Review Article

Screw versus Cement Retained Prosthesis: A Review

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Abstract

Selection of the best suited prosthesis type for replacement of missing teeth depends on a thorough patient's examination, age, bone support, abutment teeth, systemic health and socio-economic state. The treatment modalities as of date ranges from removable or fixed partial denture to implants supported prosthesis, each one presented with its own pros and cons. Due to the high success rates of dental implants, their prevalence in the rehabilitation of partially dentate and edentulous patients is growing year by year. This article provides an overview of the different characteristics of screw- and cement-retained implant restorations, and how they may influence the esthetics, retrievability, retention, passivity, occlusion, accessibility, cost, and provisional restorations. An understanding of their properties will help the clinician in selecting the ideal prosthesis for each clinical case while promoting final esthetic outcomes.

Keyword: Abutment teeth, Implants, Partial denture, Missing teeth, Speech

Introduction:

Treatment modalities for replacement of missing teeth have truly evolved from ancient transplant to modern day implants, the third dentition. Implants have revolutionized dental practice and have helped overcome many of the limitations encountered with conventional fixed or removable prosthesis and is considered as an aesthetic, functional restoration with long-term predictability.

Abutment-borne prosthesis could be cement retained similar to conventional crown and bridge prosthesis or screw retained, however, there is significant controversy in the literature regarding cement-retained versus screw-retained prosthesis. Thus there are three primary methods for attaching the final prosthesis to the endosseous implant include[1] screwing the restoration to the implant directly[2] screwing an abutment into the implant and attaching the restoration to the abutment with either additional screws or cement[3] cementing the abutment directly into the implant before attaching the crown.[2]

This article provides an overview of the different characteristics of screw- and cement-retained implant restorations, and how they may influence the esthetics, retrievability, retention, passivity, occlusion, accessibility, cost, and provisional restorations. Problems and complications frequently encountered are discussed and treatment solutions are proposed.

Screw Retained Prosthesis:[1, 3]

Screw retention in implant-supported prosthesis was developed in response to the need for retrievability even though occlusion and esthetics were sacrificed. There is almost no tolerance for error in the fabrication of the screw retained prosthesis because a direct metal-to-metal connection exists and there are many variables not in the control of the doctor.

Truly passive screw-retained prostheses are virtually impossible to fabricate and was described by Branemark to be ideally in the 10micro m range. Because there is no space between the coping and implant abutment, the casting must fit completely passively and accurately before the screw is inserted with a considerable torque force.

Elastic deformation of impression materials (dimensional shrinkage), stone expansion, analog variance, wax distortion, investment expansion, metal shrinkage, acrylic or porcelain shrinkage, soldering inaccuracies, and the manufacturer variance of a number of implant components all interrelate in the fabrication of completely passive superstructures, yet they are all not controlled directly by the dentist.

As knowledge increased and techniques advanced, implant survival rates moved rapidly from the 50% to the 90% range. With this dramatic increase in survival rates, the issue of retrievability has not been as clinically significant. However, the use of screw retention, with all of its disadvantages, still remains the retention mechanism of choice for many practitioners as evidenced by the product lines of implant manufacturers

Lewis SG, Llamas D, Avera S et al (1992) reviewed the UCLA abutment and found that after treatment of 46 patients with 118 UCLA abutments, the 4-year success rates were 95.8%.[2]

The screws most commonly used are the gold and the titanium. Retention is obtained by the friction resistance developed between the internal threads of the implant and those of the fastening screw.

Implant Screw Mechanics:[1, 3, 5]

To understand how screws can be safely kept tight, one must understand why screws become loose. When two parts are tightened together by a screw, this unit is called a screw joint. The screw loosens only if outside forces trying to separate the parts are greater than the force keeping them together. Forces attempting to disengage the parts are called joint separating forces. The force keeping the parts together can be called the clamping force.

Binon PP et al indicated that there was a direct correlation between hexagonal misfit and screw joint loosening. A rotational misfit of less than 2 degrees provided the most stable and predictable screw joint.[4]

There are two primary factors involved in keeping implant screws tight:
1) Maximize clamping force and
2) Minimize joint separating forces.

Application to Dental Implants:

It will probably not be possible to connect multiple implant prosthesis with a completely passive fit in the clinical situation. These misfits leave microgaps and as a result, a precise interface between the casting and the implant is not achieved.

The clinical reality is that implant restorations are continually subjected to joint - separating forces. These forces include the following:

- ✓ Excursive contacts.
- ✓ Off axis centric contacts.
- ✓ Angled abutments.
- ✓ Wide occlusal table.
- ✓ Interproximal contacts.
- ✓ Cantilever contacts,
- ✓ Non-passive framework

The aim is to minimize clinical joint-separating forces. Precision implant placement and treatment planning are the first critical step in maintaining tight implant screws. Occlusion plays a primary role in keeping implant screws tight.

Molar implant screws should stay tight if the centric contacts can be directed in the long axis of the screw and excursive contacts eliminated. Placing one wide-diameter implant or two small-diameter implants can reduce the moment arm applying force to the screw.

Screw-loosening incidents increase if a non-passive framework is forced to fit by tightening screws. The original framework applies joint-separating forces to the system because it attempts to return to its original position. All non-passive frameworks should be sectioned and soldered to ensure passive fit.

Maximize Clinical Resistance To Joint Separation:

One possible advantage of the anti-rotational features used in dental implants is the resistance they provide to joint-separating forces. This occurrence also explains why shorter hexes can allow some screws to loosen under heavy loads. If fit is accurate and occlusion properly adjusted, longer, more intimately engaging features should be a clinical advantage.

Fulcrums or pivot points are created at the edge where the abutment or casting meets the head of the implant. In a situation where there is an accurate fit between the head of the implant and the abutment, a continuum of pivot points is created around the circumference. In this stable situation, vertical occlusal forces that occur over the prosthetic head of the implant will produce vertical loading and will not stress the screw or cause screw loosening.

Vogel RE, Davliakos JP et al (2002) conducted a prospective multicenter study to evaluate the abutment and prosthesis screw joint stability of Spline dental implants (Center pulse Dental Division, Carlsbad, California) over 5 years of post-loading clinical follow-up and suggested that Spline dental implants might provide a stable prosthetic connection in partially edentulous cases.[6]

Binon PP et al investigated the design and engineering characteristics of the Spline dental implants and the results of the mechanical test indicated that this implant/abutment complex was mechanically stable, had minimal rotational movement, improved resistance to screw loosening, and good interface fidelity.[7]

The major clinical procedures necessary for tight implant screws are summarized as follows:

1) Implants placed parallel to the forces of occlusion.
2) Restorations designed to minimize cantilever lengths.
3) Occlusion adjusted to direct forces in the long axis of the implant.
4) Eliminate posterior working and balancing contacts.
5) Centralize centric contacts.
6) Share anterior guidance with natural teeth.
7) Anti-rotational feature engaged for single teeth.
8) Components tightened with 20 to 30N-cm of torque (unless specified by manufacture.
9) Passively fitting frameworks for multiple unit restorations.

If screw loosening occurs, all potential contributing causes should be evaluated. The clinician should pay particular attention to occlusal forces oblique to the implant long axis. Interproximal contacts and framework fit should also be evaluated. Implant screws should not be maximally tightened until joint-separating forces are controlled

Cement Retained Prosthesis:[1, 8, 9]

Many current implant systems have abutments onto which superstructures can be cemented. In cemented implant prosthesis, the metal ceramic fixed partial denture is luted onto a transmucosal abutment, which is connected to the implant. Cemented prostheses may be selected in all-traditional porcelain fused-to-metal applications ranging from single-tooth replacement to full-arch restoration.

Cement-retained prostheses have become, in many cases, the restoration of choice for the treatment of implant patients. This evolution started after a modification of the UCLA abutment, which led to a new philosophy in restorative solutions, i.e. fabrication of customized abutments to overcome esthetic and angulation problems, which implant manufacturers, had not foreseen.

These restorations permit the development of desired occlusal interdigitation, improved esthetics and correct loading characteristics. The abutment preparation design and cementation technique mimics conventional fixed prosthodontic procedures for natural teeth. Moreover, the cement space that exist between the crown and abutment can help compensate for minor discrepancies in the fit of the prosthesis.

The type of cement used is also an important consideration because it affects the retention characteristics of the restoration. It may be desirable to use a type of cement that allows the restoration to be retrieved, so that a superstructure can temporarily be cemented to evaluate the loading of the implant, occlusion, and tissue response.

TYPE OF CEMENT:

The important factor in retention is the type of cement. A wide variety of cements exist with varying degrees of strength. For cement retained implant restorations, the choice of cement is one of the most important factors controlling the amount of retention attained.

Since there is no risk of decay for the abutments, provisional cements can also be used for the cementation of implant restorations, as they are much weaker than the definitive cements and permit retrievability of the restorations. Either Temp-Bond cement or a mixture of Temp-Bond cement and petroleum jelly (reduced strength) can be used to cement implant-supported prosthesis.

A study analyzed the optimal properties of provisional luting cements and the surface treatment of abutments in single implant abutment system and found that tensile bond strength increased by surface treatment with aluminum oxide. Tensile bond strength of provisional luting cements in no surface treatment decreased with the sequence of TempBond NE, TempBond, Cavitec, TempBond with vaseline and no cement.[10]

Another study examined the retentive force of crowns retained on implant abutments with different temporary cements and found that the mechanical properties of the temporary cements, particularly their compressive strength, affected the retention of crowns cemented on implant abutments.[11]

Dudley et al (2008) showed that the retention of cast crown copings cemented to Straumann syn Octa implant abutments with a resin, glass ionomer and temporary cement was significantly affected by cement type but not compressive cyclic loading. Resin cement was the cement of choice for the definitive non-retrievable cementation of cast crown copings to Straumann syn Octa implant abutments out of the three cements tested.[12]

Resin cement is used to cement metal to metal whenever the intent is to permanently retain a coping, abutment, or prosthesis. The properties of resin cement illustrate the greatest compressive and tensile strengths of any current cement, with up to 300 MPa and 45 MPa in compression and tension, respectively. This is especially valuable when custom implant abutments are cemented within the implant body. However, the margin of the abutment is usually subgingival and near the bony crest, making it difficult to reach below the tissue. Excess cement may be left behind, especially when it is as hard as the resin cements and results in inflammation, fistula, and / or bone loss. Hence custom abutments should be designed to be threaded into the implant body.

Yu-Hwa Pan (2005) evaluated the retentive strength of 7 different luting agents on cement-retained implant abutment/analog assemblies. The cements were randomly divided into 7 groups: definitive cements included zinc phosphate cement, Advance, All-Bond 2, Panavia F, and Durelon, while provisional cements included Temp Bond and ImProv. They concluded that All-Bond 2 and Panavia F resin cements had statistically significantly higher values for cement failure loads compared to the other 5 types of cement.[13]

Ga Rey DJ (1994) compared the effects of thermocycling, load-cycling and human blood contamination on the retentive strength of five different cements for luting posts to root-form implants and found that Blood contamination in combination with thermocycling and load-cycling adversely affected the retentive strengths of all of the cements and could be a major cause of abutment failure in dental implants.[14]

Cement Versus Screw-Retained Implant Prostheses:

Advantages And Disadvantages:[15, 16]

If the issue of retrievability is set aside, it is difficult to justify the use of screws to retain prostheses, with the exception of limited abutment height. In areas of limited inter ridge space; a screw is more effective than cement.

Hebel and Gajjar (1997), Guichet (1994) explained that, the screw-retained implant restorations had an advantage of predictable retrievability but demand precise placement of the implant for optimal location of the screw access hole.[15]

Keller (1998), Lindhe (1998) stated that the disadvantages of a screw-retained implant system were numerous. First, there was the problem of a lack of esthetics at the screw access channel, particularly if the channel was cast in metal.[15] Second, if the metal was cut back to hide the nonesthetic metal, porcelain fracture around the screw access channel might occur. Third, screw-retained prostheses generally required both the abutment screws and bridge screws to be tightened using a torque driver to effect preload of the screws. This torquing appeared to have lowered but not eliminated the incidence of screw loosening. Finally, screw-retained systems generally leave a microgap beneath the gingival crest, resulting in chronic gingival inflammation.

Cementation of implant restorations eliminated unesthetic screw access holes. Cemented restorations also had the potential to compensate for any minor dimensional discrepancies in the fit of restorations to abutments, which could contribute to lack of passivity and minor dimensional discrepancies may be compensated for by using cement and cement space.

Cemented prostheses have many substantial advantages. They provide a passive stable environment because they are cemented on well-adapted machined abutments with discrepancies in fit of the castings to the abutments being negated by the grouting action of the cement. Nonpassive frameworks are seated and adjusted by use of routine chair-side clinical procedures and indicating materials. Sectioning and soldering is not a routine procedure as it is for screw retained castings.
The lack of screw holes in cemented prostheses provides a design that enhances the physical strength of porcelain and acrylic resin, resulting in less fracture.

Cement-retained implant prostheses provide easier access to the posterior of the mouth, reduced costs, reduced complexity of components, reduced complexity of laboratory procedures, and reduced chair-side time. In addition, cement-retained prostheses have superior esthetics, which is important from the patient's perspective.

Authors compared the fluids and bacterial penetration in 2 different implant systems, one with cement-retained abutments (CRA) and the other with screw-retained abutments (SRA) and found that CRA implants offered better results relating to fluid and bacterial permeability compared to SRA implants.[16]

Occlusal Concepts: Screws or screw holes in the occlusal surfaces of teeth provide poor esthetics and disrupt the occlusal surfaces. Establishment of ideal occlusal contacts in screw retained prostheses may not be possible, because the screw access hole occupies a significant portion of the occlusal table. To establish proper occlusal contacts, this should be done on composite material which is usually used to cover the screw holes. However, these contacts will not be stable long term, because, as has been documented by **Ekfeldt** and **Oilo,** composite material wears, especially when the opposing restorative material is porcelain. On the contrary, with cement-retained prostheses, ideal occlusal contacts can be established and remain stable over a long period of time.

Axial Loading: The ability to generate vertical or axial loading may be compromised when the choice is made to use screw-retained implant restorations.[17]

Ease of Fabrication and Cost: The fabrication of cement-retained prostheses is easier than that for screw-retained prostheses, because traditional prosthetic techniques are followed and there is no need for special training of the laboratory technicians.

Passivity of the Framework: Cement-retained implant superstructures have the potential for being completely passive. The absence of a screw connecting the superstructure to the abutment or to the implant tends to eliminate the strain that is introduced into the prosthesis/implant system during tightening of this screw.

Esthetics: It can influence the selection of prosthesis type. It is true that the screw access hole is highly unesthetic, but this problem is limited to only the areas of mandibular premolars and molars.

Delivery: For screw-retained restorations, only a radiographic examination is required to verify the precise fit of the prostheses to the implants before proceeding to the final torquing of the fastening screws. However, for cemented restorations, there is a need for careful removal of the cement remnants in addition to the radiographic examination.

Similarly **Vigolo P, Givani A, Majzoub Z et al** (2004) compared the marginal bone levels, soft tissue health and prosthetic complications for cement and screw-retained single-tooth restorations on implants. They concluded that both types give comparable results and the decision to use cement retention or screw retention was primarily one of choice and preference.[18]

Conclusion:

The debate between screw-versus cement-retained implant prostheses has long been discussed but the best type of implant prosthesis remains controversial among practitioners. There are advantages and disadvantages for use of screw retained versus cement retained prosthesis. An understanding of their properties will help the clinician in selecting the ideal prosthesis for each clinical case while promoting final esthetic outcomes Many clinicians would conclude that cement retained crowns are finer for esthetics and occlusion; similarly, many would conclude that a screw retained crowns are a necessity for multiple units requiring retrievability. Individual philosophy plays a huge role, however, and deciding which crown to use is best done on a case by case basis. With the evolving technology and knowledge, an update of the current trends is necessary.

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