Short Communication

Stability of Screw-Retained Implant-Supported Fixed Dental Prostheses Bonded to Gold Cylinders

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This study examined the adhesive stability of screw-retained implant-supported fixed dental prostheses (FDPs) bonded to prefabricated gold cylinders after a load cycling. Five FDP groups (n = 10 per group) that differed either in bonding or loading modality (no loading, loading, moment loading, humidity, silicoating) were compared based on the forces needed to separate the FDP frameworks from the gold cylinders. The mean separating forces for the different groups ranged from 311 N to 501 N. No statistically significant differences could be detected between the five groups (Welch *t* test, $P = .447$). Despite the limited transferability into clinical practice, it appears that sufficient bonding stability can be achieved for screw-retained implant-supported FDPs bonded to prefabricated gold cylinders. *Int J Prosthodont 2009;22:604–606*.

Passive fit of implant-supported superstructures has been suggested as a prerequisite for maintaining osseointegration, as well as for a successful prosthetic reconstruction.[1] Numerous advanced strategies, such as sectioning and soldering, laser-welding, and the use of resin luting agents,[2,3] have been proposed as ways to improve the fit of implant-supported restorations. Although an absolute passive fit cannot be achieved with any of these techniques,[4] it has been shown that screw-retained restorations consisting of separately cast frameworks bonded onto prefabricated gold cylinders placed directly on the implants revealed only moderate amounts of strain.[2,3,5] Reports on the bond strength of these fixed dental prostheses (FDPs) do not exist yet. The objective of this study was to examine the adhesive stability of screw-retained implant-supported FDPs bonded to prefabricated gold cylinders. It was hypothesized that a pretreatment of the bonding surface by silicoating, humidity during the bonding process, and moment loading would have an influence on the adhesive stability of the FDPs.

Materials and Methods

Two implants (solid screw, 4.1-mm diameter, 12-mm bone sink depth; Straumann) with abutments for screw-retained restorations were welded onto a stainless steel block at an interimplant distance of 15 mm from center to center. A total of 50 screw-retained FDP frameworks with flat occlusal surfaces were waxed directly on the cast using standardized wax molds and cast in a high noble alloy (V-Classic, Metalor Technologies) (Fig 1a). Antirotational plastic copings were fixed on one implant, while a nonengaging gold cylinder and a modeling aid for bonded restorations (Straumann) were seated on the other. This cylindrical burn-out plastic coping introduced a 0.5-mm circular gap[6] between the gold cylinder and FDP framework, with no contact between the two components (Fig 1b). The molds were embedded (Heravest Speed, Heraeus Kulzer) and cast without the gold cylinders. After devesting, the passivity of fit of the FDP frameworks on the cast with no contact between the gold cylinder and internal surface of the respective FDP abutment was verified using light body silicone (Fit Test C&B, Voco).

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Fig 1a FDP framework waxed on a stainless steel cast with a standard plastic engaging coping used for the right abutment and a modeling aid for bonded restorations on the left abutment.

Fig 1b Cross-section of the bonded FDP abutment. A central guide screw was used for the fixation of the gold cylinder and plastic modeling aid directly onto the implant. No contact between the gold cylinder and auxiliary component existed except for the bracing in the cervical portion, which was removed after casting using a standard reamer.

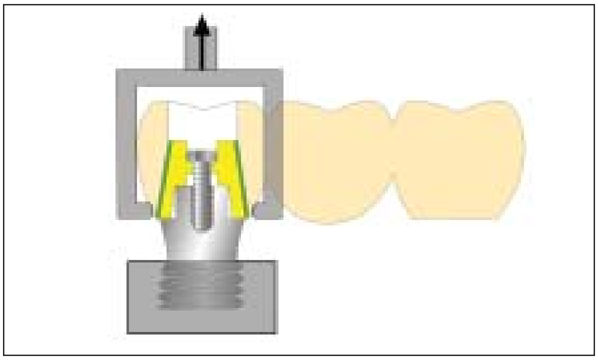

Fig 2a Schematic drawing of the separating experiment. The FDP was secured via the bonded abutment on a regular implant, which was fixed in a universal testing machine, and a tensile vertical force was applied to the FDP framework *(arrow)*.

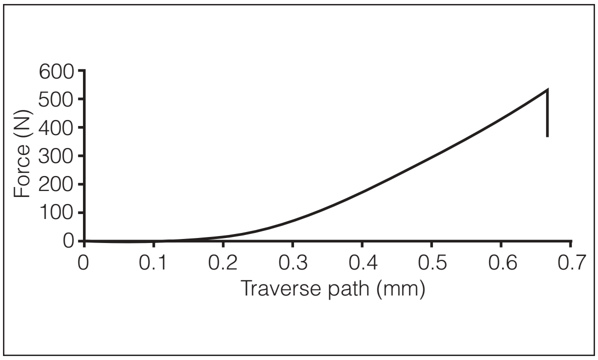

Fig 2b Characteristic development of the axial force during a separating experiment (Sample 1).

Following manufacturer recommendations for the adhesive resin, the bonding surfaces of all samples were sandblasted with aluminum oxide (FDP framework: 250-μm particle size, 2 bar, 10 seconds; gold cylinders: 50 μm particle size, 2 bar, 10 seconds). A self-curing composite resin (Degufill KE, DeguDent) was used to bond the FDP frameworks onto the gold cylinders. The adhesive was mixed for 30 seconds, injected between the surfaces of the gold cylinder and the restoration, and allowed to set for 8 minutes.

Cyclic loading of the restorations in a mastication simulator (Kausimulator, Hädrich Elektrohandwerksbetrieb) was performed for 50,000 cycles at 100 N (2 seconds of loading followed by 1 second of unloading) with the restorations mounted in a water bath at a constant temperature of 37°C. Five different FDP groups were established: *(1)* standard bonding procedure, no mastication simulation; *(2)* standard bonding procedure, mastication simulation; *(3)* standard bonding procedure, moment loading during mastication simulation introduced by a 1-mm vertical gap between the implant shoulder and FDP abutment (two layers of rubber dam; Roeko FlexiDam, Coltene/Whaledent); *(4)* bonding procedure performed in a humid environment, mastication simulation; and *(5)* bonding performed after silicoating the gold cylinder and FDP abutment (Rocatec, 3M ESPE), mastication simulation.

The specimens were mounted in a universal testing machine (Instron 4020, Instron Deutschland) via the bonded FDP abutment, which was secured on a regular implant (Fig 2a), and the forces needed to separate the FDP frameworks from the gold cylinders were recorded (Fig 2b). For statistical analysis, a Welch *t* test was performed at a level of significance of $\alpha = .05$.

Table 1 Mean Values of Forces Needed to Separate the FDP Frameworks From the Gold Cylinders in the Different Experimental Groups

Experimental group	Mean separating force (N)	SD
1 - No loading	410.00	102.85
2 - Loading	436.40	128.60
3 - Moment loading	311.20	194.83
4 - Humidity	370.80	219.07
5 - Silicoating	501.40	299.56

SD = standard deviation.

Results

The mean values of the separating forces for the different groups ranged from 311.20 N to 501.40 N (Table 1). The highest mean value, along with the highest standard deviation, was found after silicoating the bonding surfaces.

A test of homogeneity of variances revealed that the variances differed significantly between the five experimental groups ($P = .007$). A subsequent Welch t test did not reveal a significant difference between the five test groups with respect to mean separating force ($P = .447$).

Discussion

Previous investigations have revealed that bonding superstructures onto prefabricated components fixed on the implants produces superior restorations with respect to superstructure accuracy.[5] Despite the limited sample size and resulting high standard deviations, this study indicates that sufficient stability of the bonded FDP abutments can be achieved with the technique described. Further clinical trials are needed to assess the practicability and longevity of this type of restoration.

Acknowledgment

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Literature Abstract

Precision of flapless implant placement using real-time surgical navigation: A case series

This study evaluated the linear and angular differences between coordinates obtained by pre- and postsurgery computed tomography (CT) scans using real-time surgical navigation. Six patients were included in the study and 14 implants were placed. The patients underwent CT scanning protocol to undergo real-time surgery. Following the surgery, the patients were rescanned and, using appropriate software, the scans were overlaid. The linear and angular differences between the actual implant positions and the virtual implant positions were compared. Discrepancies at the implant platform ranged from 0.32 to 1.96 mm (mean: 0.89 mm) and from 0.25 to 1.99 mm (mean: 0.96 mm) at the apex. The discrepancies of the resulting angle ranged from 0.60 degrees to 9.87 degrees (mean: 3.78 degrees). These results suggest that surgical navigation is technically sensitive, and that the clinician should be aware of neighboring vital structures and the potential for cortical bone perforation.

Elian N, Jalbout ZN, Classi AJ, Wexler A, Sarment D, Tarnow DP. *Int J Oral Maxillofac Implants* 2008;23:1123–1127. **References:** 18. **Reprints:** Dr Ziad Jalbout, Vizstara, 300 Sylvan Avenue, Englewood Cliffs, NJ 07632. Fax: 201-816-1114. Email: zjalbout@vizstara.com—*Majd Al Mardini, Hamilton, Ontario, Canada*