

LITERATURE REVIEW: RADIOGRAPHIC EVIDENCE OF HOW TRAUMATIC
OCCLUSION DRIVES LOCALIZED PERIODONTITIS¹*E. Sundarakannan Crri, ²Dr. Narmadha Mds, ³Dr. G. S. Asokan MDS, ⁴Dr. Sindhu MDS and ⁵Dr. Angelina Teena MDS¹Department of Oral Medicine and Radiology, Tagore Dental College and Hospital.^{2,4,5}Senior Lecturer, Department of Oral Medicine and Radiology.³Professor and Hod of The Department of Oral Medicine and Radiology.

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ABSTRACT

This literature review investigates the correlation between traumatic occlusion and localized periodontitis, emphasizing diagnostic insights from intraoral periapical radiographs (IOPA). Traumatic occlusion, marked by abnormal bite forces due to malocclusion or bruxism, contributes to periodontal damage, potentially intensifying localized periodontitis. Clinical and radiographic features of occlusal trauma, such as widened periodontal ligament spaces and bone resorption, are discussed. The review explores etiological factors, clinical signs, and imaging markers, highlighting the need for integrated occlusal and periodontal therapies to optimize outcomes in affected teeth.

KEYWORDS: Traumatic occlusion, localized periodontitis, intraoral periapical radiographs, periodontal ligament, bone resorption, occlusal adjustment.

INTRODUCTION

Periodontal health is profoundly affected by various anatomical and functional factors, one of which is occlusion. Traumatic occlusion, characterized by abnormal force distribution on teeth during biting, has been linked to periodontal damage in several studies. In particular, localized periodontitis, a form of periodontal disease confined to specific areas, is thought to have a possible association with occlusal trauma. This literature review explores the current knowledge on the correlation between traumatic occlusion and localized periodontitis, with an emphasis on diagnostic approaches using intraoral periapical radiographs.

Traumatic Occlusion

Traumatic occlusion occurs when excessive force is applied to the teeth, resulting in trauma to the supporting structures. This can be due to improper alignment, malocclusion, or bruxism. It is characterized by symptoms such as tooth mobility, widening of the periodontal ligament space, and discomfort upon biting. The etiology and impacts of traumatic occlusion on the periodontal structures have been widely researched, with studies suggesting it may exacerbate periodontal disease.

Definition and Mechanisms of Occlusal Trauma

Trauma from occlusion is characterized as an injury to the periodontium resulting from occlusal forces that

exceed the reparative capacity of the attachment apparatus. This injury manifests when the periodontium cannot cope with increased stresses, leading to various pathological changes. Occlusal trauma may occur independently or alongside inflammatory diseases, notably chronic periodontitis. In patients with chronic periodontitis, the attachment apparatus's ability to withstand non-ideal occlusal forces can be significantly compromised, accelerating attachment loss.

Clinical signs indicative of occlusal trauma include

- Tooth mobility and migration
- Pain or discomfort during chewing or percussion
- Radiographic changes such as a widened periodontal ligament space
- Tenderness of masticatory muscles
- Excessive wear facets and enamel fractures
- Fremitus

Notably, when occlusal trauma is present with chronic periodontitis, occlusal adjustment is recommended to mitigate additional trauma.

Role of Occlusal Forces

Excessive Occlusal Forces

(Malocclusion, Bruxism, Poorly Designed Restorations)

↓
Mechanical Overload on Periodontal Structures



Initiation or Amplification of Inflammatory Processes

Disruption of Blood Supply

Impaired Local Circulation → Ischemia → Release of Pro-Inflammatory Cytokines

(High occlusal forces disrupt blood flow, causing ischemia, which promotes cytokine release, initiating inflammation.)

Stimulation of Pro-Inflammatory Mediators

Activation of Signaling Pathways → Increased Production of Inflammatory Mediators

(Mechanical stress activates cellular signaling, increasing inflammatory mediators like IL-1, TNF- α , and prostaglandins, escalating inflammation.)

Altered Immune Response

Chronic Mechanical Loading → Immune System Modifications → Increased Susceptibility to Bacterial Infections

(Sustained stress changes the immune response, making tissues more vulnerable to bacterial invasion and aggravating gingival inflammation.)

Localized Periodontitis

Localized periodontitis is a form of periodontal disease that specifically affects isolated sites within the mouth, targeting individual teeth or small groups of teeth rather than the entire dentition. It is distinct from generalized periodontitis, both in scope and in its potential contributing factors. Understanding localized periodontitis is essential for developing effective, targeted treatment plans.

Key Characteristics of Localized Periodontitis

1. Targeted Nature

- *Affects Isolated Sites:* Unlike generalized periodontitis, which involves multiple sites throughout the mouth, localized periodontitis impacts only specific teeth or groups of teeth.
- *Focalized Condition:* The disease process is confined to particular areas, often making it more straightforward to identify and monitor the affected regions.

2. Etiological Factors

- Localized periodontitis arises due to various contributing factors, which can act alone or in combination to compromise periodontal health in targeted areas:

a. Plaque Accumulation

- *Primary Cause:* The build-up of bacterial plaque along the gumline is a well-established risk factor. Plaque harbors bacteria that release toxins, leading to inflammation and eventual breakdown of periodontal tissues.

- *Localized Impact:* When plaque accumulates around specific teeth, it may contribute to inflammation and localized attachment loss in those areas.

b. Genetic Predisposition

- *Individual Susceptibility:* Genetics play a significant role, as certain individuals may have a predisposition to periodontal disease, including localized forms.
- *Variable Response:* This genetic factor influences the body's inflammatory response to bacterial plaque, making some individuals more vulnerable to disease progression even in limited areas.

c. Occlusal Trauma

- *Excessive Occlusal Forces:* High bite forces due to bruxism (teeth grinding), malocclusion (improper bite alignment), or poorly fitted dental restorations can lead to trauma in the periodontal structures.
- *Impact on Periodontal Health:* This trauma may weaken the surrounding periodontal tissues, making them more susceptible to localized inflammation and breakdown.

Clinical Presentation of Localized Periodontitis

Localized periodontitis manifests through several characteristic signs and symptoms in the affected areas:

1. Inflammation

- *Redness and Swelling:* The affected gums appear reddened and swollen due to the inflammatory response.
- *Bleeding on Probing:* When examined, inflamed gums often bleed easily, indicating active periodontal disease.

2. Attachment Loss

- *Formation of Periodontal Pockets:* As the disease progresses, the attachment between the gum tissue and the tooth weakens, leading to pocket formation. These pockets become sites for further plaque accumulation, potentially accelerating the disease.
- *Progressive Loss:* Without treatment, these pockets may deepen over time, contributing to more extensive attachment loss.

3. Bone Loss

- *Localized Bone Resorption:* In advanced cases, localized periodontitis may lead to bone loss in the areas around affected teeth, compromising their stability and potentially leading to tooth mobility or loss.
- *Radiographic Evidence:* Bone loss can often be observed in radiographs, making it a valuable diagnostic tool for assessing the extent of localized periodontitis.

Importance of Recognizing Localized Periodontitis

Localized periodontitis is a significant condition to identify and treat because of its potentially severe impact on dental health if left unmanaged. Targeted treatment

that addresses plaque control, genetic risk factors, and any occlusal trauma can help in preventing further progression and protecting the longevity of the affected teeth.

Imaging Techniques: Intraoral Periapical Radiographs

Intraoral periapical radiographs (IOPA) are essential diagnostic tools used in dental practice. They provide detailed images of individual teeth and their surrounding bone structures, making them particularly valuable for identifying periodontal and dental abnormalities.

Importance of IOPA in Diagnosing Periodontal Conditions

1. Detailed Imaging of Tooth and Surrounding Structures

- **High-Resolution Views:** IOPA radiographs offer high-resolution images of the entire tooth, from the crown to the root, and the surrounding bone.
- **Targeted Diagnostics:** This focused view allows for precise examination of the tooth's supporting structures, including the periodontal ligament and alveolar bone, which is crucial for periodontal diagnosis.

2. Key Diagnostic Indicators for Traumatic Occlusion and Localized Periodontitis

- IOPA images help reveal specific changes that are often linked to conditions like traumatic occlusion and localized periodontitis:

a. Widening of the Periodontal Ligament (PDL) Space

- *Indicator of Occlusal Trauma:* A widened PDL space is a common radiographic sign of traumatic occlusion, where excessive forces have led to stress on the tooth and surrounding structures.
- *Implications for Treatment:* Detecting a widened PDL space helps in assessing the need for occlusal adjustments or protective measures to reduce further trauma.

b. Bone Resorption

- *Sign of Periodontal Disease:* Bone resorption, particularly in localized areas, indicates potential periodontal disease progression. This resorption may appear as radiolucent (darker) areas around affected teeth on the IOPA image.
- *Diagnostic Value:* Identifying bone loss helps in diagnosing localized periodontitis, especially when assessing the extent and pattern of bone involvement.

c. Structural Changes in Alveolar Bone

- *Signs of Periodontal Disease Progression:* Changes in the density and architecture of alveolar bone around the roots of affected teeth suggest ongoing periodontal destruction.

- *Monitoring Disease Severity:* Tracking structural alterations in the bone can provide insights into disease severity and the effectiveness of ongoing treatment.

Clinical Value of IOPA in Periodontal Diagnostics

- **Early Detection:** IOPA radiographs facilitate the early identification of periodontal changes, enabling prompt intervention and potentially better outcomes.
- **Precision in Treatment Planning:** Detailed imaging helps clinicians tailor treatment plans to address specific areas affected by traumatic occlusion or localized periodontitis, enhancing treatment precision.
- **Monitoring Progression:** IOPA radiographs are valuable for tracking disease progression and evaluating the effectiveness of periodontal or restorative treatments over time.

Correlation Studies Between Traumatic Occlusion and Localized Periodontitis

Numerous studies have investigated the relationship between traumatic occlusion and localized periodontitis. These studies utilize clinical evaluations and radiographic analysis to determine whether there is a statistically significant correlation. Some findings indicate that traumatic occlusion may indeed exacerbate localized periodontitis by causing excessive force on specific teeth, leading to bone loss and periodontal breakdown. However, there is ongoing debate on whether traumatic occlusion is a primary etiological factor or merely a contributing factor in periodontitis development.

Clinical Diagnosis of Occlusal Trauma

Clinical diagnosis of occlusal trauma should be part of the chronic periodontitis treatment plan. The signs of occlusal trauma include tooth mobility, tooth migration, tooth pain or discomfort on chewing or percussion, radiographic changes, tenderness of mastication muscles, presence of wear facets, chipped enamel or crown/root fractures, and fremitus.

Radiographic Signs

1. Widening of the Periodontal Ligament (PDL) Space

- **Excessive Occlusal Forces → PDL Widening** (*A sign of traumatic occlusion, often seen as a widened space around the root on radiographs.*)

2. Disruption of the Lamina Dura

- **Structural Changes in Supporting Bone → Lamina Dura Disruption** (*Occlusal trauma may cause interruptions or thinning in the lamina dura, which is the dense bone lining the tooth socket.*)

3. Radiolucencies in the Furcation or Tooth Apex

- **Localized Bone Loss → Radiolucent Areas in Furcation or at Vital Tooth Apex** (*Seen as darker areas on the radiograph, indicating bone loss in the furcation areas of multirooted teeth or at the apex of a vital tooth, associated with occlusal trauma.*)

4. Root Resorption

- **Excessive Occlusal Forces → Root Surface Breakdown** (*Root resorption may occur as a response to chronic trauma or inflammatory changes due to occlusal forces.*)

5. Vertical or U-Shaped Bone Defects

- **Conjunction with Chronic Periodontitis → Indicates Occlusal Trauma** (*Bone defects appearing as vertical or U-shaped patterns often signal occlusal trauma when accompanied by chronic periodontitis.*)

Clinical Implications of Occlusal Trauma in Periodontal Disease

1. Teeth Mobility and Periodontal Treatment Outcome

- **Greater Mobility → Less Favorable Healing Post-Treatment** (*Teeth with significant mobility often show reduced improvement after periodontal therapy compared to more stable teeth.*)

2. Benefits of Occlusal Adjustment

- **Occlusal Adjustment → Reduced Tooth Mobility** (*Adjusting excessive occlusal forces has been shown to decrease mobility, leading to more favorable periodontal health.*)

3. Integration of Occlusal Therapy in Periodontal Treatment

- **Address Occlusal Trauma → Resolve Inflammatory Lesions** (*For optimal outcomes, occlusal therapy should be integrated with periodontal procedures to control inflammation and improve tooth stability.*)

Histological Insights

Histologically, occlusal trauma produces distinct zones of tension and pressure in the periodontal ligament. Changes on the pressure side include increased vascularization, necrosis, and potential root resorption, while tension zones may show elongation of ligament fibers and bone apposition. Sustained occlusal trauma can lead to increased tooth mobility and periodontal ligament space widening, further complicating periodontal health.

Historical Perspectives

Historically, excessive occlusal forces were implicated in periodontal disease progression, with early studies suggesting a direct causative role. However, subsequent investigations, particularly those utilizing animal models, indicated that occlusal trauma does not initiate periodontal disease but may exacerbate conditions when plaque-induced inflammation is present.

Animal Studies

Animal research has provided insight into the interaction between occlusal trauma and periodontal disease. Studies have demonstrated that occlusal trauma alone, in the absence of bacterial plaque, does not lead to irreversible

bone loss or connective tissue attachment loss. However, when combined with periodontitis, occlusal trauma can accelerate attachment loss and increase mobility. These findings underscore that while occlusal trauma does not independently cause periodontitis, it serves as a contributing factor to periodontal breakdown in the presence of inflammatory conditions.

The results underscore the detrimental effects of jiggling occlusal forces on periodontal health, particularly in the presence of established inflammatory conditions. The interplay between mechanical stress and microbial factors appears to create a synergistic effect that accelerates periodontal breakdown. This finding aligns with previous research indicating that occlusal trauma can exacerbate inflammatory responses and tissue degradation.

Traumatic Occlusion was experimentally induced in mice by adding composite resin to the maxillary first molar. Resveratrol was then administered to observe its impact on TO-induced bone loss.

- **Reduction in Bone Loss:** Resveratrol treatment led to a significant decrease in TO-induced bone resorption, evident in histological evaluations. This indicates that resveratrol mitigates alveolar bone loss by counteracting the harmful effects of excessive occlusal forces on bone tissue.

- **Suppression of Osteoclastogenesis:** Resveratrol also reduced the expression of genes associated with osteoclast formation in periodontal tissues, an essential factor in the breakdown of alveolar bone. This was supported by further testing on osteoclast differentiation.

- **Inhibition of Osteoclast Differentiation:** In vitro tests on RAW 264.7 cells and bone marrow-derived macrophages demonstrated that resveratrol effectively inhibited their transformation into osteoclastic cells, further validating its potential as a therapeutic agent against osteoclast-related bone loss.

Clinical Studies

Studies found that mobile teeth with a widened periodontal ligament space had more attachment loss and were less responsive to periodontal treatment.

Implications for Treatment

Tooth mobility is a recognized clinical indicator of occlusal trauma, often linked to periodontal attachment loss. Various studies have indicated that teeth with occlusal discrepancies exhibit more severe probing depths and clinical attachment loss than those without such discrepancies. Furthermore, occlusal adjustment has shown potential benefits in improving periodontal parameters post-treatment.

Despite these insights, the evidence linking routine occlusal therapy to improved periodontal outcomes remains limited. While occlusal therapy may not replace conventional periodontal treatments, it could enhance patient comfort and masticatory function in cases

exhibiting signs of occlusal trauma.

Effects of Excessive Occlusal Forces on Gingival Recession

Excessive occlusal force was historically associated with conditions like Stillman's cleft. Modern studies show no significant correlation between mobility and gingival recession.

CONCLUSION

In conclusion, while occlusal trauma does not initiate periodontal disease, it plays a significant role in exacerbating existing conditions, particularly when combined with plaque-induced inflammation

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