

Assessment of Angle of Convergence of Prepared Tooth for Full Veneer Crown Clinically Using a Neoteric Tool

Running Title: Angle of Convergence, Tooth preparation guide

**Thamaraiselvan KM, MDS¹, Vidyashree Nandini, V MDS, DNB², Nithyarajan.N³,
RussiaMarimuthu M., MDS⁴**

¹Senior Lecturer, Department of Prosthodontics & Implantology, S.R.M.Kattankulathur Dental College and Hospital, SRM University Campus, Potheri, Tamilnadu, India

²Professor and Head of Department, Department of Prosthodontics & Implantology, S.R.M.Kattankulathur Dental College and Hospital, SRM University Campus, Potheri, Tamilnadu, India

³Postgraduate, Department of Prosthodontics & Implantology, S.R.M.Kattankulathur Dental College and Hospital, SRM University Campus, Potheri, Tamilnadu, India

⁴Senior Lecturer, Department of Prosthodontics & Implantology, S.R.M.Kattankulathur Dental College and Hospital, SRM University Campus, Potheri, Tamilnadu, India

Abstract: *Angle of convergence is one of the most important clinical guidelines necessary for the success in fixed prosthodontics. It will be very effective if the angle of convergence can be determined clinically during tooth preparation. There are few methods to determine the angle of convergence clinically but they are expensive, time consuming and they require special equipment. A simple intraoral tool has been developed to assess the angle of convergence clinically.*

Keywords: Angle of Convergence, Tooth preparation guide

1. Introduction

For the success of the crown or fixed dental prosthesis, form of the prepared teeth and amount of the tooth structure to be removed are most important. Goodacre et al developed certain clinical guidelines that can be used to optimize success in fixed prosthodontics¹. One of the most important guidelines is the total occlusal convergence.

Total occlusal convergence is the angle formed between two opposing prepared axial surfaces. Angle of convergence is one of the most important factors that determine the retention and resistance form of the restoration. As early as 1923, Prothero indicated that the convergence of peripheral surface should range from 2°-5°². According to Shillingburg theoretically, near parallel opposing walls provide greater retention³. But these angles are theoretical and they are very difficult to achieve clinically without producing undercuts during tooth preparation⁴.

Several clinical studies have been conducted to establish optimal angle of convergence in clinical practice⁵⁻⁸. Jorgensen was the first to demonstrate experimentally that there exists an inverse relationship between retention and convergence angles⁹. Mack estimated that, a minimum taper of 6° and convergence angle of 12° was necessary to ensure the absence of undercuts during preparation and found an average clinical taper of 16.5°¹⁰. Experimental studies have also shown that preparations with tapers greater than 20 degree display a significant fall in resistance to oblique displacing forces¹¹. Goodacre^{1,12} and Wilson³ recommend

total occlusal convergence that can be clinically achieved as a range between 10-20°.

Few techniques are available to determine the angle of convergence during the clinical procedure. They include using digital photos or scanners to show the angle of convergence, but they can be used only after tooth preparation¹³. These techniques are difficult to execute in clinical practice because they are expensive, time consuming, and require special equipment. So a simple device is needed to assess the angle of convergence clinically. Not many studies have been conducted to check the convergence angle intra-orally during the tooth preparation. So the aim of the study was to create a neoteric tool i.e. Intraoral TOC analyzer to assess the angle of convergence during tooth preparation to achieve acceptable TOC (Total angle of convergence).

2. Methodology

An instrument was designed and developed for this study in the Department of Prosthodontics and Implantology. It has 6 disk shaped tools designed to fit to the head of the mouth mirror. The discs were white sheets printed with circular designs to the size of the mouth mirror and the sheets were then laminated. These designs were made using Auto CAD 2013 software.

A total of 6 designs were made. They were named according to the degree they represent as 0, 6, 10, 16, 20 and 40-degree tool (Fig.1). The design has a vertical perpendicular line and

Horizontal secant line. It was designed in such a way that in a 0-degree tool, there was a vertical middle line and the line next to the vertical line has a 0-degree angulation and all the remaining lines were parallel to each other.

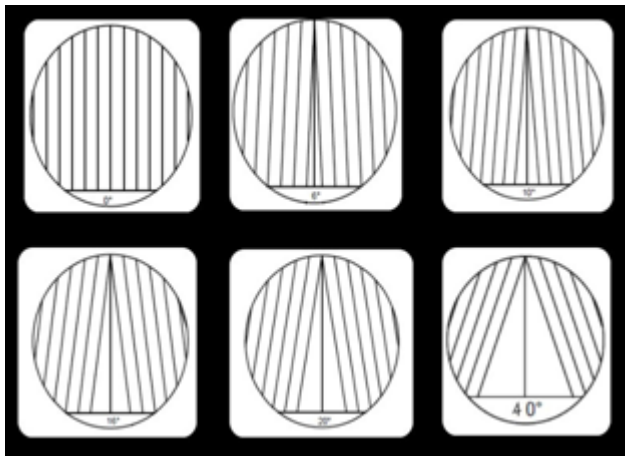


Figure 1: Images of the tools designed using Auto CAD 2013

In other tools there was a vertical middle line and line next to that was at 6,10, 16, 20 and 40 degrees respectively; the other lines were parallel to the second line. The mirror on the mouth mirror head was removed and the borders were smoothed to receive the tool(Fig.2) and the tools were then stuck to it(Fig.3).

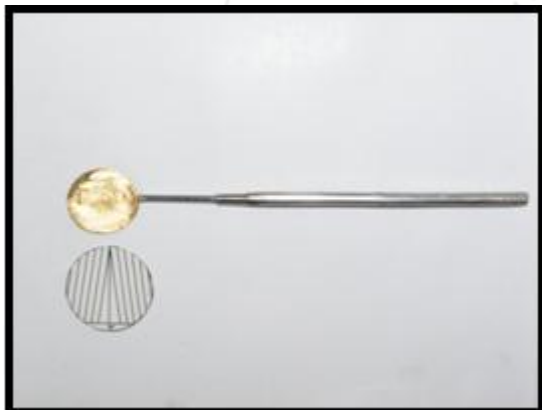


Figure 2: A tool and the prepared mouth mirror head



Figure 3: Tool attached to mouth mirror

3. Clinical Assessment

The tool should be placed in any one of the sides (buccal, lingual, mesial and distal) to the preparation, aligning the vertical diameter line with the axis of the path of placement and the secant line with the bases of the two axial walls. The mirror should be moved slightly, aligning one of the lines with one of the axial walls. The secant line helps clinician avoid errors. If necessary, the mirror can be moved to check the opposite axial wall alignment. These procedures should be repeated increasing the angle of convergence progressively using other tool, until the accurate angle was found(Fig.4 & 5).



Figure 4: Intraoral assessment in maxillary arch

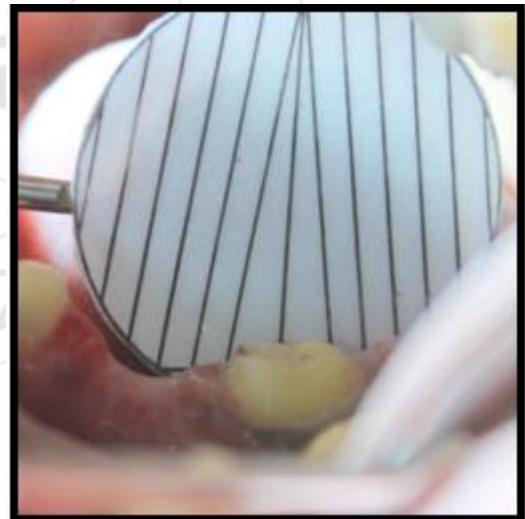


Figure 5: Intraoral assessment in mandibular arch

4. Discussion

The instrument designed was a simple tool that can be used in the daily practice. It was small and could be easily attached to the mouth mirror. It can be used to assess the angle of convergence clinically with ease. Thus by knowing the angle of convergence clinically during tooth preparation, one can easily correct and modify the preparation at early stages.

Helder & et al made a similar tool to measure the angle of convergence during tooth preparation. These are made of stainless steel discs and their bulkiness made it difficult to measure buccolingual angle of convergence¹⁴. Unlike the stainless steel tool, this Intraoral TOC analyser was lighter and easier to make, convenient to measure angle of convergence on all the sides and they are disposable. Certain limitations include it requires a short period of practice. Also if the axial wall falls in the interval between horizontal secant lines, the exact determination of angle of convergence is difficult. This limitation is not relevant in most cases.

5. Conclusion

The technique and the tool described can help in the easy determination of convergence angle clinically during tooth preparation. This assessment tool would be beneficial in cases where it is difficult to estimate the angle of convergence due to tooth position, where TOC is very critical for the total retention and resistance form and for the novice in tooth preparation.

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