

		2	-.07131*	.02634	.023	-.1350	-.0076
Average Perio Test Value	1	2	.06302	.56287	1.000	-1.3003	1.4263
		3	2.67118*	.56287	.000	1.3079	4.0345
	2	1	-.06302	.56287	1.000	-1.4263	1.3003
		3	2.60816*	.56571	.000	1.2380	3.9784
	3	1	-2.67118*	.56287	.000	-4.0345	-1.3079
		2	-2.60816*	.56571	.000	-3.9784	-1.2380

*. The mean difference is significant at the 0.05 level.

Crown to root ratio

P-value with Bonferroni for μ_1 and $\mu_3 = 0.000$ and for μ_2 and $\mu_3 = 0.023$ (both are less than 0.05)

The post hoc Bonferroni's test revealed that the teeth groups 1&3, 2&3 significantly differed regard to mean crown to root ratio.

Periotest

P-value with Bonferroni for μ_1 and $\mu_3 = 0.000$ and for μ_2 and $\mu_3 = 0.000$ (both are less than 0.05)

The post hoc Bonferroni's test revealed that the teeth groups 1&3, 2&3 significantly differed regard to mean periotest.

5. Discussion

The aim of this study was to correlate crestal bone level to mobility in maxillary anterior teeth by utilizing the CBCT and periotest device.

The commonly used radiographs for evaluating crestal bone level include panoramic and periapical x rays. Although commonly available, these methods are limited in their accuracy and reproducibility due to errors in magnification and distortion.⁽⁷⁾ More recently, Dudic et al, demonstrated that measuring root resorption may be misevaluated on panoramic x rays as compared with CBCT images.⁽¹⁹⁾ Recent studies have also shown that CBCT images provide accurate and reliable measurements of root length⁽¹¹⁾ as compared with periapical radiographs.⁽¹²⁾ In addition, CBCTs, as compared to conventional CTs, have the advantages of rapid scanning time, chairside image display, and reduced radiation dose.⁽⁸⁾

The periotest device was selected to measure mobility due to its widespread use due to its highly reproducibility. It is used for measuring the damping characteristics of healthy teeth and evaluating their mobility.⁽¹⁶⁾ The precision of its measurements was reported by Levander and Malmgren⁽²⁰⁾ and Berthold et al⁽²¹⁾. The device has some limitations, where it has been reported that the highest reproducibility of the method has been found for teeth with low to moderate TM, whereas measurements on highly mobile teeth (grade III mobility) are less reproducible.⁽¹⁸⁾ The other limitation of the periotest device, and which influence its reproducibility are the angle and the distance of the hand piece from the tooth surface, as well as the use of reproducible measurement points^(15,21) These aspects were carefully taken into consideration when assessing tooth mobility by the same experienced clinician where reproducible measuring points were drawn on the center of labial surface 4 mm away from the incisal edge, and measuring was only taken in horizontal direction to follow the common protocol.^(22,23)

Previous studies that have attempted to correlate root length with tooth mobility, did not take into consideration the crown height.⁽²⁴⁾ We preferred to consider the crown height and its horizontal cantilever effect, as well as the crestal bone level by using crown root ratio and correlating it with mobility.

In this study, there was a positive and moderate correlation between crown root ratio and mobility in maxillary anterior teeth with healthy periodontium. This means that as crown root ratio increases, mobility increases where the loss in root length moves the center of resistance more coronally, and the same amount of force will then have a greater impact than on a tooth with less crown root ratio. This result strengthens the earlier findings of Levander and Malmgren and then with Jönsson et al.^(20,24)

Grouping the teeth, revealed that the least mobility was for maxillary canines group (mean = - 1.6925), and the most mobility was for maxillary central incisors group (mean = + 0.9787) while for the maxillary lateral incisors group it was intermediary (mean = +0.9333). These results were in consistency with Burch 1960⁽²⁵⁾ who reported that teeth normally have a wide range of mobility, with single rooted teeth being more mobile than multirouted teeth and incisors have most mobility of all.

D'Hoedt et al, (1985)⁽¹⁸⁾ determined the PTV for periodontally healthy teeth with normal root length. For central maxillary incisors, the average PTV was 7 and for laterals 6. In comparison, the average PTV in the present study was 0.9787 for the central incisor group and 0.9156 for the lateral incisor group which is not similar to the results of D'Hoedt. Possible differences may be attributed to errors in measuring tooth mobility or the sample size and its characteristics.

The highest C/R was for the central incisor group (0.7113) and the least crown root ratio was for the canine group (0.5778) while that of the lateral incisor group was intermediary (0.6492). These data revealed that teeth with higher crown root ratio (incisor group) had the higher tooth mobility values while those with least crown root ratios (canine group) had the least mobility values. These results were in agreement with Jonsson (2007)⁽²⁴⁾ who reported that teeth with extreme resorption at the end of orthodontic treatment and a normal crestal bone level had a higher PTV.

Statistical analysis also revealed a positive correlation between crown root ratio within the 3 groups separately, Central incisors group being moderately correlated while the canines group being weakly correlated. This may be due to the fact that canines had the longest roots among teeth and therefore the least crown root ratio and that this ratio needs

more crestal bone loss or root resorption to be altered as compared to the other groups.

Comparing crown root ratio and periosteal values among the 3 groups, revealed statistical difference between the central incisors and canine group, and between lateral incisors and canines group.

The incisor have the greatest mobility as compared to canines not only due to their shorter roots but also due to the fact that they are labially inclined in their position in the arch and forces of occlusion can be considered as obliquely directed rather than vertically directed.

There were several aspects of this study that one could criticize. The availability of pre- and post-treatment CBCTs made this study possible; however, a greater sample size of more than 28 patients could have gained additional strength.

6. Conclusions

There is a correlation between crestal bone level and mobility of teeth in esthetic zone with central incisors being the most affected and canines being the least affected by crestal bone loss.

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