"DOUBLE STEP REVERSE" (DSR): A NEW PROTOCOL IN POLYVINYLSILOXANES (PVS) IMPRESSION-TAKING PROCESS - TWO CASE REPORTS

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ABSTRACT

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Aim
The aim of this case report is to describe a new protocol which can be useful to the clinician and can lead to a less frustrating process while taking dental impressions for fixed prosthodontics.
Summary
With the "Double-Step Reverse" technique it is shown that it is easier to take excellent impressions, especially in the post-space and in the multiple preparation impressions, without worrying about V-shaped voids and bubbles on the finishing line.
Key learning points
The DSR protocol requires that the wash material (Aquasil Ultimate) is first delivered on preparations, then we wait for its complete setting and later we deliver the tray material, with an impression tray. The DSR technique allows greater patient cooperation and greater serenity during the 3 minutes of the setting time. It is time-saving and reduces the waste of polyvinylsiloxanes (PVS) materials.
Keywords: prosthetic dentistry, PVS impressions, accuracy, dental materials, double-step impressions.

1. Introductions

The impression-taking process has always been a delicate step in fixed and removable prosthodontics; several techniques and materials have been evaluated with varying degrees of success. The scientific papers provide us with comparisons between different impression techniques and different materials, so it is hard to find a unique agreement. On the other hand, the dental supplies offer many types of hydrocolloid materials, polyether, polysulfide and polyvinylsiloxanes (PVS).
The importance of the quality of a dental impression is well known and it is shown by many articles that compare not only the available materials[1-2-3], but also the impression techniques [4-5].
Material and technique are not the only factors that affect the accuracy of impression. In 2004 Perakis, Belser, Magne[6-7], in a review, considered, among other things, the rheology of materials, remembering the three phases of process:
1) Viscous phase which allows mixing and handling;
2) Plastic phase for the adaptation to the anatomy of the mouth;
3) Elastic phase that allows the removal of the material overcoming any undercuts.
The authors pointed out that polyvinylsiloxanes (PVS) move rapidly from a viscous to an elastic phase, then requiring a short working time after mixing. Thus, compared to polyether (PE), PVS have a shorter plastic phase.
On the other hand, the rigidity of the PE, twice as double the PVS, often makes the disconnection difficult. These data are confirmed by the work of McCabe in 1998[8].
A brand new PVS, coupled with a handpiece that is attached to the turbine hose, mixes and dispenses the wash material under pressure. Thanks to the characteristics of this new PVS and method of application it is possible to apply the wash material on preparations, then wait for its complete polymerization and later on the tray material is applied. This is called the new Double Step Reverse technique (DSR).
The purpose of this paper is to show a new protocol to take impressions in polyvinylsiloxanes (PVS)

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Figure 1. Tooth #13 with a very old crown

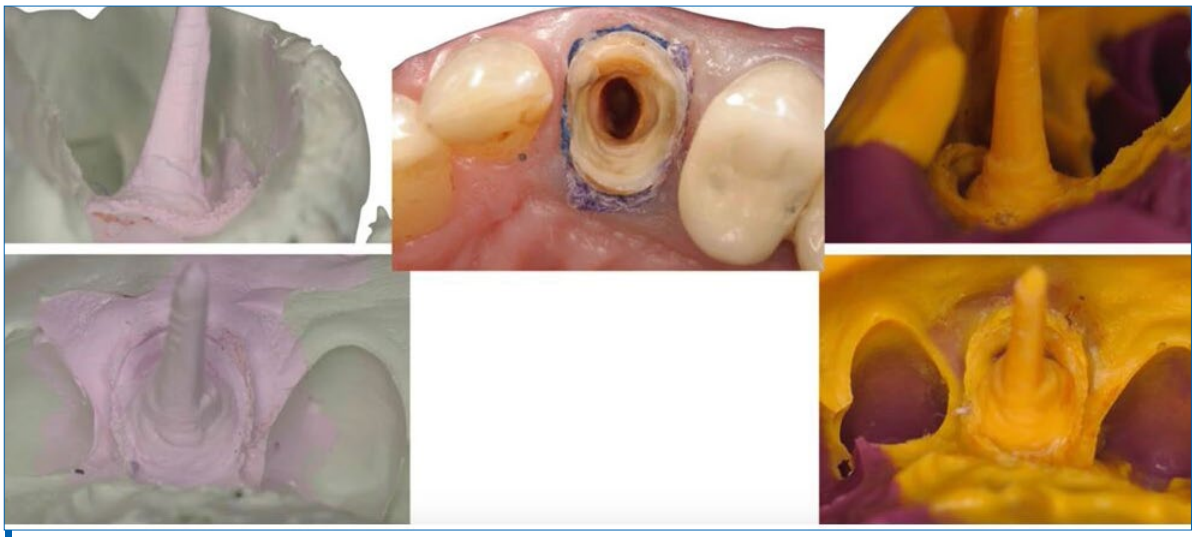


Figure 2. Post-space impression with Aquasil Ultimate on the left and Aquasil XLV on the right

by means of an Aquasil Ultimate system. The Double Step Reverse technique wants to overcome the limitation of the speed of execution, required by PVS, to keep the same application mode of Putty-Wash 1-step/ two-component technique, an is aiming to manage all the issues related to the hasty procedure of the latter.

We then aim to compare the Putty-wash 1 step technique with polivinylsiloxanes (A-silicone) and the new Double Step Reverse (DSR) with the innovative Aquasil Ultimate impression system.

In the first study, we took two impressions of each one of a 10-patient group who needed fixed prosthesis (one or more elements): one for each technique. Our laboratory then made two prosthesis for each patient. The controls were carried out on plaster models and on the patient's mouth, checked through an optic microscope, "Fit Checker" and probing of the closing edge was also done. The 30 elements examined were eligible for cementation without any evidence of dimensional differences; the closing edge has shown to be clinically acceptable in the range of 40-120 µm as indicated by McLean already in 1971[1]. The new DSR technique has shown to be clinically similar to the traditional one. The advantages were: ease of operation thanks to an easier control of the field that is free from saliva and crevicular fluids during placement of the wash, the respect of the reticulation times even in case of multiple teeth impressions and the elimination of errors due to the proper control of the thrust of the tray material ("V-shaped" voids). Moreover the patient accepted this technique well as shown by the final survey.

This work aims to describe a new workflow in the polyvinylsiloxanes (PVS) impression taking (Aquasil Ultimate, Dentsply). A handpiece connected to the air circuit of the dental unit mixes and dispenses the "wash" material pressurized. The system involves the use of a PVS provided in two textures: a "Type-3" (Aquasil Ultimate Wash) and a "Type 2" (Aquasil Ultimate Tray) according to ISO 4823.

Both the chemical and physical properties of the material allow the adoption of a new protocol in impression taking that leaves the clinician enough time to deliver the PVS in compliance with the working time specified by the manufacturer without having to rush the procedure for multiple preparations. As to do so, it is possible to have a precise control of the field and of the single elements. The new protocol is not found in the literature yet, as this new system has been available for a short time.

The procedure, called "**DSR**" (**Double Step**

Figure 3. Dies made from an Ultimate impression (U) and from Aquasil XLV + monophase (A)

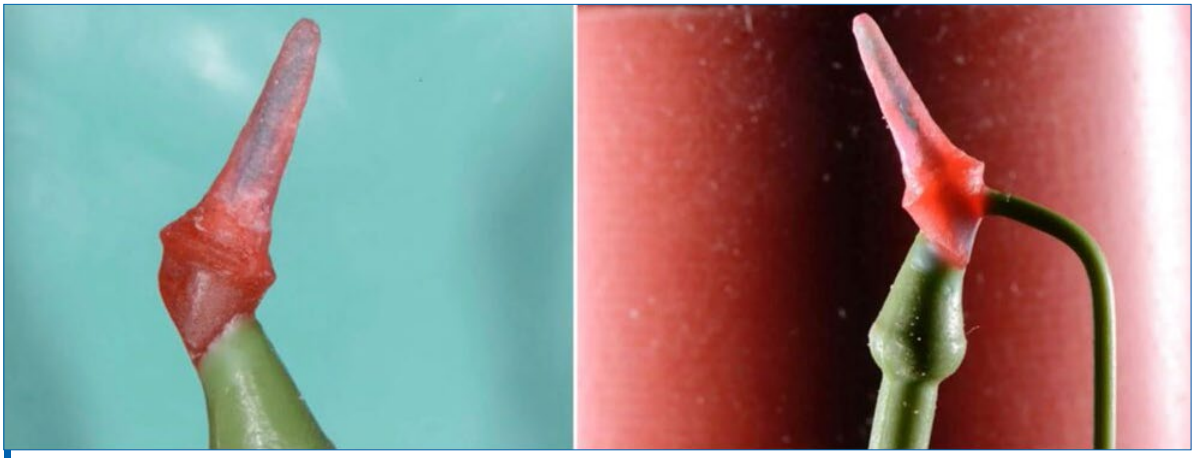


Figure 4. The duralay post ready to be transformed in a "Bio-HPP" post

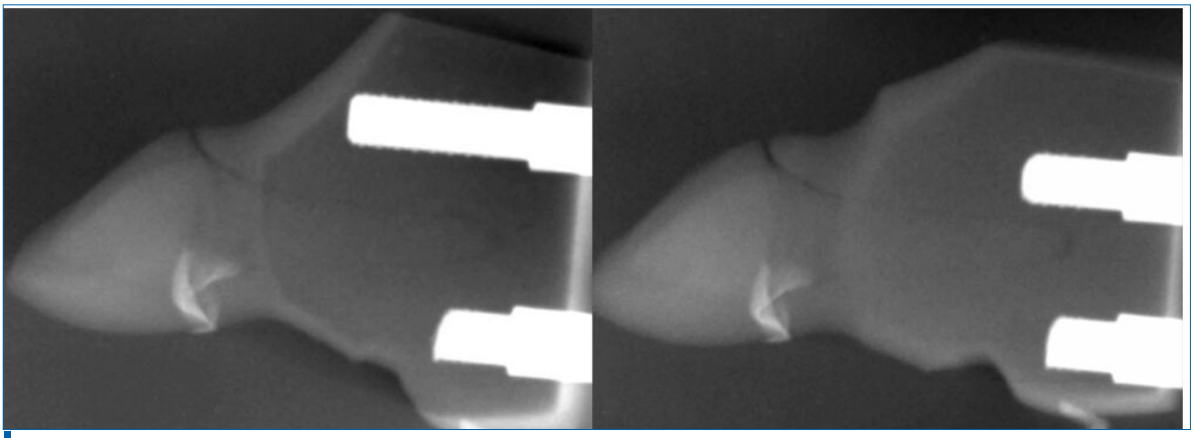


Figure 5. Endorsal x-rays that shows the space between posts and dies (Left: DRS impression, Right: traditional impression)

Reverse), requires the operator to place the intrasulcular tip straight into the sulcus for a direct material "wash" placement and leave the material wash to fully set. Exploiting the power of air-pressure, the clinician is able to precisely place the wash material over the margins in a single step without having to retract the tissues with any retraction cord or astringent paste.
Once set, the wash material is ready to be taken away from the mouth, by inserting an impression tray (with a "tray material") and positioning in patient's mouth, over the wash material.
After the recommended setting time (3 minutes), the operator removes the tray and performs a visual inspection.
The hypothesis of this work is the clinical verification of the results obtained by applying either the new DSR technique and the well-known protocol[3-6,8-9]. Putty-wash 1-step that instead recommends to place the wash material (type 3) on the preparations then the heavy-viscosity or monophase material (type 1-2).

2. Cases Reports

2.1. Case Report n°1

Tooth #13 shows a very old ceramic crown with a considerable misfit, which hides a damaged and aged core structure so that it requires a thorough

Figure 6. The sequence that leads to the definitive crown

Figure 7. Before and after the prosthetic procedures

Figure 8. Teeth #16 and #17 are in need of prosthetic treatments

replacement. (Fig.1)
We removed the metal post by means of an ultrasonic insert and then it is time to take a couple of impressions.
The First one is made following the protocol of the "DSR" technique: the "Wash material" (Aquasil Ultimate Wash), after being left for 3 minutes within the root canal, is covered and firmly bonded by the "Tray material". These two materials, after their setting time, are ready to be removed from the arch.

The Second impression is made of an eXtra-Light Viscosity (Aquasil XLV) in a monophase technique, where a lentulo is used to push the XLV material deep inside the root canal, gaining more push from the subsequent monophase material, delivered by an impression tray. (Fig. 2)
At this time, two dies are made and tagged as "U" (which stands for Ultimate) and as "A" (for Aquasil Monophase) (Fig. 3); then sent to the laboratory where they make two *duralay* resin posts according to the plaster models.

Figure 9. Juxta-gingival finish line preparation for both teeth and retraction cord to highlight the end of the preparations

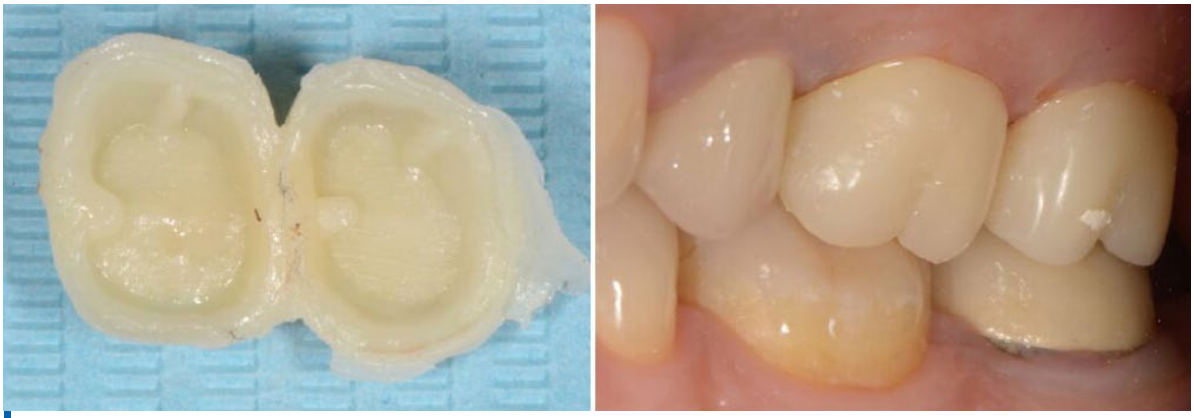


Figure 10. The temporary crowns after a direct rebasing

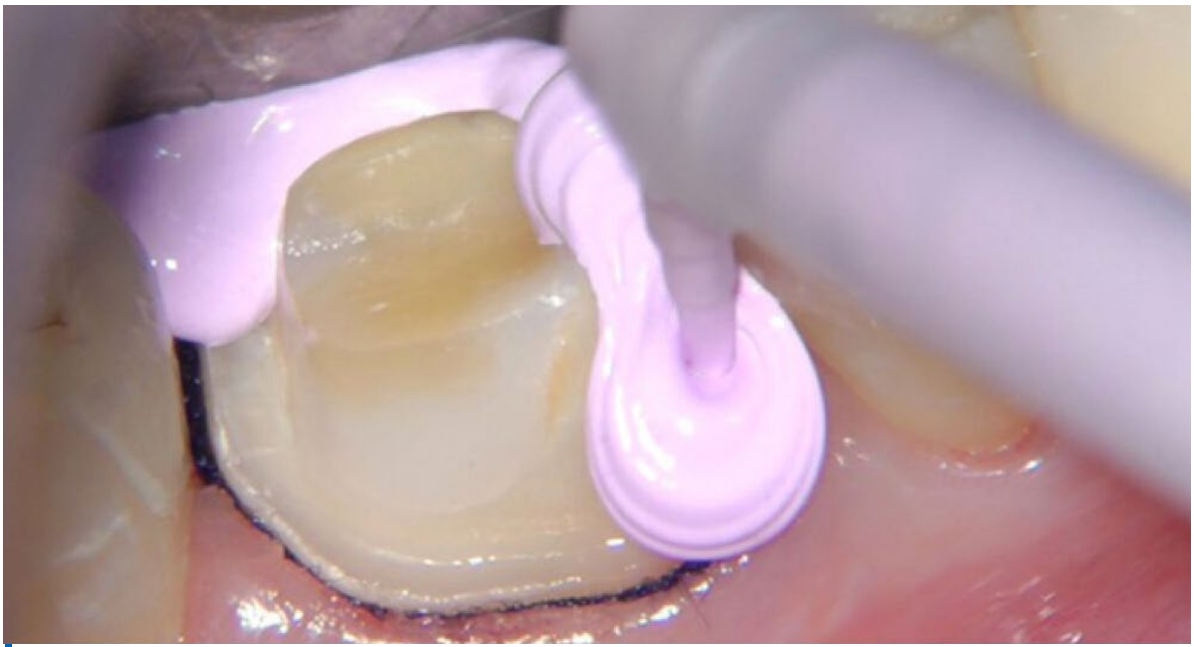


Figure 11. With a retractin cord into the sulcus, Aquasil Ultimate Wash material is delivered onto the teeth and let set for 3 minutes

Through the process of thermocompression, the duralay posts are transformed in two "Bio-Hpp" (Bredent) posts. The material is called "PEEK" (PolyEther-Ether-Ketone) and one of its characteristics is a fact that it has got a Young module very similar to the one of human dentine. (Fig. 4)
The two Bio-HPP are tried into the casts to make sure they are tight-fitting and then coated with composite resin; so as to do that we create a so called "*Post-Crown*" made of a *Bio-Hpp* core and composite resin on the outer layer.

Figure 12. In this impression the wash material is slightly different from the previous, since it is designed for multiple teeth impression and it has a longer setting time

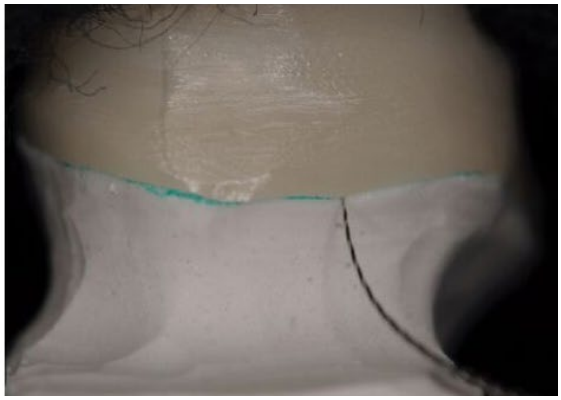
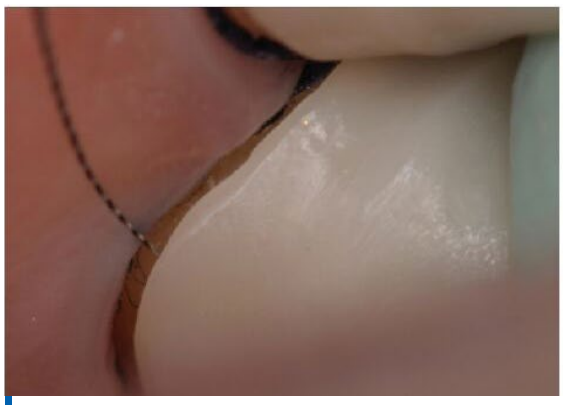


Figure 13. The finishing line is checked through an optical microscope and probed through endo files .06



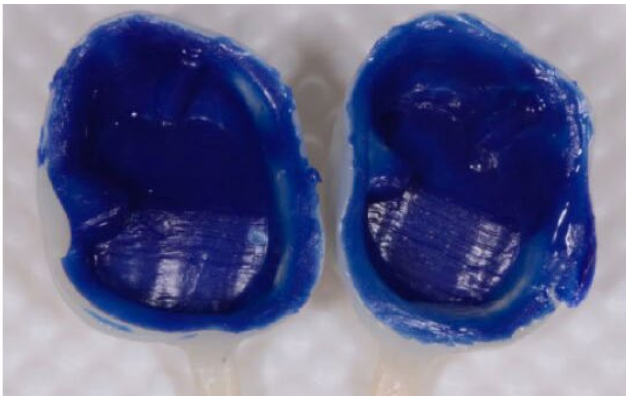


Figure 14. Further evaluation with Fit Checker Blue GC

Endoral x-rays are performed for both the models, in order to radiologically evaluate the spaces beneath the dies. (Fig. 5)
The digital x-rays show that the results are almost completely identical, therefore attesting that both the impressions and the dies are basically very reliable in terms of accuracy.
Hence the post-crown, crafted according to the DSR impression, is cemented with a radiopaque resin-based cement and hence an x-ray is taken.
Radiographically, we are able to evaluate the equal distribution of the cement all around the post.
Once we proceed with the cementation of the Crown-post, the tooth is ready to be prosthetically prepared and then another DSR impression is taken immediately. With such an accurate impression, the laboratory can craft a definitive ceramic crown with a high grade of precision. (Fig. 6)
The two impressions are very similar, as for the accuracy of the models and for the lack of deformation of the post. (Fig. 7)
Eventually, thanks to DSR technique, we can easily

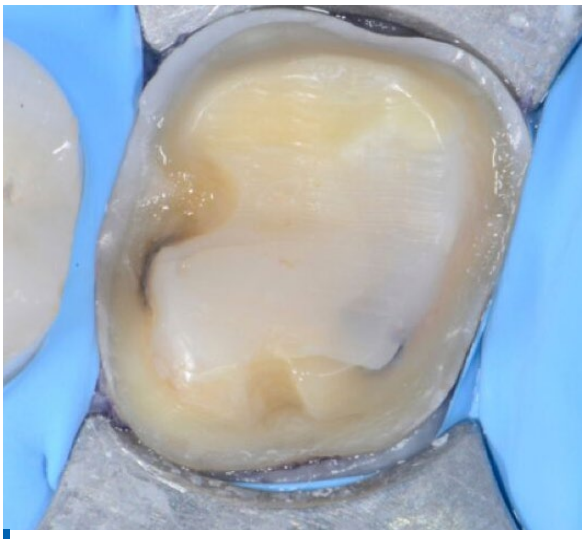


Figure 15. Dental dam application

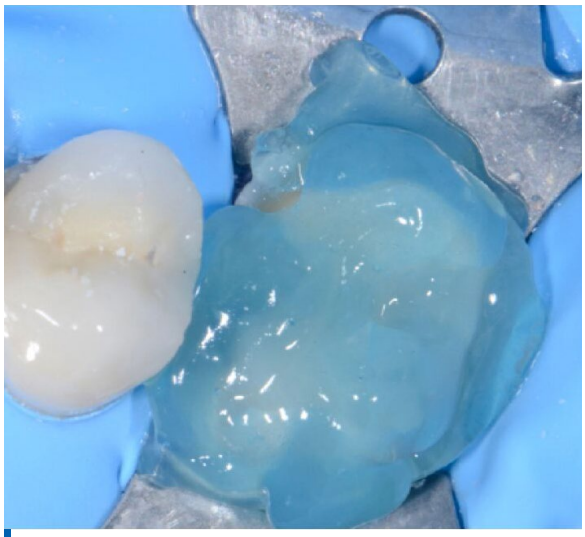


Figure 16. Etching gel on the dentin

Figure 17. Adhesive application

Figure 18. Sandblasting of the inner surface of the ceramic crown

perform an accurate impression of the root canal in case of a "post-crown" rehabilitation. This wash material has showed a "Shore hardness" of 63 and, once it is set, it does not tear off when it is time to remove the tray from the mouth.

2.2 Case Report n°2

To better highlight the advantages of this technique, we will describe another clinical case where a PVS impression with an Aquasil Ultimate system is carried out within the prosthetic rehabilitation of teeth #16 and #17 (with juxta-gingival finish line).

Case Description

A patient with a severe wear of superior posterior teeth comes to our observation, showing tooth # 17 with a massive restoration made of composite resin and #16 with a complete fracture of the disto-buccal cusp, so they are both in need of prosthetic treatments (Fig. 8).

We decided, by mutual agreement with our patient, to treat the two elements by milling a core-structure from a block of *IPS e.max ZirCAD* (Ivoclar). The CAD-CAM produced COR was veneered with *e-max* veneering ceramic. Having stated the height of the residual preparation, which guaranteed enough stability and retention of the restoration itself, a juxta-gingival abutment finish line was chosen in order to better control: the marginal trimming, the impression, the visual check of the finishing edge, the cementation and the full removal of the excess cement.

We prepared the two dental elements with a juxta-gingival finish line then we placed a retraction cord into the sulcus to highlight the end of the preparations (Fig. 9).

As for the temporary crowns, we adapted two provisional resin crowns performed in the laboratory through a direct rebasing. (Fig. 10).

We placed a retraction cord (Ultrapack #00, Ultradent) into the sulcus and, without removing the cord itself, *Aquasil Ultimate Wash* is delivered into the sulcus and on the preparations, letting it set for 3 minutes, as suggested by the manufacturer (Fig. 11).

This short time having elapsed, the tray, filled with *Aquasil Ultimate Tray*, was slowly seated on the upper arch so that the rest of the impression could be taken. In this stage, we opted for a stiff and smooth steel tray with retentive ridges where the PVS adhesive was already applied.

After 3 minutes of setting, as indicated by the manufacturer, the tray was removed from mouth

Figure 19. The crown on #16 after cementation

Figure 20. Clinical picture after the cementation of both crowns

Figure 21. The crowns from the buccal side

(Fig.12), then controlled under microscope (Leica M400 optical) at 40x of magnification and, at the end, was sent to the laboratory. After the laboratory phase, the finishing line of the cases on the respective abutments was checked through an optical microscope and probed carefully through endodontic files from 06 to 150 (according to ISO standards) in order to properly assess any hidden gaps (Fig. 13).
In the same way, we checked directly in the mouth, with Fit Checker Blue GC before resending the substructures to the laboratory for the ceramic layering. The definitive crown was again controlled and it was clear that there was no more than 120 µm and a maximum gap of 1/10 of the entire extension edge of the crown of 1.6, it was decided to proceed with cementation under dental dam for every single crown (Figs. 14 to 21).

3. Discussion and Results

By obtaining the absolute accuracy of the impressions, this new protocol allows the clinician to take impressions of multiple preparations without worrying about the setting times of PVS when he combines both wash and tray materials. The Double Reverse Step gives enough ease to the operator, allowing him to carefully the preps and apply PVS over multiple teeth in sequence; then double-checking any potential transudation, and the presence of saliva. Furthermore, the patient's increased comfort must be considered, due to the use of less fluid materials that are not likely to leak down the throat if they are in excess, and to the decreased mouth removal time of the tray (3 minutes).

4. Conclusions

In our practice, the DSR protocol has become the standard in every clinical situation since it provides us with a perfect control of the operative field, a chance of managing any sudden problems (exudation, crevicular fluid, saliva), a drastic reduction of bubbles on the finishing line (which are often related to the delivery mode of the wash material through the syringe), the absence of the V-shaped voids that often occurs when the delivery of the wash material is delayed or due to an incorrect positioning of the impression tray (not parallel to the occlusal surface nor pushed too quickly). Eventually, we have noticed a greater patient cooperation and a greater serenity during the 3 minutes of the setting time.

Acknowledgments

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Questions

What is meant by "DSR"?

❑a. A new kind of diode-laser;
❑b. A new impression material;
❑c. A technique used to retract tissues;
❑d. An impression technique.

What does the acronym DSR mean?

❑a. Dynamic Standard Registration;
❑b. Digital Standard Records;
❑c. Double Step Reverse;
❑d. Direct Simple Records.

According to the DSR protocol, which material is first delivered on the abutment?

❑a. Extra-Light Viscosity material;
❑b. Ultimate Wash material;
❑c. Ultimate Tray material;
❑d. Both of them together.

When it is advisable to deliver the tray material?

❑a. Once the Wash material is completely set;
❑b. Along with the Light material;
❑c. Before the Light material;
❑d. It is not required by this protocol.