Literature Review

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DENTAL MATERIALS AND DEVICES

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This is a review of the articles published in the Journal of the Japanese Society for Dental Materials and Devices (J J Dent Mat), written in Japanese with English abstract, and in the Dental Materials Journal (Dent Mater J), written in English, during the period from April, 1986 to March, 1987.

IMPRESSION MATERIALS AND STONE CASTS

Methods of determining the working time of elastomeric impression materials were compared,¹⁾ and the pressure distribution in a tray was analyzed²⁾ for obtaining useful guides for clinical application. The dimensional changes of alginate impressions³⁾ and non-aqueous elastomeric impression materials⁴⁾ were measured. The effect of the network-polymer structure was also examined with respect to the dynamic mechanical properties of a polyaddition-type silicone impression material.⁵⁾ As for agar impression materials, the rheological properties were investigated with a cone-plate type rheometer.^{6,7)}

In the flow test, the dental plaster mix showed different behaviors under vibration from those under static condition.⁸⁾ It was found that the addition of dicalcium phosphate dihydrate crystals to calcium sulfate dihydrate solution was useful for nucleous formation for gypsum crystals.⁹⁾

DENTURE AND POLYMERS

Residual stress in resin base denture caused by injection molding was photo-elastically analyzed.¹⁰⁾ The abrasion resistance of denture base acrylic resin was increased by treating with surface smoothing agents.¹¹⁾ The applicability of a porous metal mesh plate to the denture base was demonstrated by the examination of its function and biocompatibility.¹²⁾

The relining effects of a light-curing direct relining material "Eporex-R" on the ill-fitting denture were tested. It could improve the fitness and durability of the denture.¹³⁾

Polyfunctional cyclophosphazene monomers were synthesized for dental use and

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the properties of the bulk polymers were measured.¹⁴⁾ The mechanical properties of a new orthodontic elastomeric O-ring were reported.¹⁵⁾

CROWN AND BRIDGE RESINS

The properties of crown and bridge resin were improved by incorporating epoxy dimethacrylates (EpDMA) into the liquid component.¹⁶⁾ The light-cured resins for crown and bridge were inferior in mechanical properties to the heat-cured resins having the same formulation except for the catalyst.¹⁷⁾ It was found that 2'-acryloxyethyl 2-methacryloxyethylcarbamate (UAMA) could improve these inferior properties of the light-curing resin.¹⁸⁾

An experimental composite type adhesive opaque resin showed excellent durability of the bond between the same kind of alloys, although there were some difficulties in manipulation when it was used for bonding the veneering resin to alloys.¹⁹⁾

COMPOSITE RESINS

Much research was made on light-curing composite resins. Initiator systems²⁰⁾ and refractive indices of the base resin monomers²¹⁾ were examined for effective curing. Physical and mechanical properties of commercial UV or visible light-curing composites were measured and the factors affecting them were discussed.²²⁻²⁴⁾ Furthermore, a new matrix technique for Class II restoration with visible light-curing composites was introduced.²⁵⁾ Some differences between the light-cured resins and the chemical-cured were also reported: the light-cured resins showed larger tensile strength among the posterior restorative composites,²⁶⁾ but poorer cavity adaptation.²⁷⁾

The bond strength of silica filler to matrix resin was well correlated with the adsorption mechanism of the silane coupling agent.²⁸⁾ In alumina filled composites, the addition of 4-META was effective for enhancing the mechanical properties.²⁹⁾

Durability of composites was tested under long-term immersion in water,^{30,31)} thermal cycling³²⁾ and repeated stress.³³⁾ It was recognized from an abrasive wear test³⁴⁾ and a sliding wear test³⁵⁾ that the wear rate of composites was increased with increases in the filler content, Knoop hardness and elastic modulus.

The push-out method was developed for evaluating the bond strength of posterior composites to tooth.³⁶⁾ It was confirmed that 6-methacryloyloxyethyl naphthalene-1, 2, 6-tricarboxylate (MENTA-126) contributed to good adhesion of the experimental light-cured bonding resin to teeth.³⁷⁾ The bonding or marginal sealing effect was improved by treating dentin with GLUMA³⁸⁾ or some cleaning agents.³⁹⁾ On the contrary, the bond strength to enamel was significantly decreased with an increase in the pressure applied to the acid-etched enamel,⁴⁰⁾ and the marginal leakages were promoted by repeated loading.⁴¹⁾

ADHESIVES AND CEMENTS

The majority of research on the adhesive resins involved the durability tests and improvements of the bonding. It was demonstrated that the adsorbed water on the oxide layer of the alloy was a factor causing a decreased bond strength.⁴²⁾ The proposed thermal cycling test revealed that the deterioration of the bond strength was related to the structure of oxide film on the alloy.⁴³⁾ On the other hand, the bond durability with dental porcelain and alloys was improved by treating them with a liner containing ferric chloride and silane coupling agent.⁴⁴⁾ The improvements of the adhesion of 4-META/MMA-TBB resin to dentin were attained by the treatment with glutaraldehyde for the heat-denatured dentin collagen⁴⁵⁾ and 5% glutaraldehyde ethanol solution for EDTA treated dentin.⁴⁶⁾ It was observed that 4-META and Phenyl-P promoted monomers penetrate into dentin.⁴⁷⁾ The adhesive monomers having amide groups were synthesized and they were useful for dentin rather than for enamel.⁴⁸⁾

It was found from the *in vivo* and *in vitro* tests that EVA-MMA-TBB-O adhesive composite material was the most favorable root canal sealer.⁴⁹⁾ 4-Iodobutyl methacrylate-acrylic acid comonomer was used as a cavity liner having the ability to adhere to tooth substance with no irritation to the pulp.⁵⁰⁾

The retention of the cemented pin was well correlated with retentive area and surface roughness of the pin hole.⁵¹⁾ The pH changes on the surface of luting cements were determined.⁵²⁾ Permeability of zinc phosphate cement constituents through dentin was investigated.⁵³⁾ The bond strength to dentin was improved by treating the dentin with cleanser and subsequently with mordants for polycarboxylate and glass ionomer cements but not for resin cements.⁵⁴⁾

A new dental cement was developed using tetracalcium diphosphate monoxide and dicalcium phosphate dihydrate.⁵⁵⁾

DENTAL AMALGAMS

Bonding of amalgam to tooth cavity with adhesive resin cements was effectively applied for preventing marginal leakage,⁵⁶⁾ and the bond strength between them was increased by the fluoride treatment of the tooth prior to etching.⁵⁷⁾

Corrosion of amalgam was discussed in terms of dissolution of components and microstructural changes in various solutions,⁵⁸⁾ and polarization and corrosion products in saline solution.⁵⁹⁾ It was demonstrated that the compressive proof stress was more useful than the crushing strength for evaluating the strength of amalgam.⁶⁰⁾

When mercurous nitrate and amalgam powder-containing diet were given to rats, their growth and their kidney growth were retarded.⁶¹⁾

DENTAL ALLOYS

Released component elements from commercial Ni-Cr alloys in various solutions were analyzed.⁶²⁾ Addition of Mo could improve the mechanical properties and tarnish resistance of Ni-Cr alloy,⁶³⁾ and Ni-Cr-Co-Mo alloys were considered to be applicable for

adhesion type bridges,⁶⁴⁾ while the addition of Cu was useless.⁶⁵⁾

The optimum composition of Co alloys for ceramo-metal was Co-30%Pd and the effects of addition elements were examined.⁶⁶⁾

As for shape memory alloys for dental implant, the effect of Al concentration on the shape recovery of Ti-V-Fe-Al alloys,⁶⁷⁾ superelasticity and Ni release of Ni-Ti and Ni-Ti-Cu castings,⁶⁸⁾ and the corrosion resistance of Ni-Ti alloys coated with TiN, TiCN and oxide film⁶⁹⁾ were reported.

Pure Ti prefabricated posts were made and they seemed to be useful for the metal core which could be cast around 1,000°C at most.⁷⁰⁾

Grinding and polishing efficiencies for non-precious alloys were investigated using grinding wheels attached to handpiece,⁷¹⁾ ultrasonic polisher⁷²⁾ or newly developed TiC-containing wheels with electric conduction.⁷³⁾ An electric discharge machining was applied to dental prostheses and it showed good performance avoiding the influence of heat or vibration.⁷⁴⁾ The tensile and compressive tests of dental casting alloys was compared.⁷⁵⁾ Fracture mechanism of Ag binary alloys was investigated fractographically.⁷⁶⁾

CASTING AND INVESTMENT MATERIALS

A new method of measuring setting expansion of investment materials was devised.⁷⁷⁾ Thermal expansions of phosphate-bonded investments were compared with those of casting alloys.⁷⁸⁾ Zirconia investment developed for the higher temperature casting showed excellent characteristics.⁷⁹⁾ A new casting machine was also developed for NiTi and Ti alloys, and was equipped with an oil diffusion pump and a new control system.⁸⁰⁾

Repeated casting affected the mechanical properties and composition changes of non-precious alloys depending on the additives.⁸¹⁾ The tensile properties of Ni-Cr alloys were significantly affected by the systematized casting machine used^{82,83)} as well as by the casting condition.⁸⁴⁾

The solidification process of full crown castings was well simulated by the finite-element method.⁸⁵⁾ Deformations were observed on the cast crowns, which might have been caused by the setting expansion of the investment.⁸⁶⁾ Mold-reaction products of Ni-Cr alloys with phosphate-bonded investment were analyzed.⁸⁷⁾

PORCELAIN

In the porcelain-fused-to-metal system, the ceramic core coping showed better marginal adaptation than the metal coping.⁸⁸⁾ The sintering process and strength of the porcelain consisting of glass and alumina powders were affected by the grain size distribution of glass powders but not by that of alumina powders.⁸⁹⁾ The effects of thermal shock on the stresses developed in porcelain-fused-to-metal systems were estimated by computer calculation.⁹⁰⁾

HYDROXYAPATITE

Epitaxial growth of the calcium sulfate dihydrate crystals was experimentally observed on hydroxyapatite crystals⁹¹⁾ and on the enamel surface.⁹²⁾ When hydroxyapatites were synthesized under the presence of Mg^{2+} ions, the resultant apatites showed poorer crystallization and were more unstable with increases in the Mg content.⁹³⁾ A plasma flame spraying technique was successfully applied for coating Ti plate with hydroxyapatite and it allowed the preparation of composite implant materials.⁹⁴⁾

BIOLOGICAL STUDIES

Compression and hardness tests were conducted on human enamel and dentin.⁹⁵⁾ Commercial and experimental dental implants were immersed in three kinds of solutions and released elements from them were analyzed.⁹⁶⁾ An organ culture method using chick embryo femurs was useful for evaluating the biocompatibility of materials.⁹⁷⁾

The binding of mono- and dimethacrylates to human serum albumin was studied using fluorescent probes.⁹⁸⁾ Calorimetric studies using liposomes were carried out to clarify the biological activities at the membrane level induced by phenol derivatives⁹⁹⁾ and photo-initiators in light-curing resins.¹⁰⁰⁾

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