World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(REVIEW ARTICLE)

Check for updates

Trauma from occlusion in periodontics: A detailed review

Tejas Pande [1,*], Subharchana Das [1], Piyush Yadav [2], Akshita Yadav [2] and Manya Gupta [2]

[1] *Department of Periodontics, Institute of Dental Sciences, Siksha O Anusandhan, Bhubaneswar, Odisha, India.*
[2] *Swami Devi Dyal Hospital and Dental College, Pandit BD Sharma University of Health Sciences, Haryana, India*

World Journal of Biology Pharmacy and Health Sciences, 2025, 22(01), 325-335

Publication history: Received on 04 December 2024; revised on 12 April 2025; accepted on 14 April 2025

Article DOI: https://doi.org/10.30574/wjbphs.2025.22.1.0396

Abstract

Trauma from occlusion (TFO) is a crucial aspect of periodontics, influencing both the progression of periodontal disease and overall oral health. It refers to injury to the supporting structures of the teeth caused by excessive occlusal forces that exceed the adaptive capacity of the periodontium. While TFO does not directly cause periodontitis, it can exacerbate periodontal breakdown when inflammation is present. The relationship between occlusal trauma and periodontal disease progression remains a subject of debate, with historical theories such as Glickman's *Theory of Co-Destruction* and Waerhaug's opposing views shaping our understanding.

This review explores the pathophysiology, classification, clinical manifestations, diagnostic approaches, and management strategies for TFO, incorporating the most recent literature. Key clinical signs include increased tooth mobility, fremitus, widened periodontal ligament space, occlusal wear facets, and discomfort upon mastication. Diagnosis requires a combination of clinical evaluation, radiographic assessment, and advanced occlusal analysis techniques such as T-Scan and electromyography. Management strategies include occlusal adjustments, splinting, orthodontic corrections, behavioral therapy, periodontal interventions, and prosthetic rehabilitation.

With advancements in digital occlusal analysis and interdisciplinary approaches, clinicians can better understand and manage occlusal trauma. Future research should focus on long-term clinical trials to establish standardized treatment protocols for optimizing periodontal health and function.

Keywords: Occlusion; Occlusal trauma; Bone resorption; Periodontal disease; Tooth mobility; Digital occlusal analysis

1. Introduction

Occlusion plays a pivotal role in maintaining overall oral health, as it governs the way teeth come into contact and distributes forces during function(1). When these forces exceed the adaptive capacity of the periodontium, the resulting condition is referred to as trauma from occlusion (TFO)(1). This phenomenon has long been debated in periodontics, with conflicting views regarding its role in periodontal disease progression. Some researchers argue that occlusal trauma acts as a primary etiological factor, while others suggest it is merely a modifying element that exacerbates existing periodontal conditions.(2,3)

The concept of TFO emerged in the early 20th century when Stillman (1917) first defined it as an injury to the supporting structures of the teeth due to excessive occlusal force(1). Since then, multiple theories have been proposed regarding the impact of occlusal trauma on periodontal tissues. Glickman's *Theory of Co-Destruction* (1974) suggested that occlusal trauma could alter the pathway of inflammation, contributing to accelerated bone loss and deep

* Corresponding author: Tejas Pande

periodontal pockets(2). However, Waerhaug (1979) challenged this notion, asserting that bone loss patterns were primarily dictated by plaque accumulation rather than occlusal trauma.(4,5)

Clinically, TFO presents with signs such as progressive tooth mobility, fremitus, widened periodontal ligament (PDL) space, and pathologic tooth migration(6). Despite these noticeable changes, the fundamental question remains: does occlusal trauma contribute to periodontal disease progression, or is it an adaptive response to excessive forces? Over the years, histological, clinical, and experimental studies have sought to clarify this issue, with varying conclusions(2,7).

Recent advancements in diagnostic techniques such as electromyography (EMG), T-Scan, and digital occlusal analysis tools have enhanced our ability to assess occlusal discrepancies and their impact on periodontal health(8,9). Additionally, modern management strategies, including occlusal adjustments, splinting, orthodontic interventions, and behavioral modifications, have improved outcomes for patients experiencing TFO(10).

This review aims to provide an in-depth analysis of trauma from occlusion, its pathophysiology, classification, diagnostic methods, clinical manifestations, and treatment approaches. By integrating historical perspectives with the latest research findings, we seek to offer a comprehensive resource for clinicians and researchers in the field of periodontology.

2. Historical Perspective

The relationship between occlusal forces and periodontal health has been a subject of scientific inquiry for over a century(2,11). Early observations of occlusal trauma were largely anecdotal, but with advances in periodontal research, the understanding of its impact has evolved considerably(1).

2.1. Early Theories and Definitions

The term *trauma from occlusion* was first introduced in the early 20th century by Stillman (1917), who defined it as an injury to the supporting structures of the teeth due to excessive occlusal forces(1,12). Later, in 1978, the World Health Organization (WHO) further refined the definition, describing TFO as damage to the periodontium caused by stress on the teeth produced directly or indirectly by the opposing dentition.

2.2. Glickman vs. Waerhaug: The Periodontal Debate

During the mid-20th century, the debate on whether occlusal trauma played a significant role in periodontal disease progression intensified. In 1974, Glickman introduced the *Theory of Co-Destruction*, arguing that excessive occlusal forces could influence the direction and severity of inflammatory processes in the periodontium. According to this model, occlusal trauma could accelerate bone resorption and deepen periodontal pockets in conjunction with inflammation(13).

On the other hand, Waerhaug (1979) provided a contrasting perspective, emphasizing that periodontal destruction was primarily driven by plaque accumulation rather than occlusal forces. His research suggested that bone loss occurred in response to subgingival plaque rather than the mechanical impact of occlusal trauma. This viewpoint remains influential in modern periodontology, as the primary cause of periodontitis is now understood to be bacterial biofilm, with occlusal trauma acting as a modifying factor rather than a direct cause of periodontal disease(4,5).

2.3. Animal and Clinical Studies on Occlusal Trauma

Animal studies conducted in the late 20th century sought to clarify the role of occlusal trauma in periodontal disease(1). Experiments involving excessive occlusal loading in dogs and monkeys showed that while occlusal trauma caused adaptive changes such as increased tooth mobility and widened PDL spaces, it did not directly cause attachment loss in the absence of plaque-induced inflammation(14). These findings supported the idea that TFO might exacerbate periodontal destruction but is not an independent etiological factor.

More recently, human clinical studies have provided additional insights. Retrospective case-control studies have shown that patients with untreated occlusal discrepancies tend to have greater mobility and deeper probing depths than those with well-maintained occlusion. However, evidence remains inconclusive on whether occlusal adjustments alone can halt periodontal disease progression(13).

2.4. Modern Understanding and Future Directions

Advancements in digital dentistry and occlusal analysis tools, such as the T-Scan system, have allowed clinicians to assess occlusal forces with greater precision. This has led to a shift in focus from merely identifying occlusal trauma to understanding its biomechanical implications on the periodontium(15).

While the historical debate continues, contemporary research suggests that occlusal trauma is best viewed as a risk factor that can modify the course of periodontal disease rather than a primary etiological agent. Future studies should focus on longitudinal clinical trials to determine how much occlusal therapy influences periodontal outcomes over time.

3. Pathophysiology of Occlusal Trauma

Trauma from occlusion induces a cascade of biological and mechanical changes in the periodontium, affecting the periodontal ligament (PDL), alveolar bone, and cementum. The response to excessive occlusal forces varies depending on the magnitude, duration, direction, and frequency of the force applied(1,16).

3.1. Stages of Occlusal Trauma

TFO progresses through various stages, leading to distinct histopathological changes in the periodontal tissues:

3.1.1. Initial Stage (Acute Response to Trauma)

- Compression of the PDL fibers, leading to decreased blood flow and vascular stasis.
- Degeneration of fibroblasts and endothelial cells due to ischemia.
- Increased osteoclastic activity, resulting in localized bone resorption.
- Widening of the PDL space due to adaptive responses to the excessive forces(17).

3.1.2. Progressive Stage (Chronic Adaptation to Occlusal Forces)

- Formation of pressure-induced resorption cavities in the alveolar bone.
- Cemental tears and microfractures due to repeated excessive loads.
- Increased mobility of the affected teeth as a result of diminished periodontal support(18).

3.1.3. Advanced Stage (Severe Periodontal Breakdown)

- Severe alveolar bone loss leading to pathological migration of teeth.
- Permanent deformation of the PDL and disorganized fiber orientation.
- Apical displacement of the junctional epithelium, resulting in deep periodontal pockets.
- Exacerbation of pre-existing inflammatory conditions when combined with periodontitis(19).

3.2. Cellular and Molecular Mechanisms

Occlusal trauma triggers a complex network of biochemical and cellular reactions within the periodontium:

- **Inflammatory Response:** Increased levels of cytokines such as IL-1β, TNF-α, and prostaglandin E2 (PGE2) promote osteoclastic activity and accelerate alveolar bone loss.
- **Vascular Changes:** Occlusal forces impair microcirculation, leading to hypoxia and subsequent necrosis of fibroblasts.
- **Neural Response:** Increased mechanoreceptor activity in the PDL, altering neuromuscular coordination and leading to parafunctional habits such as bruxism.
- **Tissue Remodeling:** Persistent occlusal stress leads to cemental resorption, adaptive thickening of the alveolar bone, and increased trabecular density as a compensatory mechanism(20–23).

3.3. Relationship Between Occlusal Trauma and Periodontal Disease

While occlusal trauma does not initiate periodontitis, it serves as a modifying factor that accelerates disease progression in the presence of plaque-induced inflammation. Studies have demonstrated that excessive occlusal forces amplify periodontal breakdown by:

- Enhancing inflammatory mediator release, thereby exacerbating connective tissue destruction.
- Increasing tooth mobility, which disrupts plaque control efforts and favors bacterial colonization.

- Inducing micromotion in the PDL, further promoting collagen degradation and epithelial downgrowth(2,24).

3.4. Experimental Evidence Supporting Pathophysiological Effects

- **Animal Studies:** Research conducted on primates and rodents has shown that TFO leads to widened PDL spaces, increased tooth mobility, and bone resorption, particularly when combined with plaque accumulation.
- **Human Clinical Studies:** Retrospective analyses indicate that patients with occlusal trauma experience more significant attachment loss and mobility compared to non-traumatized teeth.
- **Histological Findings:** Biopsies of periodontally compromised teeth subjected to excessive occlusal forces reveal evidence of necrotic PDL fibers, resorptive lacunae, and increased osteoclast density(1,1).

4. Classification of Trauma from Occlusion

TFO can be classified based on its **etiology, clinical presentation, and functional impact** on the periodontium. This classification aids in diagnosis, treatment planning, and understanding the role of occlusal forces in periodontal health.

4.1. Based on Etiology

- **Primary Occlusal Trauma:** This occurs when excessive occlusal forces are applied to a periodontium with normal bone support. The primary cause is increased occlusal load from habits such as bruxism, malocclusion, or high restorations.
- **Secondary Occlusal Trauma:** This occurs when normal or excessive occlusal forces act on a periodontium that has already been compromised by bone loss due to periodontitis. This type of trauma is more damaging since the adaptive capacity of the periodontium is already weakened(2,7).

4.2. Based on Clinical Presentation

- **Acute Occlusal Trauma:** Results from a sudden excessive force, such as accidental trauma, improperly placed dental restorations, or sudden parafunctional activity. Clinical symptoms include pain, sensitivity, and sudden tooth mobility.
- **Chronic Occlusal Trauma:** Develops over time due to continuous exposure to excessive occlusal forces. This results in progressive widening of the PDL, increasing mobility, and long-term adaptation of the alveolar bone(2,25,26).

4.3. Based on Functional Impact

- **Reversible Occlusal Trauma:** Mild occlusal overload that the periodontium can adapt to over time without permanent damage. This type can often be corrected with occlusal adjustments.
- **Irreversible Occlusal Trauma:** Severe occlusal trauma leading to permanent structural damage, such as cemental tears, root resorption, and severe mobility. This often requires multidisciplinary management, including splinting, occlusal rehabilitation, and periodontal therapy(1,2).

4.4. Based on Direction and Type of Occlusal Force

- **Jiggling Trauma:** Alternating forces applied in different directions, leading to increased PDL width and mobility. Common in parafunctional habits such as clenching and bruxism.
- **Unidirectional Trauma:** Forces applied in a single direction, often associated with orthodontic movement or bite misalignment(2,24,27).

4.5. Based on Association with Parafunctional Habits

- **Parafunctional Occlusal Trauma:** Resulting from bruxism, tongue thrusting, or other abnormal oral habits that generate excessive, repetitive forces beyond normal function.
- **Functional Occlusal Trauma:** Arising from normal masticatory forces that become traumatic due to compromised periodontal support(28–30).

This classification system allows for a better understanding of the diverse manifestations of TFO and aids clinicians in tailoring treatment approaches accordingly.

5. Clinical Manifestations

TFO presents with a variety of clinical signs and symptoms, affecting both the hard and soft tissues of the periodontium. The severity of these manifestations depends on the magnitude, duration, and direction of the traumatic forces, as well as the adaptive capacity of the periodontium.

5.1. Hard Tissue Changes

- **Tooth Mobility:** One of the earliest signs of TFO, mobility increases due to the widening of the periodontal ligament space as a result of excessive occlusal forces(31).
- **Fremitus:** A palpable or visible movement of the tooth when subjected to occlusal forces, often detected during occlusal evaluation(27).
- **Wear Facets:** Flattened, polished areas on the occlusal surfaces of teeth due to repeated excessive forces, particularly in bruxers(32).
- **Abfraction Lesions:** Wedge-shaped defects at the cervical region of teeth, attributed to excessive occlusal stress causing enamel microfractures(33).
- **Root Resorption:** Chronic trauma may induce internal or external root resorption, weakening the structural integrity of the affected teeth(34).

5.2. Soft Tissue Changes

- **Gingival Recession:** In some cases, excessive occlusal forces can contribute to gingival recession, particularly when combined with parafunctional habits(35,36).
- **Periodontal Pocket Formation:** In secondary occlusal trauma, excessive forces may exacerbate attachment loss, leading to deepening of periodontal pockets(2).
- **Gingival Inflammation:** Although primarily caused by plaque, occlusal trauma may act as an aggravating factor, intensifying the inflammatory response(36).

5.3. Radiographic Features

- **Widened Periodontal Ligament (PDL) Space:** A key radiographic indicator of TFO, seen as an increased space around the root of the tooth(37).
- **Alveolar Bone Resorption:** Chronic occlusal trauma can lead to horizontal or vertical bone loss, especially in cases where inflammation is present(19).
- **Thickening of the Lamina Dura:** In some cases, the bone around the affected teeth becomes sclerotic due to adaptive responses(37).

5.4. Functional and Neuromuscular Symptoms

- **Pain or Discomfort on Chewing:** Patients may experience tenderness, soreness, or pain in teeth subjected to excessive occlusal forces(38).
- **Temporomandibular Joint (TMJ) Symptoms:** Chronic TFO may contribute to TMJ disorders, leading to pain, clicking, or restricted jaw movement(39).
- **Headaches and Muscle Fatigue:** Prolonged occlusal trauma can lead to hyperactivity of the masticatory muscles, causing myofascial pain and headaches(40).

The presence of these clinical manifestations necessitates a thorough occlusal analysis and appropriate intervention to prevent further periodontal deterioration and maintain overall oral health.

6. Diagnosis of Occlusal Trauma

Accurate diagnosis of occlusal trauma is critical for its management and requires a combination of clinical examination, radiographic assessment, and advanced occlusal analysis techniques. Since occlusal trauma does not present with a single definitive marker, a comprehensive diagnostic approach is essential to differentiate it from other periodontal conditions(1,2).

6.1. Clinical Examination

A thorough intraoral examination is necessary to identify clinical signs of TFO, which include:

- **Tooth Mobility:** Progressive mobility suggests occlusal overload, especially when not attributed to periodontal disease(41).
- **Fremitus Test:** This test involves placing a finger on the buccal surfaces of the teeth and asking the patient to bite. The presence of movement indicates occlusal interference.
- **Wear Facets:** Identifying flattened occlusal surfaces, especially in the absence of attrition due to aging, suggests occlusal trauma(27).
- **Pain or Discomfort:** Patients may report pain upon chewing or localized sensitivity due to excessive forces applied to certain teeth(42).
- **Pathologic Tooth Migration:** Shifting or extrusion of teeth, particularly in patients with reduced periodontal support(6).

6.2. Radiographic Assessment

Radiographs provide essential information about bone and periodontal structures affected by occlusal trauma. Key radiographic indicators include:

- **Widening of the Periodontal Ligament (PDL) Space:** Seen in areas of excessive occlusal force, often around the apices of affected teeth(37).
- **Alveolar Bone Resorption:** Horizontal or vertical bone loss, which may be more pronounced in secondary occlusal trauma(19).
- **Thickening of the Lamina Dura:** An adaptive response to increased occlusal forces, indicative of chronic trauma(43).
- **Root Resorption:** Chronic TFO may contribute to external or internal resorption, weakening the affected tooth(44).

6.3. Occlusal Analysis Techniques

Advanced diagnostic tools help quantify occlusal forces and identify areas of excessive pressure:

- **Articulating Paper:** Used to detect high-contact areas that indicate occlusal interference(45).
- **Shim Stock Test:** Assesses interocclusal contact strength by placing thin foils between the teeth during closure(46).
- **T-Scan Digital Occlusal Analysis:** Provides real-time assessment of bite force distribution, allowing for precise adjustments(8).
- **Electromyography (EMG):** Measures muscle activity to detect abnormal occlusal forces associated with parafunctional habits like bruxism(8).

6.4. Temporomandibular Joint (TMJ) Evaluation

Occlusal trauma may lead to TMJ disorders, necessitating additional assessments:

- **Palpation of the TMJ and Masticatory Muscles:** Evaluates tenderness or discomfort in the joint area.
- **Range of Motion Testing:** Identifies restrictions in jaw movement linked to occlusal disharmony.
- **Joint Sounds (Clicking or Crepitus):** May indicate an imbalance caused by occlusal interferences(2,47).

6.5. Differential Diagnosis

Since occlusal trauma shares symptoms with various other conditions, it is crucial to differentiate it from:

- **Periodontitis:** While both present with bone loss and mobility, occlusal trauma does not cause deep periodontal pockets unless periodontitis is already present(1).
- **Cracked Tooth Syndrome:** Pain upon biting may be due to structural fractures rather than occlusal overload(48).
- **Pulpitis or Periapical Pathology:** Inflammatory dental conditions can mimic TFO but typically present with additional radiographic findings like periapical radiolucency(2,49).

6.6. Importance of a Comprehensive Approach

A multidisciplinary approach combining **clinical findings, radiographic evaluation, occlusal analysis, and patient history** ensures an accurate diagnosis of occlusal trauma. Early identification allows for timely intervention, preventing further periodontal damage and maintaining long-term oral health(43).

7. Management Strategies

The management of occlusal trauma involves a multidisciplinary approach, including occlusal adjustment, periodontal therapy, restorative intervention, orthodontic correction, behavioral modifications, and prosthetic rehabilitation. The goal is to reduce excessive forces on the periodontium while ensuring occlusal harmony and stability(2).

7.1. Occlusal Adjustment

Occlusal adjustment is a common intervention to eliminate premature contacts and high points that contribute to occlusal trauma.

- **Selective Grinding:** Minor occlusal discrepancies can be corrected by adjusting premature contacts using fine diamond burs.
- **Equilibration Procedures:** Ensure even distribution of occlusal forces across all teeth, preventing localized trauma.
- **T-Scan Guided Adjustments:** Digital occlusal analysis systems help refine occlusal contacts with precision(1,50).

7.2. Splinting and Stabilization

For teeth with increased mobility due to secondary occlusal trauma, **splinting** may be recommended:

- **Temporary Splints:** Resin or fiber-reinforced composite splints provide short-term stability.
- **Permanent Splints:** Fixed splinting using wire-reinforced composite or crowns is used in severe cases(51).

7.3. Orthodontic Therapy

Malocclusion and dental misalignment can contribute to excessive occlusal forces. Orthodontic correction includes:

- **Repositioning of Malaligned Teeth:** Brackets, aligners, or functional appliances help achieve proper occlusion.
- **Intrusion or Extrusion of Supraerupted Teeth:** Restores occlusal equilibrium.
- **Space Closure for Missing Teeth:** Prevents drifting and secondary trauma(52,53).

7.4. Periodontal Therapy

Since occlusal trauma often coexists with periodontal disease, periodontal interventions are essential:

- **Scaling and Root Planing:** Eliminates plaque and calculus, exacerbating trauma-induced inflammation.
- **Surgical Interventions:** Procedures like guided tissue regeneration (GTR) help restore lost bone support.
- **Periodontal Splinting:** Stabilizes teeth affected by both TFO and periodontal attachment loss(54,55).

7.5. Restorative and Prosthetic Rehabilitation

Defective restorations or missing teeth can contribute to occlusal disharmony. Corrective strategies include:

- **Replacing Faulty Restorations:** High crowns, overhanging restorations, and improper occlusal morphology should be corrected.
- **Implant-Supported Prostheses:** Prevents overloading of adjacent natural teeth.
- **Full Mouth Rehabilitation:** Indicated for patients with extensive occlusal discrepancies due to wear, erosion, or tooth loss(1,56).

7.6. Behavioral and Habit Management

Parafunctional habits exacerbate occlusal trauma and should be addressed:

- **Occlusal Guards/Night Guards:** Recommended for bruxism and clenching patients.
- **Cognitive Behavioral Therapy (CBT):** CBT helps patients control involuntary parafunctional activities.
- **Biofeedback Techniques:** Assist in reducing muscle hyperactivity contributing to excessive occlusal forces(57,58).

7.7. Temporomandibular Joint (TMJ) Therapy

Patients presenting with TMJ disorders associated with occlusal trauma may require specialized care:

- Physiotherapy and Muscle Relaxation Exercises: Reduce strain on masticatory muscles.
- Occlusal Splints (Michigan or Stabilization Splints): Redistribute occlusal forces evenly.
- Pharmacologic Interventions: NSAIDs and muscle relaxants may be used for symptomatic relief(59,60).

7.8. Long-Term Maintenance and Follow-Up

Regular monitoring and maintenance of occlusal health are crucial for preventing recurrence:

- **Periodic Occlusal Evaluations:** Ensure ongoing occlusal harmony.
- **Regular Periodontal Maintenance:** Prevents further attachment loss.
- **Patient Education:** Encourages awareness of habits that contribute to occlusal trauma(1,2,27).

By integrating these management strategies, clinicians can effectively minimize the adverse effects of occlusal trauma and enhance periodontal stability.

8. Conclusion

Trauma from occlusion remains a topic of significant clinical relevance in periodontics. While it does not directly initiate periodontal disease, its role as a modifying factor in the progression of periodontitis has been well documented. The interplay between occlusal forces and periodontal health underscores the importance of early diagnosis, prevention, and multidisciplinary management.

Proper occlusal assessment and intervention strategies, such as occlusal adjustments, splinting, orthodontic correction, and behavioral modifications, play a crucial role in minimizing excessive forces and preventing long-term periodontal complications. Additionally, periodontal therapy should be integrated into the treatment plan for patients with both occlusal trauma and periodontitis to ensure comprehensive care.

Advancements in digital occlusal analysis and biomechanical studies continue to improve our understanding of occlusal trauma and its effects. Future research should focus on long-term clinical trials assessing the impact of various treatment modalities on periodontal stability and patient outcomes.

Ultimately, successful management of occlusal trauma requires a patient-specific approach, combining precise diagnostics with evidence-based interventions to preserve periodontal health and function over the long term.

Compliance with ethical standards

Acknowledgements

The authors did not receive any external support in the preparation of this review article.

Conflict of Interest

The authors declare that they have no conflict of interest.

Statement of Ethical Approval

This article is a narrative review and does not involve any human or animal research.

Statement of Informed Consent

This article does not contain any studies with human participants performed by any of the authors.

References

[1] Srivastava DA, Chaubey DKK, Agarwal DRR, Agarwal A, Bharali DJ. Trauma from Occlusion: A Review Article. 2021;3(3).

[2] Fan J, Caton JG. Occlusal trauma and excessive occlusal forces: Narrative review, case definitions, and diagnostic considerations. J Periodontol [Internet]. 2018 Jun [cited 2025 Mar 9];89(S1). Available from: https://aap.onlinelibrary.wiley.com/doi/10.1002/JPER.16-0581

[3] Passanezi E, Sant'Ana ACP. Role of occlusion in periodontal disease. Periodontol 2000. 2019 Feb;79(1):129–50.

[4] Waerhaug J. The angular bone defect and its relationship to trauma from occlusion and downgrowth of subgingival plaque. J Clin Periodontol. 1979 Apr;6(2):61–82.

[5] Waerhaug J. The Infrabony Pocket and its Relationship to Trauma from Occlusion and Subgingival Plaque. J Periodontol. 1979 Jul;50(7):355–65.

[6] Brunsvold MA. Pathologic Tooth Migration. J Periodontol. 2005;76(6).

[7] Sanadi DrRM, Chelani DrLR, Bhakkand DrSR, Sheth DrJK. Role of trauma from occlusion in periodontal disease-A controversy. IOSR J Dent Med Sci. 2016 Sep;15(09):118–22.

[8] Bathiya A, Pisulkar SK. Digital occlusal analysis using T scan: Its role, mechanism, accuracy and application. 2020;

[9] Deepika BA, Ramamurthy J. Evaluation of occlusal pattern in periodontitis patients using T-scan analysis. J Adv Pharm Technol Res. 2022 Nov;13(Suppl 1):S265–71.

[10] Papageorgiou SN, Giannakopoulou T, Eliades T, Vandevska-Radunovic V. Occlusal outcome of orthodontic treatment: a systematic review with meta-analyses of randomized trials. Eur J Orthod. 2024 Dec 1;46(6):cjae060.

[11] Soundarajan S, Gajendran P. Association between Occlusal Forces and Periodontal Conditions in Untreated Chronic Periodontitis Using T-Scan: A Retrospective Study. J Res Med Dent Sci. 2022;10(1).

[12] Glickman I. Role of Occlusion in the Etiology and Treatment of Periodontal Disease. J Dent Res. 1971 Mar;50(2):199–204.

[13] Harrel SK. Occlusal forces as a risk factor for periodontal disease. Periodontol 2000. 2003 Jun;32(1):111–7.

[14] Lindhe J, Ericsson I. The influence of trauma from occlusion on reduced but healthy periodontal tissues in dogs. J Clin Periodontol. 1976 Jun;3(2):110–22.

[15] Popa AD, Vlăduțu DE, Turcu AA, Târtea DA, Ionescu M, Păunescu C, et al. Aspects of Occlusal Recordings Performed with the T-Scan System and with the Medit Intraoral Scanner. Diagnostics. 2024 Jul 8;14(13):1457.

[16] Li Y, Zhan Q, Bao M, Yi J, Li Y. Biomechanical and biological responses of periodontium in orthodontic tooth movement: up-date in a new decade. Int J Oral Sci. 2021 Dec;13(1):20.

[17] Jiang N, Guo W, Chen M, Zheng Y, Zhou J, Kim SG, et al. Periodontal Ligament and Alveolar Bone in Health and Adaptation: Tooth Movement. In: Kantarci A, Will L, Yen S, editors. Frontiers of Oral Biology [Internet]. S. Karger AG; 2016 [cited 2025 Mar 13]. p. 1–8. Available from: https://www.karger.com/Article/FullText/351894

[18] Li Z, Yu M, Jin S, Wang Y, Luo R, Huo B, et al. Stress Distribution and Collagen Remodeling of Periodontal Ligament During Orthodontic Tooth Movement. Front Pharmacol. 2019 Oct 24;10:1263.

[19] Tsuchida S, Nakayama T. Recent Clinical Treatment and Basic Research on the Alveolar Bone. Biomedicines. 2023 Mar 10;11(3):843.

[20] Li Y, Jacox LA, Little SH, Ko C. Orthodontic tooth movement: The biology and clinical implications. Kaohsiung J Med Sci. 2018 Apr;34(4):207–14.

[21] Rojasawasthien T, Srithanyarat SS, Bulanawichit W, Osathanon T. Effect of Mechanical Force Stress on the Inflammatory Response in Human Periodontal Ligament Cells. Int Dent J. 2025 Feb;75(1):117–26.

[22] Chen S, Zhou D, Liu O, Chen H, Wang Y, Zhou Y. Cellular Senescence and Periodontitis: Mechanisms and Therapeutics. Biology. 2022 Sep 29;11(10):1419.

[23] Yamaguchi M, Fukasawa S. Is Inflammation a Friend or Foe for Orthodontic Treatment?: Inflammation in Orthodontically Induced Inflammatory Root Resorption and Accelerating Tooth Movement. Int J Mol Sci. 2021 Feb 27;22(5):2388.

[24] Mahendra J. Trauma From Occlusion - Periodontal Traumatism. 2020;24(1).

[25] Latha DTP. TRAUMA FROM OCCLUSION.

[26] Grace Umesh S, Ramachandran L, Karthikeyan J, M. Shankar S. Trauma and the Periodontal Tissues: A Narrative Review. In: Moolla A, editor. Dentistry [Internet]. IntechOpen; 2023 [cited 2025 Mar 15]. Available from: https://www.intechopen.com/chapters/84440

[27] Shetty P, Hegde S, Chelkar S, Chaturvedi R, Pochhi S, Shrivastava A, et al. Perspective Chapter: Trauma from Occlusion – Practical Management Guidelines. In: Moolla A, editor. Dentistry [Internet]. IntechOpen; 2023 [cited 2025 Mar 10]. Available from: https://www.intechopen.com/chapters/82938

[28] Jacobson A. Book reviews and article abstracts.

[29] Almutairi AF, Albesher N, Aljohani M, Alsinanni M, Turkistani O, Salam M. Association of oral parafunctional habits with anxiety and the Big-Five Personality Traits in the Saudi adult population. Saudi Dent J. 2021 Feb;33(2):90–8.

[30] Baeshen HA. Malocclusion trait and the parafunctional effect among young female school students. Saudi J Biol Sci. 2021 Jan;28(1):1088–92.

[31] Yasser DZM. TRAUMA FROM OCCLUSION.

[32] Machado NADG, Fonseca RB, Branco CA, Barbosa GAS, Fernandes Neto AJ, Soares CJ. Dental wear caused by association between bruxism and gastroesophageal reflux disease: a rehabilitation report. J Appl Oral Sci. 2007 Aug;15(4):327–33.

[33] Costăchel BC, Bechir A, Târcolea M, Mihai LL, Burcea A, Bechir ES. The Stresses and Deformations in the Abfraction Lesions of the Lower Premolars Studied by the Finite Element Analyses: Case Report and Review of Literature. Diagnostics. 2024 Apr 9;14(8):788.

[34] Consolaro A, Furquim LZ. Extreme root resorption associated with induced tooth movement: A protocol for clinical management. Dent Press J Orthod. 2014 Oct;19(5):19–26.

[35] Jati AS, Furquim LZ, Consolaro A. Gingival recession: its causes and types, and the importance of orthodontic treatment. Dent Press J Orthod. 2016 Jun;21(3):18–29.

[36] Ustun K, Sari Z, Orucoglu H, Duran I, Hakki SS. Severe Gingival Recession Caused by Traumatic Occlusion and Mucogingival Stress: A Case Report. Eur J Dent. 2008 Apr;02(02):127–33.

[37] Mortazavi H, Baharvand M. Review of common conditions associated with periodontal ligament widening. Imaging Sci Dent. 2016;46(4):229.

[38] Allison JR, Stone SJ, Pigg M. The painful tooth: mechanisms, presentation and differential diagnosis of odontogenic pain. Oral Surg. 2020 Nov;13(4):309–20.

[39] nhs.uk [Internet]. 2017 [cited 2025 Mar 21]. Temporomandibular disorder. Available from: https://www.nhs.uk/conditions/temporomandibular-disorder-tmd/

[40] Costa Y, Porporatti A, Stuginski-Barbosa J, Bonjardim L, Speciali J, Conti P. Headache Attributed to Masticatory Myofascial Pain: Clinical Features and Management Outcomes. J Oral Facial Pain Headache. 2015 Oct;29(4):323–30.

[41] Fleszar TJ, Knowles JW, Morrison EC, Burgett FG, Nissle RR, Ramfjord SP. Tooth mobility and periodontal therapy. J Clin Periodontol. 1980 Dec;7(6):495–505.

[42] Hasan S, Singh K, Salati N. Cracked tooth syndrome: Overview of literature. Int J Appl Basic Med Res. 2015;5(3):164.

[43] Jin LJ, Cao CF. Clinical diagnosis of trauma from occlusion and its relation with severity of periodontitis. J Clin Periodontol. 1992 Feb;19(2):92–7.

[44] Nilsson E, Bonte E, Bayet F, Lasfargues JJ. Management of Internal Root Resorption on Permanent Teeth. Int J Dent. 2013;2013:1–7.

[45] Manziuc MM, Savu MM, Almăşan O, Leucuţa DC, Tăut M, Ifrim C, et al. Insights into Occlusal Analysis: Articulating Paper versus Digital Devices. J Clin Med. 2024 Aug 1;13(15):4506.

[46] Harper KA. The Use of Shimstock to Assess Occlusal Contacts: A Laboratory Study. 2002;

[47] Al-Madhagy G, Darwich K, Alghoraibi I, Al-Moraissi EA. Radiographic evaluation of alveolar ridge preservation using a chitosan/polyvinyl alcohol nanofibrous matrix: A randomized clinical study. J Cranio-Maxillofac Surg. 2023 Dec;51(12):772–9.

[48] Li F, Diao Y, Wang J, Hou X, Qiao S, Kong J, et al. Review of Cracked Tooth Syndrome: Etiology, Diagnosis, Management, and Prevention. Mallineni SK, editor. Pain Res Manag. 2021 Dec 15;2021:1–12.

[49] Alani A, Patel M. Clinical issues in occlusion – Part I. Singapore Dent J. 2014 Dec;35:31–8.

[50] Singh BP, Jayaraman S, Kirubakaran R, Joseph S, Muthu MS, Jivnani H, et al. Occlusal interventions for managing temporomandibular disorders. Cochrane Oral Health Group, editor. Cochrane Database Syst Rev [Internet]. 2017 Nov 1 [cited 2025 Mar 10]; Available from: https://doi.wiley.com/10.1002/14651858.CD012850

[51] Kathariya R, Devanoorkar A, Golani R. To Splint or Not to Splint: The Current Status of Periodontal Splinting.

[52] Singh H, Roy P, Maurya RK, Sharma P, Kapoor P, Mittal T. Nonsurgical class III correction in adolescence using modified fixed reverse twin-block therapy and fixed appliances – a case series. Folia Med (Plovdiv). 2024 Aug 31;66(4):555–67.

[53] Shen Y, Jiang X, Yu J. The combined orthodontic and restorative treatment for patients with malocclusion and dentition defects: A randomized controlled trial. Medicine (Baltimore). 2023 Sep 1;102(35):e35025.

[54] Kim TJ, Littlejohn CG, Richey KH, Falsafi N, Li C, Wang TJ, et al. A Modern Approach to Treat Molar/Incisor Pattern Periodontitis—Review. J Clin Med. 2023 Sep 21;12(18):6107.

[55] Li C, Lv Z, Shi Z, Zhu Y, Wu Y, Li L, et al. Periodontal therapy for the management of cardiovascular disease in patients with chronic periodontitis. Cochrane Oral Health Group, editor. Cochrane Database Syst Rev [Internet]. 2017 Nov 7 [cited 2025 Mar 10]; Available from: https://doi.wiley.com/10.1002/14651858.CD009197.pub3

[56] Curtis DA, Sharma A, Finzen FC, Kao RT. Occlusal Considerations for Implant Restorations in the Partially Edentulous Patient. J Calif Dent Assoc. 2000 Oct 1;28(10):771–8.

[57] Shetty S, Pitti V, Babu CLS, Kumar GPS, Deepthi BC. Bruxism: A Literature Review. 2010;

[58] Ma O. Effects of an occlusal splint compared with cognitive-behavioral treatment on sleep bruxism activity.

[59] Kui A, Pop S, Buduru S, Negucioiu M. The use of occlusal splints in temporomandibular disorders - an overview. Acta Stomatol Marisiensis J. 2020 Dec 1;3(2):3–8.

[60] Albagieh H, Alomran I, Binakresh A, Alhatarisha N, Almeteb M, Khalaf Y, et al. Occlusal splints-types and effectiveness in temporomandibular disorder management. Saudi Dent J. 2023 Jan;35(1):70–9.