Original Article

A Comparative Evaluation Of Retention Of Implant Supported Crown Obtained By Laser Metal Sintering Technique Fabricated On Gypsum Abutment And Epoxy Resin Abutment Dies

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Abstract

Aim- Retention of cement retained implant prosthesis to the abutment is important for the longevity and function of prosthesis and thus the die preparation for the fabrication of the prosthesis should be accurate. Aim of this study is to compare the retention values of implant supported crown obtained by laser metal sintering technique fabricated on gypsum abutment and epoxy resin abutment dies**.**

Material and methods- Dies were fabricated (n=40) after making impression with polyether. 20 dies were made from epoxy resin die material (group 1) and 20dies from gypsum die material Group 2. CAD CAM designed, DMLS crowns were fabricated by scanning the dies and the prosthesis cemented on the abutments using zinc phosphate cement. Retention value was obtained by applying constant tensile load at crosshead speed of 0.5mm/minute in pull direction until the copings separated on the universal testing machine. Statistical analysis was done using t test.**Observation and result-** The value of retention for epoxy resin die prosthesis was higher than the value of gypsum die($p>0.05$). **Conclusion-** Epoxy resin dies are more dimensionally accurate than gypsum dies for cement retained implant prosthesis.

Key Words- Retention, Cement retained implant Prosthesis, Epoxy Resin die, Gypsum die

Introduction-

Aim of the modern dentistry is to restore the patient's normal facial contour, function, comfort, aesthetics, speech and health regardless of the atrophy, disease or injury of the stomatognathic system. Dental implants offer an excellent alternative to the limitations of conventional removable dentures and fixed partial dentures.[1]In comparison to the success rate of the fixed partial denture ,numerous studies in the scientific literature show that dental implants are moresuccessful.[2]The effectiveness of oral rehabilitation in patients receiving implant therapy

is dependent not only on the Osseo integration of the implant fixture, but also on the continuity of the prosthetic superstructure's connection to the fixture.

A passively fitting prosthesis is of utmost importance for Osseo integration to occur. If the passive fit is not maintained; there will be micro movements leading to comlications.[3,4] The misfit of prostheses can cause strains ranging from 26 to 637.6 m/mm at the implant collar.[5,6]The success of implant prosthesis fabrication depends upon impression technique, impression material, used die material, method of fabrication of prosthesis and used luting agent for prosthesis. When abutment level impression are made for supragingival abutment margin placement or thick gingival tissue height, die preparation needs to be done for prosthesis fabrication. Various die materials areavailable for implant impression. Most commonly used die material are gypsum product type IV die stone and Epoxyresin.[7]

The implant prosthesis can be screw retained or cement retained. Cement retained prosthesis are more popular due to their advantages. The cements used most often in implant dentistry for the final prosthesis cementation includes Zinc phosphate, Zinc oxide with ethoxy-benzoic acid, poly carboxylate, glass ionomer and rarely composite resin cements.

There is strong evidence that retention of prosthesis is of great importance for success of implant restoration. Fabrication of prosthesis using CAD-CAM and DMLS produces accurately fitting and retentive prosthesis.[8]The retention of prosthesis is compromised if the patient eats sticky food. In such cases, the choice of cement used for cementation and the dimensional accuracy of implant prosthesis is of utmost importance. The present study aims at evaluating the retention of implant supported crown obtained by DMLS method from Epoxy die resin and gypsum die.

Methodology:

For this study, the typhodonts were removed from the mandibular jaw set (API Dental Products) and socket space was filled with modeling wax. 10 lab analogues (IA-CS 3459 Alphabiopvtltd.) along with mounted abutment (7 mm height, 1 mm gingival cuff height and 4.8 mm diameter, TLASP-1, Alphabiopvtltd.) were mounted on the modeling wax. [Figure 1] Custom tray was fabricated using light cure acrylic resin (Individolux, Vocodental ltd.) with 3mm spacer provision and 4 abutment level implant impressions were made using monophase impression material (3 Mimpregumpenta)[figure2].2 impressions were poured in resin die material (Fast set Whip mix formula, American dental supply inc.)(Group 1)[Figure 3a] and 2 with gypsum die material(Kalrock, Kalabhai dental corp.)(Group2). [Figure 3b] The prepared dies were scanned using Digital scanner (NEWAYSCANNERS and copings with loop on occlusal surface were fabricated using DMLS technique(Pro-X100DMP). The samples were sandblasted with 50 µm Alumina powder (Refinite metals pvt.) (n=40). The lab analouges with abutments were then mounted on acrylic blocks and the copings were cemented using zinc phosphate cement (Harvard cements pvt. ltd). A hook was mounted on the acrylic block to provide the pull out force by engaging into the test samples. The samples were attached to universal testing machine (Instrom 3382 under ISO 178standard) and a constantcrossheadspeedof0.5mm/minute in pull out direction was applied to the tensile load until the copings separated. The load, at which bonding failure occurred, was recorded in Newton/mm^2 [Figure 4]. Data obtained for both groups were evaluated and statistical analysis was done using SPSS software (SPSS1.0.0.1406; IBM).

Figure no 1: Dental implant model for impression

Figure no 2 : Abutment level impression taken by polyether

Figure no 2 : Abutment level impression taken by polyether

Figure no 3b : Die fabricated from die stone

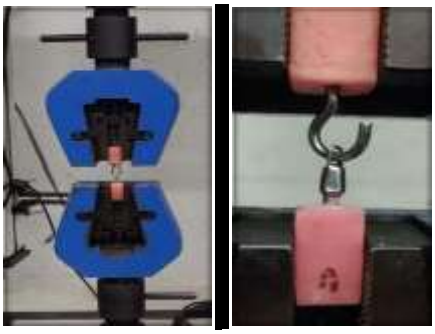
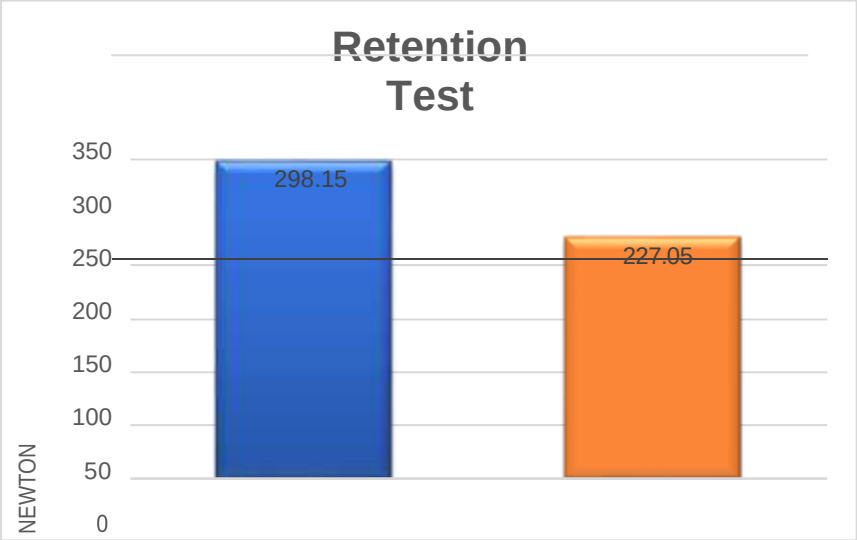


Figure no 4 : Specimen was mounted on lower member of universal testing machine and engaged to prefabricated hook mounted on upper member

TABLE 1: Shows independent sample T test which shows descriptive statistical comparison of tensile load of 2 groups.

Independent Samples Test

		t-test for Equality of Means				
		t	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
Pull out	Equal variances Assumed	4.235	38	**.000006**	71.10000	16.78702



GRAPH 1: Shows comparison of mean value of retention of both groups

Observation and Results:

The obtained values of tensile load required were noted down and mean values were obtained [Graph1]. Independent student T test was performed to analyze the comparison of tensile load of 2 groups. On comparing retention between two group shows, group 1 showed significantly higher($p<0.05$) mean value(298.15N/mm2) than group2 (227.05 N/mm2).[Table1].

Discussion-

The implant prosthesis can be screw retained or cement retained or combination of both screw cement retained or combination of both.9Screw-retained prostheses have a well-documented history of successful application. The considerable advantage of screw-retained prosthesis is its retrieval, no cement in soft tissue peri-implant area and retention even for small dimension as they provide improved peri-Implant soft-tissue health with better prosthesis retrievability. But there can be chances for abutment screw looseing.10

Cement retained prosthetics with implant support are more popular due to advantages like occlusal loading along linear axis, better passivity fit, small occlusal table (due to lack of accessibility hole), lower porcelain fracture due to lack of screw accessibility hole, and better comfort to cement restoration in posterior regions. The main drawback of the cement retained prosthesis is retaining and retrieving the superstructure for routine care and maintenance10.

The mode of retention for screw retained prosthesis is the prosthetic screw whereas for cement retained prosthesis it is the luting cement. Thus Retention becomes the major factors of concern in cement retained prosthesis. Retention is defined as “That quality inherent in the dental prosthesis acting to resist the forces of dislodgment along the path of placement”.11

Amongst the various cements available and widely used, Zinc oxide cements provide a good seal, but have a low compressive strength and a high solubility. Glass ionomer cement adheres well to natural teeth, but it lacks the strength when used on metal. Resin cements serve excellent adhesion but they are used in implant dentistry with the intention of not removing the restoration in the future or when the implant abutment is too short (less than 5 mm) and needs to be retained. Keeping in mind the retrivability of prosthesis, strong compressive strength, a thin luting layer thickness (25 microns), and the ability to remove excess material without damaging the implant surface, Zinc phosphate cement is used for implant restoration cementation.12

In thick gingival height, there are chances of error in implant level impression; in such cases abutment level impression is preferred. The abutment level implant impressions severe similar to impressions made for prepare tooth. Thus the impression needs to be poured and dies are fabricated over which the prosthesis will be made. For accurately fitting prosthesis; the fabricated die should be as precise as possible.

There are different kind of Die materials available for implant impression like gypsum products, die resins, electroplated die, amalgam die, metal sprayed die, ceramic die, flexible die material and etc. Most commonly used material is gypsum product type IV die stone which have disadvantage of high setting expansion and relatively poor abrasion resistance. Epoxy resin have higher abrasion resistance, high strength & good detail reproduction. However, fabrication of epoxy resin dies is more technique sensitive and time consuming than that of other die materials.

Resinous die materials undergo polymerization shrinkage on setting. Therefore, their dimensional accuracy has been questioned. Manufacturers have made attempts to minimize polymerization shrinkage by modifying chemical formulations or by using innovative casting techniques and heat treatment. Slow setting of resin can also be done which will allow greater relaxation of the resin minimizing shrinkage stresses during gelation and setting.13

Although the epoxy resins have the best characteristics of all the materials investigated, the setting shrinkage as die material can result into smaller size of prosthesis. Because DMLS technique has proven to fabricate accurate prosthesis, the copings were fabricated using that technique against scanned resin dies. 14

The cements used most often in implant dentistry for the final prosthesis cementation includes Zinc phosphate, Zinc oxide with ethoxy-benzoic acid, polycarboxylate, glass ionomer and rarely composite resin cements. Although resin cements have the maximum compressive strength, they are employed in implant dentistry with the intention of not removing the restoration in the future. Second, when the implant abutment is too short (less than 5 mm) and needs to be retained. Zinc phosphate cement has a number of advantages for implant restoration cementation, including strong compressive strength, a thin luting layer thickness (25 microns), and the ability to remove excess material without damaging the implant surface. 12

Retention in cement retained prosthesis was compromised compared to screw retained prosthesis, but in screw retained restoration there were more chances of screw fracture complication. As a result, in abutment level impression retention is most important factor; Retention can be enhanced by the used impression material accuracy, used die material and dental cement we used for luting.

Results of this present study shows that the copings fabricated from Epoxy die resin have the significantly higher retention for resin dies. The mean tensile load value of group 1 (epoxy die resin) was 298.15 N higher than Group 2(Die stone) which had value of 227.05 N. In the present study, the copings fabricated on epoxy resin die (group 1) required higher tensile load value to pull out from abutments than the copings fabricated on of gypsum dies. Higher tensile load signifies that the copings were more retentive when fabricated on epoxy resin die group than gypsum die group. Thus resin die materials provide better dimensional accuracy in die preparation. These results are similar to various other studies which proved that resin die materials outperformed traditional die materials.37,19,23

Conclusion:

Based on the findings of this study it can be concluded that implant prosthesis fabricated on resin die materials provide better retention than prosthesis fabricated on gypsum dies.

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