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Comparative evaluation of effect of vent holes on retentive bond strength of cement retained implant prosthesis: An in-vitro study

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Abstract

Purpose: The aim of the study was to evaluate effect of vent holes on retentive bond strength of cement retained implant prosthesis.

Materials and Methods: A stainless steeljig was fabricated with standard specifications. Straight implant abutments were tightened to the implant analogs and then stabilized into acrylic resin block by surveying device Metal copings were fabricated with retentive loop. Total 2 variables were checked:

Group A (copings without vent hole)

Group B (copings with vent hole on the centre of occlusal surface of copings). Total ten implant crown copings were cemented onto implant abutments by implalute cement (n=5). Uniaxial tensile strength was measured after cementation using Universal testing

machine. Results were statistically analysed using unpaired t-test.

Result: The mean retentive strength of Group A (13.41±1.82kgs) was higher as compared to Group B (11.16±1.86 kgs) and the difference was found to be of statistical significant ($p<0.05$).

Conclusion: It has been concluded that Copings without vents provided better retention as compared to copings with vents. But as the tensile strength difference between both the groups was less, copings with vents can also be preferred, which would further minimize excess cement at margins.

Keywords: Retentive Strength, Vent Hole, Excess cement

Introduction

During recent decades, prosthetic rehabilitation of edentulism with dental implants has become a scientifically well-documented and commonly established treatment modality. The high success rate of end osseous dental implant smokes implant-supported prostheses (ISPs) one of the most predictable options for the repla cement of missing single and multiple teeth.[1]

One of the critical factors for success of implant-supported restorations is the connection integrity of prosthetic superstructure to the implant. This integrity is provided by cement or screw as two means of implant-prosthesis retention. Retention is a key factor for determining the clinical success of cement-retained implant-supported restorations. There is no definite superiority of either of these means of retention, and choosing between them is mostly dependent on clinician preference regarding theclinicalsituation.[2,3]

Cement-retained, implant-supported restorations offer several advent ages over screw-retained restorations, including enhanced aesthetics, with the elimination of screw access holes; greater resistance to fracture; more stable occlusal contacts in the area of the screw access channel shorter and fewer appointments for fabrication and comparatively easy and cost-effective laboratory procedures. Additionally, cemented restorations can be used more universally as implant orientation is less critical, allowing greater tolerance during surgical placement, and the procedure is similar to conventional fixed restorations. The choice of cement for an implant supported restoration should be based on the need or desire forfeitability, the anticipated amount of retention needed, the ease of cement removal, andcost.[4,5]

There are many recommendations regarding control of amount, direction and placement of excess cement, including construction of vents in the restoration to facilitate cement flowthrough the openings and not below margins. The resulting thinner layer of cement leads toimprovedseating.[6]

Proper selection of luting agents is of great importance to maintain good retention, for the restoration, minimize the risk of saliva leakage and bacterial accumulation, and fill the gap between the abutment and the restoration and thereby improving the longevity of implant prostheses. The primary function of dental cement is to fill the space between the restoration and the implant a but metadata the same time resisting the dislodgement of the restoration. Therefore, a seal with a luting agent is a definite need for implant-supported restorations. Placing an insufficient amount of cement may also negatively affect retention and potentially give rise to leakage around margins, thereby exhibiting a luting agent deficiency. [6]

The decision, whether to leave a hole or not for a cement-retained crownlands diameter, is mostly made by dentists subjectively. Creating a hole on a cement-retained implant crown would decrease excess cement extrusion at the abutment margin when cementing and

could also serve as a marker for an abutments crew when retrieval is necessary.[7]

Several aspects should be considered when choosing type of cement that will affect tensile bond strength. Various authors have shown that the choice of cement material, amount of cement space or internal relief, occlusal forces, and type of luting agent can also affect there tentiveness of final restorations. The ideal cement should be strong enough to retain the crown indefinitely, yet weak enough to allow the clinician to retrieve it if necessary. [8]

This study was performed to evaluate effect of vent holes on retentive bond strength of cement retained implant prosthesis.

Materials and methodology

Ten straight implant abutments (Genesis Active, HASA320A) were tightened to implant analogs (Genesis Active, AAG19H). All implant analogs were stabilized using a surveying device in a block of acrylic resin to verify parallelism of the abutments. The screw access chamber was filled with a PTFE tape and packed by temporary cement. Metal copings were fabricated with retentive loop on the occlusal surface using direct metal laser sintering device. Crown copings were either closed or having 1.5mm of vent on centre of occlusal surface of copings.

Figure 1

Figure 2

Two parameters were studied with one dependent and one independent variable. The sample size was determined from previous pilot study.

Resin based luting cement (implalute) dual cure cement was applied on intaglio of coping surface, The copings were cemented to the abutment at room temperature using this cement assigned to each group.

Copings were seated on the abutments and abutment-analog assembly was placed on cast holder of surveyor at a load of 5 kg/ 10mins until contact of coping margin and abutment finish line has reached. Excess cement was removed using a scalpel and the specimens were light cured.

Figure 3: 5kg of weight applied on coping through survey

The experimental procedures were repeated for each coping in both the groups. After that, tensile load tests were performed on universal testing machine, at a cross head speed of1mm/min and cement fail load in kgs were recorded. This procedure was then repeated for5timesfor each variable. Descriptive statistics were obtained to analyze the differences among two experimental groups.

Result

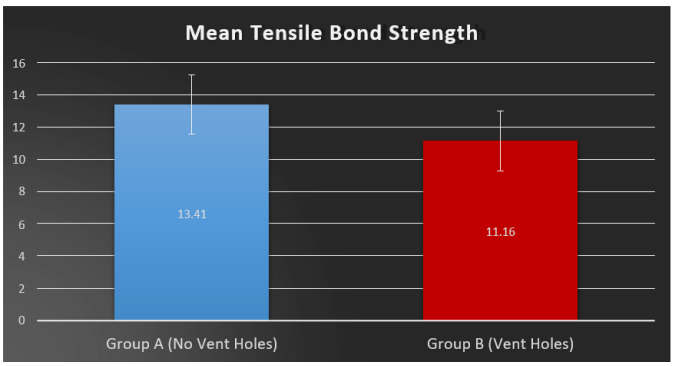
Retentive strength of all the samples were measured and statistical analysis was done for comparison of both the groups. **Table 1** shows Descriptive statistics of mean retentive strength between abutment and copings in both the groups. (Group A –no vent hole) and (Group B – with venthole) using implalute cement.

The highest mean retentive strength of 13.41 kgs was found in Group A (without ventholes) as compared to Group B (with ventholes) i.e.,11.16kgs. Results of unpaired t-test revealed statistically significant difference in retentive strength due to vent holes ($p < 0.05$).

Table 1: Descriptive statistics of tensile bond strength in kgs between group A (Without ventholes) And group B (With ventholes)

	Mean	Standard deviation	Minimum	Maximum	P value, Unpaired t-test
Group A (without ventholes)	13.41	1.82	11.31	15.6	P = 0.043
Group B (with ventholes)	11.16	1.86	8.9	13.86	

Graph 1: Bar graph representing mean tensile bond strength in both the groups.



Discussion

Generally implants and abutments are metallic. So, restoration interphases must be placed sub gingivally to a voidness thetic metallic tint from showing through the gingival tissues, which is often thin. Implant prosthesis can be either screw retained, or cement retained with the latter being more popular. However, a major drawback of cement retained prosthesis is the extrusion of excess cement into the peri implant sulcus. Therefore, creation of vent holes are to be considered on the copings, allowing space under restoration to act as reservoir for way out of the excesscementinsteadatmargins.[6] The retention of implant-supported restoration plays an important role in the success oftreatment.[9]

According to **Jimenez RA et al**[6], reduction of excess cement does not suffice if the technique used affects tensile load resistance. Although, it is desirable toachieveadequateretentionlevelswithoutexcesscementwhencementingimplant-retainedrestorations, but both characteristics may be mutually exclusive, and insufficient luting medium can lead to a decrease in retention.

Due to the size of the hole on the crown dramatically affecting patients' esthetic perceptions, leaving a tiny or micro hole on the crown would minimize its impact on aesthetics and improve patient's acceptance of the crown.

Moreover, a micro hole on the crown maintains its integrity to the maximum extent and provides better resistance to fracture compared with the regular larger

hole. Saboury et al indicated that a screw access hole decreased the fracture resistance of the crown.

Another study by Du et al indicated that a full-contour crown with a 1-mm access hole should be recommended more than holes with diameters of 0, 1, 2, 3, and 4 mm in the posterior region from the aspect of biomechanics. In addition, the technique of leaving a micro hole on the crown was even more advantageous considering that the dilemma of the retrieval of cement-retained implant crowns would be greatly simplified. Dentists were only required to slightly enlarge the hole when the crown needed retrieval, and the time spent on retrieval would be greatly reduced compared to crowns withoutmarkers.[7]

Ye S, Zhou H et al[10]shown that vent holes with smaller diameters (1 mm) can also be placed, which would be advantageous for reduction of extrusion of cement, without affecting the retention ability compared with crowns having a regular larger hole (2.5mm) Some studies showed that study showed close fitting of all the vented copings to the implant abutments, this could be the effect of the vent in decreasing the hydraulic pressure created during seating of the restoration. This finding was in accordance with Clark et al who recommended the use of vents to reduce the excess cement pressure in the ceramic crowns, and with Yeung et al who found that the use of venting significantly decreased the cement excess and enhanced the marginal fit of implant abutments. Jones et al, Cooper et al and Yeun and Wilson also agreed with this finding as they found that the margin al adaptation of vented crowns was significantly better than that observed for non-vented crowns.[11] **Patel D et al**[12]showed that the location of the vent hole does have an effect on the proportion of cement expressed at the margin. There was a statistically significant difference in the proportion of cement expressed at the margin when comparing cervico-palatal ventholes to both mid-palatal and in ciso-palatal ventholes. There was no statistical difference in the proportion of cement expressed at the margin for mid-palatal and in ciso-palatal ventholes. Previousstudiesusingventholeshavepredominantlyusedoc clusalventholes.Itwouldappear that on seating, hydraulic pressure builds up as the cement travels in an occlusal direction and accumulates at the occlusal surface under the coping. The cement in then on vented coping has no where to go but to travel to the margin to escape. Cement under copings with cervico-palatal vent holes still seems to preferentially travel to the margin to escape, the vent hole having minimal effect. Cement under copings with mid-palatal and inciso-palatal vent holes appears to preferentially travel to the vent hole to escape. It is interesting to note that there is no statistically significant difference in the proportion of cement expressed at the margin between mid-palatal and inciso-palatal vent holes, suggesting that as long as the vent hole is above the cingulum, its desired effect will occur.

Conclusion

With in the limitations of this study, following conclusions were drawn-

- Copings without vents provided better retention as compared to copings with vents.
- But as the tensile strength difference between both the groups was less, copings with vents can also be preferred, which would further minimize excess cementat margins.

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