

The Use Of Polyetheretherketone (PEEK) As A Reinforce Material For Maxillary Complete Denture Replacing Metal To Prevent Fracture Of The Denture Base

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Abstract

Background : Denture base fracture often occurs in edentulous conditions accompanied by enlargement of the torus palatinus and flat alveolar ridges. Therefore, reinforcement materials are needed. The most commonly used reinforcing material is metal. However, this material has some disadvantages, such as weight and poor biocompatibility. Currently, an alternative material that can be used to replace metal is polyetheretherketone (PEEK) which has several advantages, such as lower density and better biocompatibility than metal.

Objectives : Describe the use of PEEK as a denture base reinforce material to prevent fracture and reduce the weight of maxillary dentures.

Case report : A 51-year-old female patient came to the dental hospital Universitas Sumatera Utara, with complaints of difficulty chewing and feeling uncomfortable. The patient wants to have a complete denture. An intraoral examination showed flat alveolar ridges on both jaws and an enlarged torus palatinus. In this case, a PEEK framework was used to strengthen the upper jaw denture base, which is produced with a vacuum injection molding system. The design and manufacture of the wax framework are produced using a CAD/CAM system. PEEK framework as a reinforcing material, was used in this case due to the low density of the material. As a result, it is lighter than metal, especially in the condition of the maxillary denture.

Conclusion : The use of PEEK as reinforce material can rehabilitate and give satisfaction and comfort in this case.

Keywords : polyetheretherketone, metal, reinforce material, denture base fracture

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I. INTRODUCTION

Complete dentures have become a common and cost-effective prosthetic treatment for edentulous patients, whereas fracture and deformation of dentures is a recurring and common problem for denture wearers. Complete dentures with enlarged torus palatinus, flat ridges, or high frenum attachments can increase the risk of denture base fracture. Currently, the most widely used material in prosthetic dentistry for the manufacture of complete dentures is polymethyl methacrylate (PMMA) (1,2).

Denture bases are subjected to various stresses during function, including compressive, tensile, and shear stresses. Although widely used, PMMA has disadvantages such as low strength characteristics, including low impact strength and low fatigue strength. Fatigue failure occurs when the denture base is repeatedly deformed by occlusal forces, whereas impact failure occurs when the denture is accidentally dropped on a hard surface (1). Therefore, a reinforcing material is needed to overcome this. Currently, the most commonly used material as a reinforcing material is metal, but this material has weaknesses such as heavy and poor biocompatibility (2,3). Currently, polyetheretherketone (PEEK) has been widely used in prosthodontics, such as in the manufacture of fixed dentures as well as as a metal replacement for removable dentures. PEEK has good physical, mechanical, chemical, and biocompatibility properties so that it can be used as a denture material (3,4). PEEK with the addition of ceramic nanoparticles has a higher flexural strength than PMMA and is lighter so that it can be used as an alternative to the Co-Cr framework as a reinforcing material for PMMA dentures. The flexural strength of PEEK (180-185 MPa) is higher than PMMA (95-105 MPa), which makes this material more resistant to fatigue, so that fracture of the denture base can be avoided. PEEK can be used as an alternative material to strengthen the complete denture base because of its high flexural strength, so as to prevent fracture of the denture base (5,6).

II. CASE REPORT

A female patient, 51 years old, came to the Prosthodontics clinic of the RSGMP FKG USU with a complaint that she wanted to make maxillary and mandibular dentures where her teeth had been extracted a dozen years ago. Patients have difficulty chewing and feel uncomfortable with the state of the toothless oral cavity.



Figure 1. Facial and intraoral profile photos

First we take an anatomical impression using an irreversible hydrocolloid (alginate) impression material to obtain a preliminary cast (Figure 2). Then a tentative VD was taken. The diagnosis in this case was fully edentulous with flat ridges on the upper and lower jaws, and enlargement of the torus palatinus accompanied by a class III jaw relationship.



Figure 2. Anatomical Impression and preliminary cast

Making a physiological impression tray from the preliminary cast that has been obtained previously. Physiological impression tray were made by coating 1 wax sheets on a physiological model, and then physiological impression trays were made using Visible light polymerization acrylic resin (Figure 3).

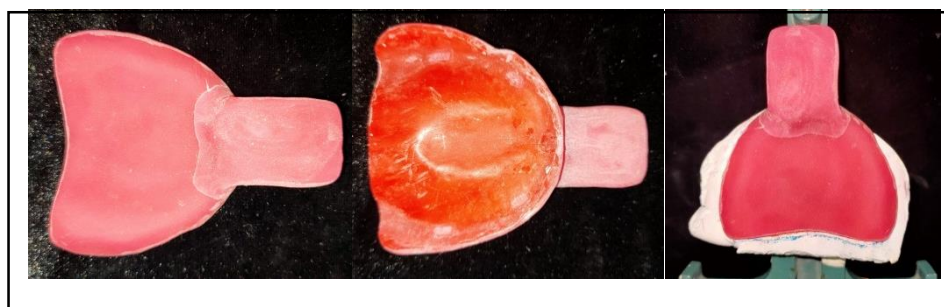


Figure 3. Physiological impression tray

After the physiological impression tray was obtained, border molding and physiological impressions were carried out using a single-stage mucocompression impression technique with polyvinyl siloxane monophasic impression material. From the results of physiological impressions, a primary model was obtained, which was followed by casting using type IV dental stone. In the maxillary primary model, the torus palatinus block out was performed using tin foil (Fig. 4).



Figure 4. Physiological impression and physiological model

The framework was made to increase the strength of the maxillary denture base. The design of the PEEK framework wax pattern is carried out on a physiological model with a CAD/CAM system. After that, the wax framework pattern will be planted into a special cuvette for injection of PEEK material using a vacuum injection molding system (Figure 5).

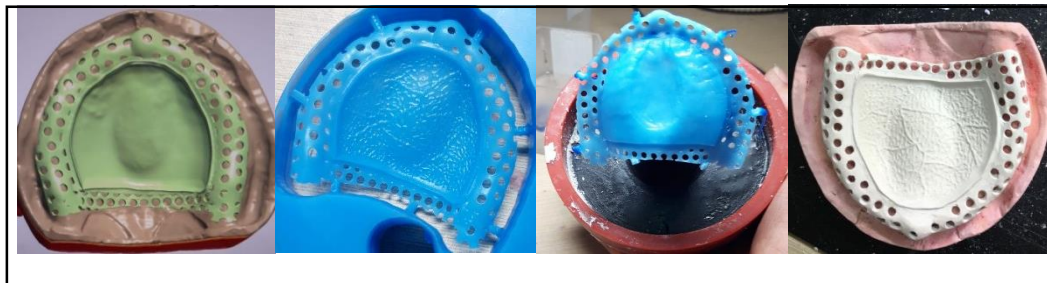


Figure 5. PEEK framework CAD/CAM design, Wax framework milling result and PEEK injection result

The arrangement of teeth in this case uses the concept of lingualized occlusion, where the maxillary teeth only contact at 1 point on the mandibular teeth (Figure 6). After a try-in to assess the aesthetics, phonetics, and occlusion (Figure 7), proceed to the completion stage. The polished denture was then inserted into the patient's mouth (Figure 8), and post-denture instructions were given and periodic control was performed.

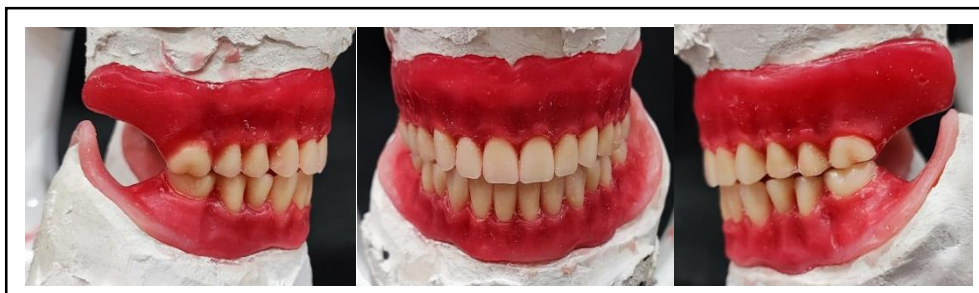


Figure 6. Teeth arrangement



Figure 7. Try in the arrangement of teeth on the patient



Figure 8. Dentures insertion on the patient

III. DISCUSSION

According to Brian C, et. al., generally, fractures in the denture base are caused by fatigue failure or failure of the impact of the denture base material. Fractures due to fatigue failure are usually characterized by the presence of microscopic cracks in the stress concentration area. This type of fracture occurs over time and not due to the application of a single force such as an impact fracture (7). Maxillary dentures are prone to fracture in the incisor or midline areas, both on the labial and lingual sides. This is caused by deformation due to tensile strength (7,8). Kim SH, et.al, state that the use of reinforcing materials in the denture base is necessary to overcome the occurrence of fractures in the denture which can be caused by several factors such as fatigue failure of the denture base material or due to negligence of the patient. The most common type of fracture in denture base fractures is midline fracture (8).

According to research by Zoidis P, et. al. and Fueki K, et. al., the use of metal framework materials in dentures is very commonly used, but this material has several drawbacks, such as weight and the presence of metallic taste. Currently, PEEK is widely used in dentistry, especially in prosthodontics, one of which is the manufacture of removable denture frameworks to replace metal (3,4). The choice of PEEK as a reinforcing material in this case is due to its lighter density and better biocompatibility than metal materials, especially when used for maxillary dentures.

IV. CONCLUSION

In this case, the use of PEEK as a reinforcing frame in the maxilla successfully rehabilitated this case. The patient felt happy and comfortable with the denture made. This means PEEK can be used as an alternative material in the manufacture of reinforcing framework materials for dentures.

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