Validity of CAD-CAM Technology on Accuracy of Removable Partial Denture Framework

(In vitro study)

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Dedicated To.....

I would like to dedicate this work to

Those who gave me so much care and support

My dear father and mother

My beloved sister

All my brothers

All my friends

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Introduction

During the past years, economic growth, coupled with a strong desire among people to maintain a healthy life style, has impacted all fields of medicine. Recently, patients tend to be less tolerant with the idea of tooth extraction, which was thought to render the science of removable prosthodontics obsolete. However, the mentioned improvements gave the people a more extended lifespan, which lead to an increase in the practice of geriatric dentistry, including removable prosthesis. Unfortunately, such improvements have not yet touched some of the less fortunate developing countries.

Kennedy's class III RPDs is the most frequently encountered pattern of partial edentulism in upper arch. Since the fixed Prosthodontic service may not be indicated in all cases, the removable partial denture (RPD) continues to be an essential prosthetic consideration in many oral reconstructions.

The main function of the removable partial denture is to preserve the integrity of the dental arch and to restore the lost function, so the partial denture must not produce unfavorable forces on the abutments.

Accuracy and adaptation play an important role in preventing undue forces on the abutments. Properly adapted and accurately manufactured partial denture will decrease the harmful forces on the abutments and maintain its health. Multiple steps in the conventional fabrication technique lead to improperly adapted and inaccurate partial denture, so CAD/CAM technology was used.

In comparison to the conventional fabrication methods, computer aided manufacturing has the advantages of omitting multiple error introducing steps such as impression, waxing and casting. This is assumed to reduce the error sources and increase the precision of the prosthesis. Furthermore, since modeling and production are automated procedures, there is an overall reduction of fabrication time and cost. Removable partial denture frameworks can be produced directly from metal or alternatively a resin pattern framework can be formed and then casting using conventional fabrication methods.

BioHPP can be used for patients allergic to metals, or who dislike the metallic taste, the weight, and the unpleasant metal display of the denture framework and retentive clasps. This modified PEEK material, known as BioHPP, is a biocompatible, non-allergic, rigid material, with flexibility comparable to bone, high polishing and low absorption properties, low plaque affinity, and good wear resistance. It has been used for years in orthopedics and medical technology. BioHPP frameworks can be constructed either via CAD/CAM manufacturing or via the conventional lost wax technique.

So this study is conducted to offer new and simplified RPD modeling techniques and to evaluate the validity of subtractive methods of CAD-CAM technology on the adaptation and accuracy of removable partial dentures.

Review of literature

I- Partial Edentulism

Partial edentulism is a dental condition in which one or more but not all natural teeth are missing. Generally, it is caused by caries, periodontal problems, trauma, supernumerary teeth, malignancies and cysts[1] .

Partially edentulous arches have been classified by various methods. The possible combinations of partial edentulism are more than 65,000 depending on their incidence in maxillary and mandibular arches .The main objective of the classification is to facilitate the communication about the combination of missing teeth to edentulous ridges between students, dental practitioners and laboratory technicians. There are various methods of classification like Kennedy, Applegate's Avant, Neurohar, Eichner, ACP (American College of Prosthodontics) etc., Kennedy's classification is widely studied and clinically accepted by dental community .In Kennedy's classification, there are four main types of partially edentulous arches which are class I, class II, class III and class IV. Kennedy's classification is widely accepted due to its advantages of immediate visualization and recognition of prosthesis support[1,2].

Partial edentulism is a widely studied topic in dentistry. The pattern of partial edentulism has been evaluated in many selected populations in different countries. Several studies clarified the correlation between partial edentulism and some influencing factors like socio-economic parameters, age, gender, etc. Country's socioeconomic situation can partially determine edentulism in addition to cultural and psychosocial factors as well. Regional disparities of the prevalence of edentulism are also marked, for example between rural and urban areas[2–5].

Data from the National Health and Nutrition Examination Survey (NHANES) indicated that in Egypt more than 7% of persons aged 65 years and older were edentulous. A study[6] was conducted determining prevalence and associated factors of edentulism in a less developed region; Kota Bharu, Kelantan and Malaysia. The study was a cross-sectional one conducted with 506 randomly selected elderly patients aged 60 years and older out of which the prevalence of edentulism was 55.9%.

The proportion of partially dentate adults is increasing, partly as a result of increased life expectancy, a rise in the number of elderly individuals within the population, and a shift from total tooth loss/ total edentulism toward partial edentulism. The prevalence of partial edentulism is already estimated at greater than 20% in some regions, and the number of individuals with partial edentulism could increase to more than 200 million in the United States alone in the next 15 years. In the United Kingdom, the 2009 Adult Dental Health Survey found that "nearly one in five adults wore removable dentures of some description (partial or complete)"[7] .

Gender has been one of the factors analyzed by various authors. Most of the authors found that there is no significant gender correlation with occurrence of partial edentulism. However, few studies have observed that there has been significant relationship between gender and different classes of partial edentulism. Also, they reported that women have more awareness to restore missing teeth. This may be because women are more conscious about their appearance and had a better health seeking behavior [8,9].

With an increase in age, there was an increase in class I & class II dental arch tendency and a decrease in class III & class IV. In younger age groups, incidence of Kennedy's class III was found to be 49% in age group of 20–29