Chapter

Interdisciplinary Reverse Planning in Orthodontics

Guilherme Nakagawa dos Santos, Charles Lenzi de Araujo and Romeu Cassiano Pucci da Silva Ramos

Abstract

Most adult patient cases are multidisciplinary cases, so it's planning can become difficult when we need to connect many dentistry fields to achieve ideal results. The interdisciplinary reverse planning is a well-known topic for dental rehabilitation professionals, so this chapter will address the role of orthodontics in reverse digital planning, improving longevity, reducing biological impacts and helping to communicate with patients, other doctors and dental technicians. 3D CAD technology allows us to plan these complex cases before the patient starts treatment, this tool will be essential to orchestrate the exact moment to start orthodontic, prosthetic and/or surgical interventions, so the workflow becomes ordenate and the outcome will be aligned with aesthetics and functional aspects and in harmony with facial references.

Keywords: orthodontics, cad/cam, interdisciplinary, clear aligners, virtual setup

1. Introduction

Among some factors that significantly increase the demand for esthetic rehabilitative treatments in dental offices, we can observe the greater access of patients to information, as well as the constant development of new technologies and dental materials, which enable a treatment with greater quality and longevity, and a bigger media appeal in this digital age. Although the search for esthetics is a major complaint and the patient's desire should be pleased, it is imperative to think about the function and balance of stomatognathic structures. It is the professional's duty to establish clear goals that can be replicated with predictability and to outline goals to be achieved for the success of the treatment.

Unfortunately, it is common to come across more complex cases where the need for a planning of all the specialties involved is present, and aiming to address only the patient's complaint, some factors and primordial steps are ignored. Analogously, transcribing and visualizing the treatment plan becomes a little more difficult for professionals who, due to incompetence, imprudence or simply negligence, abstain from more detailed planning. In order to fulfill all requirements and have a holistic view of the case, the digital reverse planning is an indispensable tool.

2. Interdisciplinary digital reverse planning

When talking about different areas of dentistry, we must pay attention to this integration. A multidisciplinary case is one that requires more than one approach (periodontics, orthodontics, implantology, etc.). However, these areas must speak the same language, that is, the goal must be common and convergent. Therefore, we must have an interconnected approach, that is, an interdisciplinary one.

2.1 Examples

2.1.1 Case 1

A 29-year-old female patient came to the office complaining that she would like to improve her esthetics through dental veneers. Upon clinical examination and complementary imaging exams, it was observed that a central incisor would be condemned for presenting a fracture and dentoalveolar abscess, the adjacent lateral incisor was decayed, and there was a moderate tooth crowding, which would require greater compensatory prepping teeth for ceramic veneers, or even endodontic treatment if the prepping was greater (**Figure 1**). Thus, aiming at the best result with less esthetic and biological damage to the patient, the case would require tooth extraction 1.1, caries removal and restoration of tooth 1.2, orthodontic alignment, implant in the tooth extraction space 1.1, tooth whitening and veneers in the upper teeth, and prosthesis on implant 1.1. Given these fundamental steps, how to organize these steps? What procedure would be mandatory? How would the esthetic defect of the loss of the upper incisive be minimized? Extract before or after orthodontic treatment?

To answer these questions, the philosophy of digital reverse planning was used, through esthetic, functional concepts and facial references [1], referenced by the integration and overlapping of digital files from the imaging exams, so that the final result could be seen with the predictability and esthetics required by the patient. The traditional approach in orthodontics sometimes does not meet the patient's expectations

Figure 1.
First exam's intraoral picture.

regarding how long he will have compromised esthetics. The classic philosophy of planning in Orthodontics follows steps that make it difficult to immediately improve the patient's esthetics, always thinking about the diagnosis and long-term resolution. However, patients with esthetic problems suffer in relation to self-esteem and are in a hurry to remedy this type of problem. Therefore, solving the esthetic part, when possible without affecting the diagnosis of the case, should be shown to the patient.

Within a 3D planning software, the BDS Planning Center team performed a digital study [2] (**Figure 2**). As seen in the occlusal view (**Figure 3**), the need for greater prepping teeth 2.1 and 2.2 for the preparation of veneers is evident, and perhaps even the possibility of an endodontic treatment of the tooth 2.2. However, this study made it possible to visualize the needs of a multidisciplinary treatment, which facilitated decision-making by the patient and the professionals involved that the best conduct

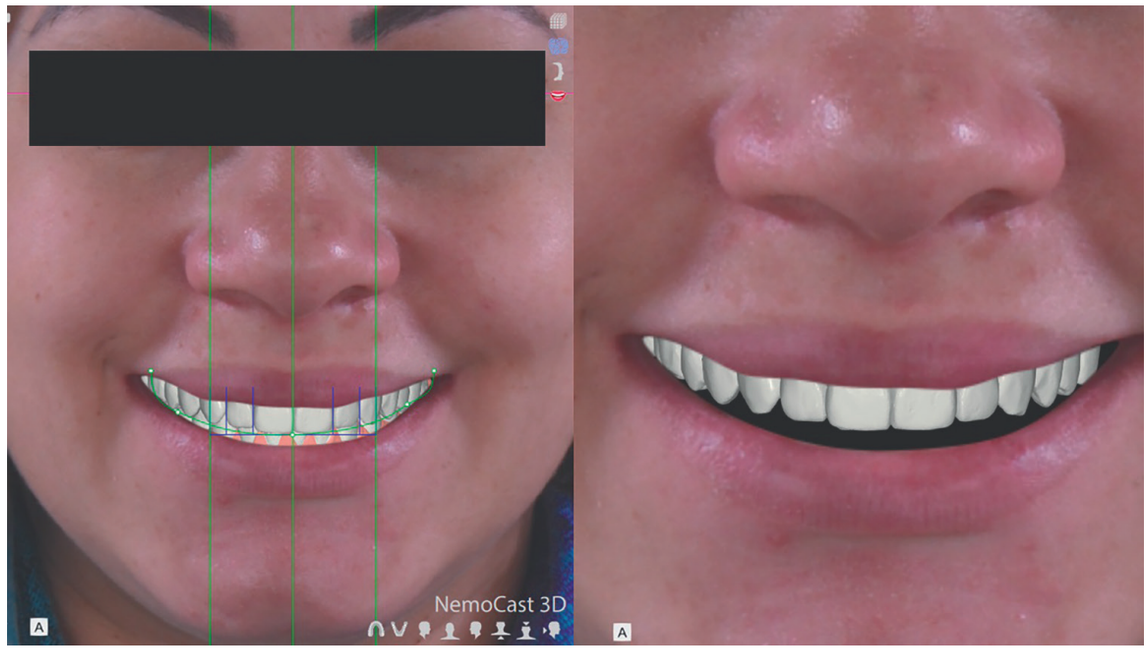

Figure 2.
Facially driven reverse digital planning showing the veneers.

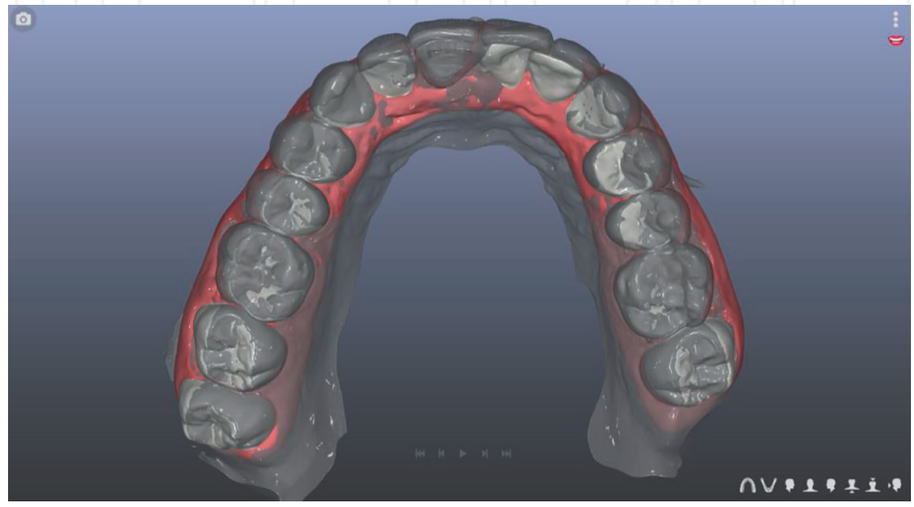

Figure 3.
Wax-up and initial models overlapping.

would be prior orthodontic treatment. After this orthodontic treatment plan was approved by the patient, she underwent tooth 11 extraction and a new intraoral scanning to proceed with the digital orthodontic setup, where this would be guided by the prior digital wax-up. (**Figures 4** and **5**).

We opted for a treatment with orthodontic aligners produced in-office to maintain an esthetic smile, with a pontic [3] on tooth 1.1, since this had a periradicular infection that prevented an immediate implant with a temporary one, thus as to be more predictable during orthodontic movements, enabling a centralization of the teeth for diagnostic waxing. As the biomodels exported by the Nemocast software (Nemotec) had a healing area of tooth 2.1, reliefs were created in the meshes in this area using the Meshmixer software (**Figure 6**), to allow tissue repair without compression of the alveolar ridge by the clear aligners. With the meshes already edited, the models were printed, and the orthodontic aligners were produced (**Figure 7**).

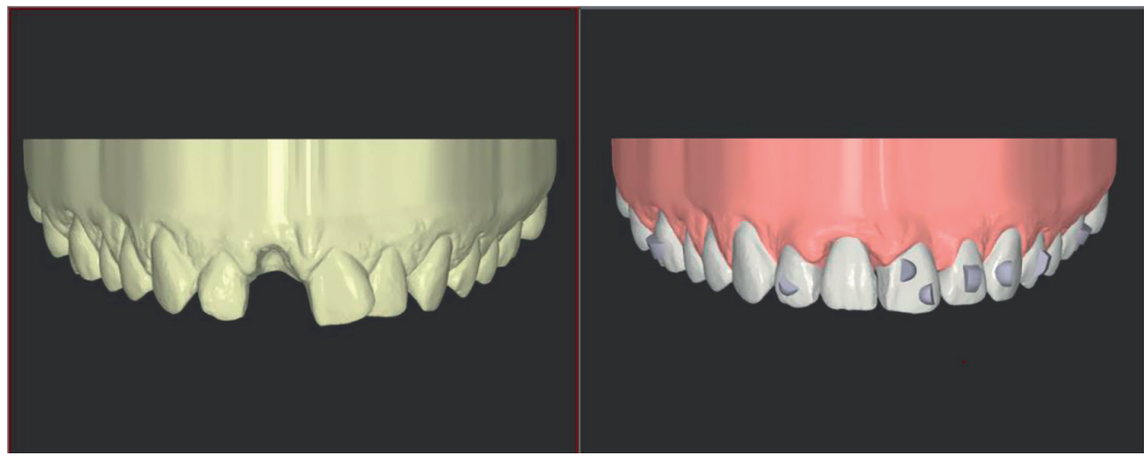

Figure 4.
Post extraction initial model and orthodontic setup.

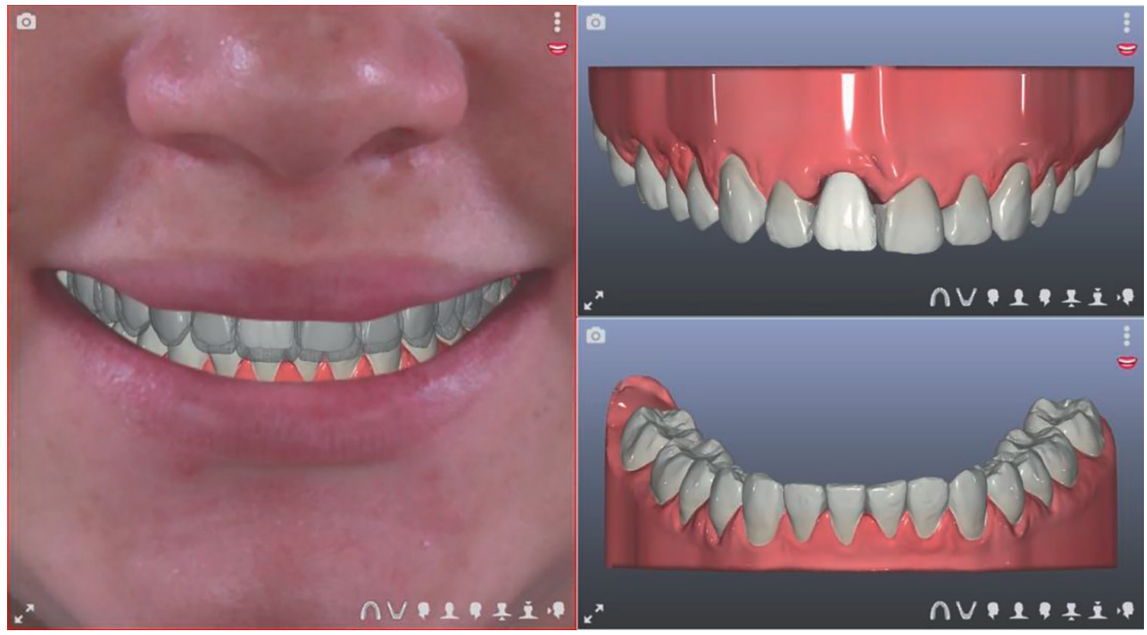

Figure 5.
Wax-up guided orthodontic setup.

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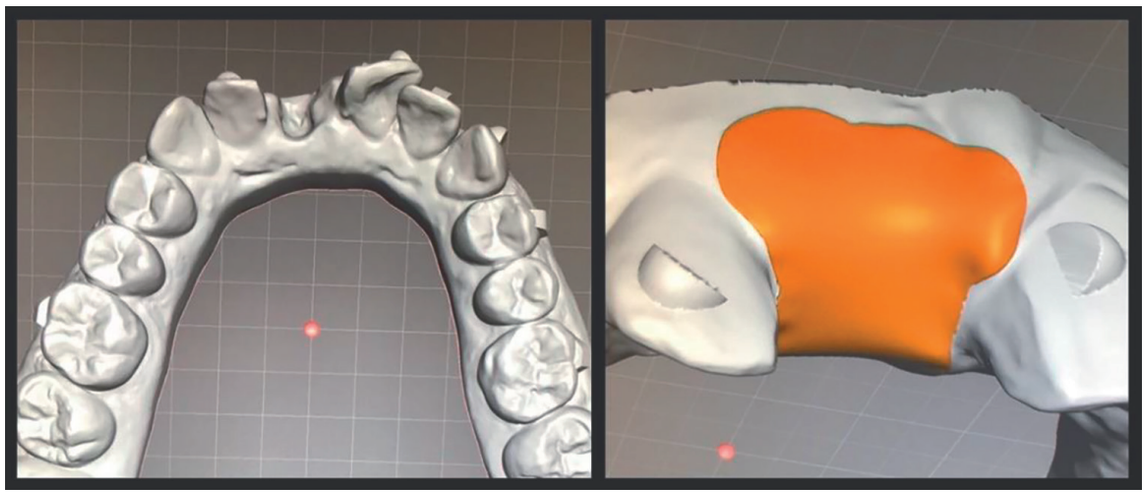

Figure 6.
3D mesh relief in Meshmixer software.

Figure 7.
Clear aligners with pontic on extraction space of tooth 1.1.

The treatment was carried out with a protocol of biweekly changes, where 15 aligners were needed for the upper arch and 8 for the lower arch, in a total of 8 months of treatment, considering the staging for greater predictability of the programmed movements. At the end of the last stage, the patient underwent a new intraoral scan, where this was superimposed on the wax-up study that served as a guide. (**Figure 8**). As verified in the overlapping models [4], the dental position obtained orthodontically was consistent with the planned one, with no need for touch-ups and alterations to the waxing study. Finally, the patient went on to implant the central incisive and subsequently perform the dental veneers as already established by the digital reverse planning, which proved to be effective and reproducible, especially because orthodontic treatment was performed using transparent aligners.

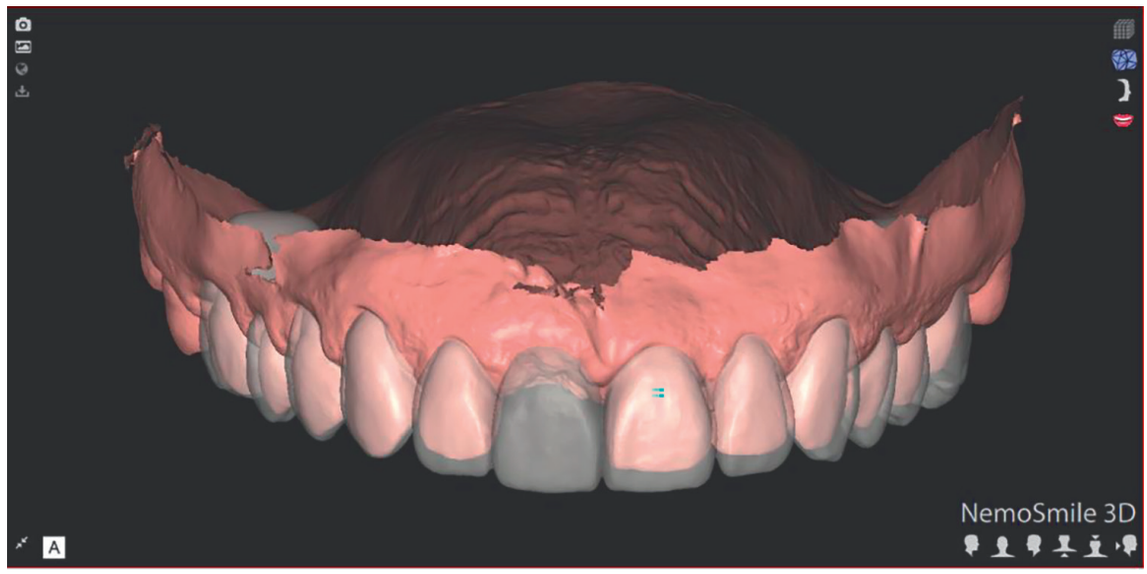

Figure 8.
Wax-up and final treatment scanning's models overlapping.

2.1.2 Case 2

Mesofacial patient, convex profile, good esthetic exposure of the smile with an inclined occlusal plane and angulation of the anterior teeth (**Figure 9**). Upper and lower tooth crowding, lower midline deviation of 2 mm to the right, caused by prolonged retention of tooth 75 with absence of its successor (tooth 35).

In view of the expectations of the results of the orthodontic treatment and the esthetic expectations of the patient, who did not accept having space for the extraction of the primary tooth, a reverse planning was carried out with an approach to installing the implant prior to orthodontic treatment. In this context, comfort and

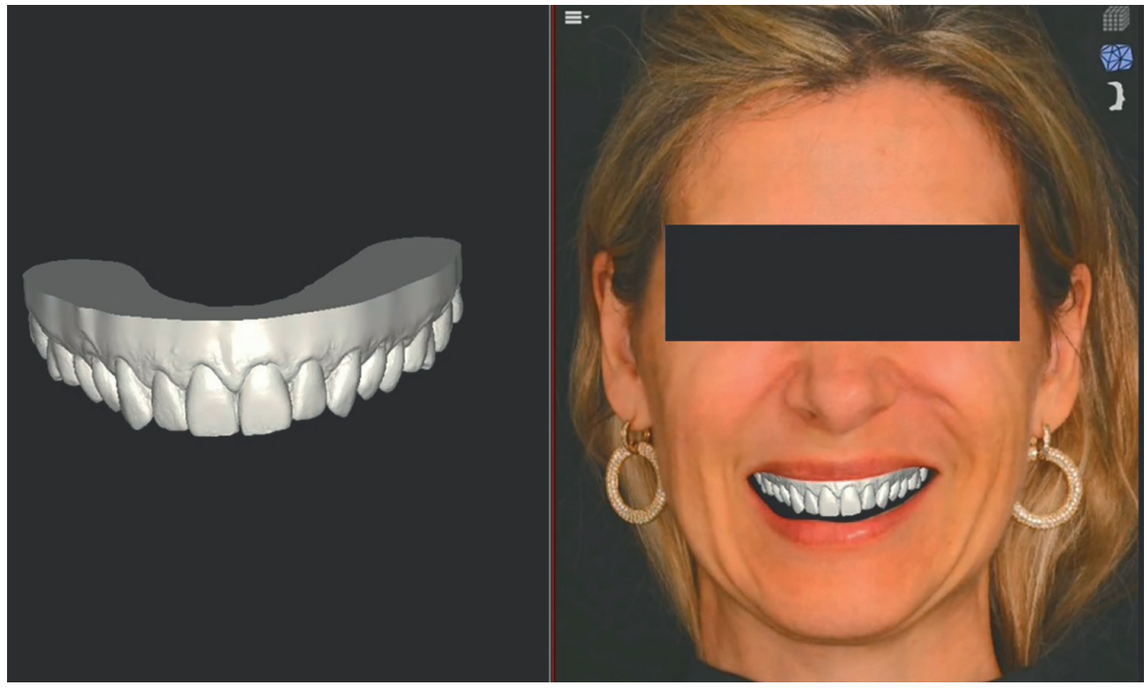

Figure 9.
Initial aspect.

safety are provided for the patient with preservation of esthetics in the area to be rehabilitated. Furthermore, the option of replacing a provisional retained in the appliance or in teeth, which may suffer constant fractures, especially located in the premolars or molars, subject to constant masticatory forces, it was decided to perform this implant in advance.

In the Nemocast software, virtual orthodontic correction was performed, guided by the face and its references, with extraction of tooth 75 (**Figure 10**). With the prediction obtained by the virtual setup of the final position of the teeth, the waxing of the crown of the 35 with the respective implant was planned (**Figure 11**). For

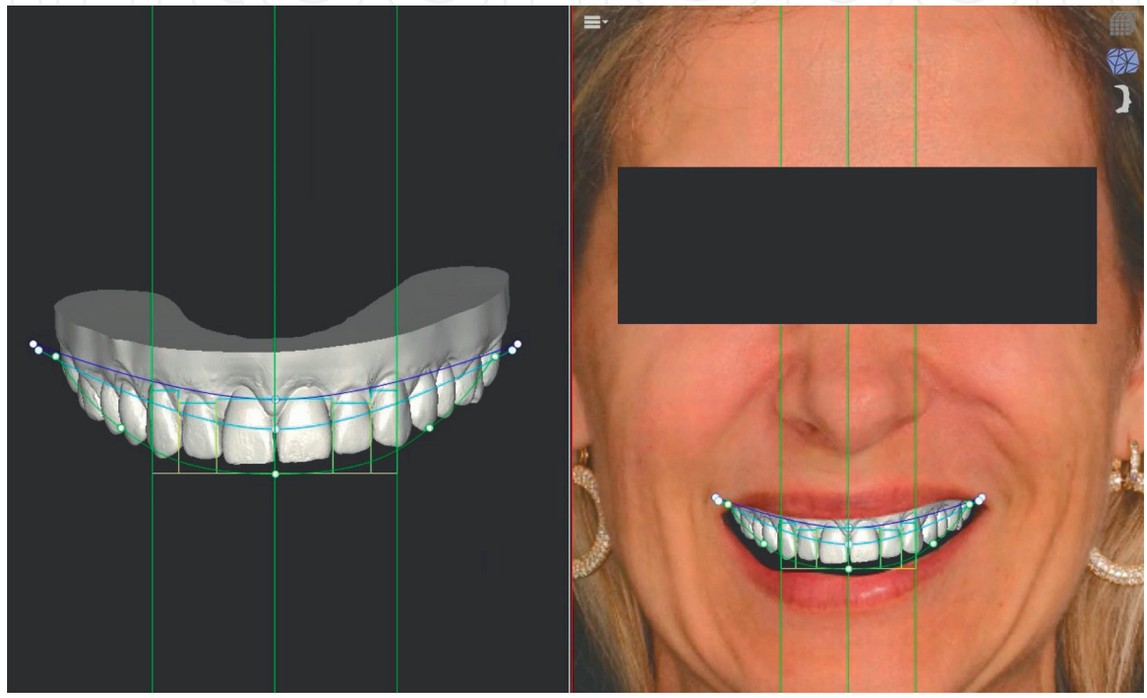

Figure 10.
Facially driven orthodontic setup.

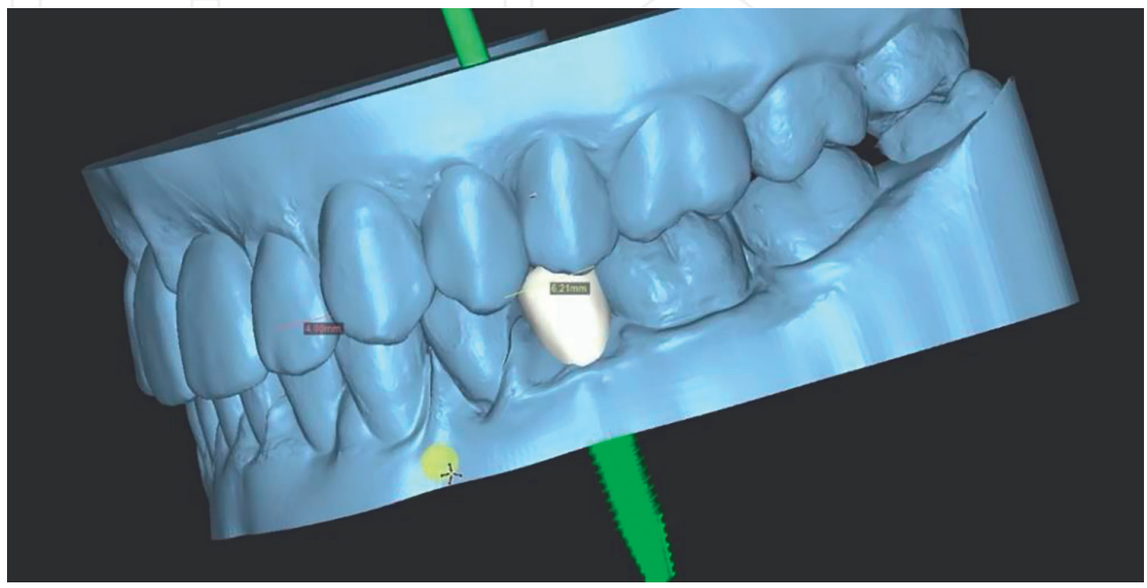

Figure 11.
Implant positioned based by orthodontic digital setup.

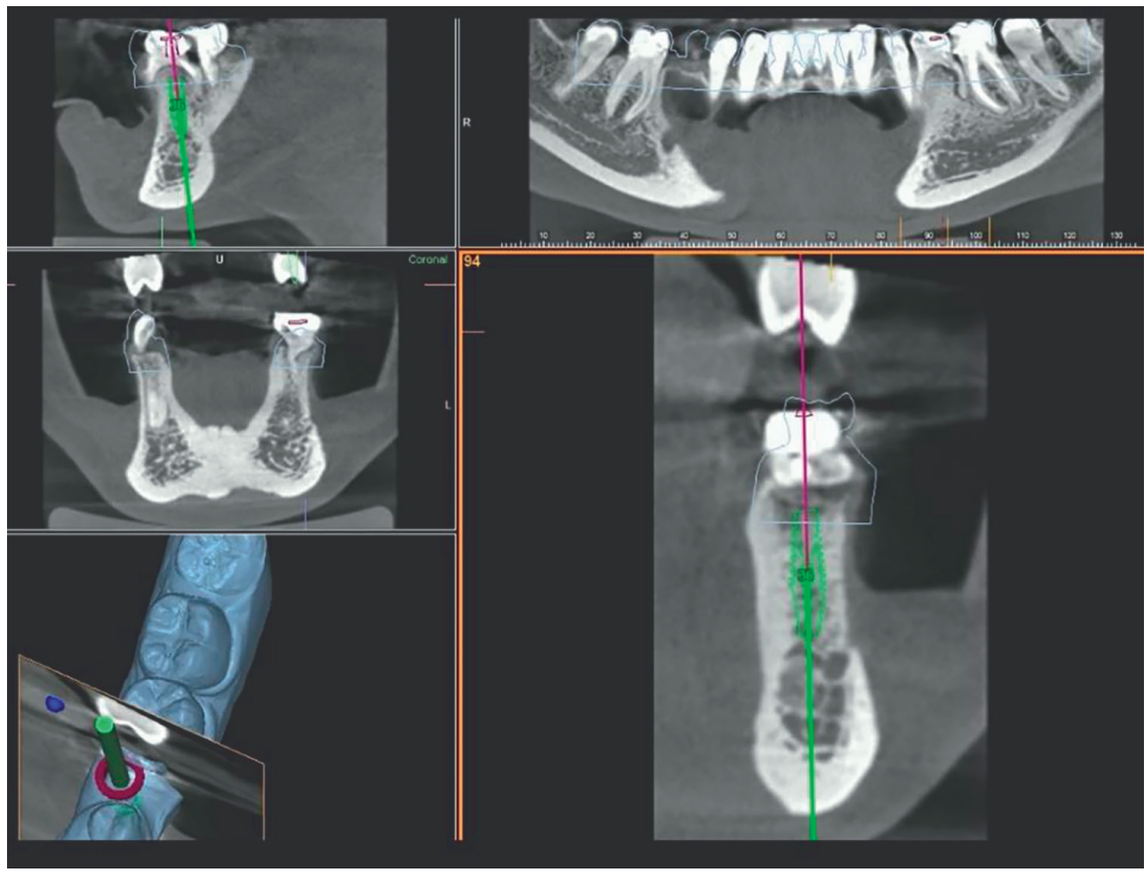

Figure 12.
CBCT and orthodontic setup model's overlapping to plan the ideal position of the implant.

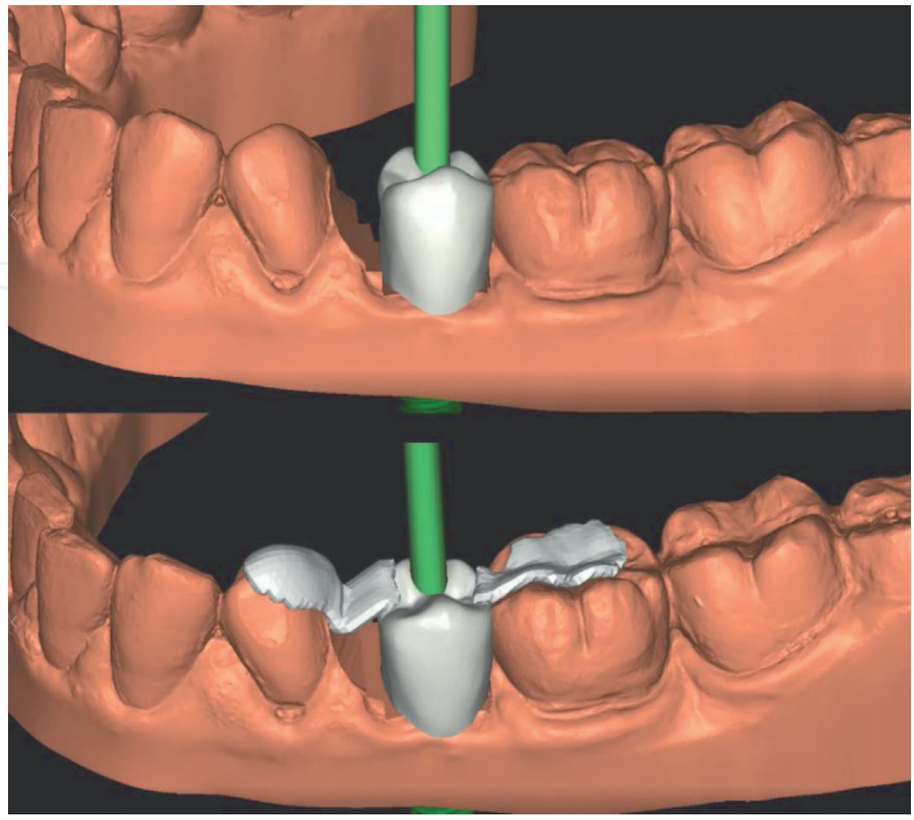

Figure 13.
Implant guide on the initial model. Tooth 75 was virtually extracted.

optimal placement of the implant, the STL model obtained from the orthodontic setup was overlaid with the CBCT DICOM file (**Figure 12**). About this project, there was the possibility of making a surgical guide for the installation of the implant, guided by the principles of ideal occlusion proposed by Angle in the 6 keys of occlusion (**Figure 13**) [5].

After planning (**Figure 14**) at the same surgical time, tooth 75 was extracted and tooth 35 was implanted guided, before the beginning of the orthodontic treatment.

In addition to the esthetic and functional gain with the anticipated surgery, the implant served as an absolute anchorage for the distalization of anterior teeth with midline correction and mesialization of the posterior teeth, guiding them to their positions predicted in the setup (**Figure 15**). With this mechanics, it is possible to establish the exact amount of movement of the adjacent teeth, having as the limit the dental contacts with this crown, minimizing the risk of loss of excessive anchorage or distalization less than necessary.

The remainder of the orthodontic sequence is not relevant to the purpose of the chapter, but rather the predictability and multiple functions of digital reverse

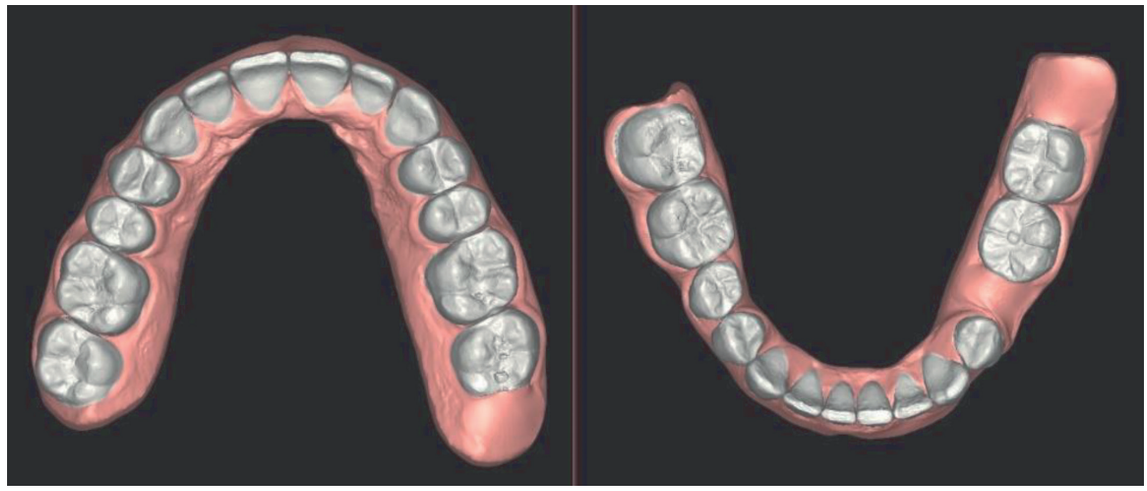

Figure 14.
Ideal digital orthodontic setup planned with virtual extraction of tooth 75.

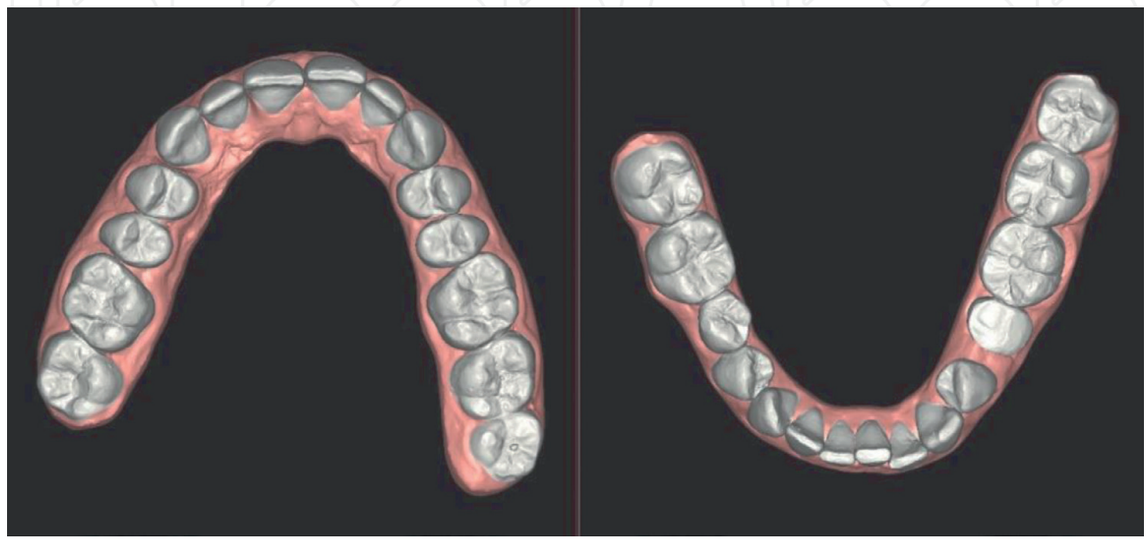

Figure 15.
Implant and crown installed new intraoral scan.

planning in orthodontics. It is noteworthy that performing the implant previously was essential to the success of the project for the acceptance of treatment and patient satisfaction.

3. Conclusion

As shown in the examples, digital reverse planning is a very important tool for the treatment of interdisciplinary cases, as it aims at better communication with the patient and among the professionals involved. The role of orthodontics in reverse planning is to orchestrate the progress of the clinical sequence, as dental rehabilitative planning often depends on the outcome of orthodontic treatment.

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