VIRTUAL INDIRECT BONDING WITH ORTHO ANALYZER SOFTWARE

Fabio Pinto Guedes[1]
Renato Parsekian Martins[2]

[1] Master in Orthodontics - Universidade Sagrado Coração - Bauru - SP – Brazil. Orthodontics Postgraduate Professor – FASURGS.
Specialist in the Health Area of Rio Grande do Sul - Passo Fundo - RS – Brazil.

[2] Master, PhD and Post-Doctor in Orthodontics – Universidade Estadual Paulista -School of Dentistry – Araraquara - SP – Brazil / Sandwich Doctorate.
Texas A&M University - Baylor College of Dentistry - Dallas – USA - Postgraduate Studies in Dental Sciences Collaborating Professor (Orthodontics Area).
Universidade Estadual Paulista - School of Dentistry - Araraquara - SP – Brazil.

ABSTRACT

Correct placement of orthodontic accessories is of paramount importance for appropriate finishing. The use of CAD/CAM technology in Orthodontics today allows to place the accessories virtually and assess the repercussion of this placement after teeth alignment and leveling. With the accessories bonded to the desired position, a virtual transfer guide is created and then printed using a 3D printer. Thus, it is possible to minimize errors which would require greater need of wire bending, and a possible longer treatment time. The aim of this article is to present through a clinical case a laboratory and clinical protocol of virtual indirect bonding.

Keywords: Orthodontic bonding, corrective Orthodontics, orthodontic brackets, indirect bonding.

INTRODUCTION

Orthodontic accessories bonding in the correct position has always been cause of great concern for orthodontists. In the past, when there was no direct bonding, all teeth were banded which made placement even more difficult. From the 1980s on, with the advent of composite resin, the bonding procedure was preferred. Some professionals consider this fact to be one of the most revolutionary in Orthodontics.

And what would be the ideal placement of accessories? To answer this question, it is necessary to mention the work developed by Andrews (1979)[1] when he conceived the straight wire technique. Considering that orthodontic accessories and all their measurements (angulation, inclination, in--out) were thought having as a reference the EV point (midpoint of the clinical crown), it would be in this position that they would be placed. However, this position can be changed depending on the individual, aesthetic and/or functional needs of each patient.

Good accessories placement may favor orthodontic finishing. At first, in order to minimize placement errors and turn the clinical procedure faster, indirect bonding in plaster models was conceived. However, this bonding perspective still requires an important laboratory time and some possible misconceptions of teeth alignment and leveling may occur, which require the need for eventual wires bending.

With the advent of CAD/CAM technology in Dentistry and its greater accessibility, new treatment proposals were conceived. In Orthodontics, in addition to the common advantages in relation to other specialties, the opportunity arises particularly to perform virtual treatment simulations, virtual indirect bonding and successive aesthetic aligners.

In this context, regarding virtual indirect bonding, it is possible to plan, place the accessories and create the transfer guide virtually and obtain it through a 3D printer. In other words, when the placement of an accessory is virtually changed, it is possible to identify the repercussion of this change after alignment and leveling. In addition, due to the fact that the transfer guide is made by means of a 3D printer, the laboratory phase is optimized.

Thus, accepting the clear advantages of the virtual bonding procedure, the objective of this article is to propose a laboratory and clinical protocol for orthodontic accessories installation.

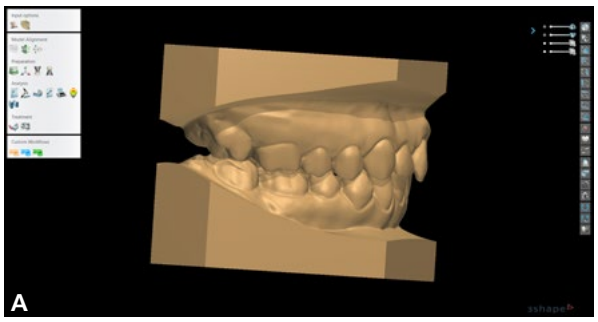
Description of the technique

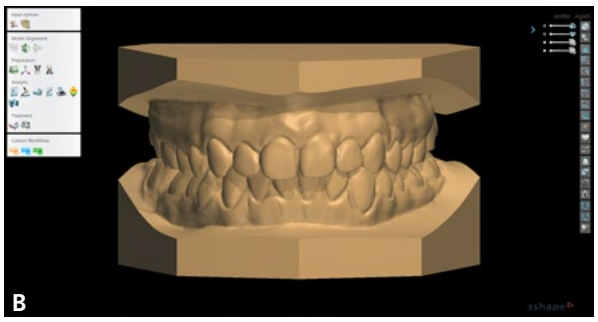
To better elucidate the suggested virtual indirect bonding protocol, follows it step by step:

Laboratory phase

1st Step: Acquisition of Digital Models

Digital models can be acquired basically in two ways: through an intraoral scan – considered by many professionals to be the best method – or by means of molding with added silicone, when after obtaining the plaster models, these will be scanned. In this clinical case, the patient was intraorally scanned with Trios Color 3 scan (3Shape, Copenhagen, Denmark). The first arch scanned was the lower arch, then the upper arch and, finally, the patient occlusion. After scan, the digital models were exported in an extension called STL (Standart Triangular Language) and inserted into the Ortho Analyzer software (3Shape, Copenhagen, Denmark) - (Figure 1).





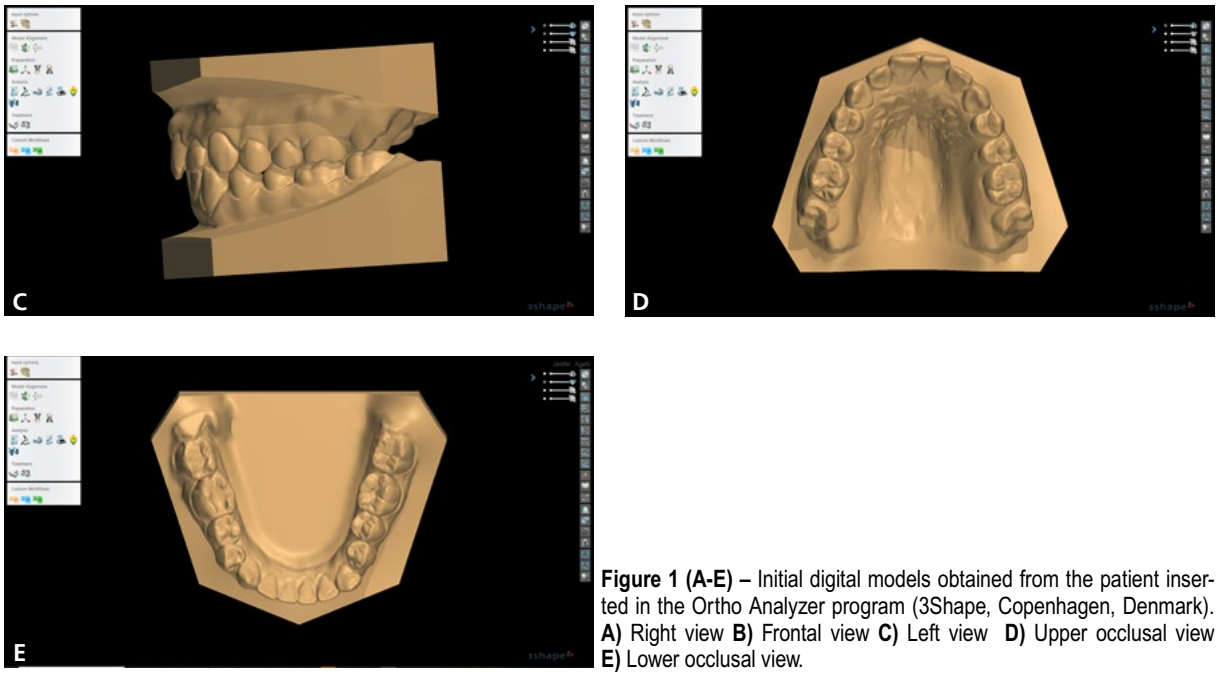


Figure 1 (A-E) – Initial digital models obtained from the patient inserted in the Ortho Analyzer program (3Shape, Copenhagen, Denmark). **A)** Right view **B)** Frontal view **C)** Left view **D)** Upper occlusal view **E)** Lower occlusal view.

2nd Step: Digital Models Segmentation

In this step teeth segmentation or separation and the distinction of teeth virtual gum are performed, first by defining teeth mesiodistal points. The software finds the best possible way to delimit and separate teeth from the gum, which can and must be corrected by the operator. After teeth correct delimitation, the long axis of each one is estimated by the software and can also be modified and finally defined by the operator (Figure 2).

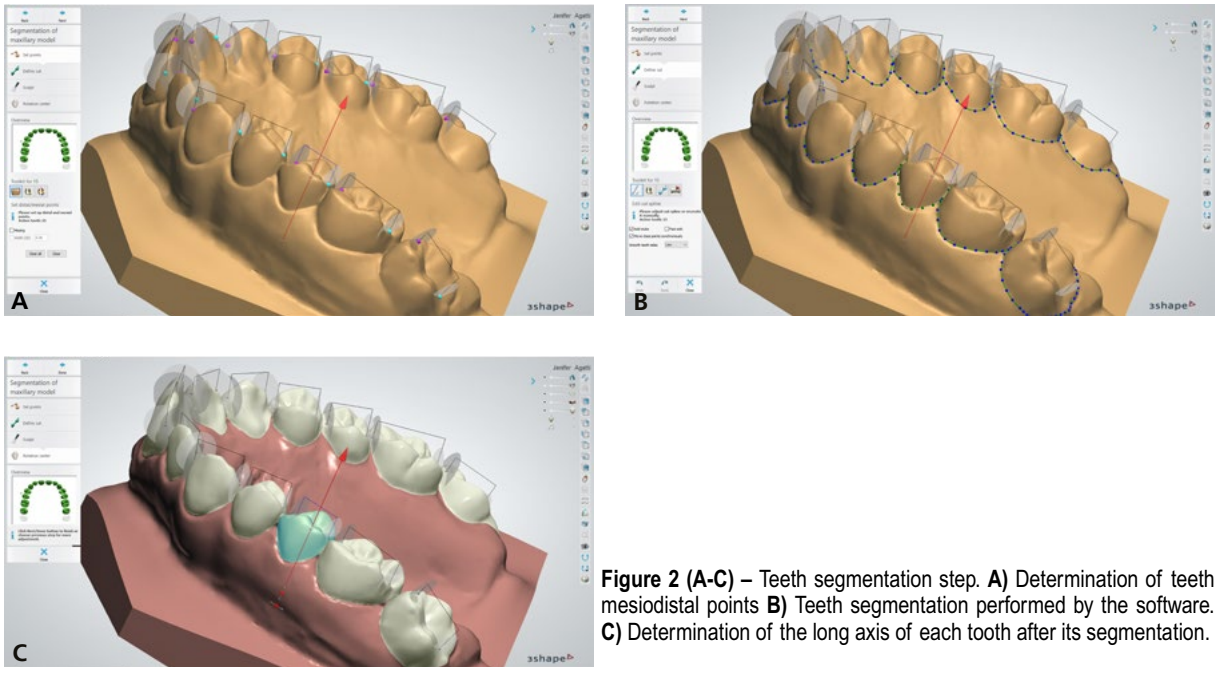


Figure 2 (A-C) – Teeth segmentation step. **A)** Determination of teeth mesiodistal points **B)** Teeth segmentation performed by the software. **C)** Determination of the long axis of each tooth after its segmentation.

3rd step: Choosing Arches Shape

In this step, an arc format needs to be defined for virtual alignment to be performed. This virtual wire serves as a standard and guide for teeth alignment, both in the upper and lower arch, so that reverse positioning or from the final teeth position is defined. In the case described, the format 3M Permachrome Resilient LA Upper was chosen as the one that best adapted to the initial shape of the patient's arch and was recorded on the dental midline in the most symmetrical possible way (Figure 3).

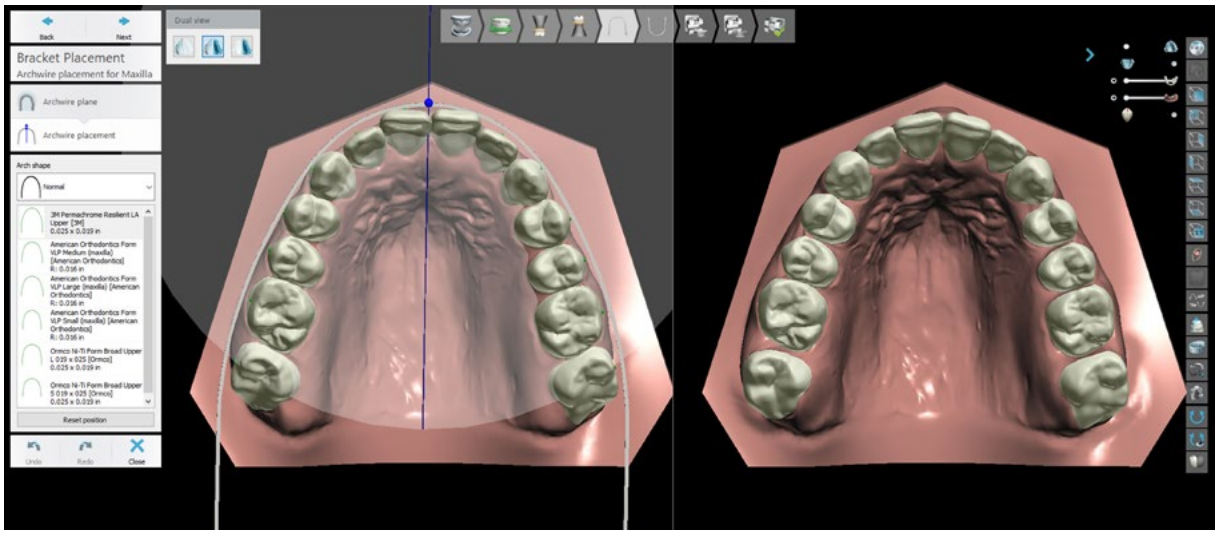


Figure 3 – Choice of arch shape consistent with the treatment intentions. In the left window, one can see its position relative to the upper arch, while in the right window, one can see the estimated effect that the arch will have on the teeth.

4th Step: Choosing Accessories Prescription for the Treatment

In this step, one chooses the type of bracket and the planned prescription. There are several brackets and prescriptions that can be used in the software and its features can be found on the website: *https://www.3shape.com/en/customer-programs/ortho-partner-integrations/bracket-library-integrations*

In the case reported, brackets Roth prescription slot .022", laboratory sapphire from the Orthometric brand were used (Iceram S, Orthometric, Marília, São Paulo) - (Figure 4).

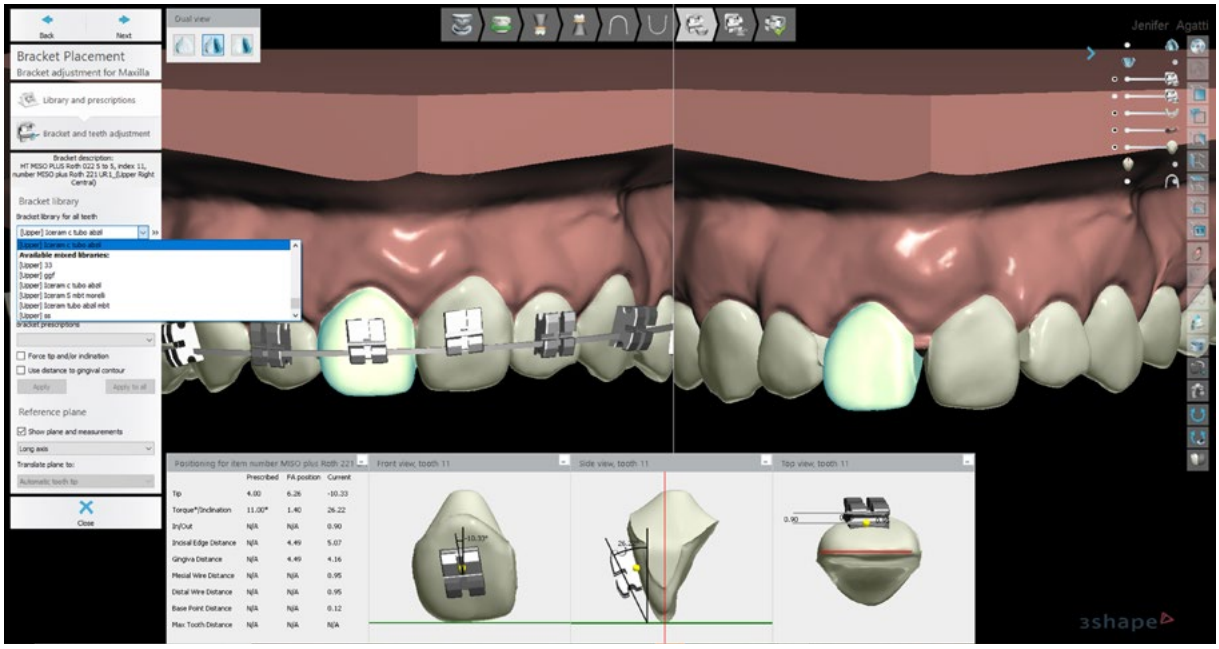


Figure 4 – Choice of bracket model and prescription to be used. There is the possibility to make personalized prescriptions, as shown, in which brackets and tubes of different prescriptions and/or manufacturers can be used.

5th Step: Placement of Accessories

After choosing the accessories, the software automatically places them on the intersection point of the greatest mesiodistal convexity with the greatest cervical-occlusal convexity of each tooth. However, it is known that this position will not always be able to promote the expected alignment and leveling. As Ortho Analyzer estimates the final position of each tooth according to the position of the bracket through the chosen virtual arc, it is possible to change the placement of each accessory according to the estimated final position (Figures 5A and 5B). Brackets angulation can be modified independently of the height and the mesiodistal position. The inclination and in-out are determined in a limited manner and with little amplitude for modification, unless the brackets can be placed without contact with the tooth, and the space is filled with a resin pad.

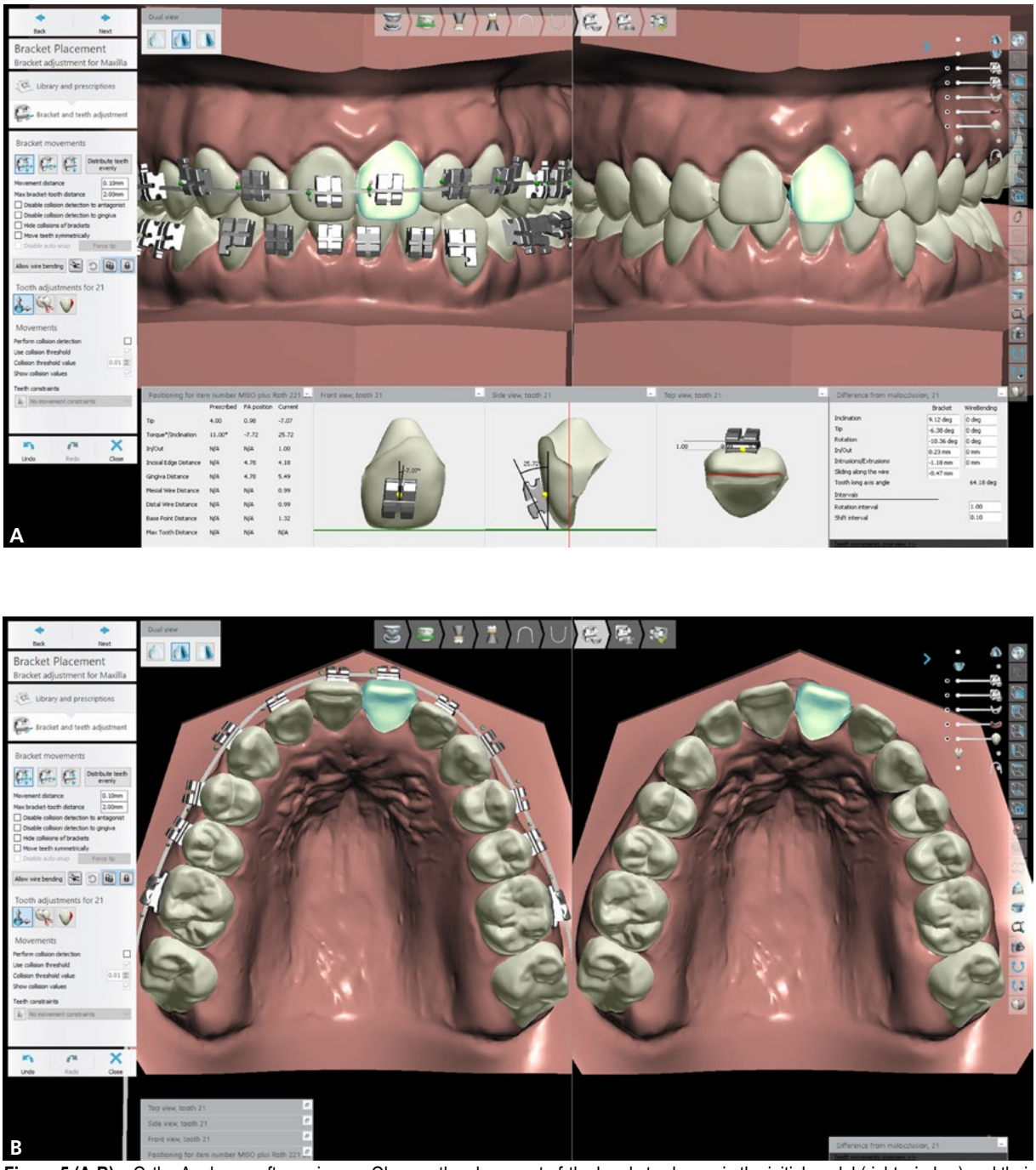
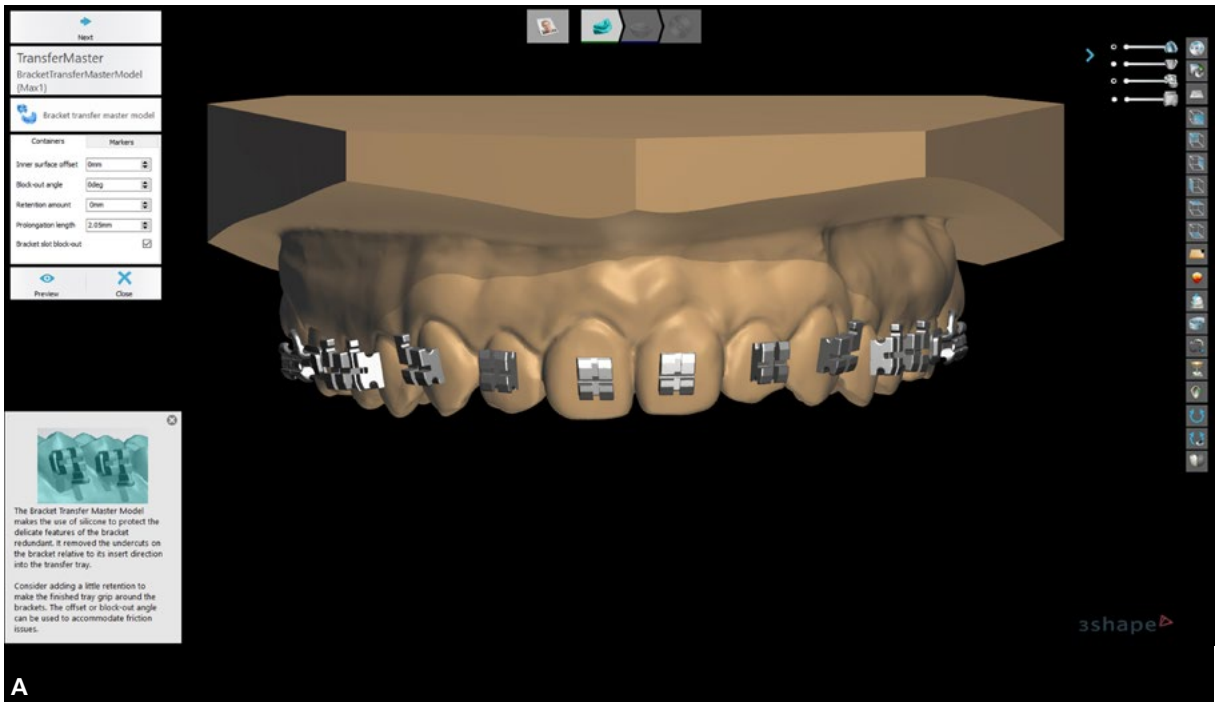


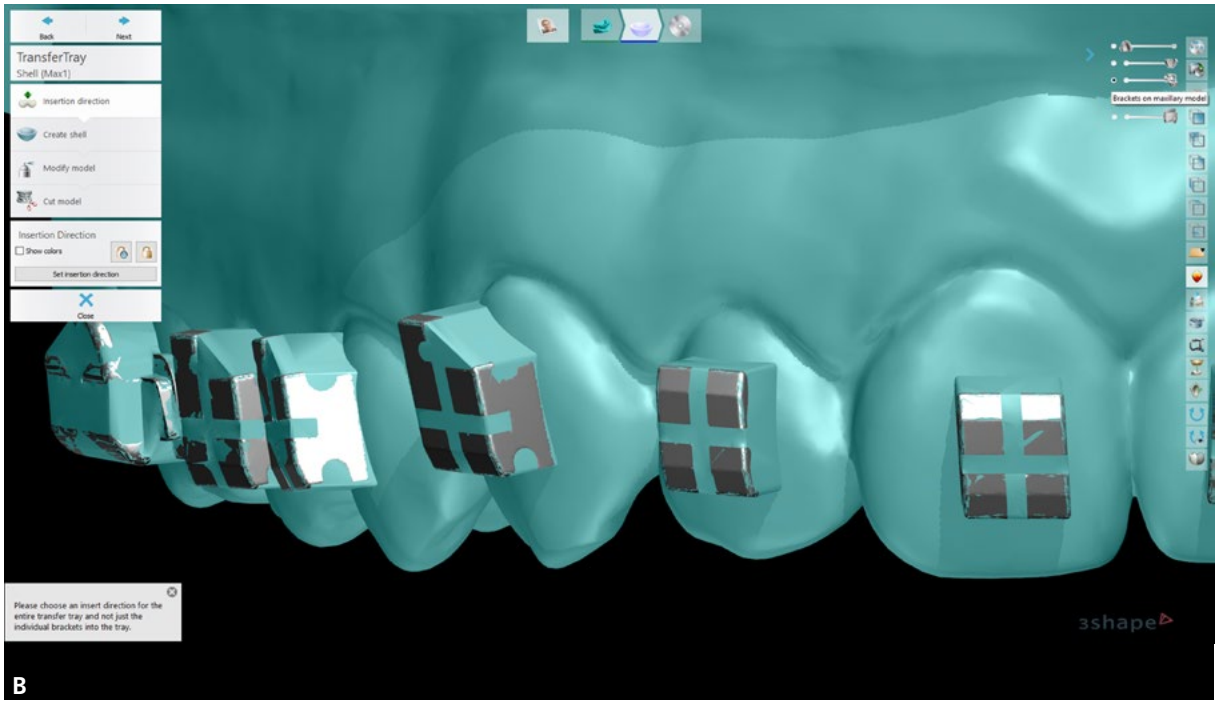
Figure 5 (A-B) – Ortho Analyzer software image. Observe the placement of the brackets chosen in the initial model (right window) and their estimated action (left window) **A)** Frontal view **B)** Superior occlusal view.

6th Step: Making Virtual Collage Guide

After accessories positioning, the virtual bonding guide must be manufactured on what is called a master model or master-model. For this, the digital model of the patient with the accessories placed is opened in the Appliance Design program (3Shape, Copenhagen, Denmark) - (Figure 6A). There the brackets are isolated and retentive areas are blocked by virtual wax (Figure 6B), allowing the drawing of a transfer guide on the teeth in the initial position. Once this is done, the virtual guide is generated by the program. (Figure 6C) and can be saved in STL format.



A



B

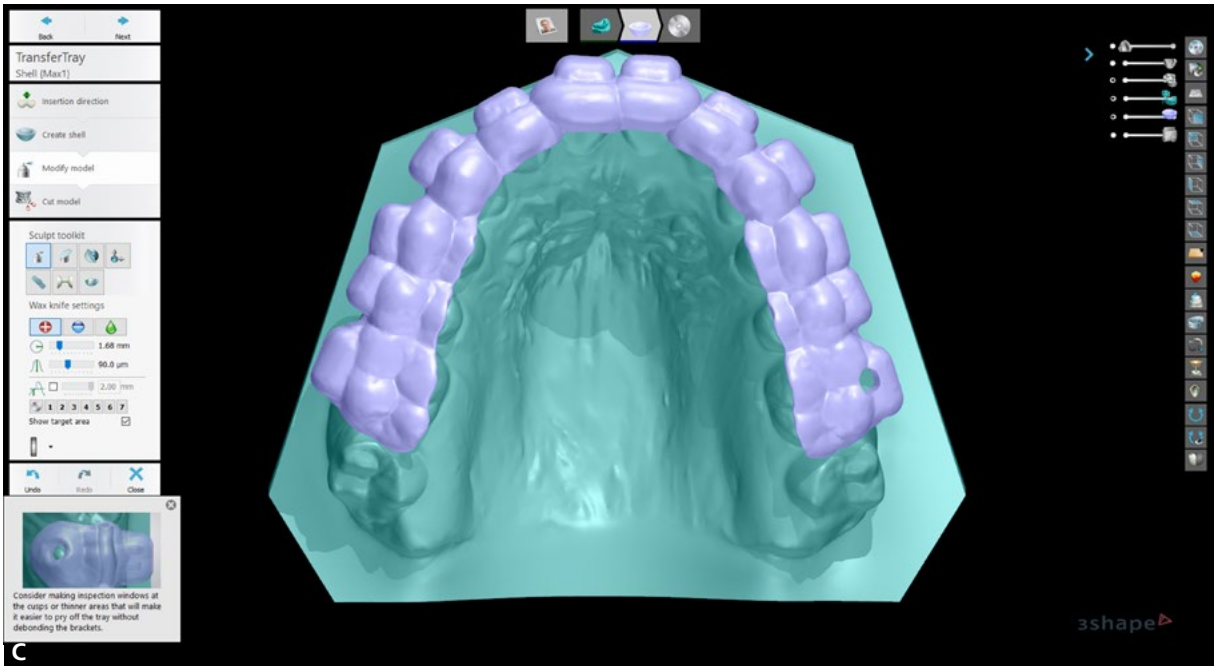


Figure 6 (A-C) – A) Image of the Appliance Design software. One can see the accessories placed in the desired way on the virtual model. On the left are the different tools that can be used for accessories relieve and to manufacture the master model, on which the virtual bonding guide was manufactured. **B)** Master model with channels and retentive areas of accessories relieved with virtual wax. **C)** Transfer guide manufactured on accessories.

7th Step: Printing the Bonding Guide

In this step, the virtual guide in STL file is opened in the chosen 3D printer software and the guide can be printed in flexible or rigid resin. Choices may involve printing the guide directly on the print platform or using support. After printing, the guide undergoes a post-curing process according to the manufacturer of the material used (Figure 7). This usually involves cleaning with isopropyl alcohol and residual curing with ultraviolet light.

Figure 7 - Transfer guide printed with flexible resin.

Clinical Phase

1st step: Accessories Insertion and Bonding Guide Proof

With the bonding guide in hand, the accessories planned for the case were inserted into their respective niches (Figure 8). Then the guide was taken to the mouth to confirm its adaptation. After the adaptation, the guide was removed and the bonding process itself was initiated in the respective patient (Figure 9).

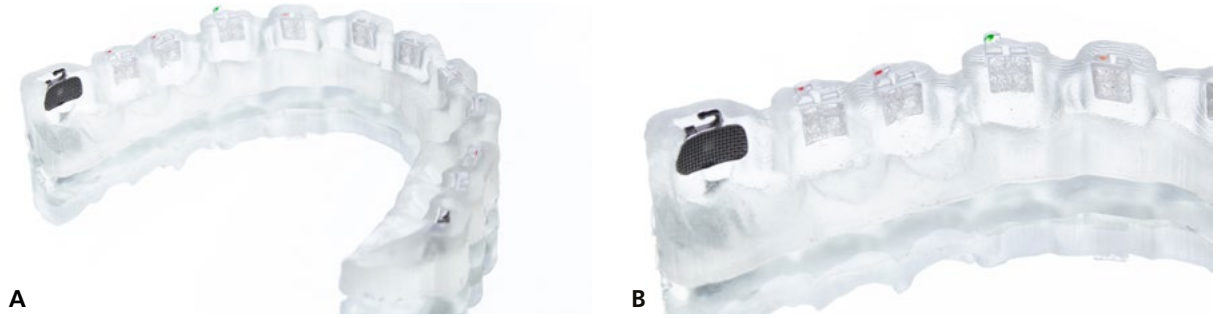


Figure 8 (A-B) – Transfer guide with the accessories inserted in their respective niches. It is observed a perfect adaptation of the accessories which allows greater stability of the guide and the warranty that they will be bonded in the desired position.

Figure 9 (A-H) - Photos of the patient prior to bonding procedure. **A)** Smile **B)** Right intraoral **C)** Frontal intraoral **D)** Left intraoral **E)** Upper occlusal intraoral **F)** Lower occlusal intraoral **G)** Intraoral of the upper arch in frontal view **H)** Intraoral of the lower arch in frontal view.

2nd step: Prophylaxis + Acid conditioning + Primer application

First, prophylaxis was performed with pumice and Robinson brush. After washing and drying all the teeth, an expandex retractor was installed and an acid attack was performed on the teeth that would receive the accessories with the Ultra-Etch acid (Ultradent). After 30 seconds, the acid was removed and washed with air and water. Then, the teeth were properly dried, the Single Bond (3M) adhesive was applied and photoactivation was performed.

3rd Step: Resin Application on Accessories Base + Accessories Installation

At this moment, a small amount of Transbond LV resin (3M) was inserted into the base of the accessories (Figure 11) and the guide was taken to the mouth (Figure 12). Then, after guide adaptation and removal of resin excess exposed to the cervical of the accessories, these were photoactivated. Photoactivation was carried out with the aid of Valo photopolymerizer (Ultradent, Sandy, Utah, USA) at maximum power, with 3 seconds of exposure, and each accessory was activated 2 times (Figure 13).

4th Step: Guide Removal + New Photoactivation of Accessories

The guide was removed with the aid of the cement extractor in the cervical-occlusal direction, from the posterior to the anterior region (Figure 14). After removing the guide, a new photoactivation was performed now facing the occlusal of the accessories. After that, a .014" wire from Rhodium was installed (Orthometric, Marilia, São Paulo) - (Figure 15).

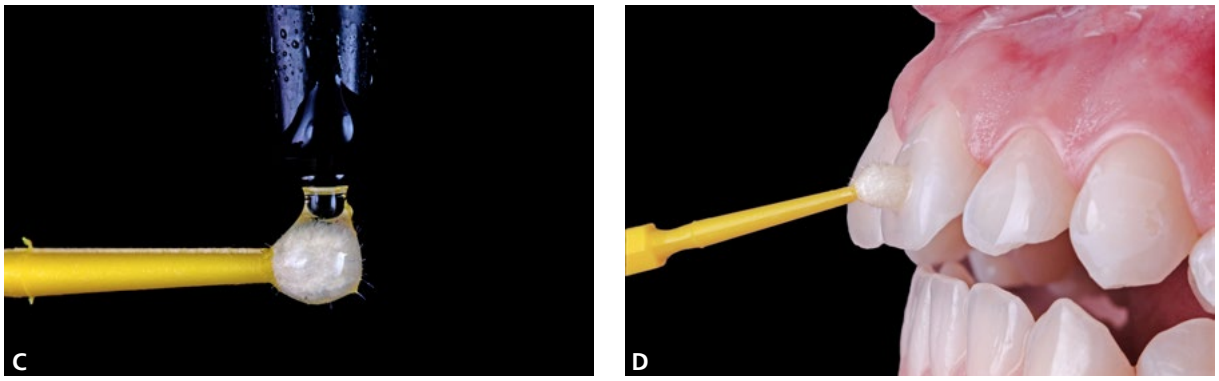


Figure 10 (A-D) – A) Upper teeth acid conditioning **B)** Conditioner washing and removal **C)** Adhesive applied to the microbrush **D)** Adhesive applied to the upper teeth prior to accessories bonding.

Figure 11 (A-C) – Insertion of Transbond LV resin (3M Oral Care) at the base of the accessories. It is noteworthy that the amount of resin should be as minimal as possible so that there is no material excess that is difficult to be removed in the presence of the guide.

Figure 12 - Insertion of the transfer guide in the mouth. Observe that a perfect fit is expected, and a slight apical pressure is required.

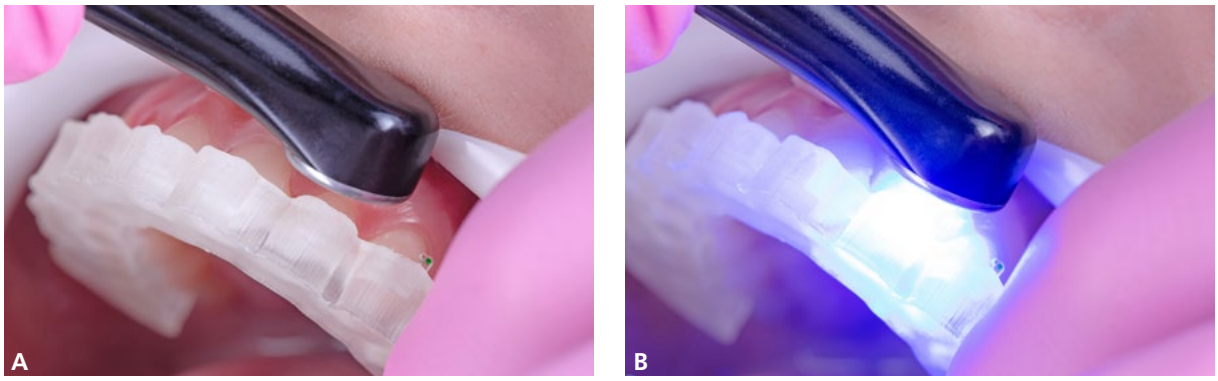


Figure 13 (A-B) - The adaptation of the guide is checked and with a slight apical pressure, the photoactivation of the resin is made through the cervical of the accessories.

Figure 14 - Removal of the transfer guide. At this stage it is clear the advantage of the guide being printed with flexible resin, which facilitates removal and decreases the chance accessories debonding.

Figure 15 (A-F) – With the accessories properly installed, a leveling wire has been inserted. Observe that the quality of the procedure with this bonding protocol is safely achieved.

DISCUSSION

In the straight wire technique, good placement of the accessories is imperative to obtain good teeth alignment and leveling, consequently, good orthodontic finishing[1]. Once the accessories are positioned incorrectly, rebonding and/or bends in the wires may be necessary, which may lead to an increase in treatment time[2]. In 1972, indirect bonding was introduced in Orthodontics[3]. Primarily, the proposal of indirect bonding was to place the accessories in plaster models and then make accessories transfer guide. Although the technique involves 2 steps – a laboratory one and clinic one – some advantages were attributed to this procedure such as reduction of accessories placement errors and shorter chair time[3-6].

In Orthodontics there has always been a concern to abbreviate treatment time as much as possible. Thus, initially, some authors[7,8] began to worry about comparing the difference in total treatment time that these bonding techniques – direct and indirect conventional – promoted, and these studies indicated that there is no significant difference.

With the emergence of CAD/CAM technology, a new window has opened to the bonding of accessories[9-11]. From this perspective, through software, the accessories are placed in the digital models and in the Ortho Analyzer program – a program used in the clinical case – it is possible to evaluate the repercussion of this placement on alignment and leveling. Thus, studies have reported that virtual indirect bonding allows a reduction in laboratory time and promotes a sensitive improvement in the positioning of accessories, when compared to the conventional indirect bonding technique[12,13]. In addition to these advantages, in 2015, some authors also depicted a notorious reduction in the total treatment length, when compared with conventional direct and indirect bonding techniques[10].

It is known that, basically, there are 2 types of indirect bonding guides manufactured by 3D printing considering the type of material: rigid and flexible. The guide used in the reported case was printed with flexible resin, which allowed easier removal and, consequently, reduced the chance of debonding. In addition, due to its flexibility, its section after photoactivation of the accessories, prior to their removal, was not necessary.

FINAL CONSIDERATIONS

The benefits that CAD/CAM technology has brought to Orthodontics is indisputable. Among its aspects in Orthodontics, the virtual indirect bonding is highlighted, which has been shown to be quite efficient, especially in relation to chair time and the quality of alignment and leveling, when compared to conventional methods. However, a safe protocol must be adopted so that these benefits are really observed.

REFERENCES

1. Andrews LF. The straight wire appliance. Br J Orthod. 1979; 6:125-143.
2. Aguirre MJ, King GJ, Waldron JM. Assessment of bracket placement and bond strength when comparing direct bonding to indirect bonding techniques. Am J Orthod. 1982; 82:269-276.
3. Silverman E, Cohen M, Gianelly AA, Dietz VS. A universal direct bonding system for both metal and plastic brackets. Am J Orthod. 1972; 62:236-44.
4. Koo BC, Chung CH, Vanarsdall RL. Comparison of the accuracy of bracket placement between direct and indirect bonding techniques. Am J Orthod. 1999; 116:346-351.
5. Thomas RG. Indirect bonding: simplicity in action. J Clin Orthod. 1979; 13:93-106.
6. Zachrisson BU, Beuyeukyilmaz T. Bonding in Orthodontics. In: Graber LW, Vanarsdall R Jr, Vig KW, editors. Orthodontics: current principles and techniques. 5th ed. St Louis: Elsevier Health Sciences. 2005; 579-659.
7. Deahl ST, Salome N, Hatch JP, Rugh JD. Practice-based comparison of direct and indirect bonding. Am J Orthod Dentofacial Orthop. 2007; 132:738-42.
8. Yildirim K, Saglam AB. Comparative assessment of treatment efficacy and adverse effects during nonextraction orthodontic treatment of Class I malocclusion patients with direct and indirect bonding: a parallel randomized clinical trial. Am J Orthod Dentofacial Orthop. 2018; 154:26-34.
9. Alford TJ, Roberts WE, Hartsfield JK, Eckert GJ, Snyder RJ. Clinical outcomes for patients finished with the SureSmile method compared with conventional fixed orthodontic therapy. Angle Orthod. 2011; 81:383-388.
10. Brown MW, Koroluk L, Ko CC, Zhang K, Chen M, Nguyen T. Effectiveness and efficiency of a CAD/CAM orthodontic. Am J Orthod. 2015; 148:1067-1074.
11. Weber DJ, Koroluk LD, Phillips C, Nguyen T, Proffit WR. Clinical effectiveness and efficiency of customized vs. conventional preadjusted bracket systems. J Clin Orthod. 2013; 47:261-266.
12. Camardella LT, Breuning H, Vasconcellos VO. Accuracy and reproducibility of measurements on plaster models and digital models created using an intraoral scanner. J Orofac Orthop. 2017; 78:211-220.
13. Groth C, Kravitz ND, Shirck JM. Incorporating three--dimensional printing in orthodontics. J Clin Orthod. 2018; 52:28-33.

Author's e-mail: fabioguedesortodontia@gmail.com
Received for publication: 29/04/2019
Approved for publication: 31/05/2019

This article was originally published in the journal Orthodontics Science and Practice.

How to quote this article:
Guedes FP, Martins RP. Colagem indireta virtual com o software Ortho Analyzer. Orthod. Sci. Pract. 2019; 12(46):100-110.
DOI: 10.24077/2019;1246-100110