Introduction

• Adults are increasingly concerned about esthetics and desire orthodontic treatment.

• Orthodontic biomechanics and treatment planning are basically determined by periodontal factors.
Orthodontic Treatment

Periodontal health
A MAGNIFICIENT ORTHODONTIC TREATMENT CAN BE DESTROYED BY POOR PERIODONTAL SUPPORT.

HENCE,
EVALUATION AND MAINTENANCE OF PERIODONTAL HEALTH BEFORE, DURING AND AFTER TREATMENT IS VERY IMPORTANT
History

• Edward H. Angle (1899) advocated the correlation between Orthodontics and Periodontics.
Objective

To restore and maintain the health and integrity of the attachment apparatus of teeth.
Rationale for Orthodontic Treatment

• Enhancement of periodontal health and restorability of teeth

• Adjunctive orthodontic therapy in implant patients
Tooth movement and the periodontium

- **Cardinal Rule** – Before doing any tooth movement there should be **no** inflammation in the periodontal attachment.
Before orthodontic treatment

• Periodontal screening.
• Oral hygiene instructions.
• Professional plaque removal and root planing.
• Inflammatory periodontal diseases.
• Mucogingival problems.
PERIODONTAL RISK ASSESSMENT BEFORE ORTHODONTIC TREATMENT

CLINICAL EXAMINATION

Check for the following:

- Bleeding on probing
- Tooth mobility
- Thin fragile gingiva
- Pockets
Before orthodontic treatment

- Pre orthodontic Osseous Surgery
  a. Crater defects to be corrected
  b. Three walled intrabony defects stabilized by augmentative surgery
- Resective bone surgery during flap surgery is contraindicated
- After regenerative periodontal therapy, a healing period of 4-6 months is recommended before orthodontic tooth movements are initiated (Zachrisson 1996).
During orthodontic treatment

- Periodontal health continuously monitored.
  - Mucogingival problems
  - Trauma from occlusion
During orthodontic treatment

- Use well trimmed bonded brackets and keep bands away from the base of the sulcus.

- Thorough planning of biomechanics reduces the risk of root & bone resorptions and gingival dehiscences.

- Uncontrolled force should be avoided - especially in periodontally affected teeth.
During orthodontic treatment

- Maintenance of periodontal health in all hygiene-critical areas bracket periphery, interproximal and gingival tooth surfaces.

- If aggravation of the periodontal destruction occurs orthodontic therapy has to be stopped.
Periodontal Problems during Orthodontic Treatment

- Gingival hyperplasia developed after 1-2 months of orthodontic appliance being placed

- It may also interfere with completion of orthodontic treatment
Periodontal Problems During Orthodontic Treatment

• The use of steel ligatures is recommended on all brackets, even the tooth-colored brackets, because elastomeric rings attract significantly more plaque than steel ties. (Forsberg 1991)
• Professional scaling indicated during active intrusion of elongated maxillary incisors because orthodontic intrusion may shift supragingival plaque to a subgingival location. (Ericsson, 1977&1978; Melsen 1988&1992)
• Orthodontic bands that extend subgingivally, coupled with plaque accumulation
After orthodontic treatment:

- Reevaluation after 6 months
- Inflammatory periodontal diseases
- Trauma from occlusion
- Tooth mobility
- Mucogingival problems
Periodontal problems after Orthodontic Treatment

- Black triangle
- Mobility
- Relapse
Black triangle

- Interproximal stripping and close space
- Converge root angulations
- Mucogingival surgery to augment interdental papilla
Mobility

- Mobility comparatively increases after treatment

- Permanent retention - Bonded retainer
- Removable plate or spring retainer
Placement of retainers immediately after surgery

- Mandibular arch - canine-to-canine retainer

- Maxillary arch - removable Hawley appliance
Relapse

• Transseptal fibers stretches elastically during orthodontic treatment and tends to pull the teeth back towards their original position.
Circumferential Supracrestal Fiberotomy (CSF)

- The term “circumferential supracrestal fiberotomy” was first introduced not only transect free gingival fibers but also transseptal ones (Campbell et al 1975)

- Supra-alveolar fibers do not adapt to new tooth positions and are in part responsible for relapse (Thompson et al)
Circumferential Supracrestal Fiberotomy (CSF)

Indications

- Rotated teeth (Campbell)
  - Crowded mandibular teeth.
  - Median diastemas (Campbell)
Contraindications

• Poor oral hygiene, gingivitis or periodontal pocketing

• Gingival recession or lack of attached gingiva

• Excessive labial root prominence with distinct possibility of dehiscence
Anaesthesia

• Intrapapillary injection
• Inserted from the facial aspect of the papilla to the lingual aspect, and an anesthetic solution deposited as the needle is withdrawn
Surgical Procedures
Post orthodontic Phase

• Retention phase should last at least six months to permit complete mineralization of osteoid tissues.
• Post orthodontic stability requires semi-permanent or permanent retention.
<table>
<thead>
<tr>
<th>FORCE</th>
<th>TISSUE RESPONSE</th>
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<tbody>
<tr>
<td>STRONG/ HEAVY FORCE</td>
<td>PDL on pressure side → ischemia &amp; degeneration of PDL = hyalinization = more delay in tooth movement</td>
</tr>
<tr>
<td>(Forces far exceeding capillary blood pressure)</td>
<td></td>
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<tr>
<td>MODERATE FORCE</td>
<td>PDL strangulation resulting in delay in bone resorption</td>
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<tr>
<td>(Force exceeding capillary blood pressure)</td>
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<tr>
<td>LIGHT FORCE</td>
<td>PDL ischemia with simultaneous bone resorption and formation = more continuous tooth movement</td>
</tr>
<tr>
<td>(Force less than capillary blood pressure)</td>
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## EFFECTS OF ORTHODONTIC TREATMENT ON THE PERIODONTIUM

<table>
<thead>
<tr>
<th>TERM</th>
<th>EFFECT</th>
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<tbody>
<tr>
<td>SHORT</td>
<td>Gingivitis &amp; gingival enlargement</td>
</tr>
<tr>
<td></td>
<td>No attachment loss</td>
</tr>
<tr>
<td></td>
<td>Effects are reversible</td>
</tr>
<tr>
<td>LONG</td>
<td>Root resorption (1.0 – 1.5 mm)</td>
</tr>
<tr>
<td></td>
<td>Attachment loss in areas of active periodontitis</td>
</tr>
<tr>
<td></td>
<td>Effects are often irreversible</td>
</tr>
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</table>
Response of the PDL to orthodontic forces

- PDL is compressed.
- Hyalinization occurs, the tooth stops moving.
- The hyalinized zone is eliminated by PDL regeneration.
- Once the hyalinized zone is removed, tooth movement can occur again.
• Regeneration of the PDL does not occur when inflammation is present in the periodontal tissues (Ericsson et al. 1977).
Response of bone to orthodontic forces

- Bone surrounding a tooth subjected to a force (Reitan 1985, Proffit 1993a)

- Resorption occurs where there is pressure

- New bone forms where there is tension
When greater orthodontic forces, for prolonged continuous bodily movements and intrusive movements are employed the chance of development of root resorption is significantly increased (Proffit 1993a).

Apical root resorption is an irreversible injury and results in permanent shortening of the root (Proffit 1993a).
Tissue response to excessive occlusal forces

- Injury
- Repair
- Adaptive remodeling
Injury

- Excessive occlusal forces produce tissue injury.

- Injury to the periodontium produces a temporary depression in mitotic activity and the rate of proliferation and differentiation of fibroblasts, collagen formation and bone formation.
• Subsequent injury to the fibroblasts and other connective tissue cells leads to necrosis of areas of the ligament.

• Vascular changes seen - within 30 minutes.

• Retardation and stasis of blood flow occur – 2 to 3 hrs
Repair

- New connective tissue cells, fibers, bone and cementum are in an attempt to restore the injured periodontium.

- **Buttressing**
  Buttressing bone is new bone formed by the body in an attempt to reinforce the thinned bony trabeculae.
Two types

Central buttressing - occurs within the jaw.

Peripheral buttressing - occurs on the facial and lingual surfaces of the alveolar plate.

Depending on its severity, it may produce shelf-like thickening of the alveolar margin, referred to as lipping.
Adaptive remodeling of the Periodontium

• The periodontium is remodeled in an effort to create a structural relationship.

• This results thickened periodontal ligament, which is funnel shaped at the crest

• The involved teeth become loose and increased vascularization reported.
Effects of Insufficient Occlusal Forces

• Injurious to the supporting tissues.

• Insufficient stimulation causes thinning of the periodontal ligament

• Atrophy of fibers

• Osteoporosis of the alveolar bone and reduction in bone height
Theory of orthodontic tooth movement

Phase 1 - Alteration of blood flow associated with orthodontic forces

\[ \text{pH} = 7.42 \]
\[ \text{PO}_2 = 45 - 55 \text{ mm Hg} \]
Phase 2 - Changes in oxygen tension between tension and compression sides

\[ \text{pH} = 4 - 6 \]
\[ \text{PO}_2 = 5 - 10 \]
\[ \text{O}_2 \text{ gradient} = 30 - 40 \text{ mm Hg} \]

\[ \text{pH} = >8 \]
\[ \text{PO}_2 = 65 - 70 \]
\[ \text{O}_2 \text{ gradient} = 55 - 60 \text{ mm Hg} \]
Phase 3 - Release of chemical mediators of inflammation and activation of cells
Orthodontic tooth movement

• Tooth movement during orthodontic therapy is placing controlled forces on teeth.

• Removable appliances - intermittent tipping forces on teeth

• Fixed appliances - continuous multidirectional forces to create torquing, intrusive, extrusive, rotational and bodily movement (Lindhe, Proffit 1993a).
Periodontal response to various kinds of tooth movement in periodontally compromised patients

1. Extrusion
2. Intrusion
3. Tipping – Uncontrolled
   - Controlled
4. Bodily movement
Optimum forces for orthodontic tooth movement

Type of movement: Tipping

The safest and biologic type of tooth movement

Periodontal Response: Compression of the apex on the buccal and alveolar crest on the lingual

Force magnitude: 35 - 60 gm/cm sq
TIPPING

UNCONTROLLED TIPPING in all cases causes heavy forces at the alveolar crest resulting in severe destruction of the epithelial attachment and crestal bone loss

Bone loss & Center of Resistance of a tooth
Optimum forces for orthodontic tooth movement

Type of movement: Translation

Periodontal Response: Compression of the entire alveolar crest on the lingual

Force magnitude: 70 - 120 gm/cm sq
Optimum forces for orthodontic tooth movement

Type of movement: Rotation

Periodontal Response: Equal and opposite compression of the apex on the buccal and alveolar crest on the lingual

Force magnitude: 35 - 60 gm/cm sq
Intrusion

- **Type of movement**: Intrusion
- **Periodontal Response**: Alter cementoenamel junction and angular crest relationships and to create only epithelial attachment root
- **Force magnitude**: Light forces of 15-25 gm/cm sq
Controversial –

Intrusion results in deepening of infrabony pockets, root resorption, bone defects
Extrusion

- Type of movement: Extrusion
- Periodontal Response: Periodontal fibers would elongate and new bone would be deposited in areas of the alveolar crest.
- Force magnitude: 25-35 gm/cm sq
Uprighting of Molars

- Molar uprighting reduces the gingival and periodontal indices thereby decreasing the pocket depth and attachment loss (Lang et al.)
Band positioning and its periodontal relevance
Optimal band and buccal tube placement.

Common banding error results in height and torque errors.
Band too far gingival creates molar tip and marginal ridge discrepancy.
Orthodontic band placement causes an overall increase in salivary bacterial counts especially *lactobacillus*, *prevotella intermedia*, *porphyromonous gingivalis*, *bacteroids*
The application of implant-orthodontic anchorage has been reported successfully in many clinical situations - retracting and realigning teeth (Odman et al. 1988, Arbuckle et al. 1991, Block & Hoffman 1995)
6 mos
Move the roots from implant site

To create space prior implant placement, the roots of the adjacent teeth should be upright and parallel.
Create bone for implant placement

Repositioning teeth
Forced orthodontic eruption of a hopeless tooth causes an alteration in the soft tissue architecture of the periodontium as well as improving the amount of bone available for implant placement.
Complications after orthodontic treatment

- Mouth breathing
- Tongue thrusting
- Gingival hyperplasia
- Unerupted teeth ankylosis
Gingival recession

- more aggressive brushing technique during orthodontic treatment.
  - Toothbrush trauma
  - The stretching and thinning of the gingiva that might be created by labial tooth movement.
Disease control, hygiene maintenance
Use bonded rather than banded attachments
Use self ligating brackets/steel ligatures.
Schedule periodontal maintenance visits in addition to orthodontic visits.
Advise mechanical aids such as powered toothbrushes, interdental brushes etc.
Advise chemical aids such as chlorhexidine
OPG reveals generalized bone resorption with increased severity in anterior segment
Comparison of pre and post treatment OPG note the amount of bone is maintained if not reduced and significant amount of bone formation in upper anterior segment due to tooth Moving closer to each other
Molar protraction

Note the amount of bone formation
NOTE - THE AMOUNT OF BONE FORMATION MESIAL TO II MOLAR KNOWN AS ORTHODONTIC SITE MANAGEMENT
CONCLUSION

• Periodontal maintenance is essential to maintain healthy gingival tissue during orthodontic treatment.

• Bonded orthodontic retainers, which stabilize the teeth, may secure optimal conditions for periodontal healing and bone regeneration.