POSTEXTRACTION COMPUTER-GUIDED IMPLANT SURGERY IN PARTIALLY EDENTATE PATIENTS WITH METAL RESTORATIONS: A CASE REPORT

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SUMMARY

Objectives. The aim of the present study was to describe a postextraction, computer-guided protocol for implant-prosthetic rehabilitations in partially edentate patients with metal restorations.

Methods. A 60-year-old man with a loose FDP (fixed dental prosthesis) in the first quadrant was selected for a postextraction computer guided implantology according with the 2-piece radiographic template protocol. A two components radiographic template was produced, with the teeth setup portion based on the wax-up. CBCT (cone beam computed tomography) scans of the patient, wearing the base portion of the radiographic template and of the assembled radiographic template alone, were accomplished. The CBCT volume were imported in a dedicated software (NobelClinician, NobelBiocare, Kloten, Switzerland) and a surgical template was produced from the digital planning. The surgery was performed with a flap approach, as a bone regeneration procedure was carried out. A delayed loading protocol was chosen to allow a healing free of masticatory stress. A mobile partial denture was delivered to the patient to grant function and social life until the delivery of the definitive FDP.

Results. The surgery was performed rapidly and free of obstacles. A good primary stability of the implants was achieved. The patient referred an acceptable postoperative pain and swelling.

Conclusions. The 2-piece radiographic template protocol was evaluated as smooth, complication-free and suitable for patients who want to maintain their teeth until the day of implant surgery. A good command of the computer-guided software as well as a comprehensive learning curve in computer-guided implantology is necessary to obtain predictable results.

Key words: computer-guided implant surgery, dental implant, postextraction implant, double scan, 2-piece radiographic template.

Introduction

In the last twenty years, an increase of computer-guided implant surgery procedures occurred (1, 2). In addition, it has been demonstrated that implants insertion in post extraction sockets is a successful option, ensuring high primary stability (3). Many advantages are related to these new approaches, both for the patients and the clinician (4). A considerable enhancement comes from new radiological techniques as CBCT (Cone Beam Computer Tomography), providing low dosage exam in association with high quality images (5). Moreover, CBCT has brought to the development and diffusion of dedicated implant planning software, that allow an optimization of implant-prosthetic procedures (6). Computer-guided implant surgery makes possible the correct positioning of implants despite the presence of anatomically sensitive structures like maxillary sinus, mandibular canal or mental foramen (7, 8). Besides, another advantage is the

possibility to avoid a more invasive surgery access (9). Being the digital implant planning prosthetically-driven by the wax-up, a superior aesthetic and control of the masticatory load is achievable (10, 11). The upgrade in implant guided surgery protocols provides new tools and procedures suitable also for postextraction implant cases, complicated by the residual bone volume and by the presence of hopeless teeth that will undergo extraction (12).

Nowadays, the gold standard computer-guided protocol for partially edentate patients is based on the fusion between the CBCT and the STL file of the patient arch belonging from a lab scan of the cast or from an intraoral scanner (IOS) scan (13, 14).

Possible radiographic artifacts could lead the fusion process between the DICOM and STL data to failure (13). For that reason, a conventional radiographic template based protocol is mandatory to perform a computer-guided approach in partially edentate patients with metal restorations. The radiographic template contains the prosthetic information that guides the clinician into a prosthetically-driven digital implant planning. In post-extractive cases a 2-piece radiographic template production is mandatory to perform a prosthetically-driven approach and to retain the patient teeth until the day of surgery. According to that protocol, the patient undergoes a CBCT wearing the base portion of the template and subsequently a CBCT of the base portion assembled with the teeth setup is carried out. The two DICOM volume are then imported into a dedicated software and a digital prosthetic-driven implant planning is practicable (12). The aim of this study was to describe a post-extractive, computer-guided case for implant-prosthetic rehabilitations.

Methods

A 60-year-old man referred the mobility of a 4-unit FDP (1.7-X-1.5-1.4) in the first quadrant. After a clinical and radiological evaluation, the teeth 1.4 and 1.5 were indicated to be extracted, while the tooth 1.7 was evaluated to be still a valid support (Figures 1, 2).

The patient was selected for a postextraction, double-scan, computer-guided approach due to the limited bone volume and the presence of metal restorations. Photographic documentation was achieved (15). Alginate impressions of both dental arches were taken, the master cast poured and mounted on an articulator. The teeth to be

Figure 1
Buccal, occlusal and palatal preoperative view.

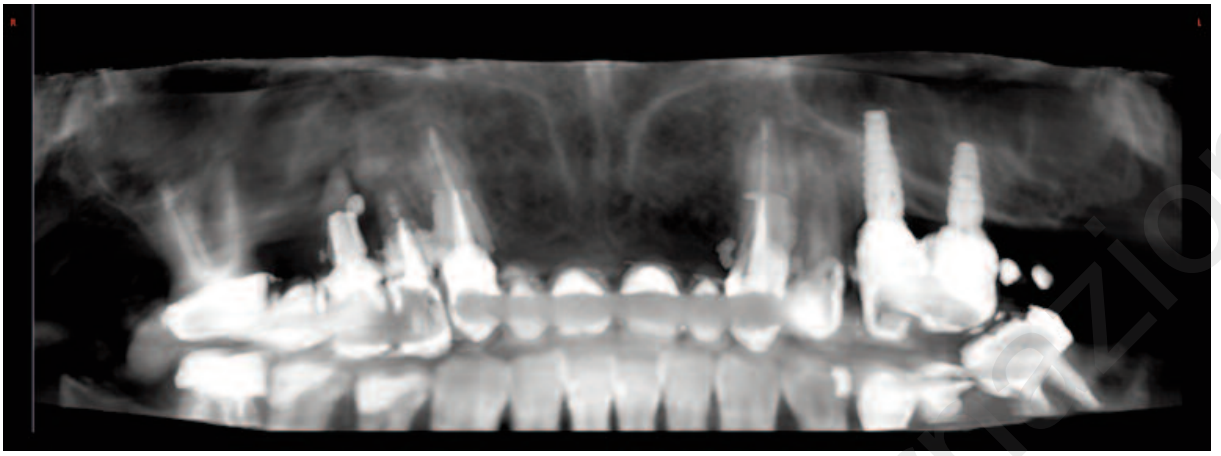

Figure 2
Pre-operative CBCT panorex slice.

extracted were removed from the cast to the gingival level. A wax-up of the teeth in the corrected final position was performed. This completed wax-up was processed in self-curing acrylic resin as the rest of the radiographic template. Nine 1.5 mm diameter radiopaque markers were placed in the radiographic template volume except the teeth setup portion. The teeth setup portion was built to be locked into the repositioning notches of the border of the window with a stable and precise fit (Figure 3).
The patient underwent a CBCT scan (Planmeca ProMax 3D, Helsinki, Finland) with a 0,2-mm slice increment wearing just the base portion of the radiographic template. A second CBCT scan with different exposure parameters was made to the assembled radiographic guide. The DICOM files obtained from this second TC scan contained data regarding the ideally planned teeth positions in the teeth setup portion, and data regarding the position of the markers in the base portion, which are the same as in the first scan. These two CBCT volumes were exported into the NobelClinician software. The implants were digitally positioned considering both the anatomy and the prosthetic project. A 1.6-X-1.4 FDP was planned over a Ø 3.5x13 mm NobelActive NP and a Ø 3.5x11.5 mm NobelActive NP implants respectively in 1.6 and 1.4 position. The posterior implant was tilted mesially to anchor as much bone as possible without violating the sinus. The anterior implant was placed straight at 1.5 mm distance from the tooth 1.3 (Figure 4).

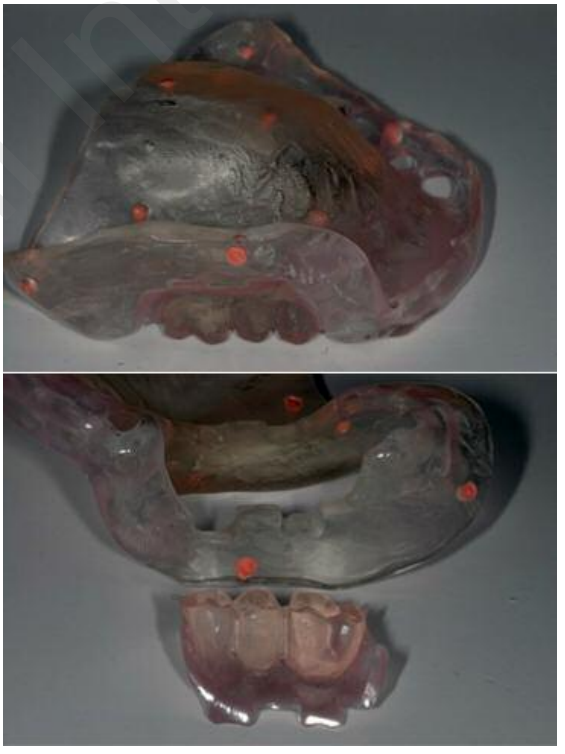

Figure 3
Radiographic template with teeth setup portion in place and out of place.

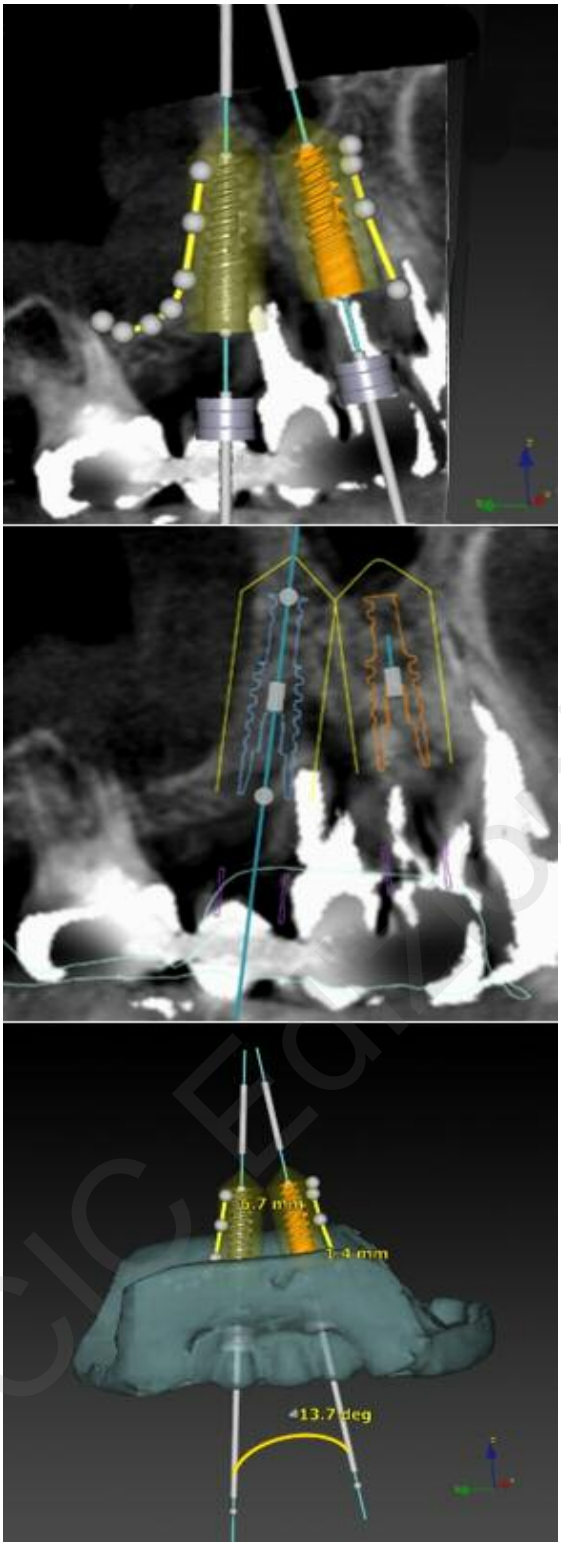

Figure 4
Digital implant planning. Frontal slice and 3D volume rendering.

Based on the digital planning a surgical template with the same shape of the radiographic base portion was fabricated and used to place the implants with a fully guided surgical protocol (Figure 5).

A fitting check of the teeth-supported surgical template was accomplished on the plaster cast. During the day of surgery, a single dose of antibiotic (2 g of amoxicillin and clavulanic acid) was administered prophylactically 1 h prior to

Figure 5
Surgical template.

Figure 6
The FDP portion atraumatically extracted.

surgery. This treatment continued for 7 days (1 g amoxicillin and clavulanic acid twice a day) after surgery. Prior to the start of surgery, the patient rinsed with 0.2% chlorhexidine for 1 min. Local anesthesia was induced by using a 4% articaine solution with epinephrine 1:100.000 (Ubistesin; 3M Italia, Milan, Italy). The FDP on 1.7 has been separated from the rest of the bridge and teeth 1.4 and 1.5 were atraumatically extracted (Figure 6).

The surgical template was relined with low-percentage contraction acrylic resin (Pattern Resin GC, Tokyo, Japan) to increase its stability and its position was checked through the inspection windows. The implant company guidelines were followed concerning the guided drilling sequence. Following the guided implants insertion, a percussion stability test was executed and cover abutments were screwed (Figure 7).

A flap has been elevated in order to perform a bone regeneration. Autologous bone obtained during the implant sites preparations was mixed with a bone substitute (Bio-Oss, Geistlich, Princeton, NJ, USA) and used to fill the gaps left by the extractions. Separated single sutures were executed (Vycril 3-0, Ethicon, Johnson & Johnson, New Brunswick, NJ, USA) and a mobile partial prosthesis was delivered to allow the osteointegration of the implants without loading forces stress (16) (Figure 8).

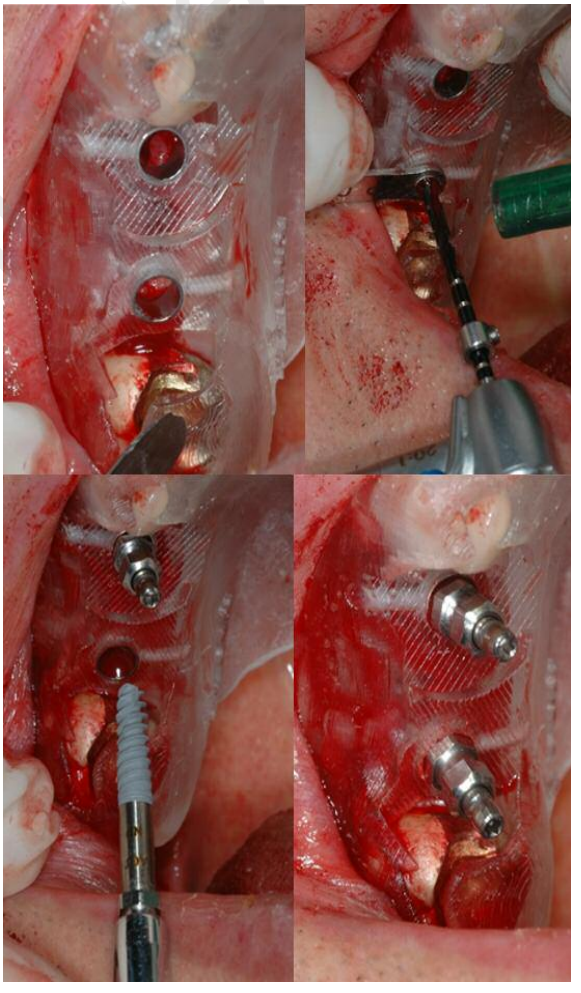

Figure 7
Intraoperative steps.

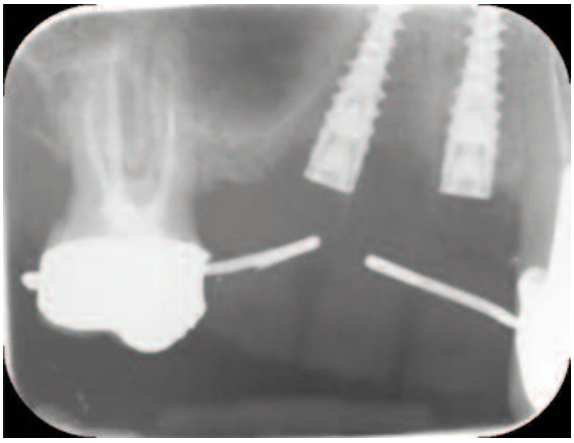

Figure 8
Post-operative intraoral X-ray.

Results

Besides the residual bone volume and the patient request of maintaining the teeth to the day of surgery, the implant insertion was accomplished. A flap approach was necessary to perform a bone regeneration. The surgery was fast and free of obstacles, the patient experienced few pain and swelling in the days after surgery.

Discussion

The objective of this study was to evaluate the predictability and feasibility of computer-guided implant surgery in multiple post extractive case. In the past decade, the development of new technologies led to the introduction of new techniques. Thanks to the 3D-guided surgery is now possible to have a realistic preview of the final outcome, reducing the number of clinical variables that can affect clinical success (17). Despite all these enhancements, post-extractive cases were still difficult to be performed with 3D-guided surgery. That was due to a poor adaptation of surgical template when the teeth to replace were still in place. An innovative procedure was introduced to overcome this issue, allowing the patient to maintain his teeth in the diagnostic phase till the surgery procedures, reducing social and biological discomfort. The 2-piece radiographic guide protocol was proposed by Cantoni and Polizzi (12) and provides a solution to handle postextraction computer-guided implant cases. The gingival margin profile is pointed out, so that the depth level of implant shoulder could be accurately positioned. The 2-piece guide offers a very good support to the guided sleeves providing advantages in surgical guide manufacturing. The clinical application of computer-guided implant surgery in postextraction cases allows more predictable clinical outcomes in terms of aesthetics and function, delivering customized implant-prosthetic treatments to the patients. A learning curve is always necessary in order to carry out properly the described workflow.

Conclusions

Within the limitations of the present study, the 2-piece radiographic template protocol has been evaluated as smooth, complication-free and suitable for patients who want to maintain their teeth until the day of implant surgery. A good command of the computer-guided software as well as a comprehensive learning curve in computer-guided implantology is necessary to obtain predictable results.

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