

Review of techniques for the intact removal of a permanently cemented restoration

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The safest and least traumatic means of removing a cemented restoration is to cut a slot and pry the crown or retainer loose, sacrificing the restoration. However, various techniques and instruments for intact removal of permanently cemented cast restorations have been described in the literature. This literature review explores conservative and semiconservative techniques that are useful for preserving permanently cemented restorations during removal. Richwil resin, ultrasonic energy, and crown tractors can be considered preferred methods for removal of temporarily cemented restorations. Patients should be informed regarding the risks and benefits before removal of a cemented restoration.

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Permanently cemented restorations may need to be removed for various reasons, such as elimination of secondary caries beneath the crown, endodontic treatment of a tooth with irreversible pulpitis, or removal of a fixed partial prosthesis with a loosened retainer at one end. Other situations that might dictate the removal of a cast restoration include the need to repair chipped or fractured porcelain and the need to correct shade or shape mismatches of the porcelain veneer. However, removal of a fixed prosthesis is always an unpredictable procedure that may result in complications. Before the removal of a crown, the dentist cannot know with certainty what lies beneath it, including the thickness of the restorative material.¹

The safest, least traumatic method of removal is the “sacrifice” of the restoration; a slot is cut buccolingually through the crown or retainer to separate it into mesial and distal halves.² The segments are then pried apart with a rigid instrument. However, several factors may necessitate intact removal and reuse of the restoration. These factors include the patient’s age and health, the time involved, esthetics, and financial considerations as well as social and psychological concerns.³

Sharma et al noted that multiple mechanisms are available for removal of a crown or fixed partial denture, but no classification existed for those removal systems.⁴ Therefore, they classified the systems into 3 groups to help guide the clinician in choosing the correct tool or technique according to the clinical situation.⁴ The first group involves conservative techniques that preserve the intact prosthesis and enable its reuse.⁴ In this approach, the clinician usually applies traction or percussion to break the bond with the luting cement. Methods of this type include ultrasonic energy, pneumatic instruments (such as CORONAflex, KaVo Dental), sliding hammers, and crown tractors. The Richwil crown and bridge remover (Almore International) does not require the use of percussive force and is among the safest of the conservative methods to remove restorations.

The second restoration removal group comprises semiconservative techniques that enable crown reuse with minor repair.⁴ Such techniques involve the creation of a small slot or hole in the prosthesis so that force can be applied between the tooth preparation and the restoration. Systems using this approach include the WAMkey system (WAM), the Metalift crown and bridge removal system (Hager Worldwide), and the Higa bridge remover (Higa Manufacturing).

The third group represents destructive techniques that destroy the prosthesis completely, as the crown is sectioned and levered off.⁴ Instruments involved in this approach include tungsten carbide burs and the Christensen crown remover (Hu-Friedy Mfg).

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**GENERAL DENTISTRY
SELF-INSTRUCTION**



Exercise No. 409, p. 54

Subject code: Fixed Prosthodontics (610)

The records of dental insurance companies indicate that crowns have an average life span of 7-8 years.¹ However, in some situations, crowns may survive throughout a lifetime.⁵ When prosthesis removal is necessary, careful planning is essential to ensure success and prevent injury to the underlying dental tissues.² Factors that significantly affect the intact and safe removal of a crown or fixed partial denture include (1) the patient's systemic health—ultrasonic techniques are contraindicated in patients with hepatitis B or herpes and those with cardiac pacemakers; (2) restoration location with respect to intraoral accessibility; (3) the number of abutment teeth involved; (4) the amount of sound tooth structure remaining—the sacrifice of a fixed partial denture may be advisable when insufficient tooth structure remains to avoid further compromise of the tooth and resultant complications; (5) the nature of the abutment—endodontically treated abutments are more susceptible to coronal and root fractures; (6) the presence or absence of a post and core restoration—if the post and core is part of a crown casting, removal is more problematic; (7) the restoration design and material; (8) the cementation agent used—newer generation bonding materials are more difficult to remove; (9) the taper of the preparation; (10) the periodontal status of the tooth; (11) the removal device to be used—in unusual cases, combined techniques are useful; and (12) the direction of force—removal force should be exerted along the path of draw, as force applied in the wrong direction may damage the tooth or core beneath the restoration.^{1,2,5-9} Patients should be informed regarding the risks and benefits before intact removal of a cemented restoration is attempted and should be cautioned that a destructive approach ultimately may be required.^{2-4,10}

Different devices and techniques have been developed for the safe and nontraumatic removal of permanently cemented fixed prostheses. The aim of this article is to present the results of a systematic, content-based analysis of the literature on conservative and semiconservative techniques for the intact removal of permanently cemented restorations and to discuss the advantages and disadvantages of each technique.

Conservative techniques for prosthesis removal

Copper band

Ewing described the use of a copper band as an instrument to remove prostheses.¹¹ In this process, a copper band is applied tightly around the tooth. The copper band is penetrated with a nail above the level of the tooth and then filled with cement. After the cement inside the band hardens, the nail is moved in a rocking action to loosen the crown and eventually allow its removal. With advancements in technology, this technique has been replaced with other methods in the clinical setting.

Back-action crown removers

Back-action crown removers are available in manual, spring-loaded, spring-loaded semiautomatic, spring-loaded automatic, and pneumatic types that deliver an impact force to the restoration.

Manual back-action instruments (sliding hammers) are the classic tools used to remove crowns and fixed partial dentures, although they are primarily designed for the removal of temporary restorations. With these devices, the crown margin is

engaged with the tip of the instrument, and impact force is then applied by manually sliding a weight along the hammer shaft, producing short, quick taps to loosen the restoration. Fixed partial dentures can be removed using brass wire threaded through the embrasures of the prosthesis to form a loop to which force can be applied.

The use of this system can be uncomfortable for the patient, and forceful percussion can lead to fracture of the tooth, the core material beneath the restoration, or the porcelain margin. Accidental sliding of the hammer is not uncommon and may injure teeth or tissues. In addition, use of these instruments on periodontally involved teeth is not recommended due to the risk of unintended extraction. Furthermore, determination of whether the force is exerted along the long axis of the preparation is difficult.^{5,10}

Spring-loaded back-action instruments include manual, semi-automatic, and automatic devices.³ In manual instruments—such as the Kohler spring-loaded crown remover (Kohdent Roland Kohler), or the Kentzler-Kaschner Dental Type C crown remover (Kenzler-Kaschner Dental)—the spring is compressed and released manually to deliver the impact force. Semiautomatic instruments—such as the Bontempi crown remover (BMT Medizintechnik), the Crown-A-Matic (Peerless International), or the Kentzler-Kaschner Dental Type A crown remover (Kenzler-Kaschner Dental)—allow for more control of the direction of force, as the clinician secures the instrument tip at the crown margin with one hand while operating the system with the other. These instruments must be removed and reactivated after each deployment. Automatic spring-loaded crown removers—such as the Kentzler-Kaschner Dental Type B crown remover (Kenzler-Kaschner Dental) or the Medesy Automatic Crown Remover (Medesy)—are operated with 1 hand. The clinician presses the handle to release successive shock impulses. Hence, the instrument does not need to be removed for reactivation.^{5,12}

Pneumatic crown removers—such as the CORONAflex, the Safe Relax (Anthogyr), or the Easy Pneumatic Crown and Bridge Remover II (Dent Corp)—are automatic devices used to remove cemented cast restorations. The tip of the instrument is placed at the crown margin, and the dental handpiece is activated to deliver short, repeated, low-impact forces while compressed air is released to break the cement seal. A pliers-type instrument is used for single crowns, and a wire loop is threaded around a fixed partial denture with a metal holder for the removal of this restoration type.^{3,12} The CORONAflex crown remover delivers a short, sharp, impact force, resulting in the breakage of the cement seal instead of tooth fracture, whereas manual crown and bridge removers deliver long, slow blows.^{4,13} Schierano et al identified the CORONAflex device as achieving greater and more consistent force amplitude than a reverse hammer during the removal of cemented crowns.¹⁴ However, Marais noted that this device can only be used for restorations cemented with carboxylate, zinc phosphate, or zinc eugenol cement.¹³

Although automatic crown removers are costly, they can save time and expense by enabling nontraumatic restoration removal (they are particularly effective for fixed partial denture removal), treatment of the underlying abutment, and recementation of the prosthesis.^{4,15} For preventing damage to

the tooth, gingival tissue, or crown margin, various clamps and jaws have been designed for adaptation to the outer surface of the crown before a back-action percussion instrument is used to remove it.^{15,16}

Matrix band

Sharma et al, citing McCulloch, reported that a Siqueland matrix band has been used successfully for crown removal.^{4,17} After the matrix band is adapted over the crown and burnished into the undercuts, it is pulled vertically to disengage the crown.

Orthodontic band remover

Karnoff reported the use of traditional orthodontic band-removing pliers to remove permanently cemented crowns and bridges.⁹ In this technique, Karnoff drilled a hole through the occlusal surface of the crown, creating a simulated orthodontic band. He placed one beak of the orthodontic pliers in the prepared hole, engaged the other beak under the margin of the crown, and applied a squeezing pressure until the crown was dislodged. This approach must be used carefully to avoid luxation of the tooth.⁹

Resin coping

If a metal-ceramic restoration resists easy removal during fitting or after temporary or final cementation, autopolymerizing acrylic resin can be applied to the restoration to provide an area of mechanical purchase for a crown puller.¹⁸ After the resin coping is fully cured, the crown puller is placed beneath the resin undercut. A light tapping force is exerted on the resin coping to remove the crown safely. This approach prevents accidental sliding of the puller during tapping or extraction of the crown. This technique can be modified by creating a retentive pit on the facial aspect of the crown to retain the resin coping. The pit is subsequently repaired with composite resin.¹⁹

Richwil crown and bridge remover

The Richwil crown and bridge remover is a water-soluble thermoplastic resin that develops strong temporary adhesive properties under compression. Oliva found that the Richwil crown remover can be used to remove both temporary and permanently cemented cast restorations.²⁰ It has been described as the most effective instrument for the successful dislodgment of cast restorations.²⁰ The resin is softened briefly in hot water and then placed on the occlusal or incisal surface of the restoration. For the removal of fixed partial dentures, the remover is applied to the occlusal surface of each retainer. The patient is then instructed to close his or her mouth, compressing the remover to two-thirds of its bulk, and the material is cooled with an air syringe. After about 10 seconds, the patient is asked to open his or her mouth quickly and forcefully. The restoration and remover will adhere to the opposing tooth.²⁰

The success of the Richwil crown remover depends not only on its proper handling but also on patient cooperation; when both of these conditions are fulfilled, restorations can be removed easily and conveniently. On some occasions, the procedure must be repeated. Oliva reported 100% success with the use of this technique in removing temporarily cemented restorations and 60% success for the dislodgment of permanent cast

restorations, this in conjunction with the application of ultrasonic energy.²⁰ The technique cannot be used if the opposing tooth or restoration is of questionable stability, as it could result in the removal of that structure.^{3,4,20} To prevent aspiration of the resin crown remover, the manufacturer recommends tying it with dental floss.¹²

Ultrasonic energy

Ultrasonic scaler tips are commonly used to remove cemented crowns. The scaler tip is placed in a small groove or tunnel cut in the restoration, and vibration with copious application of water breaks the cement seal. This technique has drawbacks if not performed correctly. It is time consuming, and the prolonged use of the vibration may cause chipping of the porcelain layer. In addition, the heat generated could damage the vital pulp.⁴ As noted earlier, ultrasonic techniques are contraindicated in patients with hepatitis B or herpes as well as individuals with cardiac pacemakers.⁶

Conservative removal of a crown or fixed partial denture can also be achieved with the application of ultrasonic energy before the use of a Richwil crown and bridge remover.²¹ During the procedure, the ultrasonic unit is set to a power level of 5-10 vibrations/second, and the tip is placed on the metal part of the restoration, thus avoiding the porcelain or casting margin. After the ultrasonic energy is applied for sufficient time to break the cement seal (5 minutes, or more if multiple dental units are involved), the thermoplastic resin is applied, and the procedure is performed as described earlier. Parreira et al reported that this technique was successful in 60% of cases.²¹ It cannot be used on porcelain-fused-to-metal restorations, where all surfaces are veneered with porcelain. The authors did not specify whether the technique was effective with certain cements, but an ultrasonic unit manufacturer (Osada) cautions that it will not work on castings cemented with zinc polycarboxylate or glass ionomer cement.²¹

As with the use of thermoplastic resin alone, patient education is important to gain cooperation, and the procedure may need to be repeated. In addition, the technique should be used with care on periodontally involved teeth and cannot be used when the opposing tooth or restoration is of questionable stability. Research has shown that the application of ultrasonic energy, alone or in conjunction with other techniques, can successfully remove restorations.⁴

Semiconservative techniques for prosthesis removal

Commercial instruments

Different instruments have been developed to actively engage a cemented cast restoration by means of a small access hole or window cut through the crown. The abutment tooth is used as a fulcrum while a lifting force is applied to the prosthesis, breaking the cement seal. These techniques are considered to be semiconservative.

The Metalift crown remover is based on the jackscrew principle. A small hole is drilled through the occlusal surface of the crown, and a screw is threaded into the hole until it contacts the occlusal surface of the abutment tooth. This procedure generates a jacking force that breaks the cement seal and lifts

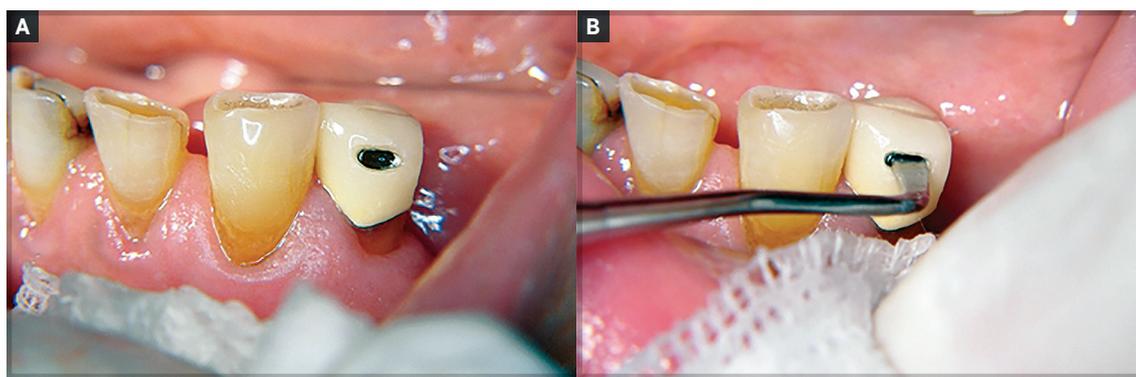


Figure. Removal of a cemented crown from a mandibular premolar. A. A tunnel is created on the buccal surface of the crown. B. A rigid plastic instrument is used to break the cement seal.

the crown from the preparation.^{3,10,22} The hole is then repaired with composite restorative material. The effectiveness of this technique relies on sufficient thickness of the occlusal metal (minimum of approximately 0.5 mm) to enable the engagement of the screw threads. It can be used to remove metal-ceramic restorations, but ceramic should be removed from the area of the hole to minimize the risk of porcelain fracture. This technique cannot be used on crowns with posts or pin build-ups.^{9,22}

The Kline crown remover (Brasseler USA) is a stainless steel pliers; one end has a pin, 6.0 mm long and 1.6 mm in diameter, that engages a hole created on the cusp tip, and the other end has a pointed tip that engages the restoration margin. Squeezing the handle of the pliers produces pressure and breaks the cement seal.¹² This system is similar to the technique of using orthodontic pliers, as described by Karnoff.⁹

Use of the Higa system involves threading a wire under the solid connector of a fixed partial denture and pulling it into a loop. The wire is then threaded to a cable system. When this system is tightened, the restoration is pulled upward while equal downward force, applied to a support pin inserted into a small hole on the occlusal surface, holds the abutment down.^{5,12}

Use of the WAMkey system involves the creation of a small tunnel on the buccal surface of the crown between the occlusal surface of the preparation and the intaglio surface of the crown. Then a narrow-shanked, oval key (available in 3 sizes) is inserted in the tunnel parallel to the occlusal surface and rotated 90 degrees. The crown follows the path of least resistance and lifts up from the preparation. With the help of resin restorative material, the hole in the crown is filled, and the restoration is recemented.^{3,4} Movement of the WAMkey instrument is an attempt not to lever off the crown but rather to break the seal.

The concept of the WAMkey is not new; Tylman described the use of a similar principle in 1965.¹⁶ A small hole is created in the buccal surface of the crown, at a level between the occlusal surface of the crown and occlusal surface of the prepared tooth. Then a long, round rod is inserted in the hole and the crown is pried occlusally. The author of the present review has successfully removed 2 permanently cemented crowns using this technique and a rigid plastic instrument (Figure). Locating the interface between the occlusal surface of the tooth preparation and the crown can be difficult, however.^{3,4,10}

Buccolingual dimple technique

Herman described a technique in which small dimples are made in the gingival thirds of the buccal and lingual crown surfaces.¹ The dimples act as receptacles for Baade pliers, which are normally used to remove temporarily cemented crowns. The clinician twists the pliers to break the cement seal and remove the crown.¹

This technique is useful for teeth with short clinical crowns or excessively tapered preparations. When a crown resists removal with this technique, the clinician should not attempt to remove it forcefully, as this approach may fracture the tooth. The technique is contraindicated for periodontally involved teeth, mobile teeth, and those with unfavorable crown-root ratios.¹

Removal of porcelain crowns and veneers

The need to remove all-ceramic restorations, such as porcelain laminate veneers and porcelain crowns, can result from recurrent caries, porcelain chipping or fracture, and patient-reported problems with a restoration's position, shape, or shade. Such clinical scenarios call for intact removal of the restoration—without damaging the underlying tooth—to permit rebonding after laboratory repair.²³

As an alternative to traditional removal techniques (such as handpieces and diamond burs), lasers can be used successfully to debond porcelain laminate veneers and crowns. The application of an erbium laser at 2780-2940 nm for less than 2 minutes can adequately debond a veneer restoration.^{3,24,25} The laser wavelength passes through the porcelain and is absorbed in the water present in the luting agent, causing thermal softening of the resin. After application of the laser, a mechanical remover (curette or crown remover) is used for complete veneer removal.²³ Thin veneers are more vulnerable to fracture during removal. Morford et al found that IPS e.max porcelain (Ivoclar Vivadent) was more fracture resistant than other types of porcelain.^{23,25}

Porcelain-fused-to-metal, zirconia, and aluminum oxide crowns have not been removed successfully with laser application.²⁵

Retrieval of implant crowns

The incidence of abutment and screw loosening appears to have declined recently; studies published through 2000 show a 5-year complication rate of approximately 24.4% (range, 5.8%-72.9%), whereas those published after 2000 show a rate of 5.6% (range,

3.2%-9.6%).²⁶ However, screw loosening remains a common complication associated with implant-supported restorations, particularly posterior implant-retained single crowns.^{27,28}

Retrievability is a major advantage of screw-retained over cement-retained implants. However, for other important reasons, such as esthetics, ease of fabrication, easier access to posterior restorations, and creation of ideal and stable occlusal contacts, the majority of implant-retained crowns are cemented to screw-retained abutments. When screw loosening occurs, these crowns become mobile, and their retrieval is difficult. Sectioning of a mobile implant crown with a loosened abutment screw may damage the abutment screw head, making the abutment nonretrievable. Furthermore, use of conventional crown removers on these restorations is contraindicated, as it can damage the internal threads of the implant.^{3,29}

If an abutment screw loosens, the abutment screw head must be located and accessed precisely. This can be achieved with the aid of an intraoral periapical radiograph or cone beam computed tomography.^{30,31} Schwedhelm & Raigrodski recommended staining of the occlusal surface of the crown at the site of the abutment screw as a means to locate screw access if it should become necessary.³²

Several approaches reported in the literature involve the creation of a small access opening or slot within the crown to reach the abutment screw and tighten it without damaging the cemented crown.^{29,33,34} Gupta & Verma stabilized the crown and abutment by placing a polyvinyl siloxane putty index over the implant crown and adjacent teeth.³³ They then sectioned the putty over the implant to create access for the cutting bur. They claimed that this approach minimized vibration during the cutting of the access hole and aided tongue and cheek retraction.

Prestipino et al described the creation of a flat retrieval slot in the lingual marginal area of the crown-abutment interface during wax-up.²⁹ They fitted a flat-headed driver into the slot and rotated the driver clockwise, creating a torquing force that pushed downward on the abutment while pushing upward on the prosthesis, eventually resulting in breakage of the cement seal.

Ichikawa et al reported 2 techniques for the retrieval of a cement-retained implant prosthesis.³⁴ One technique involves the integration of a small removal screw (4.0 mm long and 1.2 mm in diameter) on the lingual surface of the superstructure at an oblique angle from the occlusal surface. Clockwise rotation pushes the bottom of the screw against the abutment, separating it from the superstructure. In the second technique, a small dimple is included on the abutment, and a vent hole is created in the lingual surface of the superstructure. A modified dental explorer is inserted through the vent hole on the crown to engage the dimple on the abutment. Occlusal rotation of the instrument creates a shear force that breaks the cement seal.

Rajan & Gunaseelan described a technique for the fabrication of a retrievable cemented restoration.³⁵ A screwdriver is positioned to maintain a screw access channel during wax-up, casting, and ceramic application of the implant crown. When the crown is cemented, excess cement that is extruded through the channel is removed, and the channel is sealed with composite resin. Uludag & Celik later applied this method to a multiunit prosthesis.³⁶

Two clinical reports described a technique used to reach an abutment screw in a cement-retained restoration.^{37,38} The technique aims to accurately determine the 3-dimensional position of the abutment screw using a vacuum-formed clear stent or guide. The guide is fabricated over the cast of the cemented restoration, and access holes are drilled to aid the visualization of screw location. For crown retrieval, the guide is placed in the mouth, and the crown is drilled through the access holes to locate the abutment screws.

Conclusion

No universal system exists for the safe, intact removal of permanently cemented prostheses. Each clinical situation differs, and some circumstances may dictate the use of a combination of techniques. The safest and least traumatic means of removing a cemented crown is to destroy it by cutting a slot and prying it out, thereby avoiding procedures that could harm the underlying tooth. Among the methods of prosthesis removal that conserve the restoration, the buccolingual dimple technique can be utilized to eliminate the need for harmful intraoral porcelain grinding. Richwil resin and crown tractors can be considered as an alternative to ultrasonic removal of a temporary restoration. Application of ultrasonic energy prior to the use of Richwil resin has also been suggested. Regardless of the method selected, the patient should be advised of all the benefits and risks associated with the removal of a cemented restoration.

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