DEVELOPMENT OF DENNTITION

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*DEVELOPMENT OF DENTITION

from birth to adulthood can be divided into four periods:-

1. From birth to complete eruption of deciduous teeth, i.e. birth to 2 .5 years.
2. From complete eruption of deciduous teeth to the eruption of 1st permanent molar, i.e. 2.5 years to 6 years.
3. The mixed dentition period , i.e. 6 years to 12 years.
4. The period from the eruption of the 2nd permanent molars, i.e. about 12 years onwards.

*DENTITION AT BIRTH

The alveolar arches at the time of birth are termed as GUM PADS.

The basic form of arches is determined by 4th month of intra uterine life. They develop into distinct parts,

->Labio - buccal portion.

->Lingual portion.

Table 5.1: Chronology of tooth development

Tooth		*Tooth germ fully developed*	*Dentine formation begins*	*Calcification begins*	*Crown formation complete*	*Appearance in oral cavity*	*Root complete*
Deciduous	Incisors	3-4 mths	4-6 mths i.u.l.		2-3 mths	6-9 mths	1-1.5 yrs after
	Canines	i.u.l.			9 mths	16-18 mths	appearance in
	1st Molars				6 mths	12-14 mths	the mouth
	2nd Molars				12 mths	20-30 mths	
Permanent	Maxillary centrals	30th week i.u.l.	3-4 mths	3-4 mths	4-5 yrs	7-9 yrs	2-3 yrs after
	Mandibular centrals			3-4 mths		6-8 yrs	appearance in
	Maxillary laterals		10-12 mths	10-12 mths		7-9 yrs	the mouth
	Mandibular laterals		3-4 mths	3-4 mths		6-8 yrs	
	Maxillary canines	30th week i.u.l.	4-5 mths	4-5 mths	6-7 yrs	11-12 yrs	2-3 yrs after
	Mandibular canines					9-10 yrs	appearance in the mouth
	Maxillary 1st premolar	30th week i.u.l.	1.5-2.5 yrs	1.5-1.75 yrs	5-6 yrs	10-11 yrs	2-3 yrs after
	Mandibular 1st premolar			1.75-2 yrs		10-12 yrs	appearance in
	Maxillary 2nd premolar			2-2.25 yrs	6-7 yrs	10-12 yrs	the mouth
	Mandibular 2nd premolar			2.25-2.5 yrs		11-12 yrs	
	1st molar	24th week i.u.l.	Before birth	At or shortly after birth	2.5-3 yrs	6-7 yrs	2-3 yrs after appearance in
	2nd molars	6th mth	2.5-3 yrs	2.5-3 yrs	7-8 yrs	11-13 yrs	the mouth
	3rd molars	6th yr	7-10 yrs	7-9 yrs	12-16 yrs	17-21 yrs	

i.u.l. = intra-uterine life

*LABIO-BUCCAL PORTION

-Differentiate 1st

-Divided into ten segments by transverse groove, represents position of deciduous teeth.

-groove between canine & 1st molar: lateral sulcus.

assessing relationship of gum-pads to each-other.

*LINGUAL PORTION

->Smooth

->Separated from labio-buccal portion by dental groove which is the site of origin of dental lamia.

->Limited by gingival groove on the lingual side.

*GUM-PADS

->UPPER GUM-PAD

Horse-shoe shaped ,wider & longer than lower one.

shows:

***Gingival groove:-**

separates gum-pads from the palate.

***Dental groove:-**

starts at incisive papilla, extends backwards to touch the gingival groove in the canine & then moves laterally to end in the molar region.

***Lateral sulcus:-**

useful in judging the inter-arch relationship at a very early stage.

*LOWER GUM-PAD

-> U-shaped, rectangular

-> Characterized by:

*__Gingival groove__:-

Lingual extension of the gum-pads.

*__Dental groove__:-

Joins gingival groove in the canine region.

*__Lateral sulcus__.

*RELATIONSHIP OF GUM-PADS

- Anterior open bite is at rest with contact only in molar region. Tongue protrudes through this space.
- Complete overjet.
- Class pattern with the maxillary gum-pad being more prominent.
- Mandibular lateral sulci posterior to maxillary sulci.
- Mandibular functional movements are mainly vertical & to a anteroposterior. Lateral movements are not possible.

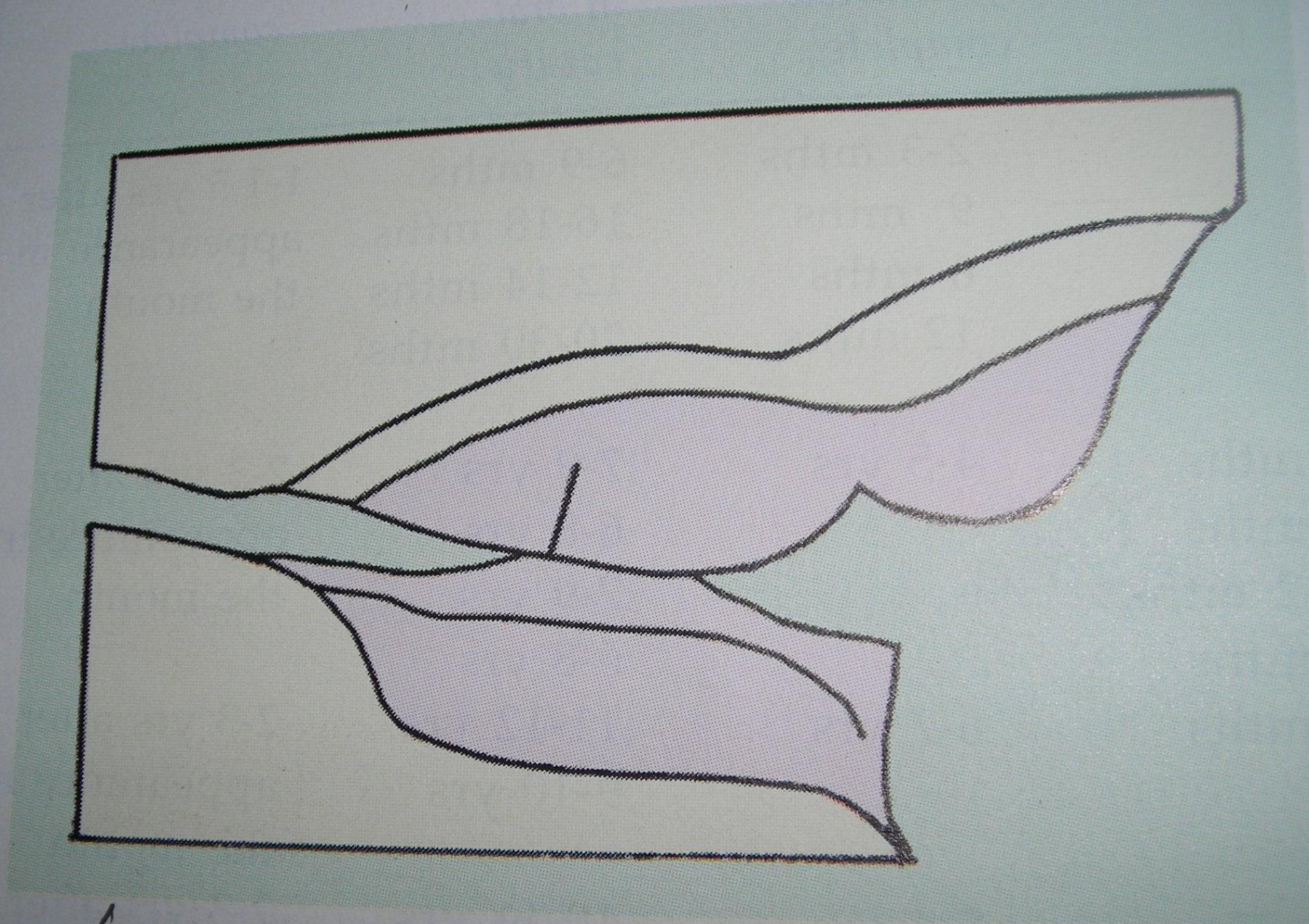


Fig. 5.3B: Relation between upper and lower gum pads at birth

During 1st year of life the gum-pads grow rapidly permitting the incisors to erupt in good alignment.

Very rarely teeth are found to have erupted at the time of birth. such that are present at the time of birth are called NATAL TEETH.

Teeth that erupt during the 1st month of age are called NEONATAL TEETH.

STAGES OF TOOTH DEVELOPMENT

- Nolla has divided the development of tooth into 10 stages.
- Tooth eruptive movements begin during the sixth stage when the crown formation is complete.
- After 2 to 3 years ,with two-thirds of root formation complete,tooth erupts into the oral cavity.

STAGE 0: ABSENCE OF CRYPT.

STAGE 1:PRESENCE OF CRYPT.

STAGE 2:INITIAL CALCIFICATION.

STAGE 3:ONE THIRDS OF CROWN COMPLETED.

STAGE 4:TWO THIRDS OF CROWN COMPLETED.

STAGE 5:CROWN ALMOST COMPLETED.

STAGE 6: CROWN COMPLETED.

STAGE 7:ONE THIRDS OF CROWN COMPLETED.

STAGE 8:TWO THIRDS OF CROWN COMPLETED.

STAGE 9:ROOT ALMOST COMPLETED,OPEN APEX.

STAGE 10:APICAL END OF ROOT COMPLETED.

*DECIDUOUS DENTITION PERIOD

- **Sequence of eruption of deciduous teeth**

  A B D C E

  A B D C E

- **Features of ideal occlusion in primary dentition:-**

1. Spacing of incisor teeth.
2. Anthropoid space
3. Distal surface of upper & lower 2nd primary molars are in the same plane-flush terminal plane.
4. Almost vertical inclination of anterior teeth.
5. Overbite & overjet varies.

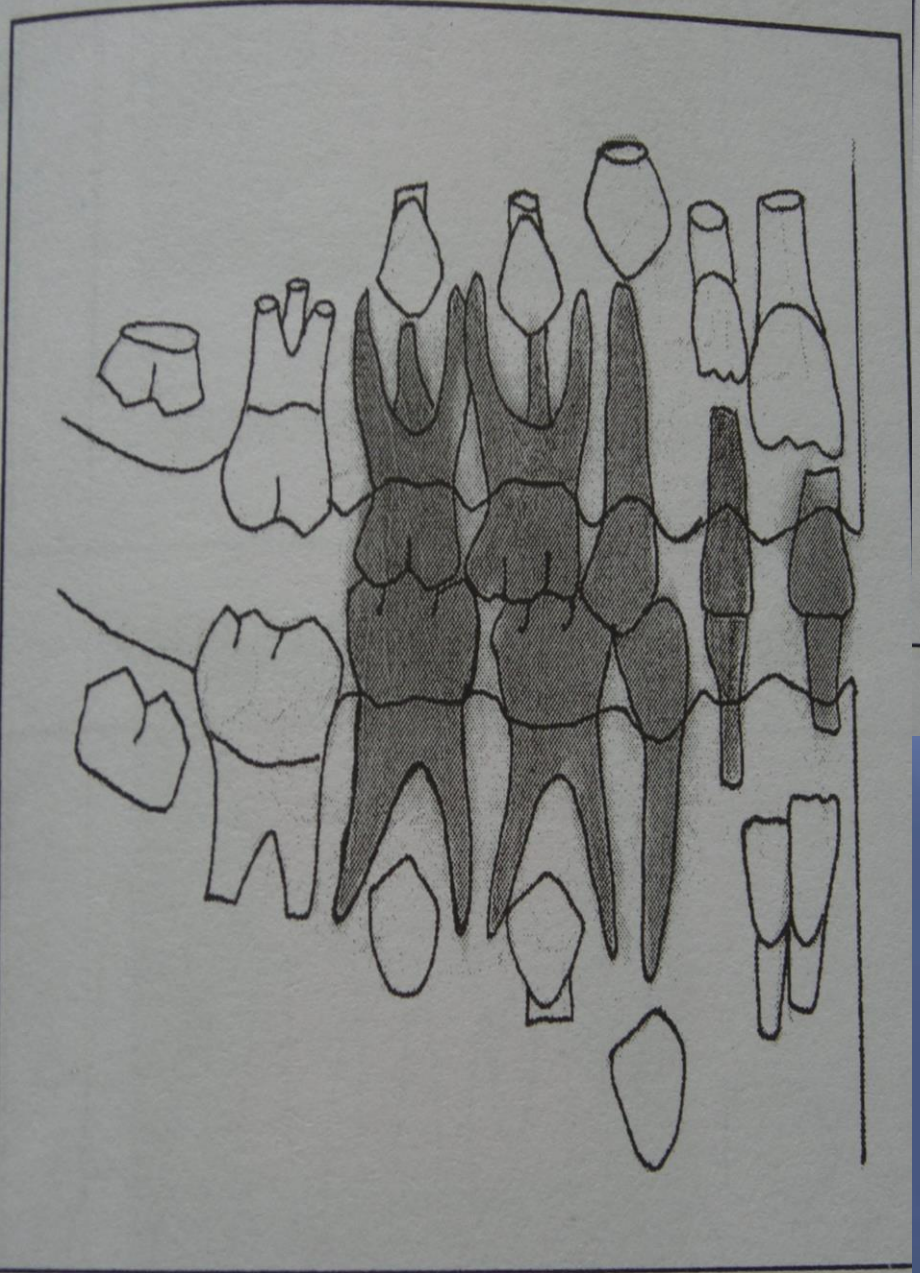


Fig. 5.7 DENTITION AT 6 YEARS

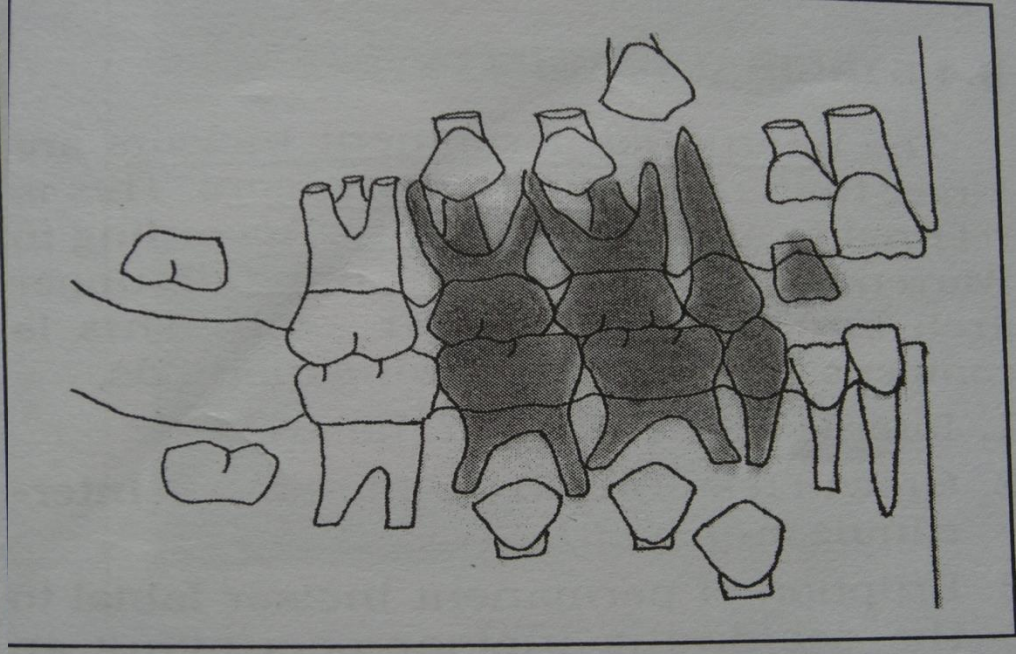


Fig. 5.8 DENTITION AT 7 YEARS

Fig. 5.9 DENTITION AT 8 YEARS

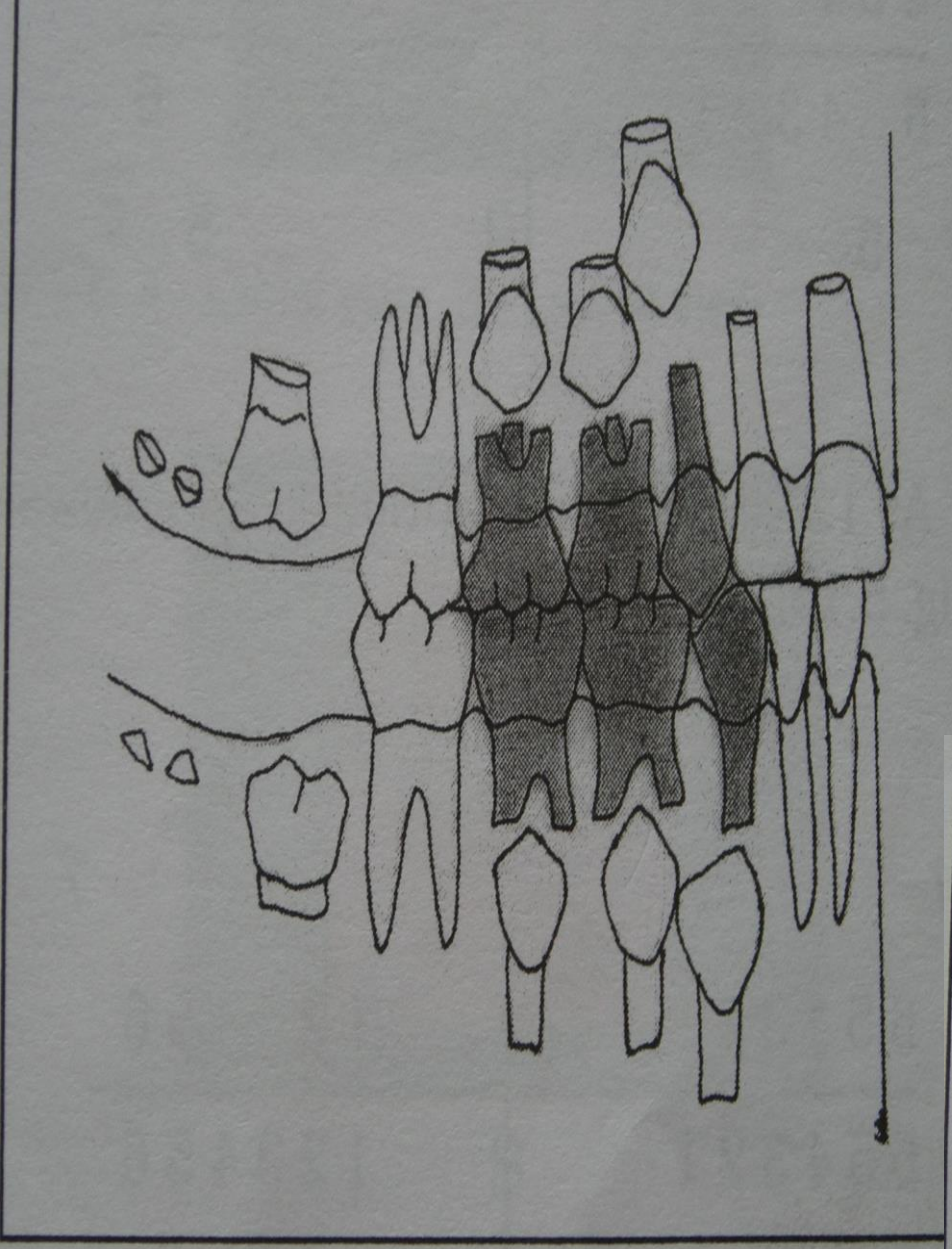


Fig. 5.10 DENTITION AT 9 YEARS

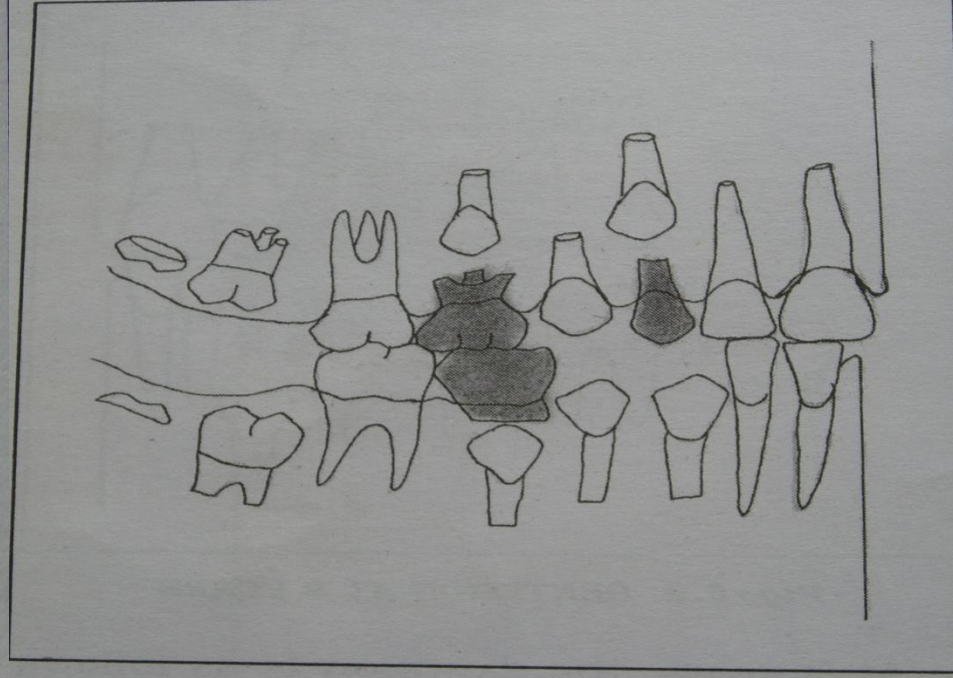


Fig. 5.11 DENTITION AT 10 YEARS

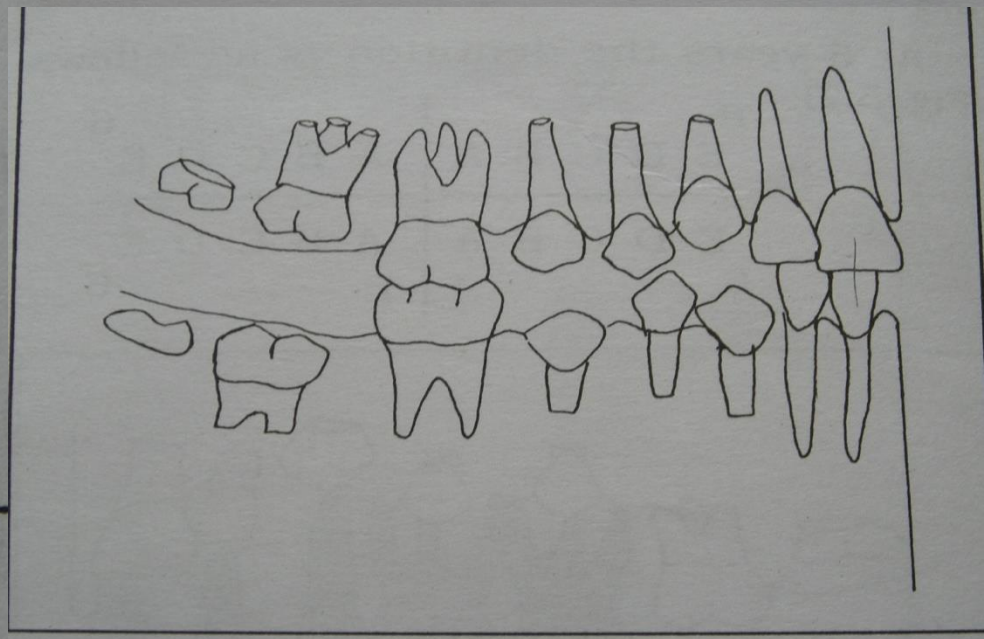


Fig. 5.12 DENTITION AT 11 YEARS

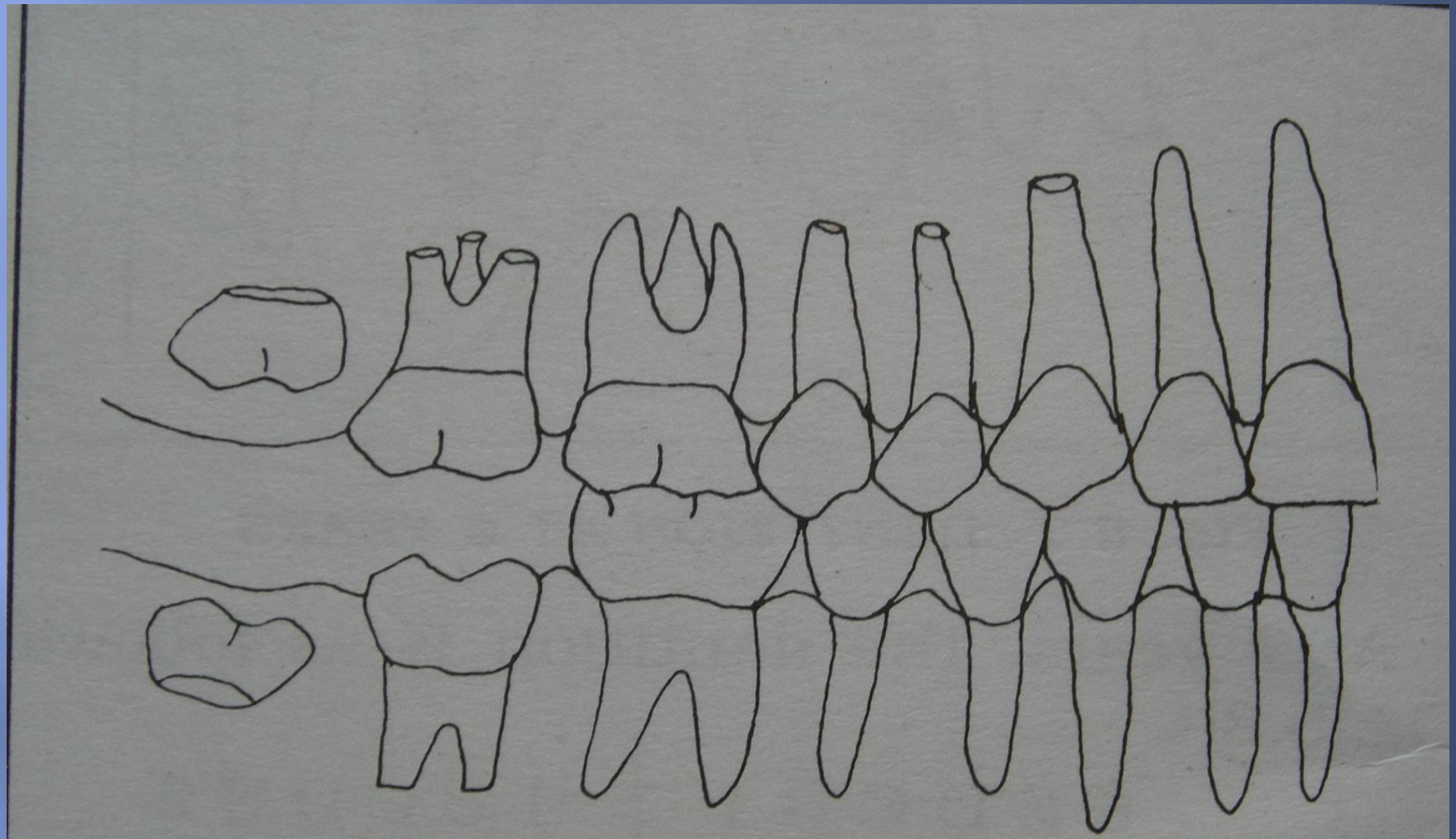


Fig. 5.13 DENTITION AT 12 YEARS

- **Spacing of deciduous teeth:-**

  -is normal

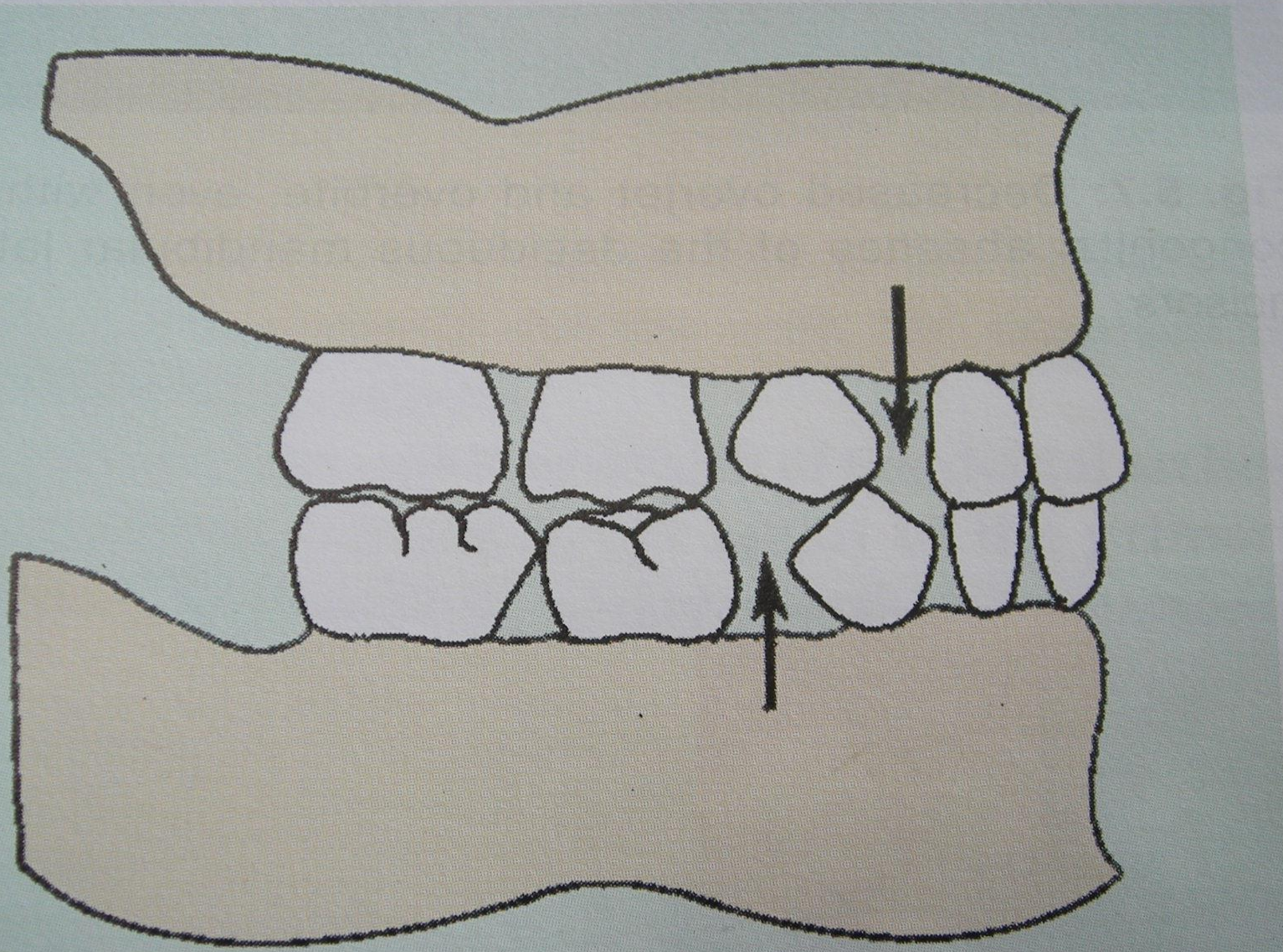
  -help in accommodating the large succedaneous permanent teeth.

  -possible to predict degree of crowding in permanent teeth based on the amount of spacing present in lower arch.

Fig. 5.5: Spacing in deciduous dentition

- **Anthropoid space [simian space, primate space]**

  Space between the mesial surface of the upper canine & the distal surface of lower canine is much more distinct as it is characteristically found in dentition of the primates & hence it is called so.



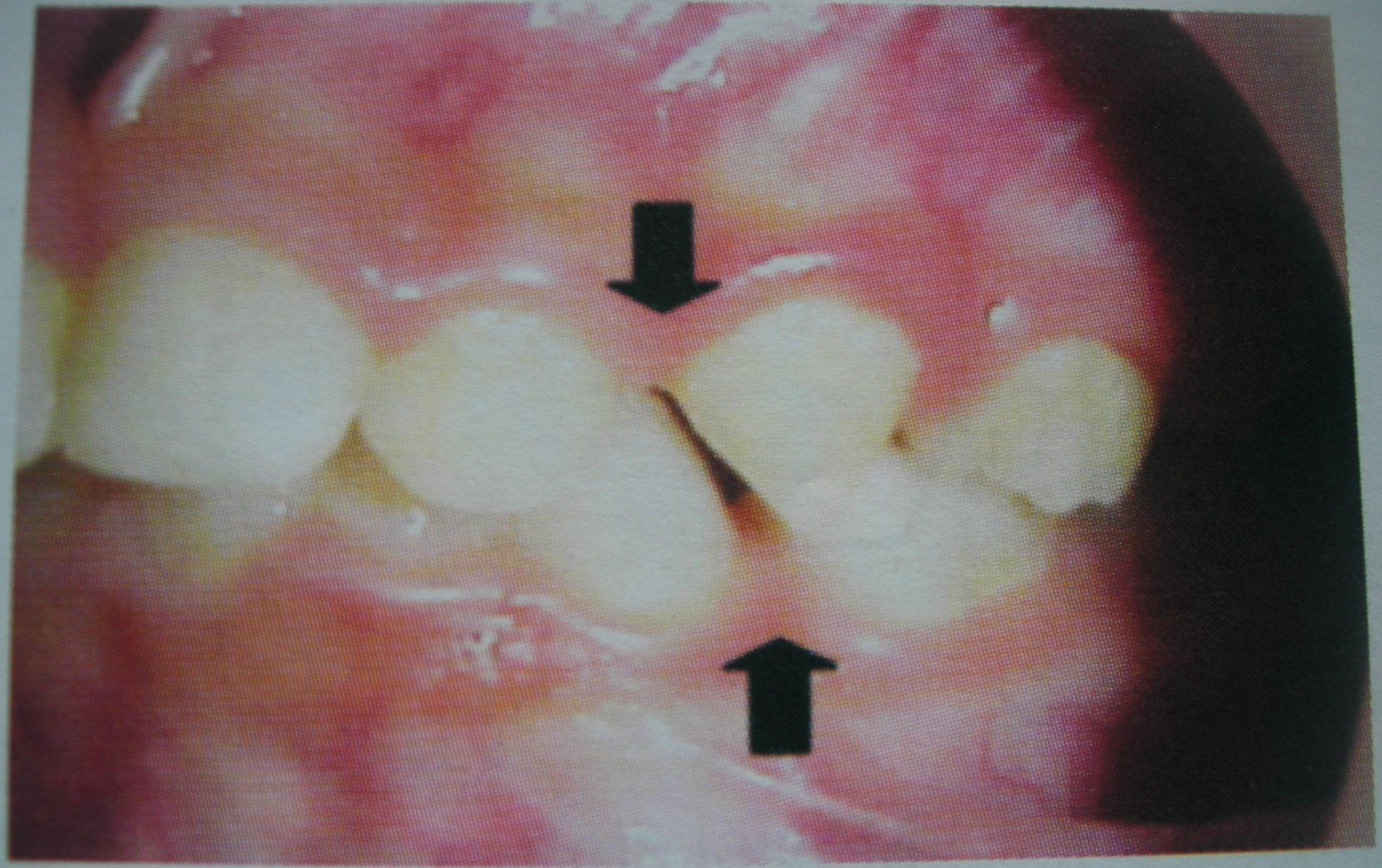


Fig. 5.6: Primate spaces

- Terminal plane relationship, it's variation & importance

  The line from distal surfaces of mandibular 2nd deciduous molar & the maxillary 2nd deciduous molar giving relationships,

->Flush terminal space:-

if line is vertically straight. (usually mesiodistally wider 2nd molar than maxillary one)

develops into class molar relationship following exfoliation of lower 2nd molar. As the 1st permanent molar erupt, they will be end on molar relationship in the presence of complete deciduous dentition. following the exfoliation of lower deciduous 2nd molar ,the lower 1st migrates mesially establishing class molar relationship.

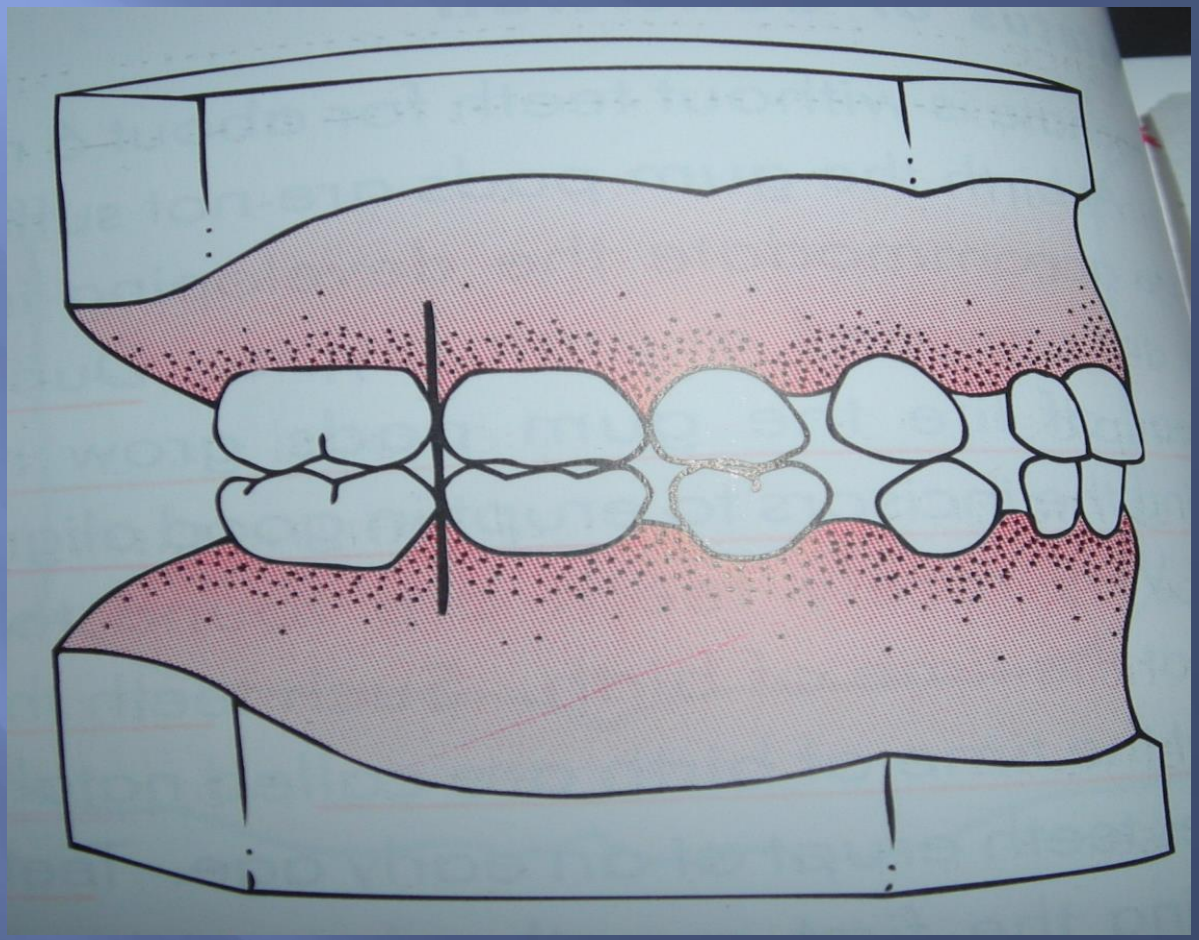
->Distal step:-

when upper deciduous 2nd molar is ahead of lower deciduous 2nd molar.

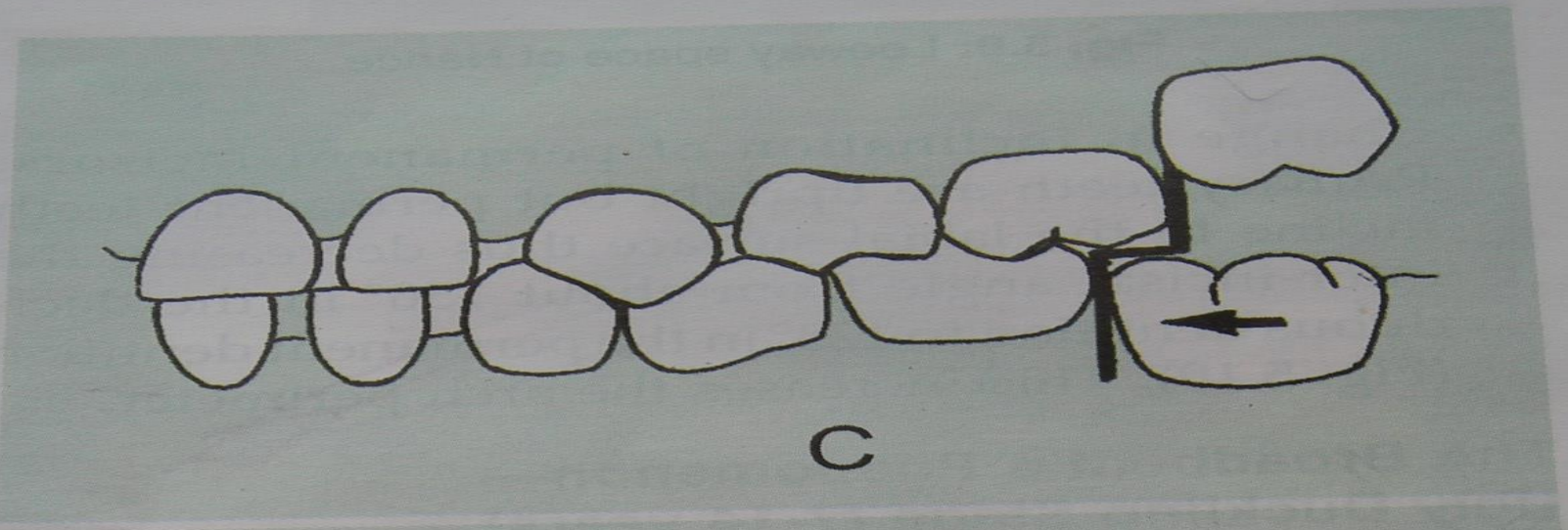
-> Mesial step:-

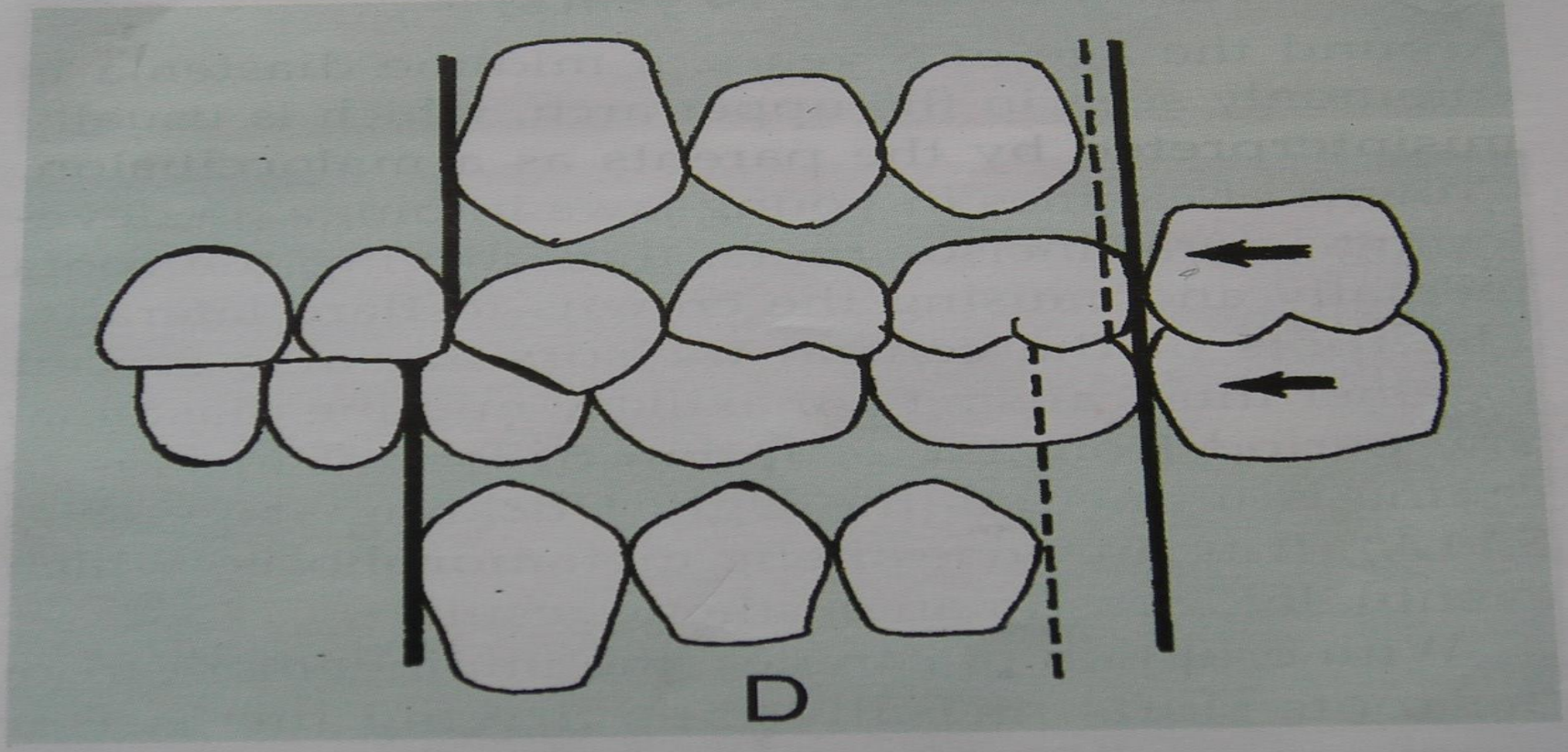
where lower 2nd deciduous molar is ahead of upper deciduous 2nd molar.

FLUSH TERMINAL PLANE



incisors to obtain an added space of





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Mesial step

Fig. 5.8A: Molar relationship in the deciduous dentitio

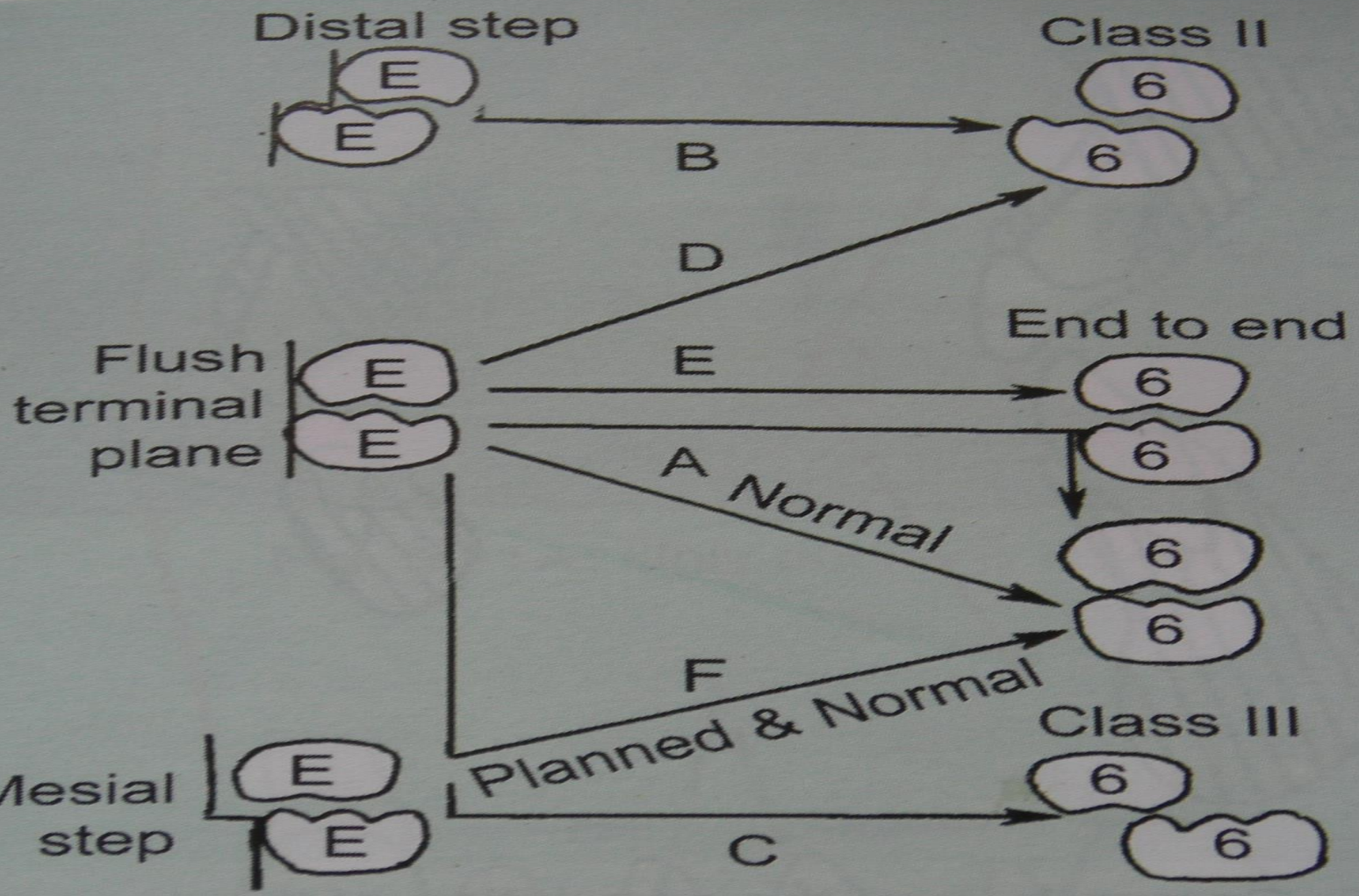


Fig. 5.8B: Occlusal relationships of primary and permanent molars

Changes in incisor relation during deciduous dentition:-

-Deep bite is present in the initial stage of development, accentuated by their more upright position such that lower incisal edge often contact the cingulum area of upper incisors.

-Reduction in incisor overbite & overjet.

Reduction in overbite us due to the attrition if teeth & differential growth of the alveolar process of jaws.

Reduction in overjet is due to the forward growth of the mandible during this period.

primary teeth undergo marked attrition & as a result dental arches are relatively free to move because of lack of cuspal inter-digitation. this leads to an edge to edge occlusion; while the buccal teeth are still in complete occlusal contact, edge to edge incisor relationship is a normal feature of the occlusion at this stage.

Table 5.1: Chronology of tooth development

Tooth	*Tooth germ fully developed*	*Dentine formation begins*	*Calcification begins*	*Crown formation complete*	*Appearance in oral cavity*	*Root complete*
Deciduous Incisors	3-4 mths	4-6 mths i.u.l.		2-3 mths	6-9 mths	1-1.5 yrs after
Canines	i.u.l.			9 mths	16-18 mths	appearance in
1st Molars				6 mths	12-14 mths	the mouth
2nd Molars				12 mths	20-30 mths	
Permanent Maxillary centrals	30th week i.u.l.	3-4 mths	3-4 mths	4-5 yrs	7-9 yrs	2-3 yrs after
Mandibular centrals			3-4 mths		6-8 yrs	appearance in
Maxillary laterals		10-12 mths	10-12 mths		7-9 yrs	the mouth
Mandibular laterals		3-4 mths	3-4 mths		6-8 yrs	
Maxillary canines	30th week i.u.l.	4-5 mths	4-5 mths	6-7 yrs	11-12 yrs	2-3 yrs after
Mandibular canines					9-10 yrs	appearance in the mouth
Maxillary 1st premolar	30th week i.u.l.	1.5-2.5 yrs	1.5-1.75 yrs	5-6 yrs	10-11 yrs	2-3 yrs after
Mandibular 1st premolar			1.75-2 yrs		10-12 yrs	appearance in
Maxillary 2nd premolar			2-2.25 yrs	6-7 yrs	10-12 yrs	the mouth
Mandibular 2nd premolar			2.25-2.5 yrs		11-12 yrs	
1st molar	24th week i.u.l.	Before birth	At or shortly after birth	2.5-3 yrs	6-7 yrs	2-3 yrs after appearance in
2nd molars	6th mth	2.5-3 yrs	2.5-3 yrs	7-8 yrs	11-13 yrs	the mouth
3rd molars	6th yr	7-10 yrs	7-9 yrs	12-16 yrs	17-21 yrs	

i.u.l. = intra-uterine life

*THE MIXED DENTITION PERIOD

This is the period teeth of both deciduous & permanent dentition are seen.

- FIRST TRANSITIONAL PERIOD

  includes -
  Emergence of 1st permanent molars & -
  Transition of incisors.

*FIRST TRANSITIONAL PERIOD

Eruption of permanent 1st molars:-

Erupts at 6 years & influence in establishing & aid in function of occlusion.

->Anterioposterior position of the permanent 1st molar is influenced by:

1. Terminal plane relationship

*Flush terminal plane later transforms into a class molar relation using primate spaces.

*Distal step result 1st molar into class relation. The molar configuration is not self-correcting & will cause a class 2 malocclusion despite Leeway space & differential growth.

*Mesial step result in class molar relation in mixed dentition. This may remain or progress to a half or full cusp class 3 with continued mandibular growth.

2. Early mesial shift in arch with physiologic spacing.
3. Differential growth of maxilla & mandible.

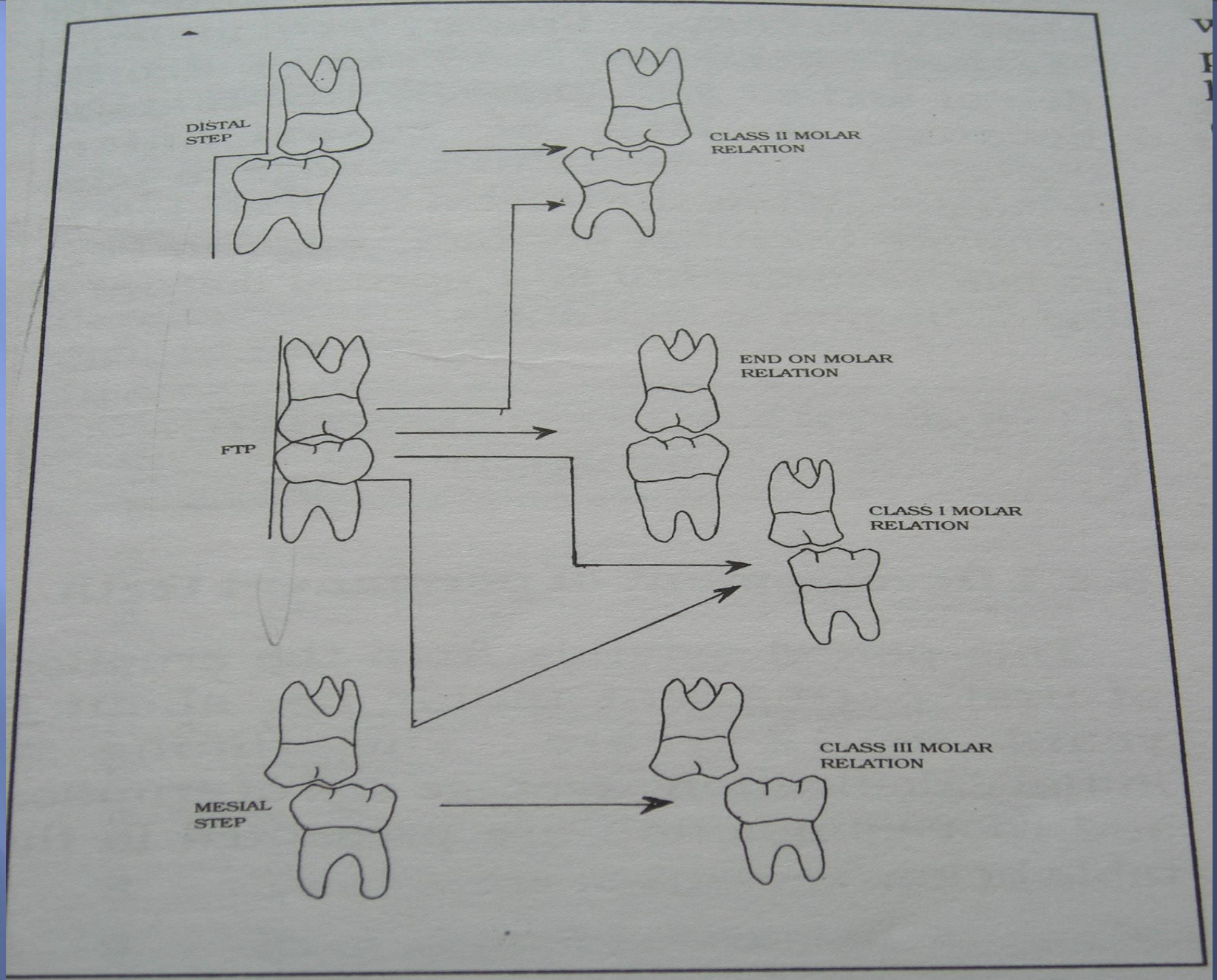
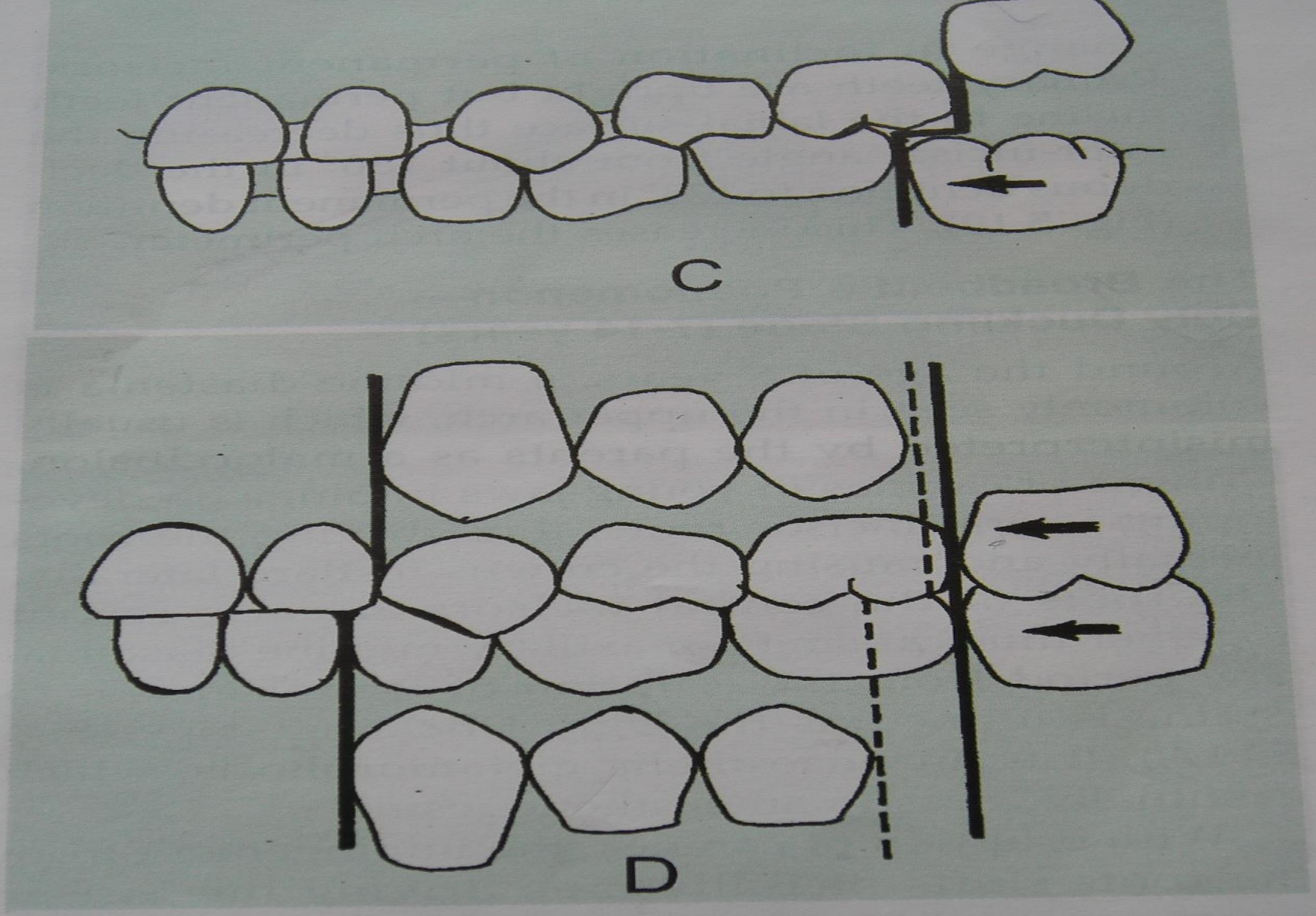


Fig. 5.4 FLUSH TERMINAL PLANE AND ITS VARIATION



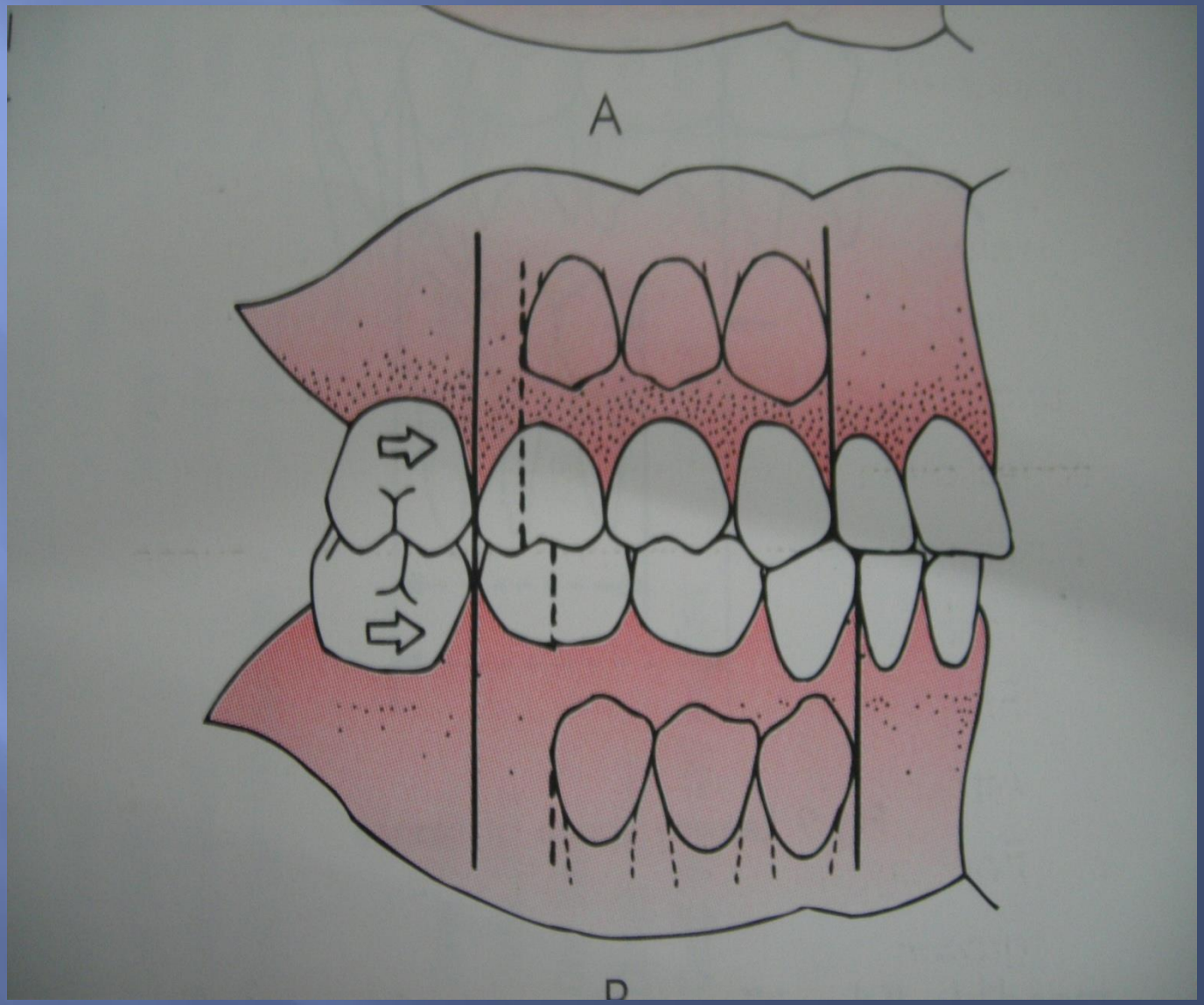
Figs 5.8C and D: (C) Early shift of the erupting first permanent molars moving utilizing the primate spaces (D) Late shift by utilization of the Leeway space

LEEWAY SPACE OF NANCE:

It is the combined mesiodistal width of deciduous canine, first & second molars is more than that of mesiodistal width of permanent canine, first & second molars.

In Maxilla 0.9mm/segment=1.8mm total

Mandible 1.7mm/segment=3.4mm total


A
B

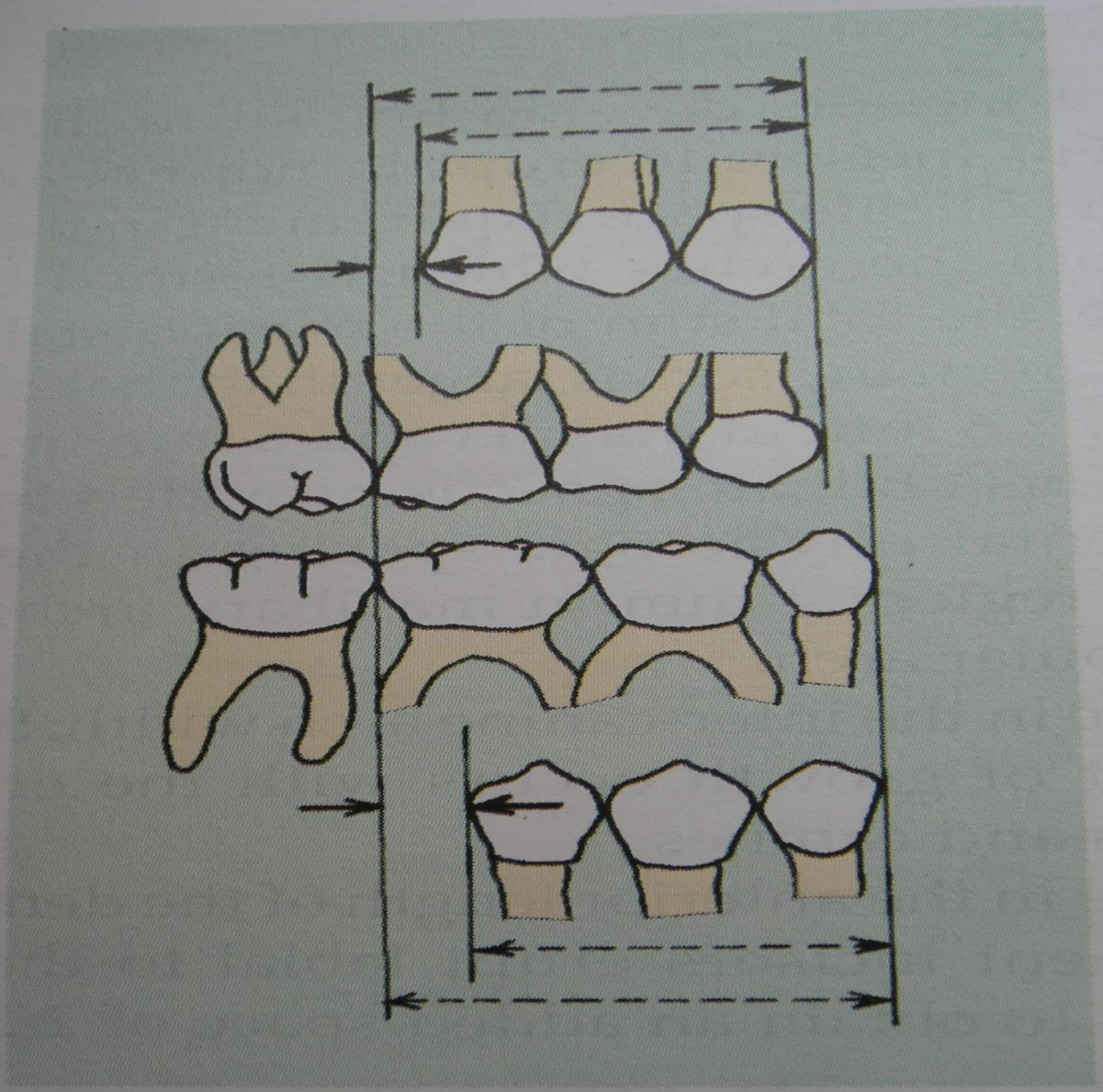


Fig. 5.9: Leeway space of Nance

*INCISOR ERUPTION

Permanent incisors develop lingual to the primary incisors .For incisors to erupt in normal alignment, there is an obligate space requirement in the anterior part of both the arches which is termed as

INCISOR LIABILITY:

In Maxilla 7.6mm & in Mandible 6 mm.

It is provided by:

- Interdental physiological spacing in primary incisor region: 4 mm in Maxillary arch;

  3 mm in Mandibular arch.
- Increase in inter-canine width.
- Increase in anterior length of the dental arches: permanent incisors erupt labial to the primary incisors to obtain an added space of 2-3 mm.
- Change in inclination of permanent incisors: primary teeth are upright but permanent teeth incline to the labial surface thus decreasing the inter-incisal angle from about 150 in the deciduous dentition to 123 in the permanent dentition. This increase arch perimeter.

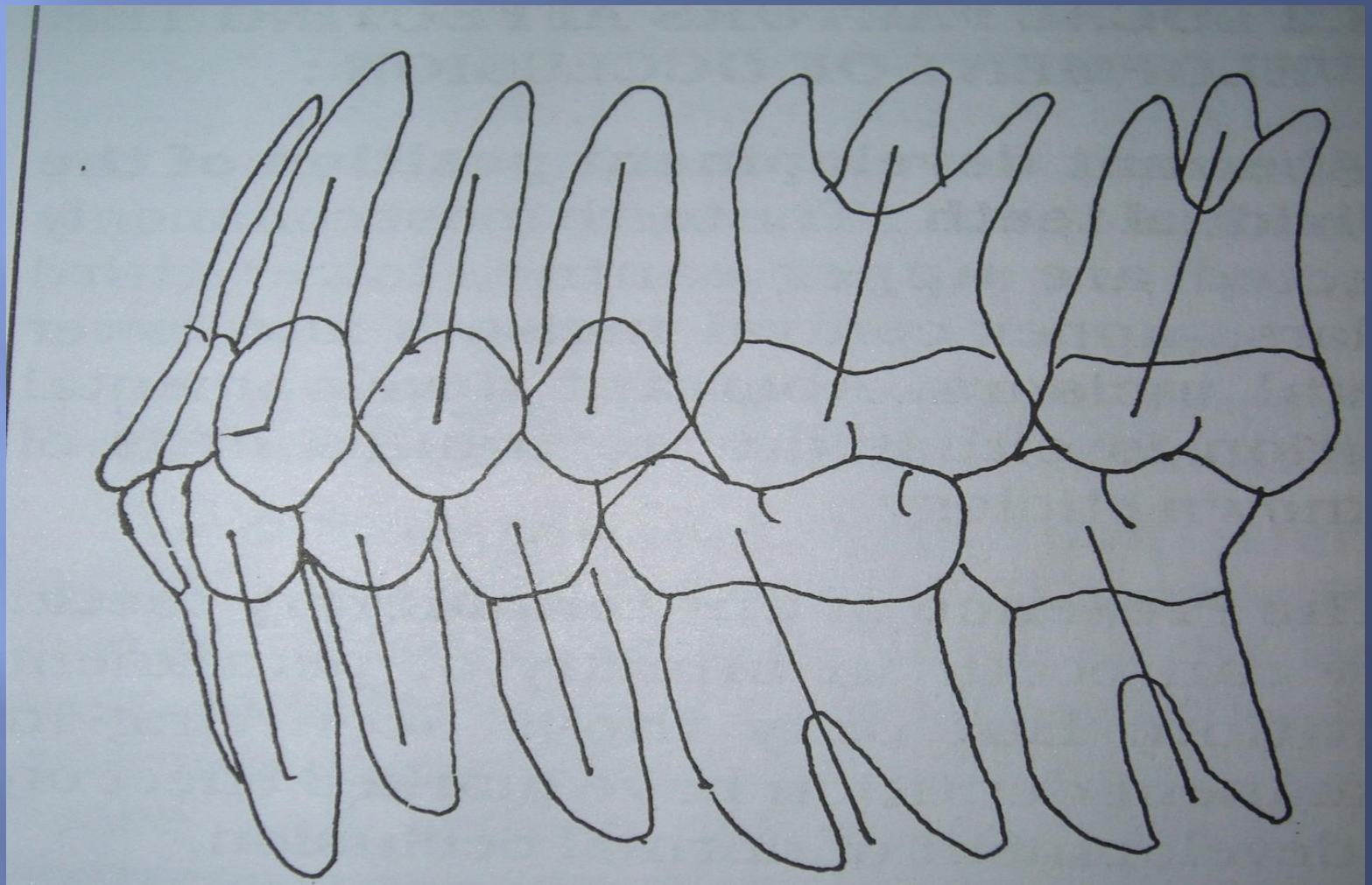


Fig. 5.19 AXIAL INCLINATION OF PERMANE TEETH

Fig. 5.13: First stage of eruption at dental age 6 years

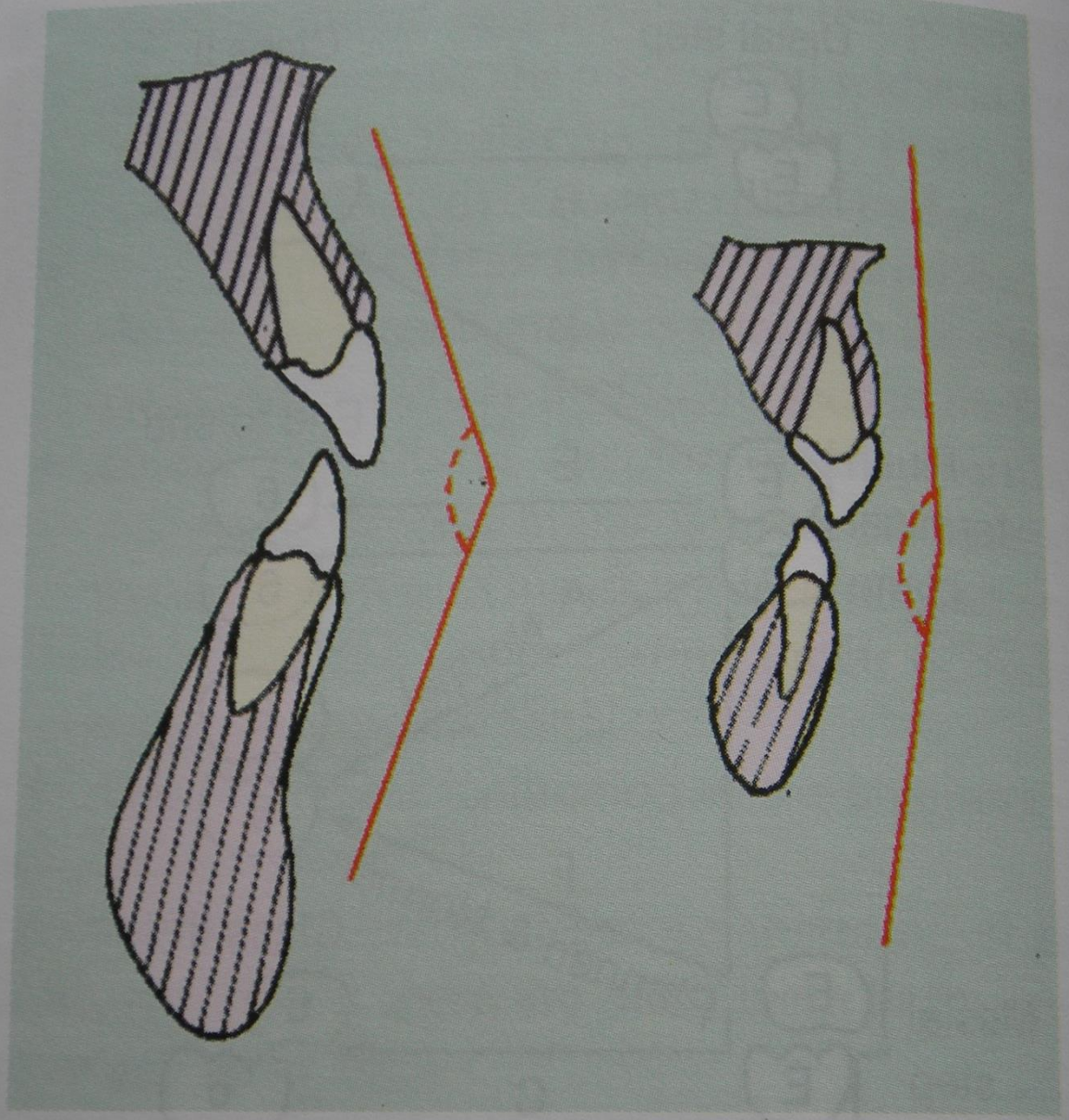


Fig. 5.10: Comparison of the angulation of the permanent and primary teeth

Ugly Duckling Stage Broadbent's Phenomena

It is a transient malocclusion which does not require any orthodontic intervention.

->Here, the developing upper permanent canines cause mesial displacement of the roots of permanent incisors around the age of 8-9 years; this cause a distal divergent of the crowns of these incisors.

->This requires no treatment as it gets corrected by own later when the canine erupts &the pressure is transferred from the roots of to the crowns of the incisors.

->This position of teeth at this stage is compared to that of an ugly walk of the duckling &hence the name is given.

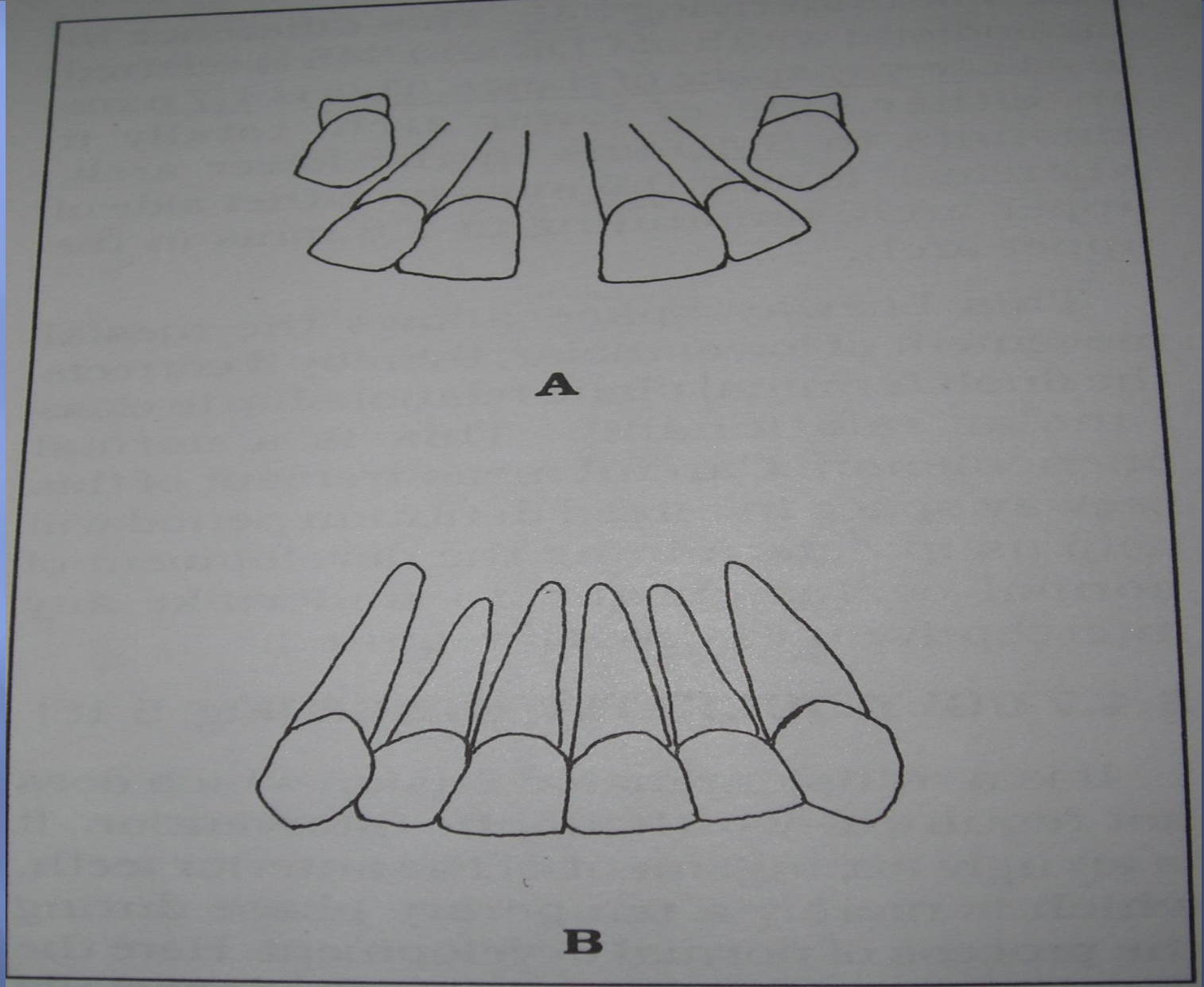


Fig. 5.15 UGLY DUCKLING STAGE
A. Erupting maxillary canine causing ugly duckling stage B. Eruption of maxillary canine, correcting the ugly duckling stage.

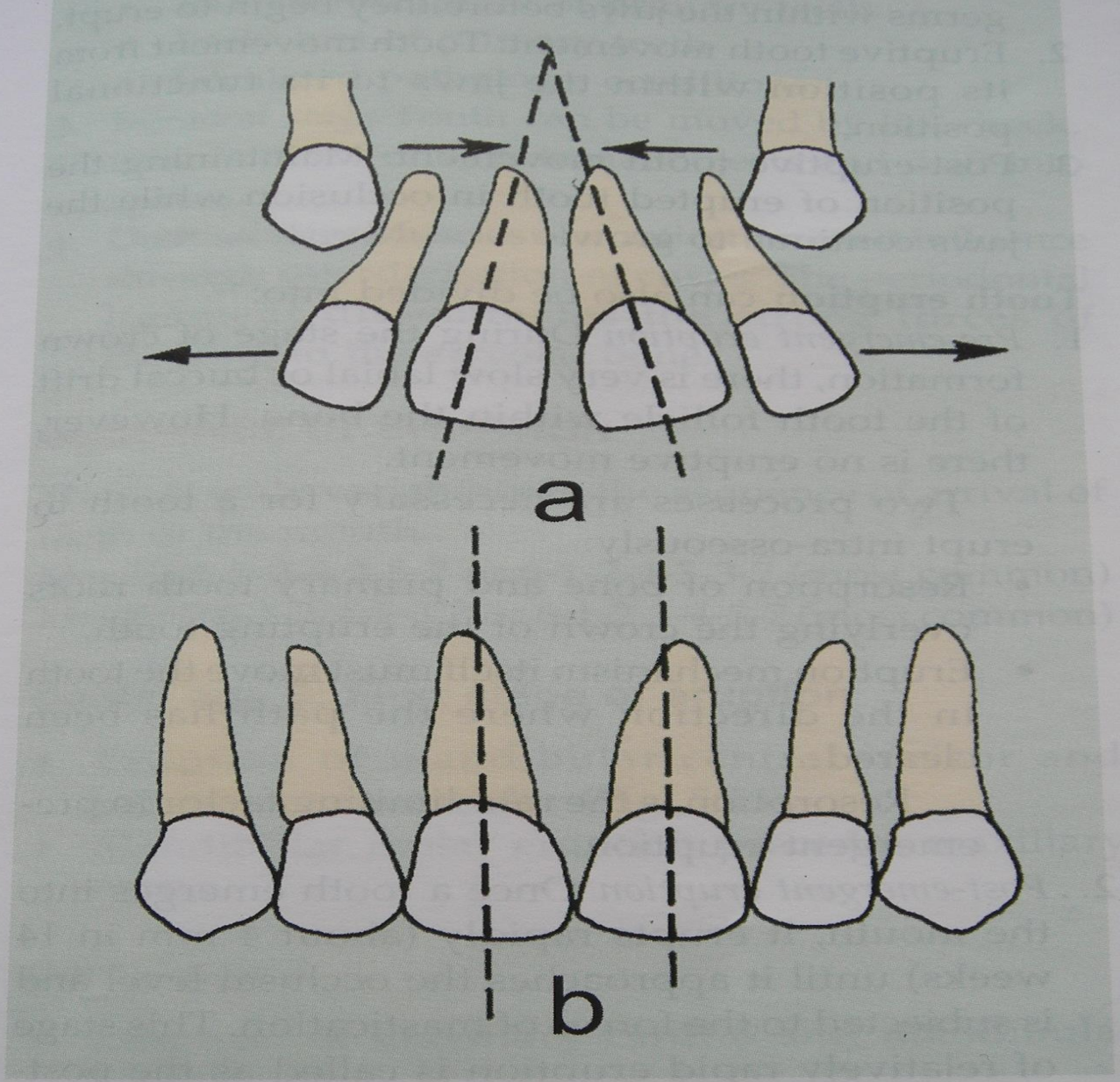


Fig. 5.11B: Ugly duckling stage (a) Canine crowns impinging on roots of lateral incisors with resultant distal flaring of incisor crowns (b) Continued eruption of canines results in closure of midline space

Fig. 5.11A: Ugly duckling stage

CLINICAL SIGNIFICANCE OF UGLY DUCLING STAGE

- As a guideline ,maxillary midline diasteme upto 2 mm closes spontaneously.
- Total closure of midline diastema greater than 2mm is unlikely.
- Any attempt to close the median diastema during ugly duckling stage will be hazardous.
- Apex of the lateral incisors will be damaged.
- Canine may be deflected from its normal path of eruption.

THE INTER-TRANSITIONAL PERIOD (1.5 YEARS)

This is a stable phase where little changes take place in the dentition.

The teeth present are the permanent incisors and first molar along with the deciduous canines and molars.

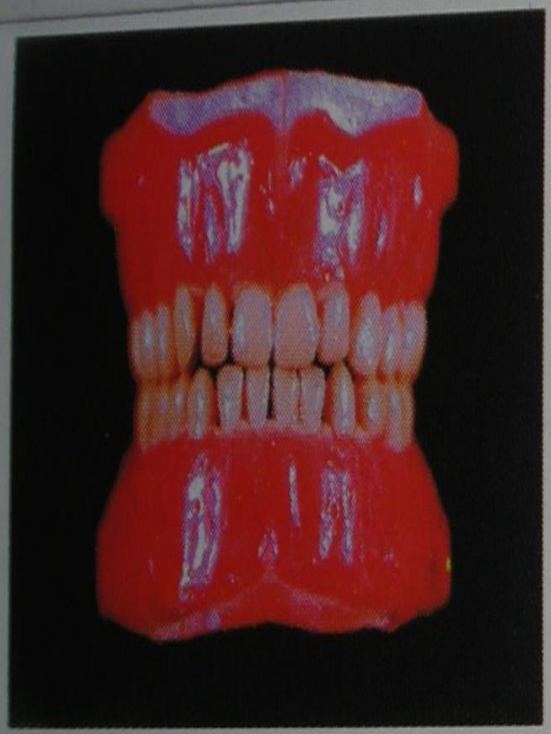
Features of this stage are :

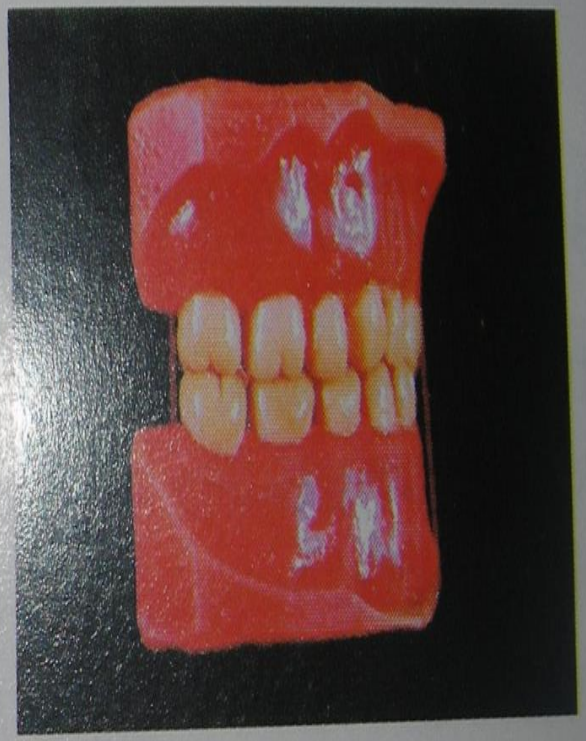
1. Any asymmetry in emergence and corresponding differences in height level or crown length between right and left side teeth.

2.Occlusal and inter proximal wear of deciduous teeth causes occlusal morphology to approach that of a plane.

3.Ugly duckling stage

4. Resorption of roots of deciduous molars





A

B

Mixed dentition - Model showing the Deciduous and the erupted first permanent molars

A - Labial view B - Lateral view

THE SECOND TRANSITIONAL PERIOD

The following events take place :

1. Exfoliation of primary molars and canines
2. Eruption of permanent canines and premolars
3. Eruption of permanent second molars.

ERUPTION SEQUENCE

*__In the maxilla__:

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

or

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

*__In the mandible__:

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

or

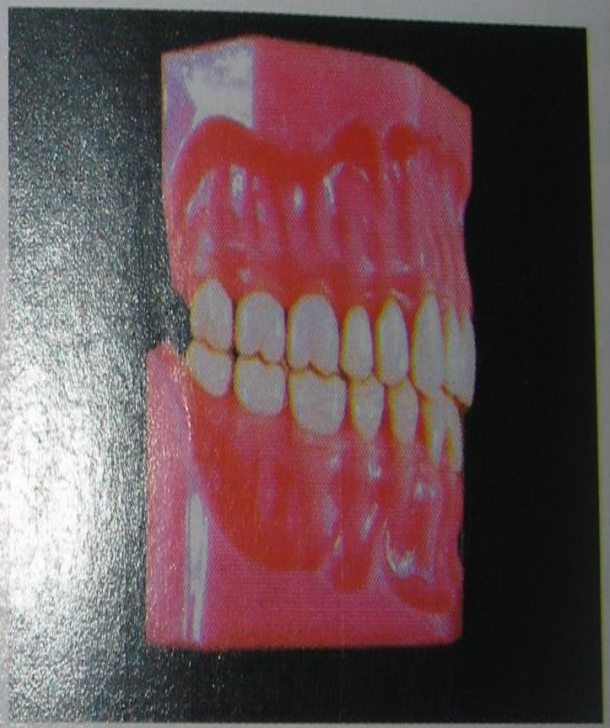
6-1-2-4-3-5-7

TOOTH	TIMING OF INITIAL CALCIFICATION	AVERAGE AGE OF ERUPTION	ROOT COMPLETION
Maxillary Central Incisor	3-4 months	7-8 years	10 years
Lateral Incisor	10-12 months	8-9 years	11 years
Canine	4-5 months	11-12 years	13-15 years
First Premolar	1½-1¾ years	10-12 years	12-13 years
Second Premolar	2-2¼ years	10-12 years	12-14 years
First Molar	At birth	6-7 years	9-10 years
Second Molar	2½-3 years	12-13 years	14-16 years
Third Molar	7-9 years	17-21 years	18-25 years
Mandibular Central Incisor	3-4 months	6-7 years	9 years
Lateral Incisor	3-4 months	7-8 years	10 years
Canine	4-5 months	9-10 years	12-14 years
First Premolar	1¾-2 years	10-12 years	12-13 years
Second Premolar	2-2½ years	11-12 years	13-14 years
First Molar	At birth	6-7 years	9-10 years
Second Molar	2½-3 years	11-13 years	14-15 years
Third Molar	8-10 years	17-21 years	18-25 years

Features of Permanent Dentition:

1. Coinciding midline.
2. Class 1molar relationship of the permanent first molar.
3. Vertical overbite of about one-third the clinical crown height of the mandibular central incisors.
4. *Overjet*:overjet & overbite decrease throughout the second decade of life due to greater forward growth of the mandible.
5. *Curve of spee:* develops during transition &stabilizes in adulthood

A



B

Permanent Dentition A - Labial view B - Lateral view

*Factors Affecting The Development Of The Occlusion:

A)GENERAL FACTOR:

1. Skeletal factors-The position, size& relationships of bone in which the tooth develops.
2. Muscle factor-form &function of the muscle surrounding to teeth.
3. Dental factor-The size of the dentition in relation to the size of the jaws.
4. The forces which guides its course after eruption-Buccinator mechanism
5. The forces which starts to operate when the tooth makes contact with its opponent.

B) Local Factors:

1. Aberrant developmental position of teeth.
2. The presence of supernumerary teeth.
3. Hypodontia-the congenital absence of certain teeth.
4. The effect of certain habits.
5. Localized soft tissue abnormalities-the labial frenum.

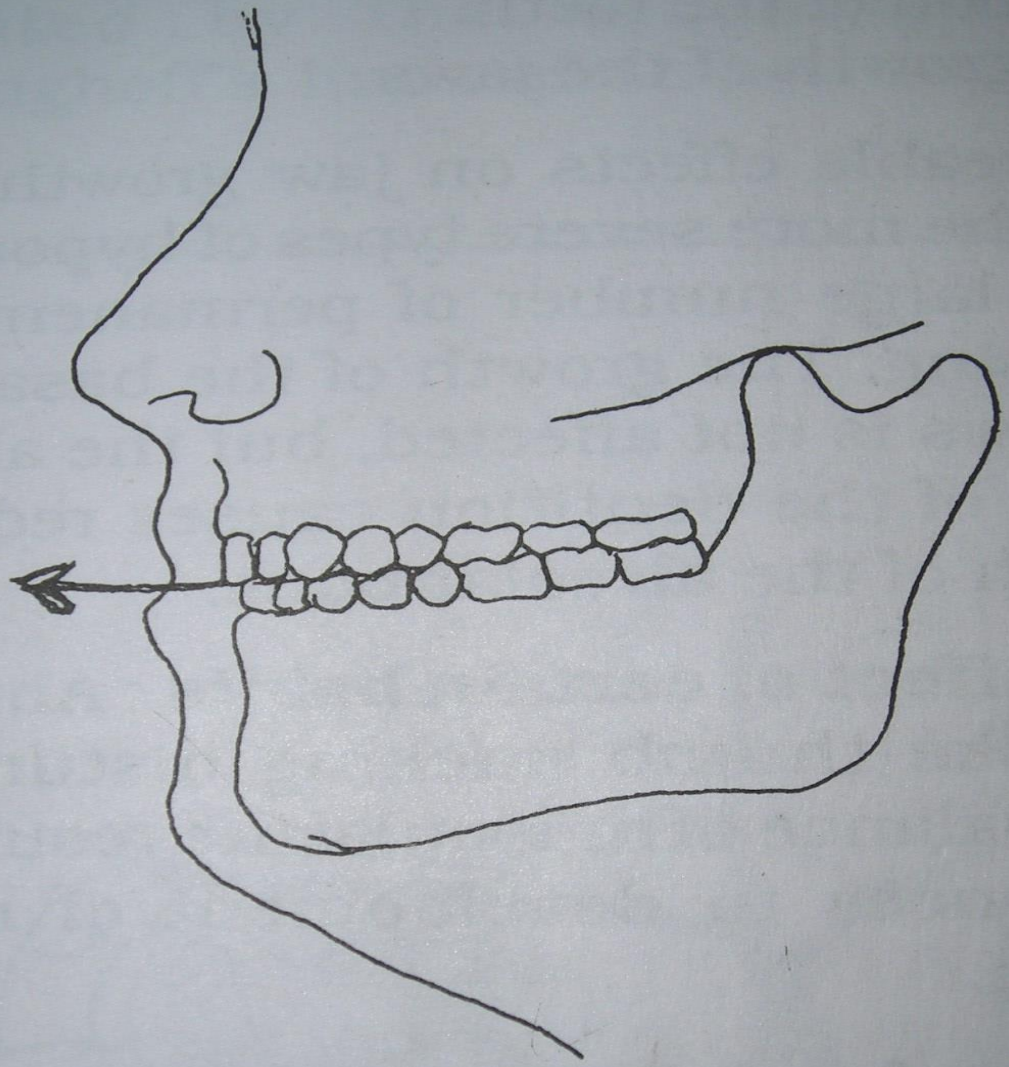
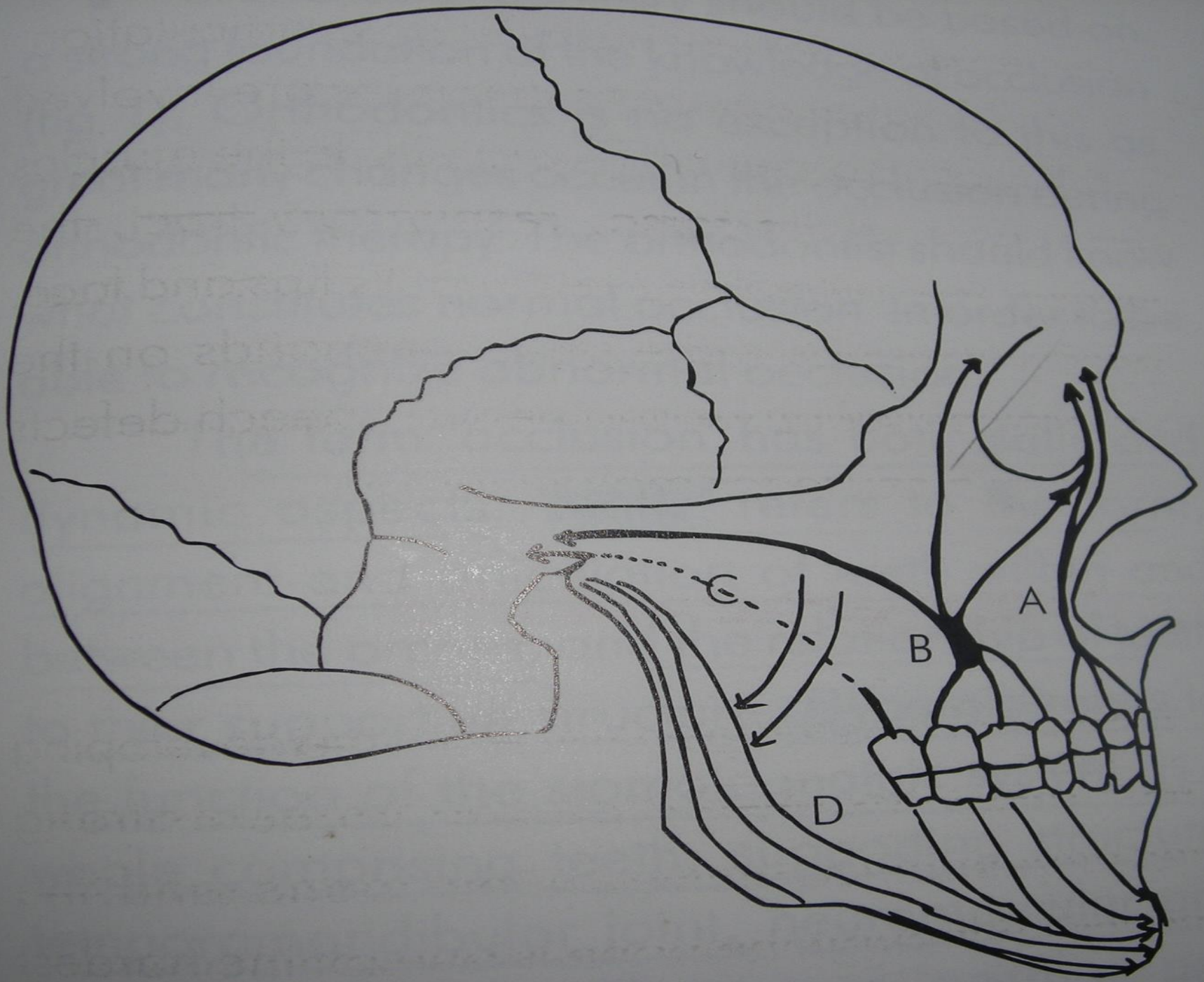


Fig. 5.20 THE ANTERIOR COMPONENT OF FORCE

TRAGECTORIES OF FORCES

In1867,Benninghoff with the help of the mathematician propounded the **Trajectorial theory of bone formation.** He pointed out that the alignment of the bony trabeculae in the spongiosa followed definite engineering principles. If lines were oriented bony elements, these lines showed a remarkably similar structure to that of the trajectories seen in a crane.


A
B
D

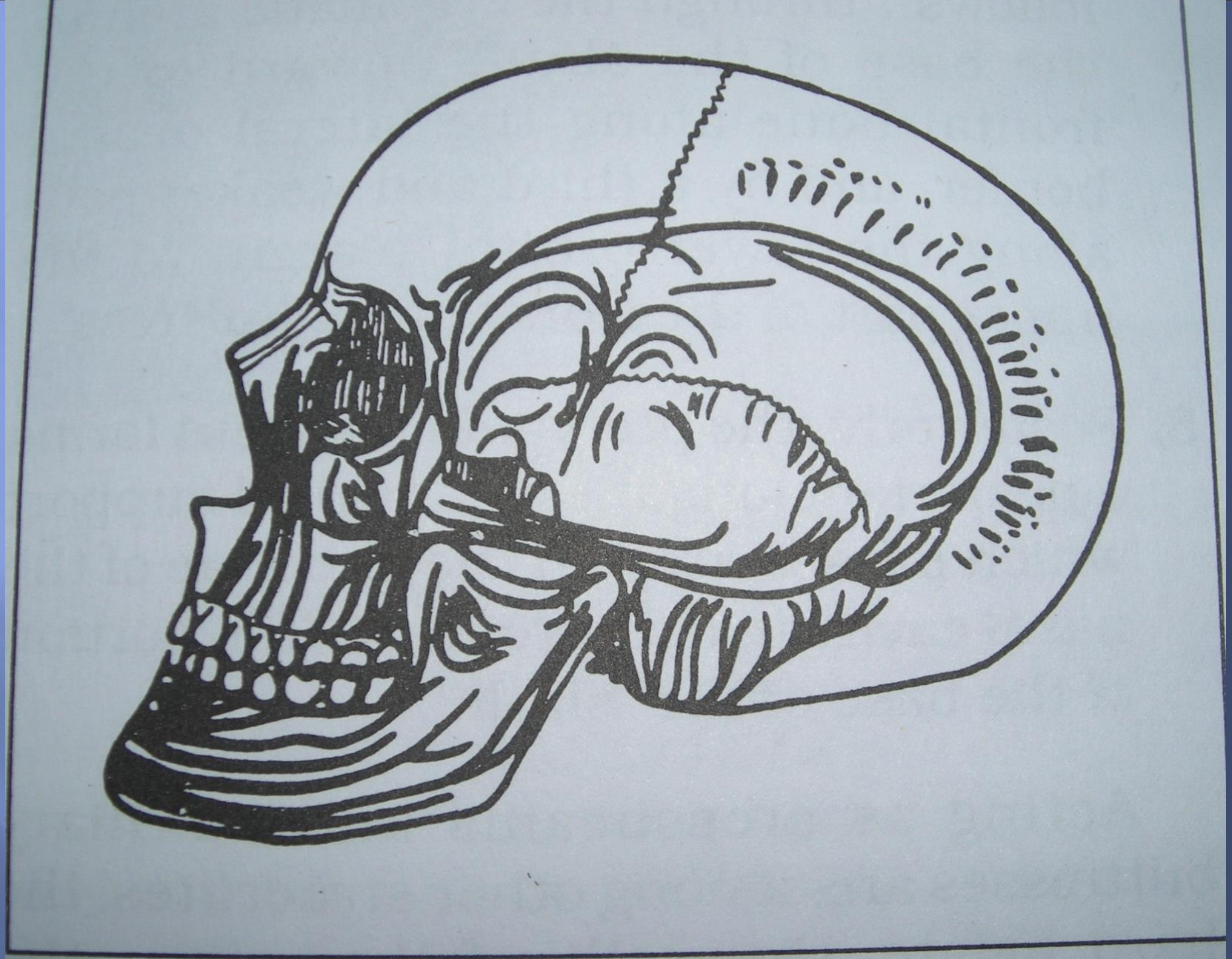


Fig. 5.21 TRAJECTORIES OF FORCES

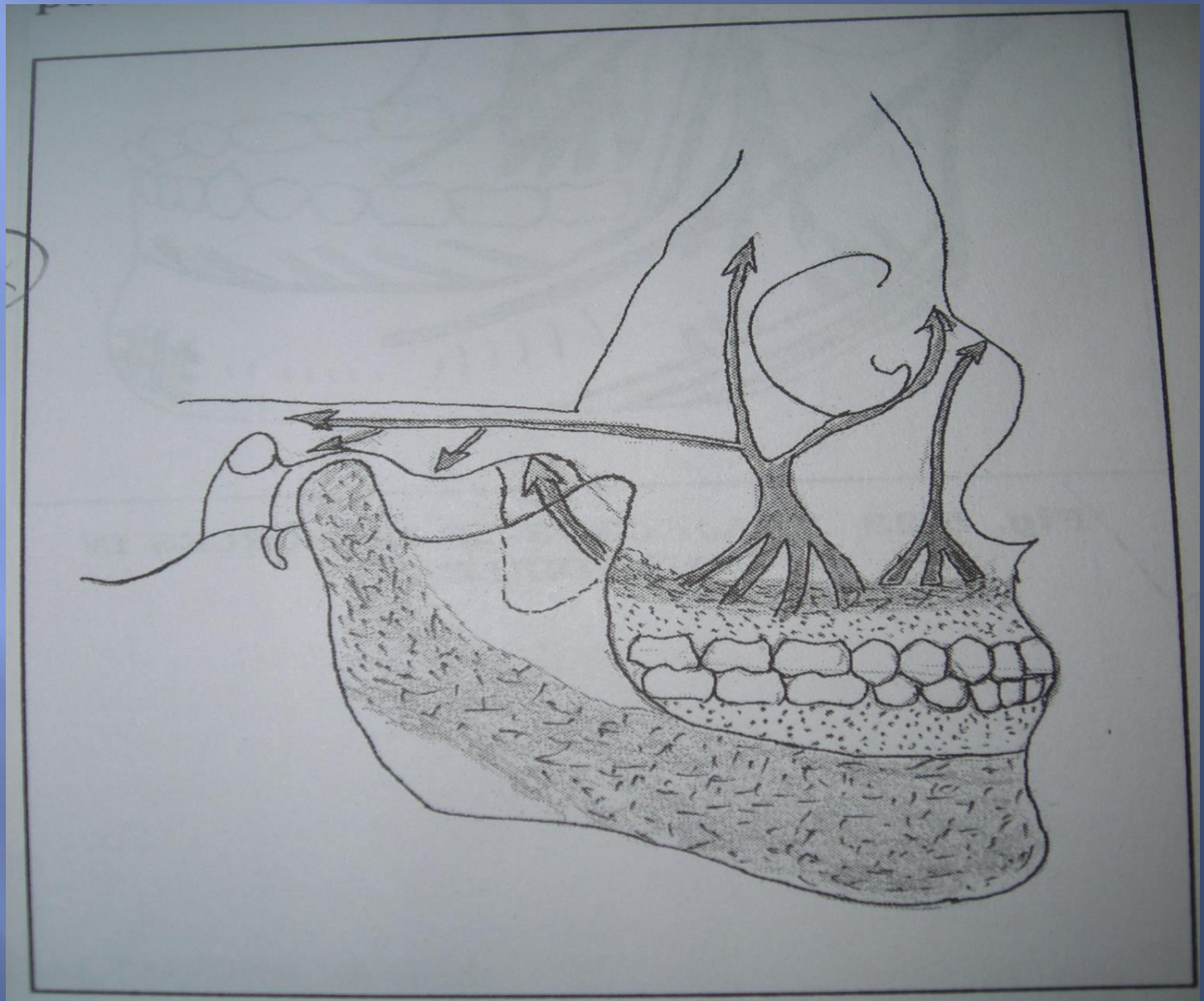


Fig. 5.22 TRAJECTORIES OF FORCES IN MAXILLA

Developmental Disturbances Affecting The Teeth

[A] **Disturbances during initiation of Tooth Germ:**

1)Ectodermal Dysplasia

2)Anodontia

3)Supernumerary & Supplemental teeth

4)Natal &Neonatal teeth

5)Predeciduous dentition

6)Post permanent teeth

[B] Disturbances During Morph-Differentiation of Tooth Germs

1)Hutchinson's incisors
2)Mullberyus molars
3)Peg shaped laterals
4)Macrodontia
5)Microdontia
6)Dense in dente
7)Dens evaginatus
8)Gemination
9)Fusion
10)Dilaceration
11)Taurodontism

[C] Disturbances During Apposition of Hard Tissue

1)Enamel Hypoplasia
2)Amelogenesis imperfecta
3)Dentinogenesis imperfecta
4)Dentinal dysplasia
5)Shell teeth
6)Odintodtsplasia
7)Pigmentation of enamel & dentin
8)Cemental hypoplasia
9)Enamel pearls

[D] Disturbance during calcification of hard tissue

1)Enamel hypocalcification

2)Interglobular dentin

[E] Disturbance during eruption of teeth

1)Concrescence

2)Retarded eruption

3)Ankylosed teeth

CONCLUSION

Development of dentition in humans is complex & depends on many variables. Development of dentition deviates markedly from that of other parts &structures of the body. Crowns of teeth are formed directly to adult size & housed within the jaws years before they emerge.

To determine an abnormal course of development, it is the **responsibility of an orthodontist** to have adequate knowledge on the subject to differentiate abnormal from normal before initiating therapy.