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Common Etiologies of Generalized Tooth Mobility: A Review of Literature

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Abstract

Background and Aim: Tooth mobility, which is prevalent among patients seeking dental healthcare services, happens when the tooth is reversibly displaced horizontally or vertically beyond its normal physiological limits. Tooth mobility is classified into 2 subgroups: localized and generalized. Generalized tooth mobility occurs when more than 2 teeth are mobile. In this review, the available studies regarding the common etiologies of generalized tooth mobility are discussed.

Materials and Methods: In this review article, data were collected by reviewing the available articles published between 2011 to 2021 in national and international journals by searching the PubMed, PubMed Central, Medline, EBSCO, Google Scholar, and Embase databases using the key words "Tooth Mobility", "Tooth Movement" "Periodontal Disease", "Systemic Disease", and "Malignant Disease". Among the relevant articles, 51 were chosen.

Results: It seems that numerous etiologies, which can be either physiological or pathological, can result in generalized tooth mobility.

Conclusion: Since an optimal treatment outcome depends on accurate diagnosis, it is crucial for the dentists to be aware of the common etiologies of this condition.

Key Words: Periodontal Diseases; Tooth Mobility; Literature Review

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Introduction

Tooth mobility refers to horizontal or vertical tooth displacement upon force application [1].

Periodontal disease is one of the most common etiologies suggested for this condition. Moreover, many other factors may cause tooth mobility such as inflammation of periodontal tissue, periodontal ligament (PDL) widening, alveolar bone loss, trauma from occlusion, and attachment loss. Profound assessment of these factors is imperative as tooth mobility is one of the essential symptoms of periodontal disease. Therefore, primary objective of periodontal treatment is to decrease the factors contributing to tooth mobility [2].

Tooth mobility may cause various side effects such as occlusal instability, chewing disorders, esthetic problems, and decreased quality of life, hence prompting dental attendance [1].

Generalized tooth mobility occurs when more than 2 teeth are involved. Different etiologies have been proposed for generalized tooth mobility which can be classified into 2 groups: pathological and physiological [3]. There are several systemic diseases such as

diabetes mellitus, hyperparathyroidism, etc. that can predispose the teeth to generalized mobility [4].

In order to obtain optimal treatment result, the etiology of mobility should be properly diagnosed [5]. This study provides an overview of the most common etiologies of generalized tooth mobility reported in the literature.

Materials and Methods

Databases including PubMed, PubMed Central, Medline, EBSCO, Google Scholar, and Embase were searched for articles yielding 89 relevant English articles and 5 Persian articles published between 2011 to 2021, which had one of the keywords of "Tooth Mobility", "Tooth Movement", "Periodontal Disease", "Systemic Disease" and "Malignant Disease" in their titles. A total of 49 English articles, and 2 Persian articles were selected by the researcher for final analysis. Moreover, 7 relevant textbooks were initially selected by the authors and 5 of them were used for this study.

Results

Several studies have suggested different etiologies for generalized tooth mobility. Among them, 5 relevant studies based on their subject and publication date were chosen to be discussed in detail (Table 1). As shown, it is rational to consider a strong relationship between physiological or systemic conditions and generalized tooth mobility [6-10].

Discussion

Tooth mobility is a possible aggravating co-factor for periodontal disease [11]. Generalized tooth mobility due to PDL widening is the result of unidirectional or multidirectional forces applied to the crowns that are adequately high and frequent to induce resorption of alveolar bone at the pressure zones [11,12]. Its effective management has a prominent effect on the outcome of periodontal treatment. For efficient clinical management of tooth mobility, it is imperative to have a trustable and standard diagnostic method which can precisely measure and quantify tooth mobility [11].

As a universal instruction, mobility is graded clinically by applying steady force with either two metal instruments or one metal instrument and a gloved finger, and is categorized into 4 grades:

Grade 0: Regular movement

Grade I: Slightly more than standard (<0.2 mm horizontal movement)

Grade II: Moderately more than standard (1-2 mm horizontal movement)

Grade III: Severe movement (>2 mm horizontal or any vertical movement)

These grades have a profound impact on the treatment plan suggested for patients with tooth mobility [13].

Types of Tooth Mobility

There are 2 major types of tooth mobility:

(I) Physiological tooth mobility: This type of mobility is a limited tooth movement or displacement which is allowed by resilience of an intact periodontium when a moderate force is applied to the crown of a tooth. Physiological tooth movement of about 0.25 mm is observed in a sound tooth [14]. This is due to lack of attachment between the tooth and jawbone, but on the other hand, the connection of tooth and the socket walls is kept stable by the PDL. This
minor movement is intended to normalize heavy pressures applied to the teeth in various functions including mastication to prevent damage [15].

(II) Pathological tooth mobility: This type of tooth mobility includes any level of movement that may be reduced or eliminated once the pathological etiology is identified and corrected [14].

Etiologies of generalized tooth mobility:

Table 1. Some trials on possible etiologies of tooth mobility

Author	Number of patients	Assessment method	Results
Ait Addi et al. (2018) [6]	53 pregnant women and 52 non pregnant women	Gingival index	During pregnancy, dental mobility increases
Hwang et al. (2010) [7]	20 patients treated with edgewise appliances	Intraoral observation	Tooth mobility had the highest score in the first six months after treatment.
Ojehanon et al. (2017) [8]	49 diabetic patients	Oral examination and Miller's mobility index	It was revealed that age of diagnosis of diabetes with tooth mobility was higher than previously reported. Moreover, the most mobile teeth and earliest teeth to become mobile were the mandibular incisors.
Roba et al. (2018) [9]	30 children with Down syndrome	Periodontal and O Leary index	There is a high prevalence of periodontal disease including tooth mobility in young people with Down syndrome
Fageeh (2018) [10]	2 case reports of Papillon-Lefèvre syndrome	Intraoral examination	There was a significant degree of periodontal breakdown including tooth mobility at an early age.

Two major etiologies have been suggested for generalized tooth mobility with several subgroups:

I) Physiological: Physiological tooth mobility is diagnosed when there is no pathological cause related to tooth movement. Physiological tooth movement can be due to two reasons:

A) Woman's sex hormones: Generalized tooth mobility is prominently amplified during prenatal period and is often slightly elevated with the menstrual cycle or the use of hormonal contraceptives [4]. On the other hand, a trial performed by Mishra et al. [16] showed no substantial change in generalized mobility of the teeth during menstruation.

In another trial performed by Mishra et al. [17], the link between female sex hormones, especially in gestation, and tooth mobility was confirmed. It was shown that the most substantial change in mobility occurred throughout the third trimester of pregnancy and most exclusively in the last month of gestation.

B) Orthodontic treatment: Orthodontic tooth movement by a multi-bracket appliance causes permanent tensile and compressive strains in the PDL and the surrounding bone. The subsequent remodeling process results in widening of the alveolar socket, decreases stiffness of the PDL, and leads to eventual movement of teeth accompanied by increased mobility and decreased restoring force [18]. Such orthodontically produced effects and increased generalized tooth mobility remain for a certain period after appliance removal, whereat post-treatment mobility reduction shows inter-individual differences. Root resorption is an additional risk of orthodontic therapy which can lead to an increase in tooth mobility [19].

II) Pathological: Pathological tooth mobility is seen when there is a diagnosable pathological pathway related to tooth mobility. This type of tooth movement can be mobility.
This type of tooth movement can be classified into 8 subgroups:

A) Periodontal disease: Periodontitis, which is an advanced form of periodontal disease, leads to tooth-supporting soft and hard tissue disruption; thus, it finally causes tooth mobility in severe cases. The mechanism through which

periodontitis induces tooth mobility includes inflammatory destruction of the periodontal tissue, widening of PDL, attachment loss, alveolar bone loss, and occlusal trauma. The tooth mobility associated with periodontitis may require specific treatments based on the stage of periodontitis.

Occlusal adjustment which is also known as selective grinding is performed to create harmonious occlusal contacts between the maxillary and mandibular teeth. The aim of occlusal adjustment is to establish a stable occlusal relationship and to maintain optimal occlusal function [5].

Splinting is a procedure by which a mobile tooth is connected to its neighboring tooth to better withstand the applied forces. One advantage of splinting is stabilization of mobile teeth by forming a firm unit, minimizing tooth mobility and enhancing the occlusal function of teeth. Before splinting, occlusal adjustment is performed in order to reduce tooth mobility by decreasing the occlusal forces [20].

B) Diabetes mellitus: This common disease is a metabolic disorder which is characterized by chronic hyperglycemia. Type 1 diabetes mellitus is mostly found in children and adolescents, whereas type 2 affects adults. About 90%–95% of all patients with diabetes are type 2. Insulin resistance is usually seen in patients with type 2 diabetes mellitus, which changes the absorption of endogenously produced insulin by the target cells. Insulin production is amplified during early stages of disease, resulting in hyperinsulinemia. Nevertheless, as the condition continues, the insulin production decreases leading to insulin deficiency. Both types 1 and 2 diabetes mellitus have a genetic predisposition, but the etiology of type 2 is also significantly related to lifestyle aspects including high fat and sugar intake, physical inactivity, and obesity [21].

There is a prominent relationship between glycemic status and generalized tooth mobility. This is probably due to decreased bone growth and mineralization in insulin deficiency. Vascular changes also cause an increase in blood glucose level [22].

C) Osteonecrosis: Osteonecrosis of the jaw (ONJ) is classically considered a disturbance of vascular supply or a vascular necrosis with exposure of jawbone [23]. ONJ is characterized by presence of necrotic, exposed bone in the jaw. Therefore, one of the most significant clinical symptoms of ONJ is generalized tooth mobility [24].

D) Oral cancer: Oral squamous cell carcinoma is a common type of oral cancer that leads to gingival edema followed by generalized tooth mobility [25].

E) Hyperparathyroidism: This condition is related to the hyper-activity of parathyroid glands. Generalized tooth mobility is one of the most common symptoms seen in both primary and secondary hyperparathyroidism due to bone loss occurring during this condition [26,27]. Moreover, diffuse bone loss in the jaws can easily be detected in this condition (Figure 1) [28].

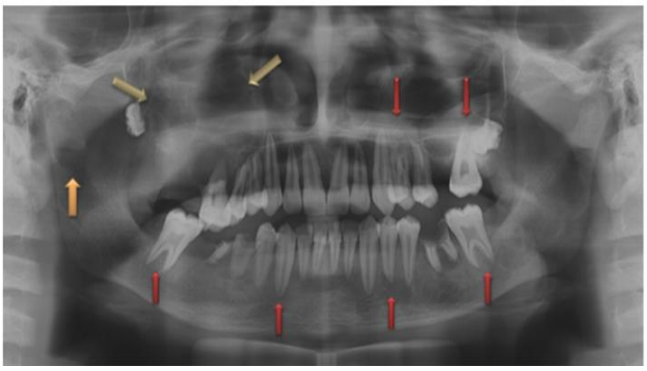

Figure 1. Preoperative radiograph representing multilocular radiolucency of maxilla, generalized loss of lamina dura, and unilocular radiolucency in condylar region

F) Burkitt lymphoma, which is a B-cell tumor can lead to diffuse neoplastic osteolysis in areas of the alveolar process which results in loss of supporting alveolar cortical bone [15]. Hence, there are several patients suffering from this tumor who exhibit generalized tooth mobility [29].

G) Down syndrome: This syndrome is the most prevalent neurodevelopmental disorder of known genetic cause. Down syndrome has usually been described to be arising from an extra copy of chromosome 21 and presenting with characteristic features including facial dysmorphology, a proportionally large tongue, low muscle tone, short stature, and intellectual disability [30].

Periodontal disease is one of the most significant oral health problems in patients with Down syndrome. Several factors such as immunological deficiency, poor oral hygiene, fragile periodontal tissue, early senescence, and masticatory malfunction may be responsible for this syndrome. Moreover, it is also probable that short tooth roots are the reason of tooth mobility and subsequent loss in such patients [31].

H) Papillon-Lefèvre syndrome: Papillon-Lefèvre syndrome is an uncommon syndrome characterized by diffuse palmoplantar erythematous, fissured hyperkeratosis and aggressive periodontal disease which initiates in early periods of childhood. The periodontal disease witnessed in this disorder may contribute to generalized tooth mobility [32].

I) Chediak-Higashi syndrome: Chediak-Higashi syndrome is a rare childhood hereditary disorder caused by mutations in the regulator gene which can be fatal if left untreated [33].

Periodontal disease in Chediak-Higashi syndrome initiates with an early onset periodontitis with premature exfoliation of both dentitions and generalized bone resorption. In addition, an aggressive and recurrent periodontitis which tends to cause generalized tooth mobility can be frequently seen in this syndrome [34].

J) Congenital neutropenia (Kostmann syndrome): Neutropenia is a granulocyte disorder characterized by a significantly low number of neutrophils. Some people are born with it which in this case the condition is called congenital neutropenia. Severe and diffuse gingival inflammation, generalized tooth mobility, alveolar bone loss, and early tooth loss in both dentitions have also been reported in this syndrome [35].

K) Cyclic neutropenia: Cyclic (periodic) neutropenia is an uncommon disease identified by cyclical depression of peripheral blood polymorphonuclear leukocyte count at 21-day intervals. Oral manifestations of this condition are similar to congenital neutropenia, and generalized tooth mobility can be seen in both diseases [35].

L)Hypophosphatemia: Hypophosphatemia (X-linked) is a prevalent congenital disorder of renal tubular transport. Dental clinical symptoms can be the initial manifestations of the disease and include mobile, abscessed teeth with fistulous tracts, leading to early loss of teeth [4].

M) Scurvy: Scurvy which results from vitamin C deficiency, is perceived as occurring rarely [36]. This disease has different oral manifestations out of which gingival pain, swelling, bleeding and generalized tooth mobility are more frequent [37].

N) Osteoporosis: Osteoporosis is a disorder in which the bones lose their density and become susceptible to fracture [38]. A link has been suggested between osteoporosis and bone loss. The jawbone supports and anchors the teeth [39]. When the jawbone loses its density, tooth loss is expected, specifically in older adults. On the other hand, other studies found a link between alveolar bone loss and increased generalized tooth mobility and tooth loss (Figure 2) [39,40].

O) Langerhans cell histiocytosis:

Langerhans cell histiocytosis is a rare disease identified by intense and abnormal proliferation of bone marrow-derived immature myeloid dendritic cells. Oral manifestations of this syndrome comprise gingival bleeding, tooth mobility, and pain

which are reported to be the most recurrent symptoms [41].

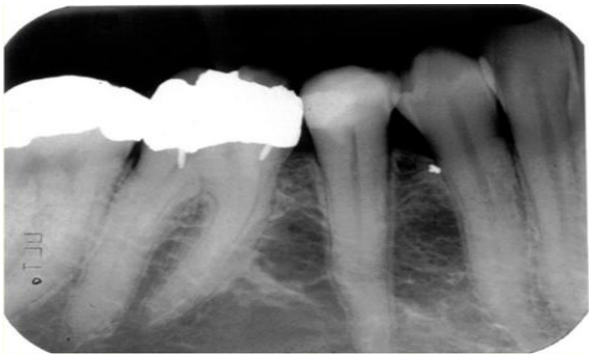

Figure 2. Radiograph of a patient with osteoporosis which shows the trabecular network is disrupted in two locations around the second premolar

P) Inflammatory bowel disease: Inflammatory bowel disease (IBD) consists of 2 major disease entities: Crohn's disease and ulcerative colitis; they are characterized by chronic inflammatory involvement of the gastrointestinal tract with relapsing and remitting courses.

Frequent oral manifestations in patients with inflammatory bowel disease include hypertrophy and nonspecific swellings of the mucosa and lips, swelling of gingival soft tissue resembling epulis fissuratum, cobblestone appearance of the buccal mucosa or palate, and aphthous-like ulcerations or deep yellowish white ulcers within the vestibule and gingiva; but tooth mobility is a very uncommon finding in such patients [42].

Q) Ehlers-Danlos syndrome: Ehlers-Danlos syndrome is a genetically heterogeneous inherited connective tissue disorder with various clinical manifestations [43]. Early onset generalized periodontitis is the main clinical finding in Ehlers-Danlos syndrome type VIII which leads to mobility and premature deciduous and permanent tooth loss. Repeated gingival damage due to increased mucosal fragility may present as recurrent gingival inflammation/infection. In addition, loss of gingival attachment and pathological migration of teeth is also a frequent finding in such patients [44].

R) Gaucher disease: Gaucher disease is the most common of inherited metabolic disorders [45]. Among the most prevalent clinical symptoms of this disease are osteoporosis and osteonecrosis, which both can lead to periodontitis accompanied by generalized tooth mobility [46].

S) HIV Infection: HIV infection suppresses the immune system of the body which can induce periodontal changes and may eventually cause periodontitis. Since prevalence and severity of periodontitis are higher in HIV-infected patients compared with healthy people, generalized tooth mobility can be assumed to be one of the oral manifestations in these patients [47].

T) Localized aggressive juvenile periodontitis: Localized aggressive periodontitis is characterized by aggressive attachment loss and bone loss which may occur mostly in children without clinical evidence of systemic disease [48]. This disease may exhibit external and internal root resorption patterns associated with periodontal bone loss, independent of other contributing factors which can ultimately cause tooth mobility [49].

U) Hyperimmunoglobulin E syndrome: Hyperimmunoglobulin E syndrome is a multisystemic disease with a broad constellation of clinical manifestations. Some of the most common oral presentations of this syndrome include bone and periodontal involvement which can lead to generalized tooth mobility [50].

V) Rheumatoid arthritis: Rheumatoid arthritis (RA) is a chronic systemic autoimmune disease with synovitis and joint destruction. One study showed that more than half of RA patients suffered from periodontitis, but there was no significant correlation between RA and severity of periodontitis. Periodontitis in RA patients may cause

generalized tooth mobility at higher levels of the disease [51].

Indices used to measure tooth mobility:

Various indices have been suggested to measure tooth mobility throughout the years but only a few of them are still qualified. The most common indices which are still being used are listed below:

I) Miller index: Miller index is the most frequently used index for clinical classification of tooth mobility. Mobility is detected by applying a controlled force on either side of the tooth using an instrument (most commonly a dental mirror handle) and it is scored subsequently. The tooth is held firmly between 2 instruments and moved back and forth. Mobility is scored on a scale of 0–3 as follows:

0: no detectable movement when force is applied

1: greater than normal movement (physiological)

2: no greater than 1 mm in buccolingual direction

3: movement of more than 1 mm in buccolingual direction and depressible

Since this classification determines tooth mobility in a linear quantity, it cannot clarify the causes for tooth mobility [52].

2) Modified Tooth Mobility Index: This index uses a scoring system from 1 to 5 (Table 2) [53]. This index has limitations in that 3 of the 5 possible scores are reserved for highly mobile teeth [52].

3) GERT index: The GERT index is a new index that expounds the linking of the grade of mobility, its etiology, radiographic appearance, and treatment plan and would be an invaluable addition to the existing repertoire of indices for tooth mobility. However, further studies are required to assess the validity and reliability of this new index and facilitate its application in clinical practice [53].

Clinical presentations and laboratory tests as diagnostic tools:

Clinical presentations of each disease can be a significant tool for diagnosis. In addition, laboratory tests can be helpful as well to meet this end. In Table 3, clinical manifestations and laboratory tests needed to diagnose diseases that were named in this article are presented [54-56].

Table 2. Modified tooth mobility index

Grade of mobility	Interpretation
Grade 0	Horizontal mobility under 0.2 mm
Grade I	Horizontal mobility ranging from 0.2 to 1 mm
Grade IIa	Horizontal mobility ranging from 1 to 2 mm
Grade IIb	Horizontal mobility ranging from 1 to 2 mm with vertical mobility or dispersibility
Grade IIIa	Horizontal mobility ranging from 2 to 3 mm
Grade IIIb	Horizontal mobility ranging from 2 to 3 mm with vertical mobility or dispersibility
Grade IV	Horizontal mobility exceeding 3 mm with or without vertical mobility or dispersibility

Table 3. Clinical presentations and laboratory tests required to achieve an accurate diagnosis

Disease or Condition	Clinical or Laboratory Symptoms	Diagnostic Process
Diabetes Mellitus	Polyuria, Polyphagia, Polydipsia	Take History, Fasting Blood Sugar Test
Squamous Cell Carcinoma	Red Nodule or Ulcer	Take History, Histopathological Evaluation
Langerhans Cell Histiocytosis	Chronic cough, Dyspnea, Chest pain, Recurrent Pneumothoraxes	Complete Blood Count, Jaw Radiography
Inflammatory Bowel Disease	Cramping, Weight Loss, Fever, Sweats, Malaise, Arthralgia	Fecal Occult Blood Test, Colonoscopy, Endoscopy
Ehlers-Danlos Syndrome	Joint Hypermobility, Hyperextensible skin, Tissue Fragility	Clinical and Genetical Evaluation
Gaucher Disease	Anemia, Bone Crisis, Thrombocytopenia, Liver Enlargement	Beta-Glucosidase Leukocyte
Hyper immunoglobulin E Syndrome	Skin Abscesses, Retained Primary Teeth, Scoliosis, Fractures with Minor Trauma	Complete Blood Count
Rheumatoid Arthritis	Pain and Stiffness in More Than One Joint, Weight Loss, Fatigue, Fever, Weakness	Anti-CCP, RF, CRP, ANA, ESR
Hyperparathyroidism	Fatigue, Weakness, Constipation, Nausea	Take History, Evaluation of Serum Parathyroid Hormone, Calcium, Phosphor, Alkaline Phosphatase
Burkitt Lymphoma	Soft Tissue Mass, Rapidly Enlarged Cervical Lymph Nodes	Take History, Complete Blood Count, Biopsy
Down Syndrome	Flattened Face, Small Head, Short Neck, Protruding Tongue, Epicanthic Fold	Chorionic Villus Sampling
Papillon-Lefevre Syndrome	Dry Scale Patches of Skin	Molecular Genetic Testing
Chediak-Higashi Syndrome	Partial Albinism, Photosensitivity, Bleeding Diatheses, Muscle Weakness	Histopathological Evaluation
Neutropenia	Muscle Weakness, Fatigue, Bone Pain, Confusion, Loss of Appetite	Serum Phosphate Level Evaluation
Hypophosphatemia	Dry Scaly Patches of Skin	Molecular Genetic Testing, Serumic Evaluation of Calcium, Phosphor, Alkaline Phosphatase
Scurvy	Anemia, Debility, Exhaustion, Spontaneous Bleeding	Take History, Blood Test, Evaluation of Vitamin C in Body

Conclusion

Numerous etiologies have been described for generalized tooth mobility which can be either physiological or pathological. Since an optimal treatment outcome depends on an accurate diagnosis, it is crucial for the dentists to be aware of the common etiologies of this condition.

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