Journal of Dental Sciences xxx (2018) 1–5

Contents lists available at ScienceDirect

Journal of Dental Sciences

journal homepage: www.e-jds.com

Original Article

External apical root resorption in non-extraction cases after clear aligner therapy or fixed orthodontic treatment

Jianru Yi [a], Jiani Xiao [b], Yu Li [b], Xiaobing Li [a,*], Zhihe Zhao [b]

[a] State Key Laboratory of Oral Diseases, National Clinical Research Center for Oral Diseases, Department of Pediatric Dentistry, West China Hospital of Stomatology, Sichuan University, Chengdu, China
[b] State Key Laboratory of Oral Diseases, National Clinical Research Center for Oral Diseases, Department of Orthodontics, West China Hospital of Stomatology, Sichuan University, Chengdu, China

ARTICLE INFO

Article history:
Received 1 March 2017
Received in revised form
17 September 2017
Accepted 20 September 2017
Available online xxx

Keywords:
Clear aligner
Fixed orthodontics
Root resorption

ABSTRACT

Background/purpose: The application of removable aligner in orthodontic treatment has increased rapidly in recent years, while its effects on root resorption remains unclear. The aim of this study was to comparatively evaluate the amount of external apical root resorption (EARR) in non-extraction patients receiving clear aligner therapy (CAT) or fixed orthodontic treatment (FOT).

Materials and methods: Eighty non-extraction patients treated with CAT or FOT exclusively were evaluated retrospectively. Panoramic radiographs were used to measure the length of crowns and roots of the incisors before and after treatment. The amount of EARR was determined by the relative change of root-crown ratio and compared between the two groups. The potential predictive factors of EARR were investigated using spearman correlation analysis.

Results: The overall EARR in the CAT patients was significantly less than the FOT. Similar results were observed in maxillary central incisors, maxillary lateral incisors, mandibular central incisors and mandibular lateral incisors. The duration of treatment positively correlated with the amount of EARR in both modalities. Gender, age, skeletal pattern or degree of malocclusion did not affect the occurrence of EARR.

Conclusion: Clear aligner therapy may have a superiority of reducing external apical root resorption compared to fixed orthodontic treatment in non-extraction patients.

1. Introduction

External apical root resorption (EARR) is defined as a physiologic or pathological process characterized by the loss of cementum or dentine resulting in the shortening of root apex.[1] The reduction of root length could cause the tooth mobility and even affect the long-term viability of dentition.[2] Since most of the structural injuries at root surface are irreversible, the identification of protective and risk factors is critical to dental practitioners to facilitate the prevention of EARR.[3]

As a common and iatrogenic problem in orthodontic treatment, the occurrence of EARR has been proved to be associated with the combination of individual biological variability and mechanical stimulations.[4] In terms of the mechanical factors, the treatment duration, force magnitude, amount of tooth movement, force type and treatment appliance have been suggested to influence the degree of EARR.[5] Previous studies found the incidence of EARR in orthodontically treated teeth was higher than 90%.[5] Another radiographic investigation reported the teeth with EARR increased remarkably from 15% to 73% after orthodontic treatment. The high incidence of root resorption could be derived from the nature of tooth movement. Among the series of biological activities during orthodontic tooth movement, the elimination of hyaline zone is considered as the prerequisite for the launch of physiological tooth movement but could also absorb the root outer surface,[6] after which, the exposed dentine would be more vulnerable to resorption by scavenger cells.[7]

In recent years, clear aligner therapy (CAT) has been widely applied in orthodontic clinics. Since the inherent advantage of

* Corresponding author. #14, 3rd Section, South Renmin Road, Chengdu, 610041, PR China.
E-mail address: lxb_30@hotmail.com (X. Li).

https://doi.org/10.1016/j.jds.2017.09.007

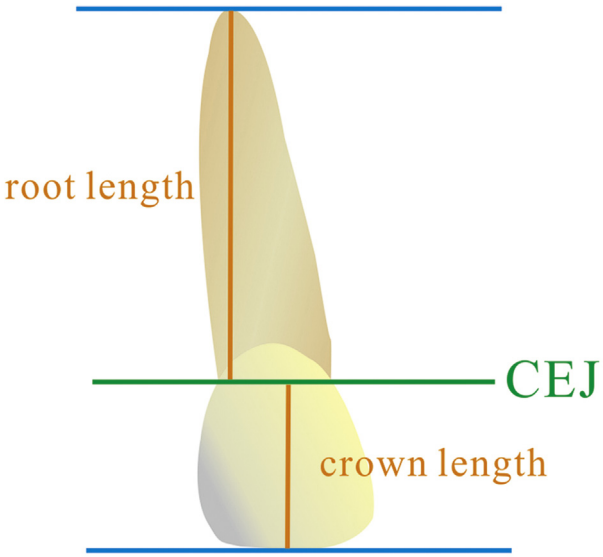

Figure 1. Measurement using panoramic radiograph. The cemento-enamel-junction (CEJ) line was determined by the connection of mesial and distal CEJ. The lengths of root and crown were measured as the distance from root apex and incisal edge to CEJ line respectively.

esthetics and comfortability, CAT has been gradually become a prior option in treatment planning, especially to adult patients. Moreover, due to the removability, CAT could also offer the convenience in oral health care to patients.[8]

From the perspective of mechanics, there are several distinct differences between CAT and fixed orthodontic treatment (FOT). First, since aligners are suggested to be removed during eating and oral hygiene procedures, orthodontic forces applied to teeth in CAT is intermittent rather than continuous in FOT. Second, the magnitude of forces and moments generated by aligners could differ from that of brackets and archwires. Third, the force is transmitted to teeth by bracket which is generally located in the center of tooth crown in FOT while by aligner *per se* and the attachment in CAT. The different mechanical properties may affect the rate of root resorption of these two modalities. However, the available evidence regarding this issue is limited. Thus, we performed the present study to evaluate the amount of EARR in patients treated with CAT and FOT. Since CAT has not yet been a totally mature technique for extraction cases,[9] we focused on the non-extraction patients in this study.

Table 1
Demographic and clinical information of participants in clear aligner therapy (CAT) group and fixed orthodontic treatment (FOT) group.

Characteristics	CAT (n = 40)	FOT (n = 40)	P value
Age	21.80 ± 5.11	23.28 ± 5.60	.222
Gender			.317
Female	31 (77.5%)	29 (72.5%)	
Male	9 (22.5%)	11 (27.5%)	
Skeletal pattern			.589
Class I	34(85%)	32(80%)	
Class II	5(12.5%)	5(12.5%)	
Class III	1(2.5%)	3(7.5%)	
Pretreatment PAR index	21.90 ± 6.69	23.33 ± 7.97	.389
Posttreatment PAR index	5.33 ± 3.39	4.30 ± 2.483	.127
PAR index reduction	16.57 ± 5.76	19.03 ± 7.68	.116
Treatment duration (month)	22.08 ± 4.51	20.83 ± 5.29	.259

PAR = peer assessment rating.

Table 2
Amount of external apical root resorption (EARR) by tooth type.

	CAT (%)	FOT (%)	P value
Maxillary central incisor (n = 160)	5.67 ± 2.92	6.80 ± 3.90	.039*
Maxillary lateral incisors (n = 160)	5.32 ± 3.08	7.08 ± 3.86	.002*
Mandibular central incisors (n = 160)	5.36 ± 2.31	6.51 ± 3.52	.016*
Mandibular lateral incisors (n = 160)	4.18 ± 2.71	7.48 ± 3.34	.001*
Overall (n = 640)	5.13 ± 2.81	6.97 ± 3.67	.001*

*indicates statistical significance.
CAT = clear aligner therapy; FOT = fixed orthodontic treatment.

2. Material and methods

The protocol of this retrospective investigation was approved by institutional review board of authors' university. The patient pool of the orthodontic department in authors' hospital from 2011 to 2015 was screened. The inclusion criteria were as follows: (1) complete treatment using CAT or FOT exclusively; (2) the medical records and pre-/post-treatment x-ray examinations (lateral cephalometric and panoramic radiograph) were available; (3) No tooth extraction (except for the third molar) or space closure for missing tooth; (4) No radiographic evidence of EARR prior to the treatment; (5) No root canal treatment was performed in the evaluated teeth; (6) The root growth should be completed before treatment; (7) No orthognathic surgery was involved in the treatment.

Patients of FOT group received the treatment using preadjusted edgewise appliance with 0.022-in slot. Patients of CAT group were treated with sequential thermoplastic appliances. A data extraction form was established to collect the basic information including gender, age, skeletal pattern, treatment duration, degree of irregularity from the medical records for each participant. The irregularity was quantified using peer assessing rating index.[10] The time wearing retainers before refinement was included in the treatment duration of CAT patients.

The digital panoramic radiographs were used to evaluate the root length before and after treatment. All radiographs were taken using the same digital orthopantomograph machine

Table 3
Correlations between the amount of external apical root resorption (EARR) and contributory factors.

	EARR in CAT(n = 320)	EARR in FOT(n = 320)
Age (y)		
r	0.1342	−0.2420
P value	0.4090	0.1324
Gender		
r	0.2278	0.1040
P value	0.0717	0.5229
Skeletal pattern		
r	0.1494	0.0521
P value	0.3576	0.7496
Pretreatment PAR index		
r	−0.0164	0.0440
P value	0.9198	0.7876
Posttreatment PAR index		
r	−0.0638	−0.0748
P value	0.6956	0.6462
PAR index reduction		
r	0.1291	0.0567
P value	0.4272	0.7284
Treatment duration (month)		
r	0.3651	0.3827
P value	0.0205*	0.0148*

*indicates statistical significance.
CAT = clear aligner therapy; FOT = fixed orthodontic treatment; PAR = peer assessment rating.

Please cite this article in press as: Yi J, et al., External apical root resorption in non-extraction cases after clear aligner therapy or fixed orthodontic treatment, Journal of Dental Sciences (2018), https://doi.org/10.1016/j.jds.2017.09.007