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Crown Removal Approaches: Regaining Entry to the Pulp Chamber

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ABSTRACT *Crowns may last a lifetime but very often they fail. There may be various reasons for the failure of a crown or a bridge placed in the oral cavity and it thereby may necessitate its removal. Among the different indications for crown removal, the most important endodontic indication is for endodontic retreatment. There are various devices, systems and techniques that can be used for this purpose. However, the clinician should have thorough knowledge and experience with these procedures to wisely select a specific technique for specific clinical scenarios and avoid unnecessary iatrogenic errors and ensure an easy and safe removal of the prosthesis.*

INTRODUCTION

Crowns and bridges, like any other prosthesis in the dynamic oral environment have limited longevity and may need to be removed at one stage or another due to functional, biological or aesthetic reasons[1] and an important endodontic reason being to gain access to pulpal chamber during retreatment procedures[2].

Gaining this access is relatively easy when only a direct intracoronal restoration is in place[3]. But when the original access preparation is too small and restrictive, it makes the search for additional canals more difficult. These considerations frequently lead to the removal of existing restorations and then temporarily replacing them for esthetics or function[2].

ACCESS TO THE PULP CHAMBER:

There are two basic approaches to gain access to the pulp chamber. Either, access the pulp chamber through the existing restoration[4,5] or if access is inadequate and additional access is required, the restoration should be Sacrificed[6]. This approach is considered ideal for endodontic retreatment[7].

Gaining Access Through The Crown

If the crown is of good quality and has only recently been cemented, the retreatment can normally be carried out through a conservative access cavity which will be sealed later using adhesive restorative materials[3]. When function or aesthetics have to be maintained or when isolation is expected to be difficult and the present restoration is reasonably satisfactory, it may be retained temporarily to facilitate retreatment comfort, though designated for future replacement.

Retreatment through a prosthetic restoration depends on several factors like the tooth morphology, the radiographic information of the coronal part of the tooth, the identification of a vertical fracture, the accomplishment of the principles of the endodontic cavity preparation or even the ability to place a rubber dam and temporary filling[8].

But it should be noted that working through a crown is always more difficult and potentially damaging. The strength is dramatically reduced by just piercing the glaze of a porcelain crown[9], while cutting through a metal ceramic crown can weaken the porcelain bond predisposing to fracture. Also, vibration can disturb the cement lute of a casting and predispose to leakage or occasionally cause debonding[10]. Also, the rubber-dam clamps may crack and pit cervical porcelain[11].

Gaining Access By Removing The Crown

The restorations of poor quality, with poor marginal adaptation, secondary caries or those intended to be replaced in the prosthetic treatment plan should be disassembled[8]. With the crown in place, a clinician cannot be absolutely certain of eradicating contributing pathological factors which may not be apparent clinically or radiographically. Even with the use of operating microscopes, this may seem difficult and destruction of unnecessary tooth structure is more likely[12].

The advantages of removing the existing crown include better visualization of pulp morphology, ease of radiographic interpretation of the chamber, better visualization of fractures[12] and open margins, shorter working distances and easier entry and as the tooth is reduced from occlusion, there is reduced risk of fracture or percussion sensitivity. Whereas, the disadvantages include loss of esthetics,

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function, interproximal and occlusal contacts, difficulty of isolation and temporization[2] and even damage to the supporting periodontal tissues during removal. Though there are a variety of tools available to clinicians for removal of crowns, most exert extracting forces to the tooth and supporting biological tissues resulting in a lot of patient discomfort[13].

CONSIDERATIONS WHILE CROWN REMOVAL

The safe removal of a coronal restoration is dependent on five factors:

1. Preparation type: its retentiveness depends on the total surface area of the tooth covered, the diameter, height and degree of taper of the axial walls.
2. Restorative material: The composition of a restoration ranges from different metals to tooth colored restoratives such as porcelain. How these materials behave related to the stresses and strains required during removal must be appreciated.
3. Restoration design and strength: depends on its physical properties, thickness of material and the quality and techniques of the laboratory technician.
4. Cementing agent: The restorations cemented with newer generation bonding materials are more difficult to remove.
5. Removal devices: Clinicians should identify and familiarize with each device, its safe application, effectiveness, limitations and cost.

So, to clearly define the risk versus benefit when entertaining the intact removal of an existing restorative the clinician must obtain a careful case history, confer with the original treating dentist if possible and then consult with their patient[6].

Also, before deciding on a particular system, apart from the above mentioned factors, a careful assessment of the patient's teeth and self need to be made [14]like:

1. Systemic health - The use of ultrasonics is contraindicated in patients with hepatitis-B, herpes and cardiac pacemakers[15].
3. Periodontal status - Periodontal support and mobility should be assessed
4. Mouth opening- if reduced, risk of damage to the opposing dentition
5. Status of underlying core - Forces of removal should be applied along the path of withdrawal as misdirected forces could damage the underlying tooth or core[14].

CLASSIFICATION OF CROWN REMOVAL METHODS

There are different techniques available to remove a failed crown or bridge, but no standardized classification of the different removal systems is available.

Ingle has classified coronal disassembly devices into grasping instruments, percussive instruments and active instruments[6].

- *Grasping Instruments/ Crown Tractors*: The first type work by applying inward pressure on two opposing handles that provide a strong purchase while reducing dangerous slippage[6]. The rubber inserts at the beak end provide a firm grip and release the restoration without producing any damage[1]. These are best used in removing temporary restorations and common examples are K.Y. Pliers (G.C. America), Trident Crown Placer-Remover, etc. The second type of grasping instrument like the Roydent Bridge Remover forceps engages the margins of the crown and uses the adjacent tooth as fulcrum. When the handles are squeezed together, the crown will be elevated off the tooth but may damage its fragile margins.
- *Percussive Instruments*: they utilize a controlled, percussive removal force that delivers an impact either directly to a restoration or indirectly to another securely engaged prosthetic removal device. These are used to remove both temporary and permanently cemented prostheses, but with caution for tooth colored restoratives. These include Crown-A-Matic (Peerless International Inc., MA) and Coronaflex (Kavo America).
- *Active Instruments*: These require a small access window to be cut through the restoration to actively engage them, enabling a specific dislodgment force to potentially lift off the prosthesis. The examples are Metalift (Classic Practice Resources, LA) and WAMkey Removal Keys (Dentsply Maillefer)[6].

Also, these crown removal systems can be grouped as:

1. *Conservative:* Prosthesis remains intact. It works by applying a percussion or traction force to break the cement lute enabling the prosthesis to be removed.
2. *Semi- conservative:* Minor damage to the prosthesis is done but still it can potentially be reused. Here, a small hole is cut in the prosthesis, enabling a force to be applied between the preparation and the crown to break the cement lute.
3. *Destructive:* Prosthesis is damaged and not reusable as the crowns is sectioned enabling it to be levered off[14].

Another classification suggested, groups these instruments into 3 categories

Devices permitting reuse of the prosthesis

a) Adhesive resins

b) Grasping instruments

-Forceps which provide a firm grip over the crown

-Forceps engaging the margins

c)Impact delivering devices

- Manual back action
- Spring loaded back action
- Spring loaded semi-automatic
- Spring loaded automatic
- Pneumatic

d)Devices that actively engage the restoration.

Devices that does not permit reuse of the prosthesis

a)Crown splitters

b)Crown spreaders.

Radiation for safe removal of the fixed prosthesis

a)ultrasonics

b)lasers

Richwill Crown and Bridge Remover/ Adhesive Resins

It is a water soluble resin which becomes pliable at 145° F. The softened resin is placed on the incisal or occlusal surface of the prosthesis to be removed and the patient is instructed to occlude and compress it to two-third of its original size. Once cooled, the sudden opening motion will remove the crown by breaking the cement seal. Their use becomes limited if there is any insecure restoration in the opposing arch[1]. This technique has been reported to be 100% successful for temporary crowns[16] and 60% successful for the dislodgement of cast restorations in conjunction with the application of ultrasonic energy[14].

Manual Back Action Instruments

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These engage the margins by a tip which is attached to a shaft with a sliding weight. An impact force is applied by activation of the weight manually that causes the rod to shift away easily from the intended axis of removal. These include Morrell crown remover (Henry Schein, NY), Pulpdent Crown and Bridge Remover (Pulpdent Corporation), etc. They may cause considerable patient trauma and ligament luxation. Furthermore, it is difficult to ascertain if the forces are exerted along the long axis of the preparation or not[1].

Spring Loaded Back Action Instruments:
The spring in the back action hammer is compressed manually and released to deliver the impact force. Examples are Kohler spring loaded (Pearson Dental) and Kentzler Kaschner Dental Type C crown remover (Kentzler Kaschner Dental GmbH).

Spring Loaded Semi Automatic
This can be operated easily with one hand while the other can be used to secure the device at the crown margin. Hence, they have better directional control when tapping forces are applied. However, the instrument should be removed and reactivated each time it is operated. The Bontempi, Toronto. Ont, Crown-A-Matic (Peerless International, Inc. S.Easton, MA) and Kentzler Kaschner Dental Type A belong to this class.

Spring Loaded Automatic Crown Remover
These can be used in a single handed manner and need not be removed for reactivation as by pressing the handle, the shock impulses are released successively. A few instruments in this category include Dexell automatic crown remover, Kentzler Kaschner Dental Type B, Medesy Crown clix, etc[1].

Pneumatic Crown Removers
It is an air-driven device that connects to standard dental airline. It works by delivering a controlled low amplitude shock at its tip along the long axis of the abutment tooth[14]. The examples are Corona Flex Crown and Bridge Remover, The Easy Pneumatic Crown and Bridge Remover II (Dent Corp.), Saferelax (Anthogyr), ATD Automatic crown and bridge remover (J. Morita), etc.[1].

Sliding Hammer:
Here a suitable tip is selected to engage the crown margin and a weight is slid along the shaft in a series of short, quick taps to loosen the restoration. It may damage porcelain margins, is uncomfortable and for patients with periodontally involved teeth involves the risk of unintended extraction.

Matrix Bands:
A Siqveland Matrix Band applied over the crown, burnished into the undercuts and then pulled vertically can be a successful technique for careful removal.

Wamkeys
They are simple narrow-shanked cam devices. The clinician cuts a hole through the crown parallel to the occlusal surface and at the imagined level of the underlying core. A suitable sized wamkey is inserted with the broadest surface of the cam parallel to the occlusal surface, until it is centrally placed then it is rotated about the axis of the shank through 90°. The restoration can later be recemented and the hole filled with plastic filling material[14].

Metalift System:
This is based on the "jack-screw" principle[14] that creates a threaded channel in the restoration to engage the self-tapping instrument thread into the metal. Turning of the instrument against the dentin past the metal causes the cement layer to break.

The Higa Bridge Removal System
It makes use of a cable system that pulls up the bridge, while a support peg holds down the prepared tooth. Tightening of the cable causes equal pressure to be applied to the bridge in the upward direction causing it to lift up while the pin supports the abutment.

Crown Splitters
The crosscut tungsten carbide burs are indicated for sectioning base metal alloys, whereas medium grit diamond burs for high noble metals[1]. Confining the slot made by burs to the labial surface, and applying an ultrasonic instrument to disrupt the cement lute, can provide space to elevate the crown and bridge so that it remains intact. Where adhesive cements are used it becomes necessary to section through the lingual surface as well, destroying the crown completely[14].

Crown Spreaders
Once the crowns are split open they need to be spread to release the metal substructure from the tooth. Crown spreaders are inserted into the groove and rotated to break open the cement seal[1]. They include Nash/Taylor crown spreader (Hu-Friedy Mfg.), Brasseler Crown Spreader, Trident crown splitter (C-K Dental), The Christensen Crown Remover (Hu-Friedy Mfg Co.), etc.[14,1].

Ultrasonics:
This is an atraumatic technique that uses special scaler tips (Piezon Ultrasonic), which are placed in a groove cut in the restoration[1]. If a porcelain crown needs to be removed with little damage, then ultrasonics should not be used as there is the potential risk of porcelain fracture[3]. Melo Filho et al. found that the application of ultrasonic vibration at the cervical margin of the crown for 15 s caused a considerable reduction in tensile bond strength due to fracture of cement layers[1].

Lasers
These are mainly indicated for debonding porcelain laminate veneers. Er, Cr: YSGG lasers (2780 nm) can be used for this purpose as it cannot be absorbed by porcelain compounds, but by the water present in the luting agent. It acts by the thermal softening of the resin without any damage on the tooth enamel[1].

Also, a simple chair side technique for removal of these fixed restorations requires an orthodontic band remover Plier (Eltee Plier) and a straight fissure carbide bur (S.S. Great White #2 gold series). These can be used for the retrievability of the cemented single or multiple-unit fixed prostheses[13].

Bucco-Lingual Dimple Technique
In this simple technique,[17] dimples are created on the buccal and lingual surfaces in the gingival one third to act as a receptacle for Baade Pliers. The twisting motion of the hands and wrist helps break the cement seal. For removing cast metal onlays and partial coverage restorations three dimples are created on the buccal and lingual surface of the restoration. The Baade Pliers can then engage and torque the casting in a variety of directions. But this technique is contraindicated in periodontally compromised

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dentition[1].

CONCLUSION

None of the systems mentioned here are universally applicable. It is also very important to make risk-benefit analysis when considering the various crown disassembly methods and inform the patient of those risks.

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