WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 9, Sep., 2022

DENTAL IMPLANTATION USING COMPUTER SOFTWARE FOR ACCURATE PLACEMENT AND LONG-TERM PROSTHETIC RESULTS

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Abstract
The use of computer software for dental implants has increased significantly over the past few years. Dental implant positioning can be either 'partial', where only the osteotomy site is prepared using consecutive removable surgical templates for drilling, or 'completely guided', with one positioner used to prepare the osteotomy site as well as the delivery of the implant. Recently, guided delivery of internal connective implants has become available. Customised protocols and special instruments are used as part of this CT-based approach to implant surgery.

Keywords: computer software, virtual planning
The purpose of this article is to provide a concept of associated dental implantation using computer software for accurate placement and long term prosthetic results.

Introduction

The invention of computed axial tomography (now known as computed tomography) and the development of interactive software that allows virtual planning in order to accurately guide surgery to a specific goal have greatly improved general as well as cavity surgery. Virtual planning of dental implants allows for an orthopaedic approach, leading to the best prosthesis design, better aesthetics, optimised occlusion and loading. This approach has also changed the surgical paradigm of using extensive flaps to obtain a proper view of the surgical field, as flapless implantation with or without immediate loading has become more predictable. Two types of guided implantation protocols, static and dynamic, have been described in the literature**.** The static approach, better known as computer-assisted surgery, refers to the use of a tissue-supported surgical template. This reproduces the virtual position of the implant directly from the CT data and this information can be converted into guiding templates to be used during surgery, with or without lifting the mucosal-periosteal flap. Dynamic guided surgery, also called navigation, reproduces the virtual position of the implant directly from the CT data and uses motion tracking technology to

control the preparation of the osteotomy of the implant. As the technology has been further developed, different levels of evidence have been presented, showing varying degrees of accuracy. Several protocols for template surgery are available in the literature, which vary in terms of template fabrication methods, support methods and drilling/installation protocols. Currently, implant planning software using cone beam computed tomography data makes it possible to plan the position of an optical implant almost optimally, taking into account the surrounding vital anatomical structures and future prosthetic requirements. This article summarises the evolution and current trends in digital and virtual planning as well as in implant surgery. The aim of this review was to clarify the different concepts of template surgery and their respective advantages, disadvantages and limitations. The result of template surgery is evaluated in terms of implant engraftment, accuracy and complications. Clinical cases are given to briefly demonstrate the workflow and clinical guidelines for the safe use of these approaches.

Materials and Methods

Clinical material includes the examination and treatment of 62 patients. Of them: women - 33; men - 29, aged from 40 to 70 years, who were treated in the outpatient clinic of the Department of Surgical Dentistry and Dental Implantology of TGSI from 2019 to 2022 and in private dental clinics. Patients with secondary partial adentia and jaw defects were included in the study. Patients with absolute contraindications to dental implantation were excluded from the study. The indications for implant surgery are various types of adentia:

-single missing tooth
- unilateral edentulous edentulous defects
- Bilateral edentulous edentulous defects

Extended, compound edentulous edentulous defects full adentia

A standard clinical examination programme has been defined for the whole cohort of patients, which included

Comprehensive diagnostics to determine the exact diagnosis

identification of relative contraindications or risk factors (osteoporosis of the jaw bones, haematological or immunological diseases, diabetes mellitus, parafunctional habits: bruxism, etc.); medical advice for patients with co-morbidities (heart failure, haemophilia, diabetes).

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Results and Discussion Methods

Patient K., born in 1962 (card number 152) Past medical history: the patient complained of aesthetic and functional discomfort caused by missing tooth 2.1. The tooth had been extracted two months prior to referral due to complications during endodontic treatment. There were no concomitant diseases and no contraindications to implant treatment were identified. During treatment a bone defect was detected in the vestibular and palatine walls of the cavity of tooth 2.1. The vestibular plate was destroyed by more than half, the lack of bone support resulted in a pronounced soft tissue defect of the alveolar process, and a partial preservation of bone peaks in the area of 1.1 and 2.2 teeth was revealed.

🔷Stages of treatment:

✓Digital anatomical reconstruction of the bony and soft tissues of the operative area Fabrication of customised permanent abutment and temporary crown using CAD/CAM technology

Setting of AnyRidge implant (Megagen), diameter 4.5 mm and length 13 mm with guided surgery template.

✓ Fixation of the permanent abutment with 35 N/cm

✓Placement of the soft tissue into the gingival papillae using the skeletal augmentation method, using the excess soft tissue volume after a single-stage abutment.

✓Use additional space for soft tissue augmentation

✓ Fixation of a prefabricated temporary restoration using frenuloplasty of the upper lip frenum

✓ Fabrication of all-ceramic restorations on teeth 1.3, 1.2, 1.1, 2.2, 2.3 and implant in position 2.1

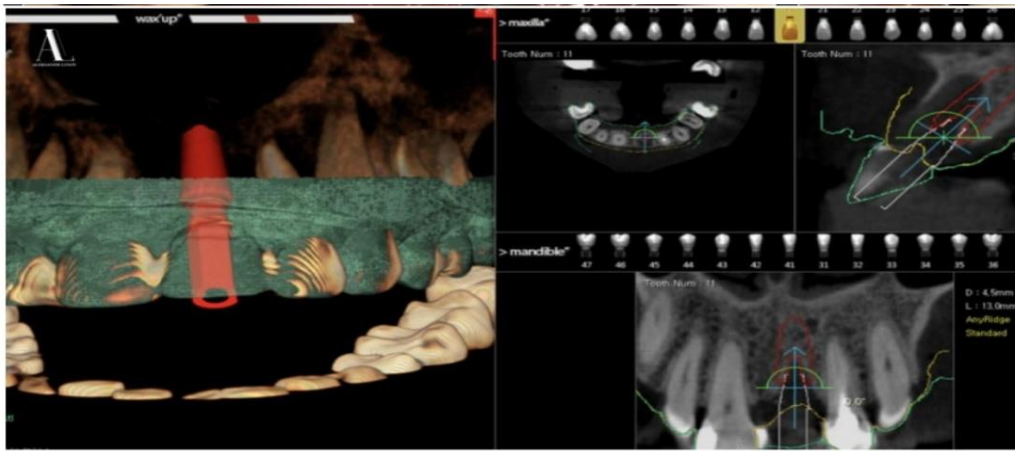

Fig.1 Scheduling the implant installation digitally

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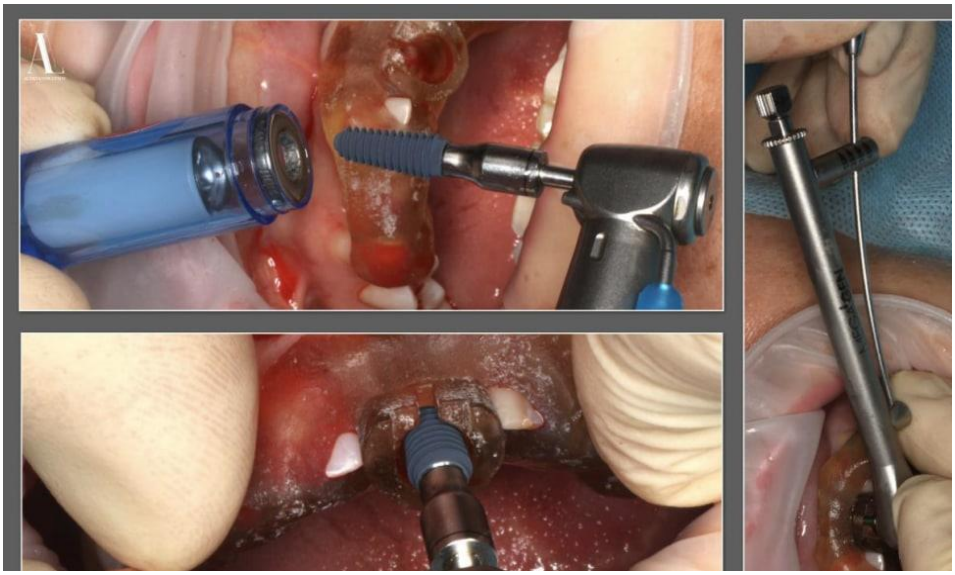

Fig. 2 Dental implant placement using a surgical template.

A total of 62 patients were operated on using this technique. A stable clinical effect was observed in all cases. During the clinical examination of patients after surgery, we were interested in the condition of the mucosa over the implants, the condition of the wound and sutures, the mobility of adjacent teeth, soft tissue swelling. It should be stressed that the result of treatment depends on the observance of important conditions in the pre- and postoperative periods, as well as the technique of the operation: sanitation of the oral cavity, treatment of the adjacent teeth, aseptic operation, correct mucosal cut of the periosteal flap, the sparing of all the stages of surgery, tight suturing, oral hygiene after surgery, rest of the operating wound. If at least one of these conditions is violated, the results of the operation could be negative. In the postoperative period, the patients were treated with antibiotic therapy for 5-7 days, if possible, taking into account the sensitivity of the microflora that had been isolated. The patients complained only about the postoperative wound, moderate pain and swelling. Pain in the area of the surgical wound ceased on day 2-3. The skin and oral mucosa in the area of the operative field were clean, not hyperemic. In the area of the wound there was a moderate swelling of soft tissues for 2-3 days. Wounds were irrigated daily. The stitches were removed on day 7-8.

In a review of the patients treated with the traditional method, it was determined that 2.6±1.5 months were spent for osseointegration. In addition, osteoresorption was observed in the vestibular plate, that is, preoperative changes of 11.14±1.2mm and postoperative changes of 6.8±1.5mm were observed. At the same time, changes in the interdental papillae and the zenith of the gingival contour, changes in the soft tissue

biotype, and fixation of the vestibular bone wall contributed to reduced aesthetic results.

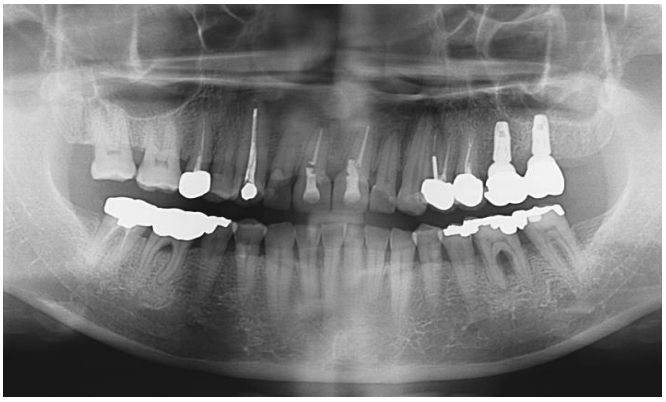

Figure 1: Condition before conventional treatment

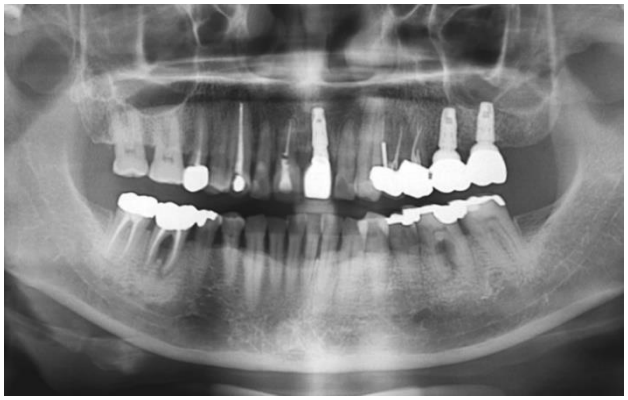

Figure 2: 3 months after surgery

CONCLUSIONS

It has been established that application of the principle of inverse planning in an engineering software environment allows for an approach which improves the accuracy of implant placement as well as error-free correlation between the orthopaedic and surgical phases of treatment at the stage of calculation of the topography of implant placement.

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