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Literature Review

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DENTAL MATERIALS AND DEVICES (1987-1988)

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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, 1987 to March, 1988.

Impression Materials and Stone Casts

The dimensional accuracy of stone cast obtained with various elastic impression materials was examined.[1,2] The effect of the immersion in disinfectant solutions on the dimensional stability was studied for alginate impressions.[3] The dimensional changes of 50 commercial agar impression materials were also measured.[4] A new polyurethane impression material was developed.[5]

The effective additives were determined to improve the bending strength and surface roughness of the dental stone.[6] A non-contact photogenic surface roughness analyzing system was developed to evaluate the surface reproduction of the dental stone.[7]

Denture Base Resins

New model and mold materials containing aluminum powder were developed for microwave polymerization.[8] It was found that the better adaptability and smaller displacement of the artificial teeth were observed in the microwave-cured resin denture.[9]

The improvement of the denture base resin by adding cyclophosphazene monomer[10] and the reinforcement of the denture with carbon-fiber and aramid-fiber cloth[11] were reported. New type composites of PMMA and siloxan ladder polymer were developed for denture base.[12] Visible light-curing MMA-PMMA resins with and without cyclophosphazene monomer were also formulated.[13-15] A commercial glazing material for a direct relining material was useful for glazing and hardening the denture base resin.[16]

The effects of the activator and inhibitor on polymerization of the self-curing rebasing resin were examined by ESR technique.[17] The compatibility of a dough-type fluoropolymer soft liner with denture base resins was discussed.[18] The dynamic viscoelastic properties of four proprietary tissue con-

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ditioners were measured[19] and they were affected by the structure of the polymer powder.[20]

Crown and Bridge Resins

The bond strength of adhesive opaque resins to metals could be increased by proper metal surface treatment, but it was markedly decreased by thermal cycling.[21,22] Incorporation of silane-treated inorganic fillers improved the hardness and resistances to water sorption as well as to abrasion of crown and bridge resins.[23] Another report showed that the abrasion resistance was improved by adding fillers or by coating with smoothing and hardening agents.[24]

New types of resins were proposed for crown and bridge work: polychlorotrifluoroethylene composite resin,[25] ethyleneglycol acrylatemethacrylate,[26] and 4-META/MMA-TBB opaque resin with PMMA-coated titanium dioxide.[27] The applicability of an FRP frame to crown and bridge work was also confirmed.[28]

Composite and Adhesive Resins

Compression test[29] and bending test[30] were carried out for commercial composite resins. Direct tensile test was also conducted to evaluate the durability in water.[31] Microfilled resins showed higher wear resistance in the glass beads abrasion test which gave analogous results to the clinical observations.[32]

The effectiveness of isocyanatosilanes[33] or polyfunctional silanes[34] was reported for the silica surface treatment.

Pretreating the dentin cavity with 35% HEMA was proposed to improve the marginal seal.[35] The wall-to-wall contraction in dentin cavity was increased with faster polymerization.[36] From the measurement of the depth of cure, the light permeability of light-curing resins were evaluated,[37] and the favorable refractive indices of monomer and filler were discussed.[38] The characteristics of the visible light-curing method were also photochemically examined.[39] It was found that the migrations of Bis-GMA and Tri-EDMA from the cured resins to various solvents were correlated with their contents while the former to dentin increased with time.[40]

In order to develop new composite resin systems, physical and mechanical properties were examined for the experimental composites consisting of: binary copolymers,[41] and RDMA monomer and TMPT fillers[42]; and for the bulk polymers from: polyfunctional cyclophosphazene monomers,[43] 2, 2'-Bis (4-methacryloxy polyethoxyphenyl) propane monomer,[44] urethane dimethacrylate monomers having different chemical backbones,[45] dimethacrylates with alicyclic skelton and aromatic dimethacrylates polysubstituted by fluorine.[46] Much research was made on adhesion of resins. The bonding to dentin was improved by EDTA pretreating for the dentin bonding agent containing 2-methacryloxyethyl p-methoxyphenyl phosphoric acid,[47] by 35% HEMA pretreating for UDMA-based composite and 4 META-bonding agent,[48] and by sealing of the pulp cavities for 4 META/MMA-TBB resin.[49] The mechanism of the effect of treating with 3% ferric chloride-10% citric acid solution on MMA/TBBO resins was discussed.[50] A shear test method was evaluated for dental adhesives.[51]

The adhesiveness to tooth was reported for methacrylates having phosphoric acid or phosphoryl chloride[52] and methacryloyloxybenzoic acid isomers.[53] New dentin bonding liners were formulated: one containing N-methacryloyl aminosalicylic acid,[54] and two light-curable ones containing 4-META and 2-methacryloxyethyl p-methoxyphenyl phosphoric acid, respectively.[55] Methyl meth-

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acrylate-p-styrene sulfonic acid copolymer was also found to be useful for an adhesive liner and for a dentin bonding agent.[56,57] A new methacrylate ester enamel-adhesive coating agent showed adequate bonding to the white spots and enhanced their remineralization.[58]

The possibility of laser irradiation to treat the dentin smear layer was confirmed with an expectation of preserving dental pulp.[59]

It was found that the bond strength of adhesive resin cements to alloys was increased with increase in hardness[60] or thickness[61] of the alloy in tensile test, as well as with increase in 0.2% proof stress and elastic modulus of the alloy in bending test.[62] In consideration of the adhesion to metals, succinoxy alkylene methacrylates[63] and triazine dithione derivative monomer[64] were synthesized. Pretreatment of the alloys by polymer/Sn plating was also effective.[65]

The application of an adhesive resin cement as a cavity liner could effectively reduce the microleakage of amalgam restoration.[66]

Dental Cements

In glass ionomer cements, marginal gap and bonding strength were examined.[67] Their tooth-bond characteristics were less affected by the storage time of the experimental tooth after extraction and the environmental humidity than those of the composite resins.[68]

For developing the calcium phosphate cements, the usefulness of the material containing tetracalcium phosphate-citric acid-malonic acid as a bioactive dental and bone cement,[69] the effects of additives on the properties of α-tricalcium phosphate (α-TCP)-polycarboxylic acid complexes,[70] and comparison of physical and chemical properties between tetracalcium phosphate (4CP) and α-TCP cements were reported.[71]

Co-precipitate mixtures containing zinc and aluminum hydroxides were prepared for applying to zinc phosphate cement.[72] The setting mechanism of the self-setting apatite cement and the accelerating effect of adding hydroxyapatite was demonstrated.[73]

Dental Alloys

In the casting Ag-Pd-Cu alloys, the effects of the components on mechanical and physical properties[74] and the optimum addition of Rh and Ir for the grain refinement were reported.[75] The addition of 4-5wt% Au could improve the mechanical properties and corrosion resistance of the casting Ti-Ni alloys and they showed effective shock absorption.[76]

The phase transformations during slow-cooling were studied for commercial ceramo-metal alloys.[77]

Corrosion and tarnishing behaviors were investigated on various themes such as corrosion products of Ag-Pd-Cu-Au alloy,[78] corrosion rate of Ag alloys,[79] tarnishes of Ag alloys in the oral cavity,[80] protection of Ti-Ni alloy from corrosion by oxide film coating,[81,82] corrosion rate measurement by polarization resistance method,[83,84] and release of metal elements from commercial precious alloys.[85]

The effective polishing conditions for titanium prostheses were determined in mechanical polishing by dental laboratory wheels, ultrasonic polishing, and barrel finishing.[86] The grinding performance of tools on a Co-Cr alloy was evaluated using a lever type testing apparatus.[87]

Casting and Investment Materials

The surface aspects and porosities of Ag-Pd-Au cast crown were significantly affected

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by the inproper determination of the casting temperature.[88] For the phosphate-bonded investment mold, the factors affecting the casting stress of Co-Cr alloy[89] and the increase in the expansion by the addition of CaO[90] were reported.

New investment materials were developed. They are aluminum orthophosphate,[91] fused calcia-methanol[92,93] and phosphoric acid-bonded zirconia[94] investments. The reactivity of molten titanium with refractory oxides contained in the new investments was investigated.[95]

Porcelain

The effects of additive metal elements in Au-Pd-Ag alloys on the bonding to porcelain were investigated.[96] The useful application of wire explosion spraying technique to Ni-Cr alloy was reported for improving the substructure color for ceramo-metal crown.[97]

It was found that the use of a silane coupling agent and ferric chloride together with 4-META/MMA-TBB resin was effective for bonding between porcelain, quartz and alumina.[98]

Clinical Applications

An improved caliper type bite gauge was devised and its usefulness was demonstrated.[99] Attractive forces of Sm-Co magnet systems for stud attachment were examined to find effective arrangement of the magnet and ferromagnetic yoke.[100]

A few studies were reported on the implant materials: excellent compatibility with bone of the porous 60wt% Zr-40wt% Ti alloy,[101,102] and successful coating of Ti-Ni shape memory alloy and titanium for implants with titanium by means of plasma thermal spray.[103]

The properties of commercial root canal sealing materials were discussed according to the ISO specifications.[104]

In a series of studies on the electromechanical grinding of dental alloys, the practical method was established.[105] The optimum conditions were also determined for the application of the electric discharge machining to dental prosthetic work.[106] It was observed that the accentricity of air turbine rotary instruments caused metal fatigue of the instruments and roughened the drilled surface.[107]

Biological Studies

The tensile test on human enamel[108] and stress relaxation test on human dentin[109] were conducted. The hardness and compressive behavior of bovine dentin and mandibular bone were also determined.[110]

In synthesizing hydroxyapatites under the presence of gelatin as denatured collagen, it was suggested that the gelatin might only act as an inhibitor of apatite crystal growth.[111]

From the DSC analyses using liposomes, it was found that Bis-GMA analogs having OH group acted as membrane surface activating agents while those having no OH group acted as membrane stabilizing agents,[112] and that Bis-GMA and its isomer could penetrate into the cholesterol and disturb the membrane structure.[113] The mutagenic activity test using *salmonella typhimurium* revealed that Bis-GMA was mutagenic and Tri-EDMA was possibly mutagenic only in the presence of the metabolic activation system.[114]

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