Chapter 05

Impression Techniques for Implant Restorations

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Abstract

Implant restorations are a documented and established treatment for edentulous or partially edentulous patients. One of the most crucial factors for the long-term success of implant-supported prostheses is the accuracy of the impression procedure in order to obtain the passive fit of the restoration on the implants.

The aim of this article was to present the impression materials and techniques that are nowadays used in implant-supported restorations through clinical examples.

Keywords

Impression Materials; Open-Tray Impression Technique; Closed-Tray Impression Technique; Implant-Supported Prosthesis

Introduction

The accurate transfer of the clinical condition to the dental laboratory by the impressions is an important stage in implant-supported restorations, especially when it comes to information concerning the position, inclination, geometry of the prosthetic platform of the implants, as well as the condition of the peri-implant tissues [1-2]. The impression procedure in implant cases present certain peculiarities compared to natural teeth as the implants are mechanical devices that are rigidly connected with the prosthetic components. In contrast to natural teeth, implants and their components have no micromovement that could possibly compensate for minor inaccuracy of fit [3].

Aim

The aim of this paper was to present the impression techniques that are nowadays used in implant-supported restorations with clinical examples through a case series.

Impression Materials

The term "impression" is used to describe a negative "copy" of the hard and soft tissues of the oral cavity, including teeth, implants, gingival, marginal ridge and mucosa. The aim is the creation of a life-size positive "copy" of the abovementioned tissues, in the form of a cast [4].

For implant impressions, addition silicones (or poly-vinyl-siloxane) and polyether are currently considered as the materials of choice. Comparative studies have been published, investigating the accuracy and clinical behaviour of both elastomeric impression materials [5-8]. Most researchers agree that there is no significant difference in the accuracy of implant impression between poly-vinyl-siloxane and polyether [8-12]. Furthermore, Wenz, et al. [13], compared the different impression techniques using only addition silicone and concluded that the single step technique resulted in more accurate impressions.

Regarding the viscosity of the impression material, the use of medium viscosity offers certain advantages in the clinical practice. Medium viscosity or monophase materials can flow around the impression posts without exerting pressure. Due to their increased hardness after polymerization, an accurate impression can be achieved. Their use however should be combined with a custom tray that allows an even thickness of the impression material around the implants. Medium viscosity materials can be used alone or combined with high flowing materials to achieve maximum detail reproduction or to allow the material to flow/penetrate even in small gaps around the impression posts.

Putty or high viscosity impression materials offer rigidity and can also be used but their flow is limited compared to medium viscosity. For this reason putty or low flowing (high viscosity) materials should be used in combination with high flowing (low viscosity) flowing materials to achieve detail reproduction.

In the daily clinical practice, the most important factor in implant impressions seems to be the practitioner's compliance with the manufacturer's specifications and guidelines, since no significant differences has been shown between the accuracy offered by polyether versus addition silicone.

Impression Techniques

The choice of the impression technique and the accuracy of the resulting impression relates directly to the passive fit of the implant-supported restoration, which is an important goal in the restorative procedure. An inaccurate impression may result to a metal framework fitting non-passively, which can possibly cause mechanical complications such as screw loosening or fracture, and/or abutment fracture. The most commonly used and widely adopted impression techniques for implants in the clinical practice are the open tray technique and the closed tray technique.

Open Tray Technique

The open tray (or pick-up) technique involves the embedding of the impression posts (or impression caps) in the mass of the impression material during the final impression and their simultaneous removal from the mouth in the tray after setting of the material. The impression tray used can be either a modified prefabricated plastic tray, or a custom acrylic trays, fabricated from auto- or photopolymerizing resin on a study cast. For the open tray technique metal trays with removable parts are also available that allow access to the screws of the impression posts through the impression material, as some occlusal parts of the tray can be removed prior to impression (Figure 1)

For the open tray technique, it is necessary to use impression posts with long retention screws that pass through the impression material and are retrievable trough the tray's openings (Figure 2). After polymerization of the material the screws are completely removed from the impression posts and the implants. The posts remain embedded in the impression material and are simultaneously removed from

the mouth. The impression posts for the open tray technique have outer surfaces with undercuts that allow the engagements of the posts in the mass of the material. For this reason, impression materials with increased hardness are recommended.

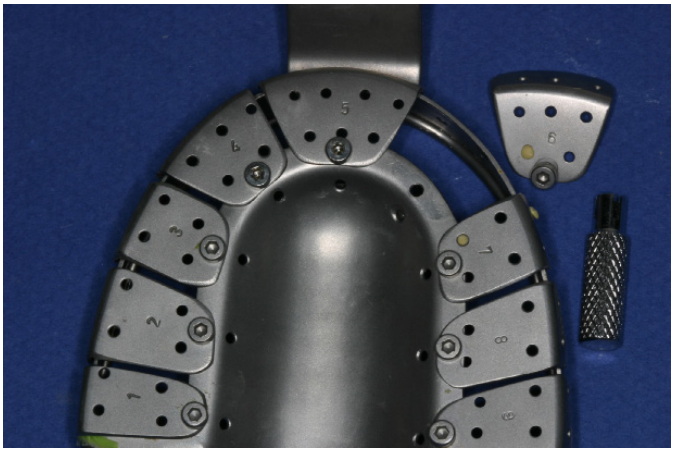

Figure 1: Prefabricated metal impression tray with removable parts to be used with the open tray technique.

Figure 2: Impression posts with long screw for open tray technique

For the fabrication of the working cast, the laboratory implant analogues are connected to the base of the impression posts protruding from the impression material and the retaining screw is fixed from the other side of the impression. On the working cast, a gingival mask is formed with the addition of an addition silicone material mimicking the peri-implant soft tissues.

The open tray technique was the standard procedure during the first years of the use of dental implants when the external hexagon was the most widely used implant type. As the main task was to transfer the exact position of the external hexagon for the fabrication of the master cast, the open tray technique facilitated the detachment of the impression posts from the top of the implants. For the same reason it is also widely used for impressions on transgingival abutments or multi-purpose abutments, where the connection mechanism (hexagon) is above the soft tissues.

In implants with internal connection and impressions on an implant level, it is not always easy to detach simultaneously multiple impression posts from the interior of the implants, especially if the axes are divergent. In these cases the closed tray technique with an impression material of medium hardness may be of advantage.

In some clinical cases splinting of the impression posts is performed before the impression procedure. Splinting offers the advantage of complete rigidity of the posts as a solid piece upon removal of the impression from the mouth. On the other side, splinting requires additional time for the patient to stay with open mouth. The splinting of the impression posts is recommended in cases of implants in proximity, where it is doubtful if the impression material will penetrate between the implants to allow removal of the posts in the mass of the polymerized material. The most widely used technique for splinting of the impression posts is the creation of a scaffold with dental floss around and between the implants and the addition of autopolymerizing resin around and between the posts in order to form a solid mass. A free space should be kept under the implants to allow penetration of the impression material in order to achieve removal of the solid

block (***Case C***). Alternatively, a metal ring can be fabricated in the laboratory by casting on a study cast. The metal ring is fitted around the impression posts intraoraly and the posts are fixed on the ring using autopolymerising resin. Adequate space should be left under the block of the resin to allow the flow of the impression material. The posts and the metal ring are embedded in the mass of the material and are removed as a block with the open tray technique.

Advantages of Open Tray Technique

- Easier impression of implants with unfavourable inclination. The impression posts remain embedded in the impression material and do not require repositioning; therefore possible errors due to incorrect handling can be avoided.
- Less strain is induced in the impression material during its removal from the mouth, since it does not need to be detached around the impression posts .
- Easier impression of implants with converging axes, or in great proximity to each other.

Disadvantages of Open Tray Technique

- Necessity of a custom tray, or a modified prefabricated tray.
- Necessity to find and expose the protruding screws of the impression posts before setting of the impression the material.
- Difficulty to apply in the posterior regions due to the increased height of the screws.
- Longer working time is needed intraorally, as all screws have to be loosened before removing the impression.

Closed Tray Technique

In the closed tray or transfer technique, the impression tray (custom or prefabricated) has no opening over the implant area. During

the impression procedure, the impression posts remain attached to the implants (***Case A***). After setting of the material, the impression is detached from the mouth, while the impression posts remain fixed on the implants in the same way as the prepared natural teeth. For that reason, the impression posts are shorter than those used in the open tray technique, with shorter screws that do not protrude from the posts (Figure 3). The shape of the posts is also rounded to allow removal of the polymerized impression material around the posts without exerting increased strain.

Figure 3: Impression posts with short screws for the closed tray technique.

Subsequently, the impression posts are loosened and sent separately to the dental laboratory. For the fabrication of the working cast, the impression post is fixed on an implant analogue, and the pair is placed in their respective spaces (identations) in the impression material. In order to ensure a more accurate placement of the posts, most manufacturers offer and recommend the use of a special plastic trans-

fer cap. The cap is fitted on the top of the impression post and remains embedded in the impression material (Figure 4). The repositioning of the posts is thus performed with greater accuracy as only a single fixed position can be ensured without sinking or rotation of the post in the mass of the impression material. The design of the impression coping varies among manufacturers. It is important however that the manufacturer of the implant to be restored offers the option between open and closed tray technique.

Figure 4: Impression posts for the closed tray technique with plastic transfer cap for accurate repositioning in the impression material.

Advantages of Closed Tray Technique

- Simpler procedure, presenting great similarities with the usual impression techniques used for natural dentition.
- Easier clinical application in all areas without need for excessive mouth opening.
- Possibility of simultaneous impressions for teeth and implants

- The use of a custom tray or a modified prefabricated tray is not necessary.
- The intraoral working time is reduced compared to the open tray technique.

Disadvantages of Closed Tray Technique

- The repositioning of the impression posts in the impression material may lead to inaccuracy of the working cast, especially if plastic transfer caps have not been used.
- Increased strain in the mass of the impression material may be induced upon impression removal.
- Difficulty in removing the impression from implants with unfavorable or diverting inclination
- Doubtful accuracy in cases of implants in proximity.

Case Presentations

Case A: Closed Tray Technique, Single Implant (Figure 5-9)

In cases of single implants that have adequate distance to the adjacent teeth and favorable inclination, both the open tray and the closed tray technique can be applied. A-silicones can be used in putty consistency combined with low viscosity flowing material (ex Hydrorise, Zhermack Co, Italy) and prefabricated metal tray, as used for natural teeth (Figure 5-8). In these cases with putty materials and closed tray technique, it is strongly advisable however to use impression posts with a plastic transfer cup that facilitates the repositioning of the post in the mass of polymerized impression material minimizing inaccuracy. Alternatively a medium viscosity material combined with low viscosity might have also been used (ex Hydrorise Implant, Zhermack Co, Italy). The patient was restored with a srew-retained implant supported crown (Figure 9).

Figure 5: Case A: initial clinical situation with impression post for closed tray

Figure 6: Plastic transfer caps for repositioning fitted on the impression posts.

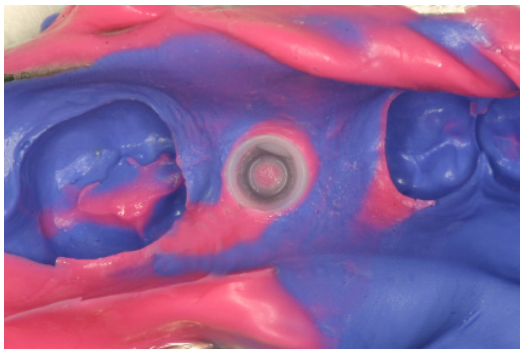

Figure 7: Closed tray impression, double mixing technique

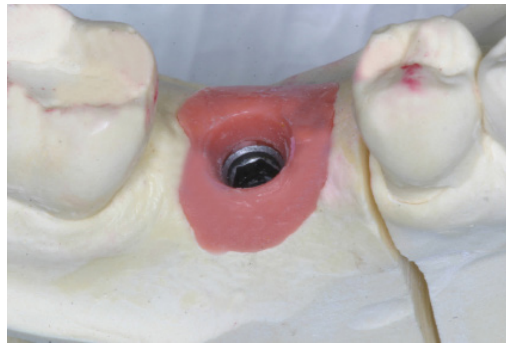

Figure 8: The working cast.

Figure 9: Case A, the final implant supported crown

Case B: Closed Tray Technique, Two Implants (Figure 10-15)

In the presented case (Case B) two mandibular right side implants (regions # 44 and 46) were to be restored. As the position and the inclination of the implants were favourable and the distance to adjacent tooth adequate (Figure 10), the closed-tray technique (repositioning technique) was applied. On the impression posts the plastic caps for the repositioning were fitted (Figure 11). An addition-silicone was used in heavy and light consistency (Hydrorise implant,

Zhermack Co, Italy) with a prefabricated metal tray and an accurate working cast was fabricated (Figure 12 and 13). The implant was restored with an implant-supported screw-retained fixed dental prosthesis (FDP) that fitted accurately (Figure 14 and 15).

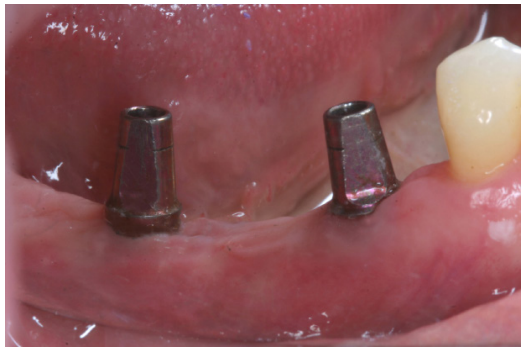

Figure 10: Case B: initial clinical situation with impression posts for closed tray.

Figure 11: Plastic transfer caps for repositioning fitted on the impression posts.

Figure 12: Closed tray impression, double mixing technique.

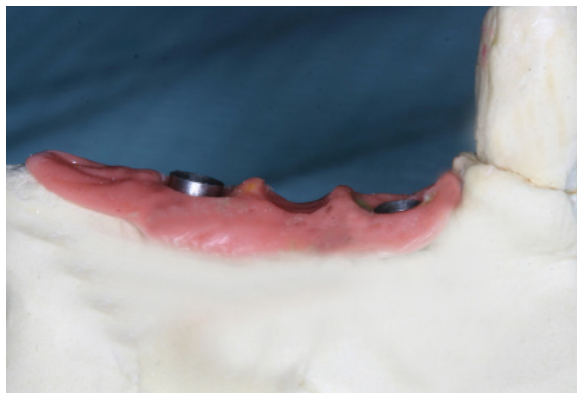

Figure 13: The working cast.

Figure 14: The restoration on the working cast.

Figure 15: Case B, the final screw-retained restoration.

Case C: Open Tray Technique, Partially Edentulous Patient (Figure 19-21)

In case B two adjacent implants in the maxillary right region (# 15,16) had to be restored and also the tooth # 14 with a crown (Figure 16 and 17). Due to the proximity and the unfavourable inclination of the implants, the open tray technique was selected. The thickness of the peri-implant tissues would also increase the difficulty for proper insertion of the transfer (repositioning) caps on the im-

pression. A custom tray from light-curing resin was fabricated on a study cast made from an initial impression with alginate. The height of the tray was checked to verify the access to the impression posts (Figure 18). An addition type silicone (Hydrorise Implant, Zhermack Co) was used in medium and light viscosity both for the implants and the tooth and an accurate working cast could be fabricated (Figure 19 and 20). The use of medium and low viscosity silicone was advantageous in this case as the space between the implants was narrow and a heavy or putty material could not embrace the impression posts. The patient was restored with two splinted screw-retained crowns on the implants and a metal ceramic crown on the tooth (figure 21).

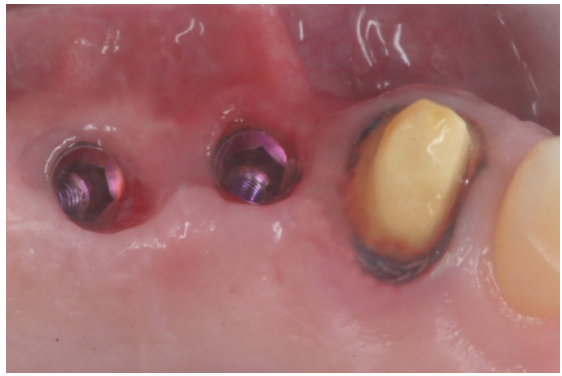

Figure 16: Case C: Initial clinical situation.

Figure 17: Impression posts for the open tray technique.

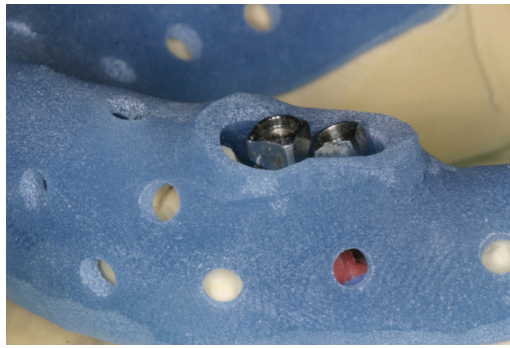

Figure 18: Custom tray with openings for the impression posts with adequate height.

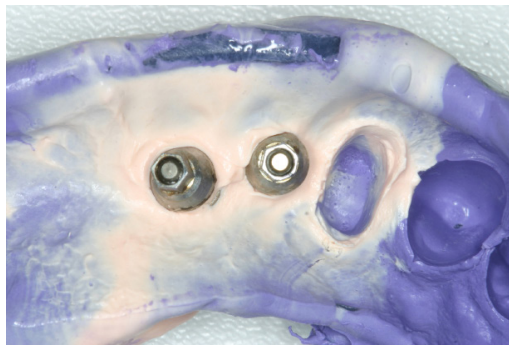

Figure 19: Open tray impression, double mixing technique.

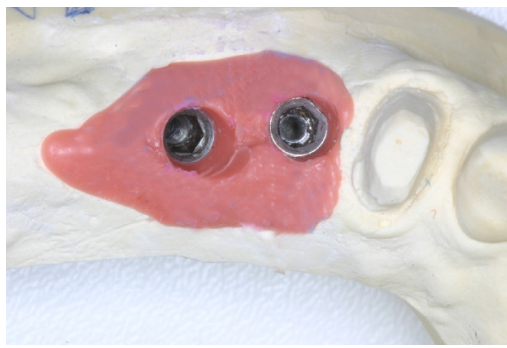

Figure 20: The working cast.

Figure 21: The final restoration.

Case D: Open Tray Technique, Partially Edentulous Patient (Figure 22-27)

In Case C three adjacent implants were to be restored in the mandibular left side in regions # 34,35,36 (Figure 22). The implants were not parallel with unfavourable inclinations. Additionally the anterior implant was placed deep subgingivally and for these reasons the open tray technique was selected. As the patient was in a heavy schedule and it was not possible to make a custom tray in the dental laboratory, a prefabricated plastic tray was used modified with openings for the impression posts. In order to achieve maximum accuracy of the impression, the impression posts were splinted with autopolymerizing resin (Pattern Resin, GC Co, Japan) which was added on a scaffold created with dental floss around and between the implants (Figure 23). An addition type silicone (Hydrorise Implant, Zhermack Co, Italy) was used. The medium viscosity of the material allowed the flow under the splinting and the increased hardness after polymerization contributed to the secure removing of the splinted impression posts in the material (Figure 24 and 25). An accurate working cast was fabricated and the patient was restored with splinted screw-retained crowns (Figure 26 and 27).

Figure 22: Case D: Initial clinical situation.

Figure 23: Splinted impression posts.

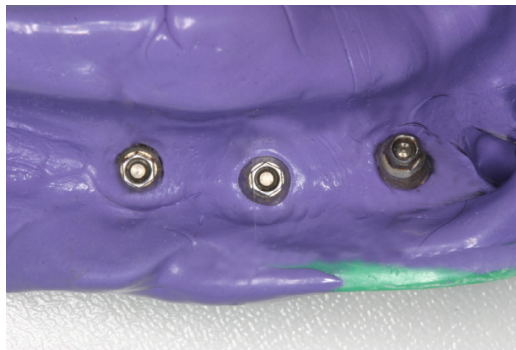

Figure 24: Open tray impression, single mixing technique.

Figure 25: Open tray impression, single mixing technique.

Figure 26: The working cast.

Figure 27: Case D, the final screw-retained restoration.

Case E: Open Tray Technique without Splinting, Edentulous Maxilla (Figure 28-35)

In case D four implants were inserted in the edentulous maxilla according to the short dental arch principle (Figure 28). The implants were parallel with favourable inclination with exception of the implant # 23 that had severely divergent axis (Figure 29). As the distance between the implants was adequate, it was decided to take the impression with open tray technique without splinting of the impression posts. A custom tray was fabricated on a study cast in the dental laboratory using light-polymerizing resin (Figure 30). The tray was tried to the patient with the impression posts fixed on the implants to verify an undisturbed insertion path. It is important to verify the correct path of insertion before loading of the impression material as the tray may need modification to allow proper placement (Figure 31 and 32). The impression was taken using medium viscosity material (Implant Hydrorise, Zhermack Co) (Figure 33-35). The patient was restored with a implant-retained fixed restoration (Figure 36).

Figure 28: Case E: Initial clinical situation.

Figure 29: Long impression posts for open tray.

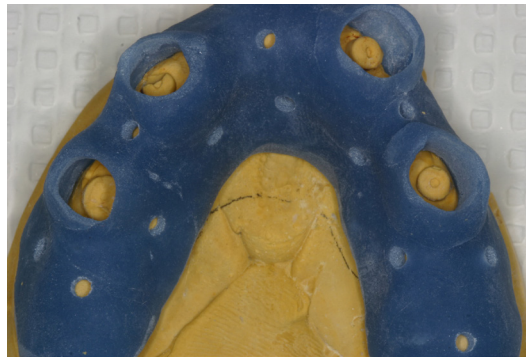

Figure 30: The custom tray on the study cast.

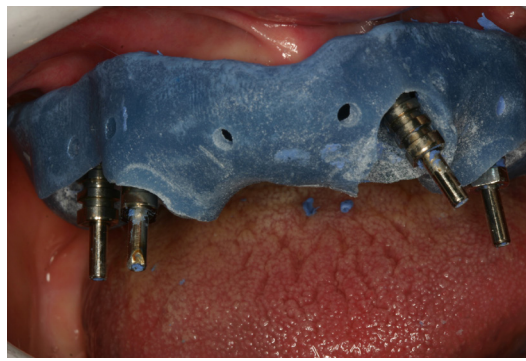

Figure 31: The custom tray tried for the correct path of insertion.

Figure 32: Modification of the custom tray to allow insertion.

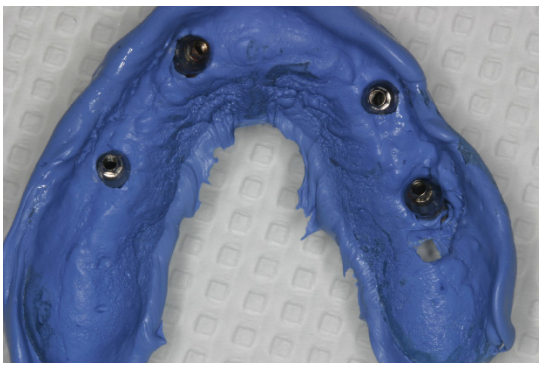

Figure 33: Impression with open tray, single mixing technique

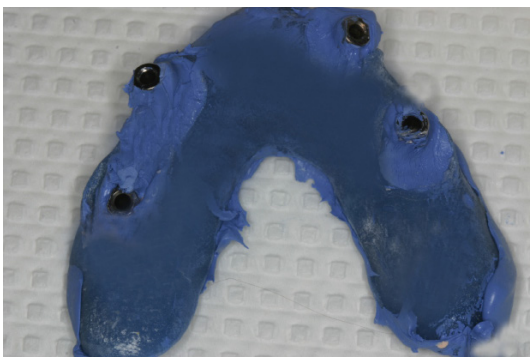

Figure 34: Impression with open tray, single mixing technique

Figure 35: The working cast.

Figure 36: Case E, the final restoration.

Case F: Open Tray Technique with Splinting, Edentulous Mandible (Figure 37-43)

In case E four implants were inserted in the anterior region of the mandible for hybrid screw-retained fixed restoration according to the short dental arch principle (Figure 37). For the open tray technique a custom tray was fabricated on a study cast without a handle in the anterior region that would cause difficulties to remove the retaining screws of the post (Figure 38). The impression posts for open tray in

this implant system for were shorter and their embedment and retention in the impression material was doubtful. The posts were splinted by means of dental floss forming a scaffold on which autopolymerising resin was added to create a block (Figure 39 and 40). The impression was taken using medium viscosity addition silicone (Hydrorise Monophase, Zhermack Co, Italy) both under the impression posts and in the tray (Figure 41 and 42). The patient was restored with a screw-retained hybrid restoration (Figure 43).

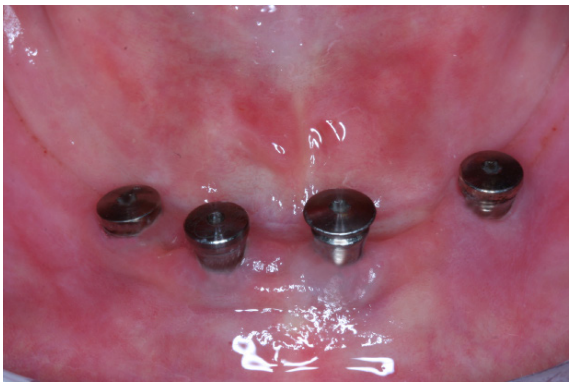

Figure 37: Case F, initial clinical situation.

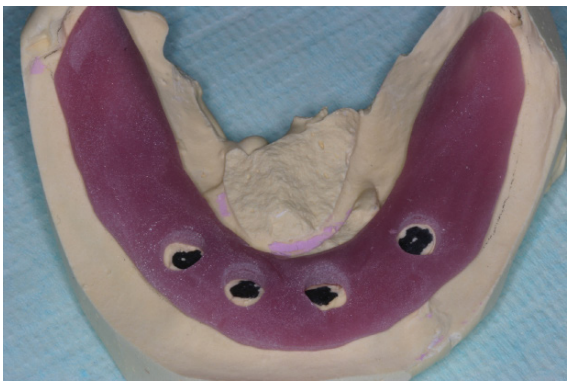

Figure 38: Custom tray without handle fabricated on a study cast.

Figure 39: The impression posts.

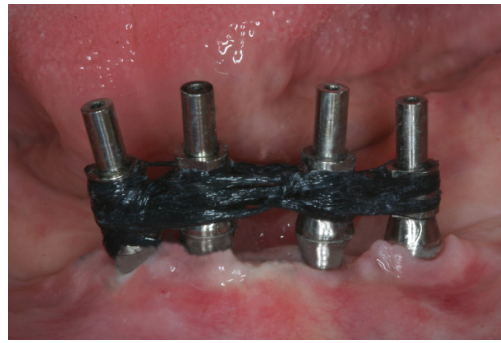

Figure 40: Splinting of the impression posts with dental floss and autopolymerising resin.

Figure 41: Impression with open tray, single mixing technique.

Figure 42: Impression with open tray, single mixing technique.

Figure 43: Case F, the final restoration.

Case G: Open Tray Technique with Splinting in Severely Reduced Space, Adjacent Implants, (Figure 44-51)

In this case two adjacent implants were placed in the maxillary left region for the replacement of teeth 24 and 25. The implants were in proximity and it was not possible to insert the impression posts simultaneously (Figure 44). The possible clinical options for this case were either the modification of the posts by grinding the opposing sides or the impression of each implant separately. Instead of using the impression posts, the implant carriers were fitted on the implants and were used as impression posts. The carriers have the same diameter as

Figure 44: Initial clinical situation with the carriers fitted on the implants.

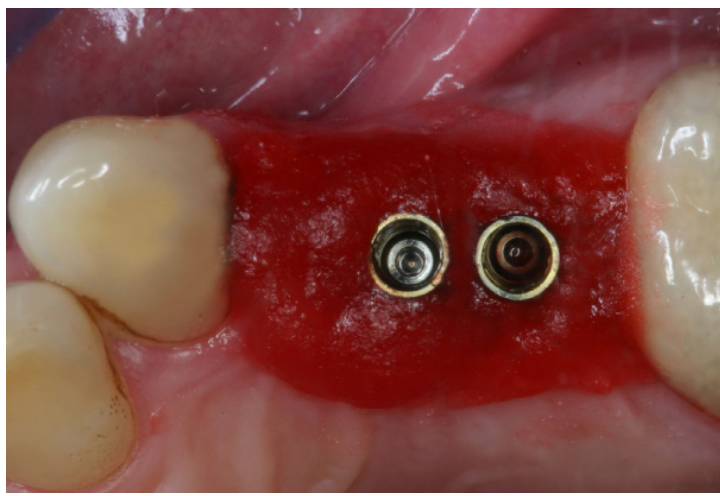

Figure 45: The implants carriers splinted with resin.

the implants (narrower than impression posts) and fit exactly to the internal hexagon to the interior of the implant. The main problem of using the carriers as impression posts, is that due to their design the repositioning in the impression material is not accurate. Additionally the carriers are provided with short screws and cannot be used as impression posts for the open tray technique.

Taking under consideration the above mentioned limitations, it was decided to use the carriers with an open custom tray by splinting. The carriers were fixed on the implants and was splinted using autopolymerising resin covering the whole edentulous space (Figure 45 and 46). Before taking the impression the unobstructed removal of the block of resin was checked. The impression was taken using heavy body addition silicone for the tray that had the proper stiffness to engage the block and remove it (Figure 47). Low viscosity silicone was injected under the block for the reproduction of details (Elite HD, Zhermack Co, Italy). Alternatively medium viscosity combined with low viscosity material could also have been used.

This impression technique resulted in a working cast with the needed precision and detail that allowed the construction of two splinted screw-retained crowns fitting accurately (Figure 48-51).

Figure 46: The implants carriers splinted with resin.

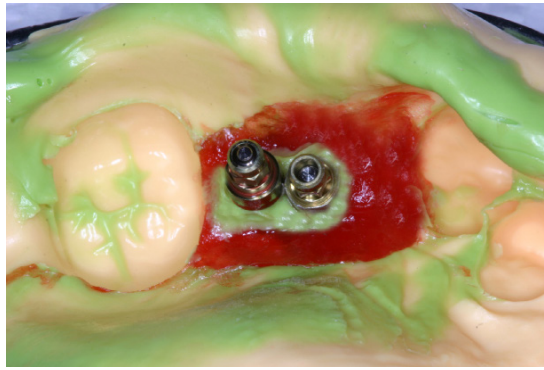

Figure 47: Final impression, double mixing technique.

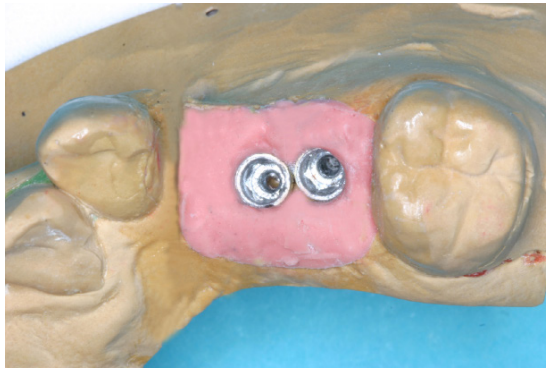

Figure 48: The working cast.

Figure 49: Screw-retained splinted crowns.

Figure 50: The final restoration in the mouth.

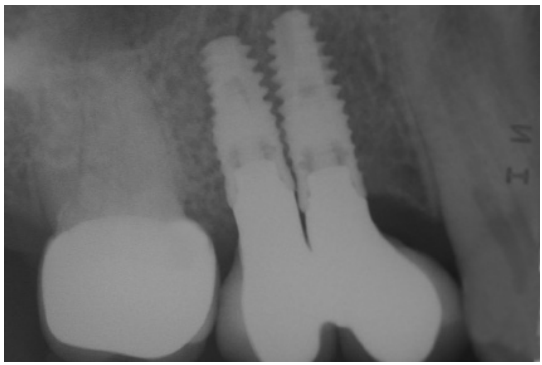

Figure 51: Case G, radiographical control of the fit of the restoration.

Case H: Open Tray Technique in Reduced Space, Single Implant, (Figure 52- 60)

In this case an implant was inserted in the region of the mandibular lateral incisor but the restoration of the implant was delayed due to a heavy schedule of the patient involving multiple long term trips abroad. As a result the available space was severely due to migration/

inclination of the adjacent teeth (Figure 52). The remaining space was not allowing the placement of the regular impression post that is wider in diameter than the implant. As in the previous case it was decided to use an implant carrier for the impression that had the diameter of the implant. In this clinical situation there was no possibility of splinting the implant carrier and it was decided to use a modified prefabricated plastic tray for the open tray technique. An additional clinical difficulty in this case was the fact that carriers are provided with short screws and the access to the retaining screw should be kept uncovered during the impression (Figure 53). The carrier was fitted on the implant and the shaft of an implant screw driver was fitted on the retaining screw to keep the access through the impressison material (Figure 54). A prefabricates plastic tray was used that was modified to allow the protrusion of the shaft of the screw driver. The hole on the top of the impression tray was covered with paper tape to avoid overflow of the impression material (Figure 55). A medium viscosity addition silicone (Hydrorise Implant, Zhermack Co, Italy) was used for the impression combined with the corresponding low viscosity material that was injected around the implant for detail reproduction (Figure 56). After setting of the impression material the handle of the screw driver was fitted on the protruding top of the shaft and loosened the retaining screw (Figure 57). A precise impression could be obtained as the stiffness of the impression material allowed the removal of the implant carrier from the implant (Figure 58 and 59). The patient was restored with a screw-retained implant crown (Figure 60).

Figure 52: Case H: initial clinical situation.

Figure 53: An impression post for open tray with long screw compared to an implant carrier for the same implant but narrower in diameter.

Figure 54: The implant carrier on the implant with the shaft of the screw driver fitted on the retaining screw.

Figure 55: The prefabricated plastic tray modified for the open tray technique.

Figure 56: Impression taking with the shaft protruding through the impression material.

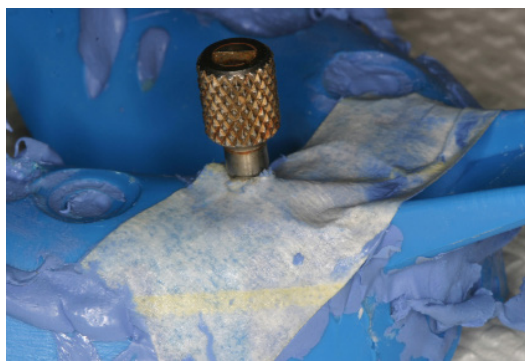

Figure 57: The handle of the screw driver fitted on the shaft for loosening of the retaining screw.

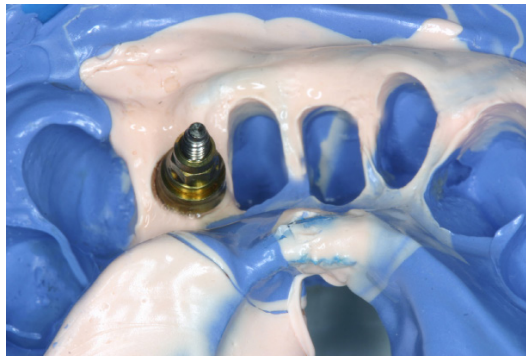

Figure 58: Final impression, double mixing technique.

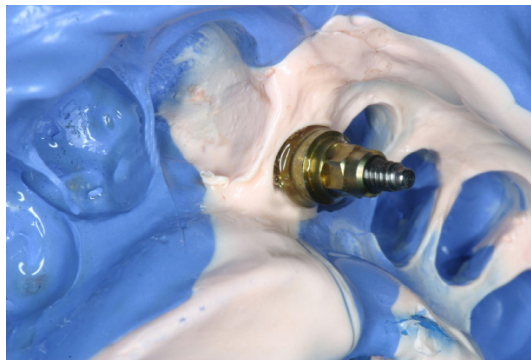

Figure 59: Final impression, double mixing technique.

Figure 60: Case H: the final restoration.

Comparative Studies of the Accuracy of Different Impression Techniques

Concerning the accuracy of both different impression techniques (open or closed tray), several comparative studies have been published [14-25]. Most studies concluded to increased accuracy of the open tray technique [15-18], others find no significant differences [19,23], while in a limited number of studies the closed tray technique presented more accurate results [24,25].

Other research studies also suggested that there is a correlation between the impression technique and the number of implants. In most studies with three or fewer implants, there was no difference [21-23] between open and closed tray techniques. Research papers in cases with more than four implants [14-18] suggested that the open tray technique had better results, while in some studies no significant differences were found [19-20]. In conclusion, it appears that for a limited number of implants (n <3) there was no significant difference between the two impression techniques, while for extended implant restorations (n> 3) the open tray technique seems to be advantageous.

Finally, although there is no clear clinical guideline, most studies report that the splinting of the impression posts can improve the impression accuracy. Some authors however, report potential problems during splinting, such as the deformation or shrinkage of acrylic material [26-27]. Many studies have compared the open tray technique in the two variants, i.e., with splinted or unsplinted impression posts. Most of these papers argue that splinting leads to improved accuracy [16,20,21,28-31], some [15,27,32] conclude that non-splinting gives better results, while in several [14,17,19,21,24,33,34] there were no significant differences in the accuracy between the two imprinting techniques.

In an extended systematic review (1980-2013) based on numerous studies the influence of different factors affecting the accuracy of impression materials and techniques was investigated [35]. In 21 in-vitro studies addition silicone was compared to polyether but in 19 studies among them no significant difference was found.

Clinical Significance

The impression of implants has several differences compared to the impression of natural teeth and the clinician should take these differences under consideration. Careful selection of the proper impression material and technique according to the needs of each clinical case is of vital importance to achieve the construction of an accurate working cast.

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