



SCHNEIDER ANGLE ALONG WITH CURVATURE HEIGHT AND DISTANCE - A NEW PARADIGM IN THE MEASUREMENT OF ROOT CANAL CURVATURE AND ITS COMPARISON WITH CANAL ACCESS ANGLE.

Health Science

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ABSTRACT

AIM: To find and record the Schneider angle with proposed curvature height and distance and to compare with Canal Access Angle.

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 counterparts (Curvature height and Curvature distance), is measured and calculated by using PLANMECA romexis (Helsinki Finland) software connected to the intraoral x-ray unit. Both the angles with its respective curvature height and distance were calculated and statistical analysis was done by using multiple linear regression analysis.

RESULTS: A significant and positive correlation was observed between the Schneider angle (in degrees) and curvature height (mm) ($r=0.7350$, $p<0.05$), whereas a non-significant and positive correlation was observed between Schneider angle (in degrees) and curvature distance (mm) ($r=0.0441$, $p>0.05$). Multiple linear regression analysis showed that, the curvature height (mm) is contributing better (94.14%) as compared to curvature distance (-3.59%) on Schneider angle.

CONCLUSIONS: Schneider angle dependent on the proposed curvature height and independent of curvature distance. This means that the curvature distance is a mere estimation of level of curvature whether curvature is in the coronal, middle or apical.

KEYWORDS:

Mesiobuccal Canal; Root Canal Curvature; Regression Analysis; Root Canal Preparation;

Introduction

Root canal treatment procedures more commonly dictated by the biomechanical preparation done, which in turn related various factors associated like flexural load applied to the instruments, and root canal curvatures encountered. Different root canal preparation technique has been evaluated with different root canal angle shapes (1-6). An initial attempt has been made by the Schneider angle (7), which has been universally accepted because of its mere simplicity in establishing the root canal curvatures. Various other root canal curvature techniques have been introduced angular methods like, Weine technique (8), Long axis technique (9) and more recently Canal Access Angle technique. The Canal access angle technique made an important observation regarding the canal access angle of two canals with different canal geometry may differ, even if they have the same canal curvature when measured using the Schneider technique (Fig 1b, 1c). Also linear method of root canal curvature like the radii of curvature measurement (3) technique gives an estimation on sudden curvature or gradual increase in curvature and thereby gives an estimation of flexural load applied to the instruments.

Also, as reported (10), similar Schneider angle exists along the canal which makes the difficulty in assessing and differentiating between the different level of canal curvatures like whether it is coronal, middle or apical. Although the similar studies (10) give Canal Access angle as an alternative to Schneider angle with different curvature height and distance, but it cannot be used as an alternative to Schneider method, since it does not calculate the canal curvature angle, rather it calculates the one more angle called as Canal Access Angle.

The present investigation was carried out to find and record the Schneider angle with curvature height and distance and to compare with canal access angle and its curvature height and distance.

Methodology:

One hundred human mandibular first and second molars were used for the study. Teeth with narrow canals, external resorption,

incompletely formed apices will not be considered. After extraction all teeth supposed to be stored in the 10% formalin solution. 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 (PLANMECA romexis, Helsinki, Finland). The teeth aligned so that the long axis of the root was parallel and as close as possible to the surface of the x-ray film. Radiographs of each root canal were taken in buccolingual direction and long axis of the root were perpendicular to the central x-ray beam. Exposure time was the same for all radiograph with a constant distance about 40 cm between the film and X-ray source. The Schneider method involves first drawing a line parallel to the long axis of the canal, in coronal third (AC), a second line is 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 1a) is the outer angle created by the line AC and BC (angle BCE). A hypothetical line is 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, 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) is defined as the Canal Access Angle (Fig 1a). 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 (PLANMECA romexis, Helsinki Finland) with closed lead doors to prevent the x-ray exposures (Fig 1b, 1c). Both the angles with its respective curvature height and distance were calculated and statistical analysis was done by using multiple linear regression analysis.

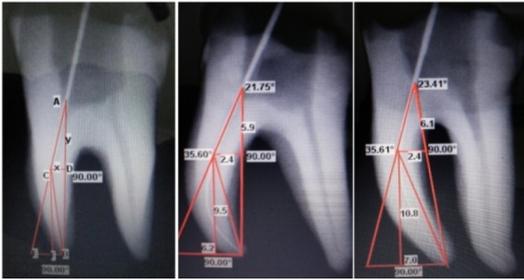


Fig 1a- Schneider angle is angle BCE, A line is drawn from apical foramen (B) to the line joining CE, which joins at point E. A perpendicular line from the point C to the line BE gives curvature distance (CF). And the distance from apical foramen to the imaginary point E gives the curvature height (BE).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

Results:

A significant and positive correlation is observed between the Schneider angle and curvature height (r=0.7350, p<0.05)(Table1). It means that, the Schneider angle and curvature height are dependent on each other. Whereas, a non-significant and positive correlation was observed between Schneider angle and curvature distance (r=0.0441, p>0.05). It means that, the Schneider angle and curvature distance are independent of each other.

Multiple linear regression analysis (Table1) showed that, the total contribution of curvature height and curvature distance on Schneider angle is 90.55%, in which the percentage contribution of curvature height is 94.14% and the percentage contribution of curvature distance is -3.59%. Therefore, the curvature height is contributing better as compared to curvature distance.

Multiple linear regression analysis showed that, exponential increase in curvature height with an increase in Schneider angle with a t-value being 30.4583 (Fig 2), and slight increase in curvature distance with an increase in Schneider angle(t-value being19. 3676) (Table 2, Fig 3).Multiple linear regression analysis showed slight increase in curvature height with increase in Canal Access Angle with t-value being 12.2108, and slight increase in curvature distance with increase in Canal Access Angle with t-value being -7.6757(Table3).

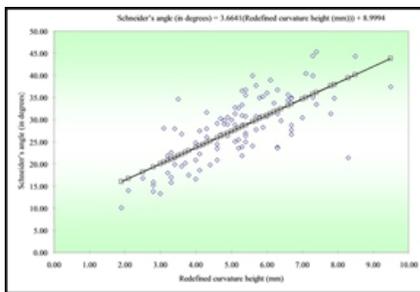


Fig 2: Correlation between Schneider angle (in degrees) with Curvature height (mm).

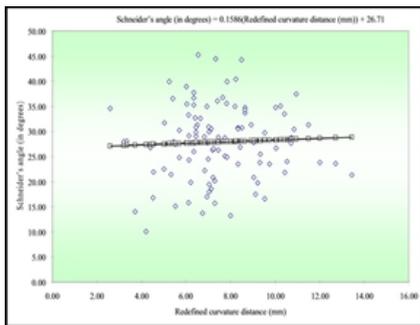


Fig 3: Correlation between Schneider angle (in degrees) with Curvature distance (mm).

Multiple linear regression analysis (Table 4) showed that, the total contribution of curvature height and curvature distance on canal access angle is 65.15%, in which the percentage contribution of curvature height is 49.26% and the percentage contribution of curvature distance is 15.89%(Table 4).Therefore, the curvature height is contributing slightly better as compared to curvature distance.

Also, the curvature height and curvature distance can be taken as predictors to predict the Schneider angle in the present study. The prediction equation of the Schneider angle by curvature height and curvature distance can be given as Schneider angle (in degrees) = 16.9884+ 6.3858*CH - 2.9313**CD

Whereas,*CH is Proposed Curvature Height and **CD is Proposed Curvature Distance.

Table 1 Relative contribution of curvature height (mm) and curvature distance (mm) on Schneider angle (in degrees).

Independent variables	Beta value	r-value	Beta x r	% of contribution
Proposed curvature height	1.2809	0.7350	0.94	94.14
Proposed curvature distance	-0.8145	0.0441	-0.04	-3.59
Total			0.91	90.55

*CH-proposed curvature height **CD-proposed curvature distance.

Table 2 Multiple linear regression of Schneider angle (in degrees) by curvature height (mm) and curvature distance (mm)

Independent variables	Regression coefficient	SE of reg. coefficient	t-value	p-value
Intercept	16.9884	0.9315	18.2378	0.00001*
Proposed curvature height	6.3858	0.2097	30.4583	0.00001*
Proposed curvature distance	-2.9313	0.1514	-19.3676	0.00001*

R=0.9515, R²=0.9055, Adjusted R²=0.9035,F(2,97)=464.85, p<0.05, S, Std.Error of estimate: 2.3075

*p<0.05

Table 3 Multiple linear regression of canal access angle (in degrees) by curvature Height (mm) and curvature distance (mm)

Independent variables	Regression coefficient	SE of reg. coefficient	t-value	p-value
Intercept	7.3419	1.7280	4.2487	0.00001*
Curvature height	7.5872	0.6213	12.2108	0.00001*
Curvature distance	-1.6611	0.2164	-7.6757	0.00001*

R=0.8071, R²=0.6515, Adjusted R²=0.6443,F(2,97)=90.677 p<0.05, S, Std.Error of estimate: 3.3293

*p<0.05

Discussion

Schneider angle is the most universal curvature measurement angle is used (7, 11, 12), since it is most simple and reliable method among all available curvature measurement techniques. Schneider angle considers mainly coronal region, where as Weine considers both coronal and apical region and long axis technique considers the apical region (7, 8, 13). Canal Access Angle technique considers the mainly coronal region. Although canal access angle is an attempt to introduce a linear method along with the angular method, it gives one more angle calculating the canal accessibility rather than the root curvature angle. An increase in the root curvature increases the difficulty in preparing the canal (8, 11, 14).Same Schneider

angulation may be present at different level of the canal like coronal middle or apical (10), which makes it difficult to differentiate between the different canals with same Schneider angle. In the present study curvature height and distance differed although the same Schneider angle is present. (Fig 4 and Fig 5).

In the present study the Schneider angle with curvature height and distance is compared to the Canal access angle technique with its curvature height and distance. The results of the present study states that positive correlation between the Schneider angle and curvature height, which are dependent on each other. This result showed that increase in Schneider angle tend to make canal more curved and hence curvature height is more.

A non-significant and positive correlation was observed between Schneider angle and curvature distance ($r=0.0441$, $p>0.05$). It means that, the Schneider angle and curvature distance are independent of each other. This means the curvature distance is not dependent on the Schneider angle and it gives a mere estimation of level of curvature whether curvature is in the coronal, middle or apical. Multiple linear regression analysis showed that, the curvature height is contributing better (94.14%) as compared to curvature distance (-3.59%) on Schneider angle.

In canal access angle significant and positive correlation was observed between Canal Access angle and curvature height ($r=0.6632$, $p<0.05$). It means that, the Canal access angle and curvature height are dependent on each other. Also significant and positive correlation was observed between Canal Access Angle and curvature distance ($r=-0.3404$, $p<0.05$). It means that, the between Canal Access Angle and curvature distance are dependent on each other. Multiple linear regression analysis showed that, the curvature height is contributing better (49.26%) as compared to curvature distance (15.89%). The findings are similar to the previous study (12). Although Schneider angle is most universally used (15, 16, 17) which does not establish the level of curvature. And most of the instruments tend to break at the apical region (18, 19, 20) hence it is advisable to know the level of the canal curvature along with the curvature angle. When quantitative methods were used, the inter-observer and intra-observer agreement with the angle measurements was considerably better (21) than on the radius measurements, hence minimal or no observer variations can be expected from the present study. Also present study can be extended to include cyclic fatigue resistance with different Niti file systems (22, 23).

CONCLUSION

Schneider angle dependent on the proposed curvature height and independent of curvature distance. This shows that the curvature distance is a mere estimation of level of curvature whether curvature is in the coronal, middle or apical. This combination of angular and linear measurement techniques opens up a new paradigm in measuring the root canal curvature measurement techniques.

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