The intersection of Technology, Implant Guided Surgery and 3D Printing

Diogo_Viegas_2024

INTRODUCTION

Implant retained restorations are becoming increasingly popular in contemporary dentistry. The practice of implant surgery was limited to periodontists and maxilofacial surgeons however today it is carried out by many dental clinicians with different levels of expertise and skills for the management of simple and complex cases.

It is notorious that the success of dental implants is directly related to patient assessment and proper planning.[1] The study of the osteointegration process has led to the massive use of dental implants in recent years. However, the associated complications result from an incomplete diagnosis, lack of planning, choice of surgical technique and inadequate implant installation.

Implant surgery performed without adequate three-dimensional planning software uses the adjacent teeth and antagonists as references, and the final positioning of the implants is evaluated by the surgeon at the time of installation. This can result in some complications, such as nerve injury, injury of adjacent roots, perforation of the maxillary sinus, implant fracture, perimplantitis, aesthetic commitment, inter proximal bone loss, , perimplantitis and implant loss.[2]

The surgical installation of an implant is not always predictable and sometimes a small variation can compromise the ideal position and cause difficulties in the manufacture of the final prostheses. The failures arise during pre-surgical planning. As the oral cavity is a relatively narrow space the accuracy in the implant placement is extremely important for the long-term success of the final restoration. This can be done through a surgical guide, which provides adequate information about the installation of the implant. Although the use of surgical guides is possible however the clinical outcome is often unpredictable, because the location and deviation of the implants may not meet the ideal prosthetic requirements. Accuracy in the planning and execution of surgical procedures are important to ensure a high success rate without causing iatrogenic damage.[3,4]

In fact, guided implant surgery is considered a safe and minimally invasive procedure without cutbacks. Therefore, their use in procedures such as the immediate placement of

fresh alveolate implants, post-extraction, and immediate prosthetic loading are highly appreciated by patients, as they are less invasive, with a lower number of surgical and protetic sessions, and consequently less time needed for treatment.[5]

For the patient the great advantage is that only it's done on a single surgical session where the procedures of dental extraction, implant placement and temporary restorative are done. This concept reduces the discomfort and facilitates your return to working life. For dental rehabilitation the temporary restoration guides the healing of soft tissues for an optimal aesthetic result.[6]

The combination of virtual engineering with the digitization of information in Dentistry gave rise to a new and innovative direction for dental diagnosis and treatment. In particular, implant-led surgery based on computer was developed to overcome the limitations associated with traditional surgical plans and significantly improved the accuracy of the implant.[7]

Undoubtedly, guided surgery represents a considerable advance in Dentistry, being increasingly used by all implant surgeons with several advantages and minimally invasive with excellent predictability.

I order to illustrate this topic it will be presented a clinical case of a fracture of a root of the upper central incisor and how it was sorted using technology.

Case 1 - Root fracture of upper right central incisor

Figure 1 - Intra-oral photo before extraction of upper right central incisor. (Buccal view)
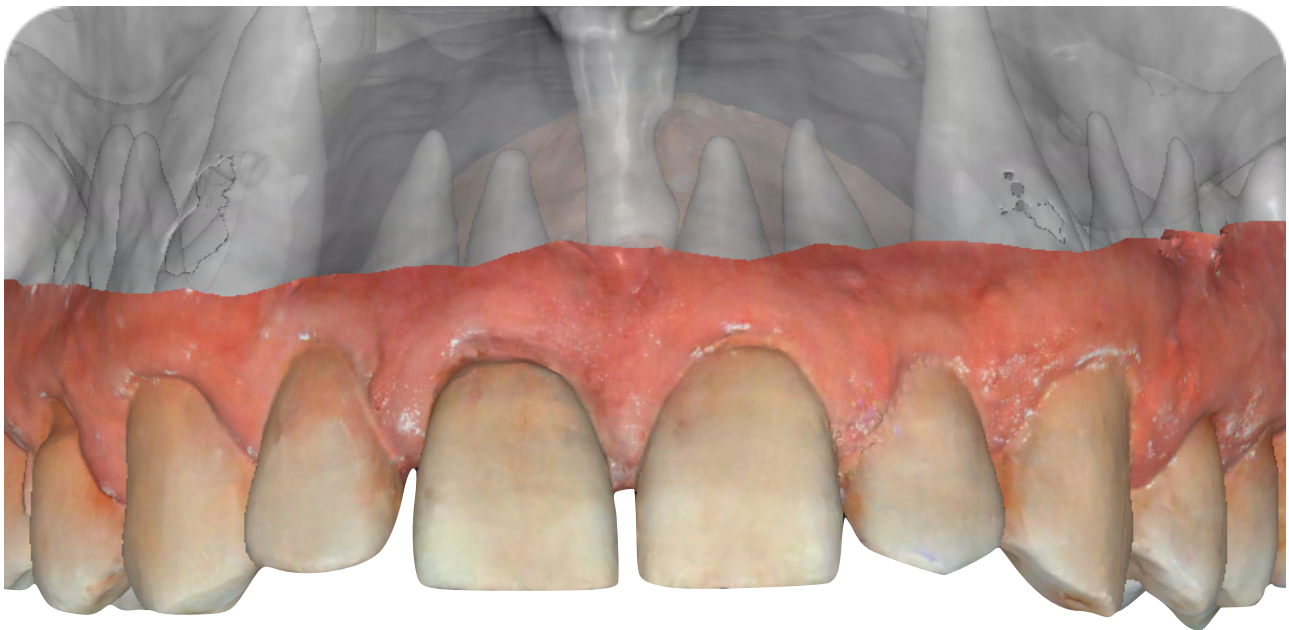

Figure 2- Screenshot of upper intral-oral scanning superimposed with CBCT segmentation .
(Buccal view)

Figure 3 - Intra-oral photo before extraction of upper right central incisor. (Lateral view)

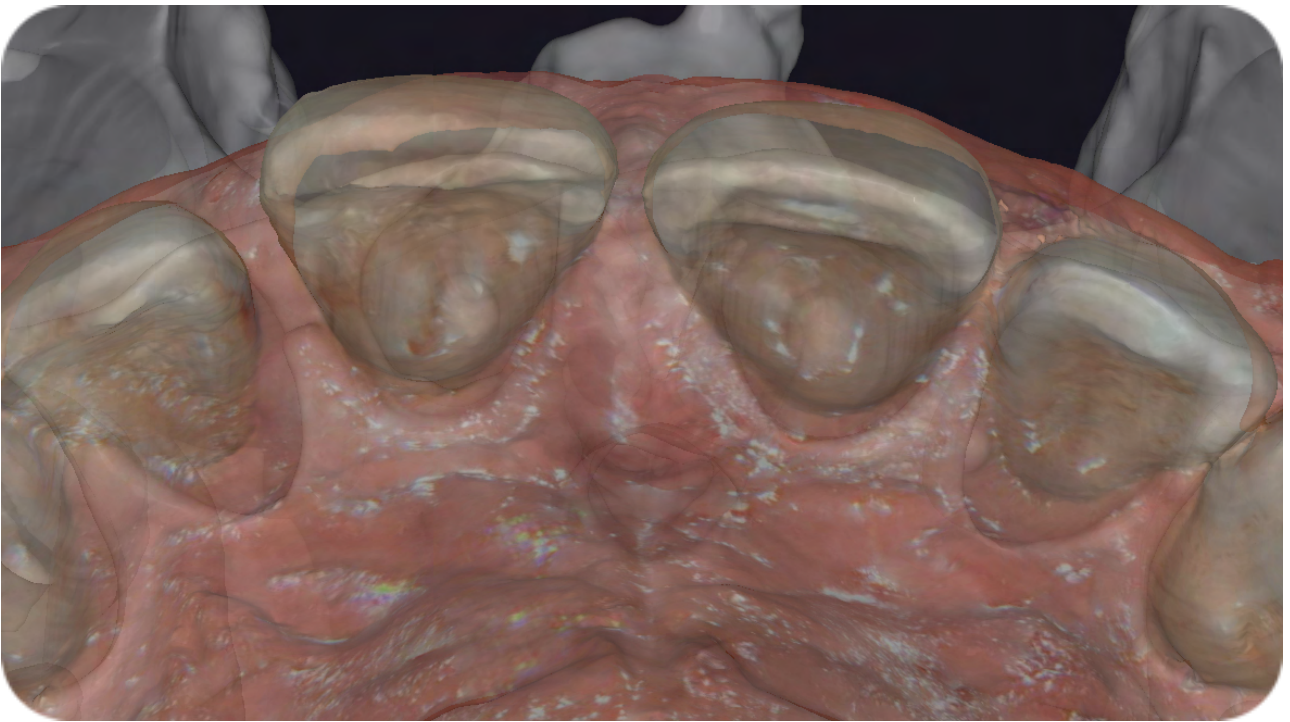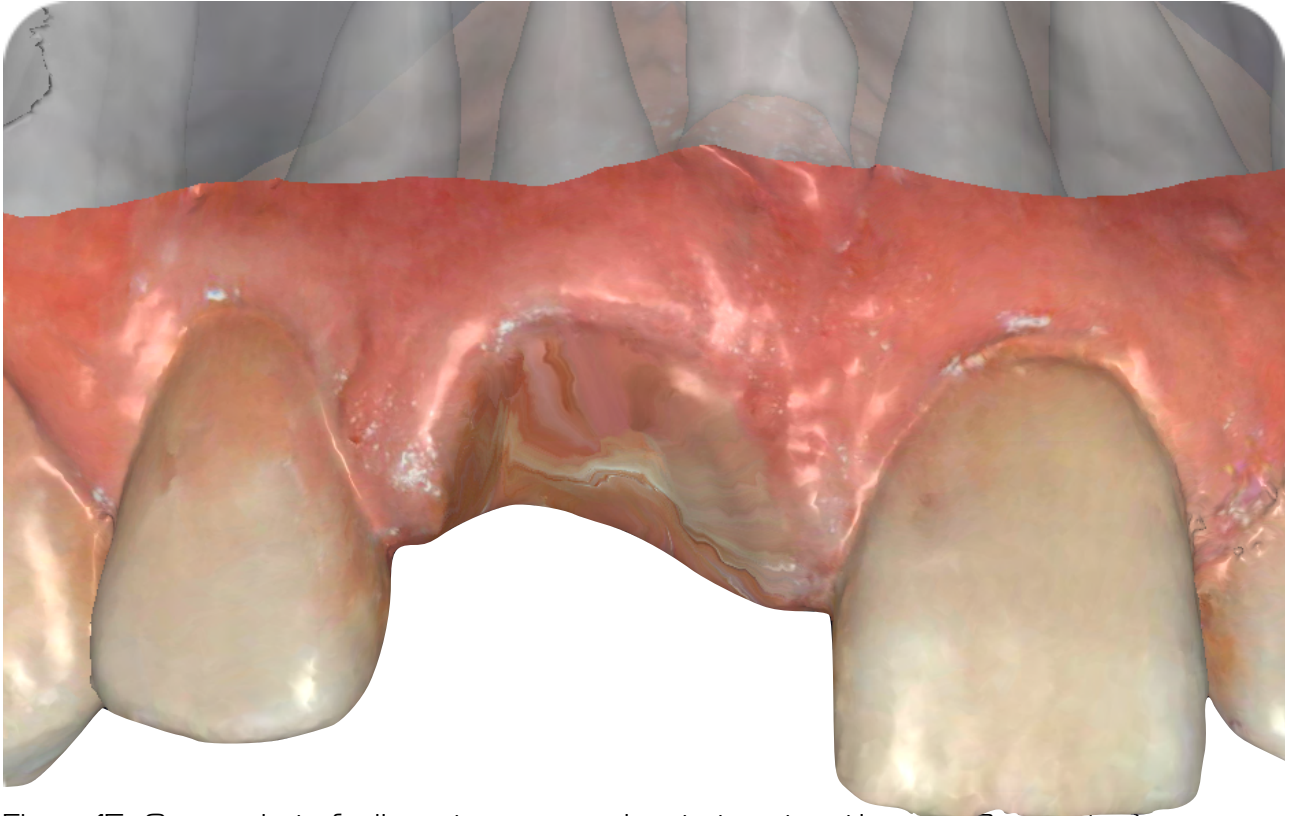Figure 4 - Intra-oral photo of baseline situation of upper right central incisor. (Occlusal view)

Figure 5 - Intra-oral photo of baseline situation of upper right central incisor. (Palatal view)

Figure 6 - Intra-oral photo of baseline situation of upper right central incisor during planning with Exoplan Rijeka. (Palatal view)

Figure 7, 8 - Photos of printed models with Denta Model using Asiga MaxUV (Buccal and occlusal views of baseline situation)

Figure 9, 10 - Intra-oral photos of printed models with Denta Model Asiga MaxUV (Buccal and occlusal views after virtual extraction)
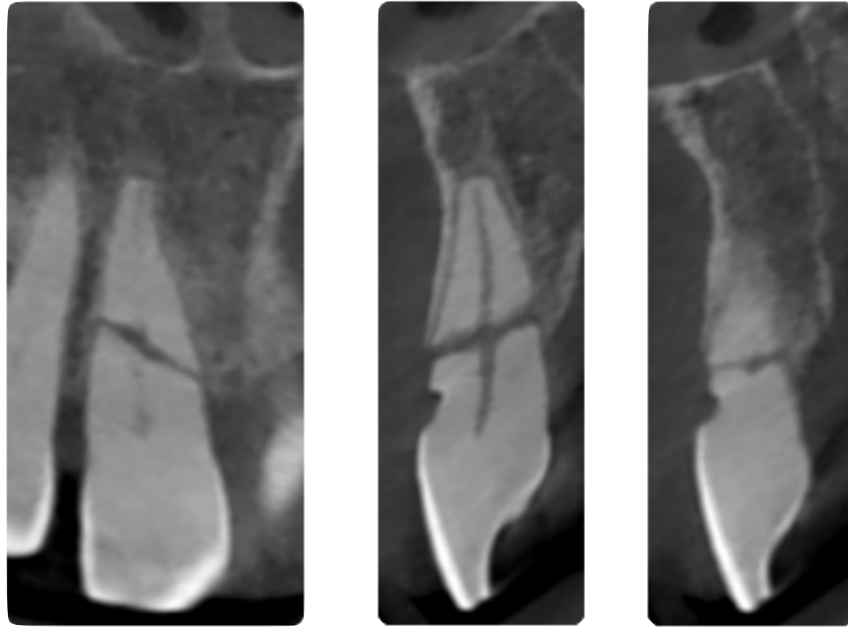
Figure 11,12,13- Pre-op axial CBCT x-rays. Root fractured of upper right central incisor.
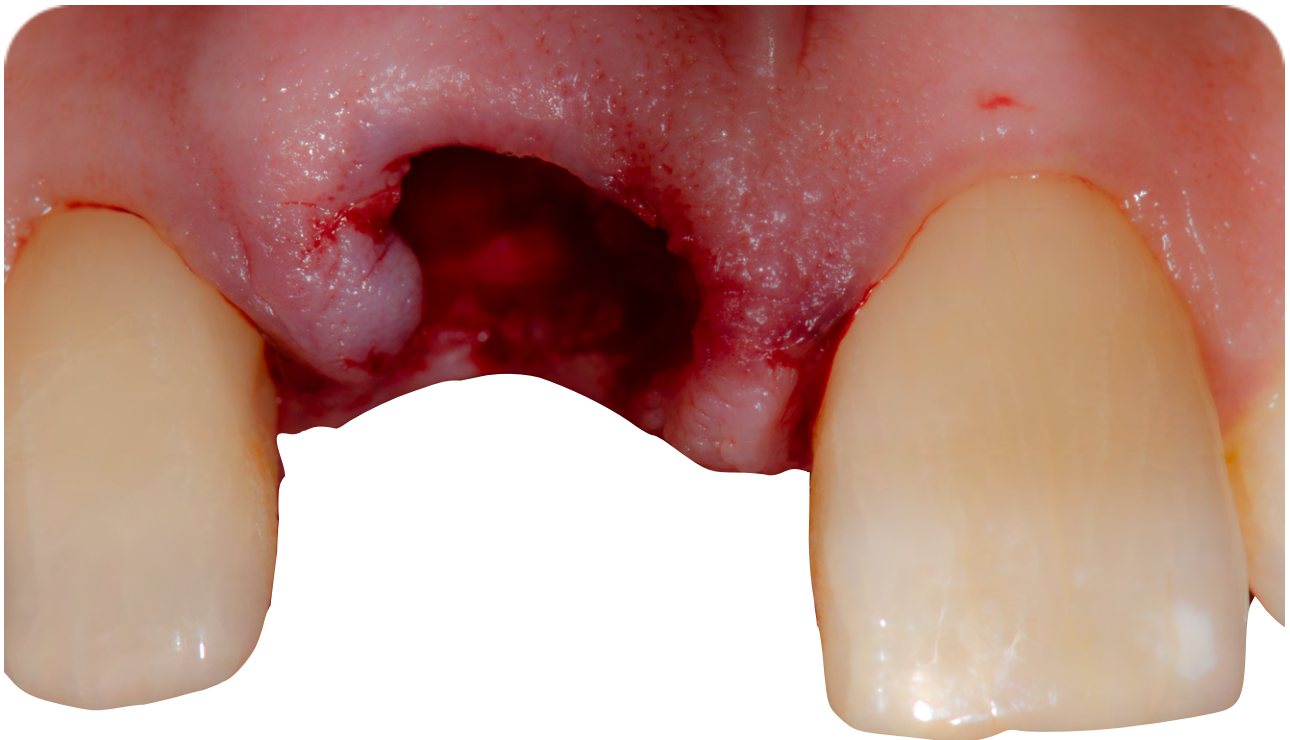
Figure 14- Intra-oral photo AFTER extraction of upper right central incisor. (Buccal view)

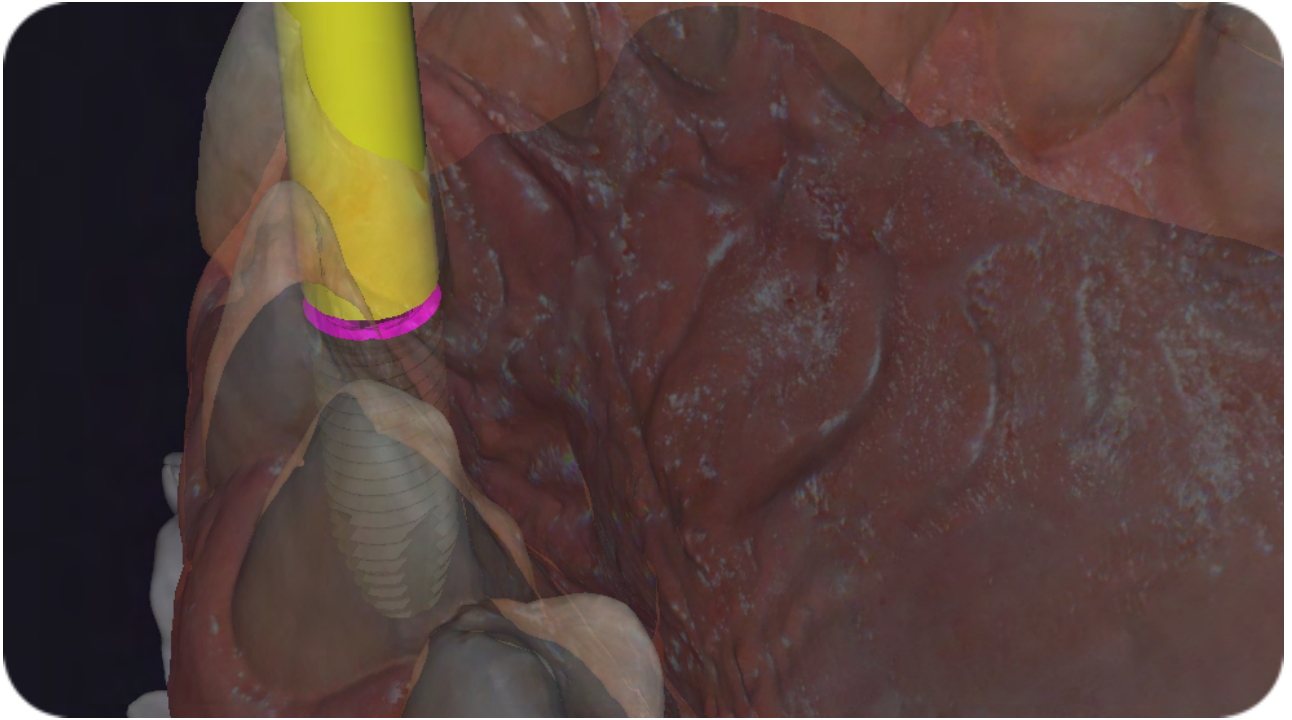Figure 15 - Screenshot of adjacent crowns and roots to extraction site. (Buccal view)
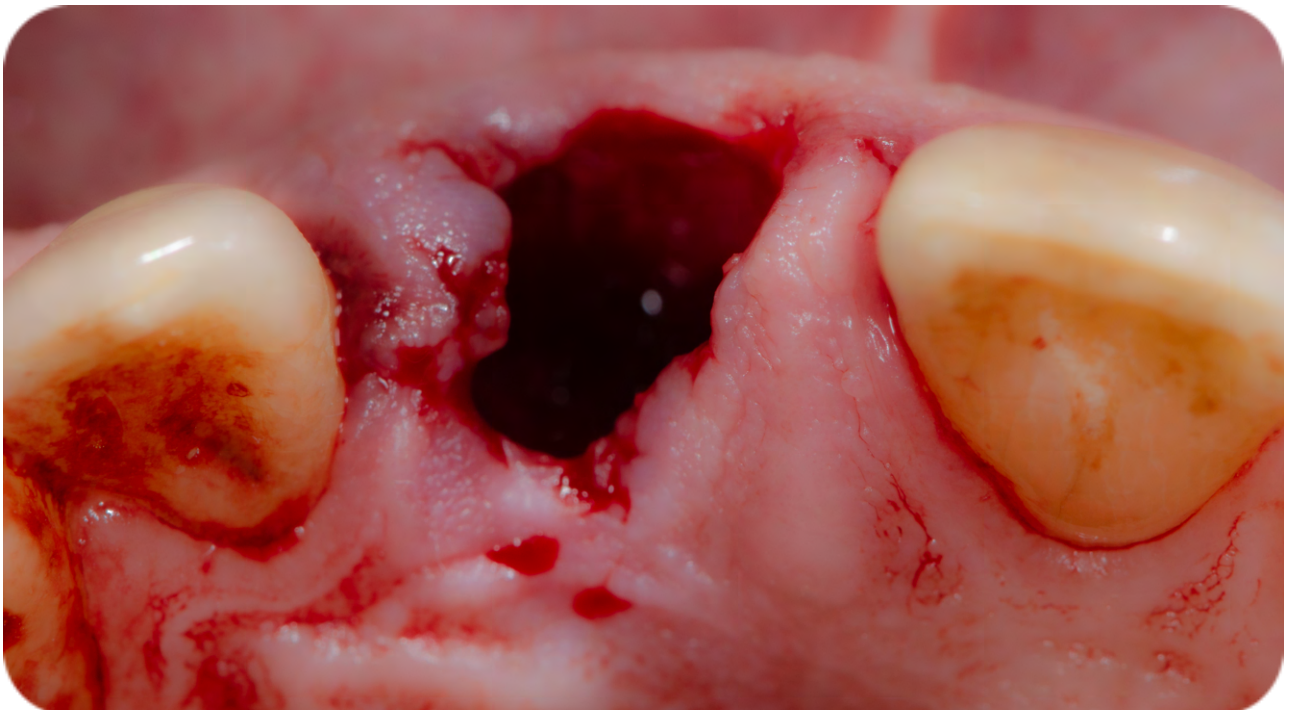
Figure 16 - Intra-oral photo AFTER extraction of upper right central incisor. (Occlusal view)
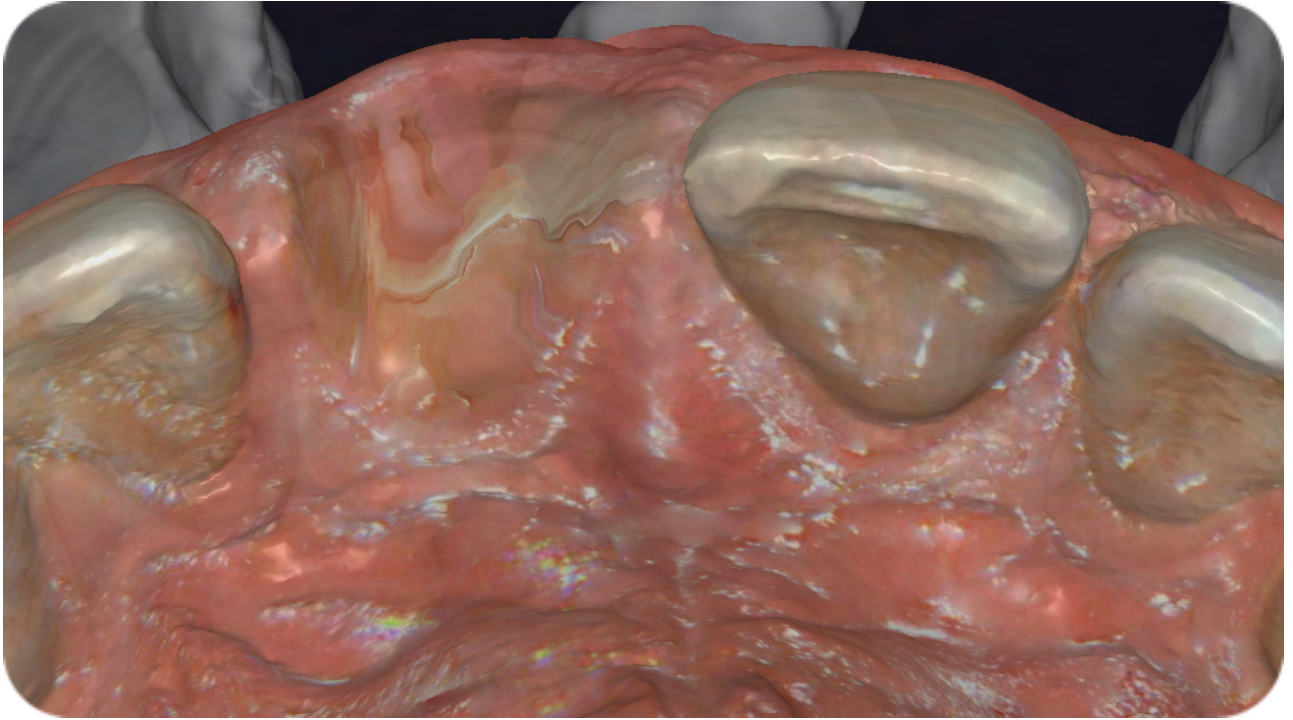
Figure 17 - Screenshot of adjacent crowns and roots to surgical site. (Occlusal view)
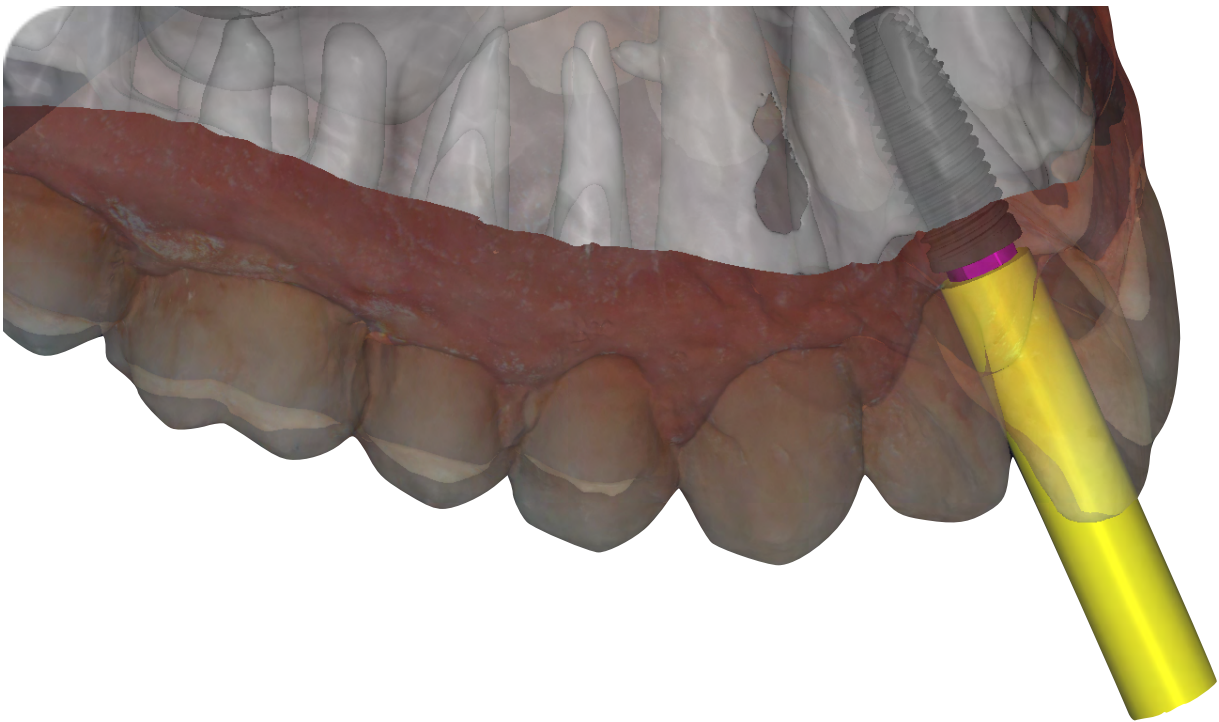
Figure 18, 19, 20 - Screenshots of upper virtual implant placement (Exoplan 3.1 Rijeka) on region #11 and relationship with adjacent teeth and roots . (Lateral, Occlusal views)
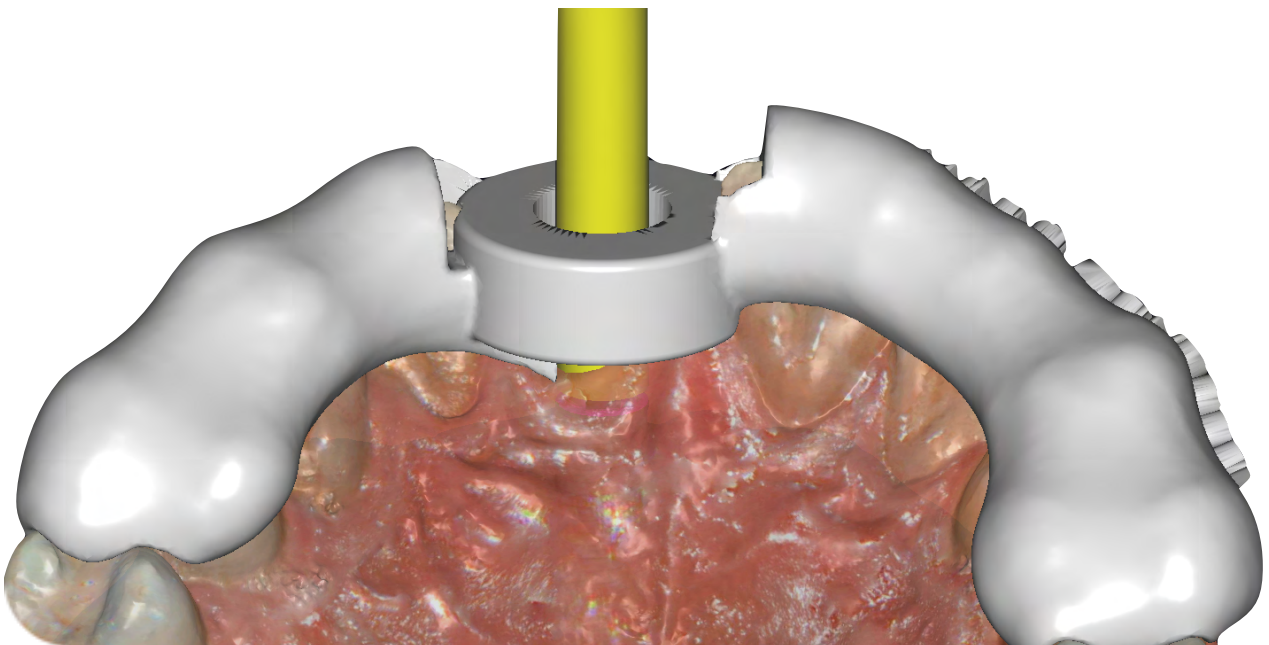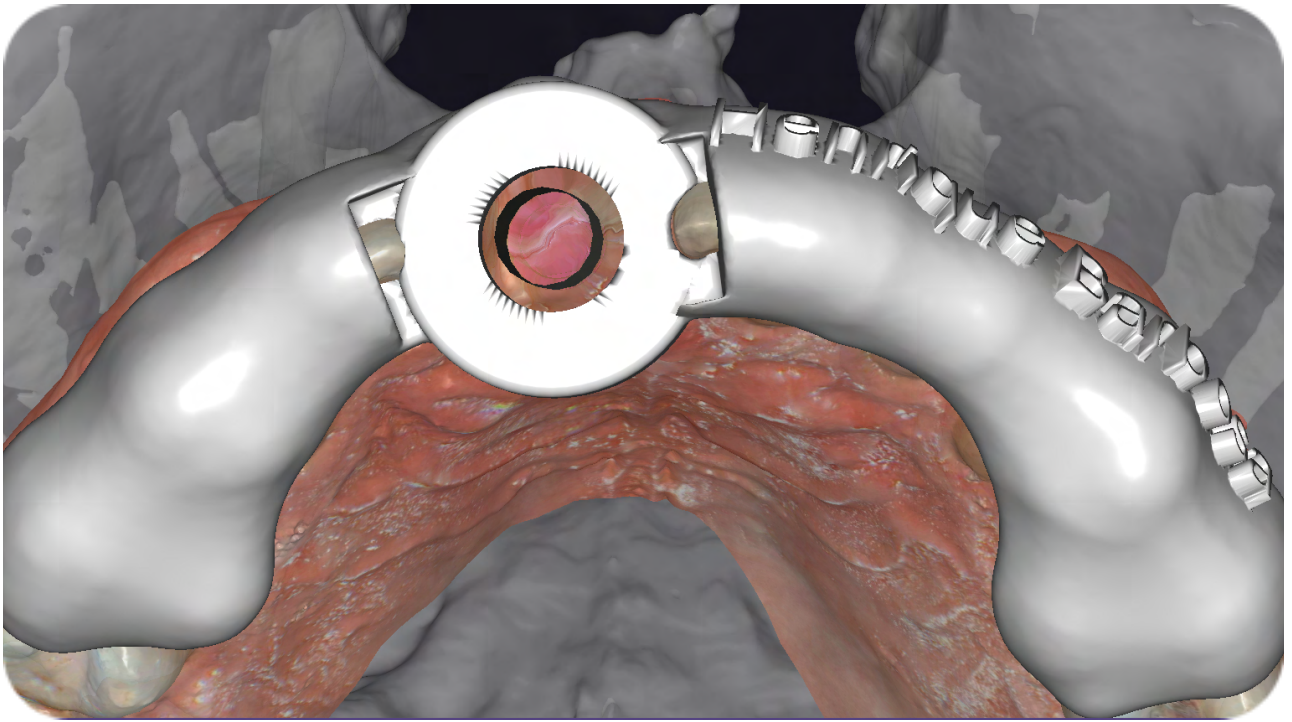
Figure 21, 22 - Screenshots of surgical guide designed (Exoplan 3.1 Rijeka) with sleeve for implant placement. (Occlusal and palatal views)
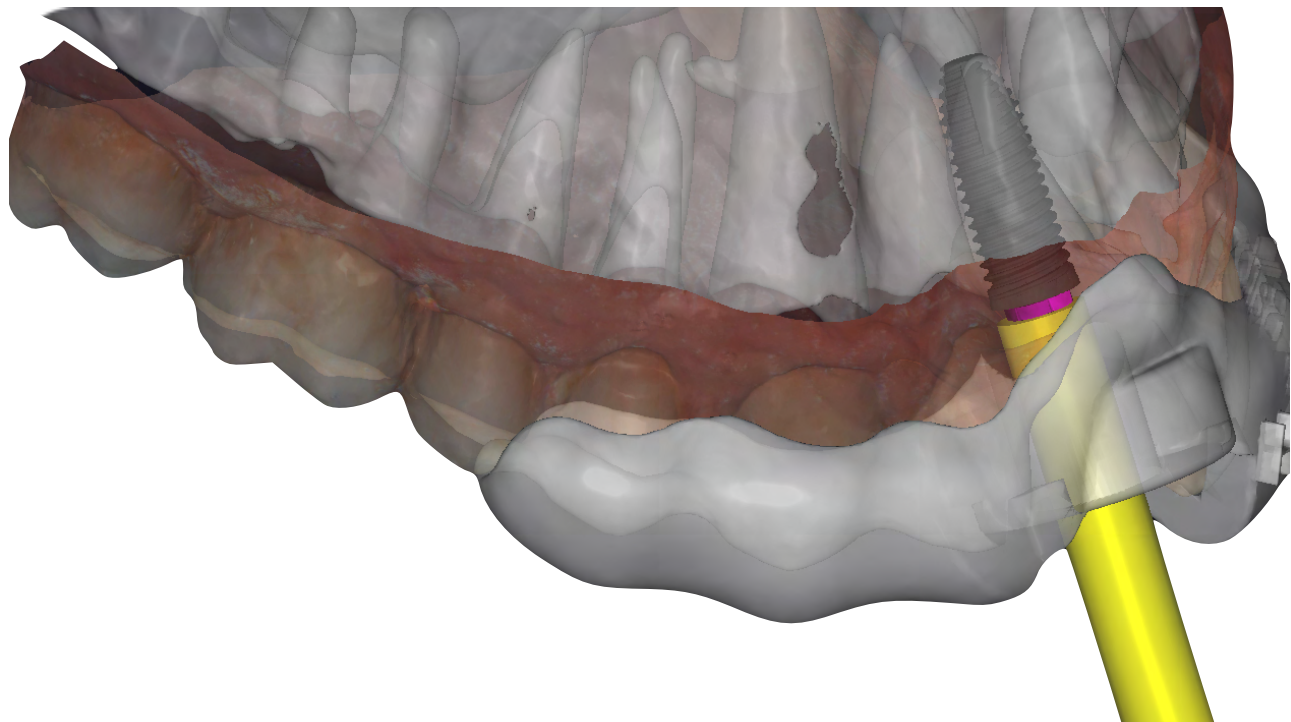
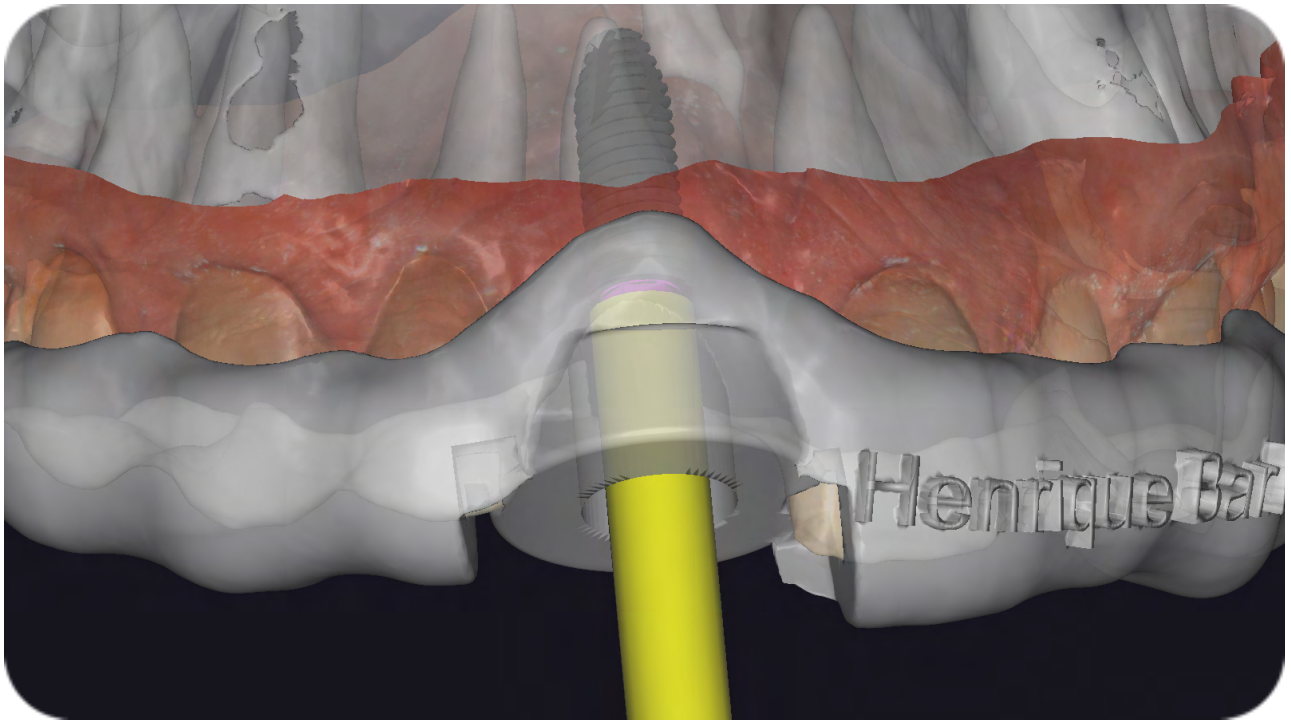Figure 23, 24 - Screenshots of surgical guide designed (Exoplan 3.1 Rijeka) with sleeve for implant placement. (Buccal and lateral views)

Figure 25 -Photos of printed surgical guide. (Occlusal view)

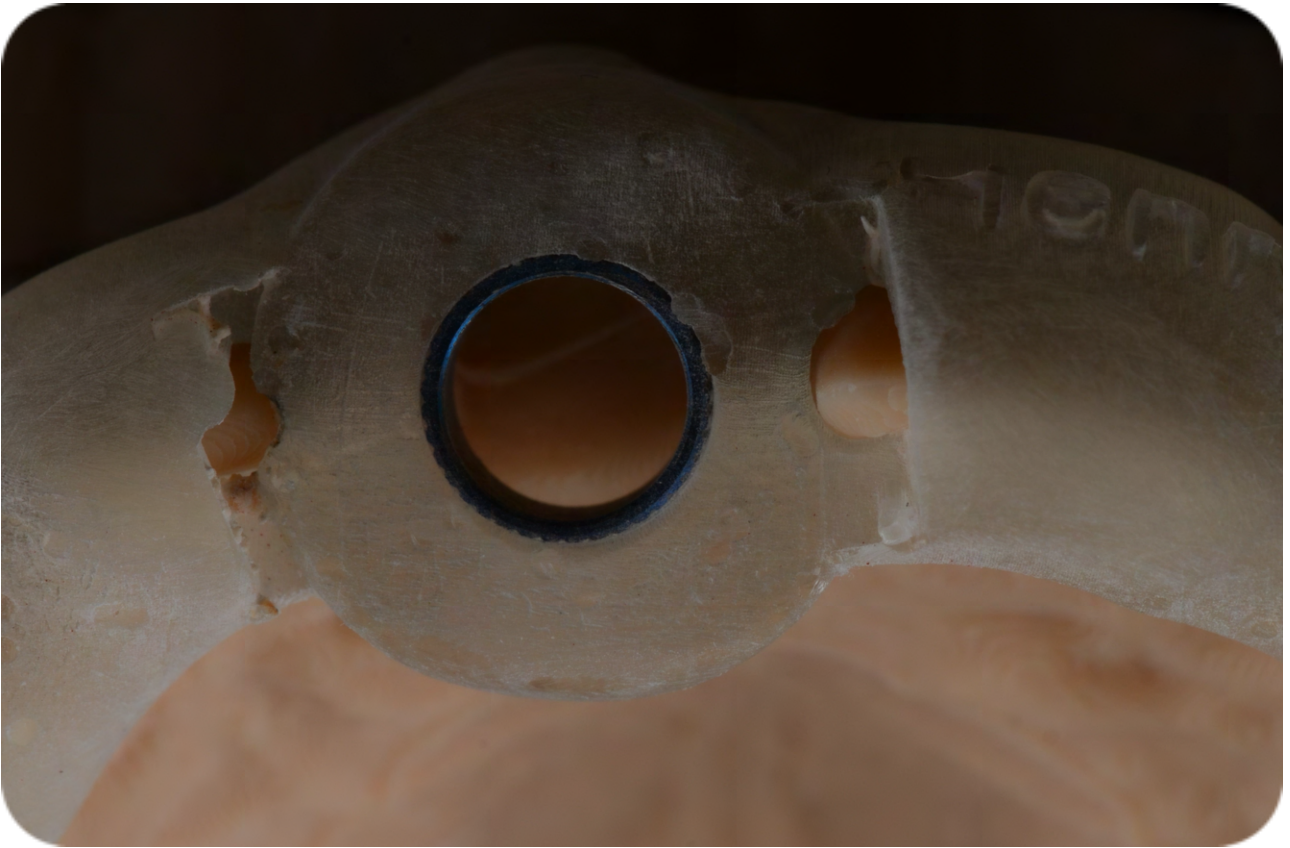Figure 26 -Photo of try-in of surgical guide (Denta Guide) into model resin. (Buccal view)

Figure 27 - Photo of try-in of surgical guide into model resin. (Occlusal view)
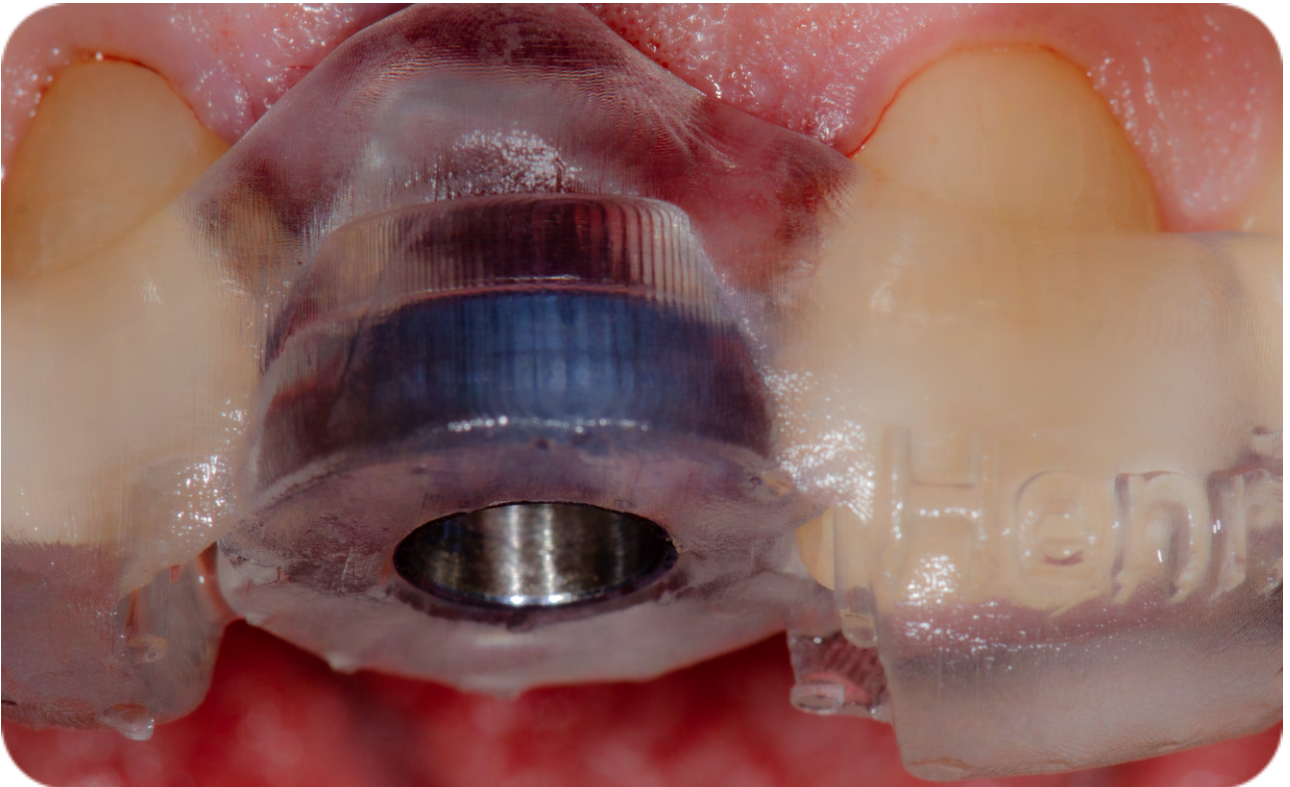

Figure 28- Intra-oral photos of fitting of printed surgical guide for implant placement.
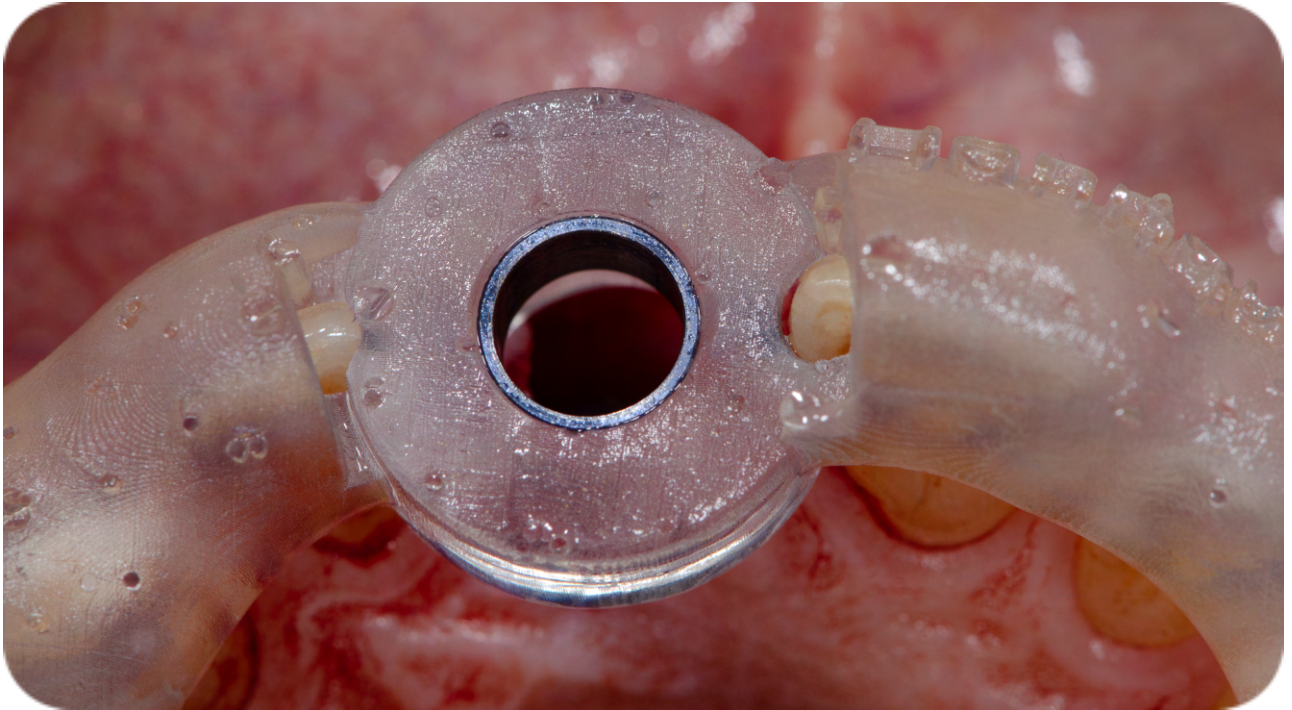
(Buccal view)

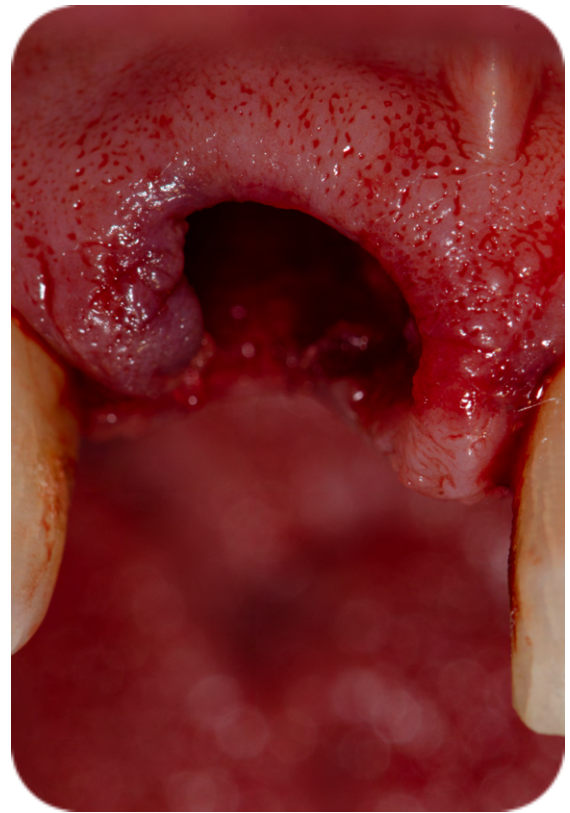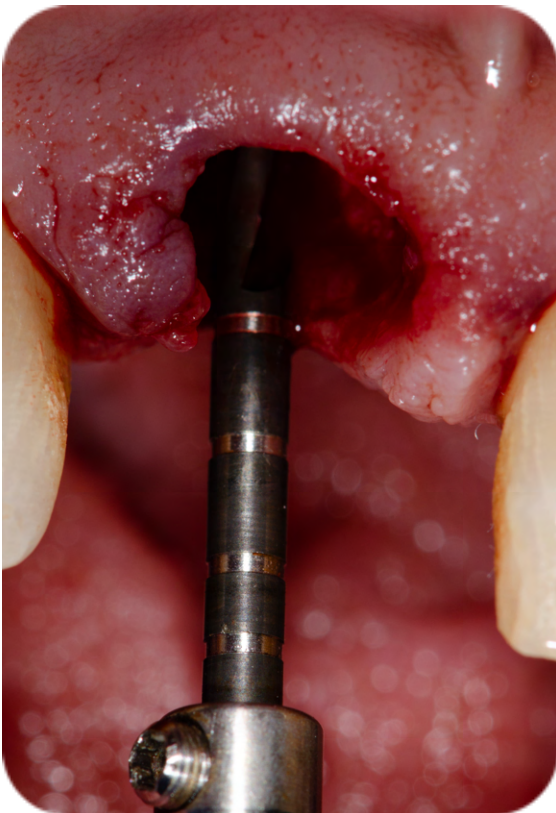Figure 29- Intra-oral photo of fitting of printed surgical guide for implant placement. (Occlusal view)

Figure 30, 31- Intral-oral photos of drill guide and after implant placement . (Buccal view)
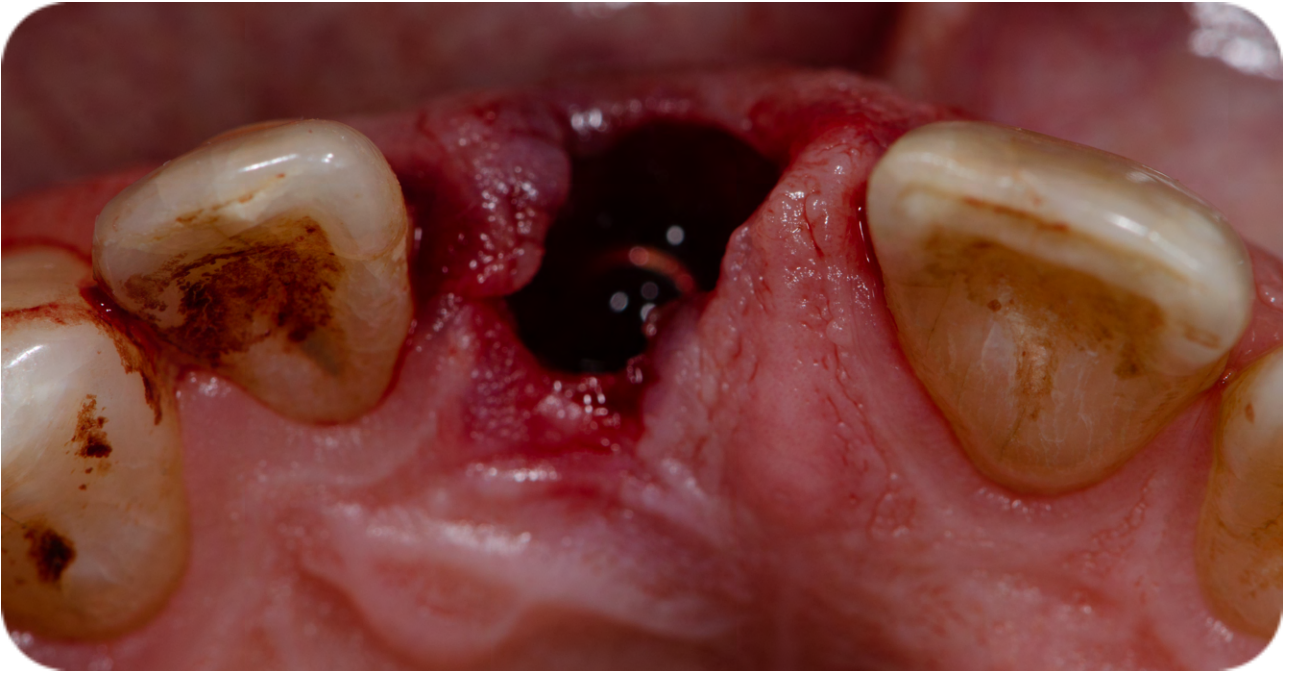
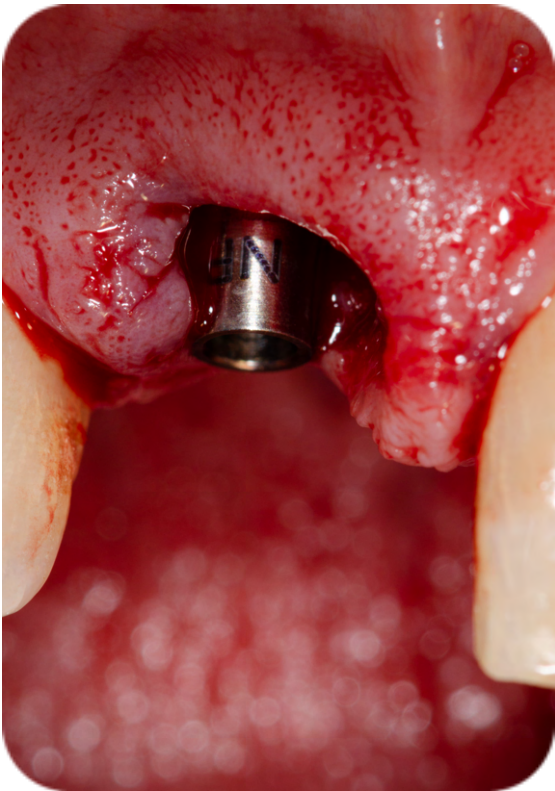Figure 32- Intral-oral photo after implant placement . (Occlusal view)

Figure 33,- Intral-oral photo of implant with ti-base inserted . (Buccal view)
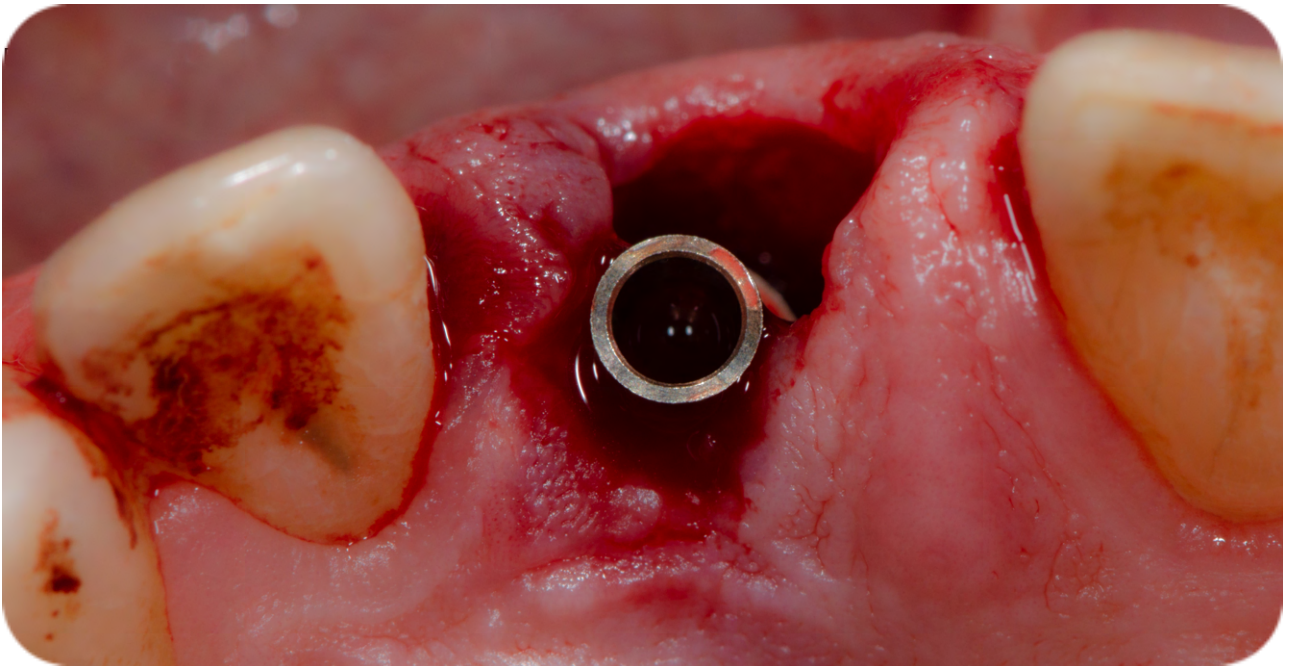
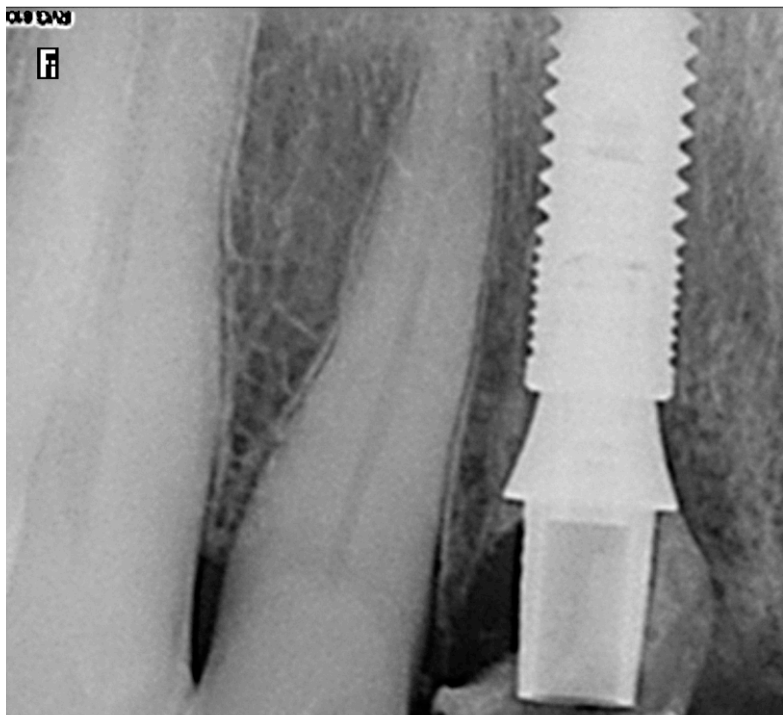Figure 34 - Intral-oral photo of implant with ti-base inserted . (Occlusal view)

Figure 35 - Post-op intra-oral x-ray after #11 implant placement.

References:

1- Ramasamy M, Giri, Raja R, Subramonian, Karthik, Narendrakumar R. Implant surgical guides: From the past to the present. J Pharm Bioallied Sci. 2013 Jun;5(Suppl 1):S98-S102.

2- 1. Panchal N, Mahmood L, Retana A, Emery R 3rd. Dynamic navigation for dental implant surgery. Oral Maxillofac Surg Clin North Am 2019;31(4):539-47.

3. Jorba-García A, González-Barnadas A, Camps-Font O, Figueiredo R, Valmaseda-Castellón E. Accuracy assessment of dynamic computer-aided implant placement: a systematic review and meta-analysis. Clin Oral Investig 2021;25(5):2479-94.

4. Parra-Tresserra A, Marquès-Guasch J, Ortega-Martínez J, Basilio-Monné J, Hernández-Alfaro F. Current state of dynamic surgery. A literature review. Med Oral Patol Oral Cir Bucal 2021;26(5):e576-e581.

5- Mello CC, Lemos CAA, Verri FR, Dos Santos DM, Goiato MC, Pellizzer EP. Immediate implant placement into fresh extraction sockets versus delayed implants into healed sockets: a systematic review and meta-analysis. Int J Oral Maxillofac Surg 2017;46(9):1162-77.

6. Block MS, Emery RW, Lank K, Ryan J. Implant placement accuracy using dynamic navigation. Int J Oral Maxillofac Implants 2017;32(1):92-99.

7. Lou F, Rao P, Zhang M, Luo S, Lu S, Xiao J. Accuracy evaluation of partially guided and fully guided templates applied to implant surgery of anterior teeth: A randomized controlled trial. Clin Implant Dent Relat Res 2021;23(1):117-30.

Author:

Diogo Viegas

Assistant Professor Prosthodontics Lisbon Dental School (DDS, MSc, PhD)

Dental Technician (CDT)

Bioemulator

Lisbon, Portugal