Impression of multiple implants using photogrammetry: Description of technique and case presentation

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Abstract

Aim: To describe a technique for obtaining impressions of multiple implants using a system based on photogrammetry. This case is presented in which a prosthetic treatment was performed using this technique.

Study Design: Three Euroteknika® dental implants were placed to rehabilitate a 55-year-old male patient with right posterior maxillary edentulism. Three months later, the positions of the implants were registered using a photogrammetry-based stereoscopic system (PICcamera®).

After processing patient and implant data, special abutments (PICabutments®) were screwed onto each implant. The PICcamera® was then used to capture images of the implant positions, automatically taking 150 images in less than 60 seconds. From these images, the software was able to capture, automatically and without user interference, the spatial position of each implant. Information regarding the soft tissue was obtained from an alginate impression, which was cast in plaster and scanned. A Cr-Co structure was obtained using the printed design, which was placed on photogrammetry. A 55-year-old male with no relevant medical history was selected as the patient for the proposed photogrammetry technique. The aim of this study was to show the accuracy and reliability of this method.

Results and Conclusions: Twelve months after loading, the implants were healthy and no marginal bone loss was observed.

The clinical application of this new system using photogrammetry showed the accuracy and precision of the method. The method for digital transfer of implant positions is an alternative to conventional impressions and can be used in case of posterior maxillary edentulism. The photogrammetry system was shown to have the accuracy and reliability to be used in clinical practice.

Key words: Dental implants, photogrammetry, digitalization technique, CAD/CAM

Introduction

Dental implants are one of the most widely used therapies for the rehabilitation of partially or completely edentulous patients. It is scientifically proven that achieving a proper passive fit of the implant-supported prosthesis is a key factor to success.

The classic system for fabricating implant-supported prostheses involves the use of conventional impression techniques, and after placement of the implant analogues, subsequent casting in plaster to make the final impression. In order to achieve an adequate passive fit of the prosthesis, the latter must be obtained in a correct registration of the three-dimensional position of the implants (Fig. 1).

Conventional impression techniques use abutments that, screwed onto the implants’ prosthetic platforms and encompassed by setting material, should register and transfer the spatial position of the implant. These methods involve time-consuming clinical work and the use of impression materials and techniques that often fail to achieve a perfectly accurate transfer. Moreover, these techniques are generally unpleasant for the patient (7,8).

In recent years, there has been an increasing application of digital techniques at different stages of dental implant therapy (7,10-12). At the stage when impressions are taken, intraoral scanners are gaining increasing clinical practice. This technique avoids the need for registration of implant positions with impression materials and transfer to model space. Therefore, it has been shown to be a useful technique that will improve the quality of dental implant therapy.

The aim of this report is to describe this technique applied to record the position of multiple dental implants using a system based on photogrammetry. A case is presented in which a prosthetic treatment was performed successfully using this technology.

The PICcamera® allows the PICabutments® to be printed and optimized for clinical use, which accurately determines the position of the implants by the use of topographical images and the identification of abutments screwed on implants with unique individual coding (PICabutments®, PICdental). Once the camera had detected the position of each implant, it automatically took 10 to 12 pictures per second with an error of less than 10 microns. The angles and distances between implants were measured and treated as a unit.

The PICcamera® is a stereo-camera (PICcamera®) equipped with infrared filters to record the position of implants with ambient light. The PICcamera® is a stereocamera that records the position of implants, allows the transfer of information to the computer, and enables the correct implant position to be registered and transferred to the patient’s mouth with a maximal angle of 45° with respect to the PICabutments®. After this, the camera had detected the position of each implant, it automatically captured 50 three-dimensional photographs for every two PICabutments®. This results in a total of 100 photographs for each implant.

Once the camera has captured the images, they are processed in a manner that allows the addition of false gum, to allow the patient to view the future restorations in the mouth.

Once the internal structure of the implant-supported fixed partial denture had been fabricated, its passive fit was checked in the patient’s mouth. The Sheffield and one-screw test were used: a distal screw was placed on the screw at 14 in this case - and a peripical radiograph was obtained to check the correct prosthetic position on the other two implant connections (Fig. 2).

The screw resistance technique was used as a subjective complementary test of the passive fit. Distal screws (at 14 and 17) were screwed with a torque of 10 Ncm and then a medial screw was introduced to verify that the tension was soft and presented no resistance to screwing. After these verifications, the Cr-Co structure was sent to the laboratory to have the ceramic loaded.

The prostheses, once finished, were screwed onto the implants (Fig. 3), with 25 Ncm torque. Occlusal adjustments were performed and the correct set- denture on the implant connections was verified with a radiograph (Fig. 4). A follow-up plan was established and twelve
months after loading, the peri-
implant tissues were healthy and no peri-implant marginal bone loss was observed (Fig. 5). Discussion The provision of ten-
sion-free connections between implants and the prosthetic structures they support is a re-
quirement for medium- and long-term success of implant-
supported rehabilitations. This situation is achieved by carrying out a prosthodontic treatment with good passive fit. Preparation of the abutments using both clinical and laboratory procedures involved in fabricating the prosthesis and performing precisely and accurately, keep-
ing the margins of error and implant-supported rehabilitations in the process to a minimum (1,2). In vitro studies have shown that discrepancies in the super-
structure will be the cause of stress on the implant-supported prosthesis and subsequent fail-
ure. As long ago as 1989, Ruhé described mechanical failures which he associated with labor-
orous positioning of the prosthesis using imprecise working models. Jenet et al. (8) and Ruhrenstein et al. both analyzed the fit between prosthesis and abutment is a key parameter for avoiding overloading of the supporting screw which leads to prosthetic failure. For this reason, the taking of im-
pression is considered an important aspect for obtaining structures with a good passive fit. There is some controversy in the literature as to which impression technique is the most reliable.

Regarding the digital techniques, some of the conven-
tional techniques it is impos-
sible to achieve a perfect passive fit. For this reason, a review of the precision of im-
pression techniques, found that 55% of the tests performed con-
sidered the open tray technique to be the most precise, 15% the conventional technique and 50% found no statistically sig-
nificant difference between the techniques. The number of implants in relation to precision, with three or more implants there did not appear to be a difference between techniques, while with four or more the open tray tech-
nique is considered to be recom-
 mendable (6). The greater accu-
raty of the open tray technique is due to the fact that the impression is taken directly from the patient, with the clinical and laboratory pro-
cess to a minimum (1,22). Furthermore, the photogram-
metry procedure can be inter-
rupted at any time, and taken up again later.

The concept of photogram-
metry consists of ‘metering what is visible in other words, obtaining reliable metric in-
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The clinical application of this sys-
tem is based on the idea of using the device to register the exact three-
 dimensional position of each implant. The result is a digital model of the implant that can be used to fabricate the prosthesis.

Photographic and video scan-
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tages of photogrammetry. Scan-
ers generate 3D images on the computer, which potentially provides greater precision and a better passive fit. An in vitro study of the accuracy of the PICcamera improves patient comfort in comparison with conventional impression techniques. The tech-
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niques. There is no need for impression abutments, implant impressions, body analogues, trays and im-
pression materials. The PIC-
camera measures angles and distances progressively according to the presence of blood, saliva or any other organic or inorganic residue does not affect measurement precision. Avoiding so many procedures and materials significantly reduces the possibility of errors saves time – both the number of visits to the clinic and their dur-
ation – economical and patient discomfort in comparison with conventional impression taking procedures.

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