

APPENDIX

APPENDIX A

LIST OF MATERIALS USED IN THIS STUDY

| MATERIALS | MANUFACTURER |
|---|--|
| Standard casting green sheet wax 0.4 mm in thickness, (7 x 15 cm), Batch No: 117-040-00. | Dentaurum [®] , Pforzheim, Germany. |
| An isolating medium fluid. | Dentaurum [®] , Pforzheim, Germany. |
| Wax profile wire round for casting sprue 3 mm in diameter, Batch No:111-830-00. | Dentaurum [®] , Pforzheim, Germany. |
| Asbestos free liner casting ring Kera-Viles, Batch No: 127-250-00. | Dentaurum [®] , Pforzheim, Germany. |
| Silicone Surface tension agents Dubblizer, Lot No: 3-1323. | Kerr [®] , Romulus, USA. |
| Jelenko complete investment Powder, Lot No: 03151-11. Liquid, Lot No: 0901511. | Armonk, NY 10504, USA. |
| Collon Bium Type I [®] (Ni-Cr alloy) Lot No: 61004. | Osaka, Japan. |
| Coarse and fine carborundum discs | Dentaurum [®] , Pforzheim, Germany |
| Diasint disc (0.4 mm in thick). Batch No: 137-856-00. | Dentaurum [®] , Pforzheim, Germany |
| Tungusten carbide bur. Batch No: 123- 584-00. | Dentaurum [®] , Pforzheim, Germany |
| Alminum oxide stone bur. | Dentaurum [®] , Pforzheim, Germany. |
| White 99.6% Aluminum oxide Particles size 50 µm. | Dentaurum [®] , Pforzheim, Germany. |
| Vita VMK [®] 68 Opaque, Shade B2, 50 g, Lot No: P533. Opaque liquid 245 ml, Lot No: 6728. | VITA Zahnfabrik, Bad Säckingen, Germany. |
| Vita VKM [®] 68 Body, Shade B2, 50 g, Lot No: 544. Modelling liquid, 245 ml, Lot No: 4756. | VITA Zahnfabrik, Bad Säckingen, Germany. |
| Vita VKM [®] 68 Enamel, 50 g, Lot No: 530. | VITA Zahnfabrik, Bad Säckingen, Germany. |

| | |
|--|--|
| Super coarse taper diamond burs (ISO No: 806 314 546 016). | Horico [®] , Berlin, Germany. |
| 0.9% w/v Sodium Chloride solution Normal Saline), Batch No: 5275A101. | B/Braun [®] , Melsungen, Germany. |
| Sheet modeling wax, pink (1.5 mm in thickness, 80x 175mm) Batch No: 119-150-00. | Dentaurum [®] , Pforzheim, Germany. |
| Silicon: Optosil [®] P Plus PS, Polysiloxane (very high consistency) 900 ml= 1370g, Lot No.: 65972849. Activator universal Optosil-Xantopren [®] Liquid 25 ml, Lot No: 66012372. | Heraeus Kulzer, D-41538 Dormagen, Germany. |
| Green Die Stone. Batch No: H0747-002. | William-Dental-Hard, Paris, France. |
| Clear Cold Curing Epoxy Resin Mirapox 950-230 A, Batch No: 5118-3, Mirapox 150-230 B, Batch No: 5114-11. | Miracon [®] , Balakong, Malaysia. |
| Supa Glue, Batch No: 38-383. | Selleys [®] , Padstow, NSW 2211, Australia. |
| Silicon carbide paper, 180 grit. | Buehler 41, Lake Bluff, 1260044, USA. |
| Diamond grinding disc, 40-4959, 70 micron | Buehler 41, Lake Bluff, 1260044, USA. |
| Vitrebond [™] resin modified glass ionomer Liner/base. Lot No: 20060429. | 3M ESPE Dental Products, St, Paul, MN, 55144-1000, USA. |
| Adper [™] Scotchbond [™] multi-purpose Plusa Adhesive system. Lot No: 7545S. | 3M ESPE Dental Products, St, Paul, MN, 55144-1000, USA. |
| Filtek [™] P60 packable composite Syringes, Shade B2, Lot No: 8100B2. | 3M ESPE Dental Products, St, Paul, MN, 55144-1000, USA. |
| Filtek [™] Z350 flowable nanocomposite Syringes, Shade B2, Lot No: 6031B2. | 3M ESPE Dental Products, St, Paul, MN, 55144-1000, USA. |
| Malyar Strip. | 3M ESPE Dental Products, St, Paul, MN, 55144-1000, USA. |
| Sof-Lex [™] Discs, Lot No: 20040706. | 3M ESPE Dental Products, St, Paul, MN, 55144-1000, USA. |
| Pen. Batch No: 842/46. | Heroldsberg, Germany. |
| Red Nail Varnish Batch No: GN0300-20 | SILKYGIRL [™] , Bangkok, Thailand. |
| Parker [®] Quink [®] Blue Ink, 57 ml Bottle, Batch No: 5-011247-021678. | Parker Pen Company, Newhaven, England. http://www.sanfordcorp.com |

Table 1. Chemical Composition of Collon Bium Type[®] I (Ni-Cr Alloy for porcelain-metal bond, Japan).

| Nickel | Chromium | Molybdenum | Beryllium | Other |
|--------|----------|------------|-----------|-------|
| Ni | Cr | Mo | Be | |
| 58.7 % | 22.0 % | 10.0 % | 0 | 8.3 % |

Table 2. Technical Data of Collon Bium Type[®] I.

| Melting Point | Vickers Hardness | Strength | Elongation | Thermal Expansion (50-700°C) | |
|---------------|------------------|----------|------------|------------------------------|-----------------------|
| | | | | (%) | (x 10 ⁻⁶) |
| (°C) | (HV) | (Mpa) | (%) | (%) | (x 10 ⁻⁶) |
| 1245 | 310 | 687 | 15 | 1.0 | 15.38 |

Table 3. Composition, Physical and Chemical Properties of Parker[®] Quink[®] Blue Ink.*

| | |
|---------------------------|--|
| Composition | Water, ethylene glycol (107-21-1), dye, preservatives. |
| Type of Ink | Standard ink. |
| Features | It resisted water, did not clog, had the desired quality of ink flow, resisted moulding, non-corrosive, did not leave deposits, did not fade and quick-drying. |
| Stability | Stable. |
| Solubility in Water | Soluble. |
| Appearance and Odor | Blue coloured liquid and Mild odor. |
| Boiling Point | Not available. |
| Specific Gravity | Not available. |
| Vapor Pressure | Not available. |
| Evaporation Rate | Not available. |
| Viscosity Coefficient** | 0.98 cps |
| Activation Energy** | 15.6 kJ mol ⁻¹ |
| Density** | 1.193 g cm ⁻³ |
| Conditions to Avoid | None known. |
| Chemical Incompatibility | None known. |
| Hazardous Decomposition | May produce oxides of carbon, nitrogen, and various hydrocarbons in fire. |
| Hazardous Polymerization | Will not occur. |
| Ecological Information | Not available. |
| Toxicological Information | No. |

*. Adapted from Material Safety Data Sheet (MSDS#:96112) of Parker[®] Quink[®] Ink (2003).

** . Adapted from Lee et al. (2004).

APPENDIX B

LIST OF EQUIPEMENT/INSTRUMENTS USED IN THIS STUDY

| EQUIPMENT/ INSTRUMENT | DESCRIPTION | MANUFACTURER |
|---|------------------------|---|
| Standard washer | | Custom made |
| Scalpal and surgical blade # 11 | Cutting | |
| Wax Knife and Lecron | Carver | |
| Casting ring size 6 sprue former size 6 | Investing and burn out | Dentaurum [®] , Pforzheim, Germany. |
| Rubber bowl and Spatula | Mixing | Dentaurum [®] , Pforzheim, Germany. |
| Vibrating machine | Vibrator | Quart de poblet, Valencia. |
| Mixing Vacuum | Mixing machine | Dentaurum [®] , Pforzheim, Germany. |
| Jelenko, acc-thermII, XL-M | Electrical furnace | N.Y., USA. |
| Casting Ring Muffle Tong | Casting | Bego, Bremen, Germany. |
| Ceramic Crucible | Casting | Bego, Bremen, Germany. |
| Induction casting machine | Casting | Fornax 35EM, Bego, Bremen, Germany. |
| Sandblasting machine Korostar | sandblaster | Bego, Bremen, Germany. |
| Colt Light Magnifier laboratory microscope | Magnification | Taiwan. |
| Metal caliper device | Measuring device | AB seveska Dental instruments, Sweden. |
| Digital vernier caliper. No. 002 | Calibration | Mitutoyo, Tokyo, Japan. |
| Digimatic micrometer, No. 271 | Calibration | Mitutoyo, Tokyo, Japan. |
| Digimatic indicator | | Mitutoyo, Minato-Ku, Tokyo 108, Japan. |

| | | |
|---|----------------------|--|
| Porcelain application kit (brushes, hemostat) | Buildup of porcelain | VITA Zahnfabrik, Bad Säckingen, Germany. |
| Vita Vacumat® 40 T | Porcelain Furnace | VITA Zahnfabrik, Bad Säckingen, Germany. |
| Laboratory Micromotor NM 4000 | Grinder | Goldach, Switzerland. |
| High speed turbine handpiece topair. Serial No. TS1-14771 | Preparation | Siemens, Berlin, Germany. |
| SV-400 | Surftester | Mitutoyo, Tokyo, Japan. |
| Standard plastic band | Punching | Custom made. |
| Mixing glass slap and cement spatula | Mixing | |
| Metaserver® 2000 | Grinder and Polisher | Buehler® IL, USA. |
| Dental Surveyor, AF30, unti No. 60290. | Mounting | Goldach, Switzerland. |
| Spectrum 800, Caulk | Light curing unit | Dentsply® Caulk, Milford, DE, USA. |
| Plastic Instruments | Adaptation | |
| Makramani-Load | Loading device | Custom made. |
| Low-speed handpiece, Serial No. T140-05905 | Polishing | Siemens, Berlin, Germany. |
| Memmert® B-400 | Incubator | D-8540 Schwabach, Germany. |
| HANNA Instrument | pH Meter | Kallay Way, Singapore. |
| Neslab thermalcyler | Thermocycling | Neslab Instrument Inc., U.S.A. |
| Isomet™ 2000 Precision | Cutting machine | Buehler®, IL, USA. |
| 0.5 diamond blade | Cutting saw | Buehler® IL, USA. |
| Watch-stop | Timer | Citizen, Japan. |
| Kyowa Optical, Model SD2-PL, No.941879 | Stereomicroscope | Tokyo, Japan. |

Tk. C1380-Colour Video
Camera, Industrial optics
lens, Video Lens-VSH300-
39708

JVC digital Camera

Tokyo, Japan.

Leica Qwin Lite T2-8,
Serial No.: 3154

Computer-Image Analyzer
Software

Leica Microsystems
imaging solutions Ltd.,
U.K.

APPENDIX C

The results of the Roughness Test

| Samples | The five random readings by μm | | | | | The Mean |
|--|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------|
| | 1 st reading | 2 nd reading | 3 rd reading | 4 th reading | 5 th reading | |
| 1 | 1.12 | 1.05 | 1.08 | 1.13 | 1.15 | 1.11 |
| 2 | 1.14 | 1.18 | 1.11 | 1.03 | 1.06 | 1.10 |
| 3 | 1.12 | 1.15 | 1.09 | 1.06 | 1.16 | 1.12 |
| 4 | 1.15 | 1.13 | 1.06 | 1.11 | 1.08 | 1.11 |
| 5 | 1.08 | 1.15 | 1.06 | 1.13 | 1.14 | 1.11 |
| 6 | 1.14 | 1.12 | 1.16 | 1.13 | 1.04 | 1.12 |
| 7 | 1.08 | 1.17 | 1.12 | 1.15 | 1.14 | 1.13 |
| 8 | 1.16 | 1.06 | 1.11 | 1.02 | 1.14 | 1.10 |
| 9 | 1.13 | 1.14 | 1.12 | 1.14 | 1.08 | 1.12 |
| 10 | 1.15 | 1.08 | 1.16 | 1.11 | 1.14 | 1.13 |
| 11 | 1.16 | 1.16 | 1.15 | 1.08 | 1.02 | 1.11 |
| 12 | 1.14 | 1.15 | 1.06 | 1.11 | 1.08 | 1.11 |
| 13 | 1.06 | 1.14 | 1.02 | 1.13 | 1.16 | 1.10 |
| 14 | 1.14 | 1.16 | 1.08 | 1.12 | 1.11 | 1.12 |
| 15 | 1.16 | 1.11 | 1.05 | 1.11 | 1.06 | 1.10 |
| 16 | 1.11 | 1.04 | 1.08 | 1.17 | 1.14 | 1.11 |
| 17 | 1.06 | 1.11 | 1.12 | 1.08 | 1.12 | 1.10 |
| 18 | 1.03 | 1.17 | 1.12 | 1.13 | 1.11 | 1.11 |
| 19 | 1.16 | 1.14 | 1.12 | 1.15 | 1.12 | 1.14 |
| 20 | 1.12 | 1.08 | 1.16 | 1.15 | 1.11 | 1.12 |
| Average Ra-μm | | | | | | 1.11 |

APPENDIX D

Table 1. Mean Penetration of Dye (mm) for all sub-groups

| Specimens No. | Sub-groups | | | | | | | |
|---------------|------------|------|-----|-----|-----|------|-----|-----|
| | A1 | A2 | A3 | A4 | B1 | B2 | B3 | B4 |
| 1 | .59 | 1.09 | .57 | .73 | .00 | .70 | .66 | .17 |
| 2 | 1.06 | 1.48 | .00 | .95 | .64 | 1.20 | .03 | .80 |
| 3 | .48 | 1.08 | .19 | .94 | .00 | .65 | .39 | .50 |
| 4 | .04 | .77 | .15 | .40 | .73 | .98 | .02 | .30 |
| 5 | .27 | 1.20 | .10 | .13 | .21 | .68 | .12 | .42 |
| 6 | .30 | .45 | .05 | .43 | .06 | .80 | .01 | .09 |
| 7 | .42 | .40 | .38 | .20 | .00 | .16 | .34 | .26 |
| 8 | .05 | .72 | .26 | .46 | .13 | 1.43 | .09 | .09 |
| 9 | .00 | .84 | .13 | .72 | .10 | .65 | .70 | .37 |
| 10 | .89 | 1.26 | .46 | .19 | .73 | .70 | .52 | .39 |

Table 2. Maximum Penetration of Dye (mm) for all sub-groups

| Specimens No. | Sub-groups | | | | | | | |
|---------------|------------|------|------|------|------|------|------|------|
| | A1 | A2 | A3 | A4 | B1 | B2 | B3 | B4 |
| 1 | 2.08 | 2.50 | 2.30 | 2.00 | .00 | 2.08 | 1.44 | .39 |
| 2 | 2.02 | 2.25 | .00 | 2.00 | 1.77 | 2.17 | .22 | 2.17 |
| 3 | 1.92 | 1.92 | 1.67 | 2.08 | .00 | 2.17 | 1.50 | 2.24 |
| 4 | .17 | 1.67 | 1.00 | 2.00 | 2.28 | 2.05 | .08 | 1.25 |
| 5 | 1.67 | 2.42 | .39 | .53 | .33 | 1.83 | .50 | 2.00 |
| 6 | .89 | 2.44 | .17 | 1.92 | .45 | 2.07 | .08 | .33 |
| 7 | 1.92 | 2.25 | 1.63 | .67 | .00 | .67 | .75 | 2.00 |
| 8 | .42 | 2.08 | 1.00 | 2.15 | 1.00 | 2.50 | .30 | .33 |
| 9 | .00 | 2.19 | 1.00 | 2.05 | .36 | 2.33 | 2.50 | .83 |
| 10 | 1.92 | 2.08 | 1.40 | .50 | 2.00 | 2.00 | 1.50 | 1.62 |

Table 3. Homogeneity Test (Levene's Test) of Equality of Variances^a for Mean dye penetration.

| | Levene Statistic | df1 | df2 | Sig. |
|----------------------|------------------|-----|-----|------|
| Mean dye penetration | .897 | 7 | 72 | .514 |

^a. Design: intercept + Restorative Technique + Water storage+ Thermocycling + Thermocycling * Water storage.

Table 4. Homogeneity Test (Levene's Test) of Equality of Variances^a for Maximum dye penetration.

| | Levene Statistic | df1 | df2 | Sig. |
|-------------------------|------------------|-----|-----|------|
| Maximum dye penetration | 3.984 | 7 | 72 | .001 |

^a. Design: intercept + Restorative Technique + Water storage+ Thermocycling + Thermocycling * Water storage.