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TRAUMA FROM OCCLUSION-A REVIEW

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ABSTRACT

Trauma from occlusion is an etiological factor or co-factor for periodontal disease and occurs when the occlusal forces exceed the physiologic capacity of teeth to withstand forces. Various factors and complication are clinically and diagnostically significant. There were several conceptions that whether TFO is an etiological factor or cofactor for the occurrence of periodontal diseases. Various experimental studies were done and they were somewhat contradictory and many early studies agreed that occlusal trauma in and of itself failed to result in pocket formation or loss of connective tissue attachment. The present review article discusses historical background, etiological factors, classification, tissue response, signs and symptoms, diagnostic methods, and treatment.

KEYWORDS: Trauma from occlusion, Periodontal disease, Bone loss.

INTRODUCTION

The cushioning effect is exhibited by the periodontal ligament when forces are exerted on the tooth and due to this elastic nature all teeth with normal bone support, present with physiologic mobility. When there is reduced bone support or absence of excessive occlusal forces induced by periodontal disease, tooth mobility persist due to notable changes induced by the physiologic forces on the periodontal tissues.[1] Therefore when there's a rise in occlusal forces, changes occur within the periodontium to accommodate for such forces. The changes that takes place within the periodontium depends on the magnitude, direction, duration and frequency of increased occlusal forces. The widening of the periodontal ligament space is seen when the magnitude of occlusal forces is increased. The reorientation of the stresses and strains within the periodontium occurs due to change in

the direction of occlusal forces.[2] The forces that injure the periodontium are lateral and torque forces and the duration and frequency of these forces additionally torment the response of the alveolar bone. Increase in frequency of application of intermittent forces and constant stress on the bone affects the periodontium. Trauma from occlusion could be a reversible change. Trauma from occlusion, however, doesn't undergo repair unless the offending forces are eliminated.[3] Occlusal forces acceptable to the periodontium may become traumatic if the adaptive capacity of the periodontium is debilitated.

Other terms often used are: traumatizing occlusion, occlusal trauma, traumatogenic occlusion, periodontal traumatism, Occlusal overload, Occlusal disharmony, Functional Imbalance, Occlusal dystrophy.

Historical aspects

In 1901, Karolyi was the first to introduce the idea of Bruxism, a significant factor in the pathogenesis of periodontitis. It is known as the “Karolyi effect”. Talbot did the first comprehensive study of the role of occlusal stress on teeth and he told that jaw function has been enormously diminished by modern methods of food preparation due to predisposing factors affecting the supporting tissues of the teeth.

In 1930s, Box and Stones did an experimental study in sheep and monkeys and they concluded that "TFO is an etiologic factor in the production of periodontal disease wherein there is vertical pocket formation related with one or a varying number of teeth".[4]

Stillman was the first to accentuate traumatic occlusion as a cause of periodontal disease and he reported that abnormal pressures of one tooth to its opposing tooth were responsible to produce traumatic injury and he identified that there are noninfectious changes that are directly produced by traumatic occlusion.[5] Glickman and Smulow (1960) proposed that a traumatogenic occlusion could act as a cofactor in the progression of periodontitis. This theory is known as the “co destructive theory.”[6] Goldman proved that occlusal trauma was not the cause of soft tissue lesions such as Stillman’s clefts and McCall’s festoons.[7]

Waerhaug proved the involvement of TFO in the pathogenesis of Infrabony pockets.[8]

Polson used squirrel monkeys as their animal model.[9]

Houston et al. concluded that there is no correlation between periodontal disease and bruxism; they seldom occurred in the same individual, and bruxism and occlusal status are not closely associated.[10]

Burgett et al. found no significant difference in the reduction in tooth mobility between the adjusted and the non adjusted groups.[11] Wolffe et al. stated that "a periodontium remained healthy despite the persistent forces that caused the drifting of the teeth and significant changes in occlusion."[12] Ericsson et al. showed that splinting failed to retard attachment loss or to inhibit plaque down growth. He showed that despite healthy gingival tissues, jiggled teeth lost marginal bone and had more probing depth when compared to the non jiggled.[13]

Definition

Trauma from occlusion was defined by Stillman (1917) as "a condition where injury results to the supporting structures of the teeth by the act of bringing the jaws into a closed position". The World Health Organization (WHO) in 1978 defined trauma from occlusion as "damage in the periodontium caused by stress on the teeth produced directly or indirectly by teeth of the opposing jaw".

In "Glossary of Periodontic Terms" (American Academy of Periodontology 1986), occlusal trauma was defined as "an injury to the attachment apparatus as a result of excessive occlusal force".[4]

Etilogy

Pre disposing factors

Teeth are constantly exposed to both horizontal and vertical occlusal forces. The center of rotation of the tooth acts as a fulcrum, the bone adjacent to the pressured side and tensioned side of the tooth will undergo resorption and apposition and increase in volume.[14]

Predisposing factors are divided as extrinsic and intrinsic factors.

Intrinsic factors are

Morphology of tooth i.e shape, size and number of roots, orientation of long axis of tooth, alveolar process, the quantity and quality of bone are more vulnerable to traumas.

Extrinsic factors are

Fabrication of long span bridges, plaque accumulation, injurious bone resection, parafunctional habits like clenching and bruxism, food Impaction, over hanging fillings, poor fitting crowns, ill fitting dentures.[15]

Precipitating factors such as magnitude of force, duration of force, direction of forces and frequency of force application.

Classification

Glickman's classification (1953)

According to duration of cause

1) Acute TFO
2) Chronic TFO.

According to nature of cause

1) Primary TFO
2) Secondary TFO.

Box's classification

Physiologic occlusion

Box defined it as a condition, in which the systems of forces acting upon the tooth during the occlusion are in a state of equilibrium, and they do not and cannot change the normal relationship existing between the tooth and its supporting structures.[15]

Traumatic occlusion

The damage produced in the periodontium is due to the overstress produced by the occlusion.

Stages of tissue response to increased occlusal forces[16]

Tissue response occurs in 3 stages

Stage I: Injury

Slightly excessive pressure stimulates resorption of the alveolar bone which results in widening of the periodontal ligament space. Slightly excessive tension results in elongation of the periodontal ligament fibers and apposition of alveolar bone. Due to increase in pressure produces compression of periodontal fibers, which leads to area of hyalinization and results in increased alveolar bone resorption whereas severe tension causes tearing and widening of periodontal ligament fibers and increased resorption of alveolar bone.

Stage II: Repair

The body strives to reinforce the thinned bony trabeculae with new bone when resorption of bone occurs due to excessive occlusal force and this compensation for lost bone is called buttressing bone formation (Central or peripheral buttressing bone formation) and is an important feature of the reparative process associated with trauma from occlusion.

Stage III: Adaptive remodeling of the periodontium

The destruction of the periodontium caused due to the occlusion results in remodelling since repair process cannot keep pace with the destruction. Thus, clinically there is no pocket formation and the involved teeth become mobile and radiographically results in angular defects in the bone and funnel shaped at the crest due to thickening of periodontal ligament.

Association between plaque induced periodontal diseases and trauma from occlusion

There have been numerous studies being performed to determine the mechanisms by which trauma from occlusion may affect periodontal disease. The forces that act alternatively in the opposing directions results in trauma from occlusion and they were analyzed as jiggling forces in experimental animals.

Studies were conducted to mimic these forces on humans to understand the effect produced by jiggling trauma and concurrent plaque-induced gingival inflammation. From these studies they concluded that accumulation of bacterial plaque initiates gingivitis and resulted in periodontal pocket formation that affects the marginal gingiva, therefore trauma from occlusion affects the supporting tissues and not the gingiva.

Following are the few theories that have been proposed to explain the interaction of trauma and inflammation

- Trauma from occlusion may alter the pathway of the extension of gingival inflammation to the underlying tissues. This could be due to reduced collagen density, increased number of osteoclasts, leukocytes, and blood vessels in the coronal portion of increasingly mobile teeth. Inflammation may proceed to periodontal ligament rather than to the bone and resulting in intrabony pocket formation and angular bone loss.
- Trauma-induced areas of root resorption that are uncovered by apical migration of the inflamed gingival attachment offer a favorable environment for the formation and attachment of plaque and calculus and thus being responsible for the development of deeper lesions.

- When the tooth is tilted orthodontically, supragingival plaque can become subgingival and therefore transforms suprabony into intrabony pocket.
- Increased mobility of traumatically loosened teeth may have a pumping effect on plaque metabolites, thereby increasing their diffusion.

Review of literature

Human autopsy studies

Based on these findings, two concepts were proposed

Glickman's concept- Theory of Co-destruction

This concept explained the relationship between occlusion and periodontal disease and here they described two regions in the periodontium: the zone of irritation (marginal and interdental gingiva and gingival and transeptal fibers) and the zone of co destruction (periodontal ligament, alveolar bone, cementum, transeptal and alveolar crest fibers). The plaque induced gingival inflammation was confined to the zone of irritation and Occlusal forces affected the zone of co destruction but did not cause gingival inflammation. However, occlusal trauma along with plaque induced inflammation acts as co destructive forces which results in alteration of the normal pathway of inflammation and the formation of angular bony defects and infrabony pockets.

In contrast to the co destructive theory, there was Waerhaug concept[24, 25] where it said that there was no proof that occlusal trauma caused or acted as a cofactor in the formation of angular defects. Here infrabony pockets were associated with "plaque front" or apical growth of subgingival plaque and the formation of bony defects such as horizontal or angular defects were dependent on the width of the interproximal bone. Horizontal defects were seen in narrow interproximal bone whereas angular defects were seen in wide interproximal bone.

Animal studies

Eastman Dental Center in Rochester and The Eastman group used repeated applications of orthodontic like forces on the teeth of squirrel monkeys.[26-29]

University of Gothenburg in Sweden -and the Gothenburg group used occlusal forces similar to those of a "high" restoration in beagle dogs.[30-33]

When the effects of occlusal trauma and gingival inflammation in animals were investigated, both the groups examined the effects of excessive occlusal forces on the periodontium in the

presence and absence of bacterial plaque induced periodontitis for a duration ranging from a few weeks to 6 months.

The conclusions of these studies include

- TFO alone could not cause attachment loss
- Gingival inflammation is not initiated by occlusal trauma
- A traumatogenic occlusion in the absence of inflammation will result in increased mobility, widened PDL, loss of crestal bone height and bone volume, but no attachment loss
- The excessive jiggling forces in the presence of inflammation did not cause accelerated attachment loss in squirrel monkeys (Rochester group studies) but accelerated attachment loss in beagle dogs (Gothenberg group studies)
- Treating the gingival inflammation in the presence of continuing mobility or jiggling trauma will result in decreased mobility and increased bone density, but no change in attachment level or alveolar bone level.
- When excessive occlusal forces were removed, loss of bone density was reversible, except in the presence of periodontitis.

Human studies			
Author	**Study**	**Materials and method**	**Conclusion**
Glenn J. Shefter et al 1984	**Early retrospective study** Occlusal Relations and Periodontal Status in Human Adults[34]	66 adults were taken and relations between various clinical parameters and periodontal status were evaluated.	They concluded that there was no significant deleterious influence on the status of the periodontium by occlusal disharmonies.
B L Pihlstrom et al 1986	**Epidemiologic study** Association between Signs of Trauma From Occlusion and Periodontitis[35]	He studied the association between trauma from occlusion and periodontitis by assessing a series of clinical and radiographic features at maxillary first molars.	After thorough measurements and examinations they concluded that teeth with increased mobility and widened periodontal ligament space had, in fact, deeper pockets, more attachment loss, and less bone support than teeth without these symptoms.
THOMAS I, FLESZAR et al 1980	**Longitudinal study** Tooth mobility and periodontal therapy[36]	He reported on the influence of tooth mobility on healing following periodontal therapy including both root debridement and occlusal adjustment.	They concluded that pockets seen in mobile teeth did not respond well to periodontal treatment than those of firm teeth exhibiting the same disease severity".
Stephen K. Harrel 2009	**Later retrospective study**	They evaluated relationships in humans between various	They concluded that multiple types of occlusal contacts were associated

	The association of occlusal contacts with the presence of increased periodontal probing depth[37]	occlusal contacts and the presence of deeper probing depths, reduced width of keratinized tissue, and less than favorable initial prognosis.	with deeper probing depths and the increased assignment of a less than ‘‘Good’’ initial prognosis.
Pratibha Panduranga Kundapur et al 2009	**Cross sectional study** Association of Trauma from Occlusion with Localized Gingival Recession in Mandibular Anterior Teeth.[38]	They explored the role of trauma from occlusion on the development of gingival recession.	The sign of tooth mobility, which is a feature of trauma from occlusion, appeared to be a predictor of positive association with gingival recession.
Kristiina Hakkarainenf 1986	**Non randomized interventional study** Relative Influence of Scaling and Root Planing and Occlusal Adjustment on Sulcular Fluid Flow[39]	The study was done to clarify the effects of the resolving of inflammation on one hand and the removal of occlusal trauma on the other hand based on the rate of sulcular fluid flow (SFF) from deep periodontal pockets.	It was concluded that occlusal interferences do not affect the quality of Sulcular fluid flow.
Burgett et al. (1992)	**Randomized clinical trial** A randomized trial of occlusal adjustment in the treatment of periodontitis patients[40]	Fifty subjects with periodontitis were examined at baseline and subsequently treated for their periodontal condition with root debridement ± flap surgery.22 out of the 50 patients, in addition, received comprehensive occlusal therapy.	Re-examinations performed 2 years later disclosed that probing attachment gain was on average about 0.5 mm larger in patients who received the combined treatment (scaling and occlusal adjustment), than in patients in whom the occlusal adjustment was not included.
Jorge Iván Campiño 2019	**Systemic review** Association between traumatic occlusal forces and periodontitis: A systematic review[41]	The objective of this systematic review was to analyze the available evidence for the association between traumatic occlusal forces and periodontitis. Cross-sectional studies revealed that there was a significant association between occlusal discrepancies and probing depth and clinical attachment level. However, the magnitude of the effect is negligible when groups with and without occlusal discrepancies are compared. Intervention studies revealed that there was a minimal effect on probing depth and clinical attachment level after occlusal adjustment in patients with periodontitis as compared to teeth without occlusal adjustment.	It was concluded that based on the human studies available there is limited evidence that traumatic occlusion is associated with periodontitis and to support the implementation of occlusal adjustment to significantly improve the periodontal condition in patients with periodontitis.

Clinical features[17]**-** The clinical features seen are tooth mobility, tooth pain or discomfort on chewing or percussion, tooth migration, presence of wear facets, chipped enamel or crown/root fractures, temporomandibular dysfunction and tenderness of the muscles of mastication.

Radiographic signs[18]

- Widening of periodontal ligament
- Vertical destruction of the interdental septum
- Radiolucency
- Alveolar bone condensation
- Resorption of root
- Tooth fracture.

Diagnosis[19]

Proper clinical history and clinical examination is required for the diagnosis of trauma from occlusion. Following are the diagnostic criteria: Increased tooth mobility, tilting and migration of individual teeth, hypertonicity of masticatory muscles can be checked by palpation, any deviation of the mandible can be observed in its various paths of closure by the palpation of TMJ.

Fremitus test:[19]**-** Test done to measure the vibratory patterns of the teeth during contact positions and during movements.

Treatment

The main goal of the periodontal therapy is to maintain the periodontium in comfort and function. Following are the treatment considerations that must be considered.[20]

Occlusal adjustment: Coronoplasty, dental restorations, tooth removal or by orthognathic surgery etc are done to maintain the functional relationship appropriate to the periodontium.[21]

Management of para functional habits: Para functional habit such as Bruxism causes injury to the periodontium due to its excessive forces while clenching. Thorough case history and clinical findings should be recorded for the proper diagnosis. Patients with bruxism can be treated- the behavioral modality, medications and the maxillary stabilization appliance

which remains the most universal and effective long-term means of interfering with the effects of bruxism.[22]

Splinting: An appliance used for immobilization or stabilization[23] and used to join two or more teeth to increase resistance to the forces applied.

Orthodontic tooth movement: Orthodontic treatment should be avoided with little bone support or moving the tooth in a position which will further compromise its stability and prognosis. The primary goal during application of orthodontic forces is to eliminate abnormal occlusal forces as well as to improve its long term prognosis.

Occlusal reconstruction: Occlusal reconstruction is the redesigning the occlusal contacts by giving crowns, bridges or implant-supported prosthesis.

Extraction of selected teeth: Extraction is done in cases with extensive periodontal involvement, having a poor prognosis or teeth which may improve prognosis of the remaining teeth. Extraction of certain teeth may be indicated during orthodontic treatment for proper final positioning and alignment.

CONCLUSION

Occlusal trauma is an important risk factor for the progression of an existing periodontal disease. Indecisive evidence has led to the treatment of periodontium affected with TFO on well-controlled prospective human studies. Removal of the aberrant occlusal forces and stabilization of the affected tooth is the pertinent therapy for teeth affected by TFO.

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