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ORIGINAL ARTICLE

Clinical evaluation of internal axial wall divergence in inlays and casting post-and-core fabrication

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KEYWORDS
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Abstract *Background/purpose:* In the fabrication of casting post and core or inlay the line angle of the cavity floor can be seen even when the internal axial walls are parallel or slightly convergent. It is conceivable that more sighted distance will be required for internal axial walls evaluation compared with external axial walls evaluation. The aim of the study is to derive a practical and convenient method and data for the evaluation of the divergent angle of internal axial walls.
Materials and methods: Through a scientific analysis, this study derived a practical and convenient method and data for the evaluation of the divergent angle of internal axial walls. The sighted distance between occlusal line angle and the cavity floor line angle at 30-cm distance was calculated by an established formula and expressed in 6°, 12°, and 18° of internal axial walls divergent angle respectively.
Results: Tables 1–3 show the value of sighted distance with cavities of 6°, 12°, and 18° tapering. Based on the data, if more divergent angle is prepared; more sighted distance will be observed.
Conclusion: Compared with the teeth preparation of external axial wall in a single crown, the sighted distance at 30-cm distance in the internal axial wall is 1.5 × wider. More sighted distances are required to prevent undesired undercuts.
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Introduction

In the fabrication of fixed partial dentures, retention form and resistance form are essential during tooth preparation. The quality of a preparation that prevents the restoration from becoming dislodged by forces parallel to the path of withdrawal is known as retention form. Resistance form of a tooth preparation overcomes lateral forces that are produced by eccentric contact in mastication or parafunctional activity. Theoretically, maximum retention and resistance are obtained if a crown preparation has parallel external axial walls. However, it is impossible to prepare a tooth this way and slight undercuts may be created. Jørgensen[1] in 1955 reported that the retention of a cap with 10° of taper was approximately half that of a cap with 5°. Too small a taper may lead to undesired undercuts; too large will no longer be retentive. When we prepare a single crown, the external axial walls are usually examined and judged by visual evaluation to ensure there is no undercut, as proposed by Shillingburg et al.[2] Chang[3] offered a scientific method to evaluate the taper of external axial walls by estimating the width and height of the prepared tooth. He found that when the external axial wall was prepared with 6° taper, the sighted distance between the occlusal line angle and the cervical margin at a 30-cm distance ranges from 0.2 mm to 0.38 mm.

However, the judgment of the convergent angle of the axial wall by estimating the above distance is not applicable in the preparation of inlays and post-and-core, as we deal with the internal axial walls instead of external axial walls. Owing to the visual angle, the line angle of the cavity floor can be seen even when the internal axial walls are parallel or slightly convergent (Fig. 1). Thus, it could be assumed that as compared with external axial walls, to ensure no undesired undercuts, more sighted distance will be required for internal axial wall evaluation. When inlay and cast post-and-core were fabricated, 6—8° taper of internal axial walls are necessary to ensure adequate retention. However, when judged or verified with the naked eye, a dependable and definite way to verify the appropriate internal wall divergence will be very beneficial.

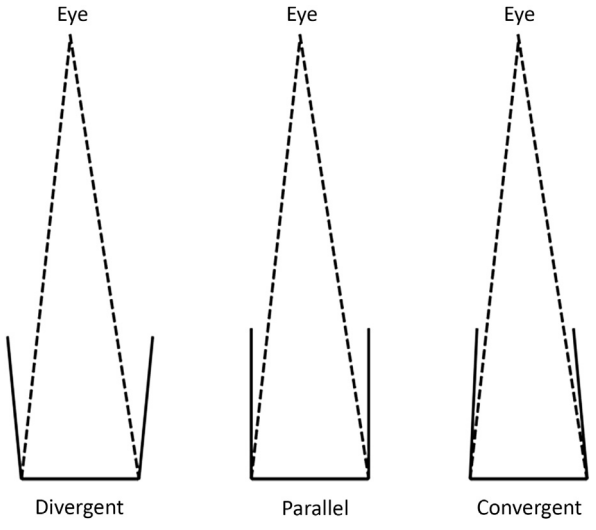

Figure 1 Visual evaluation of the presence of undercuts, owing to the visual angle, the axial wall can be seen even when the internal axial walls are parallel or slightly convergent.

The aim of the study is to derive a practical and convenient method and data for the evaluation of the divergent angle of internal axial walls through scientific analysis.

Materials and methods

When observers viewed the cavity of the inlay or post-and-core with one eye, two lines, namely the occlusal line angle and cavity floor line angle, were recognized (Fig. 2). The distance between them increased as the axial wall divergence increased. The prepared cavity of the inlay and casting post-and-core was simulated by a trapezoid model and observed at a 30-cm distance (Fig. 3). As shown in Fig. 3, the true distance between the occlusal line angle and the cavity floor line angle is X and sighted distance is X' when observing at a 30-cm distance. The formula for the calculation of X' is:

$$X' = \frac{W - Y}{2} \quad [1]$$

where W is the width of occlusal cavity; Y is sighted length of cavity floor in the occlusal level. When I is the width of cavity floor, H is the depth of cavity and θ is the angle of taper. Through the trigonometric function, we can obtain formulas as follows:

$$Y = \frac{I(300 - H))}{300} \quad [2]$$

and

$$I = W - 2H\tan\frac{\theta}{2} \quad [3]$$

Finally, the formula that calculates the sighted distance is:

$$X' = \frac{W - Y}{2} \quad [4]$$

$$X' = \frac{W}{2} - \frac{\left(W - 2H\tan\frac{\theta}{2}\right)(300 - H)}{600} \quad [5]$$

According to this formula, in order to cover all the clinical situation from inlay to post and core fabrication, three different divergent angles, namely, 6°, 12°, and 18° with the cavity width from 1 mm to 10 mm and depth from 2 mm to 10 mm, were calculated to show the difference and change in the width of sighted distance.

Results

Tables 1—3 show the value of sighted distance with cavities of 6°, 12°, and 18° tapering. Based on the data, the more divergent angle is prepared; the more sighted distance will be observed. The sighted distance in the 12° group was approximately twice that of the distance in the 6° group, and sighted distance in the 18° group was approximately threefold that of the distance in 6° group. The results were

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