



## Review Article

## Adverse effects of orthodontic tooth movement on endodontically treated teeth-An overview

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## ABSTRACT

Orthodontic tooth movement (OTM) can be possibly performed on endodontically treated teeth with remarkable outcomes. There is however a scarcity of adequate knowledge and data regarding the crisp association between endodontics and orthodontic treatment. This association comprises of various effects involving the pulp and periodontium that occurs as a result of orthodontic treatment. It is hence always suggested to apply adequate and appropriate amount of occasional forces that would bring about satisfactory tooth movement. This would in turn restrict pulpal damage, and also aid in its healing. Thus, proper evaluation of such endodontically treated case with a thorough clinical and radiographical assessment before orthodontic treatment is primarily important prior to orthodontic treatment. Hence, this review portrays a brief image about the various adverse effects of OTM on endodontically treated tooth.

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### 1. Introduction

Orthodontic-Endodontic consideration is one of the significant issues in the field of Dentistry that has been conversed and reviewed since ages. The orthodontic tooth (OTM) movement of endodontically treated teeth has become a mundane treatment for the elderly patients (undergoing orthodontic treatment) due to increased awareness and demand for aesthetics. It is usually observed that these patients present with a high rate of imperfectly root-canal-treated teeth.<sup>1</sup> Orthodontic treatment could produce certain hostile effects during the course of the treatment in relation to the patient or clinician. Some of these effects (such as root resorption), are not comprehended completely while few have correlation with orthodontic treatment deprived of secondary substantiation. Hence, it is imperative to assess the risk factors preceding such treatment procedures. Some of the deleterious effects include root resorption, pain, pulpal changes, periodontal disease, decalcification, and temporomandibular dysfunction (TMD).<sup>2</sup>

The need of orthodontic treatment in endodontically treated teeth is quite a frequent requisite. However, the factors that forms the basis for clinical decisions and biological alignments normally applied is based on the collective data relevant to inflammation, tissue repair, tooth movement biology and accompanying resorptions, pulpal and periapical disease.<sup>3</sup> There still remains scarcity of information on the crisp liaison between endodontics and orthodontics during treatment planning decisions. This association varies from outcomes on the pulp and the probability for its resorption due to OTM, to the clinical treatment of teeth demanding both endodontic and orthodontic procedures.<sup>4</sup>

The consideration for the movement of endodontically treated teeth was attempted cautiously since many years, and necessary provision as precautionary measures were undertaken while applying orthodontic movement to these teeth. Hence, the aim of this review is to define certain concerns that has to be kept in mind (in relation to endodontics) prior orthodontic treatment, and also to focus on the various changes in the pulp and periapical tissues during and after the course of orthodontic treatment.

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## 2. Root resorption due to OTM

Apical root resorption (ARR) is generally considered to be a common result following orthodontic treatment. There is a vivid collection of predisposing factors that leads to this resorption, comprising of individual susceptibility, genetic influence, endocrine disturbances, anatomical factors, and applied mechanics.<sup>5</sup> Apical root resorption causes loss of mineralized tissues such as dentin, cementum and alveolar bone and is thought to be linked to certain pathological or physiological process. Root resorption due to orthodontic treatment is typically related to inflammatory process in the periodontal ligament, resulting in shortening of the tooth apex.<sup>6</sup>

It is a general belief amongst dental practitioners that external apical root resorption (EARR) is an inevitable consequence of OTM. EARR is an irreparable and adverse side effect of orthodontics and can commence at early leveling period of orthodontic treatment. EARR is contemplated to be a type of surface resorption that occurs due to mechanical dental trauma, surgical operation procedures and orthodontic forces or excessive pressure of teeth or tumors.<sup>7</sup> It is typified by apical rounding morphologically or radiographically although, it could portray various degrees from slight blunted to round apex to over resorbed apex. Apex or lateral surfaces of roots can be resorbed but only apical root resorption can be observed by radiographic analysis wherein more than 1/3<sup>rd</sup> of original root length is lost in severe EARR.<sup>8</sup>

It has been established through several researches that heavy forces produced considerably more root resorption than light forces. The direction of force also has an important effect on the tooth movement and thus result in root resorption. Few researchers have documented that compressive forces cause more resorption than tensile forces. It has also been concluded in few studies that the intrusion of teeth causes about four times more root resorption than extrusion; though, it should be distinguished that the extrusion of teeth may also cause ARR in vulnerable individuals. Intrusive forces along with lingual root torque and wiggling movement persist to be the most prominent forces in causing ARR. The duration of force application is also one of the predisposing factors associated with orthodontic treatment.<sup>9</sup>

Ramanathan C et al. (2009) compared the extent of root resorption during different orthodontic movements using three different techniques and observed that the technique of three component intrusion arch resulted in the greatest root resorption.<sup>10</sup>

Consolaro A et al. (2013) emphasized the importance of local factors such as themorphology of the root and the alveolar osseous crest, and mentioned the lack of anycorrelation with endocrine disturbances and individual susceptibility because of geneticfactors. The use of strong forces and prolonged treatment is directly related to

anincrease in root resorption associated with orthodontics and these risks are well understood by orthodontists.<sup>3</sup>

Algerban A et al.(2018) conducted a study to evaluate the periapical status of endodontically treated teeth and the integrity of endodontic treatment before and after orthodontic treatment. They observed that the risk for periapical lesions and bone destruction after orthodontic treatment was significantly increased for teeth receiving inadequate endodontic treatment compared with those receiving adequate endodontic treatment.<sup>1</sup>

It has been advocated that an endodontically treated tooth with or without the presence of apical periodontitis should be moved after 15–30 days. It has been recommended that calcium hydroxide can be used to fill the root canal thus helps to reduce the risk of EARR until orthodontic treatment is completed.<sup>1</sup>

It is thus, imperative to examine the identified risk factors with the patient seeking orthodontic treatment, and incorporate these factors in the treatment consent form. The risk for root resorption increases with the length of treatment. A proper evaluation of the condition through a follow-up radiograph (periapical or panoramic) at 6–12 months after the initiation of orthodontic treatment is suggested. If root resorption ensues and is evident in radiographs, then the patient must be informed that the on-going orthodontic treatment has to be stopped for at least 3 months. The reparative process of root resorption commences 2 weeks after active treatment is stopped.<sup>11</sup> Hence, an alternative treatment plan should be taken into account and treatment should be ceased when severe root resorption is observed.<sup>2</sup>

Another significant change that occurs in endodontically treated teeth due to orthodontic movements is ankylosis. Ankylosis is caused by a disorder in the local metabolism of the periodontal ligament, thus causing fusion of the alveolar bone with the cement.<sup>12</sup>

## 3. Pain associated in orthodontic treatment

The two major adverse effects associated with OTM are pain and discomfort.<sup>13</sup> The adverse effects are characterized by pressure, tension, or soreness of the teeth. Pain in the anterior teeth is supposed to be greater than the posterior teeth. The pain has been stated to begin 4 hours after the placement of separators or orthodontic wires, and the intensity is found to be increased on the second day of treatment.<sup>14</sup> Usually, the pain lasts for seven days. The patient should be well-informed about the possibility of experiencing pain and discomfort in order to reduce anxiety and apprehension. The patient could be advised to chew on plastic wafers or chewing gums containing aspirin to control the ensuing pain. This mode of treatment to combat the pain, hypothetically increases the circulation in the periodontal ligament, which reduces the pain and discomfort. Apart from this, clinicians are advocated to prescribe analgesics

like Ibuprofen or acetaminophen preoperatively and for a short course after the placement of separators and initial wires.<sup>2</sup>

#### 4. Pulpal changes due to orthodontic treatment

After the application of orthodontic force, there is hyperemia in the pulp at the initial stages and mast cell degranulation occurs accompanied by cell damage and biochemical reactions. There is also an increased neural activity in the pulp and increased electrical stimulation threshold of the pulp after a few days. Due to the alteration in the metabolism of pulp occurring because of increased enzymatic activity; apoptosis and necrosis of pulp cells increases.<sup>8</sup> The use of heavy uncontrolled, continuous orthodontic forces could result in loss of pulp vitality. Hence, an orthodontist should use optimal light forces during their treatment.<sup>2</sup>

OTM can produce degenerative and/or inflammatory reactions in the dental pulp with completed apical formation. The impact of OTM on the pulp is determined chiefly based on the neurovascular system, wherein, the release of specific neurotransmitters (especially neuropeptides) could have an impact on the blood flow and cellular metabolism.<sup>4</sup>

#### 5. Periodontal disease & OTM

The factors on which the periodontal responses depend due to OTM and the forces exerted by various orthodontic appliances are host resistance, systemic diseases and the amount and composition of dental plaque. Other factors such as lifestyle (including smoking), can also jeopardize periodontal support.<sup>15</sup> Orthodontic treatment especially using fixed appliances has been shown to stimulate and increase the volume of dental plaque thus causing a shift in the type of bacteria. Therefore, fixed orthodontic treatment could lead to localized gingivitis, which infrequently progresses to periodontitis.<sup>16</sup>

Oral hygiene status has been proven to be the deciding factor that determines the condition of the periodontium during orthodontic treatment. Hence, it is mandatory to provide oral hygiene instructions to the patients before the initiation of orthodontic treatment and also during follow-up visits. Regularly brushing the teeth, use of electrical and ultrasonic tooth brushes helps adequately in controlling bacterial plaque especially on the buccal surfaces and thus reduces gingival inflammation.<sup>17</sup> The use of an interproximal brush in addition to the orthodontic brush has also been beneficial to the patients. The use of toothpaste with stannous fluoride created a stronger inhibitory action on dental plaque and gingivitis development.<sup>18</sup>

Orthodontic treatment of patients with active periodontal disease is contraindicated because of the increased risk factor for additional periodontal damage. It is thus

mandatory to examine of the level of attached gingival preceding any comprehensive orthodontic treatment. The level of attached gingival is measured from the free gingival margin to the mucogingival junction minus the depth of the gingival sulcus. Any type of dental movement in the labio-lingual direction is allowed only within the envelope of the periodontium without deleterious effects on the level of attached gingiva.<sup>19</sup> If an inadequate level of attached gingiva is found prior to the anticipated orthodontic treatment, a periodontic consultation is necessary, especially if labial movement of the teeth is projected.<sup>2</sup>

#### 6. Decalcification associated with OTM

Decalcification of enamel (white spots) leading to cavitation, is a commonly occurring unfavorable result of OTM. It is reported that decalcification of enamel occurs in 50% of orthodontic patients and maxillary incisors are the ones that are mostly affected.<sup>20</sup> The decalcifying lesions can progress within four weeks (approximate time taken for orthodontic follow-up). Hence, this could be prevented by ensuring proper plaque control through brushing of the teeth with fluoridated tooth paste, daily rinsing with a 0.02% or 0.05% sodium fluoride solution, application of fluoride varnish twice a year or a combination of antibacterial and fluoride varnish.<sup>18</sup> If decalcification is persisting even after removal of the orthodontic appliances, the clinician should not hurry into the management of these lesions. Appropriate time should be provided for possible re-mineralization of the evident white spots. Herein, the patient should be educated and instructed to continue with the plaque control protocol, includes proper brushing and rinsing with fluoridated solutions. Fluoride varnish should not be applied to the lesion during this stage as it would lead to the arrest of the lesion and the chance for re-mineralization will be diminished.<sup>2</sup>

#### 7. Temporomandibular dysfunction (TMD) and OTM

TMD is a condition that usually incorporates masticatory muscle pain, internal derangement of the temporomandibular joint (TMJ) disc and degenerative TMJ disorders either separately or in combination.<sup>2</sup>

Orthodontic treatment an extraction of teeth for orthodontic purpose especially during adolescence has been shown not to increase the risk for TMD signs and symptoms.<sup>21</sup> Also, there is no prominent risk for TMD because of the use of any specific orthodontic mechanics or appliances. It has been recommended that orthodontic treatment ought not be initiated in patients with acute signs and symptoms of TMD.<sup>22</sup> It should be deferred until the attack is controlled. If the patient acquires and shows signs and symptoms during the orthodontic treatment, then all active forces must be ceased without the need for the removal of the fixed orthodontic appliances. The signs

and symptoms of TMD must be controlled first using a conservative methodology. Once the signs and symptoms are under control, the clinician should reconsider the objectives of treatment.(talic)

## 8. Conclusion

A proper understanding the endo-ortho relationship is indispensable and forms the basis for a successful treatment outcome. The prognosis of any compromised orthodontic treatment differs with the quality of the root canal treatment and the health of the periodontal membrane. It is evident from various studies and researches that root canal treated teeth can be moved orthodontically to the same magnitude as vital teeth keeping in mind that a controlled force application should be applied to avoid the risk of inflammatory root resorption. Hence, appropriate clinical and radiographic evaluation is imperative prior to planning the course of treatment to guarantee the best treatment outcome.

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## 10. Conflict of Interest

The authors declare they have no conflict of interest.

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