Alveolar Bone (Process)

The alveolar bone may be defined as that part of the maxilla and the mandible that forms and supports the sockets of the teeth. Anatomically no distinct boundary exists between the body of the maxilla or the mandible and their respective alveolar bone.

Chemical composition of the bone

Bone consists of about 65% inorganic and 35% organic material. The inorganic material is hydroxyapatite crystals while the organic material is primarily type I collagen, which lies in aground substance of glycoproteins and proteoglycans.

Development of the alveolar process:

Near the end of the second month of the fetal life the maxilla as well as the mandible , forms a groove that is open toward the surface of the oral cavity the tooth germ are contained in this groove , which also includes the alveolar nerve and vessels. Gradually bony septa develop between the adjacent tooth germs and much later the primitive mandibular canal is separated from the dental crypts by a horizontal plate of bone. Embryonic origin of bone is from the dental follicle and the alveolar process forms with the development and eruption of the tooth and gradually diminished with loss of teeth.

Histological structure of the alveolar bone

As a result of its functional adaptation the alveolar bone (process) consist of :

1. Alveolar bone proper. This part is form the lining of the socket and it is consist of two parts:

A. Bundles bone : is that bone in which the principal fibers of PDL (bundles of sharpey's fibers) are anchored therefore it termed bundle bone . The bundle bone is characterized by presence of fibers in the

intercellular substance arranged at right angle to sharpey's fiber, since bundle bone contains more calcium salts per unit area seen in the X- ray as dense radio opacities . This part of bone is perforated so this called cribriform plate, through this perforation blood vessels and nerves are pass from PDL to alveolar bone.

B. Lamellated bone

Some lamellae of lamellated bone are arranged parallel to the surface of the adjacent marrow spaces where as other form haversian system.

2. Supporting alveolar bone.

It is consist of two parts:

A. Cortical plate B. Spongy bone (cancellous).

A. Cortical plate

The cortical plate consist of longitudinal lamellae and haversian system, it is similar to haversian bone found elsewhere in the body. The compact bone of alveolar process is dense and continuo with cortical plate of maxilla and mandible and it is form the buccal or labial plate and extend to the inner part to form the lingual plate, numerous haversian system containing blood vessels and nerves interconnected by Volkmann canal. The cortical plate are thinner in maxilla than mandible, they are thickest in premolar and molar regions of lower jaw specially on buccal side. In lower jaw cortical bone of alveolar process is dense, in the region of the anterior teeth of both jaws the supporting bone usually very thin, no spongy bone is found here and the cortical plate is fused with the alveolar bone proper.

B. Spongy bone (cancellous).

The spongy bone supporting the alveolar bone proper of alveolar bone , this bone composed generally of heavy trabeculae or plates of bone with marrow spaces between trabeculae, this spaces contained blood forming elements , osteogenic cells and adipose tissue . The supporting bone of maxilla in particular is filled with marrow tissue which contains immature

red blood cells and leukocytes especially in molar region posterior to maxillary sinus.

Bone cells

Bone consist of cells and intercellular matrix of fibrous and ground substance.

There are four types of cells in adult bone:

1. Osteoprogenitor cells *:* These are undifferentiated mesenchymal cells present in the subperiosteal layer or lying in the vascular canals of the compact bone they have the capacity to divide and give rise to any type of other bone cells.

2. Osteoblasts*:* These are the cells responsible for bone formation , found in relation to the bone surface of bone when bone matrix is being deposited , osteoblast are responsible for the secretion of osteoid tissue which will be later mineralized also by osteoblast to form bone tissue.

3. Osteocytes cells *:* Are an osteoblasts which has imprisoned within bone matrix. The cell body is located in a lacunae, the lacunae are irregular, oval or flat and biconvex on age.

Fine cytoplasmic processes of osteocytes extend for some distant into canaliculi which radiate out from the lacunae. Osteocytes maintain bone tissue and play an important role in its mineral storage.

4. Osteoclasts: They are multinucleated gaint cells which vary greatly in size and nature of nuclei. They are found in close association with the surface of bone where resorption takes place in shallow excavation known as Howship's lacunae.

Osteoclasts are derived from osteoproginator cells or probably from circulating blood cells (monocytes).

During bone resorption 3 processes occur:

1. Decalcification
2. Degradation of matrix.
3. Transport of soluble products to extracellular fluid or the blood.

- Decalcification occurs by secretion of organic acid (citric and lactic acid) by ruffled border of osteoclast.
- Degradation of matrix occurs by activity of cathepsin B1 (protease) and collagenase enzymes.
- The break down of product of bone transport to extracellular fluid or blood.

Incremental lines in bone

1. Resting line are smooth straight line, they stained dark blue with H & E stain. They represent the resting period of osteoblats during bone formation.

2. Reversal line: They stained dark blue as in the resting line , but reversal line are scalloped , not smooth , they represent the outlines of Howship's lacunae with their concavity towards the new bone , following bone resorption , new osteoblasts differentiate and deposit bone tissue leaving these lines separating between old and new bone.

Physiological changes in alveolar bone

Structures of alveolar bone is adapted to mechanical stress and these mechanical stresses are growth of the bone , eruption of the teeth , weak and loss of teeth . All these physiological factors affected the alveolar bone and result in structural changes in the bone formation or bone resorption.

Clinical consideration :

The bone considered biologically as a highly plastic tissue because it is vascularized C.T and cellular tissue . It shows a high metabolic rate in contrast with cementum so it is sensitive to pressure which leads to resorption on the bone and if there is tension , there is bone deposition . So this plasticity enables the orthodontist to move teeth without disruption their relations to the alveolar bone. Bone is resorbed on the side of tension , thus the entire alveolus is allowed to shift with teeth .

Bone have adaptation to function , increased in the functional forces leads to formation of new bone , decreased function leads to a decrease in the volume of bone . This can be observed in the supporting bone of teeth that have lost their antagonist.

Bone healing

After extraction wound or fractures of bone , healing take place by formation of an embryonic type of bone or called coarse fibrillar bone which is characterized by :

1.Great number , great size and irregular arrangement of osteocytes.

2. Coarse irregular fibers.

3. Reduced volume of inorganic substance and great amount of organic substance.

4. Absence of lamellae and resting line.

The increase amount of organic substance and decrease the inorganic substance makes this bone more radiolucent than mature bone, that's why the socket of the extracted tooth appear in the X-ray film empty at the time when its almost filled with immature bone. Then the embryonic bone (woven bone) will be resorbed and replaced by lamellated bone.