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Technical Note

New innovative method relating guided surgery to dental implant placement

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ABSTRACT

Introduction: Companies selling dental implant guided systems mostly offer similar surgical guides. The purpose of this paper is to present an innovative-guided surgery system which originality lies in its guidance device, and to report the author's experience in using this system for dental implant surgery.
Technical protocol: Two parallel tubes on either side of the drilling axis guide the successive drills and the implant placement. As a result of the lateral guidance, there is no friction of the drills on the surgical guide, which would damage it or contaminate the drilling hole with particles torn out from the guide. No radiological guide is needed during the radiographic examination stage. No successive diameter reduction tubes are requested. This guide can be used for all brands of implants.
Discussion: In our experience, 67 implants (31 titanium and 36 zircon implants) were placed in 35 patients with guided surgery system. Multiple clinical cases were treated with this system: 'one-stage' or a 'two-stage' surgical protocol, with flap and flapless surgical techniques, and with delayed or immediate loading. Clinical cases treated revealed good implant placement with planning. The widely open design of this guide allows irrigation and practitioner's sight control under conditions comparable to those of operations performed without surgical guide.
Conclusion: This dental implant guided system appears to be a significant advance in the field of implant surgical guides.

1. Introduction

The use of guides in implant surgery is constantly increasing. This success is due to the service provided both to trainee practitioners (ensuring their surgical gesture) and to experienced clinicians (for whom guided surgery provides a reliable therapeutic solution in the case of complex implantations in which the accuracy of the implant positioning is crucial and may sometimes avoid pre-implant surgery). Of course, the use of these techniques is also interesting in the implant-supported rehabilitation by immediate 'loading'.

If the characteristics of the ideal guide had to be defined, first of all one would ask for precision: absence of defective manufacturing, a perfect fit in the mouth, high stability during the operation and optimal drill guide for a perfect reproducibility of the planning. It is also necessary that the guide can be transported, stored and sterilized without any distortion or degradation. In addition, it is desirable that the design of the guide does not interfere with the visual inspection by the surgeon and with the drill irrigation. Finally, the use of this guide should not lead to a high increase in the cost of the operation. Companies selling dental implant guided systems offer surgical guides of similar design: they are dental, mucosa or bone supported, mostly made of resin, whereby drill holes are prepared within the body of the guide itself. These drill holes usually receive metal sleeves of various diameters to guide successive drills.

Having had the opportunity to test this innovative device, which differs significantly from the usual design, the authors wish to describe the system and the surgical protocol and to share their experience in their 35 clinical cases (67 implants).

2. Technical protocol

This technique required at least 3 clinical sessions, from the initial consultation to the surgical phase:

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- initial consultation;
- impression, recordings of clinical parameters, radiology;
- surgical phase.

The number of sessions increased with the implementation of temporary prosthesis or prosthetic set up in case of complex edentulous jaws (but these steps were not related to the technique of guided surgery).

After the classic early stages of implantation (case study, guiding assembly and validation of prosthetic project) had been completed, clinical and radiographic parameters were collected. An impression of the edentulous dental arch was taken using a dental impression tray on which was attached a Lego® brick (Billund, Denmark), as stated in the protocol. At this stage, it was checked that the brick was placed within the exploration field of the X-ray image (the accuracy of repositioning the various clinical, optical and radiological data for planning depends on this device). By default, the brick was located in an anterior position on the dental impression tray (Fig. 1). In the case of a posterior edentulism, when using a radiographic exam of small field cone beam type, an additional brick was added to the dental impression tray in the implantation area. The impressions were made with a polyether-based material deemed sufficiently accurate and stable over time: Impregum® Penta® Soft (3M ESPE®, Pontoise, France), implemented with an automatic mixer: Pentamix® 3 (3M ESPE®, Pontoise, France). In the case of a totally edentulous patient, two blocks of auto-polymerizing resin were also fixed to the dental impression tray in the posterior area to ensure the immobility and the stability of the impression during X-ray exposure. The impression of the antagonist jaw was also taken using an alginate-based impression material, and then plaster casted.

During this preparatory phase, the maximum size of the mouth opening was recorded using several bricks stacked on top of one another on the dental impression tray. The top of the brick was connected to the antagonist teeth via a key made of auto-polymerizing resin. Auto-polymerizing resin was used, after spreading Vaseline on the antagonist teeth to facilitate the removal of the key.

The patient then went to X-ray (CBCT in this case) and was instructed to bite on the dental impression tray as an X-ray guide.

Following radiological acquisition, the digital files in DICOM format were loaded into an usual software and shared with the company that markets the guide (2ingis®, Belgium) via its secure Internet network. The quality of the images was then controlled by the radiographic visualization of the brick. The quality of digital data could be validated by the specific external and internal geometry of the plastic brick, clearly visible in X-ray: the lack of super-positioning of a standard scanner representation of a brick with image of the brick included in the dental impression tray would identify any fault in the X-ray acquisition. After checking and validating the data, a brief study of the case was performed. If the bone quantity was considered sufficient, the practitioners were invited to submit the impression of the edentulous arch, the plaster model of the opposing arch, the pre-prosthetic wax up and the recordings of the clinical parameters (maximum mouth opening, inter arch relations) to the company, which carried out the digitization of these different elements through optical scanning. The practitioners also specified the brand of implants, which they intended to use, and the characteristics of the prosthetic project (as use of screw-retained prosthesis or cemented one, immediate loading...). All digital data were then integrated (STL format) in the planning software, where they were associated with imaging by super-positioning the images of the bricks. After planning of the positions, diameters, axis and sizes of implants by the clinicians, the company manufactured and shipped the individual patient surgical guides. The delay between sending the patterns and receiving the surgical guide was approximately about 3 weeks.

During the surgical phase, the specific surgical kit was used. It included a contra-angle with guide forks of different lengths (depending on the patient's capacity to open his or her mouth, the edentulous area and the depth of drilling). It also included depth wedges, a ring with two legs (to be inserted in the guide tubes in the same way as the drill guide fork) to guide the implant-holder during manual placement of the implant, a metal trephine to cut the gum, two zircon drills which respectively allow to flatten the bone crest and perform the initial drilling (pilot drill) (Fig. 2). Regular drills of the selected implant system were then used for the rest of the drilling sequence (using depth wedges if necessary). The practitioners followed the instruction sheet, which listed the drills needed throughout surgery. With the surgical guide remaining in place, the implants were inserted with the ratchet or the contra-angle.

This system was used by the authors to place 67 implants (36 zircon implants from Paris Implant® [Marnay, France] in ZIR-ROC clinical study, 23 titanium implants from Straumann® [Basel, Switzerland] and 8 titanium implants from Zimmer® [Florida, USA]) in 35 patients (28 patients for zircon implants and 7 patients for titanium implants). The clinical study has been conducted in full accordance with ethical principles. It was undertaken with the understanding and written consent of each patient and was independently reviewed and approved by the national ethics committee (2010-A00989-30/MS1). In the case where the edentulism was limited to three teeth, we used a small field cone beam device (Planmeca ProOne®, Helsinki, Finland). For more extensive edentulisms or completely edentulous jaws, we used a wide-field CBCT device (NewTom 5G®, Verona, Italy). The insertions were

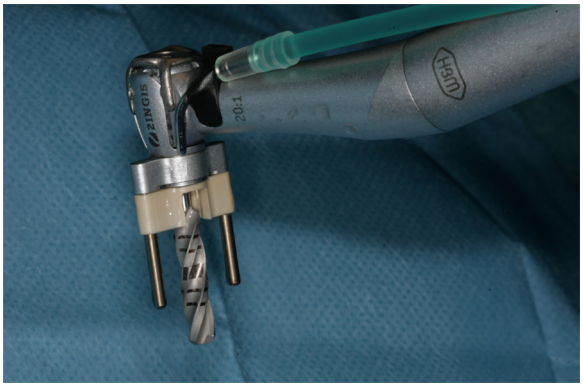

Fig. 1. Dental impression tray. As a spatial reference and a radiopaque marker, a Lego® brick is attached in the anterior position. In the posterior locations, auto-polymerizing resin wedges stabilize the impression tray during the CBCT exam.

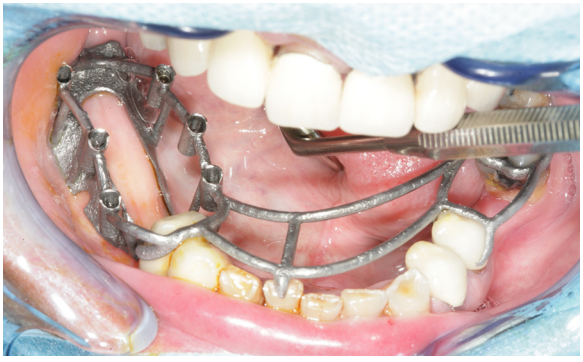

Fig. 2. Using the pilot zircon drill. A single implant was placed with this guide having thus only 2 twin tubes. Note that he guide was wider than appears on this picture, with stabilizer rods to connect it to lateral teeth.

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