand and wrist radiographs
- Cervical vertebrae
- Mid palatal suture
- Corpus index
- Tooth mineralization
- Frontal sinus

Hand and wrist radiographs

- Assessment of the skeletal age is made with the help of hand radiographs which can be considered as biological clock

- 
- Standard method
 - Easily identifiable
 - Reliable source
 - Useful diagnostic aid

- Roentgen -1895
- Rowland – April 1896 - first H&W radiograph.
- Rotch and Crampton -1900 tabulated indicators of hand and wrist.
- Carter – 1926 study on carpal bones of children.
- Hellman - 1928 studied the ossification of the epiphyseal cartilages of hand.
- Todd and Stuart– 1929 – data on hand wrist radiographs.
- Greulich and Pyle –prepared the standards of growth.

- Flory 1936 – beginning of calcification of the carpal sesamoid – determine the period immediately before puberty
- Nanda -facial spurt occurred little later than the body height spurt
- Hunter 1966- carpal bones-most satisfactory for determining skeletal maturation
- Bjork 1972 – divided the maturation process of bones of the hand into 8 developmental stages
- Grave & Brown 1976 – skeletal age determined with the help of 6 ossification centers

□ Leonard.s.Fishman 1982 chronological age alone provides little insight.

□ Hagg & Taranger 1982 – correlated maturity indicators to the pubertal growth spurt.

Indications for hand & wrist radiographs

- Prior to rapid maxillary expansion
- When maxillomandibular changes are indicated
- Marked discrepancy b/w chronologic and dental age
- Orthodontic patients requiring orthognathic surgery between 16 & 20 yrs of age.

Anatomy of skeleton of the hand

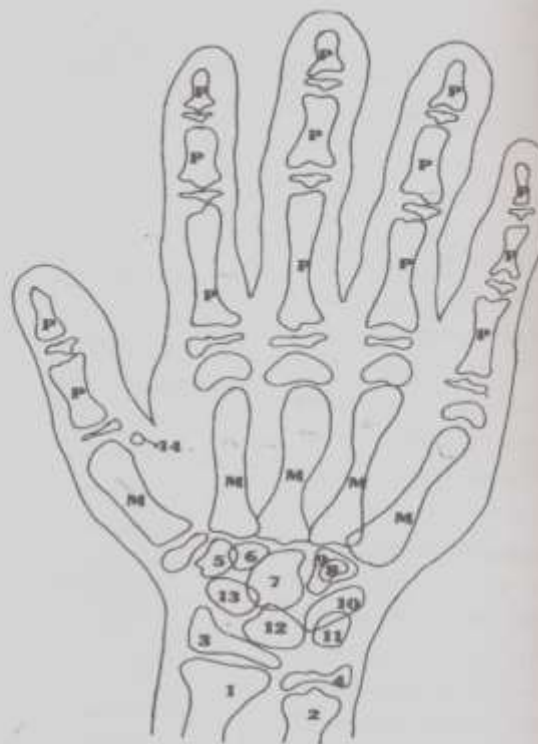


Fig 1 Anatomy of hand and wrist

- | | |
|-------------------------------|----------------|
| 1. Radius | 9. Hamate |
| 2. Ulna | 10. Triquetral |
| 3. Distal Epiphysis of Radius | 11. Pisiform |
| 4. Distal Epiphysis of Ulna | 12. Lunate |
| 5. Trapezium | 13. Scaphoid |
| 6. Trapezoid | 14. Sesamoid |
| 7. Capitate | M = Metacarpal |
| 8. Hamular process of Hamate | P = Phalanx |

A clinically oriented method based on hand & wrist films

leonard Fishman

angle orthodontist

1982

A system for the evaluation of skeletal maturity from H&W radiographs is developed & presented with complete details for implementation in clinical practice.

SMA

This system uses;

- Only four stages of maturation
- Six anatomic sites located on the thumb, third finger, fifth finger radius.



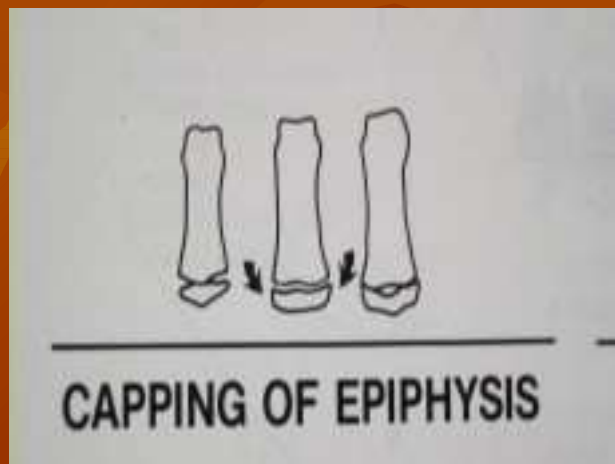
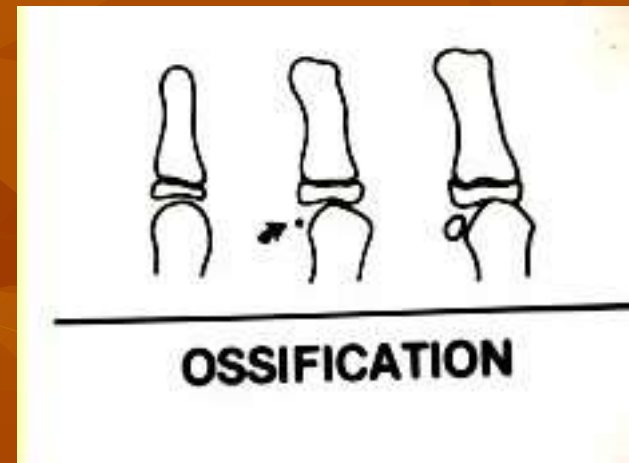
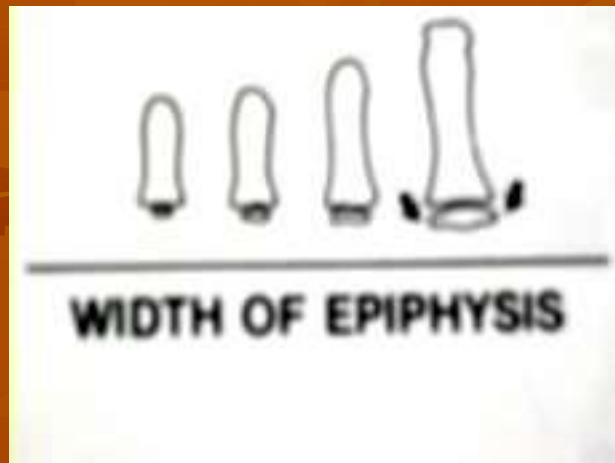
11 discrete adolescent SMIs

System of SMA

-organized

-relatively simple

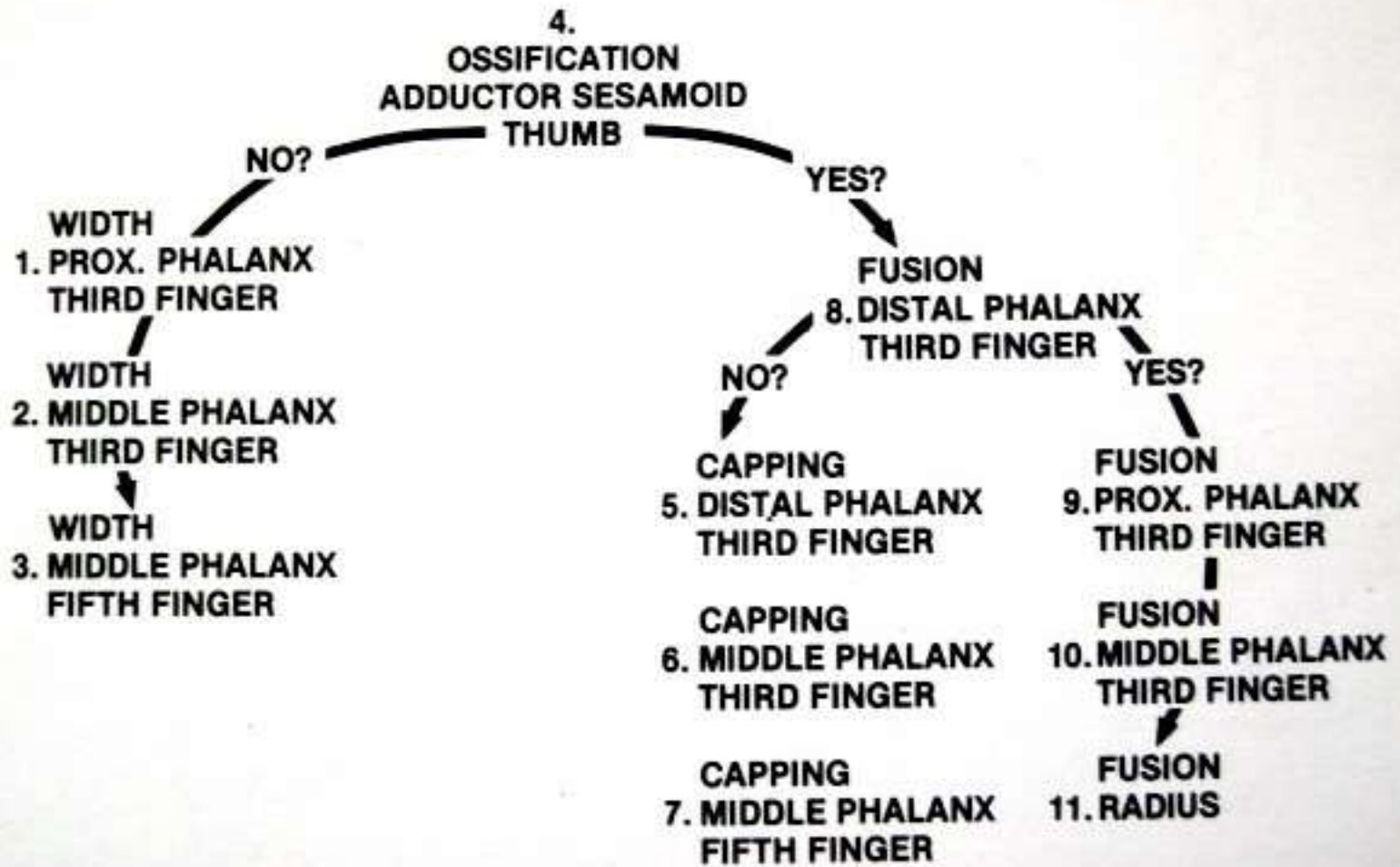
Four stages of maturation



11 Skeletal maturity indicators



HAND-WRIST OBSERVATION SCHEME

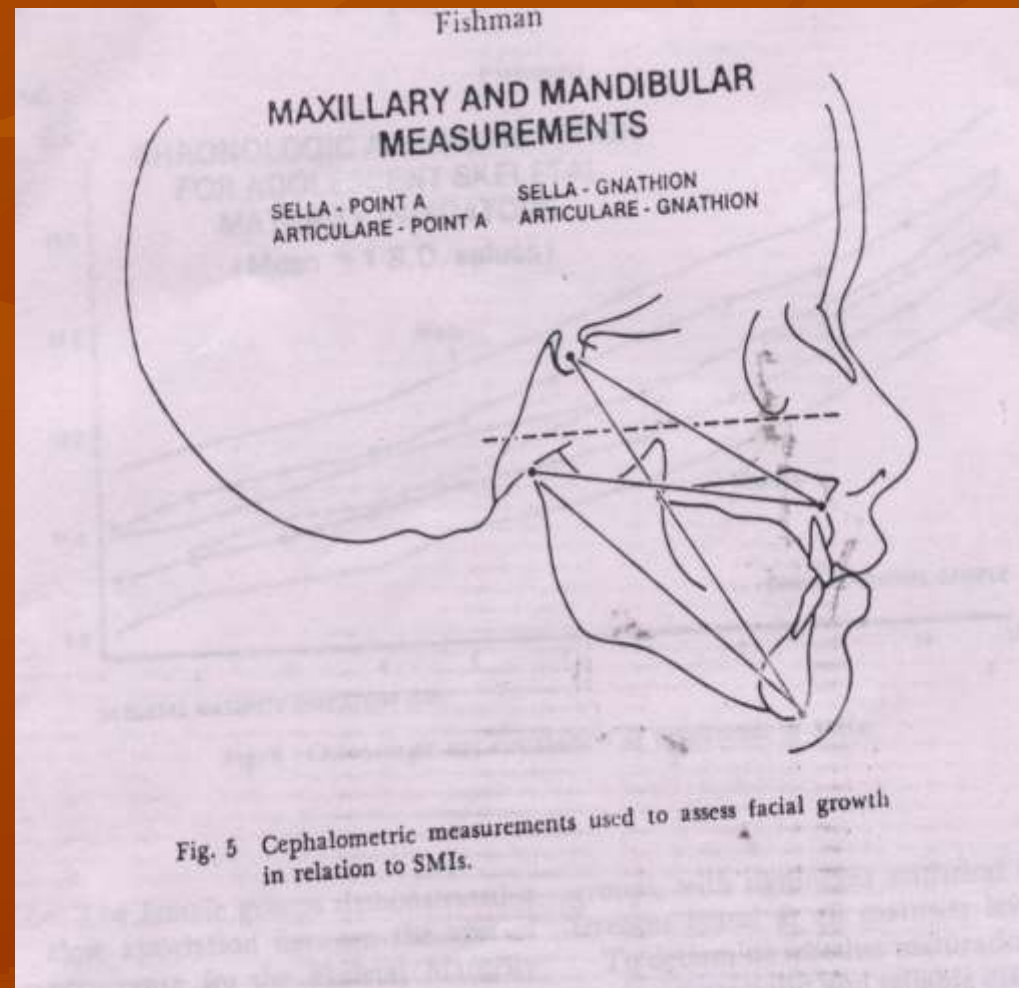


Materials and methods

- Longitudinal and cross sectional data
- 170 females & 164 males-longitudinal gp.
- Lateral cephalograms & hand wrist radiographs
- 1100 radiographs-cross-sectional sample

Measurements & evaluation

- Maxillary and mandibular measurements made
- S - A & Ar - A – maxilla
- S - Gn & Ar - Gn - mandible



Chronological age values for adolescent skeletal maturity indicators

<i>SMI No.</i>	<i>Female</i>		<i>Male</i>		<i>Diff.</i>
	<i>Mean</i>	<i>S.D.</i>	<i>Mean</i>	<i>S.D.</i>	
1	9.94	.96	11.01	1.22	1.07
2	10.58	.88	11.68	1.06	1.09
3	10.88	.99	12.12	1.00	1.23
4	11.22	1.11	12.33	1.09	1.11
5	11.64	.90	12.98	1.12	1.35
6	12.06	.96	13.75	1.06	1.69
7	12.34	.90	14.38	1.08	2.04
8	13.10	.87	15.11	1.03	2.01
9	13.90	.99	15.50	1.07	1.61
10	14.77	.96	16.40	1.00	1.62
11	16.07	1.25	17.37	1.26	1.30

SMI level -6,50% of adolescent growth

Percent of Total Adolescent Growth Completed

<i>Female</i>			
<i>SMI</i>	<i>Height</i>	<i>S-A</i>	<i>S-Gn</i>
2	12.2	16.7	14.7
3	22.5	18.5	25.0
4	32.7	20.3	33.1
5	39.8	28.6	38.3
6	51.7	49.7	47.0
7	73.6	69.0	58.0
8	86.6	83.0	72.7
9	91.9	89.6	84.0
10	96.1	92.7	90.0
11	100.0	100.0	100.0

Summary

- Growth patterns including growth rates for statural height and face were studied
- Skeletal maturation age as measured with SMI – more valid basis than chronological age for grouping individuals
- Variation in maturational development

- Facial growth as measured in max. and mand. – variations in the rate of growth
- Females tended to achieve a higher percentage of their total statural growth than males during early adolescence
- Female showed greater growth velocities and earlier maturation in stature and in max.
- Mandibular velocities highest in the males

- 
- Growth velocities diminished more rapidly in females than in males

Maturation indicators and the pubertal growth spurt

Urban Hagg, John Taranger
AJO Oct 1992.

Pubertal growth spurt and maturation of a sample of 212
swedish children were analyzed - 90 girls & 122
boys.

Factors studied

1. Definition of pubertal growth spurt, age at the
beginning, peak and end of the pubertal growth spurt.

- 
2. Age at the attainment of specified maturation level indicators
 3. The association betn the specified maturation level and pubertal growth spurt

Method

- Subjects examined
 - Data on standing height
 - Tooth emergence
 - Pubertal development
 - Radiograph of the right hand and wrist

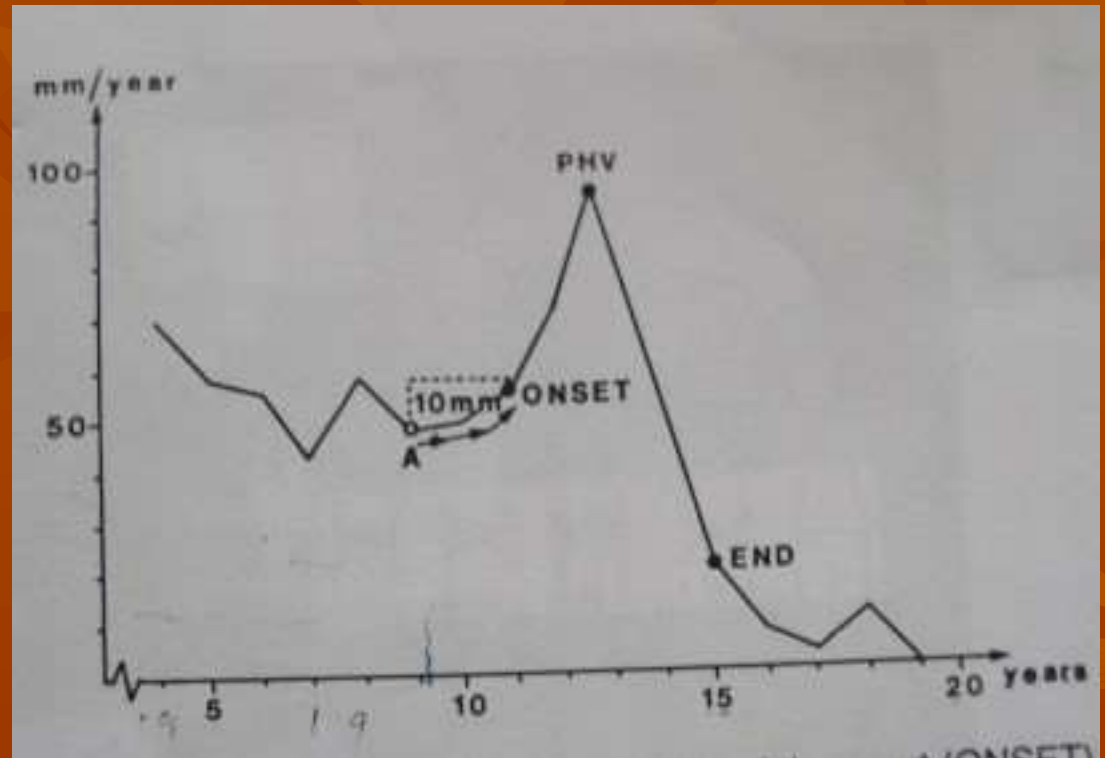
Menarche – 10 years + every 3 months

Voice change – 10 years + annual voice assessment

M	Menarche, first menstrual bleeding
PPV	Prepubertal voice; the pitch of the voice had not changed noticeably
PV	Pubertal voice; the pitch of the voice had changed noticeably but the voice had not yet acquired adult characteristics
MV	Male voice; the pitch of the voice had acquired adult characteristics

Method of analysis

- Adolescent growth studied by graphic analysis 3 - 20yrs
- PHV



- Dental development was assessed by dental emergence stages (DES)
- Stages devised by Bjork + 2 new stages DESM3 & DESM5

Dental emergence stages

Teeth anterior to the molars:

- DES 1 1 to 7 incisors*
- DES 2 All incisors
- DES 3 1 to 11 canines and/or premolars
- DES 4 All canines and premolars

Molar teeth:

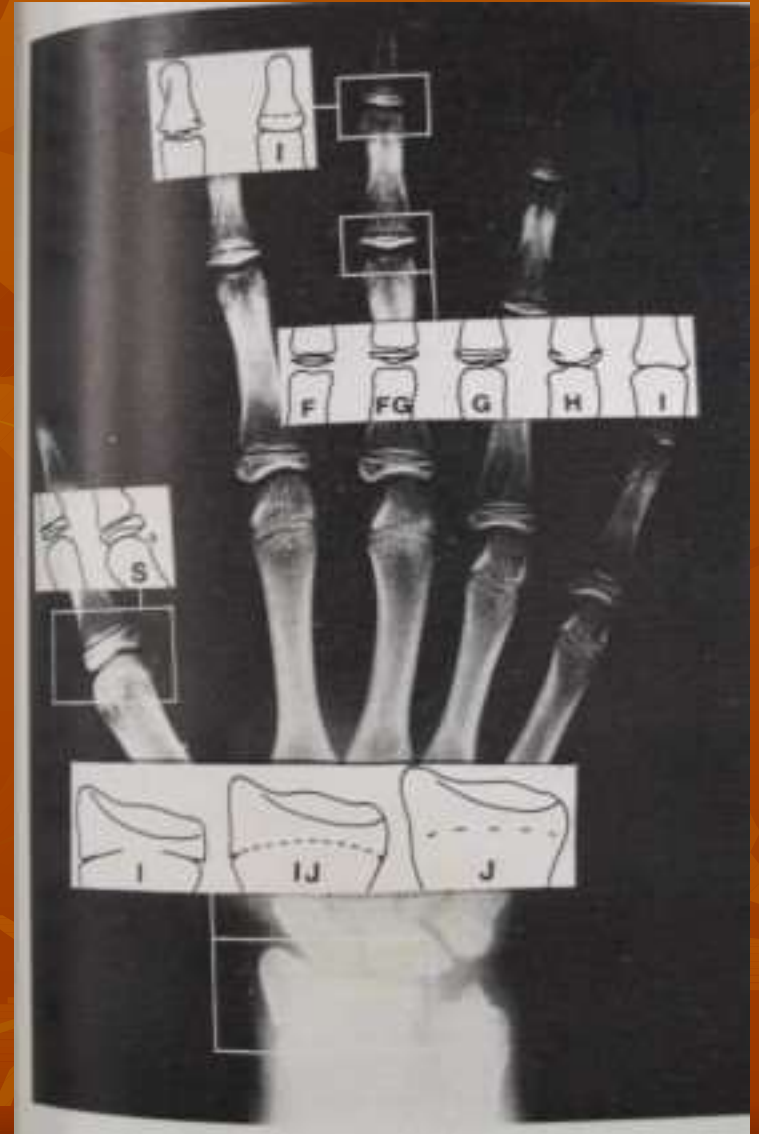
- DES M1 1 to 3 first molars*
- DES M2 All first molars*
- DES M3 1 to 3 second molars
- DES M4 All second molars
- DES M5 1 to 3 third molars
- DES M6 All third molars*

Pubertal development

- Skeletal development- in the hand and wrist radiographs
- Four bones - as indicators of skeletal development
- Ulnar Sesamoid
- Middle phalanx of the third finger
- Distal phalanx of third finger
- Distal epiphysis of radius

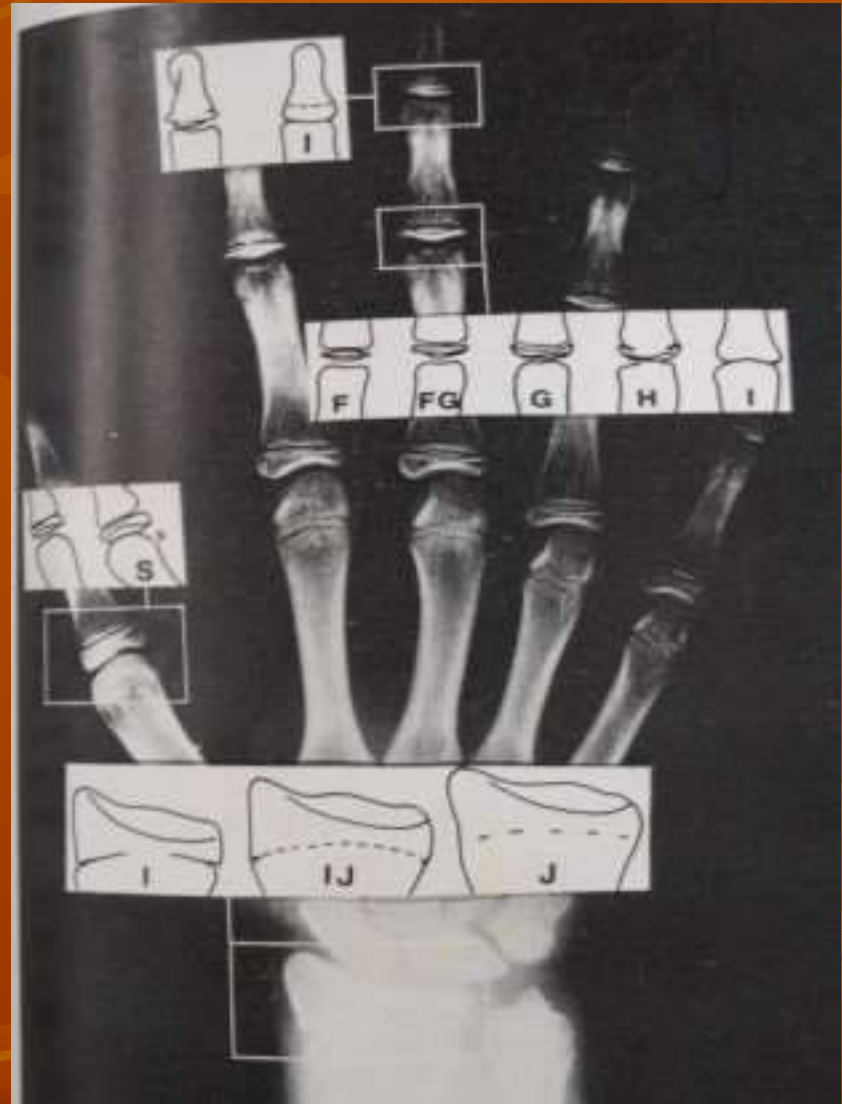
Ulnar sesamoid

□ 2 stages



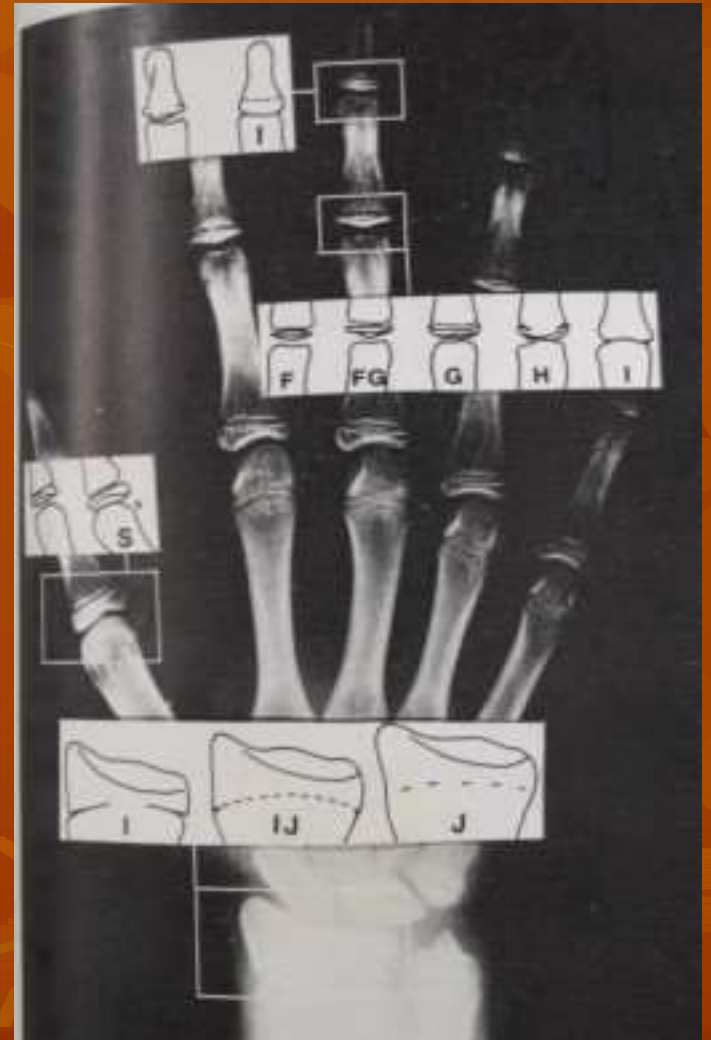
Distal phalanx of third finger (DP3)

□ Stage I



Middle phalanx of the third finger(MP3)

□ 5 stages



Distal epiphysis of radius

- 3 stages



Pubertal developement

- Assesed from 10-18 years
- Menarche in girls
- Voice change in boys

Results

1. Pubertal growth spurt

- Large differences in the ages and growth events.
- Onset 10 & 12.1 yr, End at 14.8 & 17.1 yr.
- PHV 2 yrs after onset in both sexes.

Dental development and pubertal growth spurt

- Weak correlation
- Clinical interest
- DES2 attained or passed by all subjects at onset
- DES3 attained or passed by all subjects at PHV
- DES4 attained before End by all boys and At End by all girls
- DESM3 attained or passed by all boys at PHV
- DESM4 attained or passed by all boys before and by all girls at end

Skeletal development and pubertal growth spurt

- Skeletal development at
- Onset more advanced in girls
- PHV more advanced in girls
- End more advanced in boys

Clinically important findings

- S- attained during acceleration period of pubertal growth spurt
- MP3 – F – attained before onset by 40%
- MP3FG – 1 yr before or at PHV by 90%
- MP3G- at or one yr after PHV by 90%
- MP3H after PHV but before end by all boys and 90% girls
- MP3I before or at end in all subjects

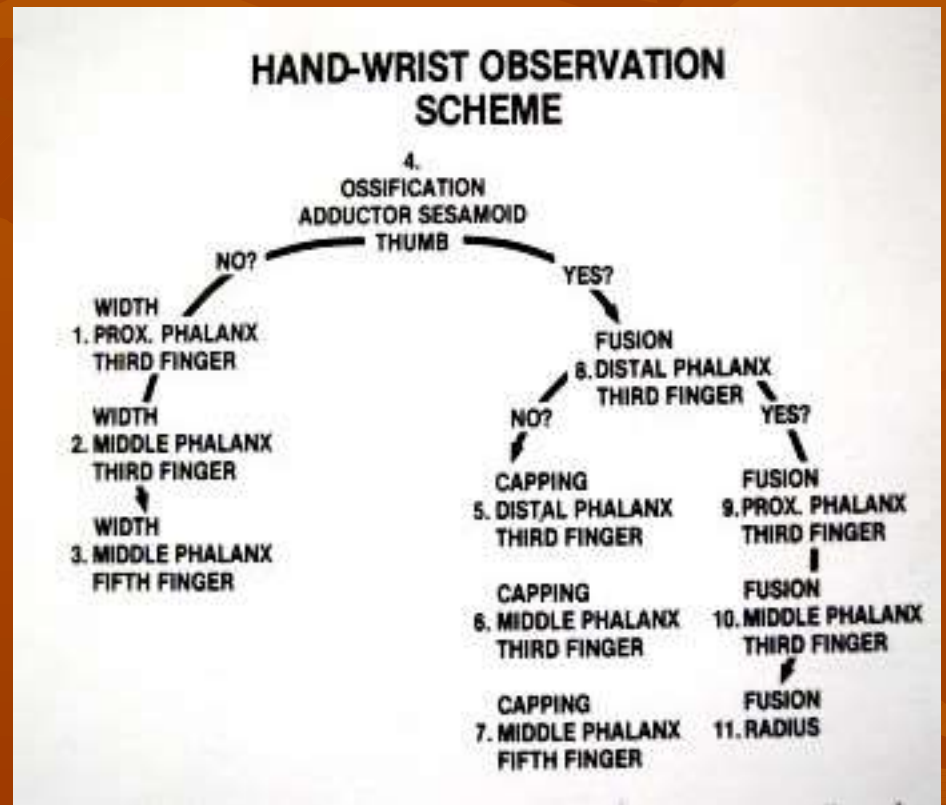
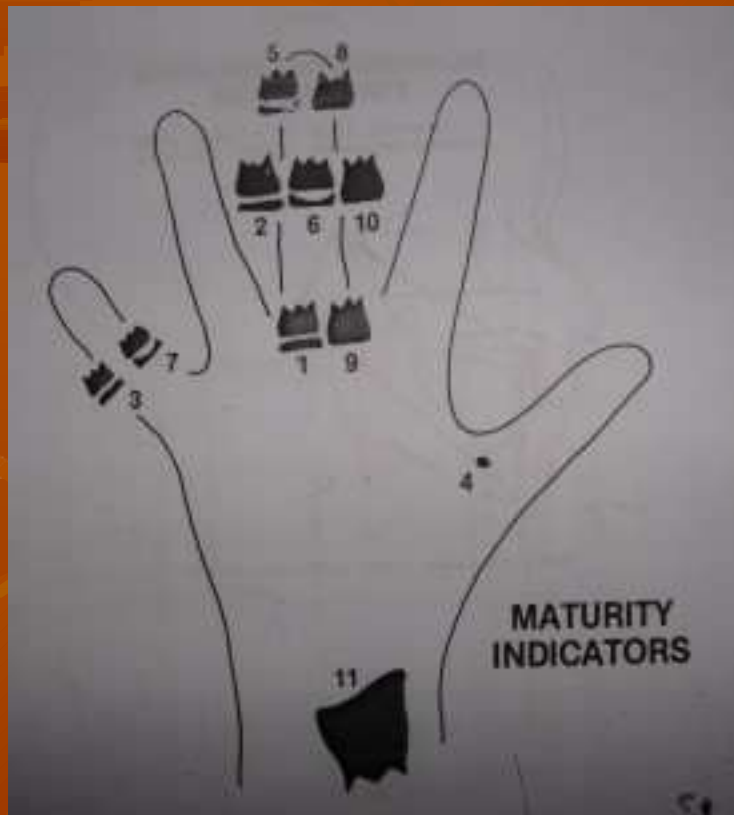
Distal third phalanx

- DP3I – during the deceleration period of pubertal growth spurt
- RADIUS
- I - 1 yr before or at end by about 80% of girls and 90% of boys
- IJ & J not attained before End by any subject

Pubertal development and the pubertal growth spurt

- Close association
- Girls – menarche – 1.1 yr after PHV
- Boys – PV 0.2 yr before PHV
MV 0.9 yr after PHV
- All girls – menarche at the End
- All boys – male voice during pubertal growth spurt.

Fishmans method



Hagg & Taranger method

- F-onset
- FG-acceleration
- G- peak of the curve.
- H-deceleration
- I-End

Cervical vertebrae

- Lamparski- 1972
- Hassel & Farman(1995) – skeletal maturity can be evaluated at any given time using CVMI.
- Garcia Fernandez(1998) - mexican population.
- Raja Gopal & Kansal(2002) - found a high correlation bn six MP3 stages & six stages of CV maturation.

Skeletal maturation evaluation using cervical vertebrae-AJO 1995

BRENT HASSEL& FARMAN

Bolton brush growth centre

Cervical vertebrae maturation index – 2,3 & 4 cervical vertebrae

Sample: 220 subjects 8- 18 yrs

Method

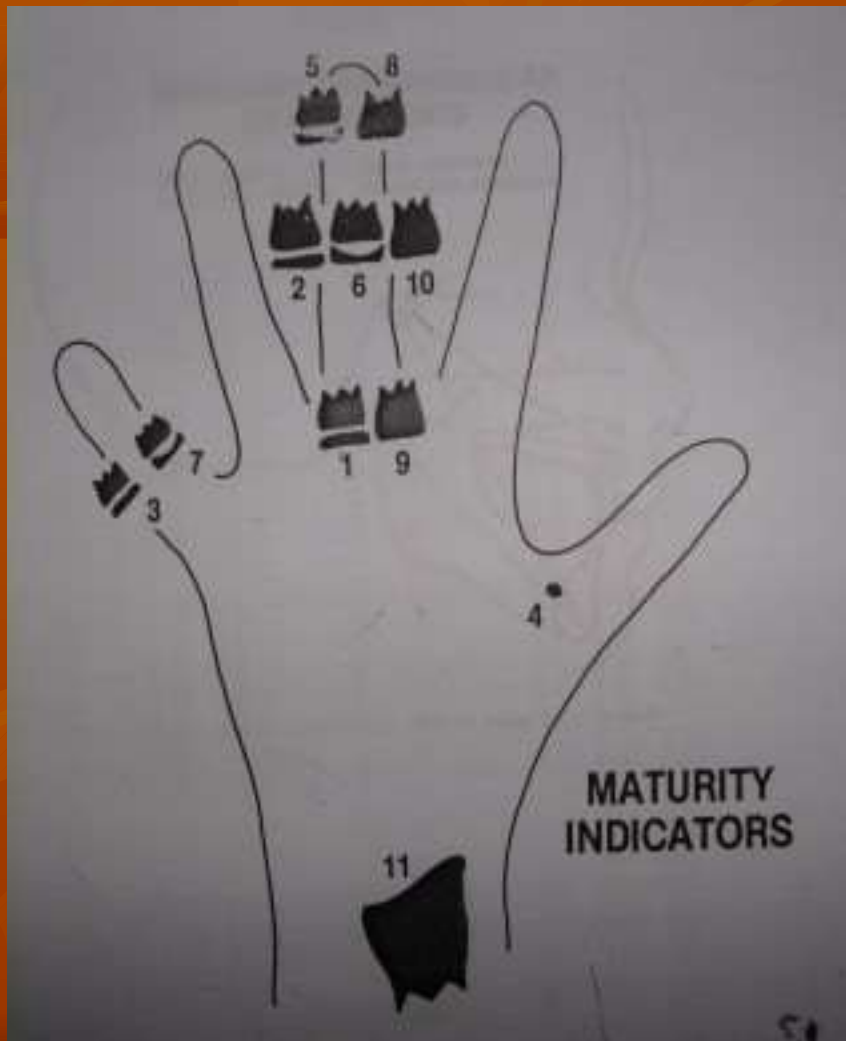
- Fishmans system- H & W radiograph
- Lateral ceph -

Dens(odontoid process)

Body of C3

Body of C4

11 Skeletal maturity indicators

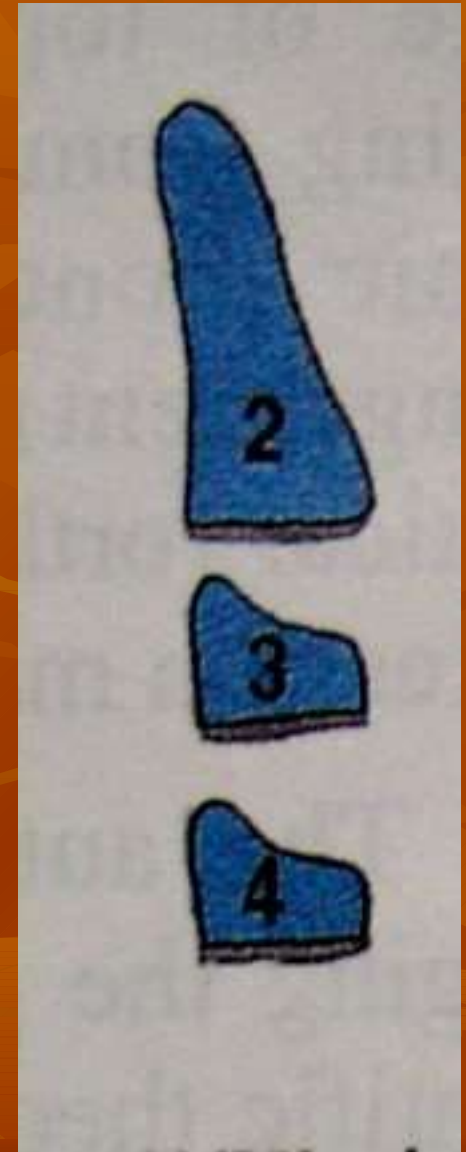


Results

- Six categories of CV maturation defined

CATEGORY 1 (initiation)

- Corresponds to SMI 1&2.
- 80 -100% of growth expected
- Inferior borders of C2,C3 & C4 were flat
- Vertebrae wedge shaped
- Tapered from post. to Ant.



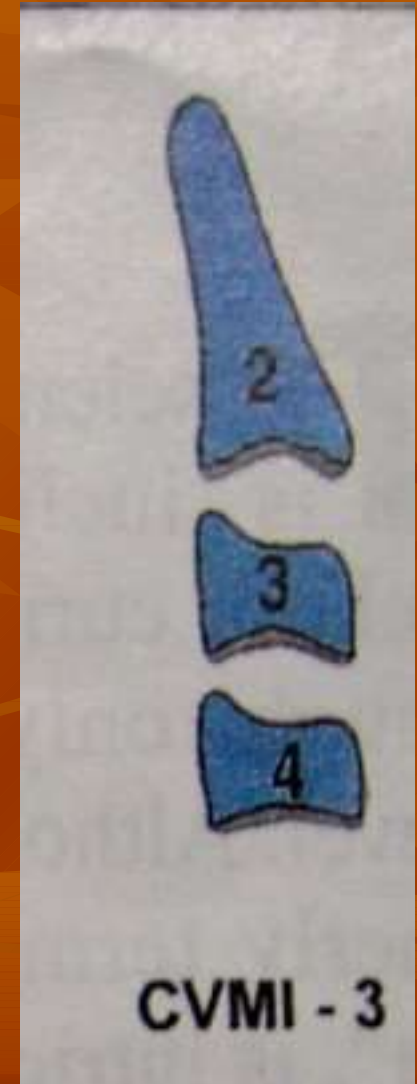
CATEGORY 2 (acceleration)

- Corresponds to SMI 3&4
- 65 - 85% of growth expected
- Inferior borders of C2,C3-concavities developing
- Inf. Border C4 flat
- C3 & C4 bodies rectangular



CATEGORY 3 (transition)

- Corresponds to SMI 5 & 6
- 25 - 65% growth expected
- Distinct concavities-C2&C3
- Concavity begins to develop-C4
- C3 & C4 rectangular.



CATEGORY 4 (DECELERATION)

- Corresponds to SMI 7&8.
- 10 - 25% growth expected
- Distinct concavities- C2, C3 & C4.
- C3 & C4-becoming square in shape.



CATEGORY 5(maturation)

- Corresponds to SMI 9 & 10
- 5 -10% growth expected.
- Accentuated concavities-C2,C3 & C4.
- C3 &C4 almost square in shape.



CATEGORY 6 (COMPLETION)

- Corresponds to SMI 11
- Adolescent growth complete
- Deep concavities- C2, C3 & C4.
- Vertebral bodies greater vertically than horizontally.



The cervical vertebrae as maturational indicators

GARCIA FERNANDEZ

JCO APRIL 1998

- Mexican population
- Sample - 113 patients
- H & W - FISHMAN
- Cervical vertebrae-
HASSEL & FARMAN

RESULTS

CORRELATION OF HAND-WRIST AND CERVICAL VERTEBRAL MATURATION STAGES

Hand-Wrist SMI ⁶	Cervical Vertebral Stage ²⁵	Percentage of Pubertal Growth Remaining
1-2	1. Initiation	85-100%
3-4	2. Acceleration	65-85%
5-6	3. Transition	25-65%
7-8	4. Deceleration	10-25%
9-10	5. Maturation	5-10%
11	6. Completion	0%

A comparison of modified MP3 stages & the cervical vertebrae as maturity indicators

RAJAGOPAL and KANSAL

JCO JULY 2002

Aim :determine whether the 6 modified MP3 stages could be correlated with the 6 stages of CVMI's.

Materials

75 males & 75 females – Age – 9 - 17yrs

Lateral cephalograms & periapical
radiographs



MP3-F & CVMI 1

MP3-F stage: Start of the curve of pubertal growth spurt (Fig. 4A)

Features observed by Hagg and Taranger¹:

1. Epiphysis is as wide as metaphysis.

Additional features observed in this study:

2. Ends of epiphysis are tapered and rounded.

3. Metaphysis shows no undulation.

4. Radiolucent gap (representing cartilagenous epiphyseal growth plate) between epiphysis and metaphysis is wide.



MP3-FG & CVMI 2

MP3-FG stage: Acceleration of the curve of pubertal growth spurt (Fig. 5A)

Features observed by Hagg and Taranger:

1. Epiphysis is as wide as metaphysis.
2. Distinct medial and/or lateral border of epiphysis forms line of demarcation at right angle to distal border.

Additional features observed in this study:

3. Metaphysis begins to show slight undulation.
4. Radiolucent gap between metaphysis and epiphysis is wide.



MP3-G & CVM1 3

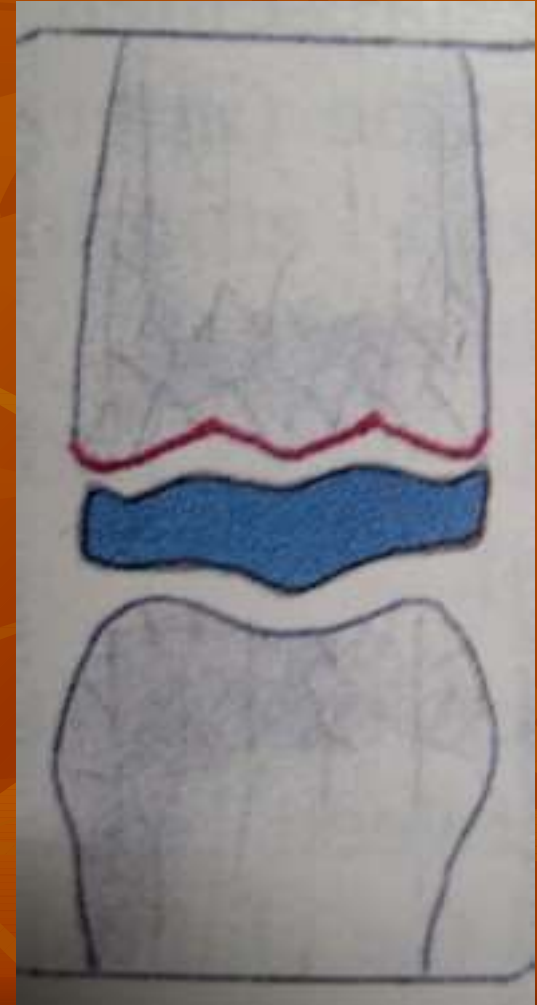
MP3-G stage: Maximum point of pubertal growth spurt (Fig. 6A)

Features observed by Hagg and Taranger:

1. Sides of epiphysis have thickened and cap its metaphysis, forming sharp distal edge on one or both sides.

Additional features observed in this study:

2. Marked undulations in metaphysis give it "Cupid's bow" appearance.
3. Radiolucent gap between epiphysis and metaphysis is moderate.



MP3-H & CVMI 4

MP3-H stage: Deceleration of the curve of pubertal growth spurt (Fig. 7A)

Features observed by Hagg and Taranger:

1. Fusion of epiphysis and metaphysis begins.

Additional features observed in this study:

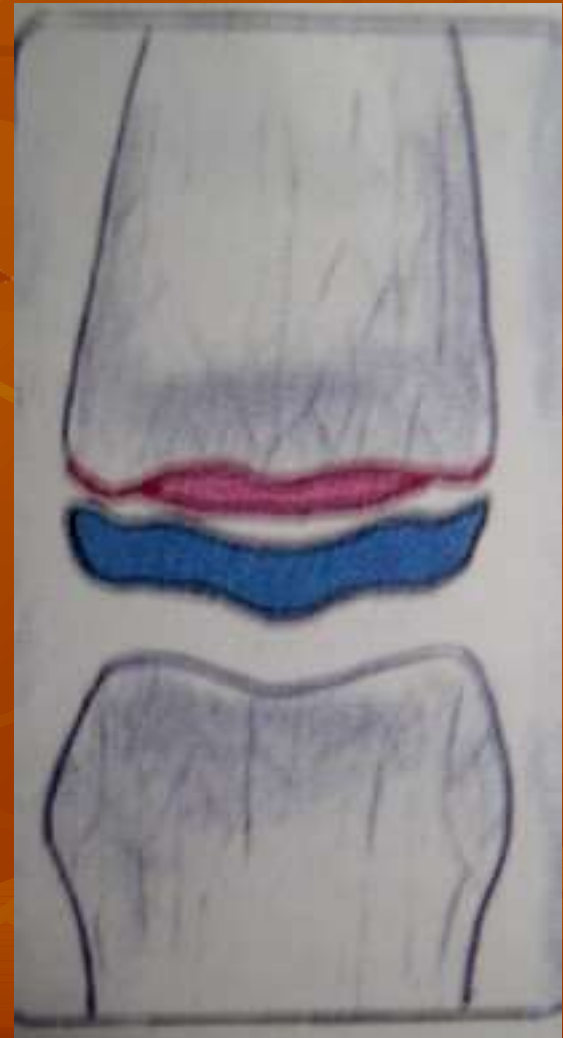
2. One or both sides of epiphysis form obtuse angle to distal border.

3. Epiphysis is beginning to narrow.

4. Slight convexity is seen under central part of metaphysis.

5. Typical “Cupid’s bow” appearance of metaphysis is *absent*, but slight undulation is distinctly present.

6. Radiolucent gap between epiphysis and metaphysis is narrower.

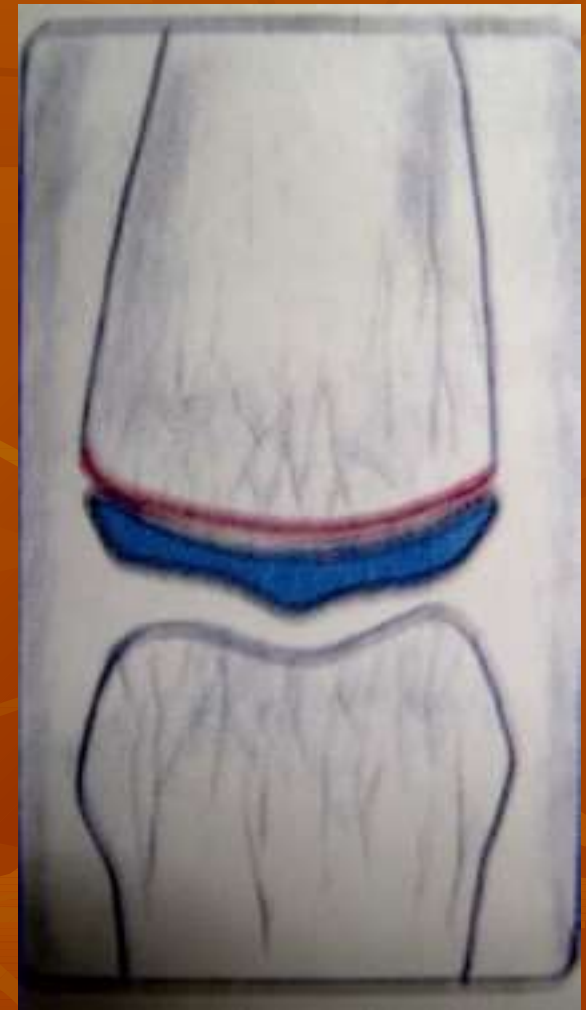


MP3-HI & CVMI 5

MP3-HI stage: Maturation of the curve of pubertal growth spurt (Fig. 8A)

Features of this “new” stage observed in this study:

1. Superior surface of epiphysis shows smooth concavity.
2. Metaphysis shows smooth, convex surface, almost fitting into reciprocal concavity of epiphysis.
3. No undulation is present in metaphysis.
4. Radiolucent gap between epiphysis and metaphysis is insignificant.



MP3-I & CVMI-6

MP3-I stage: End of pubertal growth spurt (Fig. 9A)

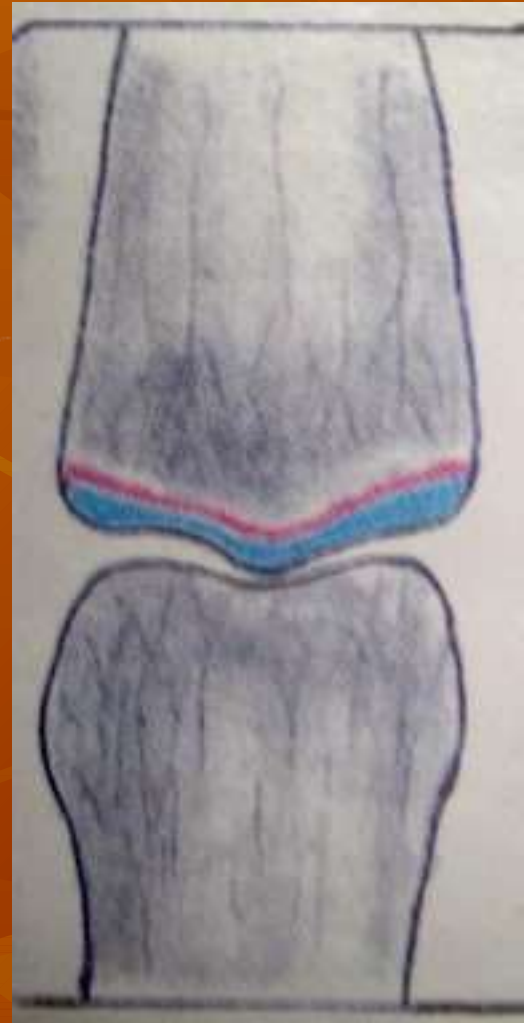
Features observed by Hagg and Taranger:

1. Fusion of epiphysis and metaphysis complete.

Additional features observed in this study:

2. No radiolucent gap exists between metaphysis and epiphysis.

3. Dense, radiopaque epiphyseal line forms integral part of proximal portion of middle phalanx.



Results

SIMILARITY BETWEEN MODIFIED MP3 STAGES AND CVM1 (ALL SUBJECTS)

	No.	Pct.
Similar	142	94.7%
Dissimilar	8	5.3%

conclusions

- Modified MP3 stages using periapical X-ray film can be an accurate & simple - growth indicator.

Skeletal Maturity indicators



A
VISION
BEYOND

DR.AJINKYA

Physiological timing of Orthodontic treatment

Julian Singer, Oct.1980, AO.

Purpose of the paper

1. To enable the clinician to rapidly and with some degree of reliability utilize the hand and wrist film to determine the maturation status.
2. Examine several other stages of the growth which could be significance in t/t.

Physiological timing of Orthodontic treatment

Methods

- 6 stages of hand & wrist development

Stage 1(early)

- Absence of pisiform,
- Absence hook of hamate.
- Epiphysis of proximal phalanx of second digit narrower than its shaft



Physiological timing of Orthodontic treatment

Stage 2 (prepubertal)

- Initial ossification of pisiform & hook of hamate.
- Proximal phalanx of second digit and its epiphysis are equal in width



Physiological timing of Orthodontic treatment

Stage 3(pubertal onset)

- Beginning calcification of sesamoid
- Increased ossification of pisiform & hook of hamate
- Increased width of epiphysis of PP2



Physiological timing of Orthodontic treatment

Stage 4(pubertal)

- Calcified sesamoid
- Capping of shaft of middle phalanx of third digit by its epiphysis - MP3 cap.



Physiological timing of Orthodontic treatment

Stage 5 (pubertal deceleration)

- sesamoid fully calcified
- DP3u stage
- All phalanges and carpals fully calcified
- Epiphyses of radius and ulna not fully calcified with respect to shafts



Physiological timing of Orthodontic treatment

Stage 6(growth completion)

- No remaining growth sites



Physiological timing of Orthodontic treatment

Discussion

Advantage of stage 2

- Maximum mand growth-before appearance of sesamoid (Pileski et al)
- Hunter- mandible growth reached its peak in this stage in girls

Physiological timing of Orthodontic treatment

Conclusions

- Hand and wrist film can be used as an indicator of the maturational status of orthodontic pt.
- 6 stages advocated as guidelines for t/t timing
- Prepubertal period - during which Cl.II correction could be effectively achieved
- Stage 5-period of residual growth during which post t/t changes could occur

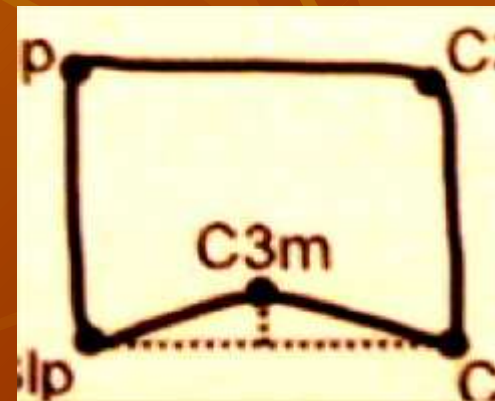
□ The Cervical Vertebral Maturation (CVM)
Method for the assessment of Optimal
Treatment Timing in Dentofacial Orthopedics
- *Tizano Baccetti., Lorenzo Franchi., James A
McNamara, Jr.*

semin in orthod 2005

Visual Analysis

2 independent investigators

- Presence or absence of Concavity with the lower border of C2, C3, C4
- Shape of the body of C3, C4
 - trapezoid
 - rectangular horizontal
 - squared
 - rectangular vertical

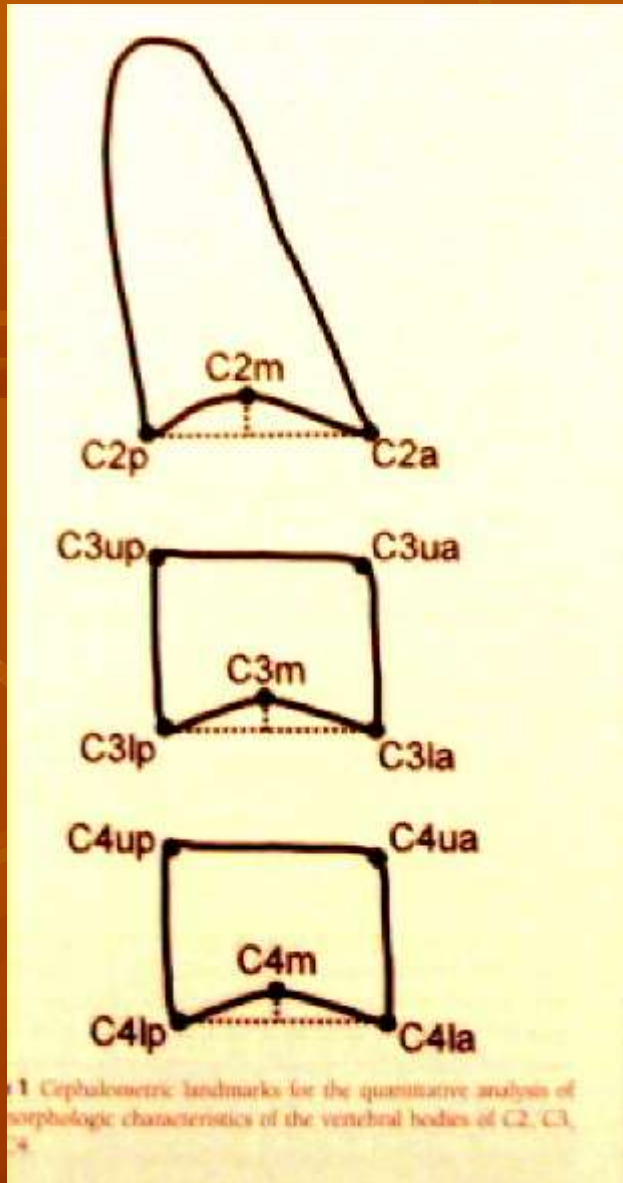


Cephalometric Analysis

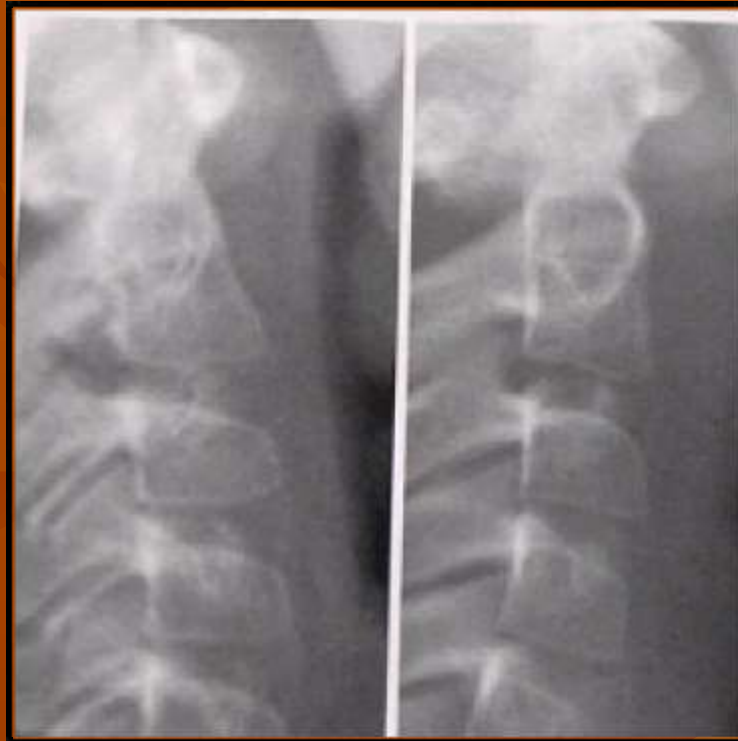
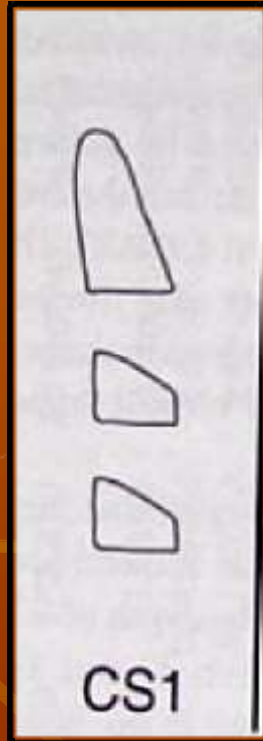
□ Concavity

□ BAR

□ PAR

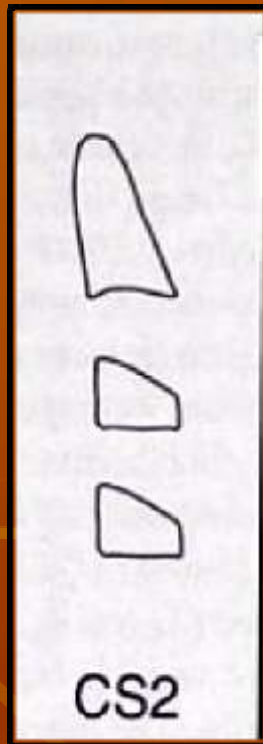


CS1



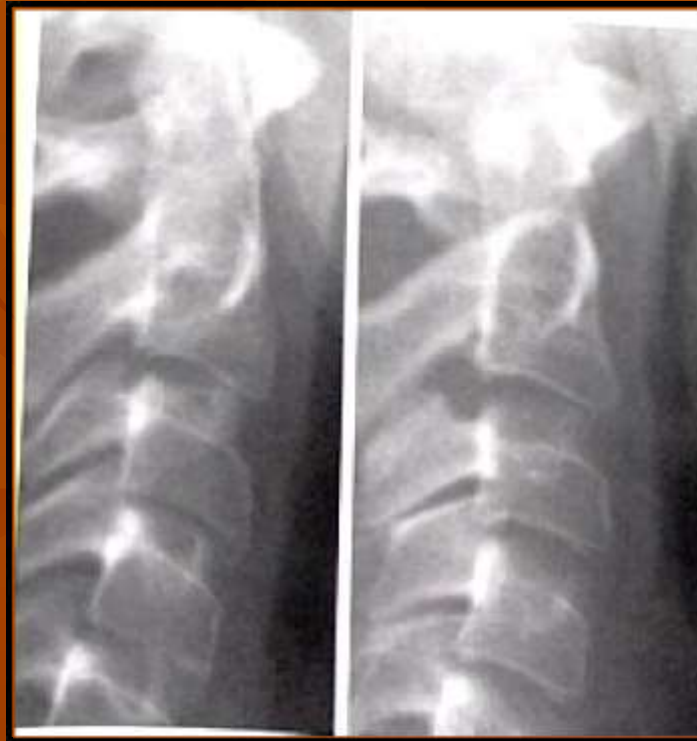
Peak mandibular growth 2yrs after this stage

CS2



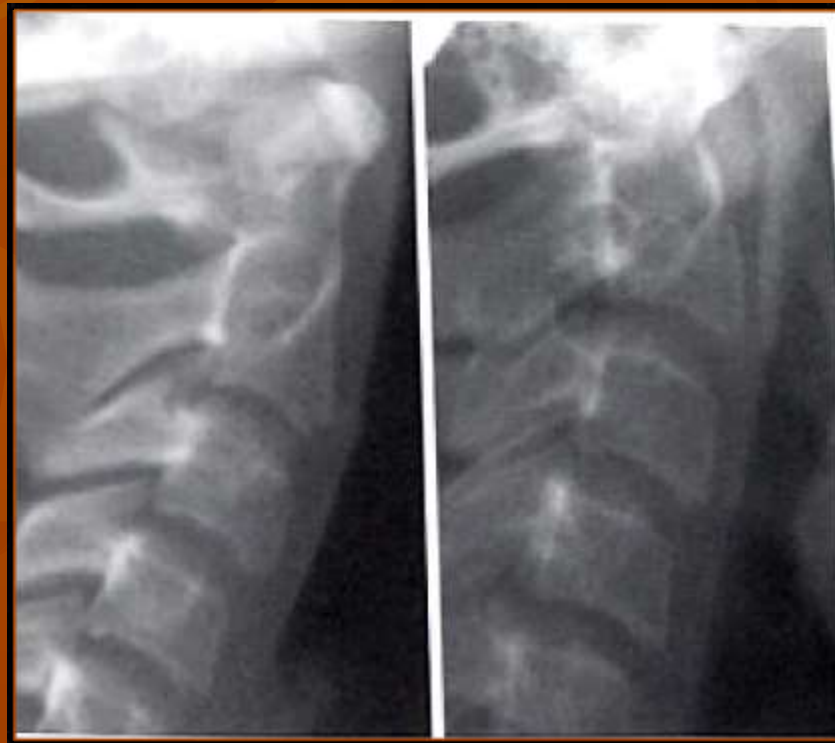
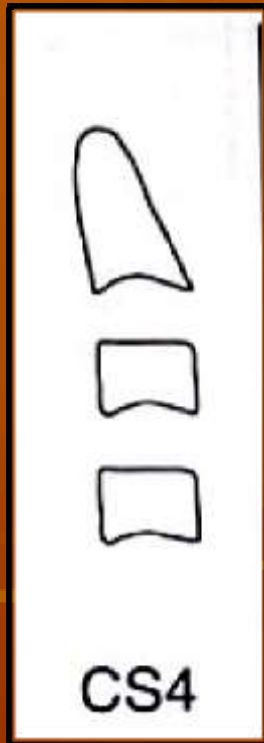
Peak mandibular growth 1yr after this stage

CS3



Peak mandibular growth during the year after this stage

CS4



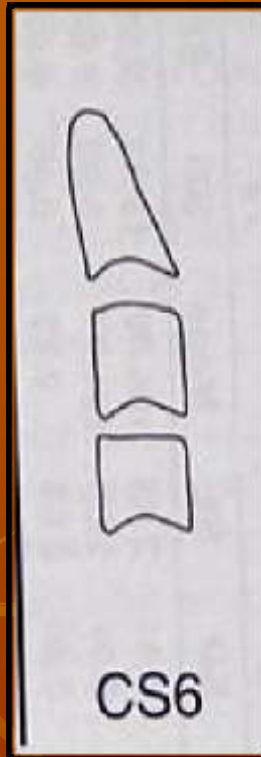
Peak mandibular growth occurred 1-2yrs before this stage

CS5



Peak mandibular growth 1 year before this stage

CS6



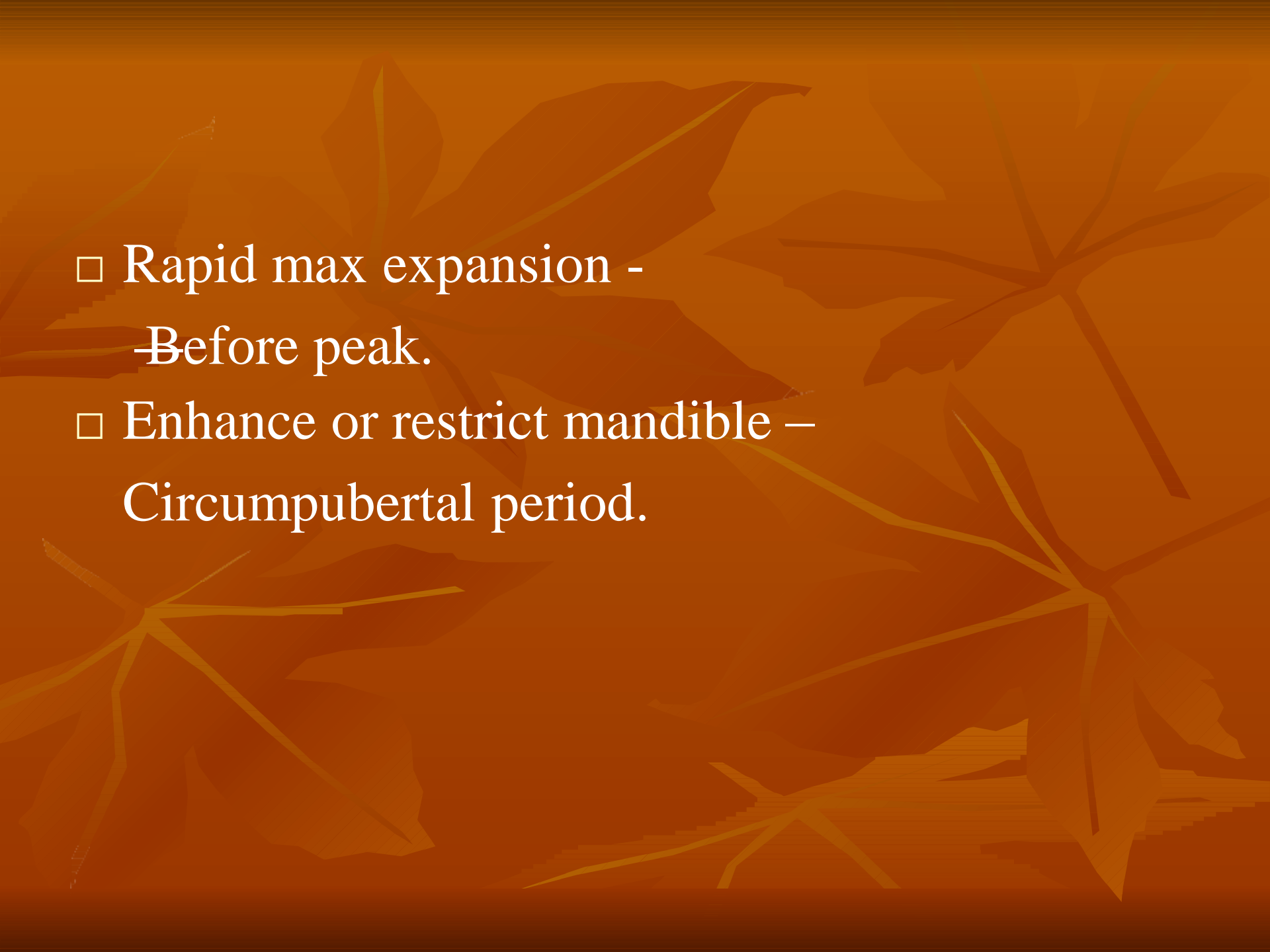
Peak mandibular growth ended at least 2yrs before this stage

Application to Dentofacial Orthopedics

- Index to detect the optimal time to start treatment
- CS1 - CS2 - wait for at least 1yr to start functional treatment
- Concavity on C2 - Growth spurt approaching - peak 1yr after this stage
- CS3 - Ideal time to start functional appliance - peak within this year (5.4 mm growth recorded)

Timing for class III

- Prepubertal orthopedic treatment –
 - Maxilla (2 mm) , Mandible (3.5mm)
- Treatment at puberty –
 - Mandible (4.5mm)

- 
- Rapid max expansion -
 - Before peak.
 - Enhance or restrict mandible –
 - Circumpubertal period.

Maturation evaluation of ossification of the mid palatal suture

BERNAL REVALO, FISHMAN

AJO MARCH 1994

PURPOSE: positive correlation b/n adolescent maturation development and the approximation of the mid palatal suture.

Method- H&W radiographs – Fishman's method

Occlusal radiographs-Approx. of mid palatal suture.

Sample

39 males & 45 females- 8-18 yrs

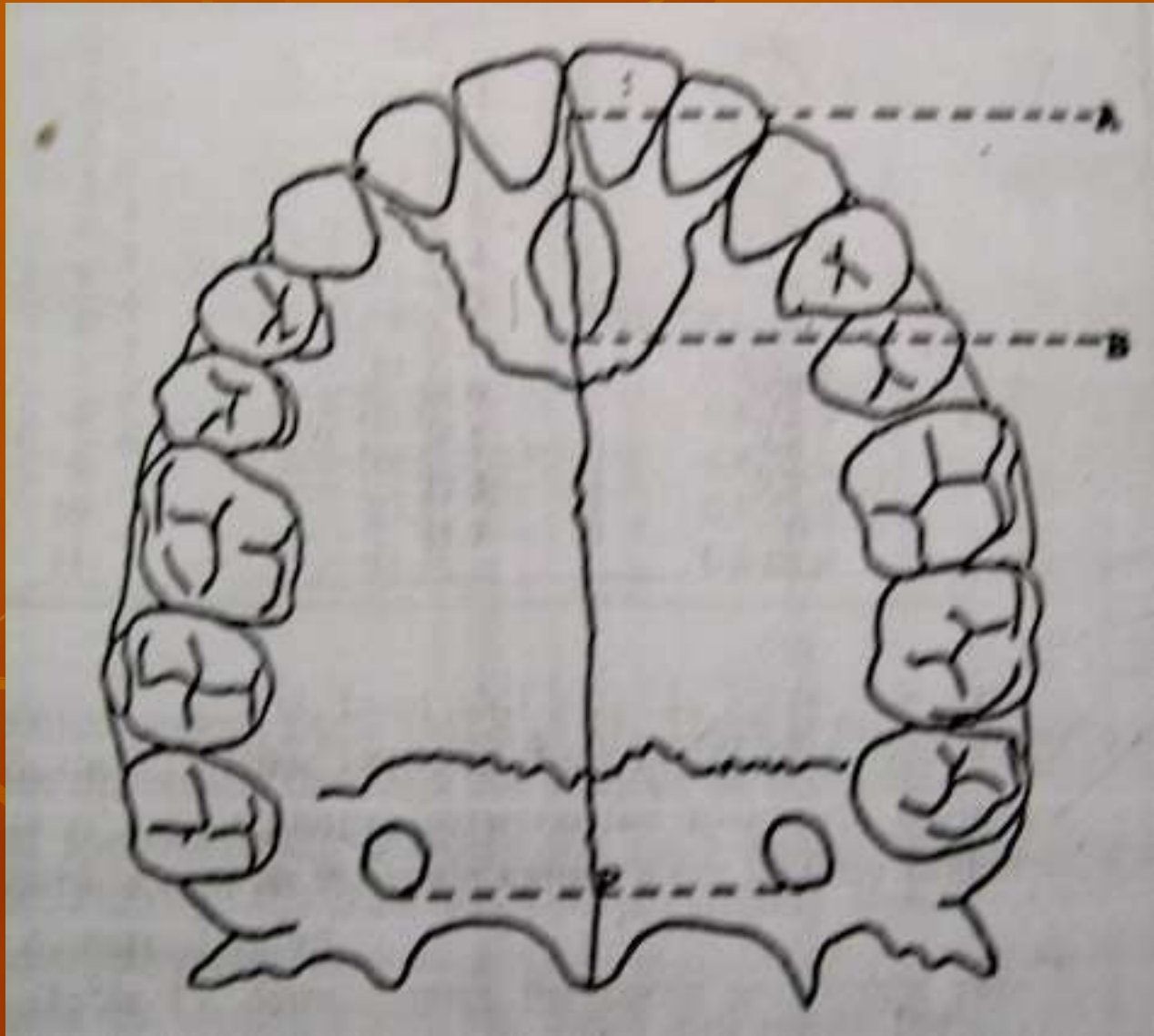


Table IV. Percentage values of total midpalatal suture fused (A-P)

<i>SMI</i>	<i>Mean</i>	<i>Range</i>
0	0.0	0.0
1	1.1	0.0-4.4
2	2.7	0.0-7.0
3	8.0	6.2-10.5
4	13.0	11.2-20.0
5	16.0	11.7-20.5
6	16.8	12.5-27.5
7	22.9	13.4-30.0
8	24.4	22.8-24.5
9	26.5	21.2-35.2
10	45.1	28.0-62.3
11	52.4	30.0-69.0

Table V. Mean and range percentage values of midpalatal suture fused (A-B)

<i>SMI</i>	<i>Mean</i>	<i>Range</i>
0	0.0	0.0
1	2.0	0.0-7.7
2	1.0	0.0-7.7
3	2.1	0.0-8.4
4	12.4	0.0-23.1
5	11.2	0.0-20.0
6	8.6	0.0-16.7
7	13.5	0.0-33.4
8	11.0	0.0-12.5
9	14.8	0.0-37.5
10	23.3	0.0-53.0
11	41.7	0.0-60.0

Table VI. Mean and range percentage values of midpalatal suture fused (B-P)

<i>SMI</i>	<i>Mean</i>	<i>Range</i>
0	0.0	0.0
1	1.7	0.0-6.7
2	3.8	0.0-12.0
3	10.8	6.7-14.8
4	14.3	11.5-22.0
5	17.2	10.4-26.7
6	23.7	14.8-35.5
7	28.3	17.0-40.0
8	30.3	24.3-32.4
9	33.6	28.2-37.0
10	54.1	37.5-66.7
11	57.6	26.5-73.4

Results

- Little correlation b/n maturational development & approximation.
- At SMI 3 only 8% fused.
- At SMI 9 –approx. 25% of fusion.
- At SMI 11- 50% of fusion.

Conclusion

- Best to accomplish ME-before SMI 9.
- Ideal time- SMI 1- 4
- Less orthopedic force required.
- Mid palatal approx. occurs more posteriorly.

Tooth mineralization as an indicator of the pubertal growth spurt

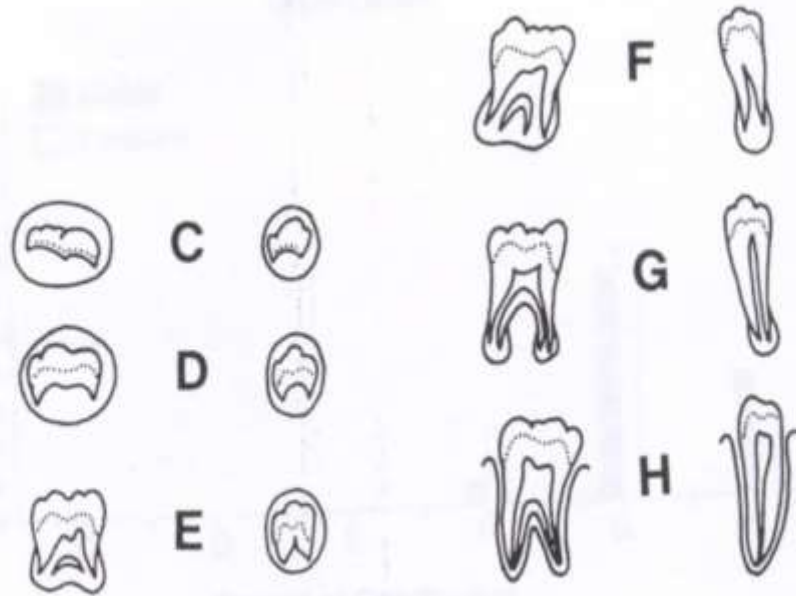
CHERTKOW

AJO 1980

- AIM: To investigate the relationship b/n stages of mineralization of various teeth & other maturational indicators of pubertal growth spurt.
- Method & materials -
 - 197 patients (66+22 b) + (93 + 16 g)
- Panoramic radiographs
- H & W radiographs

- Max. & mandibular canines, 1&2 premolars & mandibular second molars
- Appearance of sesamoid, MP3cap & calcification of hook of hamate.

Dental formation stages(Demirjian)



Diagrammatic appearance of stages C to H of tooth development for unilateral...

Results

- Uniformity of development of mand. canine
- No sexual dimorphism.
- Marked racial differences.
- Definite relationship b/n development of mandibular canine & other indicators of pubertal growth spurt.
- Caucasian population- stage G coincided with other maturity indicators.

Conclusion

- Completion of root formation of mand canine, prior to apical closure



**Maturity
indicator**

Mandibular skeletal maturity assessment

Santosh C Verghese

J M Jayraj

U S Krishna Nayak

Jios June 2003

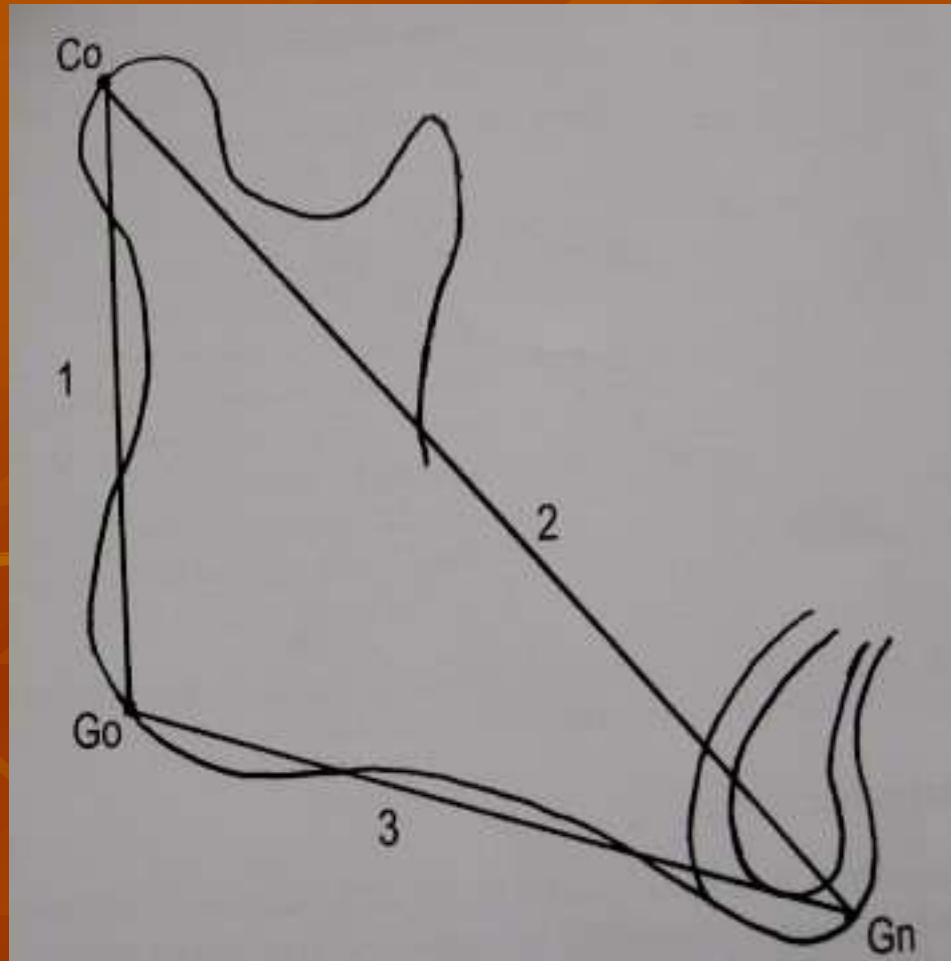
Purpose : Deduce a simpler method of estimating the skeletal maturity of mandible using corpus index obtained from transverse slicing section of the mandible

- Correlating values of the corpus index to cervical maturation stages

Materials & methods

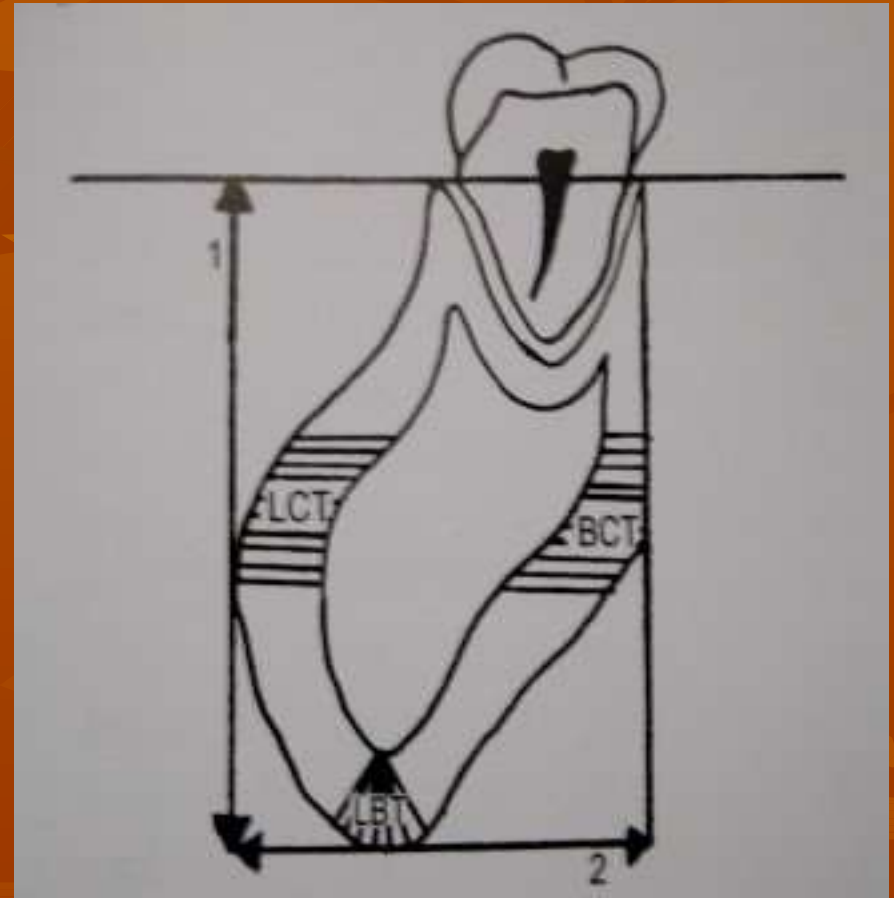
- Sample 60 pts - 30 males & 30 females(9 to 16 yrs)
- Lat ceph – left side.
- TSS – PM 2000 CC Proline machine , T – Mat E Dental film.

Measurements



Transverse slicing section(TSS)

- MEASUREMENTS
- BCT
- LCT
- LBT
- MCH
- MCD
- Corpus index-
MCH/MCD



RESULTS

Cervical vertebra maturation Stages	T.S.S			Mandibular Length		
	Height	Width	Corpus Index H/W	Effective Ramus	Corpus	
Acceleration	32.2	17.5	1.84	99.3	37	63.3
Transition	38.3	18.7	2.05	107.7	37	65
Deceleration	39	18	2.17	110.5	39	705
Maturation	39.5	17	2.3	115	42	72
Completion	36.1	14.1	2.56	125	46	74

Conclusion

- Orthopedic t/t can be accomplished - pt shows a corpus index of 1.8
- 2.05 – fixed functional orthopedic t/t
- 2.17 – orthopedic appliances minimal skeletal & more of dental changes

Can frontal sinus be used for the prediction of skeletal maturity at puberty?

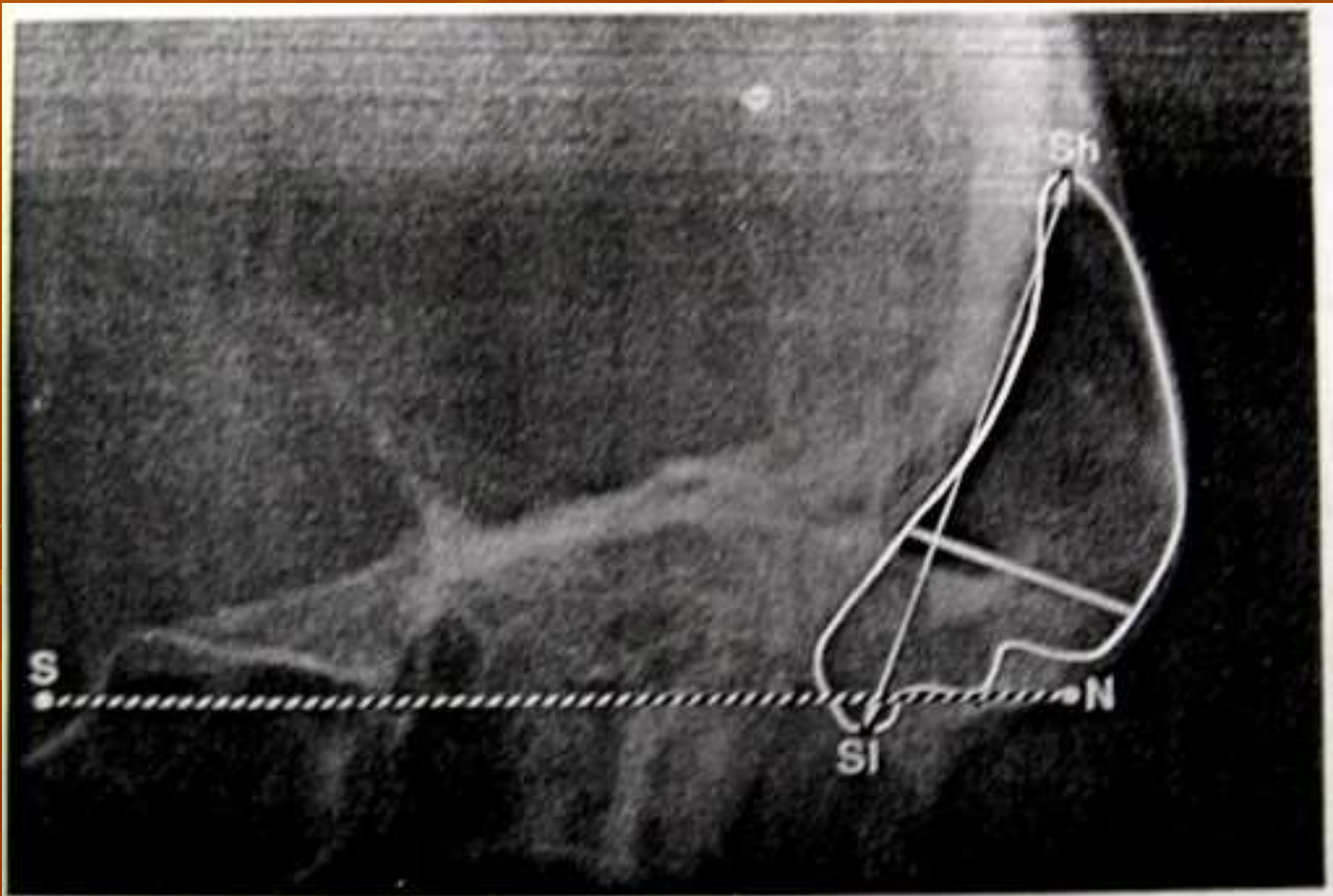
Pancherz & Sabine Ruf

Acta Odontol Scand

1996

- To evaluate the possibility of predicting the stage of somatic maturity by analyzing frontal sinus growth.
- Sample size - 59 boys (10 - 19.5 yrs)
- Method : analysis of lateral head films & H&W
 - 1 yr & 2 yrs
 - 2 prediction intervals T1 & T2

Frontal sinus measurements



Assesment of maximal frontal sinus width perpendicular to interconnecting line

Previous study results

- Frontal sinus growth velocity at puberty is closely related to body height growth velocity
- Frontal sinus growth shows a well defined pubertal peak(Sp) which on the average occurs 1.5 yr after body ht. peak
- In males – average age at frontal sinus peak is 15.1 yrs – MP3 G / MP3 H

Previous study results

- 1 yr interval, peak growth velocity T1-
1.3mm/yr.
- 2 yr interval, peak growth velocity T2-
1.2mm/yr.

Prediction procedure

$S_v > T$ - MP3 G / MP3H

$S_v < T$ - Before MP3 G (AGE < 15.1 YRS)

$S_v < T$ - MP3 I (AGE > 15.1 YRS)

Verification of reliability of cervical vertebrae as skeletal maturity indicator.

- Nitin Kalra
2003.

Material & Methods

- 260 (122 M + 138 F)
- 10 – 18 YRS.
- Lateral ceph. & MP3 radiographs
- Inf border – 2,3,4,5 c.v.
- Shape changes – 3,4,5 c.v.
- SA , SP , IA , IP.
- ANT < 69% : Wedge shaped
- 70 - 89% : Nearly rectangular
- Above 90% : Rectangular

RESULTS

F – WEDGE – FLAT

FG – NR – C2 & C3

G – R – C2 ,C3 ; C4

H – SQUARISH – C2 ,C3 , C4

I – VT INCREASE – C2 , C3 ,C4

CONCAVITY –

I = CVMI

H = CVMI

F = C4 , C5

SHAPE –

I = C3 , C4

FG = C3

F = C4 , C5

G low levels of match with respect to concavity/shape of vertebrae.

CONCLUSION –

CVMI can be an adjunct to H & W but not a substitute.



H - STAGE



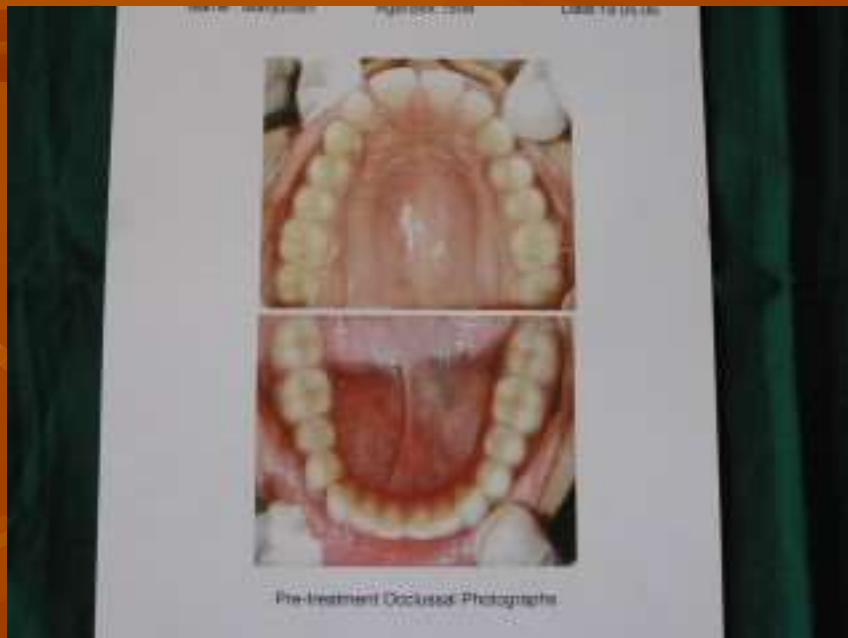
FG- STAGE



CVMI - 4



CVMI - 1



DESM -4



DES - 3



MAX – 52 : 57 ; MAN – 74:75 ; 55 - 59



22/8



25/10

POINTS TO REMEMBER

- Genetic & Acquired abnormalities often lead to deviations in maturation.
- MI – Advantage of growth – desirable.
Restrict the growth – undesirable.
- MI – Diagnosis.
Stress not to be given – any/only one.
State of confusion – correlate.



THANK YOU

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