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Implant crown cementation techniques: A review part 1

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Abstract
The adverse effects of excess cement on the success of dental implants have been discussed and studied in literature many times and many techniques were created to prevent and lessen the excess cement protruding from crowns of implants.
Conclusion: Not one technique is favorable on the other and the clinician should choose what is more convenient to his/her skill.

Keywords: Cement, implant, success, technique, crown

1. Introduction
The initial phase of soft tissue inflammation around the peri-implant mucosa is called as peri-mucositis. Per-mucositis leads to peri-implantitis which is destructive inflammatory process that causes bone damage that is beyond repair (Albrektsson and Isidor, 1994; Zitzmann and Berglundh, 2008) [1, 17]. Factors contributing to the development of peri-implantitis are unknown, however, it is believed that microorganisms have a role towards disease progression (Salvi and Zitzmann, 2014; Jespen *et al*. 2015) [12]. The success of an implantation procedure and incidence of disease can be evaluated at least five years post-surgery (Zitzmann and Berglundh, 2008) [17]. Therefore, risk factors including excess dental cement may have a significant role in early onset of peri-implantitis (Mombelli, Muller and Cionca, 2012; Jespen *et al*. 2015) [10]. Multiple methods to reduce excess dental cement have been reported in literature but there is lack of a paper that reviews all of these techniques
The aim of this part of the review is to summarize some of the different techniques of reducing excess cementation in dental implants. This review will help the practitioners decide for the best method according to the scenarios of different patients.

2. Materials & methods
Electronic databases including PubMed, Medscape, Google Scholar, Elsevier, EBSCO Discovery Service, EMBASE, Direct Scopus and MD Consult Science used for literature search. Keywords including “dental cement removal technique” and “excess dental implant removal” were adopted for research on each database. Literature was searched in English language and data in languages other than English was excluded. All the data related to dental cementation removal techniques available from 1997 to present was evaluated in detail for this review.

3. Results
Various techniques reported so far for removing extra cement from implants share somewhat similar steps and procedures. Generally, there are two methods of excess implant removal including intraoral removal that takes place while seating and an amalgam of intraoral and extraoral methods. There are ten replica techniques for removal of excessive cementation, most of which are a variation of previously describes methods. Different replica techniques are listed in Table 1. For the ease for the reader, only the first five methods will be discussed in this part of the review.

Table 1: List of replica techniques used for reduction of excess cement in dental implants

No.	Technique	Reference
1	Abutment analogue technique	Caudry, Chvartszaid and Kemp, 2009
2	Polytetrafluoroethylene tape and VPS technique	Wadhwani and Pineyro, 2009 [10]
3	Stretching polytetrafluoroethylene tape technique	Hess, 2014 [8]
4	Bis-acrylic temporary restorative material and Die spacer technique	Yuzbasioglu, 2014 [16]
5	Trial acrylic resin abutments customized abutment technique	Galvan *et al*. 2015
6	Putty index and Bis-acrylic temporary restorative material technique	Bhushan *et al*. 2017 [2]
7	Disposable plastic collar and special G-cuff measuring tool technique	Deogade, Mantri and Pandey, 2015 [4]
8	Hot melt thermoplastic material technique	Rayyan and Makarem, 2016 [11]
9	The rubber dam technique	Seo and Seo, 2017 [13]
10	The dental floss technique	Ferreira *et al*. 2018

Herein, the replica techniques are described in sequence along with preparatory procedures prior to cementation and equipment required to perform these techniques.

4. Abutment Analogue Technique

Abutment analogue technique may be used to remove excess dental cement extraorally in a controlled way followed by intraoral placement of restoration. This technique helps to minimize the intraoral extrusion of dental cement into tissues. Caudry, Chvartszaid and Kemp (2009) [3] described the simple method of using custom-made abutment replica for reducing the over-flow of dental cementation. First step of this method included the assessment of the implant platform level with respect to gingival crest either intraorally or on a definitive cast. In the second step, the location of abutment collar is adjusted such that its margin is just apical to the gingival crest in the aesthetic zone and at the gingival crest or marginally in another place. Then a putty abutment analog of the implant abutment is fabricated with a simple in-office method or with an absolute prosthesis in the laboratory (Figure 1A). For cementation, the cement of choice is applied inside the implant crown by seating the crown on the putty abutment analog such that the excess of cement is removed (Figure 1B and C). Finally, the restoration is inserted on the intraoral abutment followed by analysis of the margins to ensure perfect seating and extrusion of excess cement.

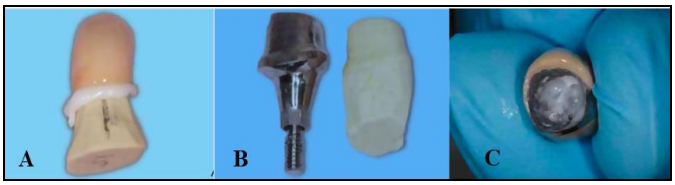


Fig 1: Abutment analogue technique (Caudry, Chvartszaid and Kemp, 2009) [3].

5. Polytetrafluoroethylene (PTFE) Tape and VPS Technique

Polytetrafluoroethylene (PTFE) tape is generally known as plumber's tape or Teflon tape or TFE threaded seal tape. PTFE tape and VPS technique provides a method uses a copy of abutment with smaller dimensions to control the flow of dental cement. The abutment with small dimensions can be fabricated easily, rapidly and thriftily at the time of crown insertion or implant abutment. Additionally, a space of 50 µm can be achieved with the PTFE tape and this space serves as the cement space that can be utilized for customized and prefabricated abutments.

Wadhwani and Pineyro (2009) [10]. described the PTFE tape and VPS technique for reducing excess cement in dental implants. The first step of this method is to ensure the fit of abutment complex and cement restoration. After this, the intaglio surface of the cement restoration is lined with PTFE tape. In order to promote the adaptation of PTFE tape to the intaglio surface of cement restoration, the cement restoration is fully placed onto abutment. Then the implant is filled with implant restoration by using a fast-setting vinyl polysiloxane (VPS) and an applicator having a tip of small diameter such that a handle is formed (Figure 2A). The PTFE and VPS material is then removed and implant abutment is compared with the VPS model ensuring absence of any spaces. Additionally, it is ensured that abutment finish line has been recreated correctly (Figure 2B). The intaglio of cement restoration is then lined using any selected luting agent and crown is placed on the VPS model. Befpre the cement exceeds its working time, excess cement is removed (Figure 2C). Finally the crown is taken off the VPS model and a thin layer of cement is applied to the intaglio of restoration. In case, any spaces are still present, they can be filled with small amount of luting agent.

Fig 2: Polytetrafluoroethylene tape and VPS technique (Wadhwani and Pineyro, 2009) [15].

6. Stretching Polytetrafluoroethylene (PTFE) Tape Technique

Stretching PTFE tape around the abutment prior to seating ensures the attachment of cement to subgingival facet of metal, zirconia or porcelain abutment. PTFE tape is sterilized before intraoral application. Sterilization of PTFE tape is done by putting it in sterilization pouches in a cassette autoclave that is adjusted at 17.5 min wrapped cycle. Thickness of PTFE tape is 50 mm while stretched and this small size of PTFE helps to prevent enlargement of peri-implant sulcus. Hess (2014) [8] described the stretching PTFE technique to protect dental cement from attaching the implant abutment. In this method, implant crown is fabricated with an ICEAM abutment and RC engaging gold abutment in a way that lingual margin is supragingival while distal, mesial and buccal margins are equigingival. Implant crown is then removed from the cast with an ICEAM abutment and attached to a laboratory analog in such a way that no PTFE tape is stuck between the implant and abutment during seating as shown in Figure 3A. Then small amount of petroleum jelly is coated onto the porcelain on ICEAM. Then the PTFE tape is stretched from lingual to the buccal margin and the ends are secured by twisting together.

In the next step, gingival margin of ICEAM is etched with

hydrofluoric acid (HF) (5%) and saline is applied to porcelain margin (Figure 3B). ICEAM is then placed and tightened according to the manufacturer's guidelines. It must be ensured that there is no PTFE tape on top of the gingival margin (Figure 3C). In case, PTFE tape seems above the gingival margin, a packing instrument is used to shift it away from the abutment margin to peri-implant sulcus. PTFE ends are stretched and retwisted to reduce possible extension of peri-implant sulcus and decrease the thickness on facial surface. The twisted PTFE tape can be customarily tinned from 0.4-0.7 mm thickness by twisting region of PTFE tape in the facial sulcus. Cement intrusion can be protected by condensing a small piece of aspectic PTFE tape on head of the screw. The access channel of abutment is kept open and not filled with anything.

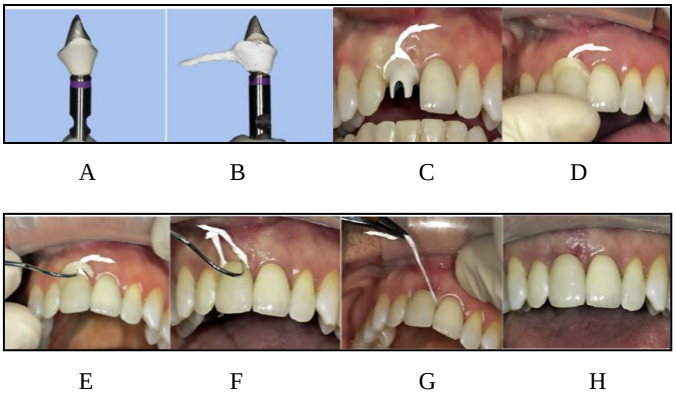


Fig 3: Stretching poltetrafluoroethylene tape technique (Hess, 2014) [8]

Seating of crown and ICEAM abutment is verified with a bitewing radiograph. Occlusion is then adjusted and crown is etched with 5% HF and silanate on the surface of intaglio. Resin adhesive is applied to the margin of ICEAM and intaglio surface of the crown. Small amount of resin cement is loaded onto the margin of crown and crown is seated in lingual to buccal or buccal to lingual direction (Figure 3D). After initial polymerization or gel state of resin, excess cement is removed, glycerine is applied and all surfaces are allowed to polymerize (Figure 3E). Then the PTFE tape is untwisted and distal and mesial ends are lifted incisally (Figure 3F). One end of PTFE tape is gently pulled towards the buccal as shown in Figure 3G. The restoration if finished by polishing the margins with composite resin polishing point, if required (Figure 3H).

7. Bis-acrylic Temporary Restorative Material and Die Spacer Technique

Bis-acrylic temporary restorative material and die spacer technique is a quick and easy method that uses daily laboratory and restorative materials and can be performed at chair-side. In this method, stock or custom implant abutments are used to control flow of cement in cases where cement reserved restorations are used. A even space between implant abutment and crown restoration can be achieved through the use of dies spacers.

Yuzbasioglu (2014) [16] described the method of this technique which involves investigation of crown restoration's marginal fit to the implant analog on dental model. Die spacer is then applied to the intaglio surface of crown restoration as per manufacturer's protocol (Figure 4A). Application of die spacer is repeated until desired thickness of cement is obtained. Additionally, the die spacer should be applied in such a way that all intaglio surface of crown restoration is covered (Figure 4B and 4C). Then, crown restoration is completely filled with bis-acrylic temporary restorative material and a handle is formed by placing retention pin having lesser diameter into the uncured filling (Figure 4D). Retention pin is secured until bis-acrylic is fully cured. Finally, crown restoration is removed ad checked for correct duplication of finish line and presence of any spaces in the new abutment (Figure 4E and 4F).

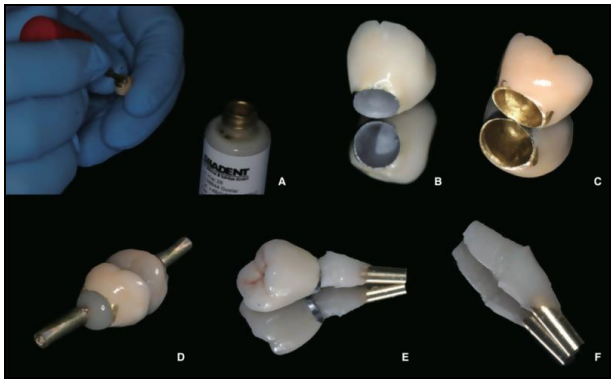


Fig 4: Preparation of crown restoration using bis-acrylic temporary restorative material and die spacer technique (Yuzbasioglu, 2014)

Crown restoration's intaglio surface is cleaned with air and any extra dye spacer is removed followed by application of a luting agent to the intaglio surface (Figure 5A and 5B). Then the crown is placed on bis-acrylic abutment and cotton swab is used to remove any extra cement (Figure 5C). Crown restoration is then taken off from bis-acrylic abutment which will have a layer of residual cement (Figure 5D). Depending on the requirement, extra layer of luting agent may be applied on the restoration. Finally, this crown restoration is ready to be placed on implant abutment intraorally.

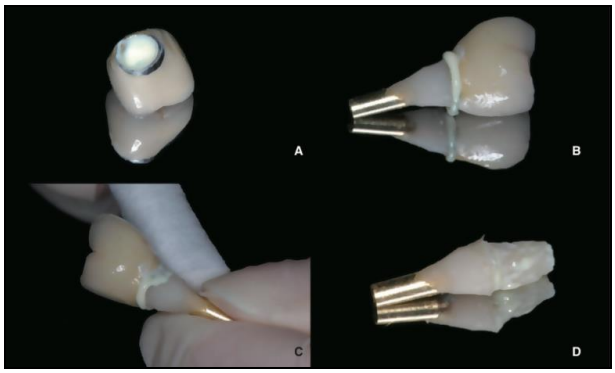


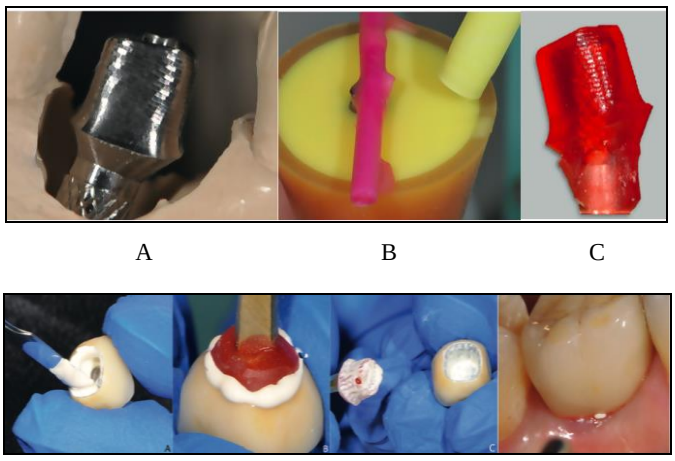
Fig 5: Removal of extra cement and finalization of crown restoration using bis-acrylic temporary restorative material and die spacer technique (Yuzbasioglu, 2014) [16]

8. Trial Acrylic Resin Abutments Customized Abutment Technique

Galvan *et al.* (2015) developed the trial acrylic resin abutments that can be shaped in a customized manner thereby making inside of crown more predictable. In this method, the inside of restoration is uniformly packed with cement. Trial acrylic resin abutment possesses less volume than the titanium abutment restoration. Although, trail acrylic resin restoration has comparable level of retention as that of 2-step cementation, however, they have minimum amount of excess cement.

This technique involves fabrication of the acrylic resin trial

abutment using an absolute titanium abutment and absolute restoration as a standard (Figure 6A). Titanium abutment is removed from the replica and its cervical portion is attached to a wax bar. Abutments attached to wax bar is then hung in a rubber dappen dish filled with polyvinyl siloxane (PVS) as shown in Figure 6B. After polymerization, the titanium abutment is removed from the PVS and any spaces are filled with fluid Pattern resin. Setting of resin is accelerated by placing a hot dowel pin in acrylic resin. Once the acrylic resin is set, abutment is removed as shown in Figure 6C.



A B C D E F G

Fig 6: Trial acrylic resin abutments customized abutment technique (Galvan *et al*. 2015)

Prior to insertion the titanium abutment in the mouth, a layer of petroleum jelly is applied to the subgingival region. Then the abutment is linked to implant and suitably tightened. Screw is retightened after 10 min to a particular torque level and access opening of the screw is closed with tape. Then the luting agent is used to fill the restoration and seated onto the acrylic resin abutment firmly. In this way excess cement comes out of the restoration margins (Figure 6D and 6E). Then, trial abutment is immediately removed from the restoration and an even layer of cement can be seen in restoration. The definitive restoration is quickly seated onto the titanium abutment introrally (Figure 6F). The final implant has the least quantity of excess cement close to margins of restoration (Figure 6G).

9. Conclusion

In conclusion, removal of excess cement is an absolute requirement of dental cementation procedures. Since various techniques have been developed and updated over the past few years, it is necessary for the clinicians to choose the most suitable technique and apply it according to the requirements of their practical conditions.

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