v. 2, n. 73, 2022

International Journal of Health Science

INFLUENCE OF IMPRESSION TECHNIQUE ON THE AMOUNT OF OCCLUSAL ADJUSTMENTS OF INDIRECT RESTORATIONS – CASE REPORT

Mariana Ribeiro de Moraes Rego
https://orcid.org/0000-0003-2992-6002

Mayra Cardoso
https://orcid.org/0000-0002-1232-8551

Decio Nunes
https://orcid.org/0000-0002-8649-4210

Luiz Carlos Santiago da Costa
https://orcid.org/0000-0003-0327-2426

Declaration of conflict of interest – nothing to declare
There is no funding source

Abstract: Introduction: Impressions are classified as the total or partial, work or study, and we want to present the classification into active and passive impressions and their relationship with the amount of occlusal adjustments in the final restoration. Passive impression does not put pressure on the teeth to push them into the sockets and the teeth are copied without dento-alveolar movement. Active impression occurs when we mold teeth and adjacent structures with the double-arch technique, a closed-mouth impression, copying the prepared and opposing tooth, including the interocclusal registration. In the plaster model obtained, the teeth are intruded, positioned in the socket in sync with the end of the mandibular closing arch. **Objective:** To test the amount of occlusal adjustment needed in indirect restorations after using active and passive impression. **Report:** Eight all-ceramic crowns were made with different levels of digital and analog phases until reaching 100% digital phases. The analysis for the need for occlusal adjustment was performed using a double-blind test using a numerical score from 1 (very high) to 4 (excellent). **Results:** A comparison using MEDIANs showed that the 100% digital crown received a score of 4 the three times it was installed for TEST, followed by the 60% digital-40% analog crown which received two scores of 3 and one score 2 and the 50% digital crown -50% analog, which received three scores 3. **Conclusions:** The more digital phases, the less the need for occlusal adjustment, and crowns made from active impressions obtained better scores when compared to those made from passive impressions.
Keywords: Molding. Active Molding. Passive Molding. Occlusal Adjustment.

INTRODUCTION

The clinical success of indirect restorations is closely related to several clinical and laboratory procedures that act as the links in a chain. If any one of them breaks, the chain will be weakened or it will make it difficult for the entire system related to it to work. One of the most important clinical phases is the molding phase.[4]

Impressions are usually discussed on two basic aspects: their copying capacity and their dimensional stability, thus having a fundamental role in the adaptation of indirect restorations to teeth and dental preparations later.[15]. However, we draw attention to the fact that this procedure also plays a key role in the spatial position of the tooth at the time of copying and in the future in the plaster model, and this will influence the occlusal relationship at the time of mounting these models on instruments used in the laboratory for determination of occlusal designs of future indirect restorations.

As there are several materials and techniques for this procedure, impressions are didactically classified to facilitate communication between professionals in the area in: total and partial, work and study, with and without gingival retraction and, to understand the relationship between the amount of occlusal adjustments that will be necessary in an indirect restoration and the impression procedure, it is necessary to discuss a type of impression almost never addressed in the texts on the subject – active and passive impressions.

To perform a clinical impression, the professional must select the tray and impression material to be used. At this moment, he is defining, without knowing, whether his impression will be passive (Figures 1A and 1B) or active (Figures 2A and 2B) and, therefore, defining the spatial positions of the teeth and adjacent tissues in

the molds and models, which will definitely influence the intermaxillary relationship between the arches and the occlusal design of the future indirect restoration.

When the tray loaded with impression material is introduced into the mouth and pressure is exerted on the teeth/surrounding tissues, because of the property called plasticity of these materials, they deform and then stiffen around the teeth to produce the copy.[11,12,13] Because of this property, the procedure does not promote enough pressure on the teeth to push them into their alveoli and the teeth are copied without dento-alveolar movement, that is, the Hydraulic Support System formed by collagen fibers in different directions that insert into the root cement and into the alveolar bone cortical and the synovial fluid that form what we anatomically call the periodontal ligament, was not stimulated to withstand the pressure exerted because it was insufficient to stimulate this system.[1,10]. After the impression is completed and the mold is cast in plaster, the model will have been obtained with the teeth in a passive spatial position within the dental arches.

Unlike passive impression, active impression occurs when we use a clinical procedure to mold teeth and adjacent structures with the double arch technique or better known as Triple Tray, created by Rand Werrin in 1980.[14] The technique consists of a closed mouth impression, which molds the prepared tooth, the antagonist and also includes the interocclusal registration.[15]In our approach to the technique, we will not emphasize the main advantages described by its creator, such as: speed, material savings, less risk when relating the models, and comfort for the patient.[8,15,16] The approach will perhaps be in a way never before done. The double arch impression or Triple Tray impression is the only way to perform an active impression since, after the insertion and positioning of the tray loaded with selected material (polyether or polyvinylsiloxane), the patient is instructed to close the mouth and tighten the teeth, as the molding material stiffens[8,16]. During this procedure, as the teeth are being pressed by their antagonists by the forces of the masticatory muscles responsible for mandibular closure, a dento-alveolar movement is taking place according to the functioning of the Hydraulic System of Support of the Periodontal Ligament1,10,14,15. When the tray is removed and the plaster model obtained, the teeth are spatially positioned in the intruded molded hemiarchs, that is, positioned in the alveolus in sync with the end of the mandibular closing arch. They are in their maximum active positions as they will be when the restorations are functioning in the mouth during mastication1,10. This will allow the fabrication of restorations as if they were working and not in a passive position.

Restorative dentistry has suffered, and still suffers with each new release, a significant impact with the current level of computerized systems. The so-called Cad-Cam Systems. These systems include a step to capture the intraoral images with scanners (Figure 3) and software for designing the restorations, and then another step that includes a milling machine or a printer to build the restoration in various materials possible at the professional's choice.[9]. One of the most used systems worldwide is the Cerec System. [2] (Dentsply Sirona, EUA) and it was from this system that we started the studies that culminated in the discovery of the effect of active shaping on the design of occlusal surfaces with less or no occlusal adjustment.

At the beginning, what caught the most attention was the very little need for occlusal adjustments that the restorations needed, with a huge difference for indirect

restorations made by the traditional analog method.[3] Comparing the details between the two, the first difference noticed was how the interocclusal record is captured by the scanner and used to occlude the upper and lower digital models. It is performed with the patient sitting, mouth closed and teeth clenching, for example: in active or functional occlusion, with the teeth pushed into their sockets and putting the Hydraulic Support System into maximum operation.

Another basic difference was in how the occlusal design is defined in the system. After capturing the intraoral images, the digital models are prepared for the beginning of the design of the restorations. In the administration phase, in which, among other details, which type of restoration or which material to use are defined, ten parameters are also defined for the design and milling of the restoration. The milling parameters will determine how the mill will design the internal and external restoration on the selected material block. Among these parameters, three are directly related to the milling of the occlusal surface. They are the Occlusal Milling Deviation (DFO), the Dynamic Force of the Contacts (FDC) and the Resistance of the Occlusal Contacts. (RCO).[5]

In 2018, in a video lesson, James Klim[6] cites 5 important items for occlusal restorations to have an adequate occlusal design and good occlusion. One is the Periodontal Ligament and the spatial position of the teeth at the time of interocclusal registration, and the other is the two occlusal parameters to be defined in Cerec during restoration design and their numerical values: DFO -175 and FDC -50. However, he never stated that these values would compensate for the dento-alveolar movement of intrusion that occurred during the recording in maximum occlusion. However, in clinical/laboratory observations, where this DFO is zeroed or restorations performed as biocopies of provisional restorations already fitted and functioning in the mouth are used, the occlusal restorations will require major occlusal adjustments. In contrast, if DFO -175 is used, restorations do not require occlusal adjustments or, when necessary, are minimal.

PROPOSITION

To bring this knowledge to the purely analog work, using impressions with Triple Tray, since this is the only impression technique that uses impression of the prepared tooth and the antagonist in an active way and still with occlusal registration in maximum occlusion as in the Cerec system and to verify if the behavior of the indirect restorations in relation to the amount of occlusal adjustment will be the same or close to the restorations performed in the Cerec system.

MATERIAL AND METHODS

A pilot project was prepared to test the proposal. A 24-year-old patient required an indirect full-crown restoration on element 16. Eight full-ceramic Empress crowns (Ivoclair/Vivadent – SP, Brazil) were performed with different levels of analog and digital phase included in the procedure until reaching 100 % of digital phases, taking into account that to complete an indirect analogue restoration, 6 phases were considered in this study: Impression, Obtaining the models, Assembly in Articulator, Waxing, Inclusion and Pressure/Casting of ceramic insert and to complete a restoration by digital process 3 phases were considered: Mouth scanning, Restoration design and Ceramic block milling. The GROUPs were then defined as follows: Gr 1, 2 and 3: 1 crown each being 100% Analog, Gr 4, 5 and 6: 1 crown each being 50% Analog and 50% Digital (Moulding, Obtaining the models, Articulation of models, Scanning of models,

Design and Milling of ceramic block), Gr 7: 1 crown being 60% Digital and 40% Analog (Scan of the mouth, Design, Milling of wax block, Inclusion and Pressure/Casting of insert) and Gr 8: 1 crown 100% Digital. All impressions were made with polyvinylsiloxane (President – Coltene, Brazil) and casts were cast in type IV plaster (Vel Mix – Kerr, USA). To make the Gr 1 crown, a total passive model was mounted on a semi-adjustable articulator (Bio-Art, Brazil) (Figure 4). To make the Gr 2 crown, a partial passive model was hinged (Jon, Brazil) (Figure 5). To make the Gr 3 crown, partial active models (using Triple Tray Moldex – Angelus, Brazil) were mounted in a verticulator (Bio-Art, Brazil) (Figure 6). For the three crowns of Gr 4, 5 and 6, the models were made and mounted in the same way as in Gr 1, 2 and 3 respectively. For the Gr 7 crown, digital models were obtained from intraoral scanning (Figure 7), as well as the restoration design, but in the final stages of the process, analog phases were performed. For the Gr 8 crown, the entire process was digital.

The analysis regarding the need for occlusal adjustments in the eight crowns made was performed by means of a double-blind test using a score as follows: the professional who installed/tested the crowns in the mouth did not know which GROUP they belonged to, nor the patient. Prior to the TEST session of the crowns, the patient was duly clarified how she must give the scores according to the difference that the crowns would make at the time of mouth closure. The scores were determined as 1 = very high, 2 = high, 3 = little high and 4 = optimal (occlusion prior to crown placement). Each crown was installed/tested in the mouth three times, maintaining the double blind test for all and at the end, an average of the three scores obtained was calculated and thus determining the score for the installed crown.

RESULTS

SCORES / GROUPS	1ª TEST	2ª TEST	3ª TEST	**MEDIAN**
GROUP 1 (ASA)	1	2	2	2
GROUP 2 (CHAR)	1	1	1	1
GROUP 3(VERT)	2	2	2	2
GROUP 4 (ASA)	1	2	2	2
GROUP 5 (CHAR)	1	1	1	1
GROUP 6 (VERT)	3	3	3	3
GROUP 7	2	3	3	3
GROUP 8	4	4	4	4

Table 1: Numerical values of the scores distributed by the groups in the 3 insertions/tests and median

In a simple numerical analysis, we can verify that the only crown that received a score of 4 in all the times it was installed for the test was the Gr 8 (100% Digital). Followed by the crowns of Grs 6 and 7 that had a median of 3 in the scores, and the crown of Gr 6 (50% Analog and 50% Digital) was even better numerically as it received a score of 3 in the three installations/tests performed while the Gr 7 (60% Digital and 40% Analog) received two scores of 3 and one score of 2. All crowns that were made from passive impressions/models had the lowest scores between 1 and 2, and when the hinge articulator was used, regardless of the group, the worst results were obtained.

DISCUSSION

Triple Tray trays, despite having been designed, manufactured and used during the last 40 years with the advantages of speed,

material savings, less risk when relating the models and comfort for the patient8,15,16, can now receive another type of advantage and indication. They also provide for the fabrication of indirect restorations with occlusal designs that require less occlusal adjustment when compared to those made from impressions and passive models.

This new approach to this impression technique could only be created from the clinical and laboratory findings of the restorations performed in the CadCam Cerec7 system. From the scanning of the upper and lower arches in maximum occlusion to take the interocclusal record and more specifically, by the clinical analysis of the occlusion of the definitive indirect restorations designed and made by the system using the occlusal parameters, mainly the Occlusal Milling Deviation, which received a value negative numerical value (-175) and for the Strength of Occlusal Contacts (-50)6, which we understand to be a form of compensation for dental intrusion caused by maximum occlusion at the time of taking the interocclusal record, it became clear that we needed to study how to bring these findings for analog dentistry, as the vast majority of dentists still do not routinely use CadCam systems.

From these analyzes on indirect restorations made with 100% Digital techniques, we can draw a parallel for 100% Analog indirect restorations and still achieve what was practically impossible before, even using the best impression materials, the best interocclusal registration techniques and the best semi-adjustable articulators. That is, to achieve indirect restorations with no or very little occlusal adjustment, without totally destroying the occlusal design that we received from the laboratory so that they are optimal in terms of occlusion in Maximum Habitual Intercuspation.

The design of this study alone is not conclusive. However, since this study was conducted, more than two hundred indirect restorations have been made using the technique described in Gr 3, when the crown was made from an active impression/model with a Triple Tray15 impression tray and verticulator + laboratory digital phases from the scanning the models and numbering the occlusal parameters as described above and with occlusal analysis at the time of installation/fitting requiring no or very little occlusal adjustment.

It must be noted that the active models obtained from the impressions made with the Triple Tray mold showed better performance when mounted on the verticulator, since this instrument prevents any lateral or anteroposterior movement of the models when they are manipulated for opening and closing as it works on three vertical axes, giving precision to the movements during the scanning and making of the restoration.

CONCLUSION

From the results obtained we can conclude that:

1. Indirect restorations made with 100% analog techniques caused greater occlusal discrepancies, requiring more occlusal adjustments.
2. The more digital steps we include in the fabrication of indirect restorations, the less need for occlusal adjustments.
3. The indirect restoration made with a 100% digital technique did not cause occlusal discrepancies and did not require occlusal adjustment.
4. Indirect restorations made with passive impressions/models caused greater occlusal discrepancies than those using active impressions/models.

REFERENCES

1. Bergomi, M., Wiskott, H. W. A., Botsis, J., Mellal, A., and Belser, U. C. **Load response of periodontal ligament: Assessment of fluid flow, compressibility, and effect of pore pressure**. *J Biomech Eng*. 2010 Jan; 132(1):014504.

2. Birnbaum NS, Aaronson H, Stevens C, Cohen B. **3D Digital scanners: a high-tech approach to more accurate dental impressions**. Inside Dent. 2009 Apr;5(4):70-4.

3. Galhano **GÁ,** Pellizzer EP, Mazaro JV. **Optical impression systems for CAD-CAM restorations**. J Craniofac Surg. 2012 Nov;23(6):e575-9.

4. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. **Clinical complications in fixed prosthodontics**. J Prosthet Dent. 2003 Jul;90(1):31-41.

5. Kim JH, Kim KB, Kim SH, Kim WC, Kim HY, Kim JH. **Quantitative evaluation of common errors in digital impression obtained by using an led blue light in-office CAD/CAM system**. Quintessence Int. 2015 May;46(5):401-7

6. Klim, J. High occlusion in Cerec! https://youtu.be/a-cW4bVRY1Q Acesso em 02 Maio 2020.

7. Liu PR, Essig ME. **A panorama of dental CAD/CAM restorative systems**. Compend Contin Educ Dent. 2008 Oct;29(8):482, 484, 486-8.

8. Mamoun JS, Javaid M. **Triple tray crown and bridge procedures: a guide to how dental assistants can assist the dentist: part 1**. Dent Assist. 2013 May-Jun 82(3):14-8, 20, 22-3.

9. Miyazaki T, Hotta Y, Kunii J, Kuriyama S, Tamaki Y. **A review of dental CAD/CAM: current status and future perspectives form 20 years of experience**. Dent Mater J. 2009 Jan;28(1):44-56

10. Niedermeier, W. **Parameters of tooth mobility in cases of normal function and functional disorders of the masticatory system**. J Oral Rehabil 1993 Mar; 20(2):189-202.

11. Sears AW. **Hydrocolloid impression technique for inlays and fixed bridges**. J Dent Assoc S Afr 1975 Jan; 30(1):129.

12. Skinner EW, Cooper EN, Beck FE. **Reversible and irreversible hydrocolloid impression materials**. J Am Dent Assoc. 1950 Feb;40(2):196-207.

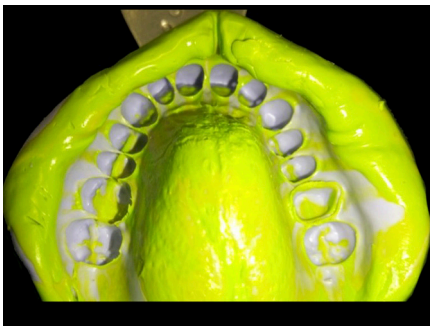
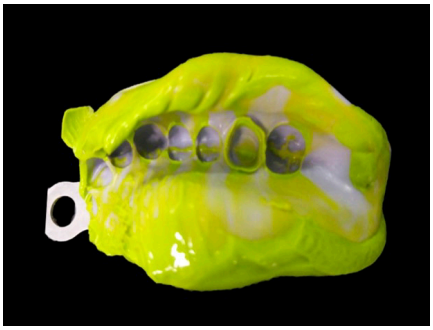
13. Skinner EW. **Some recent technical advance in dental materials**. J Am Dent Assoc. 1963 Feb;66:176-82.

14. Werrin, S.R. **The 30th anniversary of the Triple Tray**. www.Dentistrytoday.com/interview/2844, Jul 2010.

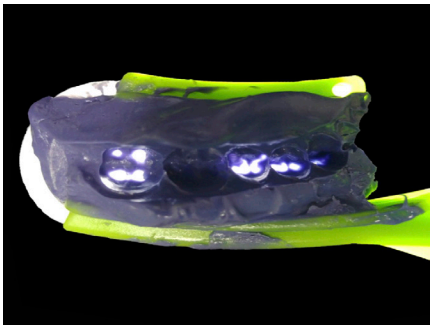
15. Wilson, EG. et al. **Double arch impressions for simplified restorative dentistry**. Journal of Prosthetic Dentistry 1983 Feb; 49(2):198-202.

16. Xing YX1, Peng D, Wang YG. **Comparasion of clinical and technical operating time of full-crown restorations between traditional and triple-tray impression techniques**. Beijing Da Xue Xue Bao Yi Xue Ban. 2012 Feb 18;44(1):151-6.

FIGURES

Figures 1A and 1B – full and partial passive impressions.

Figures 2A and 2B – active molding; note the absence of impression material at the points of contact.

Figure 3– Intraoral scanning with teeth in maximum intercuspation.

Figure 4 – Maxillomandibular relationship of groups 1 and 4.

Figure 5 – Maxillomandibular relationship of groups 2 and 5.

Figure 6 – Maxillomandibular relationship of groups 3 and 6.

Figure 7 – Maxillomandibular relationship of groups 7 and 8.