بسم الله الرحمن الرحيم

Influence of converging angles on the marginal adaptation and the fracture strength of CAD\CAM ceramic copings

A Thesis

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In

Fixed Prosthodontics

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ABSTRACT

Objective: The aim of this study was to investigate the influence of converging angles on the marginal adaptation and the fracture strength of CAD/CAM ceramic copings.

Materials and Methods: Three stainless steel metal dies representing a prepared mandibular first molar were used with three different convergence angles (٨, ١٠ and ١٢ ° respectively). All of the metal dies received a preparation of ١٠ mm cervical diameter, ٦ mm height and ١٫٥ mm occlusal reduction. The finish line was rounded shoulder with ١mm thickness. A total of ١٥ ceramic copings (٥ for each convergence angle degree) were constructed on the stainless-steel dies using the milling machine. Vertical marginal gap measurements were recorded using a stereomicroscope; the mean of marginal accuracy in microns was calculated for each group of samples. The copings were subjected to fracture resistance testing using Universal Testing Machine and the mean in Newton was calculated for each group of samples. Data were collected, tabulated and statically analyzed.

Results: ANOVA test showed that there was a statistically significant difference between the three groups (P-value < ٠٫٠٠١). Pair-wise comparisons between the three groups showed that there was no statistically significant difference between ٨ and ١٠ degrees (٥٢٫٦ ± ٥٫١ µm, ٤٩ ± ٠٫٨ µm respectively); both showed the statistically significantly highest mean marginal gap distances, ١٢ degrees (٣٢٫٢ ± ٢٫٢ µm) showed the statistically significantly lowest mean marginal gap distance. Pair-wise comparisons between the three groups showed that ١٢ degrees convergence (٤١١٫٤ ± ٦٫٦ N), recorded the statistically significantly highest mean fracture resistance; this was followed by ١٠ degrees (٣٤٩ ± ٣١٫٢N) and ٨ degrees (٢٤٢٫٨ ± ٥٫١N) group recorded the statistically significantly lowest mean fracture resistance.

Conclusions: It was found that increasing the axial convergence angle of the ceramic copings diminished their marginal gap distance and increased their fracture resistance values.

KEYWORDS: Cerec, CAD/CAM, Convergence angle, Fracture Strength, Marinal adaptation.

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Dedication

I will never be grateful enough to my family for standing beside me all over the way and for being the reason of each and every step forward in my life. **My beloved Father (Dr. Ahmed Saad)** who taught me everything in my life & for his extreme support and care, **My Mother** who supported me through the whole work and get worried till it came out to the light, MY Husband **(Dr. Kareem Ahmed Farid)** for sharing with me all the effort and worries. And last but not least my dear brother and sister for being supportive throughout my life.

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Introduction

Material selection is one of the most important factors for the success of crowns and other extra-coronal restorations. Material properties, such as the strength of the restoration, how well it fits, its aesthetics, also wear resistance and biocompatibility dictates the long-term efficiency of fixed restorations.

The use of all-ceramic materials for fixed restorations has become a key topic in aesthetically oriented dentistry. Recently, all-ceramic crowns have come into wide use in the posterior region as well as the anterior region because of their natural look and excellent biocompatibity.

Ceramics are basically brittle materials, having low tensile strength, and fracture toughness; therefore all-ceramic crowns have always come with some risk of fracture. To prevent crown fractures, it is not only necessary to use as strong material as possible, but also to fabricate the crowns with the best fit possible, providing good structural durability.

Poor marginal fit can lead to secondary caries, periodontal disease, and endodontic inflammation due to microleakage from the oral cavity, and clinical failures of the fixed restoration.Misfit in all-ceramic crowns can also affect their fracture strength and thus reduce longevity.

Adequate marginal adaptation is therefore an important criterion to consider when evaluating the success of all-ceramic restorations. The current clinically acceptable marginal opening is between ٥٠ and ١٢٠ mm.

Many factors influence the fracture resistance and marginal adaptation of crowns, including the type of cement, cementation technique, use of die spacer, and tooth preparation geometry.

Degree of convergence angle can affect both the mechanical and the biological considerations; which will consequently affect the fractural resistance and the maximum marginal adaptation of the ceramic copings.

Yet there has been relatively few studies and no clear understanding on the influence of the abutment taper on the marginal fit and fractural resistance of all-ceramic copings.

Computer-aided design/computer assisted manufacture (CAD/CAM) systems are rapidly gaining importance in dental practice as some of their products aim to combine aesthetics with strength and facilitated the development of superior dental ceramics.

Using this system, procedures may be performed without intermediate appointments, thereby decreasing cost, time and the chance of contamination during the provisional phase. However, many investigators have criticized the marginal accuracy of these restorations.

As patients are primarily concerned with improved aesthetics, and dentists are interested in the longevity of restorations in term of strength and fitness, so studying the marginal adaptation and fracture resistance was the goal of this study.

Review of literature

The traditional metal ceramic system allows maximal strength but at the same time there is growing concern among clinicians over the safety implications of using base metal restorations intra-orally and the light transmission properties which are completely different from those of the natural teeth. Patient esthetic expectations and need for biologically compatible materials lead to an increase in demand for ceramic restorations. [١-٢]

Dental ceramic materials provide essential advantages over metal-ceramic and gold restorations. Not only do they offer superior aesthetic properties but also increased biocompatibility with tissues of the periodontium and pulp as well as radio-opacity which is similar to that of the natural tooth structure. [٣]

Dental ceramics have a composite structure consisting of a crystalline phase or phases within a glassy matrix. Clinical experience with all ceramic restorations breaking under occlusal load confirms that these materials are generally susceptible to stress corrosion and slow crack growth. [٤]

There are now a number of porcelain systems in the market and research is continuing to develop materials which are strong, aesthetic and suitable for multiple applications, including crowns, bridges, inlays and onlays. Some materials rely on the production of an opaque, heavily reinforced core over which weaker but more aesthetic layers of porcelain are built eg In-Ceram and AllCeram.