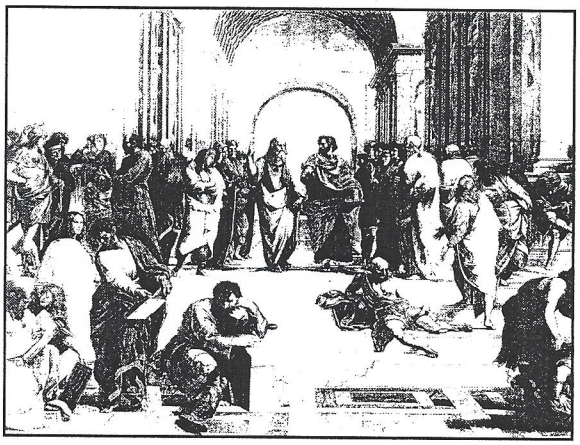

Systemic and Nutritional Dentistry

SYSTEMIC BASED RESTORATIVE DENTISTRY PART II: EVIDENCE-BASED DENTAL MATERIAL SELECTION

2

"Come to the edge," he said,
"We can't," they said,
"Come to the edge," he said,
"We can't, we're scared."
"Come to the edge"
They did,
He pushed them,
and they flew.

Marcel

3

1. The world is all that is the case
1.1 The world is the totality of facts, not of things
1.11 The world is determined by the facts, and by their being all the facts.
1.12 For the totality of facts determines what is the case and also whatever is not the case.

Tractatus Logico-Philosophicus
- Wittgenstein

4

PERSPECTIVE

1. The oral cavity is part of the body, and through this attribute, affects the body and is affected by it.
2. Factors such as malnutrition can affect under-development, hypoimmunity and opportunistic infection which directly impacts the oral cavity (the "end-organ" concept) and therefore, creates the mechanism by which the system as a whole is affected (by the oral cavity proper).

5

3. These affections may roughly be categorized by the following:
   Oral-Systemic Infections
   Oral-Systemic Dysfunction
   Oral-Systemic Sensitivity (toxicity)

[The former will be the subject of this inquiry]

6

4. The current divergence in dental philosophy, that is, the authoritative traditional approach and the equally authoritative alternative approach, can be resolved and complemented in an true evidence-based oral-systemic philosophy.

7

SUBJECT

1. Didactic

11. Test Theory and Process

III. Application: Selection Process
   A. Categorization by Clinical Protocol and its attendant "Materia Dentica"
   B. Selection Process Standardization (The Nifty - Fifty)
   C. Selection Process Individualization based upon Clinical and Physical Test findings.

8

OBJECTIVE

To present a protocol by which dental material selection can be systematized to augment existing concepts to reflect an immunotoxicological evidence based approach.

9

Disclaimer

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10

Part I: DIDACTIC

"The toxicology and pharmacology of dental restorative materials demands long-term concern not so much in the matter of acute poisonings and dysfunctions with rapid onset, but rather in the lower-grade chronic corrosion and degradation products"

Ref: Brune D; Corrosion of Amalgams, Scand J Dent Res, 89: 506, 1981.

11

Key Questions

KQ: What is the individual's greatest risk for chronic, low grade exposure to systemic toxins?

Ref: Frustaci A. et al, Marked Elevation of Myocardial Trace Elements in Idiopathic Dilated Cardiomyopathy compared with Secondary Cardiac Dysfunction, J Am College Cardiol, 33: 55, 1999.

12

KQ: What are the determinants in assessing possible systemic reactions to dental materials?

Ref: Barnes, J, Assessing Hazards from Prolonged and Repeated Exposure to Low doses of toxic substances, Br Med Bulletin 31: 196, 1975.

13

KQ: What are the potential systemic dysfunctions which may arise from chronic exposure of toxic substances?

Ref: Christian, M. Ed, Cancer and the Environment: Possible Mechanisms of Thresholds for Carcinogens and other toxic substances, J Am College Toxicology 1: 1-321, 1985.

Ref: Strominger J, Biology of the Human Histocompatibility Leucoyte Antigen (HLA) System and a hypothesis regarding the generation of autoimmune diseases, J Clin Investigation 77: 1411, 1986.

14

KQ: How can clinical dentists establish an evidence based toxicological assessment in order to propose a new model of material determination for the individual patient?

Ref: Guzelian PS, Victoroff MS, Holmes NC, James RC, Guzelian CP: Evidence-based toxicology: a comprehensive framework for causation, Human and Experimental Toxicology, 24: 161-201, 2005.

15

The Emerging Paradigm

"The biocompatibility of dental materials is a complex topic that draws on knowledge from biology, patient risk factors, clinical experience and engineering. Although ignored for many years, biocompatibility is now recognized as a fundamental requirement for any dental restorative material...

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... In spite of these oversights, [that is, standards or lack of standards for human biocompatibility by the Food and Drug Administration (FDA), the American National Standards Institute (ANSI), the American Dental Association (ADA), and the International Organization for Standardization (ISO)], materials are still used before their biological properties can be fully ascertained."

Ref: Wataha JC, Biocompatibility of Dental Materials, in ed. Anusavice KJ, Phillips' Science of Dental Materials, Saunders 2003

17

"There is a notable interest in making materials inexpensive and giving them qualities which emphasize ease of placement and workability for the dentist. There is also continuing interest in the strength, elasticity and durability of dental restoratives...

18

...many of these materials have superb wear and retentional characteristics, the leaching of various combinations of corrosion and degradation byproducts from the materials renders them relatively biologically unsuitable for those persons who possess systemic immune sensitivities.

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Increasingly, the practice of dental medicine must consider the long range total systemic health effects of any treatment being applied to the mouth. Virtually every organ system in the body may be affected by dental treatment and by the presence of inappropriate dental materials. While longevity of the tooth or filling is an important consideration, the quality of systemic health is of greater importance.

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Thus, the choice of any restorative material must include consideration of how the patient will handle the material's byproducts when the mass begins to deteriorate or break down. In the breakdown sequences, some tissues can be adversely affected and their function impaired.

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Still other tissues my not tolerate the presence of abnormal galvanically generated electrical interference or the adverse effects of electrically and chemically stimulated aberrant metabolites on cellular DNA and mitochondrial sites when the restorative material byproducts become involved in various metabolic activities and pathways.

22

Note: Aberrant metabolites can likewise be caused by medications, pollution, dystrophic foods and malnutrition.

Ref: Clifford WJ Materials Reactivity Testing: Background, Basis and Procedures for the Immunological Evaluation of Systemic Sensitization to components which emanate from biomaterials, Clifford Consulting and Research, 1990.

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MATERIAL BIOREACTIVITY

Material Degradation Processes:

Chemical Breakdown:

1. Biochemical: tarnish and corrosion
2. Electrochemical: galvanism

Physical Breakdown:

1. Release of unreacted molecules
2. Release of the reacted molecules
3. Release of corrosion products

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Bioreactivity Potential

1. Inherent reactivity of the native molecule.
2. Conversion of the native molecule to a metabolically reactive molecule.

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LOCAL EFFECTS

26

LOCAL EFFECTS

Biological Interfaces in the Oral Cavity

Restoration placement creates an interface between the material and its environs:

Tooth	Periodontium	Soft Tissue
Enamel	Gingiva	Epithelia
Dentin	PDL	Connective Tissue
Pulp	Periodontal bone	Systemic
Periapical Area	Alveolar bone	Circulation
PDL	Systemic Circulation	
Systemic Circulation		

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LOCAL EFFECTS

Material Interfaces:

Dentin-resin interface

Acid etching of the collagenous dentinal matrix causes demineralization of the inorganic matrix while preserving the collagenous matrix. Unless desicated, the matrix can physically remain intact allowing an unfilled resin to imbed within it, thereby creating a dentin-resin interface.

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Dentin-resin interface

Several factors may weaken this interface:

1. Dessication
2. Non-penetration (via poor technique or sclerotic dentin)
3. Resin shrinkage and 'tear' during polymerization shrinkage

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Dentin-resin interface

A breached dentin-resin interface results in the creation of a "gap" which results in microleakage (from lack of resin tubule penetration) or nanoleakage (partial penetration). The ramification of leakage can result in:

1. Pulpal inflammation and/or degeneration
2. Increased material breakdown and systemic exposure to the native and altered molecules

Ref: Wataha (ibid)

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Osseointegration

Integration of a material is directly related to its systemic biocompatibility.

Osseointegration, that is, the ability to form bone to within 100 angstroms of the oxide layer of the implant surface without intervening fibrous connective tissue is possible in:

- titanium oxide
- titanium alloys (Ti - Al - Va)

Ref: Wataha JC: Materials for endosseous dental implants. J Oral Rehabil 23: 79-90, 1996.

31

Biointegration

Biointegration is the ability of a material, by virtue of its compatibility, to become completely integrated into bone or soft tissue with no intervening space.

Ceramics which comprise this criteria are termed bioactive glasses. Degradation of the glass surface is also necessary to promote biointegration.

Both osseointegration and biointegration are not absolute phenomena but are functions of host response.

Ref: Wataha 1996 (ibid)

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SYSTEMIC EFFECTS

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Immune Mediated Systemic Reactions

1. Inflammation
2. Mutagenicity and Carcinogenicity
3. Allerginicity
4. Toxicity

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Inflammation

(Nonspecific Resistance)

Inflammation occurs in connective tissue and is characterized by an effusion of plasma from blood vessels to the CT.

Neutrophils are the primary cells in acute conditions and phagocytose bacteria or toxins, whereupon, macrophages later arrive to complete the immune response.

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If the acute exposure ceases, new fibrous CT grows into the inflamed area and healing begins.

If, however, exposure continues, the inflammatory response takes on a chronic mode with monocytes and lymphocytes predominating with changes evident in the blood chemistry.

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A CBC (Complete Blood Count) and SMAC can be utilized to determine whether a restorative patient is suffering from a subacute or chronic inflammatory condition.

A dental biocompatibility test can be performed to insure restorative dentistry will not further contribute to the patient's aggravated inflammatory status.

37

Chronic inflammation has been identified as one of the determinants in identifying and controlling chronic degenerative disease.

Ref: Queen HL Toxic Footprints, Health Realities Journal 19: (2) 1-8, 2003

38

Mutagenicity

Mutagenicity is the property of a dental material to exert a mutation in the base-pairing sequence in DNA.

Metal ions such as nickel, copper and beryllium, as well as some components in endodontic sealers are known mutagens. Some resins have mutagenic potential.

Ref: Wataha JC 2003 (ibid)

39

Mutagenicity

Mutagenicity does not always produce carcinogenicity:

"Currently, no dental material has been shown to be carcinogenic in dental application in patients. However, carcinogenesis is often exceedingly difficult to prove or disprove conclusively."

Ref: Wataha JC: 2003 (ibid)

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ALLERGENICITY AND TOXICITY

Terms

Exposure presentation of a foreign substance, called an antigen, to the immune system

Sensitization process in which an antibody is produced which reacts specifically to a causative antigen, typically in a dose dependent relationship

Hypersensitization a process in a non dose-dependent relationship resulting in excessive tissue damage and functional impairment.

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Terms

Allergen a foreign substance producing an IgE response.

Toxin a foreign substance typically producing an IgA, IgG or IgM response.

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Bioindividual Reactivity

Host Reactivity

Initial Contact

Exposure and subsequent systemic sensitization or hypersensitization usually occurs from non-dental and non-medical sources.

These are the result of antigens whether in food, air or water and exposure results from personal care products, and products chemical and foods found at home, the work place and in the environment.

Ref: Hamilton E, Minski M; Abundance of the chemical elements in man's diet and possible relation with environmental factors; The Science of the Total Environment 1: 375-394, 1972, 1973.

43

Hypersensitivity Reaction

(Gell and Coombs Classification)

Type I Immediate Atopic or Anaphylactic Reaction

Type II Cytotoxic Hypersensitivity

Type III Immune Complex Hypersensitivity

Type IV Delayed or Cell Mediated Hypersensitivity

Ref: Coombs R, Gell P; Classification of Allergic Reactions responsible for Clinical Hypersensitivity and Disease, Clin Aspects of Immunology 3rd Ed. Gell, Coombs and Lathman eds., Blackwell Press, Oxford P 761, 1975.

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Toxicity Reactions

Typically, dental materials cause systemic sensitivity (toxicity reaction) rather than hypersensitivity reactions, which are subacute or chronic in nature and clinically undetectable.

When degradation of the materials occurs, corrosion products may represent the most reactive molecules which enter systemic circulation.

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Toxicity Reaction

Corrosion byproducts may represent one of the greater cytotoxic products and may take the forms of:

acetates	nitrites
acrylamides	oxides
carbonates	oxylates
chlorides	phosphates
chromates	silicates
iodides	sulfates
malates	sulfides
methylates	tartrates
nitrates	metallic ions

Ref: Clifford 1990 (ibid)

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Toxicity Reactions

Once corrosion byproducts and metallic ions enter circulation, they may become complexed into binding sites for various amino acids, proteins, fatty acid and carbohydrate binding sites.

As a result, inflammation occurs in which phagocytes consume the antigens and present them to B-Lymphocytes and plasma cells for processing which produce IgG and IgM antibodies.

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Toxicity Reactions

Subsequent exposures results in IgG and IgM combining and forming antibody-antigen complexes in the affected tissues.

Under proper conditions, these complexes are segregated and eliminated via the urine, stool and skin (during perspiration).

If these complexes cannot be eliminated, which is frequently the case during long term chronic exposure, systemic issues such as clotting dysfunction and autoimmune issues may arise.

Ref: Clifford 1990 (ibid)

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Concept of Immunotoxicity

Most researchers look for cell death as an indicator of toxicity. Some materials may exert toxic effects, such as dysfunction, far below the cell "toxicity" or cell death levels. This phenomenon has been overlooked and could result in misinterpretation of findings.

Ref: Wataha JC, Hanks CT: Biological effects of palladium and risk of using palladium in dental casting alloys J Oral Rehabil 23: 309-320, 1996.

49

Immunotoxicity: Palladium

Glutathione (GSH) defends cells against toxic agents to prevent cell death by oxidative stress.

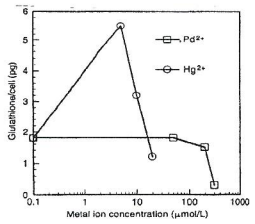
Mercury ions decrease GSH levels until at toxicity levels, the cells can no longer produce GSH and die.

Palladium ions, on the other hand, presumably prevent an increase of GSH levels until cell death occurs.

Ref: Wataha (ibid)

50

Immunotoxicity



Glutathione content of Human Monocytes after subtoxic exposure to mercury and palladium ions measured at 24 hours post exposure.

Note: GSH is the cells first line of defense against toxic exposures and its decrease indicates toxicity.

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Immunotoxicity: HEMA

HEMA (Hydroxyethylmethacrylate), a dentin bonding component, was studied on its effect on monocytes.

Monocytes will release TNF - alpha, a cytokine, in response to lipopoly-saccharide (LPS), an etiological agent in promoting inflammation.

No amount of HEMA induced or TNF - alpha secretion by itself (see squares on graph) but inhibited the monocytes ability to secrete it after LPS stimulation

Ref: Wataha (ibid)

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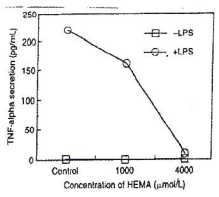
Immunotoxicity



Graph showing HEMA (Hydroxyethylmethacrylate) effect on Human Monocyte TNF-alpha secretion after stimulation by LPS (Lipopolysaccharide), an important periodontal etiological factor. The monocyte is not killed by the HEMA, but its ability to respond to a challenge is severely limited.

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Part II: TESTING THEORY AND PROCESS

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Reactivity

There are 89 important antigen groups found in over 5200 dental materials. These represent metal ions, chemical groups and various chemical compounds.

Each person, by virtue of his / her own "immunobioindividuality" will present , based upon their previous immune system exposure, with their own unique immunological sensitization record.

55

Order of Reactivity

Percentage corresponds to amount of the population (of 12,823 specimens reacting to the material).

1. 97.9% Nickel Salts Group

(Nickel, found in nonprecious alloys and nickel-titanium arch wires, can, in some cases, also produce an IgE reaction).

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Order of Reactivity*

2. 92.7%: Mercury Salts Group
   (NB: Dental amalgam)
3. 91.4%: Aluminum Salts Group
   (NB: Dental cord astringents)
4. 86.4%: Arsenic Salt Group
   (NB: low grade ceramics or porcelains from the 3rd world; can cross react with cadmium and beryllium antibodies.

*Ref: Clifford WJ: Reactivity Percentages derived from 12,823 specimens; Clifford Consulting and Research, 1995.

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Reactivity

5. 82.7%: Chromium Salts Group
   (NB: Chromium may be complexed with nickel or with cobalt)
6. 81.0%: Toluenes Group
   (NB: primarily used as a carrier solvent but usually outgasses. If there is improper mixing or curing, it may not completely react and outgas. Also found in cosmetics and skin care products to impart creamy consistency, therefore, a patient may be sensitized if using skin care products).

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I fixed this

Reactivity

7. 78.4% Cobalt Salts Group
   (NB: found in the pigment of denture materials, prefabricated denture teeth, orthodontic materials and implant materials).

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I

Reactivity

8. 77.5%: indium Salts Group
   (NB: metal alloys to improve castability)
9. 77.4%: Polyethimines Group
   (NB: essentially a byproduct of the plasticization process. Usually the manufacturer will remove it but may be found in reformed crowns, mouth guards and splint materials - especially low cost materials)

Ref: ibid

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preformed

Reactivity

10. 74.3%: Beryllium Salts Group
    (NB: Utilized in nonprecious alloys to improve etching capabiltiy in "Maryland" bridges; there is some interest to remove it from nonprecious alloys in the USA, Europe and Japan. It is still prevalent in most other countries.
11. 68.0%: Lead Salts Group
    (NB: used in the USA in gold alloys in unreputable alloy producers and in low grade ceramics)

Ref: ibid

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Reactivity

12. 63.7% Cerium Salts Group
    (NB: found in all ceramics. If the ceramics are properly fired it is locked into the ceramic matrix and cannot dissociate; can potentially dissociate in poorly fired ceramics).
13. 63.3%: Tannins Group
    (NB: Similar reaction to toluenes; tannins are also used to impart cleanliness and spreadability to cosmetic and skin care products).

Ref: ibid

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Reactivity

14. 63.0% Cadmium Salts Group
    (NB: Cadmium salts may be used as pink pigment in denture materials)
15. 54.9% Iron Salts Group
    (NB: dental alloy contaminant)
16. 43.8% Rubibium Salts Group
    (NB: dental alloy contaminant in unreputable alloy manufacturers; if found look for other rare earth metals; facilitates galvanism.

Ref: ibid

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Rubidium

Reactivity

17. 42.6%: Bismuth Salts Group
    (NB: dental alloy contaminant)
18. 36.3%: Antimony Salts Group
    (NB: dental alloy contaminant)
19. 36.2%: O-Phosphoric Acid Group
    (NB: found in phosphoric acid gels and liquids; one-step bonding agents; whitening agents)
20. 33.5%: Zinc Salts Group
    (NB: found in cements)
21. 31.5%: Palladium Salts Group
    (NB: found in precious and semiprecious alloy materials)

Ref: ibid

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Reactivity

22. 33.1% Gallium Salts Group
    (NB: alloy contaminant)
23. 32.8% Rhodium Group
    (NB: alloy contaminant)
24. 32.1% Copper Salts Group
    (NB: found in precious, semiprecious and nonprecious alloys)
25. 31.9% Tin Salts Group
    (NB: amalgam and alloys)
26. 29.8% Formaldehyde Group
    (NB: Carrier solvent system; found in composites, glass ionomers, polyethers etc to keep material liquid i.e. increase working time)

Ref: (ibid)

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Reactivity Notes

Nonprecious alloys - may contain hexavalent chromium, cobalt, molybdenum, nickel and beryllium. Although Be may be in low concentration, it migrates to the surface where it can compose up to 50% of the alloy surface.

note: Non-North American, European and Japanese alloy manufacturers may have many contaminants, including tungsten, in their non-precious alloys. Ceramic alloys in these markets, have been found to contain uranium.

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Reactivity Groups

Acetates Group	14.1%
Acrylates Group	00.8%
Aluminum Salts Group	91.4%
Antimony Salts Group	36.3%
Arsenic Salts Group	86.4%
Barium Salts Group	00.2%
Benzil Group	00.7%
Beryllium Salts Group	74.3%
Bis-GMA Group	00.2%

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Reactivity Groups

Bismuth Salts Group	42.6%
Boron Group	00.6%
Butyrates Group	00.3%
Cadmium Salts Group	63.0%
Carboxylates Group	00.3%
Cellulose Group	16.9%
Cerium Salts Group	63.7%
Cesium Salts Group	01.9%
Chromium Salts Group	82.7%

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Reactivity Groups

Cobalt Salts Group	78.4%
Copper Salts Group	32.1%
Eugenol Group	18.9%
Fluorides Group	00.9%
Formaldehyde Group	29.8%
Gallium Salts Group	33.1%
Gold Salts Group	00.6%
Hexanes Group	00.2%
Hydroxyapatite / CaOH	>0.1%

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Reactivity Groups

Indium Salts Group	77.5%
Iridium Salts Group	09.1%
Iron Salts Group	54.9%
Lanthanum Salts Group	17.9%
Lead Salts Group	68.0%
Lithium Salts Group	14.3%
Malienates Group	01.1%
Manganese Salts Group	04.8%
Mercury Salts Group	92.7%

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Reactivity Groups

Molybdenum Salts Group	14.6%
Nickel Salts Group	97.7%
O-Phosphoric Acid Group	36.2%
Palladium Salts Group	31.5%
Phenols Group	22.1%
Platinum Salts Group	00.4%
Polyethers Group	00.2%
Polyethimines Group	77.4%
Polysulfide Group	06.3%

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Reactivity Groups

Polyvinyls Group	11.7%
Quinones Group	00.1%
Rhodium Group	32.8%
Rubidium Salts Group	43.8%
Ruthenium Salts Group	09.1%
Selenium Salts Group	07.7%
Silanes Group	>0.1%
Silicates Group	>0.1%
Silver Salts Group	24.7%

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Reactivity Groups

Strontium Salts	00.4%
Styrenes Group	01.2%
Tannins Groups	63.3%
Tantalum Salts Group	13.4%
Tellurium Salts Group	02.6%
Thallium Salts Group	18.4%
Titanium Salts Group	00.2%
Toluenes Group	81.0%

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Reactivity Groups

Trihexalamines Group	00.2%
Tungsten Salts Group	05.2%
Uranium Salts Group	04.1%
Urethanes Group	00.9%
Vanadium Salts Group	02.3%
Xylenes Group	00.2%
Ytterbium Salts Group	01.4%
Yttrium Salts Group	00.8%
Zince Salts Group	33.5%
Zirconium Salts Group	14.8%

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PART III:
APPLICATION: SELECTION PROCESS

A. Materia Dentica
B. Selection Process Standardization
C. Selection Process Individualization

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MATERIA DENTICA

Procedures:

I. Cavity Preparation
II. Crown Preparation
III. Presthetic Materials
IV. Esthetic Materials
V. Pediatric Materials

Systems:

I. Direct Composites
II. Indirect Resin Systems
III. Gold based Restoration
IV. Ceramic based Restorations

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MATERIA DENTICA

I. Cavity Preparation
1. Anaesthetic Preservative
2. Cavity Cleanser
3. Desensitizers
4. Pulp Cap
5. Liner
6. Base
7. Etchant
8. Adhesive Resin
9. Pins
10. Posts
11. Core Materials

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1. MATERIA DENTICA: Anaesthetic Preservatives

Benzylkonium Chloride
Butryraldehydes
Formaldehyde
Metabisulfites
Methyl Paraben
Phenol Propionates
Sorbates
Thimerosol

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2. PREPARATION

Cleansing Agents

Product	Active Ingredient
Concepsis (Vitrdent)	2% Chlorhexidine
Preppies (Whip Mix)	Pumice
Cavity Cleanser (Bisco)	2% Chlorhexidine Gluconate
Ultracid F (Ultradent)	EDTA
	Benzalkonium Chloride
	1% Sodium Fluoride
Tubulicid Red (Global)	2% EDTA
	Benzalkonium Chloride
	1% Sodium Fluoride

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3. DESENTIZERS

Product	Active Ingredient
Gluma (Kulzer)	5% Glutaraldehyde
	35% HEMA
Super Seal	Potassium
(Phoenix)	Oxalate Based Salt
Seal and Protect	Triclosan
(Dentsply / Caulk)	Di and Trimethacrylate resins
	PENTA, nanofillers
	Acetone
ALL Bond DS	Primer A: NTG-GMA, acetone, and ethanol
(Bisco)	Primer B: BPDM, acetone and ethanol
Microprime	35% HEMA
(Danville)	5% Benzethonium Chloride
	Sodium Fluoride 10 PPM
Ultra EZ	3% Potassium Nitrate
(Ultradent)	0.11% w/fluoride ion

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Benzalkonium

4. Materia Dentica: Pulp Capping Agents

MTA (Mineral Trioxide Aggregate)

Calcium Hydroxide

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5. Liners (Resin / Glass Ionomers)

Product	Active Ingredients
Fuji Lining LC	Aluminofluorosilicate glass
(GC)	Polyacrylic Acid
	Tartaric Acid
	Camphoquinone
	Dibutyl hydroxy toluene
	HEMA
Vitrebond	Fluroaluminosilicate glass
(3M ESPE)	Photoinitiator
	Methacrylate modified Polycarboxylic acid
	HEMA

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6. BASES & BUILDUPS (Resin / Glass Ionomer)

Product	Active Ingredients
Fuji II LC	same as Fuji Lining LC
(GC)	
Vitremer	same as Vitrebond
(3M ESPE)	
Geristore	Barium fluorosilicate glass
(Den Mat)	Silica
	Aromatic dimethacrylate
	HEMA
	Initiators and Stabilizers

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7. ETCHANTS

ETCHANTS- Dentin / Enamel

Products	Active Ingredients
Ultra Etch 35%	Phosphoric Acid
Ultra Etch AB	Gels
(Ultradent)	
UniEtch	Colors
UniEtch with BAC	Silica
(Bisco)	[note: most of these etchants
Etch-Rite	can remove the smear layer]
(Pulpdent)	
Gluma Etch 35	
(Kulzer)	
Enamel Etch	
(Cosmedent)	
Gel Etchant	
(Kerr)	
Opti Bond Solo	Lactic and Citric Acid
(Optibond)	Ethyl Alcohol

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ETCHANTS-Porcelain

Products	Active Ingredients
Porcelain Etch (Ultradent)	9.5% Hydrofluoric Acid
Oral Ceram Etch (Gresco)	9.5%
Porcelain Etch Gel (Pulpdent)	9.6%
Porcelain Etchant (Bisco)	4%
Porceletch (Cosmedent)	9.5%

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8. ADHESIVES-ALL PURPOSE

Products	Solvents
Optibond (Kerr)	Ethanol, water
Prime and bond DC (Dentsply /Caulk)	Acetone, Ethanol
Scotchbond (3M Espe)	Ethanol, water
All bond 2 (Bisco)	Acetone, Ethanol, water
One Step (Bisco)	Acetone

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ADHESIVES-Light Cured

Product	Solvents
Optibond Solo Plus (Kerr)	Ethanol
Clearfil SE Bond (Kuraray)	Water
Gluma Comfort Bond + Desensitization (Kulzer)	Ethanol, water
PQ1 (Ultradent)	Ethanol
Single Bond (Espe)	Ethanol, water

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9. PINS

Product	Composition
Filpin (Filhol Dental)	Titanium
Minim TMS (Whaledent)	Gold

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10. POSTS: Metal Free

Product	Composites
Aestheti-Plus (Bisco)	Quartz Fibers in Epoxy Matrix
Para Post Fiber White (Whaledent)	Fiber Reinforced Resin
Cerapost (Brasseler)	Zirconium Oxide

Indications: Esthetics
Chainside Post is an option

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POSTS: Metal

Product	Metal
Para – Post (Whaledent)	Titanium or Stainless Steel
Flexi – Post (EDS)	Titanium or Stainless Steel
OptiPost (Brasseler)	Titanium

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CAST POSTS

NOTE: EMD Concerns

Whenever possible, ask the laboratory to fabricate the cast posts out of the same gold the crowns or bridgework is being fabricated from.

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10. CORE MATERIALS

Light-Cured

Large particle composites which cure more deeply than hybrids

Eg. Clearfil photo-cure (Kuraray)
Bisfil Cure (Bisco)

Note: Can utilize hybrid to perform build ups.

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Dual Cure

Large particle composites

Eg: LuxaCure Automix Dual (DMG)
Core Paste Syringeable (DenMat)
Build It! FR (Dentron)

Self Cure

Can build up deeper levels

No trauma to pulp from lights

Eg: Core Paste (DenMat)
Encore (Centrix)
Bisfil II / Cure Flo (Bisco)

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Materia Dentica

II. Crown Preparation

1. Impression Materials
2. Bite Registration Materials
3. Provisional Materials
4. Cements:
   A. Provisional
   B. Permanent

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Materia Dentica: Impression Materials

Impression materials are in the mouth for a short duration of time. Questions of biocompatibility arise:

KQ: Is it possible to use one material even if patients are sensitive to it?

KQ: Which type of material has the lowest systemic sensitivity?

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1. IMPRESSION MATERIALS

1. Alginate / Hydrocolloid
2. Vinyl Polysiloxane

Products	Notes:
Aquasil (Dentsply)	Easy removal
Splash (Discus)	Slight hydrophilic
Affinis (Coltene)	Latex contamination
Flexitime (Kulzer)	affects set

3. Polyether

Products	Notes:
Permadyne (Espe)	Difficult removal
Penta Soft (Espe)	Hydrophilic
Impregum (Espe	Bad taste and smell
Polyjel NF (Dentsply)	

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2. BITE REGISTRATION MATERIALS

Product	Notes
Jet Bite (Coltene)	Vinyl Polysiloxanes
Peppermint Snap (Discus)	
Vanilla (Discus)	
Blu-Mousse (Parkell)	
Regisil Rigid (Dentsply)	
Ramitec (Espe)	

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3. PROVISIONALIZATION

Inlays and Onlays

Products	Notes:
EZ-Temp (Cosmedent)	Light cured
	Semi-flexible (when set)
Systemp (Ivoclar)	No matrix necessary
	Easy Cleanup
First-fill (Dentron)	after removal

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3. Provisionalization
Crown and Bridge

Product	Notes:
Luxatemp (DMG)	Bis-acryl composites
	Flexible material
Luxatemp Solar Plus (DMS)	Easy to remove
	Sensitivity (place desensitizer before temp placement).
Integrity (Dentsply)	

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4. CEMENTS
A. Provisional Cements

Products	Composition
Temp Bond NE (SDS / Kerr) (DMG)	Poly organic acids Natural Resins, Fatty Acids, Additives
Temp Bond Clear (SDS / Kerr)	Zinc Oxide Resin
Durelon (Espe)	Polycarboxylate Acid
Provilink (Ivoclar)	Resin

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B. Permanent Cements

Traditional Cements

Most cements come in two components systems: base and catalyst. Bases are usually powders and catalyst are liquid.

Catalysts are usually acidic solutions (proton donors) and powders basic (proton acceptors) consisting of either glass or metallic oxide particles.

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Types of Cements

1. Traditional Acid-Base Reaction Cements
2. Resin Cements
3. Resin / Glass Ionomer Cements

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Acid-Base Reactions

Material	Formulation
Zinc Phosphate	Powder: Zinc Oxide (90%) and Magnesium Oxide (10%) Liquid: Phosphoric Acid
Zinc Oxide - Eugenol (EBA Modified)	Powder: Zinc Oxide Liquid: Eugenol (Ethoxybenzoic acid)
Zinc Polycarboxylate	Powder: Zinc Oxide and Magnesium Oxide or Stannous Fluoride (10-15%) Liquid: Polyacrylic Acid
Glass Ionomer	Powder: Fluoro alumino-silicate glass Liquid: Polyacrylic acid-Polybasic Carboxylic Acid Water

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Resin Cements

Delivery Systems:

Resin Light and Dual Cure
- Indications: PLV

Resin Dual Cure
- Indications: Metal-free restorations

Resin Self Cure
- Indications: Metal restorations

Resin Glass Ionomer
- Indications: Metal-free restorations

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Chemistry: Resin Cements

Powder: Polymethyl Methacrylate beads
Liquid 1: Methacrylate Monomers
Liquid 2: Catalysts

One Paste System:
- Methacrylate Monomers
- Initiators

Two paste Systems:

Base Paste:
- Methacrylate Monomers
- Fillers
- Initiators

Catalyst Paste:
- Methocrylate Momnomers
- Fillers
- Activators (chemical cure)

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Resin Cements

Light Cured / Dual Cure
- Calibra (Dentsply)
- Nexus 2 (Kerr)
- Variolink (Ivoclar)
- Rely X Veneer Cement (3M)
- Illusion (Bisco)
- Lute It! (Dentron)

Indications: Porcelain Laminate Veneer
- Metal-free periodontal splints
- Metal-free orthodontic retainers
- Metal-free restorations (less than 1.5mm in thickness)

Note: Includes initiators (for light curing) and activators (for chemical acid-base curing)

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Resin Cements

Dual Cure Only
- Compolute (3M ESPE)
- Duo-Link (Bisco)
- Panavia F (Kuraray)
- Rely X ARC (3M ESPE)
- Cement It! (Dentron)

Indications: Metal free inlays
- Metal free onlays
- Metal free crowns
- Metal free bridges

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Resin Cements

Self-Cure
- Panavia 21 (Kuraray)
- C & B Cement Luting Composite (Bisco)
- Post Cement Hl-X (Bisco)
- C & B Metabond (Parkell)

Indications: Metal based inlays & onlays
- Ceramometal crowns & bridges
- Endodontic posts
- Metal based resin bonded bridges

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Resin / Glass Ionomers: Purposes

LINERS (Eg: Fuji Lining LC; Vitrebond etc)

BASES (Eg: Fuji II LC; Vitremer Core Buildup etc)

LUTING CEMENTS (to be discussed)

NOTES:

R /GI contain resin and may form a chemical bond with overlaid composite.

R /GI do not require etching and etch or lack of etch will not interfere with a composite bond.

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Chemistry: Resin Modified Glass Ionomer

Powder: Fluoroaluminosilicate glass
Chemical and/or light activated initiators

Liquid: Polyacrylic Acid
Water Soluble Methacrylate Activators

Paste A: resembles powder

Paste B: resembles liquid

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Resin / Glass Ionomer Luting Cements

Products
Fuji Plus (GC)
Fuji CEM (GC)
Rely X Luting (3M)
PermaCem (DMG)
Principle (Dentsply)

Indications
Buildups and Cores
Class V Restorations and Primary teeth
Luting metal and ceramometal restorations

Do not cement metal-free restorations or endodontic posts!

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MATERIA DENTICA
Prosthetic Materials

1. FPD Materials
2. ISD Materials
3. RPD and Full Denture Materials

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FPD Materials

(Discussed in Restorative Systems Section)

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2. IMPLANTS

Pure Titanium
CP Grade I
CP Grade II
CP Grade III
CP Grade IV

note: trace amounts of-
Nitrogen, Carbon, Hydrogen, Iron and Oxygen

Titanium Alloys
Ti - 6 Al-4V Alloy
Ti - 6 Al-4V (ELI Alloy)
Ti -13 Nb-13 Zr (Phase Stabilizers)
Ti -15 Mo-2.8 Nb (Phase Stabilizers)

"Some controversy exists as to which titanium metal to use, because some researchers believe aluminum and vanadium can be toxic if released in sufficient quantities."

Esquivel-Upshaw "Dental Implants"
Phillips' Science of Dental Materials
11th Edition (Ed: Anusavice)

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IMPLANTS (cont)

Ceramic Implants (Non-Bioactive)
- Aluminum Oxide (Al_2O_2) [Gold Standard]
- Zirconia ($Zr O_2$)

Bioactive Ceramics
- Hydroxyapatite (HA)
- Tricalcium Phosphate (TCP)
- "Bioglasses" ($Si O_2 \cdot CaO \cdot Na_2O \cdot P_2O_5 \cdot MgO$)
  [note: Osteoinductive properties]
- Indications: Implant coatings
  Bone grafting

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IMPLANTS (others)

Surgical Austenitic Steel (Stainless Steel)
- 18% Chromium (corrosion resistance)
- 8% Nickel (stabilize austenitic steel)
- "This is not used…because of the allergic potential of nickel…"

Cobalt – Chrome – Molybdenum Alloys
- 63% Cobalt / 30% Cr / 5% Mb

Vitallium (Cr – Co – Mo alloy)

Ticonium (Ni – Cr – Mo – Be alloy)

NOTE: These generally showed:
1. no epithelial attachment
2. chronic inflammation
3. fibrous encapsulation
4. mobility

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3. DENTURES

Teeth
- Porcelain (Projection metal pins)
  Swissdent
- Acrylic and Vinyl – acrylic resin
  Bioblend

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Denture Acrylic Resins

- Poly (methyl methacrylate) resin
- Benzoyl peroxide (initiator)
- Hydroquinine (inhibitor)
- Glycol dimethacrylate (cross linking agent)
- Cadmium (pink color)

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Denture Materials (cont)

- Reline Materials
- Rebase Materials
- Denture Liners
- Denture Adhesives
- Maxillofacial Prosthetic Materials
  - Latexes
  - Vinyl Plastisols
  - Silicone Rubbers
  - Polyurethane Polymers

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MATERIA DENTICA

IV. ESTHETIC MATERIALS

Bleaching Agents

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Whitening / Bleaching Agents

Types: 1. Power
2. Assisted
3. Home Bleaching

Power Bleaching

Product	Composition
Opalescence Xtra (Ultradent)	35% Hydrogen Peroxide Carotene
Virtuoso Lightening Gel (Den-Mat)	32% Hydrogen Peroxide Potassium Nitrate Carbopol Potassium Hydroxide Sodium Fluoride EDTA
Illumine (Dentsply)	30% Hydrogen Peroxide Copolymer of Methylvinyl Ether and maleic anhydride

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Assisted Bleaching

Product	Composition
Opalescence Quick (Ultradent)	35% Carbomide Peroxide
White Speed (Discus)	18% Hydrogen Peroxide 22% Carbamide Peroxide (equivalent to 35% H_2O_2)

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Home Bleaching

Product	Composition
Opalescence	10% Carbamide Peroxide (CAP)
Opalescence F	15 and 20% CAP 0.11% Fluride ion
Opalescense PF	10.15 and 20% CAP 0.11% Flurode ion
(Ultradent)	3% Potassium Nitrate
Nite White Excel 2	CAP (10%)
Nite White Excel 2Z	CAP (16%) Potassium Nitrate Fluoride Hydrogen Peroxide (75-9.5%) Activators (Eugenol, Xylitol and Aloe Vera)
Nite White Excel 2NSF	CAP (22%)
Day White 2Z	Neutral Sodium Fluoride
(Discus)	

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MATERIA DENTICA

V. PEDIATRIC MATERIALS

1. Compomers
2. Sealants
3. Temporary Crowns

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PEDODONTICS

1. Compomers – "Scuptable"

Product	Composition
Compoglass F (Ivoclar)	Filler: Ba-Al-fluorosilicate glass Ytterbium trifluoride oxides, catalysts, stabilizers Resin matrix: urethane dimethacrylate DM tetracthylene glycol DM cycloaliphatic decarboxylic acid DM
Dyract AP (Dentsply)	Filler: Strontium – Al- fluoro-phosphato-silicate glass Resin matrix: UDMA TCB (reaction product of tetracarboxylic acid and HEMA)

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Compomers "Flowable"

Product	Composition
Compoglass Flow (Ivoclar)	Ba-Al-fluorosilicate glass Ytterbium Trifluoride Spheroidal Mixed oxides Stabilizers, Pigments Urethane DM Polyethelyene glycol DM Cycloaliphatic dicarbonic acid DM Fluoride
Dyract Flow (Dentsply)	Strontium - Al – Fl – Si Glass Titanium oxide Stabilizers, Pigments Macromonomers (M-IA – BSA) Reactive Diluent Polymerizable initiator Fluoride

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2. Sealants

Product	Composition
Ultraseal XT Plus (Ultradent)	Resin: BID – GMA / TEGDMA Fluoride releasing
Clinpro Sealant (3M Espe)	Opaque: Filled resin (26-60% depending upon product)
Guardian (Kerr) Helioseal F / Helioseal Clear (Ivoclar)	Clear: no fillers
EcuSeal (DMG)	

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MATERIA DENTICA

RESTORATIVE SYSTEMS:

I. DIRECT COMPOSITES
II. INDIRECT RESIN SYSTEMS
III. GOLD BASED RESTORATIONS
IV. CERAMIC BASED RESTORATIONS

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MATERIA DENTICA

DIRECT COMPOSITES:

1. Microfills
2. Hybrids
3. Flowable
4. Packables
5. Reinforced Fiber
6. Tints and Opaques
7. Polishing Pastes

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COMPOSITES

1. MICROFILLS

Product	Indications
Renamel and IV Restorations	Anterior Class III (Cosmedent)
Durafil VS (Kulzer)	Composite Laminate Veneers
Heliomolar (Ivoclar)	
Filtek All (3M ESPE)	
Matrixx Ant. Microfill (Discus)	
Micronew (Bicso)	

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2. HYBRIDS

Product	Indications
Esthet X (Dentsply)	Posterior Composites
Renamel Hybrid (Cosmedent)	Anterior Class IV
Point 4 (Kerr)	(note: blend better than microfills)
Vitalescence (Ultradent)	
XRV Herculite (Kerr)	
Renamel Sculpt (Cosmedent)	

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3. FLOWABLE

Products	Notes:
Flow It! ALC (Pentron)	Indicated in deep proximal boxes and Class V Abraction Lesions
Revolution 2 (Kerr)	All are light cured Except "2B"s which are Dual Cure and Self-Cure.
Tetric Flow (Ivoclar)	EMD: match hybrid or microfil to flowable to decrease EMD generated by two different composites
Renamel Flowable Microfill and Hybrid (Cosmedent)	
Filtek Flow (3M Espe)	
Bisfil 2B (Bisco)	
StarFill 2B (Danville)	

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4. PACKABLE COMPOSITES

Products	Notes:
Prodigy Condensable (Kerr)	EMD-match to Flowable / hybrid
Filtek P60 (3M)	Indication (?) – Class II boxes
Heliomolar HB (Ivoclar)	
Renamel Pack (Cosmedent)	
Pyramid (Bisco)	
SureFil (Dentsply)	
Virtuoso Packable (Den-Mat)	
Matrixx Post. Hybrid (Discus)	

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5. REINFORCED FIBERS (Fiberglass)

Product	Composites
Ribbond (Ribbond)	Polyethylene
Connect (Kerr)	Polyethylene
Splint-It (Pentron)	"S2 Glass" (a proprietary glass blend)

Indications:

1. To increase flexural strength of the restoration
2. Restorations: Periodontal Splints
   Resin bonded bridges
   Natural tooth pontics
   Dentures

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6. TINTS AND OPAQUES

Products	NOTE: Most tints are metallic oxides:
Creative color (Cosmedent)	Brown (Iron/Nickel oxide)
Kolor + Plus / belle Glass HP Opaque (Kerr)	Green (Copper oxide)
Tetric Color (Ivoclar)	Yellow-Brown (Titanium oxide)
	Lavendar (Manganese oxide)
	Blue (Cobalt oxide)
	NOTE: Opacity:
	Cerium oxide
	Zirconium oxide
	Titanium oxide
	Tin oxide

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7. POLISHING PASTES

Product	Composition
Prisma-Gloss / XF (Dentsply)	Aluminum oxide
Insta-Glaze HVB (Taub)	Fine Diamond Particles (for higher luster)
Enamelize (Cosmedent)	
Composite (Shofu)	

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MATERIA DENTICA

INDIRECT RESIN SYSTEMS

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9. INDIRECT RESIN SYSTEMS

Products	Notes:
Bell Glass HP (SDS / Kerr)	Pyrex glass with a blended resin of aliphatic and urethane dimethacrylates (same filler as Herculite XRV)
Cristobalt (Dentsply)	BIS-GMA resin matrix
Sculpture / Fiber Kor (Dentron)	Barium borosilicate glass (77%)
Sinfony (3M Espe)	PCDMA (Polycarbonate Dimethacrylate
Estenia (Kuraray)	Silica and Barrium glass particles
Targis / Vectris (Ivoclar)	Strontium Aluminum Borosilic glass
	Pyrogenic silica (silicon dioxide)
	Resin: Bisphenyl A Polyethoxy
	Dimethacrylate, hydrophobic
	Dimethacrylate and urethane
	Tetramethacrylate
	Filler: Silica and barrium glass

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NOTES: Resin inlays have a better fit than ceramic inlays
69% Dentists use resin inlays
57% use ceramic onlays
Can repair with hybrid.

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GOLD BASED RESTORATIONS

1. CAST GOLD ALLOYS
   - Type I
   - Type II
   - Type III
   - Type IV
2. CERAMOMETAL GOLD ALLOYS
   - Type III
   - Type IV
   - Type IV LS (Long Span Bridges)

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1. CAST GOLD RESTORATIONS

1905 Taggert's "Lost Wax Technique"
1932 ANSI / ADA Specification No. 5

Type		Min. Gold	Vicker's Hardness
I	Soft	83	50- 90
II	Medium	78	90-120
III	Hard	78	120-150
IV	Extra-Hard	75	>150

Copper, silver or platinum were used to strengthen gold.
Platinum was used to prevent silver tarnishing in low gold alloys.

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Hardness and Function Classification Cast Gold Restoration

Type I (Soft) Yellow Gold
(Inlays)

Type II (Medium) Yellow Gold
(Onlays)

Type III (Hard) Yellow Gold
Low Gold
Silver Palladium
(Onlays, Crowns, Abutments)

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Cast Gold Restoration (cont)

Type IV (Extra-Hard) Yellow Gold
Low Gold
Silver Palladium
(Crowns, Abutments, Partial Frameworks)

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2. CERAMO-METAL RESTORATIONS

In the 1950's, techniques were being developed to fuse gold to porcelain but laboratory failures were occurring due to porcelain's lower coefficient of thermal expansion. Two important changes allowed gold to bond to porcelain:

1. Porcelain - soda and potash raised the porcelain coefficient
2. Gold - the addition of platinum and palladium lowered it's coefficient.

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Bond Stress

The Bond Stress Test was developed to test porcelain debonding at the interface (Bond Strength is less than the cohesive strength of porcelain)

By the addition of less than 1% of:

Iron

Indium

Tin

...the bond strength was tripled.

NOTE: these metals provide an oxide film which increase bond strength.

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Metallurgy

Copper - "hardens" or strengthens the alloy
- increases tarnishing;
- 'reddens' the gold alloys
- causes greening effect on porcelain

Silver - minimizes the reddening effect of copper

Gallium - added to silver free alloys to compensate for decreased thermal expansion

Zinc - acts as an oxygen scavenger to decrease porosity in the castings

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Yield Strength

Yield Strength is the most important factor for strength in high gold alloys for bridgework.

Due to the need for high yield strength, lower gold (@72%) amounts are used, thereby necessitating the addition of other elements.

After casting, quenching as opposed to bench cooling can lower the yield strength by as much as 35%.

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Alloy Classifications

Yellow Gold - 60% or more gold

White Gold - 50% or more gold

Silver Palladium - white alloys

Palladium Silver white alloy

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Hardness and Function Classification Metal-Ceramic Restoration

Metal Ceramic: Yellow Gold 88%

White Gold 52%

Palladium - Silver *

*(can be up to 60% palladium)

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Instructions for Physical Laboratory Testing

- ☐ CLIFFORD MATERIALS REACTIVITY TEST
- ☐ Get Test Kit and Prescription from the Doctor
- ☐ Complete "Patient Information" Form
- ☐ Freeze gel packets overnight
- ☐ Fast for 12 hours prior to blood drawing.

You may drink as much water as you want.

Refrain from smoking, chewing gum, taking nutritional supplements, herbs and medications. (If you must take meds, please advise us). Do not take this test if on antibiotics or steroids!

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- □ Bring the following to the drawing:
  - □ Prescription, completed forms and frozen gel packs
  - □ $245 "Clifford Consulting"
  - □ Credit card for overnight shipping carrier
  - □ Pay fee for blood drawing
  - □ Draw blood only on Mondays, Tuesdays or Wednesdays

NOTE: Drawing laboratories or outpatient Emergency Medical Centers:

Before making an appointment inquire as to whether they can centrifuge the blood

EMO in Berkeley Heights can perform this test (908-464-6700)

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- □ BLOOD CHEMISTRY AND UROGRAM

Call the Institute for Health Realities (IHR) at 1-719-598-4968

Procedure:
- □ Request a QP2 (Queen Profile II)
- □ Payment (approx. $295 plus S/H)
- □ Upon receipt of your Blood Testing Kit, complete the "Requisition Form"

NOTE: The fee includes the blood drawing fee if performed by a Quest Laboratory (call information to find your local laboratory). Results are usually obtained within 10 days.

- □ Follow instructions above for fasting
- □ Bring the following to the drawing:
  - □ Completed Requisition Form
  - □ Complete Blood Testing Kit
- □ Draw blood only on Mondays, Tuesdays or Wednesdays

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ANCORA IMPARO
("I am still learning") - Michelangelo

SCIENTIA EST POTENTIA

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(Contact: P. Memoli DMD)

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