

# **Chapter 2: Development and Eruption of the Human Dentition**

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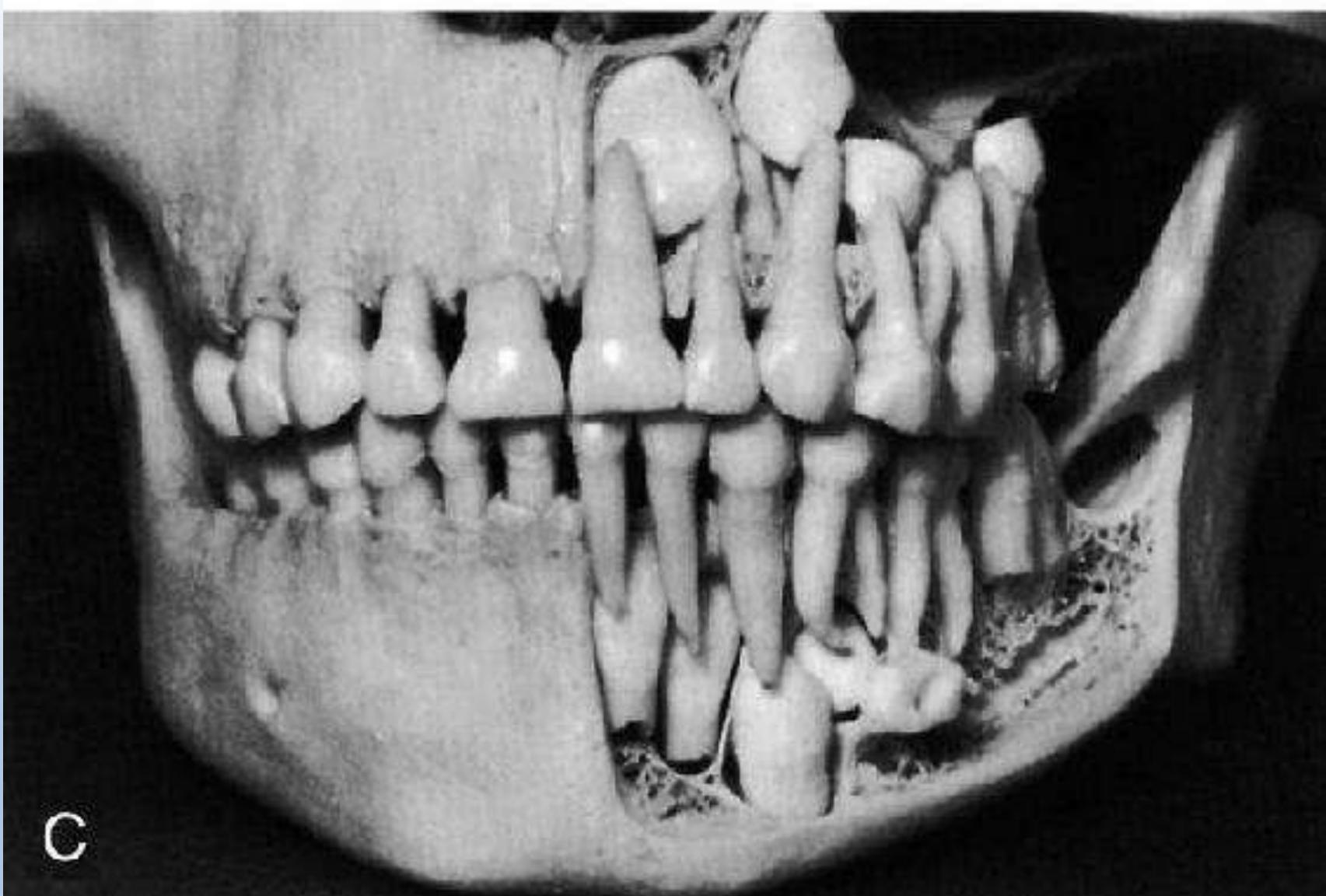


Lower central incisors 6-10 months



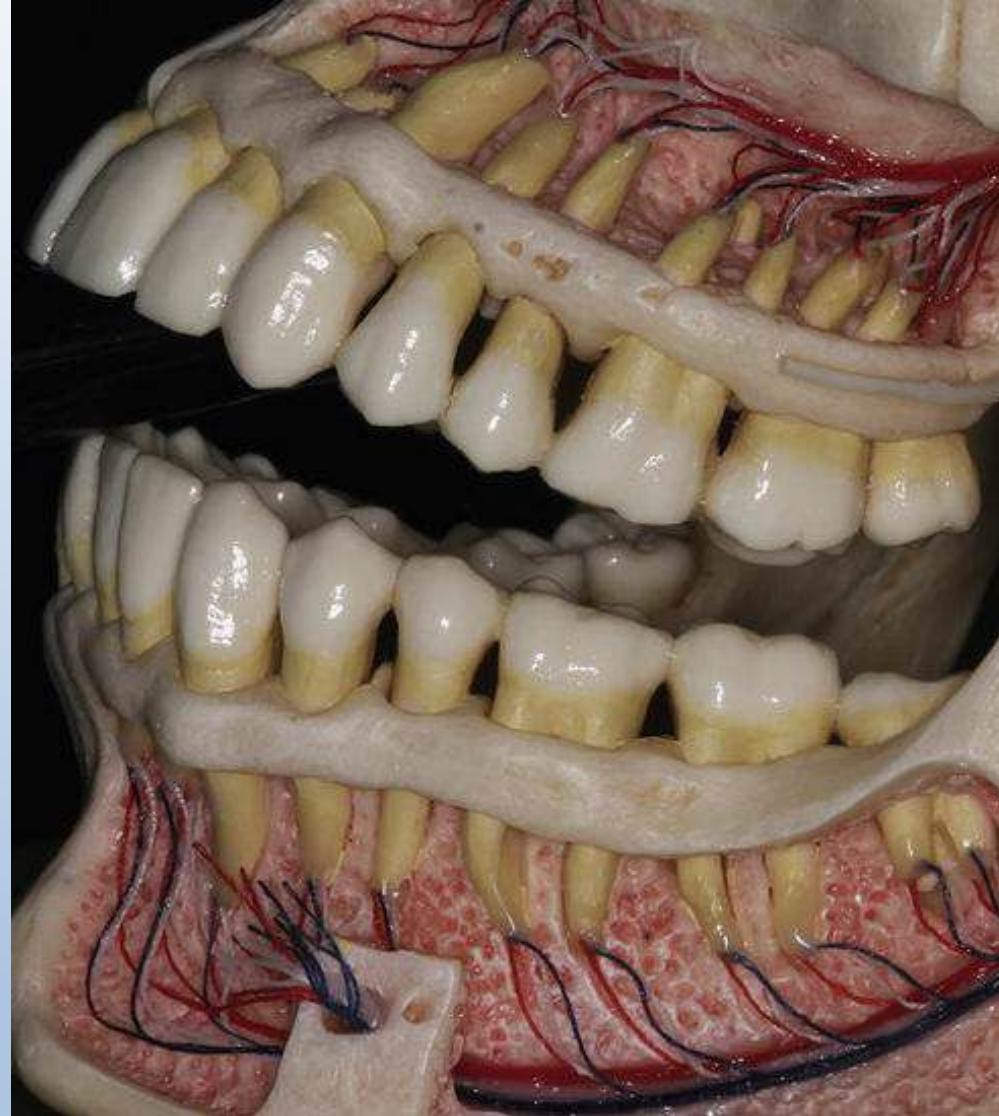
# Learning Objectives

- By the end of this session, you will be able to:
- **Define and pronounce** key terminology correctly
- **Understand** prenatal, perinatal, and postnatal tooth development
- **List and discuss** average ages for:
  - Initial calcification
  - Crown completion
  - Emergence (eruption)
  - Root completion
- **Apply** chronological knowledge to clinical practice
- **Identify** common developmental anomalies



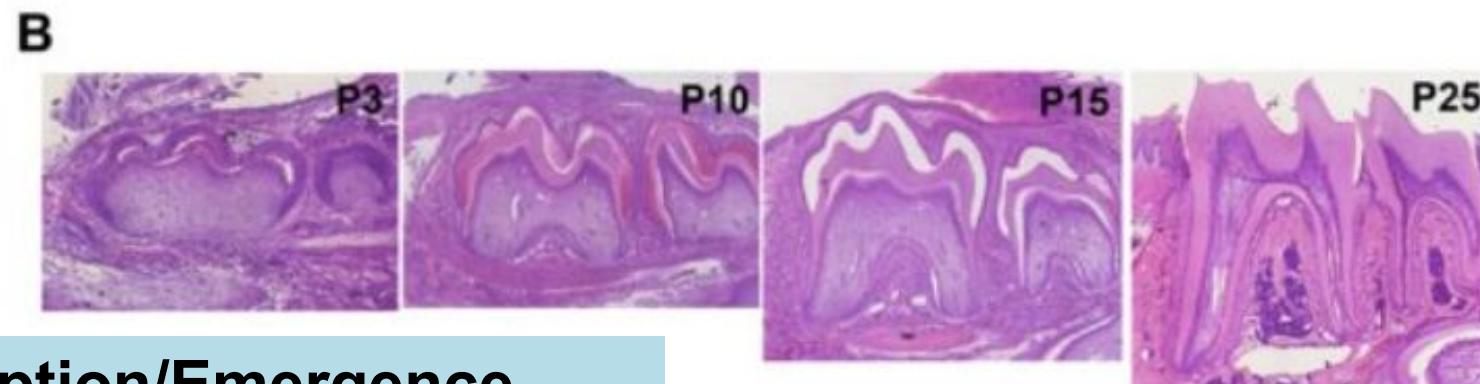
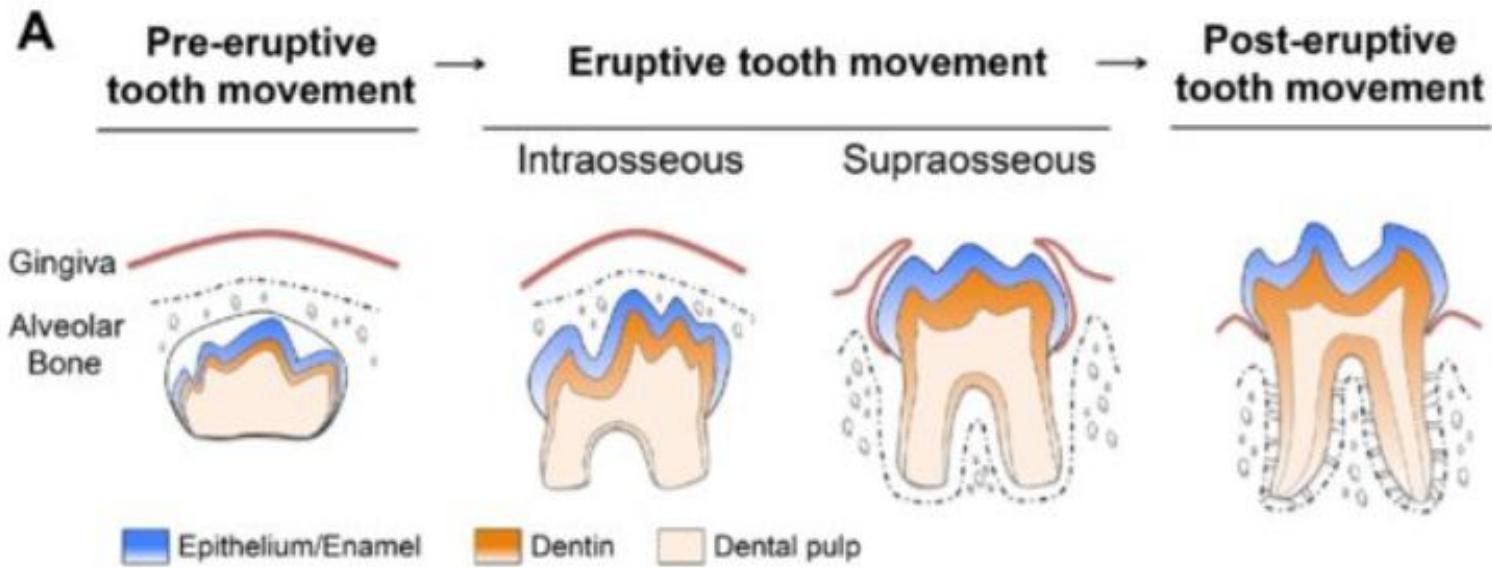
C

Identify type of dentition



Identify type of dentition

Term	Definition
Eruption	Continuous tooth movement from dental bud to occlusal contact
Emergence	Tooth's appearance through the gingiva into the oral cavity
Primary/Deciduous	First dentition ("baby teeth")
Succedaneous teeth	Permanent teeth that replace primary predecessors
Cementoenamel Junction (CEJ)	Border where enamel meets cementum at cervical line



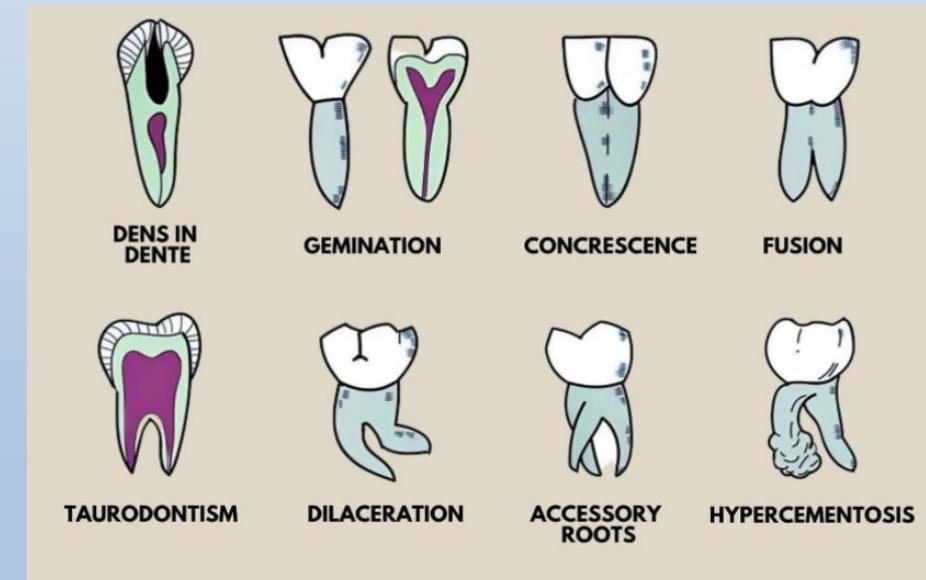
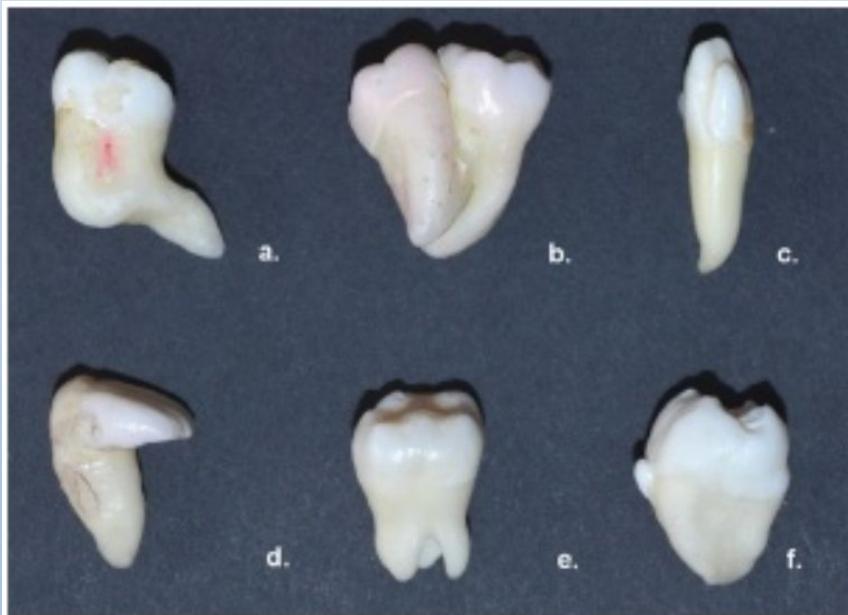
**Eruption/Emergence**

# **Foundation of Clinical Dental Practice!**

**Tooth Development & Chronology**

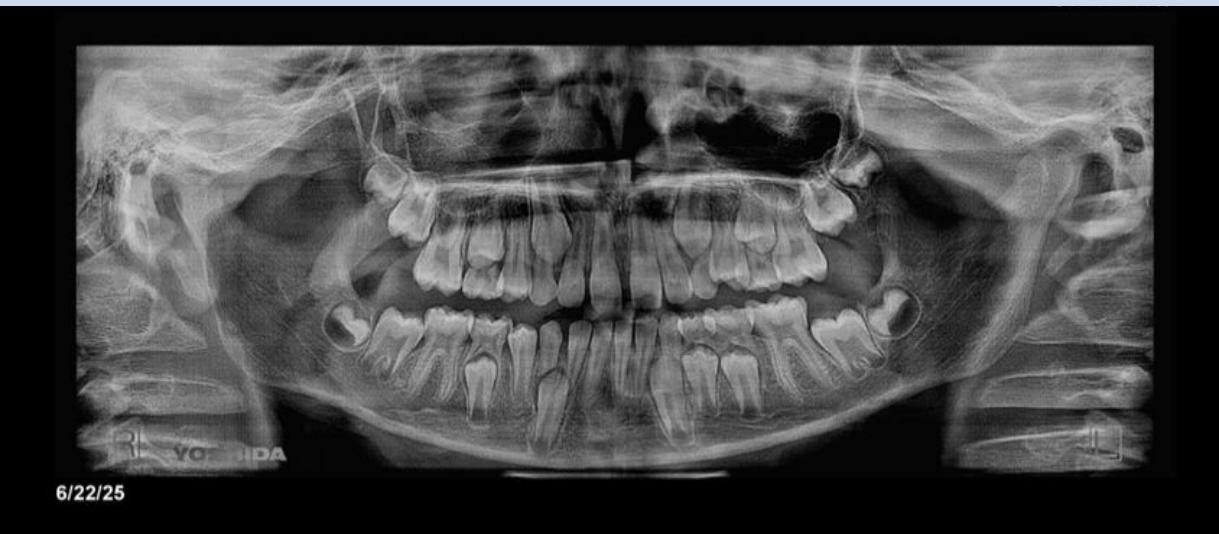
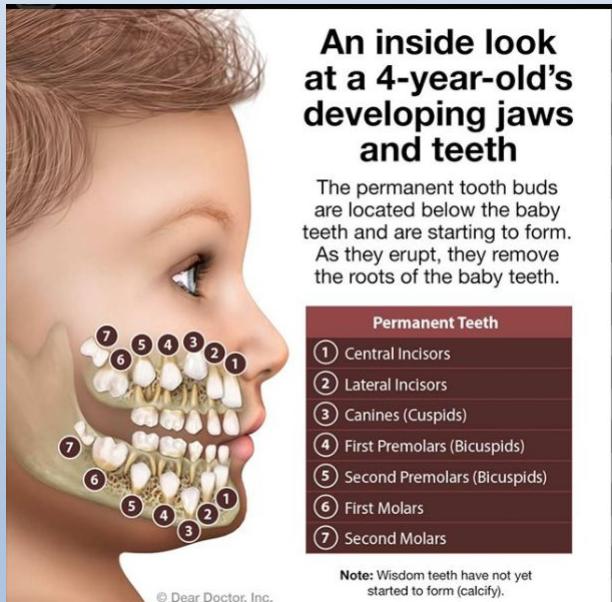
# Why Study Tooth Development?

- Diagnosis of developmental disorders
- Understanding malformations



# Why Study Tooth Development?

- Treatment planning for children

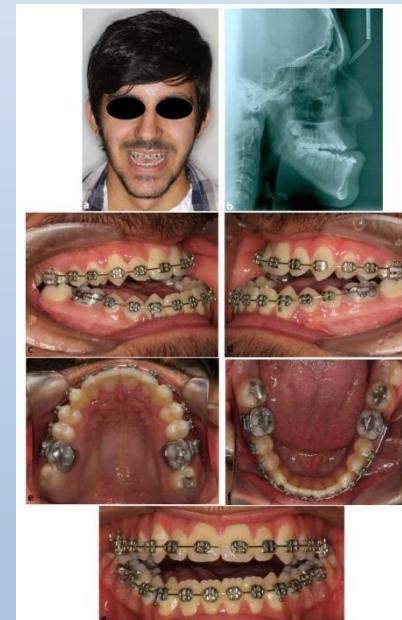


# Why Study Tooth Development?

- Orthodontic timing
- Surgical intervention timing



Before treatment records



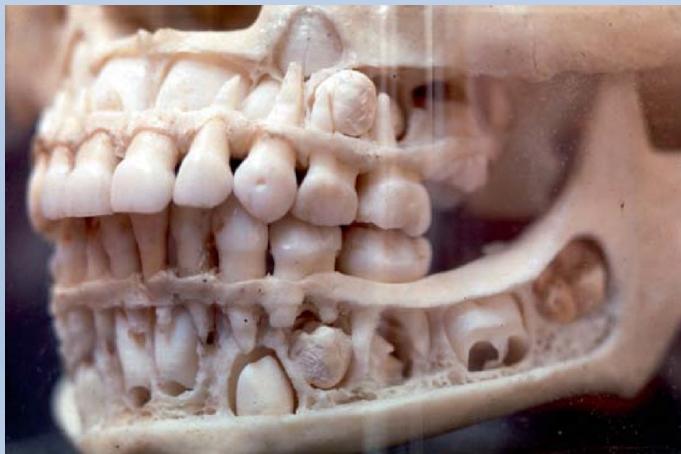
Presurgical orthodontics of the same patient



Same patient after surgery and retention

# Why Study Tooth Development?

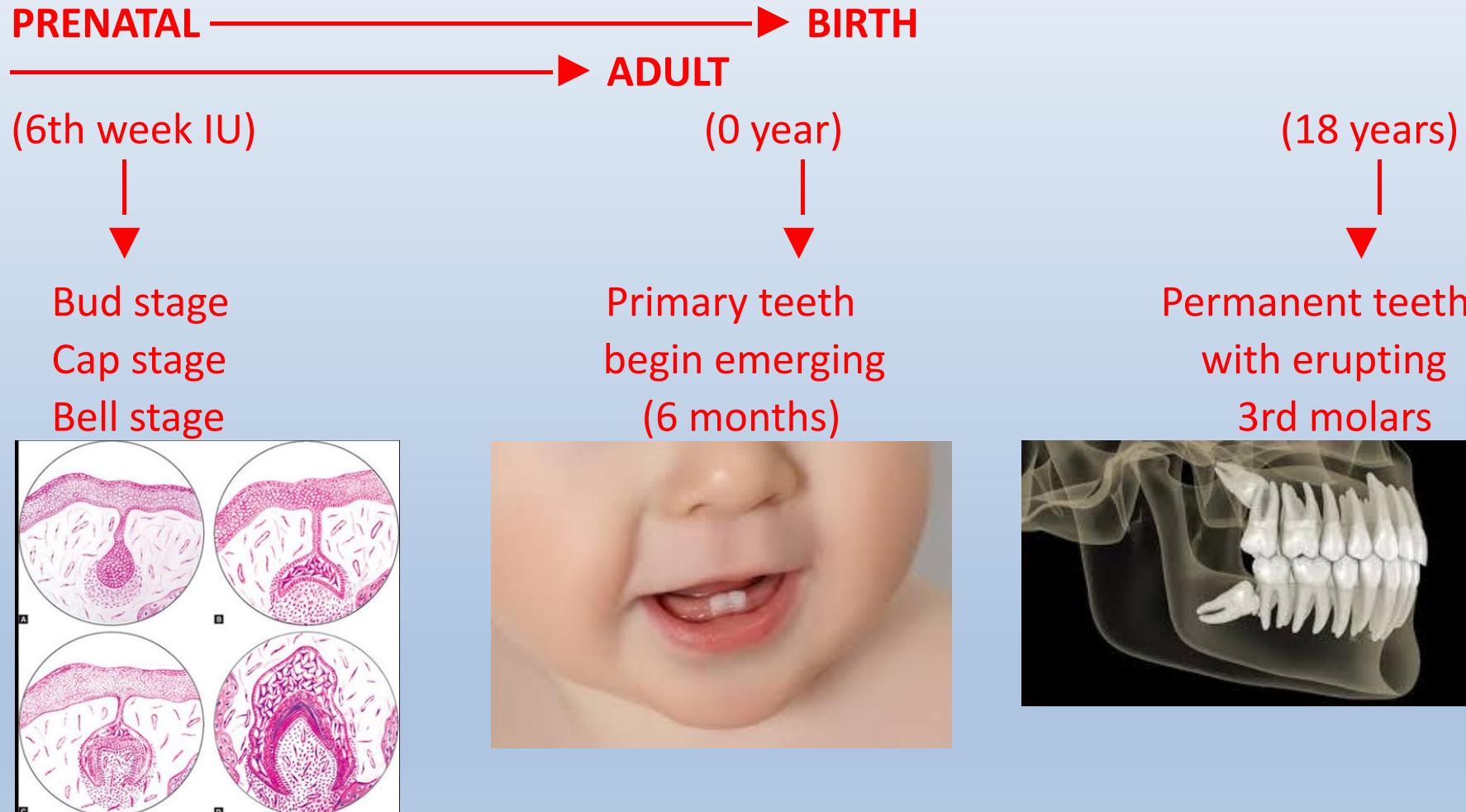
- Forensic age estimation **in children** for legal, forensic, or identification purposes.



# **Other Applications:**

- **Anthropology:** The study of humans, their origins, cultures, and physical development.
- **Demography:** The statistical study of human populations, including birth, death, and migration.
- **Forensics:** The application of scientific methods to solve legal and criminal cases.
- **Paleontology:** The study of ancient life through fossils.

# Overview of Dentition Stages



# Dentition Periods:

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**Pre-Natal / Neo-Natal Period (Birth – 6 Months)**

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**1. Deciduous Dentition Period (6 months–6 years)**

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**2. Mixed Dentition Period (6–12 years)**

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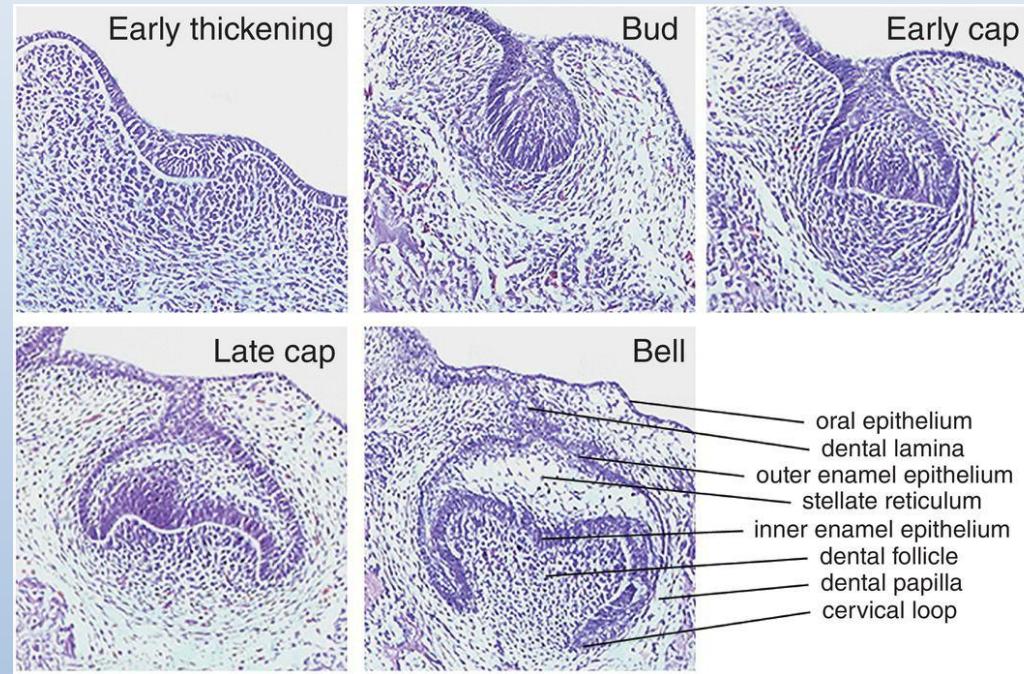
**3. Permanent Dentition Period (12+ years)**

**Pre-Dental /  
Neo-Natal /  
Pre-dentate Period  
(Birth – 6 Months)**



# Pre-Natal Period (before birth)

- The first indication of tooth formation occurs as early as the **sixth week of intrauterine life**,
- (a thickened band of oral epithelium called the **dental lamina** appears).



ORGANIC MATRIX FORMATION —→ CALCIFICATION  
(MINERALIZATION)

(Protein scaffold)  
minerals)

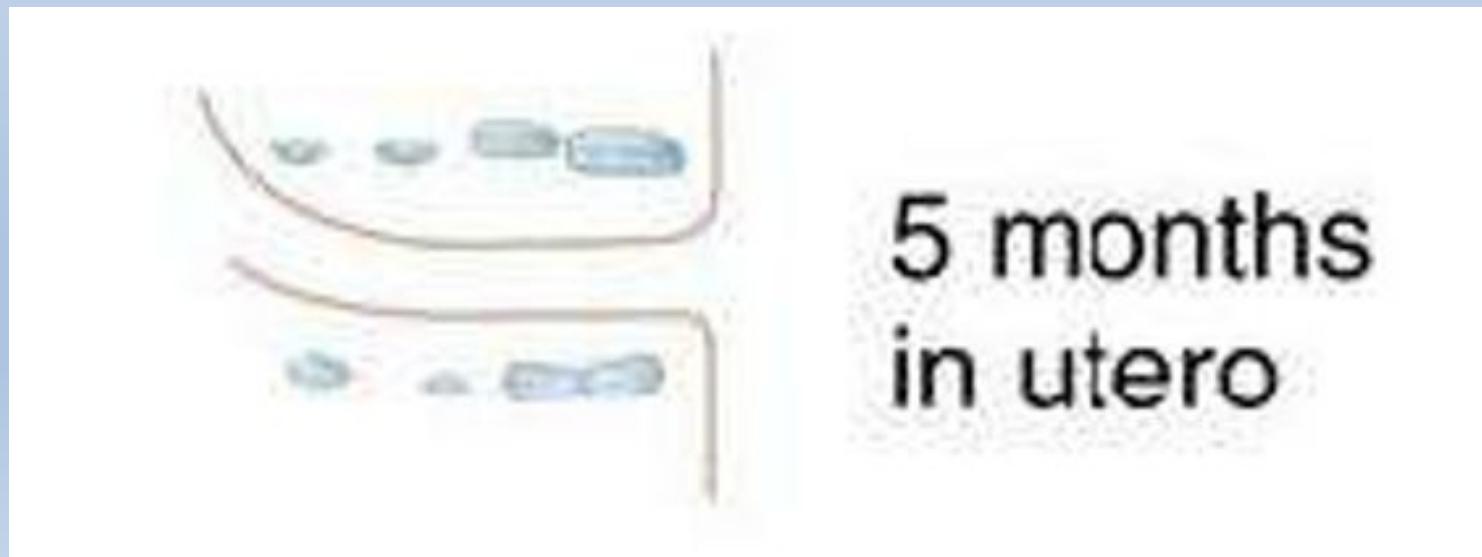


"Soft" template  
(like cartilage)

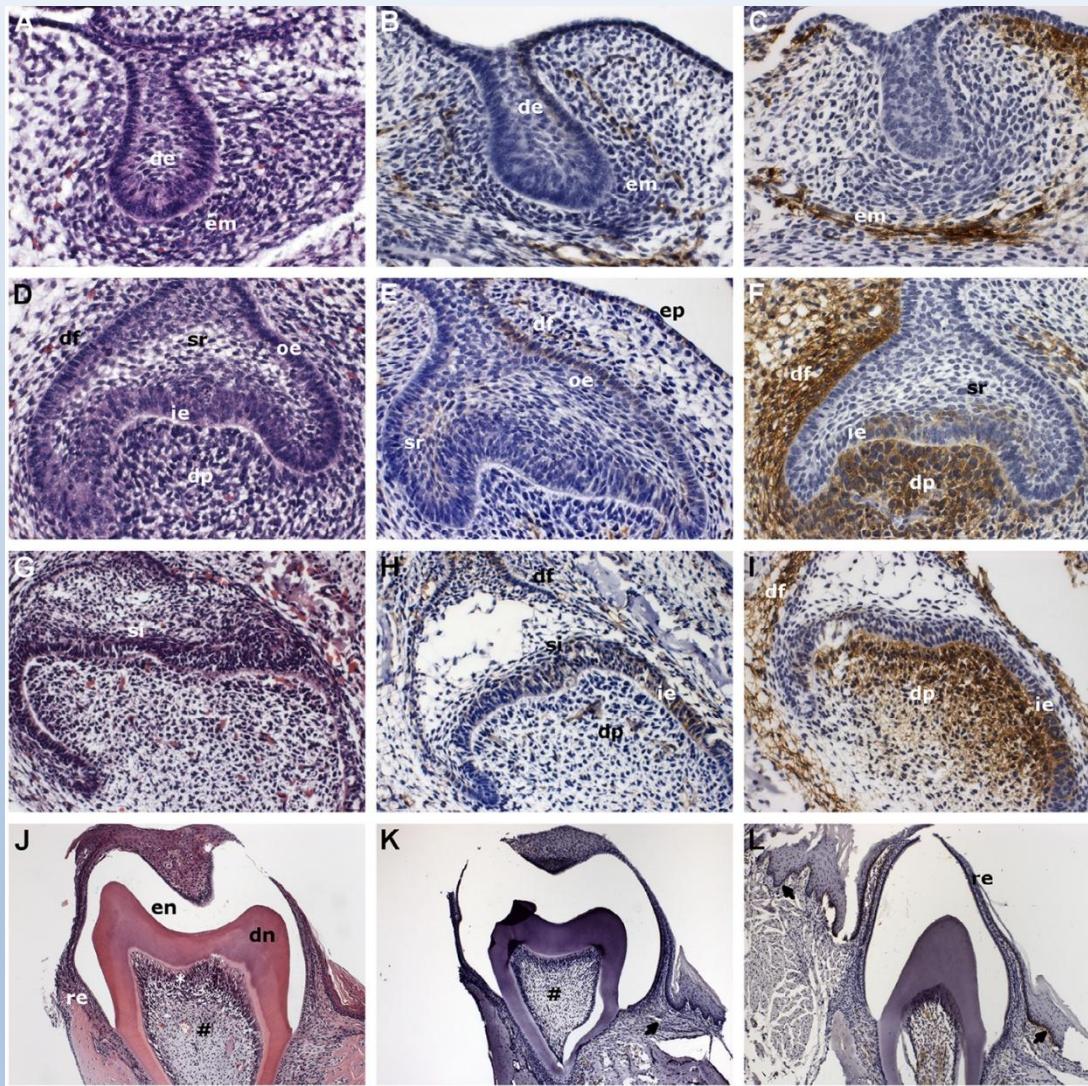
(Hardening with



"Hard" tooth structure  
(enamel, dentin)



- **Calcification begins at 13-16 weeks post-fertilization**" for primary teeth, *in the bell stage of tooth development.*
- **By 18-20 weeks:** All primary teeth have begun calcifying
  - **Incisors:** Begins at incisal edge, spreads cervically
  - **Molars:** Begins at cusp tips, spreads toward cervical region
  - **Multi-cusped teeth:** Each cusp has separate calcification centers that eventually fuse



## Bud stage

## Cap stage

## Bell stage

(#) dental pulp; (\*) odontoblasts;  
 (arrow) oral mucosa epithelium; (de)  
 dental epithelium; (df) dental follicle;  
 (dn) dentine; (dp) dental papilla; (em)  
 ectomesenchymal condensation; (en)  
 enamel space after decalcification; (ep)  
 oral epithelium; (H&E) hematoxylin and  
 eosin; (ie) inner enamel epithelium;  
 (oe) outer enamel epithelium; (re)  
 reduced enamel epithelium; (si),  
 stratum intermedium; (sr) stellate  
 reticulum

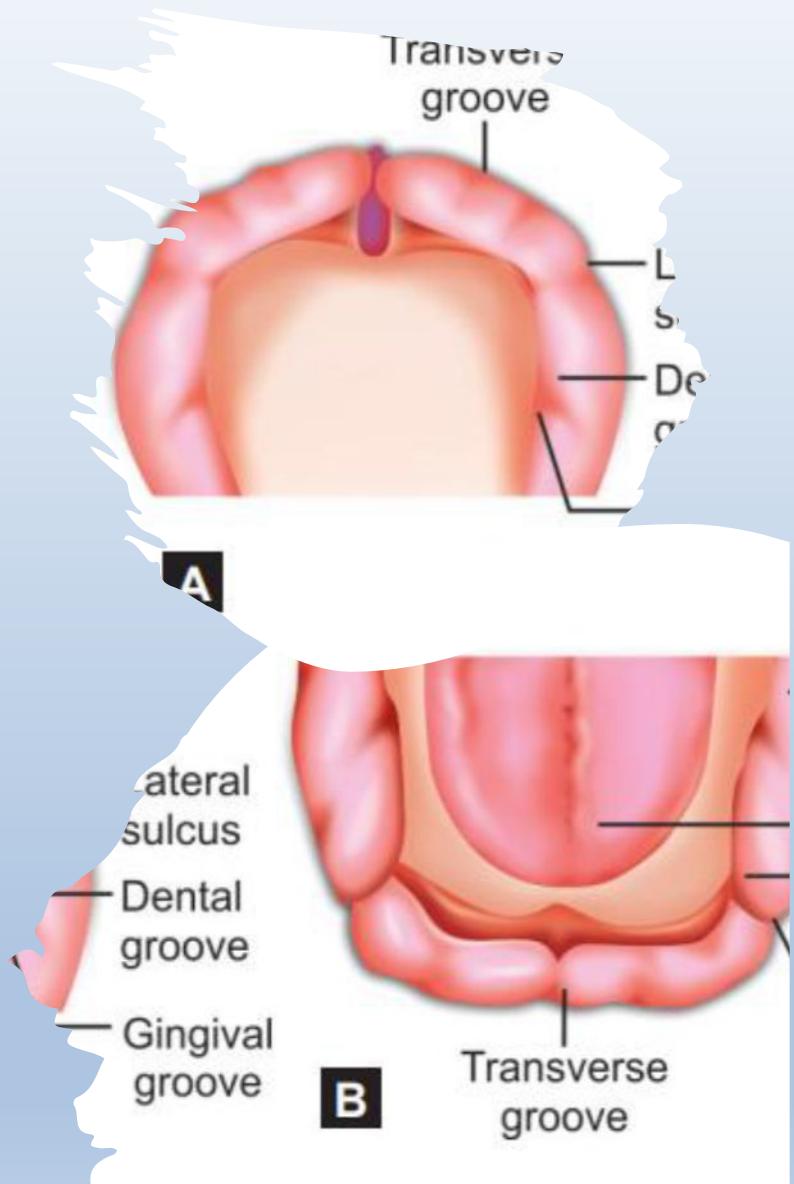
# Neo-Natal Period (at birth)

**FIG. 2.6** Neonatal skull showing large brain case and orbit; the Neurocranium (Brain Case) is larger than splanchnocranum (Facial Skeleton), which contains the jaws and all the developing teeth.

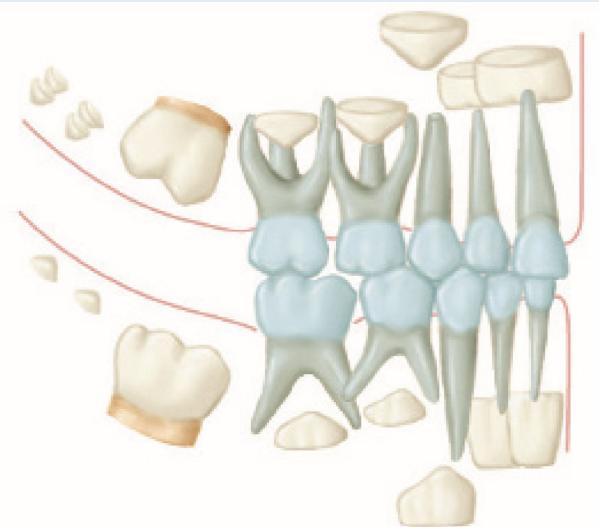


# Neo-Natal Period

- Maxillary and mandibular arches (gum pads) shaped like **segments of an ellipse (elliptical)**.
- Jaws assume initial shape
- Mandibular arch larger than maxillary arch



**3 years ± 6 months**

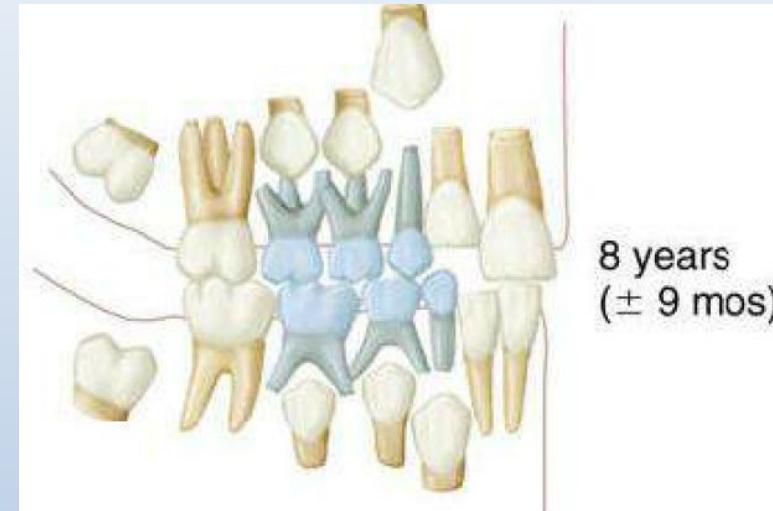
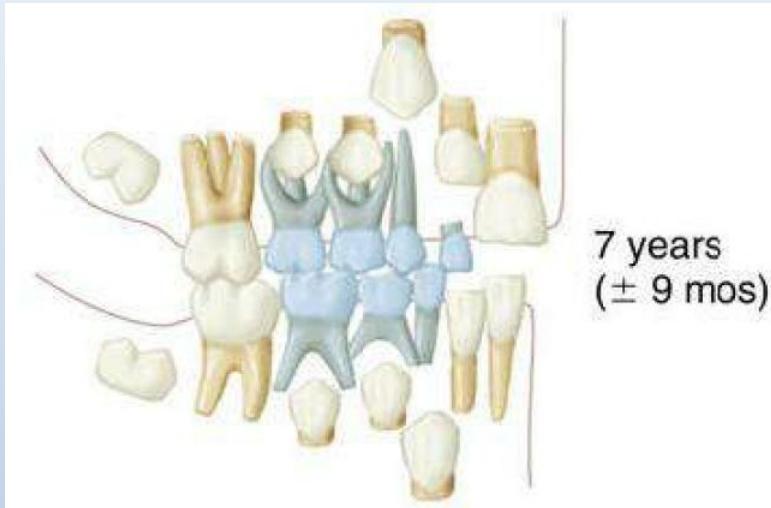


**Root formation is complete  
for all primary teeth by  $3 \frac{1}{4}$   
years of age.**

**Occlusion is achieved at 3  
years of age.**

**Primary tooth eruption is now  
complete.**

**Primary Dentition  
(0-6 years)**



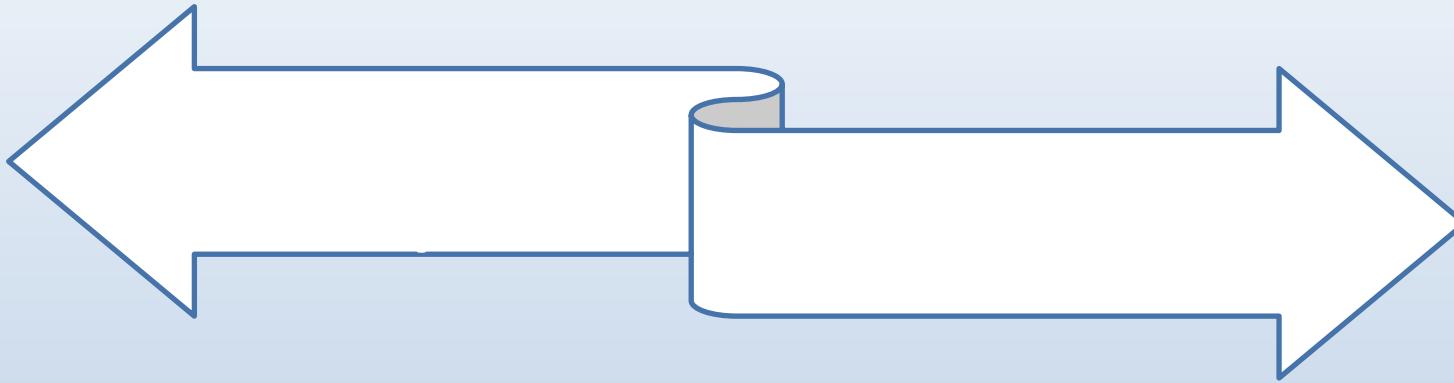
**Mixed/Transitional Dentition  
(6-12 years)**

A diagram illustrating the permanent dentition of a human mouth at the age of 35. The upper arch shows 8 incisors, 4 canines, and 12 molars, totaling 24 teeth. The lower arch shows 8 incisors, 4 canines, and 12 molars, also totaling 24 teeth. The teeth are depicted with yellowish-brown crowns and white roots.

35  
years

Permanent Dentition

# Chronology of Human Dentition



**The timeline of tooth development, from  
when teeth first start to develop**



**to when they emerge and finally when the  
roots are fully developed.**

**Eruption** – Movement of a tooth from its developmental position to its functional position in the mouth.

**Emergence** – Appearance of a tooth through the gingiva.

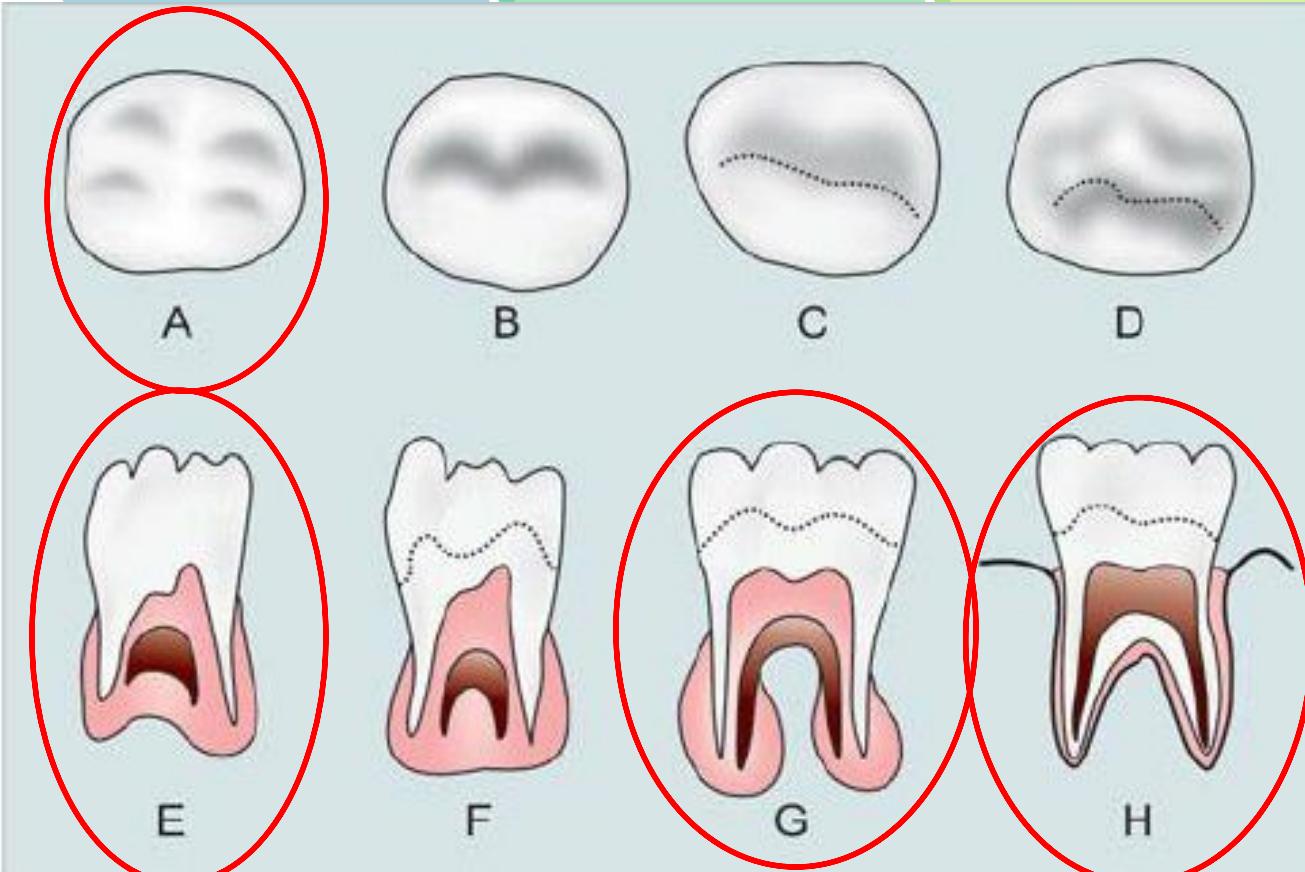
# Components of chronology of human dentition

1st  
Evidence Of  
Calcification

Crown  
Completion

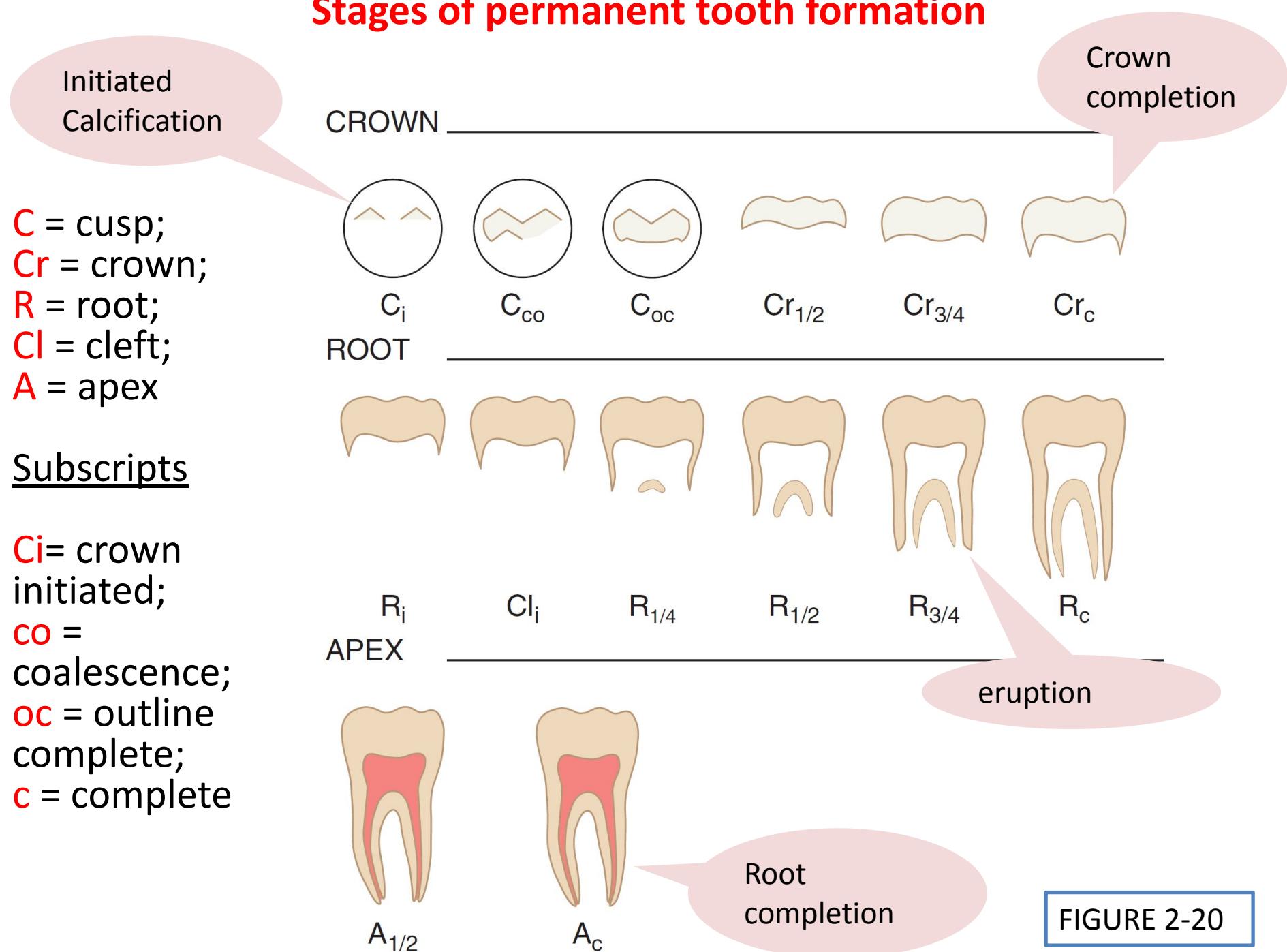
Eruption

Root  
Completed



Reference;  
Ganganagar S, Sunam S. Age estimation of adolescents and young adults based on development of mandibular third molars: A panoramic study. Journal of Indian Academy of Oral Medicine and Radiology. 2011 Jan;23(1):9-13.

## Stages of permanent tooth formation



### **Initial Calcification:**

Marks the beginning of tooth development and mineralization; used for prenatal developmental assessments.

### **Crown Completion:**

Indicates when the enamel portion of the tooth is fully formed; this is important in predicting enamel-related disorders.

### **Emergence (Eruption):**

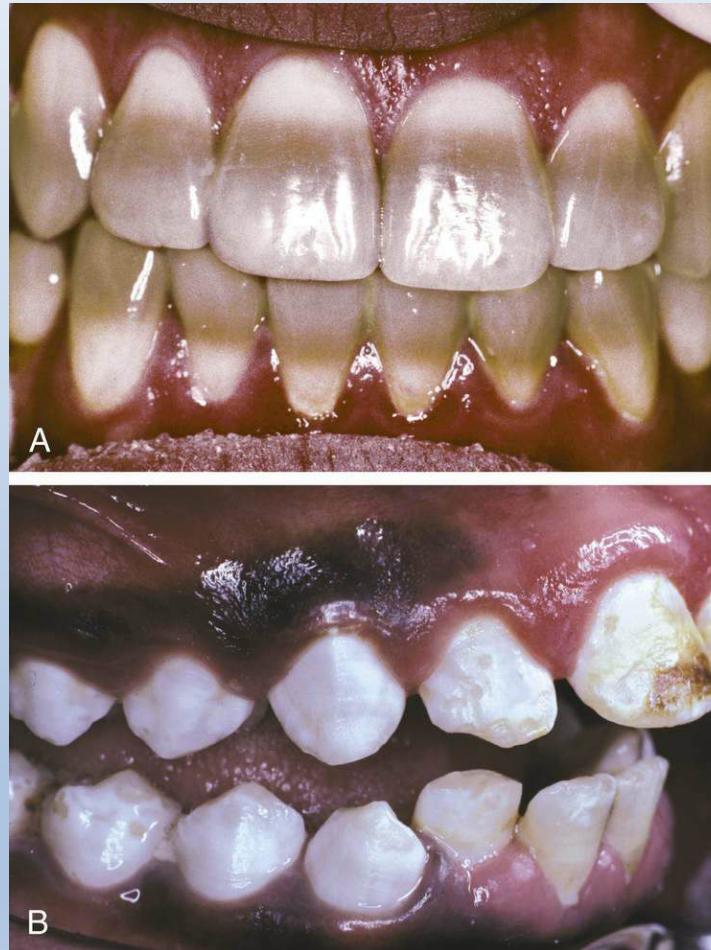
The tooth breaks through the gum; clinically used for dental age estimation and orthodontic planning.

### **Root Completion:**

The final stage of development; used to assess full maturation and to guide procedures like extractions or orthodontic anchorage.

# Relevance to Dental Practice

- Tetracycline staining shows yellow-brown bands; location reflects tooth development stage at exposure.(initial calcification)
- Fluorosis from excess fluoride during enamel formation marks exposure age; central incisor defects suggest intake at 1–3 years.(crown completion)
- **Enables early diagnosis of anomalies, dental age assessment**



# Neuromotor behavior and primary dentition



Eruption of A, B and D on the both jaws  
Smooth mastication is achieved by eruption of A on the both jaws  
Become to eat by crushing with teeth with eruption of D.  
(19 months old)  
(initiation of eating with the alveolar ridge.)

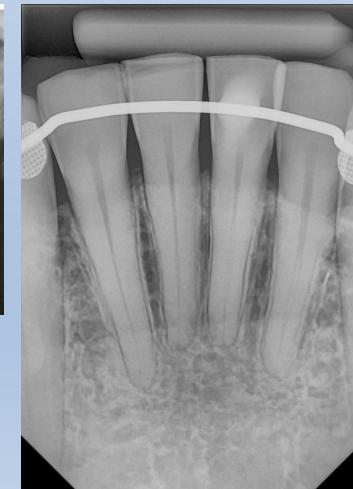


Normal and abnormal eruption  
of primary dentition

Chronologies of prenatal tooth development based on studies of dissected fetal material



Chronologies of postnatal development based on radiological data



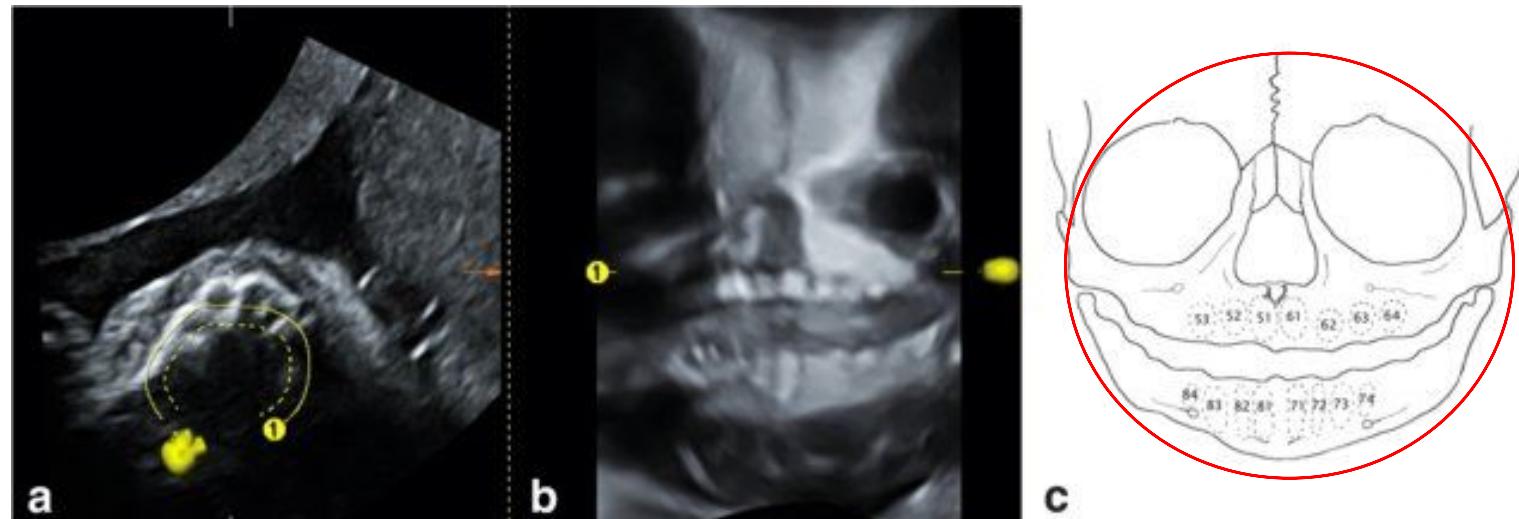
Panoramic (OPG)/  
Periapical (PA)

# Primary Dentition Eruption Facts

Mandibular teeth usually erupt before opposing maxillary teeth

Females usually exhibit eruption time frames earlier than males

**Initial Mineralization of the Primary Dentition is entirely prenatal**



Fetal dental panorama obtained in a 32-week normal fetus.

# Important Dates to remember

+

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primary dentition emerge between **6<sup>th</sup> to 30th months after birth.**



primary dentition takes **2-3 years** from initial calcification of CI to root completion of 2<sup>nd</sup> M.

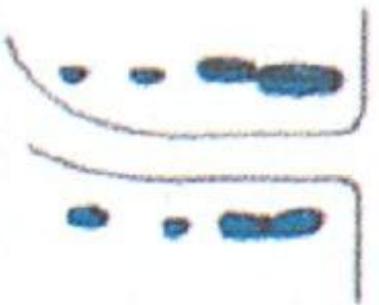


Calcification of first primary tooth begins at about **13-16 weeks in utero**

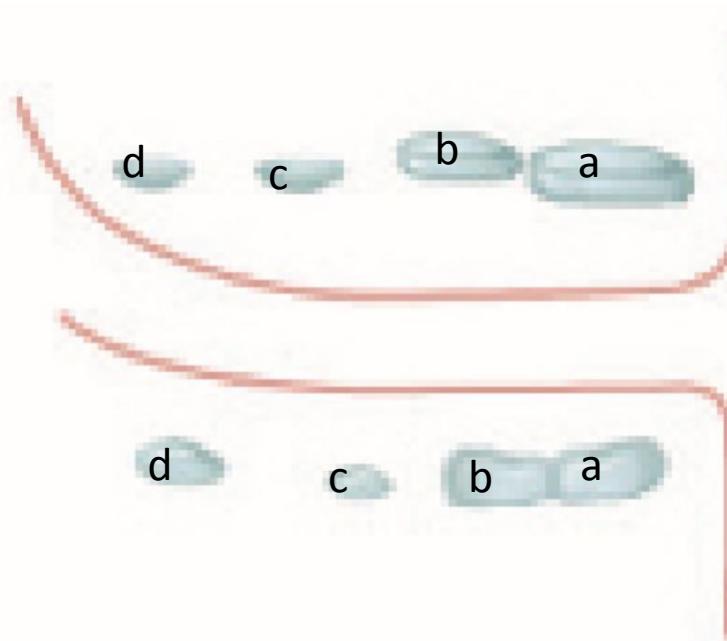


All primary teeth have initiated calcification at **18-20 weeks in utero**

# Calcification/Eruption/Emergence for Primary Teeth

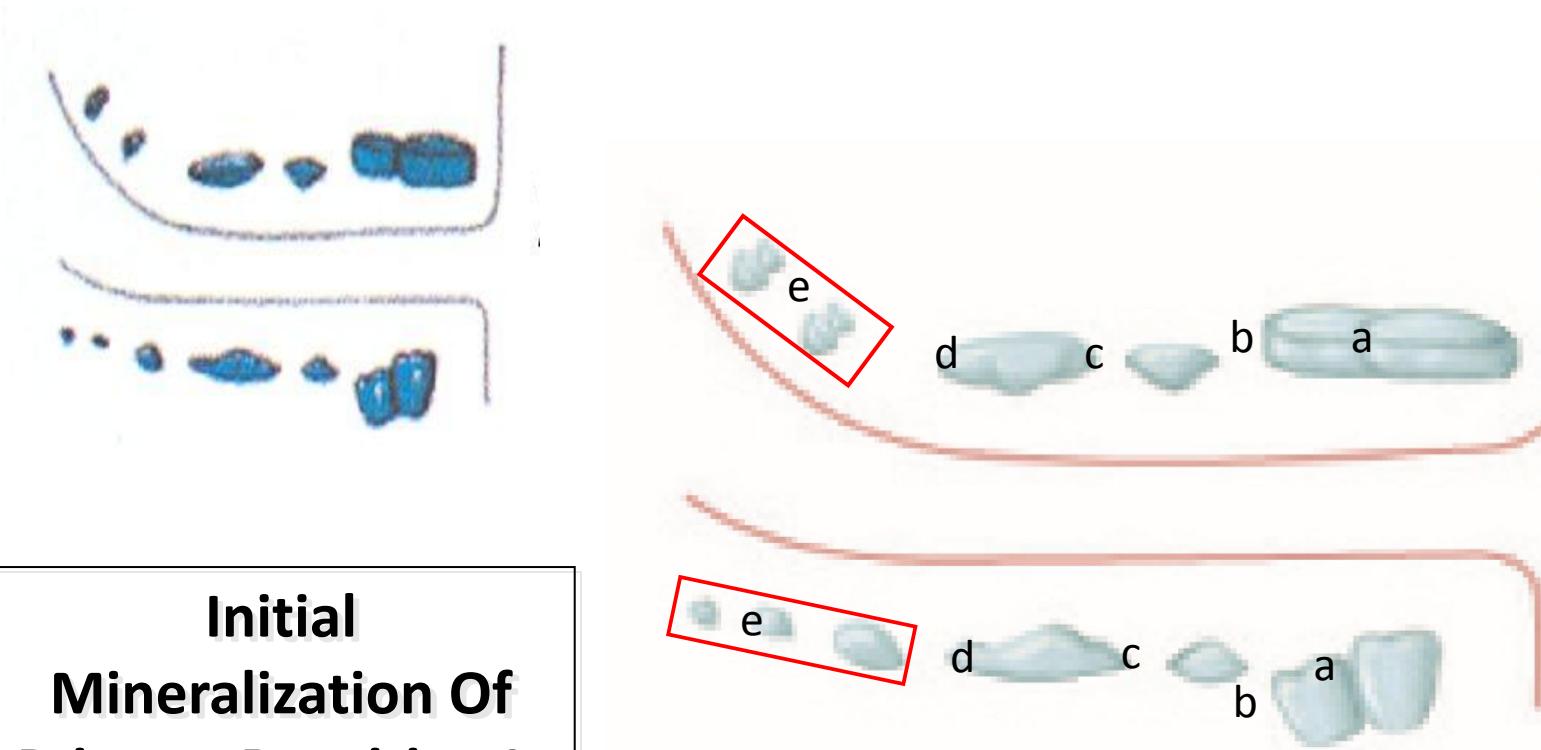


**Initial  
Mineralization Of  
Primary Dentition Is  
Entirely PRENATAL**



**$16 \pm$  weeks / 5<sup>th</sup> month in utero**



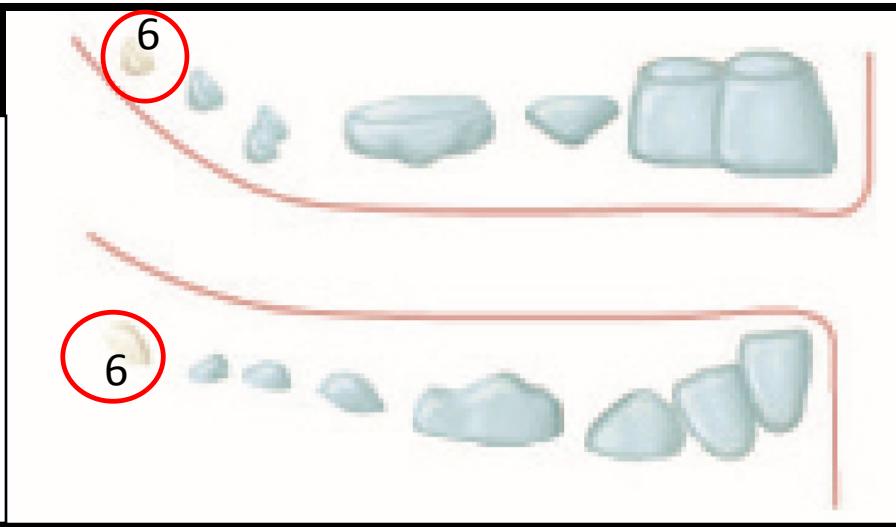


**Initial  
Mineralization Of  
Primary Dentition Is  
Entirely Prenatal**

$24 \pm$  weeks / 7<sup>th</sup> month in utero

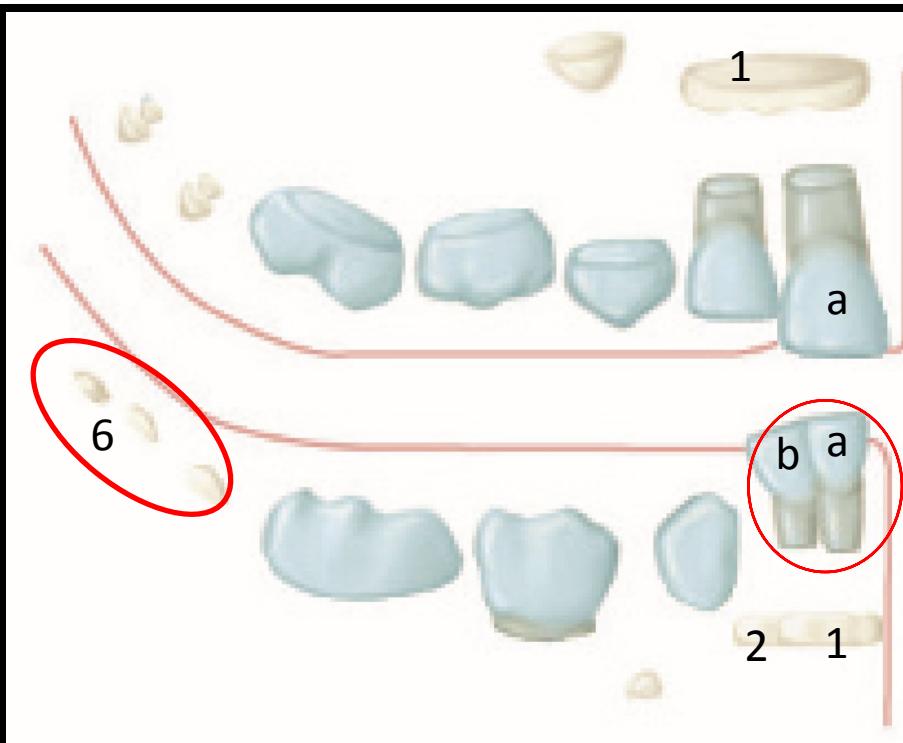
# Calcification/Eruption/Emergence for Primary Teeth

Initial  
Mineralization  
Of permanent  
**1<sup>st</sup> Molar occurs**  
**AT BIRTH**

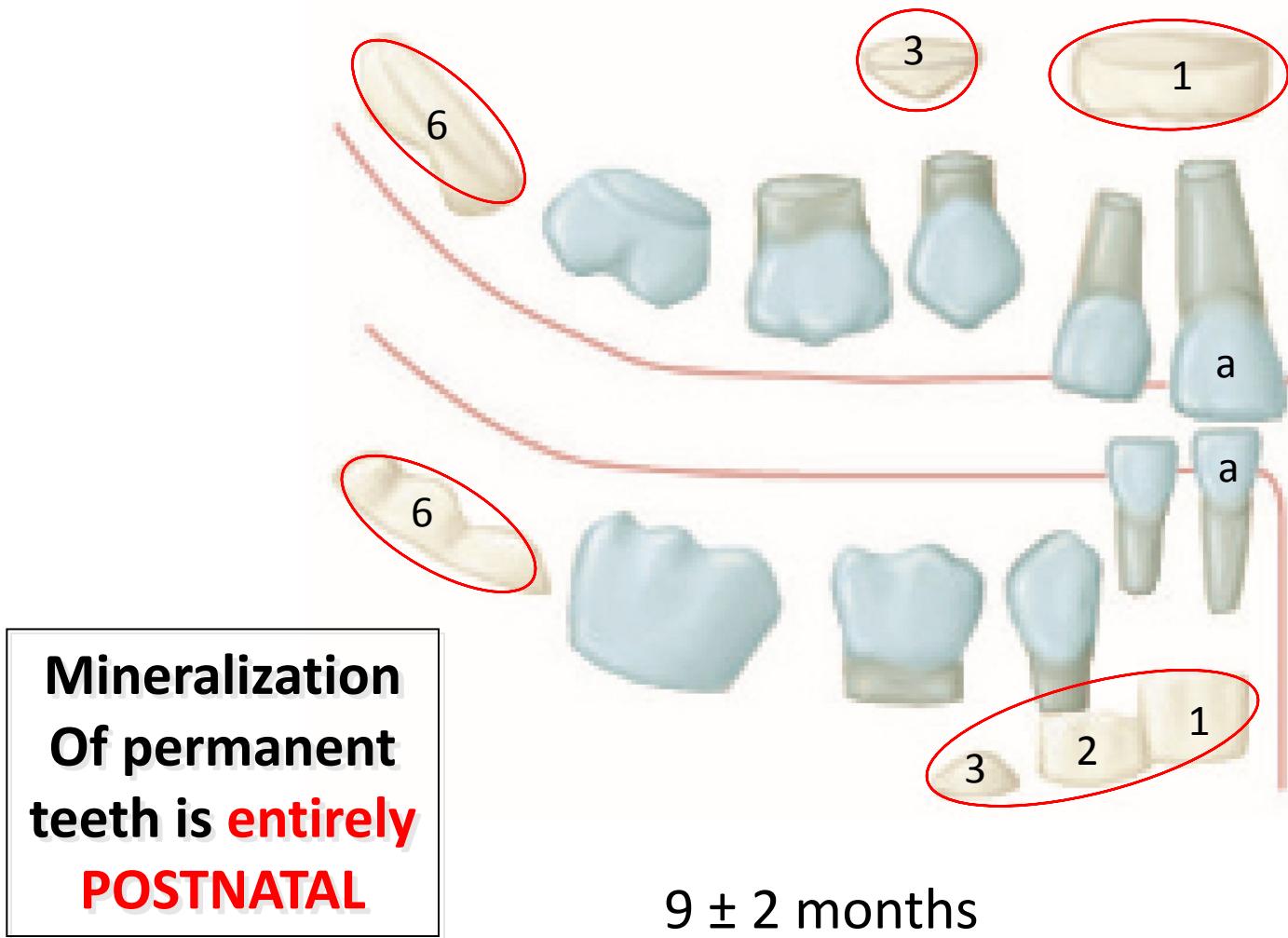


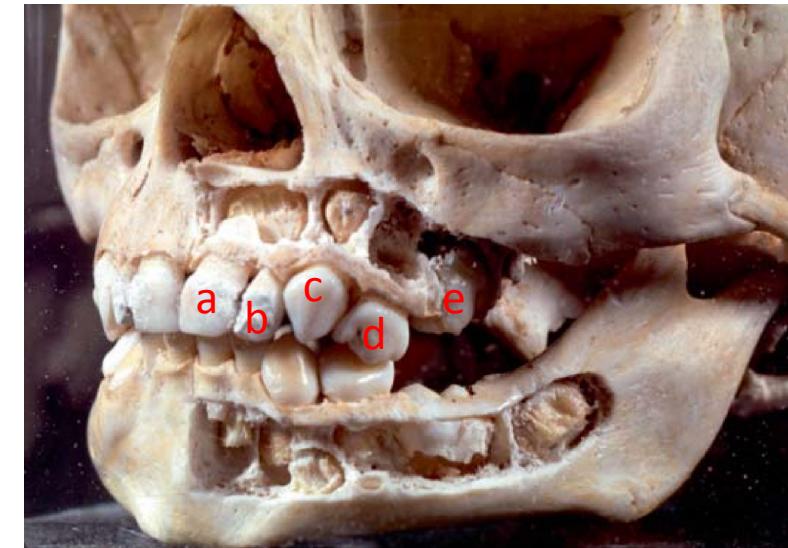
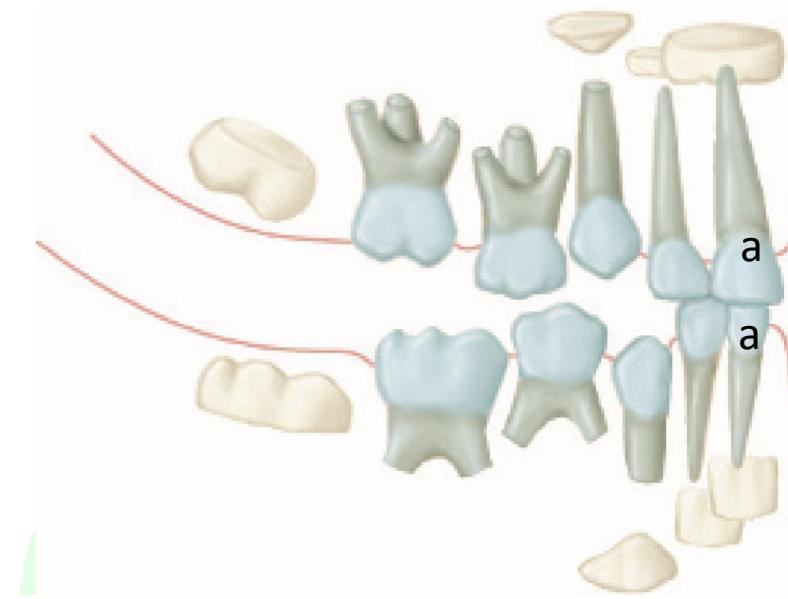
At birth

Mandibular  
Central Incisors  
Emerge At About  
8 (6 To 10)  
Months Of Age



$6 \pm 2$  months

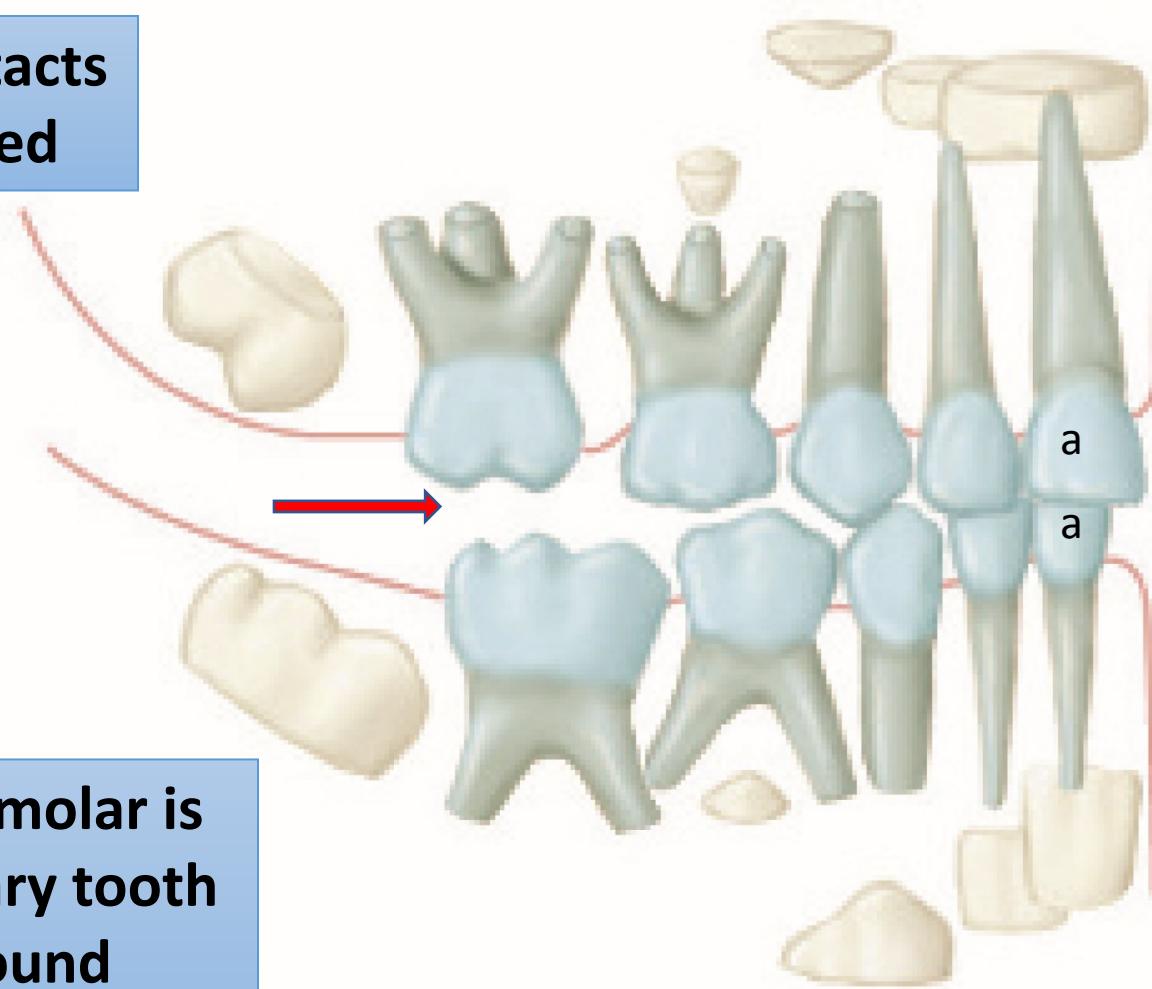




**18 months ± 3 months /  
1.6 years ± 3 months**

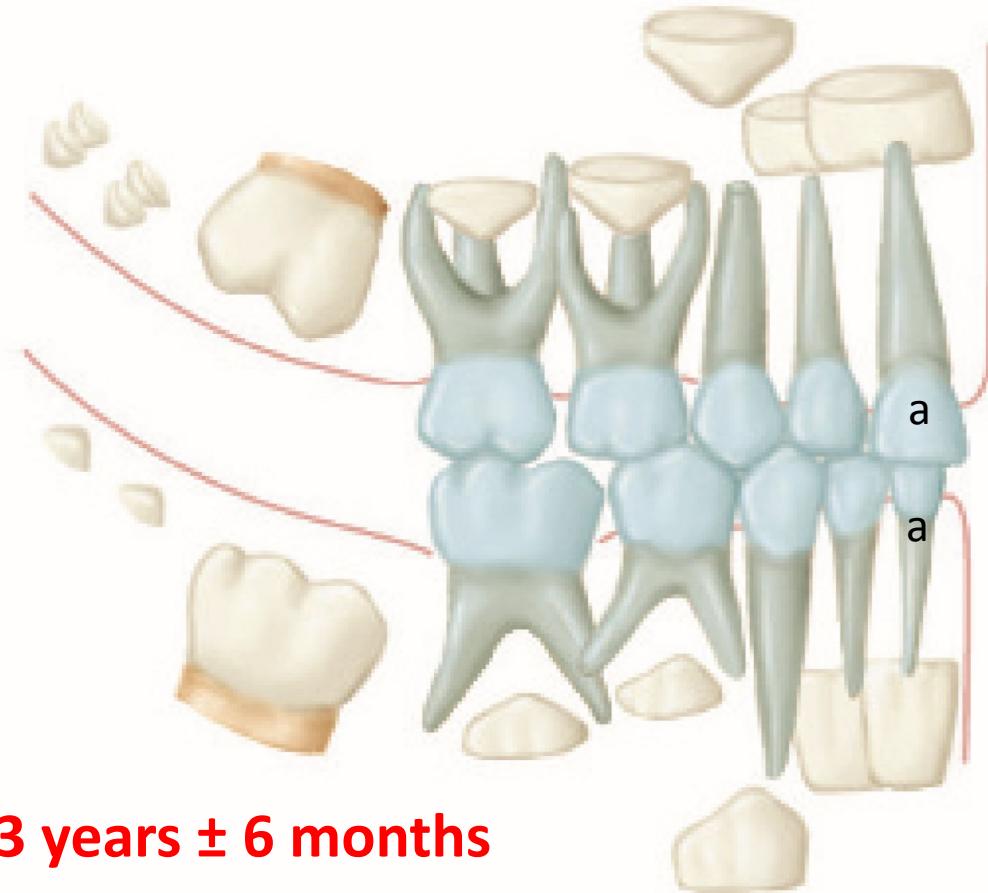
**Teeth erupted –**  
**Maxilla ABCD, Mandible ABCD;**  
**Teeth unerupted –**  
**Maxilla 123E6, Mandible  
123E6**

Occlusal contacts  
not established



Maxillary 2<sup>nd</sup> molar is  
the last primary tooth  
to emerge around  
**30 months of age**

**2 years ± 6 months**



3 years  $\pm$  6 months

**Root formation is complete for all primary teeth by  $3 \frac{1}{4}$  years of age.**

**Occlusion is achieved at 3 years of age.**

**Primary tooth eruption is now complete.**

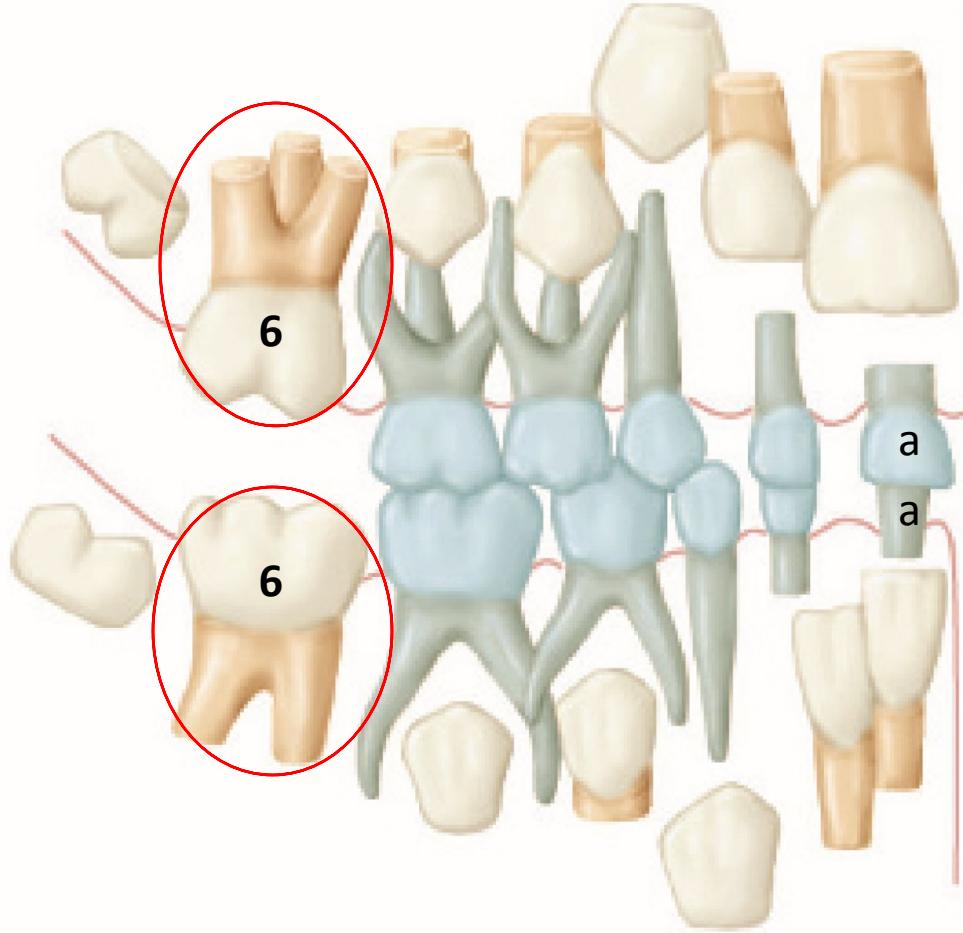


4 years old child

B

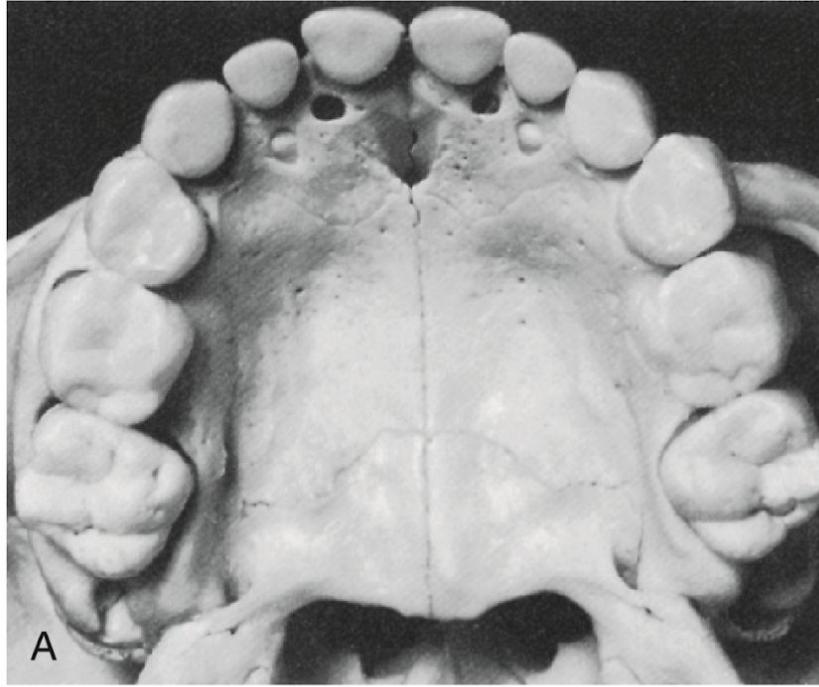
# CHRONOLOGY OF THE PRIMARY/DECIDUOUS DENTITION

		1st Evidence Of Calcification (Weeks)	Crown Completed (Months)	Eruption (Months)	Root Completed (Years)
Central Incisor	Max.	14 (13–16)	1.5	10 (8–12)	1.5
	Mand.	14 (13–16)	2.5	10 (8–12)	1.5
Lateral Incisor	Max.	16 (14–16)	2.5	11 (9–13)	2
	Mand.	14(15–16)	3	11 (9–13)	2
Canine	Max.	17 (15–18)	9	19 (16–22)	3.25
	Mand.	16-17	9	19 (16–22)	3.25
1 <sup>st</sup> Molar	Max.	15(14–17)	6	16 (13–19)	2.5
	Mand.	15½ (14½–17)	5.5	16 (13–19)	2.5
2 <sup>nd</sup> Molar	Max.	19 (16–23)	11	29 (25–33)	3
	Mand.	18 (17–19½)	10	29 (25–33)	3



**6 years ± 9 months**

**Identify the  
age of  
dental  
arches**



A

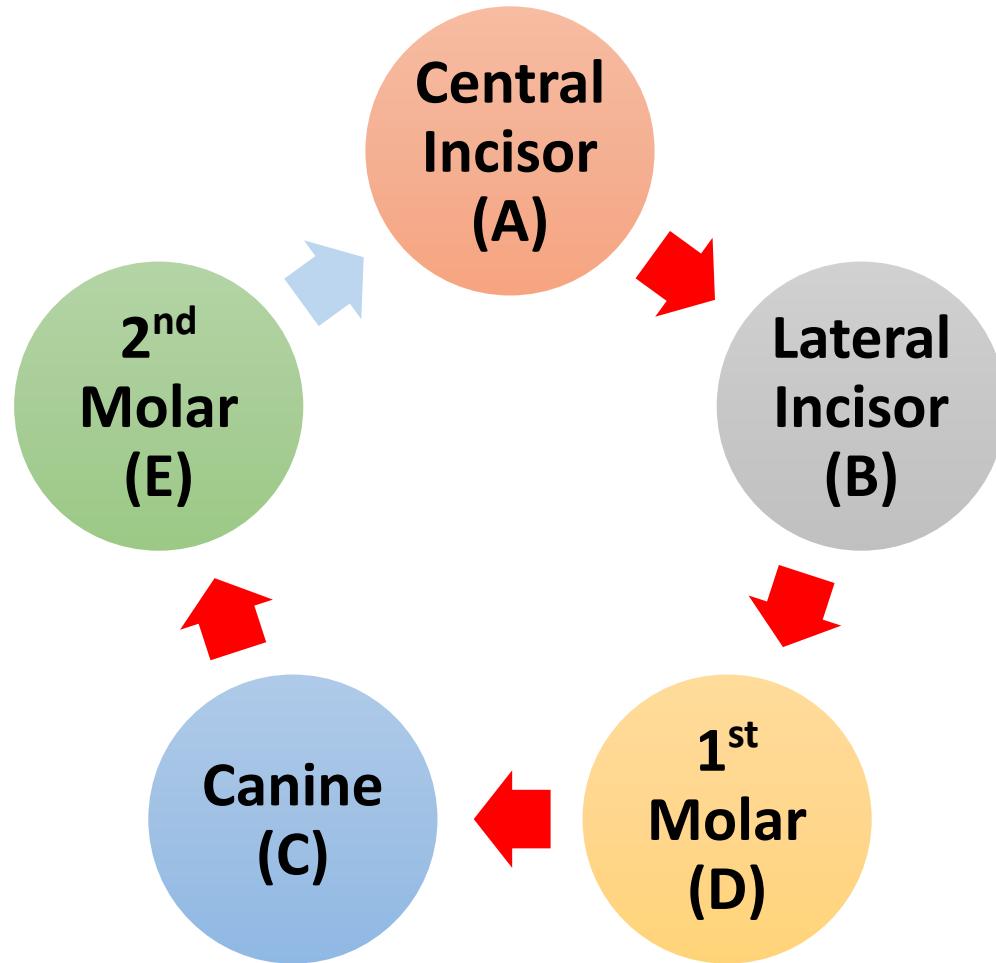


**6 years  $\pm$  6 months**

B



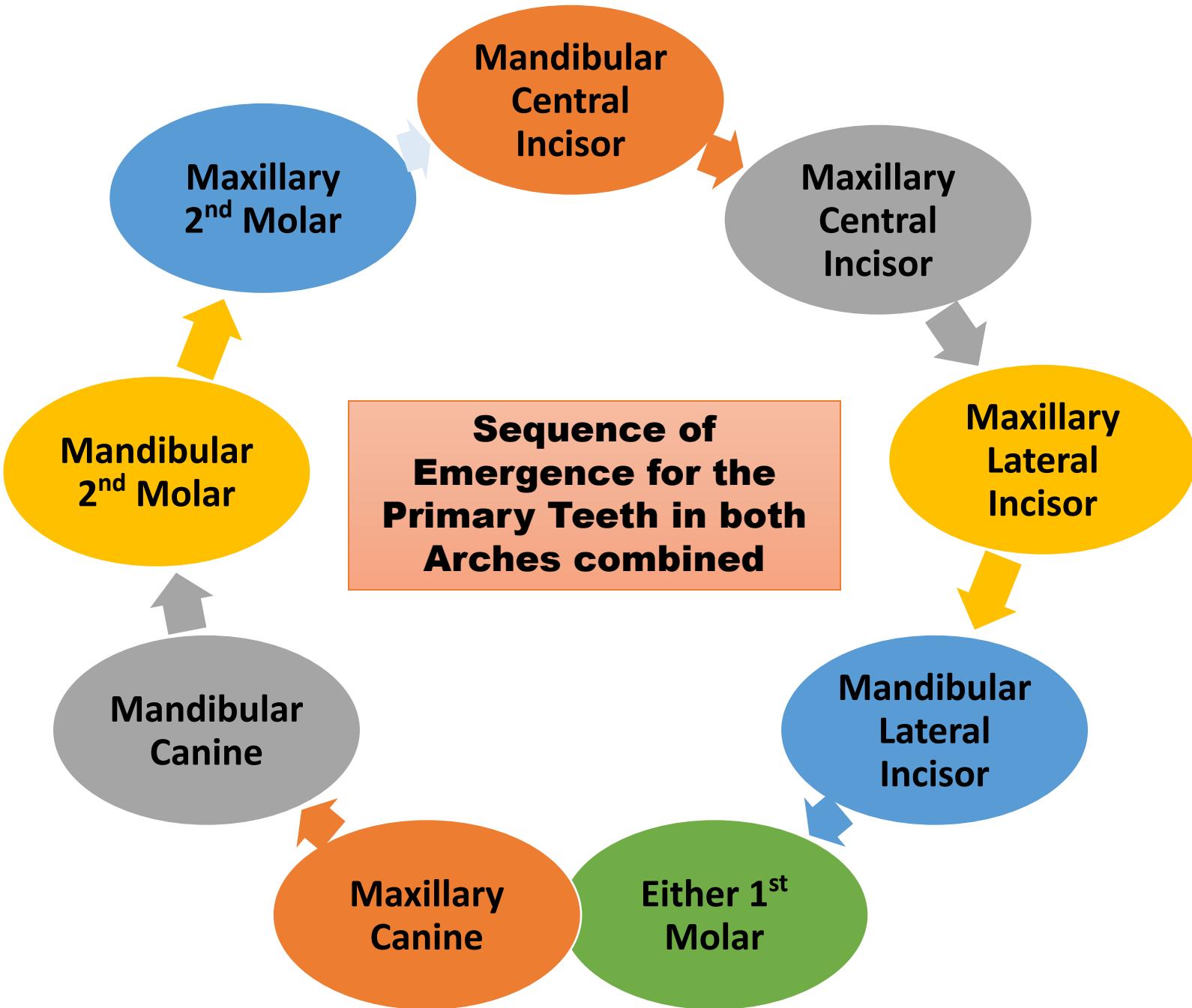
# Sequence of Emergence for the Primary Teeth in each Arch



Maxillary	Tooth #	Eruption (age in mths)
i1	E, F	10
i2	D, G	11
C	C, H	19
m1	B, I	16
m2	A, J	29

Mandibular	Tooth #	Eruption (age in mths)
i1	P, O	8
i2	Q, N	13
C	R, M	20
m1	S, L	16
m2	T, K	27

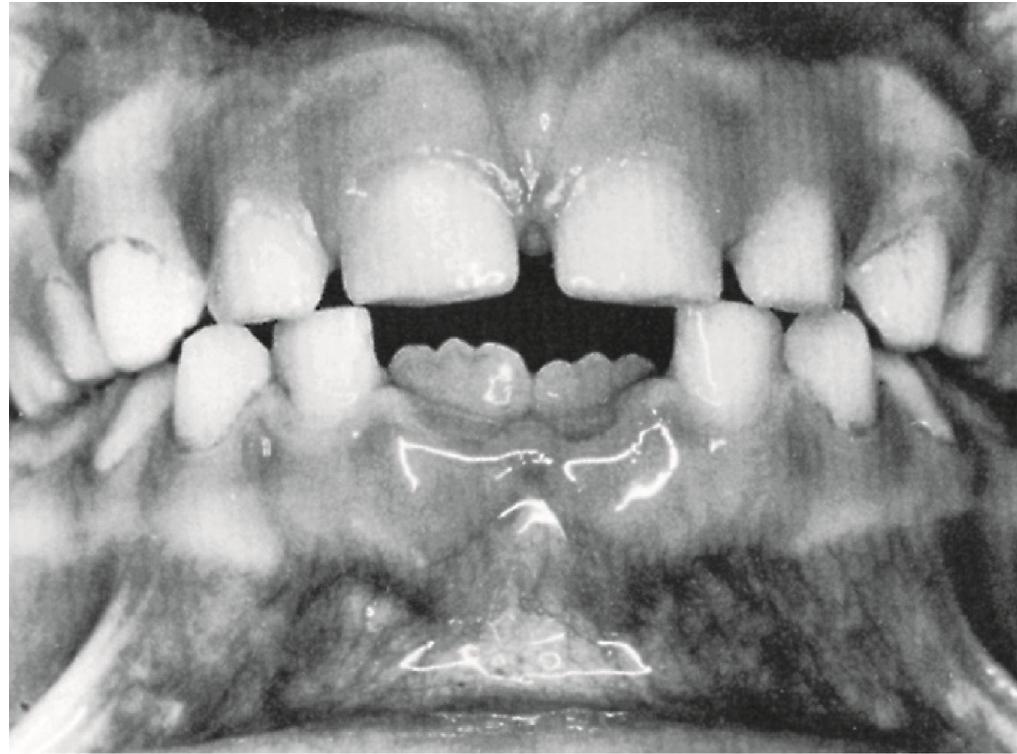


		<b>Exfoliated</b>
<b>Maxillary</b>	<b>Tooth #</b>	<b>(years)</b>
i1	E, F	6.5
i2	D, G	7.5
C	C, H	11
m1	B, I	10
m2	A, J	11
		<b>Exfoliated</b>
<b>Mandibular</b>	<b>Tooth #</b>	<b>(years)</b>
i1	P, O	6.5
i2	Q, N	7.5
C	R, M	10.5
m1	S, L	10
m2	T, K	11

# TRANSITION PERIOD

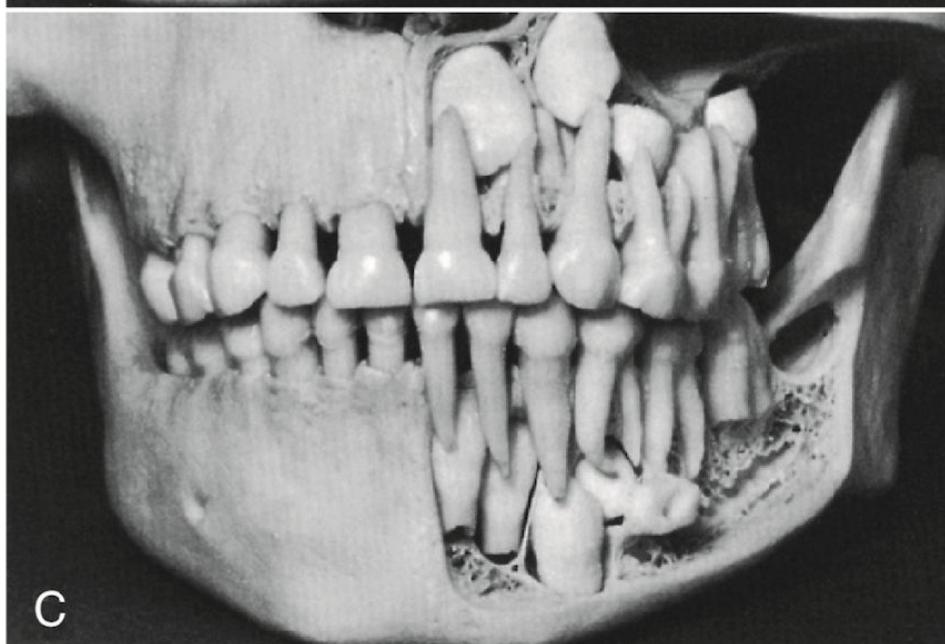
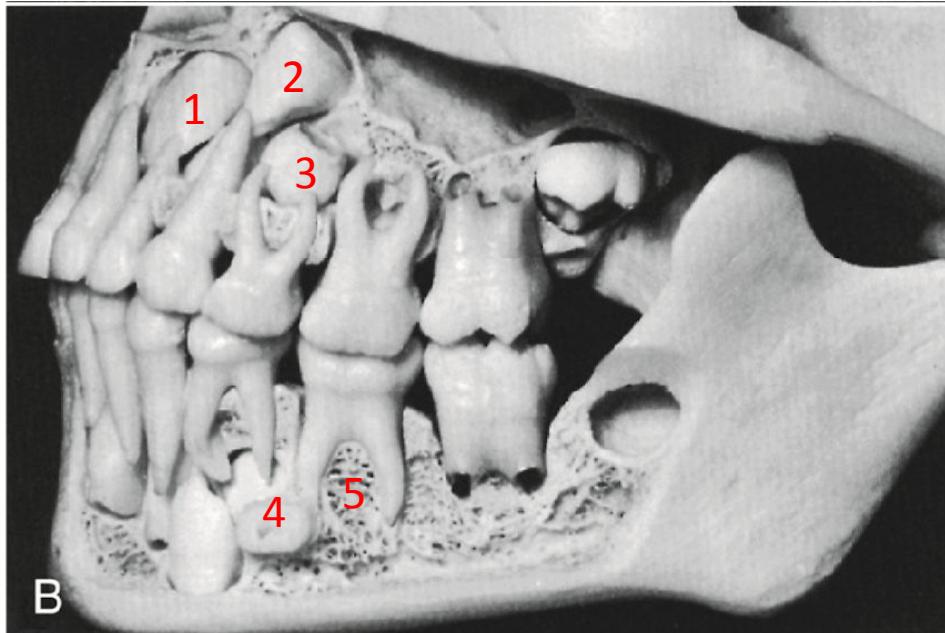
Central Incisor is the second permanent tooth to emerge into the oral cavity at age between 6-7 years.

May erupt simultaneously with or even before the mandibular first molar.



Identify the age of dental arches

The permanent incisors, canines, and premolars are called **succedaneous teeth** because they take the place of their **primary predecessors**.

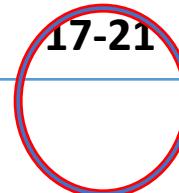


# CHRONOLOGY OF THE PERMANENT SUCCEDANEOUS DENTITION

		1st Evidence Of Calcification	Crown Completed (Years)	Eruption (years)	Root Completed (Years)
Central Incisor	Max.	3-4 months	4-5	7-8	10
	Mand.	3-4 months	4-5	6-7	9
Lateral Incisor	Max.	10-12 months	4-5	8-9	11
	Mand.	3-4 months	4-5	7-8	10
Canine	Max.	4-5 months	6-7	11-12	13-15
	Mand.	4-5 months	6-7	9-10	12-14
1 <sup>st</sup> Premolar	Max.	1½–1¾ years	5-6	10-11	12-13
	Mand.	1¼–2 years	5-6	10-12	12-14
2 <sup>nd</sup> Premolar	Max.	2–2¼ years	6-7	10-12	12-13
	Mand.	2¼–2½ years	6-7	11-12	13-14

# CHRONOLOGY OF THE PERMANENT NON-SUCCEDEDANEous DENTITION

		<b>1st Evidence Of Calcification</b>	Crown Completed (Years)	Eruption (years)	Root Completed (Years)
<b>1<sup>st</sup> molar</b>	Max.	At birth	2½–3 years	6-7	10
	Mand.	At birth	2½–3 years	6-7	9
<b>2<sup>nd</sup> molar</b>	Max.	2½–3 years	7-8	12-13	11
	Mand.	2½–3 years	7-8	11-13	10
<b>3<sup>rd</sup> molar</b>	Max.	7-9 years	12-16	17-21	18-25
	Mand.	8-10 years	12-16	17-21	18-25



## Sequence of eruption of permanent dentition over Years of age

Maxillary 2<sup>nd</sup> premolar =10-12

Maxillary 1<sup>st</sup> premolar =10-11

Mandibular 1<sup>st</sup> premolar =10-12

Mandibular 2<sup>nd</sup> premolar =11-12

Maxillary canine =11-12

Mandibular 2<sup>nd</sup> molar =11-13

Maxillary 2<sup>nd</sup> molar =12-13

Mandibular 1<sup>st</sup> molar =6-7

Mandibular canine =9-10

Maxillary lateral incisor =8-9

Maxillary central incisor =7-8

Mandibular lateral incisor =7-8

Mandibular central incisor =6-7

Maxillary 1<sup>st</sup> molar =6-7



How it looks in exams!



# Primary Dentition Eruption Mnemonic

## (Ages in Months)

Tooth	Eruption Age (approx.)	Mnemonic Word
Central Incisor	6–10 months	Children
Lateral Incisor	9–13 months	Like
First Molar	13–19 months	Milk,
Canine	16–22 months	Can't
Second Molar	23–33 months	Swallow

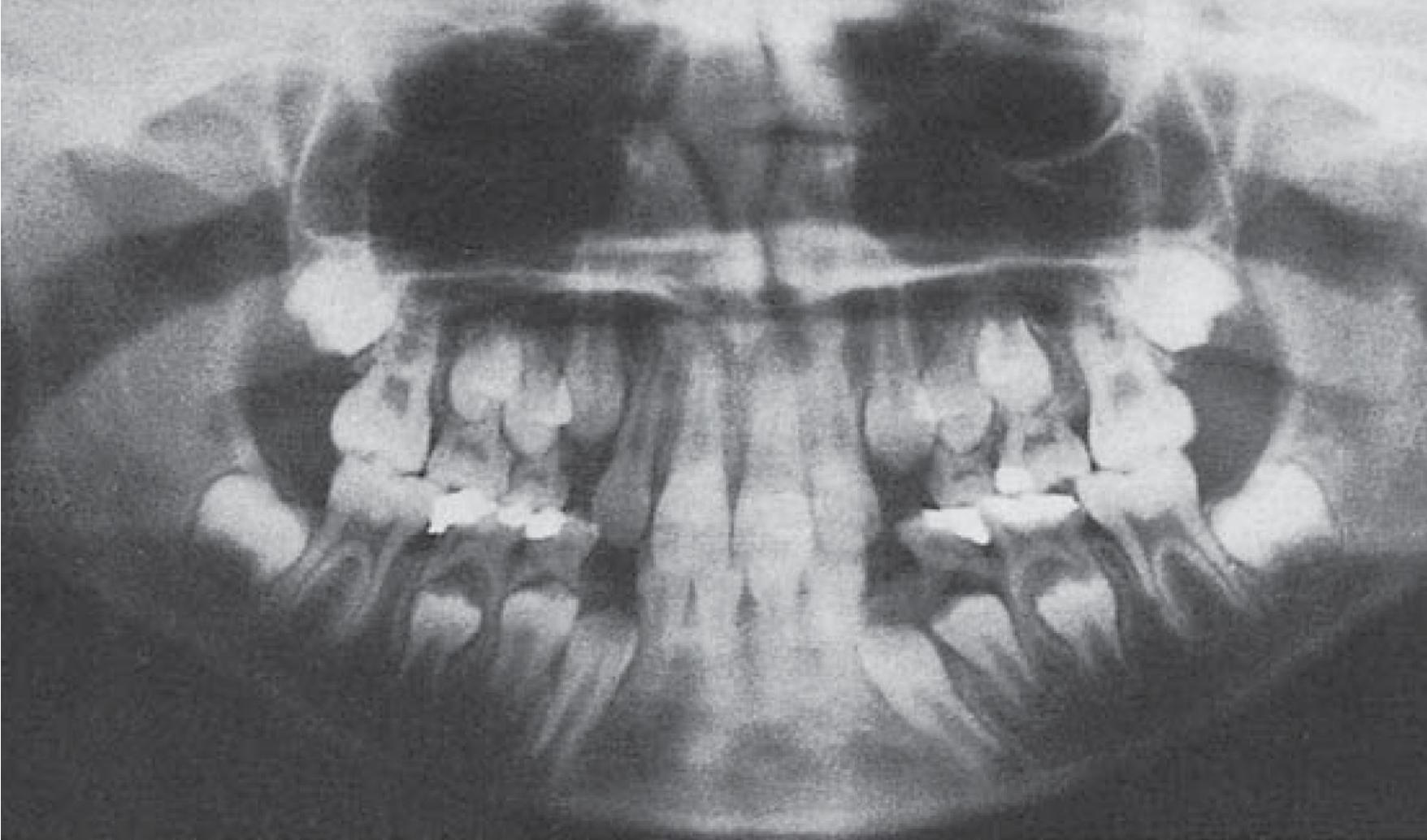


# Permanent Dentition Eruption Mnemonic (Ages in Years)

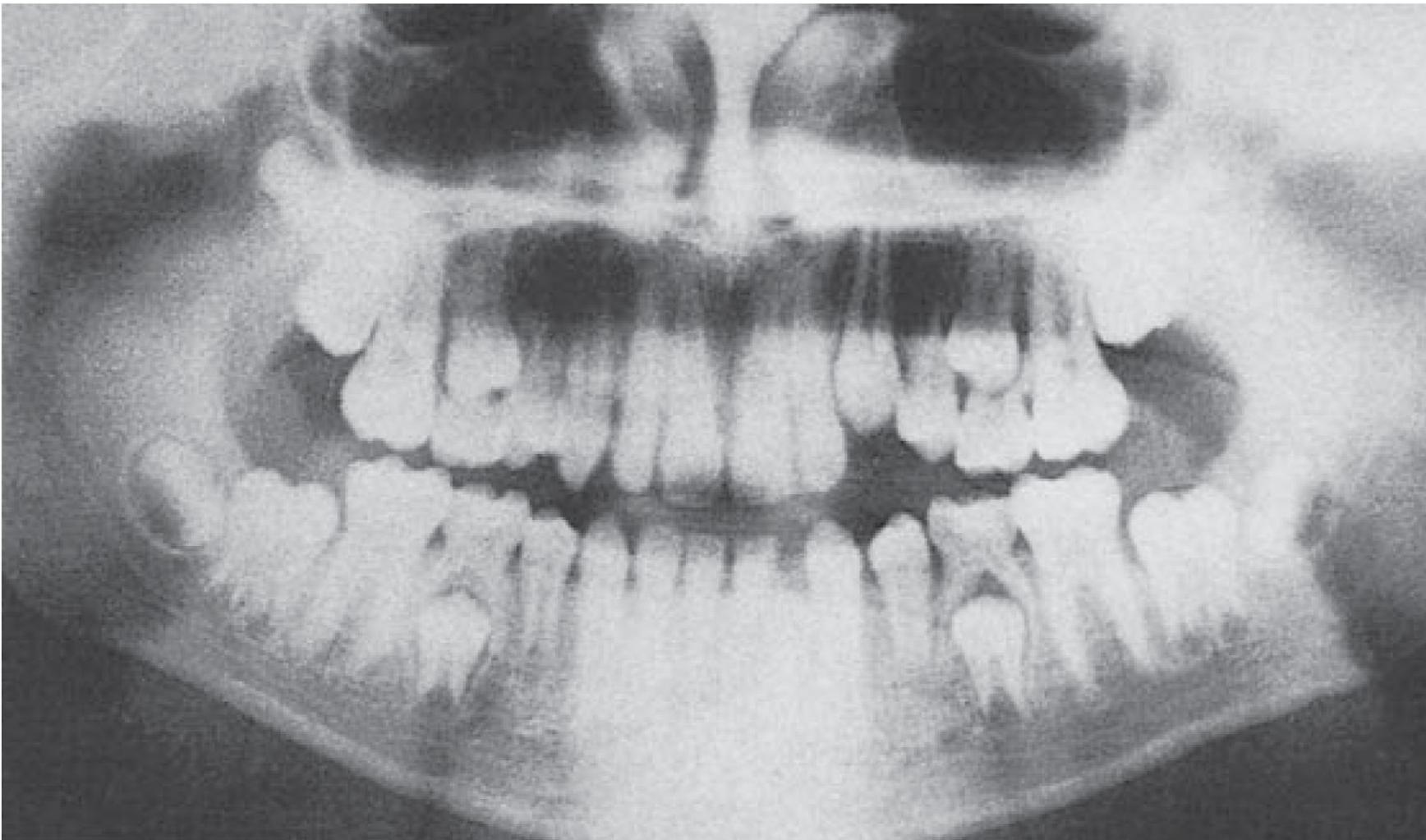
Tooth	Eruption Age (approx.)	Mnemonic Word
First Molar	6–7 years	My
Central Incisor	6–7 years	Cute
Lateral Incisor	7–8 years	Little
First Premolar	10–11 years	Puppy
Canine	9–12 years	Can't
Second Premolar	10–12 years	Play
Second Molar	11–13 years	Soccer
Third Molar	17–21 years	Thrice



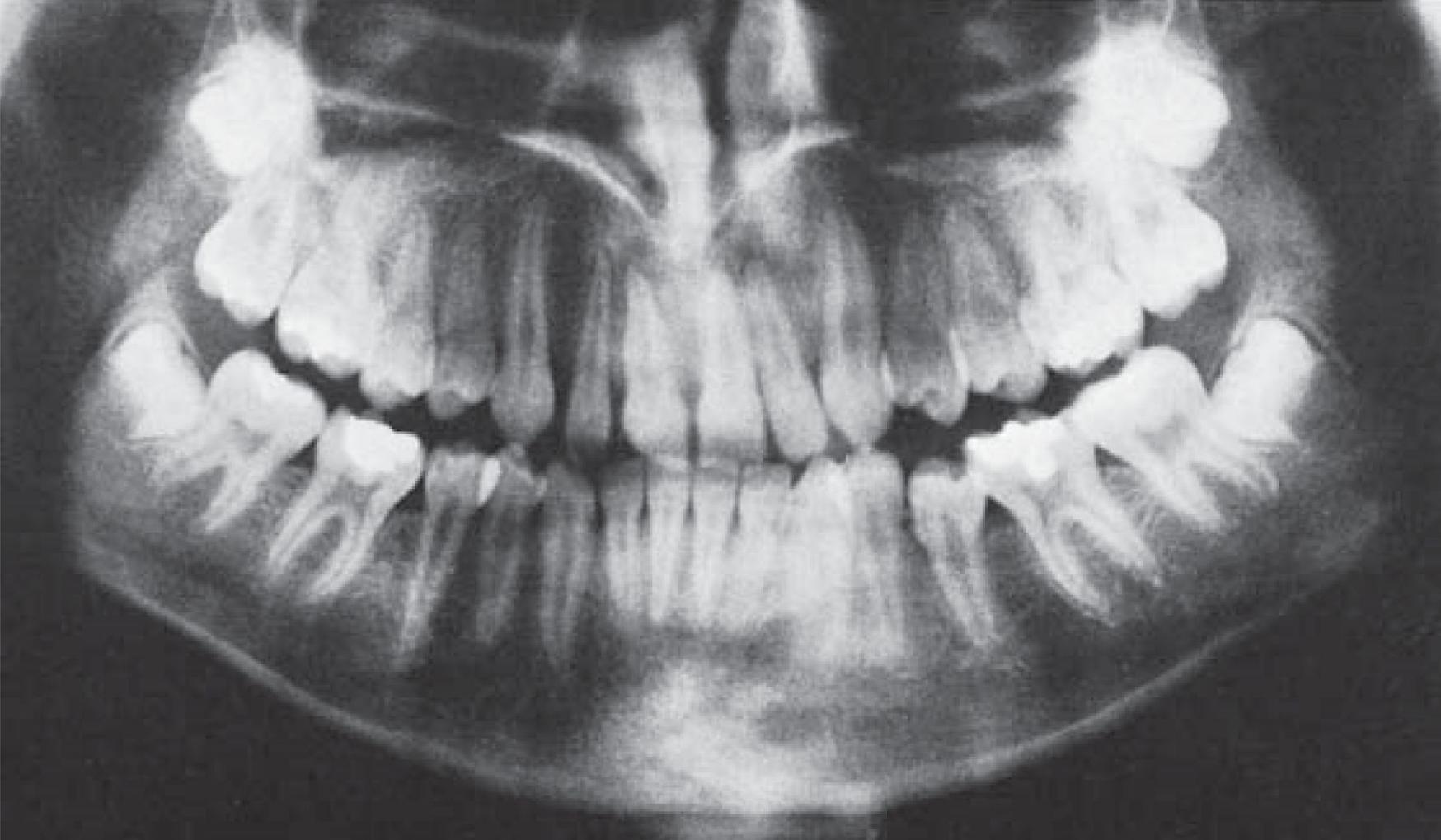
**Dental age 7-8 years**



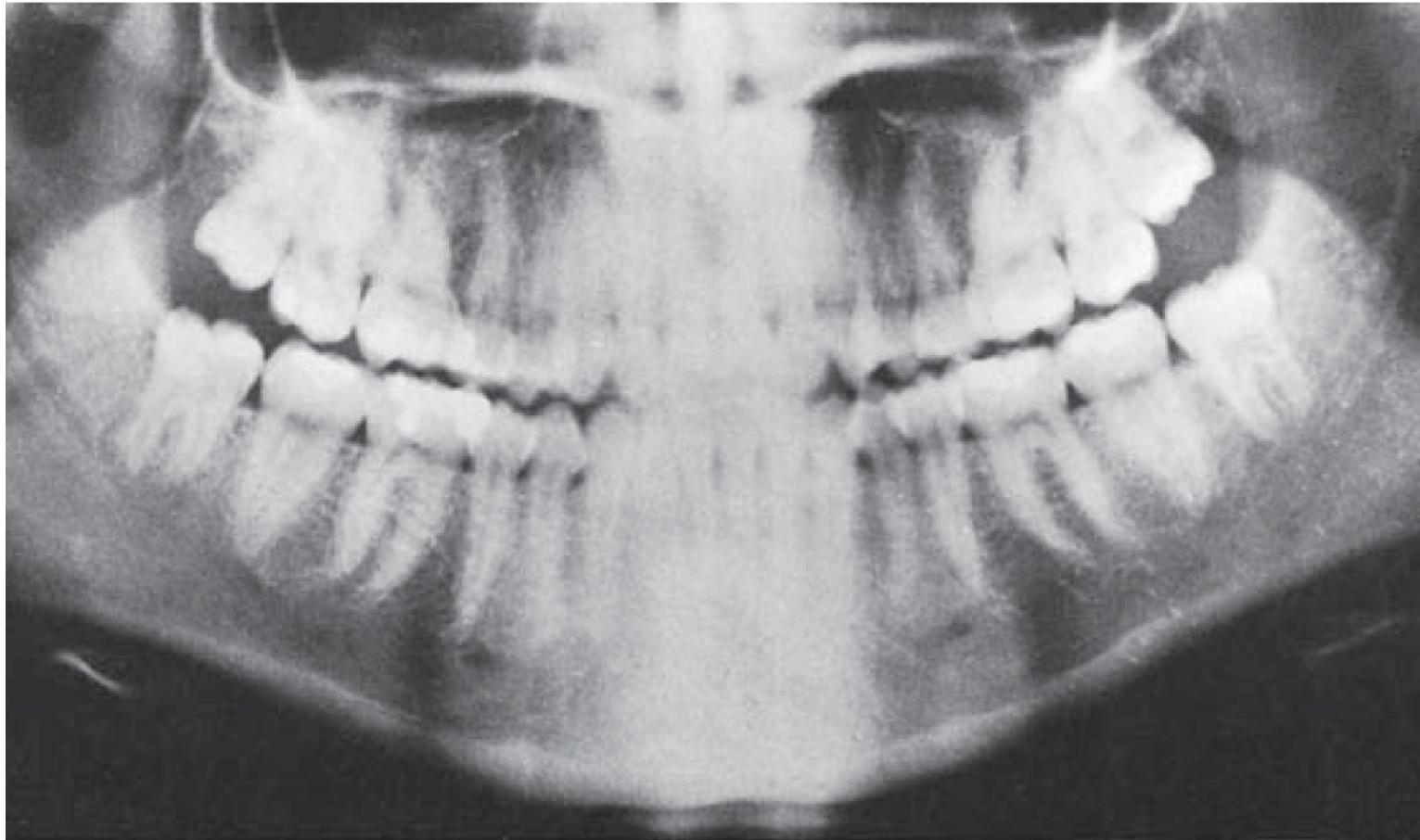
**Dental age 8-9 years**



**Dental age 10-11 years**



**Dental age 14 (12-16) years**



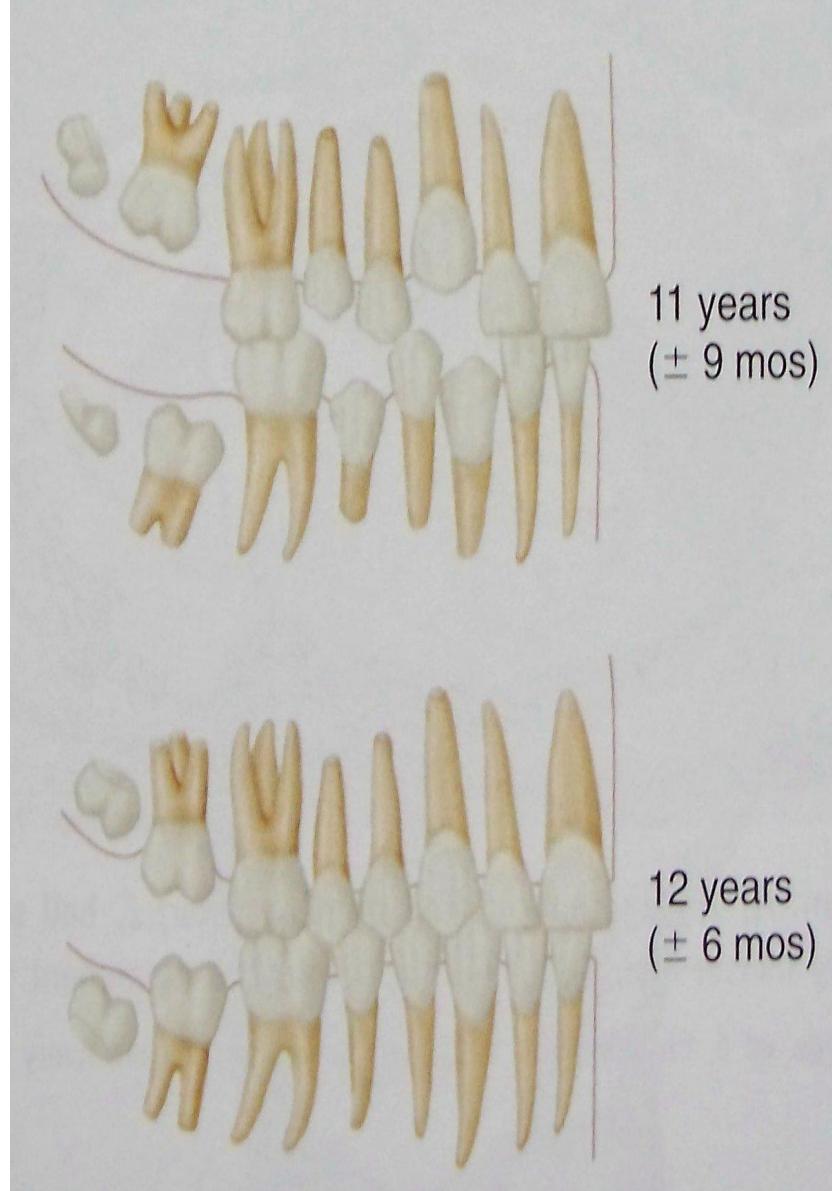
**Dental age 19 years**

# **8-9 Years of Age**



**Patient will have “early” ugly duckling stage.  
Dentition appears normal to parents after eruption of  
maxillary canine at 11 years.**

# **11 and 12 Years of Age**



**All primary teeth  
should now be  
exfoliated by 12  
years.**

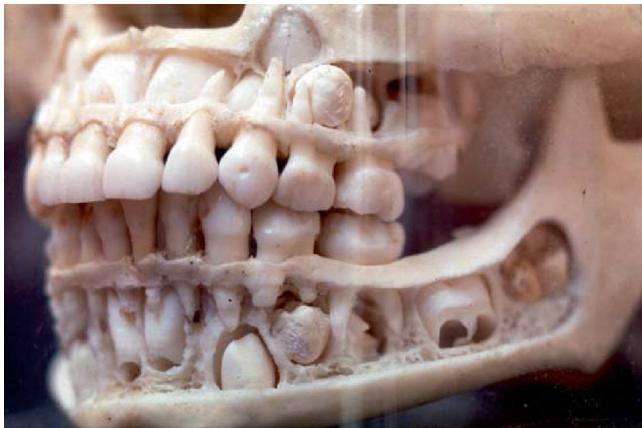
**Second molars  
should be  
erupting at age  
12 years.**

## **Calcification Schedule Notable time points**

Birth to one year	Two - four years	9 years
1 <sup>st</sup> molar Central incisor Canine Lateral incisor	Premolars Second molars	Third molars

# REFERENCE MATERIAL

- Ash MM Jr 1993 Wheeler's dental anatomy, physiology and occlusion, 7th edn. Saunders, Philadelphia
- Berkovitz, B. K., G. R. Holland, et al. (2017). Oral Anatomy, Histology and Embryology E-Book, Elsevier Health Sciences.



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## **Chronology of Human Dentition and Dental Age Estimation**

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# Learning Objectives

1. Correctly define and pronounce key terms related to the development and eruption of teeth.
2. Understand the stages of human tooth development, including prenatal and postnatal phases.
3. List and discuss the average ages of initial calcification, crown completion, emergence, and root completion for both primary and permanent dentitions.





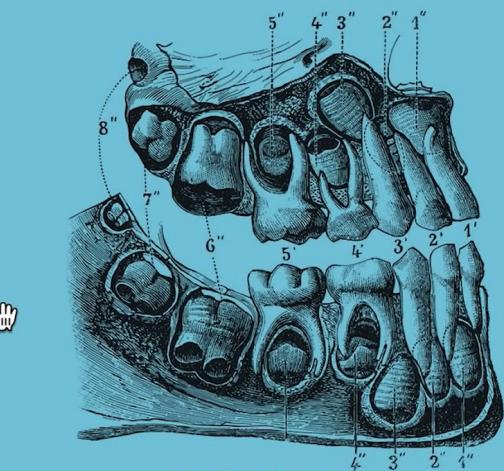
**Why do you think  
understanding  
chronology of  
human dentition is  
crucial for dental  
practitioners?**



## **Relevance to Dental Practice**

**Ensures clear,  
professional  
communication;  
improves patient  
understanding;  
crucial for exams  
and teamwork.**

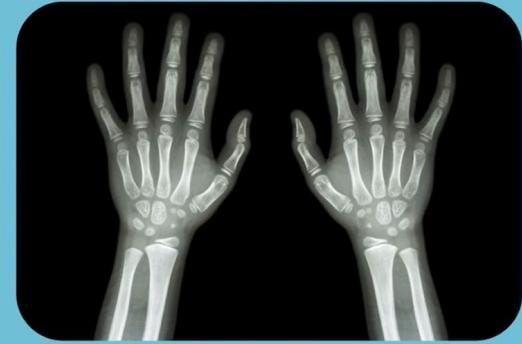
# THE 3 AGES IN ORTHODONTICS: SKELETAL, DENTAL AND CHRONOLOGICAL:



DENTAL



CHRONOLOGICAL



SKELETAL

Relevance to Dental Practice

	<b>Importance of Dental Age</b>
<b>Growth &amp; Development Assessment</b>	Monitors normal vs. delayed development; detects anomalies early.
<b>Orthodontic Treatment Planning</b>	Guides timing for braces and space management based on eruption sequence.
<b>Forensic &amp; Legal Use</b>	Estimates age in children for legal, forensic, or identification purposes.
<b>Pediatric &amp; Preventive Dentistry</b>	Helps time preventive procedures and counsel parents on tooth development.
<b>Surgical &amp; Restorative Planning</b>	Avoids injury to developing teeth during surgical or restorative procedures.