Technical procedure

The smiling scan technique: Facially driven guided surgery and prosthetics

Alessandro Pozzi\textsuperscript{a,b,\*}, Lorenzo Arcuri\textsuperscript{c}, Peter K. Moy\textsuperscript{d}

\textsuperscript{a}Dental College of Georgia, Augusta University, Augusta, GA, USA
\textsuperscript{b}Private Practice, Rome, Italy
\textsuperscript{c}University of Rome Tor Vergata, Rome, Italy
\textsuperscript{d}Department of Oral & Maxillofacial Surgery, UCLA School of Dentistry, Los Angeles, CA, USA

A R T I C L E   I N   F O

Article history:
Received 21 October 2017
Received in revised form 24 February 2018
Accepted 1 March 2018
Available online xxx

Keywords:
Digital workflow
Smile design
Computer assisted surgery
Computer guided surgery
CAD/CAM
Dental implant

A B S T R A C T

Purpose: To introduce a proof of concept technique and new integrated workflow to optimize the functional and esthetic outcome of the implant-supported restorations by means of a 3-dimensional (3D) facially-driven, digital assisted treatment plan.

Methods: The Smiling Scan technique permits the creation of a virtual dental patient (VDP) showing a broad smile under static conditions. The patient is exposed to a cone beam computed tomography scan (CBCT), displaying a broad smile for the duration of the examination. Intraoral optical surface scanning (IOS) of the dental and soft tissue anatomy or extraoral optical surface scanning (EOS) of the study casts are achieved. The superimposition of the digital imaging and communications in medicine (DICOM) files with standard tessellation language (STL) files is performed using the virtual planning software program permitting the creation of a VDP.

Conclusions: The smiling scan is an effective, easy to use, and low-cost technique to develop a more comprehensive and simplified facially driven computer-assisted treatment plan, allowing a prosthetically driven implant placement and the delivery of an immediate computer aided design (CAD) computer aided manufacturing (CAM) temporary fixed dental prostheses (CAD/CAM technology).

© 2018 Japan Prosthodontic Society. Published by Elsevier Ltd. All rights reserved.

1. Introduction

The growing interest in minimally invasive implant placement with the option of delivering a pre-fabricated provisional prosthesis immediately, have led to the development of numerous 3-Dimensional (3D) planning software programs [1–6]. The new technological advancements have significantly improved data acquisition, leading to a more realistic and accurate overview of the bony and anatomic structures, as well as bone density, to predict the stability of implants starting with the virtual planning stage [7]. Performing a prosthetically driven diagnosis and treatment are mandatory to achieve optimal implant positioning and delivering the ideal prosthetic contour [8,9]. The 3D visualization of the implant recipient site characteristics and neighboring anatomy provides the clinician with more insight into the surgical, prosthetic and aesthetic requirements of the treatment and may improve decision-making, increasing the predictability of the overall implant treatment [10]. The facial analysis, with all the interrelated anatomic parts involved in the patient smile (lips, cheeks, gingival architecture and teeth) is highly advised in order to deliver a successful facial and smile rejuvenation in the treatment of the aesthetic zone and even more important in the complete arch implant supported restorations [11–15].

The article introduces a more comprehensive, facially driven digital treatment plan to compose simulated patient models, through the superimposition of only 2 data sets of files the digital imaging and communications in medicine (DICOM) and the standard tessellation language (STL) files. The feasibility and advantages of this proof of concept digital integrated workflow are presented and discussed throughout the manuscript.

2. Materials and methods

An integrated digital workflow may enhance a more comprehensive treatment plan, based on a non-invasive simulation of the surgical and prosthetic outcomes, as well as a more effective communication among patient, clinician and dental technician [16,17]. The Smiling Scan technique allows the successful creation of a virtual dental patient (VDP) showing a broad smile under static conditions, through the superimposition of 2 different digital data sets, the DICOM files generated by the cone beam computed tomography (CBCT) scan recorded while the patient displays a broad smile on for the duration of the scan and the STL files...
obtained by the intraoral optical surface scanning (IOS) or extraoral optical surface scanning (EOS) of the patient’s intraoral anatomy (Carestream 3600 Intraoral Scanner, Carestream Dental LLC, Atlanta, GA, USA). The smile is a facial expression initiated by flexing the muscles surrounding the oral cavity (Obiculares oris) without vocalization thus displaying the front teeth. These instructions were given to the patient before taking the CBCT scan. A high speed CBCT device (Scanora 3Dx, Kavo Dental GmbH, Biberach, Germany) with an amorphous silicon detector was used to scan the patient with the following settings: field of view (FOV) 140 mm height, 100 mm width, high resolution (voxel sizes 0.25 mm), kV 90, mA 10, and an effective exposure time 6 s. The patient’s head was properly secured on the CBCT scanner chair by means of the head frame positioner. The chin rest and support were not used to avoid any restrictions to the muscle movements during the smile or limiting the facial expression. The patient was asked to keep the dental arches in contact during the smile in order to record the current maxillo-mandibular skeletal relationship and occlusion (Figs. 1 and 2).

In case of patients with terminal dentition, the Smiling Scan is performed without any removable prostheses in the mouth. In the integrated digital workflow, the superimposition of the CBCT scan and optical surface scan, through matching of the resulting DICOM and STL data files, requires identifying corresponding landmarks in both scanning datasets. The proprietary algorithm process (SmartFusion, Nobel Biocare AG, Kloten, Switzerland) automatically overlays the DICOM data with the STL data, regardless if the source of the optical scanning is an intraoral scanner or a laboratory scanner. Technically, the accuracy of this automatic matching workflow is 1 voxel size below the manual segmentation workflow (Nobel Biocare AG, Data on file), based on pairing of a minimum of three points on the surface of the patient’s CBCT anatomy with the equivalent three points from the patient’s anatomy obtained by digital high-resolution optical scanning.

Thus, the combination of CBCT and IOS images, by superimposition of the data sets and use of planning software, provides a complete and accurate 3D representation of both hard and soft tissues (Fig. 3). The novel digital integrated workflow investigated by the authors is based on the automatic integration of two software, the surgical software (NobelClinician) and the restorative software (DTX Studio Design), (Nobel Biocare AG). The combination of the two software allowed the 3D implant planning according with the automated design of the missing tooth/teeth with the proper functional and esthetic shape, as well as placing the missing tooth/teeth in occlusion with teeth in the opposing arch (Fig. 4). Moreover the prosthetic outcome can be verified and validated with the use of the fully-adjustable virtual articulator tool of the restorative software, properly set up according with the patient values assessed with an electronic face-bow (Arcus Digma, Kavo Dental GmbH).

In case of complete edentulism of one or both dental arches or terminal dentition with less than 3 teeth, the Smiling Scan was performed with a double scan technique [18].

3. Difference from conventional methods

Dentists face challenges in restoring aesthetics and function, particularly in case of patients with partial edentulism in the anterior zone, terminal dentition [19] or fully edentulism, due to the difficulties found with relating soft tissue facial features to the definitive casts used to identify the requirements of the intended restoration [11]. The smile design considers different scientific and
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات