

# **PRACTICAL CLINICAL COURSES**

A Service of the Gordon J. Christensen  
Career Development Program

**V1987**

## **Crowns - Materials and Techniques for the Best Results**

Gordon J. Christensen, DDS, MSD, PhD

### **Materials Included**

C.E. Instruction Sheet  
Products List  
New Crown Classification  
CR Report: The Crown Revolution  
Clinician Responsible  
Goals & Objectives  
Overview  
References  
AGD Post-Test

**Gordon J. Christensen**  
**PRACTICAL CLINICAL COURSES**

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*Sources of Products Discussed in*

**V1987 Crowns – Materials and Techniques for the Best Results**

Presented by: Gordon J. Christensen, DDS, MSD, PhD

1. **BruxZir, BruxZir Esthetic**  
Glidewell Laboratories  
4141 MacArthur Blvd.  
Newport Beach, CA 92660  
(800)854-7256  
[www.glidewelldental.com](http://www.glidewelldental.com)
2. **CEREC Omnicam**  
Patterson Dental  
1031 Mendota Heights Road  
St. Paul, MN 55120  
(800)328-5536  
(651)686-1600  
[www.pattersondental.com](http://www.pattersondental.com)
3. **CS 3500 and CS 3600  
Intraoral Scanner**  
Carestream Dental LLC  
1765 The Exchange  
Atlanta, GA 30339  
(800)944-6365  
[www.carestreamdental.com](http://www.carestreamdental.com)
4. **IPS e.max**  
Ivoclar Vivadent Inc.  
175 Pineview Drive  
Amherst, NY 14228  
(800)533-6825  
(716)691-0010  
[www.ivoclarvivadent.us.com](http://www.ivoclarvivadent.us.com)
5. **iTero ELEMENT**  
Align Technology, Inc.  
2820 Orchard Parkway  
San Jose, CA 95134  
(888)822-5446  
(408)470-1000  
[www.itero.com](http://www.itero.com)
6. **Lava Esthetic**  
3M Oral Care  
3M Center  
Building 275-02-SE-03  
St. Paul, MN 55144  
(800)634-2249  
(651)575-5144  
[www.3mespe.com](http://www.3mespe.com)
7. **Noritake CZR Press**  
Kuraray America, Inc.  
33 Maiden Lane  
Suite 600-D  
New York, NY 10038  
(800)879-1676  
(212)986-2230  
[www.kuraraydental.com](http://www.kuraraydental.com)
8. **Planmeca Emerald Scanner**  
Henry Schein, Inc.  
135 Duryea Road  
Melville, NY 11747  
(800)582-2702  
(631)843-5500  
[www.henryschein.com](http://www.henryschein.com)
9. **TRIOS 3D Intraoral Scanner**  
3Shape, Inc.  
10 Independence Blvd.  
Suite 150  
Warren, NJ 07059  
(908)867-0144  
[www.3shape.com](http://www.3shape.com)
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***Product names, the products themselves, and company names change rapidly. Please contact the companies shown to confirm current information.***

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## New Crown Classification

The following classification for crowns is now in effect. It simplifies your ability to identify which type of crown you are using relative to strength and the potential of areas in which to use the crown.

### CLINICAL APPLICATIONS RELATED TO CERAMIC STRENGTH – Listed weak to strong (ISO 6872 and ADA Standard 69)

- **Class 1, Porcelains**, examples – feldspathic porcelain, low fusing porcelain, ( $K_{Ic} < 1.0$  fracture toughness, and 100 or less MPa) **inlays, onlays, veneers adhesively cemented.**
- **Class 2, Leucite glass-ceramics**, example – Vita Mark II, IPS Empress ( $K_{Ic} > 1.0$  fracture toughness, and  $> 100$  MPa) **single-unit anterior or posterior adhesively cemented.**
- **Class 3, Lithium disilicate**, example - IPS e.Max ( $K_{Ic} > 2.0$  fracture toughness, and  $> 300$  MPa) **single unit or 3-unit anterior.**
- **Class 4, Cubic containing zirconia**, example – cubeX2 cubic zirconia, Katana STML/UTML, Lava Esthetic ( $K_{Ic} > 3.5$  fracture toughness,  $> 500$  MPa) **3 unit anterior or posterior.**
- **Class 5, Tetragonal zirconia**, example - Original BruxZir, Lava Plus ( $K_{Ic} > 5.0$  fracture toughness,  $> 800$  MPa) **4 or more units anterior or posterior.**



### CERAMIC STRENGTHS related to CLINICAL USES

<b>Porcelains Class 1</b> ( $> 100$ MPa; $K_{Ic} > 1.0$ )*	<b>Leucite Glass-Ceramics Class 2</b> ( $> 100$ MPa; $K_{Ic} > 1.0$ )*	<b>Lithium Disilicate High Strength Glass Ceramics Class 3</b> ( $> 300$ MPa; $K_{Ic} > 2$ )*	<b>Cubic Containing Zirconia Class 4</b> ( $> 500$ MPa; $K_{Ic} > 3.5$ )*	<b>Tetragonal Zirconia Class 5</b> ( $> 800$ MPa; $K_{Ic} > 5$ )*
Single Unit Anterior or Posterior Adhesively Cemented	Single Unit or 3-Unit Anterior	3-Unit Anterior or Posterior	4 or More Units Anterior or Posterior	

\* MPa = Indicates minimum FLEXURAL STRENGTH for each respective Class, reported in Megapascals

\*  $K_{Ic}$  = Indicates minimum FRACTURE TOUGHNESS for each respective Class, reported in Megapascals/m0.5



## The Crown Revolution: Are You Confused?

**Gordon's Clinical Observations:** For over 10 years, new types of crowns have been coming on the market faster than ever before, and research on the new types of crown materials has been minimal or none. Most dentists have had to make decisions on the acceptability of the crowns by observing ads and by their own clinical observations. The TRAC division of Clinicians Report Foundation has accomplished in-vivo research on the crown types as they have come on the market and has made suggestions to you based on that research. However, such in-vivo research requires several years to make conclusions. *Where are we now relative to what crown or fixed prosthesis type is best for your patients? The state-of-the-art is in this report!*

During the recent past, cast gold restorations have almost died, and porcelain-fused-to-metal are significantly reduced in use. Why have the new ceramic restorations made such a change when previous generations of ceramic restorations had routine failures and inadequate longevity?

The reason is greater strength and better esthetics in some of them. What are the major currently popular tooth-colored ceramic restorations?

- Veneered full-strength zirconia, since ~2000
- Full-strength monolithic zirconia, since ~2008
- Esthetic, anterior, translucent zirconia in various forms, only the last few years, changing constantly, and some types failing
- Lithium disilicate, since ~2007
- Various combinations of ceramic and polymer, recent
- Lithium silicate, only the last few years
- Polymer, only the last several years

**Are all of these types working? NO.** This report provides a state-of-the-art observation of the current expected service potential for the several categories related to current in-vitro and in-vivo research and clinical observation by practitioners.

### State of the Art on Crown Use

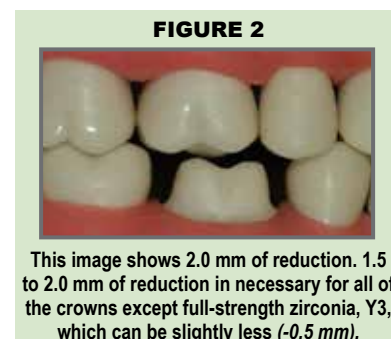
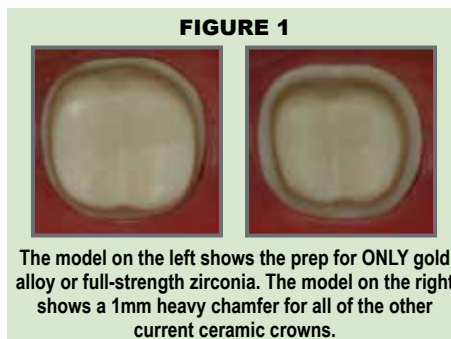
- **Significant clinician confusion** on crown use, and lack of long-term clinical research on some of the crown types makes evidence-based overall conclusions on crown use impossible.
- **Zirconia formulations have varied** from the well-proven original Glidewell BruxZir composition of Y3 (3 molar percent yttria), to the less clinically successful Y7 (7 molar percent yttria, so called anterior or esthetic zirconia), to new versions of "esthetic" zirconia now coming at the Y5 (5 molar percent yttria) content. Higher content of yttria and other oxides diminish the transformation toughening characteristic weakening the crowns but improving esthetics.
- **The CR Foundation clinical and science teams** along with the hundreds who have answered the following survey have provided the significant direction below for clinicians for 2018. *Expect significant changes and improvements soon.*

### CR Survey on Crown Use

- N = 844
- 96% general practitioner, majority with 26-40 years of practice
- **The following crown types have been placed at some time in their practice:**
  - 83-93% PFM, full-metal, full-strength zirconia, lithium disilicate
  - 51-72% "esthetic" zirconia, veneered full-strength zirconia
  - Minimal use: lithium silicate, polymer
- **Crown type currently placed most:** 45% full-strength zirconia, 21% lithium disilicate, 17% PFM, 8% esthetic zirconia, 6% veneered full-strength zirconia, 3% miscellaneous
- **Percent ceramic crown failure to date**
  - **Least failure:** full-strength zirconia, "esthetic" zirconia, veneered full-strength zirconia, and lithium silicate
  - **Next least failure:** lithium disilicate
  - **Most failure:** combination of lithium silicate and zirconia, and polymer alone

### Tooth Preparation Challenges

- **Too little tooth preparation is evident**, as shown in labs, for all of the new crowns (*Figure 1*).
- **Too little occlusal reduction is the MAJOR challenge** with current crown preparations. At least 1.5 mm to 2.0 mm of reduction is necessary for optimum strength and occlusion (*Figure 2*). *Some labs are spacing occlusal clearance too far, thereby decreasing crown thickness and increasing the problem.*



# The Crown Revolution: Are You Confused? (Continued from page 1)

## Crown and FPD Characteristics Based on Research and Clinical Observation

TABLE 1: Crown and FPD Characteristics

Type	Strength*	Esthetics	Multiple Units†	Long-Term Research to Date ‡	Wear on Opposing Teeth §	Failures to Date **	Expected Longevity ††	Comments
Gold Alloy	High	Poor	Yes	Yes	Slight	Very Low	Long	Characteristics depend on alloy composition
Lithium Disilicate	Moderate	Excellent	Anterior only	Moderate	Slight	Low	Long	Primarily single units, excellent service to date
Lithium Silicate	Moderate–High	Excellent	Yes, if PFM	Slight	Unknown	Low	Long	Mostly milled and PFM, minimal use to date
Lithium Silicate with Zirconia added	Moderate–High	Excellent	Under research	Slight	Unknown	Under research	Unknown	Research shows few failures to date
Polymer	Moderate	Fair–Good	No	Moderate	No	Moderate–High	Moderate	Significant de-bonding to date, being improved
Porcelain-Fused-to-Metal	High	Excellent–Good	Yes	Yes	Slight–Moderate	Low	Long	69 years of observation and proven clinical usefulness
Zirconia Full-Strength Monolithic	High	Fair–Good	Yes	Yes	Slight	Low	Long	Original Glidewell composition (Y3)
Zirconia with improved esthetics	Moderate	Good	Anterior †	Moderate	Unknown	Moderate for Y7	Unknown	Many variants; Y3, Y7, Y5 are different ‡‡
Zirconia-base (layered)	Moderate	Good–Excellent	Yes	Moderate to Yes	Slight–Moderate	Moderate	Unknown	Poor start, now looking good

\* Strength values vary significantly relative to testing method

† Long-term research needed for newer types

‡ Many years are required for validation of crown characteristics

§ Ratings are for optimum crown fabrication. Polished not glazed for ceramics. Slight means both crown and opposing enamel wear equally.

\*\* Failures include breakage, de-bonding, discoloration, etc.

†† Long equals 20 years or more

‡‡ See second bullet at top of page

## Suggestions for Crown Use as of January 2018

- Many research projects are now underway on the newer crown types.
- Clinicians Report Foundation TRAC division leads the profession in the long-term in-vivo evaluation of new crown types. Some of the TRAC research now in progress was initiated 13 years ago.
- **Below CR suggestions for crown use are based on research and clinical observation. Expect significant change still to come. Observing the color coding in Table 2 will show the reason there is confusion in crown use currently! (Green below and in Table 2 means best current choices; cautions are in red.)**

### 1. Maxillary anterior singles:

- **Lithium disilicate (IPS e.max):** Used most; nothing better currently; proven over 10 years.
- **PFM:** Viable choice with proper laboratory expertise.
- **Zirconia-base with ceramic overlay:** Newer versions are OK for non-bruxing patients (Kuraray/Noritake CZR Press over zirconia-base).
- **Original zirconia formulation (Y3) BruxZir:** Progressive techs using pre-sinter staining have made this previously ugly ceramic relatively esthetic.
- **Esthetic zirconias (Y7):** Questionable strength and some failures.
- **Newer esthetic zirconias (Y5):** Promising (current examples: 3M Lava Esthetic Full-Contour Zirconia, and Glidewell Esthetic Zirconia).

2. **Mandibular anterior singles:** Larger teeth have same choices as maxillary singles (#1). All choices have challenges for small teeth that do not allow adequate depth of preparations.

### 3. Maxillary anterior FPD:

- **Zirconia-base with ceramic overlay:** Newer versions are OK for non-bruxing patients (Kuraray/Noritake CZR Press over zirconia-base).
- **PFM:** Viable choice with proper laboratory expertise.
- **Original zirconia formulation (Y3) BruxZir properly stained and polished:** Must have excellent tech. Must have adequate connectors for adequate strength. Progressive techs using pre-sinter staining have made this previously ugly ceramic relatively esthetic.
- **IPS e.max:** Acceptable for short span if not a bruxing patient.
- **Newer esthetic zirconias (Y5):** Promising (current examples: 3M Lava Esthetic Full-Contour Zirconia, and Glidewell Esthetic Zirconia).

4. **Mandibular anterior FPD:** All choices have challenges for small teeth that do not allow adequate depth of preparations. Larger teeth have same choices as maxillary FPDs (#3).

5. **Maxillary and mandibular premolar singles:** Same as maxillary anteriors (#1).

6. **Maxillary and mandibular premolar FPDs:** Same as maxillary anterior FPDs (#3), except original formulation (Y3) BruxZir OK if color surrounding teeth can be matched.

### 7. Maxillary and mandibular molar singles:

- **Original zirconia formulation (Y3) BruxZir properly stained and polished**
- **PFM:** Viable choice with proper laboratory expertise.
- **Cast gold alloy:** On second molars and potentially mandibular first molars.
- **Zirconia-base with ceramic overlay:** Newer versions are OK for non-bruxing patients (Kuraray/Noritake CZR Press over zirconia-base).
- **Newer esthetic zirconias (Y5):** Promising (current examples: 3M Lava Esthetic Full-Contour Zirconia, and Glidewell Esthetic Zirconia).

### 8. Maxillary and mandibular FPD:

- **Original zirconia formulation (Y3) BruxZir properly stained and polished**
- **PFM:** Viable choice with proper laboratory expertise.
- **Cast gold alloy:** Possibility if conventional 3/4 or 7/8 crowns are used as abutments.
- **Zirconia-base with ceramic overlay:** Newer versions are OK for non-bruxing patients (Kuraray/Noritake CZR Press over zirconia-base).
- **Newer esthetic zirconias (Y5):** Promising (current examples: 3M Lava Esthetic Full-Contour Zirconia, and Glidewell Esthetic Zirconia).

# The Crown Revolution: Are You Confused? (Continued from page 2)

## Suggestions for Crown Use as of January 2018

TABLE 2: Suggestions for Restoration Use in Specific Areas

Location	Gold Alloy	Lithium Disilicate	Lithium Silicate	Lithium Silicate with Zirconia	Polymer	PFM	Zirconia Full-Strength Monolithic	Zirconia "Esthetic"	Zirconia-base (layered)
Maxillary anterior single	No	Yes	Unknown	Unknown	No	Yes	Caution	Caution	Yes
Mandibular anterior single	No	Caution	Unknown	Unknown	No	Yes	Caution	Caution	Yes
Maxillary anterior FPD	No	Caution	Unknown	Unknown	No	Yes	Caution	Caution	Yes
Mandibular anterior FPD	No	Caution	Unknown	Unknown	No	Yes	Caution	Caution	Yes
Maxillary and Mandibular premolar singles	No	Yes	Yes (PFM)	Caution	Caution	Yes	Caution	Caution	Yes
Maxillary and Mandibular premolar FPD	No	Caution	Yes (PFM)	Unknown	No	Yes	Caution	Caution	Yes
Maxillary and Mandibular molar singles	Yes	Caution	Yes (PFM)	Caution	Caution	Yes	Yes	Caution	Caution
Maxillary and Mandibular molar FPD	Yes	No	Yes (PFM)	Unknown	No	Yes	Yes	Caution	Caution

- **Yes:** well-proven choice
- **Caution:** more research needed, strength challenges present, esthetic challenges, or tooth must be large to allow adequate prep depth for the specific restoration. *(See cautions above in red.)*
- **No:** enough challenges have been reported to cause concern
- All designations assume adequate up-to-date laboratory expertise relative to staining pre-sintered zirconia, use of proven products, and proper skills.
- Gold alloy restorations are certainly proven for some of the uses indicated, and in spite of patient lack of interest, these restorations should be discussed with patients who have oral conditions that would be well served with the known desirable gold alloy characteristics. Some dentists prefer to place cast gold alloy inlays, onlays, and partial crowns on premolars and molars, but these techniques are used infrequently because of patient esthetic concerns.

### Informed Consent:

Patients requiring crowns or fixed prostheses should be provided with in-depth informed consent relative to the known characteristics of the crown types and should be included in the decision on what type of crown is best for their specific situation. You may use **Table 2** above for state-of-the-art patient education (*January 2018*).

### CR CONCLUSIONS:

- **Full-strength zirconia (Y3) and lithium disilicate are well-proven** to satisfy most of the needs for crowns and fixed prostheses, but even better formulations of these materials are in development.
- **The state of confusion relative to crown types will continue** for several years until adequate research is accomplished and clinical observation can validate the research.
- **Dentists should inform their patients** with state-of-the-art information about the various crown types before deciding the material to use.
- **Some of the new crown types are marketed after only minimal research**, most of which is NOT in the mouth. Be careful.
- **Don't throw away gold alloy and PFM yet!**
- **It appears that various formulations of zirconia currently present and new ones now under development will gradually dominate the crown and fixed prosthesis market.**



## PROGRAM

### **V1987 Crowns - Materials and Techniques for the Best Results**

#### CLINICIAN RESPONSIBLE:

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CEO, Practical Clinical Courses  
CEO, CR Foundation  
Practicing Prosthodontist, Provo, Utah

#### GOALS & OBJECTIVES

At the completion of this video presentation, viewers should be able to:

1. Discuss why there is confusion about the various crown types.
2. Discuss factors relating to the decision on appropriate crown type.
3. List the current types of popular use crowns.
4. Estimate the potential clinical longevity for each crown type.
5. Discuss necessary differences in tooth preparations for the various crown types.
6. Discuss differences in conventional and digital impressions.
7. List the characteristics of gold alloy crowns.
8. List the characteristics of porcelain-fused-to-metal crowns.
9. List the characteristics of full-strength (3Y) zirconia crowns.
10. List the characteristics of translucent (7Y) zirconia, (second generation) crowns.
11. List the characteristics of (5Y) zirconia crowns.
12. Discuss the challenges in transformation toughening relative to yttria.
13. List the characteristics of lithium disilicate crowns.
14. List the characteristics of lithium silicate crowns.
15. List the characteristics of polymer crowns.
16. Discuss a suggested discussion of the various crown types for patient education.
17. Discuss the importance of adequate patient informed consent.
18. Discuss cementation of full-strength (3Y) zirconia crowns.
19. Discuss cementation of lithium disilicate crowns.
20. Decide on cementation procedures for your practice.



## OVERVIEW

### **V1987 Crowns - Materials and Techniques for the Best Results**

There has been significant confusion about selection of crown types over the last decade. New types have almost completely replaced the conventional crown types long used in the past. There is not adequate research to validate many of the new types. This presentation provides information that is currently available and assists practitioners to select the most adequate types of crowns for their patients.

The following and other topics are included:

- Why is there confusion about crown types?
- Factors relating to the decision on appropriate crown type
- Types of crowns
- Expected clinical longevity of crowns
- Are crown tooth preparations different for the various crown types?
- Conventional impressions
- Digital impressions
- Overall characteristics of crowns
- Gold alloy
- Porcelain-fused-to-metal
- Full-strength zirconia (3Y)
- Translucent, esthetic anterior zirconia (7Y)
- Translucent, esthetic zirconia (5Y)
- Expected advancements in zirconia
- Lithium disilicate
- Lithium silicate
- Polymer
- Other older types of crowns
- Comparing crown types for patient consideration
- Patient informed consent
- Are different cements necessary for the various crown types?

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## POST-TEST

### V1987 Crowns - Materials and Techniques for the Best Results

1. Until relatively recently, what type of tooth-colored crown has been used most?
  - a. Lithium disilicate
  - b. Lithium silicate
  - c. Porcelain-fused-to-metal (PFM)
  - d. Polymer
  
2. Currently, which type of crown is most popular?
  - a. Lithium disilicate
  - b. Lithium silicate
  - c. Porcelain-fused-to-metal (PFM)
  - d. Zirconia
  
3. Which type of zirconia crown has the most strength?
  - a. 7Y
  - b. 3Y
  - c. 5Y
  - d. None of the above
  
4. Which type of crown requires the deepest tooth preparation?
  - a. PFM
  - b. Zirconia
  - c. Lithium disilicate
  - d. Cast gold alloy
  
5. Which type of impression is currently used least?
  - a. Digital
  - b. Polyether
  - c. Vinyl polysiloxane
  - d. Double-arch elastomer
  
6. Transformation toughening is present in:
  - a. 7Y zirconia.
  - b. 3Y zirconia.
  - c. lithium disilicate.
  - d. lithium silicate.
  
7. Which of the following is true concerning full-zirconia crowns unglazed and enamel relative to wear?
  - a. Zirconia wears enamel more than itself.
  - b. They wear equally in occlusion.
  - c. Enamel wears zirconia more than itself.
  - d. None of the above.

**POST-TEST (CONT'D)**

**V1987 Crowns - Materials and Techniques for the Best Results**

8. Which of the following is true concerning lithium disilicate crowns unglazed and enamel relative to wear?
  - a. Lithium disilicate wears enamel more than itself.
  - b. Enamel wears lithium disilicate more than itself.
  - c. They wear equally in occlusion.
  - d. None of the above.
  
9. The cement suggested in this presentation for full-strength zirconia use, most of the time, is:
  - a. resin.
  - b. resin-modified glass ionomer.
  - c. Ceramir.
  - d. glass ionomer.
  
10. The cement suggested in this presentation for lithium disilicate use, most of the time, is:
  - a. resin.
  - b. resin-modified glass ionomer.
  - c. Ceramir.
  - d. glass ionomer.

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