Martin-Luther-University Halle-Wittenberg
Center for Dentistry and Oral Medicine
Department for Prosthodontics
Chair: Prof. Dr. Jürgen M. Setz
Halle (Saale), Germany

IADR/AADR/CADR General Session & Exhibition Boston, MA, USA March 11-14, 2015

3625

Arnold Ch, Mansour S, Setz J, Boeckler AF

Wear of Telescopic CAD/CAM zirconia and High-noble Metal Copings for Overdenture Retention

Introduction

Patients' satisfaction with and adequate function of a removable denture prosthesis [RDP] highly depend on the retention of the denture. RDP for partially edentulous patients retained by telescopic crowns [TC] have been successful for many years [1-3]. A telescopic overdenture contains a secondary crown that covers tooth or implant-supported fixed copings. TCs can be classified into three groups according to different functions and design: telescopic parallel crowns [TP], conical crowns [CC] and crowns with additional retention modifications [CM] [4]. There is no consensus in the literature about a standardised test setup for retention forces. Thus, results vary from 1-20N. Objectively, retention forces should be adequate, constant and individually adjustable.

The aim of this in-vitro study is to establish a simulation test setup and to compare different materials and designs of telescopic crowns to evaluate changes in retention forces after aging.

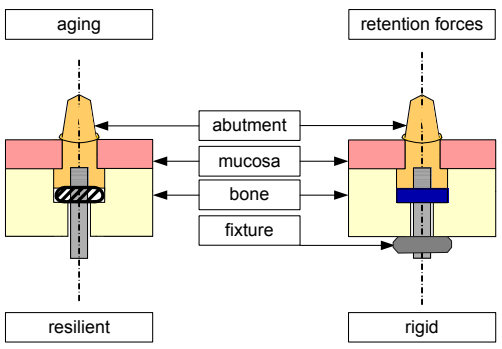
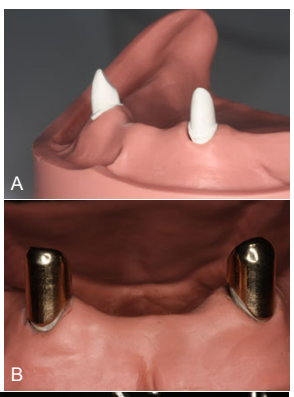


Fig. 1: Resilient and rigid fixation during aging and measurements



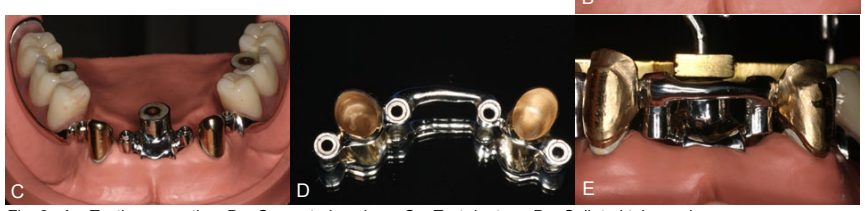


Fig. 2: A – Tooth preparation; B – Cemented copings; C – Test denture; D – Splinted telescopic crowns; E – Connected telescopic crowns and test denture

Materials and Methods

A resilient cast with two remaining canines (T2, KaVo Dental GmbH, Biberach, DE) representing a typical partially edentulous patient was used. A chamfer preparation was made (Fig. 2A) and each abutment was duplicated 15 times (epoxy resin, Tri-Dynamics, Keystone Industries, Cherry Hill, NJ, USA). All abutments could be fixed either rigidly or resiliently (Fig. 1) to the cast in a standardised way. Three groups of copings each containing 5 specimens were tested (Tab 1). In group 1 were CAD/CAM-fabricated 2-degree tapered zirconia copings (Fig. 3A) with non-precious secondary crowns and gold friction pins (Fig. 3B) [ZC]. In group 2 were 0-degree (Fig. 3C) [T] and group 3 6-degree (Fig. 3D) [K] tapered high-noble metal copings with high-noble metal secondary crowns. The copings were cemented (Nimetic Cem, 3M Deutschland GmbH, Neuss, DE) to the abutments (Fig. 2B). The splinted telescopic crown specimens (Fig. 2D) could be retrievably incorporated (Fig. 2E) into the test denture (Fig. 2C).

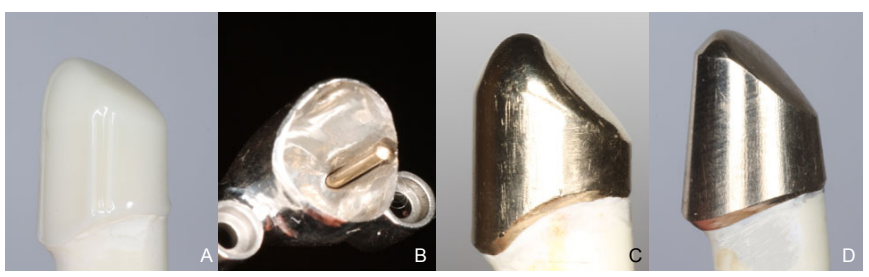


Fig. 3: A – zirconia coping (2°) with groove; B – non-precious metal TC with gold friction pin; C – parallel gold coping (0°); D – conical gold coping (6°)

Tab. 1: Tested materials (according to manufacturers)

group	1						2 and 3	
	coping		secondary crown		friction pin		coping	secondary crown
material	zirconia Organic Zirkon		Okta-M VS		gold wire (Degulor)		Bio RD 1 (Degunorm)	
composition	ZrO_2 ;HfO_2 ;Y_2O_3	>99.0 wt%	Co	61.1 wt %	Au	65.0 %	Au	73.8 %
	Y_2O_3	5.15±0.20 wt%	Cr	30.6 wt %	Ag	13.0 %	Ag	9.2 %
	HfO_2	<5.0 wt%	Mo	6.50 wt %	Pt	8.9 %	Pt	9.0 %
	Al_2O_3	0.25±0.10 wt%	Si	<1 wt%	Pd	1.0 %	Cu	4.4 %
	Fe_2O_3	<0.1 wt%	Mn	<1 wt %	Cu	11.5 %	Ir	0.1 %
	Na_2O	<0.04 wt%	C	<1 wt%	Ir	0.1 %	Zn	2.0 %
					Zn	0.5 %	In	1.5 %

A brass bar was mounted on the test denture for measuring the retention forces and for simulated aging (Fig. 5). All the experiments were conducted with the cast immersed in artificial saliva (distilled water and Glandosane, Cell pharm, Bad Vilbel, DE; Fig. 4, 5). Each system was attached to the test denture, and initial retention forces were recorded in universal testing machine Z010 (axial loading 50N, test speed 50mm/min, preload 0,1N). After aging (50,000 chewing cycles with 50N, chewing simulator, IT 116G isel Motor, Nanotec GmbH, Munich, DE; 15,000 insertion/removal cycles, Z010, Zwick Roell GmbH, Ulm, DE; Fig. 5), measurements were repeated (Fig. 4). Statistical analyses were performed using the Kruskal-Wallis and Mann-Whitney-U tests with a p-level set at $p<0.05$ (SPSS 20.0 for Windows, Chicago, IL, U.S.A.).

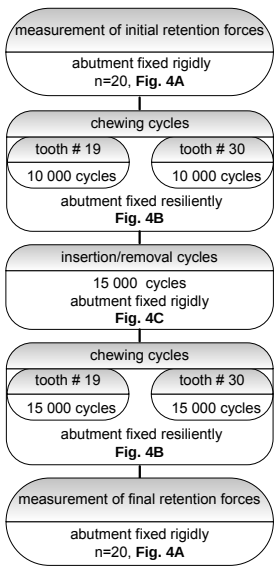


Fig. 4: Test protocol

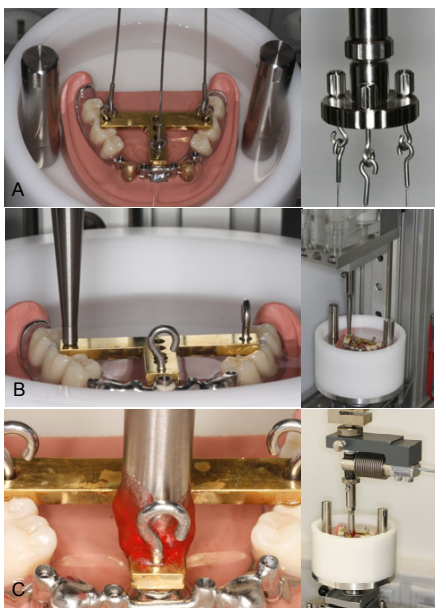


Fig. 5: Test setup

Results

The initial mean retention forces [IF] for ZC (12.23N) were significantly higher than the IF of T and K (Fig. 6). However, the IF of T (9.62N) were significantly higher ($p<0.001$) than the IF of K (6.03N; Fig. 6). The final retention forces for T and K were about 3N ($p=0.800$). The loss of retention for T was higher by 22.48% (T:69,75% vs. K:47.27%). Whereas, the retention forces of ZC were not affected by aging ($p=0.857$).

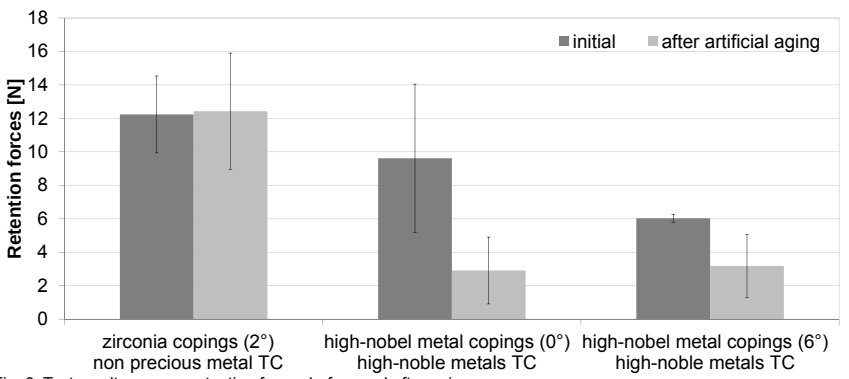


Fig. 6: Test results – mean retention forces before and after aging

The measurements of the current study are comparable to clinical results. Bayer et al. [5] recorded similar initial mean retention forces to ZC (median 12.9N). However, after 10 years of wear, mean retention forces of conical crowns decrease to 4.9N [6].

Other in vitro studies reported no loss of retention forces for the ZC, too [2], as well as decreasing retention forces for the high-noble metal TC [7]. The varying reaction on wear seems to depend on the different designs of the copings. The clearance fit, the 2-degree taper and the friction pins of the ZC provide less surface contact. On the contrary, the larger surface contact of the T might result in more wear. The 6-degree taper reduces the surface contact dramatically and therefore might be the reason for less percentage change of retention forces compared to T.

Conclusions

The retention forces of high-noble metal TC decreased significantly after aging, but were still clinically acceptably functional. Therefore, the design had an effect on the wear. Within the limitations of an in-vitro study the clinical use of zirconia telescopic crowns with gold-friction pins can be recommended based on the continuous retention forces.

1. Szentpétery V, Lautenschläger C, Setz M: Frictional Telescopic Crowns in Severely Reduced Dentitions: A 5-Year Clinical Outcome Study. Int J Prosthodont 2012; 25:217-220
2. Engels J, Schubert O, Güth JF, Hofmann M, Jauernig Ch, Stimmelmayr M, Beuer F: Wear behavior of different double-crown systems. Clin Oral Invest 2013; 17(2):503-10
3. Behr M, Hofmann E, Rosentritt M, Lang R, Handel G: Technical failure rates of double crown-retained removable partial dentures. Clin Oral Invest 2000; 4:87-90
4. Verma R, Joda T, Brägger U, Wittneben JG: A Systematic of the Clinical Performance of Tooth-Retained and Implant-Retained Double Crown Prostheses with a Follow-Up of ≥ 3 Years. J Prosthodont 2013; 22:2-12
5. Bayer S, Stark H, Gölz L, Keilig L, Kraus D, Hansen A, Enkling N: Clinical retention force development of double crowns. Clin Oral Invest 2012; 16:407-411
6. Wagner B, Kern M: Clinical evaluation of removable partial dentures 10 years after insertion: success rates, hygienic problems and technical failures. Clin Oral Invest 2000; 4:74-80
7. Güngör MA, Artunc C, Sonugelen M: Parameters affecting retentive force of conus crowns. J Oral Rehabil 2004; 31:271-277

Dr. Christin Arnold, Dipl.-Ing. (FH)
graduate engineer
Center for Dentistry and Oral Medicine
Department of Prosthodontics
Grosse Steinstr.19
06108 Halle Saale, Germany
christin.arnold@medizin.uni-halle.de