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Textbook of DENTAL ANATOMY, PHYSIOLOGY & OCCLUSION

Including Practical Workbook for Dental Anatomy



Rashmi GS Phulari

Foreword
Shreenivas S Vanaki

3rd Edition

JAYPEE

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3
CHAPTER

Chronology of Tooth Development

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DID YOU KNOW?

- It takes 8–10 years for a single permanent tooth to completely develop—from first evidence of calcification to root completion.
- Age estimation by dental means is most accurate since tooth development is not much affected by nutritional and hormonal changes.

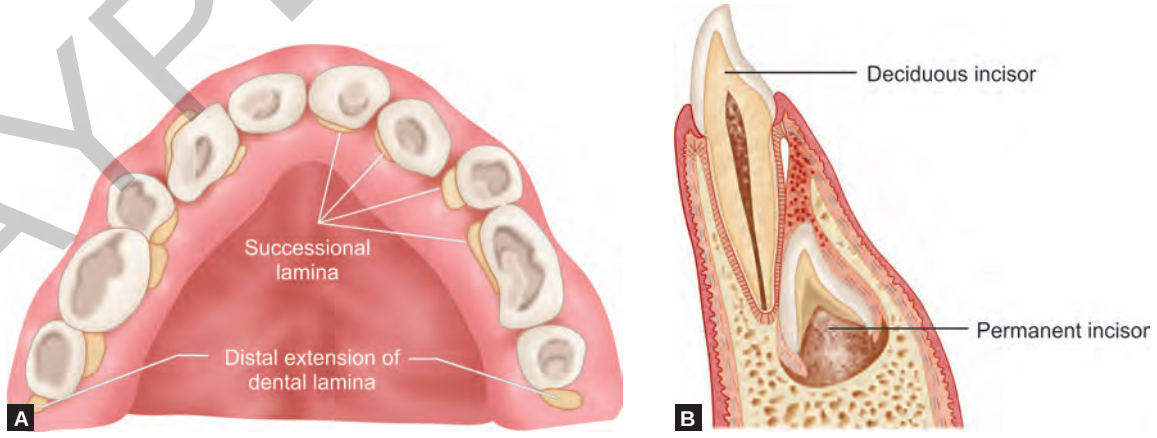
INTRODUCTION

Humans have two sets of teeth namely, the primary/deciduous dentition and the secondary/permanent dentition, which contain 20 and 32 teeth respectively. In both the dentitions, not all the teeth are formed and appear in oral cavity at the same time. Some teeth are completed before others are formed, resulting in different times of eruption for different groups of teeth. Groups of teeth develop at specific rates so that the sequence of their appearance into oral cavity is well defined, although with few variations.

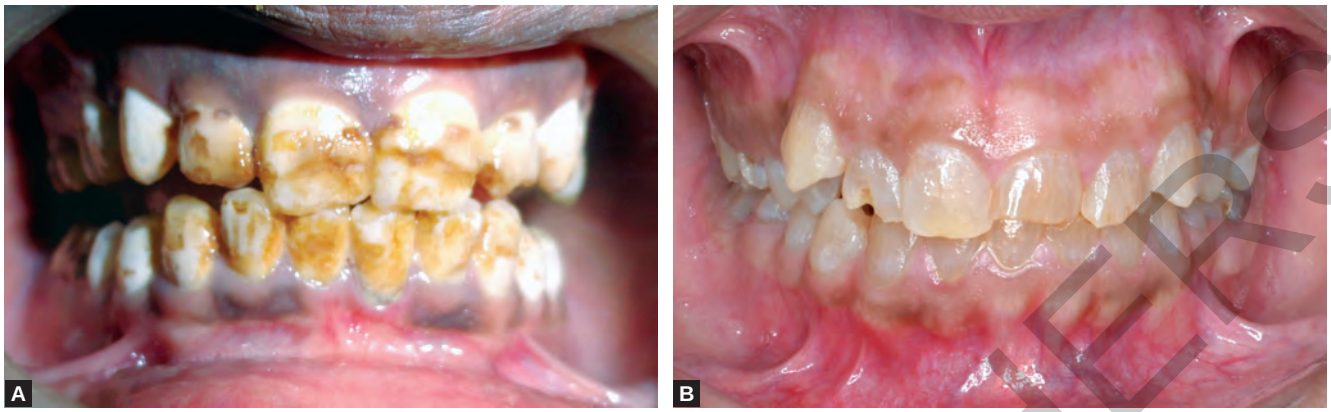
The enamel organ, dental papilla and dental sac together constitute a *tooth bud or tooth germ.* Ten such tooth germs arise in each dental arch to form the primary dentition. Tooth germs that give rise to permanent successors (i.e., the permanent incisors, canines and premolars) develop on the lingual aspect of their deciduous predecessors in the same bony crypt, by lingual proliferation of dental lamina called the *successional lamina.* The permanent molar tooth germs, which have no deciduous predecessors, develop from the *distal extension of the dental lamina/accessional lamina* when the jaws grow long enough **(Figs. 3.1A and B)**.

A thorough knowledge of development of teeth and timing and pattern of their eruption is essential for all clinical fields of dentistry. For example, an understanding of development of teeth, jaws and skull as a whole is essential for orthodontic treatment of malocclusions. It is imperative to know developmental chronology of secondary teeth so as to avoid injury to the developing tooth germs especially during the early surgical treatment of cleft palate.

It is also important to understand the effects of certain diseases and environmental factors on the development of teeth. For example, *amelogenesis imperfecta* **(Fig. 3.2A)** and *dentinogenesis imperfecta* **(Fig. 3.2B)** are genetic conditions that cause structural defects in teeth. Calcium



Figs. 3.1A and B: (A) Dental lamina gives rise to 10 teeth in each dental arch to form the primary dentition; (B) Permanent successors develop from successional lamina on lingual aspect of their predecessor teeth.



Figs. 3.2: (A) Amelogenesis imperfecta; (B) Dentinogenesis imperfecta.



Fig. 3.3: Enamel mottling caused due to dental fluorosis.

deficiency and syphilis in expectant mothers causing congenital defects in the child's teeth are examples of environmental factors that affect development of teeth.

Ingestion of drinking water that contains excessive fluoride content during the formative years of teeth may lead to defective enamel formation. The affected teeth show yellow/brownish spots on teeth or pitted enamel, and the condition is known as *fluorosis* **(Fig. 3.3)**.

ERUPTION AND EMERGENCE OF TEETH

Tooth eruption is a developmental process in which, the tooth moves in an axial direction from its anatomical position within the alveolar crypt of the jaw into its functional position within the oral cavity. The term *"eruption"* has thus come to mean a continuous process of tooth movement from within its socket until it reaches the final functional position.

The actual *emergence* of the tooth into oral cavity, when it breaks through the gum, is only one phase of eruption. Tooth eruption is a continuous process while its emergence through the mucous membrane is a single event.

In the chronology charts and in discussions about dental age the term *"eruption"* is used interchangeably with the term *"emergence"*. The eruptive movement continues after the incidence of emergence, and eventually the tooth comes into occlusion with the teeth in opposite arch. Even then it continues to erupt to compensate for occlusal wear (attrition).

Eruption of tooth begins soon after completion of the crown. When the tooth reaches the functional occlusal plane the root development is not yet complete. Root formation is usually completed 1–3 years after the eruption of the tooth.

CHRONOLOGY OF TOOTH DEVELOPMENT

Humans have three stages of dentition—primary, mixed/transitional and permanent. **Figures 3.4A and B** graphically depict the development of primary and permanent human dentitions.

The important developmental events that are recorded in the chronology chart are:

- First evidence of calcification
- Crown completion
- Emergence (eruption) through mucosa into oral cavity
- Root completion.

PRIMARY DENTITION STAGE

Usually there are no teeth present in the mouth at birth. However, occasionally infants may be born with erupted mandibular incisors, which are called the *natal teeth*. Primary dentition stage begins at around 6 months of age when the first primary teeth, generally the mandibular central incisors erupt into oral cavity **(Fig. 3.5)**. Primary dentition stage lasts until the eruption of first permanent tooth around 6 years of age.

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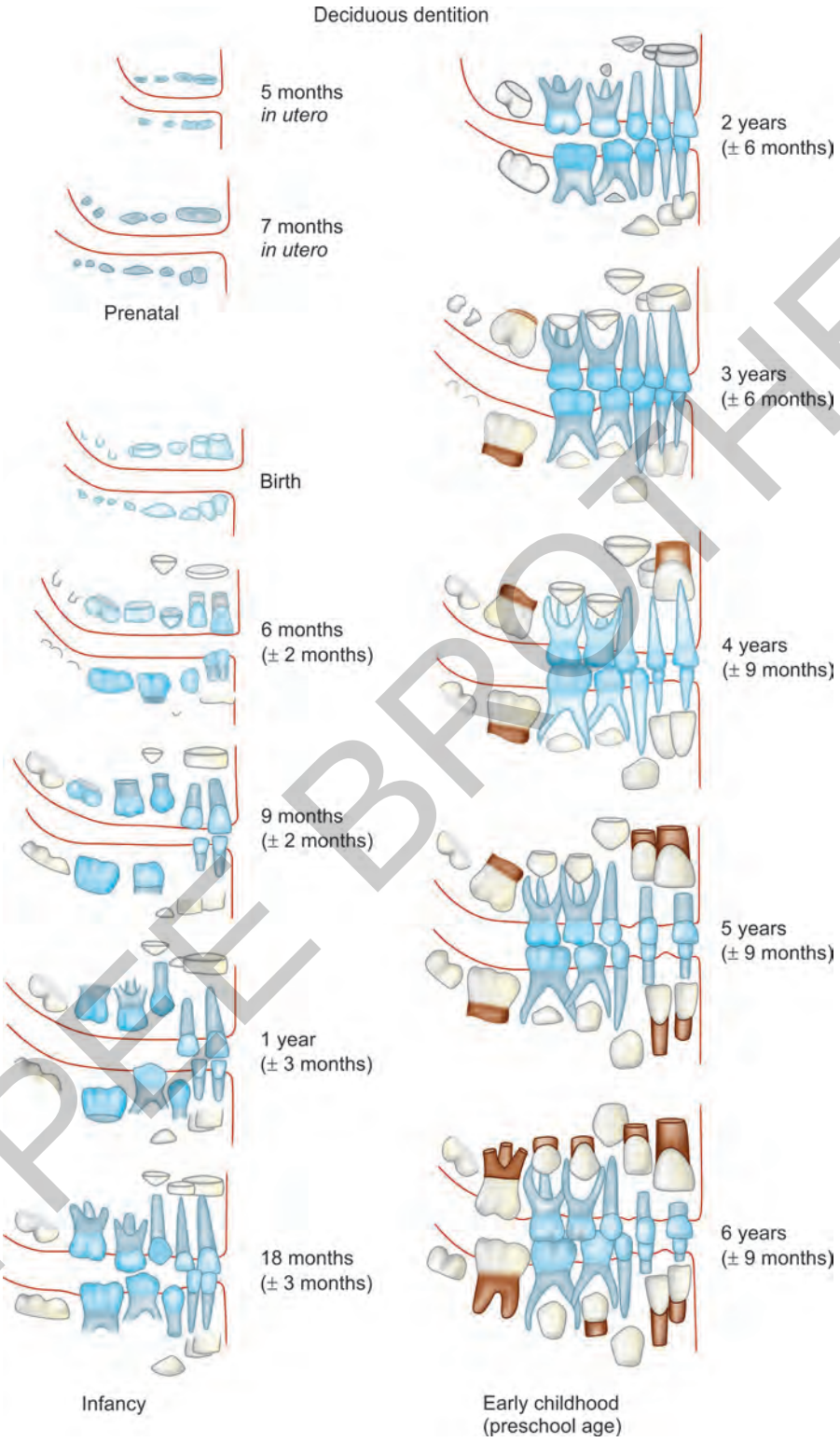

Fig. 3.4A: Development of human dentitions—primary dentition stage.

Source: Schour L, Massler M. The development of the human dentition. J Am Dent Assoc. 1941;28:1153.

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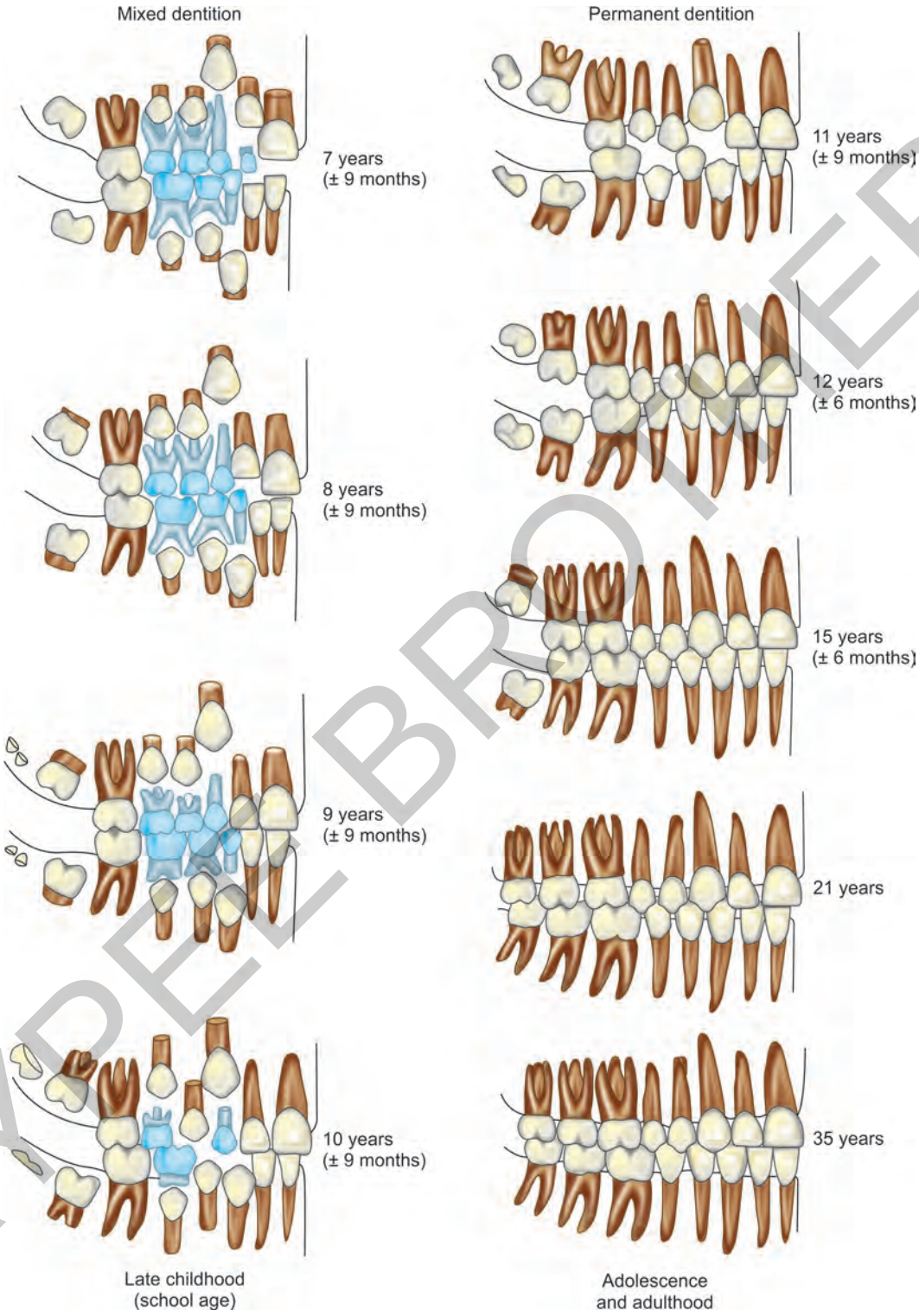

Fig. 3.4B: Mixed and permanent dentition stages

Source: Schour L, Massler M. The development of the human dentition. J Am Dent Assoc. 1941;28:1153.

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Fig. 3.5: Primary dentition stage generally begins at 6 months with emergence of mandibular central incisors.

Chronology of Primary Dentition

Table 3.1 gives the chronology of primary teeth. It must be remembered that the times given in chronology table reflect approximate values since no two individuals will chronologically develop in precisely the same manner. Thus, considerable variation exists. Nonetheless, these tables are of immense value in diagnosing any abnormal development.

The following points may be noted from the chronology of primary dentition:

- *Development of primary teeth occurs both prenatally and postnatally*; whereas the development of permanent teeth is entirely postnatal
- Crowns of primary teeth begin to calcify between 4 months and 6 months of intrauterine life
- Primary teeth take an average of 10 months for crown completion
- Primary teeth emerge into oral cavity some 6–8 months after the completion of their crown
- On an average, root completion occurs 1–2 years after the emergence of the crown
- Formation of primary teeth from initial calcification to root completion occurs in only 2–3 years (However, mineralization of permanent dentition takes about some 8–12 years, and is entirely postnatal).
- Emergence of primary dentition into oral cavity occurs between 6th and 30th month of age (postnatal)
- The mandibular central incisors are usually the first primary teeth to appear in mouth about 6 months of age
- It is followed by other incisors, so that by about 9–12 months, all the primary incisors have exposed
- Then the first primary molars emerge by about 12–16 months and establish contact with antagonistic teeth several months later, before the canines are fully erupted
- The primary canines emerge around at 16–20 months of age
- The last teeth to emerge are the maxillary second molars at the age of 20–30 months.

Table 3.1: Chronology of primary dentition.*

Tooth	First evidence of calcification weeks in utero	Amount of enamel formed at birth	Crown completed	Eruption	Root completed
Maxillary teeth					
Central incisor	14	Five-sixths	1½ months	10 months	1½ years
Lateral incisor	16	Two-thirds	2½ months	11 months	2 years
Cuspid	17	One-third	9 months	19 months	3½ years
1st molar	15½	Cusps united	6 months	16 months	2½ years
Second molar	19	Cusp tips still isolated	11 months	29 months	3 years
Mandibular teeth					
Central incisor	14	Three-fifths	2½ months	8 months	1½ years
Lateral incisor	16	Three-fifths	3 months	13 months	1½ years
Cuspid	17	One-third	9 months	20 months	3½ years
1st molar	15½	Cusps united	5½ months	16 months	2½ years
Second molar	18	Cusp tips still isolated	10 months	27 months	3 years

* Logan WHG, Kronfeld R. Development of the human jaws and surrounding structures from birth to the age of fifteen years. J Am Dent Assoc. 1933;20:379-427. (modified by McCall and Schour)

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Sequence of Emergence of Primary Teeth

Although some variation can occur, the predominant sequence of eruption of the primary teeth in each jaw is as follows:

- Central incisor (A)
- Lateral incisor (B)
- First molar (D)
- Canine (C)
- Second molars (E).

The lateral incisors, first molars and canines tend to erupt earlier in the maxilla than the mandible. The eruption sequence of primary dentition can be represented as follows:

AB	D	C	E
A	B	D	CE

Primary Dentition Period

The primary dentition is considered to be completely established by about 30 months/2½ years of age or when the primary molars are in occlusion **(Fig. 3.6)**. All the teeth are in use from about 2 years to 2½ years until the age of 6–7 years, a total of up to 5 years. The primary molars and maxillary canines stay in the oral cavity up to 11–12 years. Premature loss or prolonged retention of primary teeth, especially that of the molars and canines often leads to development of malocclusion in the permanent dentition stage **(Fig. 3.7)**.

Although the primary teeth seem to serve for a relatively short period of time in one's life, they nevertheless are as important as the permanent teeth. Major physiological, psychological, cognitive and neuromuscular development, acquisition of masticatory skills including complex mandibular and tongue movements occur during the primary dentition stage.

Thus, it is equally important to care for primary teeth that play an important role in the maintenance of child's welfare during his/her first years of growth and development both physically and mentally.

Shedding of Primary Teeth

Primary teeth are shed naturally when their permanent successor teeth are ready to erupt. Not all the primary teeth are lost at the same time; central incisors are lost early at 6–7 years while the canines and second molars are lost at around 12 years of age.

Exfoliation of primary teeth occurs due to physiologic resorption of their roots **(Fig. 3.8A)**. Only 3 years after the roots are completed they begin to resorb as the permanent successor teeth begin their occlusal migration. Pressure from erupting successional teeth plays a key role in shedding of the deciduous dentition. When a successional tooth germ is missing congenitally, shedding



Fig. 3.6: Primary dentition is completely established when primary molars are in occlusion, generally by 30 months of age.

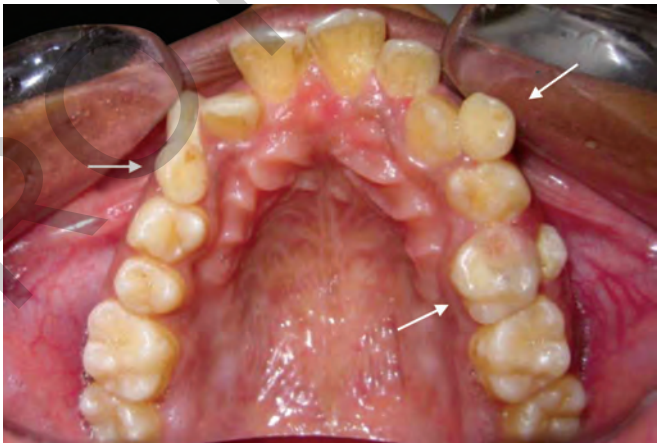

Fig. 3.7: Retained primary canines and second molars leading to malocclusion development.

of its deciduous predecessor tooth is delayed **(Fig. 3.8B)**. However, the tooth is shed eventually.

Pattern of resorption is influenced by the position of the permanent tooth germ. For example, permanent anteriors develop lingually to the deciduous teeth and erupt in an occlusal and vestibular direction **(Fig. 3.9A)**. Thus, the resorption occurs on the lingual surface of roots in case of deciduous anteriors and these teeth are shed with much of their pulp chamber intact **(Fig. 3.9B)**.

Permanent premolars on the other hand, develop between the divergent roots of the primary molars and erupt in an occlusal direction **(Fig. 3.10A)**. Hence, resorption begins at inter-radicular area. Some resorption of pulp chamber, coronal dentin, and sometimes even enamel may occur **(Fig. 3.10B)**.

Pattern of Shedding

The pattern of shedding is symmetrical for the right and left sides of the mouth. There should not be a discrepancy

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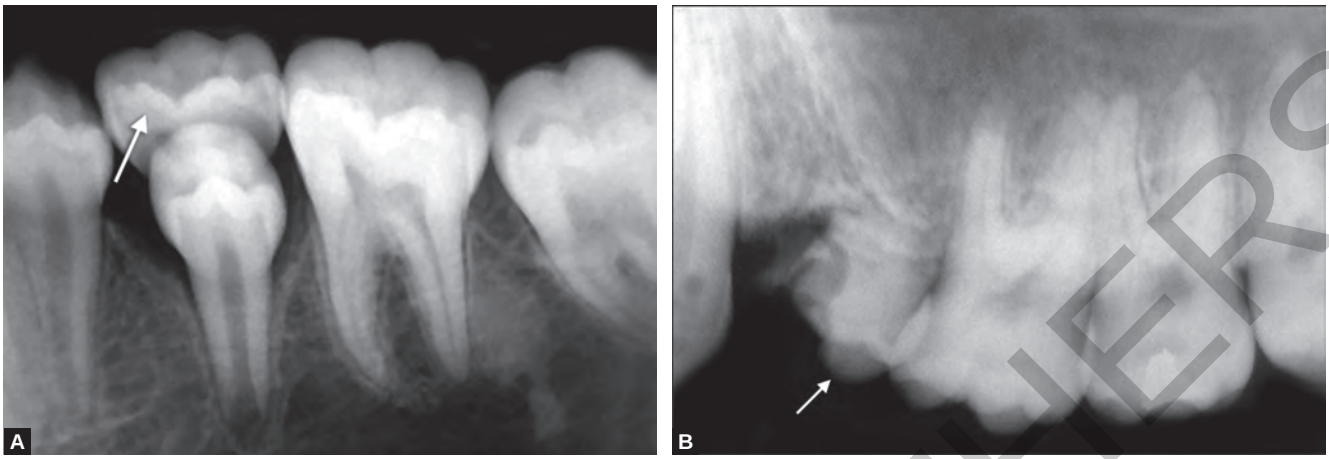
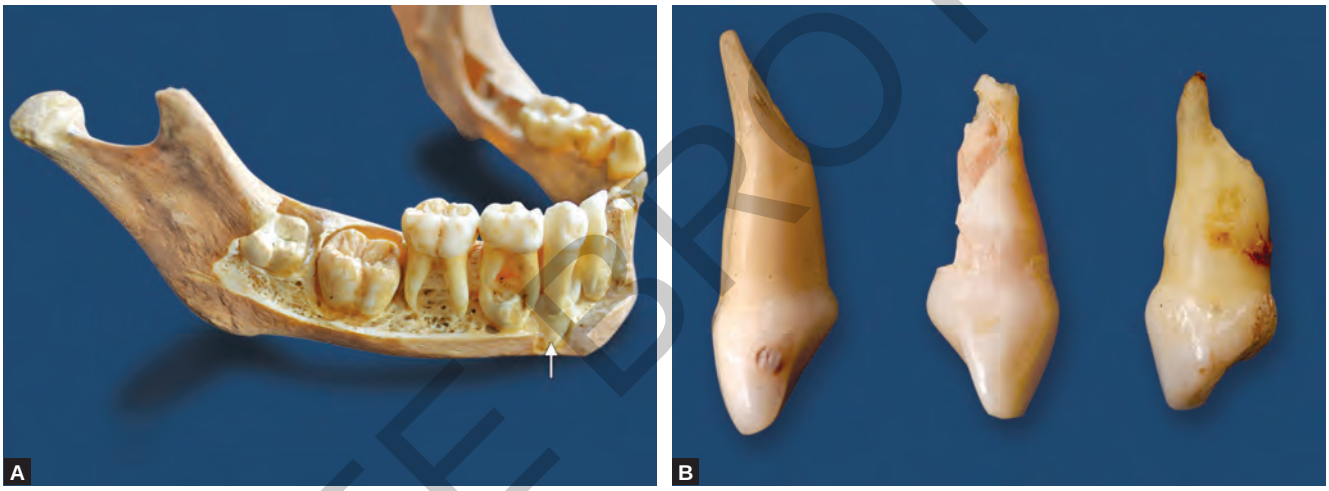
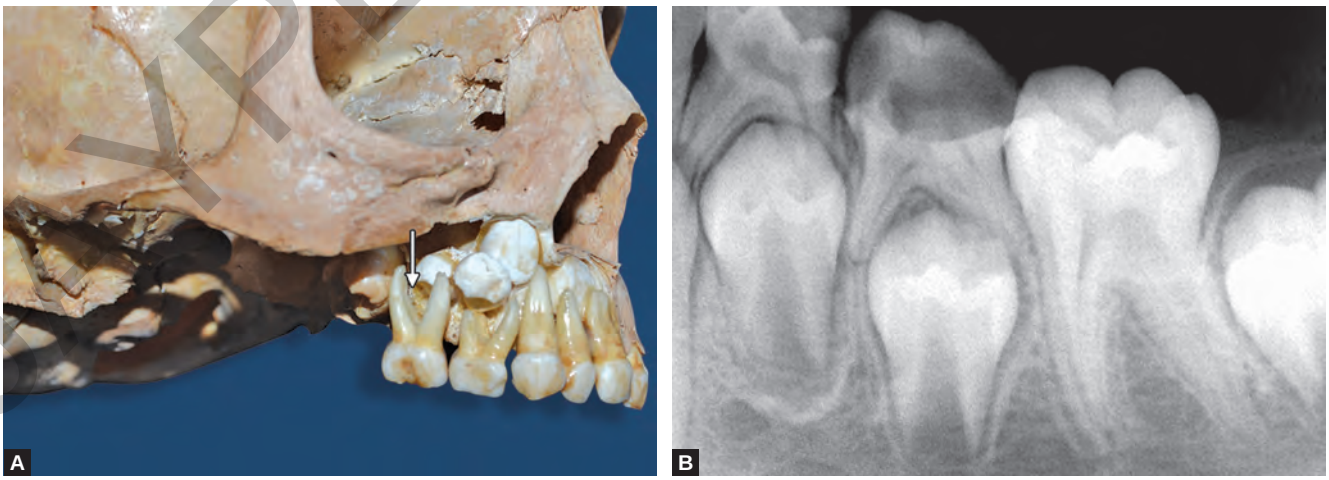


Figs. 3.8A and B: (A) Primary second molar root is completely resorbed. It is at the verge of exfoliation; (B) Shedding of primary second molar is delayed due to congenital absence of permanent second premolar.



Figs. 3.9A and B: (A) Permanent anteriors develop lingual to their deciduous predecessors; (B) Pattern of root resorption on primary anteriors on lingual surface of root.



Figs. 3.10A and B: (A) Premolars develop between the roots of primary molars; (B) Root resorption in primary molars begins at inter-radicular area.

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Fig. 3.11: Primary mandibular central incisor not yet shed when permanent successors are erupting-leading to their lingual eruption. Primary tooth should be extracted to facilitate proper alignment of the erupting successor tooth.

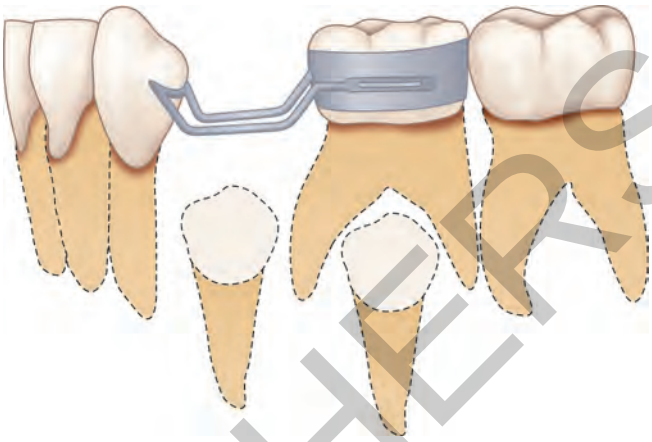


Fig. 3.12: A space maintainer designed to maintain space for the eruption of the permanent successor tooth at a later stage.

of more than 3 months between exfoliation of left and right deciduous teeth. Generally, the mandibular primary teeth are shed before their maxillary counterparts, except for the second molars. All four primary second molars are shed simultaneously. Shedding pattern of primary teeth reflects the eruption pattern of secondary (permanent) teeth.

Primary teeth shedding time table should be closely monitored to prevent abnormal developments. If a deciduous tooth has not exfoliated when its permanent successor erupts into oral cavity, the primary tooth should be promptly extracted. This usually occurs with incisor teeth **(Fig. 3.11)**.

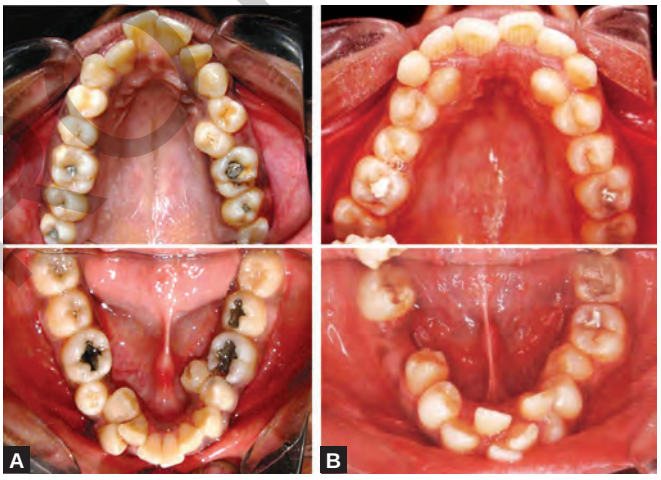
When primary teeth, especially the canines and molars are lost prematurely due to caries, trauma, etc., the space should be maintained by way of space maintainers so that there is enough space in the arch when their permanent successor teeth are ready to erupt **(Fig. 3.12)**.

Premature loss of primary teeth and/or unrestored proximal caries resulting in loss of arch length **(Fig. 3.13A)**, prolonged retention of primary teeth are important causes of malocclusion development in the permanent dentition **(Fig. 3.13B)**.

MIXED DENTITION STAGE

It is a transition stage between 6 years and 12 years of age, when primary teeth are exfoliated in a sequential manner, followed by the eruption of their permanent successors. In the *first transitional period,* eruption of permanent first molars and replacement of primary incisors by the permanent incisors occur. The *second transitional period* involves replacement of the primary molars and canines by the permanent premolars and canines respectively, and emergence of second permanent molars.

Figure 3.4B shows mixed dentition period.



Figs. 3.13A and B: Development of malocclusion due to: (A) Premature loss of primary teeth and failure to maintain space; (B) Prolonged retention of primary teeth.

PERMANENT DENTITION STAGE

Permanent dentition stage is established by about 12–13 years excluding the third molars.

Chronology of Permanent Dentition

The following observations can be made from the chronology table of permanent teeth **(Table 3.2)**:

- The permanent dentition begins to form at birth, at which time, initial calcification of permanent 1st molars becomes evident. Their crowns are completed by 3 years of age.
- Most of the anteriors begin to calcify between 3 months and 5 months and their crowns are completely formed by 5–7 years

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Table 3.2: Chronology of permanent dentition.*

Tooth	First evidence of calcification	Amount of enamel formed at birth	Crown completed	Eruption	Root completed
Maxillary					
Central incisor	3–4 months	-	4–5 years	7–8 years	10 years
Lateral incisor	10–12 months	-	4–5 years	8–9 years	11 years
Cuspid	4–5 months	-	6–7 years	11–12 years	13–15 years
First bicuspid	1½–1¾ years	-	5–6 years	10–11 years	12–13 years
Second bicuspid	2–2¼ years	-	6–7 years	10–12 years	12–14 years
1st molar	At birth	Sometimes a trace	2½–3 years	6–7 years	9–10 years
Second molar	2½–3 years	-	7–8 years	12–13 years	14–16 years
3rd molar	7–9 years	-	12–16 years	17–21 years	18–25 years
Mandibular					
Central incisor	3–4 months	-	4–5 years	6–7 years	9 years
Lateral incisor	3–4 months	-	4–5 years	7–8 years	10 years
Cuspid	4–5 months	-	6–7 years	9–10 years	12–14 years
First bicuspid	1¾–2 years	-	5–6 years	10–12 years	12–13 years
Second bicuspid	2¼–2½ years	-	6–7 years	11–12 years	13–14 years
1st molar	At birth	Sometimes a trace	2½–3 years	6–7 years	9–10 years
Second molar	2½–3 years	-	7–8 years	11–13 years	14–15 years
3rd molar	8–10 years	-	12–16 years	17–21 years	18–25 years

* Logan WHG, Kronfeld R. Development of the human jaws and surrounding structures from birth to the age of fifteen years. J Am Dent Assoc. 1933;20:379-427. (modified by McCall and Schour)

- The premolars begin to calcify by 1½ to 2½ years. Crown completion occurs by 7 years of age
- The second molars begin to form by 2½ to 3 years and their crowns are completed by 7 to 8 years
- The last teeth to develop, the third molars begin to calcify by 7–10 years, and crowns are not completed until 12–16 years.
- Usually, the first permanent teeth to emerge are the 1st molars at around 6 years of age. They are, thus, also referred to as *6-year molars.*
- The mandibular central incisors emerge next around 6–7 years, which are closely followed by the mandibular lateral incisors
- The maxillary central incisors emerge next in the order about 7–8 years. The maxillary lateral incisors emerge about 1 year later
- The mandibular canine follows next at 9–10 years. However, the maxillary canine erupt late after one or both the maxillary premolars erupt around 11–12 years
- The premolars emerge between 10 years and 12 years
- The second molars erupt next, around 12 years of age; they are also called the *12-year molars.*
- The third molars do not erupt until 17–21 years. In many individuals, the third molars remain impacted or may even be completely absent.

Eruption Sequence

- The mandibular permanent teeth tend to erupt before their maxillary counterparts.
- In addition, there are significant differences in the eruption sequences between the maxillary and the mandibular arches **(Fig. 3.14)**.
- It must be noted that there is a difference in the eruption timing of the upper and lower canine teeth.
- Thus, the maxillary canine often erupts buccally or palatally when the space is lost due to mesial migration of the already erupted premolars leading to crowding of teeth **(Fig. 3.15)**.

  Most common eruption sequence in maxillary arch:

  6-1-2-4-3-5-7-8

  or

  6-1-2-4-5-3-7-8

  Most common eruption sequence for mandibular arch:

  (6-1)-2-3-4-5-7-8

DENTAL AGE

Estimation of age is an important requisite in forensic, judicial and criminal proceedings. Circumstances where age assessment is required include—asylum seeker of

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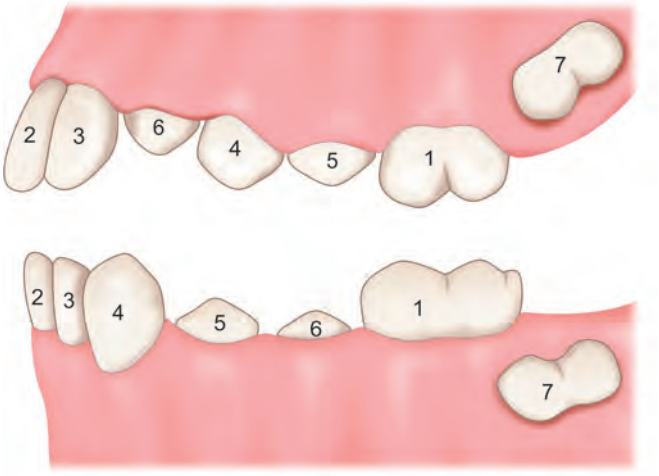

Fig. 3.14: Eruption sequence of permanent teeth.



Fig. 3.15: Maxillary canine erupts after the eruption of premolars. Thus anterior crowding is a common problem in maxillary arch due to buccal/palatal eruption of maxillary canine.

unknown age, young people accused of criminal activities, convicted criminals whose age is claimed to be less than 18 years prior to sentencing and identification of subjects from mass disasters.

Apart from forensics and anthropology, dental age assessment has an important role in pediatric dentistry and orthodontics.

The chronological age (actual age from date of birth) of an unknown person with uncertain birth record can be predicted by correlating his/her physical, skeletal and dental development. Dental age is considered a better indicator of biologic maturity than physical, skeletal or sexual age since tooth formation is least affected by nutritional status and endocrinal disturbances.

Dental age can be assessed mainly by two methods:

1. Tooth eruption status, and
2. Tooth formation status

Based on Tooth Eruption/Emergence Status into the Oral Cavity

This method takes into account the number of teeth that have emerged into the oral cavity and the last tooth to erupt. The method can only be an informed guess since tooth emergence through the mucous membrane is a single event for each tooth. Furthermore, local factors such as caries, tooth loss, ankylosis, and lack of space in the dental arch may affect emergence of teeth through gingiva.

Thus, chronologies of eruption of teeth are less satisfactory for dental age assessment than those based on tooth formation. However eruption status can be used in mixed dentition period to get a rough idea about the dental age.

Figures 3.16 and 3.17 give examples of dental age assessment using eruption status of teeth in mixed dentition period.

The permanent teeth tend to erupt in groups and it is important to know the expected timing of these eruption stages. These eruption stages are used to calculate dental age, particularly during the mixed dentition period.

Dental Age 6 (Fig. 3.18A)

The first stage of eruption of the permanent teeth is at age of 6 years. It is characterized by simultaneous eruption of the mandibular central incisors, maxillary first molars and mandibular first molars. The onset of eruption of this group of teeth characterizes dental age 6.

Dental Age 7 (Fig. 3.18B)

In the second stage of eruption at dental age 7, the maxillary central incisors and the mandibular lateral incisors erupt.

Dental Age 8 (Fig. 3.18C)

It is characterized by the eruption of the maxillary lateral incisors. After these teeth erupt there is a delay of 2–3 years before any further permanent teeth appear.

Dental Ages 9 and 10 (Fig. 3.18D)

It is marked by the eruption of mandibular canines and is assessed by the extent of resorption of the primary canines and molars and the extent of root development of their permanent successors.

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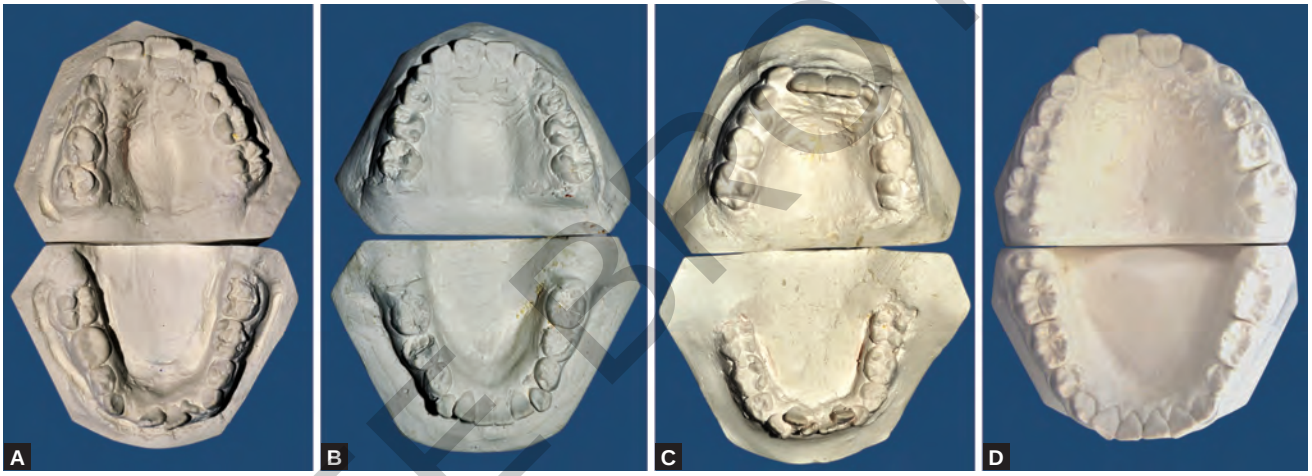
Figs. 3.16A to D: Dental age assessment using eruption status of teeth in mixed dentition period (Tooth notation in FDI system): (A) Last erupted tooth—21; approximate dental age = 7–8 years; (B) Last erupted tooth—31, 41; approximate dental age = 6–7 years; (C) Erupting teeth—13; approximate dental age = 11–12 years; (D) Erupting teeth—25 and 13; approximate dental age = 10–12 years.



Figs. 3.17A to D: Dental age assessment using eruption status of teeth in mixed dentition period—cast specimen (Tooth notation in FDI system): (A) Erupted teeth-all first permanent molars, erupting teeth—32, 11, 21, 12, 22; approximate dental age 7–9 years; (B) Last erupted teeth—12 and 22; approximate dental age 8–9 years; (C) Erupting tooth—14; approximate dental age 10–11 years; (D) Erupting tooth—23; approximate dental age 11–12 years.

Dental Age 11 (Fig. 3.18E)

It is characterized by eruption of mandibular first premolars and maxillary first premolars which all erupt more or less simultaneously.

At dental age 11, the only remaining primary teeth in oral cavity are the maxillary canine and second molar and mandibular second molar.

Dental Age 12 (Fig. 3.18 F)

At dental age 12, the remaining succedaneous permanent teeth erupt, i.e., the maxillary canine; the maxillary and mandibular second premolars.

In addition, the second permanent molars in both the arches are nearing eruption.

Dental Ages 13–15 (Fig. 3.18 G)

They are characterized by the extent of completion of the roots of permanent teeth. By dental age 15, if the third molar is going to form, it will be apparent on the radiographs and the roots of all other permanent teeth should be complete.

Based on the Stages of Tooth Formation Observed on Radiographs

Tooth formation (calcification) is a continuous process occurring throughout the growth period from birth to adolescence, and can be divided into various stages that can be defined.

Dental age based on tooth formation is superior to that based on tooth emergence because emergence of a tooth

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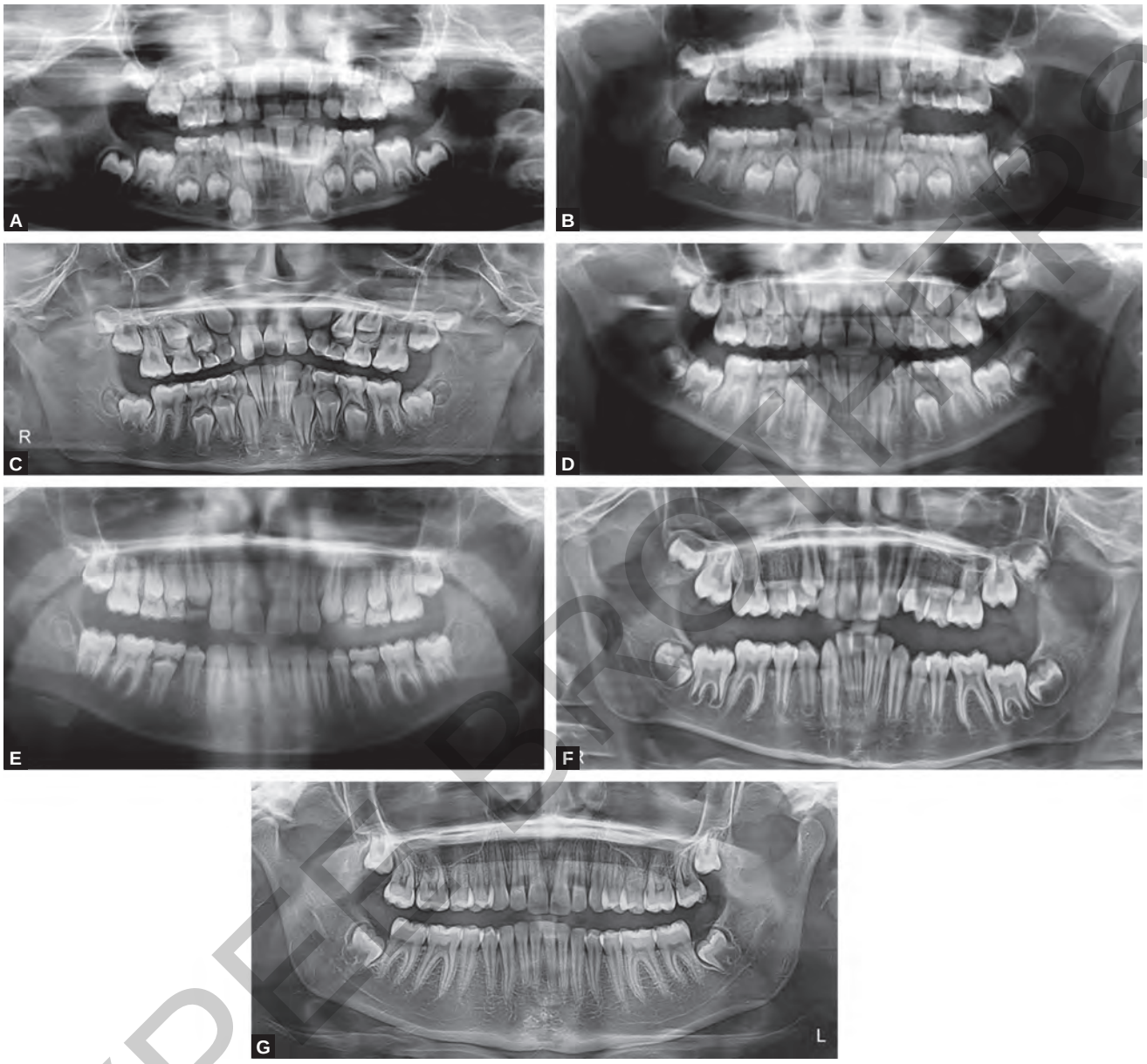

Figs. 3.18A to G: (A) Dental age 6; (B) Dental age 7; (C) Dental age 8; (D) Dental ages 9 and 10; (E) Dental age 11; (F) Dental age 12; (G) Dental ages 13 to 15.

is a fleeting single event and its precise time is difficult to determine. Whereas tooth calcification is a continuous process that can be assessed on permanent records such as radiographs.

Dental age is estimated by comparing the tooth development status in a person of unknown age with published reference dental development dataset prepared from a similar or a different population group.

Demirjian in 1973 proposed dental maturity scores from a French-Canadian population and this has served as a reference dataset for evaluation of age for various population groups.

Radiographic studies of tooth formation have used three basic stages:

1. First evidence of calcification
2. Crown completion
3. Root completion.

Nolla expanded the number of stages to 11 and Gleiser and Hunt to 13.

Morrees et al. defined 14 stages of permanent tooth formation **(Fig. 3.19)**. The 14 stages are designated by abbreviations. Morrees et al. studied the development of mandibular canines and provided normative data.

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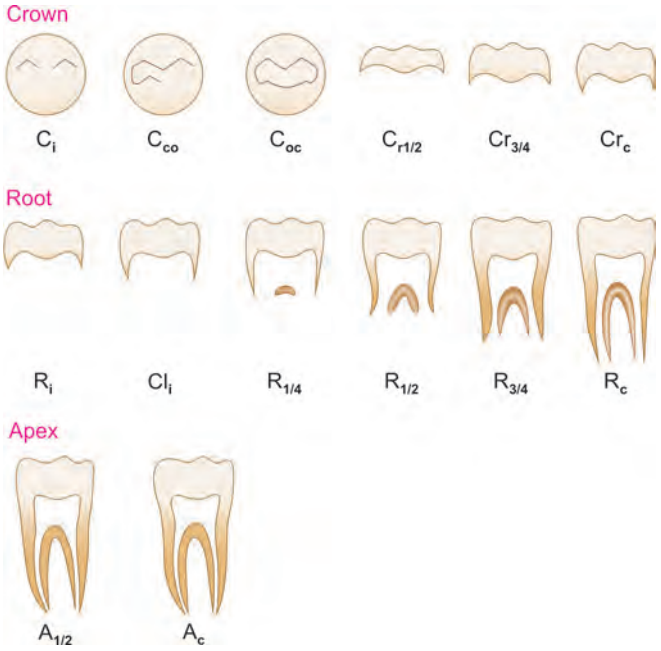

Fig. 3.19: 14 stages of permanent teeth formation as defined by Morrees et al.

Abbreviations

- C: Cusp
- Cr: Crown
- R: Root
- Cl: Cleft
- A: Apex

Subscripts

- i: Initiated
- co: Coalescence
- oc: Outline complete
- c: Complete

The 14 stages would be:

1. C_i: Cusp initiated
2. C_{co}: Cusp coalescence
3. C_{oc}: Cusp outline completed
4. $C_{r1/2}$: Crown half formed
5. $C_{r3/4}$: Crown three-fourth formed
6. C_{rc}: Crown completed
7. R_i: Root initiated
8. Cl_i: Cleft initiated
9. $R_{1/4}$: Root one-fourth formed
10. $R_{1/2}$: Root half formed
11. $R_{3/4}$: Root three-fourth formed
12. R_c: Root complete
13. $A_{1/2}$: Apex half formed
14. A_c: Apex complete

Clinicians can use such chronologies to avoid treatment that can damage developing teeth (age of attainment schedules), to assess an unknown age of a patient (e.g., age prediction in forensics), and to assess growth (maturity).

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LONG ESSAYS

1. Discuss chronology of human permanent dentition in detail.
2. Discuss chronology of human deciduous dentition in detail.

SHORT NOTES

1. Ugly duckling stage.
2. Eruption sequence of permanent teeth.
3. Shedding pattern of deciduous teeth.
4. Dental age.

MULTIPLE CHOICE QUESTIONS

1. Development of teeth in human begins:
   a. At birth
   b. Prenatally
   c. At 6 months
   d. At 1 years
2. Primary teeth begin to calcify at:
   a. Birth
   b. 6 months
   c. 6 weeks in utero
   d. 14 weeks in utero
3. First primary tooth to show its evidence of calcification (begin its development):
   a. Primary maxillary 1st molar
   b. Primary mandibular 1st molar

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c. Primary mandibular central incisor
d. Primary mandibular lateral incisor

4. All primary teeth would have begun to calcify by:
   a. 14 weeks of intrauterine life
   b. 18–20 weeks of intrauterine life
   c. 6 months of gestation
   d. 6 months of age
5. The duration of time each primary tooth takes for its formation, from first evidence of calcification to root completion is:
   a. 3–4 months
   b. 2–3 years
   c. 5–6 years
   d. 1–2 years
6. The duration of time each permanent tooth takes for its complete formation is:
   a. 3–4 months
   b. 2–3 years
   c. 5–6 years
   d. 8–12 years
7. Mineralization of permanent teeth is:
   a. Entirely prenatal
   b. Entirely postnatal
   c. Occurs both prenatally and postnatally
   d. None of the above
8. Eruption of all the primary teeth would be completed by:
   a. 6 months
   b. 12 months
   c. 12 years
   d. 2½ years
9. Development of primary dentition is considered to be completed:
   a. At 6 months
   b. 30 months
   c. When second primary molars are in occlusion
   d. Both b and c
10. Transitional (mixed) dentition period begins at:
   a. 6 months
   b. 6–7 years
   c. When first permanent teeth erupts
   d. Both b and c

Answers

1. b 2. d 3. c 4. b 5. b 6. d 7. c 8. d 9. d 10. d

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- Differences between various permanent teeth ***(arch, class, and type traits)*** in a tabular form for better correlation.
- **List of long essays, short notes, and MCQs** given at the end of each chapter for theory and viva preparation.

Online teaching materials:

- ***Video demonstration of tooth carving*** to help students learn carving at their own pace.
- ***Additional chapter-wise MCQs*** to help learning and self-appraisal.

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