Lec 5
4th stage
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Growth and development 2

Terminology:

GROWTH FIELDS

The outside and inside surfaces of bone are blanketed by soft tissues, cartilage or osteogenic membranes. Within this, blanket areas known as growth fields, which are spread all along the bone in a mosaic pattern, are responsible for producing an alteration in the growing bone.

GROWTH SITES

Growth sites are growth fields that have a special significance in the growth of a particular bone, e.g. mandibular condyle in the mandible, maxillary tuberosity in the maxilla. The growth sites may possess some intrinsic potential to grow (debatable).

GROWTH CENTERS

Growth centers are special growth sites, which control the overall growth of the bone, e.g. epiphyseal plates of long bones. These are supposed to have an intrinsic growth potential (unlike growth sites).

REMODELING

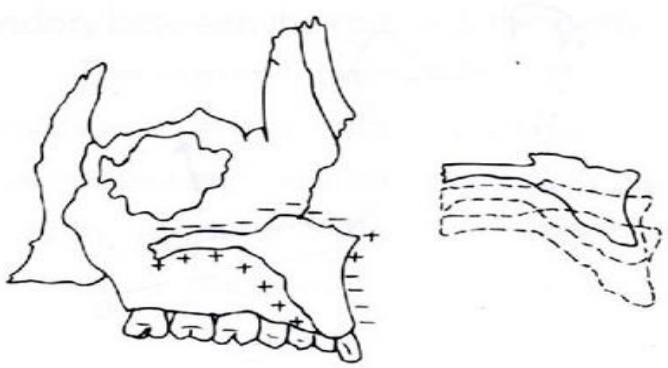
It is the differential growth activity involving deposition and resorption on the inner and outer surfaces of the bone, e.g. ramus moves posteriorly by a combination of resorption and deposition.

GROWTH MOVEMENTS

Growth movements are primarily of 2 types:

1. Cortical Drift

Cortical drift is a type of growth movement occurring towards the depository surface by a combination of resorption and deposition on the opposing surfaces



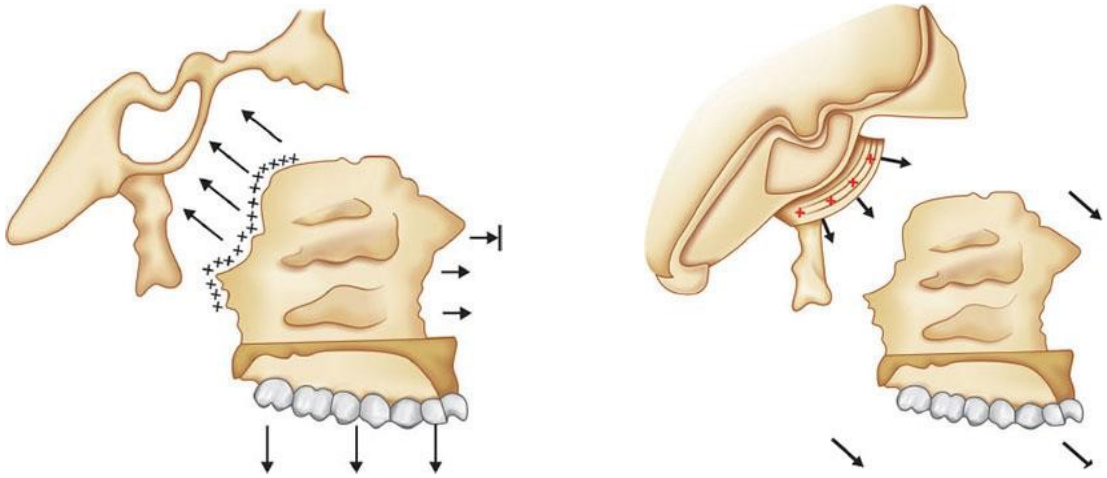
simultaneously.

2. Displacement

Displacement is the movement of the whole bone as a unit. Two types are seen:

a. *Primary displacement(a):* Displacement of bone in conjunction with its own growth. It produces space within which the bones continue to grow.

b. *Secondary displacement(b):* Displacement of bone as a result of growth and enlargement of adjacent bone/bones.



a. Primary displacement b. Secondary displacement

CHARACTERISTICS OF BONE GROWTH

Bone formation occurs by two methods of differentiation of mesenchymal tissue that may be of mesodermal or ectomesenchymal (neural crest) origin. Accordingly, two types of bone growth ossification are normally seen:

1. Intramembranous Ossification

Intramembranous ossification is the transformation of mesenchymal connective tissue, usually in membranous sheets, into osseous tissues.

2. Endochondral Ossification

Endochondral ossification is the conversion of hyaline cartilage prototype models into bone.

THEORIES OF SKULL GROWTH CONTROL

1. GENETIC THEORY:

The classic approach attributed control of skull growth largely to intrinsic genetic factors.

2. SUTURAL DOMINANCE THEORY:

the proliferation of connective tissue and its replacement by bone in the sutures.

3. CARTILAGINOUS THEORY:

Intrinsic, growth-controlling factors were present only in the cartilage and in the periosteum, therefore growth in the sutures was secondary and entirely dependent on the growth of the cartilage and adjacent soft tissues.

4. FUNCTIONAL MATRIX HYPOTHESIS:

The original version of the functional matrix hypothesis held that,' the head is a composite structure, operationally consisting of a number of relatively independent functions; digestion, respiration, vision, olfaction, audition, equilibrium, speech, neural integration, etc. Each function is carried out by a group of soft tissues which are supported and/or protected by related skeletal elements. Taken together, the soft tissues and skeletal elements related to a single function are termed a functional cranial component. The totality of all the skeletal elements associated with a single function is termed a skeletal unit. The totality of the soft tissues associated with a single function is termed as the functional matrix. It may be further demonstrated that the origin, growth and maintenance of the skeletal unit depend almost exclusively upon its functional matrix.

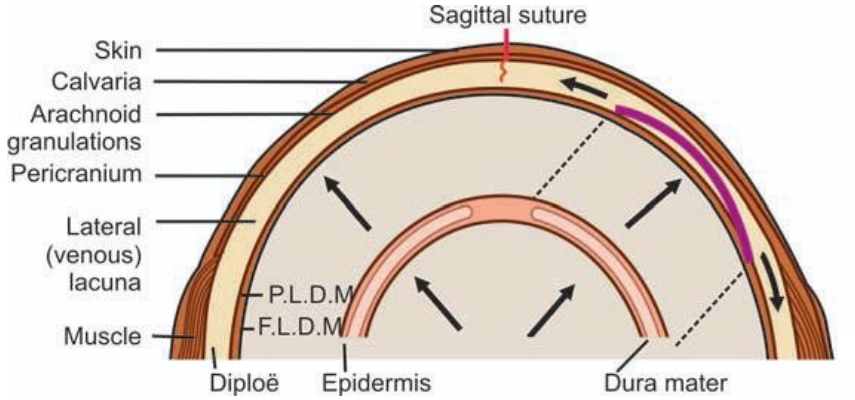
The growth of the craniofacial complex

For the basis of simplicity, the growth of the craniofacial complex can be divided into four areas that grow rather differently:

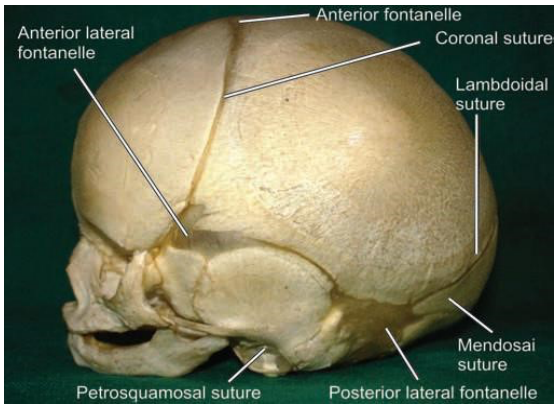
a. *The cranial vault* the bone that covers the upper and outer surface of the brain.
b. *The cranial base* the bony floor under the brain, which is also a dividing line between the cranium and the face.
c. *The nasomaxillary complex* made up of the nose, maxilla, and the associated structures.
d. *The mandible.*

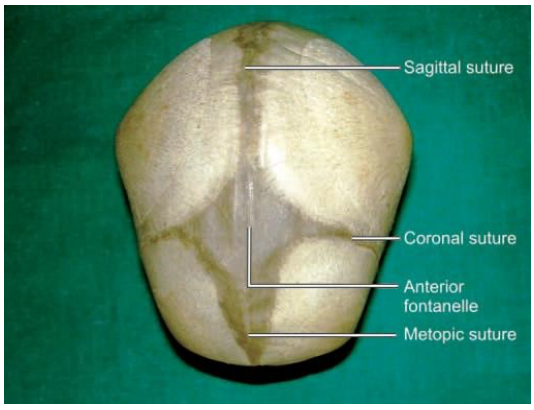
A. THE CRANIAL VAULT

The growth in the cranial vault is because of the enlarging brain. The rate of bone growth is more during infancy and by the fifth year of life more than 90 percent of the growth of cranial vault is achieved. It is made up of a number of flat bones that are formed directly by intramembranous ossification, without cartilaginous precursors.



Remodeling and growth occur primarily at the periosteum lined contact areas between adjacent skull bone, called the skeletal sutures. At birth, the flat bones of the skull are rather widely separated by relatively loose connective tissues. These open spaces, the fontanelles, allow a considerable amount of deformation of the skull at birth—a fact which is important in allowing the relatively large head to pass through the birth canal. After birth, apposition of bone along the edges of the fontanelles eliminates these open spaces fairly quickly, but the bones remain separated by a thin periosteum lined suture for many years, eventually fusing in adult life.





Growth of cranial vault consists of:

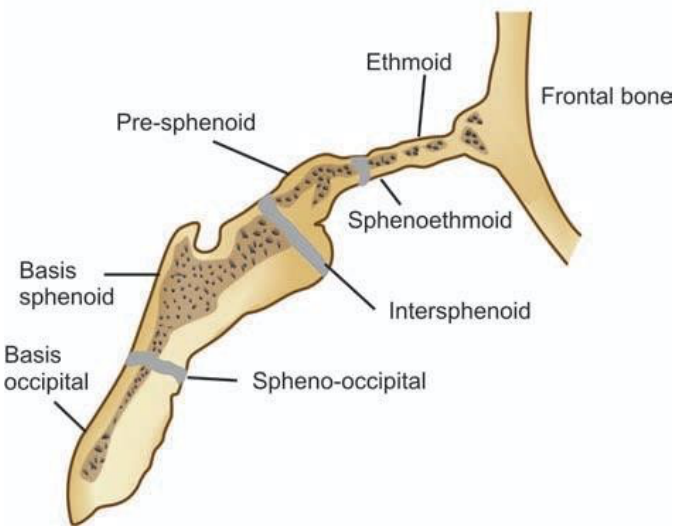
1- Drift: Internal cranial aspects of the bones are resorbed while bone is laid down on the external surface.

2- Displacement: The bones are separated by growing brain, with fill- in bone growth occurring at the sutures to maintain continuously of the cranial vault.

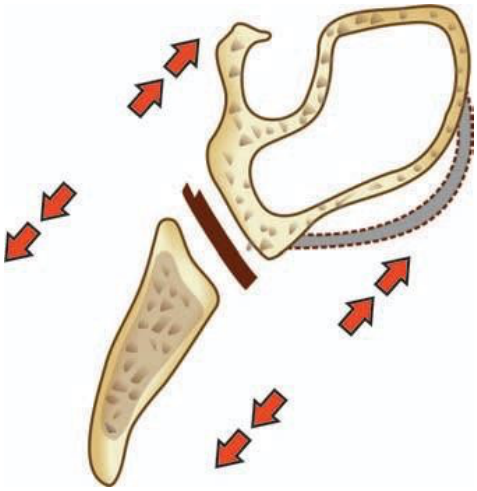
B. THE CRANIAL BASE

The cranial base, unlike cranial vault, is not completely dependent on brain growth and may have some intrinsic genetic guidance and a pattern that is, similar in some dimensions, to that of the facial skeleton. In contrast to the cranial vault, the bones of the cranial base are formed initially in the cartilage and are later transformed by endochondral ossification into bone. This is particularly true of the midline structures.

As one moves laterally, growth at sutures becomes more important, but the cranial base is essentially a midline structure. Centers of ossification appear early in embryonic life in the chondrocranium, indicating the eventual location of the basioccipital, sphenoid and ethmoid bones that form the cranial base



The cranial base grows primarily by cartilage growth in the sphenoethmoidal, intersphenoidal, spheno-occipital and intraoccipital synchondroses, mostly following the neural growth curve. Activity at the intersphenoidal synchondrosis disappears at birth. The intraoccipital synchondrosis closes in the 3rd to 5th years of life. The sphenooccipital synchondrosis is a major contributor as the ossification here extends till the 20th year of life.



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