Screwmentation the Svoboda Way

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Introduction: What prompted our esteemed colleagues to want to develop the installation system commonly called **Screwmentation**? What installation system problems were they trying to solve? Were they successful in making prosthesis installation better for patients? **Sadly, they were not successful** because previous authors did not appear to recognize the risk factors for complications inherent to their prosthesis installation systems nor their root causes. Today, the risk factors for complications[1] and their root causes have been identified and validated by multiple research findings.[2] They are described as follows.

Prosthesis Dimensional Error (PDE) is a root cause of treatment complications related to prosthesis installation**.**[2] PDE is why dentists need to adjust a prosthesis during its installation. It results from the many errors inherent in making a dental prosthesis. Part of this error is caused by fabricating a prosthesis to fit a dental model that is not an exact replica of the mouth. Many dentists do not appear to understand how current installation system designs can make it almost impossible to mitigate the adverse effects of PDE without exposing patients to several risk factors for peri-implant disease.[1] These risk factors include implant-abutment misfits, abutment-prosthesis misfits, open and overhanging margins, and subgingival cement.

Another root cause of complications is called the **Tissue Effects (TE). These include the Resistance to Displacement Effects (RTDE) and the Gingival Effects (GE).**[2] RTDE result from interactions between oral tissues and parts of the abutment-prosthesis complex during prosthesis installation. While RTDE can frustrate or unknowingly sabotage the dentist's efforts to optimize the fit of prosthetic components in the mouth, the GE can cause copious amounts of subgingival cement. The TE can independently cause problems similar to those related to PDE mentioned above. The terminology used to describe the root causes of several risk factors for peri-implant disease, related to prosthesis installation was created by Dr. Svoboda.[2]

The negative impacts of PDE and the TE are amplified by increased prosthesis span and the number of implant retainers. The installation of the multi-unit prosthesis thus adds even more complexity to an already flawed single tooth installation system. Some authors believe the screwmentation concept described for single teeth is good but that its teachings do not pertain to the safer installation of multi-unit prosthetics.[3] This rationalization of differences makes the screwmentation process less beneficial for the dentist and highlights flaws in its underlying assumptions. I will show how the Svoboda Way of Prosthesis Installation System makes installation better for single and multi-unit prosthetics.

It would be great if dentists could confirm the microscopic fit of prosthetic components in the mouth. **Our means of assessing the fit of a prosthesis are coarse at best.** X-ray images are unreliable due to angulation and resolution issues and using prosthesis stability as a measure of fit is unpredictable. Any 3 points of contact with any difficult-to-distort material like compressed gingiva or a tight contact with an adjacent tooth or implant can make the prosthesis feel stable. Unfortunately, the perception of initial prosthesis stability is not a reliable indicator of an optimized fit. Even direct vision of joints is unreliable and is often obscured during prosthesis installation by the prosthesis, gingiva, adjacent teeth, and the dentist's fingers.

Why is an optimized fit important? Firstly, patients assume it. Additionally, it is essential because Health Canada and the FDA approval for the sale of implant components is based on the stability of optimally connected components. Why? Implant parts connected in an optimized fashion are most stable under load conditions and best at reducing the movement of oral pathogens between the exterior of joints and the internal spaces of implants and abutments.

Peri-implant disease is an infection of the peri-implant environment by oral pathogens that can incubate and move between misfit implant parts. Once oral pathogens inoculate the internal spaces of the implant-abutment complex, they and their toxic by-products can move into the peri-implant environment with every bite the patient takes.[4] Yes, preventing peri-implant disease means reducing the places where oral pathogens can incubate and from which they can invade adjacent tissues. Yes, we can and should reduce the peri-implant bacterial load by optimizing the fit of parts. That should form the basis of instruction for Dental Prosthesis Installation 101.

The implications of the Svoboda Way System of Prosthesis Installation are far-reaching. Dentists can now expect to consistently optimize the fit of implant parts and install prostheses with a passive fit. This installation process supports and enhances the workings of digital workflows by safely managing expected PDE and the TE. It helps dentists **safely exploit the benefits of CAD/CAM workflows** without exposing patients to several preventable risk factors for complications.

Introduction Summary: Proposed variations of screwmentation are frequently non-optimal for single crowns and are abject failures for multi-unit prosthetics like the 3-unit or larger bridges. To update the "Screwmentation Concept," it is necessary to identify the root causes of complications and mitigate their harmful effects. Dr. Svoboda has done that and called it the **Svoboda Way of Screwmentation**. It effectively provides the dentist with a way to optimize the fit of the implant-abutment-prosthetic connectors for both single crowns and multiple-unit prosthetics. This new system of installation forms the basis of a **New Gold Standard of Care** because it enables dentists to consistently prevent several persistent risk factors for complications.

The following text will reveal where previous versions of screwmentation fail and how the Svoboda Way System of Prosthesis Installation makes treatment better.

What is Screwmentation? It is a process of prosthesis installation that separates the installation of the abutment, the screwed-in part, from the installation of the prosthesis, the cemented part. Rajan and Gunaseelan (2004)[5] appear to have been the first to report on such a system but did not use the name screwmentation. They hoped their system could enable them to combine the advantages of a cement-retained and screw retained prosthesis. They also never specifically mentioned that they wished to optimize the fit of the implant-abutment connection before installing the crown by an intra-oral cementation process. Perhaps we can assume it, as it is a possible advantage of the cement-in installation system. Why did they not specifically mention the misfit problem inherent to the screw-in installation technique? Was there some political motivation behind them not mentioning misfits, or did they realize that they were unsuccessful in preventing that problem? Perhaps they can reveal their motivations directly.

Expecting the problem of residual subgingival cement, Rajan and Gunaseelan retrieved the abutment-prosthesis complex from the mouth. They then reinstalled the crown and sealed the occlusal abutment screw-access hole with a plastic filling. The authors claimed that their described process allows for the fabrication and installation of a **"retrievable cemented prosthesis that is simple, practical, and effective."**

One must congratulate Rajan and Gunaseelan for being on the path to solving the longstanding problem of implant-abutment misfits inherent to the screw-in installation technique. Their screwmentation-like process seems logical enough until we look at their execution details considering the root causes of complications mentioned in the introduction above.

A) Rajan and Gunaseelan[5]

Rajan and Gunaseelan claimed “The advantages of cement-retained implant-supported restorations over screw-retained implant restorations are well documented. Difficulty with prosthesis retrievability and excess cement removal may be experienced with cemented restorations. The technique described allows for the fabrication of a retrievable cemented prosthesis that is simple, practical, and effective.”

On reviewing their article in detail, I would like to suggest that they were yet unaware or not yet ready to tackle prosthesis installation complications such as implant-abutment misfits and their understanding of the root causes of these misfits, open margins, and even residual subgingival cement appears to be largely unbeknownst to them. As a result, their described technique would have likely resulted in an implant-abutment misfit, open margins and they might have had some difficulty with consistently achieving their stated retrievability goal.[6] They could, however, access and effectively remove residual subgingival cement and refine the abutment-crown margin when they were able to remove the abutment-crown complex from the mouth.

1) Rajan and Gunaseelan used a cast custom abutment. This casting technique can result in a variation in the quality of the implant-abutment connector, as it is sensitive to technician experience and consistency. The high-temperature manufacturing process and removal of investment material from abutment connectors can contribute to the inaccuracy of connector quality. Today, most abutment connectors are made by CAD-directed high-precision turning machines. This newer technology can provide dentists with better consistency and verifiable tolerances of precision parts.

2) The perimeter of the tissue-facing aspect of their custom abutment was quite broad. This broad abutment profile can be expected to encounter significant Resistance To Displacement (RTDE) from gingiva and underlying bone during its installation. There is no mention of using an appropriately wide healing abutment or any surgical procedure to enlarge the trans-tissue portal between the implant and abutment. Hence, I would suggest that it would be challenging to connect their abutment to its implant retainer optimally and to effectively verify its fit. This step could result in an **implant-abutment misfit** with or without some gingival tissues trapped between the connecting parts.[1]

3) The authors mentioned that they would verify the fit of the crown framework casting intra-orally **(step 6).** If the crown casting fits the abutment casting on the model, why would they need to verify its fit in the mouth? This single unit casting would not likely have any contact with adjacent teeth. Fitting a multiple unit casting would make sense, as more PDE and RTDE could hinder its proper installation. It might also be easier to manage the tissue-pontic relationship at this time, as visibility would be better before applying porcelain. Rajan and Gunaseelan's example is a single crown case. This step makes **their process less simple**.

4) **They used the PBM crown as an abutment positioning device** in the mouth by placing the torque driver through the crown and abutment screw-access channel to tighten the abutment screw. **This is a major error.** We need to dissect this through the lens of the root causes of mechanical complications.

a. The crown is made to fit the cast abutment on a dental model. Therefore, we can **expect some PDE** from the abutment and crown, the dental model, implant analogue and simulated tissue material. All these elements vary from the oral condition they represent.[7] Thus, the prosthesis and components will need to be adjusted during their installation.

b. The dentist needs to manage contacts, fit, and occlusion during crown installation. In step 8, they used the **crown screw access opening to guide the installation of the abutment**. This adjustment process is complicated by the crown as it obscures the view of the gingiva and reduces the clinician's tactile perception while seating the abutment. The dentist would find it difficult to determine whether the intaglio surface of the crown had physically hindered the abutment from realigning itself with the top of the implant connection during its installation, and thus preventing it from seating optimally**.** The benefits derived from a separate abutment installation were lost in this step, **likely causing an implant abutment misfit.**

c. Once the abutment is in the mouth, **step 9** is about cementing the crown. The authors now advocate reducing cement volume loaded into the crown to reduce the volume of excess cement ejected from its margins into the subgingival environment. They do not quantify the cement volume loaded into the crown nor the volume lost through the screw access hole during intra-oral cementation. This **faulty step** can predispose the patient to cement voids at the crown margins and under the crown. These can reduce retention and provide unintended spaces for incubating oral pathogens that can cause peri-coronal infection.[3,8] This cement minimization technique is unwarranted, as the authors intend to remove the abutment-crown complex to remove excess cement before reinstalling it. Hopefully, they will then be able to detect and fill the unintended cement voids they may have caused.

d. If the abutment is already misfit in 2) and 4) a. above, cementing the crown onto it would now fixate the abutment and crown into a non-ideal relationship. This step would prevent any reasonable hope of achieving an optimized implant-abutment fit. This step is also not well thought out.

e. The crown margins appear to have been placed somewhat subgingivally. According to Svoboda et al.[11,12], this would likely result in open margins. If the cement is soluble, like the zinc phosphate used to lute the crown, the wide marginal separation would be expected to hasten its dissolution in adjacent oral fluids. This dissolution problem could be reduced using a resin-based cement and the margin interface could be refined and polished before abutment-crown reinstallation. However, it is prudent to reduce or prevent the occurrence of open margins. The Svoboda Way prevents open margins.[12]

Rajan and Gunaseelan added four additional instructions to manage specific circumstances, such as "when access to remove excess cement is difficult." I imagine these would include cases where the abutment-crown complex became **challenging to retrieve** because its insertion path, determined by adjacent teeth, was different from that of the implant-abutment connector. Of course, if the crown thus became non-retrievable, the expected residual subgingival cement would be difficult to remove without surgery.

They try to maintain retrievability by modifying **step 8** to "only finger tighten the abutment screw during installation, do not torque it down." Finger tightening the abutment screw will likely have failed to allow the abutment to seat and settle onto its implant connector optimally.[19] This variation **would predictably cause a gross implant-abutment misfit.** It basically realigns the abutment-crown complex with the path of insertion determined by adjacent teeth rather than that determined by the implant-abutment screw channels. They are simply trading the problem of retrievability and excess subgingival cement for an implant-abutment misfit. Shouldn't they at least mention that they are trading subgingival cement for an implant-abutment misfit? Were they aware of this problem? **In my opinion, this step is misleading and faulty.**

Then the authors suggest reinstalling the abutment-crown complex in the mouth, torquing it into place and re-evaluating the occlusion. Why do they recommend the dentist re-evaluate the occlusion? Are they expecting that the abutment will not seat optimally, leaving the abutment-crown complex will be high in the bite? Whenever a crown is in hyper-occlusion, the dentist needs to suspect the abutment and/or crown may not be optimally seated. Why would they recommend such an approach when it exposes the patient to dire mechanical and biological complications?

Summary: **The installation process described by Rajan and Gunaseelan**[5] fails to provide the patient with an optimally fitting implant-abutment connection and thus exposes the patient to a known risk factor for peri-implant disease. Separating the crown installation from the abutment installation has potential to optimize the implant-abutment fit, but their described protocol fails to do so. Their system is also more cumbersome than the current screwed-in crown installation technique and while both systems are likely to expose the patient to implant-abutment misfits and related complications.

The authors tout their system's unique retrievability feature. It appears that their system does not consistently guarantee retrievability while preventing implant-abutment misfits. The features that make a prosthesis retrievable can already be included in both cement-in and screw-in installation systems.[9] So, **I must respectfully disagree with the authors that their installation technique is simple, practical, or effective.**

B) Mitchell TW[10]

The first time I was able to find mention of "**Screwmentation"** in print was in a small case study article by Thomas W. Mitchell. While its published date was not specified, it does contain a sequence of steps that he calls screwmentation. It is available for view on www.Dentaltown.com under Screwmentation Review. Dr. Mitchell clains to have used the Screwmentation term in print in 2000, in an article called "Hiding the Screw Access".

He describes the purpose of his technique as follows, "First, allow for **easy retrieval** of the crown should that be needed either because of porcelain fracture or screw loosening. Second it **eliminates leaving cement** around the abutment or the implant." His objectives appear to be identical to those of Rajan and Gunaseelan[5] reviewed above.

Dr. Mitchell mentions that his surgeons know that he likes "wide healing covers." Wider healing abutments widen the trans-tissue portal and tend to reduce Resistance To Displacement by adjacent tissues (**RTDE)**. A wide diameter healing cover can make the optimal seating of the final abutment easier. Indeed, in his example, the author installs a rather narrow-profile Procera Custom Ti abutment into the mouth. So far, so good. This has the potential to optimize the implant-abutment fit.

Mitchell says he likes to torque the abutment in at 20 NCm for try-in and later at 25 NCm for final installation. Here I have a problem, as I am not sure **whether the seating position of his abutment and retaining element will change with the higher final installation torque**. Is the abutment optimally seated when its abutment screw is torqued down at 20 NCm? We are now beginning to guess.

I would rather he torqued the abutment screw according to the manufacturer's specifications during try-in. This would likely establish a more stable seating position for the implant-abutment connection. This would also make it more likely that a more optimal abutment-retaining-element to crown position might be re-established after luting the crown to the abutment. I say more optimal as conical connections may tend to allow the abutment connector to settle into the implant somewhat during both installation and function. It has been mentioned by Andersen 2020[7] that conical connectors are quite difficult to mill accurately, and this may affect the settling position of an abutment in its complimentary implant. Indeed, conical connections can be responsible for significant additional error attributed to connected implant parts as part of PDE.

If an abutment is not completely settled into an optimized connection with the implant during the crown try-in, there are at least three possible non-ideal outcomes. 1) The implant-abutment connection will be prevented from seating optimally by a tight crown-contact with an adjacent tooth. This causes a misfit joint. 2) The final torquing of the abutment screw will force the abutment to change orientation as it seats further into its implant retainer. This can cause a tight contact, a loose contact, and a misfit joint. 3) The abutment-crown complex can be forced into a non-ideal position, where its path of insertion differs from the path of insertion determined by adjacent dental structures. This makes the abutment-crown complex not easily retrievable and may also cause tight and loose contacts and an implant-abutment misfit. **We can call these Guesses #1,2,3.**

Dr. Mitchell then places the crown onto the abutment in the mouth and adjusts its contacts and occlusion. These are logical steps, as he is now adapting the crown to fit in the mouth. Unlike the dental model, the mouth is the most accurate representation of itself, but it is also a more complicated environment due to adjacent and underlying tissues. Gingiva can block the clinician's view of the crown margin area and may resist displacement to prevent the ideal seating of the crown (RTDE). Is the crown fully seated during its adjustment phase? Let's call this **Guess #4**.

Next, Dr. Mitchell removes the abutment and puts the healing cap back onto the dental implant to prevent the peri-abutment tissue from swelling and collapsing into the trans-tissue portal. When peri-abutment tissues swell, they can block easy access to the top of the implant and may get pinched between the top of the implant and abutment during abutment installation. This can make installation painful for the patient and can prevent the abutment from seating correctly. Trauma to the peri-implant tissues can also cause bleeding. These are longstanding problems related to installing abutments.

I experienced these problems with the old external hex implants with flat-to-flat surfaces surrounding their hex connectors. Even the angled flats on tissue level implants caused this type of problem when they were placed into the subgingival environment.

Dr. Mitchell takes the crown out of the mouth to cement it onto its abutment while holding it in his hand. This process will give him better cement control but would unlikely provide him with the necessary references for reproducing the intra-oral crown alignment created by his crown adjustments. Could he even manage to confirm that he was duplicating the intra-oral abutment-crown relationship? Perhaps it would have been better for him to cement the crown in the mouth and then refine the cement line in his hand. **Why did he choose this faulty approach?** However, by cementing the crown to the abutment in his hand, he has now fixated the relationship between these two elements, good or bad. This step adds another 3 Guesses like 1, 2 and 3 above. Let's call them **Guesses #5,6,7**.

The crown margins were clearly subgingival, and the crown profile was much larger in circumference than the abutment profile. I expect the adjacent and underlying tissues would resist seating as Dr. Mitchell tried to push the crown into place during both the crown adjustment phase (above) and during installation of the abutment crown complex. Was he ever able to seat the crown optimally during its adjustment in the mouth? Will he be able to torque the abutment-crown complex into the mouth to optimize the implant-abutment fit? Why did he not use a wider profile custom abutment to reduce RTDE and to better manage the margin-gingiva relationship? These are more unanswered questions.

Did Dr. Mitchell's previous versions of screwmentation frustrate his ability to prevent open margins due to the **RTDE** by adjacent tissues? Is that why he then chose to cement the crown onto its abutment while holding the pieces in his hand? Open margins are a common consequence of intra-oral cementation. In my in vitro studies, 100% of crowns with profiles wider than their abutments had open margins after crown installation. This open margin condition occurred when crowns were cemented onto stock abutments[11] and custom abutments with subgingival chamfer margins.[12] Did he give priority to a clean closed margin at the expense of an implant-abutment misfit? Was this process easier than cementing in the mouth? In any case, we don't really know.

The logic of Mitchell's **proposed screwmentation installation system is faulty** and causes the clinician to make too many Guesses that can cause multiple problems for the patient. Indeed, when I look at his original published pictures, the mesial contact he achieved during his try-in is not the same as the contact achieved in his final image. The rotation of the crown looks different. I suspect an implant-abutment misfit due to a tight mesial crown contact and RTDE caused by adjacent tissues.

Summary: Dr. Mitchell's approach to screwmentation could be improved by ensuring an optimized implant-abutment fit by fully torquing the abutment in place before adjusting the crown intra-orally. This process would have provided an optimal seating of the abutment. After adjusting its contacts, the crown could be cemented in the mouth and could have guided him to optimize the contact with the adjacent tooth. Instead, he removed the uncemented abutment and crown from the mouth and cemented them together while holding them in his hand. Dr. Mitchell thus lost references required for optimizing the implant-abutment fit and the adjacent contact. His proposed screwmentation system of installation is faulty. His current installation description would likely cause an implant-abutment misfit and other non-ideal installation results.

C) Linkevičius T (2019)[3]

I want to acknowledge Dr. Tomas Linkevičius' significant contribution to our understanding of intra-oral cementation and prosthesis installation. He has demonstrated the relationship between margin depth and the amount of residual subgingival cement. He has also shown that a more abrupt emergence profile transition from the narrower abutment to the wider crown causes more subgingival cement.

Referencing Dr. Svoboda's Terminology, one can say that deeper margins and steeper emergence profiles increase the Gingival Effects and thus cause more subgingival cement. Indeed, this also applies to equigingival and supragingival margins where the proximity of the emerging crown shape to adjacent gingiva impedes the outflow of excess cement from the margins of the abutment-crown complex. Several authors had demonstrated the occurrence of abundant subgingival cement even when their margins were deemed equigingival.[13,14] This occurrence is easy to explain via the Gingival Effects.[15]

Many authors have failed to identify cementation pressure as having a considerable effect on the occurrence of subgingival cement. Dr. Svoboda et al.[12,16] demonstrated that using a cementation pressure of about 40 NCm, as taught in dental schools, can cause much submarginal cement. Decreasing installation pressure can reduce or eliminate submarginal cement and cause open margins due to RTDE.[12] Chamfer Margin Systems cannot manage expected PDE or the TE effectively.

Dr. Linkevičius refers to his installation concept as the "hybrid restoration" (page 166) as it combines features of both "cemented-in and screwed-in restorations." He claims that "cementing a completely finished crown or a short span fixed partial denture to a titanium base on a dental model and then screwing it into the mouth is very cost-effective." **Unfortunately, his described system is not effective at protecting patients from implant-abutment misfits.**

When the titanium base is cemented into the bottom of a crown, it becomes a rigid part of that titanium base-crown complex. By attaching the prosthesis to its titanium bases outside the mouth on a dental model, this process essentially brings PDE[1,7] back into the picture. Now the dentist must try to manage PDE and TE simultaneously during installation. Installing the Linkevičius hybrid crown or bridge would thus be unsuccessful at preventing the implant-abutment misfit.[6]

Then Dr. Linkevičius argues for separating splinted restorations from single crown cases because their biomechanics are different and have more tension on installation.[3] (pg 167) The increased prosthesis size increases PDE and makes managing the TE more complex. Imagine installing a 3-unit bridge or other multiple-unit prosthesis using the screw-in technique. Can you see what you are doing? Can you effectively manage PDE and TE at the same time? I would say not. Also, mentioning that his proposed installation system enables the dentist to achieve a passive fit is faulty. Many authors have tried and failed and concluded that it couldn't be done.[14,17,18] Neither they nor Dr. Linkevičius appear to have yet identified the root causes of the problems they were trying to mitigate.[1]

If one wishes to install a prosthesis with a passive fit, it is necessary to use a logical installation sequence to achieve it.[19] When using the Linkevičius screw-in installation technique, the dentist may be able to optimally install a single crown that does not contact adjacent teeth.[21] A similar installation process for multi-unit prostheses would fail miserably and guarantee misfit joints. Should our patients continue to suffer the consequences of misfits unnecessarily? I think not.[6]

Dr. Linkevičius recommends pre-shaping the trans-tissue portal to reduce the resistance to displacement by adjacent tissues (**RTDE**) from causing the separation of the prostheses from their titanium bases during his installation process. Dr. Carl Misch once mentioned that 35 NCm of force used to tighten an abutment screw is enough to pull two empty boxcars together on a level track.[17] So yes, **RTDE** can force a separation of the cement bond between the titanium base and the prosthesis. It can conceivably also strip the engagement threads on the abutment screw and inside the implant and prevent the proper seating of abutment connectors.

I agree that the trans-tissue portal opening must be sufficient to allow for the optimal seating of a crown. However, it may be difficult to impossible to manage the TE while trying to adjust contacts due to PDE. Dr. Linkevičius' proposed installation system cannot effectively mitigate the root causes of mechanical complications related to a prosthesis installation and are thus likely to consistently cause implant-abutment misfits.

Summary: Dr. Linkevičius' system of prosthesis installation appears to be like conventional screw-in installation systems and thus suffers from their inherent problems. It would be expected to cause misfit joints due to PDE and the TE. Misfit connections are a risk factor for peri-implant disease. I consider his described installation system a choice between two faulty installation systems rather than a proposal for a better installation plan.

D) The Svoboda Way of Screwmentation

First, we need to understand that our current systems of prosthesis installation, whether by the screw-in or the cement-in system, expose our patients to several known risk factors for mechanical problems and related peri-implant disease. Over 10 years, 81% of our implant patients can expect to suffer peri-implant disease or implant failure, whether the prosthesis was screwed-in or cemented-in.[20] Therefore, I feel it is essential that we, as health care providers, do what we can to prevent prosthesis installation-related risk factors for complications. What follows is **a recipe describing how we can make dental treatment better**.

Let's start by understanding how Prosthesis Dimensional Error (**PDE**) and the Tissue Effects (**TE**) cause the mechanical complications that predispose our patients to biological complications.[1] I challenge you to imagine all the mechanical complications you have observed in your practice and see if you can explain them in terms of the abovementioned root causes. I have done that and designed multiple research projects to test their validity.[11,12,15,16,19] My research findings consistently support my hypotheses about the named root causes of complications.

There are many non-optimal results of prosthesis installation that I can easily explain in terms of them. **Either of these root causes, PDE and the TE, can cause similar mechanical and related biological complications.** Managing both the TE and PDE at once ranges from difficult to impossible. This problem is inherent to the screw-in installation processes.[21]

Indeed, the key to preventing their harmful effects is to separate them during the prosthesis installation process. First manage the TE during the installation of the abutment. Then find a way to use cement and cement space to safely tolerate expected PDE during the installation of the prosthesis. Yes, this is what the Svoboda Way System of Prosthesis Installation does and conventional installation systems cannot do. They are simply insensitive to the TE and PDE. That is why they fail to improve results. Indeed, the survival rates for dental implants have not changed over the course of 30 years, according to the results of Arlin (2020).[22] Why is that? Are we missing something? We were missing a fundamental understanding of the makeup of a safer prosthesis installation system. The RM System was designed to change that. (**Figure 1**)

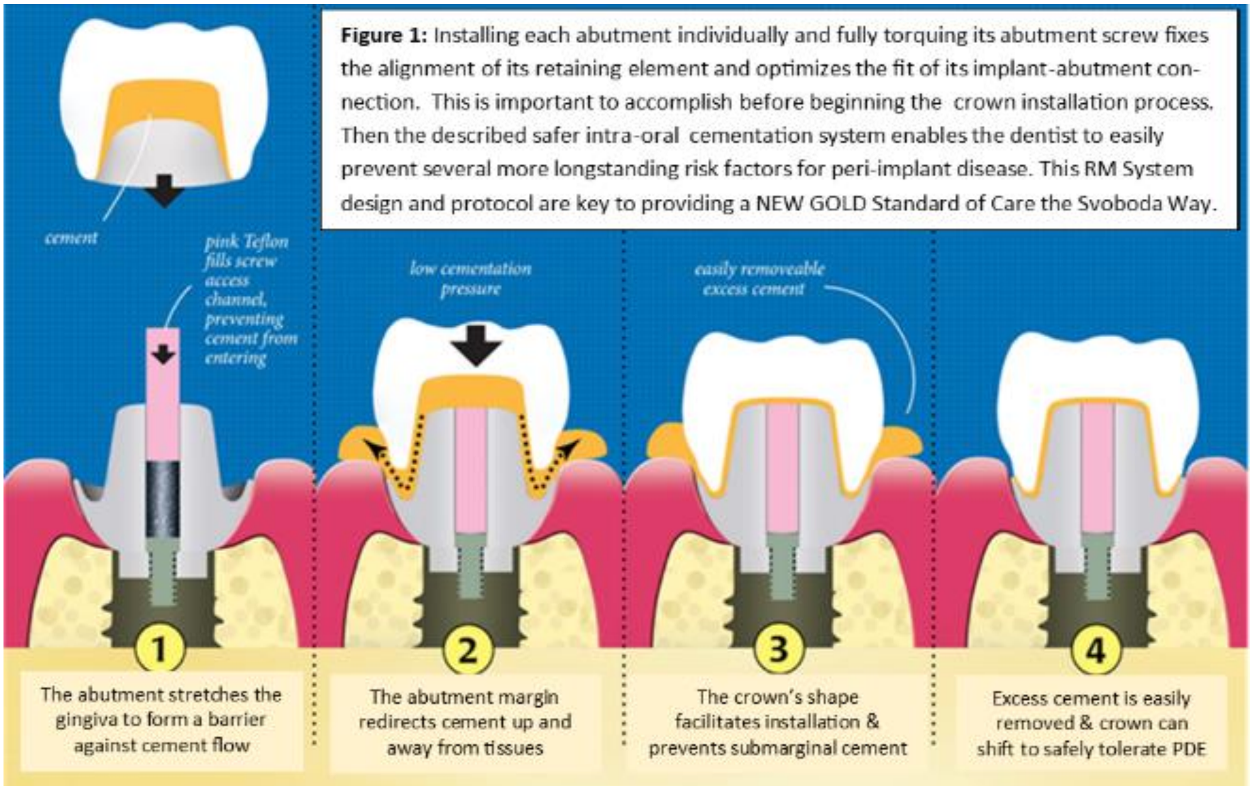


Figure 1: Installing each abutment individually and fully torquing its abutment screw fixes the alignment of its retaining element and optimizes the fit of its implant-abutment connection. This is important to accomplish before beginning the crown installation process. Then the described safer intra-oral cementation system enables the dentist to easily prevent several more longstanding risk factors for peri-implant disease. This RM System design and protocol are key to providing a NEW GOLD Standard of Care the Svoboda Way.

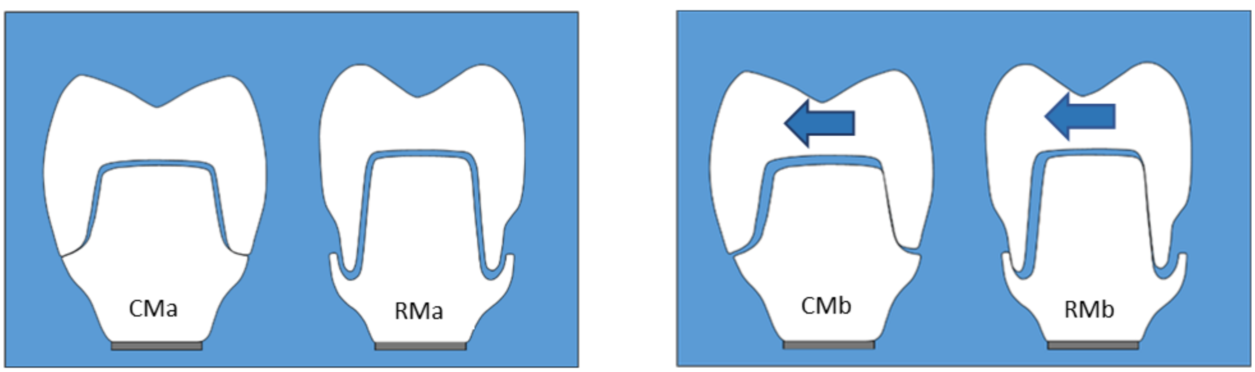


Figure 2: The Chamfer Margin (CMa) Crown System is designed to touch its abutment margin and has a cement space of about 45 µ. It is simply not designed to compensate for expected PDE without causing open and overhanging margins (CMb). The Reverse Margin (RMa Crown System design has 80 µ cement space on all sides and can safely shift, rotate, and tip within its abutment margins to safely manage expected PDE (RMb). The blue arrows inticate a lateral shift caused by tight contacts caused by PDE and/or the TE. The RM System mitigates the TE by preventing its prosthesis from contacting adjacent gingiva. This is unlike the CM System.

I want to acknowledge that the **screwmentation concept was on the right track to make prosthesis installation better because it separates the installation of the abutment from the prosthesis,** and thus separates the management of the TE from PDE. However, previous authors were frustrated by old prosthesis margin designs and installation systems that were simply were not designed to manage the TE nor tolerate expected PDE. (**Figure 2**) They did not appear to grasp how the "now-identified root causes of complications" prevented the optimized seating of implant components nor the mechanisms by which they caused abundant residual subgingival cement.

Let's see how **The Svoboda Way of Screwmentation** solves these inherent problems by its unique design and installation protocol. **Figure 1** illustrates the installation of a single RM abutment and crown to provide an overview of the RM System. Let's hope the reader will understand the involved concepts and that this will stimulate the adoption of a NEW Generation of safer prothesis designs and installation protocols that can reduce peri-implant disease.

Step 1: Optimizing the fit of Reverse Margin™ (RM) Abutments. Prepare the trans-tissue portal to facilitate the easy connection of the custom RM abutment construct (**Figure 3)** to its implant retainer. This can be done by using a wide stock healing abutment or custom healing abutment to shape the trans-tissue portal over the dental implant. If the abutments are still challenging to seat due to RTDE, release those tissues surgically from their hard tissue tethers and modify hard tissues to ensure a confirmed optimized seating. Then torque the abutment screws to specifications at least two times for the most stable results.[23] **The final abutment fit is now optimized on its implant retainer in the mouth.**

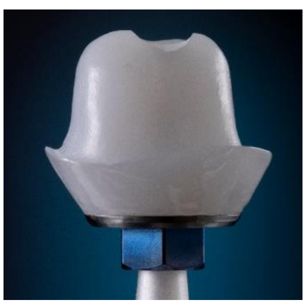


Figure 3: RM zirconia custom abutment shape cemented extra-orally to precision titanium base sitting on a white plastic stem.

Take a peri-apical x-ray image to help verify the optimized seating of the abutment. Note: Forcing these wide girth abutments into place may cause the hybrid abutment shape to separate from its titanium base and/or the abutment screw and/or implant screw channel threads to become damaged. Trying to force together misaligned implant-abutment connectors can cause misfit joints and damage mating parts.

The inflected RM abutment margin is specifically designed to displace gingiva laterally to prevent it from interacting with the prosthesis during its intra-oral adjustment phase. The inflected margin is also designed to redirect excess cement out of the tissue spaces rather than into them. (**Figure 4**) This is unlike the design of Chamfer Margin Systems that use the wider emerging crown profile to displace adjacent gingiva and direct excess cement into the tissue spaces.[6,11,12,14,15,16,19,21]

Figure 4: RM abutment installed with fully torqued fixation screw. Note the clean margin trough.

Step 2: Optimizing the fit of the Reverse Margin™ (RM) Prosthesis by managing contacts with adjacent teeth, abutment retaining elements, tissue-pontic relationships and occlusion. This step is delightfully easy, as the prosthesis is designed have an enlarged cement space on both sides and under its margin. It can thus tolerate expected PDE by allowing the prosthesis margins to safely shift and self-centre within the inflected margin trough of the RM abutment while remaining out of contact with adjacent gingiva. The RM prosthesis design includes a concavity in its tissue facing subgingival profile to provide extra space between it and adjacent gingiva. This design feature creates additional space to facilitate the unobstructed flow of excess cement away from the tissues.

Once satisfied with the fit of the RM prosthesis in the mouth, it is time to pack the abutment screw-access channels with Teflon tape to keep cement out of them.

Step 3: Cementing the RM Prosthesis in place. Ask your assistant to clean the intaglio of the prosthesis to remove saliva proteins, and then add a thin layer of bonding resin. Use a separating medium like Vaseline or some water-soluble substitute to lubricate the outer surface of the prosthesis and adjacent tissues to help with the pending removal of excess cement.

Fill the intaglio of the prosthesis at least ½ full of cement to ensure excess cement will be ejected from all margins during its installation. This will prevent unwanted cement voids at the margins. Use finger pressure to push the prosthesis into place with 2 Kg of intermittent force or less.[12] This is less than half the installation force taught in many dental schools. Once the crown contacts the abutment margin, push the prosthesis harder to ensure its optimized seating.

Briefly polymerize the excess marginal cement. Use a small straight carver to remove excess cement in "rubber stage" by pushing it along the crown surface towards the upturned RM abutment surface. The inflected abutment margin ledge will prevent the straight carver blade from traumatizing adjacent tissues during cement removal efforts.

Fully polymerize the cement again with the light and then use floss and stripping devices to clear any residual excess cement. Check and adjust the occlusion as necessary. Take an x-ray to visualize your installed prosthesis to locate any remaining excess cement. You will note that excess cement may be found above the margin interface and not below it, unlike the location of excess cement expected when cementing prostheses with chamfer margins.

Step 4: Marvel at your accomplishments. You have optimized implant-abutment fit, installed a passively fitting prosthesis, prevented residual subgingival cement, and overhanging and open margins. Yes, you have done a great job and provided your patient with a tissue-facing abutment surface to which their gingiva can attach and provide an excellent barrier to infection. This system provides consistent results due to the design of the RM System and an installation protocol that provides the dentist with a high degree of control each step. This is a low stress procedure. **Figure 5**

In addition, this installation process is efficient because it does not require the removal and reinstallation of the prosthesis to remove excess cement. It is not necessary to drill through the plastic screw access hole, remove the Teflon tape from the abutment screw-access channel, access and remove the abutment screw and prosthesis, clean away excess cement, and then reinstall it again by replacing and double torquing the abutment screw, refilling the screw access channel with Teflon and then replacing the plastic screw access cover.

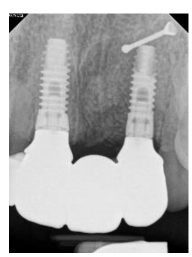
Indeed, you do not even need to ask your lab to create an acrylic covered screw access hole at all. When the implant-abutment fit is optimized, the abutment retaining screw holds better than ever, and it is easy to drill through the top of the prosthesis if it becomes

Figure 5: RM crown installed with excess cement removed.

necessary to tighten or change the abutment screw. If the screw-access hole location is not obvious, you can ask your lab to mark its location.

In any case, a solid occlusal surface without a plastic covered screw access hole is more esthetic, holds the occlusion better and requires much less maintenance. However, as the clinician, you can choose to have a plastic screw access cover if you wish. I don't choose to have a plastic screw access cover because it only takes about 1or 2 minutes to drill through the zirconia crown, if I ever need to access the abutment screw. However, if you wish to have a screw-access hole with a plastic cover, ask you lab for it. With or without a plastic screw access hole, the prosthesis will be retrievable if it has the appropriate retrievability features built into it. Retrievability is not an exclusive feature of a prosthesis that has been installed by a screw-in installation technique.[9]

I want to acknowledge Dr. Wadhwani's large contributions towards our understanding of prosthesis installation. In his book (2015)[24] he states, "it is likely that the abutments of the future will look very different from what we see today."



Figures 6&7: Show an x-ray image of the anterior zirconia bridge connected to implant retainers via zirconia hybrid abutments.

I guess he understood the shortcomings of current designs but could not yet imagine the RM System. The RM abutment and prosthesis has features that does make it look different. Its unique design features were specifically developed to mitigate the root causes of complications. Their contours look different on the dental model, but when installed, they look great in the mouth. (**Figures 6&7**) What looks better to you? Sick, swollen tissues full of pus caused by faulty installation systems, or healthy, maintainable tissues?

Now, it is up to your patient to keep the peri-prosthesis environment clean. Instruction on how to clean the peri-prosthesis area is paramount to protecting the patient's investment in his/her dental health. Using various tools, including an interdental GUM Stimulator twice a day can dislodge plaque from the margins and stimulate the gingiva. The hygiene department will have an easy time accessing and maintaining the tissues around and above the margin. In cases where the abutment margin is supragingival and bothering the tongue, a fine diamond burr can be used to smooth away the margin ledge. The margin ledge has done its work and is no longer necessary. In a subgingival location, there is no need to modify the margin shape. In cases where a little cement remains above the margin and the adjacent tissues are inflammed, it is usually simple to locate and remove the offending cement remnant without any deep scaling or surgery.

Summary: Separating the installation of the abutment from the prosthesis allows the dentist to manage the Tissue Effects, as is the dentist with the best visibility and prospects for well-controlled optimized abutment installation. The RM System design effectively manages expected PDE (**Figure 8**) during the installation of the RM prosthesis. Cement space can be safely increased to compensate as PDE increases along with the size of the prosthesis.

When installing the RM prosthesis, the RM margin trough design makes it possible for the prosthesis margin to adjust its seating position within its margin trough to safely tolerate expected PDE.[19] (**Figures 2**) It also allows the dentist to adjust contacts and pontic areas without needing to repeatedly displace and traumatize tissues adjacent to the abutment margins. This makes intra-oral adjustments of the prosthesis much easier for the dentist.

The RM System's enlarged cement space allows the dentist to cement the prosthesis with reduced pressure without causing residual submarginal cement nor open margins.[12] This feature provides the dentist with better control over the entire cementation process.

The RM System makes it easier for the dentist to deliver consistently excellent results as it prevents implant-abutment misfits, ensures a passive prosthesis fit, prevents subgingival cement, prevents open and overhanging margins, and renders the installation process easier, more predictable, and less stressful for the dentist. Yes, this system is better for dentists and patients. That is what better health care is all about!

The Svoboda Way of Screwmentation is NEXT Generation because it was developed with an understanding of the root causes of complications and designed to mitigate those root causes by design and protocol. It is not only simple and practical but is also

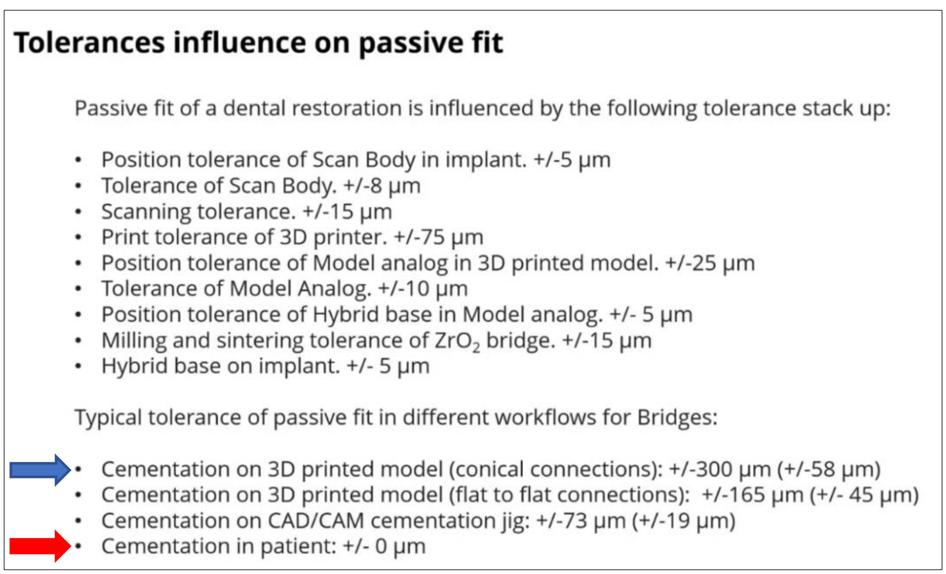


Figure 8: Data from Andersen[7]. Note the error attributed to each step in the production of the prosthesis in the lab under ideal conditions. These combine to make up **PDE**. Conical connectors (blue arrow) add greater error than others and intra-oral cementation can compensate for PDE (red arrow). However, it is only the RM System that is designed to tolerate PDE safely & efficiently.

effective at making the installation system better by preventing complications.

The degree of retrievability is dependent on the retrievability features included in the dentist's treatment plan.[9] **The Svoboda Way System of Prosthesis Installation forms the basis of a New Gold Standard of Care** because it enables dentists to consistently prevent several persistent risk factors for complications.

The whole **dental industry needs to work together** to reduce the risk factors inherent to our current prosthesis installation systems. We can reduce complications by optimizing the fit of implant parts, by preventing submarginal cement and open and overhanging margins, and by making the peri-implant environment maintainable by patients and dental professionals.[2]

There is now a clear choice before us. Does the Profession continue its current treatment trajectory and wait to see what happens, or do we step up and embrace the merits of the new knowledge, experience and innovation that is now available? Fewer complications mean happier patients enjoying better quality of life. The resulting trust and confidence elevate our Profession and organically generate more implant treatment. The RM System concepts are beneficial for all industry stakeholders and the patients we care for.

"As Knowledge advances, we all need to move to keep up. Now is the time to move and make dental treatment better because we can."

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"**A new gold standard of care is now available to our patients.**" Dental industry technology has evolved tremendously over the last 40 years and can make CAD/CAM directed site-specific custom parts from biocompatible materials with microscopic levels of precision that are both esthetic and functional. **The Svoboda Way of Prosthesis Installation** enables the dentist to fully exploit these technological benefits by mitigating the root causes of installation related mechanical complications and thus reducing related biological complications like peri-implant disease.

This innovation can provide a new foundation for advancing dental treatment protocols. Research results on success and survival of implant treatment approaches can now be revisited without confounding variables like misfit implant parts, poor prosthesis margins and residual subgingival cement.

Perhaps researchers can now more easily tease out subtle treatment variables, that have long been obscured by previously unmanageable risk factors for complications. Perhaps this will help us further improve the long-term prognosis of treatment involving dental implants. That is my hope.