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Comparison of Different Implant-Supported Fixed Restoration Types: A Literature Review

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Abstract

Background: The screw and cement-retained implant-supported fixed prosthesis has advantages and disadvantages. However, current research comparing the properties of these restorations is lacking. **Objectives:** The aim of the study was to review the current literature on the properties of screw and cement retained implant supported restorations. **Material and Methods:** A literature search was conducted from January 2010 to December 2023, using 4 databases to identify research. Sixty studies met the inclusion criteria. **Results:** Cement-retained restorations have some advantages. Passive fit is easier to achieve, and eliminating occlusal access holes can help with the occlusal adjustments in cemented restorations. However, in case residual cement is not completely removed after cementation, it becomes a predisposing factor for peri-implantitis and marginal bone loss. The main advantage of screw-retained restorations is the retrievability, which can be achieved without damaging the restoration or fixture. However, in case the implant is not ideally positioned, the location of the screw access channel can negatively affect the aesthetics of the screw-retained restorations. In addition, porcelain fracture and screw loosening occur more frequently in screw-retained restoration. **Conclusions:** Screw and cement-retained restorations display specific advantages and disadvantages; nevertheless, the selection of one retention method over another depends on the clinical scenario.

Keywords

Implant-Supported Restorations, Retention, Cementation, Screw

1. Introduction

Implant therapy is a highly predictable treatment option due to the for edentulous,

partially edentulous, and single tooth restorations. Recently, a number of questions have been raised regarding the materials and designs of implants and implant abutments to obtain the highest clinical success rates. The evolution of implant designs, surfaces, and dental materials has enhanced the potential for achieving successful and stable treatment outcomes. The restorative connection can be classified as either cement-retained or screw-retained. The choice of connection for final restoration using a screw-retained abutment is a significant decision in implant prosthodontics and has been a controversial issue [1] [2].

Ease of fabrication and cost, aesthetics, retrievability, occlusion, retention, passivity of fit, clinical performance, and complications, including peri-implant tissue inflammation, marginal bone loss, porcelain fracture, and screw loosening and fracture, are evaluated during implant prosthesis type selection. The purpose of this literature review was to offer a comprehensive analysis of the properties of cement- and screw-retained restorations, as well as guiding clinicians in selecting the appropriate type of prosthesis for specific clinical scenarios [1] [2].

2. Materials and Methods

Different databases, including Scopus, Google Scholar, PubMed, and the Web of Science (WOS) were used to search for relevant literature from January 2010 to December 2023.

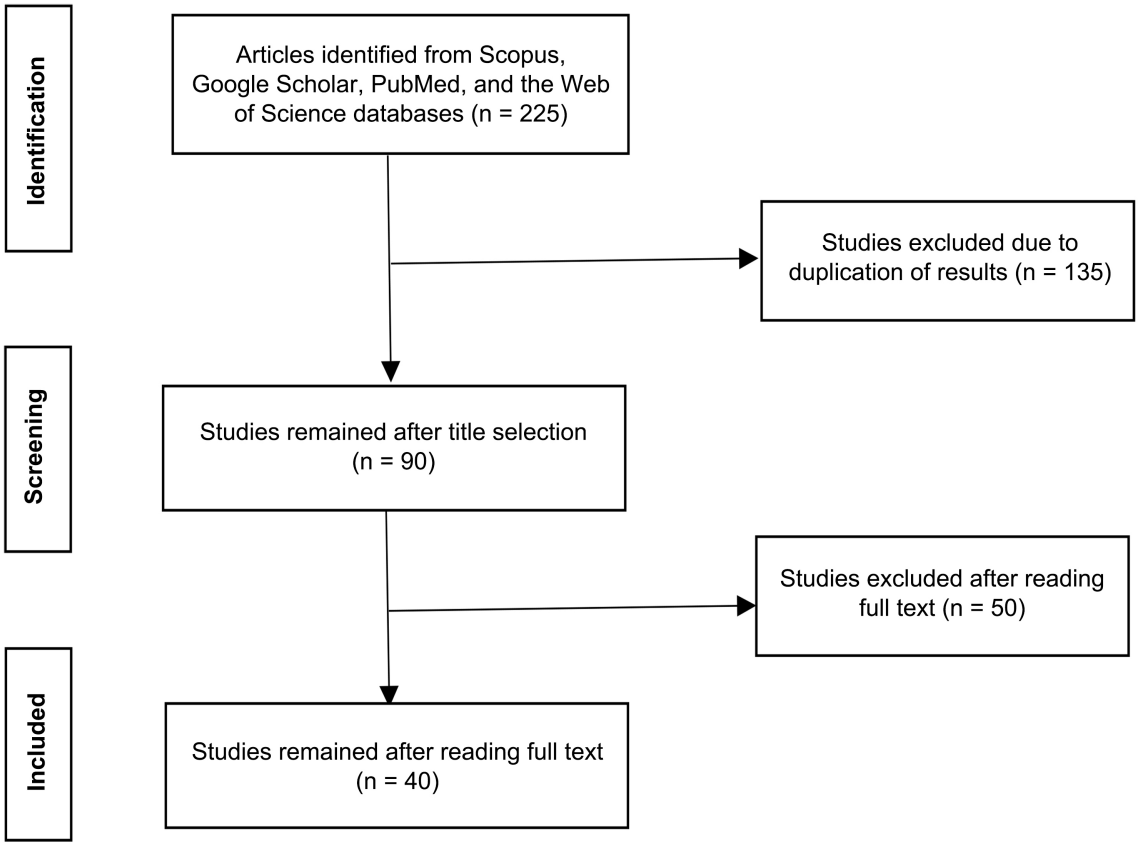

Figure 1. Flow chart of the research.

The following search terms were used: "Screw versus cement retained fixed implant-supported restorations"; "Screw versus cement-retained fixed implant supported restorations"; "Screw-retained crown"; "Cement-retained crown"; "Implant-supported crown"; "Screw retrievable"; "Implant prosthetics aesthetics"; "Screw access channel implant crown"; "Implant crown production"; "Implant crown fabrication"; "Implant crown cost"; "Implant prosthetics passive fit"; "Implant prosthetics complication"; "Retention implant crown"; "Implant prosthetics occlusion"; And "screw retained access channel".

Studies in English, having a prospective or retrospective design mentioning properties of the screw and cement-retained prostheses, were included. The studies related to implant surgery were excluded.

A total of 225 articles were found in the electronic databases from the initial search. 135 articles were removed due to duplication of results. Only 40 publications remained after 50 of them were eliminated due to the title and abstract (**Figure 1**).

3. Results

Screw and cement-retained restorations differed regarding ease of fabrication and cost, aesthetics, retrievability, occlusion, retention, passivity of fit, clinical performance, and complications, including peri-implant tissue inflammation, marginal bone loss, porcelain fracture, and screw loosening and fracture [1] [2].

3.1. Production and Cost

Cemented restorations are easier to fabricate because they can be produced using traditional laboratory methods, and additional technologies and materials are unnecessary [3]. The cost of fabricating a screw-in restoration is generally 1.5 to 2 times higher due to the extra steps and materials required, including impression transfers, analogs, and screws. However, the potential costs of restoring the cemented restoration in the event of a biological or technical complication must be weighed against the high cost of the screw-retained restoration, which enables predictable retrievability [4].

3.2. Aesthetics

In case the implant is optimally positioned, predictable aesthetics can be achieved with both types of prosthesis. In instances where the implant is not ideally positioned so that the screw access appears in the esthetic zone, a cement-retained repair is an ideal approach. In case the implant is not ideally positioned due to any anatomical limitation, the location of the screw access channel in the aesthetic zone can negatively affect the aesthetics of the screw-retained restorations [5].

To address these issues, angled or customized abutments can be used to move the screw access channel away from the aesthetic zone. Even in the posterior region, the occlusal restoration may still undermine aesthetics due to the underlying dark metal oxide. The combination of an opaquer and durable composite can

cover underlying dark metal oxide and result in a notable aesthetic enhancement of the implant restoration [6].

3.3. Retrievability

The main advantage of screw-retained restorations is the retrievability attainable which can be achieved without damaging the restoration. In screw-retained restorations, the prosthodontic components can be modified, the screws can be refastened, and the fractured components can be easily repaired with reduced time and cost compared to cement-retained restorations [7].

Various techniques have been introduced to help in the removal of cement-retained restorations. One solution presented involves the integration of a screw into the cemented restoration, which can subsequently be utilized to elevate the restoration off the abutment if activated. This approach enhances aesthetics and occlusion relative to traditional screw retention, as the access hole can be optimally positioned irrespective of the implant's location. Subsequently, by introducing a removal driver into the guide hole via the access hole and rotating it to produce shear stress, the cement will easily disintegrate. Thus, the restoration will be easily removed [8].

Alternative procedures proposed primarily focus on locating the screw access hole to facilitate access to the abutment screw with minimal future harm. These procedures are accomplished by utilizing an abutment screw access guide or by placing a precisely defined tiny ceramic stain on the occlusal surface. The integration of both screw- and cement-retained restorations inside a single prosthesis was achieved by incorporating at least one screw retainer among a sequence of cement retainers [9].

Provisional cement is sometimes utilized as the definitive cement for cement-retained restorations to facilitate future removal. However, poor physical properties of provisional cements can lead to patient dissatisfaction [10].

Despite various methods proposed to enhance the retrievability of cement-retained restorations, screw retention is increasingly essential in extensive cases requiring greater maintenance; thus, cantilevered prostheses and full arch implant reconstructions are optimally restored using screw retention [10] [11].

3.4. Retention

Retention is one of the most critical factors affecting the longevity of implant-supported prostheses. Abutment taper, height and number of axial walls, abutment platform, and surface roughness affect retention [12].

Abutment height directly influences the retention of a restoration. An increase in abutment height significantly increases retention. A minimum abutment height of 5 mm is required to ensure the retention of a cement-retained restoration. When the interarch space is restricted, a screw-retained restoration should be used [13]. A clinical study with a follow-up of 6 months to 3 years found that most of the cement failures occurred in dentures manufactured in the posterior region

with 3 to 4-mm abutment heights [14].

Abutment taper significantly affects the amount of retention in cement-supported restorations. Machined abutments often have a 6° taper, based on the ideal taper concept [15]. There is probably a linear relationship between the abutment's taper and retention. Retention decreases as the taper of the abutment increases (e.g., from 4˚ to 8˚) [16].

The abutment's surface roughness is also a factor affecting retention. Methods such as air abrasion and roughening with diamond burs have been used to roughen the abutment. Air abrasion resulted in greater retention than untreated surfaces and surfaces abraded with diamond burs for almost all bonding agents. However, if implant abutments can achieve the ideal 6˚ taper and ideal abutment height, there is usually no need to roughen the abutment surface to improve retention [17] [18].

Another method that can increase restoration retention is the use of permanent cements. Zinc phosphate, zinc polycarboxylate, glass ionomer, and self-adhesive resin cement have been preferred for the permanent cementation of implant-supported restorations [17] [19]. Permanent cement can provide 2.5 to 4.7 times more retention than temporary cement [20].

3.5. Occlusion

Optimal and stable occlusal contacts can be achieved with cement-retained restorations due to the absence of occlusal screw access holes. The screw access holes will obstruct protrusive and lateral movements, which could compromise anterior guidance [21].

Screw-retained restorations with a screw access hole exceeding 50% of the intercuspal distance necessitate the application of an occlusal restorative material that covers the screw access channel. These materials are susceptible to wear under functional forces, resulting in diminished preservation of occlusal contacts compared to cement-retained restorations with an intact occlusal surface. Furthermore, the challenge of establishing firm occlusal contacts with screw-retained restorations, due to the presence of restorative material, will influence the orientation of occlusal loads, resulting in lateral forces that are transmitting to the implant rather than axial forces [2] [22].

3.6. Passivity

Passivity is a preferred characteristic of restorations since it minimizes stress on the bone and implant. A deficiency in passivity has been associated with biological and prosthetic issues [23].

Researchers state that cement-retained restorations are more likely to obtain passive fit compared to a screw-retained restoration. Cement-retained restorations' increased passivity depends on the idea that the cement may function as a shock absorber, that reduces stress on the implant-abutment structure and the bone. Conversely, a screw-retained prosthesis without a proper fit may induce

significant stress on the prosthesis, bone, and implant [24].

It is noteworthy that most prostheses do not achieve a completely passive fit; nonetheless, they remain functional, indicating a degree of biological tolerance for misalignment. Various factors, such as impression material and porcelain shrinkage, as well as dental stone and investment material expansion, contribute to distortion, making it challenging to achieve a perfect passive fit [25].

3.7. Accessibility

The placement of screw-retained restorations in the posterior region presents more obstacles than that of cement-retained restorations, primarily because of the complexities in managing screws and screwdrivers. This problem is evident in instances of restricted mouth opening. Cement-retained restorations are preferred by many dentists in patients with limited mouth opening [13].

3.8. Provisional Restorations

Provisional restorations are crucial in the aesthetic arena for replacing missing teeth and contouring the soft tissue to enhance the emergency profile. In the posterior region, the advantages of a provisional restoration include not only the contouring of soft tissue but also an enhanced evaluation of the results and anticipation of potential complications with the definitive restoration. If sufficient material thickness cannot be achieved with the provisional, it may be needed to adjust the opposing tooth before the definitive impression to create a larger interocclusal space [13].

Cement-retained provisionals are simpler to fabricate than screw-retained provisionals, as they replicate processes used with natural teeth. However, an important disadvantage is the potential for excessive cement, which may lead to tissue irritation. This is a significant issue, especially in instances of immediate loading, where excessive cement at the surgical site can affect healing and implant osseointegration negatively [26].

Screw-retained provisionals provide the benefit over cement-retained provisionals by allowing them to be screwed into the impression, thereby providing supplementary information to the technician about the contour. In addition, the screw-retained restorations' machined surfaces are better than cement margins. Consequently, screw-retained provisional restorations are more preferable in immediate loading scenarios [27].

3.9. Complications

3.9.1. Peri-Implant Tissue Inflammation

Cement-retained restorations have many advantages but also significant disadvantages. If residual cement is not completely removed after cementation, it predisposes to peri-implantitis because the rough surface of the cement promotes bacterial plaque retention. Opportunistic pathogenic bacteria have been found in the cement, leading to the development of peri-implantitis. When the health of

peri-implant tissues between two different restorations was compared, a higher plaque index and gingival bleeding were observed in cemented-retained prostheses cases [28] [29].

The peri-implant tissue response to residual cement ranges in severity from gingival bleeding, exudation, and attachment loss to implant failure. The excess cement was associated with 81% of peri-implantitis cases. When excess cement was removed, endoscopic signs of peri-implantitis were detected in most cases [30]. In case the restoration margin is located more than 3 mm subgingivally, undetected residual cement is a serious risk for peri-implantitis. Cement remnants can only be successfully removed when the margin is located supragingivally [31].

Cementation of implant-supported fixed partial dentures requires the removal of residual cement using an instrument with a scraping motion. This may cause scratches on the surface and may not be sufficient to remove all residual cement. One study found that a stainless steel instrument left the deepest scratches on abutment surfaces, while plastic scrapers caused the least damage. Rough implant surfaces can increase plaque accumulation and negatively affect soft tissue health [32] [33].

3.9.2. Porcelain Fracture

Due to the absence of a periodontal ligament, implant crowns experience increased forces. Consequently, porcelain fracture is a commonly observed complication. Porcelain fracture is commonly observed in screw-retained restorations as the screw access hole can disrupt the porcelain structure continuity by leaving unsupported porcelain [34]. In screw-retained restorations, fracture rates of veneer ceramic are higher than cemented restorations because the continuity of the ceramic is disrupted by the screw access hole [35].

3.9.3. Screw Loosening and Fracture

The main disadvantage of screw-retained restorations is the loosening of screws during function. The prevalence of screw loosening or fractures depends on the types of restorations. Typically, it occurs more often with single tooth implant restorations, restorations in the molar region, and extended cantilevers. The primary issue with classic hexagonal implant systems has been significantly reduced by introducing advanced implant systems, such as those including internal connections with geometric locks, larger abutments, and innovative screw designs [36] [37].

To avoid screw loosening, several approaches have been documented, including the anti-rotational feature, direct mechanical interlock, modifications in torque-controlling systems and screw design, and utilizing torque wrenches. A restoration that is held by both cement and screws is referred to as the "Combination Implant Crown". The authors state that the system provides the benefits of aesthetics, retrievability, and anti-rotational characteristics through octagonal engagement [38] [39].

Detrimental factors such as excursive, off-axis centric, interproximal, and cantilever contacts must be carefully assessed and removed wherever feasible. A more favorable distribution of forces is achieved when the implant is positioned parallel to the occlusal forces. Moreover, a nonpassive framework enhances the probability of screw loosening. Fatigue failure of the screw is another noteworthy complication. The narrow diameter of the screw securing the screw-retained prosthesis compromises its strength. In contrast, the elements of the cement-retained restoration are mainly large, so fatigue failure is less frequent [13].

A summary of the comparison of the screw and cement-retained restorations' properties is presented in **Table 1**.

Table 1. Comparison of the properties of the screw and cement-retained restorations.

	Cement-retained	Screw-retained
Production	Easy to produce	Needs additional steps
Cost	Less expensive	More expensive
Aesthetics	Easily achievable in the ideal implant position	This cannot be easily achieved if the implant position is not ideal
Retrievability	Possible but may cause unpredictable results	Easy
Retention	Abutment height should be more than 5 mm	Possible even if the abutment height is less than 4 mm
Occlusion	Can be better controlled	Occlusal interferences may occur
Passivity	Easier to achieve	Difficult to achieve
Accessibility	Easier to access	More difficult to access
Provisional Restorations	Easier to manufacture, however, excess cement is a problem	Better tissue response can be obtained
Complications	More prone to porcelain fracture A, screw fractures and loosening	More prone to peri-implant tissue inflammation due to the excess cement

4. Discussion

This review emphasizes the importance and potential uses of screw and cement-retained implant restoration. The investigations demonstrated the importance of both treatment approaches for restoring lost teeth. The assessment determined that treatment selection should be based on choosing suitable treatment options for the specific dental disease.

Screw-retained restorations are favorable in some clinical circumstances. For large, full-arch implant restorations, screw retention is favored due to the higher incidence of problems associated with these long-span prostheses compared to

short-span alternatives. Cantilevered prostheses are favored to be screw-retained, as maintenance of restorative components or implants is likely required throughout the lifespan of these prostheses [4]. Screw-retained restorations are also recommended for patients at high risk of gingival recession. Also, patients who are expected to lose their teeth in the near future. In instances where technical or biological obstacles are expected, screw-retained restorations are favored to facilitate the straightforward removal of the restorations, thus addressing the issues effectively. As they can be easily removed and modified without damaging the restorations [7].

In scenarios with limited interocclusal space, achieving sufficient retention for cement-retained restorations may be unfeasible, as these restorations necessitate a vertical dimension of at least 5 mm to ensure retention and resistance form. Nonetheless, a minimum interocclusal distance of 4 mm is enough for the application of screw-retained restorations. Screw-retained restorations can be attached directly to implants without using intermediary abutment, hence minimizing the interocclusal space required for these restorations [13] [14].

In circumstances where the elimination of excessive cement is challenging when the final restorative margin extends more than 3 mm subgingivally, the application of a screw-retained restoration is required. A custom abutment for cement retention, having a restorative margin following the gingival curves, can also be used as an alternative [30] [31].

Cement-retained restorations are preferable for single-unit, and short-span cases, presuming that the implant table size, quantity of implants, and abutment screw torque are optimized. The only possible reason for utilizing screw retention in such circumstances would be if the implant's long axis is located too palatally in the anterior region. In cases of restoring misaligned implants, if the angle between the implant axis and the retaining screw of the angled abutment is less than 17˚, traditional screw retention of the restoration with pre-machined abutments is impractical [4] [13].

Cases with narrow-diameter crowns, when the screw access can compromise the crown's integrity, are preferably restored with cement-retained crowns. Cement-retained restorations are preferred in clinical scenarios where the occlusal surface may be adversely affected in terms of aesthetics or occlusal stability due to a restorative substance sealing the screw access [2] [4].

5. Conclusion

There is no absolute superiority between the retention types of implant-supported restorations. Many factors, such as cost, aesthetics, occlusion, retention, passivity, provisionalization, accessibility, possible complications, and retrievability, should be taken into consideration when determining the type of retention to be used.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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