

Recent Techniques for Removal of Indirect Restorations: Classification and Minimally Invasive Approach

Abdulrahman Jafar Alhaddad^{1*}, Samar Hatem Abuzinadah², Tamim Alkhalifah³, Dina Alkhozaim³, Imtenan Alnasser³, Haya Alfaleh³, Nada Alrkabee³, Lama Almohaimed³, Khalid Almutlaq³, Rola Alhusayni³, Shouq Aljohani⁴, Talal Alamoudi⁵, Ahmad Aldusari⁶, Khames T Alzahrani⁷ and Osama Ahmed Qutub¹

¹Oral and Maxillofacial Prosthodontics Department, King Abdul-Aziz University, Jeddah, Saudi Arabia; ²Restorative Dentistry Department, King Abdul-Aziz University, Jeddah, Saudi Arabia; ³Dental Department, Qassim university, Qassim, Saudi Arabia; ⁴Dental Department, Vision colleges, Jeddah, Saudi Arabia; ⁵Dental Department, Majmaah University, Riyadh, Saudi Arabia; ⁶General Dentist, Ministry of health, Riyadh, Saudi Arabia; ⁷BDS, PGD in Endo, Ministry of Health, Kingdom of Saudi Arabia

Corresponding author:

Abdulrahman Jafar Alhaddad
Department of Oral and Maxillofacial
Prosthodontics, King Abdul-Aziz
University, Jeddah, Saudi Arabia
E-mail: aalhaddad@kau.edu.sa

Abstract

Background: When removing a prosthesis, meticulous preparation is required to assure effectiveness and avoid harm underneath oral tissues. They can range from standard dental clinic equipment like scalar tips, chisel and hammer to specialist cranial disintegration tools like crown extractor forceps, pressure delivery devices, crown sectioning burs, and crown splitter. The study's goal is to present the findings of a systematic, evidenced literature review on recent techniques for removal indirect restorations: Classification and minimally invasive approach. **Literature Review:** Department of prosthodontic, king Abdulaziz University, Saudi Arabia between June 2020 and November 2021. A systematic search of the literature was conducted up to 2021 in seven electronic databases (Web of Science Core Collection, Brain, Pub Med, Science Direct database, NCBI, Google Scholar, Scopus, and Saudi digital library). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The initial search resulted in 96 papers. only 22 studies were chosen for systematic review. **Results:** The first search showed 96 articles. A total of 24 duplicates were eliminated. After filtering by reading titles and abstracts and discarding any extraneous topics or goals that are not directly connected to this systematic review, the first phase comprised 49 publications. There were 32 that needed to be reviewed and evaluated for eligibility. 22 articles were chosen for the final evaluation after full text screening. **Conclusion:** The article sorts all the methods of removal the indirect prosthesis techniques. It is impossible to apply a single approach to all situations. Every clinical situation is differing. Lasers as mentioned According to Morford in his study, the success rate of using laser for removing indirect restorations was 64% and only effective for debonding all-ceramic restorations.

Keywords: Indirect restorations; Minimally invasive approach; Recent techniques; Dental material

Introduction

The most common indirect restoration option for badly decayed teeth is the prefabricated crowns; that use to are a commonly used to restore function, maintain the healthy tooth structure, assist in keeping the oral hygiene, and offer a sturdy economical treatment outcome. ^[1] Any prosthesis in the dynamic oral environment has limited longevity and crowns and bridges are no exception. They need to be removed at one stage or other due to functional, biological or aesthetic reasons. ^[2] The reasons for failure have been attributed to a wide range of factors. Endodontic failure, secondary caries, periodontal illnesses, bridge span extension, broken ceramic layer, a loosened bridge retainer, sores underneath the pontics, flawed designs, misaligned finish lines, and cracked lines laminate veneer are some of the typical reasons for fixed restoration failure. ^[3] Dental restorations structures have a set time of usage. They

are frequently discarded by dissection, after which they are rendered useless. There are times when physicians should leave the restoration alone and use cautious removal methods. Aside from the traditional cutting technique, in the literature, many methods had been described of removing the prosthesis in way to preserve the remaining tooth structure. ^[4] Modern high ceramics, like zirconia and lithium disilicate, outperform their precursors in quality and rigidity, rendering them the substance of preference in many dental clinics and labs. Moreover, when contrasted to other choices, zirconia and lithium-disilicate crowns

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are regarded as “cosmetic,” They are significantly firmer than many other crown compounds.^[5] While conventional excision procedures for indirect restorations are used, the anchoring tooth and its periodontal ligament are sometimes jeopardized, and the prosthetic implant is often destroyed entirely and irreversibly. This process can be expensive regarding time and equipment, as burs and contra-angle handpieces wear out quickly.^[6] When removing a prosthesis, meticulous preparation is required to assure effectiveness and avoid harm underneath oral tissues.^[7] They can range from standard dental clinic equipment like scalar tips, chisel and hammer to specialist cranial disintegration tools like crown extractor forceps, pressure delivery devices, crown sectioning burs, and crown splitters.^[8]

Literature Review

Search strategy

An extensive literature search will be performed to create a comprehensive narrative in the relationship between MFP and headache. We selected studies published in the English-language between 2006 and 2019. We searched in the following data bases (Brain, Pub Med, Scopus, Web of Science, Saudi digital library and Science Direct database, NCBI, using the mentioned search strategies: (1) Removal indirect restorations (2) Crown and bridge removal and (3) Minimally invasive approach to disassembly prosthesis. Studies were select on the basis of the title and abstracts and methods obtained in the electronic searches, full texts.

Study Selection and Data Extraction

By using the mendeley reference manager software. We were able to remove the duplicated article. By reviewing the abstract and title of every related paper, two reviewers checked and evaluated the entire content of the prospective articles. Using the modified data extraction form, two reviewers retrieved the result and research characteristics separately and anonymously.

The initial search retrieved 96 articles. A total of 24 duplicate articles were eliminated. The first phase comprised 49 papers, which were selected after filtering by studying titles and abstracts and discarding irrelevant titles or goals that were not directly connected to this comprehensive study. 32 papers needed to be reviewed and evaluated for eligibility. After full text screening 22 articles were considered for the final review. This study’s goal is to present the findings of a systematic, evidenced literature review on recent techniques for removal indirect restorations: Classification and minimally invasive approach.

Minimally Invasive Techniques

Lasers

Erbium lasers have ability to break luting cement from porcelain restoration and crowns in 31-290 seconds. There are two types with different wavelength, the Er: YAG (Yttrium Aluminum Garnet crystal) at wavelength 2940 nm and Er,Cr:YSGG at 2780 nm. Application of lasers 1-2 minute will be absorbed by the water of luting cement and will allow the resin of cement to soften thermally without causing any harm to tooth structure.^[9-11] Saves time and is simple to use, reusing a prosthesis and

its atraumatic technique. Applicable for deboned all-ceramic restorations only. If the tips are not placed correctly, they will cause harm effect to hard and soft tissues.^[10]

Ultrasonic

Ultrasonic usually used to eradicate any cemented restoration. It disrupts luting cement layers without causing harm to the restoration. The tip of the scaler is inserted into a tiny gap in the gingival margin of the prosthesis, and the cement seal is destroyed by the vibration and abundant water application. The approach could be employed on its own or in conjunction with others techniques.^[12] Richwill remover can be used in conjunction with this approach by setting the device at 5-10 V/S, then the tip is targeting the metal substructure of the prosthesis. Using the ultrasonic for at least 5 minutes laterally to the Richwill resin. Parreira et al. stated that; there is 60% of successes in removing prosthesis using this technique. This collective technique cannot be applied with prosthesis that are fully veneered with ceramics.^[13] The least harmful to restoration, crown removal is a traumatic procedure. This approach has disadvantages if not carried out properly. The heat generation may harm the vital pulp, also the vibration of ultrasonic tip may lead to chipping of the ceramic sheet. Furthermore, it is time consuming.^[12,14] Ultrasonic techniques not indicated for hepatitis B, herpes or patients with pacemakers.^[15] Although authors had not comment where this technique can work with all types of cement or ultrasonic devices. Osada find out that; this technique dose not work with any prosthesis luted by glass-ionomer or zinc poly carboxylate luting agent.^[13]

De-cementing with Richwill resin

Richwill is asoluble thermoplastic resin. It produces a strong provisional adhesive properties.^[16] Richwill is effective for removing both temporary and permanent indirect restorations. Before applying the resin to the occlusal/incisal surface of the restorations, the material prepared by placing it in warm water bath for a few minutes then the patient instructed to bite and squeeze the resin block to two-thirds of its original size, and an air syringe can be used to chill the substance. The patient is taught to open their mouth suddenly and vigorously for around 10 seconds. The resin block and casted restoration will adhere to the opposing tooth. The casted restoration and resin block will stick to the opposite tooth.^[17] This approach is described as the most effective way for removing cemented cast restorations. According to Oliva, this procedure has a 100% success rate for removing provisionally cemented restorations and a 60% success rate for permanently cemented cast restorations when used with the ultrasonic technique.^[16] The least harmful to restoration and saves time and simple to use. Successful of this technique is highly dependent on patient cooperation. The technique may need to be repeated in some cases. If the opposing tooth or restoration is unstable, the method cannot be done since it may result in the removal of that component.^[7,12] The manufacturer recommends tying the resin block with dental floss to prevent swallowing of it.^[15]

Crown tractors

Worked *via* tightly grasping the prosthesis by the help of soft rubber attached to the tip of the beaks, without damaging the

underlying tooth structure and the porcelain margins. Save removal of crown and can be used only for single prosthesis. [18]

Conservative Techniques

Crown tapper

The most commonly used instrument for detaching any prosthesis, it premeditated to remove temporary prosthesis; the tip of the instrument can shatter the edges of the restoration with a gliding weight that is manually triggered. Include a simple design that produces short, rapid taps to release the prosthesis and a low cost. The use of this system may cause discomfort for patient and injury of periodontal ligament. [18] Activation of the weight can accidentally slide of the hammer and slide away from the axis of the abutment. Aggressive percussion can cause tooth fracture. [17]

Spring back-action crown removal

To produce the hitting force, the spring is manually compressed and released. Easy to provide precise effective forces compared to manual crown tapper and cheap in price. The tip can slide away from the tooth. [12]

Spring loaded semi-automatic remover

Bontempi crown remover (BMT Medizintechnik), Crown-A-Matic (Peerless International), or Kentzler-Kaschner Dental Type A crown remover (Kenzler-Kaschner Dental). This sort of equipment is easy to handle with one hand while another holds the extractor tip at the crown edge. [19] Firm control of the force direction and can be used by one hand. Repeated reactivation each time of use and the tip could slide of the long axis and its critical due to aggressive forces generated. [20]

A full automatic back-action remover

Use a compressed air to cassette the cement junction of prosthesis with low impact force is delivered. [12] Can be use it with one hand and does not need to be removed for reactivation. Determining the particular spur path is difficult. The procedure need time and usually cause patient’s discomfort. [20]

Ultrasonic energy

Cemented crowns are often removed with ultrasonic scaler tips. The tip of the scaler is inserted into any tiny gap or censored

in the prosthesis, and the cement seal is broken by vibration and abundant water application. If not done appropriately, this technique has drawbacks. It’s a lengthy process, the porcelain layer may be chipped if the vibration is used for a long time. Furthermore, the heat generated may harm the vital pulp. [12] Before using a Richwil crown and bridge remover, ultrasonic energy can be used to gently remove a crown or fixed partial denture.

Resin coping

Suppose a metal-ceramic restoration is hard to extract while fitting or after temporary or permanent cementite. In that case, auto polymerizing acrylic resin can be employed to create a mechanical procurement area for a puller. When the resin coping has been completely set, the crown extractor is placed under the resin undercut. [15] To carefully remove the crown, applied a feeble tapping force is to the resin coping. This method avoids the puller from accidentally sliding during crown tapping or extraction.

Removal with a chisel and a sliding hammer

It designed to involve the crown margin. After that, in a sequence of fast taps, a weight is moved along the shaft. Various designs are available on the market. Manual instruments with back-action sliding hammers are generally classic. Although their indications stipulate that they used to remove temporary restorations or even the permanent one. The restoration remains intact and can be repaired. Inconvenient for patients and practitioners moreover, no longer in use. It is not advised to use them on patients who have periodontal disease. It’s possible that the porcelain’s margins will be harmed. [8,15]

Richwil crown and bridge remover

It’s a water soluble and thermoplastic resin that, when compressed, generate sturdy momentary bonding means. It has been described as the most effective tool for removing cast restorations successfully. [18] It’s been called the most effective tool for removing cast restorations successfully. Restorations can be removed with ease and convenience if both of these conditions are fulfilled [Table 1]. With the use of ultrasonic radiation and this approach, Oliva reported 100% success in removing temporarily cemented restorations and 60% success in dislodging permanent cast restorations. [18] If the opposing

Table 1. Demographic characteristics of studies results.

Title	Country	Year of publication	Reference
Assessment of the primary stability of root analog zirconia implants designed using cone beam computed tomography software by means of the periotest device: An ex vivo study. A preliminary report	Poland	2016	Matys et al.
A survey of crown and fixed partial denture failures: Length of service and reasons for replacement	USA	1986	Walton et al.
Technique for removing cement between a fixed prosthesis and its substructure	Oman	2009	Alsiyabi et al.
A clinical evaluation of chairside lithium disilicate CAD/CAM crowns: A two-years report	USA	2010	Fasbinder et al.
Advancement in the removal of permanently cemented crowns and bridges	France	2014	Girard
Simplified technique for the removal of a fixed partial denture	USA	1981	Conny et al.
Coronal disassembly systems and techniques: An overview	India	2014	Janardanan et al.
Removal of failed crown and bridge	India	2012	Moaleem et al.
Cast prosthesis removal using ultrasonics and a thermo-plastic resin adhesive	USA	1994	Parreira et al.

Effect of ultrasonic instrumentation on the retention of simulated cast crowns	USA	1978	McQuade et al.
Systems and techniques for removal of failed fixed partial dentures: A Review	KSA	2016	Mohammed Al Moaleem
Clinical evaluation of a new crown and fixed partial denture remover	USA	1980	Oliva
Review of techniques for the intact removal of a permanently cemented restoration	KSA	2017	Bajunaid
Techniques for fixed dental restorations removal - classification, decision on the correct approach, advantages and disadvantages	Bulgaria	2021	Vasileva
Effects of different application durations of scanning laser method on debonding strength of laminate veneers	Turkey	2012	Oztoprak et al.
Removal of modern ceramics	USA	2017	Spath et al.
Using an Er, Cr: YSGG laser to remove lithium disilicate restorations: A pilot study	USA	2016	Gurney et al.
Removing cemented crowns and bridges without destroying them.	Denmark	1975	Karnoff
Crown and bridge disassembly, when, why and how.	UK	2007	Addy et al.
Crown Removal Approaches: Regaining Entry to the Pulp Chamber.	India	2016	Susan et al.
Laser Aided Ceramic Restoration Removal: A Comprehensive Review	Iran	2019	Ghazanfari et al.
Er: YAG laser debonding of porcelain veneers	USA	2011	Morford et al.

tooth or restoration is unstable, the method cannot be done since that structure will be removed. The manufacturer recommends tying the resin crown remover with dental floss to prevent aspiration. [12,18,19]

Copper band

A copper band was described by Ewing as a tool for detaching the indirect restorations. [18] A copper band is wrapped tightly around the teeth during this procedure. Above the level of the tooth, a nail is used to puncture the copper band, which is then filled with cement. The nail is moved in a rocking motion once the cement inside the band sets, loosening the indirect restoration and eventually enabling it to be dislodged. In the clinical setting, this procedure has been supplanted by newer methods due to technological improvements.

Matrix band

It has been successfully used for removing the indirect restoration, according to Sharma et al. quoting Mc Cullock. [12] The matrix band is pushed vertically to detach the crown after it has been fitted over the indirect restoration and burnished into the undercuts.

Orthodontic band remover

Karnoff described removing the cemented crown by using traditional orthodontic band-removing pliers. Karnoff employed this method to produce a mimicked orthodontic band by digging into the crown's occlusal surface. Creating a hole occlusally to insert one of the orthodontic pliers' beaks then engaged the other beneath the crown's edge, and compressed until the crown was dislodged. Disadvantages: To avoid the abutment tooth luxation, this method must be used with caution. [17]

Semi-conservative techniques

These approaches use a modest access opening made through the restorations to engage the indirect restoration to support the abutment actively. At the same time, the lifting force is applied to the indirect restoration. [15] They have the advantages of saving time, being more pleasant for the patient, allowing less traumatic separation from each other, and requiring minimal force to dislodge the indirect restoration. [21] The opening can be fixed and covered using filling materials [22] and the foundation can be utilized to create a new indirect restoration [4]

The classic system: Mtalift Baton Rouge

This process relies on the "jack-screw" model, in which a tiny dump is engrave into the occlusal face of an indirect restoration using a diamond barb, the region surrounding the hole's edge is undermined, as well as a threaded screw is put into the gap. [22]

Whenever the tool is prevented from progressing by interaction with the underneath foundation, a small cut in the metal of the casting, then continuing spinning of the screw leads to a jacking pressure that replaces the indirect restoration from the preparation. [12]

Meta lift crown remover

It is useful to remove metal-ceramic restorations. [21] Saves time with less trauma to teeth and surrounding structures. And the disadvantage of this technology could not be utilized to remove crowns retained by casted post and core.

Kline system (brasseler USA)

It is a plier with a pin on one end that enters a hole made in the tip of the cusp, and a flatter and sharp tip on the other end engages the edge of the indirect restoration. The pressure created by squeezing the handle causes the cement layer to break. [12,21] Saves time with less trauma to teeth and surrounding structures apply downwards force to the teeth while the indirect restoration is removed without fracture or extraction to the tooth repair of restorations. Uses aesthetic restoration materials expensive, requires a lot of equipment.

Higa system

The indirect restoration is pulled up by a cable system, while the prepared tooth is held in place by a support peg. When the cable is tightened, it applies equal pressure to the bridge in an rising up route, forcing it to dislodge the indirect prosthesis while the pin supports the abutment. [23] Saves time with less trauma to teeth and surrounding structures. Repair of restorations uses aesthetic restoration materials.

Wamkey System

The Wamkey System utilizes an oval-shaped keys varying in dimension from 2.5 mm to 5 mm. A Wamkey is placed and turned into the hole made among the preparation's occlusal plane and the Crown's intaglio surface. The Crown rises from

the preparation by taking the route of low effort. [21] Saves time with less trauma to teeth and surrounding structures. It is difficult to pinpoint the precise place for preparing the tunnel among the prepared tooth's occlusal side and the Crown's fitting surface.

Buccolingual dimple technique

Buccolingual dimple technique; a tiny dimple created in the lower thirds of the buccal and lingual aspect. Baade forceps are employed in this approach to remove the indirect restoration, and the practitioner rotate the pliers to cassette the luting closure. This method is ideal for teeth having small medical crowns or very tapered preparations. [17] Intraoral grinding is kept to a minimum, impact force by twisting the indirect restoration can be directed properly with pliers. And this technique not indicated for a tooth periodontally compromised.

Orthodontic removal

Using pliers, there is an orthodontic method for removing an indirect restoration. A hole is bored upon that crown's occlusal plane. One of the pliers' beaks is then put into the constructed opening, while the other is positioned at the crown's edge. The crown is dislodged as a result of the pressure. [21] Less trauma to tooth and surrounding structure. And this process must be done with precaution so that the abutment tooth does not luxate.

Discussion

The success of any technique depends on many factors such as, the type of cement and condition of the abutment. So, various possibilities should be taken into consideration. Conservative techniques work successfully only in temporarily fixated prostheses. Parreira et al. stated that the permanent luted prosthesis had a 60% success rate of prosthesis dislodgment. [22] Ultrasound tools can cause ceramic snaps or pulpal injury if it used for long time. Recently, lasers are being used to dislodge a tooth-colored prosthesis. [16,24] As we go toward conservative approaches as we found reported about failure of removing prosthesis cemented by zinc poly carboxylate and glass-ionomer cement. [22] Any schemes using a drumming or grip forces usually maintain the prosthesis intact upon removal but affect the periodontal tissue. [2,3,17,18] Moreover, maintain the tips along the long axis of the tooth need extra precaution and time consuming. [2,8] On the same side, the semi-conservative approaches are not indicated for a periodontal compromised tooth. According to Morford in his study, the success rate of using laser for removing indirect restorations was 64%. [24] The potential thermal irritation of pulp caused by laser irradiation is one of the major concerns when utilizing the laser for ceramic restorations debonding. According to Zach and Cohen, an increase in intra pulpal temperature of 1.8°C causes no damage, while an increase of 5.5°C induces pulp necrosis in 15% of the teeth. Laser is only applicable for debonding all-ceramic restorations. If the tips are not placed probably, they will cause harmful effects to hard and soft tissues. [17] Parreira et al. come to the conclusion that combine the ultrasonic with the richwill resin for removing the prosthesis offer a 60% success rate. [13] On the other hand, if not carried out properly, the heat generation may harm the vital pulp, also the vibration of ultrasonic tip may

lead to chipping of the ceramic sheet. [12,14] Ultrasonic tool not indicated with hepatitis B, herpes or a pacemakers' patients. [15] Moreover, in teeth with periodontal disease, this procedure should be done with caution. [12,14] Furthermore, this technique is ineffective with prosthesis luted by zinc polycarboxylate and glass-ionomer luting agent, and with prosthesis that are fully veneered with ceramics. [13] According to Oliva, the success rate of using richwell resin to break the seal of temporarily cemented restoration is 100%. For permanently cemented crowns, a combination of this technique with ultrasonic energy has a high success rate of 60%. [16] This technique is contraindicated for non-secure crowns or restorations, as well as for movable teeth in the opposing arch. As a result, a thorough examination of the opposing tooth or prosthesis is required. Or else, the prosthesis or mobile tooth may be removed. [7,12] Crown tractors and remover offer a prospect to maintain the indirect prosthesis. On the other hand, there is higher chance to harm the abutment tooth and the periodontium. Mostly used in single crown removal but it's not effective for permanent cementation. [8,2]

Conclusion

The article sorts all the methods of removal the indirect prosthesis techniques. It is impossible to apply a single approach to all situations. Every clinical situation is differing. Lasers as mentioned according to Morford in his study, the success rate of using laser for removing indirect restorations was 64% and only effective for debonding all-ceramic restorations. Among the methods of prosthesis removal that systems using a percussion or traction force that have a higher risk of damaging the substructure and periodontal tissues. The use of ultrasonic scalers in combined with richwill resin offer 60% success rate for removing the prosthesis. This procedure should be done with caution, as its not indicated if the opposing tooth or prosthesis is unsteady. It is important to inform the patient of both the benefits and risks of removing a cemented restoration □ □

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