

## Screwed and cement implant prosthesis: current clinical considerations

## Prótese sobre implante cimentada e parafusada: considerações clínicas atuais

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### ABSTRACT

**Introduction:** There is no consensus as to which cemented or screwed retention system is best to avoid bone loss around the implant from a fixed implant-supported restoration. **Objective:** To evaluate the prosthesis retention systems on screw and cemented implants, regarding: bone loss, survival and failure rate, biological complications and microbiological analysis. **Methods:** A search was made for scientific articles that contemplated the subject through the databases Pubmed and SciELO, without period restriction. The titles, abstracts and then access to the full text has been verified. **Results:** It was found that excess cement may play an important role in the development of peri-implant disease. Technical failures are most seen in prosthesis retained by screws, and biological complications in cemented crowns. The success rate for both restraint systems is high, and retention-independent implant prosthesis treatment provides predictability. **Conclusion:** The appropriate retention system for the patient depends on several factors, including indication, advantages and disadvantages, retention provided, aesthetics and clinical performance.

**Indexing terms:** Dental implants. Dental prosthesis, implant-supported. Dental prosthesis retention. Dental prosthesis design.

### RESUMO

**Introdução:** Não há consenso sobre qual sistema de retenção, cimentado ou parafusado, é o melhor para evitar perda óssea ao redor do implante de uma restauração fixa implanto-suportada. **Objetivo:** Avaliar os sistemas de retenção de próteses sobre implantes parafusados e cimentados, quanto aos fatores: perda óssea, taxa de sobrevivência e de falhas, complicações biológicas e análises microbiológicas. **Métodos:** Foi realizada uma busca por artigos científicos que contemplassem o tema através das bases de dados Pubmed e SciELO, sem restrição de período. Os títulos, resumos e em seguida o acesso ao texto completo foi verificado. **Resultados:** Foi observado que o excesso de cimento pode desempenhar um papel importante no desenvolvimento da doença peri-implantar. Falhas

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How to cite this article

Costa BP, Freire JCP, Melo WOS, Figueirêdo Júnior EC, Ribeiro ED, Pereira JV. Screwed and cement implant prosthesis: current clinical considerations. RGO, Rev Gaúch Odontol. 2021;69:e20210057. <http://dx.doi.org/10.1590/1981-863720210005720200082>

técnicas são mais observadas em próteses retidas por parafusos e complicações biológicas em coroas cimentadas. A taxa de sucesso para os dois sistemas de retenção é alta e o tratamento com próteses sobre implantes independente da retenção oferece previsibilidade ao caso. Conclusão: O sistema de retenção apropriado para o paciente depende de diversos fatores, incluindo a indicação, vantagens e desvantagens, retenção fornecida, estética e desempenho clínico.

**Termos de indexação:** Implantes dentários. Prótese fixa sobre implante. Retenção em prótese dentária. Planejamento de prótese dentária.

## INTRODUCTION

Implant-supported fixed dental prostheses represent a well-established treatment option that has evolved to become a standard of care in dentistry in recent decades. Osseointegration has advanced through progress in implant surface technology, refining surgical techniques, improved interface stability between implants, abutments and dental prostheses [1]. Implant prosthesis survival rate is high [2–5].

A fixed dental prosthesis can be attached to an endosseous implant via cementation (using a temporary or definitive cement) on an implant abutment that is screwed to the implant, or directly into the implant via screw retention. The clinical decision as to which patient restraint system best fits depends on several factors. These factors include individual indication, advantages and disadvantages of different retention mechanisms, aesthetics and clinical performance, including failures and complications. The decision may depend on the technical feasibility [1].

Biological complication rates such as bone loss have been more frequently reported in cemented prostheses, while screwed ones have more technical complications [1,6]. A current meta-analysis indicated that cemented fixed prostheses showed less marginal bone loss than screwed prostheses. However, the small difference between the mean values may not show clinical significance [7]. There is no consensus on which retention system, cemented or screwed, is best for preventing bone loss around the implant.

Thus, the present literature review compared prosthetic retention systems on screwed and cemented implants. The following factors were analyzed: bone loss, survival and failure rate, biological complications and microbiological analyzes.

## METHODS

We conducted a literature review based on research of scientific articles obtained from the databases:

Pubmed and SciELO, with the following keywords: Dental Implants, Implant-supported dental prosthesis, Dental Retention, dental design.

Studies comparing cemented and screw-retained fixed crown retention systems on implants and including factors such as bone loss, survival and failure rate, biological complications and microbiological analyzes were included. There was no period restriction for the search. Scientific articles that did not fit the proposed theme and inclusion criteria were excluded. The search process was performed in three phases through title search, abstract analysis and identification of full text articles.

Were obtained 9.892 two studies through the search strategy with the descriptors. After selection according to the inclusion criteria, ten scientific articles were selected for the present literature review.

## RESULTS AND DISCUSSION

The scientific studies included in this literature review are shown in the Table 1.

In a retrospective clinical study, short implants that supported a unitary crown in the premolar region were selected. Fifty-one crowns were cemented and 77 were retained by screw. No failure events were recorded for implants and prostheses. Distal marginal bone loss was significantly lower in screw-retained crowns than in cemented crowns. Marginal bone loss  $\geq 2$  mm as a biological complication was more frequent in cemented crowns. Two screw loosening events were observed in screwed restorations. These events were resolved by screw readjustment [6].

Patients with two to three implants containing cemented or screwed restorations and five years of follow-up were selected for microbiological analysis in the peri-implant grooves. The final sample consisted of 18 patients (55 implants) in the cemented group and 22 patients (46 implants) in the screwed group. Regarding the prevalence of positive bacterial sites, significant differences between

**Table 1.** Scientific studies on screw and cemented implant prostheses.

Author/year	Type of studie	Objective	Sample	Conclusion
Anitua & Alkhraisat [6]	Retrospective clinical study	Observing marginal bone loss	Short implants in the premolar region	The distal marginal bone loss was less in the screwed crowns than in the cemented ones. Marginal bone loss $\geq 2$ mm was more frequent in cemented crowns.
Penarrocha-Oltra et al. [8]	Retrospective clinical study	Verifying bacterial colonization in cemented and screwed prostheses	55 cemented and 46 screwed prostheses	Cemented prostheses had significantly higher bacterial loads in the peri-implant groove, but with significantly lower bacterial loads in the inner portion of the implant connection
Anchieta et al. [2]	Retrospective clinical study	To evaluate the probability of survival of fixed prostheses on cemented and screwed implants of three units	168 implants with internal hexagon connection	The cemented groups had a higher probability of survival than the screwed groups.
Millen et al. [9]	Systematic review with meta-analysis	Identify the influence of the type of fixed prosthesis on the rates of biological and technical complications in the context of screw retention versus cement retention	–	Screwed prostheses showed a tendency towards significantly more technical complications than cemented prostheses with single crowns and fixed partial prostheses. Full-arch prostheses, cantilever prostheses and “all fixed prostheses” had significantly higher complication rates than single crowns
Crespi et al. [3]	Eight-year follow-up clinical survey	Observe the survival and success of restorations with screwed and cemented implants	Screwed and cemented prosthetic structures.	The survival rate was 99.27%. The two groups did not show statistically significant differences in bone loss
Wittnben et al. [5]	Searching electronic databases	Evaluate survival results and complications of screwed and cemented fixed reconstructions	Screwed and cemented fixed reconstructions supported on dental implants	Screwed reconstructions showed less technical and biological complications in general.
Vigolo et al. [10]	10-year randomized controlled trial	To analyze the clinical behavior of peri-implant marginal bone and peri-implant soft tissue	Implant-retained, cemented and screw-retained single crowns	There was no evidence of a significant difference in the clinical behavior of peri-implant marginal bone or peri-implant soft tissue between groups
Nissan et al. [11]	10-year randomized controlled trial	Analyze the clinical behavior of peri-implant marginal bone and peri-implant soft tissues	Cemented and screwed single crowns retained by implants	There was no evidence of a significant difference in the clinical behavior of peri-implant marginal bone or peri-implant soft tissue between groups.
Zarone et al. [12]	In vitro studie	Obtain the fracture resistance of screwed and cemented single porcelain crowns.	Single screwed and cemented porcelain crowns	Screwed crowns showed microcracks at the level of occlusal access to the screw and extensive fractures throughout the thickness of the ceramic. Cemented restorations were affected by less extensive paramarginal fractures of porcelain.
Vigolo et al. [13]	Prospective, controlled clinical study	Compare cemented and screwed single crowns over implants for 4 years after prosthetic rehabilitation	Cemented and screwed single crowns over implants	There was no evidence of behavior different from peri-implant marginal bone and peri-implant soft tissue when cemented or screwed unitary restorations on implants were provided

groups were found only for *Tannerella forsythia*, 8.7 times more frequent in the peri-implant grooves of cemented than screwed prostheses. The contamination index values showed higher permeability to most microbes in the cemented group. Differences were found between the two prosthetic retention methods: the cemented group had significantly higher bacterial loads in the peri-implant sulcus, but with significantly lower bacterial loads in the internal portion of the implant connection [8].

Anchieta et al. [2] evaluated the probability of survival of cemented and screwed three-unit fixed implant prostheses using regular versus switching platforms). One hundred and sixty-eight implants with hexagon internal connection were selected for this study according to the horizontal implant/abutment configuration and retention method and divided into four groups: cemented regular platform; or retained by screw; cemented switching platform; or screwed. Cemented groups had a higher probability of survival than screwed groups. The survival probability of the cemented group was higher than the screwed one, regardless of the horizontal implant-abutment configuration [2].

In a systematic review with meta-analysis, Millen et al. [9] identified the influence of the fixed prosthesis type on the rates of biological and technical complications in the context of screw retention versus cement retention. Screwed prostheses showed a tendency to significantly more technical complications than cemented prostheses with single crowns and fixed partial prostheses. For "all fixed prostheses" (unreported or unknown type of prosthesis), significantly fewer biological and technical complications with screw retention were observed. Multivariate analysis revealed a significantly higher incidence of technical complications with cemented prostheses. Full arch prostheses, cantilever prostheses and "all fixed prostheses" had significantly higher complication rates than single crowns [9].

In an eight-year follow-up clinical study, the survival and success of restorations with immediately loaded screwed and cemented implants were observed. Patients who were scheduled for full arch ceramic restorations were randomly divided into two groups: in one group, prosthetic structures were screwed into implants, and in the second group, the structures were cemented into abutments. After an 8-year follow-up period, a survival rate of 99.27% was reported for all implants. Final cemented and screwed ceramic restorations are highly predictable, biocompatible

and aesthetically pleasing, and the two groups did not show statistically significant differences in bone loss [3].

An electronic database survey to evaluate survival outcomes and reported complications of screw-fixed and cemented fixed dental implant reconstructions found no statistical difference between reconstructions for survival or failure rates. Screwed reconstructions presented fewer technical and biological complications in general. There were no statistically significant differences between failure rates of different types of reconstruction or abutment materials (titanium, gold, ceramic). The failure rate of cemented reconstructions was not influenced by the choice of a specific cement, although the type of cement influenced the retention loss [5].

In a 10-year randomized controlled trial, Vigolo et al. [10] compared the long-term clinical outcome of implant-retained cemented and screwed unit crowns; the sample consisted of eighteen patients. The results indicated that there was no evidence of a significant difference in the clinical behavior of peri-implant marginal bone or peri-implant soft tissue between implant restorations of cemented or screwed single teeth.

To compare the long-term outcome and complications of cemented versus screw-retained implant restorations in partially edentulous patients, follow-up (up to 15 years) and examinations were performed every 6 months in the first year and every 12 months in the subsequent years. The following parameters were evaluated and recorded at each visit: ceramic fracture, abutment screw loosening, metal frame fracture, gingival index, and marginal bone loss. Ceramic fracture was significantly higher in screwed restorations ( $38\% \pm 0.3\%$ ) than in cemented restorations ( $4\% \pm 0.1\%$ ). Loosening of the abutment screw was statistically more frequent in screwed restorations ( $32\% \pm 0.3\%$ ) than in cemented restorations ( $9\% \pm 0.2\%$ ). There were no metal structure fractures in any type of restoration. The mean Gingival Index scores were statistically higher for screwed restorations ( $0.48 \pm 0.5$ ) than for cemented restorations. The long-term outcome of implant-supported cemented restorations was superior to that of both clinically and biologically screwed restorations [10].

Zarone et al. [12] evaluated in vitro the fracture resistance of screwed and cemented porcelain unit crowns. Screwed crowns showed microcracks at the occlusal access to the screw and extensive fractures across the thickness

of the ceramic. Cemented restorations were affected by smaller porcelain paramarginal fractures. A stronger implant-prosthetic connection was noted in the group of cemented restorations than in screw-retained single crowns.

Vigolo et al. [13] conducted a prospective controlled clinical study to compare cemented and screwed implant crowns for 4 years after prosthetic rehabilitation. Peri-implant marginal bone levels, peri-implant soft tissue parameters and prosthetic complications were verified. All 24 implants survived, resulting in a cumulative implant success rate of 100%. Statistical analysis did not reveal significant differences between the two groups regarding peri-implant marginal bone levels and soft tissue parameters. The data obtained from this study suggested that the choice of cementation versus screw retention for single-tooth implant restorations is probably not based on clinical outcomes, but seems to be based primarily on clinician preference. Results indicate that there was no evidence of different behavior of peri-implant marginal bone and peri-implant soft tissue when cemented or screwed unitary restorations were provided for this patient population [11].

Survival rate is high according to studies analyzed [2,3,5,11]. The choice of retention type (cemented or retained screw) may not have a crucial influence on overall prosthesis survival, but may be responsible for the development of a complication [1].

Biological complication rates (bone loss > 2 mm) were higher in cemented prostheses, while screwed ones had more technical complications [1,8]. In contrast, some research has not found significant differences in bone loss for different types of retention [3,4,11].

While the cemented group had significantly higher bacterial loads in the peri-implant sulcus in the study by Penarocha-Oltra et al. [8] and Nissan et al. [11] observed a higher gingival index in screw-retained prostheses. Cement remnants pose a significant risk of peri-implant infection and should be removed. The presence of excess cement plays an important role in the development of peri-implant disease [4]. In the development of a biological complication, host factors and biological interactions with the materials used play an important role [12,13].

Unsealed reconstructions - in the event of a prosthesis adjustment error or excess cement - can cause a micro-gap and a small gap between the abutment and

structure providing an anaerobic system for biofilm growth [14].

The results of this literature review corroborate that screw-retained prostheses have a higher rate of ceramic fractures than cemented ones [10,15].

Parametric analysis with finite element evaluation of cemented and screwed prosthesis-implant connections provides a biomechanical and engineering comparison between two different types of implant-supported prostheses, concluding that a screw-implanted prosthesis appears to be less durable and tends to fracture more than a cemented prosthesis. As with other types of dental implants, the screwed connection appears to be the weak link in the chain, resulting in fatigue-related values and consequent prosthesis failure. In fact, thanks to their surface uniformity, cemented retained dentures offer a better and more homogeneous distribution of load forces compared to screwed prostheses [16].

Ceramic fracture is most likely in screw-retained dental prostheses. The presence of an access opening for a pillar screw disrupts the integrity of the structure, tension can be produced during tightening of the assembly. Manipulations with a screwdriver can cause stress peaks laterally in the access opening region. Resin fracture has been seen especially in total fixed dentures. Screw retention is advantageous in the case of a technical complication as it can be repaired more easily compared to cement retention. Technical complications are more reported in cemented than screwed prostheses according to the selected studies [5,9].

An important clinical decision remains the choice of the type of connection - cement or retained screw. This connection may have an impact on the prognosis of general reconstruction. Which retention system is appropriate for the patient depends on a number of factors including indication, advantages and disadvantages, 'retention' provided, aesthetics and clinical performance (failures and complications) [1].

## CONCLUSIONS

It has been found that excess cement may play an important role in the development of peri-implant disease. Technical failures are more commonly observed in screw-retained prostheses and biological complications in cemented crowns. The success rate for both retention

systems is high, and retention-independent implant prosthesis treatment provides case predictability. Professionals need to be aware of the individual clinical characteristics of each case when choosing this system.

## Collaborators

BP COSTA and JCP FREIRE participated in the elaboration of the work, in the conception of the theme and in the writing. WOS MELO and EC FIGUEIRÊDO JÚNIOR participated in the scientific search of the articles and in the selection of researches for the literature review. ED RIBEIRO and JV PEREIRA guided and corrected the work.

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Received on: 30/5/2020

Final version resubmitted on: 29/9/2020

Approved on: 15/10/2020