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Clinical management of dental cements

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Abstract
Introduction: There is a current demand in restorative dentistry to accurately know the appropriate indication and use for each of the dental cements that are available on the market to carry out a correct clinical management of these materials.
Objective: To present current information about the factors to consider in the clinical management of dental cements, including the use of conventional cements vs resin cements, cementation in the esthetic zone, post-cementation excess and cementation in implantology.
Methodology: A search of articles published in the last 5 years was carried out, using the electronic databases PubMed, Google Scholar and Scopus. Keywords used for the search include “dental cements”, “cement systems”, “luting cement”, “adhesive cement”.
Results: Resin cements usually have better physical and aesthetic properties than conventional cements, however, we can find similar results in the last-mentioned cements. The choice of a dental cement becomes relevant when luting in the aesthetic area since it can help us improve and maintain the color of our metal-free restoration. Post-cementation residues will encourage an inflammatory response from the periodontal or peri-implant tissues. Currently, the extraoral cementation procedure is preferred in implant dentistry, but if not possible to perform, it is preferable to place the prosthetic components as coronally as possible, avoiding leaving cement residues.
Conclusion: Aesthetic standards are complemented using resin cements where the clinician must discern between which one to use (dual curing or light-curing) depending on the area or type of prosthesis to be luted. However, conventional cements remain a viable option for provisional or definitive cementation of other various types of restorations.

Keywords: Dental cements, adhesive cements, cemented restorations, dual curing

1. Introduction
There is a current demand in restorative dentistry to accurately know the appropriate indication for each of the dental cements that are available on the market to carry out correct clinical management of these materials [1].
Dental cements are materials used to create an adhesive bond between a restoration and a prepared tooth. Its main functions are to hold the restoration in place for a considerable period of time and create a seal between the tooth-restoration gap [2]. Currently, they are generally divided between conventional cements and resin cements [3].
Among the properties that dental cements have are biocompatibility with dental tissues, caries inhibition, resistance to microleakage, mechanical properties such as hardness, solubility, water absorption, adhesion, wear resistance, color stability, radiopacity, thickness or viscosity of the cement film and working and setting times[2] while other authors add its profitability and aesthetic outcomes [4].
Depending on the given clinical situation, there are occasions where conventional cementing agents are used, in order to facilitate the recoverability of the crown, however, when a higher strength at solubility in the cementing agent is sought, it is better to use resin cements [5], as well as it is important to highlight the technique with which they are used in order to minimize the residues of cementing agents in the periodontal or peri-implant tissues [6].

Due to the wide range of clinical situations that can arise when deciding to use a particular dental cement, it is necessary to expose and consider the most common situations for which we would use a certain cementing agent, presenting its correct management, thus expanding the clinician's vision when choosing this dental material. This is why the objective of this literature review is to analyze the factors to consider in the clinical management of dental cements, including conventional cements vs resin cements, cementation in the aesthetic zone, post-cementation residues and cementation in implantology.

2. Materials and Methods

A search of recent articles was carried out using the electronic database PubMed, SCOPUS and Google Scholar emphasizing in articles published within the last 5 years. Abstracts and full texts were identified and evaluated using PRISMA guidelines. Articles that included information about use of resin cements vs. conventional cements, cementation in the aesthetic zone, post-cementation waste and cementation in implantology. The implementation of the search was using Boolean operators AND, OR, NOT. The keywords used for the search include “dental cements”, “cement systems”, “luting cement”, “adhesive cement”.

3. Results and Discussion

3.1 Use of conventional cements vs resin cements

There’s a classification of dental cements, the acid-base cements, better known as conventional cements, and the resin-based cements [2].

Restorations that are metal-free can be cemented with both types of cements, however, there is a preference to use resin cements for this type of restorations due to the enhancement of the esthetics in the final restoration as well as their better physical properties. However, conventional cements are a good option when looking for resistance to compression and dissolution in water as well as when looking for film thickness [7].

In comparison, various studies have shown that the cementation of restorations based on lithium disilicate have presented better adhesion forces with resin cements, unlike conventional cements, for example, zinc phosphate [8].

On the other hand, research has found that in tooth preparations with a 12º convergence angle, zinc phosphate cement presents a better internal adaptation to the preparation than the RelyX Unicem resin cement, however the latter in turn presented better adaptation to the preparation than a conventional glass ionomer cement (Ketac Cem) [9]. Another study found that, to cement metal copings, it was preferable to have a lower degree of convergence of the preparation (6º) and the consistency of the cement to be more fluid [10].

Studies show that bioactive cements decrease more effectively demineralization than resin-based cements, specifically those containing bioavailable calcium, functional monomer, and glass ionomer formulations [11]. For example, one of the conventional cementing agents that has been perfected over the years is the glass ionomer cement (GIC) to which apatite nanocrystals have been incorporated to improve the mechanical properties of this material and the release of fluoride and its bioactivity [12]. However, a study that sought to evaluate the retention of different cements in paste-paste format for zirconia crowns, found that a resin-modified glass ionomer cement did not present sufficient retention values, unlike the other cements in the study, which were conventional and resin cements [13].

Resin cements usually have better physical and esthetic properties than conventional cements, however, if we find ourselves in situations where there are favorable degrees of convergence on the tooth preparation, thus obtaining mechanical retention, we can find similar or superior retention results with conventional cements.

3.2 Cementation in the esthetic zone

The management of cementation in the esthetic zone is extremely interesting since with the choice of the luting agent, we can change the final color of the restoration [14, 15], however, studies have investigated that resin cements, even if they are free of tertiary amine, tend to discolor, which could have an aesthetic influence, especially if the process is carried out in the anterior area [16]. Also if restoring with high translucency lithium disilicate ceramics, these tend to present greater color change as the restoration ages, which is why transparent shade resin cements are recommended [17].

Many of the cements used in the aesthetic zone only use photopolymerization to eliminate the use of tertiary amine, which has been found to lead to discoloration of the cement [16], however one of the main concerns is the conversion degree of polymerization that the cement can obtain by only photocuring, which has been found to be directly related to the thickness of the ceramic and the type of photocurable resin cement that was used. Using a longer curing time will improve the conversion degree of polymerization of the cement [18, 19], however, if the restoration is more than 1.5 mm thick, it may be preferable to use a dual cement to ensure proper polymerization since the increase in thickness negatively affects the degree of conversion of the cements [20, 21, 22].

There are luting agents that contain a new photoinitiator derived from dibenzoyl germanium (Variolink Esthetic) which has shown much better color stability unlike conventional resinous cements [1].

Some studies have found that the change in color may not be linked merely to the cementing agent, but to the restorative material, as was the case in Elter's *et al*. study in 2021, which, at the end of its tests, found that all of its samples had not experienced color change regardless of whether photocurable or dual cement was used, with the exception of the group that used Lava Ultimate [23] although other studies assure that both the aging of the cements and the restoration causes the translucency to be lost and the material to be eventually more opaque [24].

One study evaluated the thermal aging of different restorations cemented with resin-based cements, which were all considered clinically unacceptable [25].

The choice of cement becomes relevant when performing the cementing procedure in the esthetic area since it can help us to improve and maintain the color of the metal-free restorations. However, the aging of the restoration and cement will eventually dull the color of the restoration.

3.3 Post-Cementation Residues

Rapidly progressing complications associated with cement residues that were left around restorations have been reported [2].

When cementing zirconia restorations, one study found that despite removing all possible cement residues in the cementation process, all restorations still had some residues, mostly in restorations that used self-adhesive resin cements [26].

There are systems that can be used to facilitate the detection

of residual cement, such as fluorescence laser which has been found to have a specificity of 100% and 96.67% [27], as well as the Vector system which has found that, although similar values of reduction in probing depth and dentobacterial plaque accumulation have been obtained compared to the use of manual instruments, an improvement in the gingival index has been observed using this system [28].

It is important to consider that at the time the excess cement is being cleaned, we must ensure to not remove the material where it should be (at the restoration-tooth gap), however studies show that it is not a factor that the clinician has to worry much about, and it is more relevant to pay attention to the type of cement to use for the case [29]. Other authors who studied the best way to remove residual cement compared the technique of removing the cement with a curette after performing an initial light cure or removing it using cotton swabs. They found that there is no significant difference in the technique and that a small amount always remained adhered to the tooth surface[30], however, other authors found that using a brushing technique to remove residual cement helps to ensure less bacterial colonization compared to other techniques to remove residual cement [31]. Regarding the removal of residues in temporary cements, for example based on zinc oxide, the best results have been found with the ultrasonic cleaning method [32].

Post-cementation residues will encourage an inflammatory response from the periodontal or peri-implant tissues. There are a variety of devices and techniques that will help the clinician facilitate the removal of these surpluses, which will improve the prognosis of the rehabilitated teeth and their surrounding tissues.

3.4 Cementation in Implantology

Various studies have shown that excess cement in the peri-implant tissues can be a cause of the development of peri-implantitis, which is why it is recommended that the margin of the restoration be at a gingival level, to facilitate hygiene in the area, as well as perform control appointments after the restoration is placed to observe that the tissues are healthy [33].

It has also been found that the composition of the dental cement can affect the success of the implant since they can affect some cell lines that act in osseointegration, finding that only bioceramic cements achieved a viability greater than 70% for all the cell lines studied[34], as well as another study found that resin cements, resin-modified glass ionomer cements and zinc oxide-eugenol cements show moderate to severe toxicity against gingival fibroblasts and pre-osteoblasts, which shows the importance of the choice of cementing material for implant survival [35].

Post-cementation residues are related to biological pathologies related to the implant. One of the techniques that can be used is extraoral cementation, which can greatly reduce cement residues [6], however, if you choose to perform intraoral cementation, the amount of post-cementation waste may be linked to the cement used, which is why studies have found that a calcium aluminate glass ionomer cement can be a wise choice as a cementing agent for cement-retained implant-supported restorations [36].

Other studies have evaluated the amount of residual cement in implants depending on the height of the collar of the definitive restoration, and have found that the greater this height, the greater the generation of waste [37]. Similarly, other studies suggest that the margin of the prosthetic attachments manufactured in CAD/CAM are located as coronally as possible, in order to minimize the amount of cement residues [37], as well as three different extraoral cementation techniques have been studied where it was found that the analogous technique with “pattern resin” produces the least amount of cement extruded to the peri-implant tissues [39].

On the other hand, about luting to the prosthetic components of the implant, in situations where cementation has to be performed on a zirconia-based implant, it has been found that cements containing the functional monomer MDP have a more predictable chemical adhesion to the zirconia [40]. On the other hand, when the objective of the clinical operator in the implant treatment is the recoverability of the crown, it is safe to use conventional cements with a modified technique, such as zinc phosphate cement [41].

In the rehabilitation of dental implants, the procedure of extraoral cementation and screwing of the intraoral prosthesis is currently preferred. However, if intraoral cementing procedures are performed, it is preferable to place all prosthetic components as coronally as possible to facilitate the removal procedure of excess cementing and prevent peri-implantitis from developing.

4. Conclusion

There is a wide range of dental cements and their choice and management will depend on the clinical situation. The esthetic standards are complemented by the use of resin cements, which in turn the clinician has to discern between which cement to use, whether dual-cured or light-polymerizable, depending on the area where the cementation will be performed and the thickness of the restoration.

Likewise, conventional cements continue to be a viable option for provisional or definitive cementing of various types of restorations. The elimination or maximum reduction of post-cementation residues is in the hands of the clinician, thus improving the long-term prognosis of implant and tooth-supported restorations.

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