RESEARCH ARTICLE | JANUARY 10 2019

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AIP Conf. Proc. 2058, 020036 (2019)
https://doi.org/10.1063/1.5085549

Research Progress of Orthodontic Treatment and Periodontal Health

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Abstract. People have increasing demand on orthodontic treatment, adult orthodontic treatment is always accompanied by periodontal diseases, including gingivitis and periodontitis. However, the correlation between orthodontics and periodontal health is not clear, which troubles the clinical orthodontist during plan of orthodontic plan. Orthodontic treatment and periodontal health are reviewed in the paper, thereby providing ideals for clinicians to formulate therapeutic schedule and implementing future fundamental orthodontics and periodontalresearch.

Key words: Orthodontics; Periodontal Health; Gingivitis; Periodontitis; Treatment.

INTRODUCTION

People attach more and more attention to oral health and maxillofacial beauty with social progress and economic development in recent years. Patients seeking orthodontics are increasing. Orderly arrangement after orthodontics and dental arch with sound occlusion relationship are beneficial for teeth self-cleaning and health maintenance, which are beneficial to the health of teeth. Some studies show that occlusion patients prominently improve the oral hygiene habits during acceptance of orthodontic treatment, such improvement benefits the patient for the whole life. However, periodontal health suffers from potential risks during orthodontic process due to orthodontic appliance, poor oral condition of the patient himself and bad oral hygiene habit, etc. Oral orthodontist pays close attention to the periodontal health status of patient before and during orthodontics, thereby formulating orthodontic design scheme and orthodontic force. However, orthodontics has many influence factors on periodontal condition, which is a result of multiple factors. Now, the research progress of orthodontics and periodontal health is reviewed.

PERIODONTAL DISEASE AND ORTHODONTIC TREATMENT

More and more adult patients seek orthodontic treatment with the improvement of people's living level. However, many people may suffer from periodontal disease at some degree [1]. Periodontal disease is a disease category which occurs in the periodontal support tissue. It is also a result of joint action among bacterial factors, environmental factors and host factors. Liu Xuenan[2] analyzed single factors and multiple factors aiming at the relationship between the gingiva hemorrhage and plaque. It is concluded that Chinese population has high prevalence of gingiva bleeding and plaque. Six indicators of basic characteristics, oral hygiene habit, medical behavior, knowledge attitude, social economic conditions and living habit have influence on periodontal health at different degrees, wherein poor oral hygiene condition is the most important influencing factors. There is still no unified understanding on the relationship between malocclusion deformity and periodontal disease. One viewpoint shows that dental calculus is easily formed by irregular teeth arrangement[3,4]. Another viewpoint shows that they are not directly related to each other aiming at patients under good oral hygiene condition mainly because the behavioral factors play a key role[5]. When periodontal diseases are developed to the late stage, it can cause the teeth tilting to lip, elongation, twisting, generalized spacings among teeth, etc, namely tooth drift [6]. These changes may be caused due to the following reason:

International Conference on Frontiers of Biological Sciences and Engineering (FBSE 2018)
AIP Conf. Proc. 2058, 020036-1–020036-5; https://doi.org/10.1063/1.5085549
Published by AIP Publishing. 978-0-7354-1786-1/$30.00

periodontal ligaments are no longer able to stabilize teeth and resist external force [7]. Generalized spacings among anterior teeth can be caused in teeth with periodontal diseases, especially incisors which are most prone to pathological shift and elongation. These pathological changes not only affect aesthetics, but also cause occlusion changes, and interdisciplinary treatment is always required. Periodontal disease is not necessarily a contraindication of orthodontic treatment. Orthodontic treatment is of great significance for periodontal disease and generalized spacings caused by periodontal diseases. Its occlusion function and predental aesthetics are reestablished through orthodontic treatment. However, its alveolar bone and soft tissue structures may pose considerable challenges to orthodontic treatment. Therefore, the orthodontic treatment of periodontal disease patients should be implemented by orthodontist and periodontist jointly. Periodontist is particularly important in the orthodontic treatment of periodontal disease patients. Studies have shown that orthodontic treatment will accelerate the further deterioration of periodontal disease [8] even if good oral hygiene is maintained aiming at patients in periodontal disease active stage. Therefore, orthodontists must communicate with periodontists sufficiently before orthodontic treatment to ensure the smooth operation of orthodontic treatment. Albandar [9] compared the attachment loss level of patients with positive and negative gingivitis and dental calculus before acceptance of orthodontic treatment six month after treatment. Results show that the attachment loss level of patients with positive gingivitis and dental calculus is prominently higher than negative patients, and the difference is statistically significant. Therefore, it is necessary to control periodontal disease and attachment level in the normal range before and during orthodontic treatment, thereby preventing patients from rapid attachment loss. Du Lingchen [10] adopted periodontal- orthodontics joint treatment on 42 patients of anterior displaced incisors due to periodontal diseases. It is concluded that periodontal-orthodontics joint treatment can be applied to patients who are younger than 40 years old and suffer from anterior displaced incisors, and patient periodontitis symptoms can be effectively controlled, which is beneficial for eliminating biting trauma with long-term stable treatment effect. Yao Shuang[11] observed and analyzed the curative effect of orthodontic treatment on periodontitis vertical bone resorption patients. It is obvious that low friction and light force orthodontic treatment can quickly line up teeth, eliminate occlusal trauma, promote reconstruction of alveolar bones with vertical resorption, reconstruct occlusal balance, and improve periodontal health condition. Good periodontal condition is the prerequisite for the success of orthodontic treatment. Patients with periodontal disease need periodontal treatment conducted by periodontist. Orthodontic treatment can be started when periodontal disease condition is stable and at the time of rest.

INFLUENCE OF ORTHODONTIC TREATMENT ON SOFT TISSUE

Orthodontic treatment may also have adverse effects on periodontal tissue. Many scholars have studied the relationship between orthodontic treatment and patient periodontal condition. Wherein, some scholars believe that: both fixed orthodontic appliance and functional orthodontic appliance may produce high influence on supragingival dental plaque aggregation and gingivitis, oral orthodontic appliance increases the number of acidogenic biofilms so as to increase the risk of gingivitis and dental caries[12]. Other scholars believe that periodontal condition can be restored to similar level before treatment after the orthodontic appliance is removed. Orthodontic treatment does not cause permanent damage to periodontal health [13].

Gingiva Hyperplasia Caused by Orthodontic Treatment

It is proved that fixed orthodontic appliance can cause temporary oral microbiome change. Main clinical manifestations include periodontal probing depth increase, probing hemorrhage, gingiva redness and hyperplasia. However, the extent of fixed orthodontic appliance to produce permanent negative effect on patient periodontal area has not been confirmed. It is very difficult to maintain patient oral hygiene in the process of orthodontic treatment according to the existing evidence from the aspect of orthodontic treatment of longitudinal clinical studies. Ban provides a favorable environment for the concentration of dental plaques [4]. The band not only affects the patient's supragingival tissue, but also destroys its alveolar ridge. 85% bands can lead to the destruction of patient cervical connective tissue and displacement of epithelium [14]. The influence of bracket and band on related index of periodontal health was compared in a random control experiment, and Paschos [15] found that: the probing depth of teeth with band, gingiva index and IL -1β value were higher than teeth with brackets, and the difference was statistically significant ($P = 0.0001$). One study showed that the condition was prominently improved within 48h after removal of orthodontic appliance though the band can lead to patient gingiva hyperplasia and periodontal probing depth[16]. Gingival inflammation hyperplasia caused by the change of oral normal flora is temporary. After the orthodontic appliance is removed, the inflammation will be reduced, and no permanent adverse effects will be caused

to periodontal tissues. Gomes[17] conducted a comparison of periodontal status between patients after orthodontic treatment and patients in non-treatment group. It was discovered that there was no significant difference in periodontal correlation index between the two groups. The band and bracket bonding adhesive, especially the adhesive residue monomer, is easy to gather the dental plaques in addition to the stimulation of band. The gingival tissue toxicity stimulus should not be ignored.

Gingival Recession Caused by Orthodontic Treatment

Soft tissue and cementum thinning is the precondition of gingival recession, the gingival recession probability is 1.3%-10% in orthodontic treatment [18]. If keratinization gingival recession is ore more than 2mm, orthodontics force should be avoided to avoid further regression of gingiva [19]. Some scholars have shown that patients with severe chronic human periodontitis suffer from a certain degree of gingiva atrophy at the end of orthodontic treatment regardless of thin gingiva or thick gingiva. The proportion of individual gingiva atrophy with orthodontic treatment history is higher than that of no orthodontic treatment history [20]. After rapid maxillary expansion and gingival recession were studied, it was discovered that regression of adult maxillary premolars and molar buccal gingiva is likely to occurif maxillary expansion is implemented after patient palatine closure. Carmen [21] proposed that rapid maxillary expansion by surgical method is compared with orthodontics method, the former may double the gingival recession probability of maxillary premolars and molar. Kanzaki [22] compared gingival recession situation of patients with tooth extraction and non-tooth extraction after orthodontics aiming at adult patients with chronic periodontitis. It was discovered that the post-orthodontics incisor area black triangle is a disease caused by many factors [23]. Mavreas [24] studied the curative effect of Damon2 passive self-locking on periodontitis patient, and suggested that self-locking orthodontic appliance force should be gentle for avoiding hyalinization of periodontal tissue and alveolar bone resorption. Pandis[25] compared periodontal related indexes in application of self-locking bracket and traditional bracket patient 3┼3, and it was discovered that there was no obvious difference between them.

INFLUENCE OF ORTHODONTIC TREATMENT ON SCLEROUS TISSUE

The adverse effects of orthodontic treatment on sclerous tissue include alveolar bone resorption and dental root resorption [26]. Bone fenestration and bone open fracture are special manifestation forms of alveolar bone resorption. Maximum orthodontic force undertaken by the periodontal membrane can be considered in each patient's treatment plan because of orthodontic treatment side effects, and the the maximum movement scope of teeth without adverse effect is the most controversial topic. Tooth movement range has own boundary. Though it was discovered in classic textbook that our teeth are moved in the "Envelop" scope [27], several factors affecting the tooth movement scope include alveolar bone anatomy, periodontal tissue adhesion level, nerve muscle strength, lip-tooth relationship, etc. It is generally believed that tooth movement has strict physiological and anatomical boundaries, and periodontal support tissues are reduced if the tooth movement exceeds the physiological boundaries. Therefore, the orthodontic tooth movement beyond the anatomical boundaries should be avoided in clinics. If orthodontics masked treatment cannot achieve the orthodontic goal, and excellent orthodontic effect can be reached through facial bone reconstruction repair or orthognathic surgery associated with orthodontic treatment [28]. However, we do not know the boundary of orthodontic tooth movement promoting periodontal tissue damage at present. Clinical regular application of CBCT can better assist us to position the 3D position of the tooth in alveolar bone, and it has excellent guidance role to orthodontic tooth movement, thereby reducing reduce the risk of bone fenestration and bone open fracture. There is evidence to prove that adult patients suffering from severe congestion accompanied by periodontal support tissue reduction can be successfully treated through excellent orthodontics force control system. It may be caused by different responses of different therapeutic mechanism tissues. Alveolar bone is highly variable periodontal supporting tissue with the orthodontic tooth movement generally. Excessive tilt molar, trauma deep biting, tooth premature contact are likely to damage to the periodontal health and periodontal status stability.

Dental root resorption is one of the adverse reactions of the orthodontic tooth movement, which has been widely concerned by orthodontics scholars. However, the degree of dental root resorption depends on a number of factors. Maués [29] studied orthodontics dental root resorption, and it is obvious that the maxillary central incisor is most likely to suffer from dental root resorption followed by maxillary lateral incisor and mandibular lateral incisor. The risk factors of dental root resorption include the overbite upper maxillary anterior teeth ≥5mm before treatment, tooth extraction treatment, long treatment course, and the formation degree of pre-treatment dental root. In addition, the late periodontal diseases is often accompanied by front tooth elongation shift, thereby causing trauma deep biting, c soft

tissue and sclerous tissue trauma. Elongated front teeth should be lowered to rebuild patient occlusion during orthodontic treatment under the condition. The dental root resorption during teeth intrusion is four times of tooth elongation movement [30]. Each clinician should realize that tooth elongation may also result in dental root resorption.

CONCLUSION AND RESEARCH PROSPECTS OF ORTHODONTIC TREATMENT AND PERIODONTAL HEALTH

The above content is the research progress of scholars about the influence of orthodontic treatment on periodontal tissue, which provides certain reference for clinical treatment. However, mutual effect among various influence factors are not compared. Periodontal tissue disease is the result of multiple factors, and dental plaque is the initiating factor, but it is also regulated by the patient's systemic and local factors. Orthodontic treatment has been accepted by more and more people, wherein more and more patients with periodontal disease are seeking orthodontic treatment, but related risk factors can not be made clear aiming at the influence of orthodontic treatment on periodontal tissue. It is accompanied with some side effects including root resorption, bone fenestration, bone open fracture and periodontal soft tissue can not be forecast and controlled. In addition, soft tissue response is unpredictable, which may be affected by several factors. Therefore, a well-designed and long-term prospective study is needed to identify these patient and/or therapeutic factors. The loading, transmission and action mechanism of orthodontic force is a complex network in orthodontic treatment which has not been thoroughly studied. In addition, the influence on periodontal tissue is a new hotspot in future research with the promotion and use of new technology and new material in the field of orthodontics. Therefore, the influence of orthodontic treatment on periodontal tissue should always be taken seriously in order to better guide clinical work.

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