Screw-Retained Versus Cement-Retained Restorations
Aesthetic Zone Options

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INTRODUCTION

Use of a single-unit implant is a common treatment option in the replacement of a missing tooth in the aesthetic zone. This article focuses on the clinical decision making involved in the selection of the restoration type as related to retention: screw-retained versus cement-retained. The screw-retained restoration is favored due to its ease of retrievability and lack of cement (and the potential for cement induced). The cement-retained restoration is favored due to its aesthetics in situations with angled implants and lower incidence of porcelain failure. Both authors agree that there is not one solution applicable to all clinical scenarios, and that the distinct advantages and disadvantages of each must be taken into consideration in treating the specific case at hand. When properly executed, either restoration can produce a viable and predictable definitive solution for restoring single-unit implants for most situations.

CLINICAL APPROACH 1

Single-Tooth Screw-Retained Restorations
(Dr. Chandur Wadhwani)

Since the introduction of the cement-retained implant restoration almost 25 years ago, there has been an increase in the number of cemented single-unit restorations, with a move away from the screw-retained alternative. Some studies report less than 10% of implant restorations were screw-retained in general practice. Cited disadvantages of screw retention relate to aesthetics, economics, occlusal management, and lack of simplicity. Also, dentists have been using cementation as a means of attachment of prostheses for more than 100 years, so clinicians are familiar with these materials and techniques. However, controversy still exists as to the most appropriate restorative retention means. Although there is no absolute way of restoring the implant, screw retention still has many attributes and, when possible, should be considered the optimal solution.

Clinical Methods

The screw-retained implant restoration can be aesthetic, and the occlusion is easily controlled during the laboratory manufacturing process. The major argument against using screw-retained restorations is dealing with the screw access hole. The 2 clinical cases shared here (Figures 1 to 5) show how this can be readily and predictably achieved, using materials and techniques available to all technicians. These cases also exemplify the ability to fabricate and deliver a screw-retained single crown with high aesthetic value. In both instances, a porcelain plug was fabricated using pressed ceramics, a common procedure used by many dental laboratory teams today. The porcelain plug and the porcelain used on the restoration can

Figure 1. Following impression making and cast fabrication, the cast demonstrates the lingual inclination of the implant.
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be etched easily with hydrofluoric acid, and then silane applied. This allows for resin bonding of the 2 surfaces. Colors are easy to match and resin options are available to provide an indiscernible margin. This technique is similar to that used with porcelain veneers on natural teeth.

Expected Outcomes
Although there is no ideal way to restore an implant, and the aesthetic zone presents with more issues due to angulation of dental implants, screw retention still provides an excellent solution. With more control, fewer materials, and improved peri-implant health, it should be considered the ideal restorative option.

Advantages and Limitations
The screw-retained implant restoration is considered the traditional method of restoring a root-form implant restoration and has been used for more than 50 years. With the more recent advent of single-tooth replacement with dental implants, screw retention can be considered the optimal solution when dealing with the attachment of the abutment and crown to the dental implant. This option has distinct advantages, including the following:

- **Health characteristics for the soft tissues:** A 3-year study was done to compare screw-retained with cement-retained single-implant restorations, finding that the screw-retained restorations provided improved peri-implant soft-tissue health as compared to their cement-retained counterparts. More recent systematic reviews have further confirmed the health benefit of using screw-retained implant restorations. Systematic reviews have also shown there to be fewer technical complications with screw-retained implant supported reconstructions.

- **Minimal number of components:** A single-unit, screw-retained restoration has the benefit of using fewer components, with more controllable delivery of the restoration. The restoration is an integral part of the abutment that connects directly to the implant. Provided that the delivery steps and screw-down forces (torque value) are strictly followed, there should be no issues with occlusion being altered by the introduction of cement, something that can easily occur within a crown system. This also provides for more predictable retention of the crown, and there is no permanent versus provisional retention argument.

- **In tight interocclusal height spaces, no minimum height is required with a cement-retained restoration. There is also no requirement to modify the abutment form to improve retention of the crown, since it is one unit.**

- **A screw-retained restoration provides an easy and predictable means of retrievability of the restoration, with no guesswork for the screw access channel site.** The crown can be readily accessed, usually without damage. The integrity of the crown is therefore maintained, keeping its original design and strength for long-term success. Retrieval is also allows easy and direct access to the implant itself, should the implant need advanced cleaning, evaluation, or repair as a result of peri-implant disease.

- **The ability to remove and replace the restoration easily allows for repair and adjustment (as required), without an increased chance of permanent damage to the abutment during removal, which could have an economic impact for the clinician.**

- **Screw retention is highly desired for provisional restorations, providing better control during the fabrication stages of the restoration.** With fewer materials and fabrication on a cast, there is less chance for contamination of the wound site when fixing the restoration to the implant body. This makes for easy adjustment of the restoration to allow for soft-tissue

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**Figure 2.** (a) A UCLA-type cast abutment with addition of metal and porcelain restoration was fabricated. (b) Crown and porcelain “plug” was etched with hydrofluoric acid, then silane was applied for adhesive bonding.

**Figure 3.** (a) Cast with crown and plug evident. (b) Clinical presentation after delivery and adhesive cementation of the restoration. The plug was almost indistinguishable from the crown, complete control of the occlusion and aesthetics have been achieved.
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support and contouring between appointments, as the retrieval of the provisional is much easier to control.

- Screw-retained crowns can be easily made aesthetic in most sites. Angulation issues, often related to implant placement, can be avoided with well-planned and well-executed surgery. In situations where angulation issues cannot be avoided (e.g., the anterior maxilla), manufacturers have developed novel off-axial implant screw designs. These allow for up to 30° variation from the long axis of the implant.\textsuperscript{14-16} Also, with a screw designed single-tooth implant restoration, there is no separate margin for the abutment-to-crown interface, so aesthetics can be more easily controlled. In situations where the implant depth is shallow, an extra margin for the crown increases the likelihood of a poor aesthetic outcome.
- Delivery of the restoration requires only mechanical screw-in of the crown and sealing off the screw access channel, with no cleanup of other materials around the implant that could damage either the implant surface or leave material within the soft tissues.\textsuperscript{17-18}
- The screw access channel can provide a means of locating and affixing auxiliary radiographic devices to better monitor implant bone health with radiographs, allowing for orthogonal images that give direct comparison to the implant site and surrounding mineralized tissues without distortion of the true attachment site. Studies have shown that comparison of images that are not truly standardized can result in misleading information, with bone changes up to 4.8 mm measured when, in reality, there was no difference at the measurement site.\textsuperscript{19,20}

CLINICAL APPROACH 2
Single-Tooth Cement-Retained Restorations
(\textsuperscript{Dr. Todd Schoenbaum})

The controversy of implant crown retention generally revolves around 4 key factors: durability of the restoration, risk of peri-implantitis, aesthetics, and cost. The situation is further complicated, since the restoration of implants has moved into the mainstream, where clinicians without appropriate training are attempting to restore implants using principles gleaned from the restoration of natural teeth. This has inevitably presented problems, primarily with the use of cemented restorations when cement is left behind (up to 81% of cases of peri-implantitis have been reported to involve excess cement).\textsuperscript{21} However, note that cement is not the only cause of inflammation, and bone loss around implants as such problems can also appear with non-cemented restorations.\textsuperscript{5,7,22,23}

The increasing popularity of cement-retained implant restorations (one large lab reports that more than 80% of its single-unit implant restorations are prescribed as cement-retained) is due to several factors, as follows. The process of delivering a cement-retained restoration is familiar to clinicians; superficially, it seems no different than cementing a restoration on a natural tooth. In some cases, the surgical doctor will even place the definitive abutment and impression components, thus allowing the restoring doctor to avoid handling screws and torque wrenches. Angulation of the implant toward the facial area (more common in the aesthetic zones) creates a relative contraindication to screw-retained restorations due to the screw access channel exiting through the facial, where it is difficult to cover with acceptable long-term aesthetics. Some manufacturers have addressed this problem with the use of special screws and drivers that allow screw retention with up to 25° of angulation correction with a screw access through the palatal.\textsuperscript{16} Traditional cast gold screw-retained restorations have also decreased in popularity due to the screw access channel exiting through the facial, where it is difficult to cover with acceptable long-term aesthetics. Some manufacturers have addressed this problem with the use of special screws and drivers that allow screw retention with up to 25° of angulation correction with a screw access through the palatal.\textsuperscript{16} Traditional cast gold screw-retained restorations have also decreased in popularity due to the increasing (and volatile) cost of gold. Not only do such restorations tend to be more expensive, but the cost of gold presents very real and practical challenges for the restoring clinician. Additionally, with the decreasing number of
proportion lab technician training programs, there are increasingly fewer and fewer dental technicians who have been trained in the fabrication of a cast screw-retained crown.\cite{24}

**Clinical Methods**

Much of the reported problems with residual cement can be managed by strictly following a few simple clinical parameters: cement margins placed no deeper than 1.0 mm subgingivally; presence of a robust and mature band of at least 2 mm of keratinized tissue; coating the emergence profile of the abutment with petroleum jelly; and, the judicious use of a semi-soluble cement.

- **Margin placement:** Margin position is the biggest factor in controlling cement excess. Most implant systems have various stock abutments to choose from, or custom milled options are available. Selection of the abutment is commonly, and mistakenly, done by opting for an abutment that will be significantly below the gingiva in the mid-facial area. This approach is problematic because, in partially edentulous cases, the papilla is usually at least 3.0 mm higher (Figure 6). Most stock abutments, even anatomically shaped versions, are insufficient in compensating for this discrepancy. This may result in a cement margin more than 4.0 mm deep (subgingival) at the papilla, which is likely to result in retained cement in the hands of even the most dedicated and skilled clinicians. This problem is quite easily addressed through the use of custom-milled abutments that allow the clinician to prescribe how deep the margin is to be placed. Furthermore, the use of a custom-milled zirconia abutment may allow the margins to be placed in equigingival or even supragingival positions (Figure 7). A balance must be struck between aesthetics and the risk of retained cement. A clear correlation has been shown between the depth of the margin and the amount of retained cement.\cite{25} There is no biological or functional rationale for placing margins subgingivally.

- ** Mature, robust gingiva:** The peri-implant gingiva is a more fragile structure compared to that around the natural dentition, largely due to the lack of fiber insertion into the root surface.\cite{25}
### Screw-Retained Versus Cement-Retained Restorations

#### Table. Advantages and Limitations (For Single-Unit Implant Crowns)

<table>
<thead>
<tr>
<th>Concern</th>
<th>Screw-Retained</th>
<th>Cement-Retained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of Peri-Implantitis</td>
<td><strong>Advantage:</strong> Without any chance of residual cement, the screw-retained restoration has not shown the same levels of peri-implantitis.</td>
<td><strong>Disadvantage:</strong> Cement left on the emergence of the abutment is a significant cause of peri-implantitis. There is no risk for this etiology with screw-retained restorations.</td>
</tr>
<tr>
<td>Porcelain Fracture</td>
<td><strong>Disadvantage:</strong> Due to the presence of an access hole through the restoration, screw-retained PFM restorations are weaker and more prone to fracture.</td>
<td><strong>Advantage:</strong> Cemented implant crowns have shown significantly less porcelain failure (4%) compared to screw-retained (38%) at 5 years.</td>
</tr>
<tr>
<td>Ease of Retrieval</td>
<td><strong>Advantage:</strong> The screw channel is generally easily identified and accessed should the restoration need to be removed.</td>
<td><strong>Disadvantage:</strong> Cement-retained restorations are more difficult to retrieve because they require the clinician to determine the approximate location of the screw access and drill through porcelain rather than composite.</td>
</tr>
<tr>
<td>Screw Loosening</td>
<td><strong>Disadvantage:</strong> Many studies have shown an increased propensity for screw loosening, the cause of which is likely multifactorial and dependent on the laboratory selection of components and handling.</td>
<td><strong>Advantage:</strong> Abutment screw loosening has been shown to be 6 times lower with cemented, single-unit implant crowns.</td>
</tr>
<tr>
<td>Loss of the Prosthesis</td>
<td><strong>Disadvantage:</strong> Along with increased incidence of loose screws, the crown is more likely to be lost.</td>
<td><strong>Advantage:</strong> Crown loss has been shown to be 3 times lower with cemented, single-unit implant crowns.</td>
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<tr>
<td>Interocclusal Distance Requirements</td>
<td><strong>Advantage:</strong> Limited interocclusal distances can be more readily restored with a screw-retained restoration, though this is a complication generally best resolved by improved implant placement or alteration of the opposing dentition.</td>
<td><strong>Disadvantage:</strong> Screw-retained restorations can be fabricated in smaller interocclusal distances than that required for a cement-retained restoration.</td>
</tr>
<tr>
<td>Aesthetics</td>
<td><strong>Disadvantage:</strong> The screw-retained restoration is generally more difficult for the technician to create a high level of aesthetics, particularly when adjacent to other tooth-borne restorations.</td>
<td><strong>Advantage:</strong> Most technicians can produce a more aesthetic outcome with a cement-retained restoration. Additionally, there is no screw access hole cover, which some find to be aesthetically objectionable.</td>
</tr>
<tr>
<td>Angulation Correction</td>
<td><strong>Disadvantage:</strong> Though not a functional or biological concern, implant angulations that have the screw access through the facial surface are generally best restored with a cemented restoration for aesthetic reasons. New (and mostly untested) screw-retained solutions do allow for angulation correction.</td>
<td><strong>Advantage:</strong> Implants placed in the aesthetic zone sometimes are angled toward the facial, which results in a relative contradiction to screw-retained restorations due to the access exiting through the facial surface of the crown. Cement-retained restorations can resolve this aesthetic issue.</td>
</tr>
<tr>
<td>Lab Costs</td>
<td><strong>Disadvantage:</strong> Screw-retained PFM restorations generally are the most expensive, and their costs fluctuate with the costs of alloys. Future developments with non-noble alloys and zirconia may mitigate this concern.</td>
<td><strong>Advantage:</strong> Lab costs for custom-milled abutments and cemented implant restorations are constant and significantly less than a cast gold alloy PFM restoration. They are also not subject to short-term fluctuations in the cost of the materials.</td>
</tr>
</tbody>
</table>
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No such connection exists with implants, and at best, a tenuous hemi-desmosomal attachment has been found in some cases. Largely, the fiber orientation around an implant is circular in nature.\(^6\) This fibrous o-ring bundle around implants requires sufficient time to develop and mature into a more dense and robust configuration. When present, the o-ring helps to provide a barrier against the hydrostatic pressure of the cement. As a general guideline, at least 2 mm of mature, robust, keratinized tissue should be present when selecting a cemented implant restoration (Figure 8). When the peri-implant tissue is immature or is lacking in keratinization, this seal is easily breached by the cement. Such scenarios should be addressed through soft-tissue augmentation, use of a screw-retained restoration, or supragingival cement margins.

- **Coating the abutment:** The emergence profile of the abutment should be coated with a separating medium prior to insertion (Figure 9). Petroleum jelly (such as Vasoline) is applied circumferentially to this area of the abutment in an effort to minimize the adhesion of cement to this area. Some cements (many resin cements) have a natural affinity for bonding to titanium and zirconia, which is good for retention of the restoration, but increases the potential for cement-induced peri-implantitis.

- **Judicious use of semi-soluble cements:** The amount of cement placed in the intaglio of the restoration should be kept to a minimum. Various techniques have been developed to ensure this. The most sophisticated of these techniques involves the creation of a vinyl polysiloxane (VPS) analog replica onto which the cement-filled crown is placed, then the excess cement is removed, thus leaving only a bare minimum volume of cement inside.\(^27\) Alternatively, cement can be brushed into the restoration in a thin layer.\(^28\) The cement chosen should also be semi-soluble in the oral environment, allowing any residual cement to be dissolved throughout time. The most soluble cements are zinc oxide eugenol (ZOE)-based (such as Temp Bond [Kerr]) while the least soluble cements are resin-based. Glass ionomer and resin-modified glass ionomer cements are of moderate solubility.

**Expected Outcomes**

Cement-induced peri-implantitis is an avoidable problem. There are significant advantages (Table) to the use of a cemented implant restoration, so its use should not be dismissed outright. By following the above criteria, this popular and effective restoration can be utilized with minimal risks and predictable outcomes. There is no “one-solution-for-all” implant restoration option in the aesthetic zone, but through the stringent adherence to proper clinical protocols, any significant risk can be mitigated.\(^22\)

Cemented implant restorations for single units have been well documented to be significantly less prone to porcelain failure, screw loosening, and loss of the crown.\(^5-7,22-23\) It has also been shown that for single-unit implant crowns, rates of implant loss and bone loss greater than 2.0 mm are equivalent between screw- and cement-retained restorations. Instances of peri-implantitis vary markedly between papers. This is due to a lack of a cohesive standard on what is and is not peri-implantitis retained subgingival cement. This is clearly an etiological factor in inflammation around implants; however, so too are porosity of castings or layered porcelains, loose abutments, and poor fitting castings. One histological study looked at bone loss around various abutment materials, concluding that full-cast gold restorations produced more than 1.0 mm more bone and soft-tissue loss as compared to titanium.\(^29\) However, when a casting was made onto a titanium interface (rather than a casting that formed the interface), the loss was insignificant. This is likely due to the presence of greater gaps and roughness in a fully cast interface, rather than the gold alloy itself. This illustrates the importance of a precision fit at the implant-abutment junction. Unfortunately, this is a lab issue and something out of the control of the clinician. Most dental lab technicians are using the appropriate components provided by the manufacturer with a titanium insert, but some attempt to save on the cost of components by skipping this part and casting the interface in its entirety, or they sometimes improperly divest the casting with abrasive blasting techniques, which damage the abutment interface.

Porcelain fracture is arguably a minor complication in implant dentistry, but with some studies showing as much as 38% porcelain failure at 5 years for screw-retained restorations versus 4% for cement-retained,\(^30\) it can become a very real burden on the restoring clinician. Nevertheless, a crown with a hole through it is significantly less durable, no matter the material, than one with an intact surface.\(^31-32\) The risk of porcelain fracture can depend in large part on the skill and knowledge of the dental technician who designs the framework and applies the layering porcelain. However, it is difficult to know how this can be quantified preoperatively, especially when labs often have multiple technicians. Alternatively, cemented restorations can be fabricated with newer “enhanced” porcelains (such as lithium disilicate) that have very consistent and reliable strength and fracture toughness values.

Much is often made of the fact that screw-retained restorations are “retrievable,” while cement-retained restorations are not. To retrieve a screw-retained restoration, one simply identifies the screw access cover (usually a discolored composite), drills through it, removes the screw cover material, and unscrews the
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restoration. For cement-retained restorations, the process is identical with 2 minor caveats: the location to drill is not obvious, and it will be porcelain, not a composite resin, that will be drilled through.33 In most situations, the location of the screw access can be identified with radiographs and a basic understanding of implant angulation. During fabrication of the restoration, the location of this access can also be marked with an opaque porcelain stain (Figure 10).34 Once the location is identified, drilling through porcelain to gain access is only slightly more time consuming (depending on the material).◆

References


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   a. True    b. False

2. Systematic reviews have demonstrated a very high percentage of technical complications with screw-retained implant supported reconstructions.
   a. True    b. False

3. A single-unit screw-retained restoration has the benefit of using fewer components, with more controllable delivery of the restoration.
   a. True    b. False

4. Screw retention is highly desired for provisional restorations.
   a. True    b. False

5. Cement is the only cause of inflammation and bone loss around implants, as such problems can also appear with noncemented restorations.
   a. True    b. False

6. Selection of the abutment is commonly, and mistakenly, done by selecting an abutment that will be significantly below the gingiva in the mid-facial area.
   a. True    b. False

7. Cemented implant restorations for single units have been well documented to be significantly less prone to porcelain failure, screw loosening, and loss of the crown.
   a. True    b. False

8. A crown with a hole through it is just as durable, no matter the material, as one with an intact surface.
   a. True    b. False
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3. ☐ a. True  ☐ b. False

4. ☐ a. True  ☐ b. False

5. ☐ a. True  ☐ b. False

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