Growth and development 1

The term *growth* usually refers to an increase in size or number while the term *development* will be used to refer to an increase in complexity. Growth is largely an anatomic phenomenon, whereas development is physiologic and behavioral, which means a progress toward marurity.

Why should a dentist or orthodontist be interested in growth and development?

1. Knowledge of general and facial growth provides a background to the understanding of the aetiology and development of malocclusion, playing an important part of the diagnosis and treatment planning process.

2. At regular intervals of the growing child all dentists should be able to identify abnormal or unusual patterns of skeletal growth (posterior rotational growth of the mandible may lead to skeletal openbite).

3. The dentist should be able to identify abnormal occlusal development at an early stage in order to undertake suitable interceptive orthodontic treatment (premature contact may lead to sever skeletal class Ill).

4. Poorly timed extractions performed by the dentist during growth may have unfortunate consequences on the developing occlusion (serial extraction in dished-in face).

5. Many malocclusions are, at least in part, due to skeletal discrepancies between the jaws (maxilla and mandible). Such discrepancies are usually due to differences in the comparative growth of the jaws.

6. Orthodontic treatment may make use of growth spurts (maximum growth period) and other trends. The timing of treatment in relation to these may be important. So understanding of the kinetics of facial growth is necessary.

7. Most orthodontic treatments are performed in the actively growing child or adolescent. Some are dependent on favourable growth and these treatments may have an effect on the hard and soft tissues of the area, however others treatment may have limited result by unfavourable growth pattern.

8. In some treatments, for example where surgery is being considered, it is important to be able to identify when the majority of facial growth has been completed (above the age of 17th years).

9. Growth effects can have long-term effects on the stability of the occlusion after treatment. This needs to be considered when a retention regime is planned (Class III needs long retention period because there is a continuous possibility of mandibular growth till 20 years of age while maxillary growth usually stopped earlier).

Basic principles of growth: pattern, variability, and timing

1. Pattern:

The first important feature of growth corresponds to pattern. **Pattern** in general terms indicates the proportionality of the given object in relation to its various sizes. However, in the concept of growth, it refers not only to the proportionality at a point of time but also to changes in this proportionality over a period of time. The fourth dimension “time” is of immense importance

here. This can be clearly understood in the following illustration (Fig. 1), which depicts the change in overall body proportions over a period of time- from fetus to adulthood.

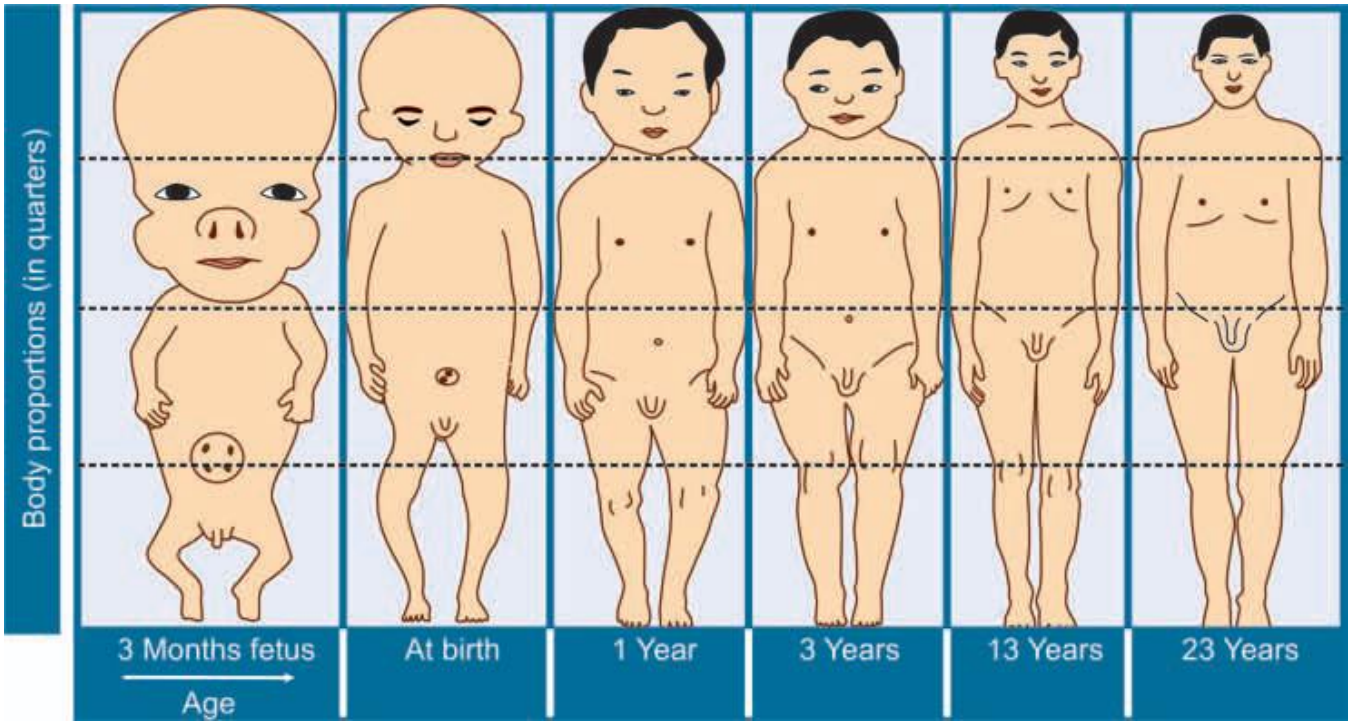

Fig. 1: Diagrammatic representation of the cephalocaudal gradient of growth

The figure illustrates the changes in overall body proportions that occurs during normal growth and development. In fetal life, at about the third month of intrauterine development, the head takes up almost 50 percent of the total body length. At this stage, the cranium is large relative to the face and represents more than half the total head. In contrast, the limbs are still at very early stage and the trunk is underdeveloped.

By the time of birth, the trunk and limbs have grown faster than the head and face, so that the proportion of the entire body devoted to the head has decreased to about 30 percent. The overall pattern of growth thereafter

follows this course, with a progressive reduction of the relative size of the head to about 12 percent in the adult.

All of these changes, which are a part of the normal growth pattern, reflect the cephalocaudal gradient of growth (Table 1). This simply means that "there is an axis of increased growth extending from the head toward the feet."

Cephalocaudal gradient of growth-Scammons: There is an axis of increased growth extending from head towards the feet

- In fetal life, about the third month of intrauterine development (IUD), head occupies 50 percent of the total body length and within the head the cranium is large relative to the face. The trunk and limbs are rudimentary
- *At birth:* head—39 percent of total body length
  Legs—1/3rd of total body length
- *In adults:* head—12 percent of total body length
  Legs— ½ of the total body length
  Therefore, with growth, trunk and limbs grow faster than the head and face

Table 1: Cephalocaudal gradient of growth

Another aspect of the normal growth pattern is that not all the tissue systems of the body grow at the same rate. After birth, the muscular and skeletal elements grow faster than the brain and central nervous system, as reflected in the relative decrease of head size. The overall pattern of growth is a reflection of the growth of the various tissues making up the whole organism. Scammon has classically described the growth of various tissues (Table 2) in the following diagram (Fig. 2).

Different tissues in the body grow at different times and different rates. Therefore, the amount of growth accomplished at a particular age is variable. Scammon divided the tissues in the body into:

a. Neural tissues
b. Lymphoid tissues
c. Somatic/general tissues (muscles, bone, viscera).
d. Genital tissues
    - Neural tissues complete 90 percent of their growth by 6 years and 96 percent by 10 years of age
    - Lymphoid tissues reach 100 percent adult size by 7 years: proliferate far beyond the adult size in late childhood (200% by 14 years) and involute around the onset of puberty
    - Somatic tissues show an S-shape curve with definite slowing of growth rate during childhood and acceleration at puberty going on till age 20
    - Growth of the genital tissues accelerate rapidly around the onset of puberty

Table 2: Differential Growth (Scammon's Growth Curve)

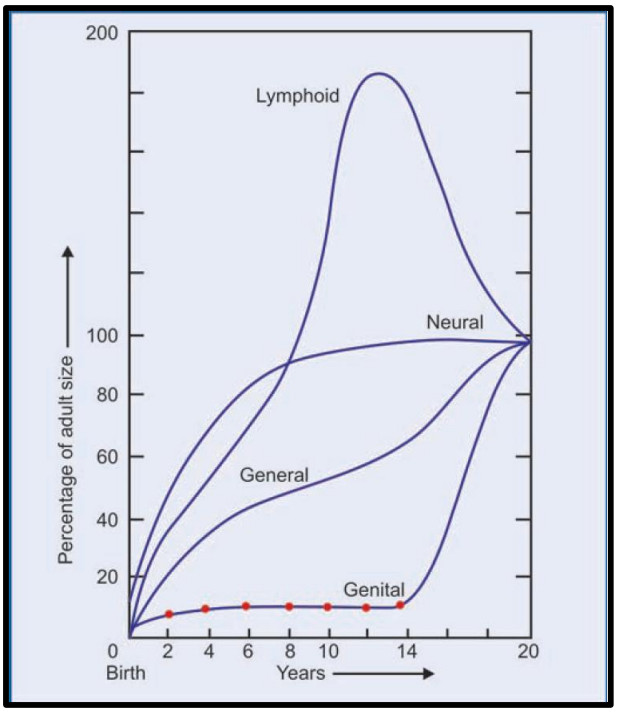

Fig. 2: Scammon's growth curve

2. Variability:

The second important concept in the study of growth and development is **variability**. It indicates the degree of difference between two growing individuals in all four planes of space including the all-important time. Since everyone is not alike in the way they grow, it is clinically very difficult to decide and decipher the deviation of growth pattern of an individual from the normal. One way to do this is to compare the growth of a given child relative to person on a standard growth chart (Fig. 3).

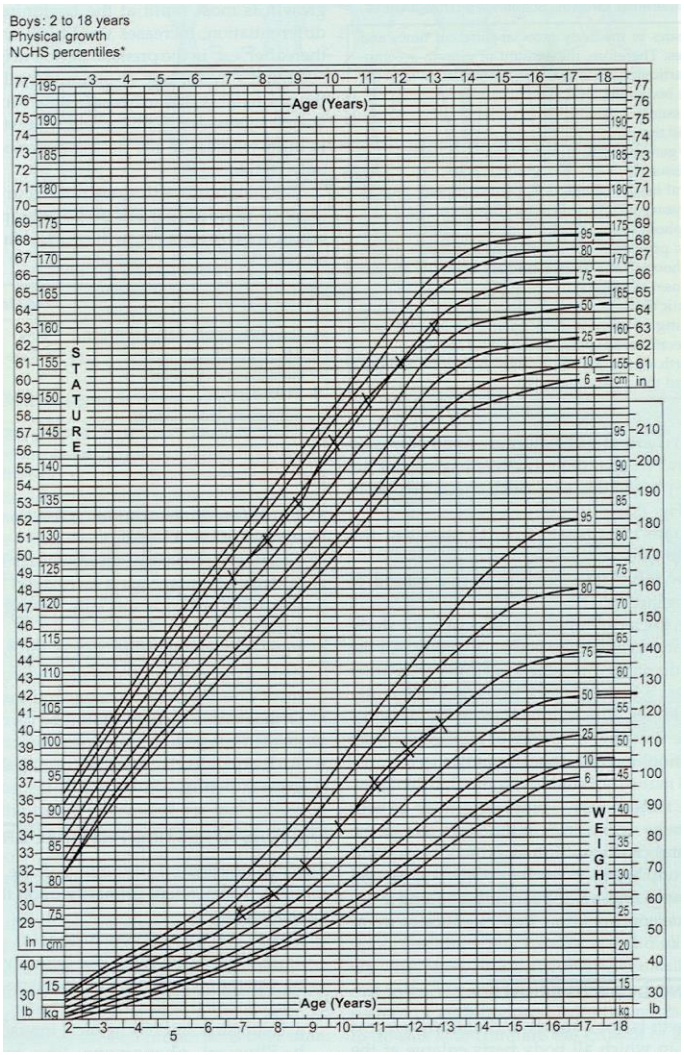

Fig. 3: Growth chart

Although charts of such nature are commonly used for height and weight, the growth of any part of the body can also be plotted this way. Such charts help us in two ways.

a. To evaluate the present growth status of the individual.

b. To follow the child's growth over a period of time using such charts.

3. Timing:

Probably, the most important concept in the study of growth and development is that of **timing**. All the individuals do not grow at the same time or in other words possess a biologic clock that is set differently for all individuals. This can be most appropriately demonstrated by the variation in timing of menarche (onset of menstruation) in girls. This also indicates the arrival of sexual maturity. Similarly, some children grow rapidly and mature early completing their growth quickly, thereby appearing on the high side of the developmental charts until their growth ceases and their peer group begins to catch up. Others grow and develop slowly and so appear to be behind even though in due course of time they might catch up or even overtake others.

RHYTHM AND GROWTH SPURTS

Postnatally growth does not occur in a steady manner. There are periods of sudden rapid increases, which are termed as growth spurts. Mainly 3 spurts are seen:

Name of spurt	*Female*	*Male*
1. Infantile/childhood growth spurt	3 yrs	3 yrs
2. Mixed dentition/ Juvenile growth spurt	6-7 yrs	7-9 yrs
3. Prepubertal/ adolescent growth spurt	11-12 yrs	14-15 yrs

CLINICAL SIGNIFICANCE OF THE GROWTH SPURTS

• To differentiate whether growth changes are normal or abnormal.

• Treatment of skeletal discrepancies (e.g. Class II) is more advantageous if carried out in the mixed dentition period, especially during the growth spurt.

• Pubertal growth spurt offers the best time for majority of cases in terms of predictability, treatment direction, management and treatment time.

• Orthognathic surgery should be carried out after growth ceases.

• Arch expansion is carried out during the maximum growth period.

FACTORS AFFECTING PHYSICAL GROWTH

The developmental ontogeny of the dentofacial complex is dependent primarily upon the following three elements:

1. Genetic endowment These include:
    a. Inherited genotype, like heredity
    b. Operation of genetic mechanisms, like race
2. Environmental factors These include
    a. Nutrition and biochemical interactions
    b. Physical phenomena like temperature, pressures, hydration, etc.
3. Functional forces These include:
    a. Extrinsic and intrinsic forces of muscle actions, like exercise
    b. Space occupying organs and cavities
    c. Growth expansion

The End