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

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Abstract

Aim: To describe a technique for registering the positions of multiple dental implants using a system based on photogrammetry and digital subtractive milling.

After processing patient and implant data, special abutments (PICabutments®) were screwed on to 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 system was programmed to describe the relative positions - angles and distances - of the implants. Information regarding the soft tissues was obtained from an alginate impression which was cast in plaster and scanned. A Cr-Co structure was obtained using a system based on photogrammetry. This was placed 15 cm away from the camera and used to check the accuracy of the scanning. The camera has an infrared flash that constantly illuminates the scanned object while eliminating the shadows that occur with ambient light. The PICcamera® needs to capture 50 three-dimensional photographs for every two PICAabutments®. To do this, it automatically takes ten extra photographs per second with an error of less than 10 microns. The registered angles and distances between implants are interrelated and treated as a unit. The system software calculates average angles and distances between implants from these photographs, obtaining an accurate relative position of each implant. This information is provided in the PICAabutments® (PIC Dental), which contains all the information on its passive fit and the position of the implant connections, the abutments and screws that are later required CAD/CAM software.

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 proper passive fit of the implant-supported prostheses improves the long-term prognosis of this therapy (1-5). The classic system for fabricating implant-supported prostheses involves the use of a plaster model of the implant and, after placement of the implant analogues, subsequent casting in plaster to make pressurisation transfers. In order to achieve an adequate passive fit of the abutments, all the data must be obtained to ensure a correct registration of the three-dimensional position of the implants (6). 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 master cast. Moreover, these techniques are generally unpleasant for the patient (7,8).

Aim: To describe a technique for registering the positions of multiple dental implants using a system based on photogrammetry and digital subtractive milling. The case is presented in which a prosthetic treatment was performed using this technique.

Study Design: Three Europeanka® 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 system (PICcamera®), after processing patient and implant data, special abutments (PICabutments®) were screwed on to each implant. The PICcamera® was then used to capture images of the implant positions, automatically taking 150 images in less than 60 seconds. From the images, the system was programmed to describe the relative positions - angles and distances - of the implants. Information regarding the soft tissues was obtained from an alginate impression which was cast in plaster and scanned. A Cr-Co structure was obtained using a system based on photogrammetry. This was placed 15 cm away from the camera and used to check the accuracy of the scanning. The camera has an infrared flash that constantly illuminates the scanned object while eliminating the shadows that occur with ambient light. The PICcamera® needs to capture 50 three-dimensional photographs for every two PICAabutments®. To do this, it automatically takes ten extra photographs per second with an error of less than 10 microns. The registered angles and distances between implants are interrelated and treated as a unit. The system software calculates average angles and distances between implants from these photographs, obtaining an accurate relative position of each implant. This information is provided in the PICAabutments® (PIC Dental), which contains all the information on its passive fit and the position of the implant connections, the abutments and screws that are later required CAD/CAM software.

Clinical Procedure

A 55-year-old male with no relevant medical history came to the Oral Surgery Unit of the University of Valencia requesting the rehabilitation of bicuspid right maxillary posterior region with dental implants. After checking the presence of enough residual alveolar bone height by means of a panoramic radiograph, three Euroteknika® (Euroteknika Ibèrica, Barcelona, Spain) implants were placed of 4.4 mm in diameter (Fig. 1). Three months later, the position of the implants was registered using the PICcamera® (PICden- tal). Firstly, the patient's den- tures were removed, and data were entered into the system. Then, the positions and the references of the implants (master model, platform diameter, di- ameter and height of the healing abutment), as well as the code of each PICAabutment® were in- troduced. The PICAabutments® were screwed onto each implant (Fig. 1), and the PICcamera® was placed 15 cm away from the patient's mouth with a maxi- mum angle of 45° with respect to the PICAabutments®. Once the camera had detected that the position was correct, it automatically captured 50 three-dimensional photographs for each two PICAabutments®. To do this, it automatically takes ten extra photographs per second with an error of less than 10 microns. The registered angles and distances between implants are interrelated and treated as a unit. The system software calculates average angles and distances between implants from these photographs, obtaining an accurate relative position of each implant. This information is provided in the PICAabutments® (PIC Dental). The healing abutments were placed and an alginate im- pression was taken and cast in plaster. The plaster model was scanned with a 3D scanner in open STL format to obtain information regarding the patient's soft tissues (Fig. 1). This information was automatically compiled into a vector PICbille® (PIC dental). The prosthesis was then fabricated and placed by the patient (Fig. 2). Conclusions

These methods involve time-consuming clinical work and the use of impression materials and techniques that often fail to achieve a perfectly accurate master cast. Moreover, these techniques are generally unpleasant for the patient. The aim of this report is to de- scribe this technique applied to register 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 technique.

Keywords: Dental implants, photogrammetry, digital subtractive milling system, CAD/CAM.

References

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- sions, interactions between implants and the prosthetic structures they support is a re- quirement for successful and long-term success of implant- supported rehabilitation. This situation is achieved by carrying out a prosthodontic treatment with good passive fit. Proper fit is achieved on all the clinical and laboratory proce- dures involved in fabricating the prosthesis, ensuring performed precisely and accurately, keep- ing the margins of error and improving the precision in the process to a minimum (1,22).

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 as 1988, Sahli described mechanical failures which he associated with labo- ratory errors, obtaining using imprécise working models. Jennet et al. (8) and Rubenstein et al. also demonstrated the differences in fit between prosthesis and abutment is a key parameter for avoiding overloading of the prosthetic screw, which leads to prosthetic failure. For this reason, the taking of im- pressions represents the starting point for obtaining structures with a good passive fit. There is some controversy in the literature as to which impression technique is the most reliable.

Recent reviews on the conventional techniques it is impo- sible to achieve a perfect passive fit to the implant. Wee et al. (23) suggested that the fit be determined by the PICcamera®. The technique avoids the in- convenience accompanying conventional impression tech- niques. There is no need for impression materials, implant- supported screw access channel. J Prosthet Dent. 1999;12:167-78.

The PICcamera improves the precision of implant impressions, which he associated with labo- ration errors, obtaining using imprécise working models. Jennet et al. (8) and Rubenstein et al. also demonstrated the differences in fit between prosthesis and abutment is a key parameter for avoiding overloading of the prosthetic screw, which leads to prosthetic failure. For this reason, the taking of im- pressions represents the starting point for obtaining structures with a good passive fit. There is some controversy in the literature as to which impression technique is the most reliable.

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