Orthodontic tooth movement/ Biomechanics of Tooth Movement

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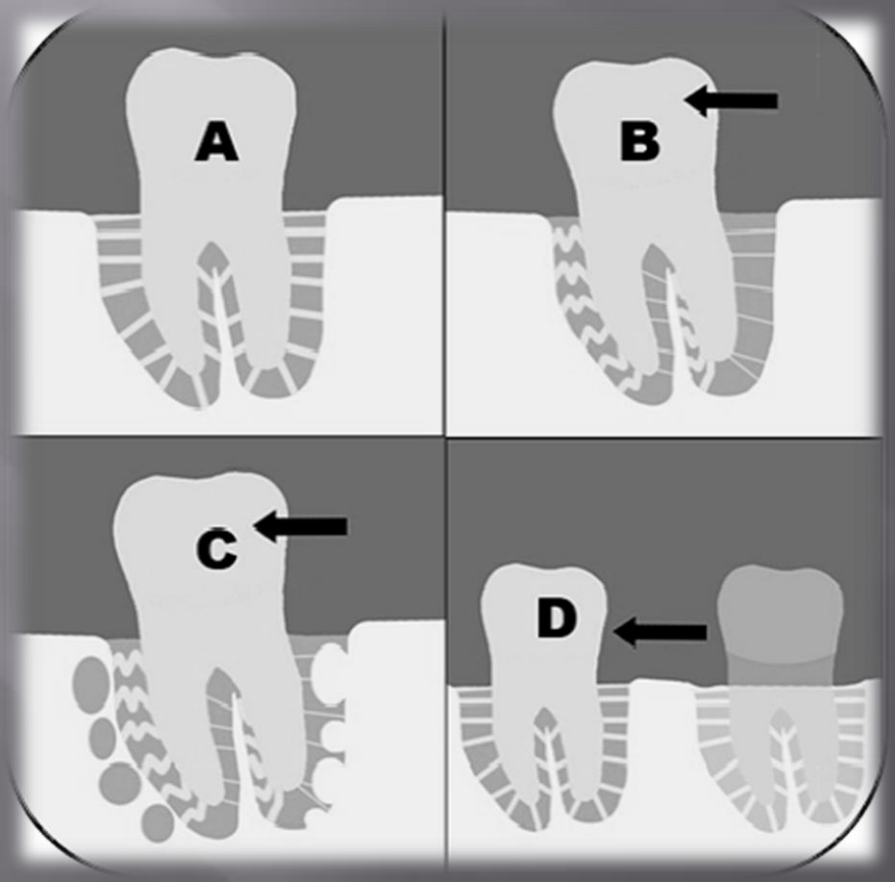
- The essence of orthodontic treatment is the movement of teeth through bone to obtain a more prefect dental occlusion.
- Orthodontic tooth movement is a unique phenomenon, where solid object (tooth) moves through a solid medium (bone).

- Tooth movement is a PDL phenomenon. When a tooth moves, it brings the periodontal ligament and the socket with it.



The basis of the Periodontal Ligament (PDL)

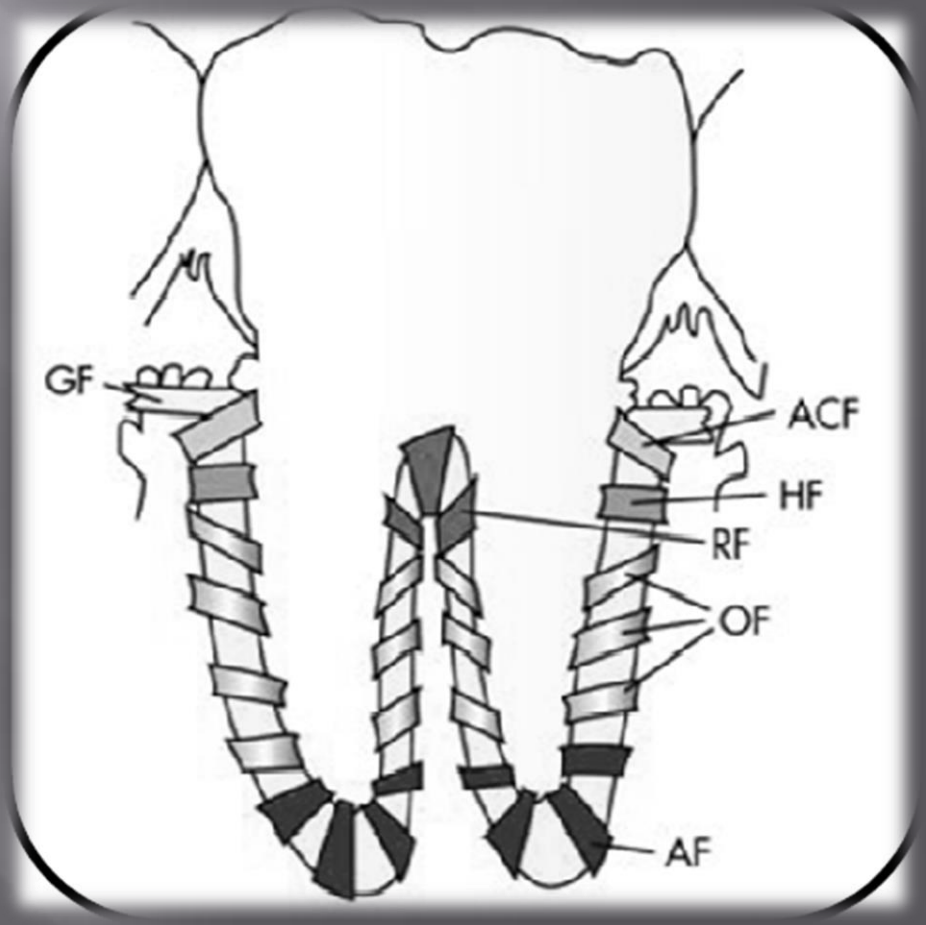
- The PDL is a heavy collagenous structure that attached the cementum on the root surface to the dense bony plate around it (lamina dura).
- Normally, the width is 0.25 mm - 0.5
- Histologically the PDL is composed of fiber cells, ground substance and tissue fluids.

Cells of PDL

- Undiferenciated Mesenchymal stem cells which can differentiate into fibroblasts , osteoblasts and cementoblasts.
- Multineoluated giant cells (osteoclasts and cementoclasts

Fibers of the PDL

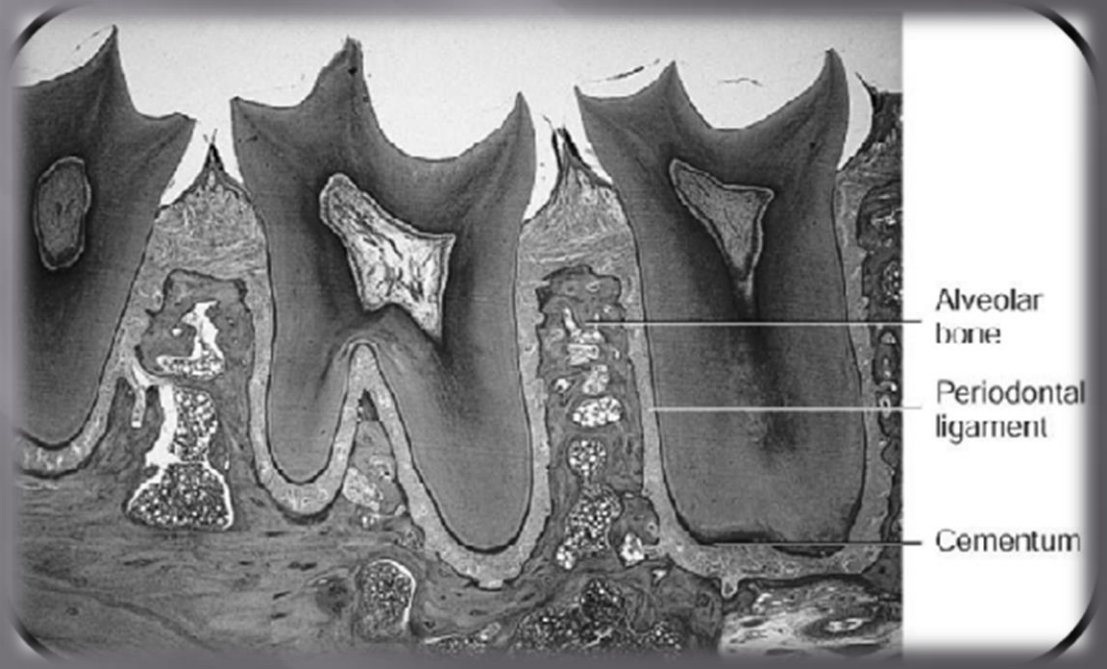
- Arranged in a manner that provides resistance to tooth displacement during normal function



Fluid of PDL

- Provides a cushion; during normal function the fluid squeeze in and out through the porous lamina dura, hence, it makes the PD Space serves as sock absorber

- Alveolar Bone
- Thin and porous cortical bone (lamina dura)
- Fluid pumped in and out of the PDL
- Trabecular bone underneath
- Must remodel before teeth can be moved



Tooth Movement

- Two type of tooth movement

1. Physiological tooth movement
2. Orthodontic tooth movement

Physiologic tooth movements

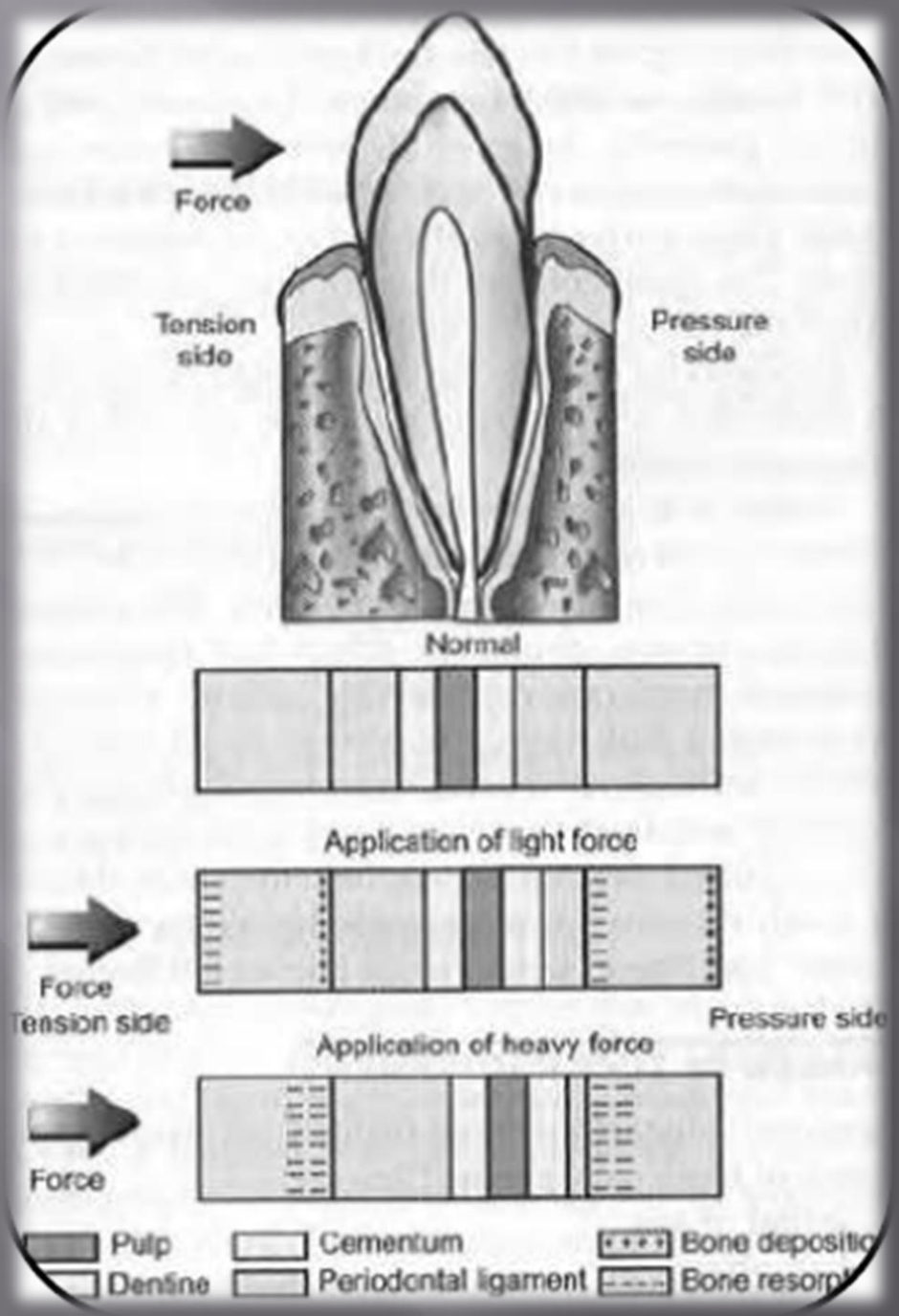
1. Tooth eruption.
2. Tooth migration or drift.
3. Changes in tooth position during mastication

THEORIES OF ORTHODONTIC TOOTH MOVEMENT

- Pressure tension theory
- Blood flow theory
- Piezoelectric theory

PRESSURE TENSION THEORY

- When force is applied on the tooth, PDL is compressed on one site and stretched on the other side.
- Blood flow is decreased on the pressure side where PDL is compressed.
- Blood flow is increased on the tension side where PDL is stretched.


Force
Tension side
Pressure side
Normal
Application of light force
Force
Tension side
Pressure side
Application of heavy force
Force
Pulp
Dentine
Cementum
Periodontal ligament
Bone deposition
Bone resorption

- The process of initiation of tooth movement has 3 stages:

1. Alteration of blood flow associated with pressure within the PDL.
2. The formation and release of chemical messengers.
3. Activation of cells which causes deposition and resorption of bone.

BONE RESORPTION

- Bone resorption (osteoclastistic activity) takesplace at the side of the PDL where there is pressure.

Bone formation (osteoblastic activity) takesplace at the side where there is tension.

- Two types of bone resorption are seen depending upon the magnitude of the applied force:

- light force - Direct/frontal
- heavey force- Undermining/rearward.

- Optimum force levels for orthodontic tooth movement should be just high enough to stimulate cellular activity without completely occluding blood vessels in the PDL.

Piezoelectric effect

- When a force is applied to a crystalline structure (like bone or collagen), a flow of current is produced that quickly dies a way.
- When the force is relased, an opposite current flow is observed.
- The piezoelectric effect results from migration of electrons within the crystal lattice

Role of piezoelectric current

- Compressed area = (-) electric osteoclastic activity
- Tension area = (+) electric osteoblastic activity

THANK YOU