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Review Article

Screw-retained crown restorations of single implants: A step-by-step clinical guide

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ABSTRACT

This paper shows the clinical steps for preparing a screw-retained crown for the restoration of a single implant. Impression-taking using open-tray technique and delivery of the crown is presented in a step-by-step manner elucidated by detailed photographs. Furthermore, the advantages and disadvantages of screw-retained crowns are discussed in comparison with the cemented restorations.

Key words: Open tray impression, retrievability, screw-retained crown, single dental implant

INTRODUCTION

The use of implant-supported single crowns has become a well-established and preferred approach to compensate missing single teeth.[1] There are two different types of prosthetic restorations fixed on dental implants: Screw-retained and cemented restorations. The choice of method is usually based on the clinician's preference.[2] Retrievability is the main advantage of screw-retained crowns that would make it more favorable to many clinicians.[3] It allows better control on the hygiene of the implants and surrounding mucosa, also, crowns can be easily repaired in case of crown fracture.[4] On the other hand, cases when the access hole is on the incisal edges or cusps teeth or easier access to the posterior area of the mouth is needed, cemented crown restorations could be more practical.[4,5]

CLINICAL STEPS FOR SCREW-RETAINED CROWN RESTORATION OF A SINGLE IMPLANT

The two main procedures needed for getting a crown restoration are taking an accurate impression and delivering the screw retained single crown. The prosthetic procedures are usually conducted after proper healing time is allowed following the surgical insertion of the implant. If surgical insertion followed a two-stage protocol, then a healing time of at least 2 weeks should be allowed after surgical exposure [Figure 1]. In one-stage as well as two-stage surgical protocols, the surgeon is responsible of placing the healing cap (or gingival former) on the fixture before referring the patient for prosthetic construction [Figure 2]. Various shapes and sizes of healing caps are available for different implant systems [Figure 3]. Radiographic evaluation of the implant may be prescribed to evaluate the quality of bone surrounding the implant; an intra-oral peri-apical X-ray can be used to check for any unwanted signs of a failure of the implant [Figure 4].

Taking the impression

There are variable techniques for taking an impression at the implant level. In this paper, the impression is obtained using the open tray (direct) method which gives high accuracy.[6] Errors more often occur with the closed tray (indirect) method during removal and replacement of the coping, especially in the

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Figure 1: Implant exposure and placement of the healing cap

Figure 3: Healing caps (Ginival formers): Various sizes

occluso-gingival direction.[7] However, a limited mouth opening of the patient may be the cause why a clinician is enforced to use a closed tray technique.

The following steps are presented to illustrate, step-by-step, the technique of open tray direct impression.

- Healing the abutment removal: The peri-implant mucosa is allowed to heal for at least 10 days after surgical exposure [Figure 2]. The healing abutment is unscrewed by anti-clock-wise rotation using a manual screw-driver [Figure 5]. The implant prosthetic platform should be examined to be free of bone and soft tissue [Figure 6]
- A fixture mount/pick-up coping compatible with the dental implant should be used [Figure 7a]. A fixture mount suitable for the open-tray impression technique is placed on the implant body and tightened by manual clock-wise rotation of its inner screw [Figure 7b]. When the mount is below the level of the mucosa, an intra-oral radiograph should be done to ensure that the mount is properly seated on the implant[8]
- A plastic stock tray or a custom made acrylic tray should be customized by cutting out a window over the area of the implant to allow clearance for the fixture mount [Figure 8a]. The impression tray should be assessed in the oral cavity to verify that the fixture mount and its screw protrudes through the tray [Figure 8b]
- Impression material application: A light-bodied addition silicone impression material is syringed around the fixture mount. Meanwhile, the impression tray is loaded with heavy-bodied addition silicone impression material and seated directly in the mouth and exactly in its place. The excess impression material should be wiped off the screw of the fixture mount before it sets [Figure 9]. Opening of the screw may be filled with wax or cotton to prevent impression material from being trapped into screw opening
- After the impression material sets, the mount is separated from the implant by un-screwing the long screw inside the mount [Figures 10a-c]. Then the impression tray is removed from the mouth with the fixture mount remaining secured in the impression [Figure 10d]. The impression material is verified to be completely adapted around the implant and mount. Then the healing abutment is placed back onto the implant to prevent soft

Figure 2: Implant with the healing cap after healing of peri-implant mucosa

Figure 4: Radiograph showing an implant with favorable bone pattern and no signs of failure or peri-implant radiolucency

Figure 5: Manual screw-driver: Various lengths

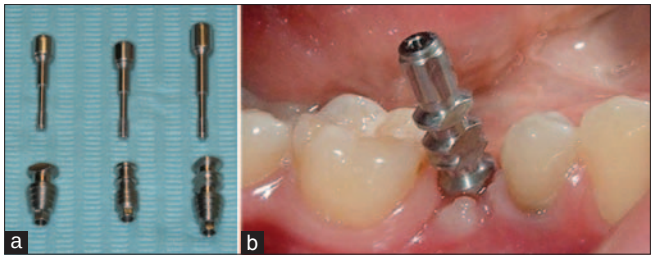

Figure 7: (a) Fixture mount for open tray technique: Various sizes (short, slim, and regular) (b) Fixture mount adapted to implant

Figure 9: Impression taken with addition silicone: removal of excess material around the screw before setting

tissue collapse till next visit when the restoration is to be delivered. An interim crown may be fabricated to promote biologically and esthetically appropriate soft tissue emergence for implants in the esthetic zone; the technique for preparing a single screw-retained interim crown is described elsewhere[9]

- Implant analog [Figure 11a]: The analog is mated with the fixture mount/transfer by holding the analog in place while inserting the long screws through the access holes in the impression tray and tightened by the hand screwing [Figures 11b].

Figure 6: Healed peri-implant mucosa: A view after removal of the healing abutment

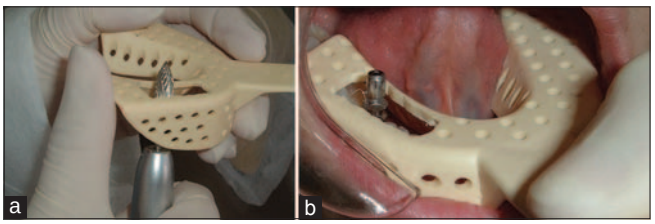

Figure 8: (a) Preparation of stock tray for direct impression (b) Trial of an impression tray intra-orally

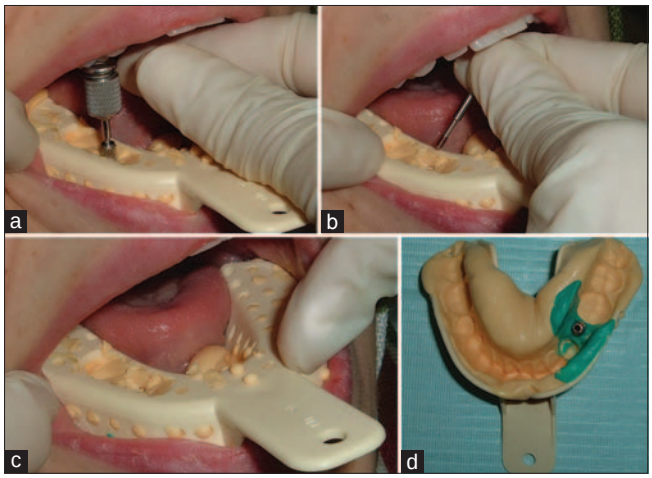

Figure 10: (a) Unscrewing the mount after the impression material sets (b) Removal of the inner screw from fixture mount (c) Mount secured inside impression ready to be removed from the oral cavity (d) Fixture mount secured inside impression removed from the oral cavity

The analog should be safely and precisely attached to the impression fixture mount. Caution to avoid the over-rotation of the mount is needed during screwing since any slight movement may cause distortion of the impression

- Impression with the fixture mount connected to the analog, bite registration, opposing impression, and shade of the restoration is sent to the dental laboratory.

Delivering the screw-retained crown

The main types of crown materials are either ceramic fused to metal or metal-free prosthesis like full zirconium crowns [Figure 12]. The restoration is sent back from the laboratory as one piece for delivery; an intermediate try-in step is unnecessary especially when an accurate impression is taken. The following steps are presenting the clinical steps of the screw-retained crown delivery after receiving a full-ceramic zirconium crown from the dental laboratory [Figure 13]:

- Healing the abutment removal: The healing abutment is unscrewed with the manual screw-driver and peri-implant mucosa should be assessed for the absence of inflammation [Figure 14]
- The crown is soaked in chlorhexidine mouthwash for sanitization for 2 min then it is placed onto the implant and tightened with the manual screw-driver [Figures 15a-c]
- After the adjustment of the contour and occlusion of the crown as necessary [Figure 16], a resilient material like a small cotton plug is placed into the screw access channel [Figure 17]. Other materials such as teflon or dental wax could be used for the same purpose; this allows easy access to the abutment screw in the future. The remainder of the channel is filled with a temporary filling [Figures 18a and b]. Screwing the restoration may cause pressure on the peri-implant mucosa; this may result in a short-term ischemia of the soft tissues [Figure 19]
- A periapical radiograph along the long axis of the implant is necessary to ensure that the abutment is seated completely on the implant[10] [Figure 20]
- After the confirmation of crown fit on X-ray, the patient is allowed to use the new restoration for few weeks. Then the previous temporary filling is removed, and the abutment screw is re-tightened to the recommended torque value (e.g.: 25 Ncm) using a calibrated torque wrench [Figure 21a] attached to a compatible screw-diver [Figure 21b]. It should be known that the mechanical torque level should follow manufacturer's instructions and is usually lower

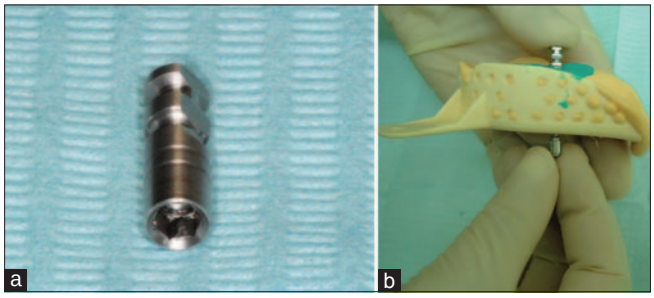

Figure 11: (a) Implant analog: Represents the implant when gypsum model is poured (b) Analog attached to fixture mount

Figure 12: Full zirconium screw-retained crown

Figure 13: Zirconium screw-retained crown on gypsum model as received from the dental laboratory

Figure 14: Peri-implant mucosa assessed for the absence of inflammation: Occlusal view

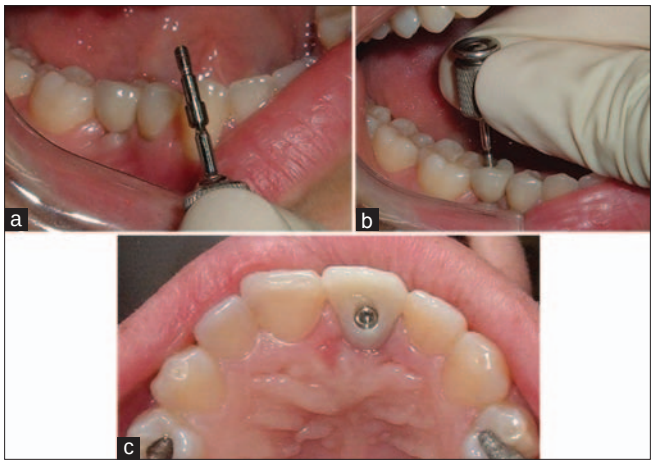

Figure 15: (a) Screw-retained single crown placed on the implant before screw attachment (b) Manual screwing of crown to the implant (c) Single screw-retained crown attached to implant: Occlusal view

Figure 16: Single screw-retained crown attached to implant: Proper size of the crown with no interruption of occlusion

Figure 17: Cotton plug is placed into the screw access channel

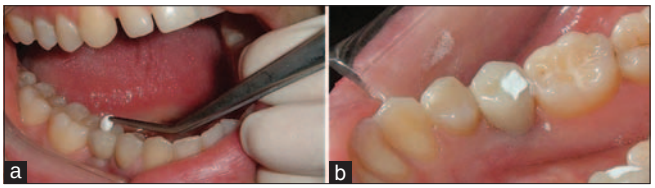

Figure 18: (a) Temporary filling material to fill the screw access channel (b) Access channel filled with temporary filling material

Figure 19: Pressure on the peri-implant tissues resulting in blanching of the buccal mucosa

Figure 20: Radiograph showing proper seating of the crown on implant

for full ceramic crowns compared to metal-based crowns [Figures 22a-c]

- A small cotton pellet or teflon plug [Figure 23a] is placed again into the screw access channel [Figure 23b]; the opening is filled with a composite resin restoration [Figures 24a and b]
- A record peri-apical X-ray, after delivery of the final prosthesis is necessary at this point; this radiograph will be useful for follow-up and maintenance comparisons of bone level with later radiographs [Figures 25a-c]. The next follow-up visit should not exceed 4 months after delivery of the crown. The patient also should receive appropriate oral hygiene instructions prior to being discharged till next recall visit.

DISCUSSION

The choice of a screw-retained versus a cemented crown is a decision that involves several points of consideration. The clinician should have good awareness regarding the advantages and disadvantages of using a screw-retained versus a cemented crown.[11-13] Here are some factors the clinician should put in consideration when choosing which type to use:

Retrievability

The main advantage of screw-retained crowns is retrievability. It is always nice to have the option to easily remove an implant crown or re-tighten the screw whenever it is needed without any damage to the restoration. In the case of crown loosening, crown fracture, screw replacement, implant assessment, and cleaning of the surrounding tissue, the crown can easily be removed. While the screw-retained crown is certainly retrievable, removing a cemented crown can be problematic particularly if full ceramic crowns are used.[4,13]

Hygiene

excess cement left behind cemented restoration is a major problem and can result in soft tissue damage, bone loss, and/or chronic inflammation.[11] The literature shows that the soft tissue surrounding screw-retained crowns are healthier than the peri-implant mucosa surrounding cemented restorations.[12] However, by removing cement thoroughly, the risk of leaving

Figure 21: (a) Adjustable mechanical torque wrench (b) Mechanical screw-driver: Various lengths

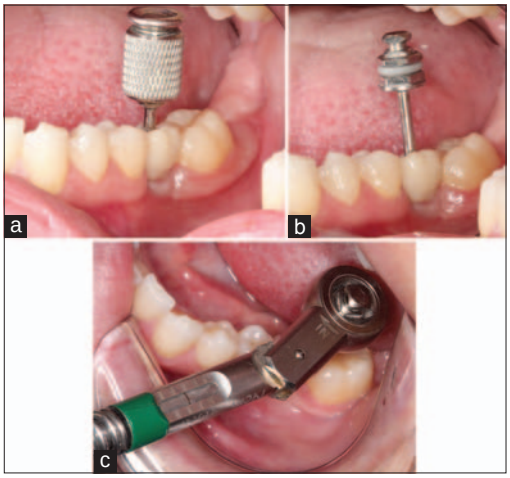

Figure 22: (a) Screw is tightened with manual screw driver first, then mechanical screwing using a torque wrench is applied (b) Mechanical screw-driver adapted to the screw of the restoration (c) Rotatory force applied till wanted torque is reached (25 Ncm)

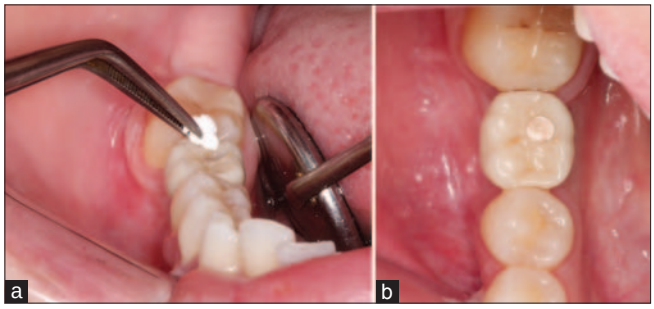

Figure 23: (a) Teflon plug is placed into the screw access channel (b) Access channel with teflon plug covering the screw

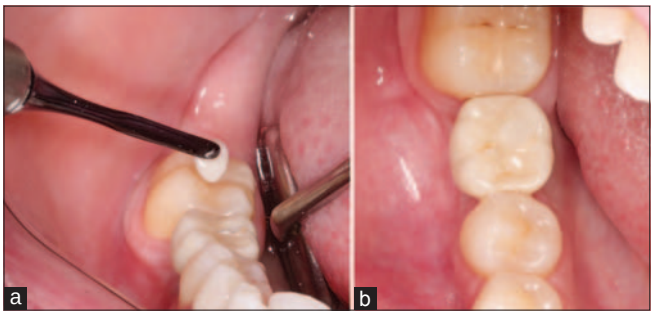

Figure 24: (a) Composite resin filling material to fill the screw access channel (b) Access channel filled with composite resin filling material

Figure 25: (a) Final restoration of left central incisor: Crown with final restorative resin material in access channel (b) Final restoration of left central incisor: Screw-retained full ceramic crown (c) Final restoration of left central incisor: Radiograph showing properly seated final restoration

cement subgingivally that could cause peri-implantitis is reduced significantly.

Retention

Abutment height, degree of taper and surface area are all factors that affect the retention of cemented crowns. Abutment height is an important factor for proper retention. Longer abutment walls have more surface area, consequently are more retentive. At least 5 mm of abutment height is needed for proper retention of cemented crowns.[14] Therefore; screw-retained crowns are necessary in situations when limited inter-arch space dictates an abutment that would be shorter than 5 mm.[15]

Esthetics

In screw-retained restorations, the access hole will exit through the central fossa of the prosthetic crown. The screw hole in prosthesis may compromise esthetic, occlusion, and porcelain strength;[16] especially if the diameter of the screw was wide.[4] The cemented crown obviously has no entrance cavity. All-ceramic screw-retained crowns reduce the challenge of masking underlying discoloration from showing through the occlusal access opening once it is sealed by resin cement.

Implant inclination

particularly, when screw-retained crown is planned to be the prosthetic choice, surgeon should bring to the attention the inclination of the implant fixture accordingly while planning the surgical procedure. This typically does not cause a problem with posterior implants, since the posterior implants are more axially positioned with regard to the alveolus and tooth. However, it may be an issue with anterior teeth where the implant needs to be inclined lingually to allow screw emergence through the cingulum area of the restoration.

Accessibility

placing a screw-retained restoration in a patient with a limited opening and/or in the posterior area of the mouth can be challenging if there was not sufficient space for the screw-driver to be inserted.[8,17]

Screw loosening

screw-retained restorations are associated with screw loosening complication especially in single crown restoration. The frequency of screw loosening is reported to be between 5% and 65%.[16,18,19] Using a mechanical torque instrument to tighten the screw to a recommended torque level (20-30 Ncm) has greatly diminished this prosthetic complication.[20,21] In a study simulating clinical settings, 60 dental students applied their maximum controlled torque to the head of a screw-driven, the mean torque value obtained by hand was 11.5 Ncm.[22] Thus, the overestimation of the hand-driven forces should be avoided. In Addition, Siamos *et al*.[21] suggested that re-tightening abutment screws 10 min after initial torque applications should be performed routinely to increase stability and decrease screw loosening.

In a recent long-term systematic review, Jung *et al*.[18] studied the survival rate and the incidence of biological, technical, and esthetic complications of single crowns on implants. They reported that survival of implant-supported single crowns was 96.3% after 5 years and 89.4% after 10 years. Technical complications reached a cumulative incidence of 8.8% for screw-loosening, 4.1% for loss of retention, and 3.5% for fracture of the veneering material after 5 years. No statistical differences were detected when comparing survival rates of screw-retained and cemented single crowns; there was no statistically significant difference between all-ceramic and metal-ceramic single crowns.

Pjetursson *et al*.[19] conducted a systematic review and reported that the survival rate of metal–ceramic implant supported fixed dental prosthesis was 96.4% after 5 years and 93.9% after 10 years. The most frequent complications over the 5-year observation period were fractures of the veneering material (13.5%), loss of access hole restoration (5.4%), abutment or screw loosening (5.3%), and loss of retention of the cemented prosthesis (4.7%).

CONCLUSION

When it comes to the restoration of implants, we typically have two treatment options: Screw-retained or cement-retained crowns. Although both treatment options can be used predictably, they have their own advantages and disadvantages; known retention, retrievability, re-tightening possibility, and the risk of not leaving residual cement are the main advantages of screw-retained crowns. Implant angulation may be a limitation to the usage of screw-retained restorations in some oral sites. While improved esthetic outcome and better occlusion are the main advantages of cemented crowns, their main disadvantages are less retention and difficulty of removal.

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