Scanning electron microscopy and photoelastic analysis on preload distribution in two in vitro loaded screw retained implant systems with different connection design

Congresso Nazionale dei Docenti di Discipline Odontostomatologiche
Abs # 128
Chieti
21-23 aprile 2010

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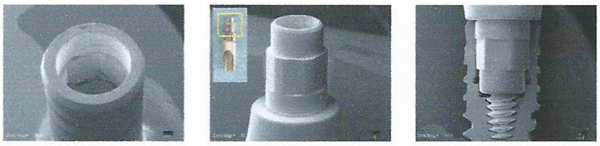
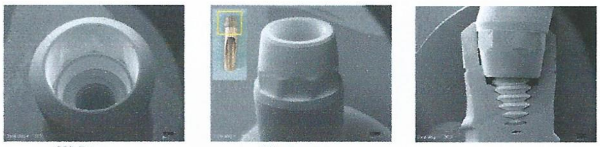
Failures of implant supported prosthesis represent an event difficult to be managed. As regards the screwed systems, screw loosening has been reported to be the most recurrent complication and many researchers state that the associated abutment mobility could compromise the survival of the rehabilitation. However, it is generally accepted that the screw loosening occurs most frequently in single crown implant restoration rather than in implant supported bridges. The **aim** of the present research is an in vitro evaluation of the preload distribution in screw retained implant system under cyclic load. **Materials and method**. In the present research two implant systems with internal connection have been tested: five 4.5x10 mm implants with internal hexagon (Xsign; Ihde Dental, Eching, Germany) and five 4.5x10 mm implants with internal octagon (SSO, Ihde Dental, Eching, Germany). One angled abutment (25°) was screwed on each implant applying a torque of 25 Ncm for Xsign implants, and 35 Ncm for SSO implants.

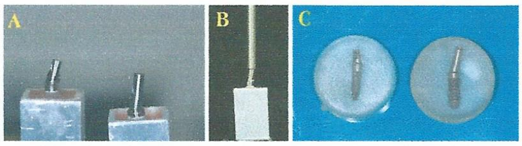


Xsign fixture | Xsign abutment | Xsign fixture/abutment assemblies



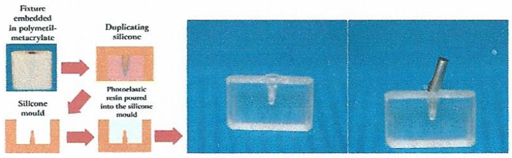
SSO fixture | SSO abutment | SSO fixture/abutment assemblies

Cyclic loading. Samples underwent to a cyclic load comprised between 100 N and 200 N for 1x106 cycles. After mechanical tests, samples were retrieved, resin embedded, sectioned along the long axis and analyzed under a scanning electron microscope.



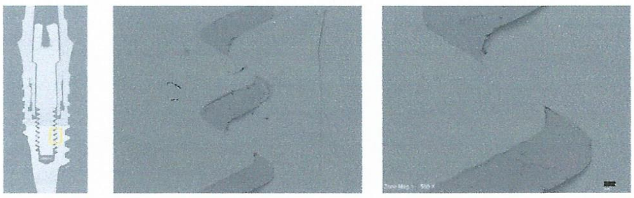
A: Implants positioned in aluminium blocks; B: implant during cyclic load; C: implants embedded in resin

Photoelastic analysis. Three 4.5x10 mm implants with internal hexagon (Xsign) and three 4.5x10 mm implants with internal octagon (SSO) were collected for photoelastic analysis. Each fixture was mounted in a resin-made parallelepiped measuring 20 mm x 20 mm x 10 mm. A mould per each resin parallelepiped/fixture assemblies was made using a silicone based impression material and an epoxy resin was poured in each mould. After setting of resin, six samples reproducing the internal parts of each fixture (exagon or octagon; internal screw threads) were obtained. 25° angled titanium abutments were screwed onto each resin made implant replica, afterwards assemblies underwent photoelastic analysis. Photographs under polarized light were taken before load and used as control images. Test photos were taken under an applied load of 25 N.



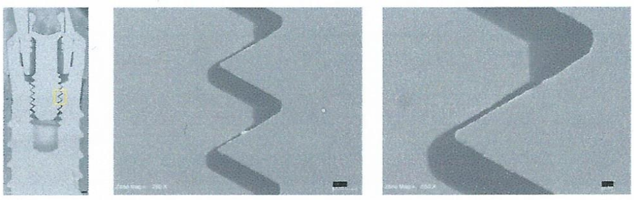
Photoelastic Models

Results. Microscopic evaluation of slices obtained from Xsign loaded implants revealed the absence of any structural damage against the screw and the internal threads. After cyclic load, screw threads and heads were still in contact respectively with internal fixture threads and abutment holes, suggesting that preload has not been loosened during load. SSO implants showed a different response; in two of the five samples tested, preload was loosened, and micrographs revealed the absence of a close contact between screw- and internal abutment- threads. In unloaded samples photoelastometry revealed the presence of fringes radiating from the region of implant neck and from the apical area of screw. During load, SSO and Xsign implant behave in a different way. Xsign samples revealed the presence of fringes radiating from the base of the abutment. SSO implants showed the presence of fringes radiating from the threads of the retention screw. **Conclusion**. From the present in vitro research it is possible to state that screw retained abutment based on a internal octagonal connection is less likely to come loose after cyclic load.



SEM images of a Xsign implant/abutment unit.

Photoelastic analysis of a Xsign sample.



SEM images of a SSO implant/abutment unit.

Photoelastic analysis of a SSO sample.

References:

1. T Tsuge, Y Hagiwara. Influence of lateral-oblique cyclic loading on abutment screw loosening of internal and external hexagon implants. Dental Materials Journal 2009;28:373381
2. HJ Conrad, JK. Schulte, MC Vallee. Fractures related to occlusal overload with single posterior implants: A clinical report. J Prosthet Dent 2008;99:251-256
3. DL Dixon, LC Breeding, JP Sadler, ML McKay. Comparison of screw loosening, rotation, and deflection among three implant designs. J Prosthet Dent 1995;74:270-8.
4. MS Schwarz. Mechanical complications of dental implants. Clin Oral Impl Res 2000;11:156158