# Chapter 06

## Screw-Retained Implant Restorations

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## Abstract

Screw-retained prostheses were the first restorations used over implants by the Branemark group at the early stages of osseointegration. Later the cement-retained implant restorations were introduced and widely used in the clinical practice. Each retention mode has advantages and disadvantages that should be evaluated according to the demands of each clinical case. The aim of this chapter is to present a short overview of the screw-retained restorations with clinical cases and analyze the characteristic for each type of retention.

## Keywords

Screw-Retained; Implant Restorations

## Introduction

Screw-retained prostheses were the first restorations used over implants by the Branemark group at the early stages of osseointegration, going back to 1965, where the first "tissue integrated prosthesis" was fabricated. At that time dental implants were used only for this type of prosthetic treatment of the edentulous mandible and 5-6 implants were considered as absolutely necessary for this prosthetic treatment. The prosthetic restorations were fixed on a transmucosal (or also called transgingival) abutment which was secured by screw on the implant. The abutments were inserted upon implant uncoverage and were fixed with high torque on the implant. Their main function was to bring the margin of the Fixed Dental Prosthesis (FDP) over the periimplant tissue in order to facilitate oral hygiene. The lower surface of the prosthesis had a distance of 2-3 mm from the periimplant tissue to allow oral hygiene even with a mouthwash. The prostheses were fabricated by a metal framework covered with polymer material (PMMA) and denture teeth. One to two cantilevers were added to the most distal abutment to ensure increased masticatory capacity to the patient. Up to the middle of 90's screw-retained restorations were the

only available option, although the spectrum of indications was wider including implant-supported single-tooth crowns and FDPs [1].

The first introduced full-arch restorations were highly demanding and technique sensitive. There was also no possibility to compensate an implant with non-favorable inclination for the prosthesis. For this reason the cement-retained restorations that were introduced at the middle of 90's were immediately adopted from the clinicians. The use of angulated abutments that allowed the fabrication of crown without access hole for the retaining screw was a solution, especially in cases of anterior maxillary implants where the implant inclination might have severe diversion to the implant axis.

At the following years the spectrum of restorations on implants was increased from total edentulism to single tooth implants [2,3]. The available materials for the fabrication of implant restorations nowadays include porcelain-fused-to metal (which is the most widely used type of restoration), polymer-to-metal restoration and all-ceramic restorations. The techniques for the fabrication have also been improved and CAD/CAM restorations fabricated from intraoral or laboratory scanning are widely used.

Despite the evolution of materials and techniques there is always the issue of fixing the prosthesis on the dental implant. The two existing available options for implant supported restorations remain the screw- or cement-retention.

## Aim

The aim of this chapter is to present a short overview of the screw-retained restorations with clinical cases and analyze the advantages, disadvantages and characteristic for each type of retention.

## Screw-or Cement-Retained?

A fixed implant restoration can be fabricated either by fixing the prosthetic directly to the implant head using a screw for retention, or can be achieved by cementing the final prosthetic on to an abutment,

which, in turn, has been screwed to the implant. There is also the possibility to secure a transmucosal abutment on the implant (also called "multi-purpose abutment") by screw and then fix the prosthesis by a retention screw on the transgingival abutment. These abutmens are prefabricated titanium abutments with diameter analogue to the implant diameter and available in different heights to fit to the clinical demands of each case.

## Advantages, Disadvantages and Characteristics of the Screw-Retention

Screw retained restorations offer easy retrievability which is important to allow repair and maintenance. Retrievability can be difficult in cement retention, even if temporary cement has been used. The loosening of the fixing screw in an abutment for cement-retained crown-while the crown remains cemented on the abutment- is a common clinical problem and may lead to severe prosthetic complications [4].

Careful presurgical planning and surgical skill is required during implant placement so that the access hole for the fixing screw is located within the occlusal or the palatal surface of the crown. This is of great importance in maxillary anterior implants where implant axis is usually located on the labial surface due to the inclination of the alveolar process.

In screw-retained restoration passive fit on the implants or the transmucosal abutments is required. This is an important factor for a long-time uneventful clinical function. In this way the masticatory forces are transmitted to the implant and shear tension of the retention screw can be avoided. In screw-retention the passive fit is more difficult to achieve, in cement-retention the use of cement is considered to be a compensating factor for minor misfits.

The passive fit should be verified clinically by the Sheffield test: In this test the restoration is fixed by the screw on the most distal implant and the existence of gap is checked on the other implants. In

cases of implants with thick periimplant tissues radiographic control may be necessary.

In screw-retained restorations the abutment (or the prosthesis) should be fixed by applying the torque recommended by the manufacturer. The final torque should be exerted by means of a torque measuring device upon the final fixation.

The access holes should be filled with a proper material to ensure sealing of the cavity and avoid leakage and microbial contamination. In former years gutta-percha had been used in a plastic consistency over the head of the fixing screw, but it became hard after time and did not allow easy removal. Teflon tape is mostly used nowadays as it be easily condensed and removed. Cotton that had been proposed several years ago should not be used as it absorbs liquids and enhances bacterial contamination. The top of the access hole is covered with composite material making it hardly distinguishable.

Cement-retained restoration may offer a better esthetic result and are often the clinical choice in anterior maxillary restorations, when the implant axis does not allow the placement of the access hole in the palatal surface. In some cases however it may be difficult to remove the excess cement from a deep sub-gingival abutment margin. If excess cement remains on the abutment margin it may cause severe problems to periimplant tissues.

## Indications of Screw-Retained Restorations

For extended full-arch restorations that demand professional oral hygiene and regular recall program, screw-retained restorations are preferable due to the retrievability of the restoration. In patients that are expected to lose more teeth in the future screw-retained restorations offer the advantage of retrievability and/ or modification. In cases with minimum inteocclusal space screw-retained restorations are also preferred as there is no need for prefabricated abutments. A very short prefabricated abutment cannot ensure proper retention

and additional height is needed for the crown materials. A screw-retained restoration may be fixed directly on the implant minimizing the needed vertical space. For implants surrounded by thick periimplant tissues or are deeply placed, screw-retained restorations are preferable as it may may difficult to remove the excess of cement. Implant restorations where complications are expected would be preferably screw-retained to allow easy removal.

## Fabrication of Screw-Retained Restorations

For the fixing of screw-retained restorations on implants there are currently four available options: Direct fixation in the implant, fixation on a transmucosal abutment, cement-screw-retained restorations and CAD/CAM fabrication.

### Direct Fixation

Direct fixation on the implant is used mainly on single tooth implants. The lower part of the prefabricated abutment has a retention mechanism (internal or external hexagon, conical part) made from metal alloy or titanium, that fits exactly on the head of the implant ensuring antirotation of the prosthesis (Figure 1). The upper part of the abutment is made of plastic so that it can be incorporated in the casting of the customized implant crown by overcastting. The first introduced abutment of that type were named as "UCLA" abutments and were used as the basis for customized abutments either for screw- or cement-retained restorations [5,6].

The main advantage of this type of restoration (direct fixation) is the possibility to create a customized emergence profile from the top of the implant to the margin of the periimplant tissue, thus facilitating the esthetic result. Another advantage is that it is simple and easy to fabricate the prosthesis without the need for transmucosal abutment. Its use is however restricted to single tooth crowns as it is difficult –if not impossible- to achieve passive fit on the heads of two implants, especially if they are of internal connection and divergent.

**Figure 1:** UCLA type abutment (Aurobase abutments) with prefabricated gold base for overcastting (Xive implants, Dentsply/Sirona Co).

On the other side numerous independent manufacturers for implant components have introduced the so called "compatible" abutments, which are fabricated to fit on implants of the major implant manufacturers with reduced cost. Among the compatible components there is a vast variety of available abutments for screw-retained restorations compatible with most implant systems. They are used extensively by many clinicians due to their reduced cost, but their efficacy has not been documented with long-term controlled clinical trials. Some abutments indicated for screw-retained restorations are made completely of burnable plastic and are used for the metal framework by casting. It remains still questionable if the anti-rotational mechanism (hexagon) can be reproduced with the needed accuracy by casting to ensure the precise fit of the abutment in the implant. Similar abutments have been presented for screw-retained all ceramic resto-

rations. In these cases instead of the burnable cylinder a zirconium oxide cylinder is used and the crown shape is completed with ceramic material to full contour.

A clinical example of a screw-retained crown with direct fixation is presented in clinical Case A.

## Fixation on a Transmucosal Abutment

Fixation on a transmucosal abutment is the technique that most implant manufacturers recommend for the fabrication of multiple unit restorations. The transmucosal abutments transfer the margin of the prosthesis from the head of the implant to the margin of the peri-implant tissues (Figure 2).The transmucosal abutments (also called multi-purpose abutments, uni-abutments, multi abutments etc) are available in different diameters and height according to the thickness of the periimplant tissue and have anti-rotational mechanism on the lower (intra-implant part). The upper part (extra-implant) may be conically shaped or have anti-rotational mechanism (Figure 3). They are fixed by screw on the implant either upon implant uncoverage or later and are not removed at any following stage. The transmucosal abutments are always accompanied by a plastic burnable cylinder that is used for the fabrication of the metal framework (Figure 4). Some implant manufacturers also provide burnable cylinders with a prefabricated metal basis to ensure proper fitting of the implant crown. Most implant manufacturers and independent abutment manufacturers also offer angulated transmucosal abutments that can compensate unfavorable or divergent implant axes. In these cases the transgingival abutment consists of two parts, the one fitting to the implant –fixed with a screw along the implant axis- and a second angulated part that supports the crown basis and receives the retention screw of the implant crown (Figure 5). Impression is taken using the corresponding impression posts and the working cast is fabricated with corresponding implant analogues with the same geometry as the transmucosal abutments.

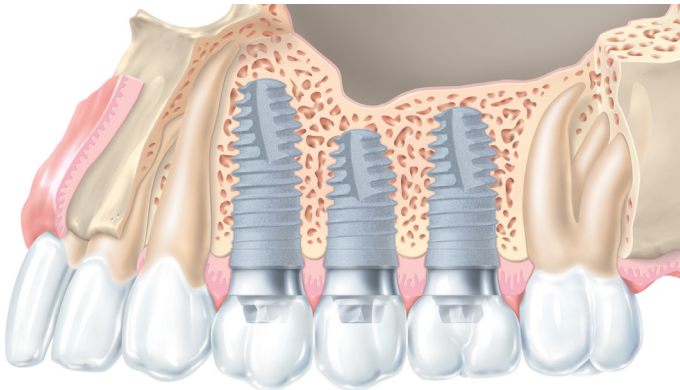


**Figure 2:** Restoration on transmucosal abutments (MP abutments) for screw- retained restorations (Xive implants, Dentsply/Sirona Co).

**Figure 3:** Titanium transmucosal abutments (MP abutments) for screw- retained restorations in different diameters with retention screws (Xive implants, Dentsply/Sirona Co).

**Figure 4:** Castable sleeves with or without prefabricated metal base for screw- retained restorations on Multi Purpose abutments (Xive implants, Dentsply/Sirona Co).

**Figure 5:** Two-piece angulated abutment (Smart-Fix abutments) for screw- retained restorations (Xive implants, Dentsply/Sirona Co). The fixing screw of the abutment has different inclination from the fixing screw of the restoration.

These abutments are widely used nowadays as they offer multiple advantages. The margin of the restoration is moved from the head of the implant to the height of the peri-implant tissue. In this way the height of the implant crown is reduced, the crown-to-implant ratio is changed favorably and an easier fit can be achieved on the conical abutment compared to the need of fixation into the implant. Their use has not been documented with long term clinical trials focused on their clinical performance but no complications have so far been reported associated with this type of abutments.

A clinical example of a screw-retained restoration on transmucosal abutments is presented in clinical Case B.

## Cement-Screw-Retained Restorations

The term "cement-screw-retained-restorations" is used to describe screw-retained restorations that are made using prefabricated titanium abutments for cement-retained crowns and an overlying metal framework that fits exactly on the prefabricated part. These abutments offer the advantage of the prefabricated titanium base with the antirotation mechanism (hexagon) without any inaccuracy caused by casting (Figure 6). The metal framework is formed surrounding the prefabricated part (usually formed as cylinder with orientation grooves or surfaces) and can be cast in any dental alloy, thus avoiding the need for overcastting with high-cost precious alloys that are needed in the UCLA abutments. The access hole for the retention screw is kept free during the laboratory procedure to allow smooth and undisturbed insertion and removal of the fixation screw.

The two parts are checked for the precise fit intraorally and are cemented after the final glaze of the ceramic veneer with dual polymerization resin cement either in the dental laboratory or chairside. This kind of fixation was lately introduced in order to combine the industrially achieved accuracy of the prefabricated part on the implant with the possibility of a simple cast restoration integrating the titanium part. Their use has not been investigated extensively with focused clinical trials but their adoption by the clinicians seems promising.

A limitating factor is that in case of two or more implants a common insertion path must be ensured to allow the restoration to "glide" over the prefabricated parts, eliminating the possibility of use in implants with divergent axes.

A clinical example of a cement-screw-retained restoration is presented in clinical Case C.

**Figure 6:** Prefabricated titanium base for the fabrication of customized cement-screw-retained restorations (Xive implants, Dentsply/Sirona Co).

## CAD/CAM Fabrication of Screw-Retained Restorations

CAD/CAM technology for implant restorations offers prosthetic solutions for the fabrication of screw-retained restorations in one piece without the need of abutments. In this way the restoration is fabricated after digital design, usually by milling or sintering. An-

other option is the fabrication of a screw-retained restoration to fit over transmucosal abutments. In both cases the digital designs of the fitting part of the restoration is captured from digital libraries that is available from most manufacturers.

## Clinical Case A: Single-Tooth Screw-Retained Restoration with Direct Fixation (Figure A1-A6)

In this case an internal connection implant (MIS Implants, MIS Co) was placed in region 15 to replace a missing maxillary premolar (Figure A1). An impression was taken at implant level and the working cast was fabricated. As it can be observed the periimplant tissues showed increased thickness (Figure A2). The implant axis was favorable and in a screw-retained restoration the access hole would be located within the occlusal surface. On the other side in a cement –retained crown the increased depth of the periimplant tissue would make the removal of excess cement more difficult and infection might be caused by cement remnants. An additional advantage of the screw-retained crowns is the possibility to create a fully customized emergence profile supporting the soft tissues and enhance the esthetic outcome (Figure A3,A4).

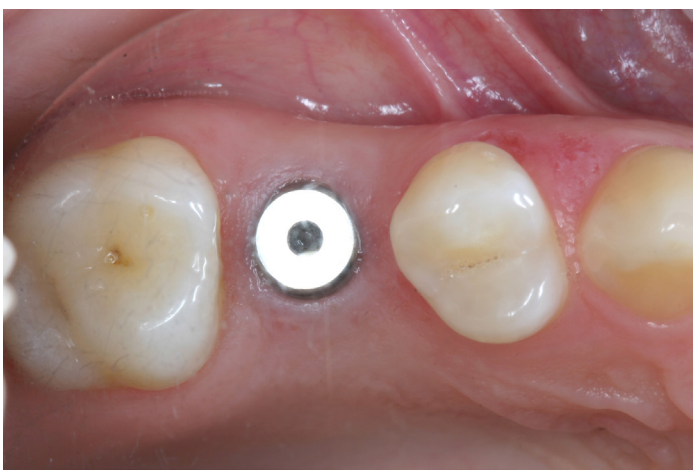


**Figure A1:** Case A: Initial clinical situation.

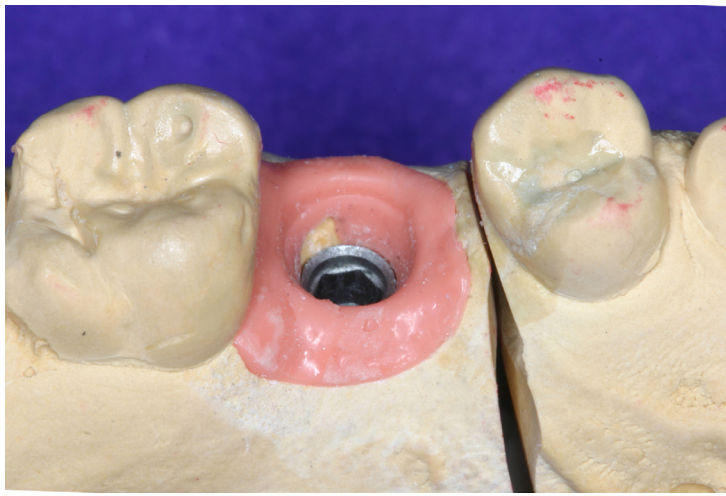


**Figure A2:** Working cast from an impression at implant level.

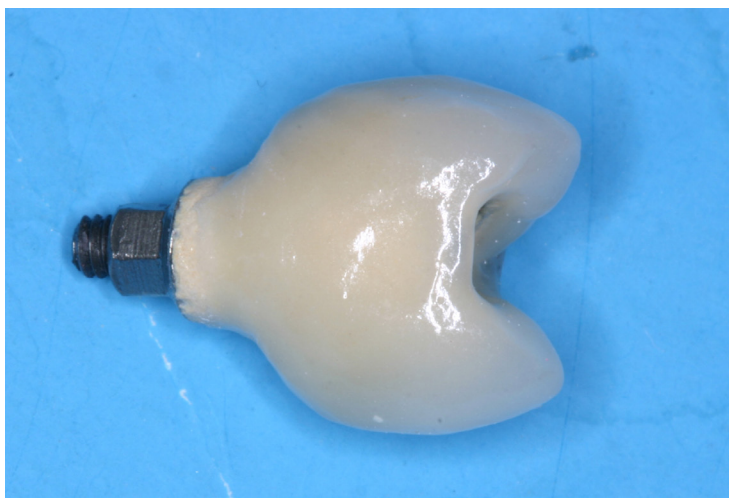


**Figure A3:** The screw-retained crown. The emergence profile has been customized to support the peri-implant tissues.

**Figure A4:** The restoration on the working cast.

A UCLA abutment (prefabricated basis with burnable cylinder) was used to fabricate the metal framework by overcastting for a screw-retained implant crown. After the fixation with the recommended torque the access holes were covered the composite resin (Figure A5,A6).

**Figure A5 and A6:** The final restoration.

## Clinical Case B: Splinted Crowns on Transmucosal Abutments (Figure B1-B10)

In this case two internal connection implants (Astra implants, Dentsply/Sirona Co) were inserted in regions 46 and 47 (Figure B1). Over and around the implants the soft tissues had increased thickness (Figure B2). An impression was taken at implant level and a working cast was poured with a gingival mask mimicking the surrounding soft tissues (Figure B3 and B4). As the implants were not completely parallel and a common insertion path for the intra-implant part of the abutments could not be ensured, it was decided to construct screw-retained splinted crowns on transmucosal abutments. On the working cast the height (thickness) of the periimplant tissue could be accurately measured and the proper transmucosal abutments were selected (Figure B5). As the axes of the implants were not severely divergent, straight transmucosal abutments with conical head were used (Figure B6). The abutments were fixed on the implants with the torque recommended by the manufacturer using the indicated insertion tool (Figure B7). An impression was taken on abutment level and

a new working cast was fabricated with implant analogues similar in geometry to the head of the transmucosal abutments (Figure B8).

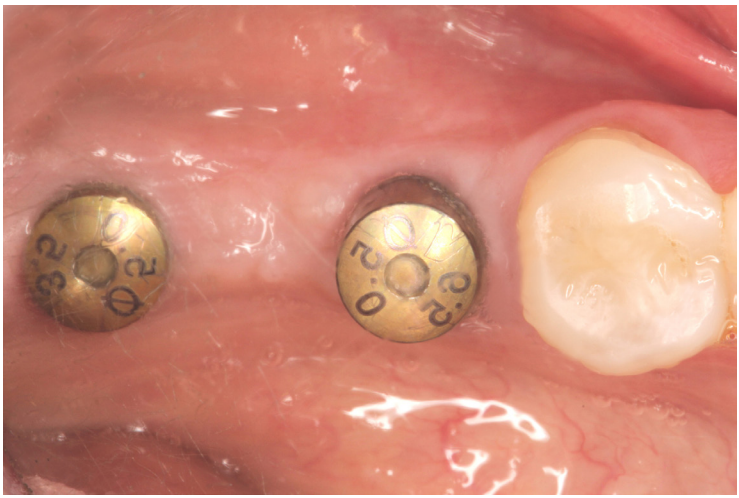


**Figure B1:** Case B: Initial clinical situation.

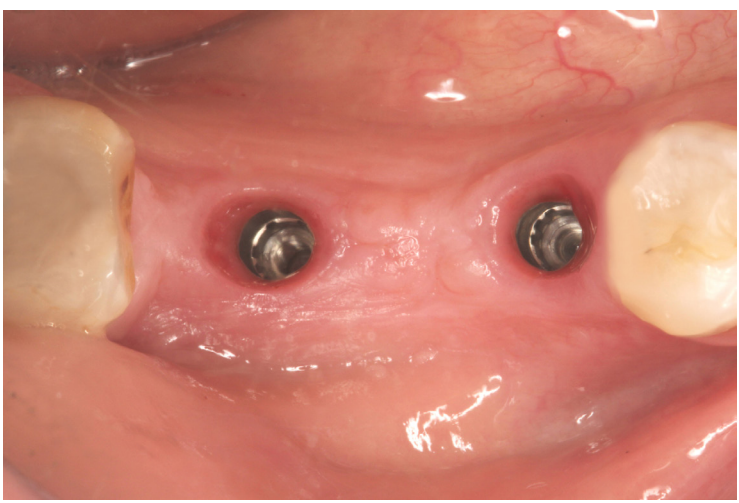


**Figure B2:** The soft tissues around the implants after removal of the healing screws

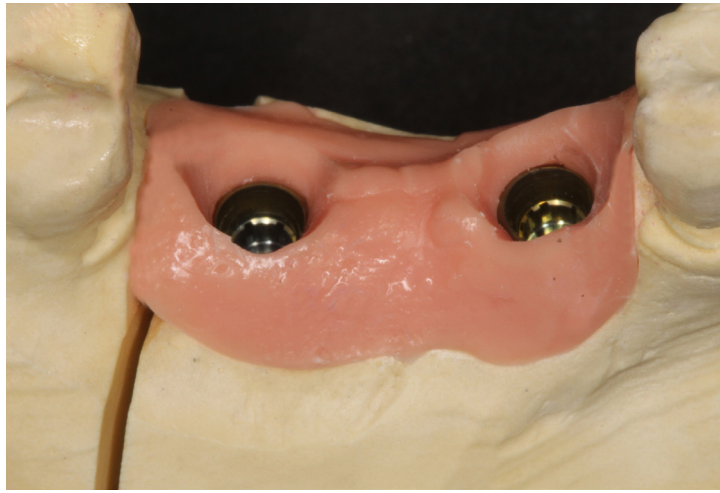


**Figure B3 and B4:** The working cast from an impression taken at the implant level.

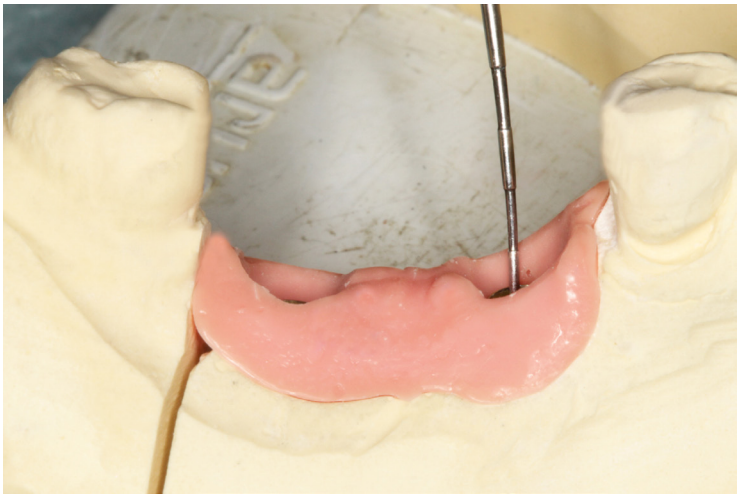


**Figure B5:** Measurement of the peri-implant tissues for the selection of the transmucosal abutment.

**Figure B6:** The transmucosal abutments fixed in the implants.

**Figure B7:** The transmucosal abutment on the insertion tool and the fixing screw for the crown.

**Figure B8:** Working cast from an impression taken at abutment level. Implant analogues with geometry corresponding to the transmucosal abutments have been used.

**Figure B9:** The splinted screw-retained crowns.

**Figure B10:** The final restoration.

The metal framework was cast using the prefabricated burnable cylinder for the specific abutments and tried intraorally. The accuracy of fit was verified radiographically, after applying the Shefield test. The final restoration were splinted screw-retained crowns with conical basis fitting exactly on the conical surfaces of the abutments and retained with screws securing the crowns on the abutment (Figure B9,B10).

## Clinical Case C: Single-Tooth Implant with Screw and Cement-Retained Crown (Figure C1-C8)

In this case an internal connection implant (Astra implant, Dentsply/Sirona implants) was inserted in region #15 to replace a missing maxillary premolar (Figure C1). An impression was taken at implant level for the planned restoration was a screw-retained crown. Customization of the abutment was needed to support the thick periimplant tissues (Figure C2) but the fit in the base of the abutment should have industrial precision. For this reason a cement-screw- retained crown was decided as the most favorable prosthetic option. A prefabricated titanium abutment was selected with the proper contour at the cervical area. The titanium abutment could be further modified in the marginal line and in the height. Two flat parallel surfaces were created by grinding on the abutment to prevent rotation of the crown. The supporting surface of the abutment over the marginal line was sandblasted to increase retention upon cementation (Figure C3,C4). An all -ceramic crown was fabricated over the titanium abutment and tried intraorally for proper fir and esthetic outcome (FigureC5, C6). After the final try-in the crown was glazed and cemented with dual-polymerization cement in the dental laboratory. The excess of the cement at the marginal line were removed and the surface was polished again. The cementation can also be accomplished chairside but is important to be done after the final glaze or the cement will be burned out. In all laboratory stages the access hole must be kept free to allow smooth and undisturbed insertion and removal of the retention screw (FigureC7). The cement-screw- retained crown was fixed with the recommended torque and the emergence profile of the soft

tissues was supported properly by the abutment-crown complex in one piece (Figure C8).

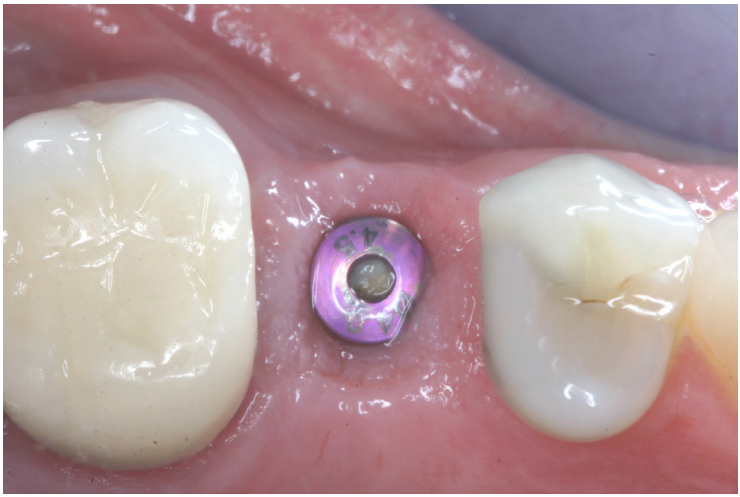


**Figure C1:** Case C: Initial clinical situation.

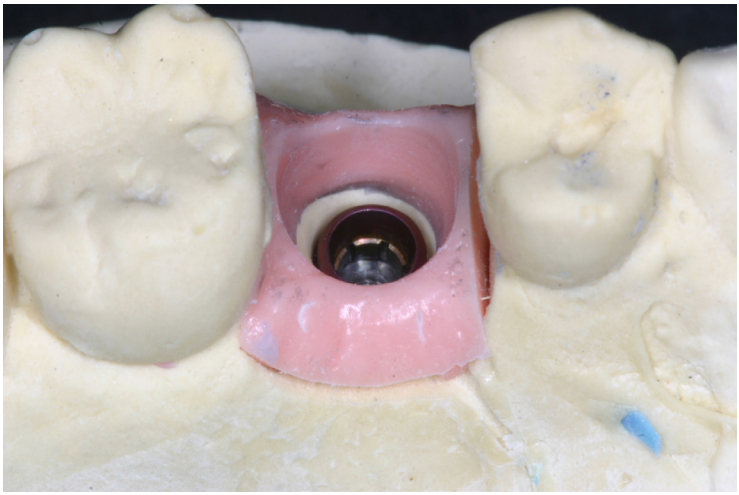
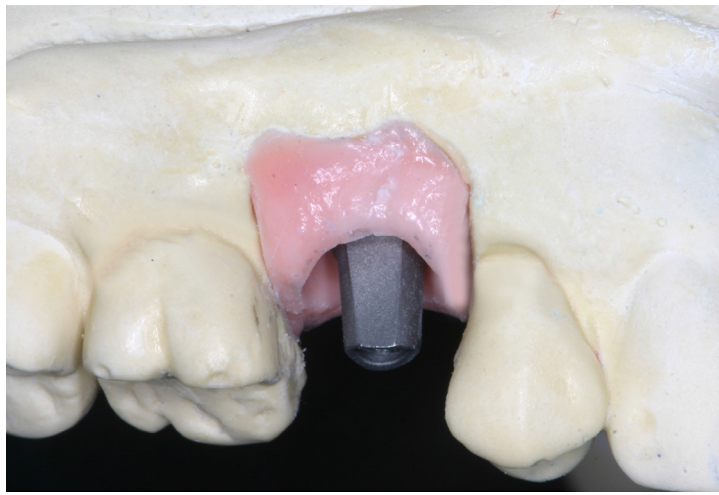


**Figure C2:** The working cast. Periimplant tissues show increased depth and a favorable soft tissue profile has been created from the healing abutment.



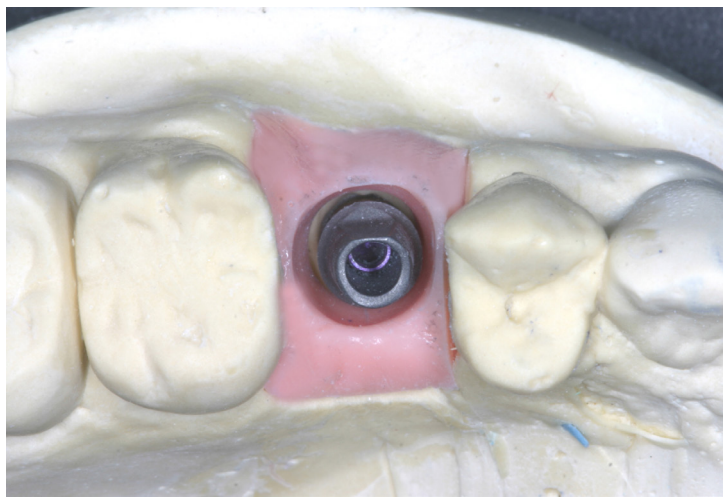


**Figure C3and C4:** Prefabricated titanium abutment customized to support the screw-retained crown.

**Figure C5:** An all-ceramic crown was fabricated to fit exactly on the titanium abutment.

**Figure C6:** The all ceramic crown prior to the final glazing.

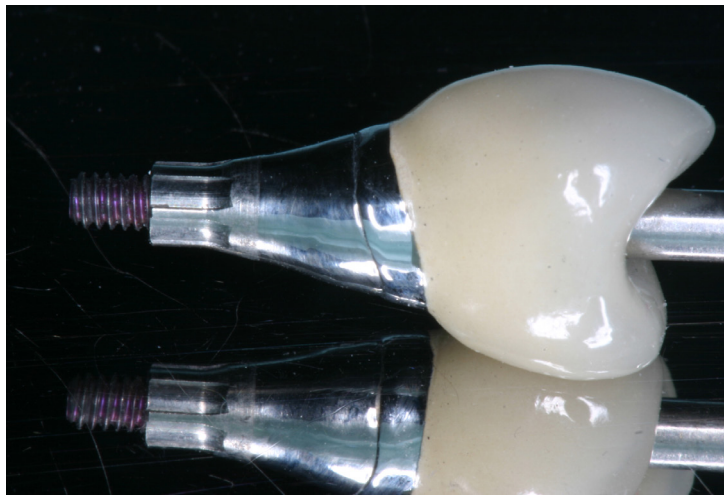


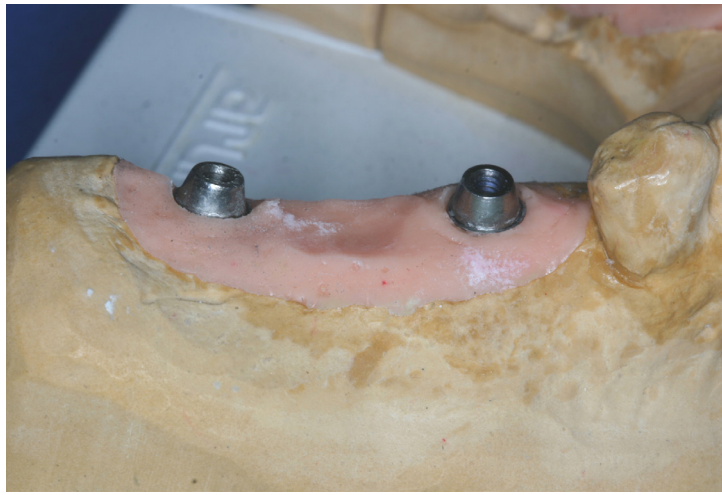
**Figure C7:** Cementation of the crown on the titanium abutment.

**Figure C8:** Final clinical result.

## Clinical Case D: FDP on Transmucosal Abutments in Reduced Vertical Space (Figure D1-D6)

In this clinical case two internal hexagon implants (Xive Implants, Dentsply/Sirona Co) were inserted in regions # 45 and 47 for the restoration of the mandibular right posterior area. The existing vertical prosthetic space was very limited due to over-irruption of the maxillary teeth (Figure D1). The patient wished a simple and cost-effective solution without any treatment involving the maxillary teeth and restorations. A screw-retained restoration was planned supported by transmucosal abutments (Figure D2,D3). These abutments (older type with conical top) are fitted in the implant by means of threads on the lower part of the abutment and the restoration is fixed by a screw on the abutment. Screw retention was the only available treatment option for the reduced height as there was not enough space for a cement-retained prosthesis. For this reason the most distal crown remained without veneering as the needed thickness for the ceramic layer could not be achieved (Figure D4).

**Figure D1:** Case D: Initial clinical situation on the working cast. Reduced vertical space.



**Figures D2 and D3:** The transmucosal abutments on the working cast.

**Figure D4:** The final restoration on the working cast. On the distal abutment there was no space for ceramic veneering.

## Survival of Implants in Screw- and Cement Retained Restorations

The 5-years survival rate and the frequency of complications was examined in a systematic review based on 59 clinical studies [7]. The 5-year survival for cemented partial fixed dental prostheses (FDPs) was similar to the one for screw-retained partial FDPs with 98%. For cemented full-arch FDPs the 5-year survival was 100%, which was somewhat higher than that for screw-retained FDPs with 95.8% .As the authors concluded both types of reconstructions influenced the clinical outcomes in different ways, none of the fixation methods was clearly advantageous over the other. Cemented reconstructions exhibited more serious biological complications (implant loss, bone loss >2 mm) while screw-retained reconstructions exhibited more technical problems. Screw-retained reconstructions are more easily retrievable than cemented reconstructions and, therefore, technical and eventually biological complications can be treated more easily.

## Clinical Performance of Screw -and - Cement Retained Restorations

The clinical performance of screw and cement retained restorations was examined in an extended systematic review based on 73 publications [8]. The authors reported 5-year survival rates of 96.03% and 95.55% for cemented and screw-retained reconstructions respectively. Comparison of cement and screw retention showed no difference when grouped as Single Crowns or Fixed Dental Prostheses. The 5-year survival rate for screw-retained full-arch reconstructions was 96.71%. Although no statistical difference was found between cement- and screw-retained reconstructions for survival or failure rates, screw-retained reconstructions exhibited fewer technical and biologic complications overall. There were no statistically significant differences between the failure rates of the different reconstruction types or abutment materials (titanium, gold, ceramic).

## Complications in Screw-Retained Restorations

### Frequency of Complications

In a recent systematic review based on 29 papers [9] cement-retained reconstructions exhibited more biological complications (implant loss, bone loss > 2 mm) and screw-retained prostheses exhibited more technical problems. Clinical outcomes were influenced by both fixations in different ways. The screw-retained restorations were more easily retrievable than cemented; therefore, technical and eventually biological complications could be treated more easily. For this reason, and for their higher biological compatibility, these reconstructions are preferable.

Similar findings were also reported to a previous extended systematic review based on 59 publications [7]. The estimated 5-year cumulative incidence of technical complications at cemented single crowns was 11.9% and 24.4% at screw-retained crowns. At the partial

and full-arch FDPs, in contrast, a trend to less complication at the screw-retained was found than at the cemented ones (partial FDPs cemented 24.5%, screw-retained 22.1%; full-arch FDPs cemented 62.9%, screw-retained 54.1%). Biological complications like marginal bone loss >2 mm occurred more frequently at cemented crowns (5-year incidence: 2.8%) than at screw-retained ones (5-year incidence: 0%).The authors concluded that both types of reconstructions influenced the clinical outcomes in different ways, none of the fixation methods was clearly advantageous over the other. Cemented reconstructions exhibited more serious biological complications (implant loss, bone loss >2 mm), screw-retained reconstructions exhibited more technical problems.

The influence of the type of restoration on the prosthetic complications was also investigated in a systematic review based on 73 papers [10]. Screw-retained prostheses showed a tendency toward and significantly more technical complications than cemented prostheses with single crowns and fixed partial prostheses, respectively. Resin chipping and ceramic veneer chipping had high mean event rates, at 10.04 and 8.95 per 100 years, respectively, for full-arch screwed prostheses. For "all fixed prostheses" (prosthesis type not reported or not known), significantly fewer biologic and technical complications were seen with screw retention. Multivariate analysis revealed a significantly greater incidence of technical complications with cemented prostheses. Full-arch prostheses, cantilevered prostheses, and "all fixed prostheses" had significantly higher complication rates than single crowns. A significantly greater incidence of technical and biologic complications was seen with cemented prostheses.

Screw-retained fixed partial prostheses demonstrated a significantly higher rate of technical complications and screw-retained full-arch prostheses demonstrated a notably high rate of veneer chipping. When "all fixed prostheses" were considered, technical and biologic complications were seen for cement-retained prostheses. Multivariate Poisson regression analysis failed to show a significant difference

between screw- and cement-retained prostheses with respect to the incidence of failure but demonstrated a higher rate of technical and biologic complications for cement-retained prostheses. The incidence of technical complications was more dependent upon prosthesis and retention type than prosthesis or abutment material.

## Screw Loosening

The most common prosthetic complication in screw retained restorations is the loosening of the fixing screw. The incidence of screw loosening was 65% for single-tooth implant restorations in one classical but older study [11] whereas the incidence of unretained cemented implant restorations was reported to be less than 5% in other studies [12,13]. However, the improvements in implant systems, including the advent of internal implant-abutment connections, enhancement of torque drivers, and screw materials and design, led to reduction in the incidence of screw loosening. The incidence of screw loosening was mere frequent in the older types of external hex-implants that used titanium and gold screws with slot-head screws. In the majority of the implant systems nowadays hex-heads screws are used, that allow higher torque without damage to the head.

On the other hand, the screw loosening of screw-retained restorations can be considered as an important advantage since the weakest component within the implant-supported restoration will be the prosthetic screw; this will allow for assessing the implant-supported restoration before more serious complications develop, such as implant fracture at screw level especially in implant systems using internal connections. Using screw-retained restorations will enable assessing the preload of implant abutment screws over time, since the preload is not constant with ongoing application of forces associated with occlusion [14].

The gingival response is found to be better when using screw-retained crowns since no cement is used. However, if retaining or abutment screws become loose, granulation tissue accumulates between

the prosthesis and the abutment and also between implant and abutment leading to fistulae formation, plaque deposition, and possibly screw fracture. Therefore, it is recommended to retighten the screws in full arch fixed prosthesis every 5 years [15].

In a clinical trial with follow-up to 3,5 years the prevalence of reconstruction loosening was significantly lower for cement-retained FDPs when a temporary cement (10%) was used than it was for screw-retained FDPs (29%). The survival rate of the reconstructions within the observation period was 97% for screw-retained FDPs and 100% for cement-retained FDPs without significant difference [16].

The influence of the implant-abutment connection on the frequency of screw loosening was investigated in a systematic review based on 60 papers [17]. Meta-analysis of these studies indicated an estimated 5-year survival rate of 97.6% for Single Crowns and 97.0% for FDPs supported by implants with internal implant-abutment connection and 95.7% for Single Crowns and 95.8% for FDPs supported by implants with external connection. The 5-year abutment failure rate ranged from 0.7% to 2.8% for different connections with no differences between the types of connections. The total number of complications was similar between the two connections, yet, at external connections, abutment or occlusal screw loosening was more predominant.

## Marginal Bone Loss

The findings concerning marginal bone loss around dental implants with screw- and cement-retained restorations are controversial. In a retrospective clinical trial with follow-up of 15 years the mean marginal bone loss was statistically significantly higher ($P < .001$) for screw-retained ($1.4 \pm 0.6$ mm) than for cemented ($0.69 \pm 0.5$ mm) restorations [18]. These results were also confirmed by another similar clinical study [19].

On the other side screw-retained restorations showed reduced marginal bone loss compared to cemented in clinical trials [20]. In a

systematic review screw-retained restorations also showed better results in marginal bone loss compared to cemented [12].

In an extended systematic review based on 9 clinical studies comparing marginal bone loss on screw- and cement retained restorations, no difference was found between the two types [21]. These results were also confirmed by another systematic review focusing on the same clinical topic [22]).

## Clinical Relevance

Screw-retained restorations have been used for decades in dental implants with high survival rates and reduced frequency of complications. Their main advantage is the predictable retrievability that allows easy professional cleaning and the possibility for modification or repair. Their use however may arise difficulties for an esthetic result in the anterior region due to implant inclination. The type of the prosthetic restoration should be selected individually for each case based on the specific criteria of each case and the demands of the patients.

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