# Acrylic Customized X-Ray Positioning Stent

## for Prospective Bone Level Analysis in Long-Term Clinical Implant Studies

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## Background

Long-term evaluation of dental implants and their surrounding structures is crucial to provide more informa- tion concerning the success or failure of these therapies in clinical trials. The radiographic analysis, in conjunc-tion with the clinical evaluation of the implant sites, is the best non-invasive method for bone level determination[1-4]. Among the diverse radiographic techniques, the periapical technique has proven to be the most accurate method for the linear measurement of alveolar bone height[5-7]. However, the diagnosis of progressive bone loss or the identification of bone gain from one radiographic examination to the next may be very difficult to interpret due to errors in the alignment of successive images.

To overcome this problem, Updegrave[8] detailed the paralleling extension-cone technique and introduced the Rinn system, the first film holder to keep the film parallel to the tooth and in a flat position, but still not producing acceptable images for continuous reproduction. Ever since, numerous systems have been proposed to obtain superimposable dental radiographs but have not proven to prevent projection errors effectively as they fail to ensure the realignment of the initial imaging geometry[9-12].

## Aim

This poster describes a technique to produce individualized X-ray positioning devices for obtaining optimally projected intraoral radiographs of dental implants with long term stability.

## Materials & Methods

### Clinical & Laboratorial Procedures

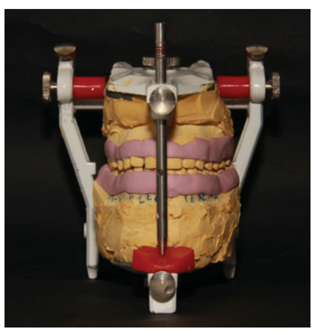

**Fig 1 -** Articulator mount and elimination of undercuts.

**Fig 2 -** Vertical and horizontal sensor basket plus sensor replica.

**Fig 3 -** Dentsply Rinn XCP-DS® system (bite block + sensor basket + positioning metallic tip).

**Fig 4 -** Tryout of the assembly to guarantee the best radiographic projection of the area of interest.

**Fig 4 -** Seating of a bilateral self-cure acrylic block over the arch containing the area of interest.

**Fig 5 -** Fitting of the assembly over the acrylic block.

**Fig 6 -** Seating of bilateral self-cure acrylic block over a minimum of 4 teeth of the opposing arch.

**Fig 7 -** Stabilization of the bite block.

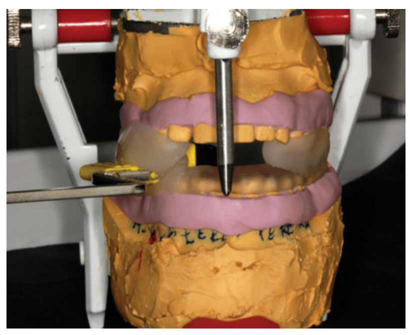

**Fig 8 -** Frontal view of the acrylic stent with the bite block, sensor basket and metallic tip.

**Fig 9 -** Lateral view of the acrylic stent.

**Fig 10 -** Occlusal and posterior views of the position of the sensor, placed in the basket parallel to the area of interest.

**Fig 11 -** Frontal view of the intra-oral trial of the acrylic stent with the bite block and sensor.

**Fig 12 -**Fitting of the aiming ring in the metallic tip and orientation of the x-ray tube

**Fig 13 -** Stabilization of the x-ray tube orientation with polivinylsiloxane

### Radiographic images

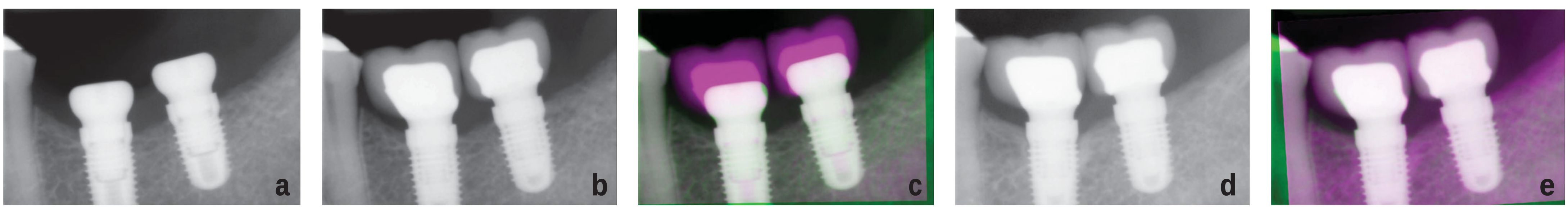


**Fig 14 -** Representative calibrated radiographs obtained at surgery (a), loading (b) and 1 year post-loading (d). Image (c) represents the corregistration of the first pair of images (a and b), revealing the superimposition of the radiographs taken at surgery and loading. Image (e) represents the corregistration of the radiograph taken at loading (b) and 1 year post-loading (d). Unchanged structures remain in grey scale whereas structures present in only one of the radiographs are either represented by green or purple.

Reliability analysis for the measurements taken at the implants in each moment (surgery, loading, 1 year post loading) revealed an intra-class correlation coefficient for the mesio-distal width of 0.964 [(0.920 - 0.986) 95% CI] ($p < 0.01$) and 0.990 [(0.976 - 0.996) 95% CI] ($p < 0.01$) for the thread pitch.

## Conclusions

The template here described for X-ray standardization is adapted from a commercially available system meant for radiovisiography. This X-ray alignment device minimizes variations in X-ray imaging geometry and prevents angular distortion and alignment errors between two consecutive radiographs, thus making matching images that are superimposable, which allows a quantitative analysis of longitudinal radiographic crestal bone changes.

## References

[1]L. Laurell, and D. Lundgren, "Marginal Bone Level Changes at Dental Implants after 5 Years in Function: A Meta-Analysis," Clinical Implant Dentistry and Related Research, Vol. 13, No. 1, 2011, pp. 19-28. [2] M. P. Hanggi, D. C. Hanggi, J. D. Schoolfield, J. Meyer, D. L. Cochran and J. S. Hermann, "Crestal Bone Changes around Titanium Implants. Part I: A Retrospective Ra- diographic Evaluation in Humans Comparing Two Non- Submerged Implant Designs with Different Machined Collar Lengths," Journal of Periodontology, Vol. 76, No. 5, 2005, pp. 791-802. [3]J. S. Hermann, J. D. Schoolfield, P.V. Nummikoski, D. Buser, R. K. Schenk and D. L. Cochran, "Crestal Bone Changes around Titanium Implants: A Methodologic Study Comparing Linear Radiographic with Histometric Measurements," The International Journal of Oral & Maxillofacial Implants, Vol. 16, No. 4, 2001, pp. 475- 485. [4]F. Isidor, "Clinical Probing and Radiographic Assessment in Relation to the Histologic Bone Level at Oral Implants in Monkeys," Clinical Oral Implants Research, Vol. 8, No. 4, 1997, pp. 255-264. [5] M. Wakoh, et al., "Reliability of Linear Distance Meas- urement for Dental Implant Length with Standardized Periapical Radiographs," The Bulletin of Tokyo Dental College, Vol. 47, No. 3, 2006, pp. 105-115. [6]E. De Smet, R. Jacobs, F. Gijbels and I. Naert, "The Ac- curacy and Reliability of Radiographic Methods for the Assessment of Marginal Bone Level around Oral Im- plants," Dentomaxillofacial Radiology, Vol. 31, No. 3, 2002, pp. 176-181. [7]H. J. Meijer, W. H. Steen and F. Bosman, "A Comparison of Methods to Assess Marginal Bone Height around Endosseous Implants," Journal of Clinical Periodontology, Vol. 20, No. 4, 1993, pp. 250-253. [8] W. J. Updegrave, "The Paralleling Extension-Cone Technique in Intraoral Dental Radiography," Oral Surgery, Oral Medicine, Oral Pathology, Vol. 4, No. 10, 1951, pp. 1250-1261. [9] N. Fernandez-Formoso, B. Rilo, M. J. Mora, I. Marti- nez-Silva and U. Santana, "A Paralleling Technique Mo- dification to Determine the Bone Crest Level around Dental Implants," Dentomaxillofacial Radiology, Vol. 40, No. 6, 2011, pp. 385-389. [10] R. L. Navarro, P.V. Oltramari, J. F. Henriques, A. L. Capelozza, E. Santana and J. M. Granjeiro, "Radiographic Techniques for Medical-Dental Research with Minipigs," The Veterinary Journal, Vol. 174, No. 1, 2007, pp. 165-169. [10] T. E. Southard, D. M. Wunderle, K. A. Southard and J. R. Jakobsen, "Geometric and Densitometric Standardization of Intraoral Radiography through Use of a Modified XCP System," Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, Vol. 87, No. 2, 1999, pp. 253-257. [11] B. Dubrez, S. Jacot-Descombes and G. Cimasoni, "Reliability of a Paralleling Instrument for Dental Radio- graphs," Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, Vol. 80, No. 3, 1995, pp. 358-364. [12]. C. Wu, et al., "Use of a Simple Intraoral Instrument to Standardize Film Alignment and Improve Image Re- producibility," Oral Surgery, Oral Medicine, Oral Pa- thology, Oral Radiology, Vol. 100, No. 1, 2005, pp. 99- 104.