Clinical dental informatics protocol to evaluate the behavior of buccal wall dimensions on immediate implants

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INTRODUCTION

Alveolar ridge resorption after a tooth extraction is a physiological phenomenon that occurs during the healing process of the wound, and may affect the stability of the hard and soft tissues. Some authors report that implants should be placed immediately after a tooth extraction in order to prevent bone resorption. However, various other authors consider that immediate implant placement in post-extraction sites does not prevent vertical or horizontal bone resorption, and bone regeneration techniques should be applied in these situations. Recently, Santz concluded also that this procedure results in a significant bone reduction, by means of a re-entering surgery process and measurements with a caliper instrument. However, evolution of dental imaging (e.g. cone-beam CT scans) and computerized technologies (based on Digital Images Processing, Pattern Recognition and Artificial Intelligence techniques) applied to Dentistry has increased over the last years, and may work today as a tool to build more precise measurement protocols.

PURPOSE

The purpose of this study is to present a dental informatics protocol – with a clinical case example - to help in the exact evaluation / quantification of the alveolar ridge width changes in a clinical procedure of immediate implant placement in an extraction socket.

PROTOCOL PRESENTATION

Inclusion criteria:
- Patients with a clinical procedure of immediate implant placement planned.
- Panoramas or dental images (CBCT) showing a recent extraction site recommended.
- Observation of GBR materials performed.

Three groups of patients differentiated:
1. - Gap < 1 mm – with GBR
2. - Gap > 1 to 2 mm – with GBR
3. - Gap > 2 to 3 mm – with GBR

Three times to perform CBCT scans:
- Immediately after surgery
- 6 months
- 12 months

Images selection:
- Midslice of the implant with its maximum length, in the CBCT scan DICOM images.

Images processing method:
- Detection based on thresholding techniques to obtain the initial implant approximation.
- Object’s contour (multistage algorithm - Canny Edge Detector) used to extract three initial points belonging to the implant (IP).
- Three another points are computed by bone’s points (BP) from the border of the bone in the same direction of the IP.
- Euclidean distances are compute between both types of extracted points with the aim to compare the obtained measures.

The proposed method was implemented in MATLAB v7.6, run in MATLAB R2007a, USA, and created by the Laboratory of Optics and Experimental Mechanics - University of Porto as a prototype software.

CLINICAL CASE EXAMPLE

Fig. 1 - Immediate implant in 34. Gap >1mm. GBR performed.
Fig. 2 - Cone-beam CT scan slices of implant in 34.
Fig. 3 - Thresholding of bone and implant.
Fig. 4 - Object’s contour determined by Canny Edge Detector, used to extract three initial points belonging to the implant.
Fig. 5 - Three bone points are computed from the border of the bone in the same direction of the points of the implant. Measures are obtained in number of pixels.

PRELIMINARY RESULTS

The application of this protocol in this particular clinical case shows a reduction in the distance implant - bone buccal wall of 2 pixels in each of the 3 points, which is equivalent to 0.6mm (1px=0.3mm), in a 6 months follow-up.

CONCLUSIONS

Cone-beam CT scan software's developed do not allow for an exact quantification of the evolution of the buccal wall on immediate implants. The proposed method demonstrated high performance in the detection of implants and bone on CBCT scans images. This protocol, with the inclusion of the developed method, may contribute as a powerful tool to help in the evaluation of the behavior of the buccal bone walls on immediate implants, without surgery re-entering processes.

REFERENCES