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Original Research

To compare two different restoration materials and two different implant designs of implant-supported fixed cantilevered prosthesis

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ABSTRACT:
Background: Implant manufacturers have produced different implant designs to reduce the stresses around the implant and supporting bone tissue. The present study was conducted with the objective aim to compare the stress distribution levels which occur around two different types of dental implants with two different restorative materials as superstructures as cantilever FPDs. **Material and methods:** The present study was carried out to compare the two different restoration materials and two different implant designs of implant-supported fixed cantilevered prosthesis. Three-dimensional finite element models of a 3-unit cantilever bridge were subjected to 150 N occlusal loads over functional cusps to evaluate the prosthetic materials and implant designs. A NextEngine 3D scanner was used to scan all structures of implants. **Results:** In the present study, when loading on implants with metal porcelain restorations, the maximum stresses were observed at the cortical bone (15.01 N/mm ^{2}) around the cylinder implant adjacent to the cantilever. While the highest stress concentrations were observed at the cancellous bone in metal porcelain implants(5.657 N/mm^2) with cylinder implants. When loading on implants with metal porcelain restorations, the maximum stresses were observed at the cortical bone (11.03 N/mm ^{2}) around the cylinder implants with microthreads. While the highest stress concentrations were observed at the cancellous bone in fiber reinforced implants(3.67 N/mm^2) with cylinder implants with microthreads. **Conclusion:** Our study concluded that that fiber reinforced composite (FRC) bear less stress than conventional metal porcelain.
Keywords: fiber reinforced, fixed cantilevered prosthesis, metal porcelain.

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INTRODUCTION:
Dental implantology is a term used today to describe anchoring of alloplastic material into the jaws to provide support and retention for prosthetic replacement of teeth that has been lost.[1] The rehabilitation of edentulous jaws with a protocol prosthesis allowed extensive rehabilitations with implants and minimal surgical intervention.[2] Dental-implant-supported dental restorations are common clinical approaches to edentulism cases because of their high success rates[3-6] and their biological and biomechanical advantages, such as preservation of adjacent and opposite teeth, simulation of supporting bone, and production of higher mastication force compared to removable prostheses[5,7]. However, biomechanical complications may impair the performance of osseointegrated dental implants due to the overload capable to induce bone remodelling.[8-10] To accelerate osseointegration and to control the stresses in the bone, the most common approach is alteration of dental implant designs such as macro-design and micro-design (surface alterations).[11-14] The

present study was conducted with the objective aim to compare the stress distribution levels which occur around two different types of dental implants with two different restorative materials as superstructures as cantilever FPDs.

MATERIAL AND METHODS:

The present study was carried out to compare the two different restoration materials and two different implant designs of implant-supported fixed cantilevered prosthesis. The two commercially available dental implants used were cylinder type and cylinder with micro threads around implant neck and two different prosthetic materials used were conventional metal ceramic and Fiber Reinforced Three-dimensional finite element models of a 3-unit cantilever bridge were subjected to 150 N occlusal loads over functional cusps to evaluate the prosthetic materials and implant designs. A NextEngine 3D scanner was used to scan all structures of implants. To evaluate the stress distributions within the bone around dental implants, 3-dimensional FEA was conducted using four mathematical models of unilateral 3-unit cantilever FPDs supported by two implants. A graphic processing program was used to construct the mathematical models, consisting of bone, two osseointegrated implants and the FPDs. The FPDs were modeled as mandibular first premolar and mandibular second premolar and first molar as a cantilevered superstructure over the implants. Porcelain fused metal (PFM) and FRC were modeled as superstructure materials. The stress levels were calculated using von Mises stress values.

RESULTS:

In the present study, when loading on implants with metal porcelain restorations, the maximum stresses were observed at the cortical bone (15.01 N/mm^2) around the cylinder implant adjacent to the cantilever. While the highest stress concentrations were observed at the cancellous bone in metal porcelain implants(5.657 N/mm^2) with cylinder implants. When loading on implants with metal porcelain restorations, the maximum stresses were observed at the cortical bone (11.03 N/mm^2) around the cylinder implants with microthreads. While the highest stress concentrations were observed at the cancellous bone in fiber reinforced implants(3.67 N/mm^2) with cylinder implants with microthreads.

DISCUSSION:

For the prosthetic framework, the increase of undesired stress occurs in the supporting tissues due to the fact that the lever arm is larger.[15] To reestablish chewing capacity in the posterior region, masticatory force may need to exist beyond the last implant.[16] Different materials strength used in frameworks is another possible factor to influence directly the success of implant rehabilitation through the dissipation of chewing load.[17,18]

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Metal-porcelain, gold alloys, acrylics and fiber-reinforced composites are used as superstructure materials in implant supported fixed restorations. [19,20]

According to a study, the ceramic veneer materials that have similar elastic modulus values to enamel supported the enamel better than resin composites.[21]

Rubo and Souza affirmed that the lower elastic modulus, the greater exerted force on the abutments closest to the load. Therefore, if a rubber structure was used, the entire load would be concentrated in the implant closest to the point of load application. The authors concluded that the more rigid structure the more uniform stress dissipation and the less damage caused to the fastening screws due to the bending of the reduced metal structure.[22]

It is recommended that if a metallic alloy is going to be used, it must have high strength (>300 MPa) and high elastic modulus (>80 GPa) to prevent deformation and structures failure.[23]

Table 1: stress levels around two different types of dental implants with two different restorative materials as superstructures.

Implant type	Maximum Stress (N/mm^2)			
	Cylinder implant		Cylinder implants with microthreads	
Superstructure	Cortical	Cancellous	Cortical	Cancellous
Metal porcelain	15.01	5.657	11.03	3.02
Fiber reinforced	14.89	5.29	10.78	3.67

Recently, Ferraz *et al.* stated that the implant with micro-threads showed higher stress concentration for cortical bone in comparison with the smooth implant, an lower stress concentration for cancellous bone. [24]

CONCLUSION:

Our study concluded that that fiber reinforced composite (FRC) bear less stress than conventional metal porcelain.

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