The Effect of Guidance Elements on the Rotation of Cast Crowns During Cementation

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The effect of guidance elements on the rotation of crowns was analyzed. Resin molars were prepared with curved or horizontal preparation lines. Further groups were formed with a groove or one or two boxes. Teeth were duplicated eightfold; crowns were produced and cemented with a rotational torque of 0.5 Ncm. The width of the cement gap was measured at 11 reference points. Having either one or two guidance boxes had a significant centering effect. No differences were found between both types of preparation lines. The use of a proximal guidance box may be considered to reduce torsion of a single crown during cementation. *Int J Prosthodont 2010;23:347–349.*

The aim of this in vitro study was to evaluate guidance elements in tooth preparation, such as retentive grooves or boxes,[1–3] to center a crown on the tooth and avoid rotation during cementation. Additionally, the influence of a horizontal and a curved preparation line were compared.

Materials and Methods

An artificial maxillary right first molar was prepared with a taper of 3.9 degrees for a full cast crown with a 0.5-mm-wide chamfer. At both proximal sides, the chamfer was situated higher than the buccal or lingual aspect by 1.0 or 1.5 mm, resulting in a curved preparation line. Further preparation (a mesial guidance groove [Fig 1a], a mesial guidance box, or two opposing guidance boxes) was performed after duplication (Table 1). Then, the preparation line was altered so that it had the same height at all sides of the tooth (Fig 1b). Eight groups were formed ($n = 8$).

Crowns were cast in the palladium-based alloy Albabond A (Heraeus Kulzer) using a 0.1-mm placeholder foil to achieve a gap of 40 to 60 µm. All crowns were cemented on the teeth using glass-ionomer luting cement (Ketac Cem, 3M ESPE) under a vertical load of 25 N and a rotational torque of 0.5 Ncm.

After horizontal sectioning and polishing, the cervical part of the tooth was positioned under a microscope in a custom-made specimen holder, which allowed stepwise rotation to measure the thickness of the cement at 11 reference points. Variations in the cement film thickness were used as an indicator for rotation of the crown. For each crown, the mean value of all measurements was calculated. Then, the difference between each measurement and the mean was calculated and squared. A new mean value was calculated for each crown to characterize its rotational position.

Groups were compared using analysis of variance, and post hoc comparisons were performed using the Dunnett T3 test.

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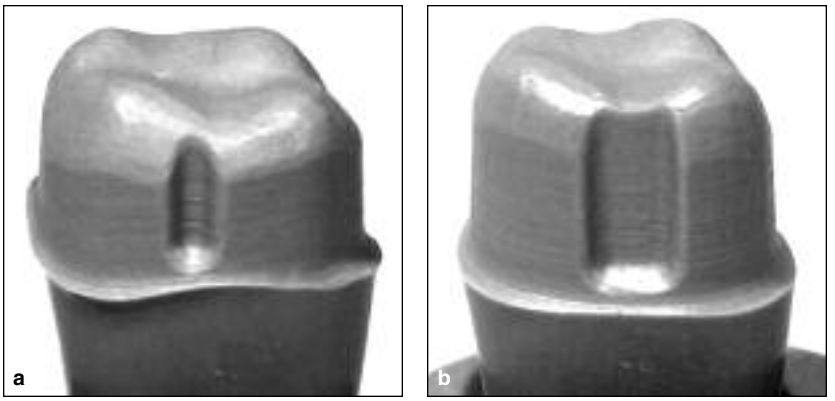
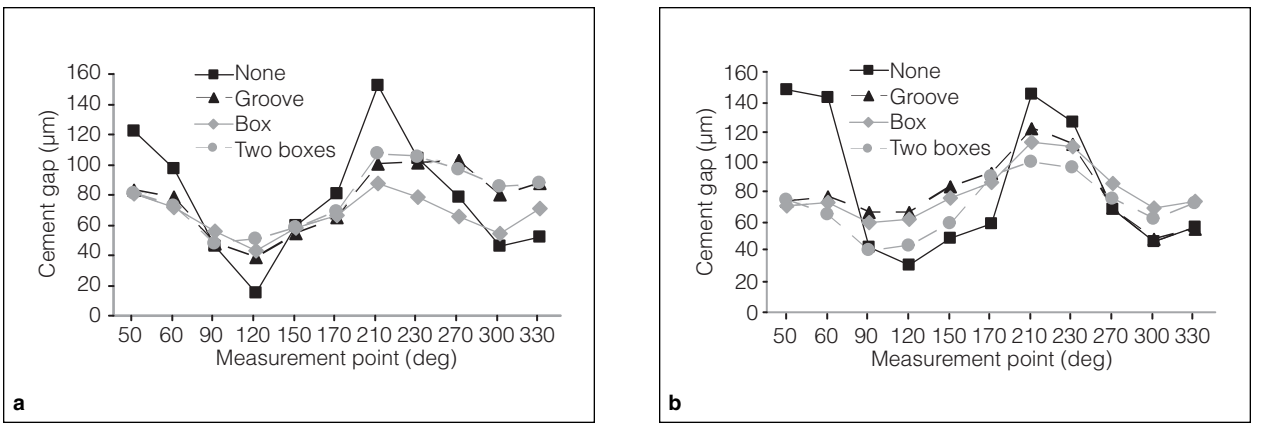


Fig 1 Two master teeth with **(a)** a curved and **(b)** a horizontal preparation line in combination with **(a)** a small guidance groove or **(b)** a guidance box.

Table 1 Description of Guidance Elements in the Different Groups

Preparation line	Type of guidance element	Group no.
Curved	None	1
	Retention groove at the mesial surface (width: 1.6 mm, depth: 0.8 mm)	2
	Retention box at the mesial surface (width: 2.5 mm, depth: 1.0 mm)	3
	Two retention boxes at the mesial and distal surfaces	4
Horizontal	None	5
	Retention groove at the mesial surface (width: 1.6 mm, depth: 0.8 mm)	6
	Retention box at the mesial surface (width: 2.5 mm, depth: 1.0 mm)	7
	Two retention boxes at the mesial and distal surfaces	8



Figs 2a and 2b Mean cement film thickness of crowns with **(a)** a curved preparation line or **(b)** a horizontal preparation line and different forms of guidance elements.

Results

The mean cement film thickness for each group revealed a different degree of rotation (Figs 2a and 2b). For both types of preparation lines, statistically significant differences were found between the group without a guidance element and those with one (curved preparation: $P = .012$, horizontal preparation: $P = .023$) or two (curved preparation: $P = .045$, horizontal preparation: $P = .024$) guidance boxes. Pairwise comparison between both preparation lines showed no significant differences.

Discussion

The results clearly show that the rotation of a crown can be reduced by guidance elements. As seen in Figs 2a and 2b, the variation of the width of the cement gap without any guidance elements is smaller for a curved preparation line than for a horizontal preparation line. This effect might be explained by the antirotational effect of the preparation line itself.

An accurate internal fit centers a crown on the tooth. However, if a crown is placed on the abutment tooth in a slightly rotated position, the excess luting cement is pressed out of the crown and the gap between crown and tooth becomes narrower, resulting in a higher mechanical resistance for the luting cement. This can inhibit rotation of the crown into its correct terminal position, leading to an increased marginal gap and a slightly too high occlusal surface. In contrast, a guidance element centers the crown at a much earlier time when the corresponding part of the crown "glides" into the guidance element in the tooth. At that time, the luting cement has a high thickness, thus the centering movement of the crown is not hindered and the crown can be pressed into its final position without torsion. During crown fabrication, a spacer or a placeholder foil should be used to ensure a sufficient outlet for the cement when the crown is seated.[4] Otherwise, an increase in vertical height could result.[5]

Conclusions

The current study shows that a proximal guidance box can reduce torsion seen on a single crown during cementation. A guidance groove or two guidance boxes cannot be recommended since the groove had no significant centering effect and two boxes did not show any further advantage when compared to a single guidance box.

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Literature Abstract

The effect of finish line curvature on marginal fit of all-ceramic CAD/CAM crowns and metal-ceramic crowns

The level of finish lines on crown preparations varies around a tooth, with the level of the labial and lingual margins usually apical to the interproximal margins. The aim of this study was to investigate if different finish line curvatures affected the marginal fit of all-ceramic and metal-ceramic crowns. Three types of abutment finish line curvatures (1-, 3-, and 5-mm curvature) were prepared on maxillary central incisor ivorine teeth. For each type of abutment, five all-ceramic and five metal-ceramic crowns were fabricated. The marginal vertical gap between the die and copings and the die and final porcelain veneered crowns were measured on a profile projector under 20× magnification. The data were analyzed using two-way analysis of variance and the Tukey HSD test. All copings of the all-ceramic crowns had similar labial, lingual, mesial, and distal marginal gaps regardless of the curvature. Copings of metal-ceramic crowns had larger mesial and distal gaps with greater finish line curvature. There was a significant correlation between the finish line curvature and the mesiodistal marginal gaps of metal-ceramic crown copings. This difference could be due to the casting process whereby the casting ring restricts the expansion of the investment more in an axial direction than in a horizontal direction. Therefore, the longer the axial length of the wax pattern, the greater the increase in the casting's axial length. A significant difference was noted between all-ceramic crown copings and metal-ceramic crown copings. After porcelain application, there was little change in the marginal gap for all-ceramic crowns. For metal-ceramic crowns, larger gaps were seen in the labial and lingual margins compared to the mesial and distal margins the greater the finish line curvature. Deterioration of the initial fit of the metal coping was seen after porcelain application. This could be due to the difference in the thermal coefficient of expansion between the porcelain and metal. This study indicates that the finish line curvature does not have much effect on the marginal fit of all-ceramic crowns, but has a significant effect on metal-ceramic crowns.

Tao J, Han D. *Quintessence Int* 2009;40:745–752. **References:** 26. **Reprints:** Dr Jianxiang Tao, Department of Prosthodontics, School of Stomatology, Tongji University, 399 Yan Chang Zhong Road, Shanghai 200072, China. Email: taojxtohoku@hotmail.com—*Clarisse Ng, Singapore*