Advancement in the Removal of Permanently Cemented Crowns and Bridges

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Abstract

Traditional techniques for removing permanent prosthetic devices do not provide reliable or satisfactory results. At best, they make it possible to keep a tooth at the cost of a time-consuming procedure that also inflicts wear and tear on rotary instruments; at worst, they can cause abutments or restorations to fracture.

Comprised of three carefully designed keys, WAMkey offers a truly unique approach to this challenge while fulfilling numerous expectations. A concrete clinical case will illustrate all of the advantages of this innovative method.

Keywords: Wamkey, Crown remover, Bridge remover, Periodontal ligament.

Introduction

Removal of a crown or bridge, often following a failed therapeutic or cosmetic procedure, is seldom a positive experience for the patient or the dentist. When traditional techniques are employed, this procedure often bears considerable risk for the supporting tooth and its periodontal ligament, and frequently results in the complete and irremediable destruction of the prosthetic device. This procedure can also be costly in terms of time and equipment, as burs and contra-angle handpieces undergo intense wear and tear.

Comprised of three carefully designed keys, WAMkey offers a truly unique approach to this challenge while fulfilling numerous expectations. To use the device, a small slot must be drilled through the axial wall of the crown at the level of the cement layer between the occlusal aspect of the prepared tooth and the inner surface of the crown. Introducing and rotating one of the keys into this slot (almost) always loosens the crown. In most cases, one to two minutes per crown is more than enough time for complete removal. Several precautions are emphasized and recommended herein to ensure the procedure is risk-free for the tooth and trauma-free for the patient. As the icing on the cake, this technique allows the crown to be reused following a simple repair procedure.

Generally speaking, the obstacles to crown removal common to all devices used are: retention, the type of seal and the supporting abutment's ability to withstand the mechanical constraints required for successful removal.

1. **Retention is essentially determined by:**
   a. The shape of the preparation: the retention force is inversely proportional to the preparation's degree of taperness[1] and can potentially be increased by the presence of retention devices (grooves).
   b. The contact surface between the abutment and the prosthetic device: the retention force is naturally proportional to this value.

2. **The seal**
   a. The adhesion index can as much as triple, depending on the product being used (i.e. an oxyphosphate vs. an adhesive such as Panavia).[2] The force required for removal therefore varies in the same proportions.
   b. The cohesion of this cement or glue seal deteriorates over time.[3]

3. **The abutment's structure and shape can contraindicate all removal attempts:**

- A high, thin abutment, for example, is much more vulnerable to fracture than a low, wide one.
- If incorrectly perceived, the angle divergence between the long axis of the tooth and that of the buildup can lead to iatrogenic removal forces.
- The very nature of the stump – be it metal, resin or natural tooth – will make it more or less resistant to the forces exerted during the removal process.

A – Traditional Solutions

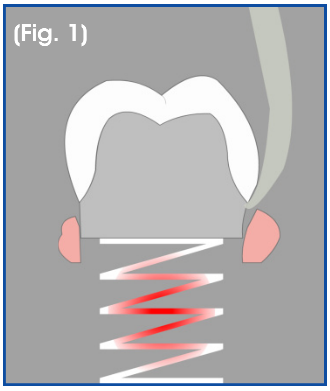
1. Traction-based methods and devices (manual crown removers, sticky paste squeezed between the teeth, various pliers, etc.)

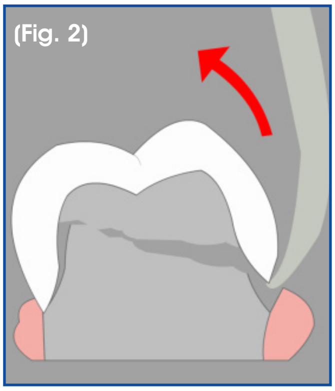
Regardless of the instrument used to remove the prosthetic device – be it manual, assisted or mechanized – dentists face **three unavoidable challenges:**

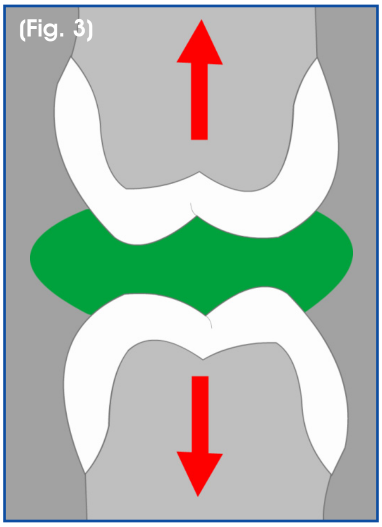
a. A significant portion of the dentist's energy or that of the instrument being used is absorbed by the periodontal ligament **(Figure 1**). Not only does this account for the pain felt by the patient, it can also cause a luxation of the ligament. Moreover, it explains the ineffectiveness of the many traction-based devices currently available on the market, in which only a very low percentage of the energy produced is utilized to actually break the cement.

b. When the crown is supported by a core buildup, the dentist does not know in advance what will come off: the buildup or the crown. In addition, when the buildup is anchored with a post, the root is more fragile, which increases the risk of fracture during removal attempts.

c. Modern technology does not enable dentists to see through metal crowns in order to have a precise view of the axis of the preparation. It is virtually impossible for the dentist to be certain that forces are being directed precisely to the same axial direction as the crown's path of insertion. For this reason, the dentist generally proceeds with a series of light, off-center tapping movements. Abutment fractures are therefore common **(Figure 2**).


(Fig. 1)


(Fig. 2)


(Fig. 3)

A similar technique involves asking the patient to bite into an adhesive paste **(Figure 3)**, as if it were a caramel or nougat, and then asking the patient to try to open, hoping that the traction will occur in the axis of coronal draw. However, there is no guarantee that the dentist made the preparations in the same axis as that in which the jaws open and close. Moreover, in the case of buildups or crowns on antagonist teeth, the result of this technique relies purely on chance or, more accurately, on a fundamental law: the weakest link always gives.

In short, besides the fact that crown "pullers" and other similar devices are often ineffective and may cause considerable patient trauma, above all their use presents serious risk factors for the periodontal ligament and the tooth, and their outcome is highly unpredictable.

2. Destruction of the crown

While some consider this to be the safest and least traumatizing method for the patient and the tooth, it destroys the margin of the crown and eliminates all chances of reusing the crown. In addition, depending on the type of alloy used, this operation can be long and can inflict superfluous wear and tear on rotary instruments.

3. Ultrasonics

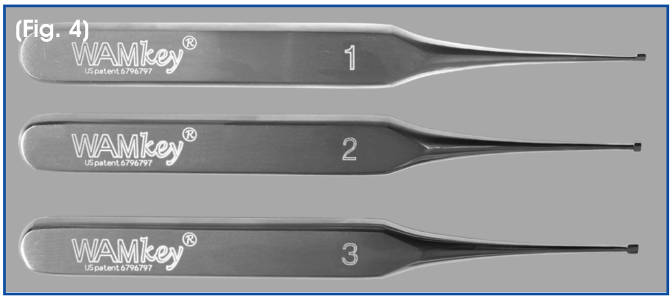
This may seem like a good solution because of its atraumatic nature. However, the application of vibrations over long periods of time can damage the ceramic or even cause it to become detached from the metal coping.[4] Ultrasonic energy also generates considerable heat which can cause permanent damage to the nearby pulp, periodontal ligament and bone. In addition, removing the crown with this method often requires more time than a dentist is willing to spend on an act that may have no value in the eyes of patients.

In 2000, a concept developed by Dr. William Muller (Aix-en-Provence, France) was introduced enabling dentists to accomplish this act with greater peace of mind and often astonishing results. Its name is WAMkey.

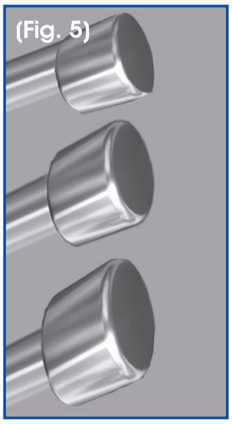
B – WAMkey

The device

A set of three keys **(Figure 4)** with oval-shaped cam-like tips whose sections range from 2.5 to 5mm^2 **(Figure 5**).



(Fig. 4)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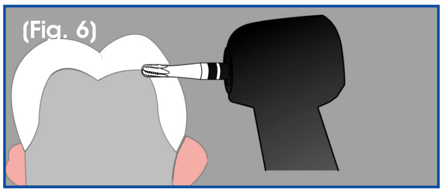
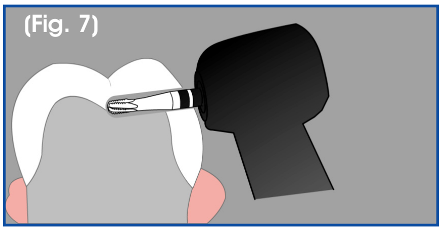

(Fig. 6)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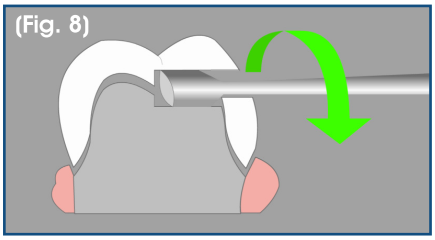
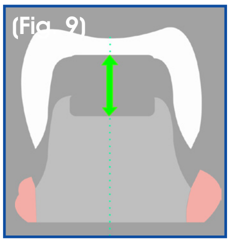
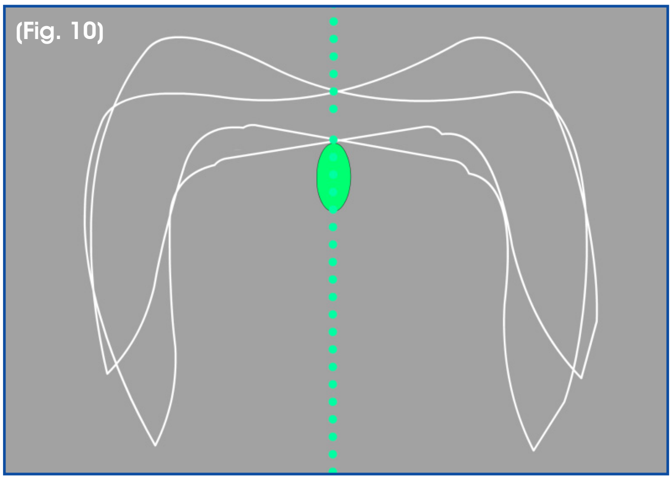

(Fig. 8)


(Fig. 9)


(Fig. 10)

The protocol
The idea is relatively simple, and consists of four steps.

1. **Create a small window in the crown** (**Figure 6**)
   Using the appropriate bur depending on the material encountered, the dentist creates a window (1-2mm in diameter) where the preparation/crown occlusal interface is assumed to be located. Of course, the opening should be made closer to the occlusal surface for metal crowns, and perhaps about halfway between the occlusal surface and the margin for porcelain or porcelain fused to metal crowns.

2. **Locate the stump/crown occlusal interface**
   Chances are, the dentist will locate this interface in Step 1, in which case he/she can directly proceed to Step 3. However, in some cases, the opening will have to be progressively enlarged until the cement seal becomes visible. The most complex procedure is the removal of crowns on post-cores. The fact that the seal is located between two structures of identical material and that it is generally very thin can be a challenge. Visual assistance devices such as a surgical loupes or a microscope can be extremely helpful.

3. **Create a tunnel between the occlusal surface of the preparation and the inner side of the crown** (**Figure 7**)
   Using a cylindrical bur (approximately 1.2mm in diameter), the dentist drills an oval-shaped tunnel between the occlusal surface of the preparation and the inner side of the crown. The difference in hardness between the dentine and the crown's structure will help the dentist ascertain the bur's position with regard to the dentine. On a vital tooth, to avoid all risk of pulpitis, a water syringe should be used for irrigation purposes in addition to the contra-angle handpiece spray.

Verify the depth of the tunnel using a rubber-stop inserted onto the smallest WAMkey device. It is essential to achieve maximal proximity to the center of the preparation, so as to work as close as possible to the long axis of the preparation during the removal procedure.

4. **Insert a key into the tunnel and rotate to loosen the crown** (**Figure 8**)
   Simply insert the key all the way to the end of the tunnel drilled in Step 3 and rotate it one quarter-turn. This creates a couple of forces between the preparation and the crown's inner side. If the tunnel was properly drilled, this movement should occur in the long axis of the preparation.

Mechanical analysis
The effectiveness of the concept can be explained in a relatively simple manner by comparing it to a crown remover.

a. There is little or no energy loss resulting from this mechanical principle (**Figure 9**). The only energy loss is caused by friction between the key and the crown's inner side, and between the key and the preparation's occlusal surface. This loss is considerably reduced by the instrument's shape and surface condition, and can be reduced even more by lubricating the tip of the device with Vaseline for the most delicate cases. The logical outcome is that a much lower degree of force is required to loosen a crown using WAMkey than with a traditional crown "puller".

b. As opposed to crown removers, the forces are essentially exerted in the axis of the preparation,[5] provided that the tunnel between the crown and the preparation was drilled as close as possible to the center of the preparation. Thus, when the couple of forces go into action, the crown, propelled from its center, is free to "choose" its trajectory **(Figure 10)**. And so it follows the path of least resistance. Combined with the fact that there is little to no energy loss, this means that crowns can be removed with very little effort.

c. No trauma for the ligament: Contrary to crown removers, pressure – not traction – is exerted on the ligament. The patient therefore enjoys maximum comfort during the procedure. In most cases, no anesthesia is required.

d. No risk for buildups. The crown is removed thanks to a couple of forces exerted between the preparation and the crown. In the case of restorations, the pressure is applied to the buildup apically, thus eliminating all risk of loosening it.

Advantages of the device

The advantages of this concept stem from what we described above.

1. Quick and simple

The device is very easy to use. Two or three uses are enough to become familiar and comfortable with the concept. In general, one-and-a-half to two minutes suffice to remove a crown. Only full-metal or porcelain fused to metal crowns can sometimes take a bit longer as the dentist must first locate the cement seal. Removal of ceramic crowns can also be delicate if one wants to keep the ceramic fully intact.

2. Efficiency

Based on what we explained above, this concept offers unprecedented efficiency. Nevertheless, one limitation must be mentioned: anterior teeth. Because of their configuration, it is generally not possible to use this method to remove crowns from anterior teeth. In all other cases, users frequently report a high success rates, even when used on the most modern cementing products.

3. Little to no risk

The innocuousness of this device stems from what we described above. The forces exerted are reduced to a minimum and are applied to the long axis of the preparation,[6] with pressure applied apically to the abutment tooth.

4. Less wear and tear on rotary instruments:

This varies depending on the type of alloy. Obviously, dentists who frequently remove prosthetic devices made of a non-precious alloy or a more recent material (e.g. zirconium) will be more swayed by this argument.

5. Reuse of the crown or bridge

The most important parts of the crown are not altered. If the dentist does not modify the margin of the abutment, and the crown still fits the abutment, then a simple repair will enable the crown to fulfill all of its original functions. This can be an advantage, particularly in the following cases:

- Immediate reuse of the removed crown when the visit does not allow enough time to fabricate a temporary crown.
- Canal retreatment procedures performed through a crown are often more delicate than if the crown is removed (improved visibility and access to the canal). When the outcome of the treatment is uncertain, permanent or long-term reuse of the crown (18-24 months) can be an effective transitional solution.[4,7-10]
- Bridges with partial detachment: If a bridge becomes loose on one abutment without posing any particular adjustment issues, reusing it can be a worthwhile alternative and compromise for the patient.[5]
- Long bridges can be temporarily reused following a rebase procedure, while adjustments are made to the various abutment restorations.

In most, if not all cases, the temporary reuse of the crown is clearly a major advantage.

For all of these reasons, WAMkey represents a major advancement compared to all previous techniques.

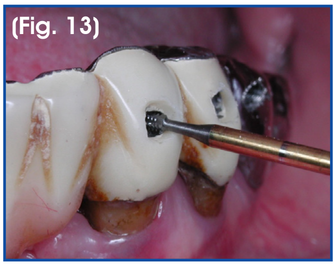
Clinical Case

Extensive work was planned to be performed for the patient. A complete maxillary prosthesis must be made, and for obvious biological and cosmetic reasons **(Figures 11,12)** the lower bridge must be removed. The nickel-chrome framework features a long support span, in one block, with no anterior abutments. Before removal, we cannot be certain of the condition of the six existing abutments or whether it will be possible to save them. Salvaged abutments will need to be endodontically retreated, rebuilt and reinforced with fiber posts. Once rebuilt, and depending on their mechanic potential, a fixed prosthetic solution will be considered, such as a tooth-supported bridge or an implant-tooth supported prosthesis. A single visit, even if very long, will not be enough to retreat and restore all six teeth and make a temporary, reinforced 12-unit bridge.

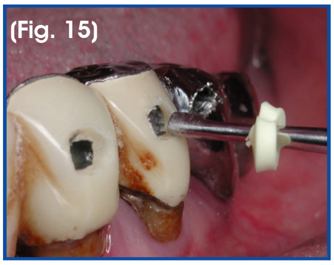
We decided to remove the fixed bridge, assess the clinical situation, apply periodontal treatment, minimally adjust the marginal limits and rebase the original bridge for temporary use until the endodontic therapy could be completed.

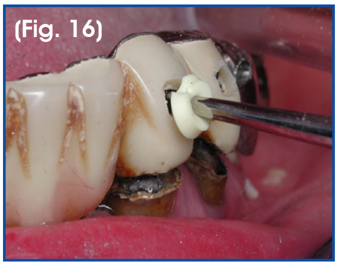

(Fig. 11)


(Fig. 12)


(Fig. 13)


(Fig. 14)

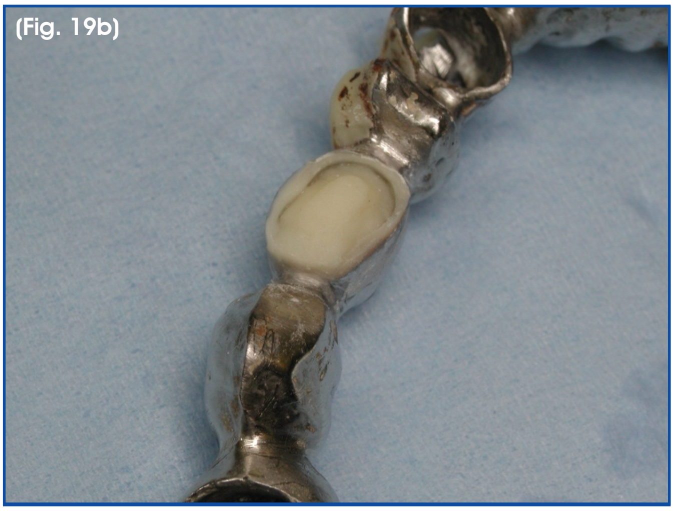

(Fig. 15)


(Fig. 16)


(Fig. 17)


(Fig. 18)


(Fig. 19a)


(Fig. 19b)


(Fig. 20)


(Fig. 21)

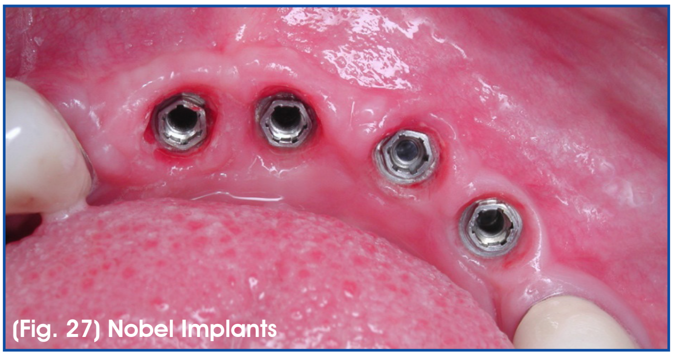

(Fig. 22)


(Fig. 23)


(Fig. 24)


(Fig. 25)


(Fig. 26) Temporary anterior bridge


(Fig. 27) Nobel Implants


(Fig. 28) Procera Framework


(Fig. 29) Completed Case

Of course, we could have removed the crown by destroying all of its components. This undoubtedly would have been lengthy and tiresome procedure for the patient and the practitioner, and given the type of alloy encountered, several burs would probably have been used. We also could have tried to remove the entire bridge using a crown remover, with all of the risks inherent to such a procedure.

Instead, we create a small opening in all six abutments **(Figures 13,14)**. This operation required seven to eight minutes. As recommended by the manufacturer, the depth of each orifice is measured **(Figures 15,16)** using a rubber-stop attached to the smallest WAMkey device so as to ensure that the forces are exerted as close as possible to the long axis of the abutments.

As compared to single crown removal, bridge removal requires more controlled action on each abutment in order to avoid generating tension on the adjacent abutments. Each abutment is therefore handled individually in order to break the cement seal. Once all six seals are broken, the bridge is manually removed. The procedure was performed without the slightest discomfort for the patient, and no anesthesia was necessary. On most abutments, an astonishingly low amount of force is required to break the seal.

Tiny nicks can be seen on the occlusal surface of each abutment **(Figures 17,18)**, caused by the bur. Although unfortunate, this loss of matter has no major impact on the outcome of the treatment. The entire bridge removal procedure, including hole-drilling, took no more than fifteen minutes.

Next, we proceeded to reline #45 **(Figure 19b)** the bridge that was just removed **(Figure19a)** before temporarily re-placing it **(Figure 20)**. Obviously, this "recycling" is a genuine God-send in a case like this, as it saved the several hours of additional work required to fabricate a temporary prosthesis of this size.

The preparations were also modified **(Figures 21,22)** and new prosthesis fabricated **(Figures 23-25)**. The final decision was to extract tooth no. 43, to make two tooth-supported lateral bridges and an implant-supported anterior bridge with Procera zirconia reinforcement.

In a case like this one, this new removal technique offered very concrete benefits in terms of patient comfort and time-savings (removal time, immediate fabrication of temporary). It also provided an extremely useful immediate transitional solution for temporization and therapeutic planning.

Conclusion

Until now, dentists were torn between safely removing a crown or bridge, and destroying it. By fulfilling three criteria in the vast majority of cases – rapid and cost-effective removal, preservation of support teeth and preservation of the prosthetic devices for temporary or permanent future reuse – WAMkey crown removal keys offer a particularly comfortable and efficient alternative, making them an integral part of every dentist's basic instrument set.

Acknowledgment

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