

# How to Find Abutment Screw Channel of a Cement-retained Implant Supported Restoration? A Literature Reviews

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**Introduction:** Screw loosening is the most common technical complication in cement-retained dental implants. To retrieve screw loosened dental abutment, making abutment screw channel (ASC) is a useful method to access the abutment screw. This article reviews the methods for preparing ASC of cement-retained implant supported restoration. **Materials and Methods:** The search was conducted on PubMed, Google Scholar, and Scopus. The keywords were screw loosening, cement-retained implant restoration, screw access hole, abutment screw channel and retrieving. **Results:** Having applied the inclusion and exclusion criterion, 24 articles, 21 technical notes, 1 case report, and 2 reviews were found. **Conclusion:** The techniques reviewed were categorized into 3 groups of marking techniques, customized guides, and imaging techniques with different outcomes.

**Keywords:** Abutment screw channel; Cement-retained; Implant restoration; Retrieving; Screw loosening; Screw access hole

## Introduction

Single implant-supported crowns, either cement or screw retained are widely used due to their reported 90-95% success rate (1). As the screw retained restorations have more complications in follow up sessions compared with cement retained restoration, the cement one is considered as a desired choice by many practitioners (2). A recent systematic review revealed superior results using cement retained restorations (CRR) in terms of less mechanical as well as biological complications compared with that of screw retained (SRR) fixed implant-supported restorations (3). Also, Hebel *et al.*, stated that CRRs are superior to SRRs in terms of occlusion and esthetics (4). The most common complication of cement retained implants is abutment screw loosening (5). Difficult retrievability is the most important drawback reported for CRR (6). In order to retrieve a CRR in situations like screw loosening, making a screw access to tighten the screw or remove the crown is necessary (7) unless more radical techniques such as crown sectioning (8) are used that technically makes the crown useless. Variances in bone configuration results in different axis of dental implant position from their crown axis (9). This may

cause a catastrophic damage to the crown or even screw while making the access channel of CRRs (7, 10). This literature reviews articles focusing on techniques and methods intending to find the best screw access channel of CRRs (6, 7, 10, 11). This will give the researchers an insight in finding the best angulation and position for retrieving with the least damage to the crown and screw.

## Materials and Methods

A comprehensive PubMed, Google scholar, and Scopus search was conducted. The key words for this search included Screw loosening, cement-retained implant restoration, screw access hole, abutment screw channel and retrieving. The titles and abstracts of the searches were checked for relevance. In addition, the full text of relevant articles was obtained via manual or electronically done search when required. Otherwise, the electronically available abstracts of the articles were studied. The inclusion criteria for articles were *in vitro* and *in vivo* studies or review articles containing relevant articles on retrieving cement-retained implant-supported restorations. Clinical or technical

reports regarding the retrieving restorations were also included. Finite element analysis studies or studies not written in English were excluded.

## Results

In line with the aim of this article, the total number of 24 articles were found that met the inclusion criteria. Articles reviewed were published in the period of 1995-2020. The articles included 21 technical notes, 1 case report, and 2 reviews. Twenty-three articles described or reviewed various techniques in finding location of abutment screw channel and direction of accessing to the screw in cement-retained dental implants. The articles were categorized into 3 groups as below:

### 1. Marking Techniques

Schweldhelm *et al.*, described a tinting technique for porcelain fused to metal restoration. Before final glazing and polishing the ceramic stain was applied to the screw access location that was distinguished using a surveyor (12). Schoenbaum *et al.*, described a technique for marking the occlusal surface of the restoration before firing. Cast was mounted on a surveyor in a way that the pin was accurately aligned with screw access chamber. The definitive restoration was placed in position and the entry location was prepared for small concavity in order for the stain not to wear under occlusion and then the brush was painted the point followed by firing the restoration (7).

### 2. Customized Guides

Ahmed *et al.*, described a simple and quite accurate technique in which they used patient's original implant analog cast to fabricate PMMA guide. A cast of loosened implant crown was made by taking impression. Then, a putty index blocked the tooth surface apical to height of contour and an index was made by pouring PMMA on the occlusal surface of the tooth on boxed cast. The guide was positioned on the implant analog cast and a thin drill was entered through the direction of implant. (13). Lautensack *et al.*, added a metallic part to distinguish the correct angulation and direction position of entrance (14). Hill proposed simple and inexpensive technique to record the position by putting a beading wax in the correct entrance position then taking a putty index of the crown prior to cementation (15). Radi *et al.*, described a technique that master cast while having impression coping on it was indexed using clear dough after putting warmed suction tips around the copings (6). Tarlow *et al.*, and Doerr *et al.*, used vacuum formed

guide on the patient's cast with restoration and abutment in place (16, 17). Wadhvani *et al.*, presented a technique that a polymerized plate was drilled approximately in the middle, and a screw driver was placed in the screw. Then, a fast setting heavy body occlusal registration material was applied between the teeth and the plate. The device was disinfected and stored for possible future need of retrieval (18). Lee described a digital technique for capturing implant position using scan body. The resulting template could be fabricated using additive or subtractive machining process (19). Mai *et al.*, also proposed a new technique which superimposes the intraoral scans of the patient before cementation of crown and the current scan of the tooth at the time of loosening. Two images were superimposed using three reference points and a drilling guide was designed on the current scan with the help of the pre-cementation scan for correct drilling angulation and location (11).

Kang *et al.*, described a rather modern and complex technique. The technique firstly requires a vacuum formed index of the patients cast with restoration in place. Then the 2 parts made using 3D printer are installed and attached to the guide. These parts are guide sleeve and hand piece sleeve parts which are installed corresponding with abutment placement position. The guide is stored and used in preparing the abutment screw channel(ASC) (20). Mai *et al.*, and Asiri *et al.*, superimposed intraoral 3D scan and CBCT images. They designed a drilling guide to access screw hole (21, 22).

### 3. Imaging Techniques

The articles focusing on imaging techniques includes wide variety of techniques from those used conventional radiographic images to those used intraoral scans. Unlike templates or pre-load made guides, these techniques neither require actual space for keeping nor they got damaged by environmental factors (23). The conventional parallel radiography technique is the most commonly used diagnostic procedure which is crucial for diagnosing screw loosening. In 2011, Patil *et al.*, described how to use parallel periapical radiography of loosened dental implants to aid in preparing a screw access hole. This was a cost effective technique with a low level of radiation exposure to the patients (24). In 2010 Alveraz *et al.*, described a simple technique to superimpose a photography of crown and abutment on the definitive cast. This helps in finding the access point of the abutment screw to retrieve the cement-retained restoration. Alveraz *et al.*, first used Photoshop software and proposed PowerPoint application in other article being widely available



(25, 26). In 2007 Daher *et al.*, described a photography technique to locate screw access channel by holding a periodontal probe vertically and horizontally in patients mouth after and before cementation of crown (27). Oh *et al.*, described a photography technique using cylindrical magnets directly on top of the abutment screw on the master cast. Having taken the first picture, the crown was seated on the abutment and the magnet was placed on followed by taking the second picture. These two photos could be superimposed to find abutment screw channel (28). In 2015, Lee JH described a technique in which a wooden blade was attached to the proximal tooth and two photographs were made using a tripod with and without any prosthesis on the abutment. Then, the two photographs were superimposed with PowerPoint application and were saved in patients records (29). In 2013, Park and Yoon described three dimensional (3D) scan image superimposition. Two scans were made, one when crown was in place on abutment and another one with a post in screw channel of abutment. The two scans were superimposed, so the location and direction of the preparation will be clear for the

clinician (23). Wicks *et al.*, also proposed a new ' CBCT imaging to find correct direction and location prepare an screw access via revealing correct axis of implant placement(9).

## Discussion

There are different ways to retrieve a loosened screw in cement retained restoration. These solutions vary from radical crown sectioning to more preventive ASC preparation techniques and prefabricated crown removing systems. Although ASC preparation is a more conservative way to restore the loosened crown, it could result in catastrophic outcomes if performed incorrectly. As the metallic part of implant restorations is thicker, drilling through the crown is difficult and could damage the abutment and its screw (8).

In this study, different methods to retrieve screw loosened crowns and their respective advantages and withdraws were reviewed (table 1 mentioned after references).

**Table 1.** Techniques for finding screw access channel in screw loosened CRRs

Authors, year	Technique	Physical Storage	Digital storage	Extra Costs	ASC location/ direction/ both	pre/post incident
Hill EE (15)	Making wax index of the crown before cementation	Yes	No	No	Location	Pre-incident
Figueras-Alvarez O. (25)	Taking photograph of the analogs on the cast	No	Yes	No	Location	Pre-incident
Daher T (30)	Photograph with periodontal probe to reference the adjacent tissues	No	Yes	No	Both	Pre-incident
Oh KC (28)	Use of cylindrical magnets below and above the prosthesis	No	Yes	Yes	Location	Pre-incident
Lee JH (29)	Taking photograph with special angulations and a piece of wood	No	Yes	Yes	Direction	Pre-incident
Patil PG (24)	Parallel radiography to measure 2d mesiodistal angulation	No	No	Yes	Direction	Post-incident
Park JI (23)	Fabricating a 3d scan record of the patient's analog on definitive cast.	No	yes	Yes	Both	Pre-incident
Mai HN (21)	Superimposing cast's 3d scan and CBCT for making a drilling milled resin guide	No	Yes	Yes	Both	Pre & Post-incident
Asiri W(22)	Superimposing cast's 3d scan and CBCT for making a resin printed drilling guide	No	No	Yes	Both	Post-incident
Wicks R (9)	Using cuts of CBCT for understanding direction and location of screw	No	No	Yes	Both	Post-incident
Ahmed A (13)	An acrylic template with drilling path made on the definitive cast	Yes	No	Yes	Both	Pre-incident
Lee DH (19)	A drilling guide made with 3d scan of cast with scan body placed on implant analog	No	Yes	Yes	Both	Pre-incident



Lautensack J (14)	Fabricating a drilling guide with sleeve on the cast	Yes	No	Yes	Both	Pre-incident
Radi IA (6)	Placing heated suction tips in an acrylic drilling guide on the implant analogs	Yes	No	Yes	Both	Post-incident
Tarlow JL (17)	A resin guide with a drilling a hole	Yes	No	Yes	Location	Pre-incident
Kang HW (20)	Adding a printed headpiece sleeve to a vacuum formed template made on the cast	Yes	No	Yes	Both	Post-incident
Doerr J (16)	Vacuum formed acrylic template that is drilled over the implant analog on the cast	Yes	No	Yes	Location	Post-incident
Mai HN (11)	Making a milled drilling guide with intra oral scans of pre and post cementation crown.	No	Yes	Yes	Both	Pre-incident
Wadhvani C (18)	Making a silicone drilling guide of definitive cast	Yes	No	Yes	Both	Post-incident
Schwedhelm ER (12)	Tinting ASC location on the prosthesis	No	No	Yes	Location	Pre-incident
Schoenbaum TR (31)	Tinting ASC location on the prosthesis	No	No	Yes	Location	Pre-incident

This table shows if the technique needs extra laboratory work, cost, and digital or physical storage, shows clinician ASC entry location, ASC entry direction, or both, and finally consideration before or after loosening incident.

There are techniques that help finding both location and direction of ASC including those using CBCT (9, 21, 22), pre cementation 3d cast records taken by digital scanners (23), conventional pre-cementation made sleeves and guides (6, 11, 13, 16, 17, 20), and digital records of the patient cast. Tinting and pre-cementation photographs that are simple techniques that show drilling entry location (25, 28). Some of these methods including simple crown staining need a strong bond between clinician and technician. Digital dentistry, although seems complex and expensive, gains precise and easy to store patients 'records. Guides that are made with digital technology are easy to work with and enables less skilled and less experienced dentists to perform retrieval procedures easily. Overall, clinicians should choose a technique among a variety of methods based on the patient needs and their experimental capability.

## Conclusion

This article reviewed various techniques to find ASC. This includes 3 categories of techniques namely marking technique (small tints applied to the surface of the restoration), customized guides (digitally or conventional), and imaging techniques (photographs and radiographs). The results obtained by each technique were studied and the respective characteristics were presented. The results presented in this article gives an insight

on how to use each technique and what would be the expected outcomes.

Conflict of Interest: 'None declared'.

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