Retention influence of crowns cemented on implants with and without screw access

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Abstract

Introduction: In Implantology, the retention mechanism of the restoration to the intermediate can be cemented or screwed. The cemented one present difficult reversibility, however, the use of an access hole to the screw would allow such reversibility, combining the low cost of the components to the reversibility of the screwed prosthesis. **Objective:** The aim of this study is to evaluate the shear bond strength of prostheses on cemented implants, having or not access to the intermediate screw. **Methods:** Sixteen specimens were prepared (similar to regular implants, "Tiprep" intermediates (Bionnovation, São Paulo / SP) and 16 metal crowns, of which 8 were for conventional crowns control (G1) and another 8 crowns were made with an access hole to the screw, trespassing the metal, being the experimental group (G2). The crowns were cemented with RelyX U100 (3M ESPE) and the specimens from the G2 had the opening of the channel restored with light cured composite resin Filtek Supreme XT (3M ESPE). Specimens were subjected to tensile test in a universal testing machine 24 hours after cementation. **Results:** G1 showed average of 191.075 N; G2 showed 161.280 N. Applied the nonparametric Kolmogorov-Smirnov test, the dependent variable followed normal distribution (p = 0.923) and, with the Student t-test, there was no difference statistically significant (p = 0.353) between groups. It was considered the level of significance of 5%, p = 0.05. **Conclusions:** Based on the analysis, it can be stated that the access hole to the screw does not compromise or decrease the retention of crowns.

Keywords: Cement. Retention. Implant-supported dentures. Reversibility.

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Introduction

The use of oral implants provides a wide range of possibilities and elements to be used, which, if properly suggested and applied, allow resolutions which were considered unviable until some time ago. These situations comprise from a simple periodontal bone loss until more complicated situations from the maxillofacial system, such as tooth loss or major traumatic anatomical losses. Implantology has its own laws and elements that include sciences such as Biomechanics, Biomaterials, Histophysiology, Immunology and Molecular Biology, associating to clinical sciences as Prosthodontics, Surgery and Periodontics.

Osseointegration in the past two decades has revolutionized the prosthetic planning. Criteria such as anchoring, parallelism, surface area, prosthetic space height, esthetics, occlusal patterns and presence of parafunctions are essential in choosing the type of prosthesis system on implants to be recommended for patients.[1, 2]

The selection of the retention system of the prosthesis on implant must happen in the planning stage, before the surgical one, in order to determine the most suitable positioning for the implant.[3] It should be taken into consideration the biomechanical principles and esthetic to be reached.[4]

Among the various decisions to be made, there is the type of implant-prosthesis retention, if screwed or cemented. Many studies evaluate their advantages and disadvantages.[5] The screwed prosthesis have been used successfully in patients completely edentulous, due to the reversibility factor and greater convenience in extensive cases; therefore, is the first treatment option when the implant position permits, of the presence of cantilever and limited prosthetic spaces, among other situations.[1,5,6,7] However, in partial edentulism treatment, the restorative concept involving the use of cemented prostheses becomes the object of study and discussion.[8] This modality is, according to some authors,[2,4,9] the first treatment option when esthetics are prioritized, when the implants are poorly positioned and in cases of passivity in the settlement and uniform load transfer in prosthetic restoration and implant.

Screwed prosthesis have as greater advantage the reversibility and ease recovery and maintenance of restoration, allowing the removal of the prosthesis for crown repairs (ceramic fracture), the exchange of components due to loosening or fracture of the screw and a better assessment of oral hygiene and peri-implant probing.[1,2,3,6,8,9,10] Moreover, cementing implies the risk of having incomplete removal of cement, which can result in peri-implant inflammation, edema, ulceration, presence of exudate and bleeding to probing.[11]

In cases of reduced intermaxillary space, screwed prostheses are well indicated by not requiring them to great height to intermediates.[12] According to Misch,[4] the retention of these prostheses is more discreet, since there is no need for a vertical component of at least 5 mm in height to provide retention and resistance as the cemented prostheses.

Compared to screwed prosthesis, cemented prostheses have superior esthetics and occlusion, as well as passive settlement of the prosthetic structure.[1,4] Despite all these advantages, the difficulty of reversibility of the prosthesis and removal of cement excess remain as disadvantages.[1,5]

Occlusion is a noted factor in the selection of the restoration type. In posterior teeth, the implant should ideally be installed in the central fossa of the tooth to be made, so that the generated force is axial. In cemented prosthesis, the occlusal contacts are more stable due to the absence of the screw access channel, which takes a significant portion of the occlusal table. The contact in screwed prostheses is generally located in this area. The material that seals the channel, usually resinous composites, has a doubtful efficiency.[8]

As for esthetics, cemented restorations are more beneficial. The screw access channel is anti-esthetic, being this problem more prevalent in areas of lower premolars and molars. The opaque resin composites are used to minimize the gray level of the channel.[1,3,4,8]

The risk of absence of passivity of screwed prosthesis results in a large concentration of stress around implants compared to cemented ones.[13] The small misalignments of cemented prosthesis can be compensated by cementing, and they also help to ensure that the forces are transferred along the whole set prosthesis / implant/bone.[2,9]

The manufacture of cemented prosthesis is simpler and less expensive than the screwed prosthesis. Techniques are similar to traditional tooth-supported prosthesis, not needing further training of laboratory technicians, or use of more expensive components, such as the screwed. [5]

Zarone et al[2] in their study evaluated the fracture resistance of screwed metal-ceramic crowns compared to cemented. Statistical analysis indicated no significant difference between the two groups, despite the cemented prosthesis showing fracture resistance values higher than the screwed. Torrado et al,[14] following the same line of research, found that a significantly smaller force was required to fracture the screwed crowns compared to cemented, and that the location of the screw access channel of the intermediate to the implant within the occlusal table does not affect the fracture resistance of the ceramic.

The cemented prostheses have the possibility to repair the decreased restoration in cases of future failures, making their maintenance difficult at the office. [15] In case of needing to repair the intermediate, usually caused by the loosening of the screw, the restoration should probably be destroyed, because its removal is difficult and it often remains cemented, being necessary to make a new prosthesis. Any force applied to removal of the prosthesis has the potential of causing damage to the inner surface of the implant, or fracture of the fixation screw of the intermediate.[5, 16]

Emms et al[17] investigated the effect of filling and sealing screw access channel of the intermediates in the retention of cemented prostheses implant-supported when used the cement TempBond (temporary cement) for fixing the crown. Existing, clinically, the risk of loosening and with the intermediate having a good retention, the result of the study suggests that the complete obturation of the screw access channel, when cemented with TempBond, may be appropriate to promote the retention of the prosthesis.

To obtain some reversibility in cemented prostheses, some authors suggest the use of temporary cements in definitive restorations.[1,8,18] The use of definitive cements results in difficulty in maintaining the cemented prosthesis.[16]

Valbao et al[19] suggest the production, in the cemented crown, of an access channel to the intermediate in the central area of the lingual face with a carbide bur, the use of temporary cement and photopolymerizable resin to close the opening of the channel. An ultrasonic device or others for removal of prosthesis may be used without danger to the intermediate, since the resin has been removed. The disadvantage of this technique is that it can not be applied when there is limited interocclusal distance.

Doerr and Tucson[20] presented a method for locating the screw access channel of the intermediate to the implant, facilitating the removal of the cemented restoration without its destruction or the intermediate. The authors made a guide similar to the surgical guide, perforated in the region of screw chamber. On this perforation it was carried out a preparation with a diamond burr in the metalic or metal-ceramic prosthesis until reaching the screw. This technique has the disadvantage of requiring the use of the original model of cemented prosthesis.

Okamoto and Minagi[21] suggested a technique for reversibility of cemented implant-supported prosthesis using temporary cements. They made a cylindrical hole on the lingual surface of the intermediate (0.7 mm) and an access channel on the lingual surface of the prosthetic crown (1.5 mm) similar to a key/lock set. To remove this prosthesis, it is inserted a cylindrical guide in the same dimensions of holes ("removing driver"), generating a force, leading to the fracture the temporary cement line and allowing removal of the prosthesis. Rajan and Gunaseelan[9] described in their article a technique for making single cemented/ screwed implant-supported prosthesis, in which the crown (cemented to intermediate) has an access channel to the screw, serving as a device for intermediate's replacement. The prosthesis and the intermediate can be easily removed from the implant without the necessity of a crown-screw or destruction of them, facilitating also the residual cement excess cleaning. This technique may be contraindicated for patients with limited interocclusal distance.

Schwedhelm and Raigrodski[16] described a technique to facilitate the location of the access channel to the intermediate screw in cemented prostheses. The crown is manufactured in a conventional manner and prior to the glaze. The intermediate is placed on the plaster model and the angle and the opening of the channel are recorded. In the region of the access channel is applied a pigment (stain) on the ceramic, identifying it. With the subsequent need for removal of the intermediate a radiograph is taken to assess the angulation of the implant and the ceramic indicated by the pigment is removed. The channel is sealed with composite resin.

Uludag and Celik[22] described in their paper a method of fabrication of implant-cemented fixed prostheses, keeping the screw access channel to the intermediate without coating of metal and ceramic; a reversible cemented prosthesis. The screw can be easily achieved by the access channel prepared in the metal polishing stage. The restoration would then be removed without its destruction.

The present study aims to evaluate the influence of the access channel in the tensile strength of implant-cemented prostheses. It is observed that in literature there are no studies that examine the physical and mechanical properties of implant-cemented prostheses, having in its structure the screw access, incorporating the simplicity of cemented prostheses and reversibility of the screwed ones, which, if not implying in biomechanics quality loss, may be another important option in the construction of implant-supported prosthesis.

Material and Methods

Sixteen specimens were made, divided in two experimental groups.

The specimens had the following characteristics: regular implant analogs (Bionnovation, São Paulo / SP, code 09004), attached to the acrylic resin contained in a PVC pipe of 3 cm in height and 0.5-in in diameter.

Over the analog, the intermediate was screwed used for cemented prosthesis, straight, 2 mm in height and made of titanium, from the commercial brand Bionnovation, denominated "Tiprep" (Fig 1). Each intermediate was attached to analog with the torque of 35N.

The implant analog was positioned with the aid of a delineator so that it was perpendicular to the ground and the traction was performed axially to its long axis, avoiding this way the decomposition of forces (Fig 2).

16 metal crowns (Co-Cr) were made on these intermediates for implant-cemented prosthesis (Fig 3), and 8 of them were conventional, constituting the control group (G1). The other 8 crowns were made, however, with an screw access channel trespassing the metal, constituting the experimental group (G2) (Fig 4).

All specimens were cemented with universal self-adhesive resin cement RelyX U100 (3M ESPE) (Figs 5, 6 and 7), according to manufacturer instructions. Specimens from G2, with screw access, had it restored with light cured composite resin, Filtek Supreme XT (3M ESPE) (Fig 8).

The specimens were subjected to vertical tensile test in a universal testing machine (EMIC DL 2000) (Figs 9 and 10), 24h after cementation of crowns. A speed of 0.5 mm/minute was used, recording in Newtons the displacement of the crown. Data were pooled and analyzed statistically with the nonparametric Kolmogorov-Smirnov test and Student *t* test.

Results

The test results are presented in Tables 1 and 2, evaluating the minimum tensile strength for removal of implant-cemented prostheses.

Table 1 presents the data of the control group (G1) which obtained 191.075 N as the mean value of force to the displacement of the crown, minimum value of 92.71 N and maximum value of 266.20 N. In the experimental group (G2) the average strength was found 161.28 N, 89.23 N for minimum value and 248.86 N for maximum value (Tables 2 and 3).

Through the Kolmogorov-Smirnov test, the dependent variable follows a normal distribution (p = 0.923) (Table 4).

Applying the Student's *t* test it was compared the average of the control and experimental groups. Through the statistical test applied, it was found that there is no statistically significant difference (p = 0.353) between the control and experimental groups. It was considered the significance level of 5%, or p M 0.05 (Table 5).

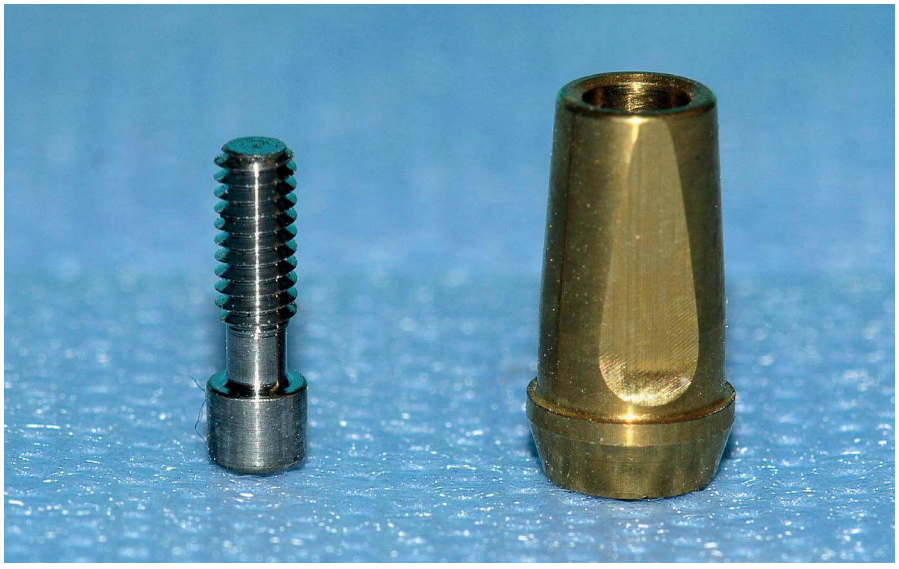

Figure 1 - EC RP 2.00 Pilar (Bionnovation).

Figure 2 - Implant analog positioned with the aid of a delineator in the PVC pipe.

Figure 3 - Full metal crowns for cemented prosthesis on implant.

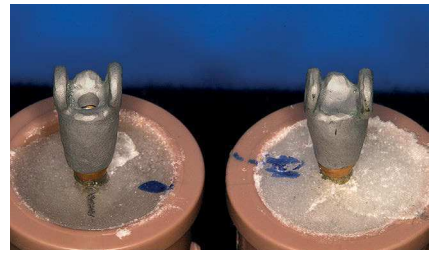

Figure 4 - Control group and experimental group.

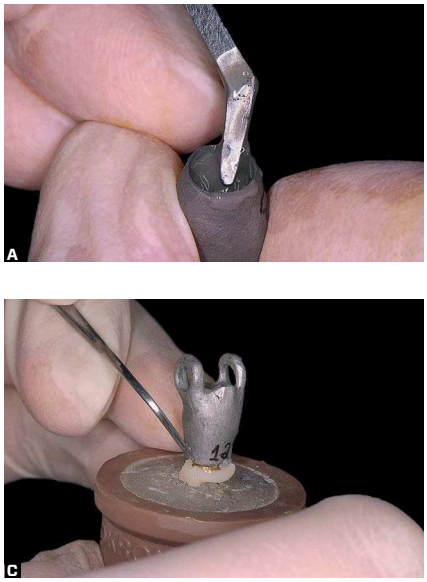

Figure 5 - Cementing of the specimens in the control group.

Figure 6 - RelyX U100 resin cement.

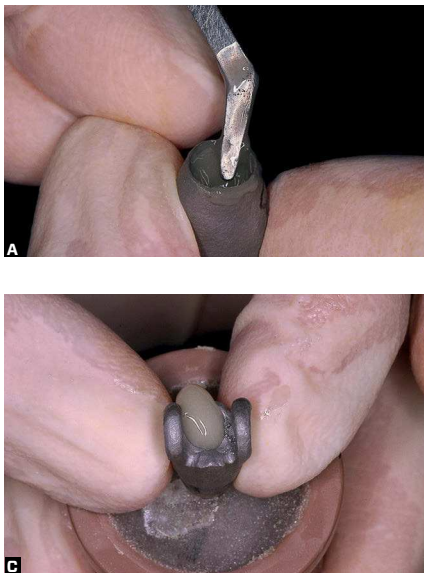

Figure 7 - Cementing of the specimens in the experimental group.

Figure 8 - Filtek Supreme XT (3M ESPE) Photopolymerizable composite resin.

Figure 9 - EMIC machine with the specimen positioned for testing.

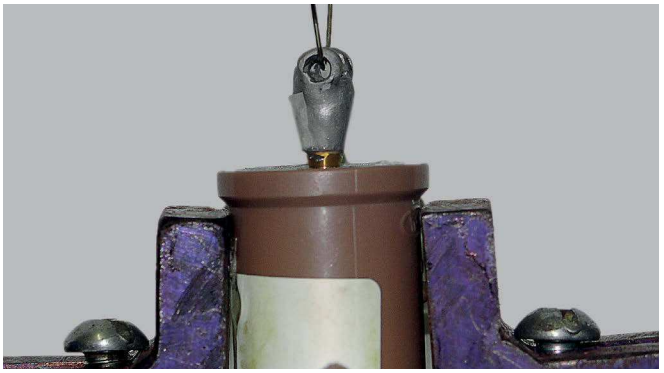

Figure 10 - Approximate view of the specimen positioned in the machine EMIC for testing.

Table 1 - Control group.

Test	Force (N)
Test 1	164.51
Test 2	135.23
Test 3	266.20
Test 4	142.20
Test 5	250.95
Test 6	221.67
Test 7	255.13
Test 8	92.71

Table 2 - Experimental group.

Test	Force (N)
Test 1	99.68
Test 2	122.69
Test 3	248.86
Test 4	159.63
Test 5	89.23
Test 6	145.69
Test 7	216.09
Test 8	208.43

Discussion

One of the major concerns with the implant-cemented prosthesis is about the challenge of restoring when there is loosening of the intermediate' screw. Several authors seek adding to cemented prostheses the feature of reversibility with the intention giving to dentists the option of removing them from their implants without total destruction.[9,16,19-22]

Doerr, Tucson;[20] Okamoto, Minagi;[21] Schwedhelm and Raigrodski[16] described techniques to facilitate the location of the access channel to the intermediate screw in cemented prostheses, such as the fabrication of a perforated guide in the region of the screw chamber, or ceramic pigmentation to identify the access area.

Rajan, Gunaseelan;[9] Uludag and Celik[22] have studies lines that corroborate the purpose of this article: The manufacturing of implant-cemented prosthesis with a access channel to the intermediate screw serving as device to replace it. This device, as verified in the results, does not promote shear-bond strength, with significantly lower values compared to conventional cemented prosthesis, offering a good treatment alternative.

Conclusion

The increase in reversibility to cemented prosthesis provides to the dentist the union of the advantages of

Table 3 - Distribution of cases for comparison group.

	Frequency	Percent	Valid Percent	Cumulative Percent
Control Group	8	50.0	50.0	50.0
Experimental Group	8	50.0	50.0	100.0
Total	16	100.0	100.0	

Table 4 - Statistical distribution of results (Kolmogorov-Smirnov test).

		Measure
N		16
Normal standards[a,b]	Mean	176.1812
	SD	61.8191
Extreme differences	Absolut	0.137
	Positive	0.137
	Negative	-0.137
Kolmogorov-Smirnov Z		0.549
Asymp. Sig. (2-tailed)		0.923

a = Normal distribution. b = Calculated from data.

Table 5 - Statistical Distribution of results (independent sample´s test).

GROUP	N	Mean	SD	Mean error
Control Group	8	191.0750	65.6361	23.2059
Experimental Group	8	161.2875	58.0864	20.5367

Group statistics.

		Levene test for equality of variances		*t* test for equality of means						
									95% Confidence Interval	
		F	Sig.	*t*	df	Sig. (2-tailed)	Mean dif.	Mean error dif.	Inferior	Superior
Measures	Equal variances assumed	0.597	0.453	0.961	14	0.353	29.7875	30.9882	-36.6755	96.2505
	Equal variances not assumed			0.961	13.796	0.353	29.7875	30.9882	-36.7678	96.3428

Independent sample´s test.

cemented and screwed prostheses on a single type of prosthetic rehabilitation. Based on the results, it can be stated that the construction of the screw access channel does not affect or decrease the retention of crowns. The shear-bond strength tests have allowed to observe that the force required for the displacement of conventional cemented prosthesis has no statistically significant difference relative to the other with screw access channel. It was also observed that there are few reported studies in literature on the tensile strength of cemented/screwed prosthesis, requiring thus more scientific works.

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