Passive fit in the treatment of fully edentulous jaws with implant supported prosthesis: clinical and biomechanical aspects of a fixed hybrid prosthesis

Ilaria Franchini, Maria Cristina Rossi, Ezio Arioli, Ernesto Cappellato

UNIVERSITÀ DEGLI STUDI DI MILANO – DIPARTIMENTO DI SCIENZE CLINICHE "L. Sacco" - ISTITUTO ORTOPEDICO GALEAZZI - IRCCS – ISTITUTO DI RICICHERE E CURA A CARATTERE SCIENTIFICO

REPARTO DI IMPLANTOLOGIA E RIABILITAZIONE ORALE - Responsabile: Dr. Tiziano Testori

INTRODUCTION
Passive fit of implant-retained frameworks is the essential requirement for long-term maintenance of osseointegration, especially in screw retained frameworks (1). Several factors influence whether an implant-supported prosthesis is acceptable or not (1). Complications in osseointegrated implant supported prostheses are reported screw loosening, fractures of the abutment, decrease in occlusal stability and metal framework and bone resorption underneath the implant (2). The main reasons for complications in osseointegrated implant supported prostheses are destructive occlusal forces, nature of the impression tray and negative shape of the impression. Occlusal loading exerts an additional dynamic and discontinuous stress, and the presence of a cantilever significantly reduces the fatigue life of the framework (3). The framework fit in association with functional loading causes stress at the interface of the prosthetic-implant and bone-implant with following mechanical and biomechanical complications. There is no evidence about a clinically acceptable degree of misfit and no statistical correlation between changes of marginal bone level and different parameters of prosthetic misfit (4). The inability to consistently achieve a passive fit with screw-retained implant prostheses is higher than with cement retained implant frameworks (5). The framework misfit influences directly the screw loosening which depends on the geometry and material of the screw is composed of pre-loading, bending and longitudinal deformation and is about 75% of the necessary breaking force. Progressive implant loading in immediate loading procedures should interfere with the osseointegration process (2). Transfer of the precise position of implants to a master cast is a prerequisite for accurate and passive fit of the framework. An additional consequence of the misfit of the framework during the casting procedure has been cited as a main cause of misfit (7). The impression (6, 8) and construction accuracy (10, 11) have to achieve the reproduction of precision implant position in the model and the passive fitting of the framework in situ. Furthermore, in situ die casting procedures have to be evaluated.

MATERIALS & METHODS
Three different impression techniques were tested by splitting the mounts of 6 implants with internal hexagon connection placed in an experimental steel model with (Tab. 1) photo polymeric composite (Teflon-Polymer) and acrylic (superior). A total of 36 impressions were tested. A titanium framework for fixed screw-retained hybrid prosthesis was constructed for each impression with the Camlog PassiveFit System (CTP) (Fig. 1). It was analyzed by a quantitative evaluation of the insertion torque with the Camlog PassiveFit System (CTP) and the passive fitting of the framework on the master cast and the steel model (Fig. 2). A comparison of the obtained results was made with the screw-extraction torque of a single screw (Fig. 3). The frames were placed in a sequence from left to right, chosen to minimize the possibility of the effects of misfit.

RESULTS
Three different impression techniques were tested in vivo in a direct passivation procedure. Seven Camlog solid-implant placed implants in an anterior lateral jaw (Fig. 4 a,b) were exposed after two months submerged healing period and provided with different prostheses with an external connection (Fig. 4 a,b). A gold-palladium metal framework was constructed in a very low and accurate one stage casting technique (6, 9) and the hybrid prostheses fixed in situ using the Camlog passivation system and the dual cure acrylic cement (Kuray Medical Inc.) (Fig. 5). At last the prosthesis was finished and polished in the laboratory (Fig. 6). The torque in the framework was analyzed with the quantitative evaluation of the insertion torque with the Camlog passivation system (Fig. 7). The central screw was tightened first, torque curves were registered tightening the six screws with the PassFit system (Fig. 8).

CONCLUSION
The torque values of the three groups at different rotational stages (100, 190, 220, 240°) were overlapping (Fig. 9). The torque was lower than the pre-loading of 190 Ncm, which is normally 10 Ncm. The framework torque was not significantly influenced by the different impression materials (Fig. 10). The framework system appeared passiv and overlapping (Fig. 6 f) with the overall measurement and a max 30 µm gap width.

FUTURE WORK
The quantitative evaluation of the insertion torque with the Camlog PassiveFit System (CTP) demonstrated a statistically valid and clinically simple method to analyze the passive fit of an implant-supported framework in laboratory. The system allows to check the passive fit of an implant-supported framework with a definite torque value and to detect the presence of the misfit and the rotational displacement of the fixation screw. The system has a high potential for reliability, reproducibility and validity. Other methods to evaluate the passive fit like radiographic analysis, alternating digital pressure, tactile exploration, Periotest®, torque measurement on the screw and low load testing in vitro have low subjectivity, low sensitivtiy and standard deviation (13, 14).

Future laboratory experiments aim to validate three different impression techniques for implant-supported screw-retained hybrid prosthesis. The splitting of the die casting with resin material on the one hand, combined with the impression using a polyether material on the other hand, both provide the precise reproduction of the implant position in the master cast.

The laboratory experiments results validate the three different impression techniques for implant-supported screw-retained hybrid prosthesis.

The splitting of the die casting with resin material on the one hand, combined with the impression using a polyether material on the other hand, both provide the precise reproduction of the implant position in the master cast.

References