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Screw Retained Versus Cement Retained Implant 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. However, longevity of the restoration, both functionally as well as esthetically depends on various factors prevailing in the clinical situation. One such factor of immense importance is the selection of connection between the implant abutment and the final prosthesis. This connection can be screw-retained or cement-retained depending on the clinical situation of the particular case. Although, screw-retained restorations have been successfully used since many years, there has been a shift in paradigm toward cement-retained restorations. This article reviews the various aspects associated with screw-retained and cement retained implant prosthesis.

Keywords: Screw-retained, cement-retained, Dental implants, passivity, retention.

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INTRODUCTION

The ideal goal of modern dentistry is to restore the patient to normal contour, function, comfort, esthetics, speech, and health. A dentist provides this restoration for a living, whether removing caries from a tooth or replacing several teeth. What makes implant dentistry unique is the ability to achieve this ideal goal regardless of the atrophy, disease, or injury of the stomatognathic system.1 More than 90% of interfacing surgical specialty dentists currently provides dental implant treatment routinely in their practices, 90% of prosthodontists restore implants routinely, and more than 78% of general dentists have used implants to support fixed and removable prosthesis.[1] The increased need and use of implant-related treatments result from the combined effect of a number of factors, including the following:

1. An aging population living longer
2. Tooth loss related to age
3. Consequences of fixed prosthesis failure
4. Anatomical consequences of edentulism
5. Poor performance of removable prostheses
6. Consequences of removable partial dentures
7. Predictable long-term results of implant-supported prosthesis
8. Advantages of implant-supported prostheses.[1]

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Screw Retained Prosthesis[2]

Screw retention in implant-supported prosthesis was developed to retrieve the prosthesis easily. There is almost no margin for error in the fabrication of screw retained prosthesis because of direct metal-to-metal connection that exists and many variables are not in control of the dentist. Truly passive screw-retained prostheses are virtually impossible to fabricate and was described by Branemark to be ideally in range of 10 micrometer. Because there is no space between the coping and implant abutment, the casting must fit 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.

Implant Screw Mechanics[2]

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 forces keeping the parts together are called as clamping forces.

Binon PP et al (1996),[3] 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. 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 is possible to connect multiple implant prosthesis with a completely passive fit in the clinical situation. These misfits leave micro-gaps 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.

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 (2002),[4] conducted a prospective multicenter study on spline dental implants and suggested that Spline dental implants might provide a stable prosthetic connection in partially edentulous cases.

Binon PP et al (1996),[3] in their study on design of Spline dental implants find that this implant/abutment complex was mechanically stable, had minimal rotational movement, improved resistance to screw loosening, and good interface fidelity.

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.

Indications[5]

Wittneben J et al. indicated screw retained prosthesis in long-span and cantilevered designs for easier maintenance in order to achieve sufficient retention for compensation of the leverage of extension.

Advantages[1]

Misch explained advantages and disadvantages of screw retained prosthesis

- Easily Retrievable
- Low profile retention
- Limited crown height space
- No cement in soft tissue peri implant area
- Retention even for small dimensions

Disadvantages[1]

- Screw loosening under final prosthesis
- Fracture
- Device not sealed (bacterial growth)
- Non passive castings
- Increased risk of porcelain fracture
- Less esthetic restorations
- Access difficult
- Increased cost

Potential Problems of Screw Retained Prosthesis

- Chronic screw loosening
- Costly
- Time consuming

Chronic Screw Loosening

The screw loosens only if outside forces trying to separate the parts are greater than the force keeping them together.[2]

Force factors[1,6,7]

External forces that act on a screw joint greatly increase the risk of screw loosening. These forces may be called joint separating forces. Therefore the external forces from:

- Parafunction,
- Crown height,
- Masticatory dynamics, and
- Cantilever (offset) length are the factors that can increase dramatically the stress to the implant and the screw joint.

Methods to limit loosening include:

- Preloading the screw
- Screw design
- Screw placement location
- Use of a mechanical torque wrench
- Accurate framework
- Proper component fit
- Sufficient number of implants
- Avoidance of patients with significant parafunction

Passive screw- retained prosthesis[1,8]

Passive screw-retained restorations are more difficult to fabricate than passive cement-retained restorations. When the screw is threaded into position, the superstructure may distort, the implant may move within the bone, or the abutment screw may distort. Greater crestal bone loss has been associated with nonpassive castings.

Factors that influence the fabrication of passive casting material[1,7]

Dimensional Changes

Occurs with addition silicones (0.06%) and poly-ethers (0.1%). Least amount of dimensional change occur with these materials, therefore use of these materials to make the final impression for a screw-retained restoration is strongly suggested. Permanent deformation has been measured as about 3% for polysulfide impression materials.

Metal Casting Shrinkage

Casting a few units together and laser soldering usually provides a more passive casting than casting large section in one piece. When the casting is made in sections, it then may be laser soldered together.

Porcelain Shrinkage

Porcelain shrinkage of about 20% occurs during the firing process and may distort the metal superstructure. Porcelain fracture is the second most common complication.

Angled Abutment

Misch et al showed that angled abutment developed transverse force under occlusal loads in the direction of angled abutment.

According to Asvanund et al (2016),[7] in their study suggested that due to micro movement as a result of functional or parafunctional load, angled abutment implant may play a role in screw loosening due to two factors-

1st factor: greater the joint preload, greater the resistance

2nd factor: lesser off-angle force, lesser stress and strain

Cement Retained Implant Prosthesis[1]

Cement-retained prostheses have become, in many cases, the restoration of choice for the treatment of implant patients. The cemented crown was first introduced for esthetic reasons and to compensate for screw loosening problems encountered with the screw- retained restorations. Cement-retained superstructures fit passively because of the cement layer between the framework and implant abutment.10 The initial disadvantage associated with cemented restorations was the lack of retrievability.

Advantages of Cement Retained Prosthesis

1. **Passive Casting**

   Passive castings represent a considerable advantage for cemented prosthesis because of the gap of approximately 40 micro meter between abutment and prosthesis.

   Five factors to be considered while fabricating cement-retained prosthesis, passively fitting over the abutments:

   Impression procedure,
   Fabrication of the master cast,
   Investing and casting procedures,
   Firing of the porcelain,
   Delivery of the prosthesis8
2. **Axial loading**[1,7,14]

   The ideal occlusion on implant prosthesis is directed over the implant body and is accomplished easily with a cemented prosthesis.
3. **Esthetics and hygiene**[1]

   Esthetics and hygiene is better in cement retained prosthesis.
4. **Occlusal material fracture**

   A decreased incidence of porcelain or acrylic fracture of the prosthesis has been observed with cement retained restorations compared with screw retained prosthesis because the screw hole may increase stress concentration to the restorative material and more often leads to unsupported porcelain.
5. **Access**[1,6,8]

   Access is more easy in cement retained prosthesis.
6. **Fatigue**[1]

   No fatigue failure is seen in cement retainedprosthesis.
7. **Progressive loading**[1,7,14]

Progressive loading can be done in cement retained prosthesis without affecting the retention.

8. **Abutment crown crevice**[1,10]
   A cemented crown seals the crown-abutment connection and impairs bacteria penetration.
9. **Cost and time**[1,8]
   The laboratory cost and time for cement retained restoration is less than screw-retained restoration.
10. **Abutment retention**[8]
    The factors influencing the retention of the cement-retained restoration include taper of the abutment, surface area and height of the abutment, surface texture of the abutment and type of the cement.

Recent Advances

Screw-And Cement-Retained Prosthesi[16]

A screw-and cement-retained implant supported prosthesis (SCRP) is a new concept for an implant restorative system and incorporates the advantage of both the screw and cement retained approaches. The (SCRP) system is composed of specially designed abutments and a cement retained prosthesis with a screw holes on occlusal surfaces.

Fabrication of Screw-and Cement-Retained Prosthesis[17-18]

Prepare the abutment for a screwdriver in position to maintain the screw access channel. Make a wax pattern for the implant crown coping. Cast the pattern using a high noble metal-ceramic gold alloy. Verify the fit of the completed casting intraorally.

Add the ceramic incrementally, keeping the occlusal screw access channel open.

Using the crown as a repositioning device, screw the abutment to the implant. Pass the hexagonal screwdriver through the open screw access channel. Tighten and torque the abutment screw. Cement the crown with definitive cement, such as zinc phosphate, glass ionomer, or resin cement. Close the screw channel with gutta-percha and seal the occlusal surface with a composite after that place it in patient's mouth.

Angulated Screw Channel Abutments[19]

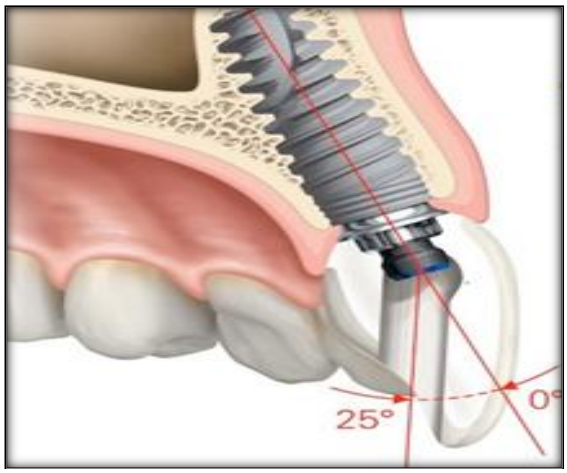
The angulated screw channel (ASC) provides the option to place the screw access hole anywhere between 0° to 25° in a 360° radius. The angulation allows the use of screw-retained restorations in the esthetic zone by avoiding a buccal screw access point and the metal adapter, means it's now possible to use zirconia implant restorations in the posteriors.

Benefits-

Highly predictable retention.

Achieve 35 Ncm torque at any angle.

Improved access for difficult cases.



CONCLUSION

The debate between screw vs cement retained implant prosthesis has long been debatable but the best type of implant prosthesis remains controversial among practitioners. There are advantages and disadvantages for use of screw retained vs 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. Cement retained prosthesis are best for esthetics and occlusion load. Similarly, screw retained prosthesis is a necessity for multiple units requiring retrievability. Individual philosophy plays a huge role, and deciding factor which prosthesis to be given.

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