

3257 Development of Calcium Phosphate Cement for Fast-transformation to Apatite. M. KONY*, H.-H. LEE, K. ISHIIKAWA, Y. MIYAMOTO and K. ASAOKA (School of Dentistry, Tokushima University, Tokushima, Japan)

α -tricalcium phosphate (α -TCP) set to form calcium deficient hydroxyapatite (HAP) when mixed with water, and thus is used in clinics for a root-sealer or a bioactive cement. However, the α -TCP cement takes a long time, more than several days, for the transformation to HAP. The purpose of this study, therefore, was to develop the α -TCP cement which transform to HAP in a relatively shorter period. α -TCP, the powder phase of this cement, was prepared from $CaCO_3$ and $CaHPO_4 \cdot 2H_2O$. The mixture with a Ca/P molar ratio of 1.5 was fired at 1400°C for 3 hours. We used $CaCl_2$ and phosphate (NaH_2PO_4 or Na_2HPO_4) solutions as the liquid phase. The powder phase was mixed with $CaCl_2$ solution, followed by mixing with phosphate solution with a powder to total liquid ratio of 2.0. The setting time measured by a Vicat needle method became shorter with the increase in the $CaCl_2$ and phosphate concentration to reach 5 min when the concentration of the liquid phase (NaH_2PO_4) was 2.0 mol/L, whereas the setting time was longer than 30 min when distilled water was used as the liquid phase. X-ray diffraction analyses revealed that the cement completely transformed to HAP within 2 h when kept in an incubator. The wet diametral tensile strength (DTS) of the cement after 24 h was 1.5±0.2 MPa when α -TCP was mixed with $CaCl_2$ solution followed by phosphate solution. We concluded that α -TCP should be mixed with $CaCl_2$ and phosphate solutions since it gives moderate setting time and fast transformation to HAP even the method of mixing became a little complex. This study was supported, in part, from the ministry of Education, Science, Sports and Culture, Japan.

3258 Effect of Additives on the Properties of a Polyacid-calcium Phosphate Cement. S. KASAHARA*, K. KIMURA*, S. TAKAGI*, L.C. CHOW², and J.M. ANTONUCCI¹ (¹Tohoku Univ., Japan; ²ADAHF, and ³NIST, Gaithersburg, MD).

Prior studies have shown the admixture of a calcium phosphate cement (CPC) powder and aqueous polyacids results in novel polymeric calcium phosphate cements (PAA-CPC). In this study the effect of additives on the setting behavior and diametral tensile strength (DTS) of a polymeric CPC derived from a high molecular weight poly(acrylic acid), PAA, and CPC powder was examined. The PAA was used as a 25% by mass aqueous solution (molecular weight of PAA = 240,000). The CPC powder consisted of 73% tetracalcium phosphate and 27% dicalcium phosphate anhydrous on a mass basis. One part by mass of the polyacid was mixed with two parts by mass of the CPC powder for a powder/liquid ratio of 2. The cement components were mixed at 23°C and 50% relative humidity for 45 s. The additives used to control setting were Mg(OH)₂, iminodiacetic acid (IDAA), methyliminodiacetic acid (MIDAA), and 2-hydroxyethyliminodiacetic acid (HEIDAA). Without the additives the workability of the cement paste was poor and the setting times rather short (<2 min). Mean DTS (n=6) in MPa of this PAA-CPC after 24 h in 37°C H₂O was 5.8(0.5) (standard deviation). Cements with small amounts (4-6%) of the additives had excellent handling properties and clinically acceptable setting times (2-8 min). Their mean DTS (n=6) values were: 4.6(0.6), Mg(OH)₂: 6.3(0.4), IDAA: 5.2(0.9), MIDAA and 6.4(0.6) MPa, HEIDAA, respectively. There were no significant differences (p>0.10) in the DTS values of the unmodified and modified PAA-CPCs except for the Mg(OH)₂ cement; however, the additives did improve the workability and handling properties of the fast-setting PAA-CPC. The results suggest that these additives to PAA-CPCs can improve workability and handling without significant loss of strength. Supported by NIH grant DE11789, ADAHF, NIST, and Tohoku University.

3259 Improvement to the Modeling Capacity and Sintering of Hydroxyapatite Paste. Y. Fukase*, H. Uehara*, S. Wada*, T. Koizumi*, M. Terakado*, H. Sato* and M. Nishiyama. (Dept. of Dent. Materials and Oral Surgery¹, Nihon Univ. School of Dent., Tokyo, Japan.)

Hydroxyapatite (HAP) is widely used in oral surgery as a bio-compatible material. The granular and brick types of HAP are usually used, but in terms of mixing, filling and molding then still do not satisfy the chair-side needs. In this study, HAPG powder was prepared from HAP powder with a viscous bio-compatible binder. A low crystalline (HAP100) and high crystalline (HAP200) HAP powder and two kinds of concentrated viscous binder solution (1%: G1 and 10%: G10) were used to prepare four kinds of HAPG powder, which was mixed with d. water to make visco-elastic HAPG paste. The HAPG10 paste had higher visco-elasticity than the HAPG1 paste. The HAPG paste was hardened after drying or sintering. The compressive strengths of dried and sintered HAPG were then examined to evaluate the concentrations of the binder. After drying, the HAPG10 was significantly (p<0.05) stronger than the HAPG1, with a maximum value of 5.3 MPa. After sintering, the HAPG1 was nine times stronger than the HAPG10, with a maximum value of 8.2 MPa. We concluded that HAPG10 paste is suitable for filling as a high molding paste, and HAPG1 for sintering as a hardened block implant material. Low and high crystalline HAPGs are selectable in the case of bio activity.

3260 Dental Cements/Resins Containing Fluoroaluminosilicate Glass: Sliding Wear and Friction Coefficients. C. DCHISNER*, D.A. COVEY, N. EWOLDOSEN, M.W. BEATTY (UNMC College of Dentistry, Lincoln, NE).

The objective of this study was to measure loss of material due to wear, *in vitro*, using a pin-on-disk device and determine kinetic coefficients of friction for each material tested. Wear tracks were created by sliding a stainless steel pin, 4.0 mm contact area, against disks 16 mm in diameter, in distilled water, creating circular wear tracks, radius = 6 mm. After 65,000 cycles at 38 rpm, under an applied load of 1.7 MPa in a Spire Tribotester, profilometry was used to measure the depth of wear tracks at four equidistant sites on each disk. Disks from separate mixes of each material were finished wet against 800 grit SiC and maintained in distilled water throughout testing in separate trials. Friction coefficients were determined (Labtech data acquisition software) from measurements made 80 seconds into each wear trial. Materials tested included Fuji II (F2), a conventional glass ionomer cement (GIC) Improved Fuji II LC (F2), a Type II resin-modified IRM GIC, Fuji Dent, a Type I IRM GIC + 2.0% wetwt powdered (P1) resin (FD2) and Fuji Dent 3.6i wetwt P1 (FD3.6), as well as Compoglass (C) and Dyract (D), fluoroaluminosilicate glass filled resins. The following results were obtained:

Wear Track Depth in microns (S.D.)	Kinetic Coefficient of Friction (S.D.)
F2*	1.80 (.41)
F2**	1.06 (.29)
FD2**	0.71 (.35)
FD3.6**	0.85 (.18)
C*, **	1.87 (.50)
D	2.88 (.53)
	F8
	FD2
	FD3.6*
	C*
	D*

* ** denote groups which are not significantly different (p < 0.05)
ANOVA was used to detect differences (p < 0.05) followed by Newman-Keuls's Multiple Comparisons. Against stainless steel, the least wear was shown by F2, FD2, FD3.6, and C. Wear differences between F2 and C were not found. D showed the most wear against stainless steel. F2 showed the highest kinetic friction against stainless steel. Also, friction differences were found between FD2 and FD3.6. Otherwise, no differences were found in the kinetic friction coefficients of IRM GICs and resins containing fluoroaluminosilicate glass.
* Products supplied by Dentsply/Caulk & GC America

3261 Use of microwave energy for processing acrylic resin near metal. K.O. BRAUN, A.A. DEL BEL CURY*, R.C.M. RODRIGUES GARCIA. (Faculty of Dentistry of Piracicaba, UNICAMP, Brazil)

The conventional method to process acrylic resin is a time consuming step to construct removable prosthodontics. The microwave processing would be a solution, but there are doubts about this process in metal presence. So, the aim of this study was to compare residual monomer, microhardness and porosity of two acrylic resin cured by different methods in the presence of a metal framework. The conditions evaluated were G1- Acrylic resin Classico, short heat-cured for 3 h; G2- Acrylic resin Classico cured for 3 min. at 500 W in microwave and G3 - Acron MC resin cured in microwave for 3 min. at 500 W. For each group 12 specimens measured 30x4 mm (diameter x thickness) and contained in the inner a metal framework (28x 10 mm) were made. After the cure the samples were immersed individually in 10 ml of deionized water. Residual monomer released in the water, changed daily, was measured spectrophotometrically for 12 days. The specimens were polished to measure the microhardness from 50 to 800 μ m of the metal framework. The specimens were cross-sectioned to evaluate the internal and external porosity by naked eye and using 10 x magnification. The results (mean \pm SE) of monomer released (%x10³) and microhardness for the three groups were, respectively: Day 1st: 178.8 \pm 17.9 A; 116.5 \pm 12.0 B; 59.5 \pm 11.1 C; Day 12th: 44.3 \pm 2.2A, 40.1 \pm 2.7A; 6.8 \pm 1.3C. The Knoop hardness were 1) 50 μ m: 16.45 \pm 0.22 B; 17.14 \pm 0.26 AB; 17.46 \pm 0.20A; 2) 800 μ m: 16.75 \pm 0.14B; 17.55 \pm 0.22A; 18.14 \pm 0.32A. Statistical analysis (ANOVA) showed difference among the groups and means followed by the same letter do not differ significantly (Tukey, p<0.05%). Porosity by naked eye was observed in all the samples from group 2 and in 50% of the group 1 and 3. Using magnification, porosity was found externally and internally in all samples. It was concluded that the microwave energy can be effectively used to polymerize removable partial denture bases and the conventional resin when polymerized with microwave energy presented higher porosity.

3262 Effect of glow discharge treatments on acrylic resin surfaces. A.N. ÖZDEN*, F. AKAL TAN, Ş. SÜZER, G. AKOVALI (Ankara University Faculty of Dentistry, Bilkent University, METU, TÜRKIYE).

The adhesive action of a thin film of saliva between the palate and surface of a complete denture has been one of the principal sources of denture retention. The objectives of the study were to show the changes in wettability of acrylic resin denture base material under different plasma atmospheres and examine the surface modifications by XPS. Twenty-five acrylic resin (Meliodent, Bayer, Berkshire) were prepared with dimensions of 10 x 15 x 1 mm and divided into 5 groups. C = Control, A = treated with glow discharge under air atmosphere and left exposed to laboratory atmosphere, W = treated with glow discharge under air atmosphere and kept in distilled water, A₂ = treated with glow discharge under argon atmosphere and left exposed to laboratory atmosphere, W₂ = treated with glow discharge under argon atmosphere and kept in distilled water. The contact angles of the specimens were by using entrapped air-bubble technique. XPS measurements were obtained on a Kratos ES300 spectrometer with MgK α x-rays (1253.6 eV) and a background pressure lower than 5 x 10⁻⁹ torr. The mean of the results of contact angle measurements for C, A, W, A₂, W₂ were 63.18°, 51.64°, 46.1°, 51.43°, 51.09° respectively. Kruskal-Wallis was performed for the statistical analysis (p = 0.0503). The study showed that glow-discharge changed the surfaces of the acrylic resin and increased the wettability as shown both by XPS and contact angle measurements. The increased wettability could be attributed to the presence of C-OH groups.

3263 Polyethylene Woven Fabric Reinforced Dentures - Properties and Construction. Y.Y. CHENG*, T.W. CHOW and N.H. LADIZESKY* (Faculty of Dentistry, University of Hong Kong, *IRC in Polymer Science and Technology, Leeds, U.K.)

The aim of this study was to investigate the mechanical properties of denture base polymer reinforced with multiple layers of polyethylene woven fabric, and to develop denture construction techniques. Tests also included water sorption, curing shrinkage and dimensional changes during water immersion. Testing of rectangular strips showed the following values for the unreinforced (control) and reinforced resin with 5 layers of woven fibers respectively (SD in brackets). Flexural modulus GPa: 3.2 (0.2) & 4.0 (0.2), Flexural strength MPa: 104 (10) & 117 (12), Impact strength kJm⁻²: 10 (1) & 57 (17), Water sorption 10⁻³gcm⁻³: 2.66 (0.03) & 1.88 (0.01), Curing shrinkage %: 0.33 (0.02) & 0.15 (0.02), Dimensional changes during water immersion %: 0.45 (0.01) & 0.26 (0.01). The differences were significant (ANOVA, p<0.05). Reinforced poly(methylmethacrylate) with woven fiber showed improvements in flexural stiffness and impact strength as well as reduction in water sorption, polymerization shrinkage and dimensional changes during water immersion. Incorporation of woven fiber into the resin also produced a notch-insensitive material. The mechanical properties of the reinforced resin were not affected by water immersion. Furthermore, a simple split-dough technique has been developed using conventional dental laboratory compression molding for the incorporation of multiple layers of woven fabric in complete denture bases. A recess formed in the resin dough by a spacer was used to position the reinforcement within the thickness of the denture base without exposure of the fibers. The fibers do not spoil the appearance of maxillary and mandibular complete dentures which were completely accepted by patients in an on-going clinical trial. The incorporation of five layers of woven polyethylene fiber in denture base resin produced substantial improvements in mechanical properties and dimensional changes. Standard dental techniques can be used to produce reinforced complete denture bases with good aesthetics. This study was supported by University of Hong Kong, Grant No. 335/255/0004.

3264 Denture polymers and lining materials containing anti-micro organismus M.SAKOIH*, H.OHYAMA, MITOH*, R.KAMEI, A.KUROWA, A.OGATA and Y.IGARASHI (Matsumoto Dent. Coll., Dept. of Remov. Prosth. and Inst. of Biomat., Goubara, Hirooka, Shiojiri, Nagano, Japan.)

Many reports have pointed out that Candida Albicans is one of the main causative factors of denture stomatitis. Test denture polymers and lining materials containing the anti-microbial (A-M) agents have developed for the prevention of denture stomatitis. Mechanical properties and bacteriostasis were analyzed about the influence of A-M agents. A-M agents was contaminated and immersed to the conventional heat cured denture resin polymers as 1.3, 5 and 7 weight percent respectively and to the lining materials as 3 weight percent. Flexural strength, Knoop hardness (or Shore hardness to the lining material), linear shrinkage, water sorption and antibacterial ability were tested with these materials. Each test polymer was thermally cycled for excluding the influence of monomer residue. Bacterial colonies were counted on the GPLP agar preparations on the tested pieces. Test lining materials containing 3% of A-M agents were developed from the results of denture polymers. Following results were concluded: All mechanical properties were scarcely influenced by containing A-M agents (p < 0.01). Bacteriostasis was clearly approved in the test polymers containing over 3% of A-M agents without degrading the mechanical properties of denture polymers. Shore hardness test was scarcely influenced by containing A-M agents in lining materials. Bacteriostasis was clearly observed in test lining materials containing 3% of A-M agents with and without thermal cycling test. Containing 3% of A-M agents was effective in Bacteriostasis without degrading the denture polymers and lining materials.