Case Report

Maxillary canine internal root resorption concomitant to orthodontic retraction; Cone Beam evaluation

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Abstract

Introduction: The objective of this retrospective study was to investigate maxillary canine internal root resorption (IRR) concomitant to orthodontic retraction evaluated by cone beam computed tomography (CBCT).

Materials and Methods: The current retrospective study was conducted on a total sample of 20 CBCT of right and left maxillary canines of 10 maxillary first premolars extraction orthodontic patients; 6 females and 4 males, with age range between 14 to 20 years old. The sample was selected at random from a total sample of 32 CBCT which had been previously used to study external maxillary canine root resorption (ERR) of 16 orthodontic patients (6 males, 10 females). Cone beam computed tomography (CBCT) image of maxillary teeth had been taken before treatment and after canine retraction using optimal orthodontic force (150 g). Internal resorption of maxillary canines had been evaluated using much more sensitive scores previously used to study canine external root resorption.

Results: the results of the current study were calculated from CBCT of 20 right and left maxillary canine teeth. The average rate of orthodontic canine retraction was 1.34+ 0.31mm/month and the average time of canine retraction was 188.75 + 45.00 days. The results showed statistically insignificant difference in IRR between; before and after right and left maxillary canine retraction. There was also statistically insignificant correlation between internal root resorption (IRR) and rate of canine retraction.

Conclusions: With the use of the appropriate mechanics for orthodontic maxillary canine retraction into the first premolar extraction space, internal root resorption (IRR) will not be expected. On the other hand the use of appropriate mechanics in orthodontics is the keystone to achieve orthodontic treatment outcome without any hazard.

Keywords: Internal, Root, Resorption, Canine, Retraction, Orthodontics, Cbct

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Introduction

The literature is very rich with different studies covering external root resorption (ERR) subsequent to orthodontic treatment of dental malocclusion, which is investigating by different radiographs ending by the use of cone-beam computed tomography (CPCT). [1-19] In a recent study on ERR using CBCT, it was concluded that with the use of optimum orthodontic force ERR is of negligible.[20] On the other hand, data base lacking studies covering internal root resorption (IRR) associated with orthodontic tooth movement. In a case report the authors reported extensive internal resorption affecting the crown of orthodontically treated teeth which could extend into the root canal and 'pink tooth'.[21]

In view of this shortage, it will be worth to investigate internal root resorption concomitant to orthodontic retraction of maxillary canine in first premolars extraction orthodontics, using CBCT.

Materials and methods

The current retrospective study was conducted on a total sample of 20 CBCT of right and left maxillary canines of 10 maxillary first premolars extraction orthodontic patients; 6 females and 4 males, with age range between 14 to 20 years old. The sample was selected at random from a total sample of 32 CBCT which had been previously used to study external maxillary canine root resorption (ERR) of 16 orthodontic patients.[20]

Cone beam computed tomography (CBCT) image of maxillary canine teeth was taken before and after orthodontic canine retraction into the first premolars extraction space with optimal orthodontic force of (150 g). Internal root resorption of maxillary canines had been evaluated using much more sensitive scores previously used to study canine external root resorption.[22]

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Measurements of internal root resorption (IRR)

To measure the changes in pulp chamber

1. When coronal view was studied, each root canal was divided into three thirds; cervical, middle and apical third. As the canine was retracted orthodontically distally into the first premolar extraction space, the mesiodistal dimension of root canal of each root canal third was measured.

2. when the axial view was studied, the vertical dimension from the tip of the pulp chamber to the apex of the root canal. All measurements of changes was undertaken using the new proposed scale index.[22] Figure 1 summarized the used CBCT measurements taken for IRR.
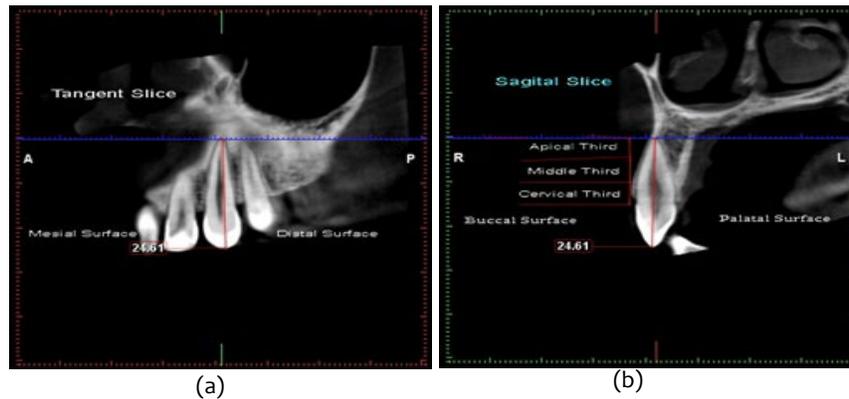

Figure 1: Internal root resorption measurements (IRR) obtained from CBCT of maxillary canine showing the coronal (a) and sagittal (b) views.

Internal root pulp chamber resorption (IRR)

a. In order to measure the difference in internal root canal length, maxillary canine pulp tip and root apex tip were identified on sagittal and the three coronal views obtained from CBCT 3D image and the software directly measure the actual changes in root canal measurements. These measurements were performed on both pre- and post-canine retraction CBCT images.

b. In order to describe root pulp changes between the pretreatment examination and after canine retraction examination were subjectively converted into an index originally designed for CBCT.[22]

Interaexaminer error

Four CBCT were selected at random from the total sample group of 20 CBCT in the current study, by the senior supervisor. All measurements had been taken again by the same examiner after at least one month of the first measurements for identifying the intra-examiner errors.

Statistical Analysis

The collected data was tabulated and statistically analyzed using SPSS statistical package. The result of the current study was considered of significant value at the level of $p \leq 0.05$.

Results

The following figure (2) illustrates the CBCT analysis of the maxillary right and left canine teeth of one of selected samples in the current study. Each tooth was divided into thirds (cervical, middle and apical) in the vertical dimension from the cemento-enamel junction (CEJ) to the apex.
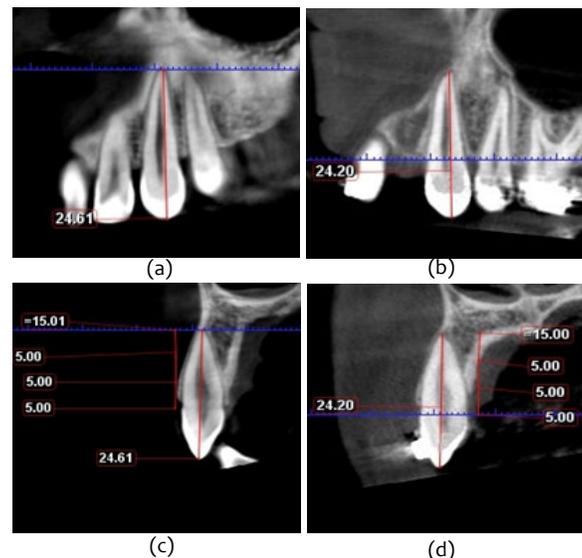

Figure 2: Standardized Cone beam computed tomography (CBCT) view of maxillary right canine showing (a) and (b) coronal slice before and after complete canine retraction (c) and (d) Sagittal slices before and after complete canine retraction.

Paired t test for measuring intra-examiner error in measuring root resorption showed statistically insignificant difference between the two intra-examiner readings of measuring internal root chamber resorption (IRR) before and after canine retraction, both from sagittal and coronal views measured from CBCT image. The results of the current study are summarized in the following tables 1-5:

Table 1: Descriptive statistics of maxillary canine tooth length before and after canine retraction and the difference between them and showing statistically significant difference between before and after tooth length (external root resorption) in different groups in the current study.

	Pre-treatment tooth length(mm)		post-canine retraction tooth length(mm)		Mean Diff.	S.E. Diff.	t value	P
	Mean	S.D.	Mean	S.D.				
Total sample group(n=20)	26.68	2.51	26.13	2.75	0.54	0.14	4.00	P ≤ 0.05*
		1.37	28.27	1.73	0.75	0.16	4.83	P ≤ 0.05*
	25.27	1.93	24.85	2.44	0.42	0.19	2.16	P ≤ 0.05*
Right side (n=10)	26.65	2.41	26.14	2.79	0.51	0.22	2.29	P ≤ 0.05*
Left side (n=10)	26.70	2.70	26.12	2.80	0.58	0.17	3.53	P ≤ 0.05*

Table 1: Descriptive statistics and difference of maxillary canine tooth length before and after canine retraction in different groups of the study.

S.D.= Standard deviation.   S.E.= Standard error.   Diff =difference
P= Probability level (paired t test).   *= Significant at (p ≤ 0.05) n = numbers of maxillary canines

Prevalence of different scores of external root length resorption is demonstrated in table 2 and shows minimal incidence of external root resorption and of minimal severity.

Score of RR	No.	%
Score 1: 0 ≤ 0.1 mm	13	40.6
Score 2: >0.1 ≤ 0.3 mm	4	12.5
Score 3: >0.3 ≤ 0.5 mm	4	12.5
Score 4: >0.5 ≤ 0.8 mm	4	12.5
Score 5: >0.8 ≤ 1 mm	3	9.4
Score 6: >1 ≤ 2 mm	3	9.4
Score 7: >2 ≤ 4 mm	1	3.1
Total	32	100.0

Table 2: Prevalence of different levels of external root length resorption (ERLR) index

Internal root resorption (IRR)

Prevalence of internal root resorption in different surfaces and different thirds of maxillary canine roots and prevalence of different levels of internal root surface resorption score has been demonstrated in tables 3 and 4 which show minimal incidence of IRR in different surfaces and thirds of the maxillary canine roots. The tables also showing statistically insignificant increased incidence of internal root resorption in the apical third in relation to middle and cervical maxillary canine root thirds.

Score of RR	Prevalence of root resorption					
	Cervical =10		Middle=10		Apical=10	
	N	%	N	%	N	%
Score 1: 0 -≤ 0.1 mm	30	93.75	32	100.0	25	78.12
Score 2: >0.1 -≤ 0.3 mm	0	0.0	0	0.0	4	12,5
Score 3: >0.3 -≤ 0.5 mm	2	6.25	0	0.0	1	3.12
Score 4: complete loss of root apex	0	0.0	0	0.0	2	6.25
P	a		a		A	

Table 3: Prevalence of different levels of internal root surface resorption (IRR) index in different thirds of maxillary canine roots.
P= Probability level between surfaces within each third using Chi square test Prevalence with similar letters within each third are not significant at p > 0.05

Score of IRR	Prevalence of root resorption							
	Mesial=10		Distal=10					
	N	%	N	%	N	%	N	%
Score 1: 0 -≤ 0.1 mm	29	90.6	29	90.6	28	87.5	27	84.3
Score 2: >0.1 -≤ 0.3 mm	1	3.1	0	0.0	1	3.1	2	6.3
Score 3: >0.3 -≤ 0.5 mm	0	0	1	3.1	1	3.1	1	3.1
Score 4: complete loss of root apex	2	6.3	2	6.3	2	6.3	2	6.3
P	a		a		a		a	

Table 4: Prevalence of different levels of internal root surface resorption (IRR) index in different surfaces of the maxillary canine roots

P= Probability level between surfaces within each third using Chi square test Prevalence with similar letters within each third are not significant at p > 0.05

In evaluation of the differences between right and left side regarding internal root resorption (IRR) and rate of canine retraction, table 5 shows statistically insignificant difference in root resorption between right and left side from numerical results obtained from CBCT.

	Right side (n=16)			Left side (n=16)			Side difference			
	Mean	S.D.	S.E.	Mean	S.D.	S.E.	Mean Diff.	S.E. Diff.	t value	P
Rate of retraction(mm/month)	1.36	0.31	0.08	1.33	0.36	.079	0.03	0.04	0.71	0.49 NS
Pre-treatment tooth length(mm)	26.65	2.41	0.60	26.70	2.70	0.68	-0.05	0.17	-0.31	0.76 NS
post-canine retraction tooth length(mm)	26.14	2.79	0.70	26.12	2.80	0.70	0.02	0.17	0.13	0.90 NS
Pre-treatment to post-canine retraction tooth length change(mm)	-0.51	0.89	0.221	-0.58	0.66	0.16	-0.08	0.14	-0.54	0.60 NS

Table 5: Paired t tests for side difference in (tooth length and tooth length difference between, before and after canine retraction) and external root length resorption (mm) in maxillary canine root.
S.D.= Standard deviation.　　　S.E.= Standard error.　　　Diff=difference
P= Probability level (paired t).　　NS= Statistically Insignificant　　n = numbers of maxillary canines

Discussion

The literature is very rich regarding the use of CBCT to study external root resorption (ERR) of the maxillary canine in premolar extraction orthodontics.[12, 15, 18, 19]

On the other hand, searching the data base revealed shorting in studies covering internal maxillary canine resorption concomitant to orthodontic retraction in first premolar extraction orthodontics using CBCT. This encouraging the proposal of the current study. In accordance the result of the current study was discussed in view of thorough interpretation of the results.

The current retrospective study was based on CBCT data of previous study by the authors on external root resorption.[20] Interpretation of the CBCT was done using the same index scale of the previous study.[22] Internal root resorption (IRR) of the maxillary canines (right and left) had been investigated by using CBCT before and after complete maxillary canine retraction into the extraction.

The results of CMPT sagittal view interpretation in the current study showed insignificant canine internal vertical length changes from the tip of the pulp chamber to the apical tip of the pulp. Which mean that there is insignificant internal vertical resorption of the canine.

On the other hand the result of CBCT three coronal views interpretation showed insignificant changes. This mean that there is insignificant coronal root canal internal resorption as well.

The current study showed negligible maxillary cane internal root resorption after complete orthodontic retraction into the first premolars extraction space. This result is explained in view of using the appropriate mechanics for maxillary canine retraction (force range of 150 gm).

The result of the current study is in agreement and supported by the result of previous study of the same sample group which aimed to determine external root resorption (ERR) due to orthodontic canine retraction using cone beam computed tomography (CBCT).[20]

In evaluation of differences between right and left side regarding internal root resorption the current study did not detect any significant difference in internal root resorption between right and left side from numerical results obtained from CBCT at the level of p ≤ 0.05. This finding could be explained by the similarity of both right and left canines in terms of treatment mechanics.

Conclusion

With the use of the appropriate mechanics for orthodontic maxillary canine retraction into the first premolar extraction space, internal root resorption (IRR) is not be expected.

On the other hand the use of appropriate mechanics in orthodontics is the keystone to achieve orthodontic treatment outcome without any hazard.

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