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Effect of various surface treatments of implant abutment and metal cope fitting surface on their bond strength to provisional resin cement

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Abstract

Objectives: The purpose of this study was to examine the effect of different surface treatments of implant abutment and metal cope fitting surface on their bond strength to provisional resin cement.

Materials and methods: Sixty implant analogs and standard titanium abutments of 6 mm height were embedded vertically in autopolymerizing acrylic resin blocks. Metal copings with a loop on the occlusal surface were fabricated using nickel chromium (Ni–Cr) alloy. Samples were divided according to their surface treatment into three groups (n = 20 for each group); Group (1) air borne particle abrasion with 50 μm Al_2O_3 powder. Group (2) air borne particle abrasion plus alloy primer. Group (3) samples were silicoated and silanated using cojet system. Each group was subdivided into two subgroups (n = 10 for each subgroup) according to storage condition and stressing; Subgroup (A) short-term water storage and Subgroup (B) short-term water storage and thermocycling plus mechanical loading corresponding to 6 month of clinical use. The copings were luted using provisional resin cement under static load of 3 kg. Samples were tested for tensile bond strength using a universal testing machine at a crosshead speed of .5 mm/min. Statistical analysis of the results and comparison between each two groups were performed using One Way ANOVA (significance at $P \leq 0.05$) followed by post-hoc tests.

Results: Silica coating using Cojet system recorded significant highest mean values (5.190 MPa) followed by air borne particle abrasion (3.698 MPa), while using alloy primer on air abraded surface recorded the lowest bonding values (1.998 MPa). Subjecting the samples to short term water storage and thermocycling plus mechanical loading has led to significant loss of retentive values.

Conclusion: Cojet surface treatment and air borne particle abrasion recorded the superior results in this study.

Keywords: Implants; Titanium abutment; Air borne particle abrasion; Alloy primer; Cojet system and provisional resin cement

1. Introduction

Dental implants have shown high capability to restore esthetic, proper function of lost teeth and they have a long durability and success. Long term implant survival and success rates of dental implants have been demonstrated [1].

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Today, Cement retained prosthesis, supported by implant, is more popular due to several advantages such as loading along linear axis, better passivity fit, small occlusal table due to the lack of accessibility hole and lower fracture of porcelain due to lack of screw accessibility hole. The only considerable advantage of screw-retained prosthesis is its retrieval [2].

Retrievability is advantageous for replacement or salvaging of the restorations and implants necessitated by (1) The need for periodic replacement of prosthodontic components (2) Loosening or fracture of the fastening screws (3) Fracture of abutments (4) Modification of the prosthesis after loss of an implant (5) Surgical reintervention [3].

Therefore, retrievability of implant prosthetic components can be a significant safety factor. The retrievability of fixed implant-supported prostheses is therefore an important consideration in delivering patient-oriented treatment outcomes [4]. Therefore, it is totally advisable to cement all implant-supported cement-retained prosthesis with provisional cement at delivery appointment to have the capability of retrieval. However, when crown is luted with provisional cement, diminished retention can cause dislodgement of the crowns. So it is advisable to increase retention by other means such as electrolytic etching, bur roughness, laser etching and chemical etching.

Surface modification of abutments and crown may increase the retentive strength of cemented casting. It was postulated that the retentive strength of restoration cemented with different cements could also be modified by the roughness and surface characteristics of implant abutment in comparison to the uniform dental abutment surface [5].

The micromechanical retention surface treatment involves air abrasion with alumina particles. This creates surface defects in the metal surface that result in an increase in surface roughness and surface area [6].

Simplified bonding procedure with fewer steps and reduced chair-side time has become the hallmarks of modern dental adhesive systems. Backed by revolutionary advances in bonding technology and aggressive research efforts, The development of dental adhesive systems has moved toward single-bottle, multi-purpose primers or adhesives which could deliver strong and durable adhesion [7].

Alloy primer is a metal conditioning agent used to enhance the bond strength between dental metals and resin base materials. It contains 6,4-vinylbenzyln-propyl amino-1,3,5-triazine-2,4-dithione (VBATDT) and 10-methacryloyloxydecyl dihydrogen phosphate (MDP) which enhances the bond strength to high noble, noble and also base metal alloys [8].

Many bonding systems have been developed by different manufacturers include Rocatec, Silicoater and Kevloc bonding systems. Studies have shown that these treatments, which are based on silica coating/silanization are effective in increasing the bond between resins and metals [9]. The system enhances the bond strength between such systems as composite-to-metal, composite-to-ceramic, and composite -to-composite [10].

Cojet system one known method has achieved both bonding mechanisms tribochemical silica coating. This method uses air borne-particle abrasion with silica-modified Al_2O_3 particles in conjunction with silanization. Cojet Sand has a particle size of 30 μm, is applied in a single step and is indicated for chair side application with the use of a chair side air abrasion device. Next silane coupling agent is applied and creates a chemically reactive surface [11].

For implant systems in which the suprastructures are cemented to the abutments, the provisional luting agent must be strong enough to resist functional forces, but weak enough to allow easy removal of the suprastructure when necessary without harm to the abutment and implant fixture [12].

The purpose of this study was to examine the effects of different surface treatments on the tensile bond strength of metal cope on Implant abutments cemented with provisional resin cement.

2. Materials and methods

Sixty standard titanium abutments[1] with 6 mm length beginning from the top of the abutment to the finish line (chamfer finish line) and 3.5 mm diameter were used in the study. Sixty implant analogues with 12 mm length and 3.5 mm diameter were used. With the aid of dental surveyor[2] analogues were handled vertically inside metal mold in which a self-cure acrylic resin was poured.[3]

The acrylic blocks were finished by removing excess and polished by water and pumice. Each abutment was tightened onto the implant analogue using hex driver. All abutments' screw access the channels were filled with two compacted cotton pellets and sealed with composite resin[4] up to the level of occlusal

[1] Tut dental implant system, Cairo, Egypt.
[2] Ramses, Alex, Egypt.
[3] Acrostone dental supply, Egypt.
[4] Z-250 XT, 3M ESPE, USA.