Cement-retained versus screw-retained dental prostheses: Literature review

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Abstract

Due to the advancement of research related to osseointegration, Implantology has become a treatment with satisfactory prognostic in Dentistry. However, in order to achieve more lasting success in prosthetic work, it is very important to choose the proper type of retention of the prosthesis, whether it is cement-retained or screw-retained. The present study consists of a literature review on the subject concerning cement-retained prosthesis as opposed to the screw-retained ones, addressing their advantages and disadvantages, and issues such as aesthetics, passivity, reversibility, retention, and occlusal aspects. The choice between screw-retained or cement-retained prosthesis is of interest to the professional, as it will contribute to the long term success of treatment.

Keywords: Cement-retained prosthesis. Screw-retained prosthesis. Reversibility. Passivity. Occlusal aspects.

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Introduction

Due to the advancement of researches related to osseointegration, allied to the increase in life expectancy and aesthetic and functional exigency by patients, Implantology has become a reality in the current Dentistry.[1,2] The first oral rehabilitation using a protocol with osseointegrated implants occurred in cases of fully edentulous patients in the lower jaw. The indication of this kind of prosthesis has growth a lot, also becoming used in unitary and partial cases, in the maxilla and mandible.[3,4] The search for long term foreseeable results has pointed out several questions related to the material used, as well as the techniques. One of these questions is about the kind of implant/prosthesis connection: screw-retained or cement-retained, or a combination of both, for example, cement-retained prosthesis with lingual or palatal screw.[5]

Initially, screw-retained prostheses were used, and they consist in an abutment screwed to the implant, on which is positioned a crown, attached to a gold or titanium screw.[3] Branemark standard protocol, proposed in 1965, was already part of this kind of connection. Over the years, cement-retained prosthesis has arisen and they are conquering more and more space in Implantology, generating doubts among clinical professionals about what connection system should they use. However, compared to screw-retained prosthesis, cement-retained restorations have limited scientific documentation.[5]

The evolution of cement-retained prostheses has begun after a change in UCLA abutment, conducting the fabrication of abutments in order to improve esthetics and solve problems in implant angulation.[5] Lewis et al[30] were the first to describe techniques for cement-retained restorations. Thus, in order to achieve a good prognosis for implant-supported prosthesis, the retention system should be chosen in the preoperative planning, aiming at a better positioning of the implant.[6] For example, in fixed screw-retained prosthesis, anterior implants are installed more toward lingual than in a cement-retained restoration, as the orifice to access the prosthetic screw must be inserted in the cingulum. It is more difficult to correct an implant installed excessively to vestibular in a screw-retained restoration, and it can lead to an unavoidable aesthetic commitment. This highlights the necessity to establish in the preoperative the retention system to be used.

Considering this questioning, the present study searched for relevant articles in the literature which discuss the advantages and disadvantages of cement-retained and screw-retained prosthesis, approaching biomechanical factors, like passivity, reversibility, retention, occlusal aspects and also aesthetic factors, in order to discuss the better indications and limitations of each one of them.

Literature review

The use of implants in Dentistry has earned the confidence of professionals since the early 80's, when long term longitudinal researches were presented, resulting in a foreseeable and satisfactory treatment option. This success was due mainly to the osseointegration, and also to the screw-retained connections over implants. At that time, abutments for cement-retained prosthesis were not used yet.[2]

Over the years, as in all other areas, requirements, mainly the esthetic ones, have increased and led to the rising of abutments for cement-retained prosthesis. This has made the range of alternatives to considerably increase, but one doubt remained: should one fix a prosthesis on the implant using cement-retained or screw-retained system? Besides personal preferences, the professional must know the advantages and disadvantages of each one of them in order to elect the appropriate component to solve the case.[7]

Following, biomechanical and aesthetics factors will be addressed, which should be considered in the planning of an implant-supported prosthesis.

BIOMECHANICAL FACTORS

Passive adaptation

The passive adaptation has been shown as an essential requirement for maintenance of bone-implant interface, and for the longitudinal success of implant-supported prosthesis. It is defined as the maximum contact between the infrastructure basis and the abutments, without generating tension between them.[1] There are several factors which directly affect the adaptation and passivity of prosthesis, among them, the precision on the whole manufacturing process, including casting and foundry, besides the skills of the surgeon and prosthetic technician.[4,8]

In conventional fixed prosthesis teeth move to compensate small mistakes in prosthesis adaptation. In the case of implants, this does not occur, therefore, the absence of passive adaptation will bring on an increase of forces transmitted to the bone, causing prosthetic failures, like loosening or even screw fracture, metal frame or ceramic fracture, accumulation of bacteria, mucositis, peri-implantitis, and even osseointegration loss.[1,4,5,8,9]

It is known that passive adaptation of screw-retained prosthesis is virtually impossible to be obtained. Screw-retained restorations can create two or three times more permanent deformation in the implants than cement-retained prosthesis.[6] Some authors also assert that, both to cement as screw-retained prosthesis do not have total passive adaptation, and it can produce low magnitude tension in implants.[10,11]

Passivity of screw-retained prosthesis is difficult to achieve due to the dimensional discrepancy inherent to the process of manufacturing, what does not occur with cement-retained prosthesis, because the cement layer has the capacity to compensate small discrepancies, facilitating the prosthetic adaptation, helping the forces to be transferred along the whole prosthesis/implant/bone system.[4,6,10,12]

It can be noticed that passive casting has a considered advantage in cement-retained prosthesis. Die spacers create a abutment/crown interface with about 40 μm — which compensate somewhat laboratory materials dimensional changes — and where the cement will be deposited, allowing a more passive adaptation in cement-retained prosthesis.[4]

Several authors assert that the action of cementing agents — absorbing impacts and reducing tensions transmitted to the bone and implant — makes cement-retained prosthesis to have more passive adaptation than the screw-retained ones.[13,14] However, it is noticed that screw-retained prosthesis possess smaller gap in the interface between their connections than the cement-retained ones.[4,14] The study conducted by Keith et al,[15] quantifying the marginal discrepancy in the abutment-crown interface in screw and cement-retained prosthesis confirm this statement. As a consequence, in cement-retained prosthesis there is higher risk of space colonization with microflora and dissolution of cement, besides gingival inflammation. This better passivity obtained by screw-retained prosthesis is due to the section of infrastructure in parts and to laser welding.[12]

The section of metal infrastructure has to respect certain specific dimensions, in order to guarantee the precision in welding (0.008-in). An excessive space causes contraction of welding and a weakened union; a reduced space can causes distortion by expansion during the heating of foundry. The union of pieces separated requires more time, and the patient has to return to another appointment after the process of welding in the laboratory. It is important to consider that this 0.008-in space is necessary in cases of conventional welding, because in punctual welding (laser or TIG) it is observed that, the closer the better resistance of welding and lower the distortion (dimensional change).[6]

Some authors have evaluated the adjustment between the abutment and the infrastructure of a screw-retained

prosthesis with three elements. The monobloc group presented higher marginal gaps, while the conventional and laser welding groups have presented similar degrees of misfit with better distribution of tensions, without significant differences between them.[16] Another work has shown significant statistical differences among laser and TIG welding and the brazing.[17]

The extent of metal contraction during the process of manufacture of an infrastructure is variable and depends on the manufacturer and on the technique, but it is near to 1.5%, whether considered that semiprecious alloys can present twice this quantity. Therefore, during the foundry of the infrastructure, separated and welded castings are necessary in order to obtain a more passive infrastructure. The casting of an infrastructure in parts and posterior laser welding normally provide more passive structure than the fusion in monobloc. When a monobloc structure is molten and does not present passivity, its section with thin disk is necessary (cut dimension must be thinner than a playing card) in the region of misfit abutments. After separated, the passivity of these components must be tested singly, and then proceed the process of union with Duralay, for posterior welding.[6]

Other authors have performed a study comparing the passivity of adaptation in four techniques for construction of screw-retained prosthesis infrastructures: Method of fusion in single piece (the piece is waxed, fused and fixed in a single piece); cut and welding (the piece is waxed, fused, sectioned, welded and fixed); welding (the structure is waxed in parts, fused, welded and fixed); and passive adaptation (in which there is an association of screw and cement-retained techniques). There was a stress generation in all prosthesis fixation methods; the higher tension has occurred in the single fusion method, followed by the cut and welding method and by the welding method. The lower tension has occurred in the passive adaptation method.[18]

It was has also performed a study evaluating the marginal discrepancy and passivity of adjustment in screw and cement-retained prosthesis before and after the torque on screw, and/or cementation. There was no significant difference in marginal adaptation between the groups before the screw was tighten or cementation. After the screw was tighten and cementation, marginal openings were much lower on screw-retained prosthesis. In relation to the stress generation, screw -retained prostheses have presented higher stress generation than the cement-retained ones.[19]

An in vitro study has measured the maladjustment compensation capacity of three prosthetic infrastructure systems: CerAdapt (cement-retained crown) and Standard and Estheticone systems (screw-retained crowns). Devices adapted to the implants have simulated rotations errors (rotation and inclination) and translation errors (height and distance). The authors have concluded that CerAdapt system (cement-retained) presented better capacity to compensate translation errors. For other rotation errors, the Standard system obtained better results, and the Estheticone system presented the worst values.[20]

Reversibility

Reversibility is described by several authors as the main advantage of screw-retained restorations.[5,21,22] These, among others, considered that the practicality in removing and repositioning screw-retained prostheses facility the control appointments for repairs, changes in rehabilitation after lose or failure of an implant, maintenance of hygiene mainly in elderly patients — who does not have complete coordination — and monitoring of peri-implant tissues. Considering these facts, the facility in removing prosthesis becomes very important for work durability.

Despite several authors consider that cement-retained prostheses cannot be removed, there is the possibility to remove them using provisory cements. These cements, whether used in metal interfaces with appropriate adap-

tation and surface area, offer adequate retention, besides can be removed for eventual control.[6,12]

As asserted before, the great advantage of screw-retained prostheses is that it can be removed. However, due to several disadvantages, some authors have suggested the temporary cement retention, or the use of a lateral screw, that once tight, provides disruption of the cement film, allowing the prosthesis to be removed.[3]

Some authors have cited the use of provisory cement associated with Vaseline to easily remove the prosthesis. They have also observed that screw-retained prostheses were developed in answer to a need to remove prostheses in a period in which there was 50% of success rate of implants. Nowadays, this index has increased to 90%, decreasing the clinical significance of reversibility.[12]

On the other hand, other authors have agreed that currently, with the evolution in materials field, the relaxation of screw become less frequent, but they also have asserted that with the increase in the amount of treated patients, the number of relaxation episodes tends to be enhanced. As the removal of cement-retained prosthesis sometimes is only possible by destructing the restoration; some authors consider more indicated to use screw-retained restorations, as they can be easily removed.[13]

However, it is verified that screw-retained single prostheses have higher reversible complications than cement-retained prostheses, with success rates of 36.3% and 2.9%, respectively.[23] The study performed by Jemt and Petterson [24] corroborates these results, and they have cited that screw-retained prostheses can present higher relaxation of screw, due to the lack of passivity.[25]

It is known that, to remove a screw-retained restoration in which the access orifice is covered by composite resin, the dentist must remove the occlusal restoration, the subjacent cotton and the prosthesis screw. After reinserting the prosthesis, the screw is substituted, the torque is carried out and the occlusal orifice is restored again (this procedure takes a considerable amount of time). Then, it will be easier and faster to remove and re-cement a prosthesis fixed with temporary cement.[6]

In order to facilitate this process, some authors describe a technique in which is used a polytetrafluoroethylene tape (PTFE), known as plumber tape, to seal the access to the abutment screw. It is a radiopaque material, easy to manipulate and does not cause bad smell as cotton. This technique allows its fast removal in one single piece, when it is necessary. It can be sterilized in autoclave and inserted with a presser plier inside the access orifice, on the screw head.[26]

In relation to the cement-retained prostheses, it is possible to assert that the so-called definitive cements do not adhere to the titanium abutment with the same tenacity than they adhere to the preparation on the teeth. Consequently, more resistant cements can be used in implants, and these can be removed easier. Implant-supported prostheses can be sealed with cements of variable resistance, which can be selected according to the localization, height, width, convergence degree, retention and the abutment shape. A provisional restoration must be used as a guide to find the type of cement that allows latter removal, but which does not loosen during function.[6]

On the contrary of this information, some authors have asserted that progressive cementation as described by Mish[6] increases clinical time, even during the provisory phase. In this way, more appointments will be necessary, not only to discover the ideal consistence of cement, as well as re-cement restorations which have become loosen.[7] Another item considered by these authors is the difficult to completely remove the excess of cement around the prosthesis, what can cause grooves in the piece or even inflammation in adjacent tissues.

Some authors have agreed that the prostheses can be difficult to remove even using provisory cement. The ideal taper of abutment, jointly with its long wall allow the use of provisory cement for a long period.[4]

Occlusal aspects: transmission of loads

Some authors have described, in relation to occlusion, that due to the low elasticity of cement-retained or screw-retained components over the implant, a carefully planning must be performed in order to avoid overload.[9]

The cement-retained prosthesis and the implant body can receive axial load, reducing the load on the bone crest. While in a screw-retained prosthesis the load must be applied in the region of the occlusal screw, which is covered by a resin layer. That highlights the advantage of cement-retained restorations due to the better distribution of occlusal loads along the implant axis, establishing contacts directly on the crown, and not on the resin that obliterates the occlusal orifice in cement-retained prostheses.[6]

The orifice for screws usually measure 3 mm in diameter, what represents 30% or more of the hole occlusal surface of posterior teeth, and 50% of functional area, because only two thirds of occlusal face are localized in the functional regions of loads. Ordinarily, the screws are in the region of primary contact; therefore, in order to address the loads along the axis of implant body, occlusal adjusts are performed on the occlusal screw or in the composite resin on the screw. Some authors have also suggested to transfer the point of contact (load) to a lateral region in the occlusal area of screw. These restorations require additional clinical time and wear out faster than porcelain or metal, which are the materials for contact used in cement-retained prostheses.[6] It is important to remember that restoration materials, in screw-retained prostheses affect the direction of occlusal load, making distribution of loads to occur laterally, instead of in the axis of the implant.[14]

Likewise, regarding cement-retained prosthesis and the occlusion, it is necessary to consider the full occlusal face, which allows to establish many occlusal contacts in the typodont, reducing the working time to adjust it in the patient's mouth. The center of occlusal face allows a better transmission and absorption of axial loads by bone-implant interface. It is also important to highlight that, when anterior cement-retained prostheses are manufactured, the crowns are made with normal palate region and without over-contouring; it enables that excursive movements of jaw occur without interference. Besides, it is also important to mention that ideal occlusal contacts which remain stable for long time are possible to be established in a cement-retained prosthesis.[5,9]

Literature provides evidences that non-axial loading can cause an elevated incidence of components failure, or screw loosening. Some authors report that the better way to avoid occlusal problems is to displace the orifice as much as possible off the occlusal face and make it as smaller as possible.[13]

A study was carried out in order to evaluate the fracture strength of cement-retained and screw-retained prosthesis. Compression strengths were performed on the crowns. Statistical analysis has shown there were no significant statistical differences between the two groups (cement-retained and screw-retained). All the samples have suffered cohesive fractures in the porcelain. Screw-retained crowns have shown microcracks at the level of access to the occlusal screw and extensive fractures in all the thickness of porcelain. Cement-retained crowns were affected by marginal fractures in the porcelain, and they resulted in a higher value of fracture strength in relation to the screw-retained ones.[21]

Another study has carried out to evaluate the fracture strength of three kinds of prostheses: cement-retained (control); screw-retained with metallic support in the orifice of access to the screw; and porcelain. The crowns were submitted to dynamic and static loads

until the limit of resistance of crowns. Higher resistance to the fracture was observed in the cement-retained group; however, there was no significant statistical difference between the two groups of screw-retained prostheses. Occlusal discontinuity of screw crowns affects its resistance, irrespective of the presence or absence of metallic support in the orifice to access the screw.[27]

Retention

The retention of an implant-supported prosthesis is an important factor which will influence in the longevity of rehabilitation works.[9] Some authors have reported that prosthesis retention depends on several factors, like angulation of the preparation, surface area, abutment height, surface roughness and type of cementation agent.[12,13,14]

The primary advantage in a screw-retained structure is the possibility to place a prosthesis over abutments with low retention profile; in other words, when the inter-occlusal space is reduced. Cement-retained prostheses require a vertical component with at least 5 mm height in order to offer retention and resistance. When the intermediary has 4 mm, the retention decreases 40%. Then, it is possible to conclude that the screw-retained system is more resistent to occlusal forces than cement-retained ones, when the height is less than 5 mm.[6,13]

In relation to the cement-retained prostheses, as we have seen in the item 'Reversibility', Michalakis et al[5] assert that cements used to fix prostheses can be provisory or definitive. Definitive cements increase the retention and provide appropriate marginal sealing in the restoration. Provisory cements have as main function the easy of removal.

For an effective retaining, the cement needs preparation with long and parallel walls as possible. According to Southan and Jorgensen,[31] ideal inclination of preparation walls should be near to 6°, avoiding loss of frictional retention. This concept can be used both to preparation and teeth, and to abutments over implants. Most manufacturers of implants produce abutments with 6° of inclination. Thus, the retention achieved with the prosthesis on the cement-retained implant is about 3 times higher than that achieved with natural teeth, because most professionals can prepare natural teeth with angulation from 15 to 25°, reducing considerably the retention of prosthesis (75%).[5,9,12]

As adjunct for the affirmation above, it is possible to cite that, due to this angulation in 6° present in abutments of cement-retained prosthesis, it is not necessary to perform additional retentions with diamond or abrasive blasting to make the intermediate surface rougher and increase the retention.[12,14]

There are authors who reports the use of progressive cementation technique for cases in which the desired retention does not exist. This technique profess the use of cements increasingly strong until achieve the desired retention.[12] In addition to this study, Mish[6] accentuates that provisory restoration can guide the professional to find an appropriate cement that does not release when in function.

In relation to the screw-retained prosthesis, the retention is obtained by fixation of the screw, and its loss by relaxation. Several factors will affect retention of screw and, consequently, of prosthesis, like insufficient torque on screw, overload, loads out of the implant axis, maladjustment of prosthesis, among others.[14]

To achieve enough force to close the screw, torque should be performed according to the manufacturer specifications. Another torque on screw is also indicated 5 minutes after the initial torque and another one some weeks late. Overload, loads out of the implant axis and prosthesis-implant maladjustment should be adjusted, because they increase the stress on the screw, leading to relaxation.[14]

ESTHETICAL FACTORS

On the esthetical issue, most authors consider cement-retained prostheses better than screw-retained ones.[5,6,12,21] Cement-retained prostheses allow surgical location of implant more related to the along the axis of dental element, obtaining crowns with more natural anatomy.[28]

The absence of occlusal orifice to the access of screw on cement-retained prostheses avoids the existence of changes in design, compromising esthetics.[1] Hebel and Gajjar[12] consider that the main motive of aesthetic disadvantage of screw-retained prosthesis is the orifice of access to the screw. Once this orifice makes the occlusal surface to present a different material from the crown, it results in a different shade. Cement-retained crown makes easy the confection of shape, with a functional and esthetical masticatory surface.[6]

Other authors assert that integrity of surface is the higher advantage in cement-retained prostheses. It allows the technician to manufacture an esthetical prosthesis, similar to the conventional fixed prosthesis, because it does not require the presence of orifices of access to the screw for retention; and also in treatments in which the implants are placed in vestibular position, they can perform the adjustment of angulation.[9] In screw-retained prostheses, the adjustment of angulation can be performed by installation of angled abutments, however, it can interfere negatively with the esthetics in cervical region. Meanwhile, according to Shadid and Sadaqa,[14] the implant placed at the ideal position will allow good esthetical results, both to cement-retained and screw-retained prostheses.

In screw-retained prostheses, anterior implants should be installed more to the lingual direction than cement-retained restorations, in order to place the access orifice for the screw in the cingulate region[6].

The emergency profile of an anterior cement-retained crown can show a satisfactory esthetical result, because the implant can be inserted beneath the incisal border, instead of the cingulate. It facilitates the preparation of an abutment slightly angled towards the vestibule, as a natural tooth. A screw-retained restoration positioned towards the vestibule direction may not be modified without the presence of an angled abutment. If the body of implant is modified, a personalized abutment, with additional appointment and costs, is required.[6]

Some authors assert that the use of composed resin to mask the access orifice for the screw may totally resolve the esthetical problem of screw-retained prostheses, but the color choice should be properly done.[3]

Esthetics largely depends on the selection of patient, on the type and volume of tissue which enfold the implant, and on the position of implant. Trajectory of implant will simply determinate the method of retention. Retention with cement can be universally used, while screw restoration can be used only when it allows an access to the screw in non-esthetical areas.[13]

Weber et al[29] performed a study where evaluated, besides the conditions of peri-implant soft tissues, the esthetical performance of implant-supported restorations in 80 patients. Patients didn't show statistically significant esthetical preference between the two types of implant-supported prostheses, while dentists shown higher satisfaction with cement-retained crowns.[1,29]

Conclusion

There are no universal truths in health area; neither extrapolated principles for all situations. Decision between using cement- or screw-retained prosthesis is one of these examples. After the present review, it is clear that both the techniques have pros and cons and the decision on the type of fixation is a professional duty for each specific case. This decision should be based on knowledge and professional experience, always achieved in the search for scientific evidences, as well as the needs of the patient.

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