Implant stability is one of the principal factors in the clinical success of implant therapy. Research has shown that one of the major causes of failures in osseointegration is excessive micro-movements, although to date, there is no clinically available method for measuring micro-movements.

In this study 32 endosseous implants (Camlog Biotechnologies®; Wimsheim, Germany) inserted in rehabilitated patients with two or more adjacent dental implants in the lower posterior jaw (Fig.1). Implants were restored using single unit crowns over two different prosthetic abutments SD (N=18) and PS (N=14), were used (Fig. 2).

Implant stability was also measured clinically in ISQ (Implant Stability Quotient) using the Osstell® ISQ (Osstell® ISQ Integration Diagnostic, Sweden) [Fig.5]. The results were statistically analyzed with the software IBM SPSS Statistics 20.0 (SPSS Inc., Chicago, Illinois, USA). Micro-movement measurements were performed by 3D DIC with two high speed photographic cameras [Fig.3] (Point Grey GRAS-2048M, PENTAX TV Lens 75mm, 1:2.8, with 1624x1224 resolution) and the video correlation system Vic-3D 2010 (Correlated Solutions®, Columbia, USA). After the application of a bite load of more than 30N, measured with a miniature compression loading cell [Applied Measurements Ltd., Berkshire, UK] and the system design software LabVIEW 2010 (National Instruments®, Texas, USA) [Fig.4].

In order to measure micro-movements, the system required a heterogeneous pattern which was handmade with a airbrush Evolution Silverline (Harder & Steenbeck, Nordstedt, Germany) over a sticker paper and placed on the buccal side of both the crown over the implant and the neighboring natural tooth (Fig.6). After images acquisition, micro-movements analysis was done with a post-processing application from Vic-3D 2010, in order to remove the rigid body motion.

For each patient, a stereo system calibration was performed using a standardized calibration target sized 14,922nm, with a pitch of 1,780nm (9x9), before acquiring images.

Conclusions

Within the limitations of this study, 3D DIC method is capable to measure dental implants micromovements, although not being a clinical system.

The results didn’t show statistical significant differences between the two prosthetic platforms (Mann-Whitney test) for any direction analyzed [Graph 1]. U: U=69,500; p=1.232; p=0.218; V: U=79,500; z= 0.766; p=0.441; W: W=76,500; p=0.908; p=0.365.

Within each platform, the paired sample analysis of the U, V and W values showed significant statistical differences between these three directions of displacement [Graph 2]. The same analysis made for all implants, independently of the prosthetic abutment confirmed that motion in W direction (Z=26,691, p=0.01) is significant statistically higher than in the other directions.