

Convergence Angle of Prepared Typodont Teeth for Full Veneer Crowns Achieved by Dental Students

Dimitar N. Kirov¹, Stefka S. Kazakova¹, Dimo S. Krastev²

¹Assistant Professor Department of prosthetic dental medicine, Faculty of Dental medicine, Medical University- Sofia, EU-Bulgaria

²Associate Professor, Department of Anatomy, College of Medicine, Medical University - Sofia, EU-Bulgaria

Abstract: *This study measured the convergence angles of typodont tooth preparations for full veneer crowns prepared by students in Faculty of Dental Medicine, Sofia, Bulgaria. The convergence angles of tooth preparations for full veneer crowns were evaluated to achieve the objective of the study. Sample of 80 typodont teeth (20 upper premolar, 20 lower premolar, 20 upper molar and 20 lower molar) prepared by third year dental students at the Faculty of dental medicine were collected. The bucco-lingual convergence angles of each preparation were measured with the help of software MB-Ruler. Mean convergence angles were calculated, and differences between groups were tested for statistical significance with Independent sample t-test at 5% level of confidence. The mean values for premolars and molars differed significantly. Convergence angle measurements were significantly different between the two groups teeth ($p < 0.05$). The greatest convergence value (mean 15.44°) was for lower molar prepared by dental students. The smallest convergence value (mean 11.12°) was for upper premolar. In this study, the mean total occlusal convergence TOC of typodont crown preparations by dental students was higher than the ideal range of $4-6^\circ$.*

Keywords: tooth preparations, convergence angles, typodont tooth, students

1. Introduction

Preparation of teeth for complete crowns is a basic technique for dental treatment and plays an essential role in pre-clinical education. One of the most important principles for the tooth preparation is achieving a retention and resistance form (17). Retention and resistance of the crown depends on various factors such as convergence angle of preparation, height of preparation, geometry, luting agent and surface area of preparation (14, 16).

Therefore, the design of tooth preparation is an important consideration in the retention of crowns. Always we need a small convergence angle (CA), (tapering) of a tooth to achieve a passive sitting of restoration. The convergence angle (CA) of a tooth preparation is the combined angle made by opposing axial walls when measured against the long axis of the tooth (17). Taper is the angle between one axial wall of the preparation and the long axis of the preparation.

The convergence angle significantly influences crown retention. Therefore, it is essential that dental students become competent in achieving acceptable abutment taper. Theoretically, the more parallel the opposing walls of a tooth preparation are, the greater the retention and the more conservative is the tooth preparation. It is widely accepted that the convergence angle of a full veneer crown preparation should be as close to parallel as possible to attain adequate retention and resistance (5).

Some manuals and textbooks on fixed prosthodontics often recommend a CA of approximately 5° ($4-6^\circ$) as the ideal. Goodacre (9, 10) and Wilson (17) recommend total occlusal convergence between $10-20^\circ$. Schillinburg (17) recommends 6° degrees taper (or 12° TOC) of tooth preparation. However, there is no close agreement between authors as to

the ideal taper, therefore the literature supports the use of a minimal convergence angle.

It is difficult to achieve parallel walls ($4-6^\circ$) in clinical practice and some authors (13) recommended minimal taper of 12° which is necessary to ensure the absence of undercuts.

Diferent authors (10) recommended total occlusal convergence (TOC) should range between 10° and 20° .

Studies on the occlusal convergence angle from data that was clinically obtained by dental practitioners (1) or students (6, 11, 7) have also been performed.

Annerstedt et al (4) revealed that the mean TOC for dental students (19.4 degrees) was less than the convergence created by dentists (22.1 degrees). Investigations (8) showed that there are differences in convergence angle between typodont preparation and clinical preparation. This is because there are limited access and visibility. There are many techniques for measuring convergence angles of preparations as photocopy machines, tool marker microscope, overhead projectors, goniometric microscopes and CAD/CAM machines (3). The present study was conducted to investigate the ability of dental students to achieve the recommended convergence angles for complete crown preparation.

2. Material and Methods

This study was based on measurements of convergence angles of tooth preparations for complete crowns. The convergence angles of 80 typodont complete crown tooth preparations prepared by third year dental students at the Faculty of dentistry in Sofia were evaluated. Special die bases were fabricated and used to allow stable and reproducible positions of typodont teeth. The bases kept the

teeth in a position with its long axis perpendicular to the horizontal plane.



Figure 1: A custom-made device was constructed to hold the teeth in the same position

Teeth images were captured with digital camera. Then the photograph of typodont teeth were taken from faciolingual direction and transferred into a personal computer for measurement of convergence angle and axial wall tapers (facial and lingual). The two images (before and after preparation) were superimposed and evaluated with Adobe Photoshop (Figure 1).

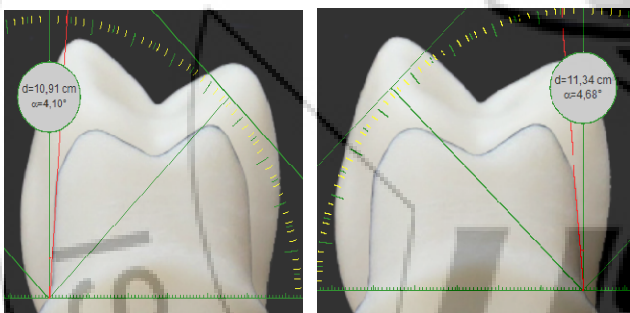


Figure 2: Measurement of convergence angle and axial wall tapers (facial and lingual)

The convergence angles of each preparation were measured with the help of software MB-Ruler. Compared with another studies that measured only TOC this study evaluated the convergence angle for facial and lingual wall separately. Data were collected and analyzed using descriptive and student's t-test with a statistical software package (SPSS v19.0, SPSS Corp., Chicago, IL, USA).

3. Results and Discussion

The results for CA comparisons for the different groups teeth are shown in Table 1 and Table 2.

Table 1: Difference in convergence angle and axial wall taper values between two groups upper teeth.

Variable	Tooth type		Mean difference	p-value
	Premolar	Molar		
Facial wall taper	5.37°	6.78°	1.41°	0.001
Lingual wall taper	5.75°	7.14°	1.39°	0.002
TOC*	11.12°	13.92°	2.80°	0.000

*TOC - total occlusal convergence

The mean CA for the upper premolar tooth preparation (mean 12.52°) was significantly less than the mean for the molar tooth preparations (mean 14.15°) (p<0.05). Mean convergence angle values for facial wall, for upper premolars and molars were 5.37°, and 6.78°, respectively. Lingual wall taper was significantly greater than the facial wall taper (p<0.05).

Table 2: Difference in convergence angle and axial wall taper values between two groups lower teeth.

Variable	Tooth type		Mean difference	p-value
	Premolar	Molar		
Facial wall taper	6.14°	7.53°	1.39°	0.004
Lingual wall taper	6.72°	7.91°	1.19°	0.009
TOC*	12.86°	15.44°	2.58°	0.000

*TOC - total occlusal convergence

Mean convergence angle values for facial wall, for lower premolars and molars were 6.14°, and 7.53°, respectively. Lingual wall taper (mean 7.32°) was significantly greater (p<0.05) than the facial wall taper (6.84°). Convergence angle and axial taper values were significantly greater for molar teeth as compared to premolar. In this study, the mean CA of crown preparations by dental students was higher than the ideal range of 4-6°. The results of our study showed that the mean TOC for upper teeth achieved by the third-year dental students were 11.12° for a premolars and 13.92° for molars. Facial CA (wall taper) was greater than the lingual wall taper. TOC for lower teeth was 12.86° for premolars and 15.44° for molars. Facial CA (wall taper) was greater than the lingual wall taper.

Convergence angle and axial wall taper values were significantly less for upper teeth as compared to lower teeth and lingual wall taper was significantly greater than facial wall taper.

This finding is in agreement with previous studies investigating CA achieved in clinical settings (14).

These angles are far in excess of those normally recommended in the fixed prosthodontic textbooks.

Rafeek et al. (15) reported the range of 4-14° total convergence angle of teeth prepared for full-veneer crowns by dental students on typodonts. We found that dental students could develop tooth preparations for complete crowns with a mean taper of 12.52° for the upper typodont teeth and 14.15° for lower teeth.

4. Conclusion

The widely recommended 6° taper have been shown to be difficult to achieve for many dental students. Only the preparations for upper premolar were in the recommended range for CA (<12°) as stated by prosthodontics manuals and textbooks. It was concluded that three-year students could not complete crown preparations within the 4°-6° criteria. Effective taper criteria must define as realistic, measurable goal that the student can visualize and achieve. However, a 12° degrees criterion is more realistic than a 6° criterion for full coverage crown preparations.

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Author Profile



Dimo Krastev graduated in 1994 Faculty of Medicine of the Medical University of Sofia and then graduated in 1999 Faculty of Dental Medicine of the Medical University of Sofia. Dr. Krastev wrote his PhD thesis at the Department of Anatomy and Histology at the Medical University of Sofia and received his doctoral degree. His research interests are related to anatomy, histology, maxillofacial surgery and orofacial pain. He is currently a member of the Bulgarian Medical Association, Bulgarian Dental Association, Bulgarian Anatomical Society and Anatomische Gesellschaft-Germany. Editor of Bulgarian scientific online magazine: www.scimagazine.org from 2013. Editor of Balkan online scientific journal: www.scimedbalkans.org from 2013. Editor of scientific Bulgarian magazine "Health & Science" at the Medical University of Sofia - 2010. Member of the Editorial Board of the Journal of Balkan History of Medicine "Asclepius" by 2012. He currently works as an Associate Professor in the Department of Anatomy in the Medical College, Medical University of Sofia, Bulgaria, EU.



Dr. Dimitar Kirov graduated in July, 1994 from the Faculty of Dental Medicine of the Medical University of Sofia. He became assistant professor in 1995 in the Faculty of Dental Medicine in the department of Prosthetic Dentistry. Dr. Kirov wrote his PhD thesis at the Department of Prosthetic dentistry at the Medical University of Sofia and received his doctoral degree in April, 2014. His research interests are involved in orofacial pain and TMD. He has published more than 30 articles or manual chapters. Dr. Kirov presents his scientific papers on national and international dental meetings. He is currently a member of the Bulgarian Dental Association and Bulgarian Scientific Dental Association.



Dr. Stefka Kazakova graduated in July, 1990 from the Faculty of Dental Medicine of the Medical University of Sofia. Dr. Kazakova became assistant professor in 1993 in the Faculty of Dental Medicine in the department of Prosthetic Dentistry. During the Spring semester of 2002 Dr. Kazakova was a visiting assistant professor in the College of Dentistry, University of Kentucky, USA. Her research interests are in esthetic and adhesive dentistry. She is currently a member of the Bulgarian Dental Association and Bulgarian Scientific Dental Association.