PROSTHETICS ON IMPLANTS: CEMENT OR SCREW-RETAINED? A REVIEW OF THE LITERATURE

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Palavras-chave: Implantes Dentários. Prótese Dentária. Retenção de Prótese.

RESUMO

Introdução: A descoberta de implantes osteointegrados de titânio possibilitou o desenvolvimento de próteses dentárias parafusadas ou cimentadas. No entanto, cada método de retenção envolve diferentes aspectos. **Objetivo**: este estudo tem como objetivo revisar a literatura de estudos in vitro e in vivo dos últimos 7 anos sobre as propriedades mecânicas, biológicas, estéticas e oclusais e o custo de próteses parafusadas e cimentadas para identificar o que pode promover maior longevidade e economia, considerando o quadro clínico do paciente. **Fontes de dados**: Nosso método foi baseado na coleção de artigos científicos publicados em inglês de 2012 a 2018 no banco de dados PubMed. **Síntese dos achados**: notamos que em alguns casos clínicos, um método de retenção foi mais adequado que o outro, como visto no acesso à região posterior ou na face palatina das coroas, a posição / angulação dos implantes na região anterior , saúde do paciente e condições econômicas. Ambas as próteses podem sofrer ou não de complicações mecânicas e biológicas. A reversibilidade também pode ser associada a próteses cimentadas. Existem alternativas às próteses parafusadas para alcançar uma estética satisfatória na região anterior, apesar de serem mais caras. A oclusão ideal tende a ser mais facilmente alcançada por próteses cimentadas, pois evita parafusos protéticos e a formação de orifícios coronários, apesar das contribuições do planejamento correto, seguido pela análise de oclusões estáticas e em movimento. **Conclusão**: cada método de retenção tem suas vantagens e desvantagens. Portanto, o melhor método é aquele que melhor se adapta às características e necessidades de cada paciente.

Keywords: Dental Implants. Dental Prosthesis. Prosthesis retention.

ABSTRACT

Introduction: The discovery of titanium osseointegrated implants enabled the development of screw or cement-retained dental prostheses. However, each retention method involves different aspects. **Objective**: this study aims at reviewing the literature of *in vitro* and *in vivo* studies of the last 7 years on the mechanical, biological, aesthetic and occlusal properties and the cost of screw and cement-retained prostheses to identify what can promote greater longevity and economy by considering the patient's clinical framework. ***Data sources:*** Our method was based on the collection of scientific articles published in English from 2012 to 2018 in the PubMed database. ***Summary of the findings***: we noted that in some clinical cases, a retention method was more appropriate than the other, as seen in the access to the posterior region or the palatal face of the crowns, the position/ angulation of implants in the anterior region, the patient's health and economic conditions. Both protheses can suffer or not from mechanical and biological complications. Reversibility can also be associated to cement-retained protheses. There are alternatives to screwed prosthetics to achieve satisfactory aesthetics in the anterior region despite being more expensive. Ideal occlusion tends to be more easily achieved by cemented prosthesis as it avoids prosthetics screws and the formation of crown holes, despite the contributions of correct planning followed by the analysis of static and in motion occlusions. **Conclusion**: each retention method has its advantages and disadvantages. Therefore,the best method is the one that best fits the characteristics and needs of each patient.

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INTRODUCTION

The number of the older population is growing in Brazil.[1] In this context, health professionals must contribute to the provision of education and prevention programs in oral health, as edentulism is still seen as a normal consequence of aging, not of lack of care, leading to caries and periodontal diseases, complications that most contribute to the loss of dental elements. [2]

However, partial or total loss of dental elements not only affects the older populations but also the Brazilian adult population. In a study Medeiros *et al*. found a prevalence of 91% of edentulism between 64 adults aged between 35 and 44 years, in the municipality of Bayeux, Paraíba. Prevalence was measured independently of social classes or conditions of access to the dentist for periodic preventive measures. But most of them reported only reaching out for professional help when in need for extractions and orthodontic treatments, rather than preventive care. [3]

Osseointegrated implants were developed to recover the smile, the phonation and the masticatory capacity of patients partially or totally edentulous.[4] Currently, immediate implants prevent patients from reaching these conditions. Osseointegration was proven by Per Ingvar Bränemark, in 1969, when using titanium implants after one decade of studies about it. The material showed biocompatibility, resistance and low corrosive potential compared to others previously used such as aluminum, copper, chrome, vanadium.[5]

Logically, the discovery has contributed to the development of screwed prostheses by Bränemark in the same decade.[6] Then came the cemented prostheses.[7] Each case must be carefully analyzed for correct indication. In addition, the range of cementing agents, as well as of abutments and screws has been generating questionings regarding the type of prosthesis that confers minor complications and greater durability.[8]

Faced with the success of dental implants, proven in the literature,[9] in 2013, the Accreditation Commission Dental required the inclusion, at graduation in Brazil, of dental implants as another treatment option for patients. [10] This fact tends to increase the access of patients to this modality of treatment.

Hence, this article aims to review the literature of in vitro or in vivo studies of the past seven years on the mechanical, biological, aesthetic and occlusal properties, and the cost of the screw and cement-retained prostheses and to identify the aspects that might promote greater longevity and economicity by considering the patient's clinical framework.

Study design

Electronic searches between 2012 and 2018 were conducted using the *U.S National Library of Meidicine/ National Institutes of Health* search portal (PubMed) and made available free of charge by the Coordination for the Improvement of Higher Education Personnel (CAPES). The searched terms were "screw-retained implant crowns", "screwed implant crowns"; "cement-retained implant crowns", "cemented implant crowns"; limited to the *text words* field. The search strategy used was (screw-retained implant crowns AND cement-retained implant crowns); (screw-retained implant crowns AND cemented implant crowns); (screwed implant crowns AND cement-retained implant crowns); (screwed implant crowns AND cemented implant crowns). A 10-year publication filter was applied. It was verified by one review author (VCFLF) if titles and abstracts of the studies identified through the research strategy were appropriate to the objectives of this study and followed the selection criteria. The studies were selected according to the following criteria:

- Publication date between 2012 and 2018 to ensure that all the data considered in this study are contemporary.
- Publication in English;
- *In vitro* or *in vivo* studies (case, randomized and comparatives) in humans;
- Study of systematic review/meta-analysis, to expand the number of articles.

Synthesis of data

Initially, 188 references were retrieved from PubMed. After the application of a 10-year post-publication limit, 150 papers remained, and based on the inclusion and exclusion criteria, 59 studies from PubMed made available free of charge by CAPES were selected. Following a full reading of the papers, 25 were included in this study. Articles and books outside this search methodology were used to compose the introduction.

Summary of the findings

With the discovery of osseointegration through titanium implants, thanks to biocompatibilities of this material, by Bränemark at the end of 1960, the partial or total rehabilitation of edentulous people became possible by means of retained implant prostheses, providing a long-lasting treatment to patients. [5]

According to the literary review, mechanical complications were more incident among users of single screwed prostheses, such as retention loss or passivity, regardless of the type of screw (conventional or lateral).[11-14]

Shadid and Sadaga [15] corroborate with these findings,

stating that screwed protheses tend to suffer from losses in passive adaptation because of its own architecture, as they need a screw to attach the abutment to the implant and another one to retain the crown on the abutment. Prosthetic misfit can also occur when there is tension during repair completion. The lack of space between the abutment and the crown and the contact between metals without the use of a cementing agent makes it necessary to ensure the accurateness of prosthetic fit, which is difficult to achieve. And although gold screws may confer better clenching and retention than those manufactured with titanium, small changes in the metal-to-metal interface are produced in each adjustment, increasing stress concentration on implants and the chances of screw loosening, fracture of prosthetic components or of the prosthesis itself, implant loss; inflammation of peri-implant tissues and bone resorption.

Because of the lack of access to the screw hole in the occlusal surface of cemented prosthesis, the implant tends to suffer from loads in the axial direction instead of the lateral one, which reduces the risk of screw loosening and fracture or failure of prosthetics components.[15,16] The same occurs due to the direct contact between metal and ceramic in cemented-retained prostheses. In other words, there is no need to fill the access hole with resin or composite, which suffer from greater wear from friction. Although the methyl methacrylate-based resin with 4-metacriloxietil has been shown to be superior to the photopolymerized nano-hybrid composite resin concerning integrity maintenance of the surface of the access hole filled with screwed prostheses, there is need to analyze investigations with more than 12 months long to confirm such findings.[17] The lateral screws installed in the palatal face of crowns of screwed prostheses did not reduce the occurrence of loose screws,[14] In this sense, on the one hand, Kosmin *et al*. [18] showed the possibility of combining the use of both forms of prosthetic retention. Screwed prostheses can receive lower hardness cementation to confer further strengthening against unwanted movements, adaptation loss and screw loosening, besides maintaining reversibility and providing best aesthetic results.

On the other hand, Vigolo *et al*. [19] found no mechanical complications between protheses retained by the two methods for 10 years, suggesting the importance of planning and using components that confer adequate adjustment to implants for each type of prosthetic retention, such as golden UCLA in screwed prostheses or customized with noble alloys in the cement-retained ones and golden screws in both.

The presence of an access hole to the screw in the occlusal surface of screwed restorations significantly reduces ceramic resistance to fractures, as the head of the screw or the restorative composite material with which part of the hole is covered occupies from 50% to 66% of intercuspal distance.[20] In other words, there is still a minimum width of ceramics around the opening access to the screw that increases the chances of fracture. In addition, the remaining hole indicates the interruption of structural continuity of ceramics, leading to changes on its center positioning through which the material choses during the sintering process. Thus, ceramics behavior becomes more sensitive when in screw-retained protheses than in the cemented ones. However, Ferreiroa *et al*. [21] verified similar occurrence of ceramic fracture of cemented and screwed crowns. Thus, it is possible to use both types of retention in the region of the mandibular molar according to the authors The evaluation of the static and in motion occlusion, i.e. considering the changes in the patient's occlusal contacts can help avoiding ceramic fracture.[19]

When it comes to biological complications, we observed more problems of this nature among cemented prostheses when compared to the screwed ones.[11,20,21] For this reason, Sailer *et al*. [11] raised the possibility of screwed protheses becoming the most popular even if both methods had presented high survival rate, which makes it harder for us to define the best option. In addition, other studies [19,23,24,25] did not observe significant difference between retention methods when considering marginal bone resorption, as they are within normal standards, which reinforces the importance of complete subgingival removal of cement excesses to prevent peri-implantitis and marginal bone loss.

For that, we recommend the conduction of an X-Ray, a less invasive procedure, to identify the amount of cement excess as sometimes it is not possible to detect it only through clinical examination.[26] But when the excess of difficult detection due to overlapping or facial implant surface location, we recommend the use of radiographic tracking markers. It was not possible to determine the most adequate method for excess removal when choosing between dental endoscope or open flap debridement. Therefore, the choice depends on the professional's familiarity with the technique.[27] Cementing with the use of a device built based on the internal structure of the crown [27] or the duplication of the abutment for cement flow control [28] are welcome, as they can reduce cement excess after crown fixation, both being procedures

of quick and easy implementation and low cost.

When it comes to reversibility, several authors point it out as an important feature of screwed prostheses.[15, 16] Manawar *et al*. [16] highlighed the risk of fracture of cemented prostheses during cement removal for cleaning or repairing, Alavarez-Arenal *et al*.,[29] mentioned cements of glass ionomer, compomer and urethane-based resin as possible alternatives in these cases, despite these being resistant. It is worth to remember that abutments made of titanium are generally used in cemented prostheses.[27] In order to solve this situation, cases where the margin of the prosthesis on the implant is located in a place of difficult access, it would be more indicated screwed protheses.

Regarding the manufacturing cost, cemented prostheses require less laboratory complexity when compared to the screwed ones, and have less prosthetic components, such as the abutment to be attached to the implant and the crown that goes over it. Prosthesis cementing occurs in the abutment, dispensing prosthetic screws to attach the abutment to the prosthesis.[16,31] Costs also vary depending on the alloy material (e.g. gold) used for making cemented prosthesis, as they allow the use of abutments of titanium, ceramics/zirconia, of lower cost compared to the UCLA gold.[30]

When it comes to aesthetics, there are no pre-angulated abutments with less than 17 degrees to correct certain axial divergencies in implants with screwed prostheses.[16] Thus, cemented protheses are more adequate to solve the inclination problem and avoid the vestibular installation of implants, which can negatively affect aesthetics, considering the cement covers the crown/abutment interface, dismissing the use of a second screw (prosthetic) and the formation of an access hole in the crown.[28,31]

Cemented protheses also allow the use of ceramics/zirconia abutments in cases of higher aesthetic need, such as cases involving the anterior region or when the gingival biotype is thin or has irregular contours. These abutments, as the ones made of titanium, can be pre-angulated and allow the correction of up to 25 degrees of inclination. The UCLA abutment in gold can also be used, as in screwed prostheses. Aesthetic is conferred to it after coverage with calcinable plastic, but it presents limited angulation, not tolerating divergences in implant axes; while conic abutments, used in screwed prostheses, allow the correction of bigger divergencies, despite not being adequate for patients with less than two millimeters of thickness of soft tissues for aesthetic reasons.[30]

To fill access holes to the screw, we recommend state of the art resins whose greater opacity can block light and hide the shadow of the screw that confers a grayish color to the screwed prosthesis. But its effectiveness is not 100% guaranteed in the long term. Coloration did not change significantly when using the photopolymerized nano-hybrid composite resin and methyl methacrylate-based resin with 4-metacriloxietil (M4M).[17] However, the duration of the investigation was only of 12 months. So, the ceramic plug was presented to work as a cover for the screw access hole sinalized and conditioned with hydrofluoric acid, allowing the integration between the filling resin and the crown ceramics.[32]

Professionals find it easier to use cemented prostheses for its greater accessibility even in the posterior regions, dismissing the use of small screwdrivers for screw placing and adjusting.[28,32] This way, Assaf and Gharbyeh [33] have recommended cemented prostheses in cases that the access hole to the screw is more vestibularly located or when the access to the posterior region hinder the conduction of adjustments.

It is hard to achieve ideal occlusion when using screwed protheses because of divergences in implant axes. Vigolo *et al*. [19] showed the manufacturing of abutments for cemented protheses aimed at correcting angulations of 12 degrees in implant axes. Manawar *et al*. [16] mentioned the lack of pre-angulated abutments with less than 17 degrees for screwed prostheses.

Still according to the authors, it is necessary to place the implant at the central tanks to generate a load at the axial direction of posterior teeth. But in screwed prostheses, the hole of access to the screw occupies 50% of occlusal table of molars and more than 50% of the occlusal table of premolars.[16] Furthermore, the restorative material used to cover the hole of access to the screw, just like composite resin, can suffer from deformation caused by occlusal loads, modifying the surface of the filled hole [14] and the direction of these loads, distributing them as lateral forces instead of axial ones to the implant, which increases the chance of fracture in the crown or prosthetic components.[15] Lateral or transverse TS screws can be used, but do not prevent the mechanical complications in screwed protheses, also being limited to patients with good access to the palatal region. Hence, the cemented prostheses may have more advantages, ensuring the stability of occlusal contacts for many years.[14,16,34]

Table 1: *- Summary of advantages and disadvantages of cemented and screwed protheses*

	Screwed Prostheses	Cemented Prostheses
Mechanical Complications	Losses in passive adaptation; Risk of screw loosening; Risk of fracture or failure of prosthetics components; Access hole to the screw reduces ceramic resistance.	Loads in the axial direction instead of the lateral one;Lower risk of screw loosening, fracture or failure of prosthetics components.
Biological Complications	No risk of excess cement causes peri-implantitis and marginal bone loss.	Importance of complete subgingival removal of cement excesses.
Reversibility	Possibility of unscrewing the crown at any time.	Difficulty of removing the crown in case of fracture of the prosthesis Cost
Cost	Greater laboratory complexity.	Less prosthetic components.
Aesthetic	Need to use a higher opacity resin that blocks light and hides the shadow of the screw that confers a grayish color to the screwed prosthesis	Cemented protheses are more adequate to solve the inclination problem; Dismiss the use of a second screw (prosthetic) and the formation of an access hole in the crown.
Ideal Oclusal	Divergences in implant axes become hard to achieve ideal occlusion.	Manufacturing of abutments for cemented protheses aimed at correcting angulations of 12 degrees in implant axes.

CONCLUSION

According to this review of the literature, it was possible to conclude that:

• Screwed prostheses may present further complications, such as screw loosening, ceramic fracture; while the cemented ones can present biological complications such as peri-implantitis and marginal bone resorption. However, this can be avoided with proper care during planning.

• Screwed prostheses are more advantageous when it comes to reversibility, but the cemented ones can also be reversible with the use of cements of smaller tenacity, such as glass ionomer, compomer and urethane-based resin. The bond between cement and titanium not necessarily hinders its removal. The use of less resistant cement in cementeded prostheses can improve retention without impairing reversibility.

• Cemented prostheses are more aesthetic as they dismiss the use of screws in the abutment-crown interface, besides having the possibility of employing aesthetic abutments made of ceramics/zirconia in the anterior region. For screwed protheses, there are some options for the correction of vestibularized installation of implants in the anterior region, such as UCLA calcinable abutments and the manufacturing of a metal substructure with ceramics vestibular face. Despite the existence of aesthetics resin to fill the access hole, the ceramic plug shows better results.

• Cemented protheses have lower manufacturing cost because of the inferior amount of used components. The use of abutments of titanium, of lower cost, is one of the most common. Screwed protheses, however, require gold abutments for better retention, which are way more expensive.

• Cemented protheses contribute to the achievement of ideal occlusion, as screws of the abutment/crown interface of screwed protheses can not correct all the discrepancies in implant axis. TS transversal screws can be a solution, but there is still need for a good palatal access.

• There is no retention method better than the other. Each one of them has its own advantages and disadvantages. Choice must be made based on the professional's preference and experience and on the patient's the needs.

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