Original Article

Curvature height and distance of MB canal of mandibular molar with Schneider angle and its comparison with canal access angle

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ABSTRACT

Aim: To measure the proposed curvature height and distance of MB canal of mandibular molar with Schneider angle and its comparison with canal access angle both before and after instrumentation, and to compare among each other with multiple linear regression analysis.

Methodology: One hundred human mandibular first and second molars were used for the study. After endodontic access, a size 10 k-file was placed in the mesiobuccal canal extending to the apical foramen and radiographs were taken by using Radiovisography. Both Schneider and canal access angle with its respective linear counterpart (Curvature height and curvature distance) was measured and calculated by using PLANMECA romexis (Helsinki Finland) software connected to the Intraoral x-ray unit both before and after biomechanical preparation with mesiobuccal canal till size F2. Statistical analysis was done by using multiple linear regression analysis.

Results: A significant difference was observed between before and after enlargement with respect to Schneider angle and Canal access angle with a t-value being ($t = 11.0629$, $p < 0.05$) ($t = 10.5773$, $p < 0.05$) for before and after enlargement of canals respectively. Percent of change is observed more with curvature height (29.62%) as compared with the curvature distance (8.87%).

Conclusions: Schneider angle with its proposed curvature height and distance reduced after instrumentation. Whereas canal access angle decreased and its curvature height and distance have increased after instrumentation.

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1. Introduction

One of the crucial and important procedure in root canal treatment is the biomechanical procedure and which involves various factors in its success. Sometimes there is a strip or excessive preparation that may lead to surgical intervention.^{1,2} Hence it became imperative to study canal curvature and that lead to the development of root canal curvature measurement techniques.^{3–9}

The rationale behind the present study is that, whether the instrumentation affects the Schneider angle with proposed curvature height and distance and, whether it affects on canal access angle and its curvature height and distance. The Present study is done after pre and post instrumentation of the canal and compared among each other. The hypothesis of the study is that instrumentation should decrease both the Schneider and canal

access angle, thereby it eases canal to be more uncurved than before instrumentation. The objective of the study was to measure the curvature height and distance of MB canal of mandibular molar with Schneider angle and its comparison with canal access angle both before and after instrumentation, and to compare among each other with multiple linear regression analysis. Schneider angle was alone used in measurement of canal curvature in previous studies.³ In the present study linear measurement is included with angular measurement and compared with before and after instrumentation.

2. Methodology

One hundred human mandibular first and second molars were used for the study. Exclusion criteria for the teeth were, teeth with narrow canals, external resorption, incompletely formed apices. Teeth were stored in the 10% formalin solution. Endodontic access cavity was prepared by using EndoAccess (DENTSPLY Maillefer, Switzerland) and Endo-Z bur (DENTSPLY Maillefer, Switzerland). Straight-line access was maintained so that to prevent premature binding of the instrument and a size 10 k-file was being placed in

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the mesiobuccal canal extending to the apical foramen and radiographs were taken by using Radiovisography (PLANMECA romexis, Helsinki, Finland). Care should be taken that the long axis of the root was parallel and as close as possible to the surface of the x-ray film. Each root canal radiograph was taken in buccolingual direction, such that long axis of the root were perpendicular to the central x-ray beam. A constant distance about 40 cm between the film and x-ray source was maintained by keeping same exposure time for all the radiographs.

The Schneider method involves first drawing a line parallel to the long axis of the canal, in coronal third (AC), a second line was then drawn from the apical foramen to intersect the point where the first line left the long axis of the canal (BC). The Schneider angle (Fig. 1) was the outer angle created by the line AC and BC (angle BCE). A hypothetical line was drawn from the apical foramen (B) to the line joining CE, which joins at point E. A perpendicular line from the point C to the line BE gives proposed curvature distance (CF). And the distance from the apical foramen to the imaginary point E gives the proposed curvature height (BE).

In the second part Canal Access Angle as described by Gunday et al.¹² the canal orifice (A) and apex (B) points were connected with a line. The angle formed by the intersection between these lines (AB) and one drawn parallel to the long axis of the canal from the coronal part (AC) was defined as the Canal Access Angle (Fig. 1). A perpendicular line from the point C to the line AB gives the curvature height (CD=x). And the distance from the canal orifice (A) to the imaginary point D gives the curvature distance (AD=y).

Both Schneider and canal access angle with its respective linear counterpart is measured and calculated by using PLANMECA romexis (Helsinki, Finland) software connected to the Intraoral x-ray unit with closed lead doors to prevent the x-ray exposures.

After that coronal enlargement was done with a Protaper (DENTSPLY, New York, USA) Orifice shaper instruments, biomechanical preparation was done with mesiobuccal canal till with a Protaper (DENTSPLY, New York) size F2. Sodium hypochlorite 5.5% (Roval, Recife, PE, Brazil) was used as intracanal irrigant and RCprep (Premier, Pennsylvania, USA) used as lubricant. Again, both Schneider and canal access angle were measured and calculated with its linear counterparts. Planmeca X-ray viewer (Helsinki, Finland) software was used for the estimation of all the angles and measuring the linear counterparts. Statistical analysis was done by using multiple linear regression analysis.

3. Results

A significant difference was observed between before and after enlargement with respect to Schneider angle, curvature height (mm), curvature distance (mm) with t-value being ($t=18.4527$, $p<0.05$) ($t=-139.6239$, $p<0.05$) ($t=73.3643$, $p<0.05$) respectively. It means that, the mean of after enlargement the values were significantly lower as compared to mean before enlargement. (Figs. 2 a,b, 3 a,b) (Tables 1 and 2). Percent of change is observed more with curvature height (29.62%) as compared with the curvature distance. (8.87%) (Table 2)

A significant difference was also observed between before and after enlargement with respect to Canal Access angle and its curvature height (mm), curvature distance (mm) ($t=-49.0000$, $p<0.05$) ($t=38.8644$, $p<0.05$) ($t=19.2326$, $p<0.05$) respectively. It means that, the mean after enlargement the values were significantly lower with canal access angle as compared to mean before enlargement (Table 3). And mean after enlargement the

Fig. 1. (a)-Schneider angle is angle BCE, A line is drawn from apical foramen (B) to the line joining CE, which joins at point E. A perpendicular line from the point C to the line BE gives curvature distance (CF). And the distance from apical foramen to the imaginary point E gives the curvature height (BE).

Fig. 2. (a)-Schneider angle with its curvature height and distance and Canal Access angle with its curvature height and distance (Pre instrumentation), 2b- Schneider angle with its curvature height and distance and Canal Access angle with its curvature height and distance (Post instrumentation).

Fig. 3. (a)-Schneider angle with its curvature height and distance and Canal Access angle with its curvature height and distance (Pre instrumentation), 3b- Schneider angle with its curvature height and distance and Canal Access angle with its curvature height and distance (Post instrumentation).

values were significantly higher with curvature height and distance as compared to mean before enlargement (Figs. 2 a,b, 3 a,b).

A significant difference was observed between before and after enlargement with respect to Schneider angle and Canal access angle with t-value being ($t = 11.0629$, $p < 0.05$) ($t = 10.5773$, $p < 0.05$) for before and after enlargement of canal respectively (Table 4).

4. Discussion

Schneider angle is the most commonly used,^{3, 4, 11} since it is most simple and reliable method among all available curvature

measurement techniques. Schneider angle measurement technique, stresses upon coronal region, where as Weines angle considers both coronal and apical region and long axis technique considers the apical region.^{3,12,13} Canal Access Angle technique considers mainly the coronal region. Also, an increase in the root curvature increases the difficulty in preparing the canal.^{11,12,14}

Curvature height is more affected due to the enlargement (29.62%) as compared with the curvature distance (8.87%) (Table 2), may be due to slight uncurving of the canal after enlargement. Hence, there was a positive correlation between the CAA and curvature height (x), the finding were similar to the previous

Table 1

Mean, SD, minimum and maximum values before and after enlargement.

Enlargement	Variables	Mean	Std.Dev.	Minimum	Maximum
Before	Schneider angle	27.90	10.09	7.43	45.29
	Proposed curvature height	5.16	1.90	1.49	9.50
	Proposed curvature distance	8.25	2.60	2.06	13.44
	Canal access angle	17.62	4.69	5.58	36.08
	Curvature height	1.59	0.52	0.40	2.80
	Curvature distance	4.93	1.23	1.57	9.52
After	Schneider angle	26.14	7.42	8.09	43.30
	Proposed curvature height	3.98	1.50	0.80	8.40
	Proposed curvature distance	7.52	2.06	3.40	14.10
	Canal access angle	16.11	5.52	3.15	34.54
	Curvature height	2.43	1.00	3.68	0.55
	Curvature distance	5.70	1.58	2.10	10.23

Table 2Comparison of before and after enlargement Schneider angle (in degrees), curvature height (mm) and curvature distance (mm) by paired *t*-test.

Variables	Enlargement	Mean	SD	Mean Diff.	SD Diff.	% of change	Paired t	p-value
Schneider angle	Before	27.90	7.43	1.76	0.95	6.72	18.4527	0.00001*
	After	26.14	7.42					
Proposed curvature height	Before	5.16	1.49	1.18	0.08	29.62	139.6239	0.00001*
	After	3.98	1.50					
Proposed curvature distance	Before	8.25	2.06	0.73	0.10	8.87	73.3643	0.00001*
	After	7.52	2.06					

* $p < 0.05$.**Table 3**Comparison of before and after enlargement canal access angle (in degrees), curvature height (mm) and curvature distance (mm) by paired *t*-test.

Variables	Enlargement	Mean	SD	Mean Diff.	SD Diff.	% of change	Paired t	p-value
Canal access angle	Before	17.62	5.58	1.51	0.31	9.37	49.0000	0.00001*
	After	16.11	5.52					
Curvature height	Before	1.59	0.52	0.85	0.22	53.55	38.8644	0.00001*
	After	2.43	0.55					
Curvature distance	Before	4.93	1.57	0.77	0.40	13.46	19.2326	0.00001*
	After	5.70	1.58					

* $p < 0.05$.**Table 4**Comparison of Schneider angle and canal access angle (in degrees) at before and after enlargement by unpaired *t*-test.

Enlargement	Schneider angle		Canal access angle		t-value	p-value
	Mean	SD	Mean	SD		
Before	27.90	7.43	17.62	5.58	11.0629	0.00001*
After	26.14	7.42	15.80	6.37	10.5773	0.00001*

* $p < 0.05$.

study.¹⁰ Curvature height and distance have decreased after enlargement of the canal may be due to C (Fig. 1) point moving towards apical part after enlargement. Whereas curvature height and distance have increased after enlargement due to the increase of radii of curvature due to slight uncurving of the canal which is the similar finding with other studies.¹⁰

Mandibular molar was used in the study which have been studied well in previous studies.^{4,15–18} Mesio Buccal canal was used in the present study, since the mesiolingual root canal is poorly visible on periapical radiographs.¹⁹ Schneider angle decreased after enlargement of the canal can be attributed to the fact that the

canal tend to become more uncurved. Also curvature height and curvature distance is decreased because the point the Schneider angle calculated or the point where the line drawn exit the coronal one third of the canal become placed more apically due to slight straightening of the canal after enlargement.

In case of Canal Access Angle, a decrease in its angle is because of the point C placed lower due to the straightening of the canal. But the line from point A to B is not much attributed since the point B is considered at apical constriction rather than the apical one third of the canal. Curvature distance in canal access angle is increased can be attributed to the fact that the enlargement placed point C more lower away from the access due to the straightening of the canal. Present study showed that the Schneider angle is decreased with enlargement along with decrease in proposed curvature height and distance. Also it showed that, proposed curvature height and distance are dependent on Schneider angle. Whereas in case of canal access angle, it is decreased and Curvature height and distance have increased after instrumentation.

Although the curved root canals and its influence have been long time addressed in Endodontics,^{4–6,8,15–23} considerable root canal preparation has been achieved by the recent development of Niti instruments with increased flexibility.^{24–27} Also, advancement

in technology like microcomputed tomography lead to the study of root canal geometry^{25,26} and anatomy^{28,29} after root canal preparation. Also microcomputed tomography should include the measurement angle with linear counterparts as mentioned in the study in order to measure and study these root canal curvatures.

5. Conclusion

With the present limitations of the study Schneider angle and its curvature height and distance reduced after instrumentation. Whereas canal access angle decreased and Curvature height and distance have increased after instrumentation. Hence curvature height and distance are dependent on Schneider angle and decreases with decrease in Schneider angle due to enlargement of the canal. From the present study following inference can be drawn as the proposed curvature height and distance are dependent on Schneider angle, and are better in assessing canal curvature than when Schneider angle is used alone.

Conflict of interest

None.

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