The Effect of Different Model Techniques on the Passivity of Fit of Implant supported Fixed Partial Denture.

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This work is dedicated to my family for their continuous love, support and great care

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INTRODUCTION

It is recommended that implant supported fixed prosthesis have a passive fit on abutments when placed in the mouth.

Brånemark [1] was the first to define passive fit; in 1983, he proposed 10 μm as the maximum misfit acceptable if bone maturation and remodeling were to occur in response to occlusal loads. Various authors have shown that with conventional fabrication methods, three-dimensional distortions of the restorations do occur, thus preventing a passive fit.[2,3] Published data on the long-term clinical effects of non-passive fitting or distorted frameworks are conflicting and still open to question.

Computer aided design and manufacture (CAD/CAM) techniques have been successfully introduced in the field of fixed partial dentures[4,5] Nowadays different model cast techniques are applied, from conventional stone casts and milled CAD/CAM casts and lately 3D printed casts have been introduced. This development was supported by the capability of modern imaging modalities, like spiral CT and MRI, to produce continuous volumetric data sets, which provide the input data for model generation.

However the literature on applications of Rapid Prototyping technologies in the dental areas still rare even though more and more attention has been paid to this area. Currently, most dental jobs are still being performed by dental technicians manually.

REVIEW OF LITRATURE

Prosthodontics is defined as the dental specialty pertaining to the diagnosis, treatment planning, rehabilitation, and maintenance of the oral function, comfort, appearance, and health of patients with clinical conditions associated with missing or deficient teeth and/or maxillofacial tissues using a biocompatible substitute, which is most commonly a prosthesis.

In order for prosthesis to fulfill its function, it should be durable, aesthetic, accurate, and comfortable. These requirements should be accomplished by any prosthesis fabrication method. [(6)]

Fixed dental prostheses (FDPs) are the rehabilitation of choice after endodontic and operative treatments; especially among all over the world Moreover, the introduction of implant restorations has increased the popularity of fabricating crowns and bridges to rehabilitate the edentulous area. The development of both casting gold alloys and dental precision casting systems has contributed to the application of metallic restorations. However, patients are increasingly requesting metal-free restorations for aesthetic sand bio-safety reasons.[(7,8)]

The use of dental implants to replace natural teeth has become commonplace in contemporary restorative and surgical dental practices throughout the world, it became the treatment of choice in many if not in most clinical situations. Their efficacy has been well documented in the dental literature. There have been many advances in surgical techniques and implant design features, and the use of implants in edentulous sites can be successful and can have predictable, functional, and esthetic outcomes.

Bone fusing to titanium was first reported in 1940 by ***bothe et al.*** [9] ***Brånemark*** [10] began extensive experimental studies in 1952 on circulation of bone marrow healing. These studies lead to dental implant application in the humans in 1965 and the introduction of the term "osseointegration"

Osseointegration:

The term osseointegration is a biological concept introduced in the 1960's denoting the inanimate anchorage of a metallic structure to the living bone under functional loading. The host response to the implants inserted in the living bone involves a series of events at the cellular and molecular levels leading to an intimate apposition of bone at the implant inrface.

According to the Glossary of dental implants, osseointegration is defined as "The procedure by which a contact is established without interposition of non bone tissue between normal remodeled bone and an implant entailing a sustained transfer and distribution of load from the implant to and within the bone tissue [11]

Concept of Passive Fit:

Long-term success of osseointegration is largely determined by the maintenance of implant–bone interface. [12] It is recommended that implant-supported fixed prostheses have a passive fit on the abutments when placed in the mouth. Failure to achieve such passivity has been indicted as an etiologic factor in the development of complications such as mechanical fatigue, fracture of implant components, [13] loosening of screw joints, marginal bone loss, and loss of osseointegration. [14]

Brånemark [1] was the first to define passive fit; in 1983, he proposed 10 μm as the maximum misfit acceptable if bone maturation and remodeling were to occur in response to occlusal loads. Other authors have suggested that castings with discrepancies greater than 30 μm over more than 10% of the circumference of the abutment interface would be unacceptable. [15]

Takayama [16] suggested that passively fitting prosthetic superstructure frameworks minimize prestressed loads to implant fixtures and favorably distribute all external loads, thus decreasing the possibility of failure at the implant tissue interface. This would provide an adequate stimulus for bone remodeling and formation of lamellar bone.

The precision of implant superstructures is determined by the entire clinical and laboratory fabrication process. Errors may occur during impression making, fabrication of the definitive cast, casting of the framework, and the ceramic veneering.[17,18,19,20] A certain degree of distortion of single-piece cast long-span multi-implant restorations seems inevitable.[21,22,23] The resulting stress can be increased by a forced tightening of screw-retained prostheses against the rigid implants. [24]

A trend to achieve passive fit is the use of a cement-retained prosthesis.[25,26] The cement layer between framework and the abutments is purported to compensate for discrepancies. Another advantage of cement-retained implant prostheses is the elimination of the need for screw access openings, which may be located in occlusal or labial tooth surfaces.[27]

Various authors have shown that with conventional fabrication methods, three-dimensional distortions of the restorations do occur, thus preventing a passive fit.[2,3] When conventional techniques for the fabrication of implant-supported fixed prostheses are used, the prostheses are fabricated on master casts in the laboratory. Die stone, the most commonly used die material, expands on setting [28]; an inaccurate cast may result ([29] and be reflected in an inaccurate intraoral seating of the fixed prosthesis. [18]

If die stone expansion results in a difference in dimensions between the actual inter-abutment distance and that reproduced on the master cast, then the effect on the fit of the fixed prosthesis may be clinically relevant. In such circumstances, the passivity of a fixed prosthesis on the master cast may not be reflected as passivity intraorally since this cast would not accurately reproduce the intraoral relationships.

Published data on the long-term clinical effects of non-passive fitting or distorted frameworks are conflicting and still open to question. Some clinical studies utilizing both animal and human models have suggested that no biologic or mechanical complications may arise from a non passive fitting implant framework. [22] Other reports in the dental literature state that, if a malfitting superstructure exerts any tension or stress on the supporting abutments, occlusal loading could result in a number of prosthodontic complications (eg, component joint opening, repeated screw loosening, component stress fractures) and adverse tissue reactions (eg, ischemia,