

Covering the Implant Prosthesis Screw Access Hole: A Biological Approach to Material Selection and Technique

Todd R. Schoenbaum, DDS^{1*}
 Chandur Wadhvani, BDS, MSD^{2,3}
 Richard G. Stevenson, DDS¹

INTRODUCTION

With implant treatment in the esthetic zone, it is a constant endeavor to maintain and increase the volume of peri-implant tissues. Many recent developments in implant and abutment design have this as the primary goal. Thus we have seen the evolution and creation of “platform switch” abutments, narrowed abutment diameters, and conical implant connections—all in an effort to maximize the volume of the peri-implant bone and soft tissues. The conical connection in particular was developed with the aim of maximizing the integrity of the abutment–implant connection and thus reducing movement, decreasing peri-implant bone stress, and minimizing leakage of the contents inside the abutment into the delicate zone where bone, connective tissue, implant, and abutment all merge (Figure 1).^{1,2} This concept is sound and it does appear to reduce leakage into the peri-implant tissues,^{3–5} but it does not eliminate leakage. This is a problem that worsens over time with repeated loading.^{6,7} The “platform switch” design has mostly (but not entirely),⁸ proven to better maintain bone levels than abutments that flare directly from the head of the implant.^{9–12} Multiple finite element analyses have shown that the conical connection may serve to significantly reduce the stresses on the peri-implant crestal bone.¹³ It appears that the mechanical integrity of the conical connection provides a biologic benefit even outside the implant itself.¹⁴

The reason for the success seen with platform switch implants appears to be twofold: First, the nonintegrating abutment components are more narrow and thus further away from the bone allowing more space for the necessary biologic width.¹⁵ When nonintegrating components encroach upon this space, the bone remodels laterally and apically to create the necessary biologic space. Secondly, the platform switch design moves the implant–abutment junction (IAJ) away from the bone, and thus moves the inflammatory cell infiltrate coming from inside the implant / abutment and exiting at the IAJ further away from the crestal bone.¹⁶ Much histological study has been made into the biologic environment adjacent to the IAJ, and it has been well established that bone is maintained at

a more coronal position when leakage is minimized by use of conical connections, and when the leakage that does occur is moved further away from the bone by use of platform switch abutments. Recent short-term data suggest that the conical connection and minimizing leakage at the IAJ is the more important factor in limiting bone loss.¹⁷ Based on these concepts, it is evident that the contents *inside* the implant/abutment directly, and negatively, affect the peri-implant bone position. Leakage from the IAJ cannot be eliminated,^{7,18} but efforts should be made by the clinician to minimize it.

It is clear that the contents of the implant/abutment negatively affect the peri-implant bone, and that they will leak from the IAJ.⁴ Thus, what is put *into* the abutment to cover the screw can have a significant effect. According to a 2008 survey,¹⁹ 59% of prosthodontic residency directors and 77% of restorative department chairpersons in the United States use cotton pellets to cover the screw access opening under the definitive restoration. The use of cotton is an adaptation of the method used to temporarily fill the access for endodontically treated teeth, though it appears to be falling out of vogue for this purpose as well. It should be noted that cotton was never intended for use under a definitive restoration.

The problem with the use of cotton is that the internal aspect of most implants and implant abutments are hollow, whereas the connection at the IAJ between them is prone to leakage. This creates a 35°C,²⁰ mostly oxygen-free, hollow tube filled with saliva, oral flora, and nutrients—an environment ripe for the proliferation of anaerobic bacteria.²¹ As the patient functions on the implant, the IAJ continues to flex and wear, pumping saliva, nutrients and oral flora into the implant chamber from the peri-implant area (not the screw access hole). As the anaerobic bacteria proliferate and the IAJ continues to flex and leak, the anaerobic byproducts are pumped out of the implant at the IAJ and directly into the peri-implant tissues.^{3,22,23}

Covering the screw with cotton, in particular, appears to be problematic because it is an open, organic, scaffold-like structure (Figure 2). These properties provide pathogenic oral flora an ideal substrate upon which to flourish and which likely increases the volume and potency of the inflammatory cell infiltrate. Additionally, cotton has been shown to allow the most leakage into the implant, when compared in vitro to gutta-percha,²⁴ silicone plugs, and polyvinyl siloxane (PVS) impression materials.²⁵ The seal created by polytetrafluoroethylene (PTFE) tape has been shown to be effective in sealing endodontically treated teeth²⁶ and in implant abutments when compared with cotton.²⁷ Ultimately, it appears that the

¹ Section of Restorative Dentistry, University of California-Los Angeles School of Dentistry, Los Angeles, CA, USA.

² Department of Restorative Dentistry, Loma Linda University School of Dentistry, Loma Linda, CA, USA.

³ Private practice limited to prosthodontics, Bellevue, WA, USA.

* Corresponding author, e-mail: tschoenbaum@dentistry.ucla.edu

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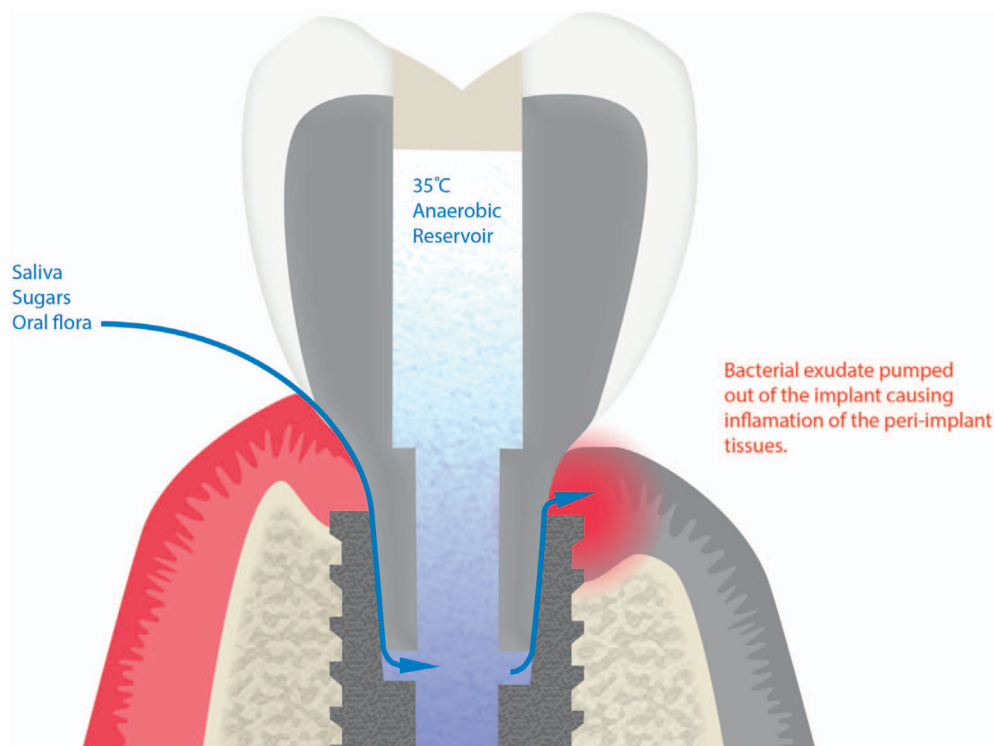


FIGURE 1. The implant abutment junction leaks with repeated use, which pumps oral flora and nutrients into the internal aspects of the implant and the abutment. Traditionally, cotton has been used to cover the abutment screw and has provided an environment where anaerobic bacteria propagate and are ultimately pumped into the fragile peri-implant tissues.

quantity and the specific species of bacteria in and around the implant is affected by the filling materials.^{4,20} The volume and microbial density of this internal leakage will likely prove to have a negative effect on the long-term stability of the peri-implant bone and soft tissue, though further in vivo investigation is needed.

The use of cotton pellets to directly cover implant screws likely continues because it is familiar, easy, and inexpensive. However, viable alternatives exist that meet the requirements of being easily retrievable, pliable, and microbiologically inert: in particular PTFE tape²⁸ and PVS impression materials. Additionally, these materials have the potential to reduce the volume and density of the internal leakage phenomenon. Although some may note that gutta-percha meets the aforementioned requirements, the authors have found it challenging to remove after years in service, which may then require the use of a handpiece and potentially damage the abutment screw. Furthermore, the PVS and PTFE techniques minimize potential leakage by fully occupying the space of the screw access chamber and creating a better long-term seal.

Technique

PTFE technique for screw-retained restorations:

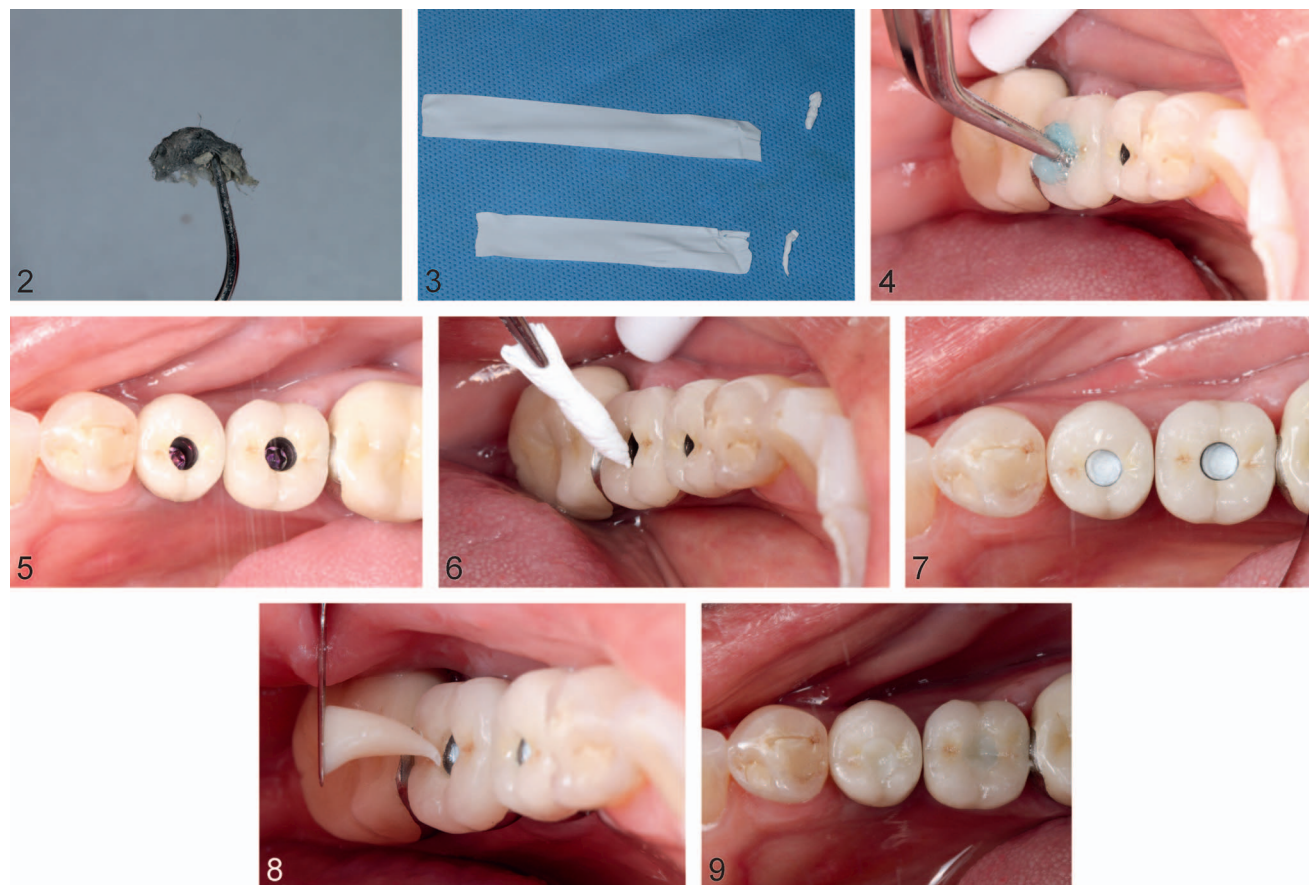
1. Prior to the appointment, individually autoclave 20–40 mm strips of commercial-grade PTFE tape (Figure 3).

2. Torque the abutment to manufacturer's specifications and verify with vertical bitewing radiograph.
3. Clean the screw access with pellets soaked in 2% chlorhexidine (Figure 4).
4. Wipe down the screw access with isopropyl alcohol.
5. Dry the screw access (Figure 5).
6. Roll the PTFE tape into a cylinder shape and deliver into the screw access (Figure 6).
7. Condense the PTFE tape into the screw leaving 2–3 mm above (Figure 7).
8. Etch the occlusal ceramic with the appropriate hydrofluoric acid (2%–10%). Alternatively, this can be done prior to placement.
9. Silanate the occlusal ceramic.
10. Apply an appropriate composite bonding agent to the ceramic, inside the screw access, and over the PTFE plug. PFM crowns may benefit aesthetically by applying an opaquing resin to the walls of the screw channel.
11. Fill the remaining with an opaque composite, shape and polymerize (Figures 8, 9).

As an alternative to steps 10 and 11, Wadhvani et al²⁹ have developed a novel ceramic plug that is more durable and aesthetic than composite (Figures 10, 11).

PVS technique for cement-retained restorations:

1. Torque the abutment to manufacturer specifications and verify with radiograph.



FIGURES 2–9. **FIGURE 2.** Clinical sample of cotton screw cover placed under gutta-percha after 4 years in function. Patient reported foul odor and taste under function. **FIGURE 3.** Commercial-grade polytetrafluoroethylene (PTFE) tape is precut and autoclaved prior to use. **FIGURE 4.** Two percent chlorhexidine is used to clean the internal aspects of the channel prior to placing the screw cover. **FIGURE 5.** The channel is wiped with isopropyl alcohol and dried. **FIGURE 6.** The PTFE tape is rolled into a cigar shape, delivered into the screw access channel and condensed. **FIGURE 7.** Sufficient PTFE tape is used to fill the screw access to 2 mm from the occlusal surface. Ideally, this will serve to block the graying effect of the metal channel. **FIGURE 8.** Light cured composite resin is applied following hydrofluoric acid etching and silanation of the ceramic ring. **FIGURE 9.** The completed composite cover is finished and polished.

2. Clean the screw access with pellets soaked in 2% chlorhexidine.
3. Wipe down the screw access with isopropyl alcohol.
4. Dry the screw access.
5. Use a narrow diameter syringe tips to inject and backfill the screw access with the PVS material (Figure 12).
6. Wipe off excess material prior to polymerization (Figure 13).
7. Cement the prosthesis ensuring the abutment margins are no deeper than 1 mm^{30,31} and that the minimum amount of cement is utilized.^{32,33}

In the case of necessary retrieval, the PVS plug is simply removed with an explorer (Figure 14).

SUMMARY

The PTFE or PVS screw access cover techniques provide simple alternatives to the traditional use of cotton pellets, and will minimize the colonization and proliferation of oral flora *inside* the implant system. These materials are likely to minimize the occurrence of patient-reported halitosis and cacogeusia (foul

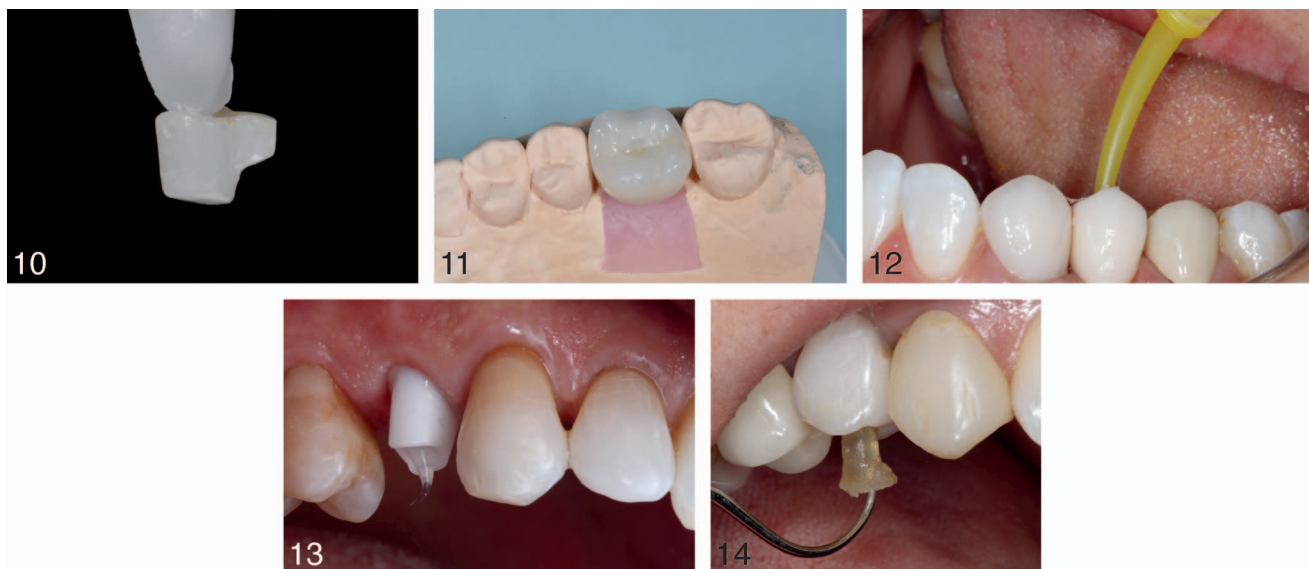
taste) following implant treatment. It is likely that by minimizing the intra-implant bacterial load, inflammation and peri-implant bone loss will be decreased.

Potential disadvantages

Further study (in vitro and in vivo) is needed to quantify the ability of the various materials for preventing leakage, for minimizing the proliferation of the oral flora in the internal aspects of the implant/abutment, and for long-term durability/breakdown tests. Follow-up studies are needed to quantify the effect of the various screw cover materials on the microbial profile inside the implant system and the ultimate effect of this leakage on the long-term stability of the peri-implant tissues.

ABBREVIATIONS

IAJ: implant-abutment junction
 PTFE: polytetrafluoroethylene
 PVS: polyvinyl siloxane



FIGURES 10–14. **FIGURE 10.** The ceramic plug is pressed concurrently with the crown. It has an opaque apical layer added to prevent show through from the screw access channel as well as an antirotation portion to enable improved seating. **FIGURE 11.** The plug is shown seated in the crown. It will be adhesively bonded, after application of ceramic etch and silane; then composite resin is used. **FIGURE 12.** A clear polyvinyl siloxane (PVS) material is syringed with a narrow diameter tip into the abutment, directly onto the head of the screw. **FIGURE 13.** Excess clear PVS will be wiped away and the plug allowed to polymerize. **FIGURE 14.** Should retrieval become necessary, the PVS plug is simple to remove with an explorer.

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